Enrich Your SAS® Reporting with SAS® Predictive Analytics

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ABSTRACT ENRICH YOUR SAS® REPORTING WITH SAS® PREDICTIVE ANALYTICS

The SAS® Reporting clients have many out-of-the-box capabilities that fully meet most reporting requirements. While most reporting tools are limited to the out-of-the-box capabilities, SAS Reporting can leverage the powerful underlying SAS® programing language to supplement those standard capabilities. Think of it as your "get out of jail free" card. This paper shows you how to leverage SAS full predictive analytics capabilities in SAS Reporting including SAS® Information Maps, SAS® Web Report Studio, SAS® BI Dashboard, and the SAS® Information Delivery Portal.

INTRODUCTION

SAS Reporting provides a platform for both production reporting and ad-hoc analysis for all users across an organization. Business users have access to static and interactive reports through a browser-based interface as well as directly within Microsoft Office (Excel, PowerPoint, Word, and Outlook). One of the key differentiators for SAS Reporting vs. other reporting tools is that it is built on the SAS engine, which opens the full power of the SAS programming language for building reports that meet complex reporting requirements as well as exposing powerful predictive analytics capabilities to business users without requiring any specialized training. This paper will describe how to fully leverage the power of SAS within the reporting environment, whether it's by augmenting the out-of-the-box capabilities to meet specific business requirements or by integrating predictive capabilities so business users can do more advanced ad-hoc analyses.

SAS® STORED PROCESSES

There are different ways to leverage custom SAS programs and analytics within SAS® Business Intelligence. One of the main constructs that enables this is SAS® Stored Processes. A SAS stored process is a SAS program that is hosted on a SAS server and registered in SAS metadata. There are several different ways to integrate SAS Stored Processes within SAS Reporting to enhance your reports while making it seamless to the end user. This enables the SAS Reporting developer to leverage SAS capabilities that may not be directly available with the out-of-the-box capabilities in the Reporting client. This is a tremendous advantage for organizations that already have an investment in SAS and have existing intellectual property in SAS applications. These applications can be easily made available to a broader user base by leveraging the SAS Reporting environment without rebuilding them. For organizations or departments that are new to SAS, they can leverage SAS® Enterprise Guide® and its 60-plus wizard-driven tasks to build analytic applications that leverage the full power of SAS data management, analytic, and reporting capabilities. These new analytic applications can be easily saved as a SAS stored process and leveraged by SAS Reporting.

Why Integrate SAS Analytics in SAS Business Intelligence?

Advanced analytics are typically reserved for the back office at most organizations, but making powerful predictive analytics available for business users will give them better insight to make proactive decisions in addition to simply reacting to historical trends. Most business users only have access to reports with information about current or past business performance or to static results from the output of work done by the statisticians or predictive modelers. SAS Reporting gives business users the ability to run their own analytics on the fly or to do their own what-if analyses driven by powerful predictive analytics.

If you are currently using SAS BI, but not leveraging the underlying analytic capabilities, you are missing out on a powerful capability to empower your business users to make better business decisions. If you are currently using SAS for data management or analytics, but are not using SAS BI, then you are missing out on the ability to extend the power of SAS to a much broader user community through a self-service environment where business users can run their own analyses without always going back to the SAS programmer for updates.

Integrating Analytics with SAS BI Dashboards

SAS Reporting provides a Flash-based browser interface for both building and viewing SAS Enterprise dashboards. Developers can easily and quickly build pixel perfect dashboards with Key Performance Indictors that are highly interactive. This interactivity allows the users to do their own analysis to find the insight they need to make fact-based decisions. In addition to leveraging SQL and MDX to access corporate data sources, dashboards can also leverage the powerful SAS language to access and process data. This gives dashboards the ability to show forward-looking predictive information as well as historical views of past performance. This includes basic statistics, forecasting,

predictive models and optimization. SAS Stored Processes can be leveraged by dashboards in a couple of different ways. A stored process can be used to pre-process the data that is then fed into one of the out-of-the-box dashboard visualizations. This enables dashboard developers to leverage the SAS DATA step and procedures to produce data on the fly for the dashboard as opposed to pre-processing this in batch and storing the results. SAS Stored Processes can also be used to create custom visuals to augment the out-of-the-box visuals.

SAS BI Dashboard Examples

Custom Display Type Generated by a Stored Process

SAS BI Dashboard comes with many out-of-the-box visualizations for displaying data including traditional line and bar charts, gauges, and more advanced visuals (like tile charts, spark line tables, waterfall charts and scatter plots). Dashboard developers can design additional visualizations by leveraging a Custom Graph display type that runs a SAS stored process to dynamically generate the visualization. The example in Figure 1 shows a geographic map that's dynamically created by a SAS stored process that leverages SAS PROC GMAP.

Figure 1

You can create this stored process in SAS Enterprise Guide or by writing the SAS program manually and registering it as a stored process. To enable this to display in the SAS BI Dashboard, the stored process must utilize the Output Delivery System (ODS) to generate an image file (for example, GIF, JPEG, TIFF, BMP, and PNG). You'll need to make the following modifications to the stored process:

```
goptions gsfname=_webout gsfmode=replace;
        goptions device=png;
```

To leverage this stored process in the SAS BI Dashboard, you create a new indicator in the dashboard designer and choose the Custom Graph display type. In the properties for the indicator, you specify the URL to the stored process in the image URL box. You can find the URL for the stored process in the Stored Process Web Application. Here's the URL for the stored process in Figure 1.

http://sasbi.demo.sas.com:8080/SASStoredProcess/do?_action=form,properties,execute,nobanner,newwindow&_program=%2FOrion+Star%2FSales+Department%2FStored+Processes%2FUSGeoSales_Map2

By leveraging stored processes and the underlying SAS language, there are numerous custom visualizations that you can add to a SAS BI Dashboard. Other examples are box and whisker plots, graphs with multiple axes, 3D surface plots, histograms, and vein diagrams among others. Robert Allison has many examples of custom graphs created with SAS/GRAPH® software at http://robslink.com/SAS/democd20/aaaindex.htm.

