User's Guide for Star Tracker™

Overview

Star Tracker™ has been developed as a tool for answering real business questions in terms that businesses find most useful. While most database reporting and query tools can do an adequate job of formulating simple queries and reports, they often fall short in their ability to produce the meaningful and sophisticated business metrics and ratios that can be extracted from large, complex databases. The key features that make Star Tracker unique include the following:

- Explicit support for the *dimensional model* of a business through SQL
- Automatic *multiquery strategy* for assembling complex reports involving comparisons, multiple time grains, multiple product groupings, and multiple sale and geography groupings
- Creation of the optimum *minimal query set* for a multiquery report
- *Outer join* support for merging separate answer sets
- *Interfield browsing* within a dimension
- *Protected fields* in the browser to inhibit the inadvertent fetching of very long lists
- User-defined private and public *constraint groups*
- A library of *comparison functions* between constraint groups
- A library of *sequential functions* impossible to program in SQL, including rank, tertile, quartile, moving average, and moving sum
- Special extensions to the SQL aggregation operators for *period average sums and counts* that support average period balance and inventory calculations as well as comparisons of additive measures across dissimilar time intervals
- *Break rows* with correct handling of all simple and compound measures
- *User-defined calculations* among fact table columns that are *correctly additive* across all aggregations and break rows
- Red-Green highlighting of *exceptional values* in report columns using five criteria
- *Drill-down* capability that assigns a separate drill-down target to every report column
- Full column and selected cell *drill-down modes*
- *Drill-across* capability to query two or more fact tables in the same report
- Creation of *study groups* that are records of behavioral outcomes otherwise impractical to express in terms of attribute constraints, such as the Big Sellers in 1Q93
- Creation of *derivative study groups* via union, intersection, and set difference
- Full report and selected cell *report copying* through the clipboard to other applications
- Multifont *printing* with horizontal and vertical pagination
- *Saving and retrieving of reports* with long filenames
- Automated *debugging facilities* for reporting bugs to Star Tracker support

About the User's Guide

This *User's Guide for the Star Tracker* is intended for the end user who will be running reports from a desktop PC as well as for the business analyst who is responsible for formulating the ratios, metrics, and reports that provide information for running a business. A companion appendix, *Star Tracker System Administrator's Guide*, covers Star Tracker's installation, data dictionary, and database interfaces, as well as database schema considerations.

This *User's Guide* contains the following sections:

- *Star Tracker Basics* covers the actions necessary to run an already formulated report, including connecting to the database, selecting an existing report, running the report, and printing it.

- *Star Tracker Main Window* section describes the elements in the main report window, and explains their significance. It also covers the use of enhanced features such as drill downs and exceptions, which, if implemented in a report, can be used to refine data analysis.
- *Browsing and Defining Groups* tells you how to preview your database contents and how to use browsing to build constraint groups that greatly simplify reporting in very large databases.
- *Building a New Report* provides a step-by-step guide to producing a report using the demonstration Order/Account database available via the author's web page at http://www.rkimball.com.
- *Other Features* describes less-used Star Tracker features, such as SQL capture.

Star Tracker Basics

This section describes actions needed to start up Star Tracker, connect to a database, select and run a predefined report, and print out the report.

Starting up Star Tracker

To start up Star Tracker, double-click the STARTRAK.EXE file. You can also locate and double-click Star Tracker icon in a program group. Star Tracker only runs in Windows environments. It shows a picture of the Big Dipper.

Selecting a Database

After Star Tracker completes its opening sequence the Database Finder dialog box seen in Figure D.1 will appear.

This dialog is used to select the database that you want to use. Single-click a database name to select it. For example, click the database name *ACCESS: ORDERS.MDB: Orders*. In this example, ACCESS represents the name of the database server being used. The master database name is ORDERS.MDB. The System Administrator has selected tables that relate to orders, and given

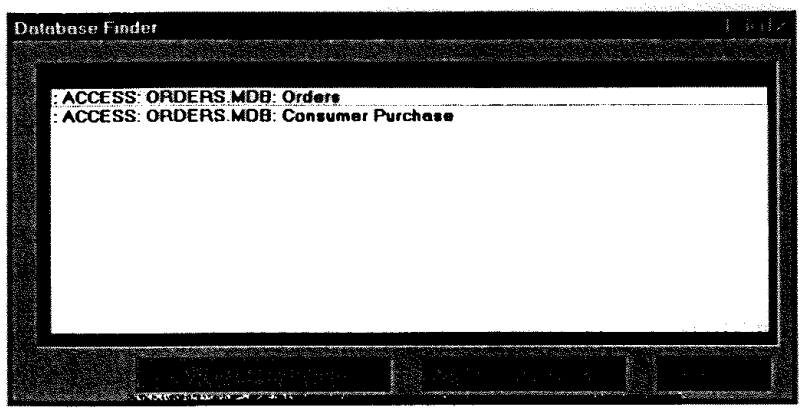


FIGURE D.1

Database Finder dialog.

it a working database name of "Orders." The System Administrator could have created other working databases in this master database, for example, "Consumer Purchase."

Once the database has been selected by clicking it you can choose to either run an existing, previously defined report, or define a new report from scratch. To run a previously defined existing report for this database, click the **Open Existing Report** button.

To create a new report from scratch, either double-click the report's name, or click the **Open Blank Report** button after selecting the database.

Logging onto the Database

If you are connecting to a remote database via an ODBC connection, you will be asked to log into the database after you first select a database. If you are connecting to an ACCESS database on your local PC, you will not see the login dialog.

When the login dialog appears, enter your password, and if requested, your database user ID. When you type into the password field you will not see the actual letters you type for security reasons.

After you have entered your user name and password, click the **OK** button.

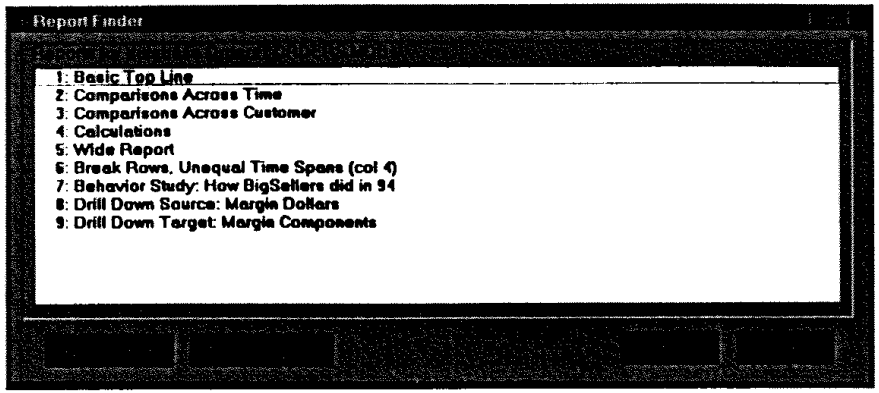


FIGURE D.2

Report Finder dialog.

Opening an Existing Report

When you ask Star Tracker to open a previously defined existing report you will see the dialog box shown in Figure D.2.

To open a particular report select the name of the report by clicking on it, then click the **OK** button. You may also open a report directly by double-clicking its name. If you are running the demonstration database, double click *1: Basic Top Line*.

Running the Report

After the report is selected, the application's main Star Tracker window will open. This window, described in the following section of this *User's Guide*, contains two main parts: The Report Definition section occupies the top half of the window. The spreadsheet in the bottom half of the window contains the report results. To run a report, click the **Run Report** button. This produces a report by accessing the database for current information. The speed of running any report is a function of the report's complexity and the intrinsic speed of your database server.

FIGURE D.3

Run Report button.

If you are running the demonstration database, click the **Run Report** button shown Figure D.3 to run the Basic Top Line report. This will take a few seconds to run, depending on the speed of your PC.

HINT: Press your PC's **Esc** *key to enlarge the report spreadsheet so it occupies the entire window. Press it again to toggle back to the original two-part depiction. If you scroll to a remote location on the spreadsheet, press CTRL-H to return Home, and CTRL-E to jump to the End of the report.*

Printing a Report

To make a hard copy of your report, select **Print** from the **File** menu on Star Tracker window's menu bar. For more information on printing, see the Other Features section.

Star Tracker Main Window

Most of the features and controls for Star Tracker are found in the main window, shown in Figure D.4. The main window is divided into two sections. The top half depicts the report definition while the bottom half contains the report results. We will begin by examining the report definition section of this window. Your screen may differ in some small details from the illustration because Star Tracker is constantly being upgraded.

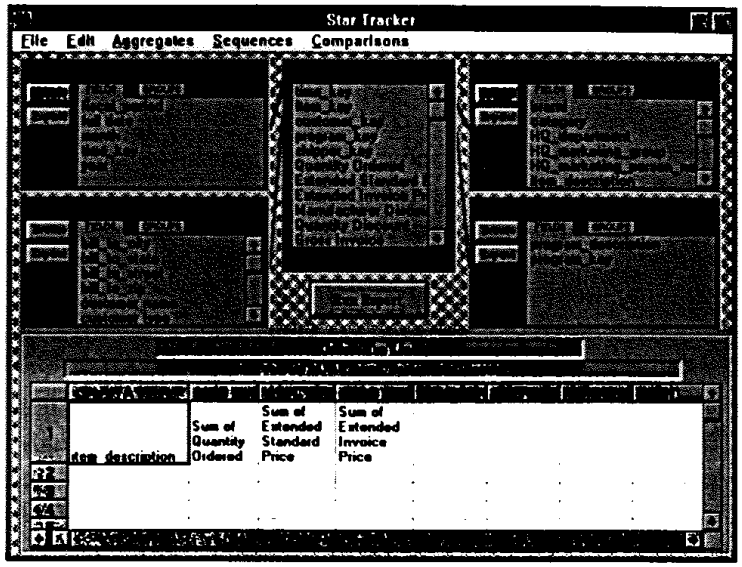


FIGURE D.4

Main window.

