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Statistical Analysis for Microsoft® Access



For Microsoft® Access



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## *Acknowledgments*

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Many people at FMS contributed to the creation of Total Access Statistics, including:

- **Development:** Luke Chung
- **Documentation:** Luke Chung and Molly Pell
- **Quality Assurance/Support:** John Litchfield, Molly Pell and Madhuja Nair

# Table of Contents

<b>Chapter 1: Introduction</b> .....	<b>3</b>
Program Highlights.....	4
Enhancements from Previous Versions.....	4
Visit Our Web Site .....	9
<b>Chapter 2: Installation</b> .....	<b>11</b>
System Requirements .....	12
Licensing Rules .....	12
Upgrading from Previous Versions.....	12
Installing Total Access Statistics .....	13
Using the Update Wizard .....	14
Uninstalling Total Access Statistics.....	14
<b>Chapter 3: Running Total Access Statistics</b> .....	<b>17</b>
Important Concepts .....	18
Starting Total Access Statistics .....	19
Analysis Types .....	21
Preparing Data.....	23
Scenarios .....	25
Calculation Accuracy .....	26
<b>Chapter 4: Using the Statistics Wizard</b> .....	<b>27</b>
Scenario Selection (Main Form) .....	28
Creating a New Scenario .....	29
Data Sources that Require Parameters .....	32
Field Selections.....	33
Ignoring Data .....	36
Analysis Options .....	37
Output Tables and Description.....	38
<b>Chapter 5: Parametric Analysis</b> .....	<b>41</b>
Parametric Analysis Overview .....	42
Describe (Field Descriptives) .....	43
Frequency Distribution.....	53
Percentiles.....	55
Compare (Field Comparisons) .....	60
Matrix.....	63
Regression .....	65
Crosstab and Chi-Square .....	71
Running Totals.....	77
<b>Chapter 6: Group Analysis</b> .....	<b>81</b>
Group Analysis Overview .....	82
Two Sample t-Test.....	82



Analysis of Variance (ANOVA) .....	86
Two Way ANOVA.....	88
<b>Chapter 7: Non-Parametric Analysis .....</b>	<b>91</b>
Non-Parametric Analysis Overview .....	92
Chi-Square .....	93
Sign Test — One Sample .....	96
K-S Fit — Kolmogorov-Smirnov Goodness of Fit Test .....	99
2 Sample.....	101
N Sample — Kruskal-Wallis One Way Analysis of Variance .....	106
Paired Fields .....	108
N Fields — Friedman’s Two Way ANOVA of Ranks .....	111
<b>Chapter 8: Record Analysis .....</b>	<b>115</b>
Record Analysis Overview .....	116
Random Records .....	116
Ranking.....	121
Normalize .....	125
<b>Chapter 9: Financial Analysis .....</b>	<b>131</b>
Financial Analysis Overview .....	132
Periodic Cash Flows .....	132
Irregular Cash Flows .....	137
<b>Chapter 10: Probability Calculator .....</b>	<b>143</b>
Calculator Options.....	144
Z-Value .....	145
t-Value.....	146
Chi-Square .....	147
F-Value .....	148
<b>Chapter 11: Advanced Topics.....</b>	<b>151</b>
Programmatic Interface .....	153
Preparing Your Database.....	153
Statistics Function .....	156
Probability Function .....	160
Inverse Probability Function .....	162
<b>Chapter 12: Product Support .....</b>	<b>165</b>
Support Resources .....	166
Web Site Support .....	166
Technical Support Options .....	167
Contacting Technical Support .....	169
<b>References.....</b>	<b>171</b>
<b>Index .....</b>	<b>173</b>



## *Welcome to Total Access Statistics!*

Thank you for selecting Total Access Statistics for Microsoft Access. Total Access Statistics is the most powerful data analysis tool for Access and is developed by FMS, the world's leading developer of Microsoft Access products. In addition to Total Access Statistics, we offer a wide range of products for Microsoft Access developers, administrators, and users:

- [Total Access Admin](#) (database maintenance control)
- [Total Access Analyzer](#) (database documentation)
- [Total Access Components](#) (ActiveX controls)
- [Total Access Detective](#) (difference detector)
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Please make sure you sign up for our free email newsletter. This guarantees that you will be contacted in the event of news, upgrades, and beta invitations. Once again, thank you for selecting Total Access Statistics.



Luke Chung  
President



# Chapter 1: Introduction

*Microsoft Access lets you store and manage large amounts of data, however it wasn't designed for complex numerical analysis. Total Access Statistics addresses this problem with a wide range of statistical functions that significantly extend the power of Access queries. It was designed specifically for Access and provides its results in the format you like best — Access tables.*

*This chapter provides a brief description of Total Access Statistics and an outline of the rest of the manual.*

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## Topics in this Chapter

- **Program Highlights**
- **Enhancements from Previous Versions**
- **Visit Our Web Site**

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## Program Highlights

### Designed for Access

Total Access Statistics was designed specifically for Microsoft Access and addresses the special needs of Access users and developers. It offers a wide range of statistical functions to analyze the data stored in your tables. It can use data from native Access tables in MDBs, ACCDBs, ADPs, linked tables (including SQL tables), or even queries/views across one or more tables. Best of all, the results are in tables, which allows you to view, sort, query, and add them to reports.

Available directly from the Access Database Tools | Add-ins ribbon, Total Access Statistics is available when you need it, and away when you don't.

### Wizard Interface

The Total Access Statistics Wizard looks and feels like an Access wizard, and guides you through the data analysis process with no programming required. Perform powerful analyses with point-and-click ease. Your selections are automatically saved as “scenarios” for re-use.

### Programmatic Interface

Total Access Statistics includes a programmatic interface for Access VBA programmers who want to incorporate statistical functions directly into their applications. You can even “hide” Total Access Statistics so your users don't realize how you implemented such complex formulas.

Total Access Statistics includes a royalty-free runtime license, allowing you to distribute your applications economically to non-Total Access Statistics owners. Some restrictions apply — see the license agreement at the front of the manual for details.

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## Enhancements from Previous Versions

This version of Total Access Statistics is the 12<sup>th</sup> version of the product since its debut in 1995. Here is the history of versions and enhancements:

### Version 16 for Access 2016

Total Access Statistics for Access 2016 includes these enhancements:

- Support for the 32 and 64 bit versions of Access 2016 with separate add-ins and redistributable runtime libraries for each.
- Runtime libraries work with earlier Access versions

## **Version 15 for Access 2013**

Total Access Statistics for Access 2013 includes these enhancements:

- Support for the 32 and 64 bit versions of Access 2013 with separate add-ins and redistributable runtime libraries for each.
- Runtime libraries work with earlier Access versions
- Improved performance when analyzing large data sets
- For Percentiles, when assigning percentile values to a field in your table, you can specify calculations such as quartiles, quintiles, octiles, deciles, etc. rather than just percentile.
- The field format of percentage fields in the Frequency, Crosstab when percentages are in columns, and Chi-Square details tables are set to Percent.
- When tables are generated from the add-in, the field column widths are resized to show the entire field name and data.

## **Version 14 for Access 2010 (August 2010)**

Total Access Statistics for Access 2010 includes these enhancements:

- New financial calculations for cash flow analysis of regular and date specific payments. Easily calculate present value (PV), net present value (NPV), future value (FV), internal rate of return (IRR) and modified internal rate of return (MIRR).
- Support for the 32 and 64 bit versions of Access 2010 with separate add-ins and redistributable runtime libraries for each.
- A new Access 2003 MDE runtime library for legacy support.

## **Versions X.8 for Access 2007, 2003, 2002, and 2000 (Aug 2010)**

In conjunction with the debut of Total Access Statistics 2010, new versions were released for prior versions of Access. Versions 12.8, 11.8, 10.8, and 9.8 were released for Access 2007, 2003, 2002, and 2000 respectively with the enhancements from version 14.

## **Version 12 for Access 2007 (June 2007)**

Many significant enhancements were made in version 12 for Access 2007 since the release of version 11.5 for Access 2003:

### ***Access 2007 Features***

- Supports the new Access 2007 ACCDB database format and new field types

- Supports Tabbed Documents display, so the main screen of Total Access Statistics can exist as a tab on your workspace that's easily selected or hidden

#### ***Data Analysis Enhancements***

- Supports analysis in ADPs. Now you can analyze data from your SQL Server database when running Access from an ADP.
- Supports parameterized “ad hoc” queries as data sources. All the analyses support the use of a parameterized query where you specify the values the query needs. A new screen lets you specify the value for each parameter in your query. This appears when you choose a parameterized query and is available when you select fields, if you want to change it.
- Similarly, parameters used by ADP views, stored procedures, and user defined functions are supported.
- Running Totals analysis to calculate running averages, sums, counts, etc. for a sorted list of values and placing the values in a field in your table. The running value can be for all records or a moving set of records such as the running average over the last 10 records.
- For Regressions, the estimated Y value can now be added directly into a field in your data source. This is available where there's only one regression equation calculated at a time such as a multiple regression or a simple or polynomial regression with only one independent (X) field.
- For Percentiles, a new option is available for assigning percentile values to records. If there are multiple percentile values for the same record's value, you can choose to assign the low or high percentile to that record. Previously, it always assigned the low value.

#### ***Programmatic Interface Enhancements***

- A new option is available to let you specify the table containing parameters for parameterized queries.

#### ***User Interface Enhancements***

- A completely revised Access 2007 look and feel with support for Office 2007 color schemes, system colors, transparent buttons, buttons with graphics, newer fonts, etc.
- Enlarged screens show more options and fields to select.
- Field data type names are now localized in non-English versions of Access.



## Versions X.7 for Access 2000, 2002 and 2003 (June 2007)

In conjunction with the debut of Total Access Statistics 2007, new versions were released for prior versions of Access. Versions 9.7, 10.7, and 11.7 were released for Access 2000, 2002 and 2003 respectively with the non-Access 2007 enhancements of version 12.

## Version 11.0 for Access 2003 (February 2004)

Version 11 for Access 2003 includes the following new features:

### *General Enhancements*

- Support for Access 2003, with databases created in Access 2000, 2002, and 2003.
- Support for multi-selection of fields during field assignments.
- Code Generator that automatically creates code for running a scenario.
- Deletion of Total Access Statistics temporary tables when exiting, if the current database doesn't contain saved scenarios.
- New user manual and online help file.

### *Data Analysis Enhancements*

- Option to use Crosstab queries as data sources (previously only supported Select queries).
- Three new analysis types: Random, Ranking, and Normalize (see **Chapter 8: Record Analysis** for details).
- For Describe analysis, new percentile options for calculating Quintiles, Octiles, and every 5<sup>th</sup> percentile.
- For Percentile analysis, new options for calculating Octiles, every 5<sup>th</sup> percentile, and updating each record in your data source with its percentile value.
- For Crosstab analysis, new option to show percentage results in fields rather than rows.
- Programmatic Interface Enhancements
- New code generator, which writes code to add statistical analysis and probability calculations to your applications.
- New optional parameters that allow you to override the scenario's data source and output table names when running scenarios programmatically.
- New optional parameter that allows you to specify the title bar of the progress form as a scenario runs. If you pass "[Scenario\_Description]," the title bar shows the description of the scenario that is currently running.

- New function to return the current application version when running scenarios programmatically.
- A digitally signed library for Access 2003 and a non-signed library to support Access 2000 and 2002/XP deployments.

## **X.5 Versions for Access 97, 2000 and 2002**

In conjunction with the enhancements added to version 11.0, updates were released for previous versions of Total Access Statistics to offer the same features. Version 10.5 for Access 2002, 9.5 for Access 2000, and 8.5 for Access 97 were released.

### **Version 10.0 for Access 2002 (October 2001)**

Version 10 for Access 2002 includes the following new features:

- Support for Access 2002, with databases created in Access 2000 or 2002.
- Enhanced Statistics Wizard, including:
  - The list of scenarios shows more fields with adjustable column widths.
  - The page is enlarged to show more scenarios while still supporting 800 x 600 resolutions.
- New user manual and online help file.

### **Version 9.0 for Access 2000 (January 2000)**

Version 9 for Access 2000 includes the following new features:

- Support for Access 2000.
- New autonumber field (as the primary key) for all output tables.
- Royalty-free runtime license to allow distribution to non-Total Access Statistics users.
- New user manual and online help file.

### **Version 8.0 for Access 97 (February 1997)**

- Version 8 for Access 97 includes the following new features:
- Support for Access 97.
- Redesigned forms that match the look and feel of Windows 95 and Access 97.
- Modified Statistics Wizard and table dialog forms that use a tab control user interface.
- New percentile calculations for Quintiles, and 0<sup>th</sup> and 100<sup>th</sup> percentiles (see page 55).

- New inverse feature in the probability calculator to show the test value for a given probability.
- New VBA function to calculate inverse probability.
- New user manual and online help file.

### **Versions 2.0 and 7.0 (January 1996)**

Two versions were released simultaneously: version 2.0 for Access 2.0, and version 7.0 for Access 95. Changes include:

- Reduced form heights that fit in 640 x 480 screens.
- Option to ignore a specific value or range of values.
- Uninstall support and Windows 95 user interface.
- Workaround for an Access 95 bug for field reformatting.

### **Version 1.0 (March 1995)**

The first version was released for Access 2.0.

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## **Visit Our Web Site**

FMS is constantly developing new and better developer solutions. Total Access Statistics is part of our complete line of products designed specifically for the Access developer. Please take a moment to visit us online at [www.fmsinc.com](http://www.fmsinc.com) to find out about new products and updates.

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# Chapter 2: Installation

*Total Access Statistics comes with an automated setup program to get you up and running as quickly as possible. This chapter describes the system requirements, installation steps, instructions for upgrading from previous versions, and instructions for uninstalling.*

---

## Topics in this Chapter

- **System Requirements**
- **Licensing Rules**
- **Upgrading from Previous Versions**
- **Installing Total Access Statistics**
- **Using the Update Wizard**
- **Uninstalling Total Access Statistics**

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## System Requirements

The requirements for Total Access Statistics are:

- Microsoft Access version corresponding with the version of Total Access Statistics (separate versions of Total Access Statistics are available for each version of Microsoft Access)
- Operating system, processor, and memory that can run Microsoft Office Access successfully
- 30 MB of free disk space, plus space for your data and results

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## Licensing Rules

Licensing rules are described in detail at the beginning of the user manual. Each user or developer must own a Total Access Statistics license. The license includes the right to use Total Access Statistics, as well as a runtime license for distributing applications containing Total Access Statistics to others. Those other users may use Total Access Statistics in your application, but may not add it to their own.

FMS offers a discounted five-user license of Total Access Statistics that provides development and distribution rights for five developers. FMS also offers quantity discounts and site license programs to let you economically add user counts. Please contact us for more information.

---

## Upgrading from Previous Versions

The latest version of Total Access Statistics is compatible with previous versions and can use existing scenarios without any changes.

The current version uses the same format as scenarios created in version X.7, X.5, and X.0.

Scenarios created in earlier versions are automatically converted to the new format when you open Total Access Statistics on your database. Once converted, however, the scenarios are no longer compatible with the original X.0 releases of Total Access Statistics.

Total Access Statistics' scenarios are saved in four hidden tables in your database (see page 152 for more information). When you convert your database, these tables are converted automatically.

Just like you can have multiple versions of Access on the same machine, you can have multiple versions of Total Access Statistics running on the same machine, as long as they are installed to different directories.

## Output Table Changes

If you are upgrading from the Access 97 version or earlier, the output tables generated by Total Access Statistics are different. Starting with Total Access Statistics 2000, an AutoNumber field, named StatOutputID, is added to each table as its primary key. In earlier versions, the output tables were not keyed. This change may cause compatibility problems if you reference output fields programmatically by number rather than name.

## Total VB Statistics

FMS also offers Total VB Statistics, a statistical analysis program for Visual Basic developers. Total VB Statistics is similar to Total Access Statistics, but is a programmer-only tool. Total VB Statistics uses data in or linked through an Access/Jet Engine database.

Scenarios created with Total VB Statistics can be converted to support this version of Total Access Statistics. Likewise, Total VB Statistics can use scenarios created with Total Access Statistics, but Record Analysis, Running Totals, and enhancements to percentile, regression, and crosstab calculations are not supported in Total VB Statistics.

## Total SQL Statistics

FMS also offers Total SQL Statistics, a statistical analysis program designed specifically for Microsoft SQL Server data. While Total Access Statistics can perform analysis on SQL Server tables linked from an Access database, Total SQL Statistics allows you to perform analysis on SQL Server data directly, bypassing Access/Jet Engine databases completely. Total SQL Statistics stores its results in SQL Server tables. Developers can use VB 6 or VB .NET to integrate this functionality into their applications.

---

## Installing Total Access Statistics

Total Access Statistics is installed using an automated setup program. To install Total Access Statistics, follow these steps:

1. Locate and run the setup program.
2. When prompted, enter your registration information and product key (serial number).
3. Specify whether you want to install it for just yourself or any user on your PC. The latter requires administrative rights.
4. Specify the destination directory for the files.

Be sure to read the README file for any late-breaking news that is not included in this User's Guide.

---

## Using the Update Wizard

Total Access Statistics includes a built-in mechanism to check the availability of updates via the Internet. If you have an active Internet connection, you can use the Total Access Statistics Update Wizard to ensure that you have the latest version.

To run this program, press the Windows Start button and select Programs, FMS, Total Access Statistics, Update Wizard. Follow the prompts on the form to check for the latest update.

---

## Uninstalling Total Access Statistics

Total Access Statistics supports the standard Windows installation protocol, so uninstalling is similar to uninstalling other programs:

### Start the Uninstall Process

From the Windows Start Menu, select Control Panel, then:

#### *Windows Vista, Windows 7, 8, and Windows 10*

- In the Programs section, select Uninstall a Program

#### *Windows XP*

- Select Add/Remove Programs

### Select Total Access Statistics for Removal

- Select Total Access Statistics from the list of installed programs
- Click on Uninstall from the menu
- The installation program loads. Choose Remove and follow the prompts.

After a few moments, the Total Access Statistics program files and its registry entries are deleted.

### Total Access Statistics Tables in Your Databases

Total Access Statistics also creates four tables in each database that you use to generate Total Access Statistics scenarios. These tables contain information about your analysis selections, and are not removed when you uninstall the program. You may choose to delete them from your databases manually, but you may want to keep them to preserve your scenarios if you expect to use Total Access Statistics in the future. In general, these tables are very small and do not interfere with your application.



If you do not need to keep your scenario settings, delete the four Total Access Statistics tables that begin with “usysTStat” (usysTStatScenarios, usysTStatOptions, usysTStatFields, and usysTStatParameters). These files are hidden in your navigation pane. To see them, right click on the Navigation Pane and select Navigation Options, and check the Show System Objects option.



If you open Total Access Statistics but do not create scenarios, or if you delete all scenarios before exiting Total Access Statistics, the hidden scenario tables are automatically removed from your database when you exit the program.



# Chapter 3: Running Total Access Statistics

*You can invoke Total Access Statistics interactively to design and run analysis scenarios, or you can run the analysis programmatically from your VBA code. This chapter describes how to start Total Access Statistics and run it interactively, the analysis types that are available, and how to prepare your data to get the most out of Total Access Statistics.*

---

## Topics in this Chapter

- **Important Concepts**
- **Starting Total Access Statistics**
- **Analysis Types**
- **Preparing Data**
- **Scenarios**
- **Calculation Accuracy**

---

## Important Concepts

There are several important concepts you should be familiar with before installing and using Total Access Statistics:

- Total Access Statistics analyzes data in Access/Jet databases (MDB and ACCDB files) and Access Data Projects (ADPs). The interactive program is version specific and only runs with its version of Access, but it runs on all database formats supported by that version.
- Analysis is performed on the tables and queries in your database. The tables may be Access tables or linked tables. The queries may be select queries or crosstab queries. For ADPs, the data sources may be tables, views, stored procedures, or user defined functions that output data.
- Results are stored in tables in your database. You can use these tables like any other Access table (SQL Server tables in ADPs) and add them to forms, reports, or other queries.
- With the exception of analyses that you specify to place results in your table, your data is never modified and temporary tables are never created in your database. When it needs temporary tables, Total Access Statistics creates them in its own temporary database.
- Multiple fields and an unlimited number of records can be analyzed at one time.
- Groups of records can be analyzed separately. This is similar to “Group By” in Access or SQL summary queries.
- Records can be weighted by assigning a weighting field that designates the number of times the record is counted.
- Null values are automatically ignored. You can also specify specific values or ranges of values to ignore.
- Your analysis selections (scenarios) are automatically saved for reuse. Only the settings are saved, not the data, so the latest data is always used to recalculate the results when you run a scenario.
- The scenario information is stored in four hidden system tables in your database. The information remains with your database even if you rename or move the database, re-install Total Access Statistics, or upgrade to a new version.

### Tip: Using a Separate Database

Since Total Access Statistics creates output tables in the current database, you may clutter your database with unnecessary tables. If you are performing a lot of ad hoc analysis, consider creating a new database and

linking to your data tables. This keeps Total Access Statistics and its results separate from your main database. If you are not familiar with using linked tables, consult your Microsoft Access manual or help file.

If you plan to add Total Access Statistics features to your applications via Visual Basic for Applications (VBA), you need to create your scenarios in your application's database (see page 153 for details).

---

## Starting Total Access Statistics

Open the database with the data you want to analyze or a database that is linked to the table(s). Make sure that you have the proper permissions to the database — you must have rights to read and create tables.

To begin, use the sample database (SAMPLE.MDB), located in the directory where you installed Total Access Statistics. This database contains sample tables and scenarios, and is a useful learning tool.



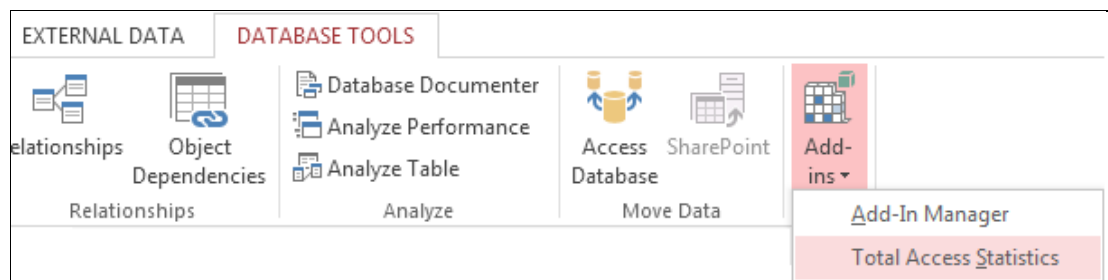
**Tip**

When you install Total Access Statistics, a link to the sample database is created in your Windows Start menu:

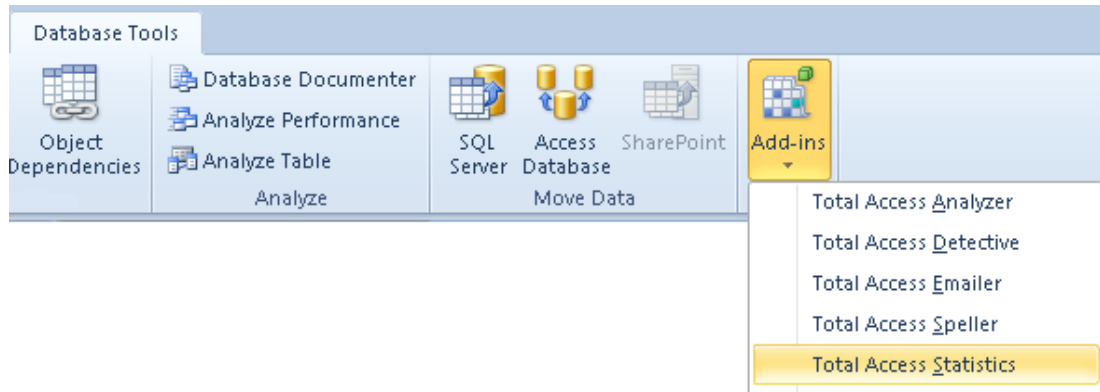
```
All Programs, FMS, Total Access Statistics, Sample Database
```

When you launch the sample database from this link, it always opens in the correct version of Access, regardless of what Microsoft considers the default for MDB files. This is accomplished using Total Access Startup from FMS. Visit our website or contact us for more information.

With the database open, launch Total Access Statistics from the Access Database Tools, Add-ins ribbon:

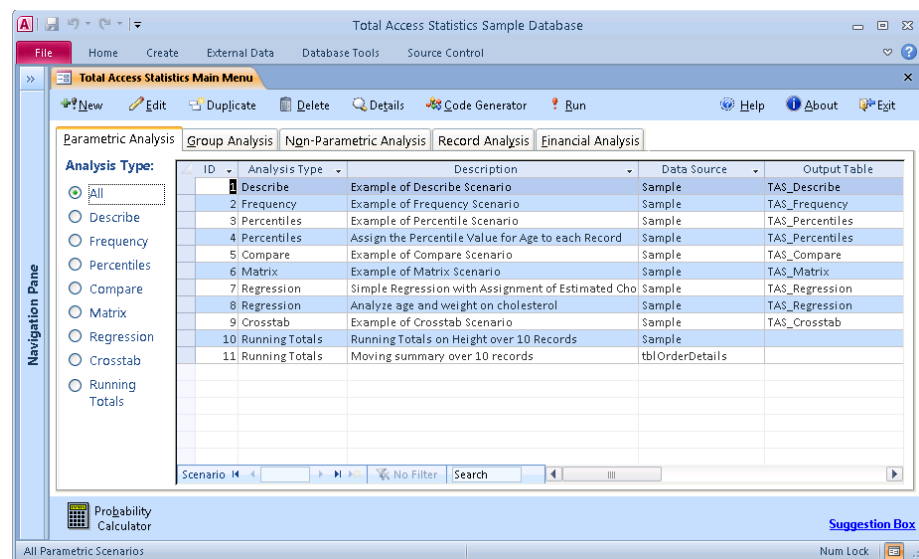


*Microsoft Access 2013 Add-ins Ribbon*



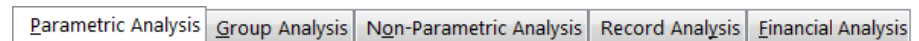
*Microsoft Access 2007 and 2010 Add-ins Ribbon*

The initial screen of the Statistics Wizard appears:



*Main Form*

The main form of the Statistics Wizard controls the program. From here, you can create, edit and run scenarios. The scenarios are organized by Analysis Type:



*Analysis Type Tabs*

When you click on the Analysis Type tabs, the corresponding page of options and scenarios appears. Each of the analysis types has additional types, which are displayed in the option group buttons on the left side of the page. If you have existing scenarios, they appear in the list on the right. When you click on a scenario to select it, the buttons below the list become enabled to let you edit, copy, delete, get details, generate code, or run it. See **Chapter 4: Using the Statistics Wizard** for details about the Statistics Wizard.

---

## Analysis Types

All of Total Access Statistics' features are organized in analysis type categories. In general, every analysis shows the number of observations and the number of missing (ignored) values. Details about each feature are provided in future chapters, but a quick summary is provided below.

### Parametric Analysis Options

Parametric analysis is performed on numeric fields that are assumed to be continuous and normally distributed. Fields can be analyzed individually or compared with each other.

Type	Description
<b>Describe</b>	Analyze a numeric field: standard deviation, standard error, variance, coefficient of variance, skewness, kurtosis, geometric mean, harmonic mean, RMS, mode, confidence intervals, t-Test vs. mean, percentiles, etc.
<b>Frequency</b>	For each field, analyze frequency distribution for each interval (range of values): count, sum, percent of total, cumulative count, percent, and sum.
<b>Percentiles</b>	Perform analysis similar to Describe, but place results in records rather than fields (each percentile is a separate record): Median, quartiles, quintiles, octiles, deciles, and percentiles. Results can also be placed in a field in your table with the percentile for each record.
<b>Compare</b>	Compare two fields: mean and standard deviation of difference, correlation, covariance, R-square, paired t-Test.
<b>Matrix</b>	Perform analysis similar to Compare, but rather than comparing several fields to one, compare all fields to each other creating a matrix.
<b>Regression</b>	Calculate simple, multiple, and polynomial regressions with ANOVA and residual table. Estimated Y can be placed in a field in your table.
<b>Crosstab</b>	Create cross-tabulation with row and column summaries, and % of row, column, and total for each cell. Chi-Square analysis is also available with expected value and % of expected for each cell.

<b>Running Totals</b>	Perform running totals such as average, sum, count, median, min, max, etc. over a sorted list of records. Totals can be for the entire list or a moving number of records (e.g. the last 10 records)
-----------------------	--

## Group Analysis Options

Group analysis is the comparison of continuous, normally distributed numeric data between groups of records. A comparison field in the table defines the groups. For instance, you may want to compare data by gender or by race. Unlike the Compare feature in Describe, which is for paired values, these groups are usually of different sizes (number of records).

Type	Description
<b>Two sample t-Test</b>	Compare means between two groups of records. Calculations include pooled and separate t-values for the two groups.
<b>ANOVA (analysis of variance)</b>	Compare the means of multiple groups of records. Calculations include degrees of freedom, sum of squares within and between groups, F-value, and probability.
<b>Two way ANOVA</b>	Compare multiple fields between groups of records. The results are the same as ANOVA, except that they have additional values for each additional field. Use two way ANOVA to measure relative impact of each variable on the mean.

## Non-Parametric Analysis Options

Less powerful than parametric analysis, non-parametric analysis is used when the underlying data is not continuous, such as data that is ordinal or not normally distributed. Non-parametric analysis makes no assumption on the distribution of the underlying data, since the results are based on the ranks of the data. Non-parametric analysis can be made for each numeric field individually, compared with each other, or between groups of records (samples).

Type	Description
<b>Chi-Square</b>	Evaluates distribution and expected value for each unique value in a field.
<b>Sign Test</b>	Calculates a one sample sign test versus median, mean or user defined value.



<b>K-S Fit</b>	Performs Goodness of Fit tests to determine if a numeric field fits a uniform, normal, or Poisson distribution.
<b>2 Sample</b>	Executes Wald-Wolfowitz Runs Test, Mann-Whitney U Test, and Kolmogorov-Smirnov.
<b>N Sample</b>	Performs Kruskal-Wallis one way ANOVA.
<b>Paired Fields</b>	Performs field comparisons: paired sign test, Wilcoxon Signed Rank, Spearman's Rho correlation.
<b>N Fields</b>	Calculates Friedman's two way ANOVA.

### Record Analysis Options

Unlike other analysis types, Record Analysis features generate results that manipulate your records directly. With options to update your existing records or create new records similar to your data source, Record Analysis helps you manage your data.

Type	Description
<b>Random</b>	Selects a random number or percentage of records from your data.
<b>Ranking</b>	Assigns ranking values to your records and accounts for ties.
<b>Normalize</b>	Normalizes an existing data source by creating a separate record for each value in your specified fields.

### Financial Analysis Options

Type	Description
<b>Periodic Cash Flows</b>	Calculates the discounted values and rates of return for cash flows with regular payment intervals.
<b>Irregular Cash Flows</b>	Calculates the discounted values and rates of return for cash flows with irregular, date specific, payments.

---

## Preparing Data

To take full advantage of Total Access Statistics, it is best to follow these guidelines:

- Use normalized data
- Analyze one data source at a time

## Using Normalized Data

Total Access Statistics uses the same principle as Microsoft Access queries, which are optimized for normalized data. Rather than going into theoretical discussions on data normalization, we present you with the basic idea. The fundamental concept is to store your data in a format that supports using summary queries, which allow Totals with Group By and Sum fields. Avoid storing data across several fields (in spreadsheet format), since new columns need to be added if new categories arise.

A normalized structure allows you to store data by adding records rather than fields. In relational databases, records are free, but fields are expensive.

Like Microsoft Access, Total Access Statistics does not perform “sums” across fields, only within fields. If you need spreadsheet-type reports, use the Total Access Statistics or Microsoft Access crosstab feature when needed, but store your data in a normalized format.

Data Type	2011	2012	2013	2014	2015
Receipt	\$2,303	\$2,590	\$2,882	\$3,145	\$3,273
Outlay	\$3,603	\$3,717	\$3,655	\$3,807	\$4,021
Deficit	\$1,300	\$1,127	\$772	\$662	\$749
Discretionary: Defense	\$699	\$709	\$700	\$673	\$678
Discretionary: Non-Defense	\$600	\$610	\$565	\$546	\$543
Social Security	\$725	\$773	\$820	\$867	\$918
Medicare	\$480	\$478	\$528	\$564	\$586
Medicaid	\$275	\$255	\$283	\$339	\$372
TARP	(\$38)	\$35	\$12	\$8	\$5
OtherMandatory	\$631	\$635	\$571	\$595	\$6,322
Interest	\$230	\$223	\$246	\$305	\$384

*Bad Non-Normalized “Spreadsheet” Data*

Data Type	DataField	Value
Deficit	2011	\$1,300.00
Deficit	2012	\$1,127.00
Deficit	2013	\$772.00
Deficit	2014	\$662.00
Deficit	2015	\$749.00
Discretionary: Defense	2011	\$699.00
Discretionary: Defense	2012	\$709.00
Discretionary: Defense	2013	\$700.00
Discretionary: Defense	2014	\$673.00
Discretionary: Defense	2015	\$678.00
Discretionary: Non-Defense	2011	\$600.00
Discretionary: Non-Defense	2012	\$610.00
Discretionary: Non-Defense	2013	\$565.00
Discretionary: Non-Defense	2014	\$546.00
Discretionary: Non-Defense	2015	\$543.00

*Good Normalized Data*

### ***Convert Data to Normalized Format***

To manually convert data from a non-normalized format, you'll need to create a table with the proper structure, and use a series of APPEND queries to fill the new table and delete records with blank values.

Fortunately, Total Access Statistics offers a **Normalize** feature under Record Analysis that makes it easy to normalize your data. Learn more on page 125.

### **Analyze One Data Source at a Time**

While you can analyze several tables during a Total Access Statistics session, you can only analyze one table or query at a time.

In some cases, related data may exist in several tables. A select query usually does the trick. For instance, if you have an Invoice and Customer system and want to analyze invoices based on customer information (e.g. sales by state), you need to combine the Invoice and Customer information in a query prior to running Total Access Statistics (the Invoice record plus its corresponding state or zip code).

In other situations, a query is unable to combine your data properly, requiring you to create a new table, combine your data there, and analyze that. For example, a separate table may exist for each year of sales. To analyze this, create a table similar to the original tables with an additional field designating the year, and fill it with your data.

If you want to analyze a subset of records, create a query with your criteria, then use that as the data source for Total Access Statistics. If you perform multiple analyses on the same data, you may find it more efficient to put the query results in a table via a Make Table query, and have Total Access Statistics analyze the resulting table.

---

## **Scenarios**

Total Access Statistics saves each analysis as a scenario, which is saved in four tables within the database where the analysis is run. A scenario stores all information about the analysis, including the data source and fields to analyze, the type of analysis to perform, any options within the analysis type, the output table(s), and the description. A scenario does not store the data that you analyze — the latest data is always used when you run a scenario. Since results are not saved within your scenarios, you can easily repeat an analysis on updated tables, modify your analysis, or share analyses among users.

**Chapter 11: Advanced Topics** provides more information about how scenarios are saved. It also shows how to bypass the interactive Wizard completely, and run your saved scenarios within your applications.

---

## Calculation Accuracy

Total Access Statistics uses double precision (15 digits of accuracy) for all calculations. Results are placed in Access tables, which show all decimal places for each number. Probability values (0 to 100%) are presented as decimal values between 0 and 1 (i.e. 48% is 0.48).

# Chapter 4: Using the Statistics Wizard

*The Statistics Wizard guides you through the process of creating and running your scenarios. No programming is required — just point and click to choose the table and fields to analyze and the options to generate. This chapter provides details about using the Statistics Wizard to create and run scenarios. Detailed information about each type of analysis is provided in later chapters.*

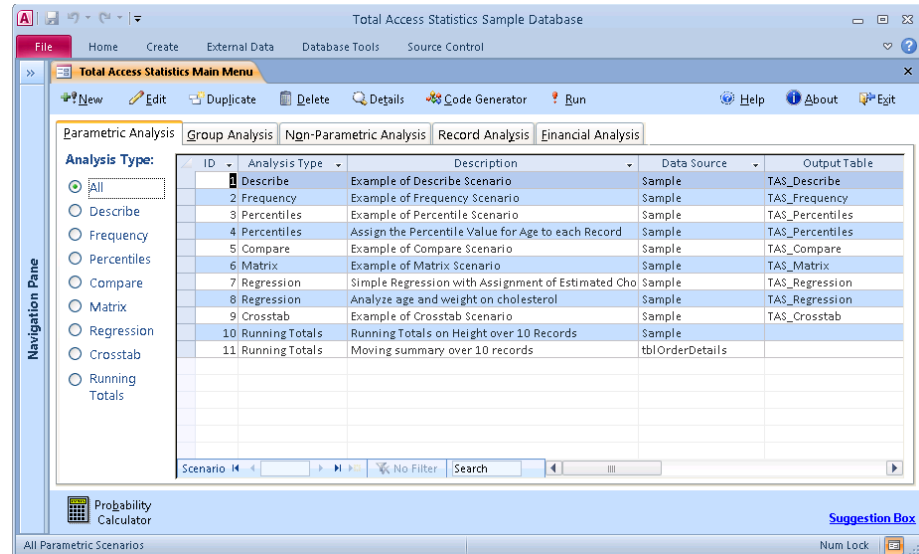
---

## Topics in this Chapter

- **Scenario Selection (Main Form)**
- **Creating a New Scenario**
- **Data Sources that Require Parameters**
- **Field Selections**
- **Ignoring Data**
- **Analysis Options**
- **Output Tables and Description**

## Scenario Selection (Main Form)

When you open Total Access Statistics from your Access Add-ins menu, the Statistics Wizard Main Form appears:



*Main Form*

The analysis tabs across the top determine the list of scenarios displayed. The analysis types are organized into Parametric, Group, Non-Parametric, and Record options. When you select one of these tabs, the corresponding sub-analysis types are displayed on the left side of the page. If you select one of the subtypes (e.g., Describe, Frequency, Percentiles), only scenarios of that particular type are shown. Select *All* to show all scenarios of the selected analysis type.