Custom Data Generated by a Stored Process and Displayed in a Standard BI Dashboard

SAS BI Dashboard uses SQL or MDX to query and summarize data to display in the dashboard. You can also use a stored process to process the data leveraging DATA step or SAS procedures to process the data and then display the data using one of the out-of-the-box display types. The dashboard example in Figure 2 allows the end user to select a state from a dropdown menu and then dynamically runs a stored process that forecasts sales for the selected state. The stored process returns the data and a standard Forecast Chart display type is used to display the results. Every time the user selects a different state, a forecast is run and the results are updated.
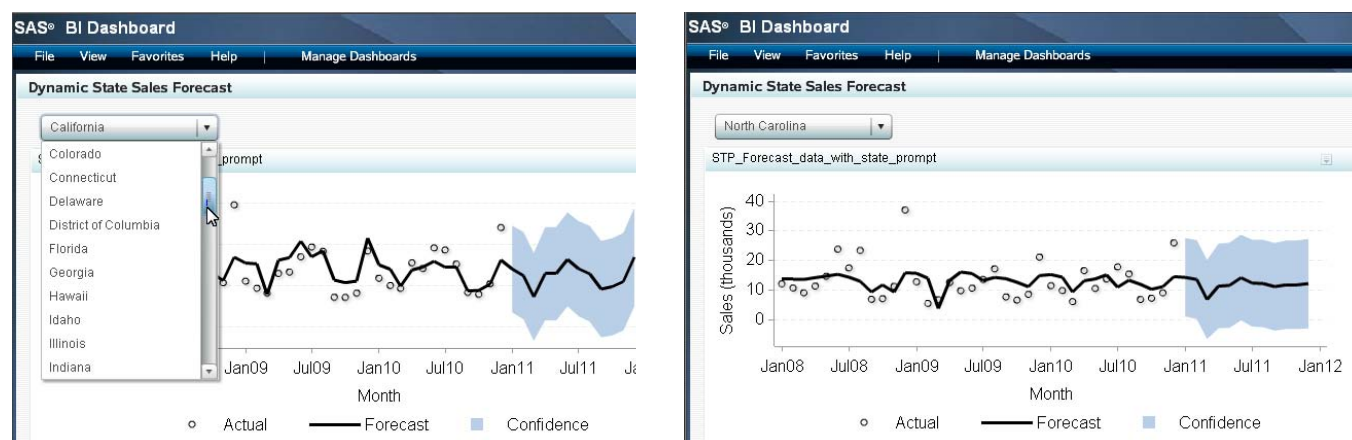
Figure 2

Custom code needs to be added to the stored process to create a package file that will be used by the SAS BI Dashboard to access the data:

```
data null;
rc = 0;
pid = 0 ;
desc = 0;
nameV = '';

call package_begin( pid, desc, nameV, rc);
call insert_dataset( pid, "WORK", "TRNSTransposedFCS0FORECASTQUERY_",
"Transposed Forecast Data", '', rc);

length fullpath $4096;
call package_publish(pid, "TO_ARCHIVE", rc,
                     "archive_path, archive_name, archive_fullpath",
                     "&_ARCHIVE_PATH", "&_ARCHIVE_NAME", fullpath);

call symput('_ARCHIVE_FULLPATH', fullpath);

call package_end(pid, rc);

run;
```

When you create the indicator data, you choose Stored Process as the Data Source type and then select the stored process that generates the data. For this example, Forecast Chart was chosen as the display type for the indicator.

Integrating SAS Analytics with SAS Web Report Studio

SAS Reporting provides a Web browser-based reporting interface for both production and ad-hoc reports. Developers can quickly and easily build reports off of Enterprise Data Structures like corporate data warehouses, reporting marts, OLAP cubes, and SAS data sets. SAS metadata is leveraged to simplify the view of the data by structuring the data in terms that the business user is familiar with as opposed to the way it's stored in the data warehouse. Joins between tables are pre-defined as well as business rules, calculations, prompts, and filters.   In addition to making it easier for business users to build reports, this also ensures that optimal SQL or MDX code is submitted to the underlying database for processing.

SAS Web Report Studio developers can easily create reports with embedded analytics and custom visualizations by including stored processes in the report or linking to a stored process. The stored process can be parameterized, giving the end user the option to apply their own filters to run their own custom analytics.

SAS Web Report Studio Examples

Custom Geographic Map and Sales Forecast Are Included on the Same Page as Standard Graphs

SAS Web Report Studio makes it easy to insert SAS Stored Processes directly on the same page as standard SAS Web Report Studio graphs and tables. When you edit a report, you can simply drag a stored process object onto any cell in the report layout grid and then select the specific stored process from metadata. In the example shown in Figure 3, I have inserted two stored processes. The first one creates a geographic map of the United States that shows sales color-coded by state. The second stored process generates a sales forecast. These stored processes can include parameters so that the users are prompted to enter values to control the information that is being returned. SAS Stored Processes makes it easy for the report developer to augment their reports with custom visuals or to imbed predictive analytics.

Figure 3

Standard Web Report Linked to Another Report that Dynamically Runs a Forecast for the Selected State and Product Line

The report example in Figure 4 shows sales values for 2010 by state and product line. The users can right-click on any value in the table and run a dynamic forecast to show what sales will be for the next 12 months for the selected state and product line. This is enabled by building two reports: the first report is a standard SAS Web Report Studio report and the second is a report with an embedded stored process that generates the sales forecast. Report linking can be used to link the first report to the second report and define the parameters to pass to the second report and its stored process. This gives the end users the powerful capability to dynamically run their own custom forecasts.