About Tables

The data in your database is stored in tables, which can be thought of as very large spreadsheets. In database tables, a column is often called a field, while a row is sometimes called a record. We will refer to a table's fields and records throughout this document. Each of the rectangles in the report definition area represents a table in your database.

In a Star Tracker report definition, the central table in a database is the fact table. In our example Basic Top Line report, the fact table is named Orders. The tables which surround the fact table on the left and right are called dimension tables. In our example these are labeled Time, Customer, Item, and Program.

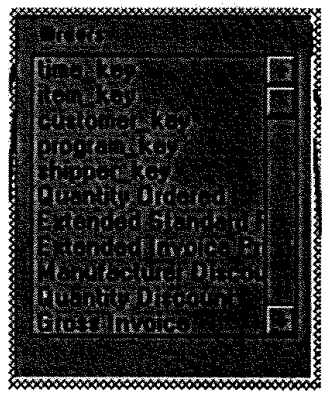


FIGURE D.5

Fact table depiction.

The Orders Fact Table

The first several fields in Figure D.5, such as time_key, item_key, customer_key, and program_key, are pointers to the dimension tables. Key fields may be of little interest because they contain pointer numbers that are not related to business measurements. The remainder of the fields in this fact table, such as Quantity Ordered and Extended Standard Price, are fact fields.

When you define a report you can add fact columns to the report result by dragging their names from the fact table down to the report spreadsheet column in which you want them to appear. Defining reports is covered in a later section of this *Guide*.

Additive and Nonadditive Facts

Facts that can meaningfully be summed are called additive facts. In our example, Quantity Ordered is an additive fact because it is meaningful if it summed over several time periods, several items, or several customers.

Because your system administrator has identified additive versus nonadditive facts in the Data Dictionary, Star Tracker will not let you inadvertently attempt to sum nonadditive facts.

Calculated Facts

Certain very useful measurements may not be in the fact table, but can be calculated on the basis of existing facts. Your fact table may contain such computed facts that have been defined by the system administrator. Calculated fact names are marked by an asterisk (*). In our example Orders table, Average Standard Price and Average Standard Cost are calculated facts. They are always composed of additive facts so that they will be valid regardless of the choice of groups.

Dimension Tables

Dimension Tables contain information that lets you access specific subsets of facts in your database. Dimensions are the keys to facts. For example, if your fact database contained invoice line-item detail it might have time, product, and customer dimensions. Each dimension, such as customer or item (see Figure D.6) has its own dimension table.

Our sample Orders database has dimensions of time, customer, item, and program.

In a database with many dimensions you may want to zoom in on a particular dimension table to see more of its field or group names at once. To do this, click the **Expand** button. This produces an enlarged view of the dimension table and of its associated fact table. To zoom back out again, click the **Reduce** button.

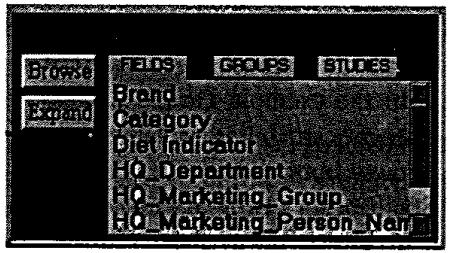


FIGURE D.6

Item dimension table showing fields.

Dimension Attributes

Each dimension may have a number of attribute fields that categorize the dimension in a number for different ways that can be used for identifying facts. For example, consider the following three dimensions with some of their possible attribute fields:

- Item—accessible by attribute fields like brand, category, and diet indicator
- Customer—accessible by attribute fields like customer name, and various bill-to and ship-to attributes
- Time—accessible by attribute fields like fiscal period, month, and year

In an item table there will be a record of each different item that our database tracks.

When you define a report you can add dimension attribute columns to the report by dragging their field names from a dimension table down to the report spreadsheet column in which you want them to appear. Defining reports is covered in a later section of this *Guide*.

To view a dimension's attribute fields, click the **FIELDS** tab in the dimension's depiction area. If you look at the attribute fields in our example database's Item dimension, you will find attributes such as item_key, item_description, category, brand, etc.

Simple Attribute Browsing

The Browse feature of Star Tracker allows you to see what different values of an attribute your database contains. Browsing has many more purposes, covered in the following section on Groups, but we will describe a simple use here.

In the example Orders database, suppose you want to view the various Category attributes available in the Item dimension. To do this, first click the Browse button in the Item dimension's depiction area. This switches you to Star Tracker's Browse window, shown in Figure D.7.

To browse the available Categories, double click on the word "Category". In a few moments a list appears (see Figure D.8), which shows each unique value of category that has been included in the database's Dimension table. From this list you can see that our sample database may contain information on five categories: Candy, Cleaning Supplies, Frozen Foods, Salty Snacks, and Soft Drinks. To browse the available brands, double click on that field.

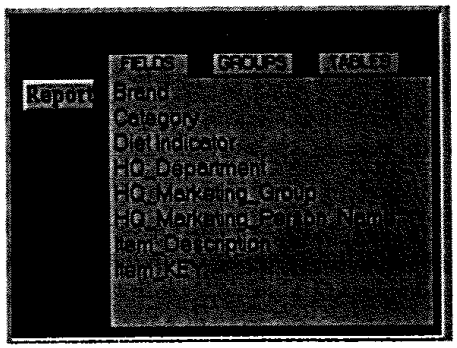


FIGURE D.7

Browse header control for Item dimension.

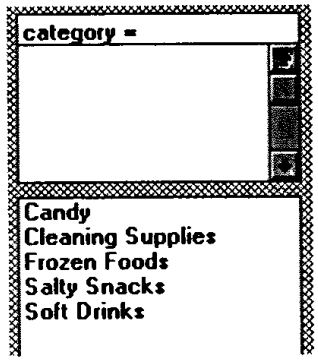


FIGURE D.8

Browse result list for Item: Category.

To return to Star Tracker's main window, select **Exit** from the Browser's **File** menu, or click the **Report** button in the Browser's depiction panel.

Groups

Dimension Groups are sets of one or more dimension attribute *values*, used to define a specific subset of facts you want to use in your report. For example, instead of a report column being Quantity Ordered, you could qualify the column to be Quantity Ordered of *Salty Snacks*.

Star Tracker provides an intuitive point-and-click browsing method for defining groups. This simple process gives you enormous power to tailor a report for specific business needs. In most cases, your System Administrator will already have defined many groups that you can use in your reports. You may add additional groups using the point-and-click browser.

To view the groups that have been already defined for a dimension, click the **GROUPS** tab in that dimension's depiction area. Our example database's Item dimension shown below includes groups like Candy, Cleaning Supplies, and Soft Drinks.

Base Groups

In order to run a Star Tracker report, each dimension must be constrained. The primary constraint used for a given dimension is called the base group, and the group name appears immediately after the dimension name in the dimension's depiction area. In the Item dimension example in Figure D.9, "all items" has been selected as the base group. This means that the report will show each item in the database.

Base groups set the range and default scale for the entire report. For example, if you select a time dimension base group of 1Q94, your report cannot contain dates that fall outside of the first quarter of 1994, and all comparison will use this time range as a basis. You can request, however, that within the base range, dates be broken down into a finer *scale* within a base range. The technique for doing this is described in the section Adding Dimension Columns. The example in Figure D.10, also selected from the Order Top Line example, shows the Time dimension, which has the group "February 94" selected as its base.

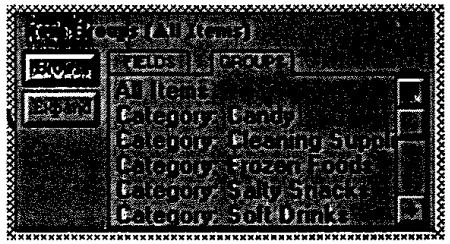


FIGURE D.9

Item dimension table showing groups.

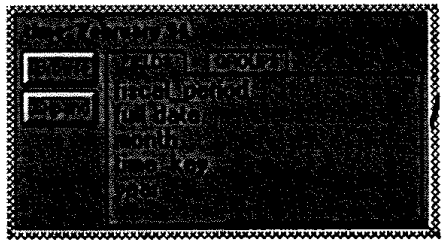


FIGURE D.10

Time dimension table with "February 94" as base group.

The use of group definitions allows you to correctly run a report even if the actual contents of a group varies over time.

Comparison Groups

Many business metrics involve percents, ratios, or differences that compare one set of measurements against another. Comparison groups can be used to form a variety of ratios, percentages, and other metrics as shown in the following examples:

Item Dimension

- Sales ratio of Candy vs. Salty Snacks
- Sales percent of Cleaning Supplies vs. Total Products

Customer Dimension

- Quantity shipped to Convenience Stores vs. Delicatessens

Time Dimension

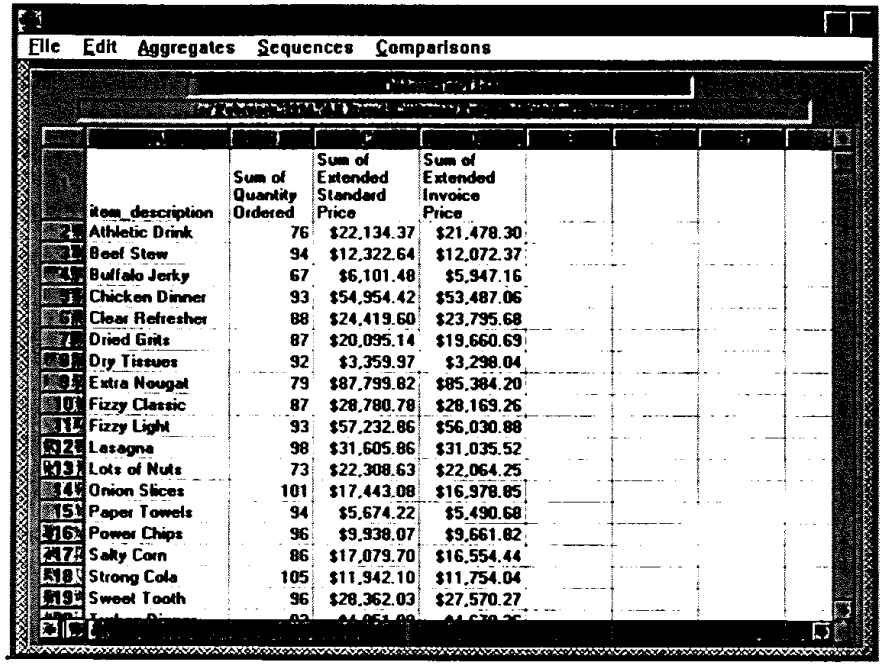
- April sales this year vs. last year
- YTD sales this year vs. YTD sales last year

Each of these examples requires a comparison, and the sets being compared are defined by dimension groups. The base group must constitute one of the pairs for each comparison. For example, if I was reporting on this month's sales then the base group of the report's time dimension would likely be something like "This Month," or "July 1994," depending on the group definitions available.