The following buttons are available at the top of the Main Form:

Button Name	Description
<b>New</b>	Create a new scenario
<b>Edit</b>	Edit the currently highlighted scenario
<b>Duplicate</b>	Copy the current scenario
<b>Delete</b>	Delete the current scenario
<b>Details</b>	See detail information for the current scenario
<b>Code Generator</b>	Generate code that you can paste into your module to run a scenario programmatically. See Scenario Code Generator on page 159 for details.
<b>Run</b>	Run the current scenario
<b>Help</b>	Display the help file

<b>About</b>	Display the About screen
<b>Exit</b>	Close the Total Access Statistics Wizard
<b>Probability Calculator</b>	Show the Probability calculator for evaluating test values (Z, Student's t, Chi-Square, F). See Chapter 10: Probability Calculator for more information

## Creating a New Scenario

To create a new scenario, click the [New] button, and you will see the following screen:

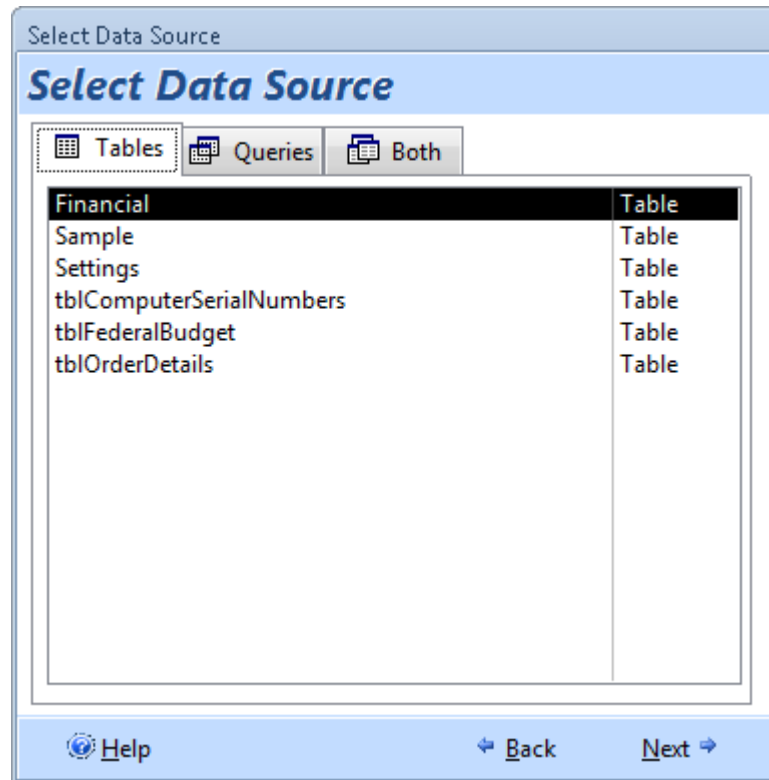
*Select Analysis Type Form*

Choose the type of scenario to create and press [Next] to go to the Select Source Object screen:

### Select Data Source

#### ***Access Databases (MDBs and ACCDBs)***

For Access Jet databases, you can select a table or query as your data source. Tables can be tables in your database or linked tables from SQL Server, dBase, Paradox, etc. Queries must be Select queries that return records or Crosstab queries. For obvious reasons, action queries, which do not return records, cannot be a data source.



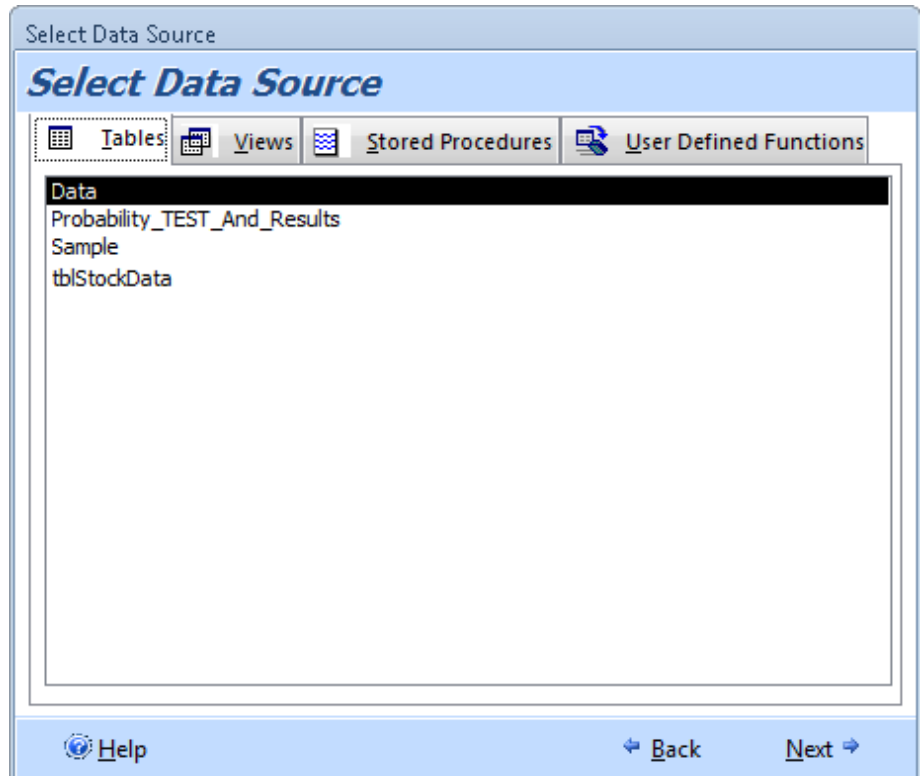
*Select Data Source for MDBs and ACCDBs*

Select the table or query containing the data to analyze. The tabs across the top allow you to select from a list of tables, queries, or both. Highlight the data source you want and press [Next].

#### ***Access Data Projects (ADPs)***

Access Data Projects connect directly to a SQL Server database. If you are not familiar with ADPs, look in your Microsoft Access help file. For ADPs, you may select among tables, views, stored procedures or user defined functions:

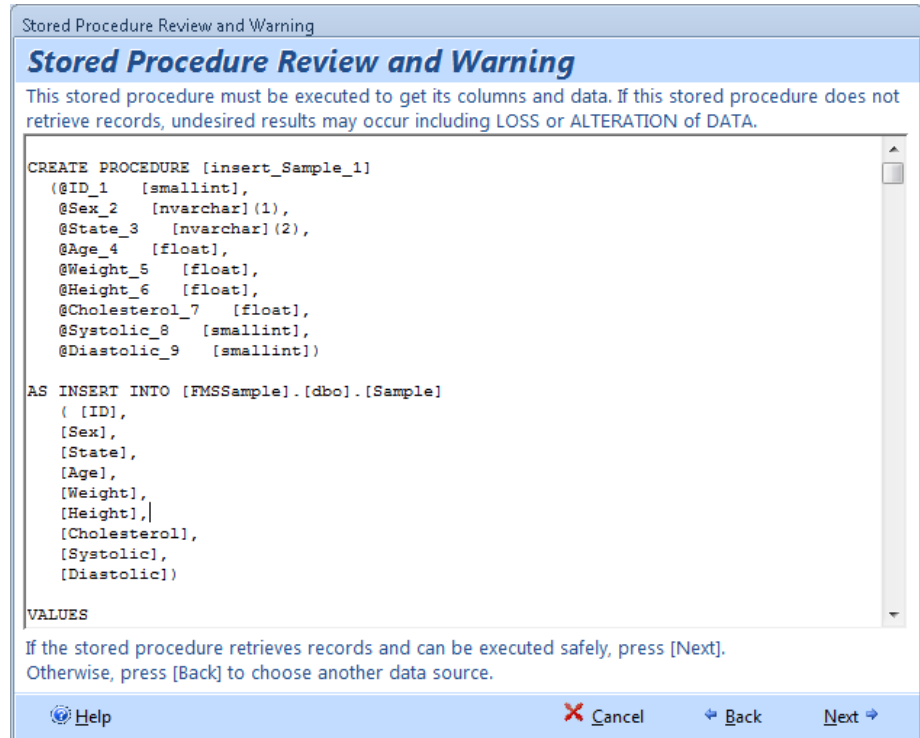




*Select Data Source for ADPs*

### **Verifying Stored Procedures and User Defined Functions**

If you choose a Stored Procedure or User Defined Function, a screen appears to confirm you want to execute it. Stored Procedures and User Defined Functions can do all sorts of things (like delete records) and not just provide a set of records for analysis. You need to confirm the code behaves as you expect and only returns records because Total Access Statistics may need to execute it multiple times and it should not alter data:

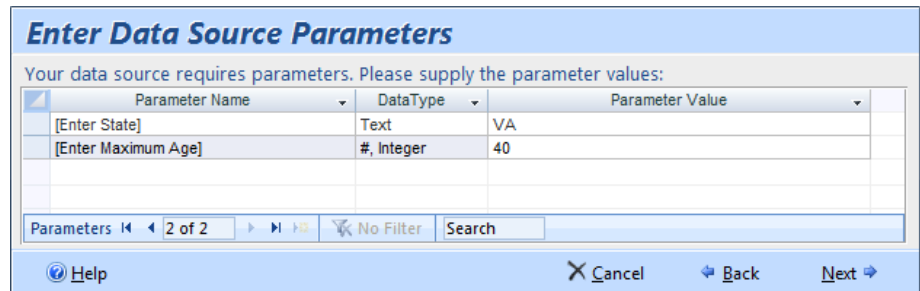


*Review of Stored Procedure or User Defined Type Code*

Confirm this is safe and valid before pressing [Next].

## Data Sources that Require Parameters

If you select a query, stored procedure or user defined function that requires parameters, a screen appears for you to enter the values:



*Enter Parameter Values for Your Data Source*

Each parameter is on a separate line with its data type. Enter your values in the [Parameter Value] column.

For Access queries, you should explicitly define the parameters and their data type under the Query, Parameters menu when the query is in design mode. Otherwise, all your parameters will be treated as text strings.


For Boolean (Yes/No) fields, enter -1 for Yes (True) and zero for No (False).

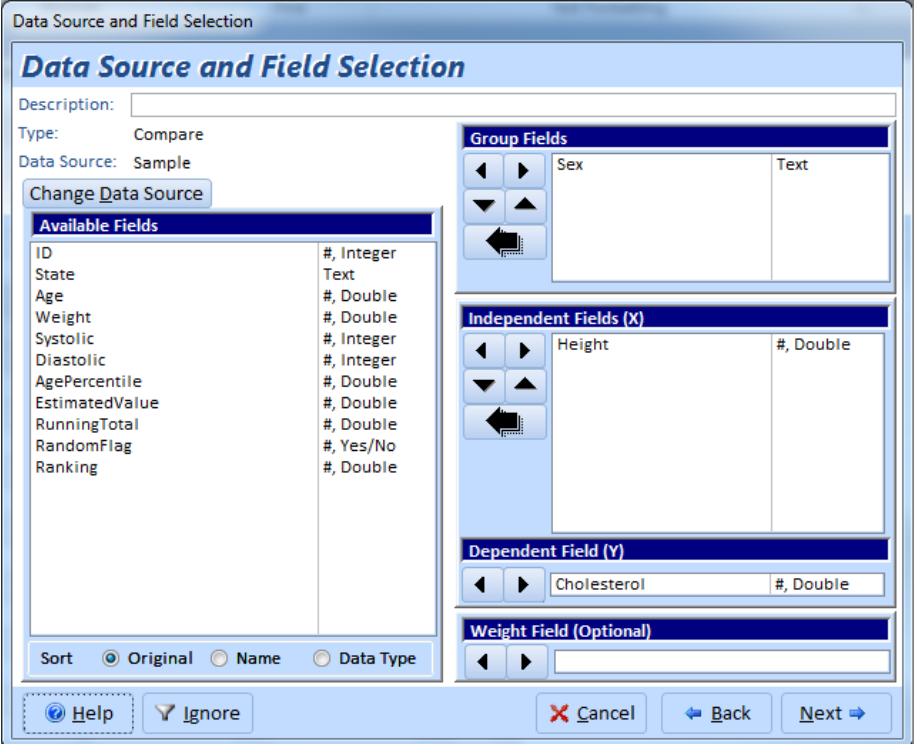
Press [Next] to continue. If you edit an existing scenario that has parameters, a button appears on the Field Selection form that lets you change the parameters.

---

## Field Selections

When you select [New] or [Edit], the Statistics Wizard takes you to the Field Selection screen.

The Field Selection screen is divided into two parts. The left side allows you to enter a description for this scenario, change the table to analyze, and view the list of available fields in the selected table. The right side of the form displays the fields selected for analysis and how they are assigned. To assign a field, highlight it on the left, and press one of the  buttons.



Available Fields	
ID	#, Integer
State	Text
Age	#, Double
Weight	#, Double
Systolic	#, Integer
Diastolic	#, Integer
AgePercentile	#, Double
EstimatedValue	#, Double
RunningTotal	#, Double
RandomFlag	#, Yes/No
Ranking	#, Double

*Field Selection Form*

Use the Sort options at the bottom of the form to change the order in which the fields display.

### Field Assignment Types

All analysis types have Group, Independent (X), and Weighting field options. Analyses that require field comparisons (such as Regressions) have the Dependent (Y) field option. The Comparison field is used for group analysis.

Crosstabs have a completely different set of options: Row Fields, Column Field, Value Fields and Weighting Field. See page 71 for more information on Crosstab options.

The right side of the form varies depending on the analysis type selected, but there can be as many as five field types:

#### ***Group Fields***

You can optionally select one or more Group fields to define unique sets of records for analysis. This is similar to placing a “Group By” in the Totals section of a query. With a Group By and Sum in a query, Access’s datasheet (query output) includes a separate record for each unique Group By field’s value. The same principle applies in Total Access Statistics. For every combination of unique values in the group fields, a separate analysis (output record) is generated. If no group fields are specified, every record in the table is analyzed as one set.

#### ***Independent (X) Fields***

X fields are the number fields (independent variables) to analyze. You must select at least one X field.

#### ***Dependent (Y) Field***

When you select an analysis type involving field comparisons, you must assign a numeric value as the Y field. The Y field is the dependent variable that each X field is compared against.

#### ***Weighting (W) Field***

The Weighting field (variable) is an optional numeric field that allows you to “Weight” each record. It is useful if your records contain summary information. For instance, if each record is a country with [Population] and [Average Age] fields, by assigning [Population] as the weight field and [Average Age] as the X Field, you can calculate the statistics for all the countries taking relative size into account. If the weight field is null or zero, the record is ignored.

#### ***Comparison Field***

Use a comparison field when performing group analysis and non-parametric sample comparisons. The comparison field defines each sample set of records (e.g. a Sex field with Male and Female values). This field is explained in more detail in **Chapter 6: Group Analysis** on page 81.

## Selecting Fields for Analysis



Button to  
assign a field

To assign a field to a particular type, highlight the field in the list, and press the right arrow button in the box where you want to assign the field. For instance, to assign the [State] field as a Group field, click to highlight “State” in the Fields list, and then click on the right arrow in the “Group Fields” box.

You can select multiple fields at once by selecting them with the [Ctrl] button while you click, or a range of fields holding the [Shift] button and clicking.



Double click on a field to automatically assign it. Numeric fields are assigned to X Field, while other field types are assigned as Group fields.

## Reordering Fields



Move field up



Move field  
down

For some fields such as Group and X fields, several fields may be assigned. By default, the fields are processed in the order you select them, but you can change this by using the up and down buttons. To move the selected field, simply highlight the field you want to move and click on one of the buttons.

## Removing Fields from Analysis



Un-assign one  
field

To remove a selected field, highlight it and press the left arrow button, or double click on it. You can select multiple fields at once by holding the [Ctrl] button while you click.



Un-assign all  
fields

You can remove all the fields of a particular type by pressing the large left arrow.

## Finishing

After selecting the fields, press [Next] to display the analysis type options. If you decide not to proceed, press [Back] to cancel changes and return to the main form.

---

## Ignoring Data

Total Access Statistics automatically ignores null values during analysis. By default, all non-null values are used in the calculations, but there may be times when you want to ignore a specific value or range of values. Total Access Statistics includes a powerful feature that allows you to do this.

Press the [Ignore] button on the field selection form:

The screenshot shows a dialog box titled "Ignore Values" with a close button in the top right corner. The main heading is "Specify Data Values to Ignore". There are three radio button options: "Analyze All values (do not ignore any values)", "Ignore a Specific Value:", and "Ignore a Range of Values:". The "Ignore a Range of Values:" option is selected. Below this, there are two input fields: "Greater Than (>):" with the value "100" and "Less Than (<):" with the value "0". At the bottom of the dialog are three buttons: "OK", "Cancel", and "Help".

*Ignore Values Form*

### Ignoring a Specific Value

In some situations, you may use a dummy value rather than or in addition to nulls (for instance 999). This is useful when you want to designate a value is unknown rather than not filled. In this instance, you want to keep the dummy value out of your calculations and treat it as a missing value. To specify a value to ignore, choose the option to “Ignore a Specific Value” and enter the value to ignore.

### Ignoring a Range of Values

Alternatively, you may want to limit your analysis to a range of values. You can choose to ignore all values above a certain value, below a value, or both. Select the “Ignore a Range of Values” option and enter the values in the two fields. Values equal to the number you enter are not ignored, so if you want to ignore values greater than and equal to a value (e.g. 100), enter a value slightly smaller (99.999999).

### What Values are Ignored

When Ignore options are set, they are applied to the Independent (X) and Dependent (Y) fields. If a Comparison field is numeric it also respects the

ignore options. The Weighting (W) field is affected if a Specific value is ignored, but ignoring a range of values does not affect weightings.

Values in Group fields are not affected. Group fields can be any field type and create separate records for each group in the output table. Calculations of each group are entirely separate, so there is no problem with Groups of invalid values. You can easily ignore the records you do not want in the output table.

### Impact on Analysis with Updated Records

There are a few calculations with the option of updating a field in your data source:

- **Percentiles**  
The percentile value of the record
- **Regressions**  
The estimated Y value of the record
- **Running Totals**  
The running total of the record
- **Random**  
Whether the record is selected
- **Ranking**  
The rank value of the record

When you ignore a specific value or a range of values, the skipped records are not updated. Therefore, the data that existed in the update field for those records is unchanged.

This may cause confusion, so to avoid mixing the new information with existing information in the ignored records, you should clear the field for all your records before running the scenario.



There are situations when you may not want to clear the data. For instance, you may be combining data from multiple ranges of ignored (non-overlapping) values in that field.

---

## Analysis Options

After you assign the fields to analyze, press the [Next] button to display other analysis options.

The options available vary depending on the analysis type selected. Options for each type of analysis are discussed in future chapters.

*Options Form*

After choosing the options desired, press [Next] to continue.

### Check Boxes

Click on a check box to select the option, and click on it again to unselect it. Each check box is independent of other options.

### Option Group Buttons

Options group buttons are linked to each other, and you can only select one option in the group.

---

## Output Tables and Description

When you press [Next] on the analysis option screen, you see the following screen:



The screenshot shows a dialog box titled "Output Tables and Description". It has a subtitle "Output Tables and Description". The dialog is divided into two main sections:

- Analysis:** This section contains two text input fields. The first is labeled "Analysis Type:" and contains the text "Describe". The second is labeled "Description:" and contains the text "Example of Describe Scenario".
- Output Table:** This section contains one text input field labeled "Name for Describe output table:" which contains the text "TAS\_Describe".

At the bottom of the dialog, there is a row of five buttons: "Help", "Cancel", "Back", "Save", and "Save and Run".

*Output Table Form*

Enter a name for the output table(s) to be generated. By default, each analysis type's output table has a unique name. The table is created in your current database. You can change the name to any valid Microsoft Access table name.

You can optionally add a scenario description to help you remember details about the analysis. This description is saved with the scenario and can be viewed from the main screen of the Wizard.

When you finish, press [Save] to save the scenario and return to the main screen of the Wizard, or press [Save and Run] to save and run the scenario. If the output table already exists, a message appears asking for permission to overwrite it.

If the scenario is successful, the output tables are created and displayed. Use these tables like any other Microsoft Access table: search, reformat fields, export, etc. You can also use the Access AutoReport feature to create a report. When you are finished examining the output, close the tables and return to the Statistics Wizard for additional analysis.



# Chapter 5: Parametric Analysis

*This chapter describes Total Access Statistics' parametric analysis options. Parametric analysis should be performed on continuous numeric fields where data is assumed to be reasonably normally distributed. Numeric data that does not satisfy these conditions should be analyzed with non-parametric tests.*

---

## Topics in this Chapter

- **Parametric Analysis Overview**
- **Describe (Field Descriptives)**
- **Frequency Distribution**
- **Percentiles**
- **Compare (Field Comparisons)**
- **Matrix**
- **Regression**
- **Crosstab and Chi-Square**
- **Running Totals**

## Parametric Analysis Overview

The Parametric Analysis features are available when you select the [Parametric Analysis] tab from the main form:

ID	Analysis Type	Description	Data Source
1	Describe	Example of Describe Scenario	Sample
2	Frequency	Example of Frequency Scenario	Sample
3	Percentiles	Example of Percentile Scenario	Sample
4	Percentiles	Assign the Percentile Value for Age to each Record	Sample
5	Compare	Example of Compare Scenario	Sample
6	Matrix	Example of Matrix Scenario	Sample
7	Regression	Simple Regression with Assignment of Estimated Cho	Sample
8	Regression	Analyze age and weight on cholesterol	Sample
9	Crosstab	Example of Crosstab Scenario	Sample
10	Running Totals	Running Totals on Height over 10 Records	Sample
11	Running Totals	Moving summary over 10 records	tblOrderDetails

*Parametric Analysis Tab*

The types of parametric analysis are listed on the left:

- **Describe (Field Descriptives)**  
Analyze all X fields you specify, customizing the statistical values that are calculated.
- **Frequency Distribution**  
Determine the number of occurrences within each range of numeric values.
- **Percentiles**  
Determine the percentiles for each Group and X field you select.
- **Compare (Field Comparisons)**  
Perform a record-by-record comparison between each X field and the specified Y field.
- **Matrix**  
Perform calculations similar to Compare, but with a quick way to look for correlations and other relationships between many fields.
- **Regression**  
Calculate the least squares (best fit) curve to determine an equation that relates the Y (dependent) variable to the X (independent) variable(s).
- **Crosstab and Chi-Square**  
Create matrices showing summaries of one field across two fields, and optionally measure the independence of the two variables.

- **Running Totals**

Perform running totals such as average, sum, count, median, min, max, etc. over a sorted list of records. Totals can be for the entire list or a moving number of records (e.g. the last 10 records)

---

## Describe (Field Descriptives)

Describe allows you to analyze all X fields you specify, creating the following statistical values:

- Count, Missing, Mean
- Minimum, Maximum, Range
- Variance, Coefficient of Variance, Standard Deviation, Standard Error
- Sum, Sum Squared
- Geometric Mean, Harmonic Mean, Root Mean Square
- Skewness, Kurtosis
- Mode, Mode Count
- Confidence Intervals using t or Normal distribution
- t-Test versus Mean
- Percentiles (Median, Quartiles, Deciles)
- Frequency distribution

### Field Selection

On the Field Selection form, you can select multiple Group and Weight fields in addition to choosing X fields. Separate calculations are made for each group (combination of unique Group fields values), and a separate record is created for each group and X field.

*Describe Field Selection Form*

See page 33 for details about the Field Selection form. After selecting fields, press [Next], to display the Describe options.

## Describe Options

*Describe Options*

When you select a check box, the corresponding fields are generated. See page 37 for details about the Options form.

When you finished, press [Next] to specify the output table and description (described on page 38).

## Describe Output Table

Following is an example of an analysis of three X fields (Age, Weight, Cholesterol) grouped by State (not all fields are shown):

State	DataField	Count	Missing	Mean	Minimum	Maximum	Range	Variance	CoeffOfVariance
FL	Age	17	0	46.82353	24	69	45	215.4044118	0.313446302125344
FL	Weight	17	0	143.9412	90	233	143	1775.433824	0.292729975692678
FL	Cholesterol	17	0	185.8824	157	267	110	982.4852941	0.168626128077298
MD	Age	33	0	45.60606	20	68	48	184.1212121	0.297529034264548
MD	Weight	33	0	153.2121	95	239	144	1807.609848	0.277497595302169
MD	Cholesterol	33	0	192.9394	140	322	182	1625.058712	0.208936164595888
VA	Age	50	0	46.54	20	69	49	212.0902041	0.312920435539527
VA	Weight	50	0	152.62	91	239	148	2170.403673	0.305252204238662
VA	Cholesterol	50	0	191.98	155	300	145	1042.958776	0.168219982700781

Describe Output Table

## Describe Output Fields

The following fields are always created for the Describe analysis:

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	X field name identifying the data in the record
<b>Count (N)</b>	Number of non-Null X field records (or if Weight field specified, the sum of weightings)
<b>Observations</b>	Number of X field records (different from N). This field is only created if Weight field specified.
<b>Missing</b>	Number of blank X field records
<b>Mean (<math>\bar{x}</math>)</b>	$\bar{x} = \sum x/N$ Sample mean and an estimate of the population mean ( $\mu$ )

The following sections list the fields that are created if its checkbox is selected:

### Minimum, Maximum, Range

<b>Minimum</b>	Smallest value in X field
<b>Maximum</b>	Largest value in X field
<b>Range</b>	Range of values in the field = <i>Maximum</i> - <i>Minimum</i>

### Variance Fields

There is an option for calculating these values using an N-1 or N method. The variance divisor depends on the method selected. The N-1 method creates an “adjusted” (unbiased) sample variance as corresponds to the

Access VAR( ) function. The N method is for a population variance and is equivalent to the VARP( ) function. The N-1 Method is preferred when the data represents a portion (sample) of the entire population. For large N (N > 30), both definitions result in similar numbers.

<b>Variance (s<sup>2</sup>)</b>	$\frac{\sum (x_i - \bar{x})^2}{N - 1} \quad \text{or} \quad \frac{\sum (x_i - \bar{x})^2}{N}$ <p>Variance is a measure of the distribution of the data from its mean. It is a data point's average squared difference from the sample mean. The formula depends on the method selected.</p>
<b>CoeffOf Variance</b>	<p>Coefficient of Variance = <math>\frac{s}{\bar{x}}</math></p> <p>This removes the effect of a larger variance due to larger means.</p>
<b>StdDeviation (s)</b>	<p>Standard Deviation is the square root of variance</p>
<b>StdError (SE)</b>	<p>Standard Error of the Mean = <math>s/\sqrt{N}</math></p> <p>Regardless of whether the population is normally distributed, the sample means (<math>\bar{x}</math>) should be normally distributed. Standard error measures the standard deviation of <math>\bar{x}</math> to the population mean. As sample size increases, <math>\bar{x}</math> approaches population mean and standard error decreases.</p>

### Sum, Sum Squared

<b>Sum</b>	Sum of X values = $\sum x$
<b>SumSquared</b>	Sum of squared values = $\sum x^2$
<b>AdjSum Squared</b>	Adjusted sum squared = $\sum x^2 / N$ The mean squared value.



## Means: Geometric, Harmonic, RMS

<b>Geometric Mean</b>	$\sqrt[N]{X_1 \cdot X_2 \cdot X_3 \cdot \dots \cdot X_N} = \exp\left(\frac{\sum \log(x)}{N}\right)$ <p>Geometric Mean is used for a variable that has a constant rate of change; that is, as the mean increases, so does its variance. A logarithmic transformation eliminates this effect. The geometric mean is undefined if any X value is zero or negative.</p>
<b>Harmonic Mean</b>	$= \frac{N}{\sum (1/x)}$ <p>Harmonic Mean</p> <p>The Harmonic Mean is the mean of a reciprocal transformation, and is often used to analyze ratios. It is undefined if any X value is zero or negative.</p>
<b>RMS</b>	$\text{Root Mean Square} = \sqrt{\sum x^2 / N}$ <p>Root Mean Square, or quadratic mean, is often used in physical systems. It is the mean of the square transformation.</p>

For positive values of X,  $H.M. \leq G.M. \leq \bar{x} \leq RMS$

## Skewness, Kurtosis

<b>Skewness</b>	$= \frac{N}{(N-1)(N-2)} \sum \left( \frac{x_i - \bar{x}}{s} \right)^3$ <p>Skewness measures the symmetry of the data. A normal distribution (bell curve) has zero skewness. If it has a longer tail to the right of the mean, it is skewed to the right and has positive skewness. Negative skewness indicates skew to the left.</p>
<b>SE_Skewness</b>	<p>Standard Error of Skewness depends on sample size, not data values.</p>

<b>Kurtosis</b>	$= \left( \frac{N(N+1)}{(N-1)(N-2)(N-3)} \sum \left( \frac{x_i - \bar{x}}{s} \right)^4 \right) - \frac{3(N-1)^2}{(N-2)(N-3)}$ <p>Kurtosis measures the peakedness of the data. A normally distributed sample has a Kurtosis equal to zero. A highly peaked distribution is called leptokurtic and has positive kurtosis. A relatively flat (thick tailed) distribution is called platykurtic and has negative kurtosis. A moderately peaked distribution is called mesokurtic.</p>
<b>SE_Kurtosis</b>	Standard Error of Kurtosis depends on sample size, not data values.

### Mode, Mode Count

<b>Mode</b>	Mode is the most common value. If a tie exists for multiple values, there is no mode.
<b>Mode Count</b>	Mode Count is the occurrences of the Mode. If there is a tie, this value is shown, but Mode is blank.

### Confidence Intervals

*Confidence Intervals Options*

Confidence intervals are used to estimate the population mean from sample data. The sample is assumed to contain sampling variability, so its mean is not necessarily the population mean. Confidence intervals estimate the value of the population mean with an expected degree of accuracy. For instance, one may describe the mean as having a 95% chance of being  $52 \pm 5$ , where 95% is the confidence interval, 52 is the sample mean, and 5 is the confidence interval band width. As the sample size increases, this band becomes smaller. Similarly, the band increases as the confidence interval (%) increases.

#### **Intervals**

There are two possible confidence intervals to select. You can either select the check box for the 95% interval or type in your own interval (between 1 and 99.999%). Type in whole numbers (e.g. type 50 for 50% not 0.5).

Two techniques may be used:

### ***t-Test***

The t-Test (sometimes called the Student's t) is a distribution that changes with sample size. For small samples ( $N < 30$ ), t-Tests are considered the most robust test. For large samples ( $N > 30$ ), t-Test yields results similar to the normal distribution test. The t-Test uses the sample standard deviation to determine the confidence interval. This always results in a wider interval than that of the Normal distribution option.

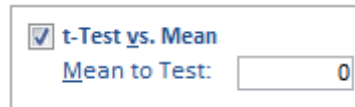
### ***Normal***

The Normal distribution test provides a more accurate result, but requires knowledge of the standard deviation of the population. Enter this value in the Std. Dev. field. If you selected more than one X field, and each X field has different standard deviations, you need to run a separate scenario for each X field.

These are the confidence interval fields created:

Field Name	Description
<b>n% T Band</b>	Band width for t-Test, where n is the confidence interval. For Normal distribution the field is n% N Band.
<b>n% Upper</b>	Upper limit = (mean + band)
<b>n% Lower</b>	Lower limit= (mean - band)

### **t-Test vs. Mean**



*t-Test vs. Mean Options*

This feature is sometimes called a one-group or one-variable t-Test and is used to compare each X field to a hypothetical mean. The result indicates the probability that the sample has the hypothetical mean. Enter the mean to test in the field.

Both 1-tailed and 2-tailed probabilities are calculated. A 2-tailed test is used to determine if the sample mean is significantly different from the hypothetical mean (greater than OR less than). A 1-tailed test is only concerned with the difference on one side (e.g. Is the sample mean significantly greater than zero?).

Field Name	Description
<b>Population Mean</b>	Population mean being tested (your input value)

<b>t-Value</b>	$= \frac{\sqrt{N} (\bar{x} - \text{Population Mean})}{s}$ <p>where N is the count of the group and s is the sample's standard deviation calculated by the N-1 method</p>
<b>Prob (1-tail)</b>	Statistical probability (0-1) that the sample mean is the same as the [Population Mean]. If the probability is too small (e.g. less than 1% or 5%), the hypothesis is rejected. Probability is calculated from the t-Value and degrees of freedom (N - 1).
<b>Prob (2-tail)</b>	2-tailed probability that the sample mean is the same as the [Population Mean]. This probability is used when there is no a priori reason to assume the sample mean will be greater than or less than the population mean.

## Percentiles

Percentiles:

Quartiles	Every 25th Percentile
Median	50th Percentile
Quartiles	Every 25th Percentile
Quintiles	Every 20th Percentile
Octiles	Every 12.5 Percentile
Deciles	Every 10th Percentile
5th Percentiles	Every 5th Percentile

*Percentile Options*

To create Percentile calculations, select the percentiles check box, and choose the type of Percentiles to calculate.

Percentiles are calculated by sorting the data from smallest to largest. The middle value is the median (50th percentile). Dividing into 4 groups gives quartiles (25th, 50th, and 75th percentiles), and 10 groups give deciles. This is the formula used to determine which record is selected:

$$\left[ \frac{\text{Percentile}}{100} (N - 1) \right] + 1$$

Where N is the number of items, and Percentile a number between 0 and 100. For instance, for a sample size of 13, the quartile records for the 25<sup>th</sup>, 50<sup>th</sup>, and 75<sup>th</sup> percentiles are 4, 7, 11. By definition, the 0<sup>th</sup> and 100<sup>th</sup> percentiles are the lowest and highest values.

If the percentile cutoffs do not coincide with a particular data point, a linear interpolation of the two closest points is used. If a weighting field is assigned, values are considered continuous and no interpolation is performed.

The following percentile options are available:

<b>Median</b>	50th percentile
<b>Quartiles</b>	Every 25th percentile
<b>Quintiles</b>	Every 20th percentile
<b>Octiles</b>	Every 12.5 percentiles
<b>Deciles</b>	Every 10th percentile
<b>5<sup>th</sup> Percentiles</b>	Every 5th Percentile

The field names correspond to the percentile number. For instance, for Quartiles, these fields are created:

- 25\_Percentile
- 50\_Percentile
- 75\_Percentile

Because Access field names cannot have decimals, for Octiles, the .5 is represented by -5. For instance, its field names include:

- 12-5\_Percentile
- 37-5\_Percentile
- etc.



Calculating Mode and Percentiles requires sorting each X Field in each group separately. For large tables, select Mode or Percentiles only when needed.

### ***Separate Percentile Feature***

There is a separate Percentiles feature outside this Describe section, which has some different calculations and output table format. See page 55 for more details.

## **Frequency Distribution**

Frequency distribution counts the number of records for each evenly spaced range of X field values. For instance, this feature can let you determine the number of records for each age group (20 to 30, 30 to 40, etc.). If you are interested in the frequency of individual values within a field (e.g. the response to a survey question where answers are 1 through 5), you should use the detail table of the non-parametric Chi-Square feature (see page 93).

**FREQUENCY DISTRIBUTION**

Include in each interval:  Lower  Upper Limit

Count of Occurrences  Display Type:  Count  Cumulative

Percent of Occurrences  Groupings:  Default  Specified

Number of Intervals:   
(2 to 50)

Initial Value:   
Width:

*Frequency Distribution Options*

Frequency Distribution creates a field for each data interval, and counts the number of occurrences in each. You can select two types of output: Count and Percent. Count is the number of occurrences, and Percent is the Count as a percentage of total occurrences in the group. These are the options:

***Number of Intervals***

Determines the number of frequency intervals (fields) to create.

***Include in Each Interval***

Determines to which group an interval “boundary” value belongs. Lower places the value in the lower limit of the interval ( $x \leq N < z$ ), while Upper makes the intervals  $x < N \leq z$ . For example, with Lower, 20 is placed in the interval 20-30. Upper places the value in the interval 10-20.

