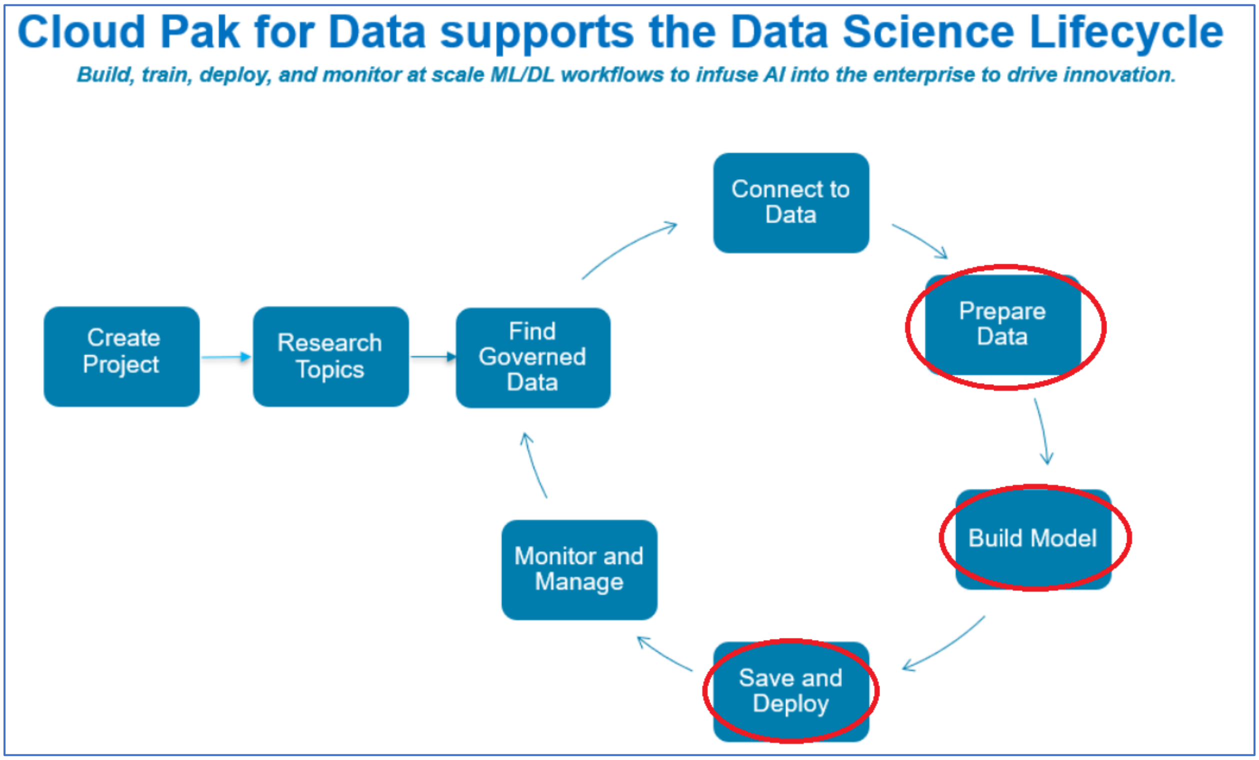
# Watson Studio SPSS Modeler Overview

## 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.



Cloud Pak for Data supports the Data Science Lifecycle

*Build, train, deploy, and monitor at scale ML/DL workflows to infuse AI into the enterprise to drive innovation.*

*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 | Merge |
| Algorithms are green | CHURN |
| The models that are created based on algorithms are orange | 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.

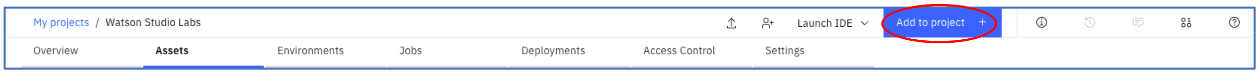
Other columns in the dataset are similarly very granular and could also be categorized for modeling purposes. This lab does not include steps to accomplish this, but it would be similar to what was done for the occupation column.

# Lab Steps

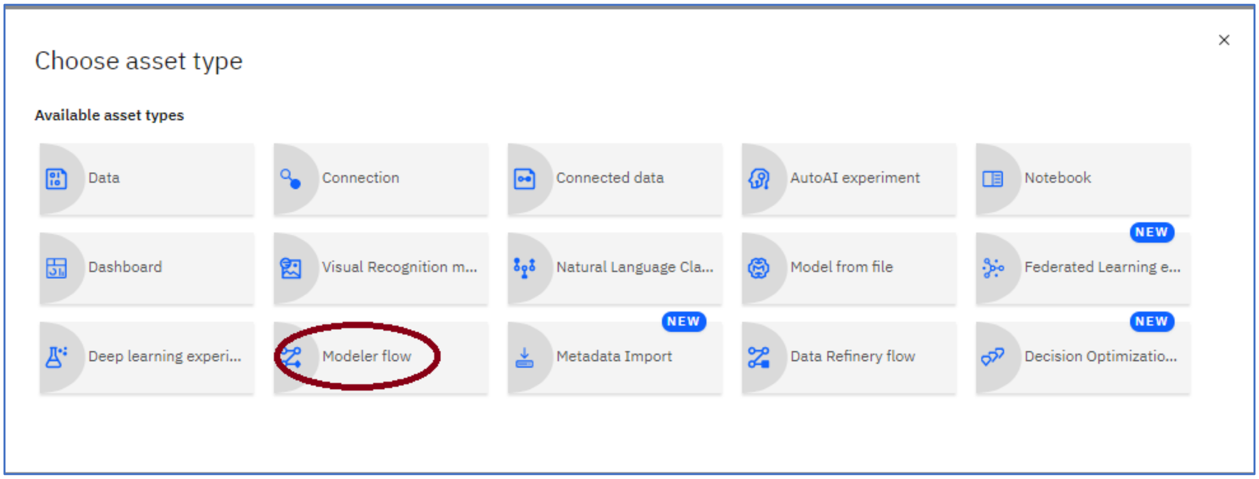
In this section, we will create a Machine Learning flow using SPSS nodes.

## Step 1 - Create a New Flow

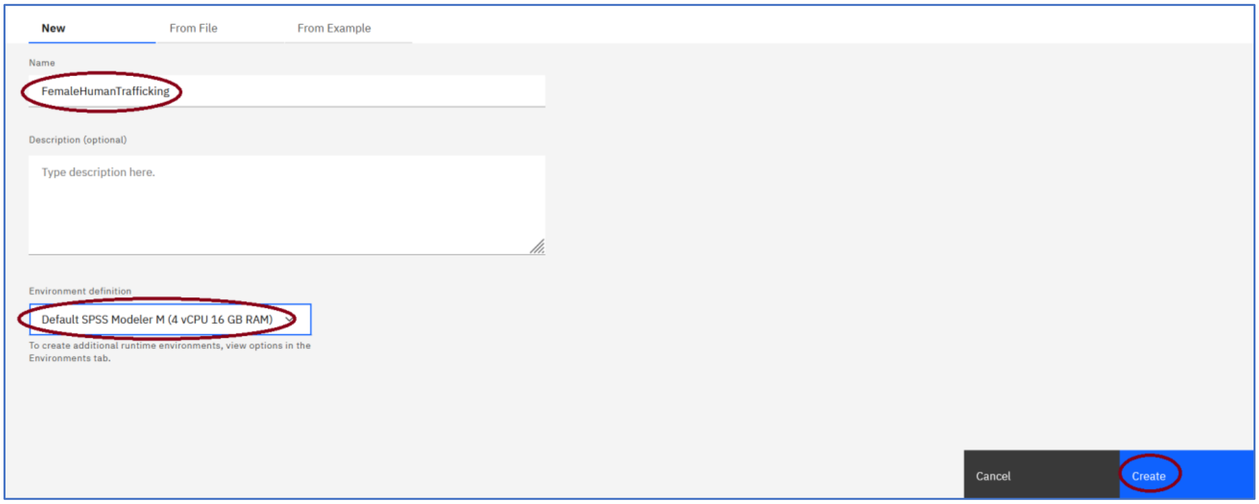
1. In the Watson Studio project, click on **Add to project**.



2. Select **Modeler Flow**.



3. Enter a **Name** for the flow, optionally enter a **Description**, change the **Environment** to **Default SPSS Modeler M (4 vCPU 16GB RAM)** and click on **Create.**



Name

FemaleHumanTrafficking

Description (optional)

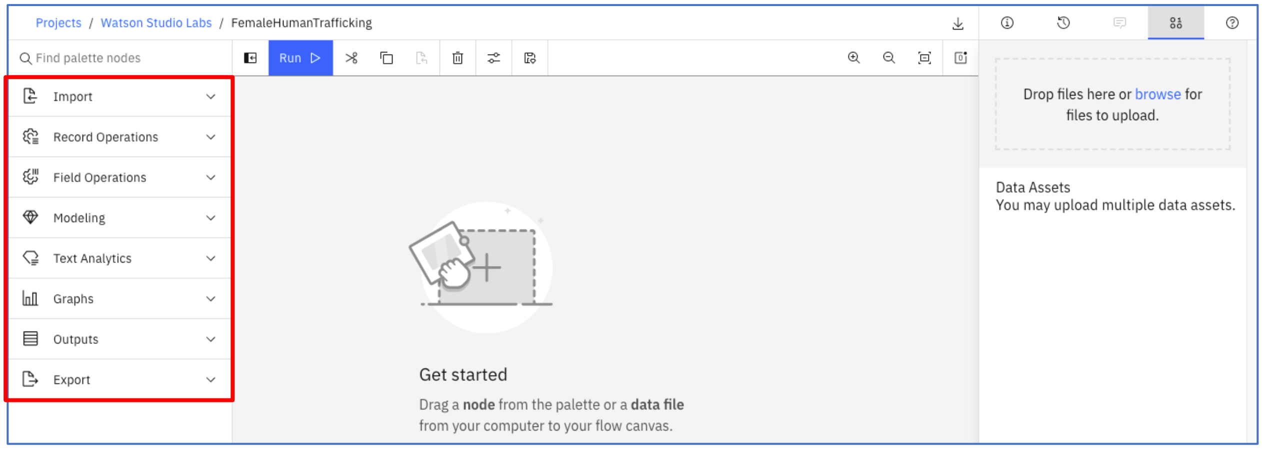
Type description here.

Environment definition

Default SPSS Modeler M (4 vCPU 16 GB RAM)

To create additional runtime environments, view options in the Environments tab.

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



Projects / Watson Studio Labs / FemaleHumanTrafficking

Get started

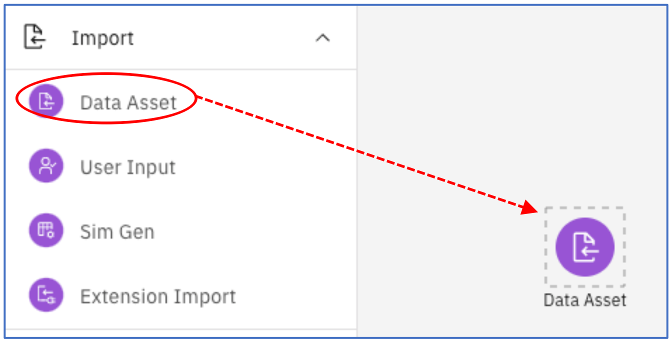
Drag a **node** from the palette or a **data file** from your computer to your flow canvas.