Report Results

The spreadsheet-like portion of Star Tracker main window shown in Figure D.11 contains the report results.

HINT: Press your PC's ***Esc*** *key to enlarge the Report Spreadsheet so it occupies the entire window as shown above. Press it again to toggle back to the original two-part depiction.*



	item_description	Sum of Quantity Ordered	Sum of Extended Standard Price	Sum of Extended Invoice Price
2	Athletic Drink	76	$22,134.37	$21,478.30
3	Beef Stew	94	$12,322.64	$12,072.37
4	Buffalo Jerky	67	$6,101.48	$5,947.16
5	Chicken Dinner	93	$54,954.42	$53,487.06
6	Clear Refresher	88	$24,419.60	$23,795.68
7	Dried Grits	87	$20,095.14	$19,660.69
8	Dry Tissues	92	$3,359.97	$3,298.04
9	Extra Nougat	79	$87,799.82	$85,384.20
10	Fizzy Classic	87	$28,780.78	$28,169.26
11	Fizzy Light	93	$57,232.86	$56,030.88
12	Lasagna	98	$31,605.86	$31,035.52
13	Lots of Nuts	73	$22,308.63	$22,064.25
14	Onion Slices	101	$17,443.08	$16,978.85
15	Paper Towels	94	$5,674.22	$5,490.68
16	Power Chips	96	$9,938.07	$9,661.82
17	Salty Corn	86	$17,079.70	$16,554.44
18	Strong Cola	105	$11,942.10	$11,754.04
19	Sweet Tooth	96	$28,362.03	$27,570.27

FIGURE D.11

Report results for Orders Top Line.

Row 1 of the Report Spreadsheet contains the report's column titles. Note: Because many of Star Tracker's intermediate calculations are done in this spreadsheet the spreadsheet can scroll backward to reveal cells prior to Row 1 or Column A. Similarly, you might find unlabeled columns of data somewhat to the right of the data you requested. These are also intermediate results. *Your* report data begins at cell location A1, and all of the meaningful data columns are labeled. Rows and columns used by Star Tracker for intermediate results won't show when you print your report or copy and paste it to another document or spreadsheet.

Formatting Reports

You can alter the format of report data just as in a spreadsheet. First highlight the column you want to format by clicking the column's header label (A, B, C, . . .). Then choose **Format Column** from the **File** menu. the Format Finder dialog will open as shown in Figure D.12.

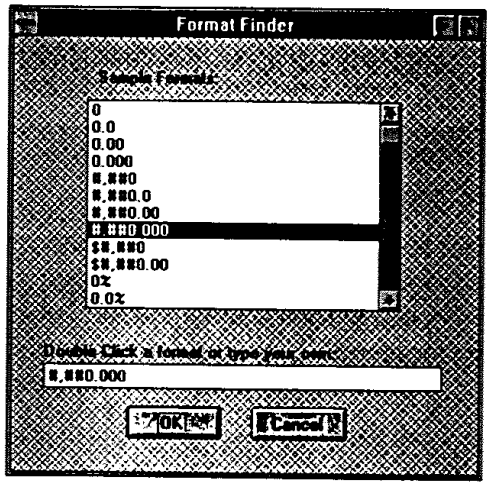


FIGURE D.12

Format Finder dialog.

You can choose one of formats from the Sample Format list by double-clicking to select it. Format characters have the following meanings:

- 0 Significant digit (will be shown as least or most significant digit even if zero).
- # Placeholder digit (blank if zero in least or most significant digit position).
- . Indicates position of the decimal point.
- , Will create comma at that position.
- $ Dollar sign will be placed before the number.
- % Percent sign will be placed after the number (value remains the same).

Date formats may also be altered using the standard spreadsheet m-d-y conventions. The Sample Format list contains several date formats that automatically convert to the m-d-y convention when they are double-clicked. Also in the Sample Format list are two integer date formats that can be useful for sorting date values.

Sorting Reports

You can sort reports by invoking the sort commands in the Edit menu. To initiate a sort, first highlight the column you want to sort by clicking its alphabetic header letter. Then activate the sort by choosing either **Sort Ascending** or **Sort Descending** commands from the **Edit** menu. You can sort just one column in the result spreadsheet. To undo the sort, select **Remove Sort.**

Hiding a Column

If a report contains a column you don't want to show in a printed version of the report you can hide it. First highlight the column by clicking its alphabetic header letter, then choose **Hide Column** from the **Edit** menu. The word "[hidden]" will be added to the column label. When you print the report, the column will be calculated but not shown. To unhide a column, highlight then choose **Hide Column** again to reverse the original hiding process.

Deleting a Column

If you want to permanently delete a column from a report, first highlight the column by clicking its alphabetic header letter then choose **Delete Column** from the **Edit** menu. Or, simply press the Delete key.

Editing a Column Heading

Star Tracker automatically assigns each report column a heading based on the calculation that was used to produce the heading, such as "Ratio of Sum of Quantity Ordered for 1Q94 vs. 1Q93." To make a report easier for others to read or understand you might want to change that to another title like "Unit Ratio This Year vs. Last." Changing a column heading doesn't alter the underlying results calculation.

First, highlight the column whose heading you want to change by clicking its alphabetic header letter. Then select **Edit Heading** from the **File** menu. The Column Header Editor dialog will open. Enter your new heading and click **OK**. If you want to use your new heading each time you run the report, be sure to save the report before closing it.

To restore the system-supplied heading completely delete your custom heading in the Column Header Editor dialog shown in Figure D.13.

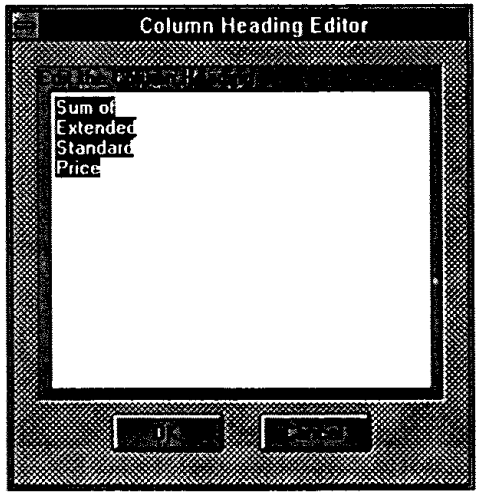


FIGURE D.13

Column Heading Editor dialog.

Exception Reporting

You may want to produce a report that emphasizes exception or out-of-bounds conditions. Star Tracker provides a powerful tool for identifying and reporting exceptions, for example:

- Show only the top 10 salespeople
- Show only the bottom 20 customers
- Highlight the products which have more than 25 percent market share
- Highlight the customers which have had a negative sales growth

To activate exception reporting for a column, first highlight the column by clicking its alphabetic header letter. Then select **Define Exceptions** from the **Edit** menu. This opens the Exception Conditions dialog shown in Figure D.14.

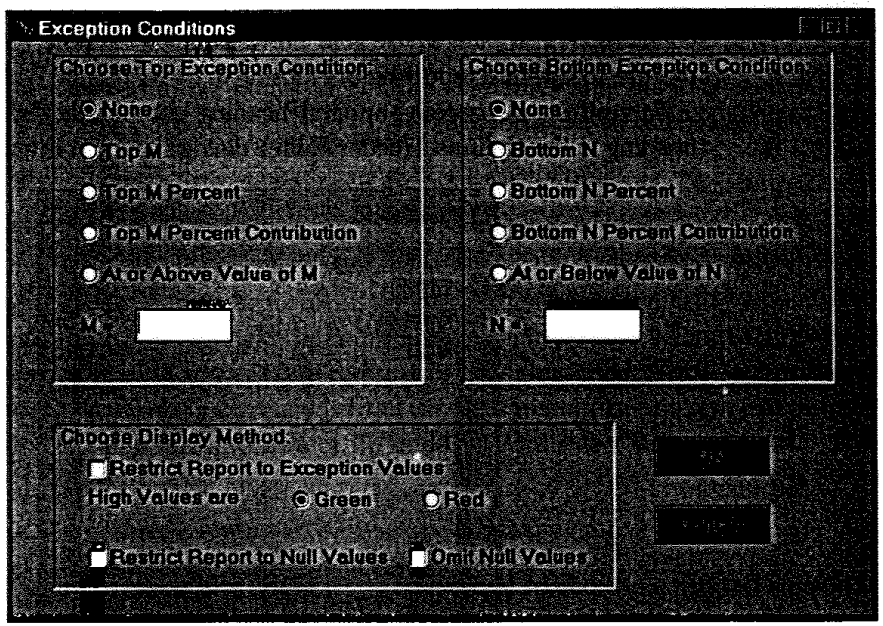


FIGURE D.14

Exception Conditions dialog.

You can set exception conditions for upper bounds, lower bounds, or both using the Choose Top and Choose Bottom panels in the dialog. The letter M represents the upper bound breakpoint and the letter N represents the lower bound breakpoint.