***Display Type***

Count displays the number of occurrences in each interval. Cumulative displays the number of occurrences in each interval plus all the previous intervals. The Percent fields also reflect the choice selected.

***Groupings***

Specify the grouping intervals for calculating frequency. *Default* calculates an initial value and width interval to accommodate all the data points for the number of intervals specified. However, the intervals may not be the most desirable groupings since the interval width would rarely be a nice round number. If you select *Specified*, two fields appear, [Initial Value] and [Width], to let you specify the exact initial value (start of the first interval) and the interval width. By default, Total Access Statistics creates two additional intervals for the count of items so that no records are skipped: less than the initial value and greater than the maximum interval.

The following frequency fields are created:

Field Name	Description
<b>N &lt;= x</b>	The count of records (or weightings) with values less than or equal to x (first interval value). This field is created if Groupings = Specified.

<b>y &lt;= N &lt; y + w</b>	The count of records (or weightings) with values between y and y + w (width). There is one of these fields for each of the intervals.
<b>z &lt;= N</b>	The count of records (or weightings) with values greater than z (last interval value). This field is created if Groupings = Specified.

For percentages, the field names use “%” rather than “N”.

### ***Frequency Analysis Type***

From the main Statistics Wizard screen, there is a Frequency analysis type that is separate from Describe. That frequency feature has additional options and presents the results differently. Read the next section for more information.

---

## **Frequency Distribution**

Frequency analysis determines the number of occurrences within each range of numeric values. If you want to determine the count of specific values rather than ranges, use the non-parametric analysis Chi-Square (see page 93). The detail table of Chi-Square gives a result similar to the Frequency table.

### **Difference from Describe**

The Frequency feature here differs from the frequency calculation in Describe (described on page 51) in these ways:

- The Frequency feature always calculates count, cumulative and percent of total and cumulative values. Describe requires you to choose count or cumulative.
- Results are shown with each interval as a separate record with information for each interval shown in one record side-by-side. With Describe, results are in one record with each interval as a separate field, so examining an interval’s count and percent of total is more difficult.
- The Frequency feature provides the option to calculate the sum and percent of sum.

### **Frequency Field Selection**

The Frequency field selection is identical to Describe field selection. Choose as many X fields as you want. Group and Weight fields are optional. Since the frequency intervals are identical for all the X fields, choose fields with

similar values. For instance, using the same intervals for Age and Annual Income would be meaningless since the values are so different.

### Frequency Options

**Number of Intervals:**  (2 to 50)  
 Calculate sum of values

**Should border values be in the lower or upper limit of an interval?**  
 Lower     Upper

**Groupings:**     Default     Specified  

**Initial Value:**   
**Width:**

*Frequency Options*

Refer to page 51 for details on Number of Intervals, Include in Each Interval, and Groupings. In addition to these features, you can optionally choose to calculate Sum of Values.

### Frequency Output Table

This example is an analysis of the Age field, grouped by State, with 5 intervals, lower option, specified initial value of 25, and interval width of 10. Since specified values were provided, two extra intervals before and after the range are added for a total of 7 intervals:

State	DataField	Interval	Low<=Range	Range<High	Count	Cumulative	Count%	Cumulative%
FL	Age	1		25	1	1	5.88%	5.88%
FL	Age	2	25	35	2	3	11.76%	17.65%
FL	Age	3	35	45	6	9	35.29%	52.94%
FL	Age	4	45	55	2	11	11.76%	64.71%
FL	Age	5	55	65	4	15	23.53%	88.24%
FL	Age	6	65	75	2	17	11.76%	100.00%
FL	Age	7	75		0	17	0.00%	100.00%

*Frequency Output Table*

### Frequency Output Fields

These fields are always created:

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	Field name identifying the data in the record
<b>Interval</b>	Interval number (1 to number of intervals)



<b>Low&lt;Range</b>	Interval range's low value. If Lower option is selected, the field is [Low<=Range]
<b>Range&lt;High</b>	Interval range's high value. If Upper option is selected, the field is [Range<=High]
<b>Count</b>	Number of records (or weightings) in interval
<b>Count%</b>	Percent of interval's count to total count of group
<b>Cumulative</b>	Sum of count for this and all previous intervals in group
<b>Cumulative%</b>	Cumulative sum of percentages

### *Sum of Values*

This option creates these additional fields:

<b>Sum</b>	Sum of X field values in each interval (adjusted for weightings if specified)
<b>Sum%</b>	Percent of interval's sum to total sum for group
<b>CumulativeSum</b>	Sum for this and all previous intervals in group
<b>CumulativeSum%</b>	Cumulative percentage of cumulative sum

---

## Percentiles

Percentile analysis determines the percentiles for each Group and X field you select. It uses the same formula as the Percentile calculation in the Describe section (explained on page 50).

### Difference from Describe

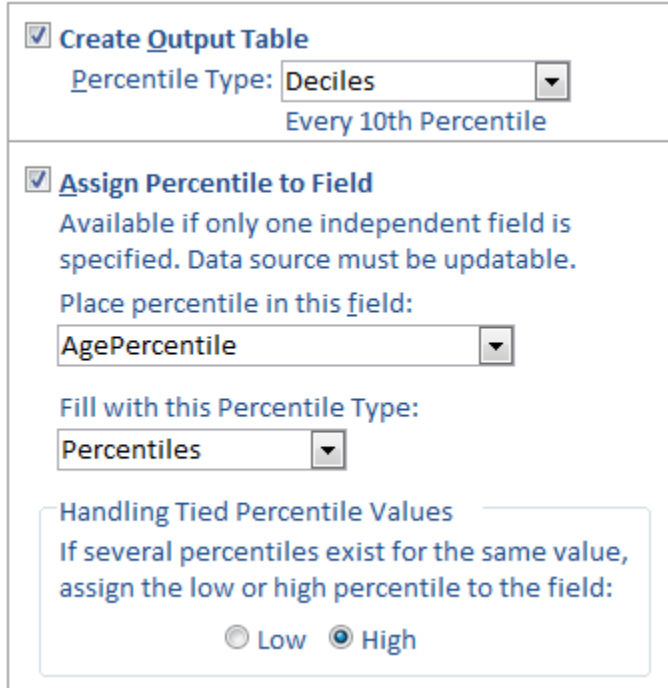
The Percentile analysis type differs from the percentile calculation under Describe in these ways:

- Results are shown with each percentile as a separate record. In Describe, results are in one record with each percentile as a separate field.
- The minimum and maximum values are displayed (0<sup>th</sup> and 100<sup>th</sup> percentiles).
- There are options to calculate every percentile (0 through 100) and every 0.5<sup>th</sup> percentile.
- Percentiles can be assigned to individual records to a field in your data source.

## Percentile Field Selection

The Percentile field selection is virtually identical to the field selection of Describe and Frequency. Choose as many X fields as you like. Group and Weight fields are optional. Unlike frequency intervals, however, percentiles are unique to each field, so it does not matter if the X fields are of similar values or not.

## Percentile Options



**Create Output Table**  
Percentile Type: Deciles  
Every 10th Percentile

**Assign Percentile to Field**  
Available if only one independent field is specified. Data source must be updatable.  
Place percentile in this field:  
AgePercentile  
Fill with this Percentile Type:  
Percentiles

**Handling Tied Percentile Values**  
If several percentiles exist for the same value, assign the low or high percentile to the field:  
 Low  High

*Percentile Options*

The percentile options are divided into two sections depending on where you want the results. If you want the results in an output table, check the Create Output Table option. If you want to assign the percentile value to a field in your data source, check the Assign Percentile to Field option and specify the field name where the results should be placed. You may select one or both options.

## Create Output Table

Create Output Table

Percentile Type: Percentiles

Assign Percentile

Available if only one percentile is specified. Data source: AgePercentile

Place percentile in: Percentiles

Fill with this Percentile Type: Octiles

Handling Tied Percentile Values

If several percentiles exist for the same value, assign the low or high percentile to the field:

Low  High

Median	50th Percentile
Quartiles	Every 25th Percentile
Quintiles	Every 20th Percentile
Octiles	Every 12.5 Percentile
Deciles	Every 10th Percentile
5th Percentiles	Every 5th Percentile
Percentiles	Every Percentile
X.5 Percentiles	Every 0.5 Percentile

*Percentile Calculation Options*

Every percentile type generates the 0 and 100th percentiles (lowest and highest values). Based on your selection, these percentiles are also calculated:

- Median for the middle value (50)
- Quartiles for 4 groups (25, 50, 75)
- Quintiles for 5 groups (20, 40, 60, and 80)
- Octiles for 8 groups (12.5, 25, 37.5, 50, 67.5, 75, and 87.5)
- Deciles for 10 groups (10, 20, 30, through 90)
- Percentiles for 100 groups (1, 2, through 99)
- X.5 Percentiles for 200 groups (0.5, 1, 1.5, through 99.5)

### Percentile Output Table

This example shows octile calculations for the Age and Weight fields, grouped by State:

State	DataField	Percentile	Value
FL	Age	0	24
FL	Age	12.5	31
FL	Age	25	36
FL	Age	37.5	42
FL	Age	50	43
FL	Age	62.5	46
FL	Age	75	62
FL	Age	87.5	64
FL	Age	100	69
FL	Weight	0	90
FL	Weight	12.5	103
FL	Weight	25	117
FL	Weight	37.5	124
FL	Weight	50	133
FL	Weight	62.5	149
FL	Weight	75	150
FL	Weight	87.5	200
FL	Weight	100	233

### Percentile Output Fields

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	Field name identifying the data in the record
<b>Percentile</b>	Percentile number: a value between 0 and 100 depending on which percentile type was selected
<b>Value</b>	Value corresponding to the percentile

### Assign Percentile to Field

Percentiles can also be assigned to the individual records of your data source. This option is only available if you selected one field to analyze and your data source is updatable.

Your data source also needs a field where the percentile value is placed. This must be a numeric field and may be an integer or double. Specify the field name:

**Assign Percentile to Field**  
 Available if only one independent field is specified. Data source must be updatable.  
 Place percentile in this field:

AgePercentile

AgePercentile	#, Double
Cholesterol	#, Double
Diastolic	#, Integer
EstimatedValue	#, Double
Height	#, Double
RandomFlag	#, Yes/No
Ranking	#, Double
RunningTotal	#, Double
Systolic	#, Integer
Weight	#, Double

Select an Existing Field in the Data Source to Update

By default, the field is updated with the Percentile value corresponding to each record's data value. You can also specify other Percentile calculations:

Fill with this Percentile Type:

Octiles

Median	50th Percentile
Quartiles	Every 25th Percentile
Quintiles	Every 20th Percentile
Octiles	Every 12.5 Percentile
<b>Deciles</b>	<b>Every 10th Percentile</b>
5th Percentiles	Every 5th Percentile
Percentiles	Every Percentile
X.5 Percentiles	Every 0.5 Percentile

Fill with Percentile Type Option

### Handling Tied Percentile Values

There is also an option to specify which percentile to assign to a record if the record's value equals multiple percentiles. For instance, there may be several records tied for the highest value (100<sup>th</sup> percentile). That value could represent the 96<sup>th</sup> to 100<sup>th</sup> percentile. By choosing to assign the low value, the record would be assigned 96 (no other records would be assigned 97 to 100). By choosing the High option, they would all be assigned 100, and there would be no 96-99.

### Percentile Field Assignment

This example shows the percentile value of each Age in the AgePercentile field.

The percentile field is only updated for the records analyzed. If the data field has null values, you specified records to ignore, or used a query that filtered records, be sure to clear the percentiles field to avoid mixing old data with the new data.

Age	AgePercentile
33	21
30	16
43	46
59	75
62	83
56	71
67	92
28	13
62	83
32	19
42	40
69	100

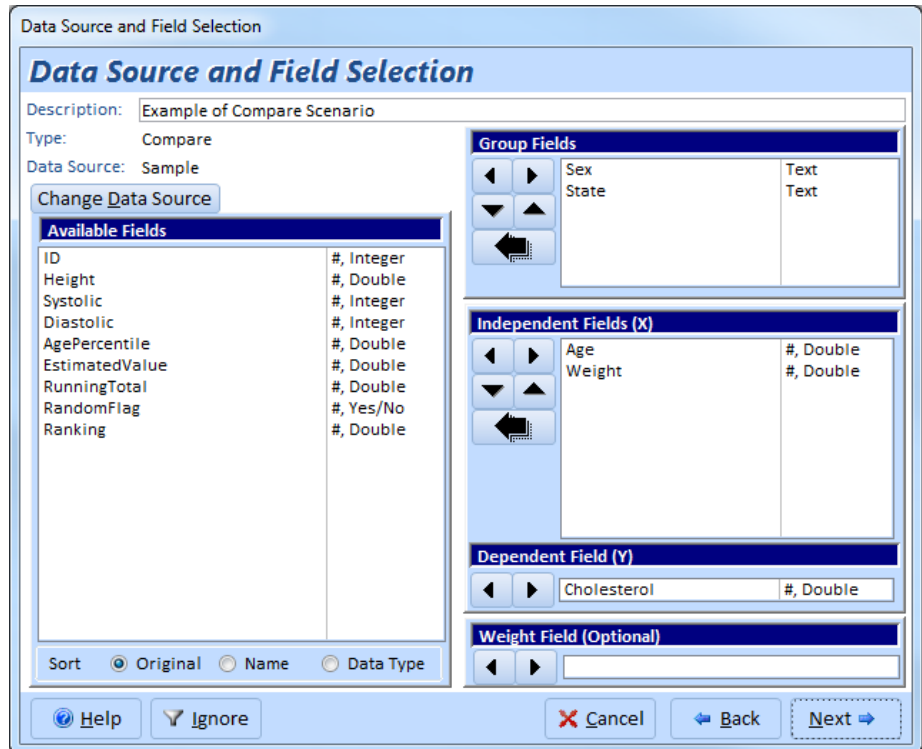
---

## Compare (Field Comparisons)

Compare performs a record-by-record comparison between each X field and the specified Y field. If the Y field is blank, the record is skipped. If the Y field exists and the X field is blank, the record is skipped for that X field calculation, but not for other X fields that exist. The output table contains a record for each combination of check fields and X field.

### Compare Field Selection

The Compare field selection screen differs from the previous screens with the addition of a Y field option:



*Compare Field Selection*

One numeric field must be designated the Y field. At least one X field must be assigned. The Group and Weight fields are optional. A separate calculation is made for each group of records (combination of unique Group fields values). A separate record is created for each group and X field. After you select your fields and press the [Next] button, the Compare options appear.

## Compare Options

<input checked="" type="checkbox"/>	<b>C</b> ount <b>D</b> ifference:	Count < Y, Count = Y, Count > Y
<input checked="" type="checkbox"/>	<b>M</b> ean <b>D</b> ifference:	Mean X, Mean Y, Mean X-Y, Standard Deviation X-Y
<input checked="" type="checkbox"/>	<b>C</b> orrelation:	Covariance, Correlation, R-Square
<input checked="" type="checkbox"/>	<b>P</b> aired <b>t</b> -Test:	Degrees of Freedom, t-Value, Probability (1 and 2 tails)

*Compare Options*

You can create the following statistical values:

- Count Difference: cases where X is less than, equal, and greater than Y
- Mean Difference: difference and standard deviation of means
- Correlation: covariance, correlation, R-square
- Paired t-Test: degrees of freedom, t-value, probability

## Compare Output Table

Following is an example of comparing Age and Weight against Cholesterol grouped by State (not all fields are shown):

State	DataField	Count_of_Cholesterol	Missing	Count<Y	Count=Y	Count>Y	MeanX	MeanY
FL	Age	17	0	17	0	0	46.823529	185.88235
FL	Weight	17	0	16	0	1	143.94118	185.88235
MD	Age	33	0	33	0	0	45.606061	192.93939
MD	Weight	33	0	30	1	2	153.21212	192.93939
VA	Age	50	0	50	0	0	46.54	191.98
VA	Weight	50	0	42	0	8	152.62	191.98

Compare Output Table

## Compare Output Fields

By default, the following fields are always created (formulas are adjusted for Weight field if specified):

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	Field name identifying the data in the record
<b>Count of Y Field (N)</b>	Count of X field values (if Weight field specified, the sum of weightings) where X and Y are not blank. The Y field name is included for reference.
<b>Observations</b>	Number of X field records (different from N). Only created if Weight field specified.
<b>Missing</b>	Number of records with blank X or Y fields

### Count Difference

<b>Count &lt; Y</b>	Count of cases where X < Y
<b>Count = Y</b>	Count of cases where X = Y
<b>Count &gt; Y</b>	Count of cases where X > Y

### Mean Difference

<b>MeanX</b>	Mean of the X field
<b>MeanY</b>	Mean of the Y field
<b>MeanDiff</b>	Mean difference between X and Y
<b>StdDevDiff</b>	$= \sqrt{s_x^2 + s_y^2 - 2 \cdot \text{COV}}$ Standard deviation of the difference between X and Y



### Correlation

<b>Covariance</b>	$\text{COV} = \frac{N\sum(xy) - \sum x\sum y}{N(N-1)}$
<b>Correlation (R)</b>	Pearson's Correlation = $\frac{\text{COV}}{s_x s_y}$ , where $s_x$ and $s_y$ are the standard deviation of X and Y. Correlation measures the relationship between X and Y, and is a value between -1 and 1. 1 is an exact match, -1 a perfect negative correlation, and zero is no correlation.
<b>R-Square (R<sup>2</sup>)</b>	Square of the correlation. R-Square is a value between 0 and 1.

### Paired t-Test

The Paired t-Test determines if the X and Y fields have statistically similar means. Probabilities greater than 5% are usually accepted as statistically significant.

<b>t-DF</b>	Degrees of freedom = (N - 1)
<b>Paired t-Value</b>	$t = \frac{\text{MeanX} - \text{MeanY}}{\sqrt{\frac{s_x^2 + s_y^2 - 2}{N}}} = \frac{\text{MeanX} - \text{MeanY}}{\frac{\text{StdDevX} - \text{Y}}{\sqrt{N}}}$
<b>Prob (1-tail)</b>	One-tailed probability (0-1) that X and Y have the same mean
<b>Prob (2-tail)</b>	Two-tailed probability that X and Y have the same mean

---

## Matrix

Matrix performs the same calculation as Compare but offers a quick way to look for correlations and other relationships between many fields. Compare compares several X fields to one Y field. Matrix compares all the X fields against each other.

### Matrix Field Selection

The Matrix field selection screen is identical to the Describe field selection screen (see page 43). Choose the X fields to analyze. The matrix becomes larger as more X fields are selected — keep in mind that the number of calculations and amount of time needed increases with the square of the number of X fields ( $N^2$ ).

## Matrix Options

<input checked="" type="checkbox"/> <b>C</b> ount	<input checked="" type="checkbox"/> <b>C</b> orrelation
<input checked="" type="checkbox"/> <b>M</b> issing	<input checked="" type="checkbox"/> <b>R</b> -Square
<input checked="" type="checkbox"/> <b>M</b> ean <b>D</b> ifference	<input checked="" type="checkbox"/> <b>P</b> aired <b>t</b> -Test (t Value)
<input checked="" type="checkbox"/> <b>S</b> td. <b>D</b> eviation <b>D</b> ifference	<input checked="" type="checkbox"/> <b>P</b> aired t-Test <b>P</b> robability
<input checked="" type="checkbox"/> <b>C</b> ovariance	<input type="radio"/> <b>1</b> -tail <input checked="" type="radio"/> <b>2</b> -tail

Matrix Options

Each selection creates a separate matrix comparing the fields.

## Matrix Output Table

This is a matrix of Age, Weight and Cholesterol grouped by State with Correlation, R-Square, t-Value and Prob (2-tail) options:

State	DataField	CalcType	Age	Weight	Cholesterol
FL	Age	Correlation	1	-0.077130375898	0.0181572091737
FL	Weight	Correlation	-0.077130375898	1	0.7555403590328
FL	Cholesterol	Correlation	0.0181572091737	0.7555403590328	1
FL	Age	R-Square	1	0.0059490948862	0.000329684245
FL	Weight	R-Square	0.0059490948862	1	0.5708412341274
FL	Cholesterol	R-Square	0.000329684245	0.5708412341274	1
FL	Age	t-Value		-8.766797364424	-16.68262033610
FL	Weight	t-Value	8.7667973644241		-6.263761391792
FL	Cholesterol	t-Value	16.682620336101	6.2637613917917	
FL	Age	Prob (2-tail)		1.658503383E-07	1.535964185E-11
FL	Weight	Prob (2-tail)	1.658503383E-07		1.130432955E-05
FL	Cholesterol	Prob (2-tail)	1.535964185E-11	1.130432955E-05	

Matrix Output Table

Each matrix is a set of records identified by the [CalcType] field.

The correlation matrix is symmetrical (i.e. the correlation between Age and Weight is the same as Weight and Age). This is true for Count, Missing, Covariance, Correlation, R-Square, Std. Deviation Difference, and Probability. Mean Difference and Paired t-Value produce negatively symmetrical matrices (i.e. Mean X-Y of Age to Weight is the negative of Weight to Age). Definitions of these calculations are given in the Compare section on page 60.

## Matrix Output Fields

The output table for Matrix always includes these fields, regardless of which options are selected:

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)

<b>DataField</b>	Field name identifying the data in the record
<b>CalcType</b>	Type of calculation: <ul style="list-style-type: none"> <li>• Count</li> <li>• Correlation</li> <li>• Missing</li> <li>• R-Square</li> <li>• MeanDiff</li> <li>• t-Value</li> <li>• StdDevDiff</li> <li>• Prob (1-tail)</li> <li>• Covariance</li> <li>• Prob (2-tail)</li> </ul>
<b>X Field Names</b>	Name of the X Field. The value in this field is the <i>CalcType</i> comparison with the field in <i>DataField</i>

## Regression

Regression calculates the least squares (best fit) curve to determine an equation which relates the Y (dependent) variable to the X (independent) variable(s). The field selection screen is identical to that for Compare on page 60.

Choose among three regression types and two calculation options:

**Regression Type**

**Simple**      ( $y = Ax + C$ )

**Multiple**      ( $y = Ax + Bz + \dots + C$ )

**Polynomial**      ( $y = Ax + Bx^2 + \dots + C$ )

---

**Calculate Y-Intercept**  
(Leave blank for zero-intercept)

**Calculate Regression ANOVA**

*Regression Types*

### Regression Type and Calculation Options

**Simple**  $y = Ax + C$

where A and C are the constants that are solved. "A" is the slope of the line, "C" is the y-intercept. A linear (simple) regression is calculated between the Y field and each X field. Any record with a blank X or Y field is ignored. One equation (record) is created for each set of group fields and X field.

**Multiple**  $y = \sum A_n x_n + C = A_1 x_1 + A_2 x_2 + C$

where  $x_i$  is the  $i^{\text{th}}$  X field, and  $A_i$  and  $C$  are constants. A multiple regression of the linear combination of X fields to the Y field is calculated. All X fields are assumed to be independent variables. At least two X fields must be assigned; otherwise you should use simple regression. Any record with a blank X field or Y field is ignored. One equation (record) is created for each set of group fields.

**Polynomial**  $y = \sum A_n x^n + C = A_1 x + A_2 x^2 + \dots + A_N x^N + C$

where  $N$  is the polynomial order, and  $A_i$  and  $C$  are constants. A polynomial regression between each X field and Y field is calculated. The polynomial order (up to 9) determines the maximum power (exponent) of X in the equation. Any record with a blank X or Y field is ignored. One equation (record) is created for each set of group fields and X field.

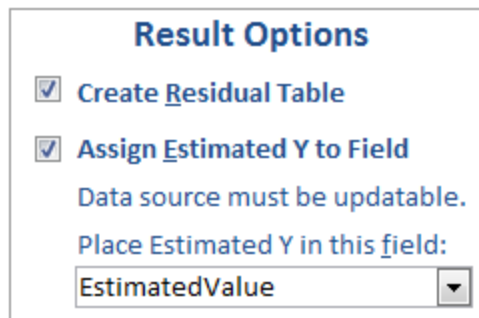
**Calculate Y-Intercept**

This option controls whether the y-intercept ( $C$  constant) is calculated or set to zero (through the origin). If this option is checked, the y-intercept is calculated.

**Calculate Regression ANOVA**

If this option is selected, each regression’s ANOVA values are calculated. The field names are described later.

**Result Options**



*Regression Result Options*

**Create Residual Table**

If this option is selected, a separate Residual table is created. The residual table contains one record for each data point used in the regression calculation along with residual information. The Residual is the difference between the actual Y and the regression’s estimated Y value.

**Assign Estimated Y to Field**

The value of Y based on the regression equation can be inserted directly into a field on each record. This feature is available when only one

regression equation is being created for each record. This is always the case for a multiple regression. For simple and polynomial regressions, this exists if only one Independent (X) field is selected.

Simply specify the field where you'd like the result to be placed. The field should be a double and the data source must of course be updateable.

## Regression Output Tables

The following examples are different types of regressions for comparing X fields [Age] and [Weight] against Y Field [Cholesterol], grouped by [State] (not all fields shown).

State	DataField	Count_of_Cholesterol	Missing	Y-Intercept	Coef_of_X	SE_of_Y-Intercept
FL	Age	17	0	184.066632531145	0.03877794845543	26.9828152178556
FL	Weight	17	0	104.981425417978	0.56204158884118	18.827894938892
MD	Age	33	0	167.982394873271	0.54722987985519	24.9236652840621
MD	Weight	33	0	107.614581870834	0.556906407884192	21.8906153125101
VA	Age	50	0	201.928284268725	-0.21375771956866	15.5220626397162
VA	Weight	50	0	130.395700677518	0.403513951791914	12.9713037943465

*Simple Regression Output Table*

State	Count_of_Cholesterol	Missing	Y-Intercept	Coef_of_X1: Age	Coef_of_X2: Weight
FL	17	0	96.6574296568232	0.16421172206722	0.566453275467304
MD	33	0	96.98506264686	0.28023547389796	0.542867591858619
VA	50	0	137.848389427693	-0.15268800336997	0.401243023516872

*Multiple Regression Output Table*

State	DataField	Count_of_Cholesterol	Missing	Y-Intercept	Coef_of_X^1	Coef_of_X^2
FL	Age	17	0	104.42295269881	3.7242830540470	-0.038796588902
FL	Weight	17	0	290.85676765501	-1.89537117594	0.0074965208230
MD	Age	33	0	92.816452532741	4.17989367434	-0.040074104221
MD	Weight	33	0	293.61143666676	-1.827846758326	0.0071105460286
VA	Age	50	0	199.49279776686	-0.095733598720	-0.001287947731
VA	Weight	50	0	329.28104485243	-2.312144710983	0.0084807107882

*Polynomial Regression (Order 3) Output Table*

## Regression Output Fields

Regardless of which options are selected, the output table for Regression always includes these fields:

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	Field name identifying the data in the record
<b>Count of Y Field</b>	Number of data points in group, where Y Field is the name of the Y field
<b>Missing</b>	Missing number of records
<b>Multiple R (R)</b>	Square root of R-Square

<b>R-Square (<math>R^2</math>)</b>	$= 1 - \frac{\text{Residual Sum of Squares}}{\text{Total Sum of Squares}}$ $= \frac{\text{Regression Sum of Squares}}{\text{Total Sum of Squares}}$ <p>R-Square measures the proportion of variation in Y that is explained by the regression. R-Square is between 0 and 1 (1 is a perfect fit).</p>
<b>Adj_R-Square</b>	$= R^2 - \frac{(1 - R^2)}{(N - 2)}$ <p>Adjusted R-Square</p>
<b>StdError_of_Estimate</b>	Standard error of the Y estimate (regression) is the standard deviation of the residuals.
<b>Y-Intercept</b>	Y-Intercept value, if this option is selected
<b>Coef_of_X</b>	Coefficient(s) of regression equation

The regression coefficient fields vary depending on the type of regression selected:

- Simple Regressions: one field for the X coefficient.
- Multiple Regression: one field for each X field:  
Coef\_of\_X1, Coef\_of\_X2, Coef\_of\_X3, etc.
- Polynomial Regressions: one field for each polynomial order:  
Coef\_of\_X^1, Coef\_of\_X^2, Coef\_of\_X^3, etc.

## Coefficient Analysis

In addition to the Y-Intercept and equation coefficients, four other fields are calculated for each coefficient to determine the accuracy and relative importance of each coefficient. The four fields are explained below with the field names in brackets:

### **Standard Error of Coefficients [SE\_of\_X]**

Standard Error of Coefficients is a measure of each coefficient's variability. Although the coefficient is calculated, the sample data is assumed to contain variability. The population coefficient is the sample coefficient plus or minus the standard error.

### **Beta Value of Coefficients [Beta\_of\_X]**

Beta Value of Coefficients (also known as standardized regression coefficients) shows the relative importance of each coefficient in the regression equation. For multiple and polynomial regressions, it can be misleading to examine only the unstandardized coefficients for importance. A large coefficient may have little impact if its variable does not vary much. The Beta removes this effect. Beta is not calculated for the Y-Intercept.

$$Beta_i = A_i (s_i / s_y)$$

where  $A_i$  is the coefficient of variable  $i$   
 $s_i$  is its standard deviation, and  
 $s_y$  is the standard deviation of  $Y$

#### ***t-Value of Coefficients [t-Value\_of\_X]***

The t-Value of the coefficient is used to determine (via t-Test) the probability that the coefficient value is significantly different from zero. t-Value is the ratio of the Coefficient to its Standard Error.

#### ***Probability of Coefficients [Prob\_of\_X]***

Probability of coefficients determines the probability that the coefficient is zero based on its t-Value.

### **Regression ANOVA**

The regression ANOVA indicates how much of the data variance is due to the regression, and how much is not (residual). If the regression has a poor “fit” (large residual), the F-Value is small and the probability that all regression coefficients are zero (the null hypothesis) approaches 1. These are the ANOVA fields:

<b>Field Name</b>	<b>Description</b>
<b>Regression_DF (DF1)</b>	Regression degrees of freedom. Number of independent variables.
<b>Residual_DF (DF2)</b>	Residual degrees of freedom = $N - DF1 - 1$ (where $N$ is the number of data points).
<b>Total_DF (DFT)</b>	Total degrees of freedom = $N - 1$
<b>Regression_SS (SS1)</b>	Regression (estimated-average) sum of squares = $\sum (y_{est} - y_{avg})^2$
<b>Residual_SS (SS2)</b>	Residual (actual-estimated) sum of squares = $\sum (y_{act} - y_{est})^2$
<b>Total_SS (SST)</b>	Total sum of squares = $SS1 + SS2$
<b>Regression_MS (MS1)</b>	Regression mean squares = $SS1 / DF1$
<b>Residual_MS (MS2)</b>	Residual mean squares = $SS2 / DF2$
<b>F-Value</b>	Ratio of mean squares = $MS1 / MS2$
<b>Prob</b>	Probability (0-1) that all coefficients = 0

## Regression Failures

If regressions cannot be calculated, the output record only displays the group fields, count, and missing values, and leaves all other fields blank. Although the regression is not possible for a particular group, other regressions are not affected and are calculated as usual. These are various reasons this may happen:

### *Insufficient Data*

A minimum number of data points is required to calculate a regression. Regressions with Zero-Intercept require one fewer data point since the constant (Y-Intercept) is not calculated:

Minimum Number of Records		
Regression Type	Y-Intercept	Zero-Intercept
Simple	3	2
Multiple	X Fields + 2	X Fields + 1
Polynomial	Polynomial order + 2	Polynomial order + 1

### *X or Y Has Zero Variance*

If X or Y has no variance (all values are identical), a regression cannot be computed.

### *Multicollinearity*

Regression calculations solve a matrix of equations. When the matrix is singular or near singular (multicollinear), the matrix inverse does not exist and a unique least squares solution cannot be found. This is the most common cause of a regression failure given a large and diverse data set. To avoid this problem for multiple regressions, exclude X fields that are highly correlated to Y. For polynomial regressions, reduce the polynomial order.

## Residual Table

If the Residual table option is selected, a second table is created:

State	DataField	X_Value	Y:Cholesterol	Estimated_Y	Residual
FL	Age	24	189	171.45891078853	17.541089211466
FL	Weight	149	189	174.876721232	14.123278768003
FL	Age	25	170	173.2821609864	-3.282160986395
FL	Weight	160	170	179.50831257413	-9.50831257413
FL	Age	31	195	182.59220543969	12.407794560308
FL	Weight	147	195	174.22952325664	20.770476743356
FL	Age	36	157	188.21676342784	-31.21676342784
FL	Weight	125	157	171.06850852232	-14.06850852232
FL	Age	36	159	188.21676342784	-29.21676342784
FL	Weight	98	159	177.10697839725	-18.10697839725

*Residual Table*



This table contains all data (X and Y) used in the regression as well as the estimated Y value and the residual. A record is created for every data point. Data that is not used in the regression (blank values) or groups for which a regression could not be calculated are not included in the Residual table.

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	Field name identifying the data in the record
<b>X Value</b>	Value of the X field
<b>Y:Y Field</b>	Actual Y value where <i>Y Field</i> is the Y field name
<b>Estimated Y</b>	Estimated Y value using X and the regression equation
<b>Residual</b>	Actual Y minus estimated Y

---

## Crosstab and Chi-Square

Cross-tabulations allow you to create matrices showing summaries of one field across two fields. Crosstabs compare the row field to the column field to display relationships between the values in the two fields quickly. Each unique value in the column field is a field in the crosstab. The determination of unique values is case insensitive (i.e. “age” is the same as “Age”).

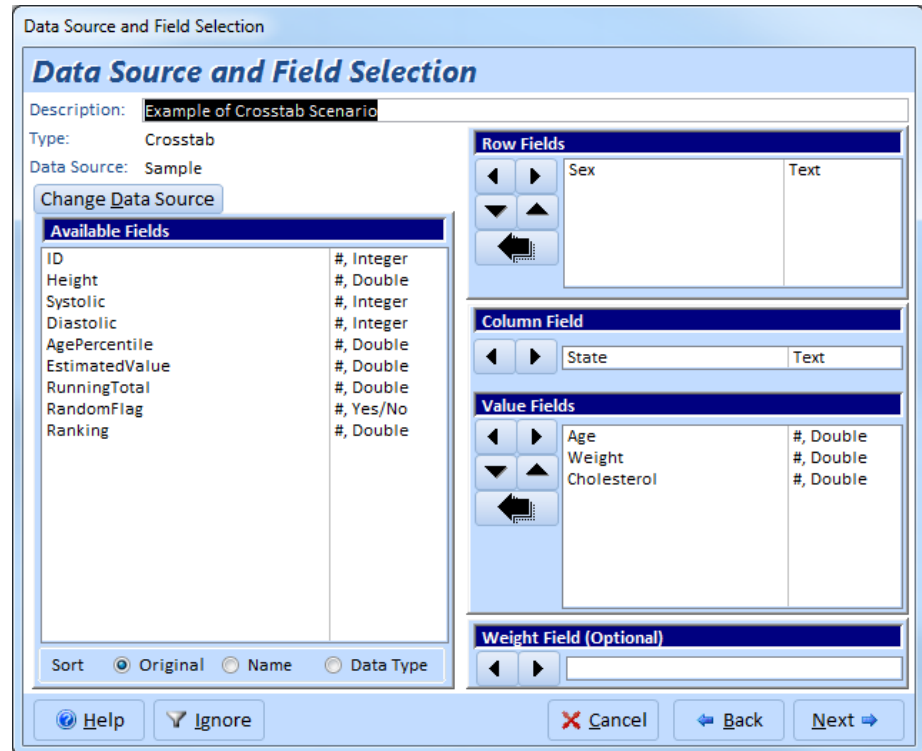
Two output tables may be created: Cross-tabulation and Chi-Square. Chi-Square measures the independence of the two variables. If you are interested in Chi-Square for a single variable, refer to the Chi-Square feature under Non-Parametric Analysis (on page 93).

Microsoft Access also performs crosstabs, but Total Access Statistics offers extra features:

Feature	Total Access Statistics	Access
Row Summary	Yes	Yes
Column Summary	Yes	No
% of Column, Row, Total	Yes	No
Expected Cell value	Yes	No
Expected Cell %	Yes	No
Chi-Square Analysis	Yes	No

## Crosstab Field Selection

The field selection screen for crosstabs is different from the screen for other types of analysis:



*Crosstab Field Selection*

For a crosstab, three types of fields are required:

### **Row Fields**

Specify at least one row field. The row field(s) becomes the left column(s) of the crosstab. If you choose more than one row field, totals are calculated for the first R-1 row fields (where R is the number of row fields); basically, a separate crosstab for each set of unique values in the first R-1 row fields.

### **Column Field**

Specify only one column field. Each unique value in the column field becomes a field in the crosstab.

### **Value Fields**

Specify the fields to be calculated (Sum, Count, etc.) and placed in each of the crosstab's cells.

### **Weight Field**

As with other types of analysis, you can optionally specify a Weight field.

