

Paper 038-2011

## Seamless Dynamic Web Reporting with SAS®

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### ABSTRACT

The SAS® Business Intelligence platform provides a wide variety of reporting interfaces and capabilities through a suite of bundled components. SAS® Enterprise Guide®, SAS® Web Report Studio, SAS® Add-In for Microsoft Office, and SAS® Information Delivery Portal all provide a means to help organizations create and deliver sophisticated analysis to their information consumers. However, businesses often struggle with the ability to easily and efficiently create and deploy these reports to the Web. If it is done, it is usually at the expense of giving up dynamic ad-hoc reporting capabilities in return for static output or possibly limited parameter-driven customization.

### INTRODUCTION

Traditional web report building can be a complex and time-consuming process. Quite often the time spent in building a web application is not consumed building the graphical or tabular content of the report itself, but rather in building the complex web interface that allows users to specify front end parameters, filtering options, security constrains, or ad-hoc design flexibility that empowers users to build reports on their own without requiring assistance from IT. Furthermore, traditional technologies such as OLAP<sup>1</sup> only complicate the process by requiring a pre-defined hierarchy or combination of dimensional analyses that restricts users from exploring relationships beyond the constraints of the developer's initial report design.

A strategy of allowing users to drill down, drill through, and specify any combination of dimensional analysis is typically desired. Pinnacle Solutions has developed a web-based reporting application that runs on the SAS® Foundation. Built utilizing the Futrix® development platform<sup>2</sup>, PINNACLE BINOCULARS™ offers end users a tool that facilitates rapid development and easy maintenance of web reports and portals.

### SYSTEM REQUIREMENTS

The BINOCULARS application is written in SAS. Therefore, there are components of SAS that are required for this solution. Base SAS®, SAS/Graph®, and either SAS® Integration Technologies or SAS/IntrNet® are minimum requirements. Although not required, other features such as the SAS® Metadata Server and SAS® OLAP Server greatly enhance the functionality of BINOCULARS.

### CREATING YOUR FIRST WEB REPORT

#### Edit Custom Library Reference

Like all SAS applications, you must first define SAS libraries for your data sources. These sources can be either local or remote references. The figure below shows the wizard screen for defining the Custom Library Reference or (or SAS Libname).

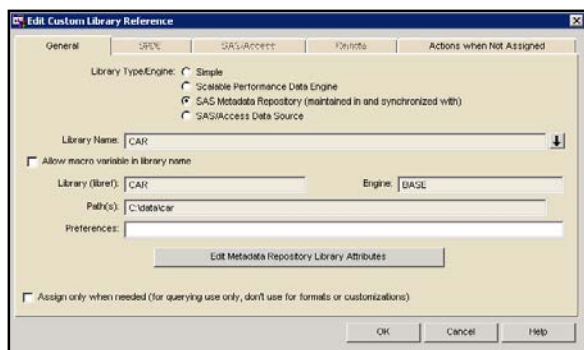


Figure 1 - Creating the SAS LIBNAME

The BINOCULARS application will support the following library types or engines:

- Simple SAS Datasets
- Scalable Performance Data Engine (SPDE)
- SAS Metadata Repository
- SAS/Access Data Source

A simple library is used when the reference to the physical directory is specified in BINOCULARS, whereas with a SAS Metadata Repository library the directory is obtained from the SAS Metadata Server, which is a centrally managed directory of SAS resources.

Special custom library types include the SAS<sup>®</sup> Scalable Performance Data Engine (SPDE) and SAS/ACCESS data sources. An SPDE library can take advantage of a system's multiprocessing facilities. A SAS/ACCESS Data Source allows a library to be assigned to reference external database management system (DBMS) tables and other external data sources via SAS/ACCESS. So relational databases such as SAS/ACCESS<sup>®</sup> Interface to DB2, SAS/ACCESS<sup>®</sup> Interface to Informix, SAS/ACCESS<sup>®</sup> Interface to Microsoft SQL, SAS/ACCESS<sup>®</sup> Interface to MySQL, SAS/ACCESS<sup>®</sup> Interface to ODBC, SAS/ACCESS<sup>®</sup> Interface to OLE DB, SAS/ACCESS<sup>®</sup> Interface to Oracle, SAS/ACCESS<sup>®</sup> Interface to Sybase, SAS/ACCESS<sup>®</sup> Interface to Sybase IQ, and SAS/ACCESS<sup>®</sup> Interface to Teradata for example.

### Edit Subject Area Window

Once a data source has been defined, you can create a Subject Description or Project. The subject description is a title for the collection of meta-items (data sources) that it contains. This description is mainly used within the BINOCULARS Administration environment to refer to the collection of meta-items, dimensions and measures that make up the matrix contained in the subject.