The following selection options are available:

- Top M: The top (or bottom) M values will be selected.
- Top M percent: The top (or bottom) M percent of values will be selected.
- Top M percent contribution: The top (or bottom) M percent total column sum will be selected.
- At or above/below: Values above (or below) M will be selected.

Items that are selected can be highlighted in two ways: First, the report can be restricted to show *only* the rows that contain exceptions. Second, the exceptions can be highlighted in color.

To restrict the report to only the exception rows, check **Restrict Report to Exception Values** box. To restrict the report to only null values, check **Restrict Report to Null Values.** To omit the rows with null values check **Omit Null Values.**

To color-highlight exception values, click either the **green** or **red** checkbox. If red is selected for high values then green will be used for low, and vice versa.

Drilling Down in a Report

Sometimes while reading a report you might want to examine the source of a number or ratio in greater detail. This process, sometimes called "drill down," is supported by Star Tracker through its drill-down feature. In order to drill down, you or the report designer needs to have previously created a drill-down target report for a particular column in your first report. To define a drill-down target, select a column in your report and invoke the Define Drill Down command in the Edit menu. You will be presented with the standard report finder window. When you double click on one of the reports, that report will become the drill-down target for the original column. Using this approach, you can define separate drill-down targets for each column in a report.

Run the Item Top Line Report to produce the result shown in the Report Results section. Suppose in this report, you want to discover which customers are ordering a particular product. We have predefined a drill-down report for the example named Item Margin Drill Down. When you select in the Sum of Margin Dollars column, you can invoke the Drill Down command in the File menu. The Item Top Line Report will be replaced by the Item Margin Drill Down report.

The Item Margin Drill Down report will inherit all of the constraints of the previous report. In addition, it will further restrict itself to the exceptional values specified in the selected column of the first report.

The exceptional values are determined by how you made your selection in the Sum of Margin Dollars column in the first report. If you selected the column header cell (i.e., the whole column) then the second report will be restricted to all the green and red cells found in that column. If instead you selected one or more individual cells in that column, the second report will be restricted to all the selected cells, regardless of their green and red highlighting.

After running the second report, you may remove the restriction to the specific rows described in the previous paragraph by invoking the Remove Drill Down Constraints command in the Edit menu. Now the second report will be constrained only by the inherited groups of the first report. These inherited groups, of course, may be changed at any time simply by double clicking on a group name or dragging a group name to a comparison column in the usual way.

The Item Margin Drill Down report may itself have defined drill-down targets in any of its columns. In this way, a drill-down path may be followed to an arbitrary depth. (See Figure D.15.)

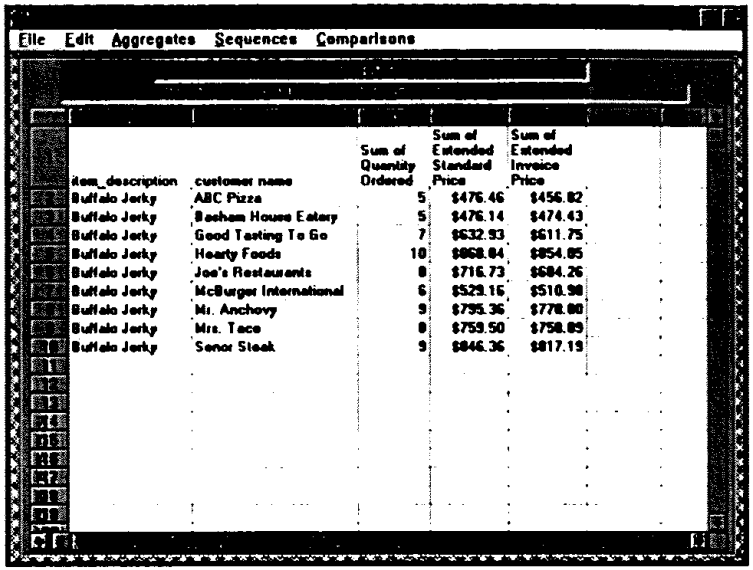


FIGURE D.15

Drill-Down example.

Drilling Across in a Report

Star Tracker allows reports to be built that rely on multiple fact tables. After building a report in the usual way, you may invoke the Drill Across command in the File menu. You are then allowed to pick any other database that Star Tracker can access. Only those databases that share dimensions can be usefully linked with the Drill Across command, however.

After invoking the Drill Across command and selecting the next database, you will able to add columns from the new database to the existing report. You may continue the process of drilling across to as many databases as you wish, subject to the restrictions discussed below. Drilling across is ideal for assembling reports that examine an entire value chain of fact tables, such as inventory, orders, shipments, and customer take away.

Two restrictions apply to Drill Across. First, if you insert a row header (a dimension attribute) from a dimension that is not shared by all of the fact tables in the report, Star Tracker will notify you that you must remove the incompatible row header. There is no logical way to interpret such a row header in the context of those fact tables that do not have the dimension. Second, if you constrain a dimension that is not shared by all the fact tables in the report (but do not use any attributes from that dimension as row headers), then Star Tracker will run the report, but will advise you at report runtime that you have a constraint on a "hidden" dimension. In this case you may want to apply a special edit to the column names drawn from those fact tables with the constrained hidden dimension to alert the reader of the report that the values in that column have a nonobvious constraint on them.

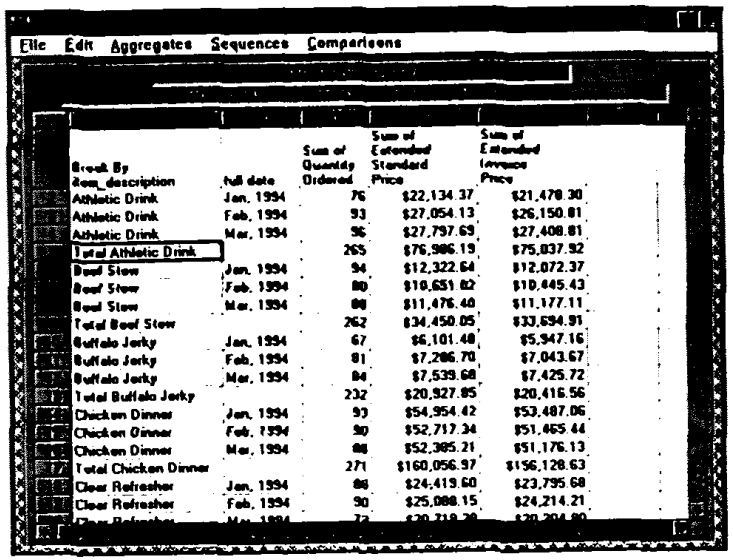
Inserting Break Rows

Star Tracker's Break Row feature allows you to insert subtotal rows into your report. To set a break row you must specify the column on which the break totals are to be triggered. Then each time the value in this column changes, the previous rows are summed and a summary total row is inserted into the report.

To see how break rows work, open and run the Monthly Order Top Line report. This is similar to the Orders Top Line used in previous examples, but includes totals for each month for 1Q94.

After the report has been run, select the first column (Item Description) by clicking the **A** button on the spreadsheet. Then select **Set Break Rows** in Star Tracker's **File** menu. A dialog box will open in which you can set the caption for the subtotal rows. The default caption, "Total•" is used in the example. In the dialog, the asterisk (•) character is used to represent the break value text. Thus, for the first subtotal caption in the report, "Total•" becomes "Total Athletic Drink."

The illustration in Figure D.16 shows the Monthly Orders Top Line report with added subtotals. A subtotal row has been added for each product.



Break By Item_description	Null date	Sum of Quantity Ordered	Sum of Extended Standard Price	Sum of Extended Invoice Price
Athletic Drink	Jan, 1994	76	$22,134.37	$21,478.30
Athletic Drink	Feb, 1994	93	$27,054.13	$26,150.81
Athletic Drink	Mar, 1994	96	$27,797.69	$27,408.81
Total Athletic Drink		265	$76,986.19	$75,037.92
Beef Stew	Jan, 1994	94	$12,322.64	$12,072.37
Beef Stew	Feb, 1994	80	$10,651.82	$10,445.43
Beef Stew	Mar, 1994	88	$11,476.40	$11,177.11
Total Beef Stew		262	$34,450.85	$33,694.91
Buffalo Jerky	Jan, 1994	67	$6,101.48	$5,947.16
Buffalo Jerky	Feb, 1994	81	$7,286.70	$7,043.67
Buffalo Jerky	Mar, 1994	84	$7,539.68	$7,425.72
Total Buffalo Jerky		232	$20,927.85	$20,416.56
Chicken Dinner	Jan, 1994	93	$54,954.42	$53,487.06
Chicken Dinner	Feb, 1994	90	$52,717.34	$51,465.44
Chicken Dinner	Mar, 1994	88	$52,385.21	$51,176.13
Total Chicken Dinner		271	$160,056.97	$156,128.63
Clear Refresher	Jan, 1994	86	$24,419.60	$23,795.68
Clear Refresher	Feb, 1994	90	$25,088.15	$24,214.21

FIGURE D.16

Report with break rows.

Using Studies in a Report

Star Tracker allows you to define a constraint on a dimension that is a "behavioral outcome" defined from a previous report, rather than a constraint based on attribute vales in that dimension. For example, suppose that you ran a report identifying the products that were Big Sellers in 1Q93. You can define these Big Sellers to be a "study" and then use that study in any subsequent report, such as a follow up report that tracked these Big Sellers during 1994. This facility is especially useful for large dimensions such as Product or Customer where the ability to enumerate individual items in a Star Tracker group definition is awkward.

A study may be defined in three different ways. Physically, a study is a separate table in the database consisting of a single column containing the distinct values of the dimension key that define the contents of the particular study. The first and most powerful way to define a study is to prepare a report (such as Big Sellers in 1Q93), and to include the key attribute from the dimension on which you want to define the study. For the products included in the Big Sellers you would drag the product key (actually the item key in the sample database) into the report and run the report. You then select the product key column and invoke the Create Study from Report command in the Edit menu. You will be prompted for a table name and a description. The file name must be a legitimate SQL table name (i.e., no blanks or punctuation) and the description can be any text string that fits in the blank provided on the screen.

