Predictive Analytics 123 Guide

PV620 SV103

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Overview

Predictive Analytics 123 provides a forecast baseline based on historical data patterns. The solution cycles through multiple statistical forecast methods based on seasonality and trend to determine the most accurate forecast. It creates and presents models to support forecasting, prediction, and what-if analysis to determine the most appropriate forecast scenario.

Some key points to know about Predictive Analytics are:

• No use of external variables for predictive enhancement

• Uses past target values (history) to produce future results. Example: Using the last 2 years of monthly total sales values to produce estimates for each of the next 6 months.

> **NOTE:** The more volatile the historical data the more likely the model is to produce negative values in the forecast.

• Includes 12 base algorithms

• Each run has 10+ variations of models

• ARIMA models require 48 months of historical data

• Easy to interpret and understand

> **IMPORTANT:** Predictive Analytics 123 is more effective when run on dense historical data. If you have months in your historical data that are missing a value, you should input a zero in that month.

Getting Started

Use the following information to understand prerequisites and dependencies, plan your installation, and configure the database server.

> **NOTE:** Before beginning setup, verify that the SQL server has table creation rights on the SQL database to create the custom tables.

Software Dependencies

This table describes external software dependencies:

Component	Description
OneStream App for Windows	Predictive Analytics 123 is optimized to run in the OneStream App for Windows.

Select the Predictive Analytics 123 Development Location

Before beginning installation, decide whether to build the solution directly in the Production OneStream application or in a separate Development OneStream application. This section provides some key considerations for each option.

Production OneStream Application: The primary advantage of building the solution in a Production application is that you will not have to migrate the resulting work from a Development application. However, there are intrinsic risks when making design changes to an application used in a Production capacity and not advised.

> **NOTE:** OneStream strongly recommends that you implement the solution in the Development environment with a fresh copy of the Production application before starting work.

Development OneStream Application: As a best practice, use the Development OneStream application to build the solution.

See Also: Modifying MarketPlace Solutions

Create the OneStream Development Application

1. Ensure that all the OneStream artifacts relating to Predictive Analytics 123 such as **Workflow Profiles** and **Entities** are in the Production application.
2. Copy your Production OneStream application to your Development environment and rename it. This Development version will be used for your Predictive Analytics 123 project.

Application Server Settings

> **IMPORTANT:** OneStream cloud-based installations require users to log a support ticket. Contact OneStream Support for assistance.

You may need to edit the OneStream Application Server Configuration so users can create and change data in the additional database tables. If other MarketPlace solutions (such as Specialty Planning) are already in the application, these adjustments may already exist.

Configure the OneStream Application Server

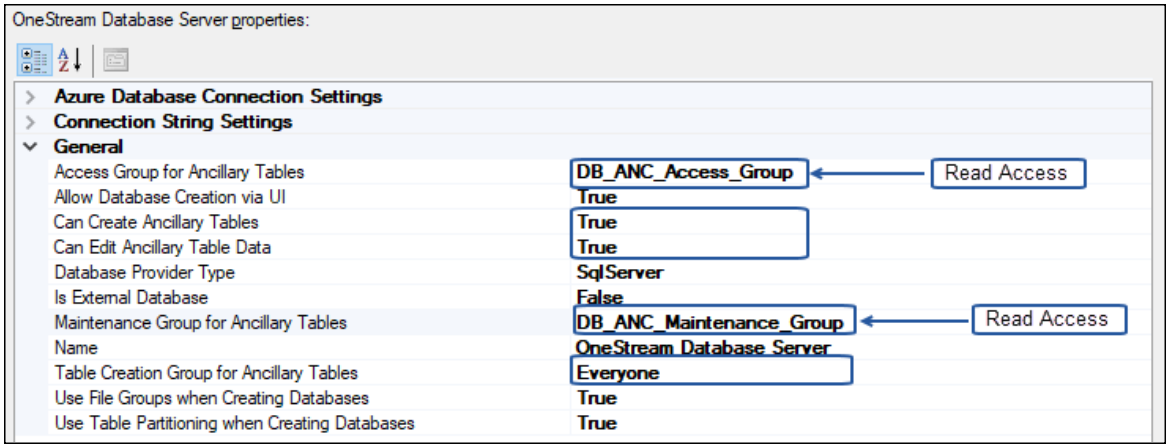
Be sure that the security group settings include the users who work on and set up the solution before proceeding.

> **NOTE:** Group settings are applicable to all MarketPlace solutions; it is important to keep the group names generic.

1. Start the OneStream Server Configuration Utility as an Administrator.
2. Click **Open Application Server Configuration File > Database**.
3. Edit the following **OneStream Database Server properties**:

- **Access Group for Ancillary Tables**: Select a group that includes those who will access records.
- **Can Create Ancillary Tables**: True
- **Can Edit Ancillary Table Data**: True
- **Maintenance Group for Ancillary Tables**: Select a group to edit and maintain tables.

- **Table Creation Group for Ancillary Tables**: Select a group who can create tables.



4. Restart Internet Information Server.

Install Predictive Analytics 123

1. From the OneStream MarketPlace Dashboard, click **Solutions Exchange** > **Predictive Analytics 123**.

2. On the Predictive Analytics 123 Solution page, select your OneStream platform version from the **Minimum Platform Version** dropdown list.

   This selection displays the appropriate solution version in the next box.

3. Select the most recent version from the **Solution Version** drop-down list and click **Download**.

4. Log in to OneStream.
5. On the **Application** tab, click **Tools** > **Load/Extract**.
6. On the **Load** tab, locate the solution package using the **Select File** icons and click **Open**.
7. When the solution's file name appears, click **Load**.
8. Click **Close** to complete the installation.

Predictive Analytics 123 Setup

The first time you run Predictive Analytics 123, you are guided through the table setup process.

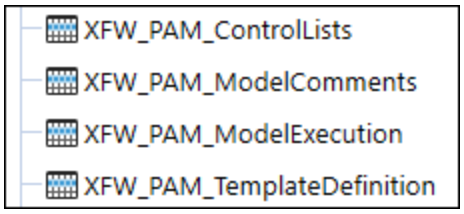
1. In OneStream, click **OnePlace** > **Dashboards** > **Predictive Analytics 123** > **Predictive Analytics 123**.

   Step 1: Setup Tables
   This step may be necessary when upgrading even if tables are already present. Predictive Analytics 123 will not drop any tables that already exist but will modify table structures and add any new ones if necessary.

2. When setup is complete, click **Step 2: Launch Solution** to begin.

Dashboard Maintenance Unit

XFW Predictive Analytics 123 (PAM)
The Dashboard Maintenance Unit provides the user interface for Predictive Analytics 123 and includes the Dashboard Groups, Components, Data Adapters, Parameters, and Files used to build the solution.



Business Rules

Business Rule	Description
PAM_DataMgmt	Extensibility Business Rule that manages the execution of the Run All functionality.
PAM_ HelperQueries	Dashboard Dataset Business Rule that provides various data helper functions for populating charts, grids, and BI Viewer components.
PAM_ ParamHelper	Dashboard XFBR String Business Rule that provides conditional parameter processing functions that allow a parameter value to be interpreted and substituted with a different string.
PAM_ SolutionHelper	Dashboard Extender Business Rule that provides various helper functions for Predictive Analytics 123 such as management of the solution setup, configuration settings, and management of Predictive Models.

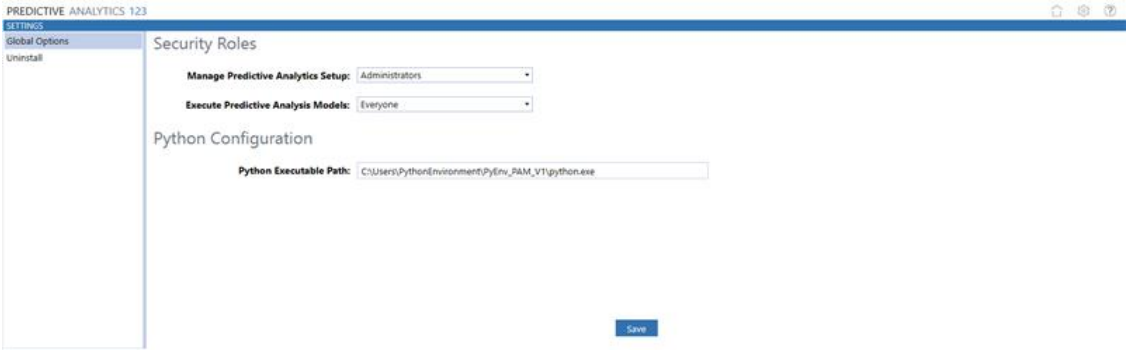
Settings

The **Settings** page contains the Global Options tab where you set key properties that guide Predictive Analytics 123 administration. It also contains Uninstall options.

All global option settings are retained during solution upgrades.

Global Options

The **Settings** > **Global Options** page should be one of the first pages visited when configuring Predictive Analytics 123.



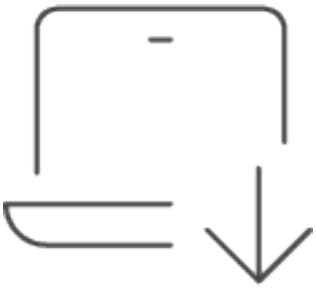
NOTE: This file path will need to be obtained correctly from the Cloud team.

Assign User Group to Security Roles

1. On the **Settings** page, click **Global Options** and select the user group from the dropdown list for each Security Role (the default value for all security roles is Administrators).
2. Click **Save**.

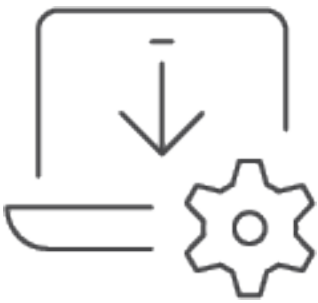
Security Role	Description
Manage Predictive Analytics Setup	Users in Predictive Analytics 123 are administrators who can manage security settings in the Global Options page and access the Setup page to create, edit, or delete templates.
Execute Predictive Analysis Models	Users can Run, Clear, and Delete models.

Predictive Analytics 123 Uninstall Options



Uninstall UI removes Predictive Analytics 123, including related dashboards and business rules but leaves the database and related tables in place. Use this option to accept a Predictive Analytics 123 update without removing the data tables. The Predictive Analytics 123 Release Notes will indicate if an overinstall is supported.

For some releases, this step should be performed before accepting any new version of Predictive Analytics 123 since some of the Dashboard or other objects may have been renamed. Note that some Global Options will also be cleared as their values are stored in Parameters under Dashboards.



Uninstall Full removes all the related data tables, all data, Predictive Analytics 123 Dashboards, and Business Rules. Use this option to completely remove Predictive Analytics 123 or to perform an upgrade with enough significant changes to the data tables that this method is required.

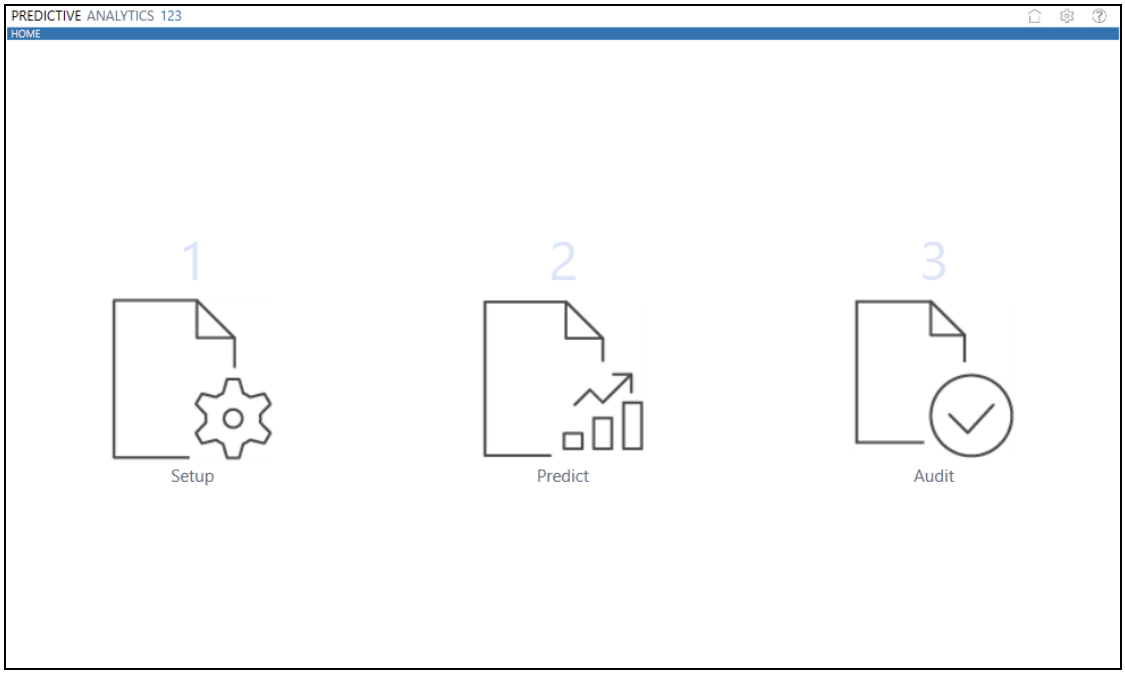
CAUTION: The Uninstall procedure cannot be reversed.

Home

The **Home** page contains Setup, Predict, and Audit.

Predictive Analytics 123 is grouped into three sections:

1. **Setup** establishes model templates that define the types of models to run, the data sources, and determining the length of the forecast. It ties these parameters into a designated Cube View through the template.
2. **Predict** displays the interactive mode that runs the models against a selected cell or all accounts in a Cube View. Results are graphically displayed and written back to the target scenario.
3. **Audit** provides auditability into the entire application by logging what is run, by whom, and retains a comment log.



Setup

The **Template Setup** page displays the **Template Definition List** which defines the Cube where the data comes from, the Cube View against which you want to run models, and where the results will be written.

Template Setup

The template sets up the use case scenario and can be modified in the Setup page until the ideal build is calibrated. The **Template Definition** defines the prediction based on the cube view, target scenario, and model functionality. This is the first step in the Predictive Analytics Machine process.