Drop files here or browse for files to upload.

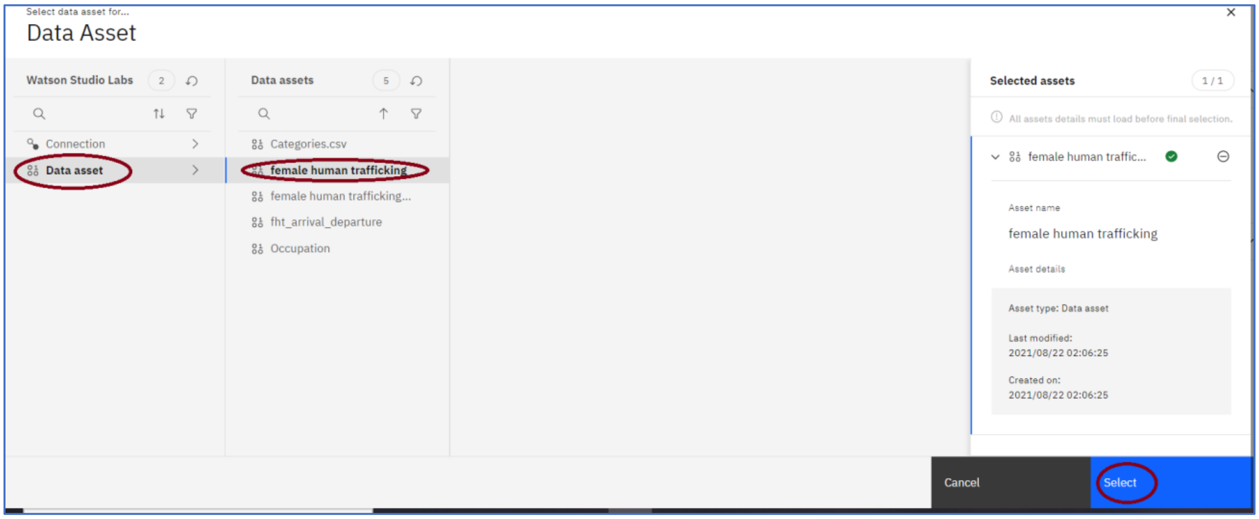
Data Assets
You may upload multiple data assets.

## 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**. Click on **Data Assets**, click on **female_human_trafficking** (make sure not to select on female_human_trafficking_shaped), then click **Select.**



All assets details must load before final selection.

Asset name
female human trafficking

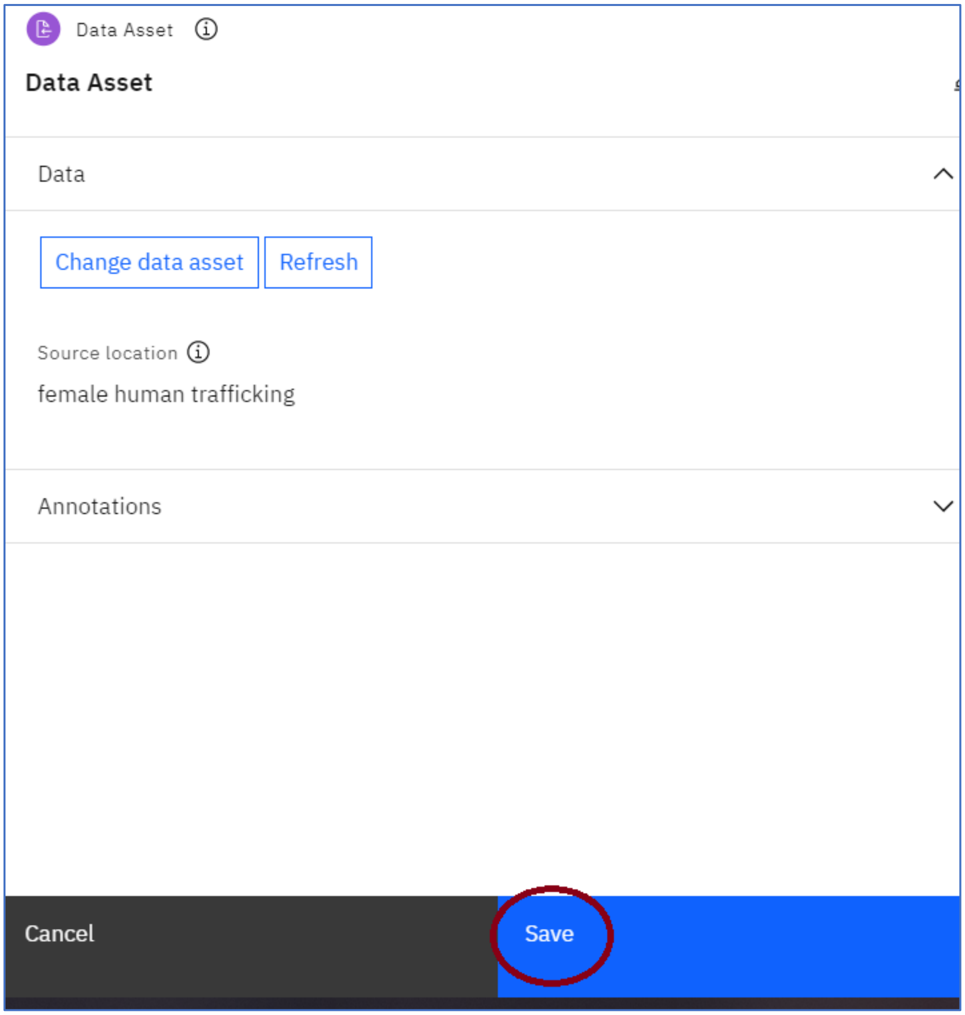
Asset details

Asset type: Data asset

Last modified:
2021/08/22 02:06:25

Created on:
2021/08/22 02:06:25

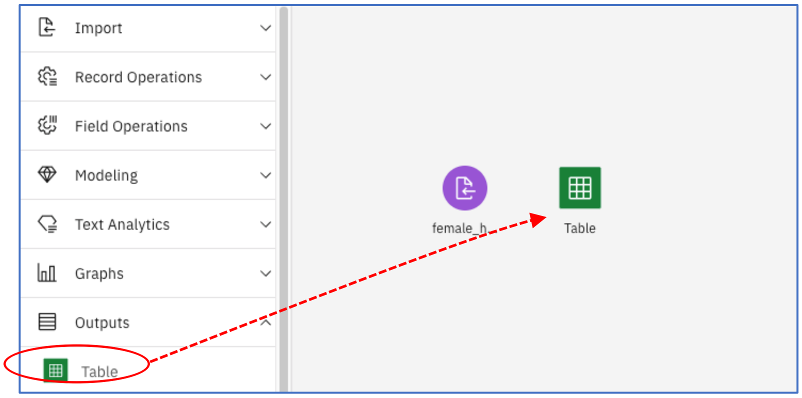
3. Click **Save**.



Source location

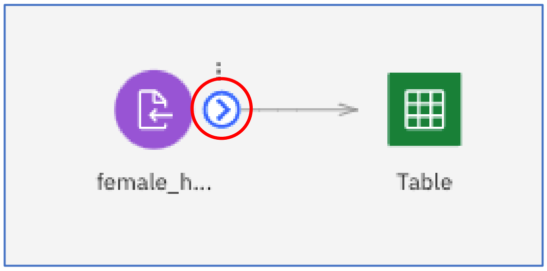
female human trafficking

4. 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 .

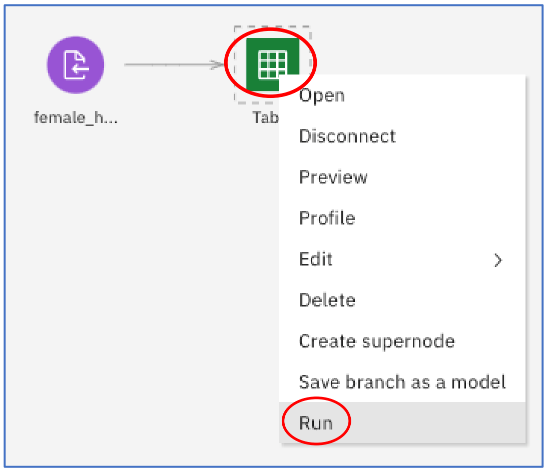


5. **Connect the right side of the female_human_trafficking icon to the left side of the Table icon**. This is accomplished by hovering over the data asset icon, clicking on the

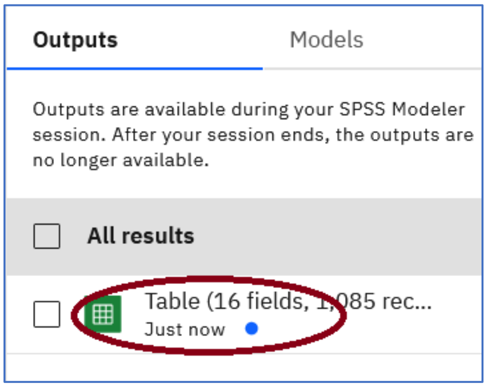
little blue arrow that appears the right side of the icon, holding the left mouse key, and dragging the mouse to the Table icon, and then releasing the left mouse key.



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



7. 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 Table entry.

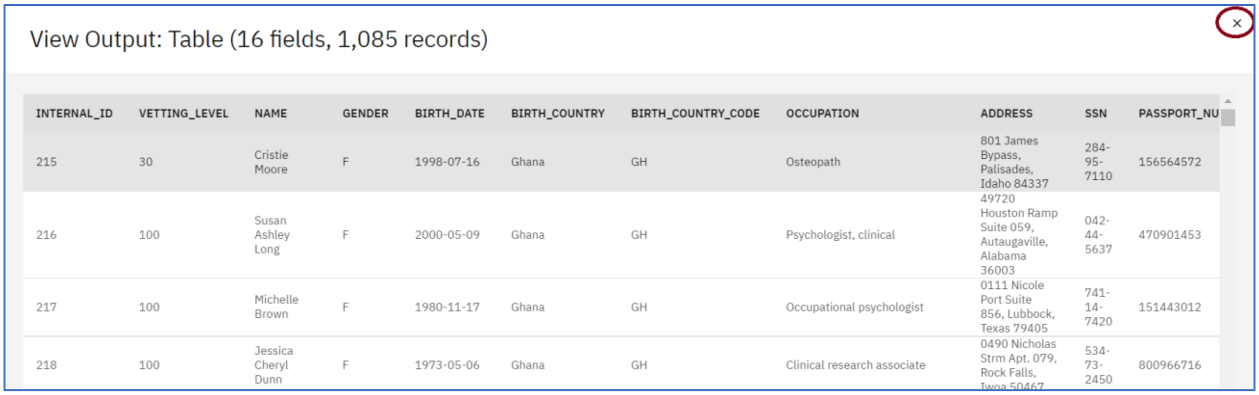


Outputs are available during your SPSS Modeler session. After your session ends, the outputs are no longer available.