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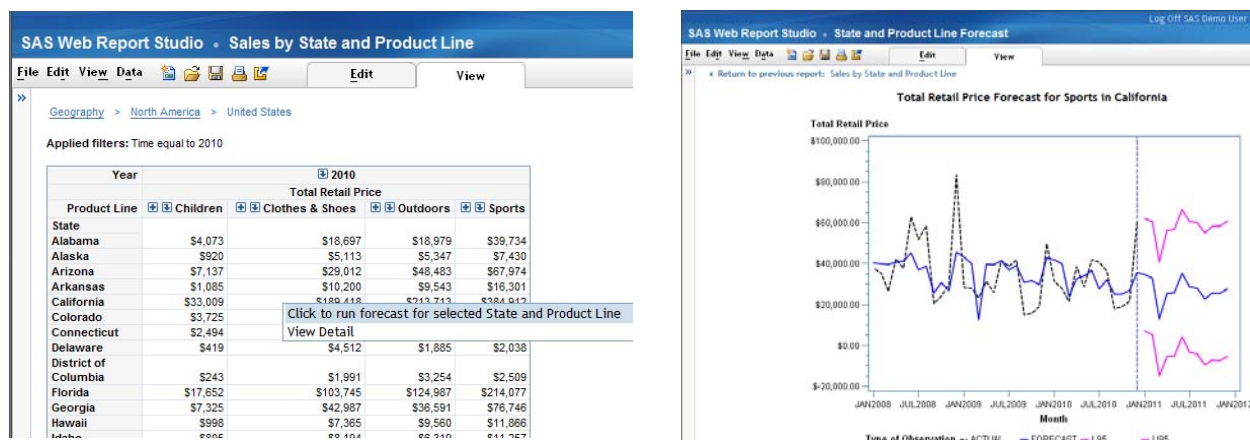
Figure 4

Integrating SAS Analytics with SAS Information Maps

SAS Information Maps are typically leveraged to simplify the view of the data by restating the data in terms that the business user is familiar with as opposed to the way it's stored in the data warehouse. In addition to relational data and OLAP data, SAS Information Maps can be built on top of SAS Stored Processes. This enables the data to be processed dynamically by leveraging the power of SAS and then providing the data to the end users, so they can perform their own analysis of the results. This enables the reporting developer to meet complex reporting requirements that cannot be met by traditional SQL or MDX.

SAS Information Map Example

Multi-Pass Ranking Example

Some organizations rank their sales agents based off of various sales and performance metrics and their ranking ultimately determines their sales commission. For example, a call center may rank their employees based off of a combination of calls handled, sales for a specific product, and sales overall, but they may want to weight these individual components differently. This can be accomplished by leveraging SAS Stored Processes to process the data that's then fed to SAS Web Report Studio. This can be parameterized so the reporting user can dynamically select the agents they want to rank. The first step is to create the stored process that will process the ranking. In the example in Figure 5, the data is processed by four specific steps. The first step ranks the agents for each individual metric. The second step creates a weighted combination of the individual metrics as some are considered more important than others. The third step ranks the agents on the new combined weighted metric. The last step adds some additional calculations to the output data that will be fed to the information map. This process flow is then registered as a stored process, with parameters that let the users select the call center site and the sales teams to include in the ranking.
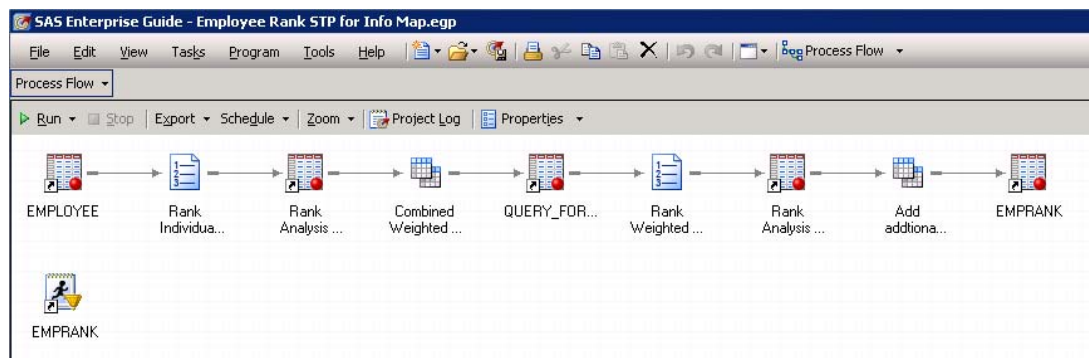
Figure 5

After the stored process has been created, the next step is to create the information map, register the information map contents from a physical table, and then add the stored process to the information map so it is used to process the data instead of the standard SQL.
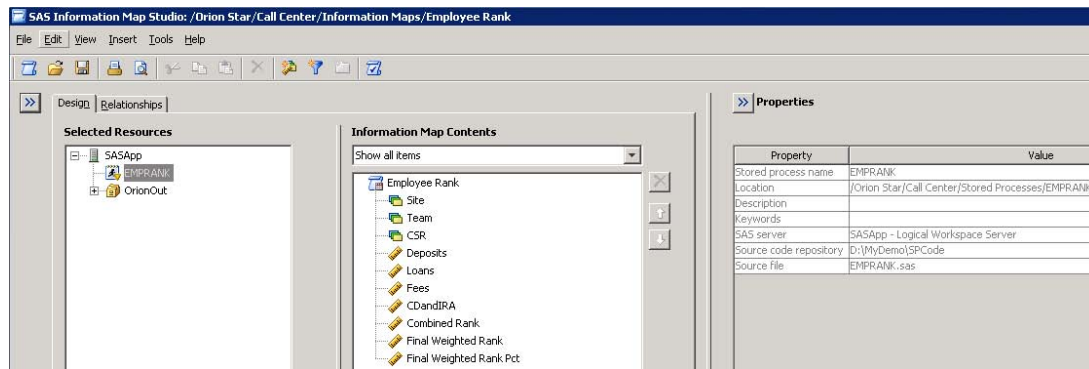
Figure 6

