#### **Watson Studio SPSS Modeler Overview**

### Introduction

In this lab you will learn how to implement analytics in **SPSS Modeler**, a well-known visual data mining workbench which is part of **Watson Studio**. The lab will introduce the SPSS Modeler capability using the trafficking datasets. The lab will guide the development of an SPSS Modeler stream that will prepare the input data to train and evaluate a machine learning model for predicting the trafficking risk based on the travel itinerary.

#### **End-to-End Data Science**

The general flow of the End to End Data Science PoT will be guided by the activities shown in Figure 1- End to End Flow. The SPSS capability spans the Prepare Data, Build Model, and Save and Deploy activities.

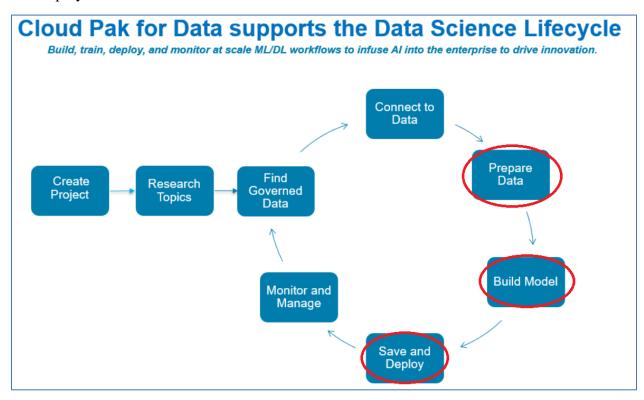


Figure 1- End to End Flow

# **Objectives**

- 1. Become familiar with the Watson Studio SPSS Modeler capability
- 2. Load the trafficking data into SPSS Modeler
- 3. Join the datasets
- 4. Profile the trafficking data
- 5. Prepare the trafficking data
- 6. Train/Evaluate a machine learning model.
- 7. Save the model.

# **Background**

**SPSS Modeler** is a visual data mining workbench. Modeler can be used to complete all tasks in analytic application development

- Data understanding
- Data preparation
- Model building
- Model evaluation

Assets developed in Modeler are called "flows". Another frequently used term in Modeler documentation is "streams" (used in Modeler desktop documentation). A flow starts with one or several data sources. Using visual nodes, a user can apply different operations to data. Data "flows" from one node to another in the direction of the arrows.

Visual nodes in modeler are color-coded and organized by type of operation: **Import**, **Record Operations**, **Field Operations**, **Graphs**, **Modeling**, **Output**, and **Export** (data sources). Most operations are well-known functions in data preparation and analytics, such as sampling, filtering, binning, etc.

The data sources are purple	custome
Data preparation operations are blue	
Algorithms are green	≥ → Q CHURN
The models that are created based on algorithms are orange	S CHURN
Different types of output (graphs, tables, external files) are black	TelcoCh
The nodes with a star icon are called "supernodes" because they contain several nodes. Supernodes are used for visual organization of the flow.	Derive_A

If a user needs more information about a particular node, it can be looked up in Modeler documentation. SPSS also publishes the **Algorithms Guide** that explains how machine learning algorithms are implemented in Modeler.

# **Female Human Trafficking Data**

The data sets used for this lab consist of **simulated** travel itinerary data. The use case corresponds to an analyst reviewing the travel data to assign a risk of trafficking. The risk is recorded as the VETTING\_LEVEL column in the dataset. Some of the records have already been analyzed and have a VETTING\_LEVEL of low (value is 30), medium (value is 20), or high risk (value is 10). Others have not yet been vetted (value is 100). We will use the data that has been vetted to train a model to predict the risk for the unvetted records. This can be used to automate the process and augment the analyst. For example, one option would be to send the predicted high-risk persons to the analyst for further investigation.

The OCCUPATION data included in the travel data is very granular. For modeling purposes, it was decided to categorize the OCCUPATION data. Two additional datasets are used for this purpose. The occupation.csv dataset maps the granular occupation data to a category code. The categories dataset maps a category code to a category description. These datasets will be joined to the main dataset to prepare the data for modeling.

Other columns in the dataset are similarly very granular and could also be categorized for modeling purposes. This lab does not include steps to accomplish this, but it would be similar to what was done for the occupation column.

# Lab Steps

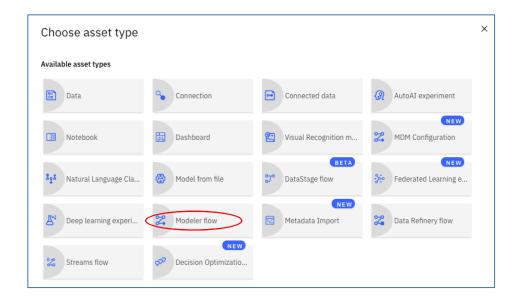
In this section, we will create a Machine Learning flow using SPSS nodes.

# **Step 1 - Create a New Flow**

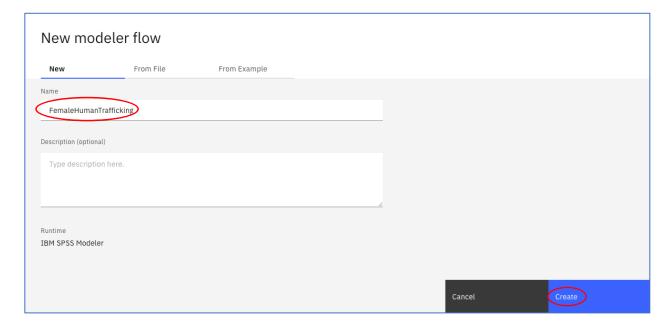
1. In the Watson Studio project, click on **Add to project**.



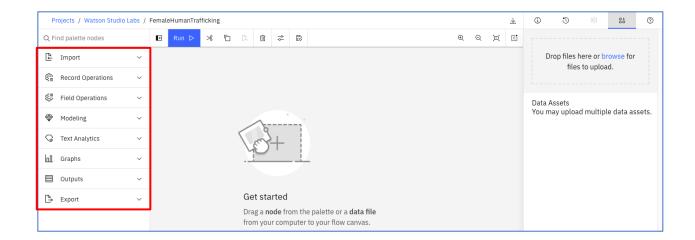
2. Select **Modeler Flow**.