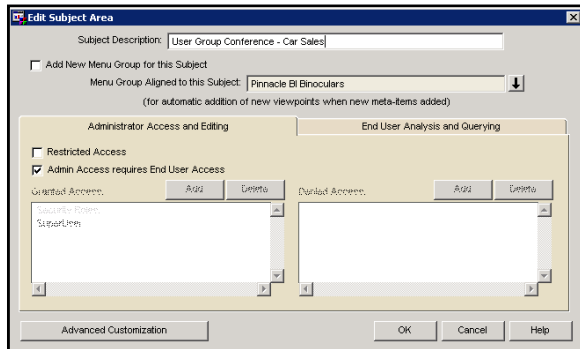


Figure 2 - Creating the Subject Description

### Add New Menu Group for this Subject

When creating a new subject, it is possible to create an associated menu group. If the Add New Menu Group for this Subject box is ticked, a new menu group will be created within the Menu Items Manager. This will be given the same name as the subject description entered here.

### Menu Group Aligned to this Subject

When editing an existing subject (or adding a new subject without adding a new menu group), set the menu group aligned to this subject by clicking the down arrow and then selecting a Menu Group from the list displayed.

When a menu group is aligned to a subject, then any new meta-items that are registered within the subject can be automatically be added to the menu as a new viewpoint (if the administrator who is registering the meta-item wishes).

### Restrictions

There are two types of restriction for a subject:

- restrictions relating to administrator access and editing
- restrictions relating to end user analysis

Administrator restrictions can be used to restrict access to administrators so that they cannot access the Metadata Matrix for particular subjects, and therefore cannot view and modify the details of a subject.

End user restrictions can be used to prevent access to any viewpoints or metadata from a subject within the end user environment. They can also be used to prevent selection of viewpoints or meta-items within other aspects of BINOCULARS administration.

## Restricted Access

If Restricted Access is ticked, it means that this subject will be accessible by the specified security roles/users that are granted access and will be inaccessible to the specified security roles/users that are denied access.

## Admin Access requires End User Access

Under Administrator Access and Editing, it is possible to control whether an Administrator must have access to both Administrator Access and Editing and End User Access to update and modify a subject by selecting Admin Access requires End User Access. If Admin Access requires End User Access is not selected, the Administrator does not require access to be set in End User Access.

## Granted Access

The users or security roles in this list will have access to this restricted item. Select Add to display a pop-up menu from which to select the security role(s) or users to have access to this item.

To add users, select users registered within BINOCULARS or from the external user database. Select the appropriate Add Access for a User from the pop-up menu and then the required users from the Select User window.

To remove a user or security role from this list, select it in the list and click Delete.

## Denied Access

The users or security roles in this list will be prevented from accessing this restricted item. Click Add to display a pop-up menu from which to select the security role(s) or users to be denied access to this item.

To add users, select users registered within BINOCULARS or from an external user database (such as LDAP or SAS Metadata). Select the appropriate Add Access for a User from the pop-up menu and then the required users from the Select User window.

To remove a user or security role from this list, select it in the list and click Delete.

## Add New Data Source

Once the Subject has been defined, click Add New Data Source to register new data sources. This will add the new data source (meta-item) to the current subject. When clicking Add New Data Source it is possible to register metadata for any of the following sources:

- Add a SAS Data Set, View or MDDB Data Source
- Add a new Futrix HOLAP Structure
- Import a SAS HOLAP Structure (maintain in Binoculars)
- Register a SAS HOLAP Structure (still maintain in SAS)
- Add a Custom Data Source

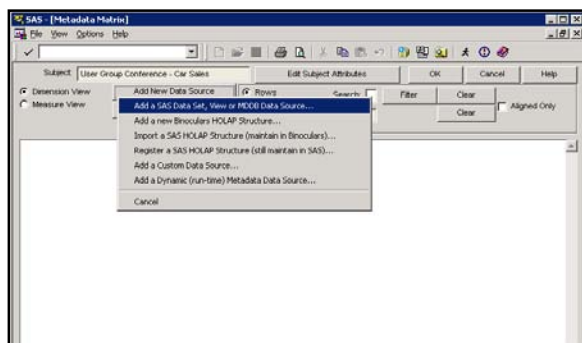


Figure 3 - Defining the Data Source

Since all SAS/ACCESS data sources are treated like SAS datasets, most administrators will simply select Add a SAS Data Set, View or MDDB Data Source. This consists of a multi-step process.