The Template Setup page contains the following functions:

Add: creates a new template

Edit: updates an existing template

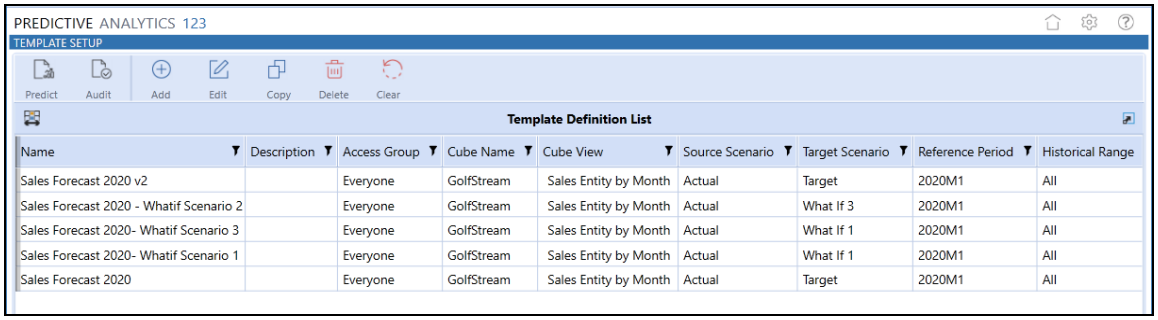
> **NOTE:** Once a model is run, elements of the Cube View and Scenario sections cannot be modified.

Copy: creates a new template based on the field-level parameters of the existing template

Delete: removes the entire template with the associated models and comments

Clear: removes the saved default models associated with the form, but keeps the results of previously run models

> **NOTE:** The **Delete** function on the **Template Setup** page is different than the **Delete** function on the **Predict** page.

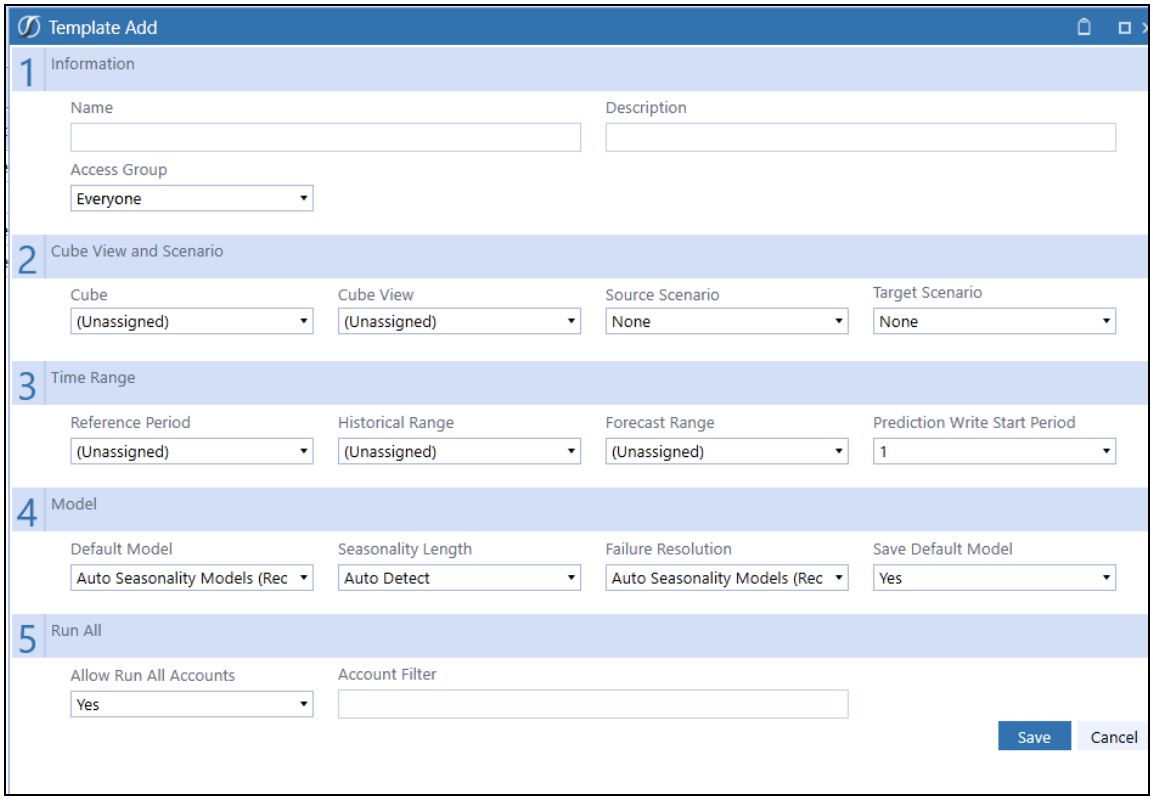


Name	Description	Access Group	Cube Name	Cube View	Source Scenario	Target Scenario	Reference Period	Historical Range
Sales Forecast 2020 v2		Everyone	GolfStream	Sales Entity by Month	Actual	Target	2020M1	All
Sales Forecast 2020 - Whatif Scenario 2		Everyone	GolfStream	Sales Entity by Month	Actual	What If 3	2020M1	All
Sales Forecast 2020- Whatif Scenario 3		Everyone	GolfStream	Sales Entity by Month	Actual	What If 1	2020M1	All
Sales Forecast 2020- Whatif Scenario 1		Everyone	GolfStream	Sales Entity by Month	Actual	What If 1	2020M1	All
Sales Forecast 2020		Everyone	GolfStream	Sales Entity by Month	Actual	Target	2020M1	All

Create a Template

IMPORTANT: There must be at least one template saved in order to run a model.

1. On the Template Setup page, click **Add**.
2. Complete the information in each section of the **Template Add** box and click **Save**. See Template Field Definitions for detailed descriptions of the field-level options in this template.



Template Field Definitions

1 | Information	
Name	Descriptive name to identify the template.
Description (Optional)	Description of template.
Access Group	Name of the user who can run/view this template
2 | Cube View and Scenario	
Cube	Name of the Cube to run models against for the template.

Cube View	Name of the specific Cube View in the Cube to run the models against for this template. See Also: Cube View Setup

NOTE: The Cube View can only pull data from the Cube that was specified above. Pulling data from multiple Cubes for a single Cube View is not allowed in Predictive Analytics 123.

Source Scenario	Scenario specified as the source of historical data points used to generate predictive models.
Target Scenario	Scenario to write the results of the model execution.

IMPORTANT: The Source Scenario and Target Scenario must have the same writable cells.

3 | Time Range	
Reference Period	The period used to identify the last period to be included in the historical dataset for models run on the specified account. Required for Run and Run All. The reference period used should also be included in the Cube View to be visible on the Predict page.
Historical Range	The number of data points to use to fit the models. Example: If the selected cell for the account is 2019M11, and Historical Range is 24, the historical datapoints to be used for fitting the models will be all the values from 2017M11 to 2019M11.

IMPORTANT: A minimum of 18 months of data is necessary to return valid prediction models. For predictive models, particularly seasonality, twenty-four months of historical data are necessary (ARIMA models require 48 months). Rows missing the required number of historical months will be excluded from the prediction.

Forecast Range	The number of datapoints to run against, going forward from the selected cell.
Prediction Write Start Period	The number of periods forward from the selected cell period to begin writing forecasts. The template defaults to a write start of 1, which corresponds to the period directly after the selected cell period. Example: If the selected cell in the account is for 2005M11, and the Prediction Write Start Period is 5 with a Forecast Range of 12 months, 12 forecast values would be written beginning at 2006M4 through 2007M3.
4 | Model	
Default Model	Determines the models to run for the template.
	Auto-Seasonality Models performs a grid search of all Seasonality specific models with all possible parameter subsets. *This method will return the best performing Seasonality specific models for the account in the template.*
	Auto-All Models performs a grid search of all models with all possible parameter sub-sets. *This method will return the best performing models for the account in the template.*
	Auto-Trend Models performs a grid search of all Trend specific models with all possible parameter sub-sets. *This method will return the best performing Trend specific models for the account in the template.*
	If a specific model type is selected in this section, a grid search of that specific model's parameter sub-sets will be performed. *This method will return the best performing parameter subset model of the specified model type.*

Seasonality Length	Sets the seasonality length for the data that the models will use as the seasonal cycle. This value can be specified by the user or Auto-Detect can be specified in which case the algorithm itself will determine the best seasonality length for the data.
Failure Resolution	Determines the models to run in the event the default model returns a Failure response.
Save Default Model	Saves the selection in **Default Model**.
5 | Run All	
Allow Run All Accounts	Runs every account in the Cube View and determines the best model for each account according to the specifications set in the template editor.
Account Filter (Optional)	Follows the standard OneStream member filter, an admin can filter the Cube View accounts using the standard formulas present in the Member Filter Builder .

NOTE: It is advised not to edit and run templates in two separate tabs/sessions because the newest information will not update. If using Predictive Analytics in this way, always click refresh before running the model. If multiple users are working collaboratively on different machines, lasting changes can only be made by the user who most recently called for a run

Cube View Setup Notes

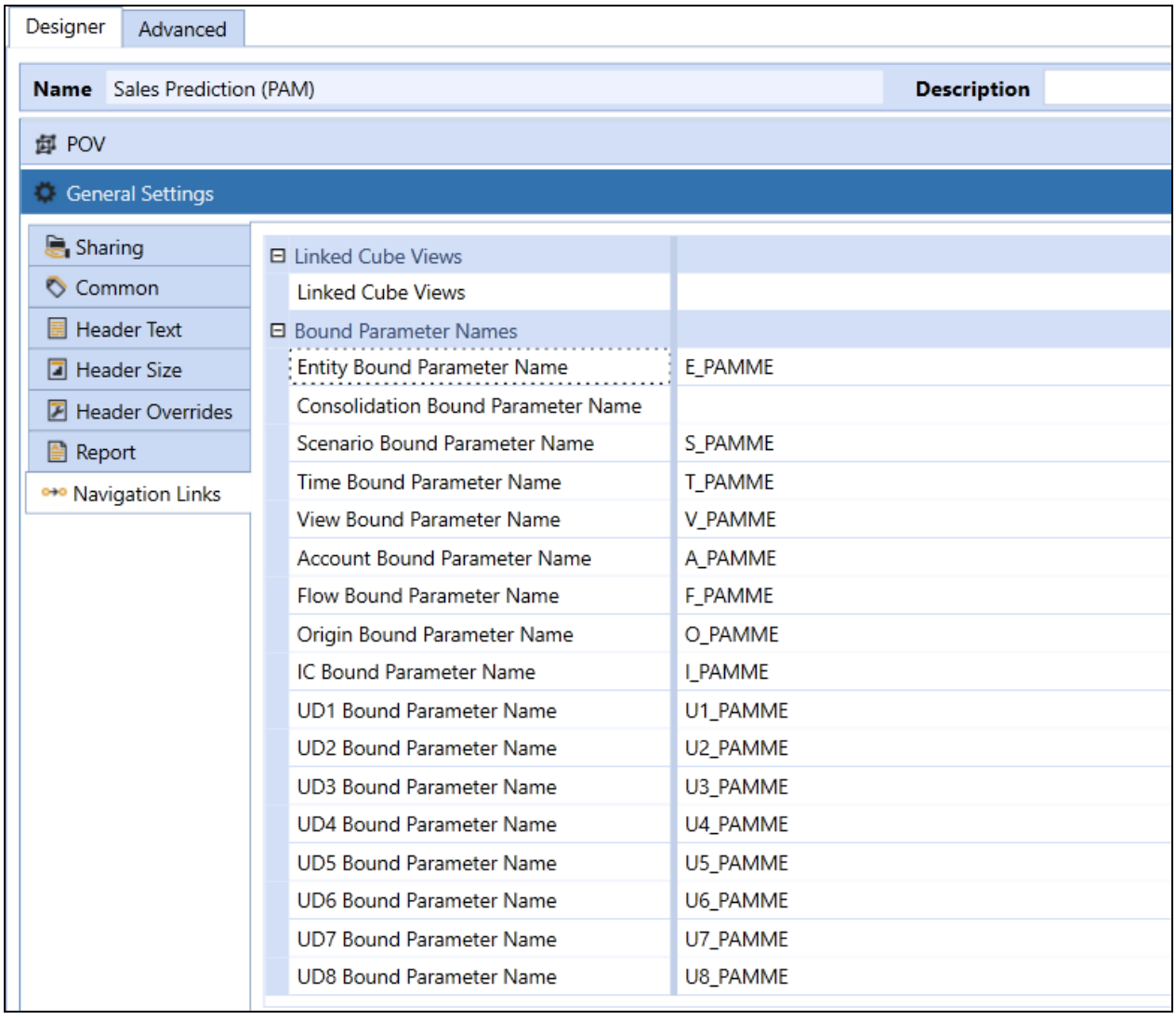
- Predictive Analytics 123 will only write prediction model results for Base level accounts.
- For Predictive Analytics 123 to write prediction model results to forecasted cells in a Cube View, set **Can Modify Data** to **True**.
- Users must be in the **Access** and **Maintenance** security groups of the Cube View where predictive models will be run.

IMPORTANT: Data must be controlled using Cube View settings or it will be overwritten by prediction model results.

Assign Cube View Bound Parameters

Bound Parameters are required to apply predictive models to a Cube View. To assign Bound Parameters in OneStream, click **Application** > **Cube Views** > **General Settings** > **Navigation Links**.

> **TIP:** Set parameters once in a Cube View and then use the **Copy** button on the Cube View page to create a new one from a template.