3. Enter a Name for the flow, optionally enter a Description, and click on Create.

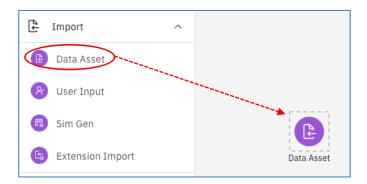


4. This opens the Flow Editor. Note the palette of operations on the left-hand side.

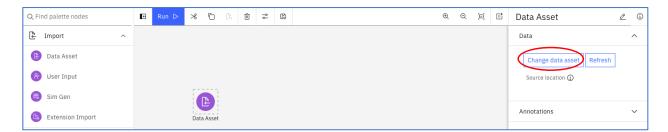


### **Step 2 - Load the Trafficking Datasets**

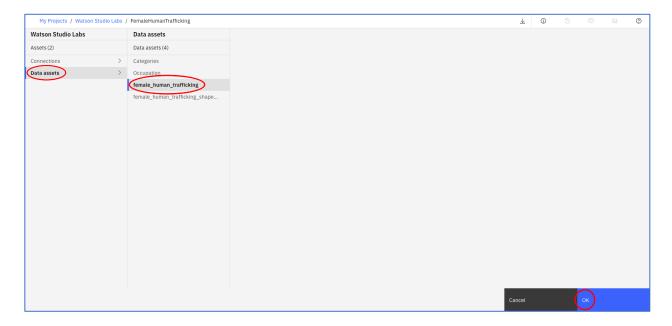
1. Click on **Import** and then **Data Asset** and hold the left mouse key on the Data Asset icon and **drag it onto the left side of the canvas**. Release the left mouse key.



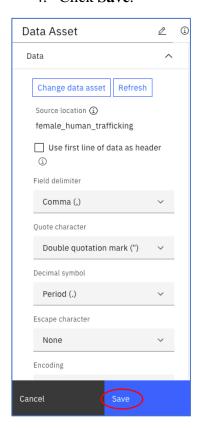
2. Double click on the **Data Asset**. In the window pane on the right-hand-side click on **Change data asset**.



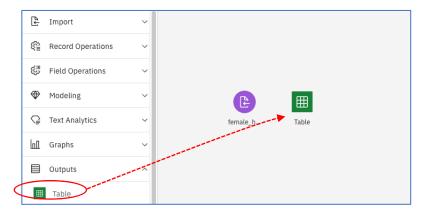
3. Click on Data Assets, click on female\_human\_trafficking, then click OK.



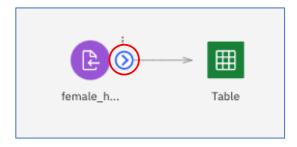
#### 4. Click Save.



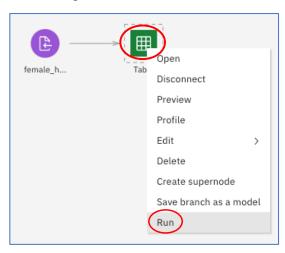
5. Click on the **Outputs** menu item in the Node Palette on the left and then click on the **Table** icon and drag the icon to the right of the female\_human\_trafficking to display its contents. If the Node Palette is not visible, click on the Node Palette icon .



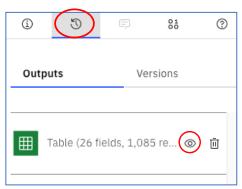
6. Connect the right side of the female\_human\_trafficking icon to the left side of the **Table icon**. This is accomplished by hovering over the data asset icon, clicking on the little blue arrow that appears the right side of the icon, holding the left mouse key, and dragging the mouse to the Table icon, and then releasing the left mouse key.



7. Right click on the **Table** icon and select **Run**.



8. The "Running Flow" prompt will appear and then when completed a Table output selection will appear on the right side of the screen under the **Outputs** tab. If the Table output selection does not appear, select the clock icon. **Click on the** other contents of the female\_human\_trafficking is displayed.



9. Each row contains travel information for a person. We will use this data to make predictions on trafficking risk. **Click on your flow name**.



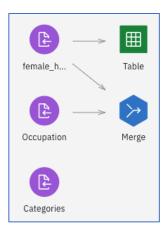
10. **Repeat steps 1-5 for the occupation dataset** and then **repeat steps 1-5 for the Categories dataset**. When complete, the canvas should appear as below.



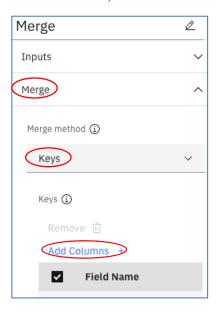
**Step 3 - Join the Data Sources** 

In this step we will join the data sources using **Merge** Nodes.

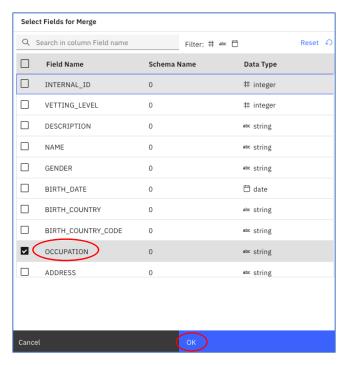
1. Add a **Merge** node to the flow by clicking on the **Record Operations** menu in the Node Palette, and then dragging the **Merge** node to the right of the **Occupations** data source. If the Node Palette is not visible, click on the Node Palette icon ■. Connect the **female\_human\_trafficking** data source to the Merge node. Connect the **Occupations** data source to the **Merge** node. The canvas should appear as below.



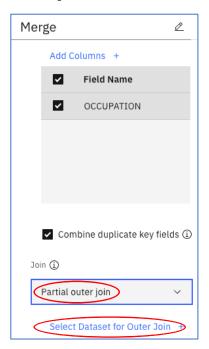
2. Double-click on the **Merge** Node. Click on **MERGE**, then click on **Keys** for the Merge method, and click on **Add Columns**.



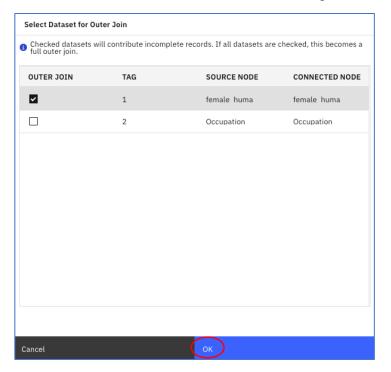
3. Click on OCCUPATION and then click on Ok. You may need to scroll down.



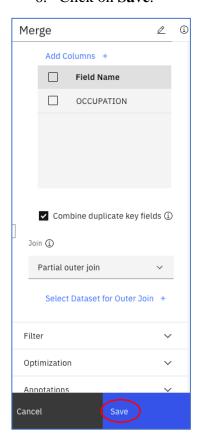
4. Scroll down in the Merge side panel that you have been working in. Select **Partial outer join** and then click on **Select Dataset for Outer Join.** 



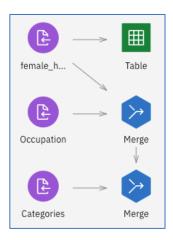
5. Make sure the female\_human\_trafficking **SOURCE NODE** is checked and click **OK**.



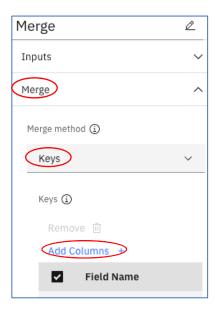
#### 6. Click on Save.