Now end users can create their own reports from the information map in SAS Web Report Studio. When the user runs the report, they are prompted to select the site and list of sales teams to include in the ranking, Figure 7. These filters are passed to the stored process, which then ranks the selected agents.
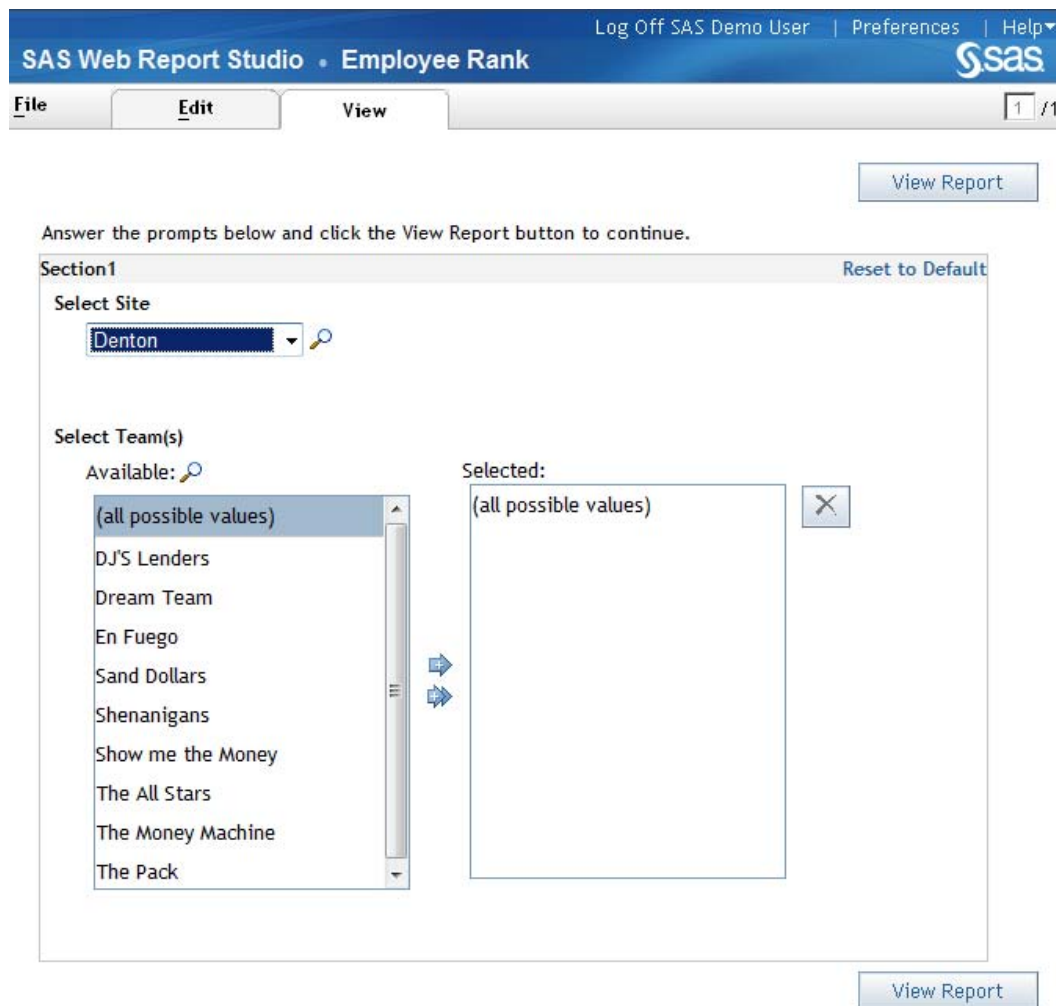

Figure 7

Because this report is built from an information map as opposed to directly from a stored process, the results are interactive for the user. For example, the user can sort or filter the data based on any of the columns, Figure 8.

Figure 8

Integrating SAS Analytics with the SAS Information Delivery Portal

The SAS Information Delivery Portal is a Web-based portal that can serve as the standard access site for all SAS Reporting content. Each group or user can have their own custom site, with content and layout that meets their specific requirements. With the SAS Information Delivery Portal, you can deliver custom analytic applications to business users so they can perform their own what-if analyses. This can be done by simply leveraging SAS Stored Processes with prompts for the users to provide input or by designing custom Web pages that provide more control over the layout of the input and output screens and make it more intuitive for the end user.

SAS Information Delivery Portal Example

The following shows an example of a custom what-if analysis that is created with custom HTML pages and SAS Stored Processes. Figure 9 shows the input screen that allows you to select a data set, the dependent and independent variables, the date variable, the time interval and the number of intervals to forecast. In this example, I've chosen to forecast Revenue Growth by month for 6 months, and I've chosen Absence Rate, One Call Resolution Rate, and Turnover Rate as my input variables.