□ All results

□ Table (16 fields, 1,085 rec...
Just now ●

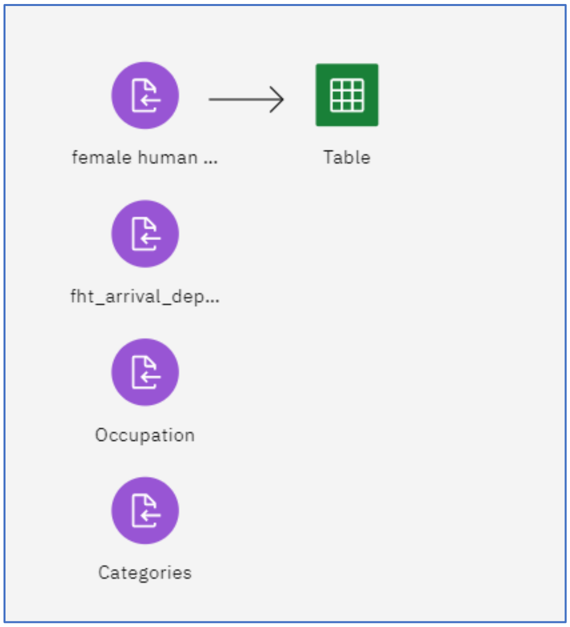
8. Each row contains travel information for a person. We will use this data to make predictions on trafficking risk. Click **x** to close the window.



View Output: Table (16 fields, 1,085 records)

| INTERNAL_ID | VETTING_LEVEL | NAME | GENDER | BIRTH_DATE | BIRTH_COUNTRY | BIRTH_COUNTRY_CODE | OCCUPATION | ADDRESS | SSN | PASSPORT_NU |
|---|---|---|---|---|---|---|---|---|---|---|
| 215 | 30 | Cristie Moore | F | 1998-07-16 | Ghana | GH | Osteopath | 801 James Bypass, Palisades, Idaho 84337 | 284-95-7110 | 156564572 |
| 216 | 100 | Susan Ashley Long | F | 2000-05-09 | Ghana | GH | Psychologist, clinical | 49720 Houston Ramp Suite 059, Autaugaville, Alabama 36003 | 042-44-5637 | 470901453 |
| 217 | 100 | Michelle Brown | F | 1980-11-17 | Ghana | GH | Occupational psychologist | 0111 Nicole Port Suite 856, Lubbock, Texas 79405 | 741-14-7420 | 151443012 |
| 218 | 100 | Jessica Cheryl Dunn | F | 1973-05-06 | Ghana | GH | Clinical research associate | 0490 Nicholas Strm Apt. 079, Rock Falls, Iwoa 50467 | 534-73-2450 | 800966716 |

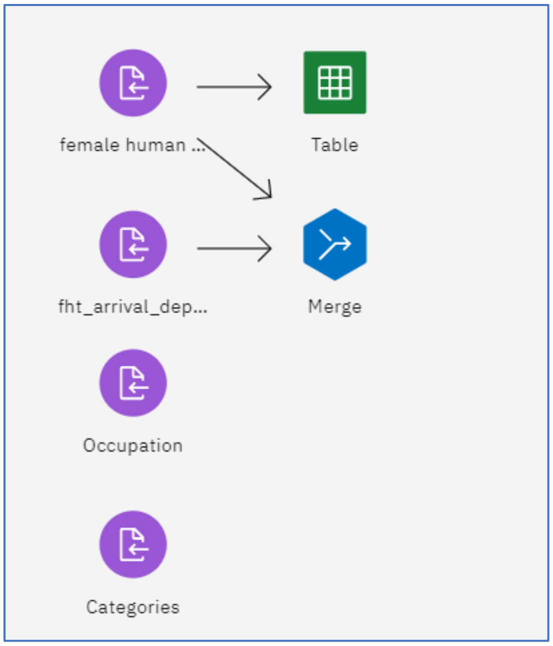
9. **Repeat steps 1-3 for the fht_arrival_departure, Occupation dataset** and the **Categories dataset**. When complete, the canvas should appear as below.



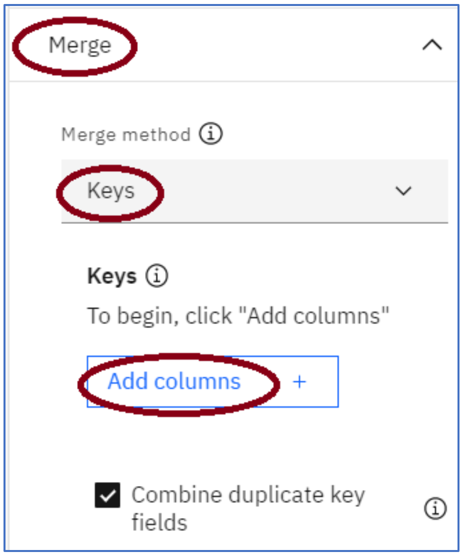
## Step 3 - Join the Data Sources

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 **fht_arrival_departure** 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 **fht_arrival_departure** 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**.



Merge

Merge method ⓘ

Keys

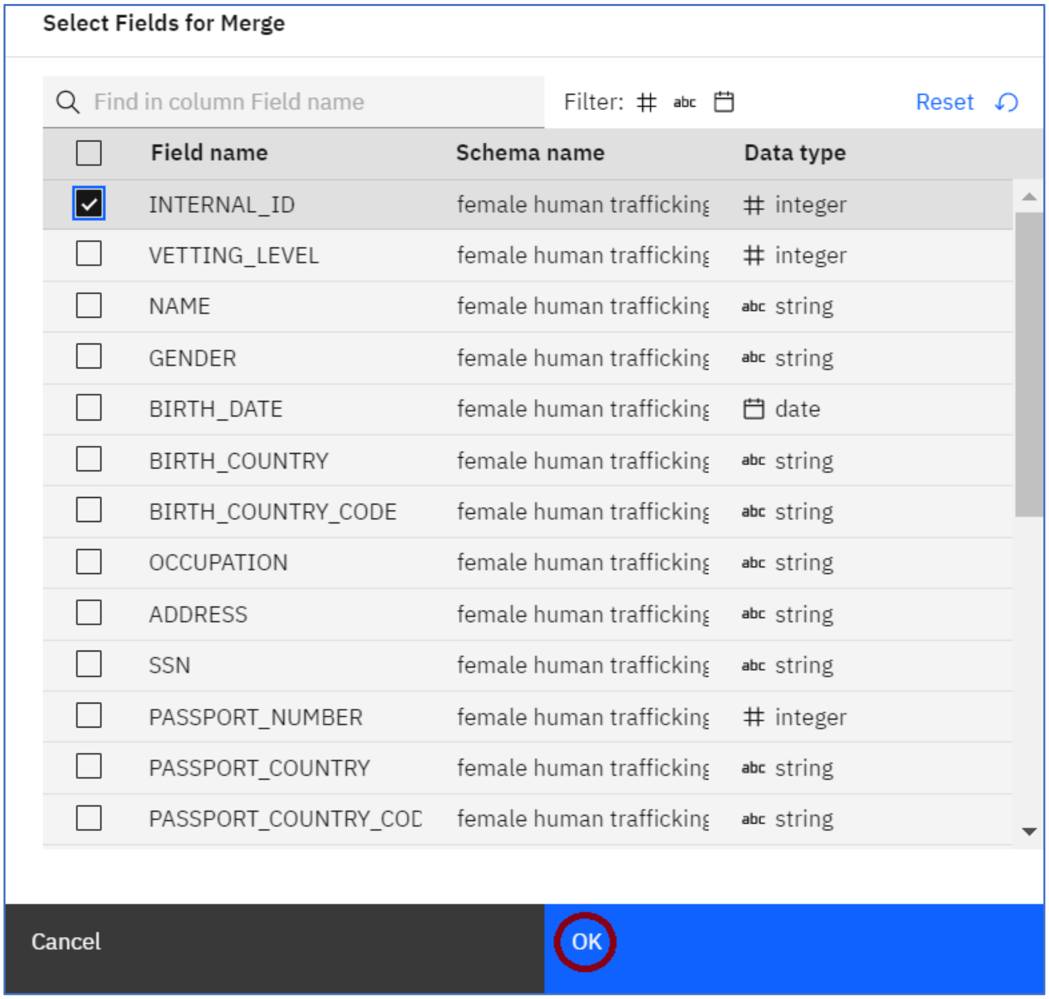
**Keys** ⓘ

To begin, click "Add columns"

Add columns +

☑ Combine duplicate key fields ⓘ

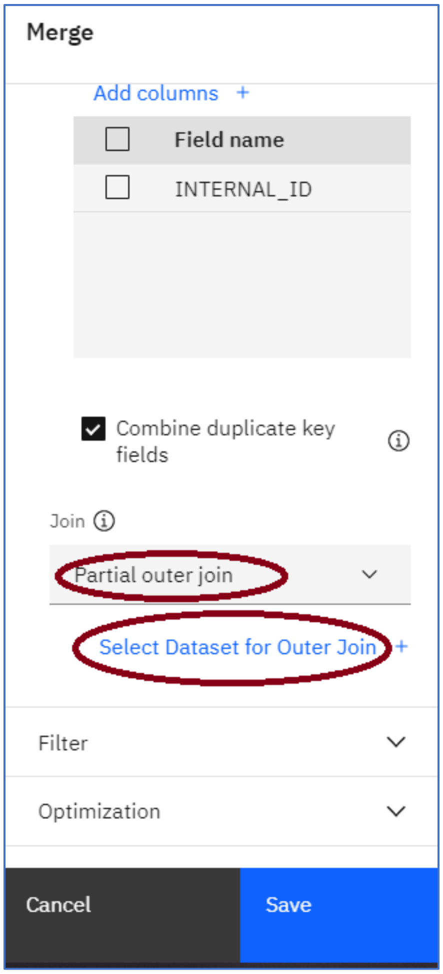
3. Click on the checkbox next to INTERNAL_ID and click **OK**.