### Step 1 - Source of Data

When registering a SAS data set, SAS data view or an existing MDDB, BINOCULARS will automatically list all the libraries registered under it, together with their respective paths and data sets. All that is required in this first step is to

select the library where the source data is located, and then a list will be displayed of all the data sources in that library that are available for use.

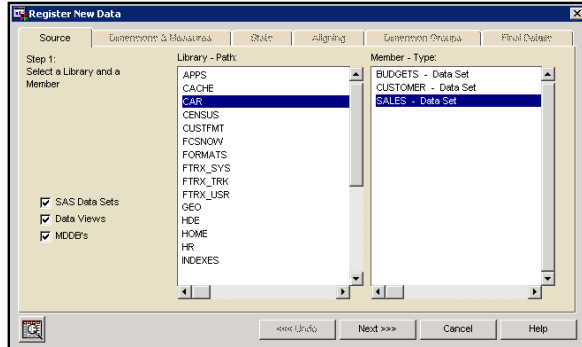


Figure 4 - Step 1 Source of Data

During the registration process, quickly scanning the raw data can be very useful. At any stage after selecting the data set, view the raw data by clicking the Data Table button in the bottom left of the window.

### Step 2 - Defining Dimensions and Measures

The next step involves grouping the SAS variables correctly as dimensions or measures, or throwing them away by putting them in the "Trash". It is also possible to re-order the dimensions and measures into a more meaningful order at this time.

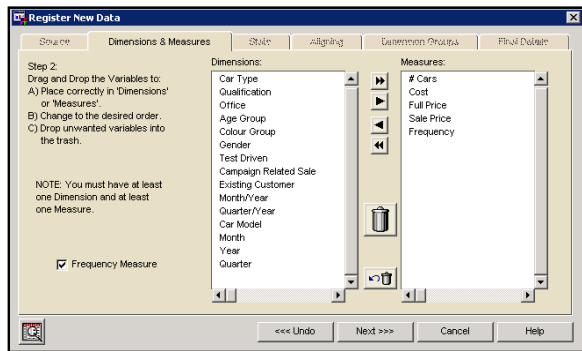


Figure 5 - Step 2 - Defining Dimensions and Measures

Some of the work is done automatically. All character variables will have been placed into the dimension list, as it is not possible to use character variables as measures.

BINOCULARS also assumes that any numeric variables which have any date type formats are also dimensions, as these would almost never be used as a measure. All other variables will be initially placed in the measure list.

The variables must be dragged and dropped from one list to the other to ensure they are in the correct list. If a variable is not desired then simply highlight that variable then click on the trash can icon. Multiple variables can be deleted by highlighting more than one by using the shift key on user's keyboard.

There must always be at least one dimension and at least one measure, although the frequency measure can be used as the only measure if wished.

### Step 3 - Selecting Statistics

All measures must have a statistic associated with them so that BINOCULARS can work out how to aggregate the values.

By default, all statistics will be assigned to SUM. To change from the default statistic or to add a new statistic for a particular measure, select the measure to alter and a pop-up menu of statistics will be provided for the selected measure. After clicking what type of action is required (change, add, delete) then it is possible to select which statistic would be preferred.

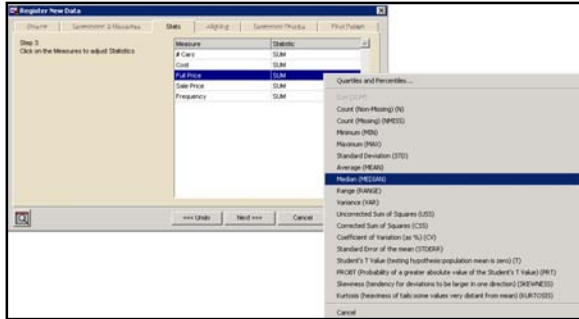


Figure 6 - Step 3 - Selecting Statistics

Frequency Measures must have a statistic of SUM, but all other measures can be altered from the default statistic of SUM to whatever is most appropriate for end user analysis.

#### Step 4 - Aligning with Existing Variables in a Subject

Step four is only available (and necessary) if there is already a meta-item registered within the same subject. Because this is our first meta-item that is being registered, we will not see this wizard screen.

The purpose of this step is to align variables which may have different variable names in different data sets, but want to treat them as the same dimension or measure. If the same variable names have always been used (where synonymous across data sets) then this step can be skipped.

BINOCULARS automatically aligns variables which have exactly the same SAS variable names. Aligned dimension variables will allow the end users to drill into other meta-items using this relationship.

#### Step 5 - Dimension Groups

Every new dimension not yet aligned with an existing dimension must be placed into the Dimension Groups. The next step will not be available until the New Dimensions list is empty.