## Crosstab Options

Cross-Tabulation Type		
<input checked="" type="radio"/> Count	<input type="radio"/> Minimum	<input type="radio"/> Variance
<input type="radio"/> Sum	<input type="radio"/> Maximum	<input type="radio"/> Coef. of Variance
<input type="radio"/> Average	<input type="radio"/> Range	<input type="radio"/> Std. Deviation
		<input type="radio"/> Std. Error

Percentage Options	Chi-Square Options
<input checked="" type="checkbox"/> % of Row	<input checked="" type="checkbox"/> % of Expected
<input checked="" type="checkbox"/> % of Column	<input checked="" type="checkbox"/> Expected Value
<input checked="" type="checkbox"/> % of Total	<input type="checkbox"/> Create Chi-Square Table

Show Percentage Values As: <input checked="" type="radio"/> Rows <input type="radio"/> Columns
--

*Crosstab Options*

### ***Cross-Tabulation Type***

This specifies the type of calculation to perform. Refer to the Describe section on page 45 for definitions of these functions.

If you select a type other than Count, the crosstab generated includes an extra row that shows the Count of each cell. For instance, for Standard Deviation, you would see both the standard deviation for each cell and the number of data points used to calculate the value.

### ***Percentage Options***

You may optionally calculate each cell's value (based on the Cross-Tabulation Type) relative to its row, column, or total summaries. For percent of column and total, the cell is compared to the corresponding value for its subset of records (unique values in R-1 rows).

### ***Chi-Square Options***

Chi-Square options are available (visible) if the calculation type is Count or Sum. Chi-Square measures the independence of the distribution between the row and column fields.

There are several Chi-Square options. For the main crosstab table, you can add % of Expected values or the Expected value for each cell. Expected values are calculated for each subset. You can also create a separate Chi-Square table that calculates the Chi-Square for each crosstab (subset).

### ***Show Percentage Value As Option***

When you choose to calculate Percentage Options, the values can be shown as rows or columns in the output table. If you choose Rows, the percentage

values are shown as additional rows with the value in the DataField field designating what the values are in the row.

If you choose Columns, the percentage values are shown as additional columns, so if you have a column called “Virginia”, there would be additional columns like “Virginia%Row”, “Virginia%Column”, “Virginia%Total”, etc. This makes it easy to create reports which show the value and it’s percentages on each row. Note that because this adds more fields, it can be a problem if your Column field has a lot of unique values (Access has a 255 field limit per table). The default setting is Rows to allow the most unique column values.

The Chi-Square fields (% Expected and Expected) are also displayed in Columns rather than records if you choose the Columns option.

See the output table examples for the result differences.

### Crosstab Output Table

This is a crosstab of the Sample table examining Sex vs. State, with the count of the Age field. This quickly shows how many people fall in each combination of Sex and State:

DataField	Sex	DataType	RowSummary	FL	MD	VA
Age	F	Data: Count	48	9	15	24
Age	F	% Row	1	0.1875	0.3125	0.5
Age	F	% Col	0.48	0.52941176	0.45454545	0.48
Age	F	% Total	0.48	0.09	0.15	0.24
Age	F	% Expected	0.48	0.0816	0.1584	0.24
Age	F	Expected	48	8.16	15.84	24
Age	M	Data: Count	52	8	18	26
Age	M	% Row	1	0.15384615	0.34615385	0.5
Age	M	% Col	0.52	0.47058824	0.54545455	0.52
Age	M	% Total	0.52	0.08	0.18	0.26
Age	M	% Expected	0.52	0.0884	0.1716	0.26
Age	M	Expected	52	8.84	17.16	26
Age		GROUP Total	100	17	33	50
Age		GROUP % Row	1	0.17	0.33	0.5
Age		GROUP % Col	1	1	1	1
Age		GROUP % Total	1	0.17	0.33	0.5
Age		GROUP % Expected	1	0.17	0.33	0.5
Age		GROUP Expected	100	17	33	50

*Crosstab Output Table with Percentage Values in Rows*

The [DataType] field shows each record’s calculation including the percent calculations and “GROUP Total” for the crosstab summary. There is also a [RowSummary] field.

If the option to Show Percentage Values is set to columns, the output looks like this:

DataField	Sex	DataType	RowSummary	FL	MD	VA	FL%Row	MD%Row	VA%Row
Age	F	Data: Count	48	9	15	24	18.75%	31.25%	50.00%
Age	M	Data: Count	52	8	18	26	15.38%	34.62%	50.00%
Age		GROUP Total	100	17	33	50	17.00%	33.00%	50.00%

*Crosstab Output Table with Percentage Values in Columns (truncated with just the first set of fields)*

The data is identical to the option with the values in rows, but displayed in columns.

### Crosstab Fields

Field Name	Description
<b>DataField</b>	Field name identifying the value field
<b>Row Fields</b>	Row fields in the order you selected them
<b>DataType</b>	Record identifier: Data: type    Cell value where type is the calculation type (Count, Sum, Min, Max, etc.) % Row        Cell's percent of row summary % Col        Cell's percent of subset column % Total      Cell's percent of subset total % Expected   Cell's percent of expected value Expected    Cell's expected value using Chi-Square calculation GROUP ...    Group (subset) summary: Total, %Row, %Col, % Total, etc.
<b>RowSummary</b>	Summary for the row. This is the summary of the input table data associated with the row and not the values in the crosstab. For instance, the row's average is not the average of the crosstab's cells.
<b>Column Fields</b>	A field is created for each unique value in the column field. This is case insensitive, i.e. "AAA" is the same as "aaa". If the column field contains a null value, a field named <Null> is created.
<b>Column Fields for Percentages</b>	If the option for Show Percentage Values As is set to Columns, a field is created for each unique value in the column field, plus its percentage type. Therefore, there are fields named: "Value%Column", "Value%Row", "Value%Total", "Value%Expected", and "Value_Expected"

### Chi-Square Table

Chi-Square (also known as Pearson's Chi-Square) is a test to determine if the variables in the crosstab row and column fields are independent. The results are placed in a separate table. One record is created for each subset (unique

combination of the first R-1 fields, where R is the number of row fields). If there is only one row field, only one record is created per value field.

Chi-Square is only calculated if the Crosstab type is Count or Sum. If a Sum crosstab is selected, all values in the Value field must be positive. Chi-Square analysis of Sum crosstabs is intended for data that contains summed counts.

DataField	Count	MinExp	MaxExp	Col	Row	DF	Chi-Square	Prob	Phi-Coeff	Coeff_of_Cont	Cramer's_V
Age	100	8.16	26	3	2	2	0.251953928425	0.8816352	0.05019501	0.0501318976309	0.0354932338
Weight	100	8.16	26	3	2	2	0.251953928425	0.8816352	0.05019501	0.0501318976309	0.0354932338
Cholesterol	100	8.16	26	3	2	2	0.251953928425	0.8816352	0.05019501	0.0501318976309	0.0354932338

Chi-Square Output Table

## Chi-Square Fields

Field Name	Description
<b>DataField</b>	Field name identifying the value field
<b>Row Fields</b>	First R-1 row fields in the order selected
<b>Count (N)</b>	Number of records (or sum of weightings)
<b>MinExpected</b>	Minimum cell's expected value
<b>MaxExpected</b>	Maximum cell's expected value
<b>Columns (C)</b>	Number of columns with data (some subsets may have no values for a column)
<b>Rows (R)</b>	Number of rows with data
<b>DF</b>	Degrees of freedom: = (C-1) x (R-1)
<b>Chi-Square (<math>\chi^2</math>)</b>	$\chi^2 = \sum [(O - E)^2 / E]$ , sum over all the cells where O is the observed value and E the expected. A cell's expected value is: $\left( \frac{\text{Cells Row Total}}{\text{Total}} \right) \times \left( \frac{\text{Cells Column Total}}{\text{Total}} \right) \times \text{Total}$
<b>Prob</b>	Probability that the rows and columns are independent. Based on $\chi^2$ and DF.
<b>Phi-Coefficient</b>	Phi-Coefficient: $\phi = \sqrt{\chi^2 / N}$
<b>Coeff_of_Contingency</b>	Coefficient of Contingency: $= \sqrt{\chi^2 / (\chi^2 + N)}$
<b>Cramer's_V</b>	$= \sqrt{\chi^2 / N(k - 1)}$ where k is the smaller of C and R. Same as Phi-Coefficient for 2 x 2 crosstabs

## Running Totals

Running Totals are calculations for a set number of records through your dataset. Easily calculate results like running sums, averages, minimum, maximum, median, etc. and place them into fields in your data source. Up to five fields can be updated at one time.

For instance, you may want to calculate the average of the last 10 records. This “moving” average is determined based on the sort order of your data, calculating the mean for those 10 records and putting it in a field you designate with record 10. For record 11, record 1 is ignored and the calculation is performed for records 2 through 11, etc. Like the other features, you can specify group fields so that each group has its own running totals. This feature does not create a separate table. The results are placed in the fields you specify in your data source.

### Running Totals Field Selection

The field selection screen for Running Totals is different from the screen for other types of analysis. Here you specify the fields to sort upon and the fields to place the results. The field to analyze is specified after this screen:

The screenshot shows the 'Data Source and Field Selection' dialog box. The title bar reads 'Data Source and Field Selection'. The main title is 'Data Source and Field Selection'. The description is 'Moving summary over 10 records'. The type is 'Running Totals'. The data source is 'tblOrderDetails'. There is a 'Change Data Source' button. The 'Available Fields' list includes ID (#, Long Integer), Sales (#, Currency), and Quantity (#, Integer). The 'Sort Fields' list includes Date (Date/Time) and OrderID (#, Long Integer). The 'Fields to Update' list includes RunningTotal (#, Currency), RunningAverage (#, Currency), RunningCount (#, Long Int), RunningMedian (#, Currency), and RunningMaximum (#, Currency). The 'Weight Field (Optional)' field is empty. The 'Sort' options are Original (selected), Name, and Data Type. The bottom buttons are Help, Ignore, Cancel, Back, and Next.

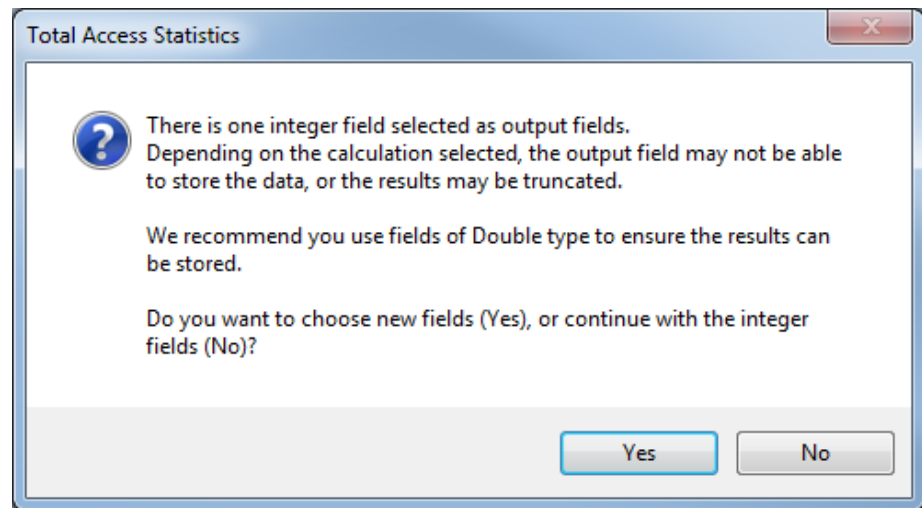
*Running Totals Field Selection*

### **Sort Fields**

Specify the fields to sort in order to calculate the running values. Specify at least one sort field. This may include the field you're performing the calculations upon. Fields are sorted in ascending order.

### **Fields to Update**

Specify up to five fields to update with your totals. Make sure the fields are of data types that can hold the data you expect to put in them. For instance, they should be doubles if you expect to store values like average (mean), variance, etc. If your fields are integers, a warning message appears:



*Warning Message if Selected Fields are Integers*

This warning message appears before you select what data you want to go into your fields, so it's just a reminder. If integer fields are fine, then press [No] to continue. Otherwise, press [Yes] to modify your selections.

### **Weight Field**

As with other types of analysis, you may optionally specify a Weight field. Note that if you choose to calculate the values over a specified number of records (instead of all the records) under the Running Totals options, the weighting field has no impact. The calculation is over a moving number of records not the weighted number of records. Of course the values generated reflect the weightings of the individual records.



## Running Totals Options

<b>Field to Analyze:</b> Sales <input type="text"/> This may be a sort field from the previous screen.	
<b>Number of Records to Calculate Totals Over:</b> <input type="text" value="10"/>	
Specify the number of records in the running (moving) total. Calculations are based on this sliding set of records through the data source controlled by the sort order. Use 0 for a running total across all records.	
<b>Calculations for initial set of records:</b> <input checked="" type="radio"/> Calculate <input type="radio"/> Leave Blank	
Should values be calculated for the set of records before the number of moving records is reached, or should they be left blank?	
<b>Specify the Calculation Type</b>	<b>Field to Update (calculation goes in this field)</b>
Sum <input type="text"/>	RunningTotal
Average (Mean) <input type="text"/>	RunningAverage
Count <input type="text"/>	RunningCount
Median <input type="text"/>	RunningMedian
Maximum <input type="text"/>	RunningMaximum

*Running Totals Options*

### **Field to Analyze**

Specify the field the calculations are based on. This field may be a field that was specified as a sort field. For instance, you may want to calculate the running average based on sales sorted in ascending order.

### **Number of Records to Calculate Totals Over**

Specify the number of records in the moving total. If you specify 0, the totals are calculated for every record.

If you enter a specific number, the calculations are based on that number of records. The first record is dropped when the next one is added, and the calculations are based on this “moving” set of records.

### **Initial Set of Records**

If you specify the number of records to calculate totals over, there is an option to determine what happens before you reach that number of records. Either the totals should be skipped or calculated based on the records processed.

Choose “Calculate” to see the running totals regardless of whether the number of moving records is reached.

Choose “Leave Blank” to only have running totals when the specified number of records is reached without any calculations for smaller number of records.

### **Calculation Type**

There are many calculation types available. Specify the one you want for each of the update fields you selected:

Average (Mean)	Std. Deviation	Geometric Mean
Count	Variance	Harmonic Mean
Observations	Coeff. of Variance	Root Mean Square
Sum	Std. Error	Skewness
Sum Squared	Median	Kurtosis
Minimum	Mode	Std. Error of Skewness
Maximum	Mode Count	Std. Error of Kurtosis
Range		

The definitions of these calculations are provided with the Describe options on page 44.

### Running Totals Results

The Running Totals results are placed in the fields you specified in your data source.

Date	Order ID	Sales	RunningCount	RunningTotal	RunningAverage	RunningMedian	RunningMaximum
9/7/2010	10756	\$720.00	1	\$720.00	\$720.00	\$720.00	\$720.00
9/7/2010	10756	\$75.00	2	\$795.00	\$397.50	\$397.50	\$720.00
9/7/2010	10756	\$1,312.50	3	\$2,107.50	\$702.50	\$720.00	\$1,312.50
9/7/2010	10756	\$380.00	4	\$2,487.50	\$621.88	\$550.00	\$1,312.50
9/8/2010	10751	\$374.76	5	\$2,862.26	\$572.45	\$380.00	\$1,312.50
9/8/2010	10751	\$776.70	6	\$3,638.96	\$606.49	\$550.00	\$1,312.50
9/8/2010	10751	\$325.00	7	\$3,963.96	\$566.28	\$380.00	\$1,312.50
9/8/2010	10751	\$225.00	8	\$4,188.96	\$523.62	\$377.38	\$1,312.50
9/9/2010	10758	\$420.00	9	\$4,608.96	\$512.11	\$380.00	\$1,312.50
9/9/2010	10758	\$600.00	10	\$5,208.96	\$520.90	\$400.00	\$1,312.50
9/9/2010	10758	\$624.60	10	\$5,113.56	\$511.36	\$400.00	\$1,312.50
9/10/2010	10726	\$105.00	10	\$5,143.56	\$514.36	\$400.00	\$1,312.50
9/10/2010	10726	\$550.00	10	\$4,381.06	\$438.11	\$400.00	\$776.70
9/10/2010	10727	\$380.00	10	\$4,381.06	\$438.11	\$400.00	\$776.70
9/10/2010	10727	\$780.00	10	\$4,786.30	\$478.63	\$485.00	\$780.00
9/10/2010	10727	\$550.00	10	\$4,559.60	\$455.96	\$485.00	\$780.00

#### *Running Totals Results in with Percentage Values in Rows*

In this example, the data is sorted by Date and OrderID, and calculations on the Sales field. Notice the values in the [RunningCount] field increasing from 1 to 10. Once it reaches 10, it remains at 10 because that is the maximum number of records in the moving total. The [RunningTotal] field shows the sum of [Sales] over the records in the moving set of records. Because the option to calculate the values for the initial set of records was selected (before it reached 10 records), the values are displayed, otherwise, the first 9 records would have null values.

# Chapter 6: Group Analysis

*The Group Analysis feature allows you to detect statistical differences within a field across groups of records. The groups are based on the values in a grouping/comparison field. In general, the groups are of unequal size. This chapter describes Total Access Statistics' group analysis options.*

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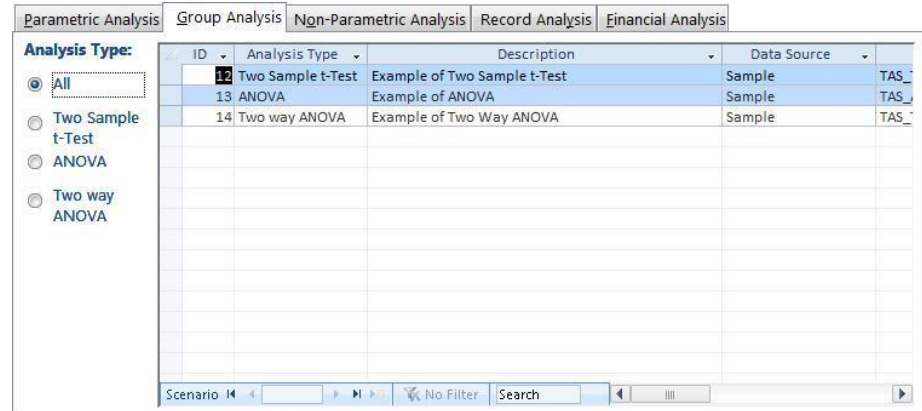
## Topics in this Chapter

- **Group Analysis Overview**
- **Two Sample t-Test**
- **Analysis of Variance (ANOVA)**
- **Two Way ANOVA**

---

## Group Analysis Overview

The Group Analysis features are available when you select the [Group Analysis] tab from the main form:



*Group Analysis Tab*

The three types of group analysis are listed on the left:

- **Two Sample t-Test**  
Compare two sets of records defined by a Comparison field containing only two values (e.g. Sex, Yes/No, etc.)
- **Analysis of Variance (ANOVA)**  
Analyze multiple sets of records defined by a Comparison field with multiple values (e.g. Race, State, etc.)
- **Two Way ANOVA**  
Analyze multiple groups of records where each record belongs to more than one group. Multiple Comparison fields with multiple values in each field define the groups. The impact of each Comparison field is shown.

---

## Two Sample t-Test

The Two-Sample t-Test compares two samples (sets of records) to determine if their means are identical. A Comparison field designates the samples (for example, Sex: Male vs. Female), and each sample must have at least two data points. This test is sometimes called an unpaired t-test because the data points come from different records (unlike the paired t-test in Compare and Matrix), and each sample generally has a different amount of data (records).

## Two Sample t-Test Field Selection

The field selection screen for the Two Sample t-Test has a Comparison field to designate the field defining the two samples to compare. Each unique value in the Comparison field defines a sample set of records.

The screenshot shows the 'Data Source and Field Selection' dialog box. The title bar reads 'Data Source and Field Selection'. The main title is 'Data Source and Field Selection'. The description is 'Example of Two Sample t-Test'. The type is 'Two Sample t-Test'. The data source is 'Sample'. There is a 'Change Data Source' button. Below this is a list of 'Available Fields' with their data types: ID (#, Integer), State (Text), Height (#, Double), Systolic (#, Integer), Diastolic (#, Integer), AgePercentile (#, Double), EstimatedValue (#, Double), RunningTotal (#, Double), RandomFlag (#, Yes/No), and Ranking (#, Double). At the bottom of this list are 'Sort' options: Original (selected), Name, and Data Type. To the right are three sections: 'Group Fields' (empty), 'Comparison Field (Factor)' (set to 'Sex', Text), and 'Dependent Fields' (Age, Weight, Cholesterol, all #, Double). At the bottom right is a 'Weight Field (Optional)' section (empty). The bottom of the dialog has 'Help', 'Ignore', 'Cancel', 'Back', and 'Next' buttons.

*Two Sample t-Test Field Selection*

This example scenario above would perform a Two Sample t-Test to determine if the mean Age, Weight and Cholesterol are the same between the sexes.



**Tip**

For each X field, the Two Sample t-Test compares all samples against each other, even if there are more than two samples. If there are many samples, the number of pairings can be huge and will take time to calculate. This test should be used when there are only two unique values in the comparison field. For more values, use ANOVA.

## Two Sample t-Test Options

- Ignore records with blank value in comparison field**
- Create Detail table**

*Two Sample t-Test Options*

These options are identical for all Group Analysis including ANOVA and Two Way ANOVA.

### Ignore Blanks

You can exclude records with blank values in the Comparison field. For instance, a logical field such as [Sex] can contain Male, Female and blank values. If this option is not checked, the blank records are treated as another group and compared to Male and Female records. To prevent this, select this option. Records with blank X field values are automatically ignored.

### Create Detail Table

You can choose to create a separate table that shows the basic information for each sample. Further details are provided below.

## Two Sample t-Test Output Table

This is an example of a Two-Sample t-Test comparing the means between Female and Male records. Not all fields are shown.

DataField	Sex-1	Sex-2	Count-1	Count-2	Mean-1	Mean-2	Mean_Diff	StdDeviation-1	StdDeviation-2
Age	F	M	48	52	46.9583333	45.6538462	1.304487179487	14.8481080295349	13.5398969141739
Weight	F	M	48	52	117.6875	182.403846	-64.7163461538	19.7550491795163	37.2717943166641
Cholesterol	F	M	48	52	179.1875	202.403846	-23.2163461538	26.9804154739866	37.5135319978839

Two Sample t-Test Output Table

## Two Sample t-Test Output Fields

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	Field name identifying the data in the record
<b>CompareField-1</b>	Sample #1's comparison field value
<b>CompareField-2</b>	Sample #2's comparison field value
<b>Count-1 (<math>N_1</math>)</b>	Count of non-blank records in Sample #1
<b>Count-2 (<math>N_2</math>)</b>	Count of non-blank records in Sample #2
<b>Mean-1 (<math>\bar{X}_1</math>)</b>	Mean of values in Sample #1
<b>Mean-2 (<math>\bar{X}_2</math>)</b>	Mean of values in Sample #2
<b>Mean 1-2</b>	Difference between Sample #1 and #2 mean
<b>StdDeviation-1 (<math>s_1</math>)</b>	Standard deviation of Sample #1
<b>StdDeviation-2 (<math>s_2</math>)</b>	Standard deviation of Sample #2
<b>StdError-1</b>	Standard error of Sample #1

<b>StdError-2</b>	Standard error of Sample #2
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### Pooled t-Test

A pooled t-Test is generated with the fields below. Use these values if you assume the samples have the same variance.

<b>DF-Pooled</b>	Degrees of freedom = $N_1 + N_2 - 2$
<b>t-Value_Pooled</b>	$t_{\text{pooled}} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\left(\frac{(N_1 - 1)s_1^2 + (N_2 - 1)s_2^2}{N_1 + N_2 - 2}\right)\left(\frac{1}{N_1} + \frac{1}{N_2}\right)}}$
<b>Prob_(2-tail)_ Pooled</b>	Probability (2-tailed) that the two samples have identical means

### Separate t-Test

A separate t-Test is also generated. Use these values if you assume the samples have different variances:

<b>DF-Separate</b>	$\frac{\left(\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}\right)^2}{\frac{\left(\frac{s_1^2}{N_1}\right)^2}{N_1 - 1} + \frac{\left(\frac{s_2^2}{N_2}\right)^2}{N_2 - 1}}$ Degrees of freedom =
<b>t-Value_Separate</b>	$t_{\text{separate}} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}}}$
<b>Prob_(2-tail)_ Separate</b>	Probability (2-tailed) that the two samples have identical means.

To decide which t-test values to use, you need to analyze the population variance between the two samples. The Detail table can help you by providing the variance for each sample. If the variances can be assumed to be similar, the pooled t-test can be used; otherwise, the separate t-test is appropriate.

### Two Sample t-Test Detail Table

If you select the option to create a detail table, this is the result:

Sex	DataField	Count	Mean	Min	Max	Range	Sum	Variance	CoeffOfVariance	StdDeviation	StdError
F	Age	48	46.9583333	20	69	49	2254	220.46631206	0.316197509058418	14.848108029535	2.143139792
M	Age	52	45.6538462	20	69	49	2374	183.32880845	0.296577354480641	13.539896914174	1.877645869
F	Weight	48	117.6875	90	149	59	5649	390.26196809	0.167860216076612	19.755049179516	2.851395740
M	Weight	52	182.403846	110	239	129	9485	1389.1866516	0.204336668894732	37.271794316664	5.168667905
F	Cholesterol	48	179.1875	140	322	182	8601	727.94281915	0.150570857196995	26.980415473987	3.894287534
M	Cholesterol	52	202.403846	150	300	150	10525	1407.265083	0.185340015571493	37.513531997884	5.202190890

Two Sample t-Test Detail Table

This table gives detailed information on each sample and is similar to the data you can create under the Describe option with the Comparison field as a Group field.

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>Compare Field</b>	Comparison field value, which is summarized where Compare Field is the compare field name
<b>DataField</b>	X field name identifying the data in the record
<b>Count</b>	Count of X field values (if Weight field specified, the sum of weightings)
<b>Mean</b>	Sample mean
<b>Minimum</b>	Minimum value
<b>Maximum</b>	Maximum value
<b>Range</b>	Difference between maximum and minimum
<b>Sum</b>	Sum of the X field
<b>Variance</b>	Variance using N-1 method
<b>CoeffOf Variance</b>	Coefficient of variance
<b>StdDeviation</b>	Standard deviation
<b>StdError</b>	Standard error

For more information on the calculation of these fields, refer to the Describe section (beginning on page 43).

---

## Analysis of Variance (ANOVA)

Analysis of variance (ANOVA) analyzes variance between and within multiple groups of records. The assumption is that all the groups come from populations with the same mean. Based on group sizes and variances, ANOVA determines if the assumption is true. A Comparison field defines the groups. One record is created for each X field. The field selection is identical to that of a Two Sample t-Test (described on page 83).

### ANOVA Output Table

This is an example of an ANOVA analyzing Age, Weight, and Cholesterol, grouped by State.



DataField	Index	Source_of_Variation	Sum_of_Squares	DF	Mean_Square	F-Value	Prob
Age	1	Main: [State]	23.390623886	2	11.695311943	0.0574963	0.9441576
Age	2	Residual	19730.769376114	97	203.40999356819		
Age	3	Total	19754.16	99	199.53696969697		
Weight	1	Main: [State]	1128.20367201	2	564.101836005	0.2841008	0.7533149
Weight	2	Residual	192600.23632799	97	1985.5694466803		
Weight	3	Total	193728.44	99	1956.8529292929		
Cholesterol	1	Main: [State]	610.61650624	2	305.30825312	0.2492278	0.7798999
Cholesterol	2	Residual	118826.62349376	97	1225.0167370491		
Cholesterol	3	Total	119437.24	99	1206.4367676768		

ANOVA Output Table

Notice how each of the three ANOVA calculations is displayed in three records.

### ANOVA Options

The ANOVA options are identical to the Two Sample t-Test options described on page 83. Select whether you want to include all groups or only records with non-blank values in the Comparison field.

### ANOVA Output Fields

The ANOVA table contains these fields:

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	X field name identifying the data in the record
<b>Index</b>	ID number for each record in the ANOVA
<b>Source_of_Variation</b>	Record identifier has these values: <ul style="list-style-type: none"> <li>• <b>Main: Field</b> (where <i>Field</i> is the name of the Comparison field) The Main variation is the variation “Between Groups.”</li> <li>• <b>Residual</b> The variation “Within Groups.”</li> <li>• <b>Total</b> The total variation of the X field.</li> </ul>

<b>Sum_of_Squares</b>	<p>Sum of squares, depending on type of variation:</p> <ul style="list-style-type: none"> <li>• <b>Main: Field</b> The sum of squares between groups:  <math display="block">SSM = \sum_{\text{bygroup}} \left( \frac{x^2}{N} \right) - \left( \frac{\sum_{\text{all}} x}{N} \right)^2</math></li> <li>• <b>Residual</b> The sum of squares within groups:  <math display="block">SSR = \left( \sum_{\text{all}} x^2 - \sum_{\text{bygroup}} \left( \frac{x^2}{N} \right) \right)</math></li> <li>• <b>Total</b> The sum of Main and Residual squares:  <math display="block">SST = SSM + SSR</math></li> </ul>
<b>DF</b>	<p>Degrees of freedom:</p> <ul style="list-style-type: none"> <li>• <b>Main: Field</b> <span style="float: right;"><math>DFM = (Groups - 1)</math></span></li> <li>• <b>Residual</b> <span style="float: right;"><math>DFR = N - Groups</math></span></li> <li>• <b>Total</b> <span style="float: right;"><math>DFT = N - 1</math></span></li> </ul>
<b>Mean_Square</b>	<p>Mean squares: [Sum_of_Squares] divided by [DF] fields</p>
<b>F-Value</b>	<p>F-value: the ratio between Main and Residual Mean_Squares</p>
<b>Prob</b>	<p>Probability that all groups have the same mean. The probability is the F-Value with DFM and DFR degrees of freedom.</p>

### ANOVA Detail Table

The Detail table is identical to the Detail table for the Two Sample t-Test described on page 85.

---

## Two Way ANOVA

Two way ANOVA, also known as two-factor ANOVA, is a generalization of the one way or one factor ANOVA, and allows analysis of multiple Comparison fields.

## Two Way ANOVA Field Selection

The field selection screen for Two Way ANOVA is similar to the other Group Analysis field selections, except that you may select two Compare Fields (factors). The Compare Fields determine the groups to compare:

The screenshot shows the 'Data Source and Field Selection' dialog box. The title bar reads 'Data Source and Field Selection'. The main title is 'Data Source and Field Selection'. The description is 'Example of Two Way ANOVA'. The type is 'Two way ANOVA'. The data source is 'Sample'. There is a 'Change Data Source' button. The 'Available Fields' list includes: ID (#, Integer), Height (#, Double), Systolic (#, Integer), Diastolic (#, Integer), AgePercentile (#, Double), EstimatedValue (#, Double), RunningTotal (#, Double), RandomFlag (#, Yes/No), and Ranking (#, Double). The 'Group Fields' panel is empty. The 'Comparison Fields (Factors)' panel contains 'Sex' (Text) and 'State' (Text). The 'Dependent Fields' panel contains 'Age' (#, Double), 'Weight' (#, Double), and 'Cholesterol' (#, Double). The 'Weight Field (Optional)' panel is empty. The bottom of the dialog has 'Sort' options: 'Original' (selected), 'Name', and 'Data Type'. There are 'Help', 'Ignore', 'Cancel', 'Back', and 'Next' buttons.

Two Way ANOVA Field Selection

## Two Way ANOVA Options

The Two Way ANOVA options are identical to the other Group Analysis options (see page 83). You may choose to include all groups or only those with non-blank values in all Compare fields.

## Two Way ANOVA Output Table

Two Way ANOVA is calculated using the Experimental method. The output fields are identical to those for ANOVA. There is a record that measures the total Main Effects, each main effect (factor) separately, the Interaction between the factors, the total Explained effect (sum of Main and Interactions), and the Residual and Total. Note that the total Main Effects is not the sum of the factors.

DataField	Index	Source_of_Variation	Sum_of_Square	DF	Mean_Square	F-Value	Prob
Age	1	Main Effects	63.339150128	3	21.113050042667	0.10098788	0.95925973
Age	2	Main: [Sex]	39.948526242	1	39.948526242	0.19108167	0.66302047
Age	3	Main: [State]	20.865047564	2	10.432523782	0.04990082	0.95134896
Age	4	Interactions	38.692644744	2	19.346322372	0.09253727	0.91169817
Age	5	Explained	102.031794872	5	20.4063589744	0.09760763	0.99232357
Age	6	Residual	19652.128205128	94	209.06519367157		
Age	7	Total	19754.16	99	199.53696969697		
Weight	1	Main Effects	104921.7844937	3	34973.928164567	38.5930275	2.4027E-16
Weight	2	Main: [Sex]	103793.58082169	1	103793.58082169	114.534132	5.9757E-18
Weight	3	Main: [State]	384.17622447	2	192.088112235	0.21196537	0.80937832
Weight	4	Interactions	3621.59845502	2	1810.79922751	1.99818059	0.14129978
Weight	5	Explained	108543.38294872	5	21708.676589744	23.9550887	1.8357E-15
Weight	6	Residual	85185.05705128	94	906.22401118383		
Weight	7	Total	193728.44	99	1956.8529292929		
Cholesterol	1	Main Effects	13823.47392099	3	4607.82464033	4.14480775	0.00833202
Cholesterol	2	Main: [Sex]	13212.85741475	1	13212.85741475	11.8851645	0.00084810
Cholesterol	3	Main: [State]	370.06565176	2	185.03282588	0.16643982	0.84692274
Cholesterol	4	Interactions	1113.01650636	2	556.50825318	0.50058757	0.60778109
Cholesterol	5	Explained	14936.49042735	5	2987.29808547	2.68711967	0.02578570
Cholesterol	6	Residual	104500.74957265	94	1111.7101018367		
Cholesterol	7	Total	119437.24	99	1206.4367676768		

Two Way ANOVA Output Table

## Two Way ANOVA Output Fields

The Two Way ANOVA table contains the same fields as the ANOVA table described on page 87. The only difference in the tables is the addition of records for every extra Compare Field.

The [Prob] field shows the probability of variation due to each Compare field.

## Two Way ANOVA Detail Table

The Detail table is identical to the Detail table for the Two Sample t-Test described on page 85, with the addition of two fields: Compare\_Field and Compare\_Value. These fields show the record's Compare field name and value:

DataField	Compare_Field	Compare_Value	Count	Mean	Min	Max	Range	Sum	Variance
Age	Sex	F	48	46.9583333	20	69	49	2254	220.466312
Age	Sex	M	52	45.6538462	20	69	49	2374	183.328808
Age	State	FL	17	46.8235294	24	69	45	796	215.404412
Age	State	MD	33	45.6060606	20	68	48	1505	184.121212
Age	State	VA	50	46.54	20	69	49	2327	212.090204
Weight	Sex	F	48	117.6875	90	149	59	5649	390.261968
Weight	Sex	M	52	182.403846	110	239	129	9485	1389.18665
Weight	State	FL	17	143.941176	90	233	143	2447	1775.43382
Weight	State	MD	33	153.212121	95	239	144	5056	1807.60985
Weight	State	VA	50	152.62	91	239	148	7631	2170.40367
Cholesterol	Sex	F	48	179.1875	140	322	182	8601	727.942819
Cholesterol	Sex	M	52	202.403846	150	300	150	10525	1407.26508
Cholesterol	State	FL	17	185.882353	157	267	110	3160	982.485294
Cholesterol	State	MD	33	192.939394	140	322	182	6367	1625.05871
Cholesterol	State	VA	50	191.98	155	300	145	9599	1042.95878

Two Way ANOVA Detail Table

# Chapter 7: Non-Parametric Analysis

*Up to this point, the analysis and tests assumed the distribution of the population was continuous and normal (or close to normal). However, many situations involve skewed, non-normal data or non-continuous (ordinal) distributions. In these situations, use non-parametric analysis. This chapter describes Total Access Statistics' non-parametric analysis options.*

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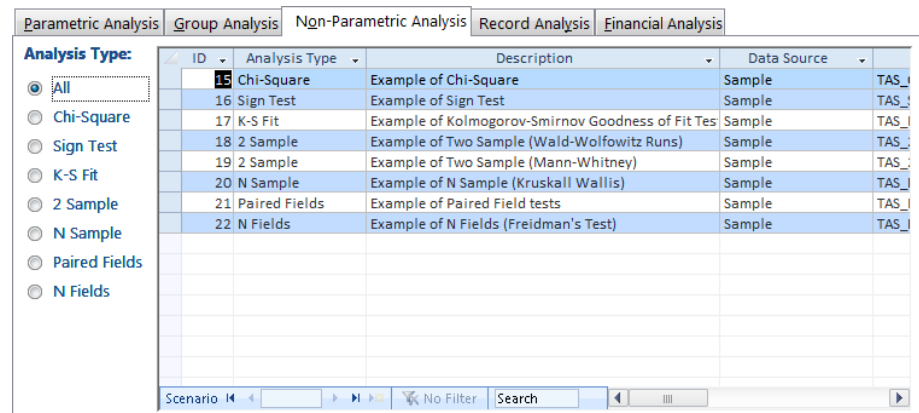
## Topics in this Chapter

- **Non-Parametric Analysis Overview**
- **Chi-Square**
- **Sign Test — One Sample**
- **K-S Fit — Kolmogorov-Smirnov Goodness of Fit Test**
- **2 Sample**
- **N Sample — Kruskal-Wallis One Way Analysis of Variance**
- **Paired Fields**
- **N Fields — Friedman's Two Way ANOVA of Ranks**

## Non-Parametric Analysis Overview

Parametric calculations are necessary for analyzing data that is non-continuous and/or non-normally distributed. Because these assumptions cannot be made, these tests are less powerful than parametric analysis. Non-parametric tests allow examination of data independent of the population distribution.