Select Fields for Merge

| ☐ | Field name | Schema name | Data type |
|---|---|---|---|
| ☑ | INTERNAL_ID | female human trafficking | # integer |
| ☐ | VETTING_LEVEL | female human trafficking | # integer |
| ☐ | NAME | female human trafficking | abc string |
| ☐ | GENDER | female human trafficking | abc string |
| ☐ | BIRTH_DATE | female human trafficking | date |
| ☐ | BIRTH_COUNTRY | female human trafficking | abc string |
| ☐ | BIRTH_COUNTRY_CODE | female human trafficking | abc string |
| ☐ | OCCUPATION | female human trafficking | abc string |
| ☐ | ADDRESS | female human trafficking | abc string |
| ☐ | SSN | female human trafficking | abc string |
| ☐ | PASSPORT_NUMBER | female human trafficking | # integer |
| ☐ | PASSPORT_COUNTRY | female human trafficking | abc string |
| ☐ | PASSPORT_COUNTRY_COD | female human trafficking | abc string |

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**



Merge

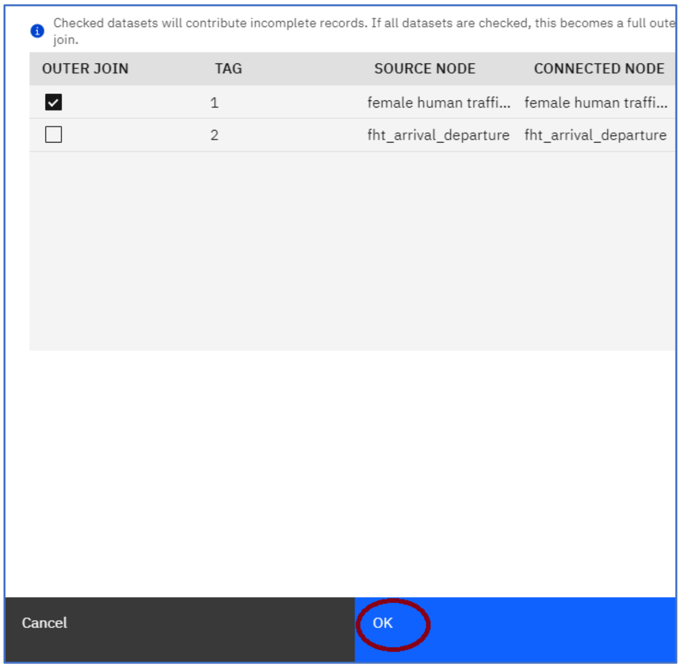
| ☐ | Field name |
|---|---|
| ☐ | INTERNAL_ID |

☑ Combine duplicate key fields

Join

Partial outer join

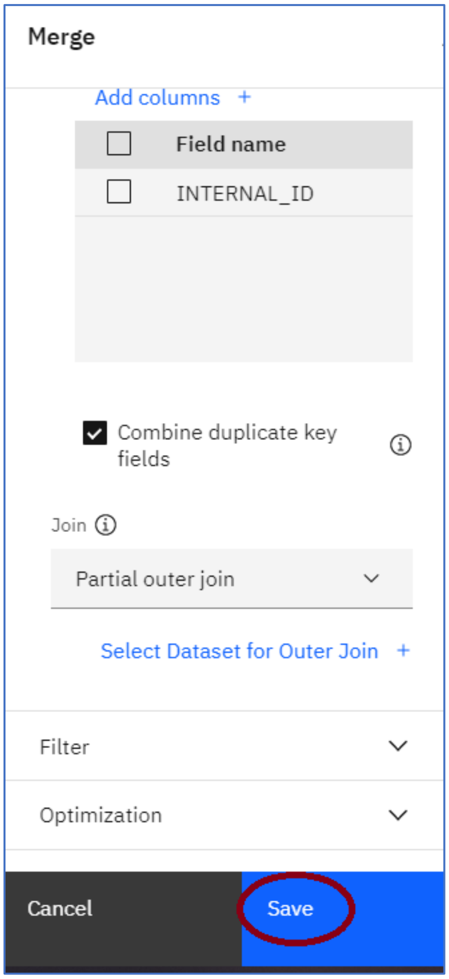
5. Make sure the **female_human_trafficking** data source is checked. Click **OK**.



Checked datasets will contribute incomplete records. If all datasets are checked, this becomes a full oute join.

| OUTER JOIN | TAG | SOURCE NODE | CONNECTED NODE |
|---|---|---|---|
| ☑ | 1 | female human traffi... | female human traffi... |
| ☐ | 2 | fht_arrival_departure | fht_arrival_departure |

6. Click **Save**.



Merge

Add columns +

| □ | Field name |
|---|---|
| □ | INTERNAL_ID |

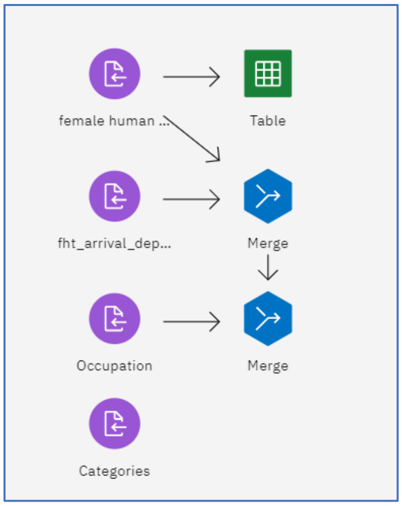
☑ Combine duplicate key fields

Join

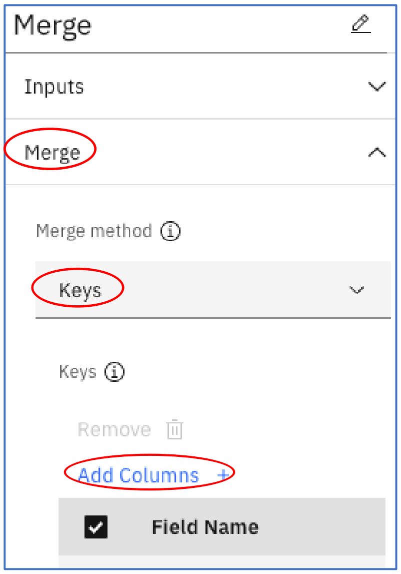
Partial outer join

Select Dataset for Outer Join +

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 **Occupations** data source. If the Node Palette is not visible, click on the Node Palette icon ◧. Connect the previous **Merge** node to this **Merge** node. Connect the **Occupations** data source to the **Merge** node. The canvas should appear as below.



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


Merge

Inputs

Merge

Merge method ⓘ

Keys

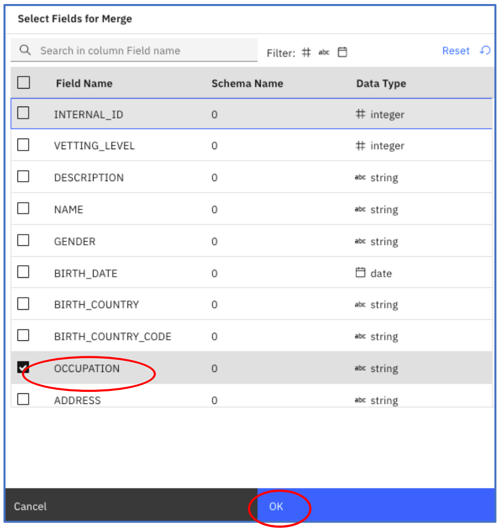
Keys ⓘ

Remove

Add Columns +

☑ Field Name

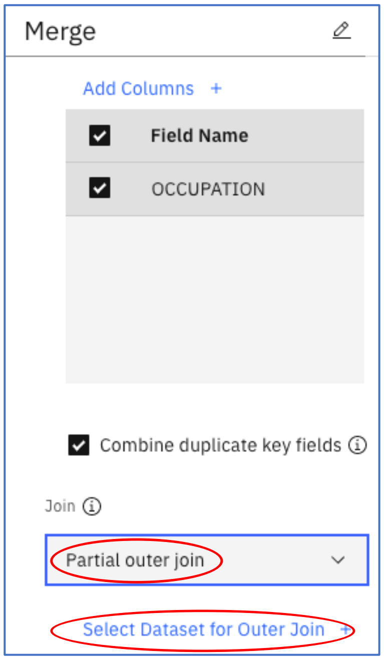
9. Click on **OCCUPATION** and then click on **Ok.** You may need to scroll down.



Select Fields for Merge

| □ | Field Name | Schema Name | Data Type |
|---|---|---|---|
| □ | INTERNAL_ID | 0 | integer |
| □ | VETTING_LEVEL | 0 | integer |
| □ | DESCRIPTION | 0 | string |
| □ | NAME | 0 | string |
| □ | GENDER | 0 | string |
| □ | BIRTH_DATE | 0 | date |
| □ | BIRTH_COUNTRY | 0 | string |
| □ | BIRTH_COUNTRY_CODE | 0 | string |
| ☑ | OCCUPATION | 0 | string |
| □ | ADDRESS | 0 | string |

10. 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.**

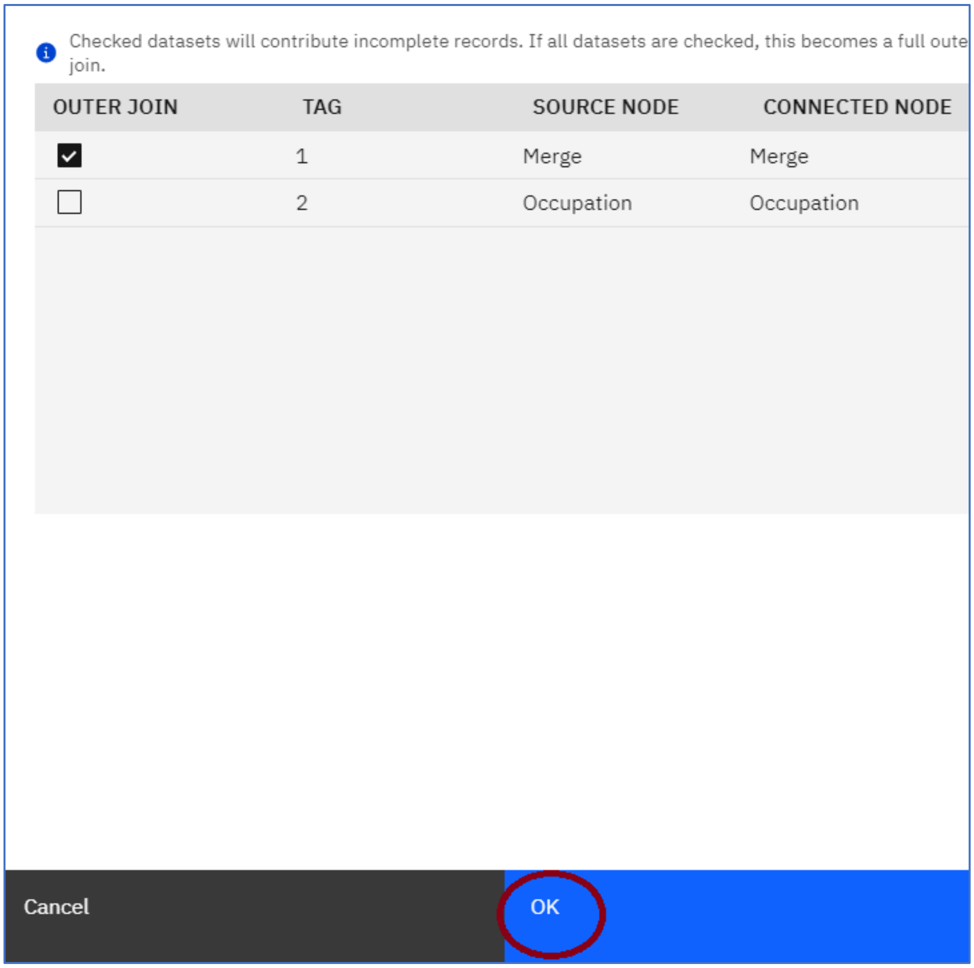


| ☑ | Field Name |
|---|---|
| ☑ | OCCUPATION |

☑ Combine duplicate key fields

Join: Partial outer join

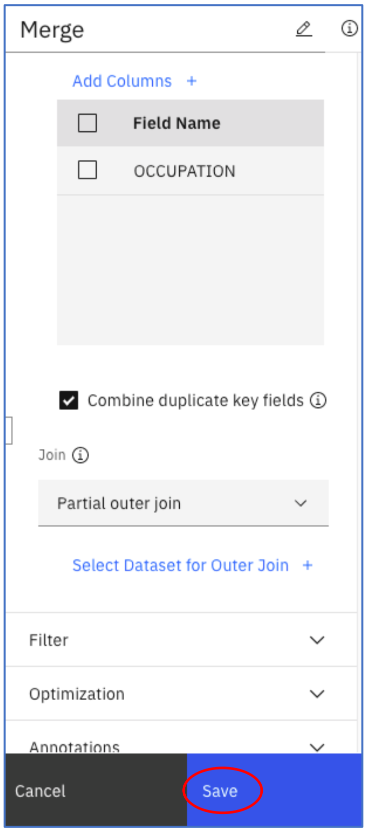
11. Make sure the Merge node is checked and click **OK**.