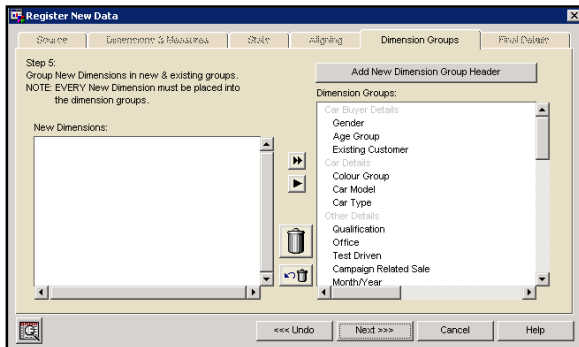


Figure 7 - Step 5 - Dimension Groups

The purpose of this step is to place the dimensions into a more meaningful order and separate them into groups by adding in dimension group descriptions which describe what the following dimensions are.

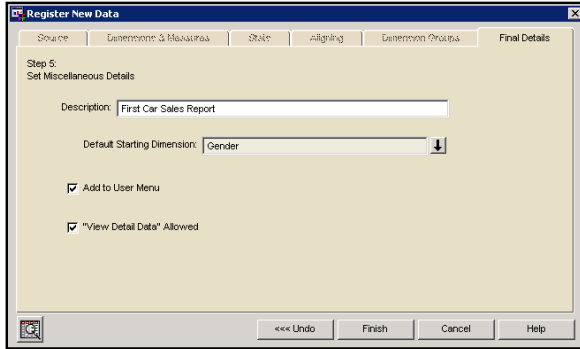
These are simply descriptive groups that are being created. There does not have to be any true relationship between the dimensions placed in the same dimension groups. Because you can "drill-anywhere" in BINOCULARS, this is simply a way of grouping the dimensions into a logical order with logical separators to make data navigation easier for end users.

#### Step 6 - Final Miscellaneous Details

Finally, specify a few miscellaneous details and the registration process is finished.

##### Description (Required)

The description will be used as the title for all viewpoints from this data, so will be used for the window title while doing analysis and for any printed or exported output. This must be unique over all meta-items within the current subject. It will also be used as the default text in the menu item if Add to Menu is checked, which is the default.



**Figure 8 - Step 6 - Final Miscellaneous Details**

#### Default Starting Dimension (Required)

The Default Starting Dimension is a requirement for this meta-item and will also be used as the default first classification in order to produce a viewpoint.

#### Add to Menu

If this checkbox is selected, then this new registration will automatically be available to users from the main menu, which means there is no need to manually add an entry into the main menu.

If the current subject is still associated with a menu group, then this new item will be found in that menu group.

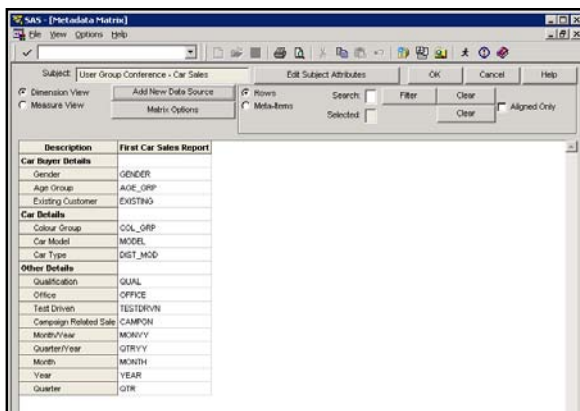
If the subject is no longer associated with any menu group, then this new item will be added to the top level root directory of the Main Menu.

#### "View Detail Data" Allowed

If this is not selected, the users will not be able to gain access to the underlying detail data.

### Metadata Matrix

Once the last step is completed, the Metadata Matrix screen will be displayed. The administrator can now either add other data sources, make modifications to the existing data sources, or simply click OK to view the report.



**Figure 9 - Metadata Matrix**

The meta-item is now ready to be viewed on the web. By opening up Internet Explorer and navigating to the logon page, the user will first be presented a menu with various folders and reports, which corresponds to the Subjects that were created during the registration process. Within the folder, the user can select the newly created report.

The following figure shows the report. By default, the report is simply a table with the default dimension and all of the defined measures and default statistics.

Gender	# Cars	Cost	Full Price	Sale Price	Frequency
Female	55,739	\$2092061973	\$4160336170	\$2935272375	8,697
Male	192,471	\$7311967485	\$14049613477	\$10562013759	25,770
Unknown	37,318	\$1389875394	\$2760451485	\$2025929051	5,447
Summary	285,528	\$10793904852	\$20970401132	\$15523215185	39,914

Figure 10 - Default Report

From here, the user can create any combination of reports, graphs, or portal pages.