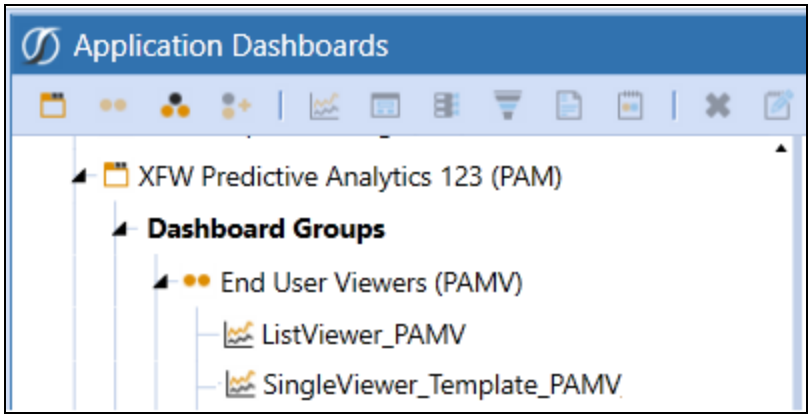
Bound Parameter Name	Value
Entity	E_PAMME
Consolidation	*Not used*
Scenario	S_PAMME
Time	T_PAMME
View	V_PAMME
Account	A_PAMME
Flow	F_PAMME
Origin	O_PAMME
IC	I_PAMME
UD1	U1_PAMME
UD2	U2_PAMME
UD3	U3_PAMME
UD4	U4_PAMME
UD5	U5_PAMME
UD6	U6_PAMME
UD7	U7_PAMME
UD8	U8_PAMME

NOTE: Predictive Analytics writes data prediction results to O#Import and not O#Forms no matter what is specified in the Cube View.

Apply Predictive Analytics 123 to Forms

There are two end user Dashboards in the **XFW Predictive Analytics 123 (PAM)** Dashboard Group:

1. ListViewer_PAMV
2. SingleViewer_Template_PAMV

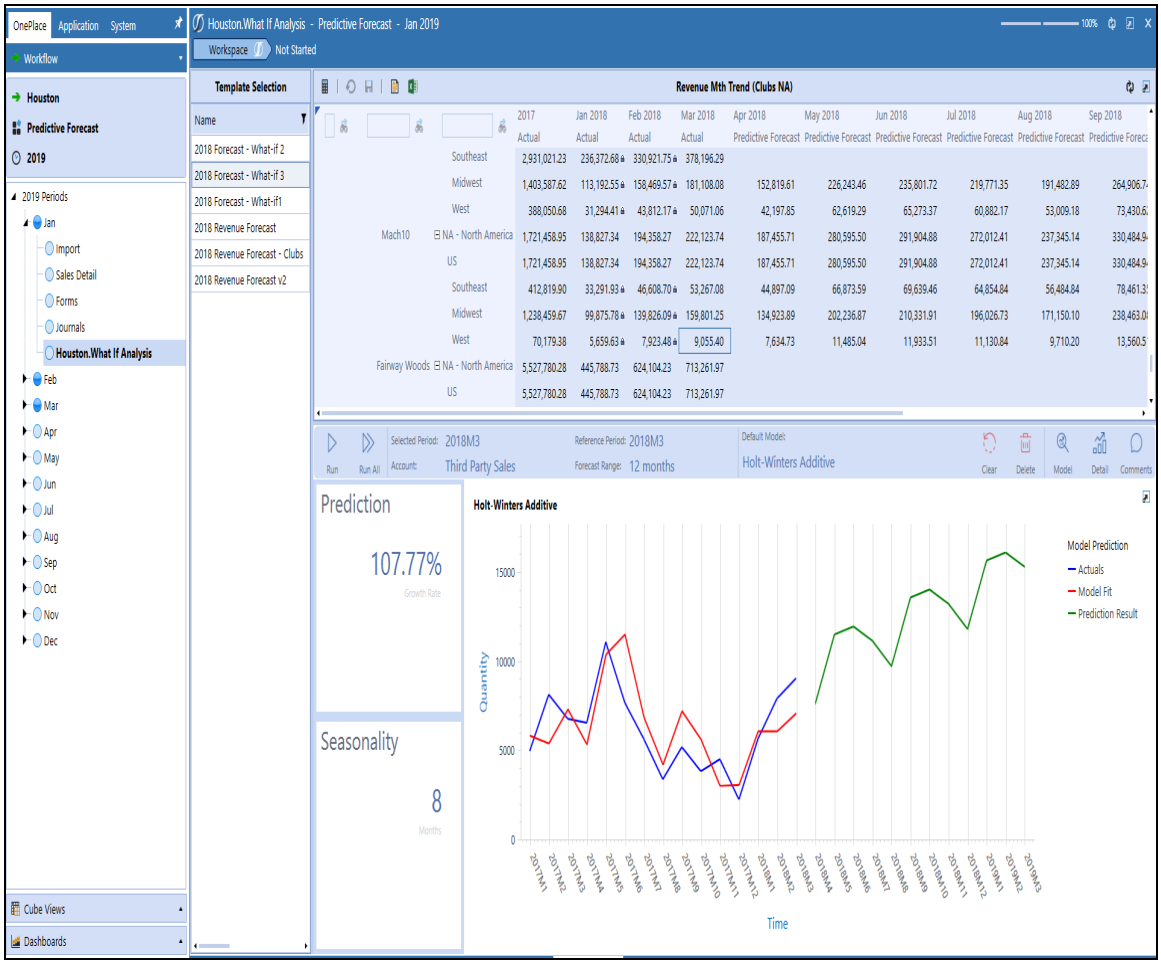


Set Up List View

The List View dashboard contains the information from the Predictive Analytics 123 Predict page including the Template Selection list. This dashboard can be embedded into a workspace inside a workflow.

1. In OneStream, click **Application** > **Presentation** > **Dashboards**.
2. Click **Dashboard Maintenance Units** > **XFW Predictive Analytics 123 (PAM)** > **Dashboard Groups** >**End User Viewers (PAMV)** > **ListViewer_PAMV.**
3. (Optional) On the **ListViewer_PAMV** dashboard, click **Rename** to rename the dashboard.

4. Click **Save**.
5. Click **Run** to verify that the dashboard opens correctly.



Setup Single View

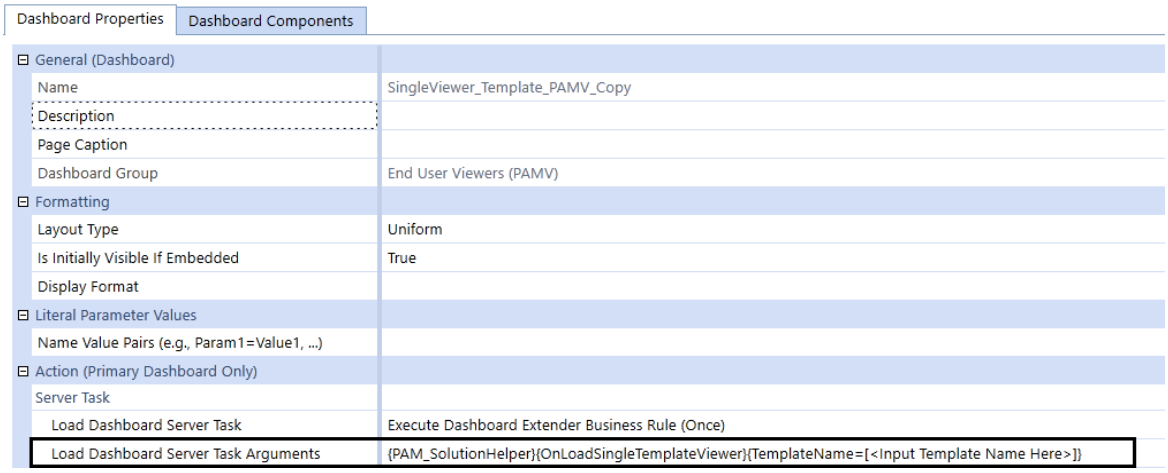
The Single View dashboard contains the information from the Predictive Analytics 123 **Predict** page excluding the Template Selection form.

1. In OneStream, click **Application** > **Presentation** > **Dashboards**.
2. Click **Dashboard Maintenance Units** > **XFW Predictive Analytics 123 (PAM)** > **Dashboard Groups** > **End User Viewers (PAMV)**.

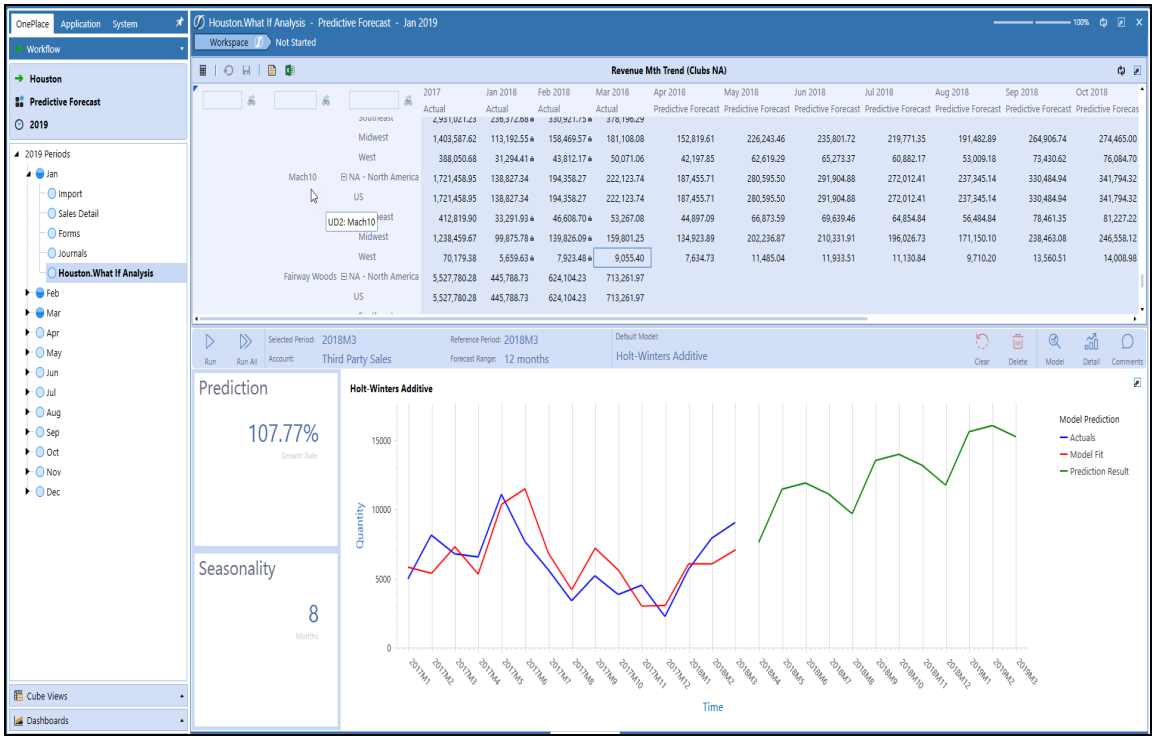
3. Select **SingleViewer_Template_PAMV** and click **Copy** on the top toolbar.
4. Click the **Paste** on the top toolbar.
   A new dashboard called SingleViewer_Template_PAMV_Copy displays.
5. Select the SingleViewer_Template_PAMV_Copy and click **Rename** in the top toolbar.

> **TIP:** Replace the word "Template" in the name for the name of the Predictive Analytics 123 template that will be embedded into this single view. Remove all spaces in the template name.

6. Click **Save** and navigate to the new dashboard.
7. In the **Dashboard Properties** pane, expand **Action (Primary Dashboard Only)**.



8. Type the exact name of the template to embed in the dashboard in the Load Dashboard Server Task Arguments field.
9. Click **Save**.
10. Click **Run** to verify that the template name was correctly specified.
    This newly created Template Dashboard can now be embedded into a workspace inside a workflow.



11. Click **Save**.

Predict

The **Predict** page displays the interactive mode that runs the models against a selected cell or all accounts in a Cube View. Results are graphically displayed and written back to either a Cube View or a different target scenario.

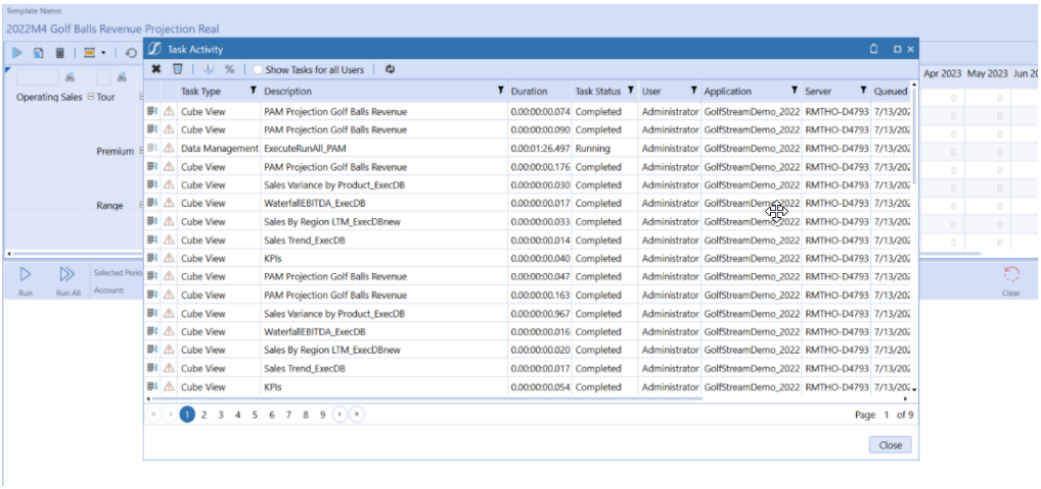
Run Prediction Models

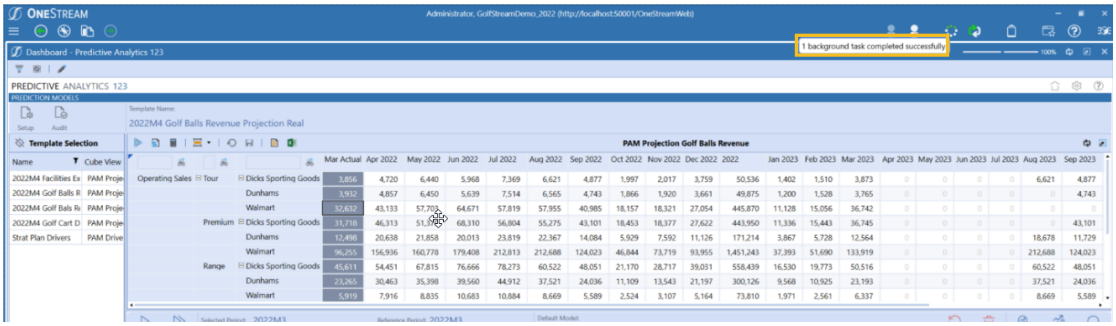
> **IMPORTANT:** Consolidate must be set to **#Local** or Predictive Analytics 123 does not store predicted data. Within the POV Pane, ensure that Consolidate is set to **#Local** under the Cube POV.