Figure 9

When I click Forecast, the inputs are sent to a stored process that creates the forecast. In Figure 10 I can see that the forecast is pretty flat for the next 6 months. Below the graph is a table that shows the forecasted values for Absence Rate, One Call Resolution Rate, and Turnover Rate for the next 6 months. I can now make changes to these values and do my own what-if analysis to see what the impact will be on the forecasted Revenue Growth.
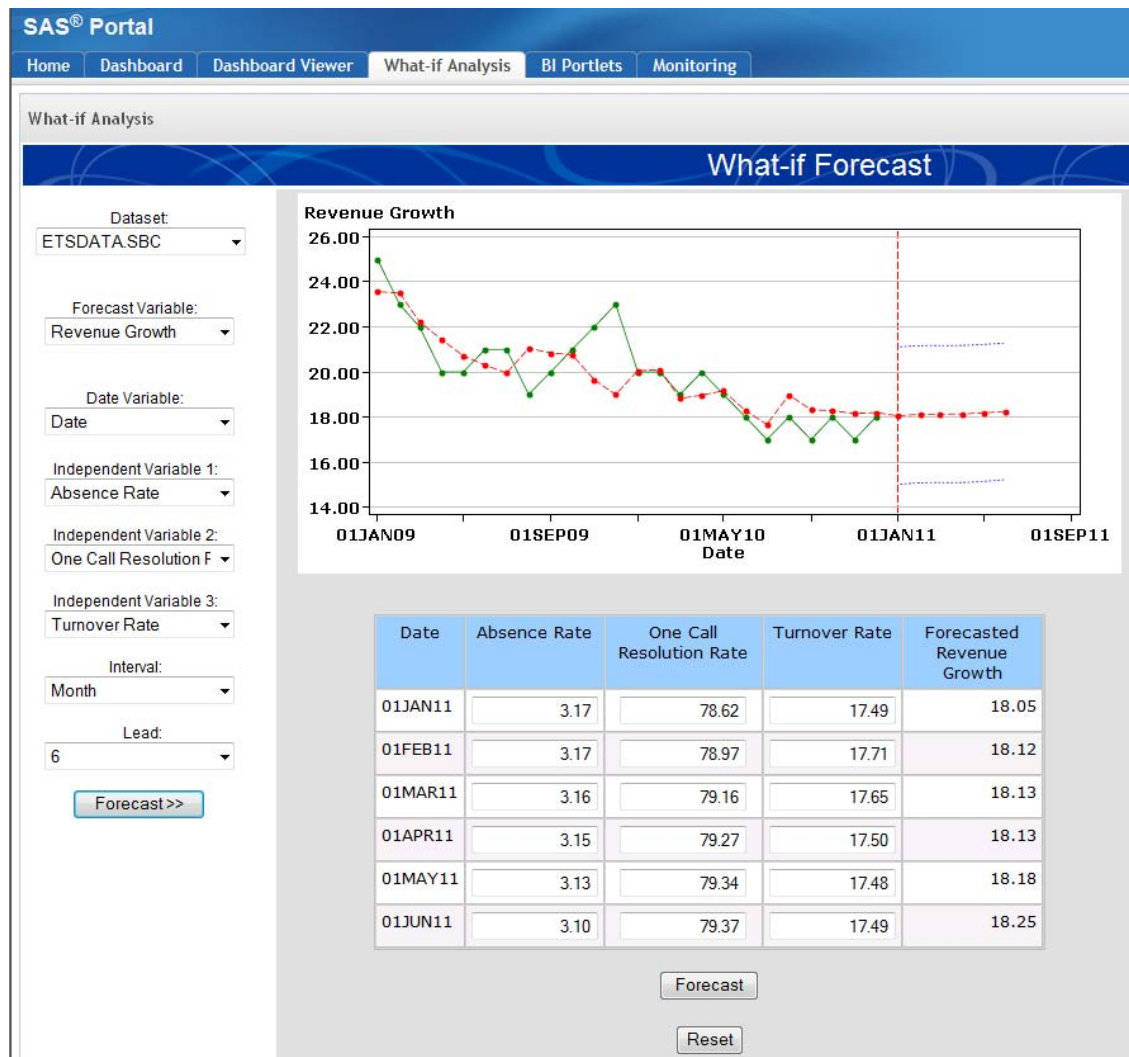
Figure 10

I'll change the Absence Rate to 2.8, the One Call Resolution Rate to 80, and the Turnover Rate to 17 for the month of June. When I click Forecast, it sends these updates to a stored process that recalculates the forecast for Revenue Growth. In Figure 11, I can see that the forecasted value for Revenue Growth has increased to 18.92%. This type of analysis enables business users to do their own what-if analysis so that they can better understand the correlation between the variables and what they can do to improve performance.
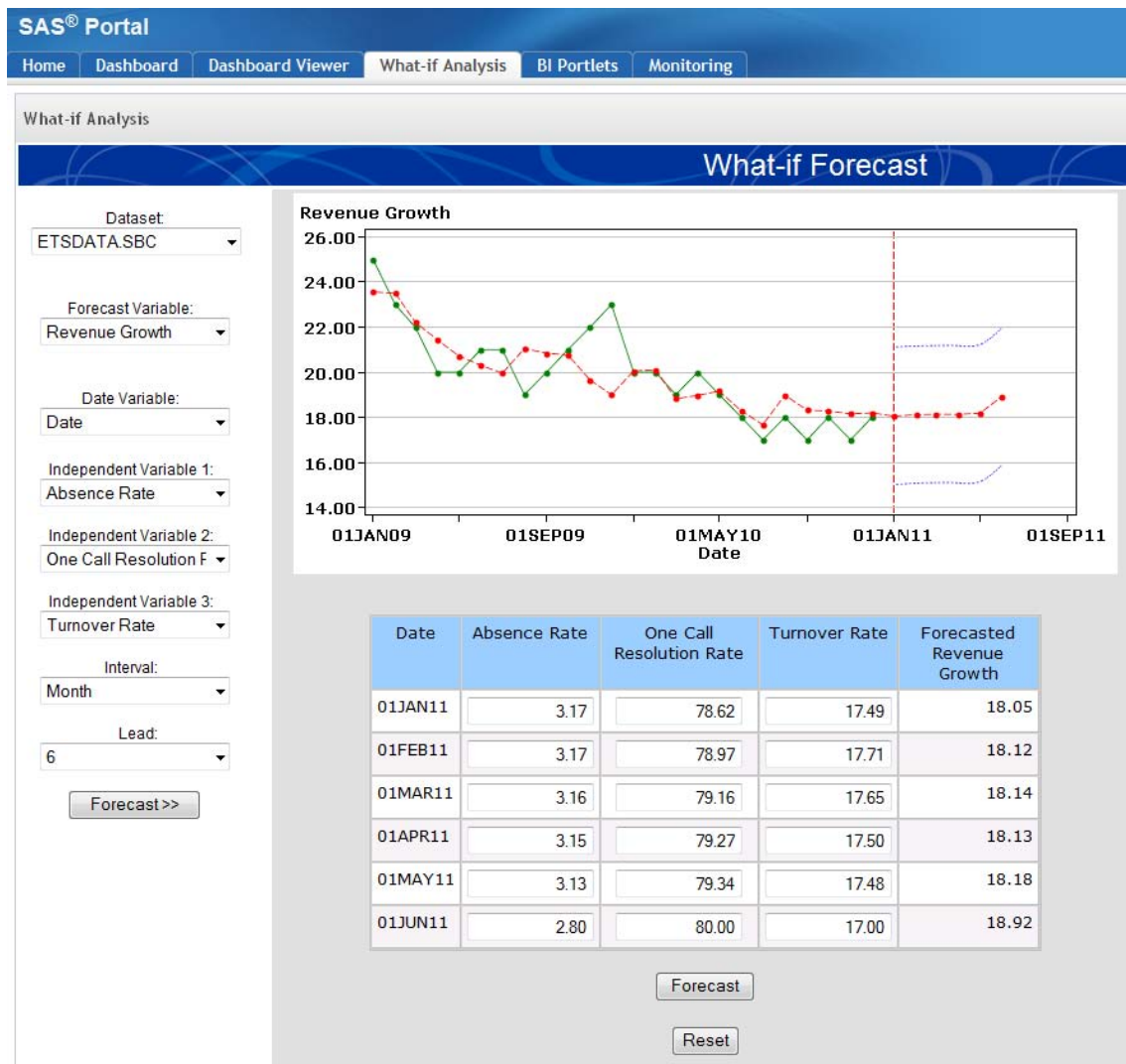
Figure 11