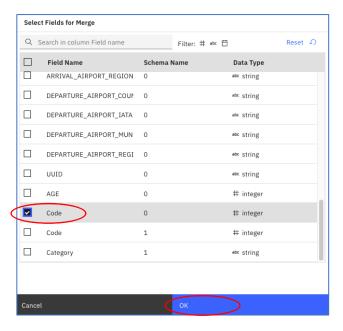
7. Add a **Merge** node to the flow by clicking on the **Record Operations** menu in the Node Palette, and then dragging the **Merge** node to the right of the **Categories** data source. If the Node Palette is not visible, click on the Node Palette icon ■. Connect the prior **Merge** node to this **Merge** node. Connect the **Categories** data source to the **Merge** node. The canvas should appear as below.



8. Double click on the second **Merge** node to set the merge options. Click on **MERGE**, click on **Keys** for the Merge method, and then click on **Add Columns** to add the key columns.



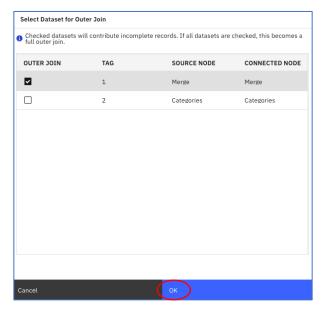
9. Scroll down and click on the **Code** checkbox where the Schema Name column is 0. Click on **OK**.



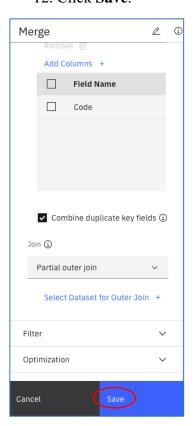
10. Scroll down in the side panel and click on **Partial Outer Join** and click on Select Dataset.



11. Make sure the Merge SOURCE NODE is selected and click Ok.



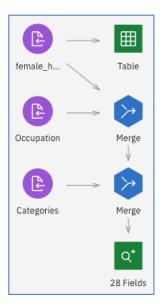
### 12. Click Save.



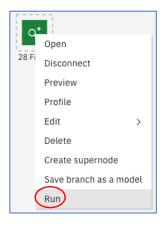
### **Step 4 - Explore the Data using the Data Audit Node**

The SPSS Modeler has a Data Audit node that provides profiling information on the input data that is useful for cleansing and preparing the data. It provides a comprehensive first look at the data, including summary statistics, as well as information about outliers, missing values, and extremes.

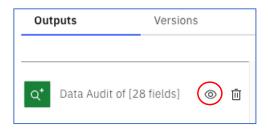
1. Add a **Data Audit** node to the flow clicking on the **Outputs** menu item in the Node Palette, and then dragging the **Data Audit** node to underneath the **Merge** node. If the Node Palette is not visible, click on the Node Palette icon . Connect the node to the Data Audit node. The canvas should appear as below.



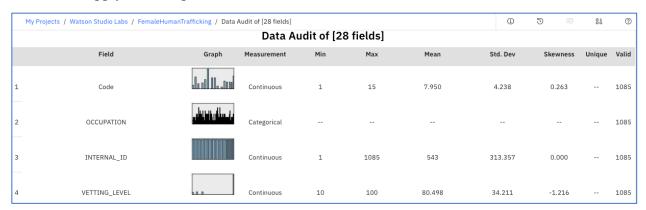
2. Right click on the Data Audit node and click Run.



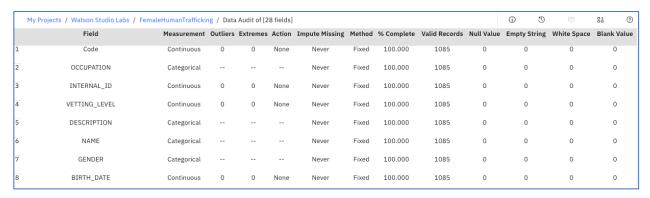
3. The "Running Flow" prompt will appear and then when completed a Data Audit output selection will appear on the right side of the screen under the **Outputs** tab. If the **Outputs** tab doesn't display, click on the clock icon.



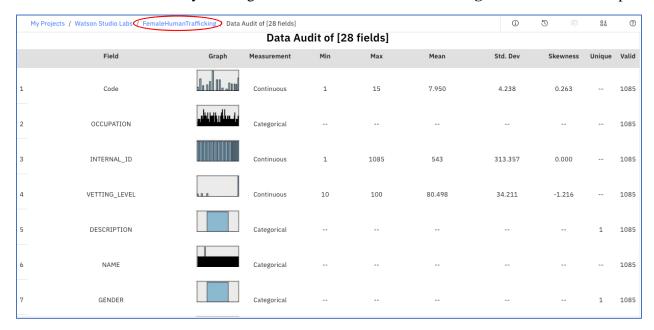
4. Double click on the **Data Audit of [28 fields]** to view the Data Audit output. The top section of the Data Audit report displays profiling information. For modeling purposes, fields that have only 1 unique value, or have many unique values should be eliminated. In addition, certain fields are directly related such as PASSPORT\_COUNTRY, PASSPORT\_COUNTRY\_CODE, BIRTH\_COUNTRY, and BIRTH\_COUNTRY\_CODE. Only one of these fields need to be retained. The fields that we will keep for modeling purposes are VETTING\_LEVEL, Category, AGE, COUNTRIES\_VISITED\_COUNT, ARRIVAL\_AIRPORT\_REGION, DEPARTURE\_AIRPORT\_COUNTRY, PASSPORT\_COUNTRY. Later in the lab we will apply a filter operation to retain these fields.



5. **Scroll down** to view the bottom section. It displays data quality checks in the form of missing values or anomalous values. In our travel data simulator, we didn't simulate any of those type of values!



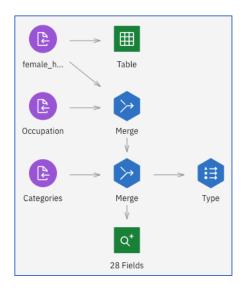
6. Return to the flow by clicking on the **FemaleHumanTrafficking** breadcrumb at the top.