Starting with the shortcut icons on the upper-right hand of the screen, the left-most icon is the Viewpoint Layout button and it will allow the user to create custom reports using a wizard-like interface.

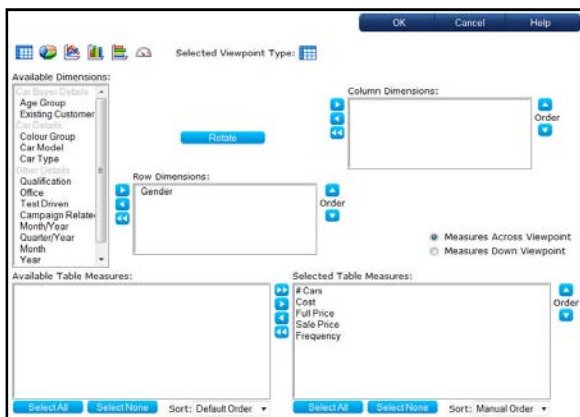


Figure 11 - Viewpoint Layout

The next icon, Viewpoint Attributes, will allow the user to define custom properties of the report.

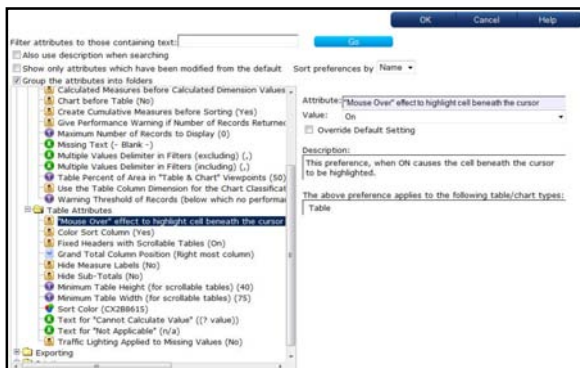


Figure 12 - Viewpoint Attributes

The next icon, Filters, allows the user to subset the data in the reports by querying on the measures or the dimensions. You can even apply aggregate filters, which are applied after the statistics have been calculated. This is commonly used to answer questions such as "what are my top 10 selling products?", "who are my bottom 5 performers?" for example.



Figure 13 - Filters

The next icon is used to produce a table. Does this information look familiar? It is the default report that was generated when we first registered the meta-item. The next icon to the left will produce a chart.

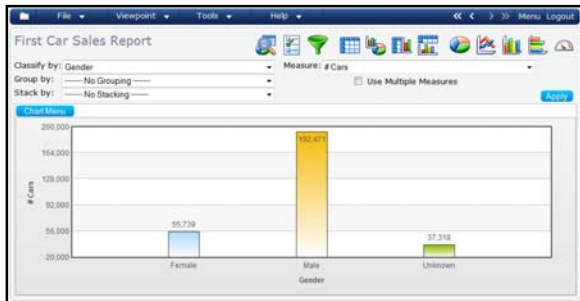


Figure 14 - Chart

Continuing from the left, the next icon when clicked can produce a side-by-side table and chart combo.

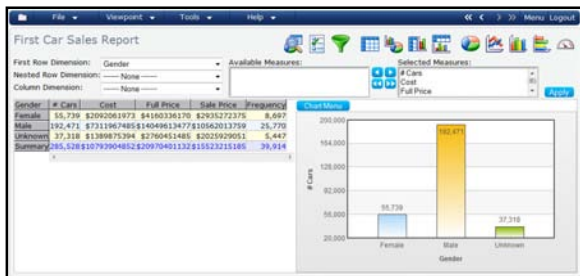


Figure 15 - Side-by-Side Table and Chart Combo

The next icon is to produce a top-by-bottom table and chart combo.



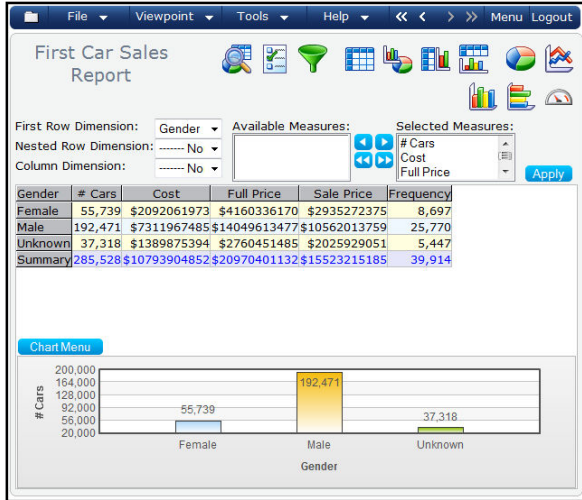


Figure 16 - Top-by-Bottom Table and Chart Combo

The remaining icons allow the user to select a Pie Chart, Line Chart, Vertical Bar Chart, Horizontal Bar Chart, and KPI Dial.