Checked datasets will contribute incomplete records. If all datasets are checked, this becomes a full oute join.

| OUTER JOIN | TAG | SOURCE NODE | CONNECTED NODE |
|---|---|---|---|
| ☑ | 1 | Merge | Merge |
| □ | 2 | Occupation | Occupation |

12. Click on **Save**.



Merge

Add Columns +

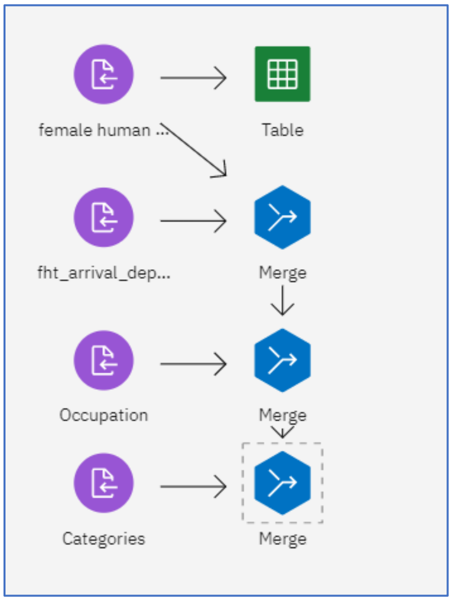
| □ | Field Name |
|---|---|
| □ | OCCUPATION |

☑ Combine duplicate key fields

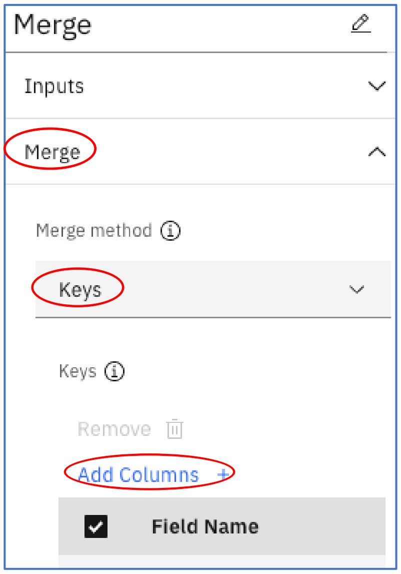
Join

Partial outer join

13. 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.



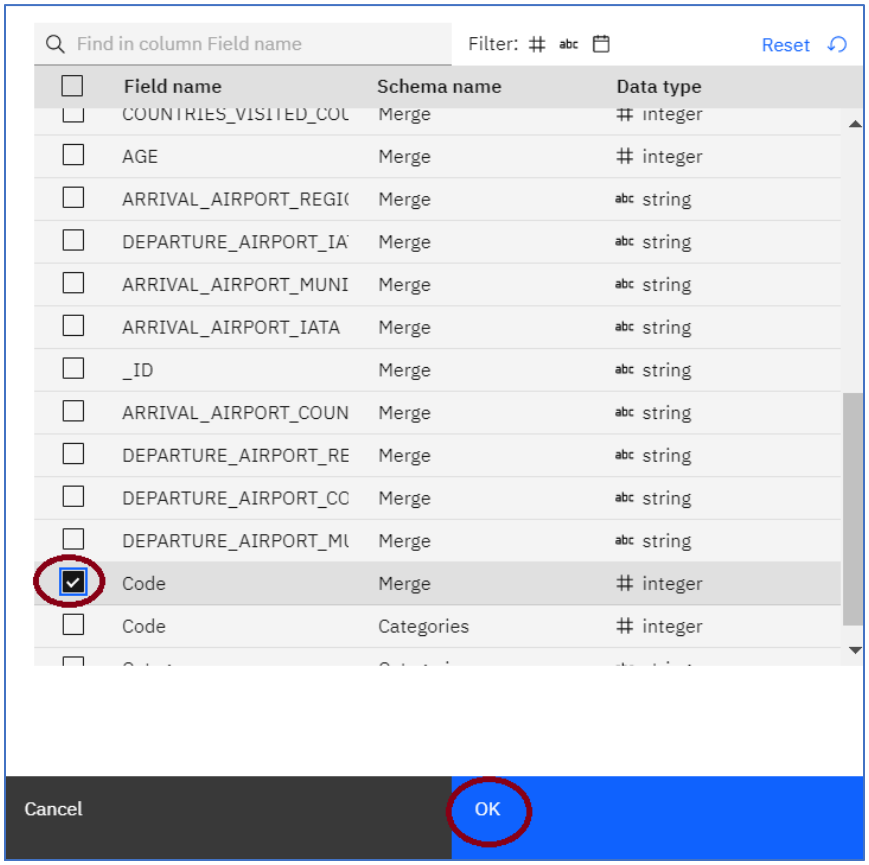
14. Double click on the third **Merge** node to set the merge options. Click on **Merge**, click on **Keys** for the Merge method, and then click on **Add Columns** to add the key columns.



Merge method: Keys

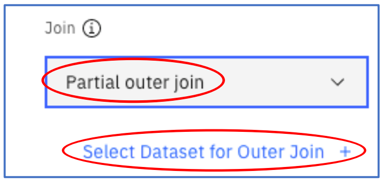
☑ Field Name

15. Scroll down and click on the first **Code** checkbox.  Click on **OK**.



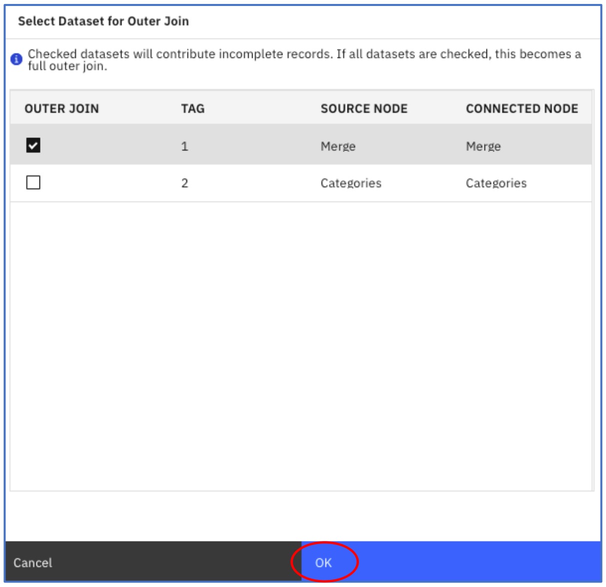
| ☐ | Field name | Schema name | Data type |
|---|---|---|---|
| ☐ | COUNTRIES_VISITED_COL | Merge | # integer |
| ☐ | AGE | Merge | # integer |
| ☐ | ARRIVAL_AIRPORT_REGI( | Merge | abc string |
| ☐ | DEPARTURE_AIRPORT_IA | Merge | abc string |
| ☐ | ARRIVAL_AIRPORT_MUNI | Merge | abc string |
| ☐ | ARRIVAL_AIRPORT_IATA | Merge | abc string |
| ☐ | _ID | Merge | abc string |
| ☐ | ARRIVAL_AIRPORT_COUN | Merge | abc string |
| ☐ | DEPARTURE_AIRPORT_RE | Merge | abc string |
| ☐ | DEPARTURE_AIRPORT_CC | Merge | abc string |
| ☐ | DEPARTURE_AIRPORT_MU | Merge | abc string |
| ☑ | Code | Merge | # integer |
| ☐ | Code | Categories | # integer |

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



Join: Partial outer join

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

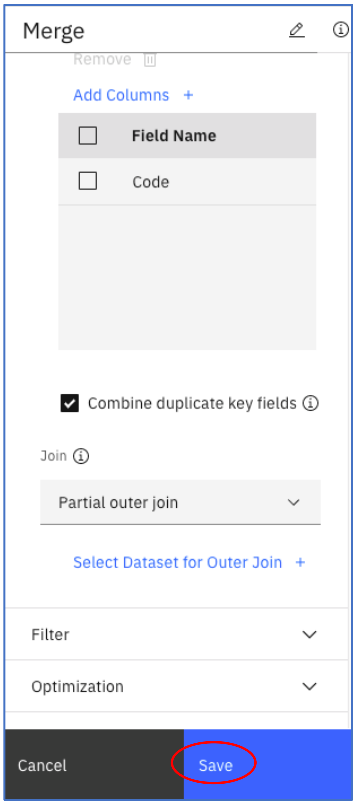


Select Dataset for Outer Join

Checked datasets will contribute incomplete records. If all datasets are checked, this becomes a full outer join.

| OUTER JOIN | TAG | SOURCE NODE | CONNECTED NODE |
|---|---|---|---|
| ☑ | 1 | Merge | Merge |
| ☐ | 2 | Categories | Categories |

18. Click **Save**.



Merge

| ☐ | Field Name |
|---|---|
| ☐ | Code |

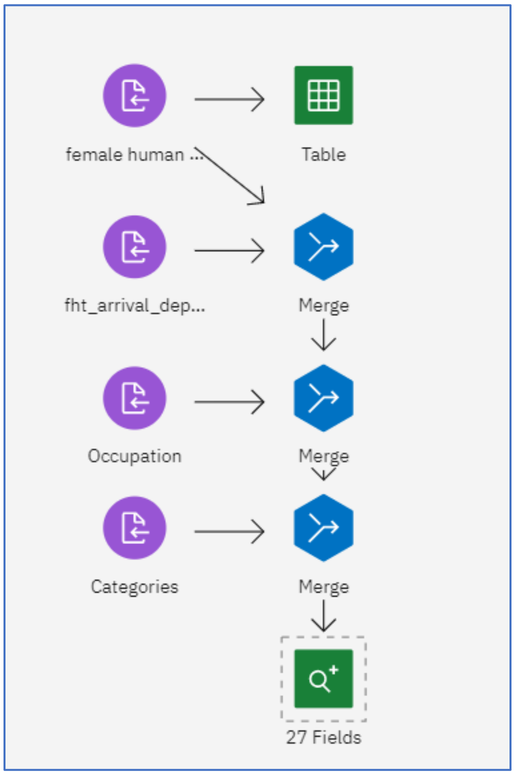
☑ Combine duplicate key fields

Join: Partial outer join

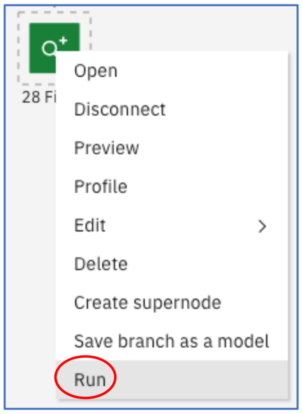
## Step 4 - Explore the Data using the Data Audit Node

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.