Integrating SAS Analytics with SAS Add-In for Microsoft Office

SAS Reporting is fully integrated with Microsoft Office including Excel, Power Point, Word and now Outlook. This integration provides business user's access to the full power of SAS data access, reporting and analytics directly in these familiar and commonly used tools.

With SAS Add-In for Microsoft Office, There Are Three Ways to Integrate Predictive Analytics

Business analysts can use SAS tasks in Microsoft Excel, PowerPoint, and Word to create new predictive analytics. This includes descriptive statistics, forecasts, predictive models, and optimizations as well as other predictive analyses. Figure 12 shows a list of the descriptive statistic tasks that are available. In this example, the Summary Statistics wizard is used.
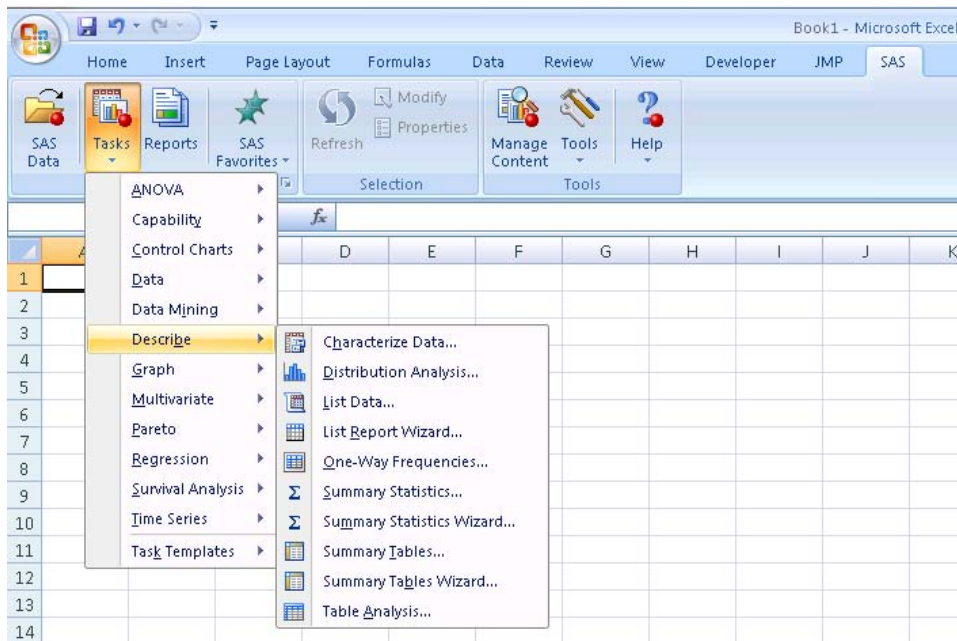
Figure 12

Figure 13 shows two of the steps available in the wizard. In step 2, you can choose the analysis variables and the classification variables. In step 3, you choose which descriptive statistics as well as which graphics to include in the output.
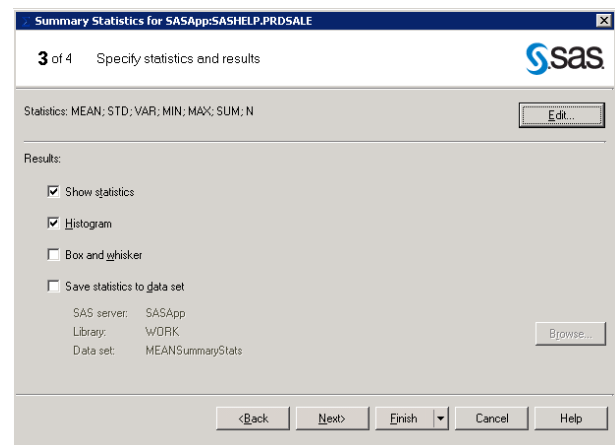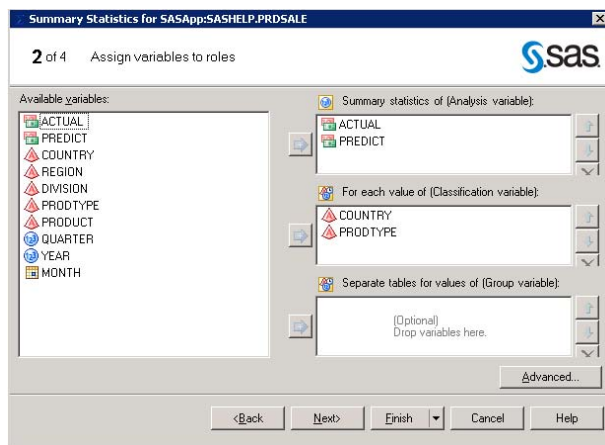