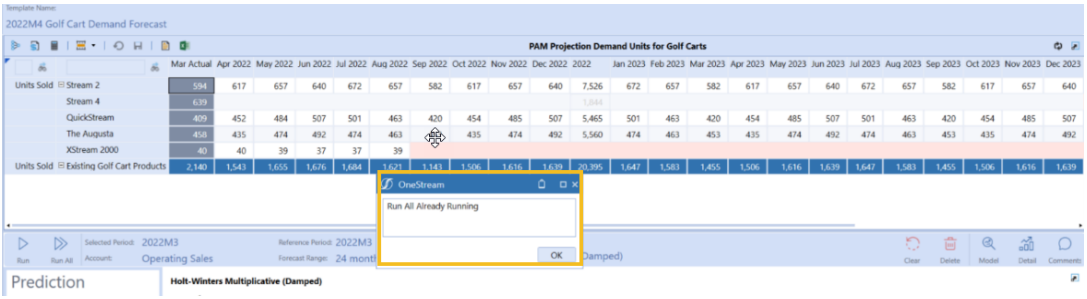
Predictive Analytics runs predictions sequentially, meaning if a client wants to run predictions on multiple data sets or entities, the system will have to finish one template first before going to the next one.

> **NOTE:** Predictive Analytics will run one template at a time. If a second user clicks **Run** while the first user's prediction is still running, the second user will get an error message. The first user's prediction must complete before the second user can click **Run**.

Users can utilize the **Task Activity** button in OneStream that shows a backlog of all events in the application. This is especially helpful when utilizing the **Run All** function, as the **Task Activity** will show that ExecuteRunAll_PAM is running, with a duration of the activity next to it. When completed, a banner that says **1 background task completely successfully** will pop up underneath the **Task Activity** button. If another **Run All** is started, a pop-up box will read **Run All Already Running**.







To run the model with respect to the selected cell:

1. In the **Template Selection** panel, select a template.

> **NOTE:** Templates could be restricted based on the current user's access level and the Access Group associated with the template in the template definition step.

2. Click on the cell in the account to run models for.
   You can only run against cells that are within the reference period as defined in the setup.

3. Click **Run**.
   If the cell for that account already has models run on the selected template, the lower panes will be pre-populated.

> **NOTE:** The **Run** button is hidden until a historical cell is selected but Run All is always visible.

For a growth rate to be displayed as a non-NAN value, the forecast period must be equal to or longer than the total number of historical values.

After the models are run against the selected cell, a graph of the results and the Prediction growth rate display in the lower pane:

Run: This button will be hidden until a cell is selected. Select this button to run a model against a specific account.

Run All: determines the best model for each account according to the specifications set in the template editor. After using this function, each account will be pre-populated with a model.

Selected Period: The time that the model corresponds to.

Account: The account dimension member name.

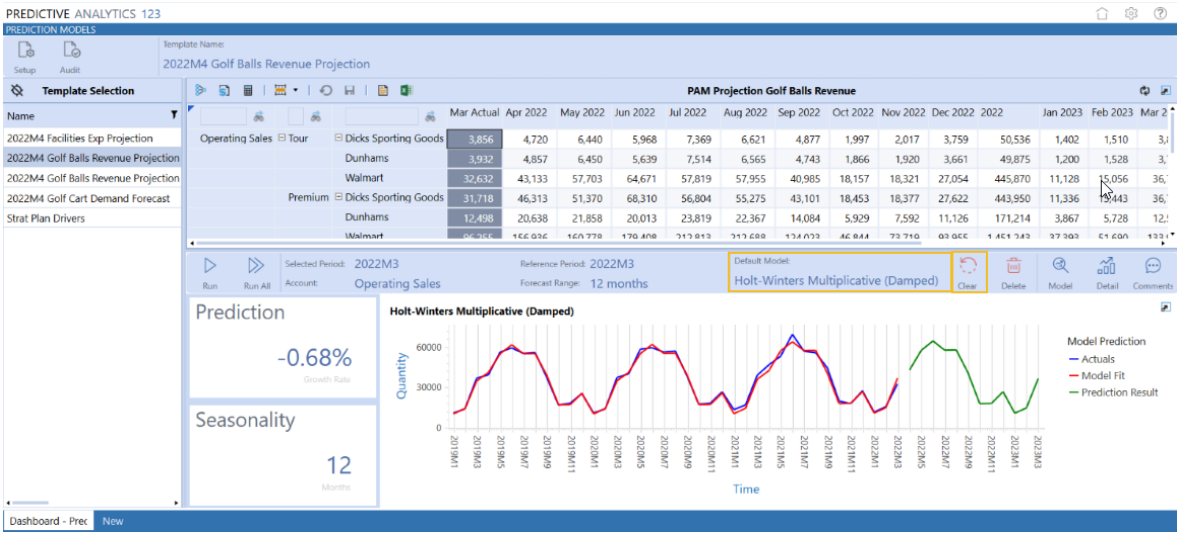
Reference Period: Used to identify the last period of the historical dataset used in the forecasting of the model.

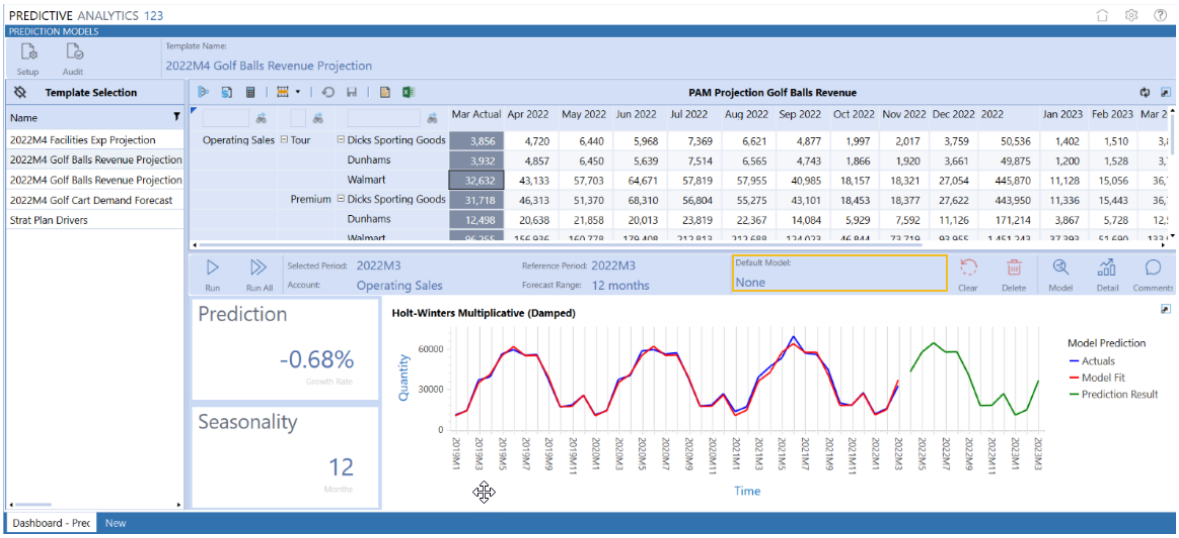
Forecast Range: Determines how far into the future the model runs through, going forward from the selected cell.

Prediction Growth Rate: Percent change of the target variable throughout the forecast range.

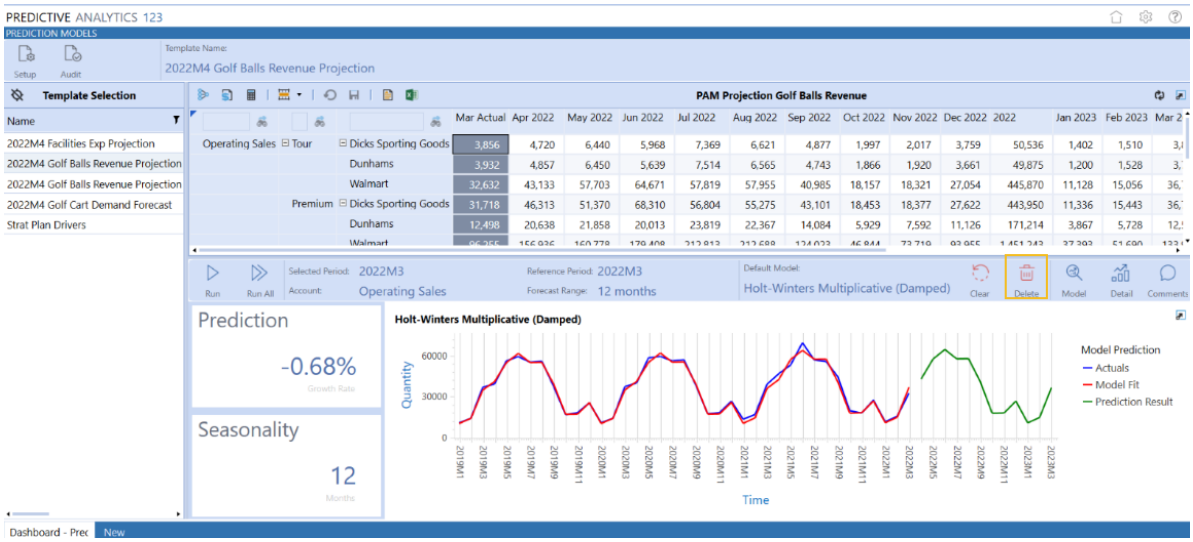
Default Model: Determines the model type being run for the selected template and produces the displayed growth rate.

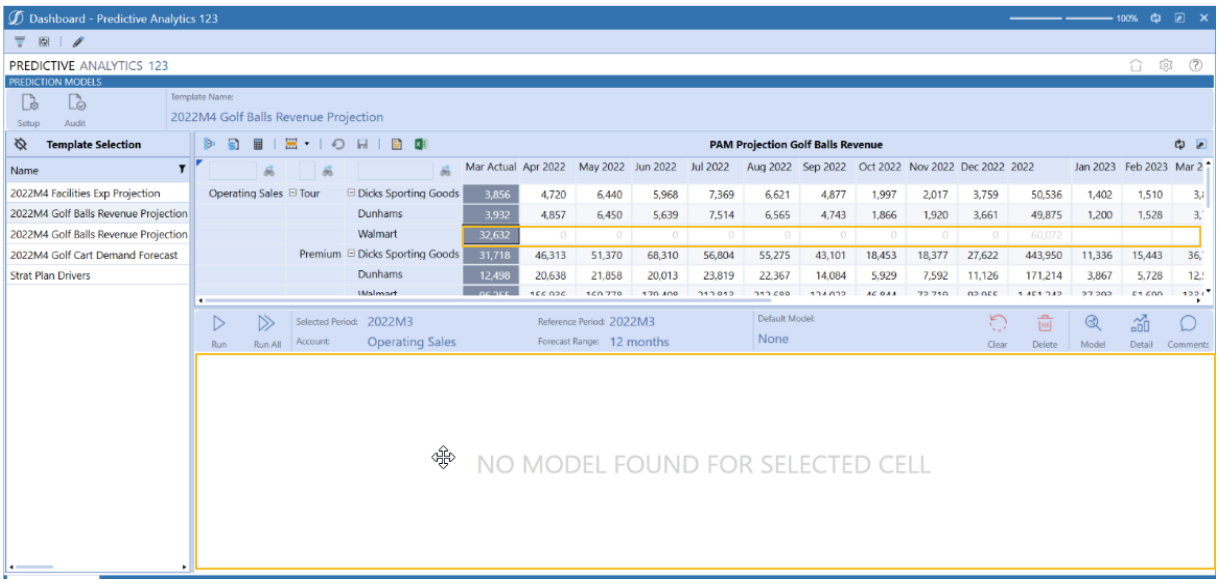
The **Clear** button removes the saved default model from each line on the template but keeps the graphical results and details of previously run models. When it is rerun, it will once again choose the most optimal model. This can be helpful when there is an update to the historical data. As shown below, the default model section of the graph is the only element cleared.





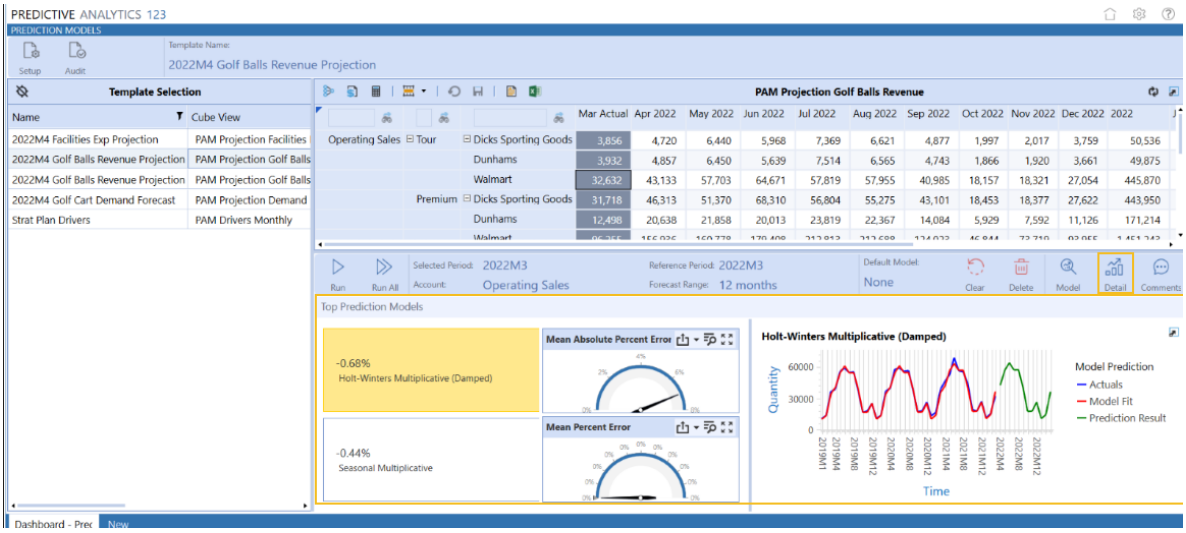
The **Delete** button removes the graphical results, details, and comments of the model but does not delete the template. As shown below, the **Delete** button is used to clear out the model forecast that has been run. Using this button does not delete any of the historical data, so the model can be rerun as soon as it is deleted. This can be helpful if there is an update in the historical data that would result in the possibility of new results.