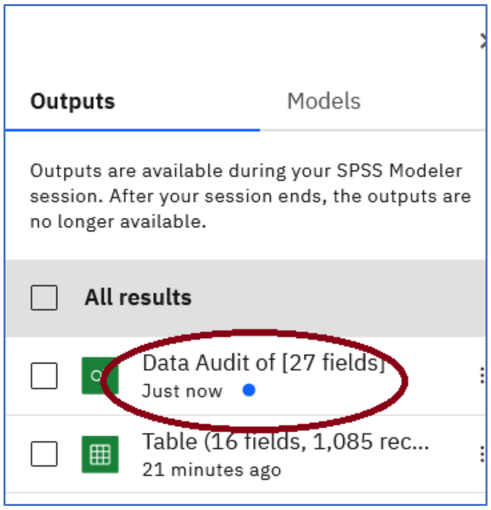
1. Add a **Data Audit** node to the flow by clicking on the **Outputs** menu item in the Node Palette, and then dragging the **Data Audit** node to underneath the final **Merge** node. If the Node Palette is not visible, click on the Node Palette icon ◧ . Connect the node to the Data Audit node. The 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 ⏱ .



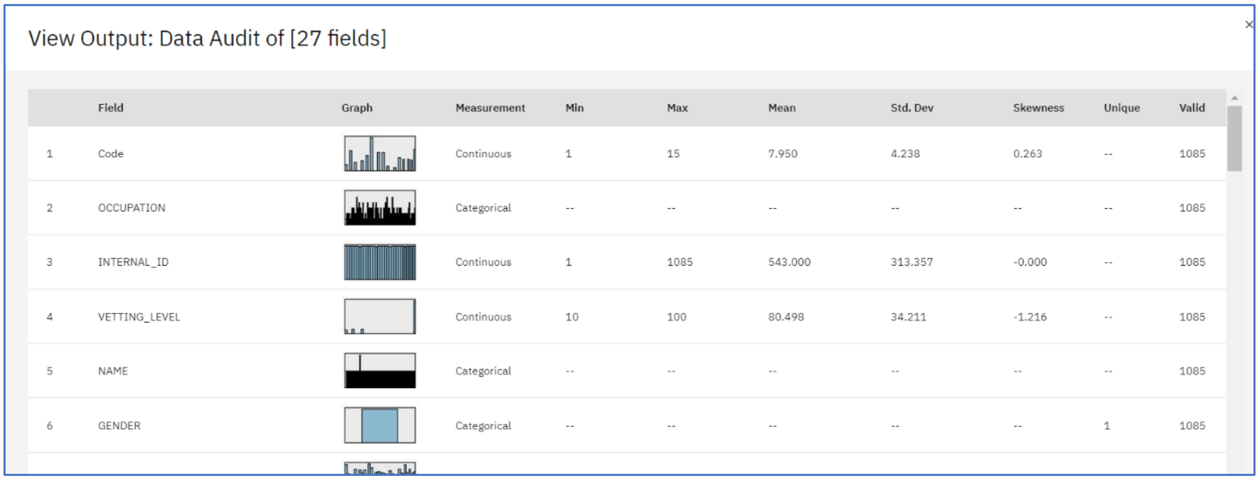
Outputs are available during your SPSS Modeler session. After your session ends, the outputs are no longer available.

☐ All results

☐ Data Audit of [27 fields]
Just now ●

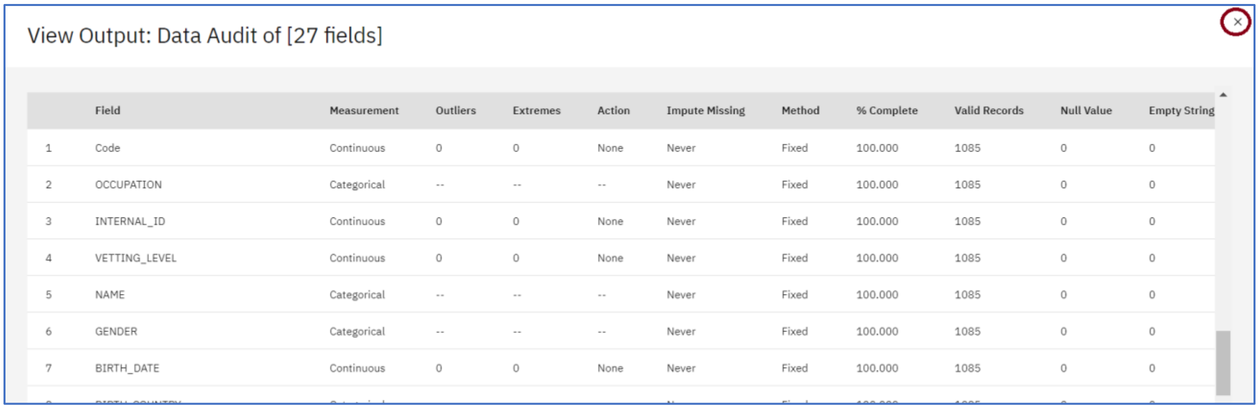
☐ Table (16 fields, 1,085 rec...
21 minutes ago

4. 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.


View Output: Data Audit of [27 fields]

| | Field | Graph | Measurement | Min | Max | Mean | Std. Dev | Skewness | Unique | Valid |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Code | | Continuous | 1 | 15 | 7.950 | 4.238 | 0.263 | -- | 1085 |
| 2 | OCCUPATION | | Categorical | -- | -- | -- | -- | -- | -- | 1085 |
| 3 | INTERNAL_ID | | Continuous | 1 | 1085 | 543.000 | 313.357 | -0.000 | -- | 1085 |
| 4 | VETTING_LEVEL | | Continuous | 10 | 100 | 80.498 | 34.211 | -1.216 | -- | 1085 |
| 5 | NAME | | Categorical | -- | -- | -- | -- | -- | -- | 1085 |
| 6 | GENDER | | Categorical | -- | -- | -- | -- | -- | 1 | 1085 |

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! Click the **x** to close the window and return to the flow.



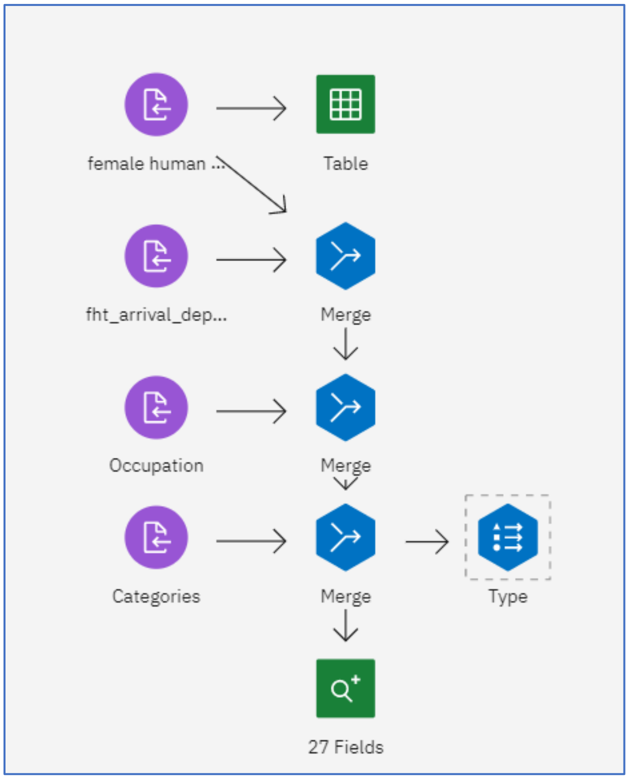
View Output: Data Audit of [27 fields]

| | Field | Measurement | Outliers | Extremes | Action | Impute Missing | Method | % Complete | Valid Records | Null Value | Empty String |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Code | Continuous | 0 | 0 | None | Never | Fixed | 100.000 | 1085 | 0 | 0 |
| 2 | OCCUPATION | Categorical | -- | -- | -- | Never | Fixed | 100.000 | 1085 | 0 | 0 |
| 3 | INTERNAL_ID | Continuous | 0 | 0 | None | Never | Fixed | 100.000 | 1085 | 0 | 0 |
| 4 | VETTING_LEVEL | Continuous | 0 | 0 | None | Never | Fixed | 100.000 | 1085 | 0 | 0 |
| 5 | NAME | Categorical | -- | -- | -- | Never | Fixed | 100.000 | 1085 | 0 | 0 |
| 6 | GENDER | Categorical | -- | -- | -- | Never | Fixed | 100.000 | 1085 | 0 | 0 |
| 7 | BIRTH_DATE | Continuous | 0 | 0 | None | Never | Fixed | 100.000 | 1085 | 0 | 0 |

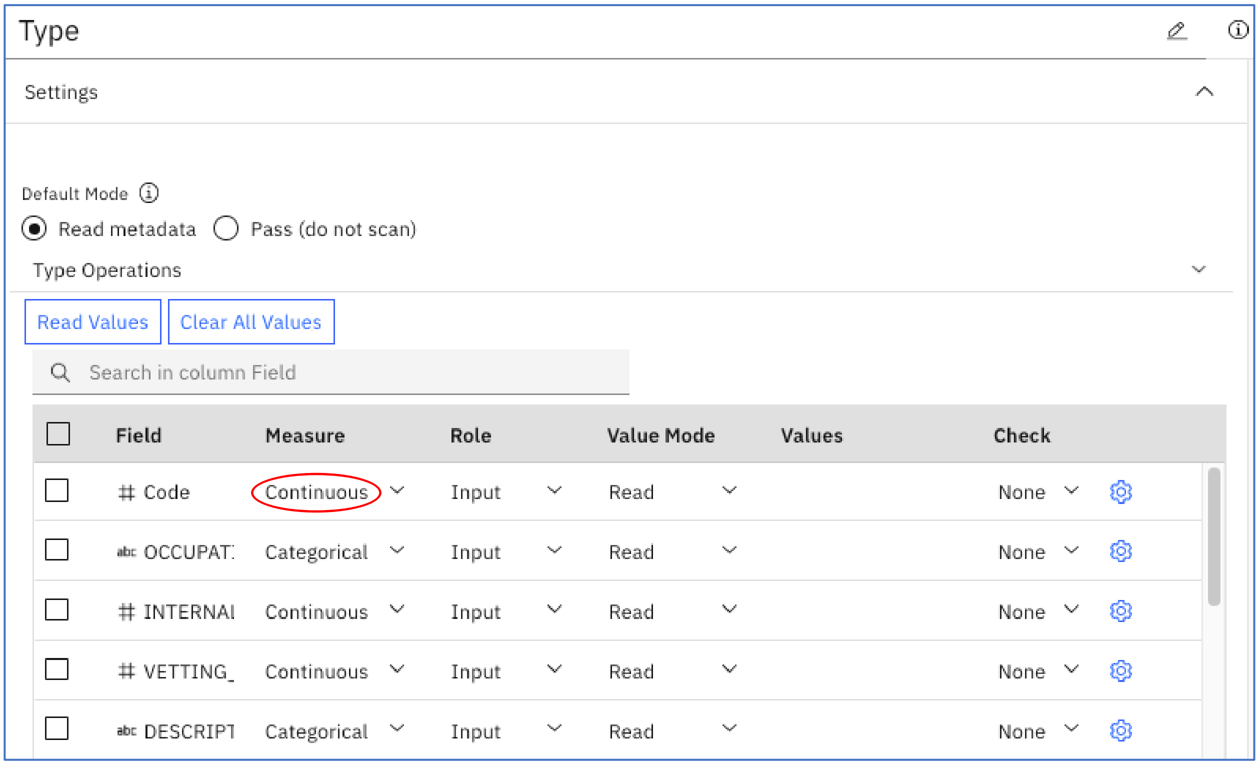
## Step 5 - Explore the Data using Graph Nodes.