 Figure 13

You can also specify where to place the results in the Excel spreadsheet. Figure 14 shows the resulting table of summary statistics and distribution graphs.
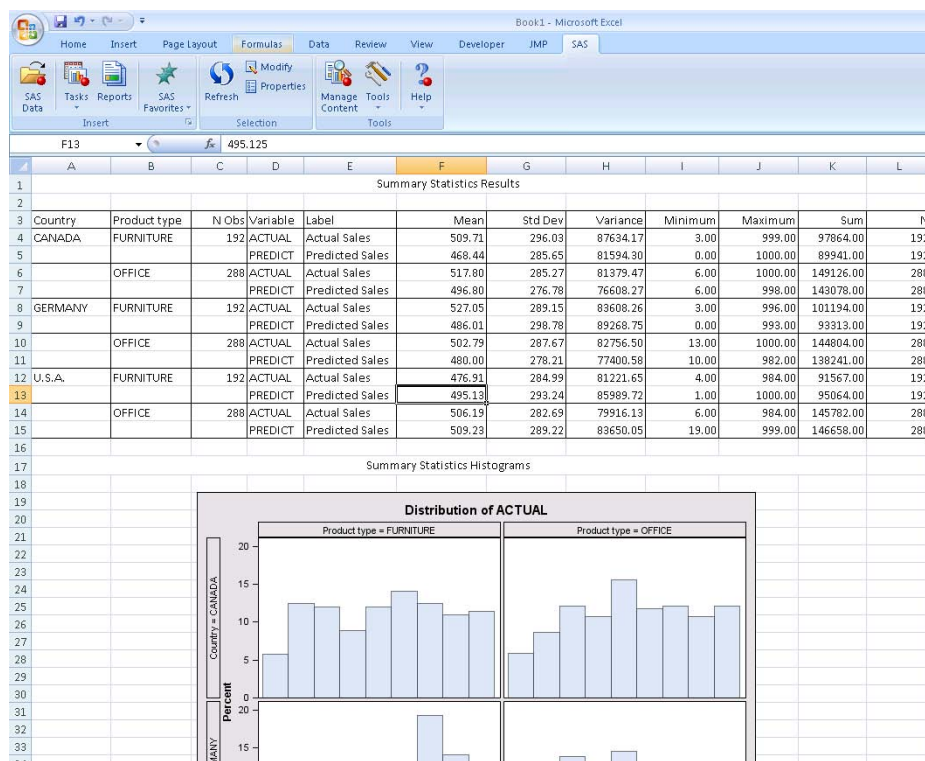
Figure 14

Another way to leverage analytics in Microsoft Office is through SAS Stored Processes. SAS Stored Processes can make predefined predictive analytics available to business users. Figure 15 shows the list of available SAS Stored Processes. In this example, the Excel Forecast is being run.
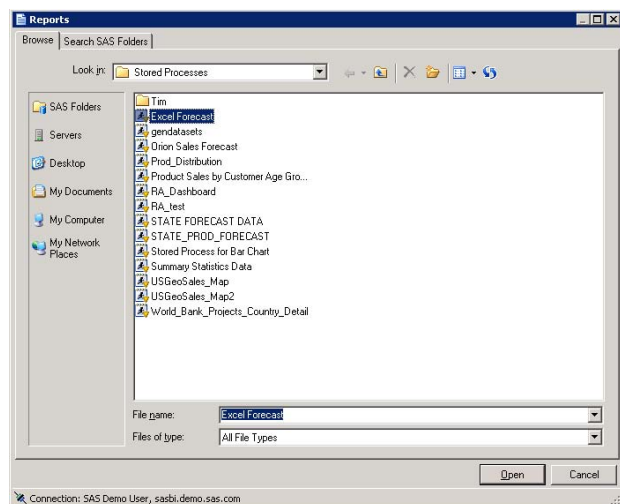

Figure 15

Excel gives you the added ability to provide the data that will be used by the stored process. In the example in Figure 16, you specify the Input Data Source which is the data that will be fed from the spreadsheet to the stored process for processing as well as where to place the results in the spreadsheet.
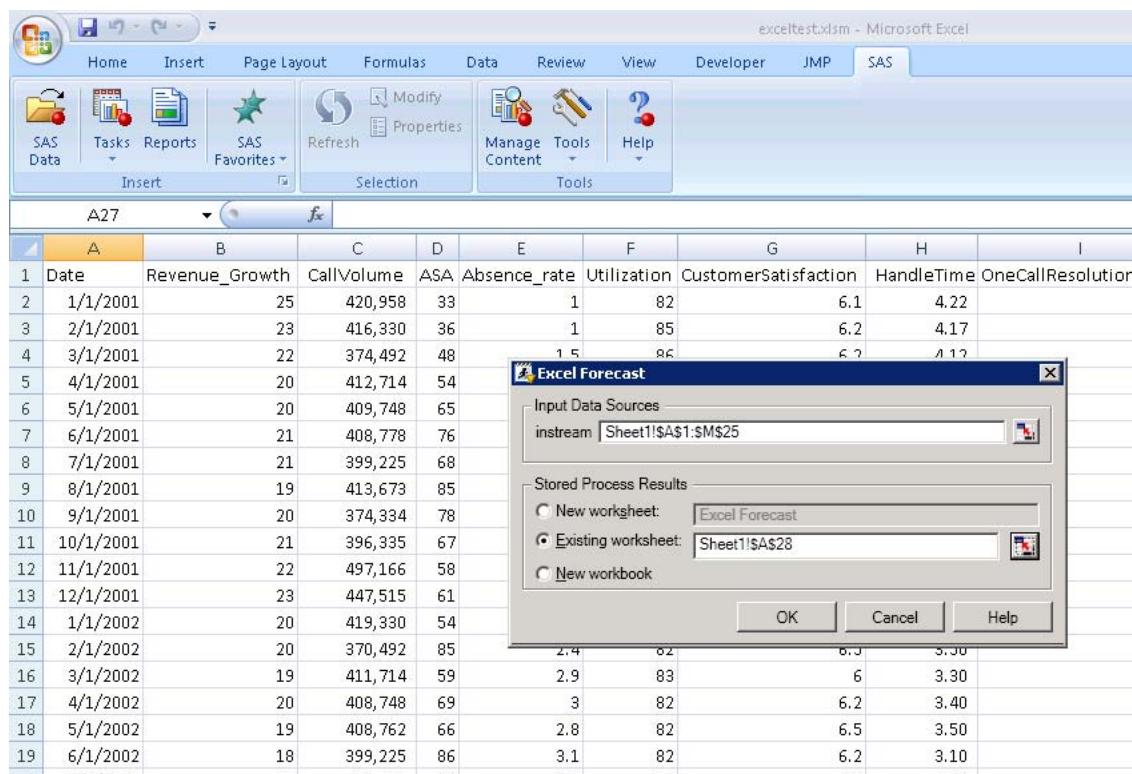
Figure 16