The second way to define a study is to enter the browser facility as if you were going to define a regular Star Tracker constraint group. After specifying the group constraints in the usual way, instead of making a group, you invoke the Create Study command from the Group menu. You will prompted for the table name and the description as described in the previous paragraph. In and of itself, this second study mechanism does not provide any advantages over defining a regular group, but in combination with the third way to define studies, described in the next paragraph, this way of defining studies can be quite useful.

The third way to define a study is to combine two or more previous studies using Union, Intersection, or Set Difference. To access these set operations, click on the STUDIES tab in the desired dimension and then click on the EXPAND command. Below the list of studies are two blank fields and various command buttons. To create a new study based on the intersection of two previous studies, drag the desired study names from the study list into the two boxes and select the Intersection command. When these operations have been done, click on the Create Study command. The familiar dialog box will appear, asking for the table name and description of the new study.

To delete a study, drag its name from the study list into the first blank box and click on the Delete Study command.

To use a study in a report, set the report up in the usual way. Click on the STUDIES tab in the desired dimension and double click the desired study. The report description just above the spreadsheet area will append "in STUDYNAME" to the description of the constraints on the affected dimension where STUDYNAME is the name of your selected study. The constraint implied by the use of the study will be AND'ed into the constraints on that dimension. Thus, you may use either the default constraint group (such as All Items) or a specific constraint group (such as Category: Candy) in addition to using a study. The result will be the logical AND (i.e., intersection) of these two kinds of constraints.

To remove the use of a study from a report, make a selection within the ap-

propriate dimension table, and then invoke the Remove Study from Report command in the Edit menu. You must select within the desired dimension table first so that Star Tracker can figure out which study you are trying to remove from the report. Note that removing the use of a study from a report is not the same thing as permanently deleting a study from the system. Deleting a study is described in a previous paragraph.

Browsing and Defining Groups

Star Tracker requires that a base group be selected for every dimension before a report can be run. Groups can be created at any time using the Browser. This section describes how to use the Browser to examine your database contents and to define groups.

Opening the Browser

To open the browser, click the **Browse** button in the depiction panel of the dimension you want to browse.

Example: Use the Database Finder and Report Finder to return to the "Order Top Line" report in the "ORDERS.MDB: Orders" database (see Star Tracker Basics section). Then click the **Browse** button in the Customer dimension depiction area. The browser will open to the depiction of the Customer dimension table. See Figure D.17.

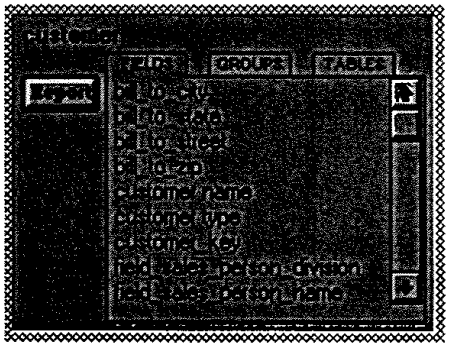


FIGURE D.17

Browser—Customer table in Fields mode.

Viewing Existing Groups

To view the names of groups already defined for the customer dimension, click the **GROUPS** tab at the top of the panel. Note that a number groups are already defined, as shown in Figure D.18. Return to the field list by clicking the **FIELDS** tab at the top of the panel.

Viewing a Group Definition

To view the definition of an existing group, double-click the group name in the group display. As an example, you may view the definition of the group "Customer Type: Deli" by double-clicking its name in Figure D.18.

Defining New Groups

New groups are defined by browsing the field or fields you want to use to create the group. This method allows you to preview the contents of the group while you are defining it.

Browsing a Single Field

To browse a single field, double-click the desired field name in the table's field list. This opens a frame with three parts:

- At the top of the frame there is a label field that, in the example below, says "bill_to_city =". This is a *constraint label*.

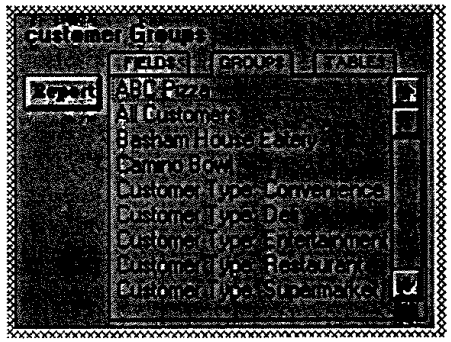


FIGURE D.18

Browser—Customer table in Groups mode.

- Immediately below the constraint label is a field that contains any *constraint tokens* that you might select.
- The bottom field of the frame lists *browse tokens*: unique values found while browsing this field. By *unique*, we mean that even if there were multiple records with the same value, the token would occur only once in the table. When a token is selected, it selects all records containing this value.

Example: Double-clicking the "bill_to_city" field name in the customer table browser window above produces the browse frame shown above. In Figure D.19, there are just two tokens: "Los Angeles" and "San Francisco". There are no constraints in the example shown.

Browsing Multiple Fields

To add an additional browse frame, simply click on another field name in the table's field list. This places an additional browse frame to the right of the existing one(s).

Example: Double-click the "customer_name" field name at the top of the browse windows to add a second browse frame for this field, as shown in Figure D.20.

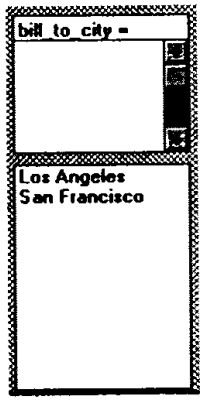


FIGURE D.19

Browser—bill_to_city frame, unconstrained.

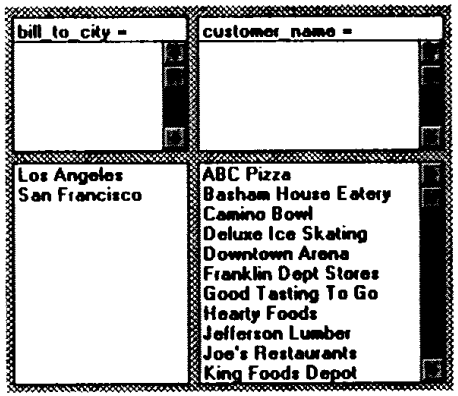


FIGURE D.20

Browser_bill_to_city and customer_name frames, unconstrained.

Adding a Simple Constraint

When you define a group you usually want to limit it to encompassing just a subset of all possible dimension values. For example, you might want to create a product group constrained to just your own products, or a time group constrained to 3rd Quarter 1995. You define the subsets you want by constraining one or more fields to just the token values you want. The simplest way to do this is to double-click a token value. This selects the value and places it in the top part of the browser frame where it becomes part of the group's constraints.

Example: In the Figure D.20 depiction, which shows two browse frames, double-click "Los Angeles" in the bill-to-city frame. This enters the token "Los Angeles" into constraint portion of the frame, resulting in a constraint that reads "bill_to_city = 'Los Angeles' ". (The single quotes around the 'Los Angeles' token are needed for proper formation of the database query). Because you double-clicked, the action also initiated a refresh of the entire browse. See Figure D.21. Single-clicking the token would have added it to the constraint list but not initiated the refresh.

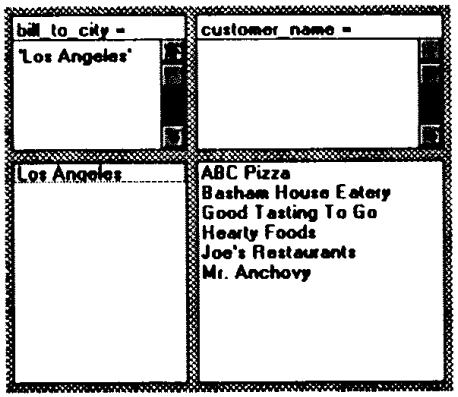


FIGURE D.21

Browser with bill_to_city constrained to Los Angeles.

Note: On adding this constraint, it was immediately applied to all of the browse panels. The number of tokens in the customer_name frame has been reduced from its original number (20) to *just those six customers whose bill_to_address is Los Angeles.* You can immediately see the effects of a change in the constraint definition.

Removing a Constraint

You can remove a constraint by simply erasing it. Click anywhere in the constraint token list in the upper middle of the frame. This highlights all of the tokens in the frame. Then press the **Delete** key. The constraint will be erased, and the browse will be updated to reflect the change.

Removing a Browse Frame

You can remove a field frame by clicking in constraint label field at the top of the frame. This highlights the label. Then press the **Delete** key. The frame will disappear. You can restore the frame by double-clicking the field name in the dimension depiction panel.

Multiple Constraints

Star Tracker's ability to use multiple constraints in a single dimension group is a very powerful aid to defining groups for large dimensions. Consider, for example, the problem of defining a customer group in a retail-store product table. Such a table might contain 100,000 products, but you are interested only in a few.

Since each such entry is probably unique and you have 100,000 tokens to choose from for your constraint, neither you nor your PC will be able to handle such a task. It's likely, however, that besides UPC and description fields the product dimension table will also contain other attributes that will assist you in subsetting the product table. In a retail database these might include such attributes as department, manufacturer, brand, size, and color.

Using this technique you can successively "home in" on the product set you want without browsing an entire very large dimension table.

Example: From the example shown in Adding a Simple Constraint single-click the first three customer name tokens to add them to the constraint token list. The resulting Browse window is shown in Figure D.22.

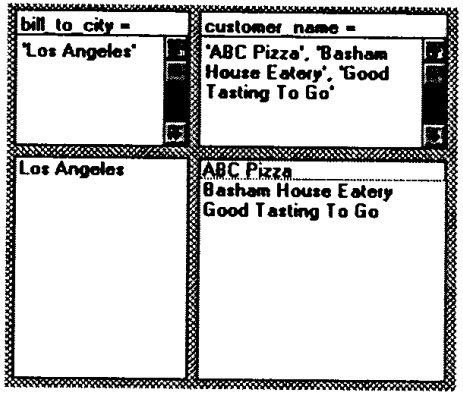


FIGURE D.22

Browser_bill_to_city and customer_name both constrained.