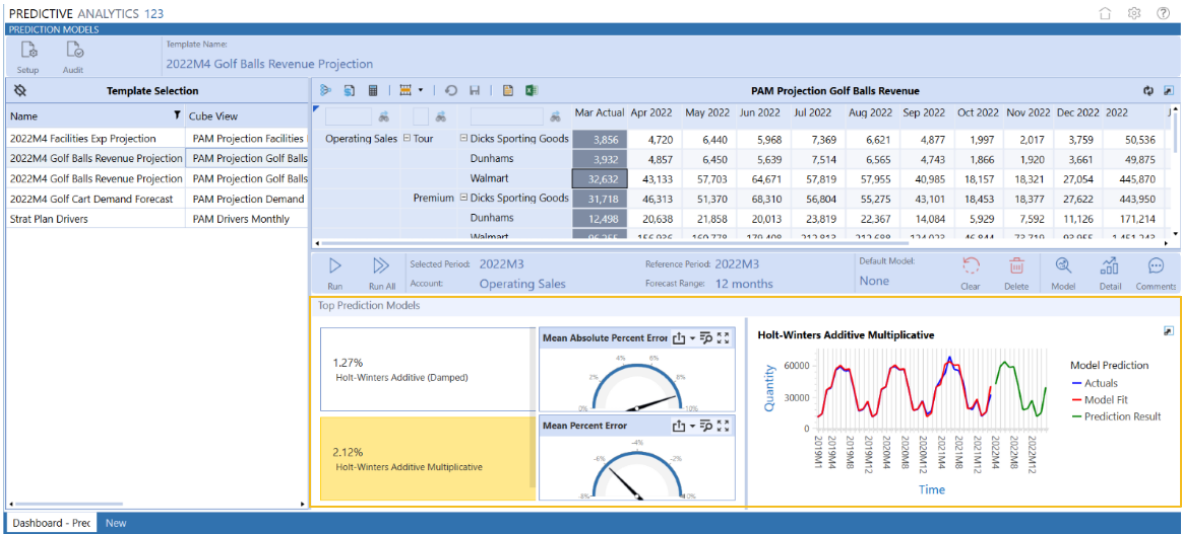




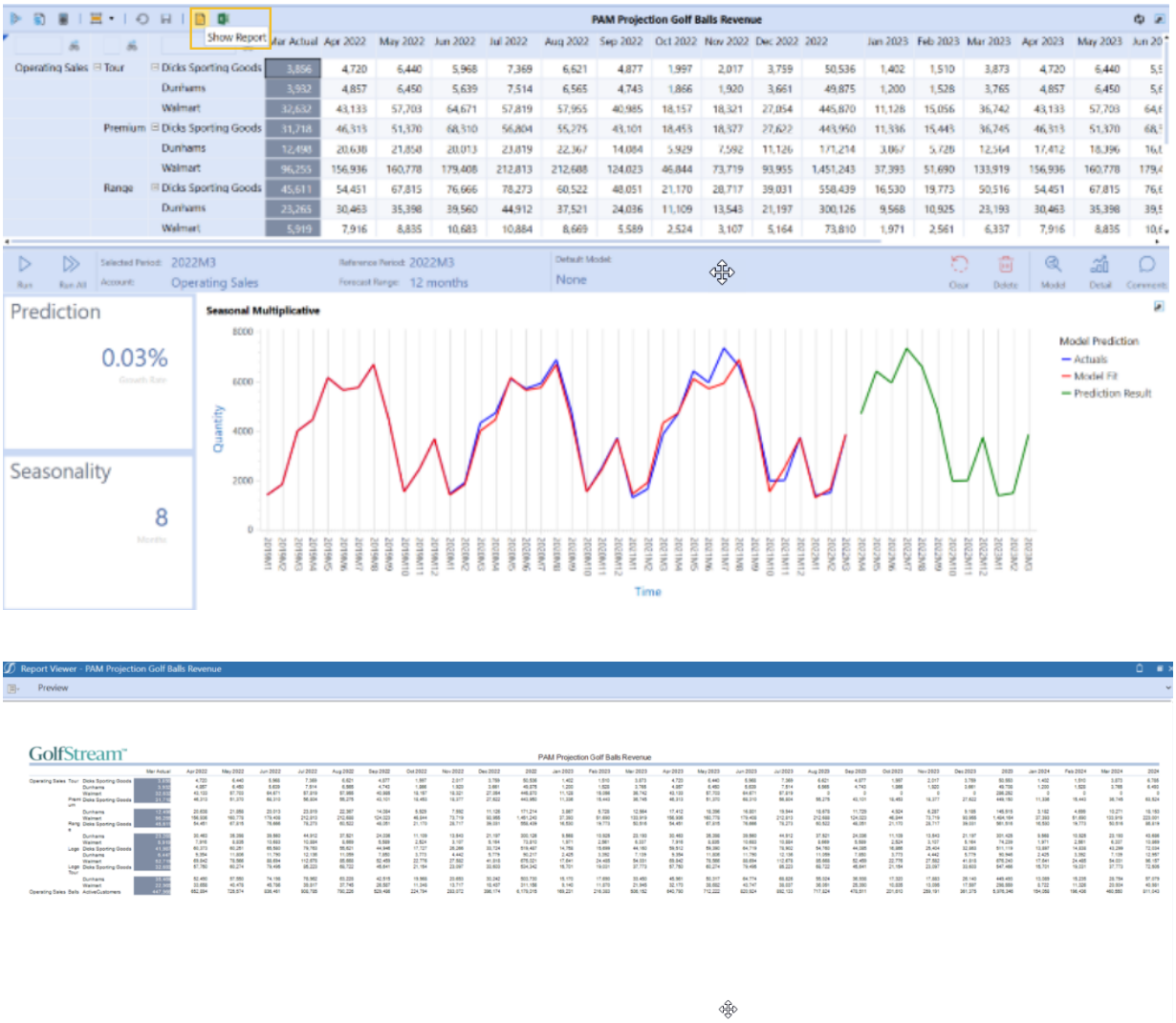
The **Model** button brings the user back to the page with growth rate, seasonality, and graphical results that contains the prediction and actual forecast rates.

The **Detail** button populates and displays the top prediction models with their corresponding growth rates on a scrollable pane (only scrollable if multiple models are returned). To the right of this, the Mean Absolute Percent Error and Mean Percent Error are displayed on dials to show model accuracy. The right pane of the graph displays the selected model, and the error gauges and graphs change when a different model is selected.

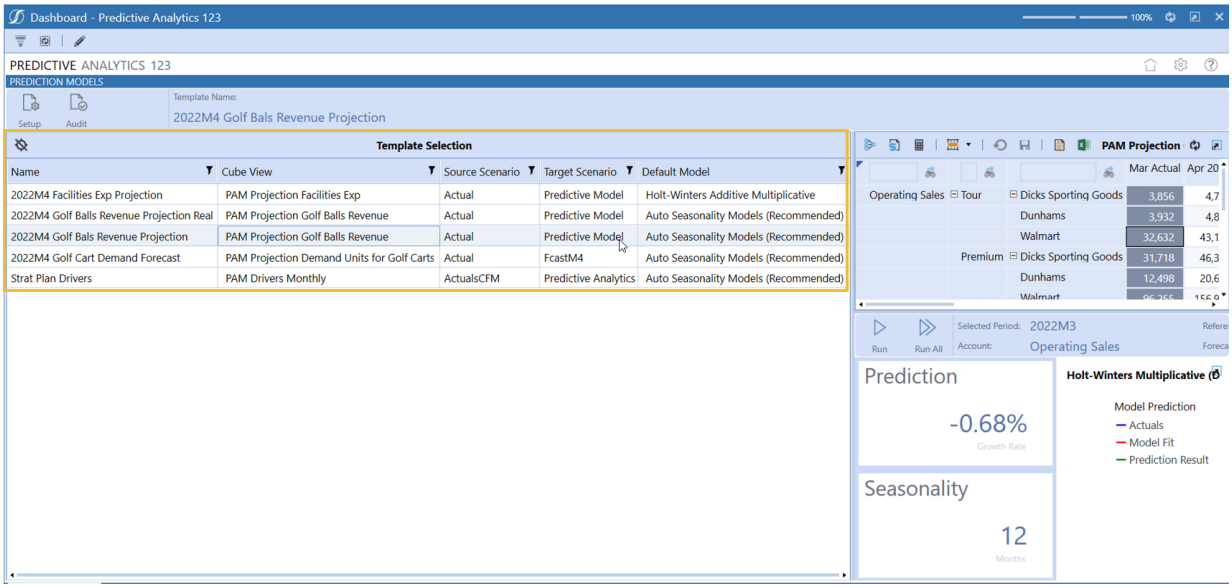




The **Show Report Function** produces a printable table of the projected forecast.



NOTE: The **Predict** page has a scrollable pane on the left-hand side under the Template Selection that allows the user to see the build of the template. Once expanded, the pane shows the base information needed for the source of the model, the target scenario, and the default model it will use when.



Model Comments

The Comments button opens a new dialog box that allows the user to add/save a comment that stays with the model run for that specific line. The dialog box will display the comment, the user, and the time stamp.

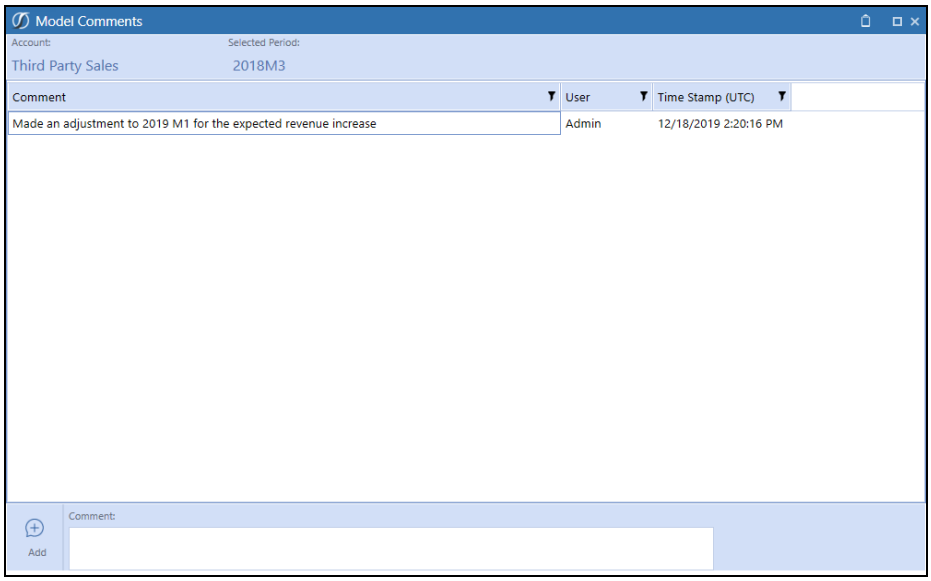
> **NOTE:** If there is already a comment for that model, there will be a pre-populated table in this section and the icon will change to a comment bubble with three dots inside. If there are no comments, the table will not be pre-populated.

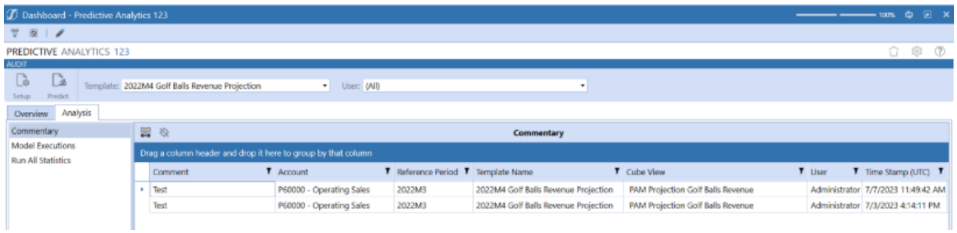
Functions of Model Comments:

- When a comment is made on a line item, it will remain on that line for the life of the template.
- Comments can be left individually for each line item, but they cannot be made on the template itself.
- In the Audit section, once the correct template is selected, the comments will populate for each line within the template.
    - As shown below, two comments were made on different days and for different lines within the template, but both will show for that template in the Audit section.

- In the top drop-down bar, the user can choose if they want to see comments for everyone/all templates or a specific individual/one template.

IMPORTANT: There is no way to delete a comment once it has been made.





NOTE: Comments are associated with the account of the Cube View and the currently selected template.

Forecasting Methods

This appendix describes the supported forecasting methods.

Simple Exponential Smoothing

This forecasting method develops a model where the prediction is a weighted linear sum of recent past observations. Exponential Smoothing models explicitly use an exponentially decreasing weight when considering past observations. Single Exponential Smoothing only requires one parameter alpha, also called the smoothing factor or smoothing coefficient. Alpha controls the rate of influence of the observations at each prior timestep. The parameter is handled inside the algorithm and thus is unspecified by a user.

> **NOTE:** Simple Exponential Smoothing Models are best at handling data with no clear trend or seasonal components.

Holt Linear

This forecasting method is an extension of Simple Exponential Smoothing (See Simple Exponential Smoothing) that adds the ability to capture the trend of the time series. This method is commonly referred to as Double Exponential Smoothing because it uses an additional smoothing factor beta to handle the influence of the overall trend. The method is broken into two variations, Additive and Multiplicative.

> **NOTE:** Holt-Linear Models are capable of handling data with a trend component but not seasonal components.