Figure 17 shows the resulting forecast for Revenue Growth placed on the same spreadsheet as the input data.
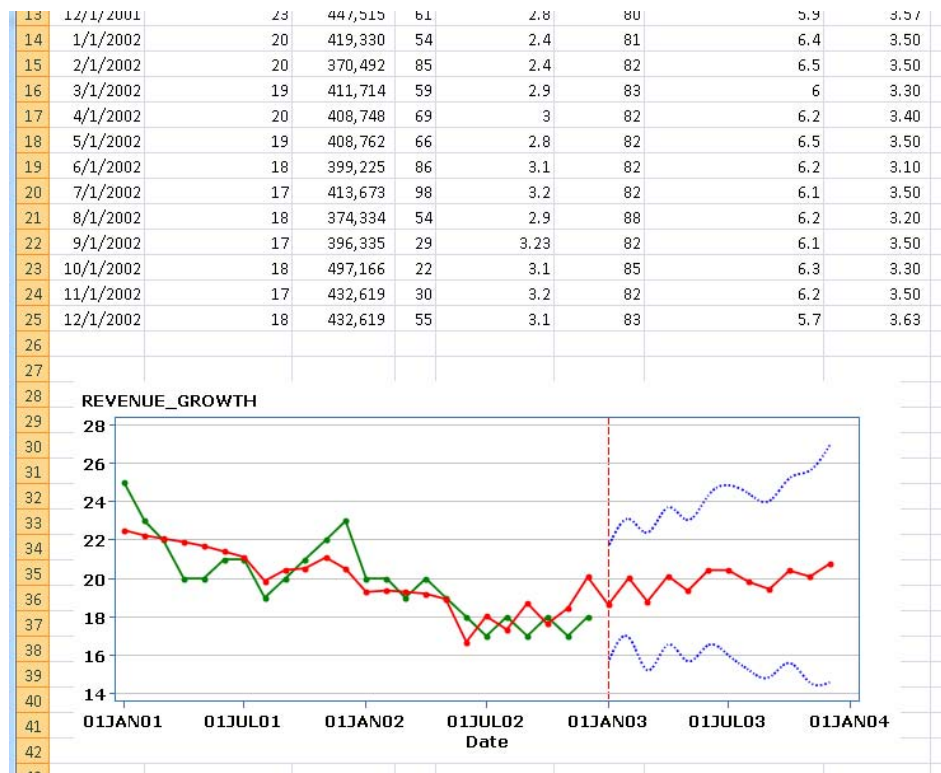

Figure 17

SAS® Enterprise Miner™ 6.1 has a new feature called Rapid Predictive Modeler, which enables business users to create predictive models from SAS® Enterprise Guide® or Excel using the SAS® Add-In for Microsoft Office. With SAS Rapid Predictive Modeler, business analysts and subject-matter experts with limited statistical expertise can quickly generate their own predictive models based on their specific needs and business scenarios. This enables a wide range of individuals to use and benefit from predictive analytics without always having to rely on a potentially limited pool of overburdened analytic resources. SAS Rapid Predictive Modeler automatically guides users through a behind-the-scenes workflow of data preparation and data mining tasks, enabling them to generate their own models, derive on-demand insights, and act on them to solve business problems quickly and effectively.

More details can be found in the SGF 2010 paper "Rapid Predictive Modeling for Customer Intelligence" by Wayne Thompson and David Duling at http://support.sas.com/resources/papers/proceedings10/113-2010.pdf

CONCLUSION

SAS Reporting has many easy-to-use interfaces and out-of-the-box capabilities that enable business users to access canned reports and do their own ad-hoc reporting. Some complex reporting requirements may require customized reports. SAS Reporting provides a great deal of flexibility in customizing reports by leveraging SAS Stored Processes. This enables the reporting developer to easily leverage the powerful SAS programing language to dynamically process data, create custom visualizations, or embed predictive analytics. SAS is the analytics standard for many organizations. SAS Reporting enables organizations to make their existing predictive analytic applications directly available to a broader audience of business users by embedding analytics in easy-to-use reporting interfaces. This provides business users with the ability to do their own what-if analyses based on predictive analytics, so they can make more informed business decisions.

REFERENCES

Allison, Robert. "Robert Allison's SAS/Graph Examples!" Available at http://robslink.com/SAS/Home.htm

Beese, Tim. 2011. "Tips and Techniques for Automating the SAS® Add-In for Microsoft Office with Visual Basic for Applications." *Proceedings of the SAS Global Forum 2011 Conference*. Cary, NC: SAS Institute Inc.

Chitale, Anand V. 2011. "Turbo-Charging Your Microsoft Office Environment with SAS® Add-In for Microsoft Office 4.3." *Proceedings of the SAS Global Forum 2011 Conference*. Cary, NC: SAS Institute Inc.

Thomas, Michael, and Gordon Hirsch. 2010. "Interactive Dashboards: Powered by Flash and the SAS® Programmer." *Proceedings of the SAS Global Forum 2010 Conference*. Cary, NC: SAS Institute Inc. Available at http://support.sas.com/resources/papers/proceedings10/045-2010.pdf

Thompson, Wayne, and David Duling. 2010. "Rapid Predictive Modeling for Customer Intelligence." *Proceedings of the SAS Global Forum 2010 Conference*. Cary, NC: SAS Institute Inc. Available at http://support.sas.com/resources/papers/proceedings10/113-2010.pdf

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