Logical Connections in Constraints

In a constraint such as the one illustrated in Multiple Constraints the tokens selected within a field are connected by implied logical ORs, while the constraints across multiple fields are connected with implied logical ANDs. Thus, the compound constraint defined in the example above would be interpreted as:

WHERE (bill_to_city = 'Los Angeles') **AND** (customer_name = 'ABC Pizza' **OR** 'Basham House Eatery' **OR** 'Good Tasting to Go')

Advanced Constraints

Constraints based on other operators, such as less than, greater than, not equals, between, and like, may be entered to a limited extent into the constraint box in the browser. The syntax of the constraint is passed directly through to the underlying DBMS, and hence there may be some syntactical differences from DBMS to DBMS. In Access, the following entries are valid:

Entry	*Meaning*
<100	Any numerical value less than 100
<"M"	Any text value that sorts before M. Note the double quotes.
between 100 and 200	Numeric values between 100 and 200.
between "C" and "DZZ"	Text values starting with C and D.
<>"Lasagna"	Any text value not equal to Lasagna.
like "Diet*"	Any text value starting with Diet. Note the asterisk as wild card.

Oracle, Sybase, and Red Brick may use single quotes as delimiters, and will probably use % as a wild card. While it is possible to use this facility for complex Boolean expressions, the user interface was not designed to support such use.

Creating Groups

After you have defined a constraint for a dimension using one of the techniques in the preceding section, you can convert the constraint into a group definition.

In Figure D.23 shows the browser with bill_to_city constrained to 'Los Angeles'. This constraint could be used to define a group. Now, suppose we added a new customer with a Los Angeles bill_to_city.

The makeup changes when we added the new customer. Since the customer has a 'Los Angeles' bill_to_city it would be added to the group and the Los Angeles group would contain seven rather than six customer names.

Creating a Simple Group

To create a group, first set up the constraints for the group using the Browser. Then select **Create Group** from the Browser's **Group** menu. You will be prompted for the group name. Enter the name and click **OK**. The group will be created. A group name can't be a duplicate of another group name.

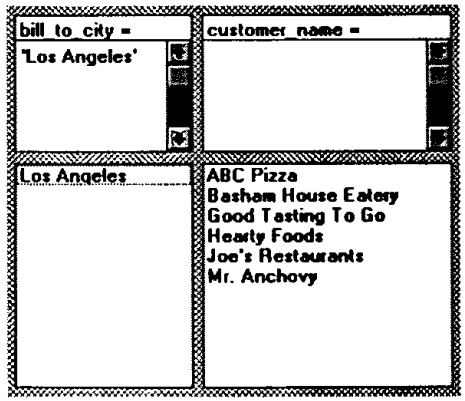


FIGURE D.23

Browser with bill_to_city constrained to Los Angeles.

Creating a Group Cluster

Frequently you will want to create a set of similar groups with one group for each unique instance of a token. In the example in Figure D.24, suppose you wanted to create a group for each bill_to_city. You could do this by creating simple groups for each city, or much more easily by requesting Star Tracker to create a cluster of groups--one for each unique value of bill_to_city.

As an example, first open the browser, double-click on the bill_to_city field, then select the title "bill_to_city =" at the top of the bill_to_city panel.

Next select **Create Group Cluster** from the Browser's Group menu. You will be prompted for the name template, which will be common for each group in the cluster. Enter "Bill-to City:*" in the template field as shown in Figure D.25. The asterisk will be replaced in each group name by the unique value of the group.

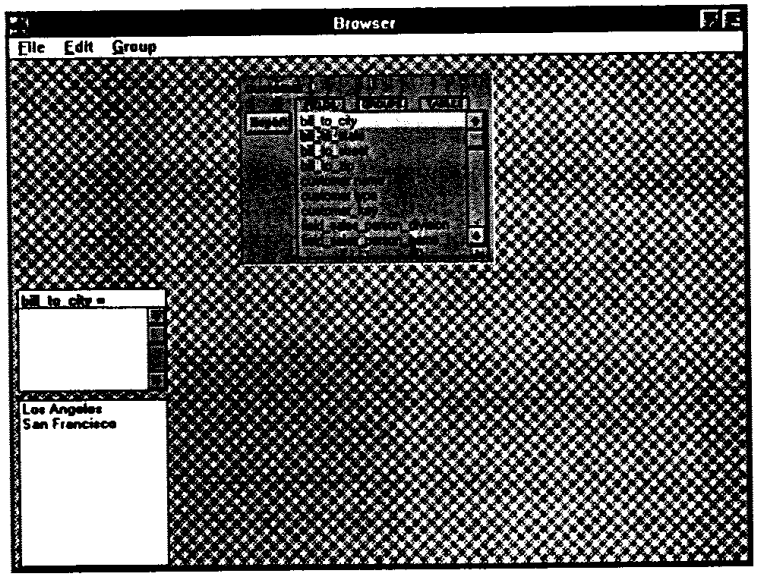


FIGURE D.24

Selecting a Field for a group cluster.

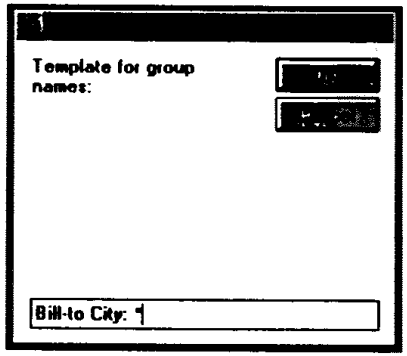


FIGURE D.25

Entering a group cluster name template.

Click the OK button to create the group cluster. When you examine the group list again you will find that two groups have been added, corresponding to the two values of bill_to_address, as shown in Figure D.26.

Deleting a Group

To delete a group select the group name in the browser group list and press the **Delete** key.

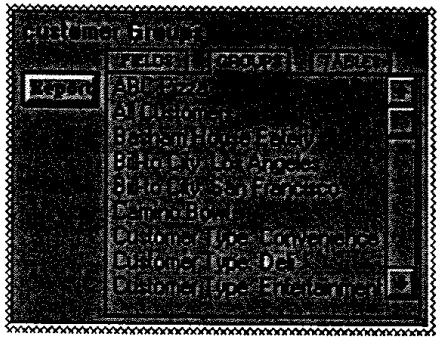


FIGURE D.26

Group example with bill-to city cluster.

Deleting a Group Cluster

To delete a set of groups, select the command Delete Group Cluster in the Group menu. You may be advised to display the group list (and make a selection in it). You will then be asked to supply enough leading characters to specify the group names you wish to delete. For instance, in the above figure, if you supply "Cust", you will delete all groups beginning with these characters.

Generalized Browsing: Tables Tab

When you click the **Tables** tab in the Browser's list panel you will see a list of all of the tables that are associated with your current database. These include the dimension and fact tables already discussed, as well as several other auxiliary tables, such as the tables used to store group definitions. You can browse the contents of these auxiliary tables in the same way that you browse the dimension and fact tables. In the Tables mode, group creation is disabled.

BUILDING A NEW REPORT

This section describes how to build a new report or modify an existing one. In general, the following steps may be required:

1. Select a database and click New Report.
2. Set the report's scale by dragging dimension field names to your report.
3. Set the base groups for each dimension.
4. Select primary facts by dragging fact field names to your report.
5. Apply alternative aggregates or ranks to the fact fields in your report, if desired.
6. Build comparison groups, if desired.
7. Run the report.

The following sections describe each step of this process and provide examples using the sample database shipped with Star Tracker.

Selecting a Database

In Star Tracker main window, select **Change Database** in the **File** menu. Choose the database you want in the Database Finder dialog, then click the **Open Blank Report** button.

Example: In the Database Finder open a blank report for the database labeled "ACCESS: ORDERS.MDB: Orders"

Adding Dimension Columns

To add a dimension column to your report, drag the attribute field name from the dimension depiction area to the report spreadsheet. If you drop it to the right of existing attribute columns it will be positioned immediately right of existing columns. If you drop it over an existing column it will be positioned to the left of that column.

Example: The beginning of this section showed you how to open a blank report for the labeled "ACCESS: ORDERS.MDB: Orders" database. In blank report, click the customer_name attribute in the customer dimension table and hold down the left mouse button. While the button is held down, drag the attribute name down to column A of the report spreadsheet, and release the mouse button. This drag-and-drop action will put the attribute name, customer_name, into the spreadsheet as the header (row 1) of column A.

The main window will now look like the one shown in Figure D.27.

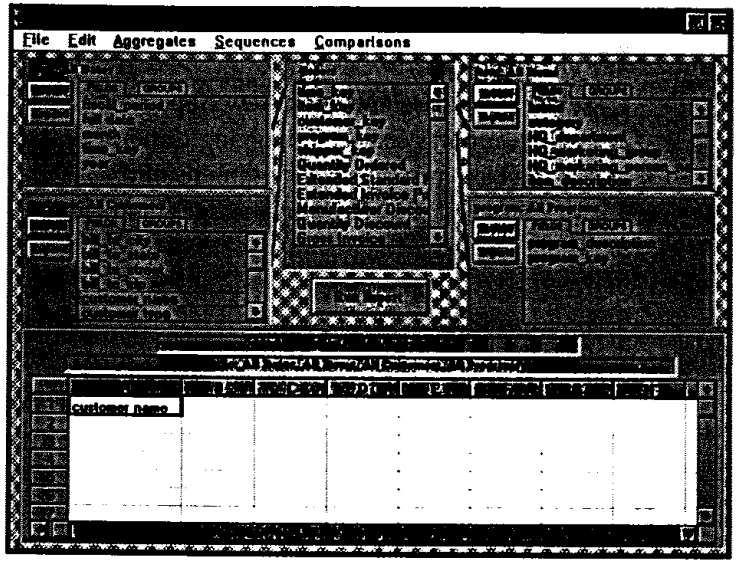


FIGURE D.27

Main window with first report column: Customer Name.