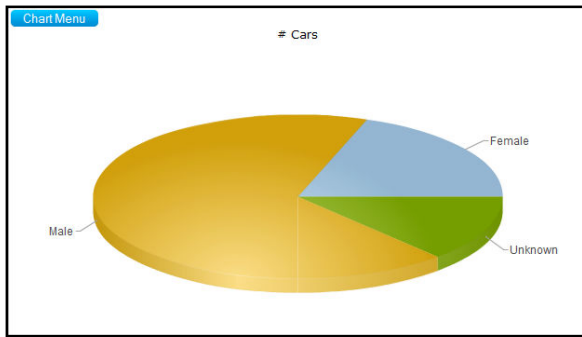


Figure 17 - Pie Chart

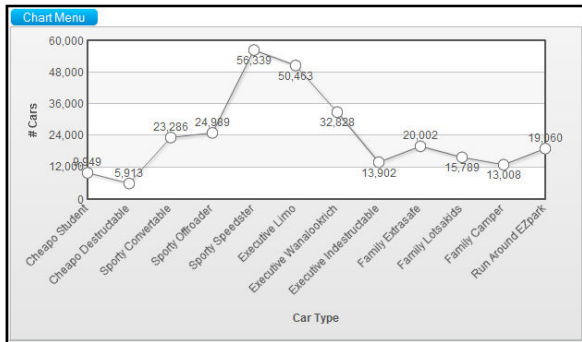


Figure 18 - Line Chart

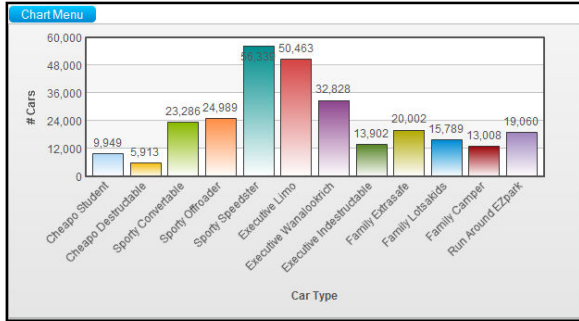


Figure 19 - Vertical Bar Chart

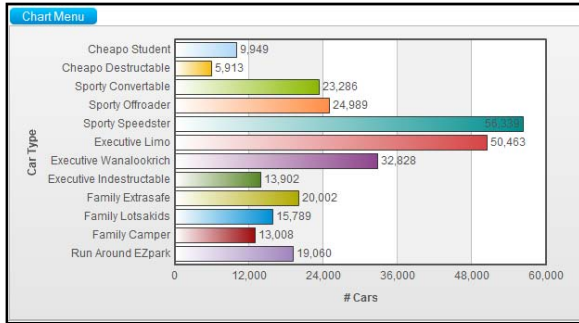


Figure 20 - Horizontal Bar Chart



Figure 21 - KPI Dial

**Context Interactivity with Reports**

The BINOCULARS application excels at allowing the users to interact directly with the report objects. All report items are context sensitive. The figure below shows the pop-up menu when right-mouse clicking on an individual cell within the report.



Figure 22 - User Menu Interaction on Table

Using defined Groups and Roles, BINOCULARS can also limit what specific functionality a user sees. By default, an Advanced, Intermediate, and Beginner role is created. Any of these roles, as well as the creation of custom roles, can

be modified to remove menu items. This way, Beginner users can be presented with only a handful of pre-determined reporting tasks to simplify their user experience.

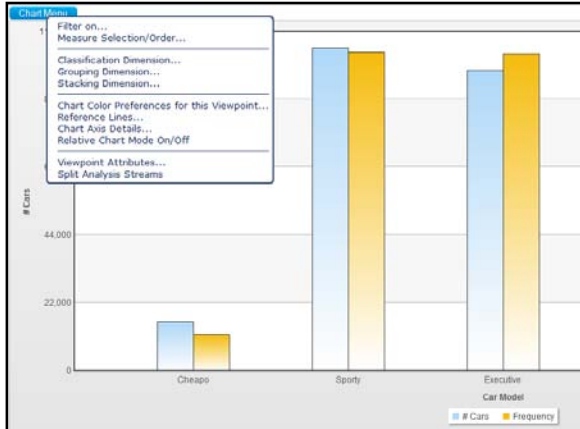


Figure 23 - User Interaction on Chart

### DRILL ANY-WHERE FUNCTIONALITY

In BINOCULARS, you do not need to program dynamic links. All of the links are automatically created during the meta-item registration process. This is quite possibly the most important feature of the application as the linking and drill-down capabilities of most systems (including SAS) can be quite time-consuming.