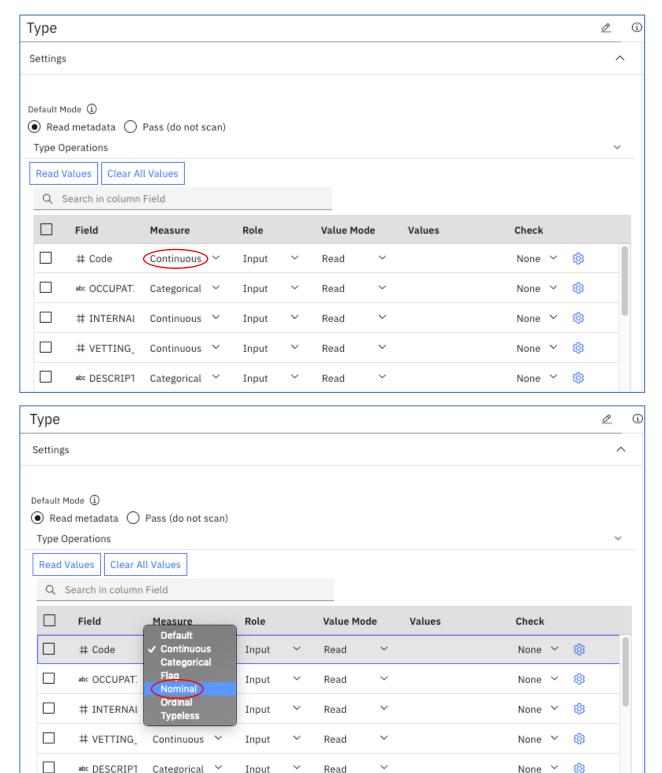
Step 5 - Explore the Data using Graph Nodes.

Let's explore the data using Graph Nodes. The Distribution node, and the Histogram node will be used to explore some of the characteristics of the trafficking data. First, we will add a Type node to the canvas. The Type node specifies field metadata and properties. We will change the measurement property for the "Code" and "VETTING\_LEVEL" fields that were derived as "Continuous" (by scanning the data values) to "Nominal".

1. Add a **Type** node to the flow by clicking on the **Field Operations** menu item in the Node Palette and then drag the **Type** node to the right of the second **Merge** node. If the Node Palette is not visible, click on the Node Palette icon Connect the **Merge** node to the **Type** node. The canvas should appear as below.



2. Double click on the **Type** node. This will open a **Type** menu pallet on the right side of the screen. Select the dropdown in the Measure column next to Code. Change the Measure to Nominal.



Read

None ~

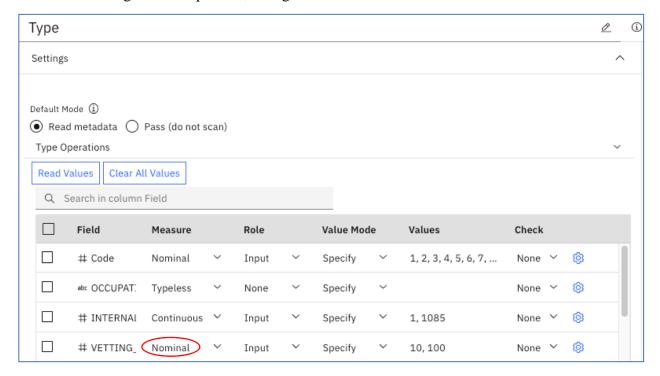
(6)

abc DESCRIPT

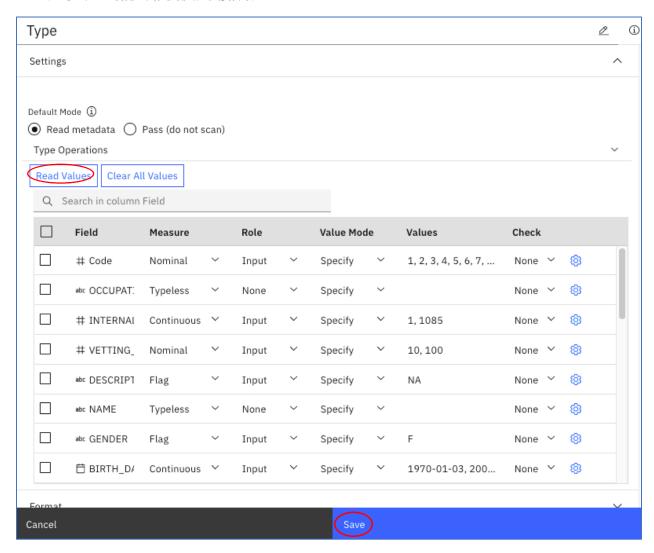
Categorical ~

Input

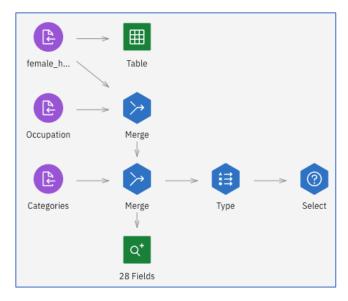
3. Following the same process, change the **Measure** of VETTING\_LEVEL to **Nominal**.



4. Click **Read Values** and **Save**.



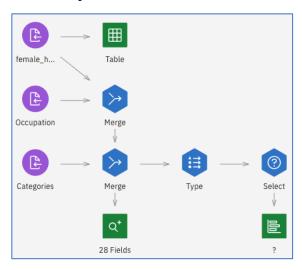
5. We will now discard the unvetted records. Add a **Select** node to the flow by clicking on the **Record Operations** menu item in the Node Palette and then dragging the **Select** node to the canvas to the right of the **Type** node. If the Node Palette is not visible, click on the Node Palette icon . The canvas should appear as below.



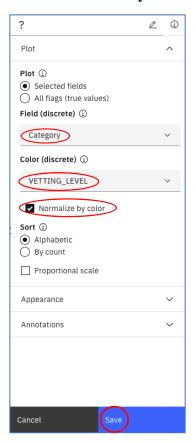
6. Double-click the **Select** node. Click on **Discard** for **Mode**. In the Condition, enter VETTING\_LEVEL==100, click **Save**.



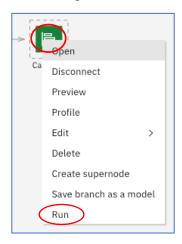
7. Add a **Distribution** node to the flow by clicking on the **Graph** menu item and then dragging the **Distribution** node to the canvas underneath the **Select** node. If the Node Palette is not visible, click on the Node Palette icon Connect the **Select** node to the **Distribution** node. The canvas should appear as below. The ? indicates that the fields to be plotted have not been identified.



8. Double click on the Distribution Node. In the **Field (discrete)** dropdown, select **Category**. In the **Color (discrete)** dropdown, select **VETTING\_LEVEL**. Click on the **normalize by color** checkbox, and then click **Save**.



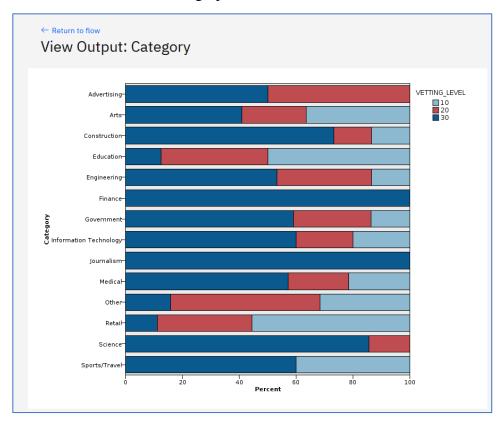
9. Right click on the Distribution node and select **Run**.