Holt-Linear Additive

In this variation, the smoothing factor beta is expressed in absolute terms in the scale of the observed series. The additive method is preferred when the seasonal variations are changing proportionally to the level of the series.

Holt-Linear Multiplicative

In this variation, the smoothing factor beta is expressed in relative terms or as a percentage. The multiplicative method is preferred when the seasonal variations are changing disproportionally to the level of the series.

Holt-Winters Exponential

This forecasting method is an extension of Double Exponential Smoothing (see Holt Linear) that adds the ability to capture the seasonality of the time series data. This method is referred to as Triple Exponential Smoothing. In addition to the alpha and beta parameters found in Double Exponential Smoothing, there is an added smoothing seasonal parameter gamma used to handle the influence of the overall seasonality. The method is broken into two variations based on the handling of the parameter gamma:

Seasonal Additive

The seasonal additive model is an extension of the Holt-Winters Exponential Additive Model. The Seasonal Additive model does not contain a trend equation, or parameter beta, and instead only applies the seasonal parameter gamma using the additive method.

> **NOTE:** The Seasonal Additive model is only capable of handling data with a Seasonal component but no Trend Component.

Holt-Winters Exponential Multiplicative

In this variation, the seasonal parameter gamma is expressed in relative terms or as a percentage. The trend equation of the series is seasonally adjusted by dividing each value by the seasonal parameter gamma. The multiplicative method is preferred when the seasonal variations are changing disproportionally to the level of the series.

Holt-Winters Damped Method

The damped method is used for long-term forecasts and is and extension of the Holt-Winters Exponential (Additive and Multiplicative). For long-term forecasts, a Holts-Winters Exponential model will increase or decrease indefinitely into the future. With the addition of a damping parameter between zero and one, this long-term increase or decrease can be minimized, and accurate long-term predictions can be maintained. The damping parameter is handled inside the algorithm and is unspecified by a user.

> **NOTE:** Holt-Winters Exponential Models are capable of handling data with trend and seasonal components.

Seasonal Multiplicative

The seasonal multiplicative model is an extension of the Holt-Winters Exponential Multiplicative Model. The Seasonal Multiplicative model removes trend equation, or parameter beta, and instead only applies the seasonal parameter gamma, using the multiplicative method.

> **NOTE:** The Seasonal Multiplicative model is only capable of handling data with a Seasonal component but no Trend Component.

Autoregressive Integrated Moving Average (ARIMA)

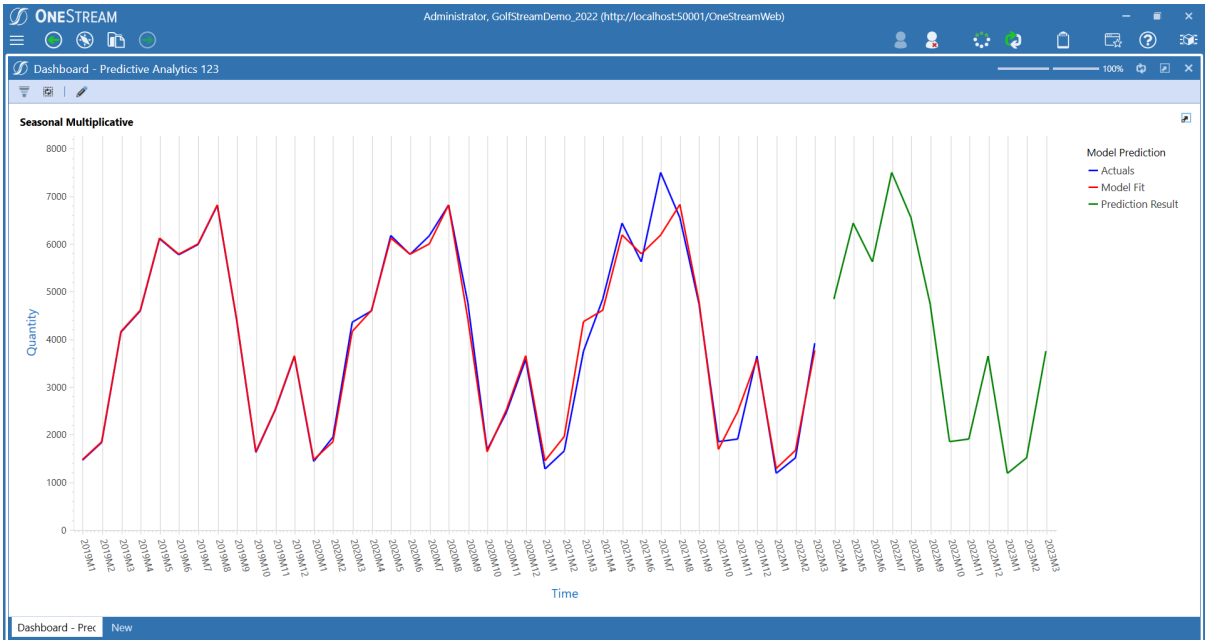
The Autoregressive Integrated Moving Average model is a non-seasonal time series method that combines three techniques when producing predictions. The first, corresponding to the “AR”, indicates the autoregressive component. This component regresses the desired variable over its previous values. The order of this portion of the model is specified by the parameter P. The second, corresponding to the “MA”, indicates the moving average component and is a regression of the desired variable’s errors over its previous values. The order of this portion of the model is specified by the parameter Q. The third, corresponding to the “I”, indicates the integrated or differencing component and is a differencing of each value and its previous value. The order of this portion (number of times to perform differencing) is denoted by the parameter D. The differencing “I” component is performed before the “AR” and “MA” components are fit. The overall ARIMA is the combination of each of these three components into one condensed model.

> **NOTE:** The ARIMA model is only capable of handling data with a trend component but no seasonal component.

Seasonal Autoregressive Integrated Moving Average (SARIMA)

The SARIMA model is a seasonal time series method and an extension of the ARIMA modelling method. It contains the same three components of the ARIMA, however, a SARIMA adds an additional seasonal autoregressive, seasonal differencing, and seasonal moving-average component to the overall model to account for the recurring cycle of the data. The parameters for each of these additional seasonal components are denoted by *P*, *D*, and *Q*respectively. The SARIMA also takes in a seasonal parameter which accounts for the length of a singular cycle in the data.

Graph Details



The **Title** will display the model type that is run for the account.

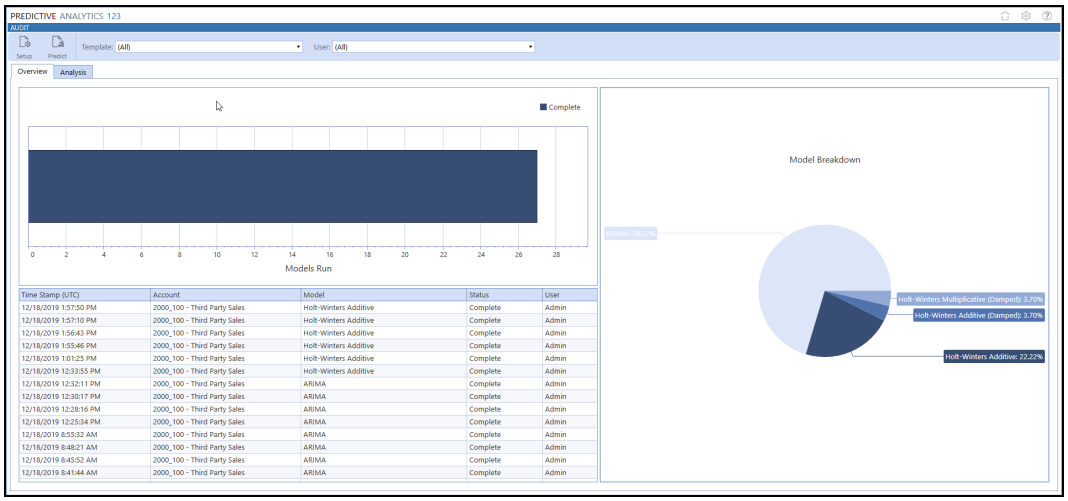
The **Axes** will always be labeled as Quantity and Time. The Quantity axis will scale to the given line item. The Time axis will do the same in a year-month format. For example, 2022M3 references March of 2022.

The **Legend** on the right-hand side of the graph displays the three line types shown. Actuals refers to the historical data that was selected in the model template. Model Fit shows the line of best fit for the historical data. Prediction Result is the official forecast produced by the model.

NOTE: The gap between the Model Fit/Actuals lines and the Prediction Results is not actually a gap in the dataset. The Actuals ends in one month and the Prediction starts in the next month, so there is no data in between as the data is set at a monthly level of time detail or granularity.

Audit

The **Audit** page is three sections of report-style data that displays information such as the number of models run per account, the types of models, who ran each model, which model was run, the target scenario, and the creation date of the model run. This information is summarized on the **Overview** tab with detail in the **Analysis** tab.



The **Analysis** tab contains the following information:

- Commentary provides all commentary by Account and Cube View.
- Model Executions provides all single account model executions by Cube View.
- Run All Statistics provides statistics of all Run-All account model executions by Cube View.

Help & Miscellaneous Information

This page contains solution documentation.

Specify Optimal Display Settings

To best display multiple data elements such as reports and forms for data entry and analysis, set your screen resolution to a minimum of 1920 x 1080.

Package Contents & Naming Conventions

The package filename contains multiple identifiers that correspond with the Platform. Renaming any of the elements contained in a Package is discouraged to preserve the integrity of the naming conventions.

Example package name: PAM_PV6.2.0_SV103_PackageContents.zip

Identifier	Description
PAM	Solution ID
PV620	Minimum Platform version required to run solution
SV103	Solution version number
PackageContents	Filename

MarketPlace Solution Modification Considerations

A few cautions and considerations regarding the modification of MarketPlace solutions:

- Major changes to business rules or custom tables within a MarketPlace solution will not be supported through normal channels as the resulting solution is significantly different from the core solution.
- If changes are made to any dashboard object or business rule, consider renaming it or copying it to a new object first. This is important because if there is an upgrade to the MarketPlace solution in the future and the customer applies the upgrade, this will overlay and wipe out the changes. This also applies when updating any of the standard reports and dashboards.
- If modifications are made to a MarketPlace solution, upgrading to later versions will be more complex depending on the degree of customization. Simple changes such as changing a logo or colors on a dashboard do not impact upgrades significantly. Making changes to the custom database tables and business rules, which should be avoided, will make an upgrade even more complicated.

Appendix A: Target Scenarios

To get accurate predictions, the accounts need to have at least twenty-four months of historical data. Historical data should be set up in dense cube views. Sparse data is not recommended as Predictive Analytics cannot use sparse data to make time series statistical predictions.

This solution is meant to be used interactively and not in batch mode. Predictive Analytics can only run one template at a time and cannot run multiple templates at once in a batch. There is no built-in functionality to automate running templates for Predictive Analytics.

> **NOTE:** It is recommended that users not exceed 300 targets in a Predictive Analytics template, as going beyond this value will result in long prediction run times.

Predictive Analytics 123 can be used in situations where there is anywhere from one target to up to three-hundred targets. Some examples of use cases are listed below:

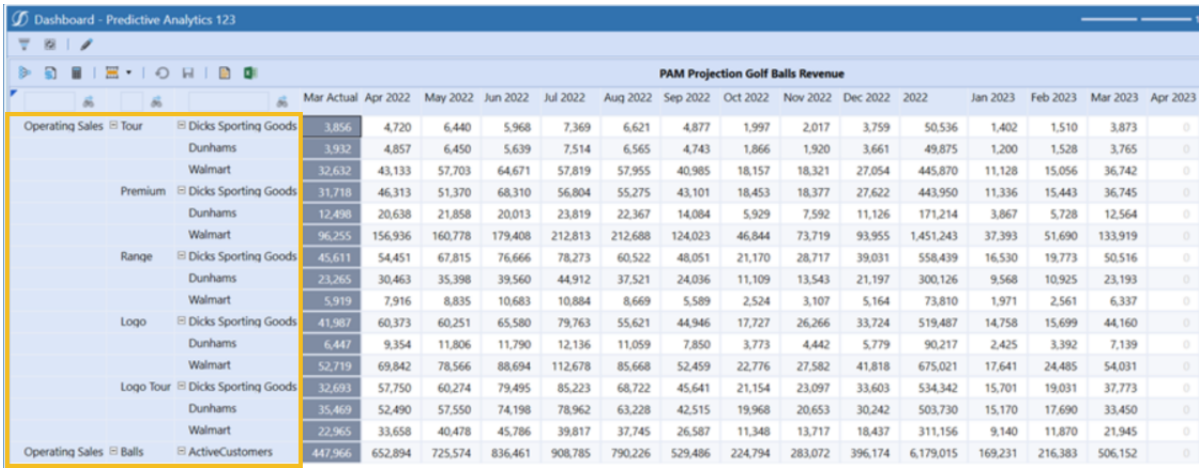
- One Sales account by one Entity by one UD1 member by one UD2 member across twenty-four time periods is one target.
- One Sales account by five Entities by one UD1 member by one UD2 member across twenty-four time periods is five targets (five Entities)
- One Sales account by five Entities by five UD1 members by one UD2 member across twenty-four time periods is twenty-five targets (five Entities * five UD1 members)
- One Sales account by five Entities by five UD1 members by five UD2 members across twenty-four time periods is 125 targets (five Entities * five UD1 members * five UD2 Members)

An example use case is written and shown below:

- One Sales account by five UD2 members by three UD4 members across 12 time periods is 15 targets (5 UD2 members *3 UD4 members)

In this scenario, Operating Sales is the account, the type of ball is the UD2 member, and the store is the UD4 member. The final row is the column total and is not included in the target number.

NOTE: If your use case calls for making automated predictions or utilizing larger volumes of data (greater than 300 targets), it is suggested that you consider Sensible Machine Learning for your predictive analytic use cases. Sensible Machine Learning has the ability to handle a larger amount of targets along with a number of other features.