Rather than direct comparisons of the values in your fields, many non-parametric analyses rely on their relative rank. These features are available by selecting the [Non-Parametric Analysis] tab from the main form:



ID	Analysis Type	Description	Data Source
15	Chi-Square	Example of Chi-Square	Sample
16	Sign Test	Example of Sign Test	Sample
17	K-S Fit	Example of Kolmogorov-Smirnov Goodness of Fit Test	Sample
18	2 Sample	Example of Two Sample (Wald-Wolfowitz Runs)	Sample
19	2 Sample	Example of Two Sample (Mann-Whitney)	Sample
20	N Sample	Example of N Sample (Kruskal Wallis)	Sample
21	Paired Fields	Example of Paired Field tests	Sample
22	N Fields	Example of N Fields (Freidman's Test)	Sample

*Non-Parametric Analysis Tab*

A wide variety of non-parametric tests are available and depend on the analysis you seek. There are single field (one sample), group comparisons, and paired fields analysis.

The first three options are for one sample test:

- **Chi-Square**  
One sample Chi-Square: evaluates expected value for each unique value in a field.
- **Sign Test**  
One sample sign test versus median, mean or user defined value.
- **K-S Fit**  
Goodness of fit tests for comparison against Uniform, Normal and Poisson distributions.

The following options compare groups of records:

- **2 Sample**  
Two sample tests: Wald-Wolfowitz Runs Test, Mann-Whitney U Test, and Kolmogorov-Smirnov.
- **N Sample**  
Kruskal-Wallis one way ANOVA.

The following options compare fields:

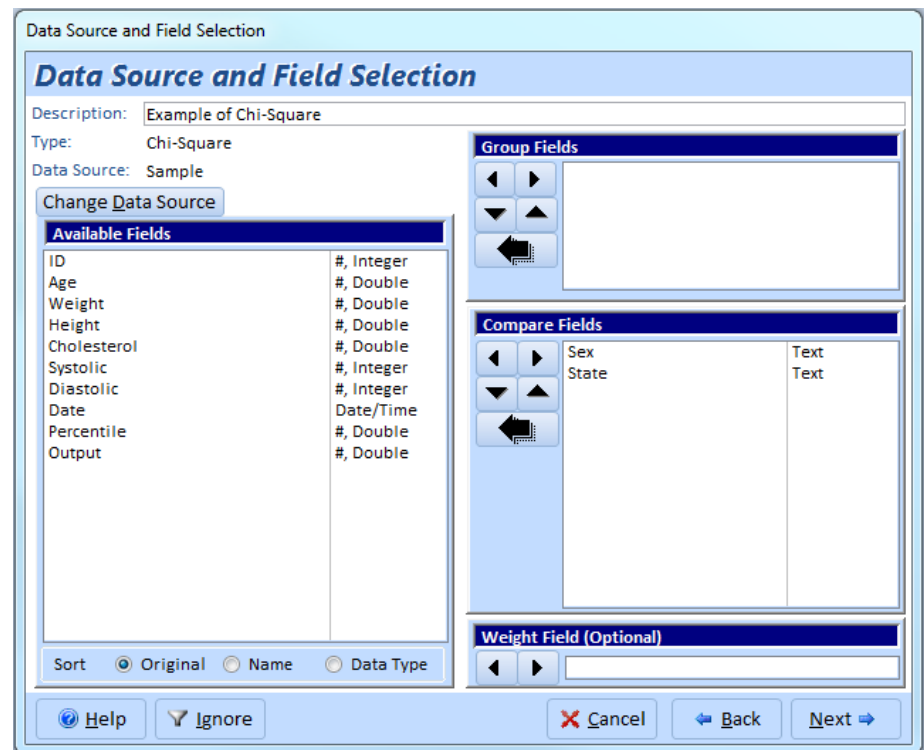
- **Paired Field**  
Field comparisons: paired sign test, Wilcoxon Signed Rank, Spearman's Correlation Coefficient.
- **N-Field**  
Compare multiple fields with Friedman's two way ANOVA.

## Chi-Square

Chi-Square measures the number of occurrences of each value in a field and determines how randomly (evenly) the values are distributed. Unlike the Frequency Distribution feature in Parametric analysis, which counts occurrences for ranges of numeric values, Chi-Square counts each value of any field type (rather than the range).

### Chi-Square Field Selection

The following field selection screen appears for Chi-Square:



*Chi-Square Field Selection*

### Compare Fields for Chi-Square

Assign the fields to analyze to the Compare Fields. Each Compare Field is analyzed independently within each group (unique combination of group fields). In the example, the comparison fields Sex and State determine if the data has the expected samples by Sex and State separately. It does not test whether the combination of Sex and State are distributed evenly.

If you want to see the distribution for the combination, make Sex the Group By field, then generate the Chi-Square values comparing State. The results would then show the Chi-Square distribution by State for each Sex value (Male and Female).

You must specify at least one Compare field, and you can optionally select a Weight Field.

## Chi-Square Options

After selecting the fields, the Chi-Square options are presented:

<input checked="" type="checkbox"/> <b>If group fields are specified, use the same comparison values for each group</b> (expected value for each comparison field value is calculated for all groups including those without records for some comparison values)  Without this option, calculations are only based on comparison values in each group.	<input checked="" type="checkbox"/> <b>Ignore records with a blank (null) value in the comparison field</b>  <input checked="" type="checkbox"/> <b>Create Detail table</b> Shows the count and percent of total for every unique value in each Compare field
---	--

*Chi-Square Options*

### ***Same Comparison Values for Each Group***

This option is only necessary if you specify group fields. Every combination of unique values in the group fields defines a group of records that is analyzed separately. A Compare field may have many values, but some groups may not have all of them. In this situation, you may analyze each group with only its Compare field values, or use the same Compare field values for each group. If you have the check box selected, the unique values in the Compare field are determined regardless of group. Then the values for each compare value in each group are counted and all results (including zeros) are presented.

### ***Ignore Records with Blank Value in Comparison Field***

Select this option to ignore blank values (nulls) in the Compare field. This affects the Chi-Square analysis by eliminating Null as a degree of freedom.

### ***Create Detail Table***

The detail table shows the actual count and percent of total values for each comparison field value. This is explained in detail below, and is similar to the frequency distribution feature in the parametric analysis (described on page 53).



## Chi-Square Output Table

Chi-Square analysis is performed for each group and X field:

DataField	Count	Groups	Expected	Chi-Square	DF	Prob
Sex	100	2	50	0.16	1	0.6891565
State	100	3	33.33333333	16.34	2	0.0002830

Chi-Square Output Table

## Chi-Square Output Fields

Chi-Square analysis determines the distribution of the data for each Compare field value. Following traditional statistical terminology, each Compare field value forms a “Group”. This is different from the groups formed by the Group fields, and is similar to the groups defined in the Group Analysis feature. Therefore, other than the Group Fields, the groups below refer to groups formed by the Compare fields.

Chi-Square determines the number of groups and calculates the expected value or frequency for each group (total count divided by number of groups). The actual (observed) value is compared. The larger the difference, the larger Chi-Square becomes and the more likely the Compare field values are independent.

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	The compare field name
<b>Count</b>	Number of records (or weighting)
<b>Groups</b>	Number of groups (unique Compare field values)
<b>Expected (E)</b>	Expected value for each group: $E = N / \text{Groups}$
<b>Chi-Square (<math>\chi^2</math>)</b>	Chi-Square value: $\chi^2 = \sum [(O - E)^2 / E]$ The sum over all the groups where $O$ is the observed value and $E$ the expected.
<b>DF</b>	Degrees of freedom = $\text{Groups} - 1$
<b>Prob</b>	Probability of Chi-Square based on DF. A large probability indicates that distribution is close to expected.

## Chi-Square Detail Table

The Chi-Square detail table is only created if you select the option, and provides information for each Compare field value used in the Chi-Square

analysis. This table is similar to the Frequency feature of parametric analysis described on page 53 (not all fields are shown):

Compare_Field	Compare_Value	Observed	Expected	Difference	Chi-Square	Observed_Pcnt
Sex	F	48	50	-2	0.08	48.00%
Sex	M	52	50	2	0.08	52.00%
State	FL	17	33.3333333333333	-16.3333333333333	8.00333333333333	17.00%
State	MD	33	33.3333333333333	-0.3333333333333	3.3333333333267E-03	33.00%
State	VA	50	33.3333333333333	16.6666666666667	8.33333333333337	50.00%

*Chi-Square Detail Table*

The detail table also shows the distribution percent for each compare field within each group of Group fields:

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>Compare_Field</b>	Compare field name
<b>Compare_Value</b>	Compare field value
<b>Observed (O)</b>	Count of occurrences of the compare field value
<b>Expected (E)</b>	Expected value for this group (same as in Chi-Square table)
<b>Difference</b>	Difference between Observed and Expected values $= O - E$
<b>Chi-Square</b>	Chi-Square value: $\chi^2 = (O - E)^2 / E$
<b>Observed_Pcnt</b>	Observed percent of total in group = $O / Total$
<b>Expected_Pcnt</b>	Expected percent of total (same value for all Compare values in group)
<b>Pcnt_Diff</b>	Difference between Observed and Expected percentages.
<b>Cumulative</b>	Cumulative sum of observed values
<b>Cumulative_Pcnt</b>	Cumulative sum of observed values as percent of group total

If only one Compare field is selected, the [Compare\_Field] and [Compare\_Value] fields are replaced by just the Compare field using the Compare field name and containing the Compare field values.

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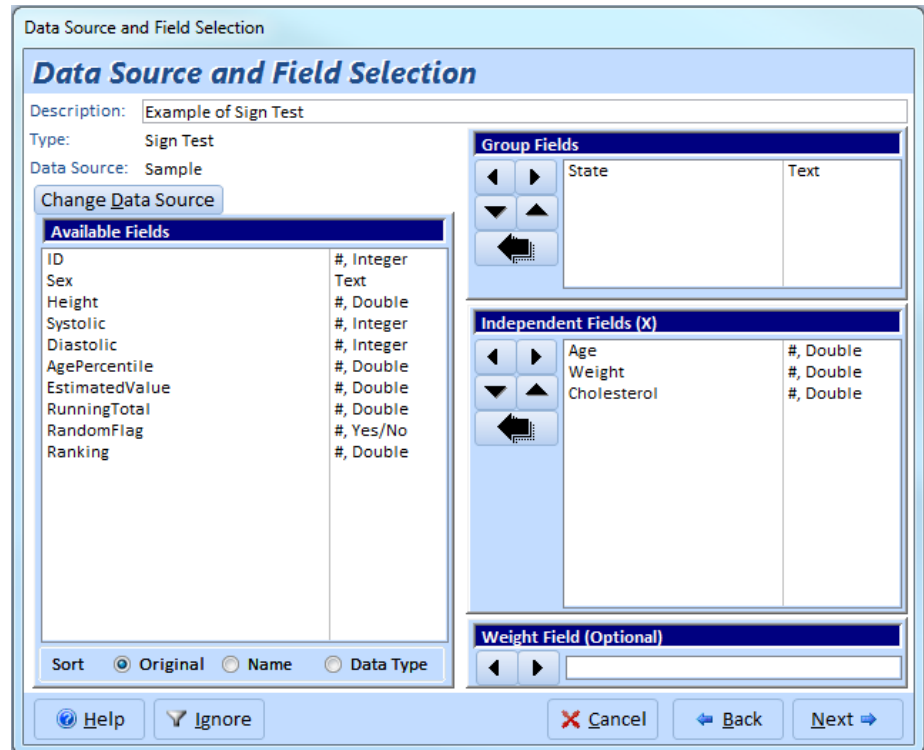
## Sign Test — One Sample

Given a sample distribution, the one sample Sign test statistically measures whether the median of a population is above or below the test value

provided. Total Access Statistics allows you to test either the sample data's mean or median, or your own custom value. This test should not be confused with the paired Sign test (described in **Paired Fields** on page 108), which compares the means between two fields.

## Sign Test Field Selection

Sign test field selection is similar to parametric field selections. Specify the numeric fields to analyze as the Independent (X) fields, and optionally specify Group and Weight fields.



*Sign Test Field Selection*

## Sign Test Options



*Sign Test Options*

Mean and Median options test either each group's mean and median, or the entire data set's mean and median if no group fields are specified. If you select Custom, you can enter the value to test all the groups.

## Sign Test Output Table

A separate record for each selected test appears in the Sign test output table. In the example below, there are three records for each group and X field (Group by State, X field = Age). Each test is identified by the [TestType] field with the value tested in [TestValue]:

State	DataField	Count	Missing	TestType	TestValue	Count<Test	Count=Test	Count>Test	Prob<=Test	Prob>=Test
FL	Age	17	0	Mean	46.82352941	11	0	6	0.9282684326	0.16615295410
FL	Age	17	0	Median	43	8	1	8	0.5981903076	0.59819030762
FL	Age	17	0	Custom	50	11	0	6	0.9282684326	0.16615295410
MD	Age	33	0	Mean	45.60606061	16	0	17	0.5	0.63613822667
MD	Age	33	0	Median	46	16	3	14	0.7080587896	0.42756607029
MD	Age	33	0	Custom	50	21	0	12	0.9591386239	0.08186717716
VA	Age	50	0	Mean	46.54	25	0	25	0.5562314580	0.55623145801
VA	Age	50	0	Median	46	25	0	25	0.5562314580	0.55623145801
VA	Age	50	0	Custom	50	28	1	21	0.8734510455	0.19568296915

Sign Test Output Table

## Sign Test Output Fields

Based on the observed number of cases less than, equal to, and greater than the test value, the probability of the true (population) median being less than or greater than the test value is determined:

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	X field name identifying the data in the record
<b>Count</b>	Number of records in the group
<b>Missing</b>	Number of blank (missing) records
<b>TestType</b>	“Mean” “Median” or “Custom” depending on the options selected.
<b>TestValue</b>	The analysis tests the probability that the population median is above or below this value
<b>Count&lt;Test</b>	Count of records with values below the test value
<b>Count=Test</b>	Count of records with values equal to the test value
<b>Count&gt;Test</b>	Count of records with values above the test value
<b>Prob&lt;=Test</b>	Probability the median is less than or equal to the test value
<b>Prob&gt;=Test</b>	Probability the median is greater than or equal to the test value

---

## K-S Fit — Kolmogorov-Smirnov Goodness of Fit Test

The Kolmogorov-Smirnov Goodness of Fit tests determine how closely data fits a uniform, normal, or Poisson distribution. If you want to determine if two sets of records are distributed similarly, use the Kolmogorov-Smirnov option under the 2 Sample feature.

### K-S Fit Field Selection

The field selection is identical to the Sign test screen described on page 97. Specify the numeric fields to test as X fields.

### K-S Fit Options

The Kolmogorov-Smirnov Goodness of Fit test sorts your data in ascending order. Based on your data, a “perfect” distribution of each test is created, and the difference between the data and test distributions is calculated (between 0 and 1). The maximum difference is used to determine how closely the data fits the distribution being tested. If there is no difference, the data fits the test type exactly. The larger the difference, the less likely the fit. Choose the type of distribution to test:

**Distributions to Test**

- Uniform**
- Normal**
- Poisson**  
Requires non-negative integers.  
(time consuming for large values)

*K-S Fit Options*

#### **Uniform**

Data is distributed linearly (straight line).

#### **Normal**

Data is normally distributed (bell curve).

#### **Poisson**

A Poisson distribution is given by:

$$p(x) = \frac{\lambda^x e^{-\lambda}}{x!}$$

Since the Poisson calculation involves a factorial calculation ( $x!$ ), it takes a longer time to calculate for large values of  $x$ . Only select Poisson calculations for small  $X$  values (less than 1000) or small data sets.

## K-S Fit Output Table

The output table has a separate record for each distribution type selected. In the example below, there are three records for each group. Each test is identified by the [TestType] field. Not all fields are shown.

State	DataField	TestType	Max_Absolute	Max_Positive	Max_Negative	K-S_Z
FL	Age	Uniform	0.1751633986928	0.1581699346405	-0.175163398693	0.722217
FL	Age	Normal	0.1858988835780	0.1694323290247	-0.185898883578	0.766481
FL	Age	Poisson	0.2748238046576	0.2328837041816	-0.274823804658	1.133128
MD	Age	Uniform	0.1041666666667	0.0340909090909	-0.104166666667	0.598392
MD	Age	Normal	0.0811918884545	0.0641770957581	-0.081191888454	0.466412
MD	Age	Poisson	0.1905135606096	0.1905135606096	-0.1851894321	1.094417
VA	Age	Uniform	0.1077551020408	0.04	-0.107755102041	0.761944
VA	Age	Normal	0.0757605515708	0.0637453908425	-0.075760551571	0.535708
VA	Age	Poisson	0.2261764626344	0.216554388991	-0.226176462634	1.599309

K-S Fit Output Table

## K-S Fit Output Fields

The first set of fields is independent of the test type (most not shown in the output table example):

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	X field name identifying the data in the record
<b>Count (N)</b>	Number of records in the group
<b>Mean</b>	Mean value
<b>StdDeviation</b>	Standard deviation
<b>Minimum</b>	Minimum value
<b>Maximum</b>	Maximum value
<b>Range</b>	Range of values: Maximum - Minimum

These fields are based on the test type:

<b>TestType</b>	The test type selected: "Uniform", "Normal", or "Poisson"
<b>Max_Absolute (D)</b>	Maximum absolute difference between the data and test distribution (between 0 to 1)
<b>Max_Positive</b>	Maximum positive difference between the tests
<b>Max_Negative</b>	Maximum negative difference between the tests
<b>K-S_Z</b>	Kolmogorov-Smirnov Z value: $Z = D\sqrt{N}$

<b>Prob</b>	Probability that the data matches the distribution test type
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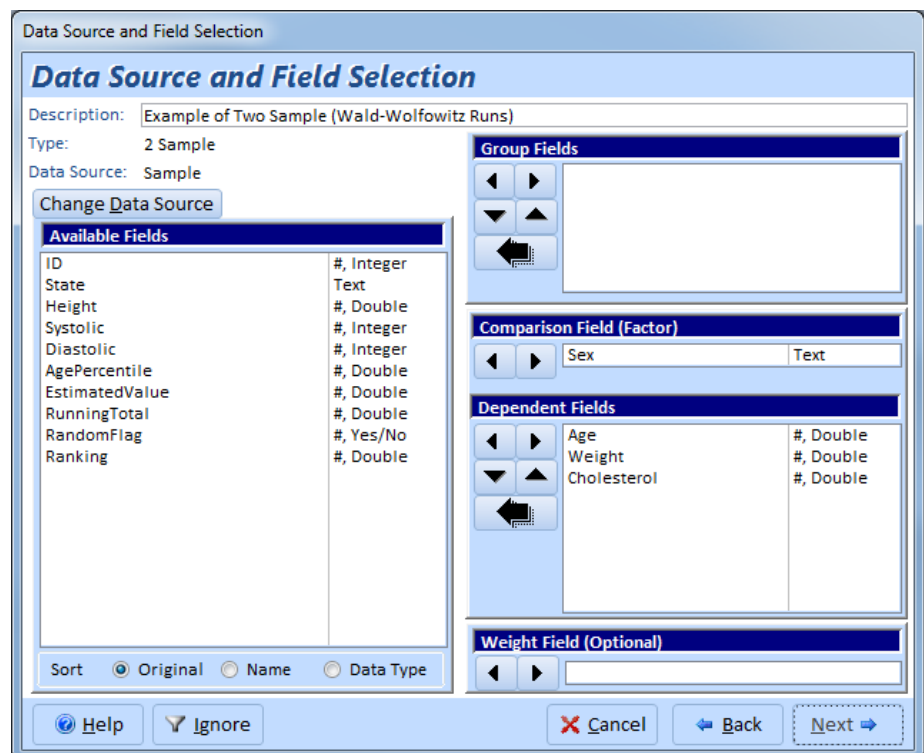
## 2 Sample

The two sample non-parametric test compares two sets of records, which may be of different sizes. A Compare field containing two values designates the samples. Tests include:

- Wald-Wolfowitz Runs test
- Mann-Whitney U test
- Kolmogorov-Smirnov Two Sample test

### Two Sample Field Selection

The Two Sample field selection screen is similar to that of Two Sample t-Test. The Comparison field can be any field type, and it defines the two samples. The Dependent field must be numeric, and it sorts the data.



**Data Source and Field Selection**

Description: Example of Two Sample (Wald-Wolfowitz Runs)

Type: 2 Sample

Data Source: Sample

Change Data Source

Available Fields	
ID	#, Integer
State	Text
Height	#, Double
Systolic	#, Integer
Diastolic	#, Integer
AgePercentile	#, Double
EstimatedValue	#, Double
RunningTotal	#, Double
RandomFlag	#, Yes/No
Ranking	#, Double

Sort:  Original  Name  Data Type

**Group Fields**

**Comparison Field (Factor)**: Sex (Text)

**Dependent Fields**

Age	#, Double
Weight	#, Double
Cholesterol	#, Double

**Weight Field (Optional)**

Buttons: Help, Ignore, Cancel, Back, Next

*Two Sample Field Selection*

## Two Sample Options



*Two Sample Options*

Two options are available:

- Wald-Wolfowitz Runs test
- Mann-Whitney U test and Kolmogorov-Smirnov Two Sample test

## Wald-Wolfowitz Runs Output Table

The Wald-Wolfowitz Runs test determines if data is randomly distributed between two samples (Comparison field values), using the run theory to determine randomness. A run is a series of cases from the same sample. With the X field sorted in ascending order, a random distribution would expect a random number of runs; that is, groups distributed independent of the values (i.e. a few cases from one sample followed by a few cases from the other, and so on).

A low number of runs indicates no randomness (all the low values are of one sample and the high values for the other). Similarly, a very high number of runs (e.g. every other case is a different run) also indicates a lack of randomness since the distribution is so orderly. Both the minimum and maximum number of runs is determined, and the associated Z and probability values calculated. For a random distribution, the number of runs should neither be too high or too low.

DataField	Sex-1	Sex-2	Wald_Mean	Wald_StdDev	Ties	TiedGroups	Wald_Min_Runs	Wald_Min_Z	Wald_Min_Prob
Age	F	M	50.92	4.9666426682357	66	19	34	-3.40672787036	0.00032873321575
Weight	F	M	50.92	4.9666426682357	12	6	14	-7.43359296535	0
Cholesterol	F	M	50.92	4.9666426682357	37	13	31	-4.01075763461	3.0262108126E-05

*Wald-Wolfowitz Runs Output Table*

## Wald-Wolfowitz Runs Output Fields

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	X field name identifying the data in the record
<b>CompareField-1</b>	The compare field sample #1 value
<b>CompareField-2</b>	The compare field sample #2 value



<b>Count (N)</b>	Number of records in the sample = N1 + N2
<b>Missing</b>	Number of blank (missing) records
<b>Cases-1 (N<sub>1</sub>)</b>	Number of records in sample #1 (defined by CompareField-1 field)
<b>Cases-2 (N<sub>2</sub>)</b>	Number of records in sample #2 (defined by CompareField-2 field)
<b>Wald-Mean (<math>\mu_w</math>)</b>	Mean of sampling distribution: $\mu_w = \frac{2N_1N_2}{N_1 + N_2} + 1$
<b>Wald-StdDev (<math>\sigma_w</math>)</b>	Standard deviation of sampling distribution: $\sigma_w = \frac{2N_1N_2(2N_1N_2 - N_1 - N_2)}{(N_1 + N_2)^2(N_1 + N_2 - 1)}$
<b>Ties</b>	Number of records tied to other records
<b>TiedGroups</b>	Number of X field values with more than one record
<b>Wald_Min_Runs</b>	Minimum number of runs
<b>Wald_Min_Z</b>	Z value associated with the minimum runs: $z = \frac{R - \mu_w}{\sigma_w}$ Where R is the minimum number of runs. If N < 50, the numerator of Z is adjusted: if R < $\mu_w$ , 0.5 is added if R > $\mu_w$ , 0.5 is subtracted
<b>Wald_Min_Prob</b>	Probability of [Wald_Min_Z]
<b>Wald_Max_Runs</b>	Maximum number of runs
<b>Wald_Max_Z</b>	Z value associated with the maximum runs
<b>Wald_Max_Prob</b>	Probability of [Wald_Max_Z]

### Mann-Whitney U Test and Kolmogorov-Smirnov Output Table

Both of these tests sort the X fields and rank the values with average rank assigned to ties. The ranks for each of the two groups are then summed and compared.

DataField	Sex-1	Sex-2	MW_U	MW_U_Prime	MW_W	MW_Z	MW_Prob	KS_Z	KS_Prob
Age	F	M	1195.5	1300.5	2476.5	-0.362215	0.717191049	0.728583	0.66327594
Weight	F	M	164	2332	1340	-7.478886	0	3.650922	0
Cholesterol	F	M	758	1738	1934	-3.380677	0.000723074	1.817455	0.0027037

Mann-Whitney U Test and Kolmogorov-Smirnov Output Table

## Mann-Whitney U and K-S Output Fields

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	X field name identifying the data in the record
<b>CompareField-1</b>	The compare field sample #1 value
<b>CompareField-2</b>	The compare field sample #2 value
<b>Count (N)</b>	Number of records in the group
<b>Missing</b>	Number of blank (missing) records
<b>Cases-1 (N<sub>1</sub>)</b>	Number of records in sample #1 (defined by CompareField-1 field)
<b>Cases-2 (N<sub>2</sub>)</b>	Number of records in sample #2 (defined by CompareField-2 field)
<b>SumRank-1 (R<sub>1</sub>)</b>	Sum of ranks for sample #1
<b>SumRank-2 (R<sub>2</sub>)</b>	Sum of ranks for sample #2
<b>TotalRank</b>	Sum of all ranks = R <sub>1</sub> + R <sub>2</sub>
<b>MeanRank-1</b>	Mean of ranks for sample #1 = R <sub>1</sub> /N <sub>1</sub>
<b>MeanRank-2</b>	Mean of ranks for sample #2 = R <sub>2</sub> /N <sub>2</sub>
<b>Ties</b>	Number of records tied to other records
<b>TiedGroups</b>	Number of X field values with more than one record
<b>SumTies (T)</b>	Sum of ties: $T = \sum(t^3 - t)$ where t is the number of tied records in each tied group (identical X value). The summation is over all tied groups.

## Mann-Whitney U Tests Fields

The Mann-Whitney U Test, sometimes just called the U Test or Wilcoxon test, determines whether or not there is a statistical difference between two data samples. The closer the rank sum between the two samples, the

more likely it is that the samples are similar. This test is similar to the parametric Two Sample t-Test, described on page 82.

<b>MW_U (U)</b>	Mann-Whitney U value based on smaller rank sum. For $R_1 < R_2$ this is U: $U = N_1 N_2 + \frac{N_1(N_1 + 1)}{2} - R_1$ otherwise: $U = N_1 N_2 + \frac{N_2(N_2 + 1)}{2} - R_2$
<b>MW_U_Prime(U')</b>	Mann-Whitney U prime value is the same as U for the larger Runs: $U' = N_1 N_2 - U$
<b>MW_W</b>	Rank sum of the sample with the larger count.
<b>MW_Z</b>	$Z = \frac{U - (N_1 N_2 / 2)}{\sqrt{\frac{N_1 N_2}{N(N-1)} \left( \frac{N^3 - N}{12} \right)}}$
<b>MW_Prob</b>	Probability that the two samples are distributed identically.
<b>MW_Z_(ties)</b>	Z adjusted for ties: $Z = \frac{U - (N_1 N_2 / 2)}{\sqrt{\frac{N_1 N_2}{N(N-1)} \left( \frac{N^3 - N - T}{12} \right)}}$
<b>MW_Prob_(ties)</b>	Probability that the two samples are distributed identically accounting for ties.

### Kolmogorov-Smirnov Fields

From the sorted data, the Kolmogorov-Smirnov two sample test determines the difference between the relative rankings of the two samples. Similar to the K-S Fit tests described on page 99, this test determines if the two samples are distributed similarly.

<b>KS_MaxAbsoluteDiff (D)</b>	Maximum absolute difference (0 to 1) between the two distributions
<b>KS_MaxNegDiff</b>	Maximum negative difference
<b>KS_MaxPosDiff</b>	Maximum positive difference
<b>KS_Z</b>	$Z = D \sqrt{\frac{N_1 N_2}{N}}$

<b>KS_Prob</b>	Probability that the two samples have similarly shaped distributions
----------------	--

## N Sample — Kruskal-Wallis One Way Analysis of Variance

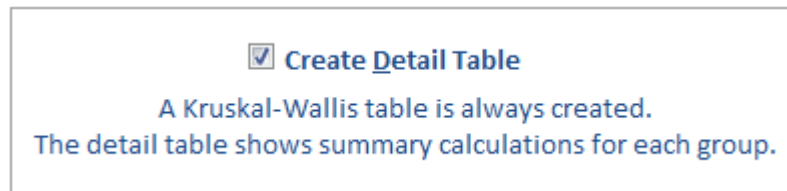
N Sample is a generalization of the Mann-Whitney U (2 sample) test for comparing multiple (N) sets of records. Each set may be a different size (number of records). This is similar to the ANOVA feature under Group Analysis, described on page 82. For non-parametric analysis, the equivalent function is the Kruskal-Wallis H test (or just H test).

Kruskal-Wallis sorts and ranks the data across all the samples. The sum of rankings for each group is calculated and compared to determine if all the samples come from the same population.

### Kruskal-Wallis Field Selection

The field selection screen for N Sample analysis is identical to the 2 Sample screen described on page 101. Rather than a Compare field with only 2 values, select a Compare field with more than 2 values.

### Kruskal-Wallis Options



*Kruskal-Wallis Options*

There is an option to create a detail table that provides rank sum information for each group.

### Kruskal-Wallis Output Table

Like the Mann-Whitney U Test, Kruskal-Wallis sorts and ranks the X fields across all the samples. Average rank is assigned to tied cases. Ranks are summed for each sample (group).

DataField	Groups	Ties	TiedGroups	SumTies	H	Prob	H_(ties)	Prob_(ties)
Age	2	82	26	1080	0.131200	0.717191	0.131341882	0.7170447665
Weight	2	50	22	258	55.93374	7.5E-14	55.94817560	7.440675E-14
Cholesterol	2	62	24	474	11.42898	0.000723	11.43439988	0.0007209676

*Kruskal-Wallis Output Table*

## Kruskal-Wallis Output Fields

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	X field name identifying the data in the record
<b>Count (N)</b>	Number of records
<b>Missing</b>	Number of blank (missing) records
<b>Groups (k)</b>	Number of unique comparison field values
<b>Ties</b>	Number of records tied to other records
<b>TiedGroups (g)</b>	Number of X field values with more than one record
<b>SumTies (T)</b>	Sum of ties: $T = \sum (t^3 - t)$ , where $t$ is the number of tied records in each tied group. The sum is over all tied groups.
<b>H</b>	H test statistic: $H = \frac{12}{N(N+1)} \sum_{i=1}^k \frac{R_i^2}{n_i} - 3(N+1)$
<b>Prob</b>	Probability that the sample groups are similar. The calculation uses H in a Chi-Square distribution with $k-1$ degrees of freedom.
<b>H_(ties)</b>	$1 - \frac{\frac{H}{\sum_{i=1}^g T_i}}{(N^3 - N)}$ H adjusted for ties:
<b>Prob_(ties)</b>	Probability based on [H_(ties)]

## Kruskal-Wallis Detail Table

The detail table shows the size (count), sum of ranks, and mean rank for each sample. This is the data used for calculating the Kruskal-Wallis results.

Sex	DataField	Count	SumRanks	MeanRank
F	Age	48	2476.5	51.59375
M	Age	52	2573.5	49.4903846153846
F	Weight	48	1340	27.9166666666667
M	Weight	52	3710	71.3461538461538
F	Cholesterol	48	1934	40.2916666666667
M	Cholesterol	52	3116	59.9230769230769

*Kruskal-Wallis Detail Table*

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	X field name identifying the data in the record
<b>Count (<math>n_i</math>)</b>	Number of records
<b>SumRanks (<math>R_i</math>)</b>	Sum of rankings for this group
<b>MeanRank</b>	Mean rank for the records in this group = $R_i/n_i$

## Paired Fields

The non-parametric Paired fields option allows you to compare fields similar to the parametric Compare feature (described on page 60). Tests include:

- Paired Sign test
- Wilcoxon Signed Rank test (or Wilcoxon Matched Pairs)
- Spearman's Rank Correlation Coefficient

### Paired Fields Field Selection

*Paired Fields Field Selection*

You must specify a Dependent (Y) field to compare the X fields, and you can optionally specify Group and Weight fields.

## Paired Fields Options

**Paired Sign Test**

**Wilcoxon Signed Rank Test**

**Spearman's Rank Correlation**

*Paired Fields Options*

Select the analysis to generate. The options are described in detail below.

## Paired Fields Output Table

State	DataField	Count_of_Cholesterol	Count<Y	Count=Y	Count>Y	Pearson's_R	SignZ	SignProb
FL	Age	17	17	0	0	0.01815720917	3.8805700006	0.0001042119
FL	Weight	17	16	0	1	0.75554035903	3.3954987505	0.0006850369
MD	Age	33	33	0	0	0.18419896568	5.5704849906	2.502684E-08
MD	Weight	33	30	1	2	0.58735414273	4.7729707730	1.815279E-06
VA	Age	50	50	0	0	-0.0963936757	6.9296464556	0
VA	Weight	50	42	0	8	0.58209684040	4.6669047558	3.057706E-06

*Paired Fields Output Table*

## Paired Fields Output Fields

These fields are always generated (see the Compare section on page 60 for more details):

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	X field name identifying the data in the record
<b>Count_of_Y-Field</b>	Number of records, where Y-Field is the name of the Y field
<b>Missing</b>	Number of blank (missing) records
<b>Count&lt;Y</b>	Number of records with X < Y
<b>Count=Y</b>	Number of records with X = Y
<b>Count&gt;Y</b>	Number of records with X > Y
<b>MeanX</b>	Mean of X field
<b>MeanY</b>	Mean of Y field
<b>MeanDiff</b>	Difference of means: MeanX - MeanY
<b>Correlation</b>	Pearson's correlation between X and Y

### Paired Sign Test

The Paired Sign Test determines if two fields have the same distribution even if they are not normally distributed. The analysis is based on the number of pairs where the difference between X and Y is positive or negative.

<b>SignZ</b>	Z value for sign test: $Z = \frac{N_{\max} - (N/2) + 0.5}{\sqrt{N}/2}$ where $N$ is the total count, and $N_{\max}$ the count of the larger group
<b>SignProb</b>	Two-tailed probability that the X and Y fields have the same distribution

### Wilcoxon Signed Rank Test

The Wilcoxon Signed Rank Test is similar to the parametric paired t-test in the Compare analysis type (see page 63). Unlike the Paired Sign Test, the Wilcoxon Signed Rank measures the difference — not just the sign — between the fields:  $D_i = X_i - Y_i$ . It sorts the absolute values of the differences and assigns ranks.

<b>Wilcoxon_Neg_SumRank</b>	Sum of ranks for differences < 0
<b>Wilcoxon_Pos_SumRank</b>	Sum of ranks for differences > 0
<b>Wilcoxon_Neg_MeanRank</b>	Mean rank of negative differences: $[Wilcoxon\_Neg\_SumRank]/[Count<Y]$
<b>Wilcoxon_Pos_MeanRank</b>	Mean rank of positive differences: $[Wilcoxon\_Pos\_SumRank]/[Count>Y]$
<b>Wilcoxon_Z</b>	Wilcoxon Z value based on positive and negative SumRanks
<b>Wilcoxon_Prob</b>	Two-tailed probability that the two fields have the same mean

### Spearman's Rank Correlation Coefficient

Similarly to the Pearson's Correlation in the Compare analysis type (see page 60), Spearman's Rank Correlation Coefficient is used in non-parametric situations. Rather than the actual values, the rankings of values in X and Y are compared, and a value between -1 and 1 is generated. A value of -1 or 1 indicates a perfect (linear) correlation.

Spearman's Rank Correlation is calculated by sorting and ranking the X and Y fields separately. The difference ( $d_i$ ) in rank between each paired fields is calculated and summed.