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 third **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.



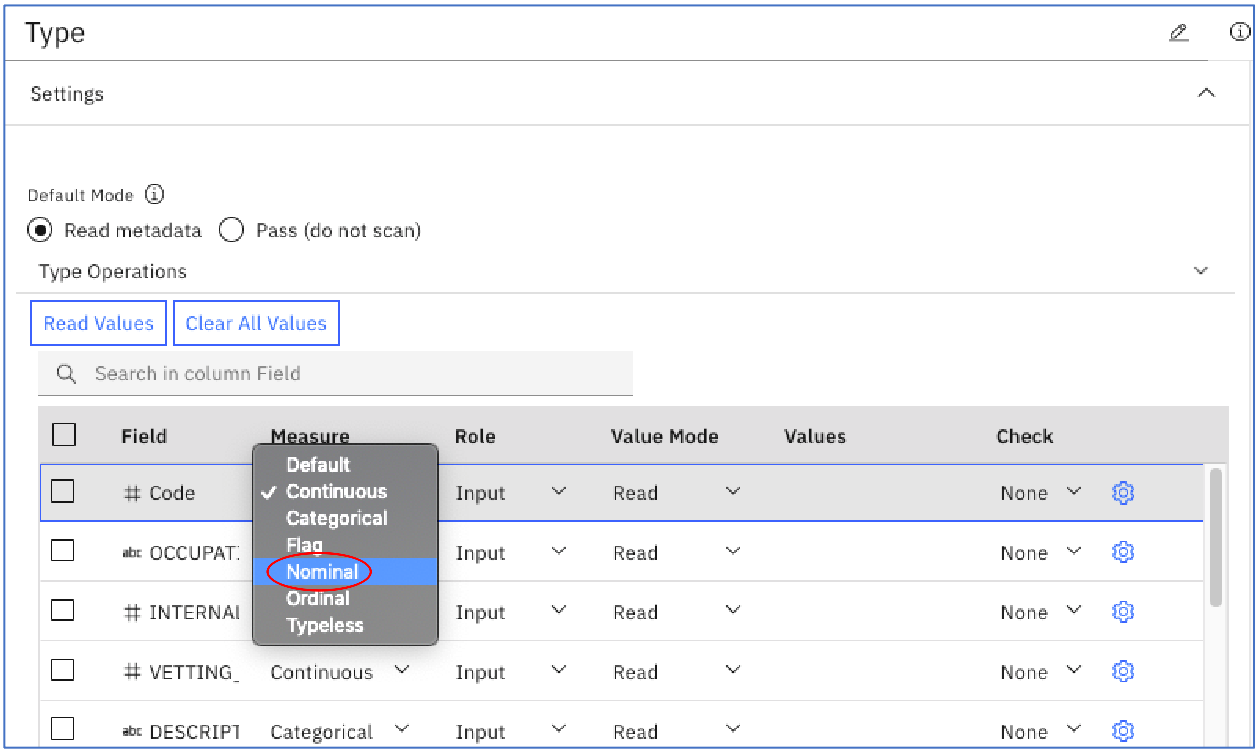
2. Double click on the **Type** node. This will open a **Type** menu pallet on the right side of the screen. Select the dropdown in the **Measure** column next to **Code**. Change the **Measure** to **Nominal**.



Default Mode

● Read metadata ○ Pass (do not scan)

| □ | Field | Measure | Role | Value Mode | Values | Check |
|---|---|---|---|---|---|---|
| □ | # Code | Continuous | Input | Read | | None |
| □ | abc OCCUPAT: | Categorical | Input | Read | | None |
| □ | # INTERNAI | Continuous | Input | Read | | None |
| □ | # VETTING_ | Continuous | Input | Read | | None |
| □ | abc DESCRIPT | Categorical | Input | Read | | None |

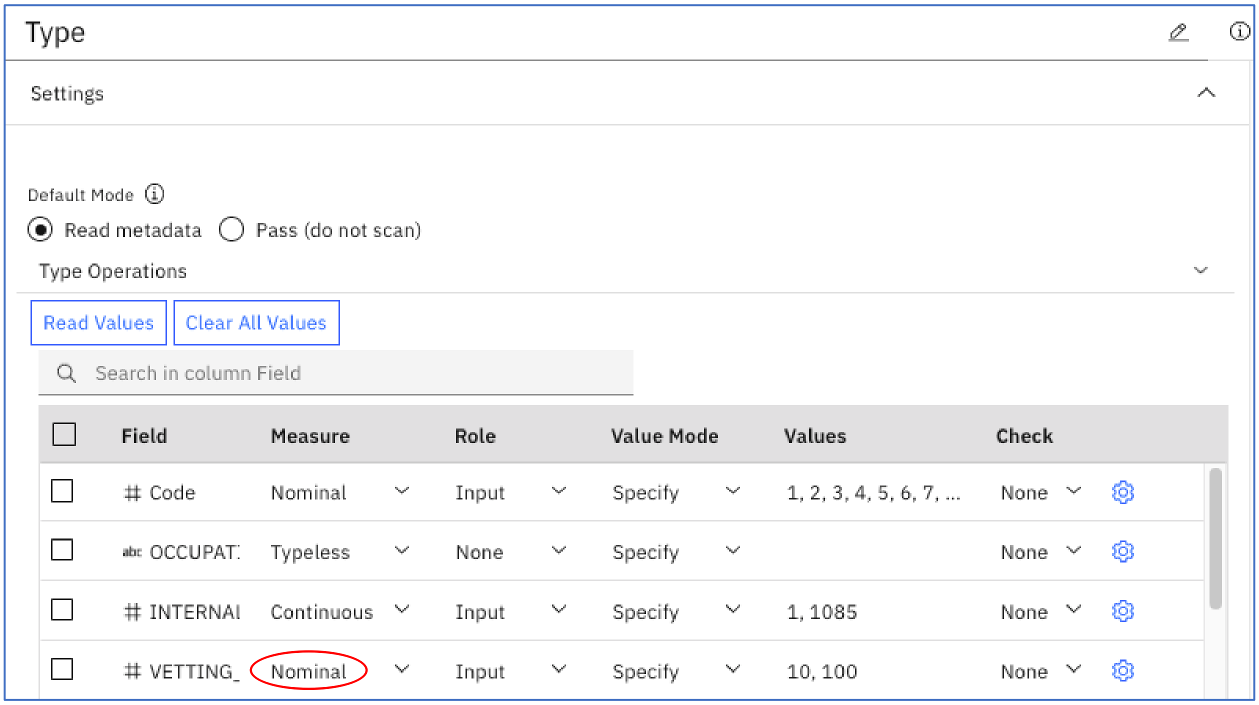


Default Mode

● Read metadata ○ Pass (do not scan)

| □ | Field | Measure | Role | Value Mode | Values | Check |
|---|---|---|---|---|---|---|
| □ | # Code | | Input | Read | | None |
| □ | abc OCCUPAT: | | Input | Read | | None |
| □ | # INTERNAI | | Input | Read | | None |
| □ | # VETTING_ | Continuous | Input | Read | | None |
| □ | abc DESCRIPT | Categorical | Input | Read | | None |

3. Following the same process, change the **Measure** of VETTING_LEVEL to **Nominal**.

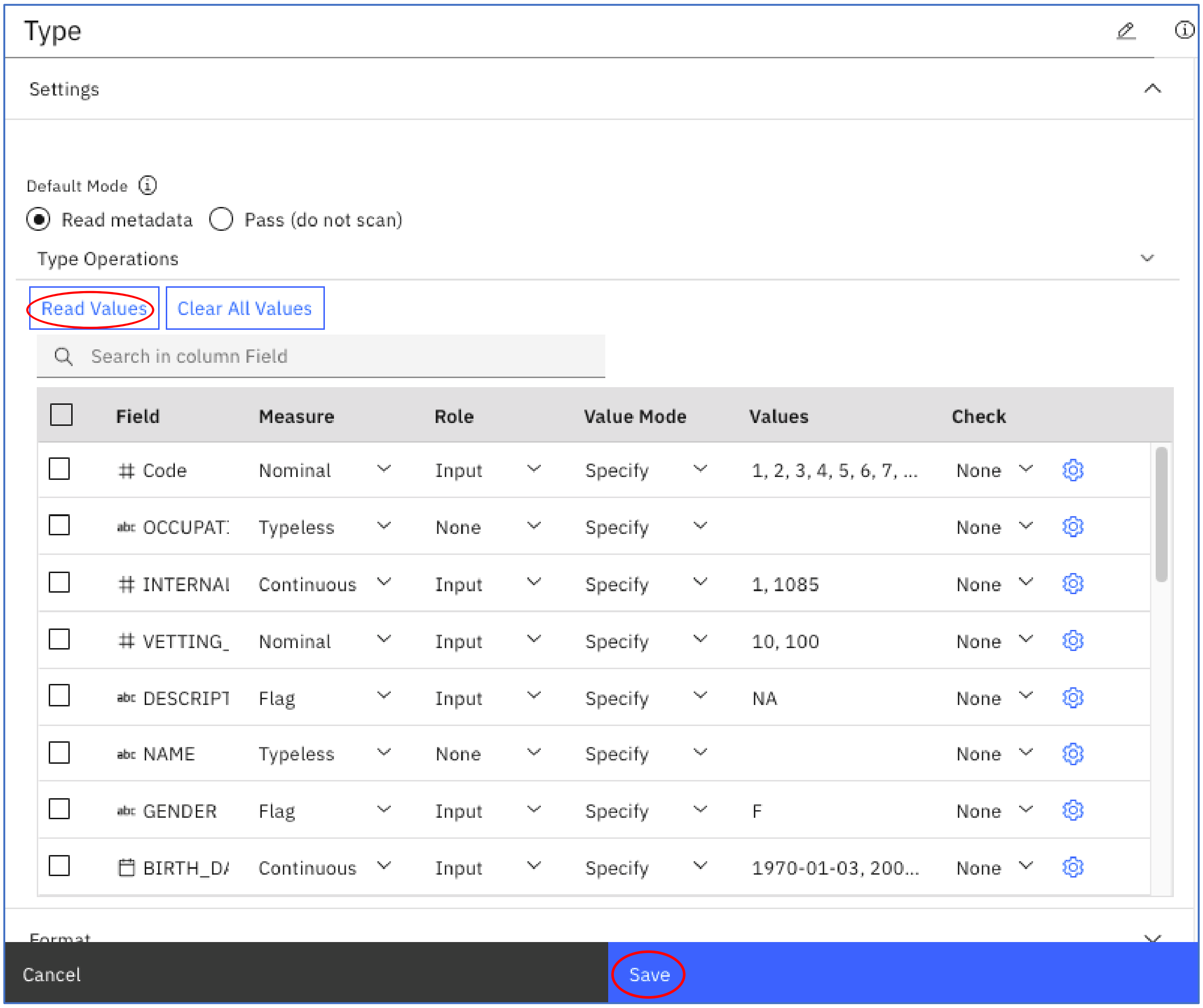


Default Mode ⓘ

● Read metadata ○ Pass (do not scan)

| □ | Field | Measure | Role | Value Mode | Values | Check |
|---|---|---|---|---|---|---|
| □ | # Code | Nominal | Input | Specify | 1, 2, 3, 4, 5, 6, 7, ... | None |
| □ | abc OCCUPAT | Typeless | None | Specify | | None |
| □ | # INTERNAI | Continuous | Input | Specify | 1, 1085 | None |
| □ | # VETTING_ | Nominal | Input | Specify | 10, 100 | None |