10. The Distribution output will appear under the **Outputs** tab. Double-click on Categories to view the graph. If you don't see the Outputs, click on the Outputs ("clock") icon.



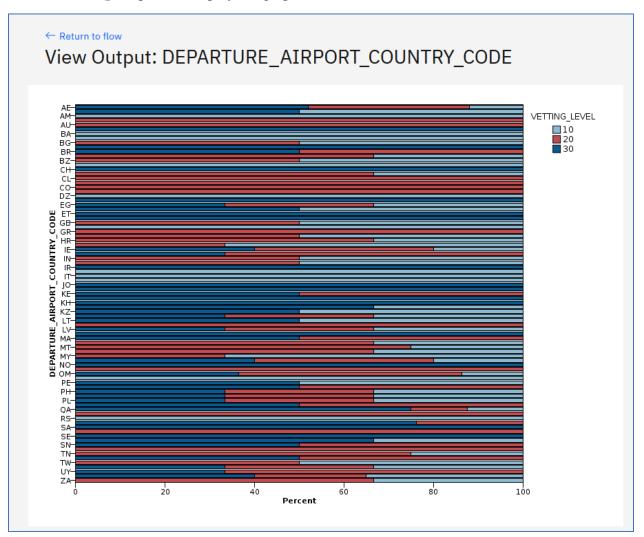
11. We can see from the graph that the VETTING\_LEVEL does differ based on Category.



12. Return to the flow by clicking on the FemaleHumanTrafficking breadcrumb at the top.

My Projects / Watson Studio Labs FemaleHumanTrafficking / Category

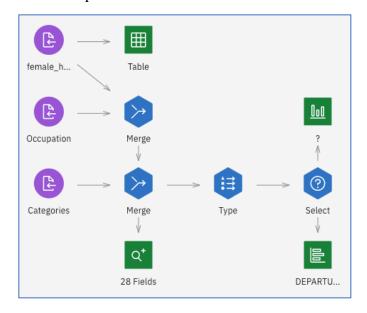
13. You can change the distribution graph to show the VETTING\_LEVEL by DEPARTURE\_AIRPORT\_COUNTRY\_CODE by double clicking on the Distribution node and replacing Category with DEPARTURE\_AIRPORT\_COUNTRY\_CODE and clicking Save. Re-run the graph by right clicking on the Distribution node and selecting Run. Double click on the DEPARTURE\_AIRPORT\_COUNTRY\_CODE in the Outputs pane to display the graph.



14. Return to the flow by clicking on the FemaleHumanTrafficking breadcrumb at the top.

My Projects / Watson Studio Labs FemaleHumanTrafficking

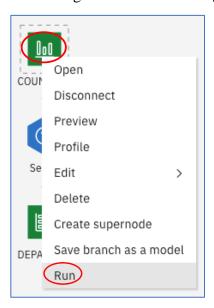
15. Add a **Histogram** node to the flow by clicking on the **Graphs** menu item and then dragging the **Histogram** node to the canvas above the **Select** node. If the Node Palette is not visible, click on the Node Palette icon ■. Connect the **Select** node to the **Histogram** node. The canvas should appear as below. The ? indicates that the fields to be plotted have not been identified.



16. Double click on the **Histogram** node. Select **COUNTRIES\_VISITED\_COUNT** from the Field (continuous) dropdown. Select **VETTING\_LEVEL** from the Color (discrete) dropdown. Click on **Save**.

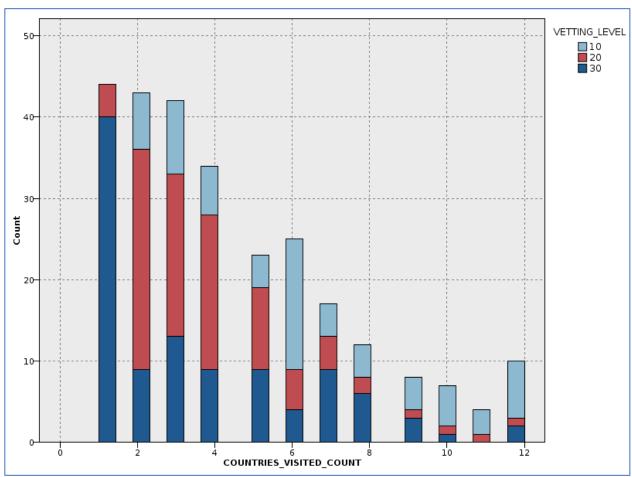


17. Right click on the **Histogram** node and select **Run**.



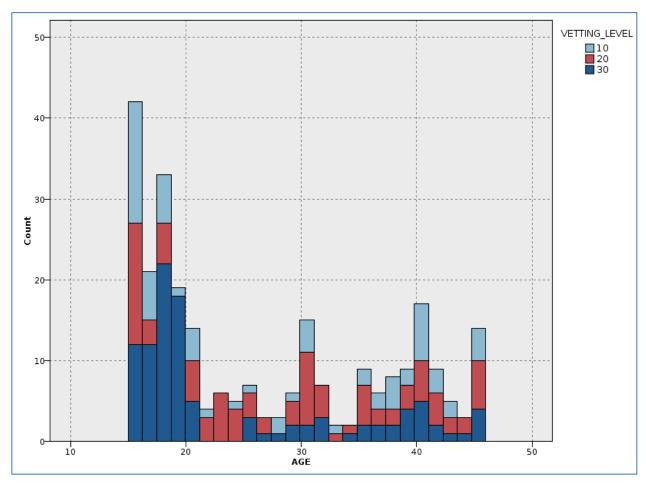
18. Double click on the **COUNTRIES\_VISITED\_COUNT** under the **Outputs** tab at the right of the screen.





19. The general trend appears to be that the more countries visited, the higher likelihood to be a "High Risk". You can change the histogram to show the **AGE** by **VETTING\_LEVEL** by double clicking on the Histogram node and replacing **COUNTRIES\_VISITED\_COUNT** with **AGE** and clicking **Save**. Re-run the graph by

**COUNTRIES\_VISITED\_COUNT** with **AGE** and clicking **Save**. Re-run the graph by right clicking on the **Histogram** node and selecting **Run**. Double click on the **AGE** in the **Outputs** pane to display the graph.