<b>TiedGroups_X</b>	Number of X field groups with ties
<b>TiedGroups_Y</b>	Number of Y field groups with ties
<b>Spearman (<math>r_s</math>)</b>	Spearman's correlation coefficient (sometimes called Spearman's Rho): $r_s = 1 - \frac{6 \sum d_i^2}{N^3 - N}$
<b>Spearman_t</b>	Spearman t value: $t = r_s \sqrt{\frac{N-2}{1-r_s^2}}$ The significance of Spearman value.
<b>Spearman_Prob</b>	Two-tailed probability associated with [Spearman_t] with N-2 degrees of freedom
<b>Spearman_(ties) (<math>r_s</math>)</b>	Spearman's correlation coefficient adjusted for ties: $r_s = \frac{T_x + T_y - \sum d_i^2}{2\sqrt{T_x T_y}}$ where $T_x$ and $T_y$ is $\frac{N^3 - N - \sum (t^3 - t)}{12}$ where $t$ is the number of ties for an X or Y rank. The summation is over all tied groups.
<b>Spearman_t_(ties)</b>	Spearman t value adjusted for ties
<b>Spearman_Prob_(ties)</b>	Probability for [Spearman_t_(ties)]

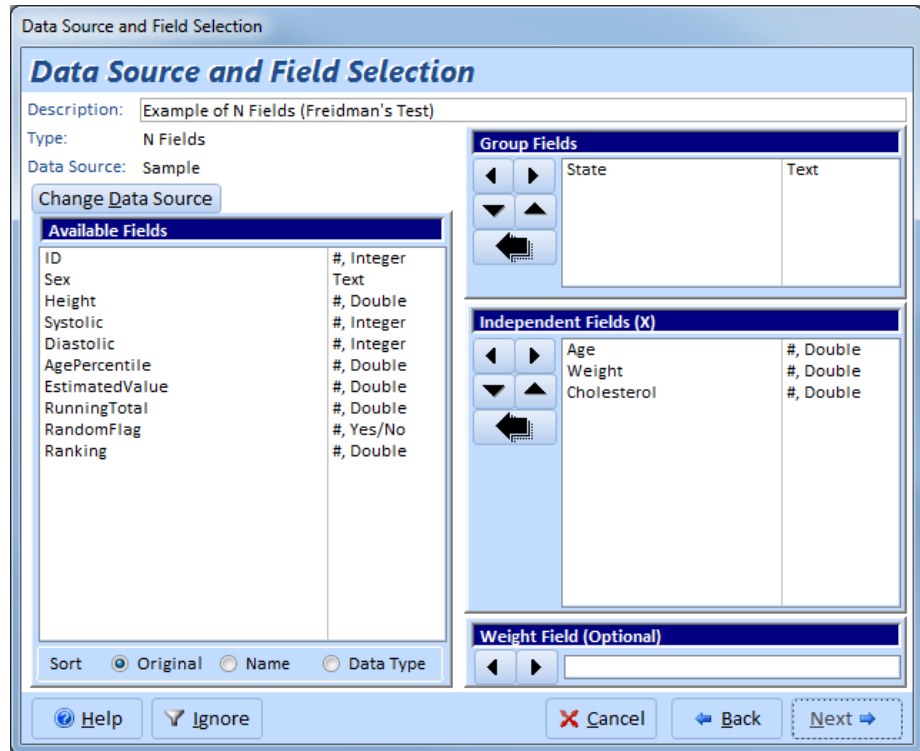
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## N Fields — Friedman's Two Way ANOVA of Ranks

The N Fields test, Friedman's Two Way ANOVA of Ranks, is a generalization of the N Sample tests. This test compares multiple numeric fields to determine whether data is normally distributed among the fields.

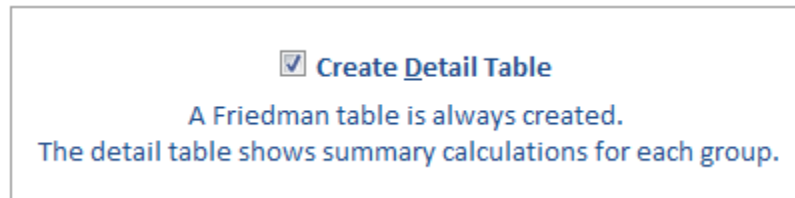
### Friedman's Field Selection

Specify the numeric fields to analyze as Independent X fields:



*Friedman's Field Selection*

## Friedman's Two Way ANOVA Options



*Friedman's Two Way ANOVA Options*

There is an option to create a detail table with the count, sum of ranks and mean rank for each group and X field.

## Friedman's Two Way ANOVA Output Table

State	Count	Missing	DF	Fields	Chi-Squared	Friedman_Prob
FL	17	0	2	3	32.117647058824	1.06106393985403E-07
MD	33	0	2	3	61.378787878788	4.69640518850507E-14
VA	50	0	2	3	86.56	1.59858164931428E-19

*Friedman's Two Way ANOVA Output Table*

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	X field name identifying the data in the record
<b>Count</b>	Number of records in group

<b>Missing</b>	Number of missing records (if any X field is blank, it is considered a missing record)
<b>DF</b>	Degrees of freedom: $k - 1$
<b>Fields (k)</b>	Number of X fields
<b>Chi-Square</b>	Chi-square calculation: $\chi^2 = \frac{12}{Nk(k+1)} \sum S_i^2 - 3N(k+1)$ where $S_i$ is sum of ranks for the $i$ th X field.
<b>Prob</b>	Probability based on Chi-Square and DF that the X field populations are identical

### Friedman's Detail Output Table

The detail table provides rank summaries for each X field:

State	DataField	Count	SumRanks	MeanRank
FL	Age	17	17	1
FL	Weight	17	35	2.05882352941176
FL	Cholesterol	17	50	2.94117647058824
MD	Age	33	33	1
MD	Weight	33	68.5	2.07575757575758
MD	Cholesterol	33	96.5	2.92424242424242

*Friedman's Detail Output Table*

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	X field name identifying the data in the record
<b>Count</b>	Number of records
<b>SumRanks</b>	Sum of ranks for the X field
<b>MeanRank</b>	Mean rank = SumRanks / Count



# Chapter 8: Record Analysis

*The Record Analysis features are focused on manipulating your records directly. Unlike the other analysis types in Total Access Statistics, these features generate results that update your existing records or create new records similar to your data source. This chapter describes Total Access Statistics' Record Analysis options.*

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## Topics in this Chapter

- **Record Analysis Overview**
- **Random Records**
- **Ranking**
- **Normalize**

---

## Record Analysis Overview

Unlike other analysis types, Record Analysis features generate results that manipulate your data. With options to update your existing records or create new records similar to your data source, Record Analysis helps you manage your records.

These features are available when you select the [Record Analysis] tab from the main form:

ID	Analysis Type	Description	Data Source
23	Random	Example of Random Scenario	Sample
24	Ranking	Example of Ranking Scenario	Sample
25	Normalize	Example of Normalize Scenario	Sample
26	Normalize	Example of Normalizing Text Fields	tblComputerSerialNum
27	Normalize	Transform Spreadsheet Layout to a Normalized Table	tblFederalBudget

*Record Analysis Tab*

The three types of Record Analysis are listed on the left:

- **Random**  
Identify a subset of records from the data source.
- **Ranking**  
Sort a field and assign rank values adjusting for ties.
- **Normalize**  
Transform your non-normalized data into a normalized format.

---

## Random Records

When analyzing data, you may need to create a subset of records for further analysis or testing, especially when you're dealing with large datasets. The Random feature generates or flags a subset of your records based on the options you select.

Random selections are useful in many situations. For instance, you may have survey information and need to confirm a hypothesis by interviewing your respondents again. Rather than asking all your respondents, which is time consuming and expensive, you may want to start with a small random sample. Based on the results of that study, you can then decide if continuing with a larger sample is warranted.

## Random Field Selection

The following field selection screen appears for Random:

The screenshot shows the 'Data Source and Field Selection' dialog box. The title bar reads 'Data Source and Field Selection'. The main title is 'Data Source and Field Selection'. The description is 'Example of Random Scenario'. The type is 'Random' and the data source is 'Sample'. There is a 'Change Data Source' button. The 'Available Fields' list includes: ID (#, Integer), State (Text), Height (#, Double), Systolic (#, Integer), Diastolic (#, Integer), AgePercentile (#, Double), EstimatedValue (#, Double), RunningTotal (#, Double), RandomFlag (#, Yes/No), and Ranking (#, Double). The 'Group Fields' list contains 'Sex' and 'Text'. The 'Output Fields' list contains 'Age' (#, Double), 'Weight' (#, Double), and 'Cholesterol' (#, Double). The 'Weight Field (Optional)' is currently empty. At the bottom, there are 'Sort' options: 'Original' (selected), 'Name', and 'Data Type'. Navigation buttons include 'Help', 'Ignore', 'Cancel', 'Back', and 'Next'.

*Random Field Selection*

Group Fields let you select a random set of records for each set of unique values in your group. Records are selected from each of these Groups of records separately.

If you choose to generate an output table (specified in the next Options form), the Output fields are the fields in your output table. Your data source is sorted first by Group fields, and then by Output fields in the order you select them.

The Weight field is disabled since weighting records is not relevant for the selection of random records.

If you ignore values, there are implications if you are updating a field in your data source. See **Ignore Implications for the Flag Field** on page 120 for more information.

## Random Options

After you select the fields, press [Next] to display the Random options:

**Selection Options**

**Nth Record:** Every  records

**I**nclude first record of each group

**N**umber of Records:

(per group)

**P**ercent of Records:  %

**R**andom  **E**xact

**Result Options**

**C**reate **O**utput Table

**F**lag Field in **D**ata Source

Data source must be updatable.

Flag this field:

▼

This field is assigned -1 (True) for Selected records and 0 (False) for

*Random Options*

The options are divided into two sections:

- **Selection Options**  
How the random records are selected.
- **Result Options**  
How the results are presented.

### ***Selection Options***

The subset of records can be selected in one of three ways. Some methods are more “random” than others.

**Selection Options**

**Nth Record:** Every  records

**I**nclude first record of each group

**N**umber of Records:

(per group)

**P**ercent of Records:  %

**R**andom  **E**xact

*Random Selection Options*

## **Nth Record**

This is a simple approach to simply grab the  $n^{\text{th}}$  record in every group. The selection is based on sorting the data source by the output field in each group. In the example above, every 10<sup>th</sup> record is retrieved.

**I**nclude first record of each group

When you select the  $n^{\text{th}}$  record option, there is an additional option to include the first record of each group. If you select this, the first record is always retrieved, guaranteeing at least one record for each group. In our example, this would mean the 1<sup>st</sup>, 11<sup>th</sup>, 21<sup>st</sup>, etc. records.



If you do not select this option, the 10<sup>th</sup>, 20<sup>th</sup>, 30<sup>th</sup>, etc. records are retrieved. If a group has fewer than the number of records you specify (e.g. 10), no records from that group are selected.

### Number of Records

Specify the number of records from each group to retrieve, regardless of how many records are in the group. If the group has fewer records than the number you specify, all of its records are retrieved. The records are selected randomly (unlike the nth record approach).

### Percent of Records

Select a percentage of records from each group. For instance, for 10% of the records, enter 10 here:



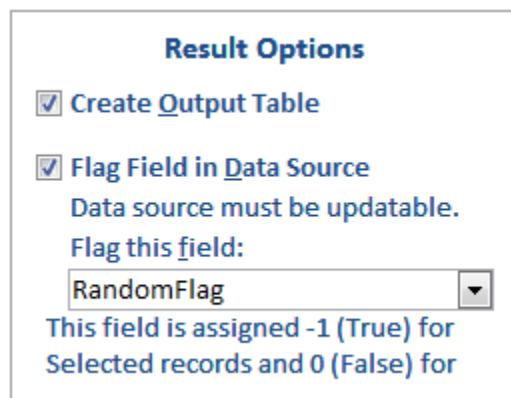
The screenshot shows a form with a radio button selected for 'Percent of Records', a text input field containing '10', and a '%' symbol. Below this, there are two radio buttons: 'Random' (selected) and 'Exact'.

There is an additional option to select a Random or Exact. If you select Random, a random number of records is selected for each group. This may be larger or smaller than the percentage you specify. A random number is generated for each record, and if it's less than the percent specified it's retrieved.

If you select Exact, the exact percentage of records you specify in each group is selected (the number of records is rounded to the nearest integer).

### Result Options

The result options determine how the random records are retrieved. Choose one or both options:



The screenshot shows a dialog box titled 'Result Options'. It contains two checked checkboxes: 'Create Output Table' and 'Flag Field in Data Source'. Below the second checkbox, there is a text label 'Data source must be updatable.', a label 'Flag this field:', and a dropdown menu with 'RandomFlag' selected. At the bottom, there is a text label: 'This field is assigned -1 (True) for Selected records and 0 (False) for'.

*Random Result Options*

## Create Output Table

A new table is created with the selected records and the Group and Output fields specified.

Sex	Age	Weight	Cholesterol
F	33	117	181
F	42	112	190
F	56	94	190
F	66	123	165
M	31	147	195
M	42	233	248
M	47	233	228
M	56	137	169
M	67	211	222

## Flag Field in Data Source

Instead of, or in addition to, creating an output table, you can flag a field in the data source to identify the selected records. The data source must be updatable for this feature.

Specify the field name to be updated. The value placed in this field depends on the field type:

Field Type	Value if Selected	Value if Not Selected
<b>Numeric</b>	-1	0
<b>Text</b>	1	0
<b>Yes/No</b>	True (-1)	False (0)

The result looks like this, where the [RandomFlag] field shows which records were randomly selected.

RandomFlag	ID	Sex	State	Age	Weight	Height	Cholesterol	Systolic
<input type="checkbox"/>	1	F	VA	33	117	66	181	138
<input type="checkbox"/>	2	M	VA	30	137	65	189	151
<input type="checkbox"/>	3	F	FL	43	90	58	200	144
<input type="checkbox"/>	4	F	MD	59	146	66	322	187
<input type="checkbox"/>	5	M	MD	62	142	68	165	142
<input checked="" type="checkbox"/>	6	F	VA	56	144	67	155	129
<input type="checkbox"/>	7	F	VA	67	125	64	156	129
<input type="checkbox"/>	8	F	VA	28	109	64	203	146
<input checked="" type="checkbox"/>	9	M	VA	62	144	69	164	142
<input checked="" type="checkbox"/>	10	M	VA	32	180	73	300	200
<input checked="" type="checkbox"/>	11	F	VA	42	112	66	190	141

*Random Records Selected in Original Table*

## Ignore Implications for the Flag Field

If you specified values to ignore when selecting fields, the data in the first Output field is examined to determine if the record is valid. If the record is ignored, its Flag Field is never updated.

Therefore, you may want to clear this field for all your records to avoid accidentally mixing the new selections with previous selections in ignored records. In certain cases, however, you may not want to clear the field (for instance, if you are using a different Random option for separate ranges of values).

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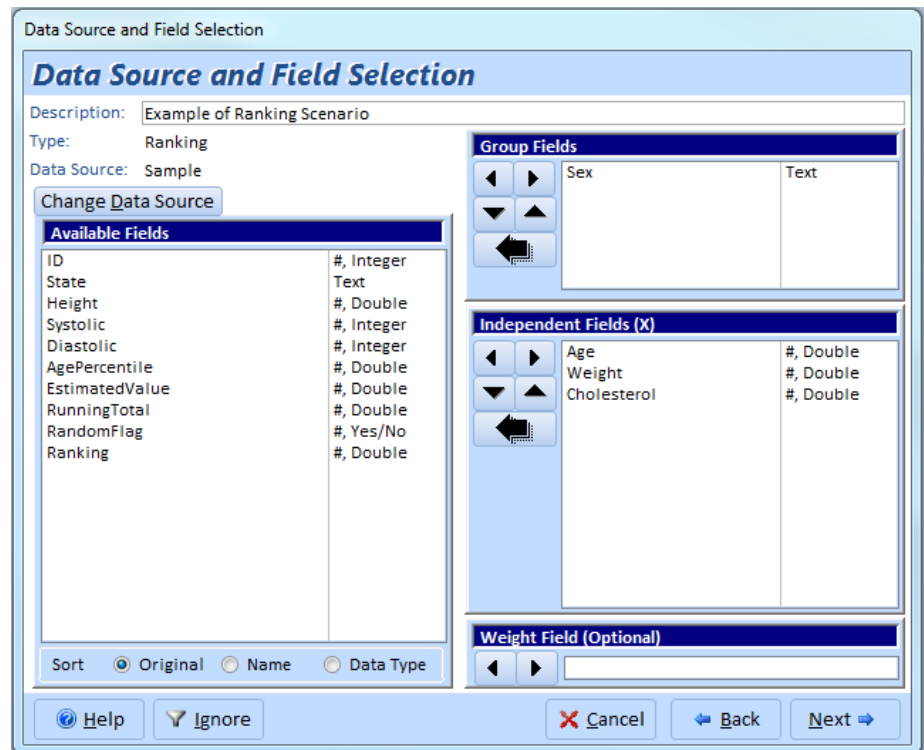
## Ranking

The Ranking feature assigns a numeric rank to each record based on its value. The lowest value is assigned 1, the next value 2, etc. If ties occur, one of three options is available to assign the rank values.

Ranking can be useful in many situations; for instance, golf tournament winners are ranked (and awarded) based on each person's score. It's not the score that matters, but the score relative to other players.

### Ranking Field Selection

The following field selection screen appears for Ranking:



*Ranking Field Selection*

Group Fields let you rank records for each group (set of unique values in your group fields).

The Independent Fields are sorted and assigned rank values for each group.

The Weight Field allows you to weight the record by the value in this field.

Records with blank values in the independent field or weight field (if assigned) are not ranked.

## Ranking Options

After selecting the fields, press [Next] to see the Ranking options:

Calculation Options	
<b>Sort Order:</b> <input checked="" type="radio"/> <u>A</u> scending <input type="radio"/> <u>D</u> escending	<b>Rank Ties:</b> Average <input type="text"/>
<b>Multi-Field Option</b> If you have more than one independent field, the fields may be combined and ranked together in the order they are selected, or each field may be ranked separately:  <input checked="" type="radio"/> <u>T</u> ogether <input type="radio"/> <u>S</u> eparate	Tied values are given the average rank, and the following values reflect the cumulative number of records.  If records 2 and 3 are tied for 2nd, they are ranked 2.5, and record 4 is ranked 4.

Result Options	
<input checked="" type="checkbox"/> <b>Create Output Table</b>	
<input checked="" type="checkbox"/> <b>Assign Rank to Field:</b>	Ranking <input type="text"/>
Data source must be updatable.	Field type should be Double, if there are ties

### Ranking Options

The options are divided into Calculation Options and Output Options.

#### Calculation Options

The calculation options specify how to rank the values.

#### Sort Order

<b>Sort Order:</b> <input checked="" type="radio"/> <u>A</u> scending <input type="radio"/> <u>D</u> escending
--

Rank your data in ascending or descending order. If first place is for the lowest value, like golf scores, choose Ascending. If the first rank is for the largest value, like number of wins or highest ratings, choose Descending.

#### Multi-Field Option

<input checked="" type="radio"/> <u>T</u> ogether <input type="radio"/> <u>S</u> eparate
--

If you selected more than one independent (X) field, you can specify whether you want the fields sorted together or separately.

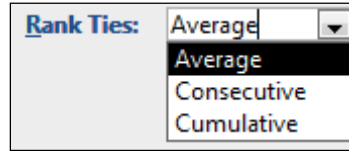
The Together option assigns each record one rank value. Records are sorted by the first field, then the second, third, etc. If there are ties in the first field, the second field breaks the tie. If all the fields have the same value, the records are considered tied and given the same value.

The Separate option treats each independent (X) field separately. The output table contains a field with the X field name, its value, and its rank. If you have more than one independent field and choose Separate, the Assign

Rank to Field option is not available since a separate rank is given to each independent field.

## Rank Ties

When ties occur, there are three ways to rank the records:



*Ranking Calculation Options*

These are the rank calculation differences based on tied data:

Data Value	Average	Consecutive	Cumulative
10	1	1	1
12	2.5	2	2
12	2.5	2	2
13	4	3	4

*Example of Different Ways to Rank Tied Data*

### Average Ties

If you select the Average option, tied values are given the average rank, and the following values reflect the cumulative number of records.

For example, if records 2 and 3 are tied for second place, each record is ranked 2.5, and the fourth record is ranked 4.

### Consecutive Ties

If you select the Consecutive option, tied values are all given the first rank, and the next value is given next consecutive number, regardless of record count. The result is a simple ranking of every unique value.

For example, if records 2 and 3 are tied for second place, each record is ranked 2, and the fourth record is ranked 3.

### Cumulative Ties

If you select the Cumulative option, tied values are given the first rank, and the following values reflect the cumulative number of records.

For example, if records 2 and 3 are tied for second place, each record is ranked 2, and the fourth record is ranked 4.

### Result Options

The result options determine how the ranked records are retrieved or displayed. Choose one or both options:

Result Options	
<input checked="" type="checkbox"/> Create Output Table	
<input checked="" type="checkbox"/> Assign Rank to Field:	Ranking
Data source must be updatable. Field type should be Double, if there are ties	

#### Ranking Result Options

The result options determine how the scenario should behave when run.

### Create Output Table

The output table includes a record for each ranking showing the value of the Independent X field and the number of records with that value.

If multiple fields were selected, and the Multi-Field Option was set to Together, each of the field's values is a separate column.

If Separate was selected, a field called [DataField] contains the field name and [Value] its value.

Total	Count	Rank
270	1	1
275	1	2
276	3	4
277	1	6
278	2	7.5
279	3	10
280	2	12.5
281	2	14.5
282	4	17.5
283	4	21.5
284	5	26
285	5	31

### Ranking Output Fields

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	If Multi-Field Option is Separate, the X field name identifying the data in the record.
<b>Value</b>	If Multi-Field option is Separate, this contains the unique value of the Data Field. For Together, each data field is a separate column containing its values.
<b>Count</b>	Number of records (or weighting) for the value
<b>Rank</b>	Ranking based on the options selected

### Assign Rank to Field

Instead of, or in addition to, creating an output table, you can assign the rank value to a field in the data source for each record.

This feature is available if the Multi-Field Option is set to Together. The data source must also be updatable.

Specify the field name to update. The field must be a numeric field. If Average is the selected Calculation Option, the rank field should be a Double, otherwise, an Integer or Long Integer field is acceptable.

In this example of a golf tournament results, the Total field is ranked in the Ranking field:

Ranking	GolferName	Total
1.00	Tiger Woods	270
2.00	Shaun Micheel	275
4.00	Adam Scott	276
4.00	Sergio Garcia	276
4.00	Luke Donald	276
6.00	Mike Weir	277
7.50	Steve Stricker	278
7.50	K.J. Choi	278
10.00	Ryan Moore	279
10.00	Ian Poulter	279
10.00	Geoff Ogilvy	279
12.50	Sean O'Hair	280
12.50	Chris DiMarco	280
14.50	Henrik Stenson	281
14.50	Tim Herron	281
17.50	Ernie Els	282
17.50	David Toms	282
17.50	Woody Austin	282
17.50	Phil Mickelson	282

## Ignore Implications for the Ranking Field

If you specified values to ignore when selecting fields, the data in the Independent and Weighting fields are examined to determine if the record is valid. If the record is ignored, the Ranking field is never updated.

Therefore, you may want to clear this field for all your records to avoid accidentally mixing the new rankings with previous rankings in the ignored records. In certain cases, however, you may not want to clear the field (for instance, if you use multiple non-overlapping ignore value ranges for different rankings).

---

## Normalize

### Data Normalization Overview

The Normalize feature allows you to quickly convert non-normalized data into a new table in normalized format. You may want to do this just one time to more easily analyze normalized data, or make a permanent conversion of your data into a new normalized table.

Whether you use Access or another platform, having normalized data is a fundamental part of relational databases. Normalized data is easier to store and analyze, and is more flexible over time. Normalized data is expected for optimal analysis with Access queries and with Total Access Statistics.

Relational databases can store an incredible amount of data and almost unlimited records. A properly normalized database takes advantage of the

principle that “Records are free, Fields are expensive.” Over time, a properly normalized table does not need to add fields, it simply adds more records.

There are a lot of theoretical discussions about how data should be normalized and to what degree. Much depends on the type of data being stored and how the data is used. That said, one often inherits non-normalized data, especially if it comes from a spreadsheet. Visit our web site and look under our technical papers for more discussions about data normalization in Access.

### Example of Data Normalization

The following example illustrates how non-normalized data can be converted.

This original table stores federal budget data with a separate field for each year. This is similar to a spreadsheet. While it is easy to add a new field when a new year’s data arrives, any query, form, report, or code that uses this table would also need to be updated and retested. It would be far easier if the year were a field.

Data Type	2011	2012	2013	2014	2015
Receipt	\$2,303	\$2,590	\$2,882	\$3,145	\$3,273
Outlay	\$3,603	\$3,717	\$3,655	\$3,807	\$4,021
Deficit	\$1,300	\$1,127	\$772	\$662	\$749
Discretionary: Defense	\$699	\$709	\$700	\$673	\$678
Discretionary: Non-Defense	\$600	\$610	\$565	\$546	\$543
Social Security	\$725	\$773	\$820	\$867	\$918
Medicare	\$480	\$478	\$528	\$564	\$586
Medicaid	\$275	\$255	\$283	\$339	\$372
TARP	(\$38)	\$35	\$12	\$8	\$5
OtherMandatory	\$631	\$635	\$571	\$595	\$6,322
Interest	\$230	\$223	\$246	\$305	\$384

*Data Source to Convert: Non-normalized Budget Data*

Manually converting the data is cumbersome and time consuming, but the Normalize feature makes it easy to convert the example table to normalized format:



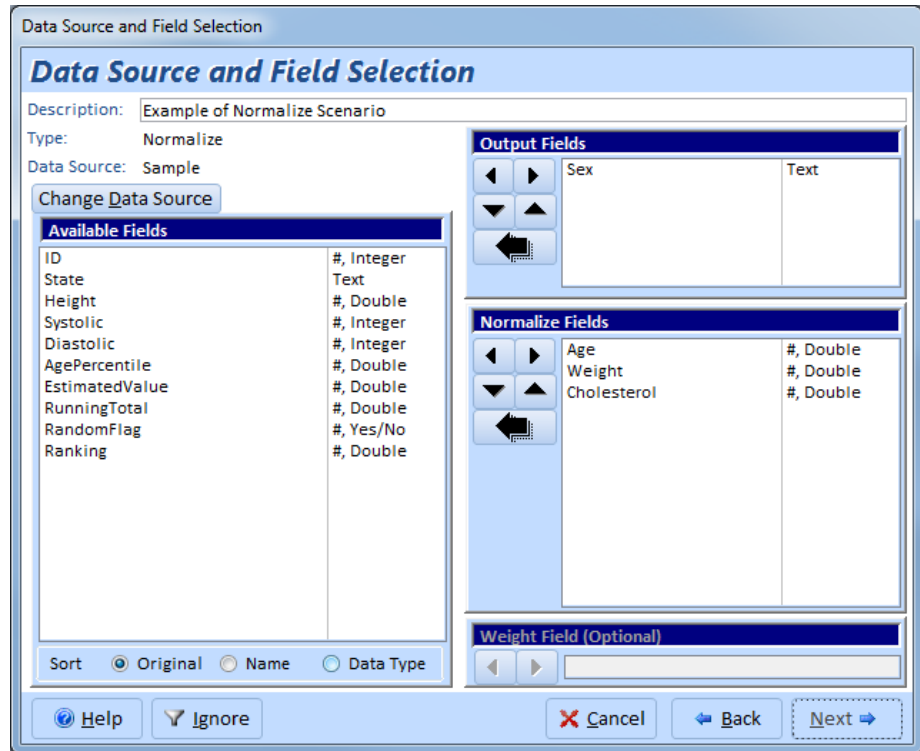
Data Type ▾	DataField ▾	Value ▾
Deficit	2011	\$1,300.00
Deficit	2012	\$1,127.00
Deficit	2013	\$772.00
Deficit	2014	\$662.00
Deficit	2015	\$749.00
Discretionary: Defense	2011	\$699.00
Discretionary: Defense	2012	\$709.00
Discretionary: Defense	2013	\$700.00
Discretionary: Defense	2014	\$673.00
Discretionary: Defense	2015	\$678.00
Discretionary: Non-Defense	2011	\$600.00
Discretionary: Non-Defense	2012	\$610.00
Discretionary: Non-Defense	2013	\$565.00
Discretionary: Non-Defense	2014	\$546.00
Discretionary: Non-Defense	2015	\$543.00
Interest	2011	\$230.00
Interest	2012	\$223.00
Interest	2013	\$246.00
Interest	2014	\$305.00
Interest	2015	\$384.00

*Normalized Data from Data Source*

Notice how a separate record is created for each year with the ID and Data Type fields preserved from the original record.

### **Normalize Field Selection**

The following field selection screen is available for Normalize:



Normalize Field Selection

The Normalize Fields become fields in the output table containing the data from the data source. The type of the output field depends on the types of normalize fields that you select:

If the Normalize field types include...	The output field type will be...
<b>Numeric fields only</b>	Numeric. Select the specific numeric field type (Currency, Integer, Long Integer, or Double) on the Normalize Options page. For ADPs, the equivalent numeric fields such as Float, Money, Int, etc. are available.
<b>Text and numeric fields</b>	Text. The field size is 255.
<b>All text fields</b>	Text. The field size is equal to the largest Normalize field selected.
<b>At least one memo field</b>	Memo

Each of the Normalize Fields is transformed into a separate record in the output table. The DataField in the output table contains the name of the field to identify the data.

## Normalize Options

After selecting the fields, press [Next] to show the Normalize options:

**Output Field Name:**  
Value

**Output Field Type:** Double

Ignore blank (null) data field values

*Normalize Options*

### **Output Field Name**

The name you want in the output table for the normalized data.

### **Output Field Type**

If the Normalize fields are all numeric, select the specific numeric field type (Currency, Integer, Long Integer, or Double) from the list. If there is at least one text Normalize field, this option is disabled, and the output field type is determined automatically. See the chart on page 128 for more information.

### **Ignore Blank Values**

If you check this option, blank values are ignored. If unchecked, a record is created even if the data is blank (null).

### **Normalize Output Fields**

Here's an example of the transposed data:

TAS_Normalize			
StatOutputID	Sex	DataField	Value
1	F	Age	20
2	F	Weight	114
3	F	Cholesterol	140
4	F	Age	24
5	F	Weight	149
6	F	Cholesterol	189
7	F	Age	25
8	F	Weight	101
9	F	Cholesterol	200
10	F	Age	25
11	F	Weight	119
12	F	Cholesterol	177
13	F	Age	26
14	F	Weight	139
15	F	Cholesterol	162

*Transposed Data*

Here are the field definitions:

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	Field name identifying the data in the record
<b>ValueField</b>	Value from the Data Field

# Chapter 9: Financial Analysis

*The Financial Analysis features calculate present, future, and discounted values and returns based on the cash flow data in your data source. The cash flow can be periodic (regular) or date dependent (irregular) payments.*

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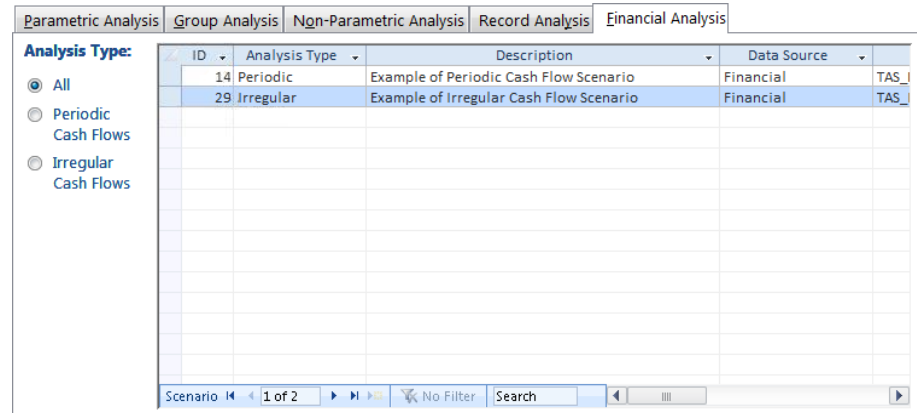
## Topics in this Chapter

- **Financial Analysis Overview**
- **Periodic Cash Flows**
- **Irregular Cash Flows**

---

## Financial Analysis Overview

Easily calculate discounted values and returns for a series of cash flow investments and receipts. Negative values are considered investments (payments) and positive values are receipts (returns).



The screenshot shows a software interface with a tabbed menu at the top: Parametric Analysis, Group Analysis, Non-Parametric Analysis, Record Analysis, and Financial Analysis. The 'Financial Analysis' tab is active. On the left, there is a sidebar titled 'Analysis Type:' with three radio button options: 'All' (selected), 'Periodic Cash Flows', and 'Irregular Cash Flows'. The main area is a table with the following data:

ID	Analysis Type	Description	Data Source	
14	Periodic	Example of Periodic Cash Flow Scenario	Financial	TAS_I
29	Irregular	Example of Irregular Cash Flow Scenario	Financial	TAS_I

At the bottom of the table, there is a status bar with 'Scenario 1 of 2', 'No Filter', and a search field.

*Financial Tab*

Two Financial scenario types are available depending on whether your data represents Periodic or Irregular cash flows:

- **Periodic**  
Each record is a cash flow payment or receipt that is identically separated in time from each other (for instance, annual or monthly transactions), but the amount may vary for each period.
- **Irregular**  
Each record has a date field for its cash flow payment or receipt which may not be evenly spaced over time. The amounts may also vary with each record.

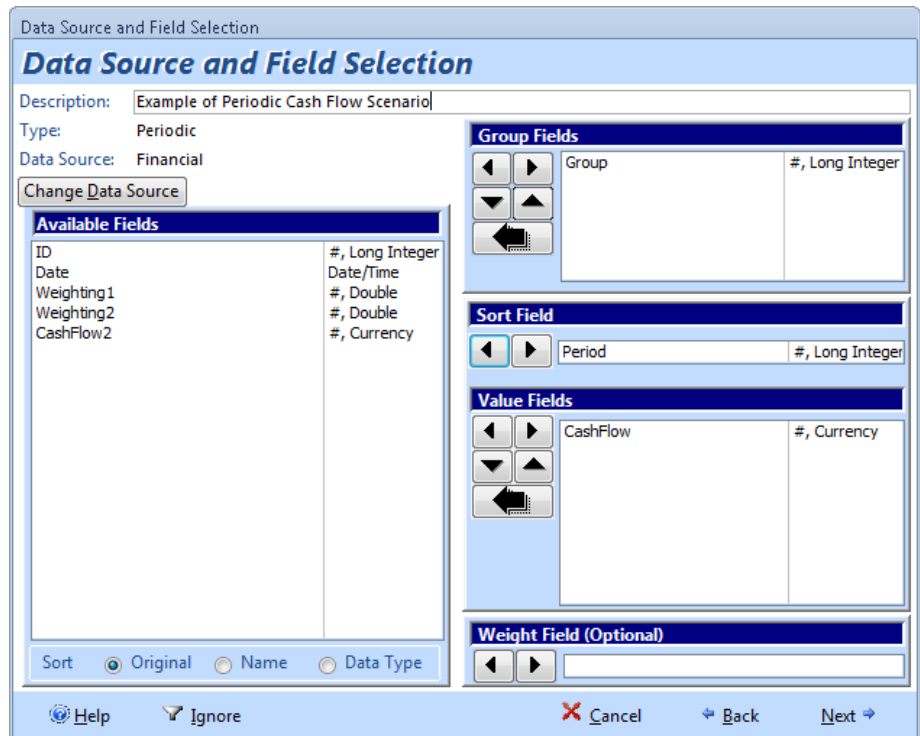
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## Periodic Cash Flows

The simplest and most common cash flow analysis is based on periodic transactions. Payments or receipts can vary in size but occur on a regular schedule. Most common intervals are annual, monthly, and quarterly. Depending on the frequency of your cash flows, you'd enter the appropriate interest rate for each period.

### Periodic Cash Flow Field Selection

The following field selection screen appears for Periodic Cash Flows:



*Periodic Cash Flows Field Selection*

The Value Fields contain the cash flow data. Each field you selected is analyzed separately. The values in the field should be negative for payments (investments or outflows), and positive for receipts (returns or inflows).

Group Fields let you generate a separate set of analysis for each combination of unique values among the group fields.

The Sort Field is used to ensure your cash flows are sorted properly. This may be the AutoNumber field of your table or another field that can be used to ensure Total Access Statistics processes each cash flow in the right order. It is critical that your cash flows be in the right order.

If no group field is specified, the Sort Field is not required and Total Access Statistics analyzes your records in their natural order, which may or may not be okay.

You can optionally specify a Weight Field which can be used in situations where you have a field for the receipt amount and another weighting field that specifies the quantity of those receipts.