Deleting Attribute Columns

To delete an attribute column from a report, first highlight the column by clicking its alphabetic header letter then choose **Delete Column** from the **Edit** menu.

Choosing Base Groups

When you first open a new report, the base group for each dimension is set to a default value selected by your System Administrator. In the example above the default base groups are set to All Items, All Customers, etc.

Before running a report, you will need to choose the base you want to use for reporting. To choose a base group, first click the **GROUPS** tab in the dimensions depiction panel. Group names will be shown in blue. To choose the base group, double-click on the group name.

Example: In the sample report that you are building select, by double-clicking, the following base group:

time: **4Q94**

customer: **Customer Type: Restaurants**

item: **Category: Soft Drinks**

program: **Regular Program**

This sets the basis of the report. See Figure D.28. Taken together, this set of groups tells you (except for comparisons) what the basis of the facts will be. You also know, from the dimension columns you have chosen, which of these will be enumerated. Your report will list each individual customer within the group of Restaurants, and will list totals for Soft Drinks for each restaurant.

In order to run this report you must still add one or more fact columns.

Adding Fact Columns

Fact columns are added to a report in much the same way as adding attribute columns, except that their names are dragged from the fact table instead of from a dimension table. They will automatically be placed to the right of the attribute columns.

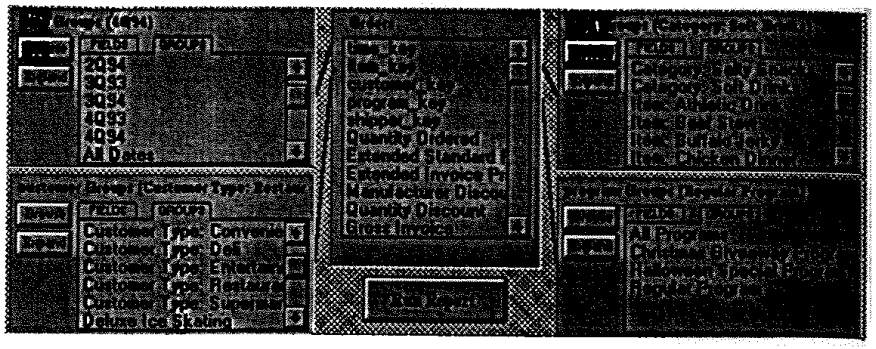


FIGURE D.28

Table depiction with base groups selected.

In a report, fact columns are always additive. By default, they represent the sum of the values of the fact over one or more dimensions.

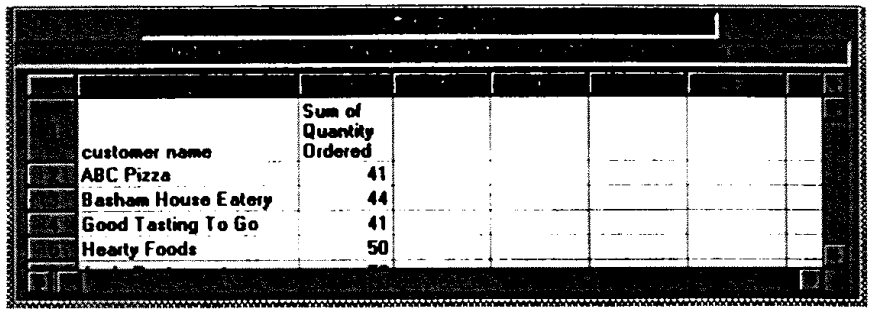
Nonadditive facts are treated as attributes and will be placed in the left-hand columns with other attributes.

Aggregate Types

When you initially drag a fact name to the report Star Tracker will label it "Sum of <fact name>". Star Tracker is aware that it will sum over one or more dimensions, and labels the column accordingly. It assumes that what you want is a sum of the individual records. If you want an alternative aggregation such as Maximum, Minimum, or Average, first highlight the new column by clicking its alphabetic header letter. Then select the new type of aggregate you want from the main window's **Aggregates** menu. This changes the fact column's aggregation method.

The First Fact Column

To add a fact column to the report, drag-and-drop the fact column name from the fact table to the report spreadsheet. The first fact column you add will be placed immediately to the right of report's dimension columns. Subsequent facts will be placed where you put them as long as they are to the right of the attributes.



customer name	Sum of Quantity Ordered
ABC Pizza	41
Basham House Eatery	44
Good Tasting To Go	41
Hearty Foods	50

FIGURE D.29

Simple report.

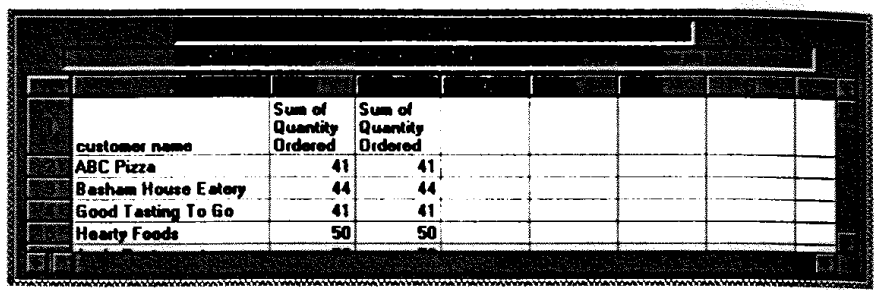
Example: Add a fact to the report that you are making. Drag the fact name **Quantity Ordered** from the fact table depiction to the second column of the report. You now have defined a dimension column, base groups, and one fact column. You are now ready to run this report. Click the **Run Report** button to run the report in Figure D.29.

There are nine report lines, one for each of the distinct values of restaurant name that comprise the customer dimension's Restaurants group. Note that the Quantity Ordered column has automatically been renamed "*Sum of* Quantity Ordered". Star Tracker recognizes that this is an aggregate and names it accordingly.

Adding Additional Fact Columns

If you are adding subsequent facts and want to place the new column to the right of existing columns, drag the name to the right of the right-most column already in the report. If you want the new column to be placed within the existing facts, drag the name to an existing fact column, and the new fact will be added immediately to the left of the target column.

Example: Add a second identical fact column to your report by dragging the fact name **Quantity Ordered** from the fact table depiction to the third column of the report, and run the report in Figure D.30.



customer name	Sum of Quantity Ordered	Sum of Quantity Ordered
ABC Pizza	41	41
Basham House Eatery	44	44
Good Tasting To Go	41	41
Hearty Foods	50	50

FIGURE D.30

Example report with two Quantity Ordered columns.

Comparisons

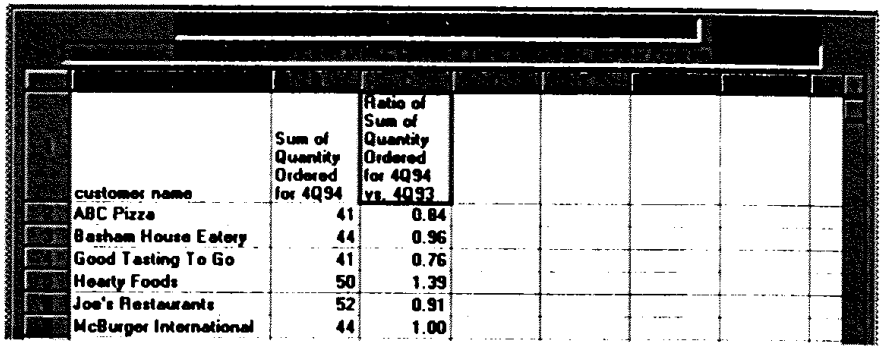
Business analysis frequently revolves around comparisons: This year vs. last year, my products vs. your products, our products vs. the entire marketplace. Star Tracker provides an extraordinarily powerful and easy way of generating such comparisons through the use of comparison groups.

Complex multidimensional comparisons is not simple to generate, so Star Tracker provides several aids to ensure that comparisons are meaningful at any level of scale.

Adding a Comparison Group

The first step in making a comparison is to select the group on which we want to base the comparison. Recall that in our example, we selected a base time period of 1Q94. Suppose we want to compare this (our current quarter) with results for last year: 1Q93.

Example: In the main window (shown in Figure D.31, click the **GROUPS** tab in **time** dimension depiction. This opens the list of groups available to you. Drag and drop the group 4Q93 from the time groups into column C of the report. The report changes to the picture shown below. Note that column C is now qualified, reading Sum of Quantity ordered for 4Q93, reflecting the change we just made. Note also that the time dimension's base group remains



customer name	Sum of Quantity Ordered for 4Q94	Ratio of Sum of Quantity Ordered for 4Q94 vs. 4Q93
ABC Pizza	41	0.84
Basham House Eatery	44	0.96
Good Tasting To Go	41	0.76
Hearty Foods	50	1.39
Joe's Restaurants	52	0.91
McBurger International	44	1.00

FIGURE D.31

Sample report with comparison group: 4Q93.

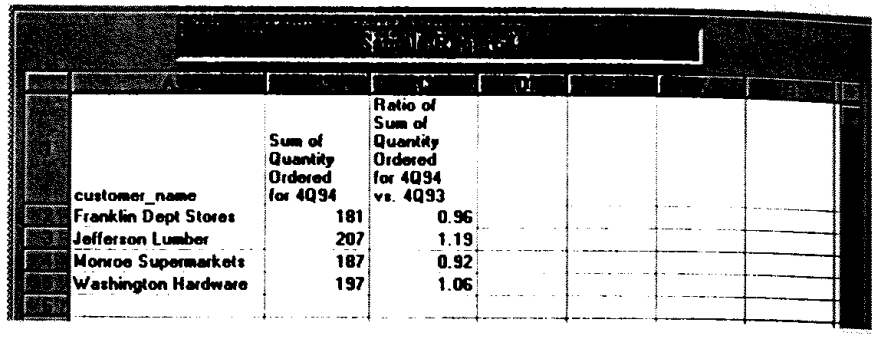
4Q94, as originally set, and that the label for column 2 now is labeled with the base group, to distinguish it from the alternative group we just added. Column 2 will contain the same values as before; only its label has been changed for clarity.