PAM Projection Golf Balls Revenue

			Mar Actual	Apr 2022	May 2022	Jun 2022	Jul 2022	Aug 2022	Sep 2022	Oct 2022	Nov 2022	Dec 2022	2022	Jan 2023	Feb 2023	Mar 2023	Apr 2023
Operating Sales	Tour	Dicks Sporting Goods	3,856	4,720	6,440	5,968	7,369	6,621	4,877	1,997	2,017	3,759	50,536	1,402	1,510	3,873	0
		Dunhams	3,932	4,857	6,450	5,639	7,514	6,565	4,743	1,866	1,920	3,661	49,875	1,200	1,528	3,765	0
		Walmart	32,632	43,133	57,703	64,671	57,819	57,955	40,985	18,157	18,321	27,054	445,870	11,128	15,056	36,742	0
	Premium	Dicks Sporting Goods	31,718	46,313	51,370	68,310	56,804	55,275	43,101	18,453	18,377	27,622	443,950	11,336	15,443	36,745	0
		Dunhams	12,498	20,638	21,858	20,013	23,819	22,367	14,084	5,929	7,592	11,126	171,214	3,867	5,728	12,564	0
		Walmart	96,255	156,936	160,778	179,408	212,813	212,688	124,023	46,844	73,719	93,955	1,451,243	37,393	51,690	133,919	0
	Range	Dicks Sporting Goods	45,611	54,451	67,815	76,666	78,273	60,522	48,051	21,170	28,717	39,031	558,439	16,530	19,773	50,516	0
		Dunhams	23,265	30,463	35,398	39,560	44,912	37,521	24,036	11,109	13,543	21,197	300,126	9,568	10,925	23,193	0
		Walmart	5,919	7,916	8,835	10,683	10,884	8,669	5,589	2,524	3,107	5,164	73,810	1,971	2,561	6,337	0
	Logo	Dicks Sporting Goods	41,987	60,373	60,251	65,580	79,763	55,621	44,946	17,727	26,266	33,724	519,487	14,758	15,699	44,160	0
		Dunhams	6,447	9,354	11,806	11,790	12,136	11,059	7,850	3,773	4,442	5,779	90,217	2,425	3,392	7,139	0
		Walmart	52,719	69,842	78,566	88,694	112,678	85,668	52,459	22,776	27,582	41,818	675,021	17,641	24,485	54,031	0
	Logo Tour	Dicks Sporting Goods	32,693	57,750	60,274	79,495	85,223	68,722	45,641	21,154	23,097	33,603	534,342	15,701	19,031	37,773	0
		Dunhams	35,469	52,490	57,550	74,198	78,962	63,228	42,515	19,968	20,653	30,242	503,730	15,170	17,690	33,450	0
		Walmart	22,965	33,658	40,478	45,786	39,817	37,745	26,587	11,348	13,717	18,437	311,156	9,140	11,870	21,945	0
Operating Sales	Balls	ActiveCustomers	447,966	652,894	725,574	836,461	908,785	790,226	529,486	224,794	283,072	396,174	6,179,015	169,231	216,383	506,152	0

NOTE: The example shown is from one of the GolfStream applications. Your results will differ depending on your historical results and the configuration of your prediction template.

Appendix B: Use Case Example

A company wants to predict monthly golf ball sales for the next 12 months from five different lines (Tour, Premium, Range, Logo, and Logo tour) in three different stores (Dick's Sporting Goods, Dunham's, and Walmart). Twenty-seven months (January 2020 to March 2022) of historical monthly data points with no additional variables will be used in the prediction with a forecast length of 12 months.

Template Field Inputs

Cube View and Scenario: To predict the monthly revenue of gold balls, the Cube of Profitability and Cube View of PAM Projection Golf Balls Revenue must be selected.

- The **Source Scenario** will stem from the data spanning twenty-seven months with a **Target Scenario** of producing a predictive model.

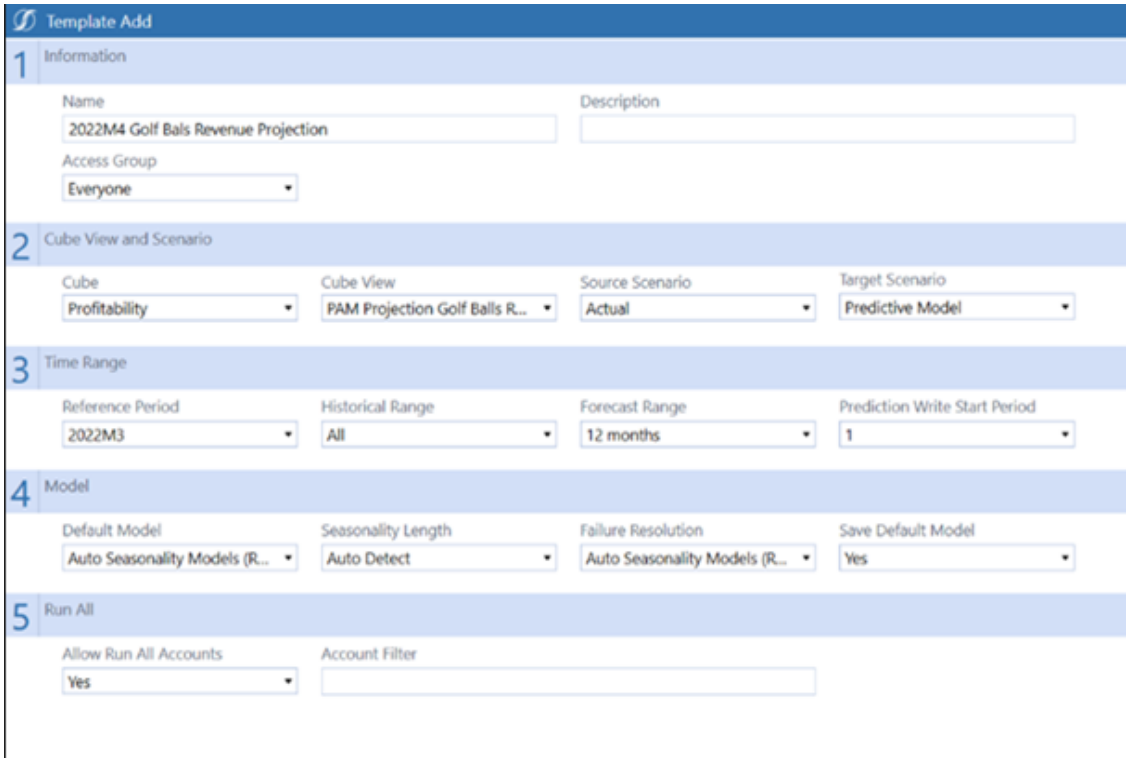
Time Range:

- The **Reference Period** refers to the last month of historical data that should be included in the model (in this case March of 2022) and displays in the first column on the Predict page.
- The **Historical Data** refers to the number of months prior to the reference period that will be used to train the model. In this case, with only twenty-seven months of historical data, all the data is useful and will stem back to January 2022.
- A **Forecast Range** of one to sixty months can be selected; however, with only twenty-seven months of historical data, a forecast of 12 months will be selected since a prediction set too far in advance can lead to extrapolated data.
- A **Prediction Write Start Period** of one is selected to set the forecast values for the period directly after the reference period.

Model:

- The **Default Model** will be set to **Auto-Seasonality Model** since golf is more popular in the summer and the data will have seasonality.
- The **Seasonality Length** will be set to **Auto-Detect** since no external factor gives the data a specific range.

- The **Failure Resolution** will be set to **Auto-Seasonality** so that this model will run if there is a failure response.
- The **Default Model** should be saved so the results do not need to be rerun each prediction.



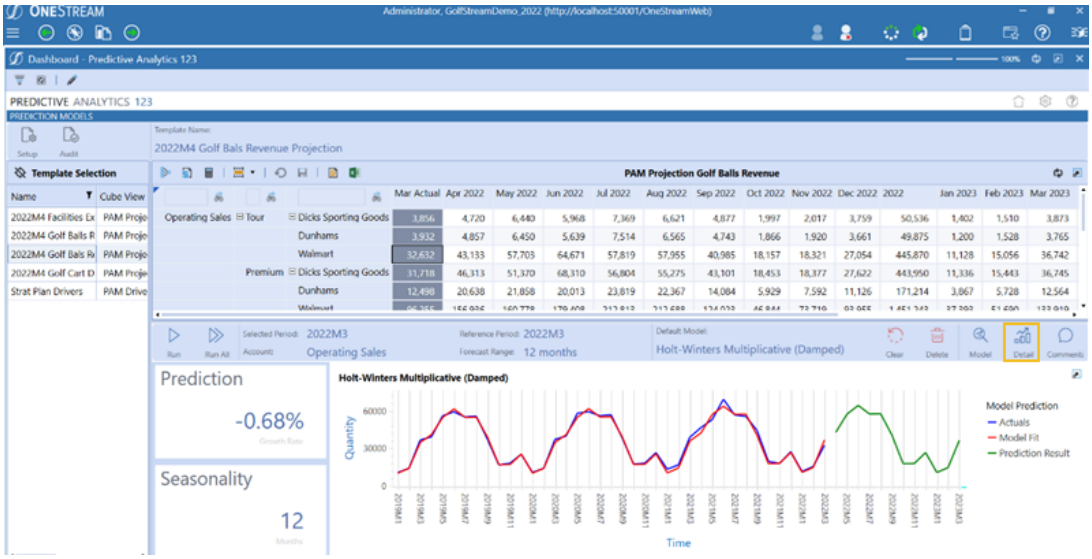
Predict

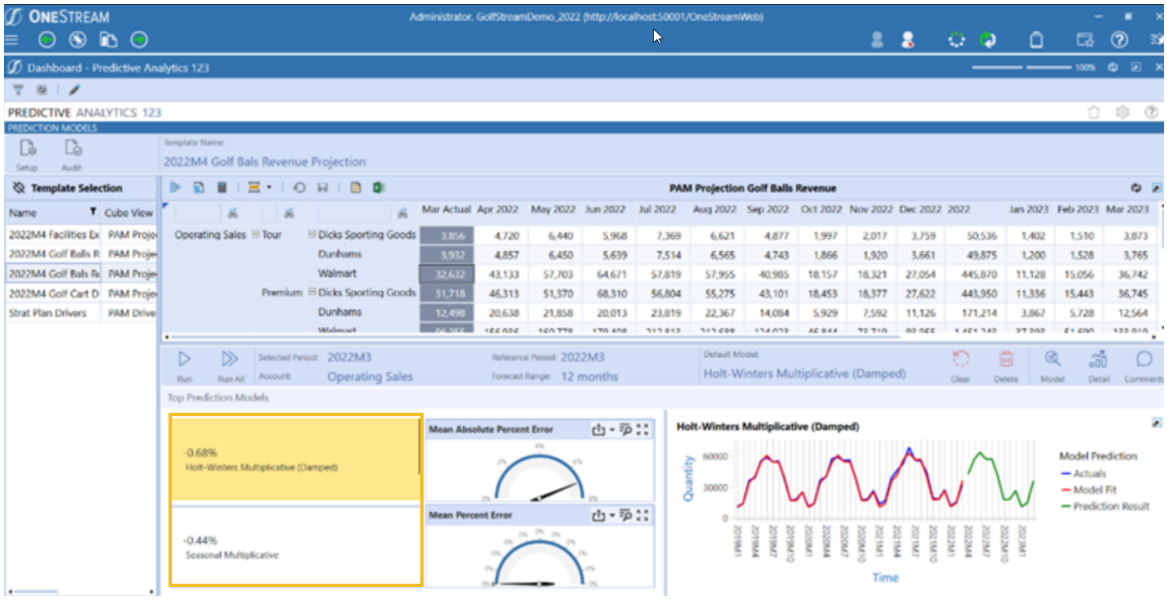
The **Template Selection** is a list of all templates created by the user. In this case, 2022M4 Golf Balls Projection Revenue will be selected to use the created template. Each line item on the table has its historical data and forecast.

- To get a specific forecast, click on a box in the grayed-out **Mar Actual** column and click **Run** to get the forecast for that location.
- Clicking **Run All** will make each account forecast for their respective locations.

- The **Growth Rate** encapsulates what to expect in the coming 12 months. The model is projected to perform slightly worse than past years in this instance, so it has a very low negative growth rate.
- The user should click **Details** to check the error values from each of the top prediction models. With a Mean Absolute Percent Error of 7%, the percent value can be interpreted as the average difference between the forecasted value and the actual value.

There are six models being run in this example, so the user can select which model to display and use the scrollable bar on the left pane. The selected model on the left will change the growth rate, each of the error dials, and the graph projection.





NOTE: The example shown is from one of the GolfStream applications. Your results will differ depending on your historical results and the configuration of your prediction template.