### **Periodic Cash Flow Options**

After selecting the fields, the Periodic options are presented:

**Value and Returns of Cash Flow with Regular Intervals**  
Assumes each cash flow occurs at regular time periods.

**Cash flow timing for each time period:**

Beginning (first item is not discounted)

End (first item is at the end of the first time period)

**Net Present Value (NPV)**  
Discount Rate per Period:

**Internal Rate of Return (IRR)**  
At least one negative (payment) and one positive (income) value is required.

**Modified Internal Rate of Return (MIRR)**  
Finance Rate per Period:   
Reinvestment Rate per Period:

*Periodic Cash Flow Options*

***Cash flow timing for each time period***

For Cash Flow analysis, it's important to determine whether the first item represents an event at the beginning of the time period or the end of the time period. For instance, if your initial investment (a negative number) occurs on Day 1, choose the Beginning option. If the first investment occurs at the end of the first year, choose End.

The implication of this selection can be most easily understood with the first investment. If it's at the beginning of the period, the first cash flow is not discounted since there hasn't been any time to apply the interest rate. If it's at the end, it is adjusted by the discount rate.

***Net Present Value (NPV)***

Net Present Value is the current value of a future series of payments and receipts and a way to measure the time value of money. Basically, money today is worth more than money tomorrow. And future money is discounted by the interest rate you specify.

Assuming cash flows occur at the end of each period, an NPV with a 10% discount rate would divide the cash flow of period 1 by (1 + 10%) then add the cash flow in period 2 divided by (1 + 10%) ^2, etc.

The NPV calculation ends with the last cash flow. The formula for NPV is:

$$NPV = \sum_{n=0}^N \frac{C_n}{(1+r)^n}$$

where N is the number of periods, n is a specific period, C is the cash flow for a particular period and r is the discount rate for each period.



## Set the Discount Rate to Your Time Interval

The discount rate you enter must correspond to the period of time between each cash flow. For periodic cash flow analysis, Total Access Statistics does not have date information on when the events occur.

If it's monthly, you should use  $1/12^{\text{th}}$  of your annual rate, for quarterly one-fourth, etc. For most accurate results, take the  $n^{\text{th}}$  root of your annual discount rate to capture the compounding effect.

### ***Internal Rate of Return (IRR)***

The Internal Rate of Return is used to measure an investment's attractiveness. It is the interest rate that makes the NPV equal to zero for the series of cash flows. At least one negative payment and one positive receipt are required to calculate IRR. If this doesn't exist, the result is null. IRR is sometimes called the discounted cash flow rate of return, rate of return, and effective interest rate. The "internal" term signifies the rate is independent of outside interest rates.

Depending on the number of cash flows and their values, IRR can require many iterations to generate an accurate result. Microsoft Excel stops after 20 tries. Total Access Statistics generates its standard level of double precision accuracy and will do so for up to 1000 iterations.

### ***Modified Internal Rate of Return (MIRR)***

Modified Internal Rate of Return is used to measure an investment's attractiveness. MIRR is a modification of the IRR calculation and resolves some problems with the IRR.

IRR assumes that positive cash flows are reinvested at the same rate of return as that of the investment. This is unlikely as funds are reinvested at a rate closer to the organization's cost of capital or return on cash. The IRR therefore often gives an overly optimistic rate of the cash flows. For comparing projects more accurately, the cost of capital should be used for reinvesting the interim cash flows.

Additionally, for projects with alternating positive and negative cash flows, more than one IRR may be found, which may lead to confusion.

To use MIRR, provide the two interest rates:

- Finance Rate: the cost of capital
- Reinvestment Rate: the interest received for cash investments

Similar to the discount rate provided for NPV, these rates should be the rate for each period and not the annual rates if your periods are not yearly.

The formula for MIRR is:

$$MIRR = \sqrt[n]{\frac{-FV(PositiveCashFlows, reinvestmentRate)}{PV(NegativeCashFlows, financeRate)}} - 1$$

where n is the number of equal periods at the end of which the cash flows occur (not the number of cash flows), PV is present value (at the beginning of the first period), FV is future value (at the end of the last period).

MIRR sums the discounted negative cash flows to the starting time, and sums the positive cash flows to the final period adjusting for the reinvestment rate. By dividing and taking the n<sup>th</sup> root, it determines the rate of return for the positive and negative cash flows.

Note that in Excel or VBA, the MIRR function always assumes the cash flows are at the beginning of the period. If you want to use the End of period option in Total Access Statistics and compare it to Excel, add an extra cash flow of zero to the beginning of the Excel data set.

## Periodic Cash Flow Output Table

Periodic Cash Flow analysis is performed for each value field:

Sum	Sum-Negative	Sum-Positive	Rate	FV	NPV	IRR	MIRR	RateFinan	RateReinves	MIRR-FV	MIRR-PV
300	-1000	1300	0.1	113	77.1805	0.1492	0.12837	0.1	0.12	1473.76	-909.0909
150000	0	150000	0.1	192890.25	108881.51			0.1	0.12		
50000	-100000	150000	0.1	15734.15	8074.1068	0.12978	0.121513	0.1	0.12	202879.72	-90909.09
3000	-10000	13000	0.1	486.75	302.2	0.11541	0.1138	0.1	0.12	15584.752	-9090.9
22000	-70000	92000	0.1	-4321.5	-2439.374	0.08	0.09889	0.1	0.12	112055.352	-63636.3
2000	-5000	7000	0.1	1329	907.724	0.25482	0.158796	0.1	0.12	7600	-4214.876

Periodic Output Table

## Periodic Cash Flow Output Fields

These fields are calculated for all periodic cash flow analysis:

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	Value field name identifying the data in the record
<b>Count (N)</b>	Number of records in the group
<b>Missing</b>	Records with missing values
<b>FirstCashFlow</b>	Value of the first cash flow
<b>LastCashFlow</b>	Value of the last cash flow
<b>Sum</b>	Sum of the values (profit)
<b>Sum-Negative</b>	Sum of the negative cash flows (values less than zero)
<b>Sum-Positive</b>	Sum of the positive cash flows (values greater than zero)

These fields are created if the NPV option is selected

Field Name	Description
<b>Rate</b>	The discount rate you specified for each period
<b>FV</b>	The Future Value of the cash flows at the end of the last period
<b>NPV</b>	Net Present Value of the discounted cash flows

These fields are created if the IRR option is selected

Field Name	Description
<b>IRR</b>	Internal Rate of Return

These fields are created if the MIRR option is selected

Field Name	Description
<b>MIRR</b>	Modified Internal Rate of Return
<b>RateFinance</b>	The periodic finance rate you specified
<b>RateReinvest</b>	The periodic reinvestment rate you specified
<b>MIRR-PV</b>	The present value of the negative cash flows discounted by the finance rate
<b>MIRR-FV</b>	The future value of the positive cash flow discounted by the reinvestment rate

As with all other values generated by Total Access Statistics, the rates (percentages) are shown as a decimal value between 0 and 1 (e.g. 5% is 0.05).

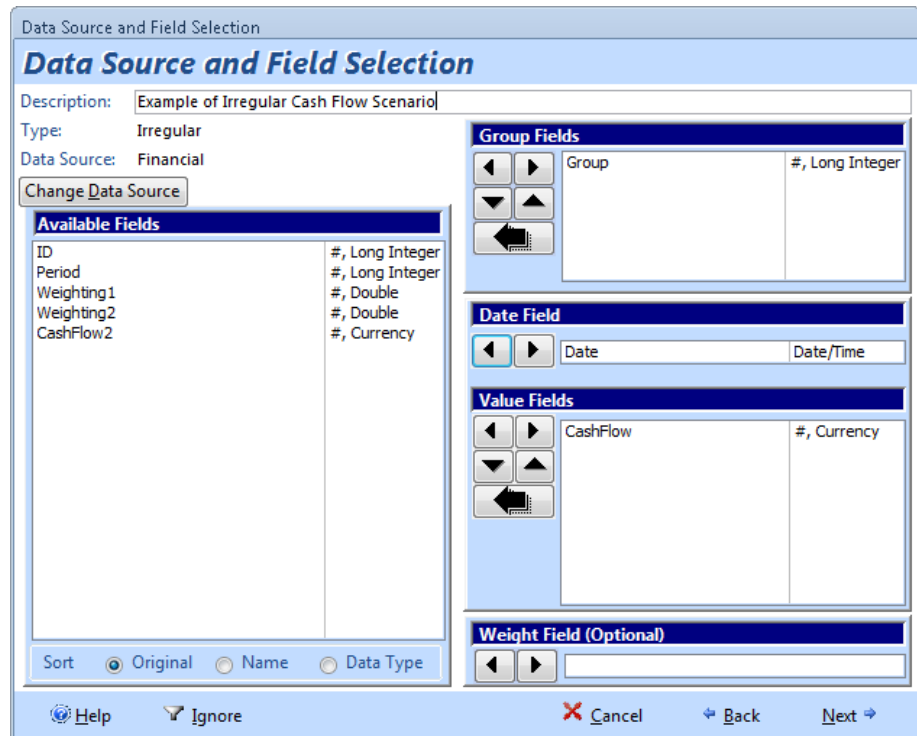
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## Irregular Cash Flows

Irregular Cash Flow analysis is similar to Periodic Cash Flow analysis, except the timing of individual cash flows is taken into account. Periodic analysis assumes the same amount of time between each cash flow. For situations where you have dates associated with each cash flow, the irregular cash flow analysis will provide a more accurate result.

### Irregular Cash Flow Field Selection

The following field selection screen appears for Irregular Cash Flows:



*Irregular Cash Flows Field Selection*

This is similar to the selection for Periodic Cash Flows, except a date field is required to identify the timing of each cash flow.

The Value Fields contain the cash flow data. Each field you selected is analyzed separately. The values in the field should be negative for payments (investments or outflows), and positive for receipts (returns or inflows).

Group Fields let you generate a separate set of analysis for each combination of unique values among the group fields.

You can optionally specify a Weight Field which can be used in situations where you have a field for the receipt amount and another weighting field that specifies the quantity of those receipts.

### **Irregular Cash Flow Options**

After selecting the fields, the Irregular options are presented:

**Value and Returns of Cash Flow with Irregular Intervals**

Cash flows occurs at irregular time periods.  
The date of the first cash flow is the starting date.

**Number of Days in Year:**

365       365.25

**Net Present Value (XNPV)**  
Annual Discount Rate:

**Internal Rate of Return (XIRR)**  
At least one negative (payment) and one positive (income) value is required.

**Modified Internal Rate of Return (XMIRR)**  
Annual Finance Rate:   
Annual Reinvestment Rate:

*Irregular Cash Flow Options*

***Number of Days in Year***

To adjust the interest rate to apply to cash flows between two dates, the annual interest rate needs to be divided by the number of days in a year. 365 days is the most common selection but if your cash flows span over multiple years, using 365.25 to adjust for leap year is more accurate. The difference of course is rather small.

***Net Present Value (XNPV)***

Net Present Value is the current value of a future series of payments and receipts and a way to measure the time value of money. This is identical to what's calculated in the Periodic cash flow analysis (explained on page 134).

The difference in the irregular cash flow analysis is that each cash flow is adjusted by the overall annual discount rate based on the date it occurs. NPV where dates are taken into account is called XNPV.

Unlike the periodic cash flow analysis where you specify the discount rate for each period, the discount rate specified here is always the annual rate.

***Internal Rate of Return (XIRR)***

The Internal Rate of Return is the interest rate that makes the NPV equal to zero for the series of cash flows. At least one negative payment and one positive receipt are required to calculate IRR. If this doesn't exist, the result is null.

This is identical to what's calculated in the periodic cash flow analysis (explained on page 135).

The difference in the irregular cash flow analysis is that each cash flow is specific to the date it occurs. IRR where dates are taken into account is called XIRR.

### **Modified Internal Rate of Return (XMIRR)**

MIRR is a modification of the IRR calculation and is a more accurate reflection of the true rate of return for a series of cash flows. For detailed definitions of MIRR and how it differs from IRR, read the MIRR section on page 135.

MIRR where dates are taken into account is called XMIRR. To calculate XMIRR, provide the two interest rates:

- Finance Rate: the cost of capital
- Reinvestment Rate: the interest received for cash investments

Unlike periodic cash flows, the rates for irregular cash flows are always the annual rate.

### **Irregular Cash Flow Output Table**

Irregular Cash Flow analysis is performed for each value field:

FirstDay	LastDay	TotalDay	DaysPerYe	TotalYears	Sum	Sum-Negative	Sum-Positive	Rate	FV	XNPV	XIRR	XMIRR	RateFinal
1/1/2001	1/1/2006	1826	365	5.0027	150000	0	150000	0.1	192926.9	119761			0.1
1/1/2000	1/1/2006	2192	365	6.00547	50000	-100000	150000	0.1	15678.27	8845.35	0.129	0.1251	0.1
1/1/2008	4/1/2009	456	365	1.24931	3000	-10000	13000	0.1	2246.718	1994.51	0.3733	#####	0.1
1/1/2000	1/1/2003	1096	365	3.002739	2000	-5000	7000	0.1	1328.652	997.97	0.2546	0.1791	0.1

*Irregular Output Table*

### **Irregular Cash Flow Output Fields**

These fields are calculated for all irregular cash flow analysis:

Field Name	Description
<b>Group Fields</b>	Group fields selected (if any)
<b>DataField</b>	Value field name identifying the data in the record
<b>Count (N)</b>	Number of records in the group
<b>Missing</b>	Records with missing values or dates
<b>FirstCashFlow</b>	Value of the first cash flow
<b>LastCashFlow</b>	Value of the last cash flow
<b>Sum</b>	Sum of values (profit)
<b>Sum-Negative</b>	Sum of the negative cash flows (values less than zero)
<b>Sum-Positive</b>	Sum of the positive cash flows (values greater than zero)

These fields are created for irregular cash flow analysis and not periodic cash flow analysis:

<b>FirstDay</b>	Date of first cash flow
<b>LastDay</b>	Date of last cash flow
<b>TotalDays</b>	Total number of days between the first and last cash flows
<b>DaysPerYear</b>	The days per year you specified (365 or 365.25)
<b>TotalYears</b>	Total number of years (TotalDays / DaysPerYear)

These fields are created if the XNPV option is selected:

Field Name	Description
<b>Rate</b>	The annual discount rate you specified
<b>FV</b>	The Future Value of the cash flows at the end of the last period
<b>XNPV</b>	Net Present Value of the discounted cash flows for specific dates

This field is created if the XIRR option is selected:

Field Name	Description
<b>XIRR</b>	Internal Rate of Return for date specific cash flows

These fields are created if the MIRR option is selected:

Field Name	Description
<b>XMIRR</b>	Modified Internal Rate of Return for date specific cash flows
<b>RateFinance</b>	The annual finance rate you specified
<b>RateReinvest</b>	The annual reinvestment rate you specified
<b>XMIRR-PV</b>	The present value of the negative cash flows discounted by the finance rate
<b>XMIRR-FV</b>	The future value of the positive cash flow discounted by the reinvestment rate

As with all other values generated by Total Access Statistics, the rates (percentages) are shown as a decimal value between 0 and 1 (e.g. 5% is 0.05).





# Chapter 10: Probability Calculator

*The probability calculator is a utility that quickly evaluates the probability of test values. By using this feature, you can avoid the tedious task of interpolating values in statistical probability tables (usually in the back of statistics books).*

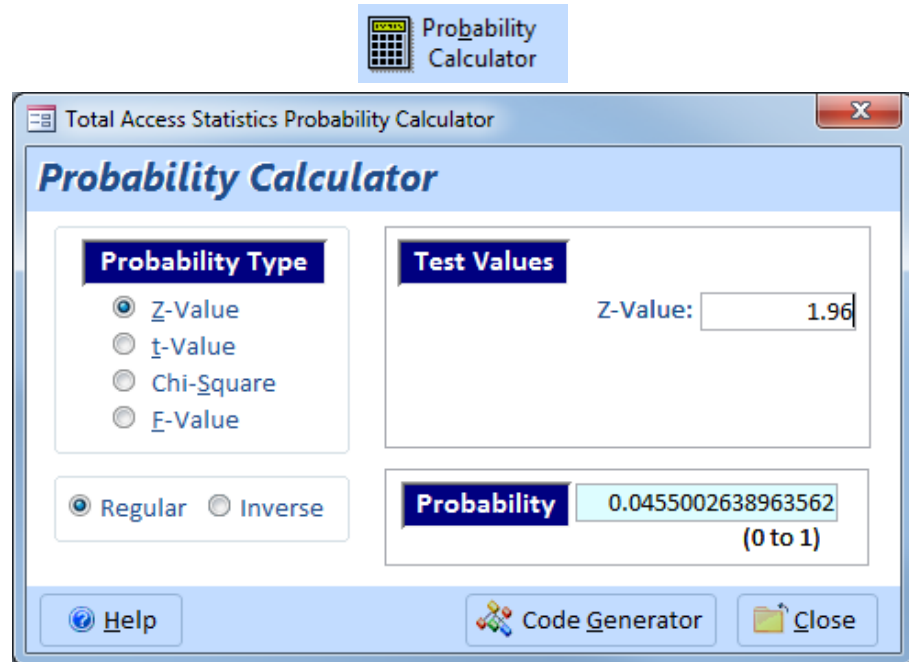
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## Topics in this Chapter

- **Calculator Options**
- **Z-Value**
- **t-Value**
- **Chi-Square**
- **F-Value**

## Calculator Options

From the main form, press the [Probability Calculator] button to display the Probability Calculator:



*Probability Calculator*

### Probability Type

The Probability Type options allow you to choose the type of probability to evaluate: Z-Value, t-Value (student's t test), Chi-Square, and F-Value. Depending on the option selected, you may need to enter zero, one, or two degrees of freedom in addition to the test value to evaluate.

### Calculation Type (Regular vs. Inverse)

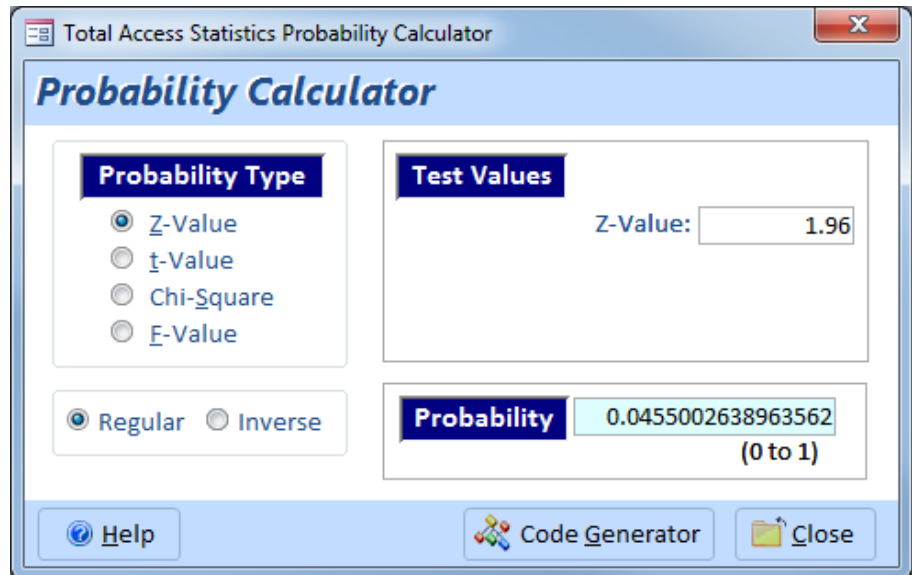
The Probability Calculator gives you the option to calculate the probability based on the test value (Regular calculation), or to calculate the test value based on the probability and degrees of freedom (Inverse calculation). Select the desired calculation type, and specify the values to calculate the probability.

### Code Generator

A VBA function is available for you to include the probability calculator in your applications. The Probability Calculator even generates the code for you—just specify your values, press the [Code Generator] button, and paste the code into your module. See **Probability Calculator Code Generator** on page 161 for details.

## Z-Value

The Z-Value is a number associated with the Standard Normal Distribution. Z is a measurement of a sample's deviation from the mean of a normally distributed population with known standard deviation. For example,  $Z = 1.96$  equals  $p = 5\%$  (0.05). As Z increases, probability decreases. The probability displayed is the two tailed probability. To calculate the one tailed probability, simply divide the probability by two.



The screenshot shows a software window titled "Total Access Statistics Probability Calculator". The window has a blue header with the title "Probability Calculator". Below the header, there are two main sections. The left section is titled "Probability Type" and contains four radio buttons: "Z-Value" (selected), "t-Value", "Chi-Square", and "F-Value". Below this section are two more radio buttons: "Regular" (selected) and "Inverse". The right section is titled "Test Values" and contains a label "Z-Value:" followed by a text input field containing the value "1.96". Below this section is a "Probability" label followed by a text input field containing the value "0.0455002638963562" and the text "(0 to 1)" below it. At the bottom of the window, there are three buttons: "Help", "Code Generator", and "Close".

*Probability Calculation for a Given Z-Value*

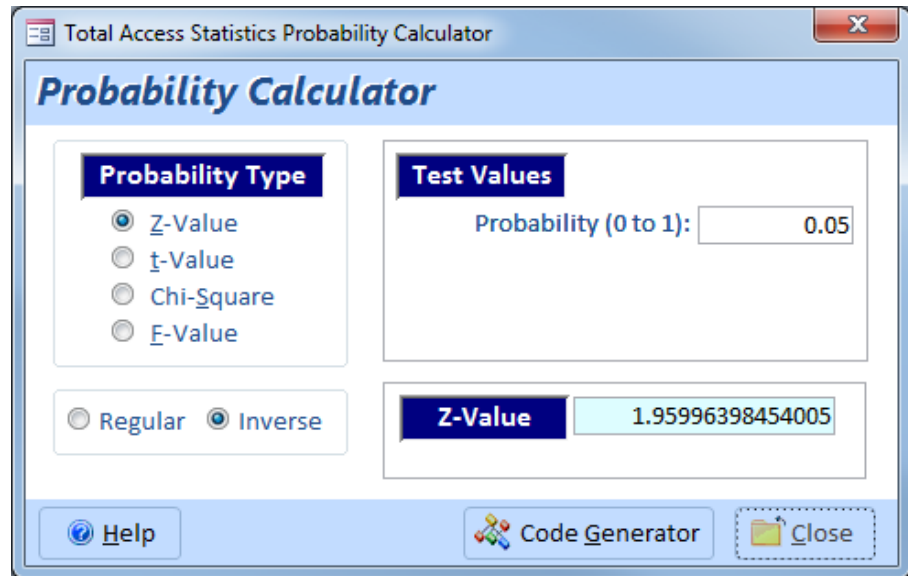


**Tip**

Some references use 1 minus this probability, so when  $Z=1.96$ , the probability is 95%. Make sure you understand the definition you are seeking and subtract the calculator's results from 1 if necessary.

### Inverse Z-Value Calculation

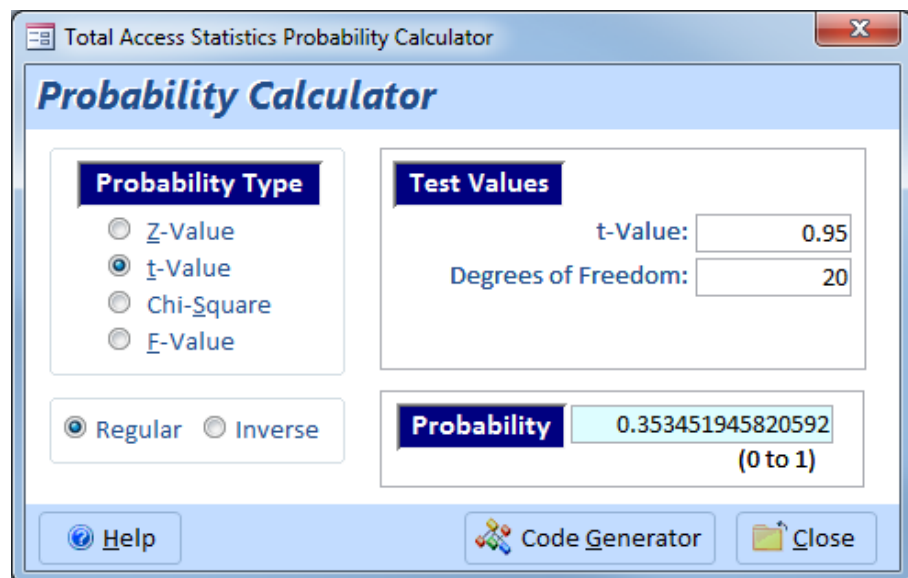
Press the [Inverse] button to calculate the t-Value for a given Probability and Degrees of Freedom:



*Z-Value Calculation for a Given Probability*

## t-Value

The t-Value is the Student's t-distribution. t-Values are used to analyze sample data from a population with unknown variance. The t-distribution is a function of the degrees of freedom ( $DF = \text{sample size} - 1$ ). You must enter both the t-value and the Degrees of Freedom. Probability decreases as the t-Value increases. The probability displayed is the two-tailed probability. To calculate the one-tailed probability, simply divide the probability by two.



*Probability Calculation for a Given t-Value and Degrees of Freedom*

## Inverse t-Value Calculation

Press the [Inverse] button to calculate the t-Value for a given Probability and Degrees of Freedom:

The screenshot shows a window titled "Total Access Statistics Probability Calculator" with a sub-header "Probability Calculator". On the left, under "Probability Type", the "t-Value" radio button is selected. Below it, the "Inverse" radio button is also selected. In the "Test Values" section, "Probability (0 to 1)" is set to 0.05 and "Degrees of Freedom" is set to 30. The "t-Value" field displays the result 2.04227245626163. At the bottom, there are buttons for "Help", "Code Generator", and "Close".

*t-Value Calculation for a Given Probability and Degrees of Freedom*

---

## Chi-Square

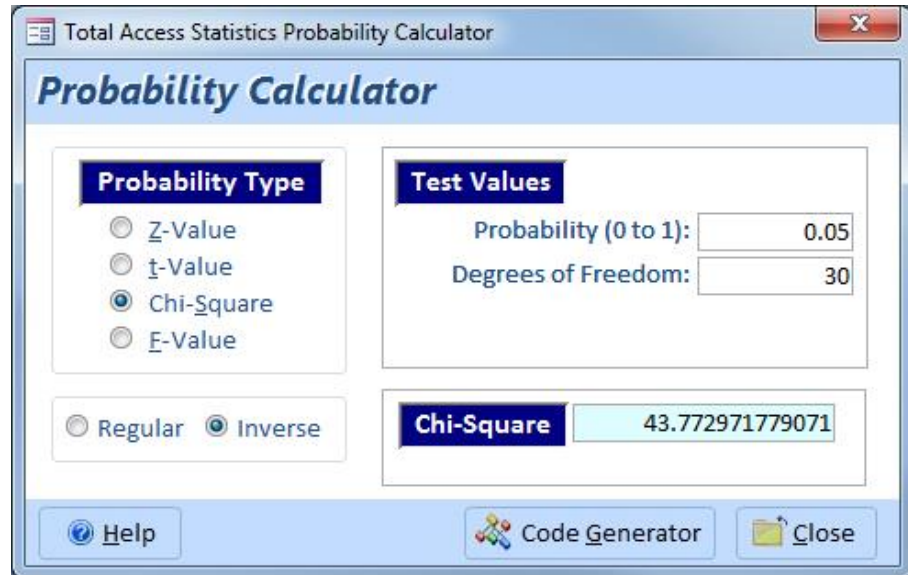
Chi-Square is a measurement of independence between variables. Provide the Chi-Square and Degrees of Freedom. Probability (independence) decreases as Chi-Square increases:

The screenshot shows the same "Total Access Statistics Probability Calculator" window. Under "Probability Type", the "Chi-Square" radio button is selected. Below it, the "Regular" radio button is selected. In the "Test Values" section, "Chi-Square" is set to 40 and "Degrees of Freedom" is set to 30. The "Probability" field displays the result 0.104864281533195, with "(0 to 1)" written below it. The "Code Generator" and "Close" buttons are visible at the bottom.

*Probability Calculation for a Given Chi-Square*

## Inverse Chi-Square Calculation

Press the [Inverse] button to calculate the Chi-Square for a given Probability and Degrees of Freedom:



The screenshot shows a window titled "Total Access Statistics Probability Calculator" with a sub-header "Probability Calculator". It features two main sections: "Probability Type" and "Test Values".

- Probability Type:** Includes radio buttons for Z-Value, t-Value, Chi-Square, and F-Value. The "Chi-Square" option is selected. Below this, there are radio buttons for "Regular" and "Inverse", with "Inverse" selected.
- Test Values:** Contains input fields for "Probability (0 to 1):" with the value "0.05" and "Degrees of Freedom:" with the value "30".
- Chi-Square:** A text box displays the result "43.772971779071".

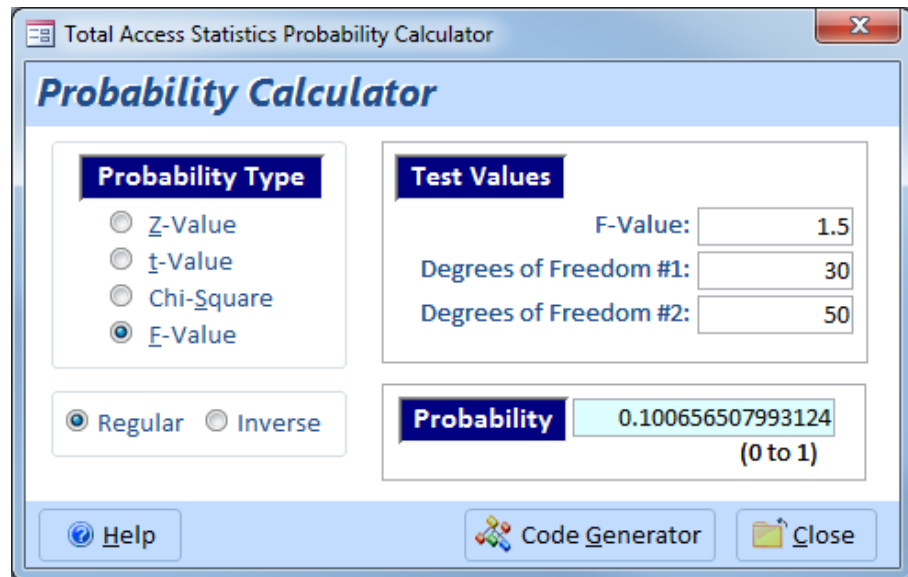
At the bottom, there are buttons for "Help", "Code Generator", and "Close".

*Chi-Square Calculation for a Given Probability and Degrees of Freedom*

---

## F-Value

The F-Value (Fisher's F Distribution) is the ratio (usually of variance) between two data sets. Provide the F-Value and two different degrees of freedom. The order of the two Degrees of Freedom is important. Probability decreases as F increases.



The screenshot shows a window titled "Total Access Statistics Probability Calculator" with a sub-header "Probability Calculator". It features two main sections: "Probability Type" and "Test Values".

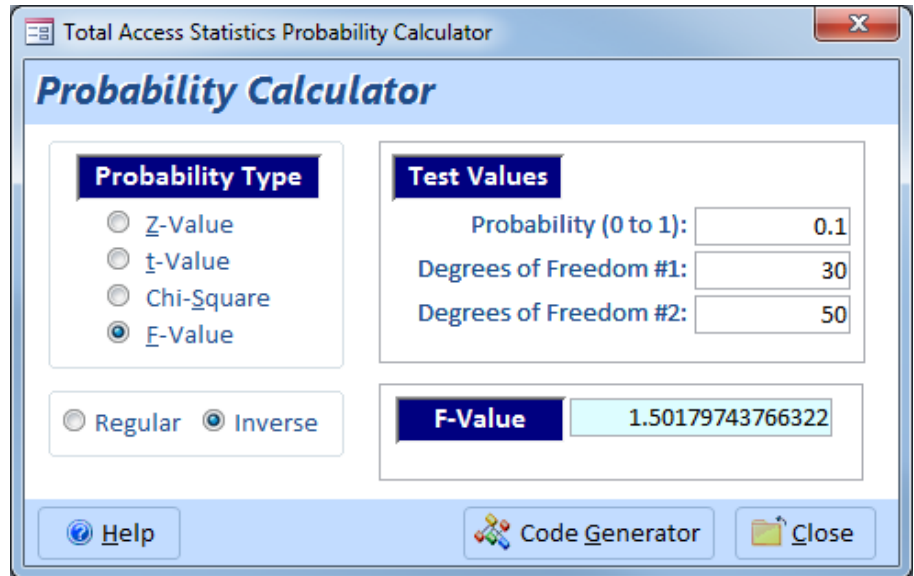
- Probability Type:** Includes radio buttons for Z-Value, t-Value, Chi-Square, and F-Value. The "F-Value" option is selected. Below this, there are radio buttons for "Regular" and "Inverse", with "Regular" selected.
- Test Values:** Contains input fields for "F-Value:" with the value "1.5", "Degrees of Freedom #1:" with the value "30", and "Degrees of Freedom #2:" with the value "50".
- Probability:** A text box displays the result "0.100656507993124 (0 to 1)".

At the bottom, there are buttons for "Help", "Code Generator", and "Close".

*Probability Calculation for a Given F-Value*

## Inverse F-Value Calculation

Press the [Inverse] button to calculate the F-Value for a given Probability and two Degrees of Freedom:



The screenshot shows a software window titled "Total Access Statistics Probability Calculator". The main heading is "Probability Calculator". It features several input sections:

- Probability Type:** Radio buttons for Z-Value, t-Value, Chi-Square, and F-Value. The F-Value option is selected.
- Test Values:** Input fields for Probability (0 to 1) set to 0.1, Degrees of Freedom #1 set to 30, and Degrees of Freedom #2 set to 50.
- Calculation Mode:** Radio buttons for Regular and Inverse. The Inverse option is selected.
- Result:** A box labeled "F-Value" displays the result 1.50179743766322.

At the bottom, there are buttons for "Help", "Code Generator", and "Close".

*F-Value Calculation for a Given Probability and Degrees of Freedom*





# Chapter 11: Advanced Topics

*This chapter provides information on advanced topics that are not necessary for using Total Access Statistics through the Wizard. If you are not interested in learning more about how Total Access Statistics works or how to use its programmatic interface, you can skip this chapter.*

---

## Topics in this Chapter

- **How Total Access Statistics Works**
- **Programmatic Interface**
- **Preparing Your Database**
- **Statistics Function**
- **Probability Function**
- **Inverse Probability Function**

---

## How Total Access Statistics Works

Total Access Statistics is written entirely in Microsoft Access using its native Visual Basic for Applications (VBA) programming language, and a combination of tables and forms.

### Tables

Total Access Statistics saves scenario settings in each database it analyzes. Scenarios are stored in four tables:

- **usysTStatScenarios**  
Contains one record for each scenario, and holds the basic scenario information (analysis type, data table name, output tables, options, description, etc.).
- **usysTStatOptions**  
Contains one record for each scenario and holds the analysis options selected.
- **usysTStatFields**  
Contains the list of selected fields for each scenario in a one-to-many relationship to the first table.
- **usysTStatParameters**  
For data sources that have parameters (some queries, stored procedures and user defined functions), the list of parameters and their values for each scenario in a one-to-many relationship to the first table. This table was added with the X.7 version.

These tables are usually hidden and do not appear in the database's list of tables. To see these tables, check the Show System Objects box. In Access 2007 or later, it's available by right clicking on the Navigation Pane and selecting Navigation Options. For Access 2003 and earlier, use the menu Tools | Options, then go to the View tab.

While you can edit these tables, we strongly recommend you not do this directly and only update them through the Wizard.

### Forms

The Total Access Statistics Wizard uses many forms in four steps. The first form displays the list of saved scenarios, the second form is the table and field selection form, the third form shows the analysis type options, and the fourth form is for the output table(s) and scenario description input.

## Analysis

How Total Access Statistics performs its analysis depends on the type of analysis selected. It generally uses a query to retrieve the selected fields and sort the records by the group fields. It processes the records and generates calculations for each group of records (unique combination of group field values). Some calculations allow processing all the X fields in one pass, while others require processing each field separately. Temporary tables (created in a temporarily linked database) may also be used. All calculations are performed with double precision (15 digits accuracy).

---

## Programmatic Interface

Total Access Statistics includes three functions to let you add its features directly inside your own database:

- A function to run any saved scenario
- A probability function as used in the probability calculator
- An inverse probability function as used in the probability calculator

This section describes the VBA interface to Total Access Statistics, and assumes you are familiar with using VBA and invoking functions. If you are not, please refer to your Microsoft Access manual and on-line help. You should be familiar with using Total Access Statistics interactively before using these features. You must interactively create the scenarios to run prior to using them programmatically.

## Licensing Rules

Licensing rules require that each user of Total Access Statistics own a Total Access Statistics license (user count). Total Access Statistics includes a runtime distribution license that lets you distribute your applications with our statistical features to non-Total Access Statistics owners. You are only allowed to distribute the runtime statistics file (TASTAT\_R.MDE or TASTAT\_R.ACCDE). You cannot include the interactive Statistics Wizard, and may not build an application that emulates the Wizard. See the License Agreement at the front of the manual for complete licensing details.