### EASILY CREATING DASHBOARDS

Once you have built an inventory of viewpoints, you can easily aggregate them together to create complex dashboards or portals with a few clicks of a mouse.



Figure 24 - Sample BINOCULARS Dashboard

## ADVANCED INTEGRATION WITH SAS

### SAS® OLAP Server

BINOCULARS can generate Secondary Data Sources for Queries. This is useful for very large datasets where performance issues may arise when dynamically generating results each time.

Secondary Data Sources can be a Summary Data Set, Indexed Datasets, SAS® Multi-Dimensional Databases, SAS OLAP Server Cubes, or SAS HOLAP Data Groups. For those organizations that have SAS OLAP Server licensed, BINOCULARS can easily create these secondary data sources without needing to utilize the SAS® OLAP Cube Studio application.

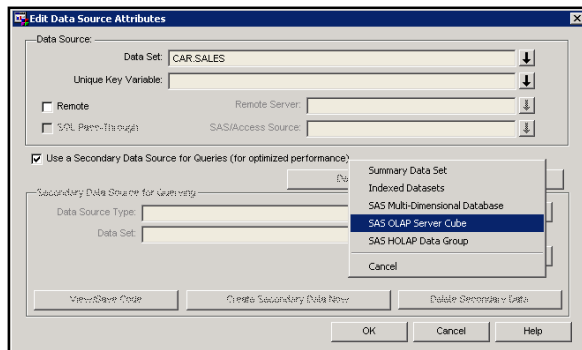


Figure 25 - Building SAS OLAP Server Cubes

There is an advantage of building the SAS OLAP Cube from the BINOCULARS application. BINOCULARS has many optimization features built into the system. It can make recommendations on which specific sub-tables, or dimension combinations, should be generated. By using an automated scheduler, BINOCULARS can then automatically create, or delete, sub-tables based on usage or performance criteria.

The example below would include any sub-table that was requested by the end user that was used 1 time or more, AND the Query Time is Slower than 10 seconds.

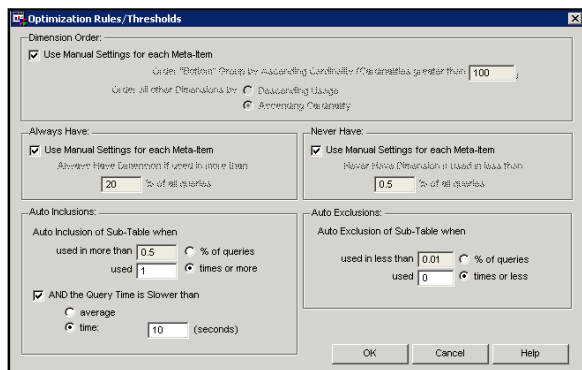


Figure 26 - Optimization Rules / Thresholds

For example, any report that took more than 10 seconds to render would automatically be calculated in advance during a scheduled process. By modifying the Auto Exclusions parameters, BINOCULARS can also automatically prune any sub-tables that are stagnant and haven't been used in a while or very often.

### SAS® Stored Process Server Integration

BINOCULARS can integrate SAS® Stored Processes into a dashboard area. A SAS Stored process is SAS code which creates a standard output that is available to many other SAS applications. A stored process is a simple way to customize BINOCULARS to leverage the full analytical power of SAS such as statistical modeling, specialized analysis, and forecasts.

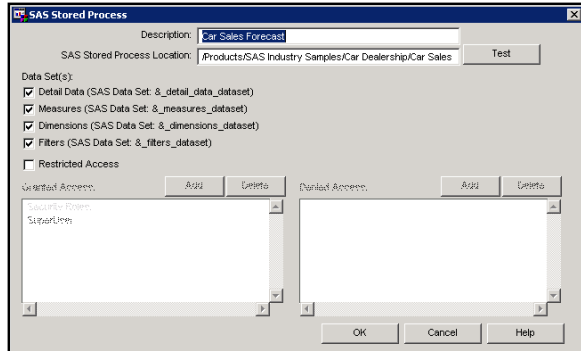


Figure 27 - SAS Stored Process Integration

There are four global macro variables that can be captured from the resulting data on the BINOCULARS report. **&\_detail\_data\_dataset** (resulting detail data set), **&\_measures\_dataset** (list of displayed measures), **&\_dimensions\_dataset** (list of displayed dimensions), and **&\_filters\_dataset** (list of any applied filters). These macro variables, when utilized in a SAS Stored Process, can be linked together dynamically. The following screenshot shows a time-series forecast that was created in SAS Enterprise Guide and SAS/ETS®. Using the global macro variables, the stored process can dynamically produce the forecast measure (in this example, # Cars) by using the first measure found in the table. It can also customize the title on the fly by capturing any filtered parameters (in this case, Year NOT = 2000, Gender NOT = Male).