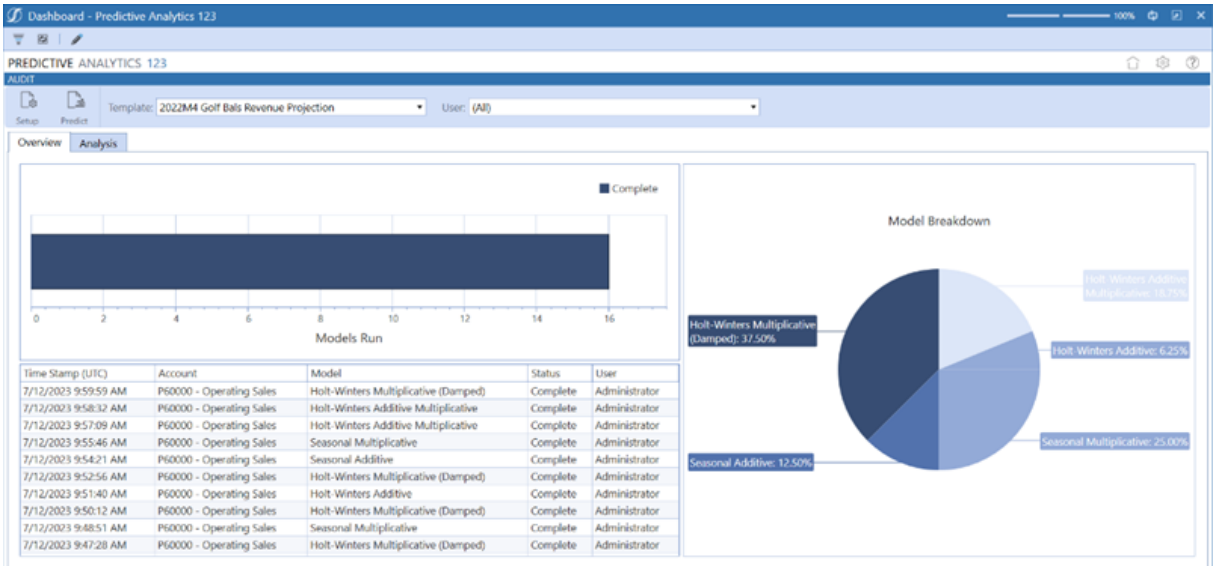
Audit

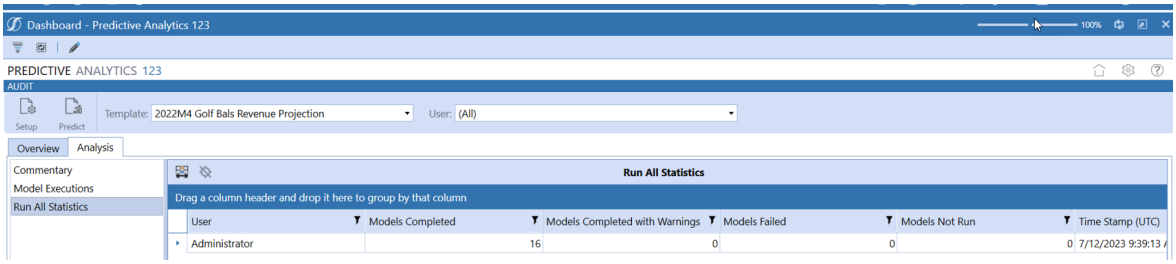
Viewing the Audit Report:

- Click **Audit** to see the audit report that corresponds to the project.
- Use the **Template** drop-down menu to select the desired template (in this case 2022M4 Golf Ball Revenue Projection). The table populates with information about each model run in the specified template.
- Use the **User** drop-down menu to select the desired user (In this case **All** is the preferred option). The table populates with information about the specified template for that user.
- The **Model Breakdown** pie chart specifies the number of times each model was run. The chart can help users refine which model to select if they need one uniform choice across all locations.

The **Analysis** Tab:

- The **Commentary** tab holds the comments from the **Predict** page for each line item within the specified template.
- The **Model Executions** tab is the full version of the **Overview** tab's lower-left pane.
- The **Run All Statistics** tab is used to check for any model failures when running a Run All.



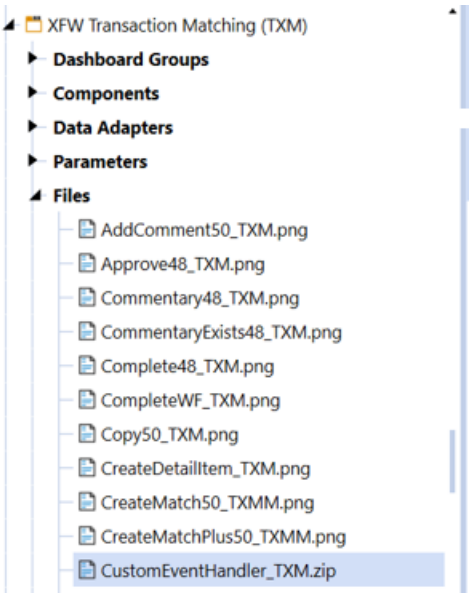


Appendix C: Custom Event Model

The purpose of the Custom Event Model is to provide user customization that remains in place and is bypassed during a solution upgrade. The Predictive Analytics solution supports these models using Business Rules.

Set Up the Custom Event Model

1. On the Application tab click **Dashboards > Dashboard Maintenance Units > XFW Predictive Analytics (PAM) > Files**
2. In the **Files** folder, click **CustomEventHandler_Pam.zip.**

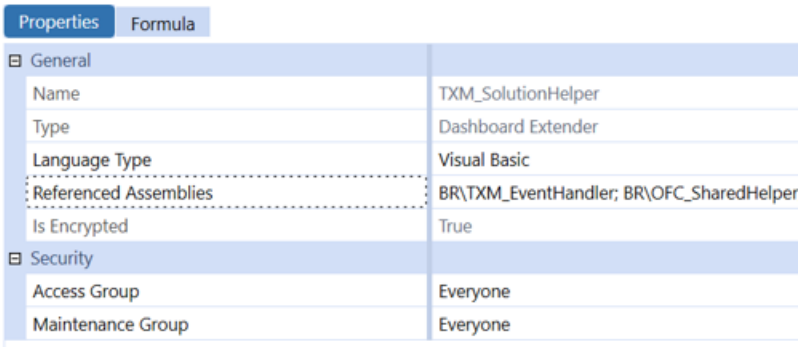


3. In the **General (File)** pane, click **Download File** and save the file to an appropriate location.
4. On the **Application** tab, click **Tools > Load/Extract.**
5. On the **Load** tab, locate **CustomEventHandler_PAM.zip** using the **Select File** icons and click **Open**.
6. When the solution's file name appears, click **Load** to import the business rule.

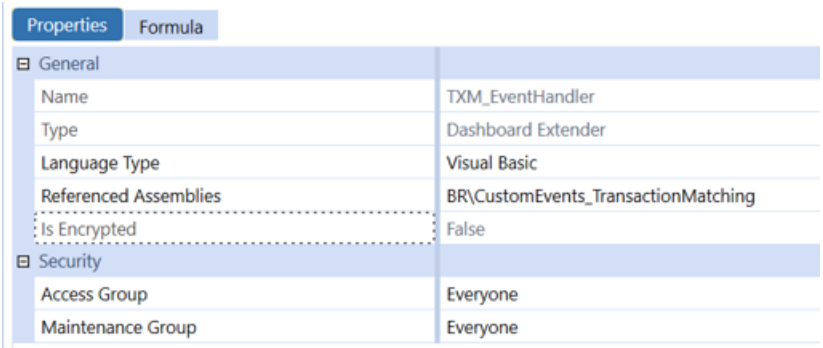
Integrate Business Rules

After importing the business rule, updating the PAM_EventHandler business rule to integrate with the CustomEvents business rule.

1. In the **General** section of the PAM_SolutionHelper script Properties tab, add `BR\CustomEvents_[[[[PredictiveAnalytics]]]]` to **Referenced Assemblies.**



2. In the **General** section of the PAM_EventHandler script Properties tab, add `BR\CustomEvents_[[[[PredictiveAnalytics]]]]` to **Referenced Assemblies**



3. Comment out line 42 of the PAM_EventHelper business rule.

4. Uncomment line 43 of the PAM_EventHelper business rule.

```
41          'Custom Event Handler Declaration
42          'Public Property m_CustomEvents As Object = Nothing
43          Public Property m_CustomEvents As New DashboardExtender.CustomEvents_TransactionMatching.MainClass
```

Once the custom event integration is set up, event actions can be defined in the *CustomEvents_[[[[PredictiveAnalytics]]]]* script.

> **IMPORTANT:** These events will not be deleted or overridden when upgrading to new versions of Predictive Analytics. However, each time a new version is upgraded, apply these setup steps.

Available Custom Events

Before/After Selection Changed Events

These events run before/after a custom control is clicked.

- SaveSettings
- CreateSolutionTables
- ValidateSetupStepsExecuted
- Uninstall
- OnTableEditorOrGridSelection
- OnComboBoxSelection
- OnButtonClick
- OnShowContentPage

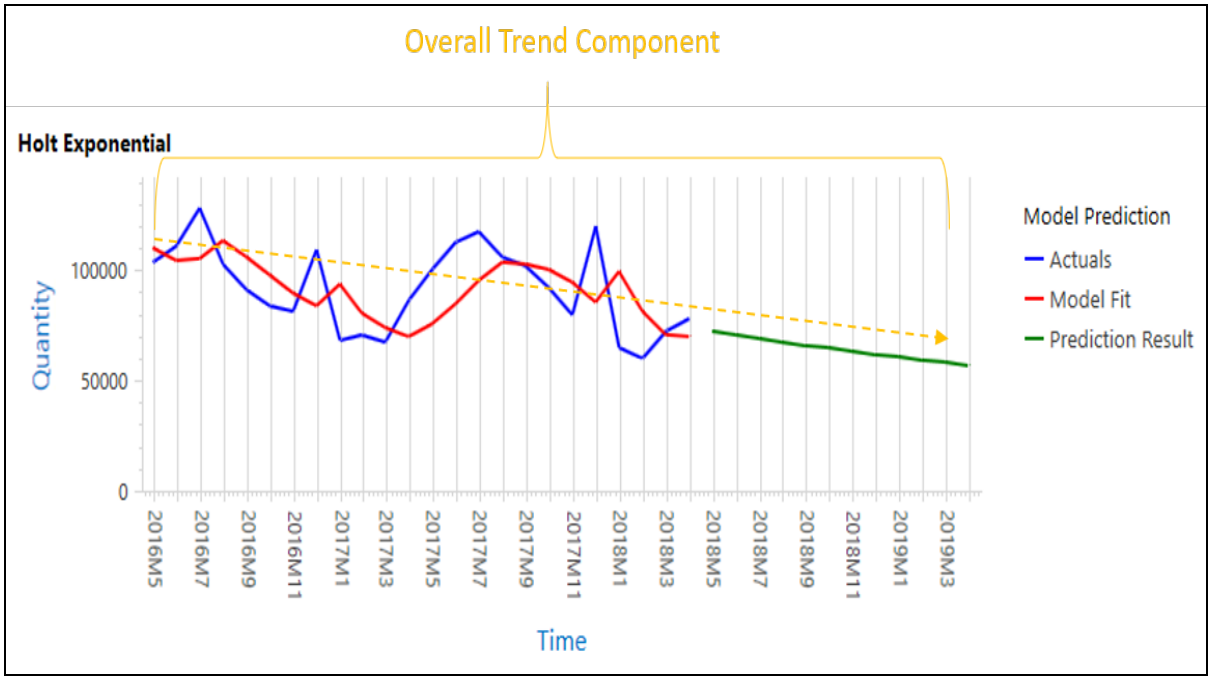
Before/After Save Data Events

These events run before/after the save event for a table editor. For example, this can be used to test grid data prior to saving and potentially not allowing data to be saved if a check fails.

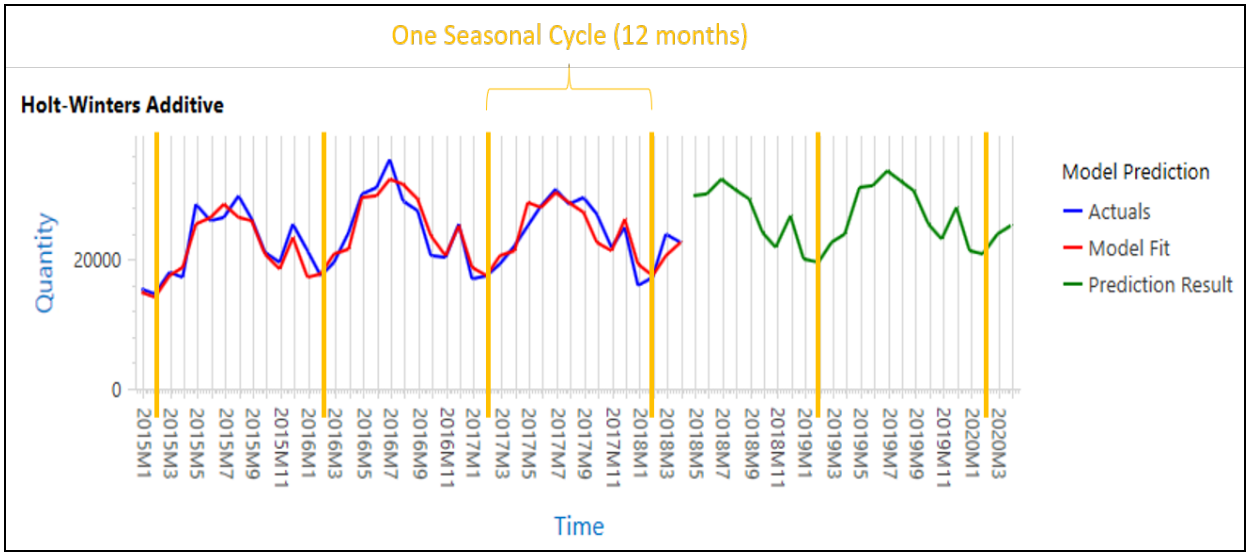
- OnSaveOrUpdateTableEditor

Appendix D: Trend and Seasonality Definitions

A **Trend** is a general systematic linear or nonlinear component that changes over time and does not repeat. The following graph shows the result of the Holt Exponential method applied to an overall trend component.



The **Seasonality** or seasonal cycle of a dataset is the number of points that occur in one cycle of data. Common seasonal cycles include 12 months (yearly) and three months (quarterly).



Appendix E: Predictive Analytic Metrics

This appendix describes the predictive analytic metrics you can use to evaluate results.

Metrics

$y_i =$ i'th actual datapoint value

$\hat{y}_i =$ i'th predicted datapoint value

$n =$ total number of datapoints

Mean Percentage Error (MPE)

Mean Percent Error (MPE) shows the average deviation between the actual and predicted values. This is useful for understanding the magnitude and direction of the errors in relation to the actual values. The drawback of Mean Percent Error is that the results are more biased when the actual values are closer to zero.

$$MPE = \frac{100\%}{n} \sum_{i=1}^{n} \frac{y_i - \hat{y}_i}{y_i}$$

Mean Absolute Percentage Error (MAPE)

Mean Absolute Percent Error (MAPE) shows the average absolute deviation between the actual and predicted values. If large outliers are present, it is best to remove them from the dataset as they can skew the error. However, Mean Absolute Percent Error is the better option in a dataset where outliers provide value as it cannot be skewed directionally.

$$MAPE = \frac{100\%}{n} \sum_{i=1}^{n} \left| \frac{y_i - \hat{y}_i}{y_i} \right|$$