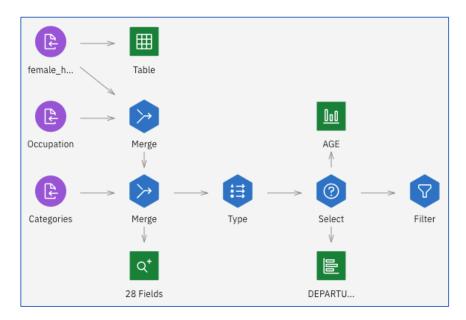
**Step 6 - Prepare the Data for Modeling** 

Based on our exploration of the data, there are several transformations that are needed to prepare the data for modeling. This section will introduce, the **Filter** node and the **Reclassify** node that will do the necessary transformations. The **Filter** and **Reclassify** nodes act on a field level.

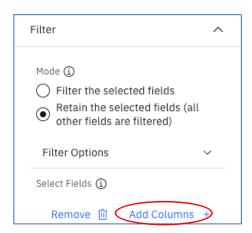
**Filter** node – The **Filter** node performs two functions. It specifies fields that can be dropped or the fields that should be retained. It also allows fields to be renamed. We will retain the following fields – VETTING\_LEVEL, COUNTRIES\_VISITED\_COUNT, ARRIVAL\_AIRPORT\_REGION, DEPARTURE\_AIRPORT\_COUNTRY\_CODE, AGE, and Category.

**Reclassify** node – The **Reclassify** node allows us to map input values to output values. We will use this node to map the VETTING\_LEVEL values of 10, 20, 30, and 100 to "High Risk", "Medium Risk", "Low Risk", and "Unvetted" respectively.

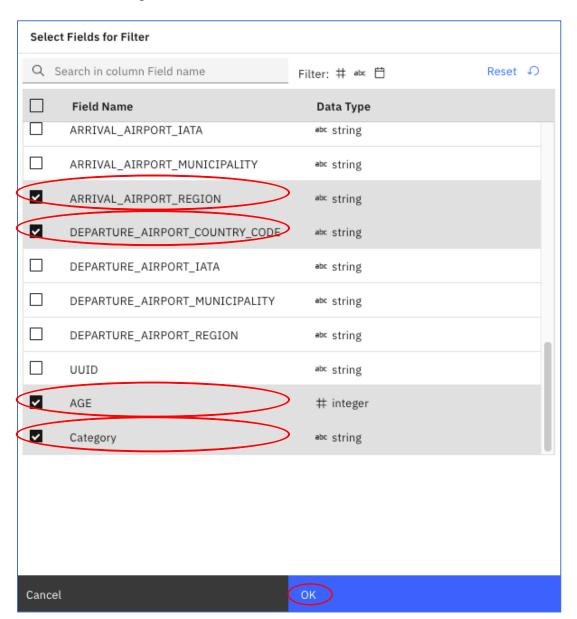
1. Add a **Filter** node to the flow by clicking on the **Field Operations** menu in the Node Palette and then dragging the **Filter** node to the canvas to the right of the **Select** node. Connect the **Select** node to the **Filter** node. If the Node Palette is not visible, click on the Node Palette icon The canvas should appear as below.



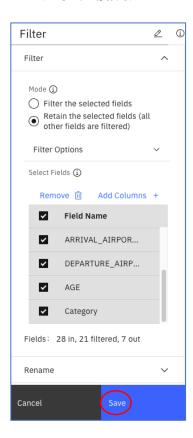
2. Double-click on the Filter node. Click Retain the selected ..., and click Add Column.



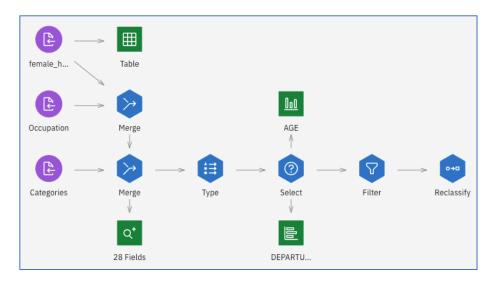
3. Scroll down and click on VETTING\_LEVEL, PASSPORT\_COUNTRY, COUNTRIES\_VISITED\_COUNT, ARRIVAL\_AIRPORT\_REGION, DEPARTURE\_AIRPORT\_COUNTRY\_CODE, AGE, and CATEGORY, then click OK. Scroll as required to check all of the above fields.



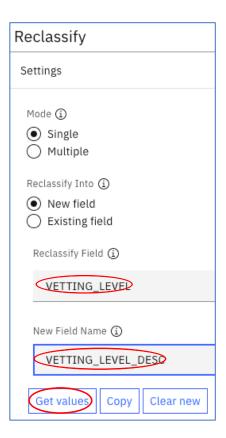
#### 4. Click Save.



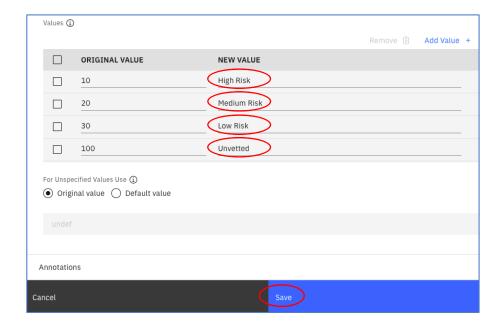
5. Add a **Reclassify** node to the canvas by clicking on the **Field Operations** menu item in the Node palette, and then dragging the **Reclassify** node onto the canvas to the right of the **Filter** node. If the Node Palette is not visible, click on the Node Palette icon Connect the **Filter** node to the **Reclassify** node. The canvas should appear as below.



6. Double-click on the **Reclassify** node. Configure the **Reclassify** node as follows. Select **VETTING\_LEVEL** for the **Reclassify** field. Enter **VETTING\_LEVEL\_DESC** for the **New Field Name**. Click **Get values**.



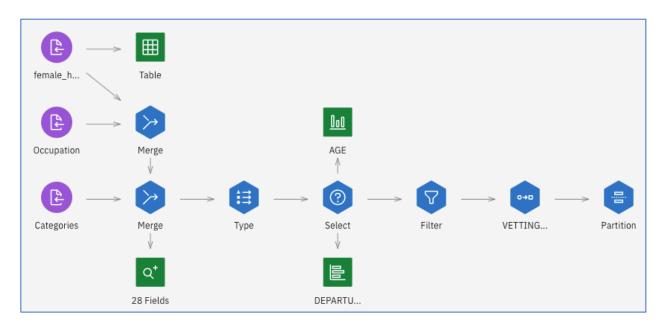
7. Scroll down. Enter in "High Risk" as the new value for "10", "Medium Risk" as the new value for "20", "Low Risk" as the new value for "30", and "Unvetted" as the new value for "100". Click on **Save**.



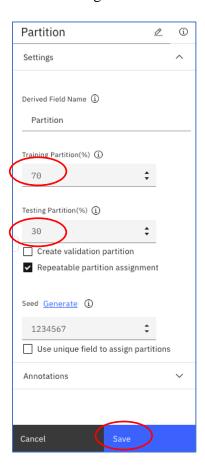
### **Step 7 - Modeling and Evaluation**

Now that the data is prepared, we can start the modeling effort. First, we will add a **Partition** node to divide the data set into Training and Testing sets. In addition, a **Type** node is needed prior to modeling to set the roles of the data fields. Then we will add several modeling nodes and use the Training set to train the model. Finally, we will add **Analysis** nodes to evaluate the results.