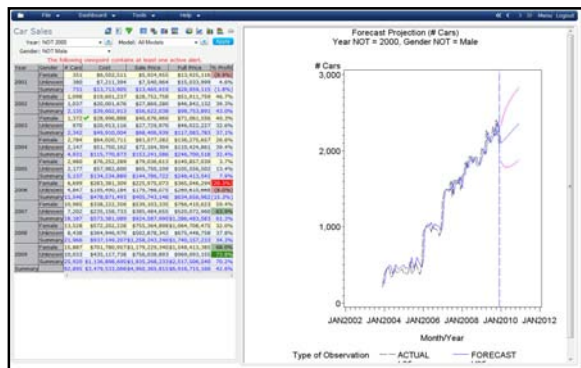


Figure 28 - SAS Stored Process Linked to Table

### Users Stored in the SAS Metadata

The external user database feature allows integration of the organization's existing security database with BINOCULARS. Rather than re-registering each user in BINOCULARS, using this feature enables BINOCULARS to connect to the external security database for this information instead.

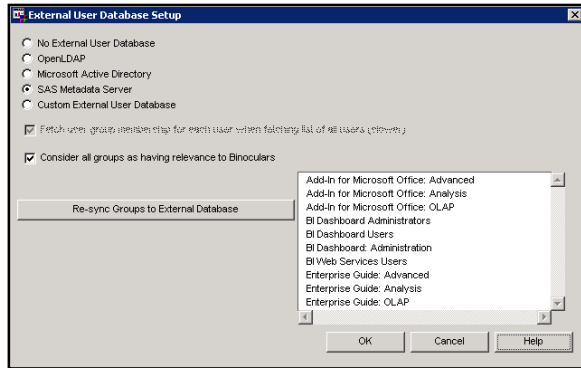


Figure 29 - External User Database Setup

The External User Database Setup window is used to configure access to an external user database. Standard implementations are provided for BINOCULARS LDAP Integration with OpenLDAP<sup>3</sup> and Microsoft<sup>®</sup> Active Directory<sup>4</sup>, and access to user groups defined in SAS Metadata Server but if the business security data is located elsewhere, there is also the option of implementing a custom interface to that security data.

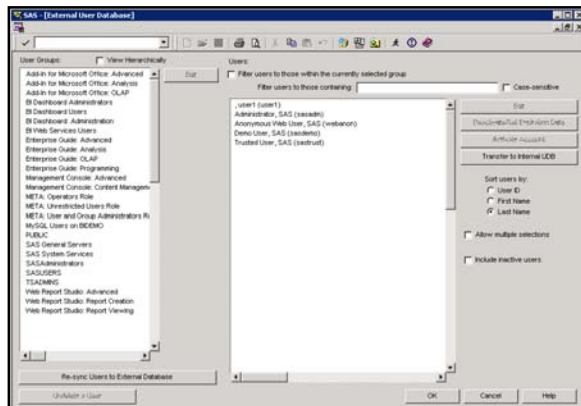


Figure 30 - Importing SAS Groups and Users

## CONCLUSION

Creating dynamic web reports and portals can be a difficult and challenging process. With BINOCULARS, the ability to empower end-users to create their own reports offers several advantages over traditional systems that need to be built and maintained by IT groups. Since the interface of the application is intuitive and the skill-sets required for using the application is minimal, the process of building reports is greatly streamlined. End users can create content that exactly meets expectations rather than negotiating requirements and deliverables with the developers. Finally, integration with other SAS components such as the SAS Metadata Server, SAS OLAP Server, and SAS Stored Process Server can greatly enhance the product and provide a robust end-to-end application on the SAS platform.

## CONTACT INFORMATION

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## REFERENCES

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<sup>1</sup> Wikipedia OLAP:

[http://en.wikipedia.org/wiki/OLAP\\_cube](http://en.wikipedia.org/wiki/OLAP_cube)

<sup>2</sup> Futrix product page:

<http://futrix.com/products>

<sup>3</sup> Wikipedia OpenLDAP:

<http://en.wikipedia.org/wiki/Openldap>

<sup>4</sup> Microsoft Server 2003 Active Directory:

<http://www.microsoft.com/windowsserver2003/technologies/directory/activedirectory/default.msp>