Run the sample report at this time, to see the difference in quantities order for 4Q93 (the comparison group) and 4Q94 (the base group).

Computing a Comparison

Once you have introduced alternative groups for a dimension into your report you can calculate a comparison between the facts for the base group and the comparison group. To do this, first select a column that is qualified by an alternative group. Then apply the comparison you want to use from the **Comparison** menu.

Example: Highlight column C of the report by clicking its header letter then choose Ratio from the **Comparison** menu. The heading of column C will change as shown in Figure D.32. Run the report to see the ratio of orders for 4Q93 to 4Q94.



customer_name	Sum of Quantity Ordered for 4Q94	Ratio of Sum of Quantity Ordered for 4Q94 vs. 4Q93
Franklin Dept Stores	181	0.96
Jefferson Lumber	207	1.19
Monroe Supermarkets	187	0.92
Washington Hardware	197	1.06

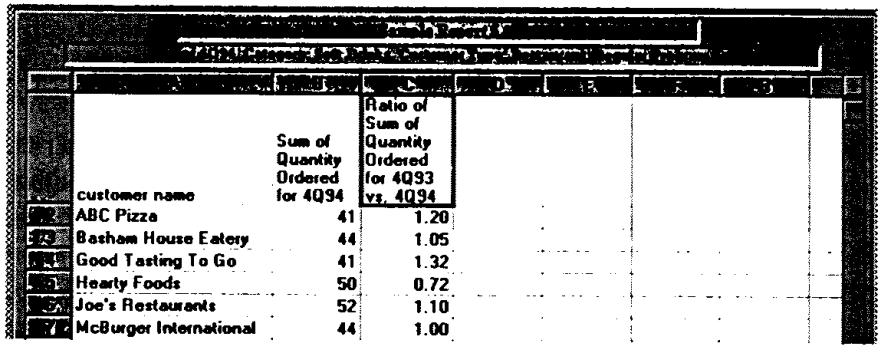
FIGURE D.32

Example report—with column C expressed as a ratio.

Reversing a Comparison

The inverse of a comparison can be easily calculated by selecting Reverse Comparison from the selection menu.

Example: Suppose instead of the ratio of 4Q94 to 4Q93, we wanted the report to contain the ratio of 4Q93 to 4Q94. We can accomplish this simply by highlighting column C of the report by clicking its header letter then choosing **Reverse Comparison** from the **Comparison** menu. The report in Figure D.33 would result.



customer name	Sum of Quantity Ordered for 4Q94	Ratio of Sum of Quantity Ordered for 4Q93 vs. 4Q94
ABC Pizza	41	1.20
Basham House Eatery	44	1.05
Good Tasting To Go	41	1.32
Hearty Foods	50	0.72
Joe's Restaurants	52	1.10
McBurger International	44	1.00

FIGURE D.33

Example report with ratio reversed.

Independent Comparisons

A fully set up comparison, such as the one developed in the last three figures, can be made independent of the main base group of the report by dragging a group name from a group list with the shift key held down. This would allow, for example, a column to be defined in the previous report that was the ratio of all of 1993 to all of 1994, even though the base group of the report remained 1Q94. This command can only be applied to a fully set up comparison column.

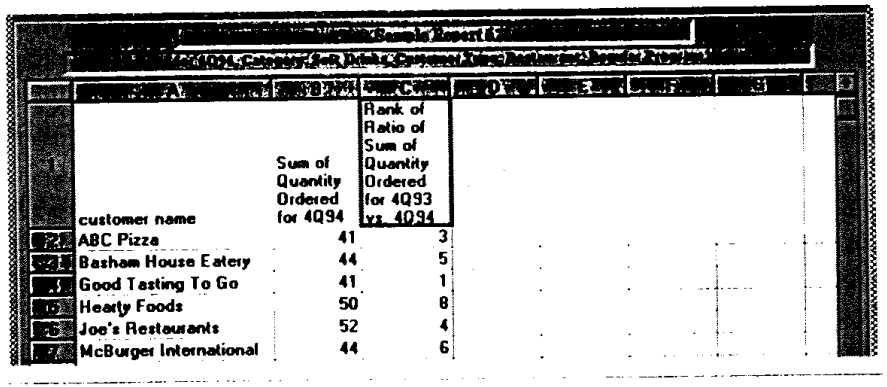
Sequence Columns

Often, business measurements are expressed as sequence metrics rather than as values. A sequence might expressed as a simple rank (1, 2, 3, . . . n), as a range (high, medium, low), or a more complex measure such as a moving sum. Star Tracker provides several methods of including sequences in a report.

Building a Sequence Column

To build a sequence column, first build a fact column. This column may contain simple facts, facts for alternative groups, or comparisons. The select the type of sequence you want from the main window's **Sequences** menu.

Example: In the sample report, highlight column C of the report (the ratio) by clicking its header letter. Then choosing **Rank** from the **Sequences** menu. Rerun the report, and instead of ratios the column will contain the *rank* of each ratio relative to all of the ratio values. See Figure D.34.



customer name	Sum of Quantity Ordered for 4Q94	Rank of Ratio of Sum of Quantity Ordered for 4Q93 vs. 4Q94
ABC Pizza	41	3
Basham House Eatery	44	5
Good Tasting To Go	41	1
Hearty Foods	50	8
Joe's Restaurants	52	4
McBurger International	44	6

FIGURE D.34

Example report with column C expressed as a rank.

Types of Ranks

Star Tracker provides the following types of Sequences:

rank	The ordinal of the fact value beginning with 1, in ascending order
cume	The cumulative sum of the fact value
moving average	The mean of the previous 3 values of the fact (inclusive)
moving sum	The sum of the previous 3 values of the fact (inclusive)
tertile	The third into which the value falls relative to all other values: Low, Medium, or High
quartile	The quadrant into which the value falls relative to all other values: 1st, 2nd, 3rd, or 4th
value	Exits the ranking operation and returns the column to its values

Average Period Calculations

Star Tracker provides two measurements that are specific to the time dimension: AveragePeriodSum and AveragePeriodCount. Suppose that you have a nonadditive fact such as bank balance. It makes no sense to sum bank balance over a time period. However, bank balance can be summed over other dimensions: The sum of an individual's various bank balances or the sum of bank balances for a customer group both have meaning.

Average period sum computes an average by summing the fact values over all dimensions including time, then dividing the resulting values by the number of time periods in the time dimension group.

OTHER FEATURES

This section describes miscellaneous features of Star Tracker such as report printing.

Printing a Report

Reports can be easily formatted and printed. To print a report, simply select **Print** from the **File** menu. This will produce a formatted report. The report's header will contain the report title and base group selections. This will be followed by the report values with columns labeled as shown on your screen. Hidden columns will be omitted. The report footer contains the date and page number. Reports may span multiple pages both horizontally and vertically.

Report formats may be altered by selecting **Print Setup** from the **File** menu. This opens the dialog shown in Figure D.35. Various report printing settings may be changed in this dialog.

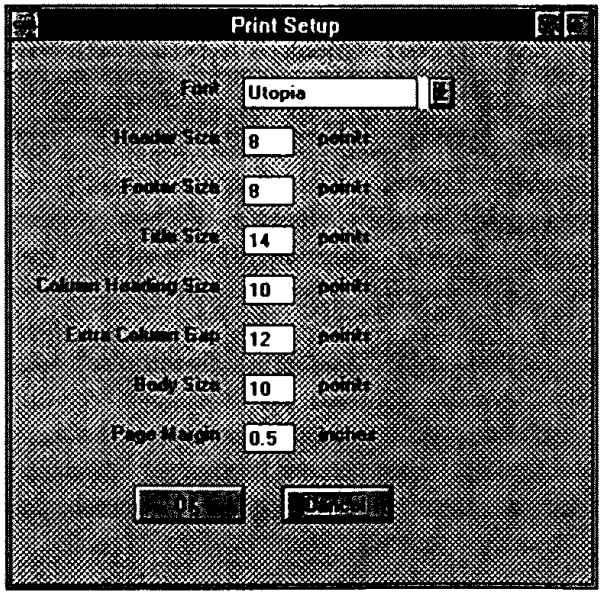


FIGURE D.35

Print Setup dialog.

Showing SQL

System analysts can examine the SQL (structured query language) being sent by Star Tracker to the database server by selecting Show SQL from the File menu. This opens the dialog box in Figure D.36, which contains recently executed queries.

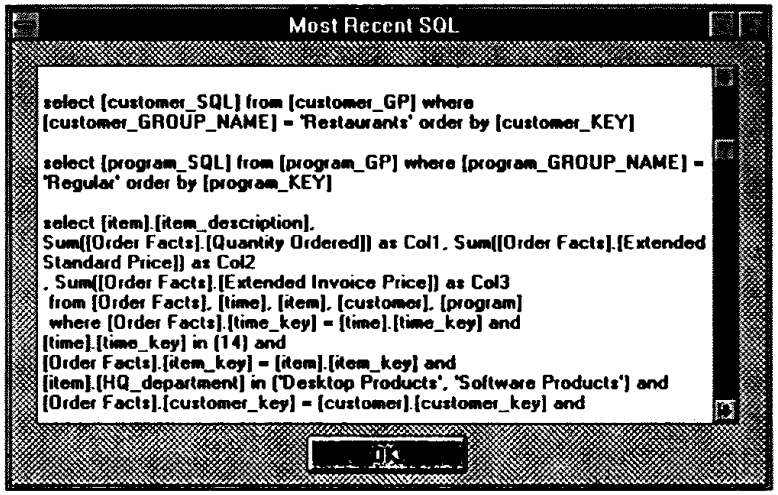


FIGURE D.36

SQL dialog.