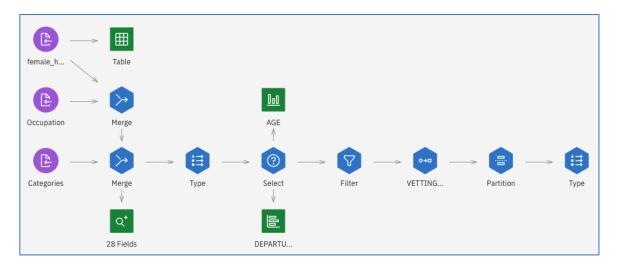
1. Add a **Partition** node to the canvas by clicking on the **Field Operations** menu item in the Node Palette, and then dragging the **Partition** node onto the canvas to the right of the **Reclassify** node. If the Node Palette is not visible, click on the Node Palette icon ■. Connect the **Reclassify** node to the **Partition** node. The canvas should appear as below.



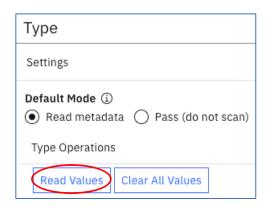
2. Double-click on the **Partition** node. Use a 70-30 breakdown between training and testing. Leave the other defaults and click **Save**.



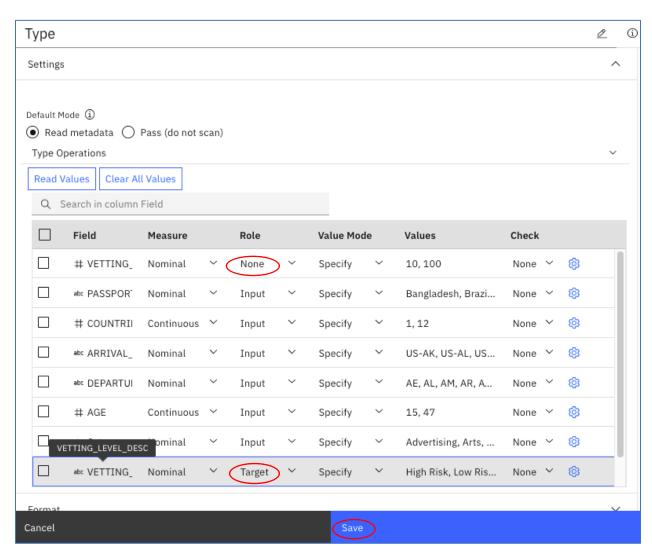
3. Add a **Type** node to the canvas by clicking on the **Field Operations** menu item in the Node palette, and then dragging the **Type** node onto the canvas to the right of the **Partition** node. If the Node Palette is not visible, click on the Node Palette icon **Connect the Partition** node to the **Type** node. The canvas should appear as below.



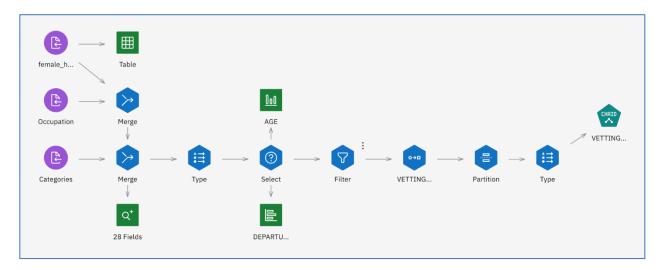
4. Double-click on the **Type** Node. Click on **Read Values**.



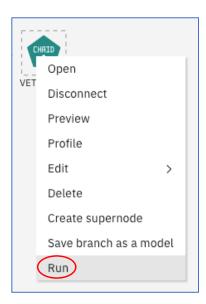
5. Hover over the Field name to see the full name. Change the role of **VETTING\_LEVEL** to None. Change role of **VETTING\_LEVEL\_DESC** to **Target**. Click **Save**.



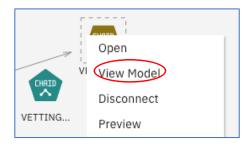
6. Add a **CHAID** node by clicking on the **Modeling** menu item in the Node palette and dragging the **CHAID** node onto the canvas to the right of the **Type** node. Connect the **Type** node to the **CHAID** node. The canvas should appear as below.



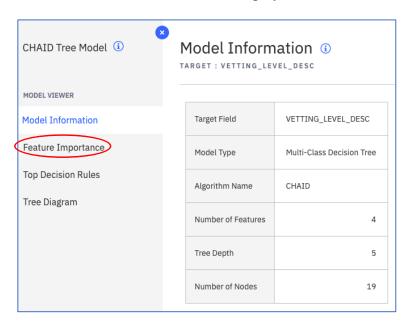
7. Right-click on the CHAID node and click Run.



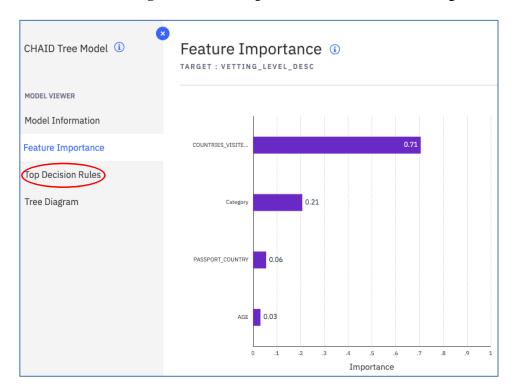
8. A **Model** node is created. Drag the **Model** node to the right of the **CHAID** node. Right-click on the **Model** node and click **View Model**.



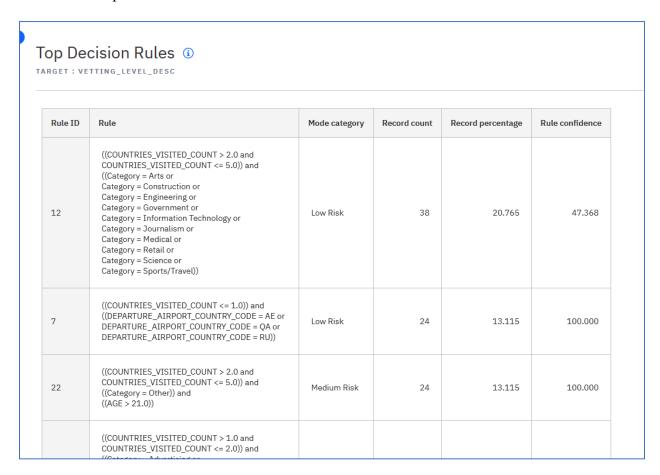
9. The Model Information is displayed. Click on **Feature Importance**.