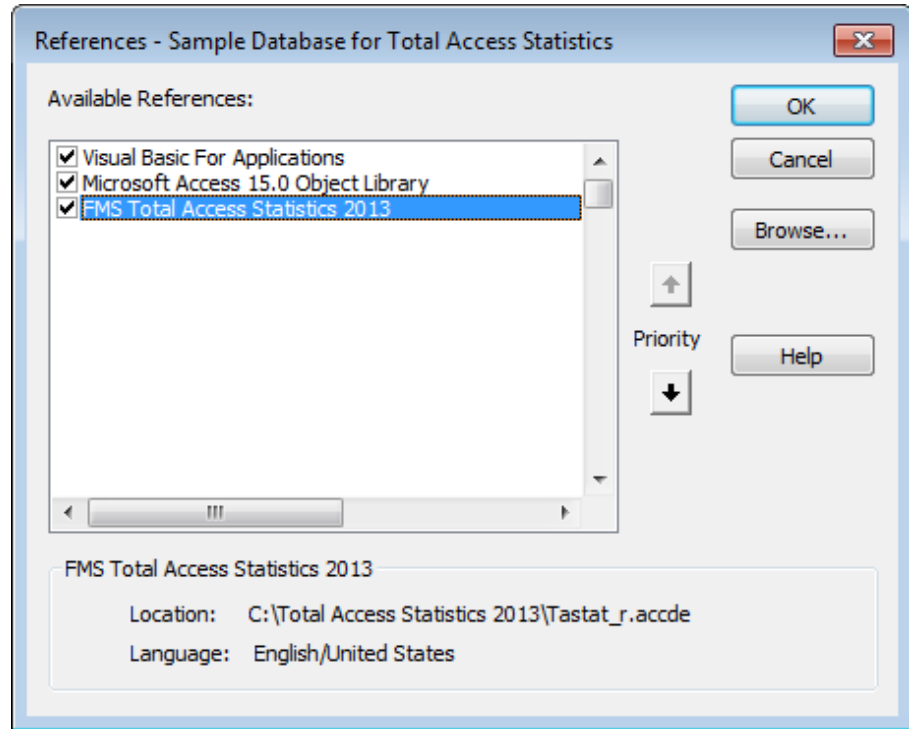
---

## Preparing Your Database

### Library Reference

To use a function in a library database, you need to create an explicit reference from your database to the library. Handle this by putting a

module in design mode, and invoking the VBA Editor's Tools, References menu:



*Access Library References Selection*

Make sure Total Access Statistics is selected. If it does not appear in the list, use the [Browse] button to locate the library file (TASTAT\_R.MDE or TASTAT\_R.ACCDE) in your installation directory.

The reference is an explicit path, which means if you change the drive or location of the library, the reference is broken and the function calls will not compile.

You can programmatically add library references with the AddFromFile command. This example adds a reference to the file name in the strFileName variable:

```
Dim ref As Reference
Set ref = References.AddFromFile(strFileName)
```

Please refer to the VBA help file for more information on reference commands.

## Runtime Library Files

### *Total Access Statistics 2010, 2013 and 2016*

Total Access Statistics 2010, 2013 and 2016 have three runtime library files:

- **TASTAT\_R.ACCDE for Access 2007, 2010 and 2013 (32-Bit)**  
Reference this runtime library if your users are running Access 2007 or Access 2010/2013/2016 (32-Bit). This library supports all database formats used by Access 2007, 2010, 2013, and 2016 including ACCDBs, MDBs, and ADPs. Access 2016 does not support ADPs.
- **TASTAT\_R\_64.ACCDE for Access 2010 and 2013 (64-Bit)**  
Reference this runtime library if your users are running the 64-Bit versions of Access 2010, 2013 or 2016. This library supports all database formats used by Access 2010, 2013 and 2016 including ACCDBs, MDBs, and ADPs. (ADPs are not supported in Access 2016).
- **TASTAT\_R.MDE for Access 2003 and later (32-Bit)**  
Reference this library for running your application with Access 2003 or later. This runtime library supports MDBs, MDEs, and ADPs in Access 2003 or later. It does not support databases in ACCDB or ACCDE format. This library is digitally signed to address the security issues in Access 2003.

#### ***Total Access Statistics 2007***

Total Access Statistics 2007 includes two runtime library files:

- **TASTAT\_R.ACCDE for Access 2007**  
Reference this library if all application users are running Access 2007. This library supports all database formats in Access 2007, including MDBs, ADPs, and ACCDBs.
- **TASTAT\_R.MDE for Access 2003 and 2007**  
Reference this library to support running your application in both Access 2003 and 2007. This runtime library supports MDBs, MDEs, and ADPs. It does not support databases in ACCDB or ACCDE format. This library is digitally signed to address the security issues in Access 2003.

#### ***Total Access Statistics 2003***

Total Access Statistics 2003 includes two runtime library files:

- **TASTAT\_R.MDE**  
If your users are running Access 2003, use the TASTAT\_R.MDE library.  
This library is digitally signed to address the security issues in Access 2003. This allows you to deploy the Total Access Statistics library with your databases to Access 2003 users without any security problems. The digitally signed file allows your program to run if your Access 2003 users have their security set to High, and avoids a warning message if their security is set to Medium.

- **TASTAT\_R2K.MDE**

If you are deploying your database to Access 2000 and 2002/XP users, they will be unable to use the digitally signed library. For these situations, reference the TASTAT\_R2K.MDE library, which does not include a digital signature. The drawback to this library is that Access 2003 users will encounter security issues.

### ***Total Access Statistics 2002 and Earlier***

Total Access Statistics 2002 and earlier include a single runtime library file:

**TASTAT\_R.mde**

### **Library Version Number**

If the library reference to Total Access Statistics is installed, a function is available to identify the library version in use:

```
Function TAS_RuntimeVersion() As String
```

Simply call this function in code or from the Immediate Window. This function returns a string with the version number like: "15.01.0002". The first number (15) is the major version number, the second part (01) is the minor version, and the last part (0002) is the build number.

---

## **Statistics Function**

Total Access Statistics includes a special VBA function (TAS\_Statistics) for your use in the runtime library. To add this to your code, follow these easy steps:

1. Make sure Total Access Statistics is properly installed and referenced by your database as a library database.
2. Create the scenario in the database with the data to analyze.
3. Determine the scenario number of the scenario desired.
4. Invoke the Total Access Statistics function.

The function is:

```

Function TAS_Statistics(
    ByVal lngScenarioNo As Long,
    ByVal strScenarioTbl As String,
    ByVal strFieldTbl As String,
    ByVal strOptionsTbl As String,
    ByVal fMessage As Boolean,
    Optional strDataSource As String = "",
    Optional strOutput1Tbl As String = "",
    Optional strOutput2Tbl As String = "",
    Optional strMessageTitle As String = "",
    Optional strParameterTbl As String = "")
As Boolean

```

When you execute this function, it returns a value of TRUE (-1) or FALSE (0) depending on whether the analysis was successfully completed (TRUE).

## Parameters

Parameter	Description
<b>lngScenarioNo</b>	The Scenario Number of the scenario to run. Each scenario has a unique ID. The scenario number is the ID column in the main Statistics Wizard form. You can also view the usysTStatScenarios table directly to find the scenario ID you want.
<b>strScenarioTbl</b>	The name of the table listing the scenarios. By default this is blank and uses the usysTStatScenarios table. However, you can create a copy to separate your scenarios from interactive users.
<b>strFieldTbl</b>	The name of the table with the field assignments. By default, this is blank and uses the usysTStatFields table.
<b>strOptionsTbl</b>	The name of the table with the scenario options. By default, this is blank and uses the usysTStatOptions table.
<b>fMessage</b>	TRUE for Total Access Statistics to display progress information during its analysis. A form appears showing the number of records processed. This is useful if your tables are large and you don't want your users to think nothing is happening during the analysis. FALSE lets you control the workspace and prevents Total Access Statistics from updating it.

### Optional Parameters

To add functionality and maintain compatibility with previous versions of Total Access Statistics, five optional parameters are available. If you are not familiar with optional parameters, reference your VBA help file on this topic. Basically, you don't need to use them unless you want to add their functionality.

These optional parameters allow you to override values in the selected scenario without having to modify the saved scenario's settings.

Optional Parameter	Description
<b>strDataSource</b>	Override the scenario's data source. The new data source must have the same field names as the saved data source or the scenario will fail.
<b>strOutput1Tbl</b>	Override the scenario's output table name.
<b>strOutput2Tbl</b>	Override the scenario's second output table name (if any).
<b>strMessageTitle</b>	Override the default title bar text for the fMessage progress form.  The default text is "Total Access Statistics." To override the default, pass any valid string, or use "[Scenario_Description]" to display the description of the scenario that is currently running.  Note that this property only applies if the fMessage parameter is set to True.
<b>strParameterTbl</b>	The name of the table with the parameters for queries, stored procedures or user defined functions. By default, this is blank and uses the usysTStatParameters table. This parameter is not with the other table parameters to preserve backward compatibility with procedure calls made with versions prior to X.7.

### Limitations

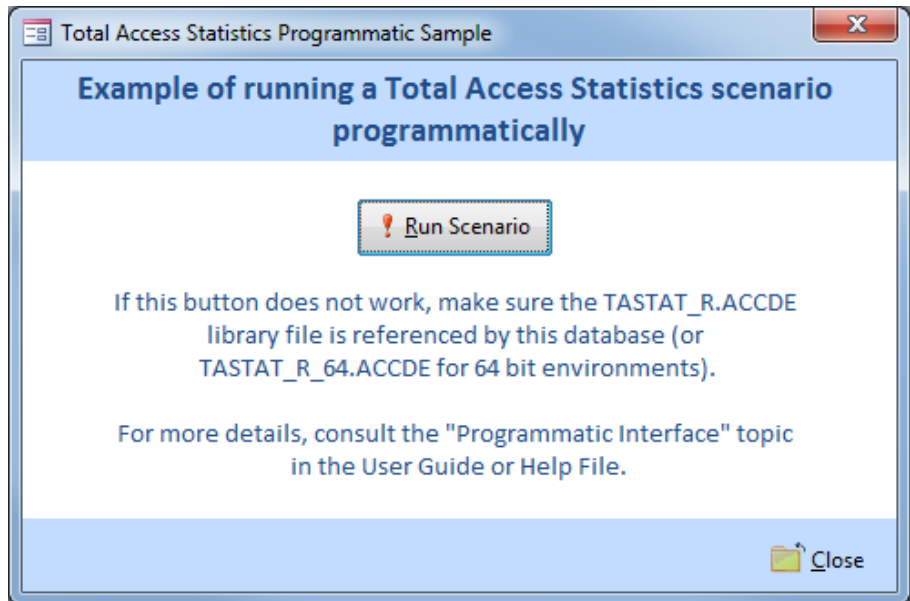
When you run scenarios outside the Statistics Wizard, there is significantly less error checking. The Total Access Statistics function assumes the scenario settings are correct and the data table is available. If not, the analysis fails.



- If the output table or tables already exist, this function overwrites them automatically without warning.
- All security rights (ability to read the data table and create output tables) are assumed to be available.

## Sample Form

The Total Access Statistics Sample form in the SAMPLE.MDB file provides an example of using the VBA function:



*Sample Form*

The code is located in the [Run Scenario] button's OnClick procedure, and the scenario runs when you press this button. You can easily copy and paste the code to your own form, and change the scenario number for the scenario you want.

```
Dim fOK as Boolean
Dim lngID as Long

lngID = 5           ' Scenario number to run

fOK = TAS_Statistics(lngID, "", "", "", True)
```

## Scenario Code Generator

A code generator is available to write this code for you. From the main Statistics Wizard form, highlight the scenario desired, and press the [Code Generator] button to display the Scenario Code Generator form:

**Scenario Code Generator**

Paste this code into your module to run this scenario programmatically.  
 Make sure the Total Access Statistics library file (TASTAT\_R.ACCDE) is referenced by this database.  
 For more details, consult the user manual chapter on Advanced Topics, Programmatic Interface.

```

Private Function RunScenario() As Boolean
' Comments: Run Total Access Statistics scenario: Example of Describe Scenario
' Created : 7/31

Dim fSuccess As Boolean

DoCmd.Hourglass True

fSuccess = TAS_Statistics(1, "", "", "", True)

DoCmd.Hourglass False

If fSuccess Then
MsgBox "Scenario successfully calculated", vbInformation
Else
MsgBox "Scenario failed", vbCritical
End If

RunScenario = fSuccess
End Function
  
```

SHOW:  Comments  Hourglass  Status Messages  Results Message

Scenario Tables:  Default  Explicit  Optional Parameters

[Help](#) [Send to Clipboard](#) [Close](#)

*Scenario Code Generator*

Press [Send to Clipboard], and paste the code into your module. Several options are available:

**Comments**

Adds comments in the code including the description of the selected scenario and the current date.

**Hourglass**

Turns the hourglass on during processing and off when it's done.

**Status Messages**

Displays a form showing the number of records processed while the analysis is running (sets the fMessage parameter).

**Results Message**

Displays a message box after the scenario is run to show whether it was successful or not.

**Scenario Tables**

The Default option passes "" for the table names storing the scenario details. The Explicit option displays the table names.

**Optional Parameters**

Inserts the optional parameters, making it easy to enter your own values to override them.

## Probability Function

In addition to running scenarios, Total Access Statistics also lets you incorporate the probability calculator into your applications:

```
TAS_Probability(
    ByVal strProbType As String,
    ByVal dblTestValue As Double,
    Optional ByVal dblDF1 As Double,
    Optional ByVal dblDF2 As Double)
As Double
```

## Parameters

Parameter	Description
<b>strProbType</b>	"Z", "T", "C" or "F" depending if you want to perform probabilities for Z-Value, t-Value, Chi-Square, or F-Value
<b>dblTestValue</b>	The test value to evaluate
<b>dblDF1</b>	The first degrees of freedom. Ignored for Z-Value, required for other Test Types
<b>dblDF2</b>	The second degrees of freedom. Only needed for F-Value. Otherwise, pass a zero or omit this parameter.

## Sample Code

This example calculates the probability of an F-value of 1.5 for 30 and 50 degrees of freedom:

```
Dim dblProb as Double
dblProb = TAS_Probability("F", 1.5, 30, 50)
```

## Probability Calculator Code Generator

A code generator is available to write this code for you. From the Probability Calculator, press the [Code Generator] button:

## Probability Calculator Code Generator

Paste this code into your module to run this scenario programmatically.  
Make sure the Total Access Statistics library file (TASTAT\_R.ACCDE) is referenced by this database.  
For more details, consult the user manual chapter: Advanced Topics, Programmatic Interface.

```
Function CalculateProbability() As Double
' Comments: Total Access Statistics Probability calculation
' Created : 7/31

Dim dblResult As Double

dblResult = TAS_Probability("F", 1.5, 30, 50)

MsgBox "The value is " & dblResult, vbInformation

CalculateProbability = dblResult
End Function
```

SHOW:  Comments  Results Message

### Probability Calculator Code Generator

Press [Send to Clipboard] button then paste it into your module. Several options are available:

#### Comments

Adds comments to the code with the current date.

#### Results Message

Displays a message box with the calculation results.

---

## Inverse Probability Function

Total Access Statistics lets you incorporate the inverse probability calculation (part of the Probability calculator) directly into your applications:

```
TAS_ProbInverse(
    ByVal strProbType As String,
    ByVal dblProb As Double,
    Optional ByVal dblDF1 As Double,
    Optional ByVal dblDF2 As Double)
As Double
```

### Parameters

Parameter	Description
<b>strProbType</b>	"Z", "T", "C" or "F" depending if you want to find Z-Value, t-Value, Chi-Square, or F-Value.
<b>dblProb</b>	The probability value to evaluate.

<b>dbIDF1</b>	The first degrees of freedom. Ignored for Z-Value, required for other Test Types.
<b>dbIDF2</b>	The second degrees of freedom. Only needed for F-Value. Otherwise, pass a zero or omit this parameter.

### Sample Code

This example finds the t-value with a probability of 0.05 (5%) for a distribution with 30 degrees of freedom:

```
Dim dblValue as Double  
dblValue = TAS_ProbInverse("T", 0.05, 30)
```

The Code Generator is also available for creating the code you need for the inverse probability function.



# Chapter 12: Product Support

*This chapter provides information on troubleshooting problems that arise and obtaining support for Total Access Statistics.*

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## Topics in this Chapter

- **Support Resources**
- **Web Site Support**
- **Technical Support Options**
- **Contacting Technical Support**

---

## Support Resources

There are many resources available to help you resolve issues you may encounter. Please check the following:

### Readme File

Check the README file for the latest product information. The README file is located in the directory where you installed the product.

### Product Documentation

We've spent a great deal of care and time to make sure the Total Access Statistics manual and help file are very detailed. Check the Table of Contents and Index for your question, and read the appropriate pages.

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## Web Site Support

The FMS web site contains extensive resources to help you use our products better. Resources include product updates, frequently asked questions (FAQs), forums, information on new versions, betas, and other resources.

### Home Page

The FMS home page is located at:

[www.fmsinc.com](http://www.fmsinc.com)

News and important announcements are posted here.

### Support Site

The main support page is located at:

<http://support.fmsinc.com>

From this page, you can quickly locate the other support resources.

### Product Updates

FMS takes product quality very seriously. When bugs are reported and we can fix them, we make the updates available on our web site. If you are encountering problems with our product, make sure you are using the latest version.

### Frequently Asked Questions (FAQs)

Common questions and additional information beyond what is in the manual is often available from our FAQs.



## Microsoft Patches

Our support site also includes links to Microsoft patches that are related to our products. Make sure you're using the latest versions by checking here or visiting the Microsoft site.

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## Technical Support Options

FMS is committed to providing professional support for all of our products. We offer free access to our online FAQs and forums. Bug reports, feature requests, suggestions, and general pre-sales questions related to our products are always available at no cost.

Additional maintenance plans are available to provide subscribers with enhanced technical support. This is the best way for you to stay current with the rapidly changing technologies that impact project development, and to ensure you are getting the maximum return from your software investment. Please visit our web site, [www.fmsinc.com](http://www.fmsinc.com), for the most up-to-date information.

Features & Benefits	Premium	Incident	Standard
Access to FAQs	✓	✓	✓
Access to Forums	✓	✓	✓
Minor Upgrades/ Bug Fixes	✓	✓	✓
Telephone Support	✓	Per incident	First 30 Days
Email Support	✓	Per incident	First 30 Days
Priority Response Time <sup>1</sup>	✓	✓	
Senior Engineer Support Team	✓	✓	
Email Project for Testing	✓	✓	
Programmatic Code Assistance <sup>2</sup>	✓	✓	
Major Upgrades for Current Version (not between Access versions)	✓	Additional fee	Additional fee

Cost	Annual Fee	Fee Per Incident	Included
<ol style="list-style-type: none"> <li>1. Response generally within two business days. Actual resolution may take longer depending on complexity of the issue reported.</li> <li>2. Custom Programming implementation is not provided in our Support Maintenance plans. For products that include a programmatic interface, we can provide instructions for using our programmatic interface, and show examples, but we do not implement this into your projects. This service is available from our Professional Solutions Group.</li> </ol>			

## Premium Subscription

The Premium Subscription is the ideal option for customers seeking the highest level of support from FMS. The annual fee entitles you to telephone and email technical support from a senior support engineer.

From time to time, FMS may release new versions of existing products which add new features. These are point releases (e.g. from version 15.0 to 15.1) and are different from new builds that correct problems in existing features (e.g. from version 15.00.0001 to 15.00.0004).

These point releases are available for a nominal upgrade fee to existing customers. Premium Technical Support subscribers receive these upgrades automatically and for no additional charge during their subscription term.

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**NOTE:** Upgrades between versions (for instance going from Access 2013 to Access 2016) are not considered Point Release Upgrades and are not included in the Premium Subscription.

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Subscriptions are available for a twelve month period, and may be purchased at any time. You must be the registered owner of the product to purchase a subscription and the only person contacting FMS for support under the subscription.

Please ensure you have purchased the Subscription you need for Total Access Statistics.

## Per Incident

Our Per Incident package is available individually or by purchasing multiple incidents in advance. The Per Incident support package provides telephone and email technical support from a Senior Technical Support Engineer for resolving one incident.

An incident is defined as a single question related to one of our products. The Per Incident period is from start to finish (report of the incident to resolution) for a single incident. If you anticipate multiple

questions for a single product, we recommend purchasing the Premium Subscription.

### **Standard Subscription**

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### **Microsoft Technical Support**

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# References

*The following reference sources will give you a better understanding of statistical analysis and additional information on the equations used in Total Access Statistics.*

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## Overview

Some people spend their whole life dedicated to learning the complex world of statistical analysis. Due to the complexity of statistics, this manual can only cover how Total Access Statistics works, and not the wide variety of situations and conditions for using particular tests. If you are not familiar with some statistical functions, we strongly urge you to explore other sources, including formal training if you are serious about the field.

Of course, there are thousands of books on statistics available at technical bookstores and college libraries. The following are a few books we know that may help you better understand Total Access Statistics and statistics in general. Some of these books were used during the development and testing of Total Access Statistics. The Basic books provide fundamental overviews of statistical definitions and concepts. The Advanced books provide information on the actual calculation of statistical functions.

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# Index

## 2

- 2 sample. *see* two sample
- 2 sample t-Test. *see* two sample t-Test
- 2 way ANOVA. *see* two way ANOVA

## 5

- 5<sup>th</sup> Percentiles, 51

## A

- accuracy, 26, 153
- Add-ins menu, 20
- analysis
  - options, 37
  - output. *see* output table
- analysis of variance. *see* ANOVA
- analysis types, 21
  - group. *see* group analysis
  - non-parametric. *see* non-parametric analysis
  - parametric. *see* parametric analysis
  - select, 29
- ANOVA, 22, 82, 83, 86–88
  - degrees of freedom, 88
  - detail table, 88
  - field selection, 86
  - F-Value, 88
  - options, 87
  - output table, 86
  - regression, 66, 69
  - two way. *see* two way ANOVA
- assign rank to field, 124
- attached tables, 4, 19
- autonumber field, 13
- average
  - running, 80
- average ties, 123

## B

- blank values. *see* nulls
- blog, 10

## C

- calculation accuracy, 26, 153
- check boxes, 38
- chi-square, 22, 43, 51, 53, 71, 92, 93–96, 147, 161, 162
  - degrees of freedom, 95
  - detail table, 94, 95
  - field selection, 93
  - options, 94
  - output table, 95
- code generator, 28
  - probability calculator, 161
  - scenario, 159
- coefficient analysis, 68
- coefficient of contingency, 76
- coefficient of variance, 46
- compare, 21, 60–63
  - correlation, 63
  - count, 62
  - covariance, 63
  - degrees of freedom, 63
  - field selection, 60
  - options, 61
  - output table, 62
  - Pearson's correlation, 63
  - r-square, 63
  - t-Value, 63
- comparison field, 33, 34, 86, 88, 93, 106
- confidence intervals, 48
- consecutive ties, 123
- copy scenario, 28
- Cramer's V, 76
- crosstab, 21, 34, 71–75
  - chi-square, 73, 75, 76

- coefficient of contingency, 76
- column field, 34, 72
- Cramer's V, 76
- cross tabulation type, 73
- degrees of freedom, 76
- field selection, 72
- options, 73
- output table, 74
- percentage options, 73
- Phi-Coefficient, 76
- row field, 34, 72
- show percentage value as option, 73
- value fields, 34, 72
- weight fields, 34, 72
- cumulative ties, 123

## D

- data normalization, 125–28
- data preparation, 23
- database preparation, 153
- deciles, 51
- deciles, 57
- delete scenario, 28
- demos, 9
- dependent field, 33, 34
- describe, 21, 41–53
  - 5<sup>th</sup> Percentiles, 51
  - band width, 49
  - boundary, 52
  - confidence intervals, 48
  - count, 45, 52
  - deciles, 51
  - display type, 52
  - field selection, 43
  - frequency, 51
  - geometric mean, 47
  - groupings, 52
  - harmonic mean, 47
  - intervals, 52
  - kurtosis, 48
  - median, 51

- normal distribution, 49
- octiles, 51
- options, 44
- output table, 45
- percentiles, 50
- population mean, 49
- quartiles, 51
- quintiles, 51
- root mean square (RMS), 47
- skewness, 47
- standard deviation, 49
- standard error
  - kurtosis, 48
  - skewness, 47
- t-Test, 49
- t-value, 50
- description, 39
- detail table
  - ANOVA, 88
  - chi-square, 94, 95
  - N fields, 113
  - N sample, 107
  - two way ANOVA, 90
- details, 28
- digital signatures, 155
- distribution, 12, 22, 153
- duplicate scenario, 28

## E

- edit scenario, 28
- enhancements, 4
- estimated Y, 66

## F

- field comparison. *see* compare
- field selection, 33–35
  - ANOVA, 86
  - chi-square, 93
  - compare, 60
  - crosstab, 72
  - describe, 43
  - frequency, 53
  - irregular cash flows, 137
  - K-S fit, 99
  - matrix, 63
  - N fields, 111
  - N sample, 106
  - normalize, 127

- paired fields, 108
- percentiles, 56
- periodic cash flows, 132
- random, 117
- ranking, 121
- regression, 65
- removing, 35
- reordering, 35
- running totals, 77
- sign test, 97
- two sample, 101
- two sample t-Test, 83
- two way ANOVA, 89
- financial analysis, 131–41
- Fisher's F distribution. *see* F-Value
- flag field in data source
  - random, 120
- FMS web site, 9
- frequency, 21, 51, 53–55, 96
  - field selection, 53
  - groupings, 54
  - include in each interval, 54
  - number of intervals, 54
  - options, 54
  - output table, 54
  - sum of values, 54
- Friedman's two way ANOVA. *see* N fields
- F-Value, 69, 88, 148, 161, 162

## G

- goodness of fit. *see* K-S fit
- group analysis, 22, 81–90
  - ANOVA. *see* ANOVA
  - two sample t-Test. *see* two sample t-Test
  - two way ANOVA. *see* two way ANOVA
- group field, 18, 33, 34, 43
- groupings, 52

## H

- H test. *see* N sample
- H test statistic, 107
- harmonic mean, 47
- highlights, 4

## I

- ignoring data, 36–37
  - null values, 36
  - random, 120
  - range of values, 36
  - ranking, 125
  - specific value, 36
  - updated records, 37
- independent field, 33, 34, 43
- installation, 11–15, 13
- inverse probability, 162
  - chi-square, 148
  - F-Value, 149
  - t-Value, 147
  - Z-Value, 145
- irregular cash flows
  - output table, 140
- irregular cash flows, 132, 137
  - field selection, 137
  - options, 138

## K

- Kolmogorov-Smirnov. *see* K-S fit
- Kruskal-Wallis One Way ANOVA. *see* N sample
- K-S fit, 23, 92, 99–101
  - field selection, 99
  - normal distribution, 99
  - options, 99
  - output table, 100
  - poisson distribution, 99
  - standard deviation, 100
  - uniform distribution, 99
- kurtosis, 48

## L

- library references, 153
- library version, 156
- license agreement, i
- licensing, 12, 153
- limitations, 158
- linked tables, 4, 19

## M

- matrix, 21, 63–65
  - calculation type, 65
  - field selection, 63



- options, 64
- output table, 64
- probability, 65
- mean, 97
  - difference, 62
  - population, 48, 49
- median, 51, 57, 96
- multicollinearity, 70
- multi-field ranking, 122
- multiple regression. *see* regression, multiple

## N

- N fields, 23, 93, 111–13
  - chi-square, 113
  - degrees of freedom, 113
  - detail output table, 113
  - field selection, 111
  - options, 112
  - output table, 112
- N sample, 23, 92, 106–8
  - chi-square, 107
  - detail table, 107
  - field selection, 106
  - options, 106
  - output table, 106
- new features, 4
- new scenario, 28, 29–33
- non-normalized data, 24–25
  - converting, 25
- non-parametric analysis, 22, 91–113
  - chi-square. *see* chi-square
  - K-S fit. *see* K-S fit
  - N fields. *see* N fields
  - N sample. *see* N sample
  - normalize. *see* normalize, *see* normalize
  - paired fields. *see* paired fields
  - ranking. *see* ranking, *see* ranking
  - sign test. *see* sign test
  - two sample. *see* two sample
- normal distribution, 49, 99
- normalize, 23, 116, 125–28
  - field selection, 127
  - options, 128
  - output table, 129
- normalized data, 24–25
- nth record, 118
- null, 18, 36, 94, 129
- number of records, 119

## O

- octiles, 51, 57
- option buttons, 38
- optional parameters, 158
- options, 37
  - ANOVA, 87
  - chi-square, 94
  - compare, 61
  - crosstab, 73
  - describe, 44
  - frequency, 54
  - irregular cash flows, 138
  - K-S fit, 99
  - matrix, 64
  - N fields, 112
  - N sample, 106
  - normalize, 128
  - paired fields, 109
  - percentiles, 56
  - periodic cash flows, 133
  - random, 117
  - ranking, 122
  - regression, 65
  - running totals, 79
  - sign test, 97
  - two sample, 102
  - two sample t-Test, 83
  - two way ANOVA, 89
- output table, 38
  - ANOVA, 86
  - changes, 13
  - chi-square, 95
  - compare, 62
  - crosstab, 74
  - describe, 45
  - frequency, 54
  - irregular cash flows, 140
  - K-S fit, 100
  - matrix, 64
  - N fields, 112
  - N sample, 106
  - name, 39
  - normalize, 129
  - overwrite, 39
  - paired fields, 109
  - percentiles, 58
  - periodic cash flows, 136
  - random, 119
  - ranking, 124
  - regression, 67
  - sign test, 98

- two sample, 102, 103, 104, 105
- two sample t-Test, 84
- two way ANOVA, 89

## P

- paired fields, 23, 93, 108–11
  - correlation coefficient, 111
  - field selection, 108
  - options, 109
  - output table, 109
  - paired sign test, 108, 110
  - sign Z, 110
  - Spearman probability, 111
  - Spearman's Rank Correlation Coefficient, 108, 110
  - T value, 111
  - Wilcoxon Signed Rank, 108, 110
  - Wilcoxon Z, 110
- paired sign test. *see* paired fields
- paired t-Test, 63
- parameters, 157
  - data sources, 32
  - optional, 158
- parametric analysis, 21, 41–76
  - compare. *see* compare
  - crosstab. *see* crosstab
  - describe. *see* describe
  - frequency. *see* frequency
  - matrix. *see* matrix
  - percentiles. *see* percentiles
  - regression. *see* regression
- Pearson's correlation, 63
- percent of records, 119
- percentiles, 21, 50, 55–60
  - assign to field, 58
  - correlation, 61
  - count difference, 61
  - create output table, 57
  - deciles, 57
  - field selection, 56
  - ignore, 37
  - mean difference, 61
  - median, 57
  - octiles, 57
  - options, 56
  - output table, 58
  - paired t-Test, 61
  - quartiles, 57
  - quintiles, 57
  - ties, 59
- periodic cash flows, 132

- periodic cash flows, 132
- periodic cash flows
  - field selection, 132
- periodic cash flows
  - options, 133
- periodic cash flows
  - output table, 136
- permissions, 19
- poisson distribution, 99
- polynomial regression. *see*
  - regression, polynomial
- pooled t-Test, 85
- population mean, 48, 49
- precision, 26, 153
- probability, 50, 90
- probability calculator, 29, 143–49
  - chi-square, 147
  - F-Value, 148
  - options, 144
  - t-Value, 146
  - Z-Value, 145
- probability function, 160
- programming, 153–63

## Q

- quartiles, 51
- quartiles, 57
- queries, 25
- query parameters, 32
- quintiles, 51
- quintiles, 57

## R

- radio buttons. *see* option buttons
- random, 23, 116
  - field selection, 117
  - ignore, 37
  - nth record, 118
  - number of records, 119
  - options, 117
  - output table, 119, 120
  - percent of records, 119
- random records, 116–21
- ranking, 23, 116, 121–25
  - average ties, 123
  - consecutive ties, 123
  - cumulative ties, 123
  - field selection, 121
  - ignore, 37

- options, 122
  - output table, 124
- output table, 124
- record analysis, 23, 115–41
- references, 153, 171–72
- registration, 9, 169
- regression, 21, 65–71
  - ANOVA, 66, 69
  - assign estimated Y, 66
  - beta value, 68
  - coefficient analysis, 68
  - coefficients, 68
  - degrees of freedom, 69
  - failures, 70
  - field selection, 65
  - F-Value, 69
  - insufficient data, 70
  - multicollinearity, 70
  - multiple, 66, 68
  - options, 65
  - output table, 67
  - polynomial, 66, 68
  - probability, 69
  - residual table, 66, 70
  - simple, 65, 68
  - standard error, 68
  - t-Value, 69
  - type, 65
  - Y-intercept, 66, 68
  - zero variance, 70
- regressions
  - ignore, 37
- removing fields, 35
- reordering fields, 35
- root mean square (RMS), 47
- run scenario, 28, 39
- running average, 80
- running sum, 80
- running totals
  - weight fields, 78
- running totals, 22, 77
  - field selection, 77
  - fields to update, 78
  - ignore, 37
  - sort field, 78
- running totals
  - options, 79
- running totals
  - field to analyze, 79
- running totals
  - number of records, 79
- running totals

- initial set of records, 79
- running totals
  - calculation type, 79
- running totals
  - results, 80
- runtime, 153
- runtime library version, 156

## S

- sample form, 19, 159
- save scenario, 39
- scenario, 18, 25
  - analysis type. *see* analysis types
  - copy, 28
  - delete, 28
  - description, 33, 39
  - details, 28
  - duplicate, 28
  - edit, 28
  - field selection, 33–35
  - new, 28, 29–33
  - output. *see* output table
  - run, 28, 39
  - save, 39
  - selection, 28–39
  - source object, 29
- security, 155
- sign test, 22, 92, 96–98
  - field selection, 97
  - options, 97
  - output table, 98
- simple regression. *see* regression, simple
- skewness, 47
- sort order, 122
- source object, 29
  - linked table, 18
  - query, 18, 29
  - table, 18, 29
- Spearman's Rank Correlation Coefficient. *see* paired fields
- standard deviation, 46, 49
  - difference, 62
- standard error, 46
  - kurtosis, 48
  - skewness, 47
- statistics function, 156
- Statistics Wizard, 20
- StatOutputID, 13
- stored procedures, 31
- sum, 46

- running, 80
- sum squared, 46
- support forums, 10
- system requirements, 12

## T

- TAS\_RuntimeVersion function, 156
- TAS\_Statistics function, 156
- TASTAT\_R.ACCDE, 153, 155, 156
- TASTAT\_R.MDE, 153, 155, 156
- TASTAT\_R\_64.MDE, 155
- technical papers, 10
- technical support
  - Microsoft, 170
- Total SQL Statistics, 13
- Total VB Statistics, 13
- t-Test, 49, *see* two sample t-Test
- t-Value, 50, 146, 161, 162
- two sample, 23, 92, 101–6
  - absolute difference, 105
  - field selection, 101
  - Kolmogorov-Smirnov, 102, 103, 105
  - Mann-Whitney U, 102, 103, 104
  - maximum difference, 105
  - options, 102
  - output table, 102, 103, 104, 105
  - Wald-Mean, 103
  - Wald-Standard Deviation, 103
  - Wald-Wolfowitz Runs, 101, 102–3
- two sample t-Test, 22, 82–86, 105
  - comparison field, 83

- degrees of freedom, 85
- detail table, 84, 85
- field selection, 83
- ignore blanks, 84
- options, 83
- output table, 84
- pooled, 85
- separate, 85
- standard deviation, 84, 86
- standard error, 84
- two way ANOVA, 22, 82, 88–90
  - compare field, 89
  - detail table, 90
  - field selection, 89
  - options, 89
  - output fields, 90
  - output table, 89

## U

- uniform distribution, 99
- uninstall, 14–15
- unpaired t-Test, 82
- update wizard, 14
- updates, 10
- upgrading, 12
- user count, 153
- user defined functions, 31
- usysTStatFields, 152, 157
- usysTStatOptions, 15, 152, 157
- usysTStatParameters, 158
- usysTStatParameters, 152
- usysTStatScenarios, 15, 152, 157

## V

- variance, 46
- version
  - runtime, 156
- version history, 4
- Visual Basic for Applications (VBA), 19, 152, 153–63

## W

- W field. *see* weight field
- Wald-Wolfowitz Runs. *see* two sample, Wald-Wolfowitz Runs
- web site, 9
- weight field, 18, 33, 34, 43, 72, 78
- weighting values. *see* weight field
- Wilcoxon Signed Rank. *see* paired fields

## X

- X field. *see* independent field

## Y

- Y field. *see* dependent field

## Z

- zero variance, 70
- Z-Value, 145, 161, 162