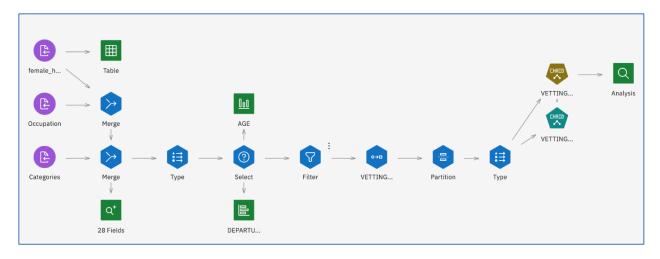
10. Feature Importance is displayed with similar results to the Feature Selection output. Click on **Tree Diagram and/or Top Decision Rules** to see the algorithm output.



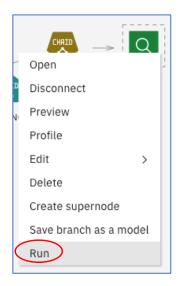
11. The Top Decision Rules are shown below.



7. Add an Analysis node by clicking on the Output menu item in the Node palette and dragging the Analysis node onto the canvas to the right of the CHAID Model node. Connect the CHAID Model node to the Analysis node. The canvas should appear as below.



8. Right-click the **Analysis** node and click **Run**.



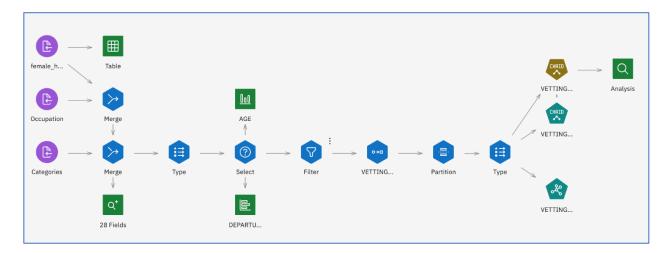
9. Double-click on the Analysis results in the Output area.



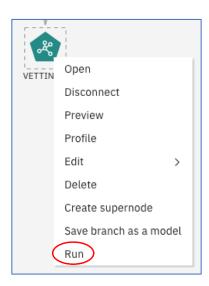
10. Accuracy results are displayed for the CHAID algorithm.

lesults for output field	VETTING_LEVEL_DE	SC			
omparing \$R-VETTIN	G_LEVEL_DESC with \	/ETTING_LE	VEL_DESC		
Partition'	1_Training		2_Testing		
orrect	142	77.6%	61	70.93%	
rong	41	22.4%	25	29.07%	
otal	183		86		

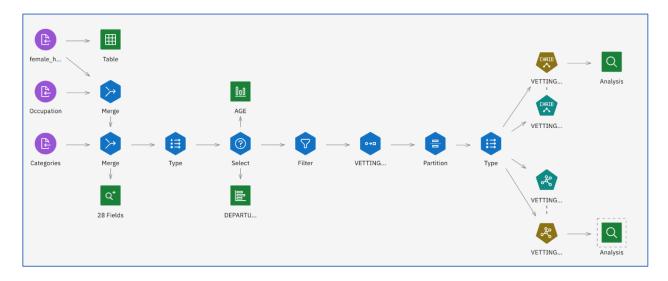
6. Add a **Random Forest** node by clicking on the **Modeling** menu item in the Node palette and dragging the **Random Forest** node onto the canvas underneath the **CHAID** node. Connect the **Type** node to the **Random Forest** node. The canvas should appear as below.



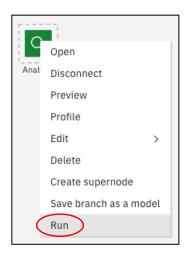
7. Right-click the **Random Forest** node and click **Run**.



8. A Random Forest Model node is created. The Random Forest Model node does not have a View Model option. Add an Analysis node to the right of the Random Forest Model node by clicking on the Outputs menu of the Node Palette. Connect the Analysis node to the Random Forest Model node. The canvas should appear as shown below.



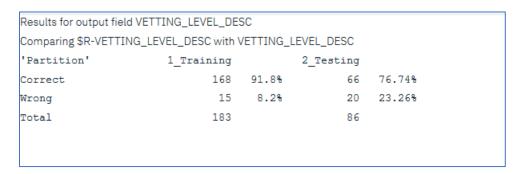
9. Right-click on the **Analysis** node and click **Run**.



10. The Analysis node output appears in the Outputs area. Double-click Analysis of ...



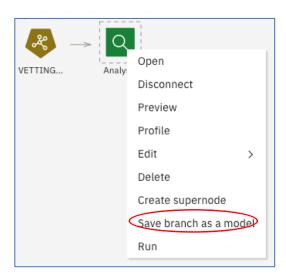
11. The results appear below. Based on the results, it appears the Random Forest model is overfitting given the disparity between training and testing results.



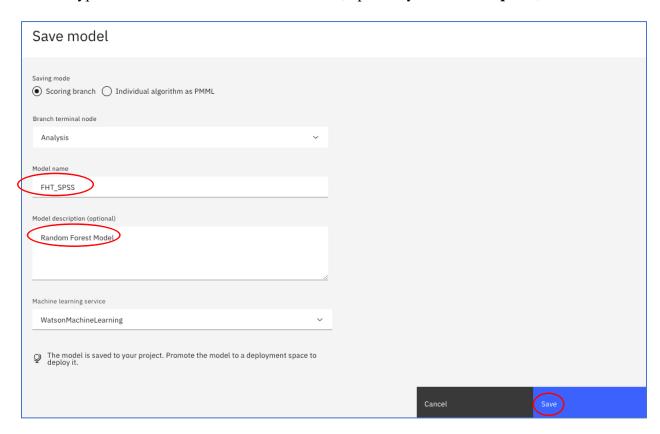
# Step 8 - Saving a Model

Now that we have created and evaluated a model, we will save the model as an asset. This saved model can be deployed at a future date, removing the need to recreate the same model from scratch.

1. Right click on the Random Forest Analysis node and then click on **Save branch as a model**.



2. Type in "FHT\_SPSS" as the Model Name, optionally add a Description, and click Save.



### 3. Click Close.



4. Navigate to your project "assets" page. Click on Watson Studio Labs.

My Projects Watson Studio Labs FemaleHumanTrafficking

5. Note that the model you built is now saved as an asset and the work you have completed can be easily reused in the future.



# You have completed Lab-4!

- ✓ Became familiar with the Watson Studio SPSS Modeler capability
- ✓ Loaded the trafficking data into SPSS Modeler
- ✓ Joined the datasets
- ✓ Profiled the trafficking data
- ✓ Prepared the trafficking data
- ✓ Trained/Evaluated a machine learning model.
- ✓ Saved the model.