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



Type

Settings

Default Mode

● Read metadata ○ Pass (do not scan)

Type Operations

Read Values Clear All Values

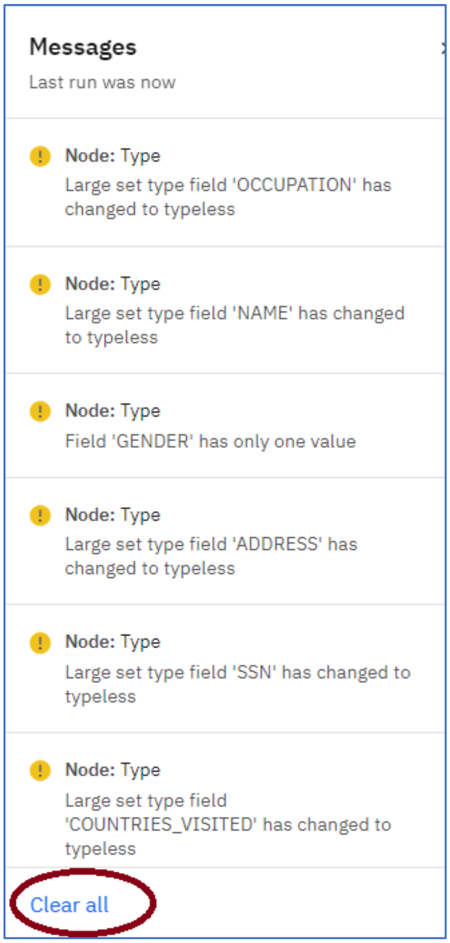
Search in column Field

| □ | Field | Measure | Role | Value Mode | Values | Check |
|---|---|---|---|---|---|---|
| □ | # Code | Nominal | Input | Specify | 1, 2, 3, 4, 5, 6, 7, ... | None |
| □ | abc OCCUPAT | Typeless | None | Specify | | None |
| □ | # INTERNAI | Continuous | Input | Specify | 1, 1085 | None |
| □ | # VETTING_ | Nominal | Input | Specify | 10, 100 | None |
| □ | abc DESCRIPT | Flag | Input | Specify | NA | None |
| □ | abc NAME | Typeless | None | Specify | | None |
| □ | abc GENDER | Flag | Input | Specify | F | None |
| □ | BIRTH_D/ | Continuous | Input | Specify | 1970-01-03, 200... | None |

Format

Cancel Save

Informational messages are displayed as some fields are set to Typeless measure given the large number of distinct values. Click **Clear all**.



Messages

Last run was now

Node: Type
Large set type field 'OCCUPATION' has changed to typeless

Node: Type
Large set type field 'NAME' has changed to typeless

Node: Type
Field 'GENDER' has only one value

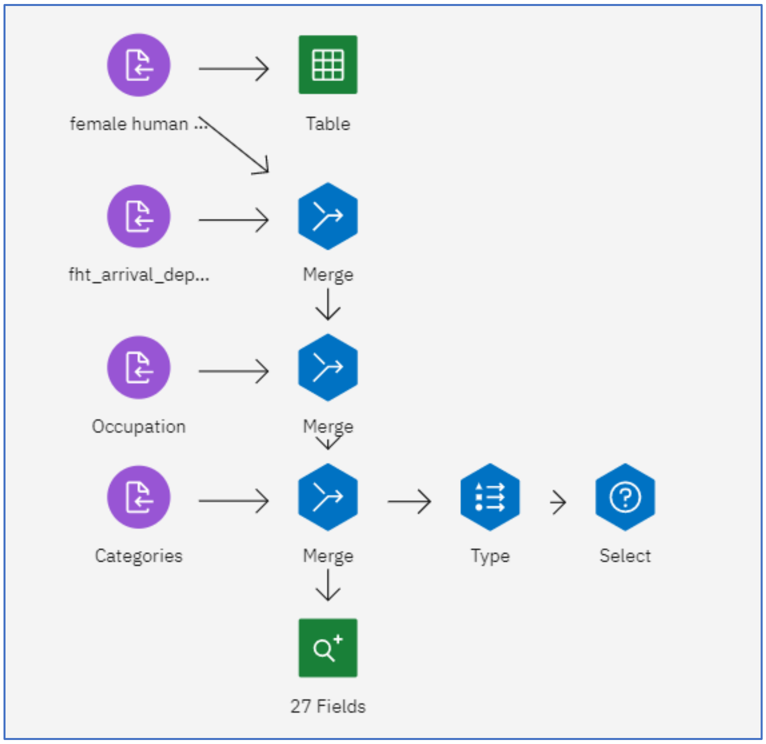
Node: Type
Large set type field 'ADDRESS' has changed to typeless

Node: Type
Large set type field 'SSN' has changed to typeless

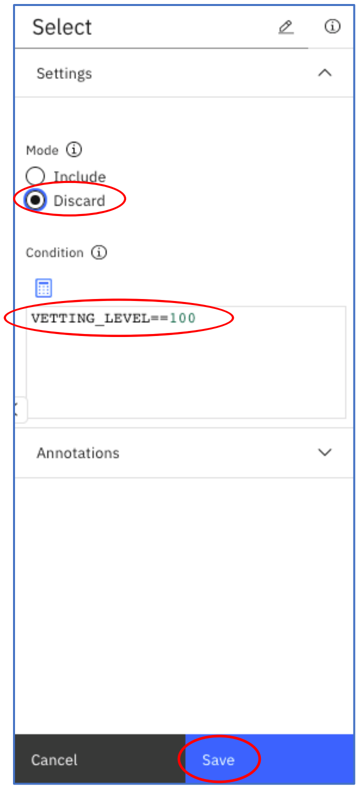
Node: Type
Large set type field 'COUNTRIES_VISITED' has changed to typeless

Clear all

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**.


Select

Settings

Mode

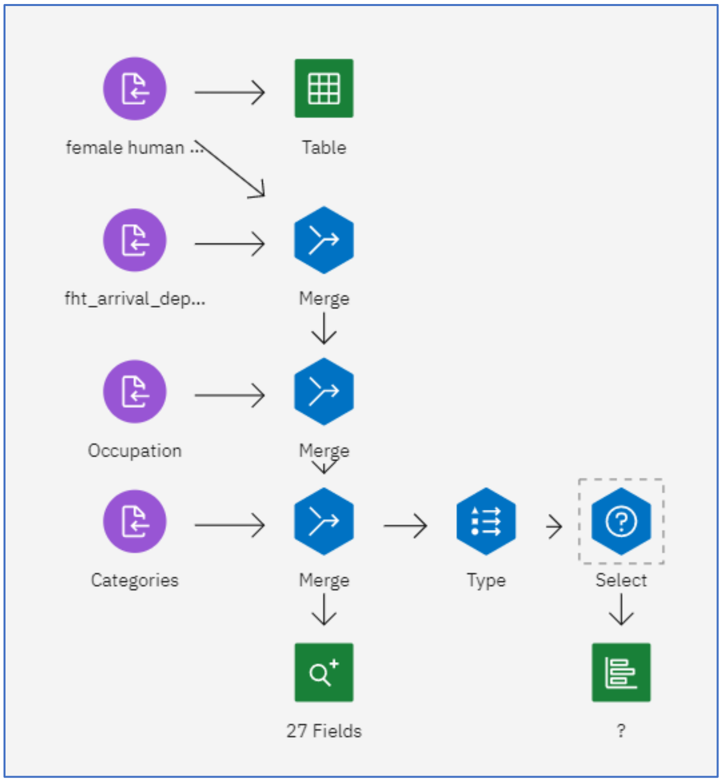
○ Include

● Discard

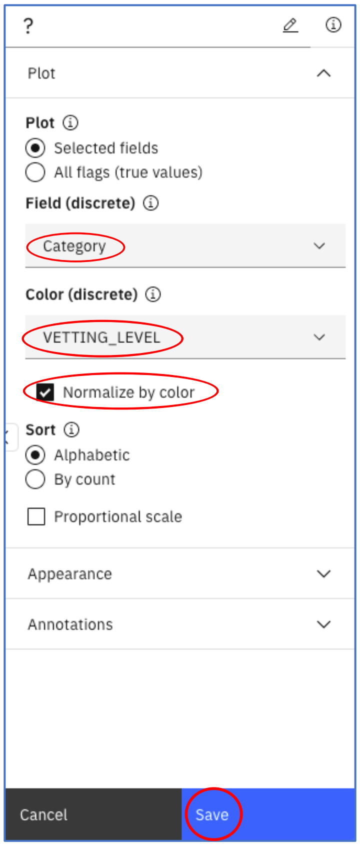
Condition

```
VETTING_LEVEL==100
```

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**.



?

Plot

Plot

● Selected fields

○ All flags (true values)

Field (discrete)

Category

Color (discrete)

VETTING_LEVEL

☑ Normalize by color

Sort

● Alphabetic

○ By count

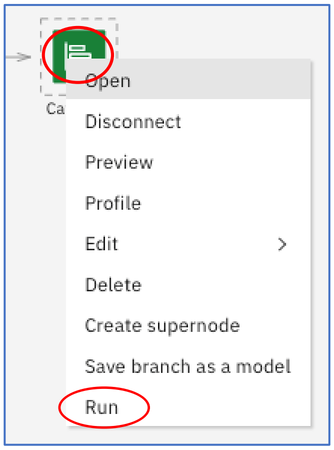
□ Proportional scale

Appearance

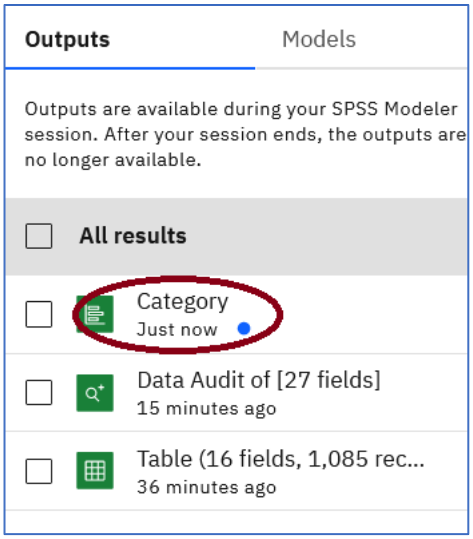
Annotations

Cancel Save

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



10. The Distribution output will appear under the **Outputs** tab. If you don't see the Outputs, click on the Outputs ("clock") 🕓 icon. Click on **Category**.



**Outputs** Models

Outputs are available during your SPSS Modeler session. After your session ends, the outputs are no longer available.

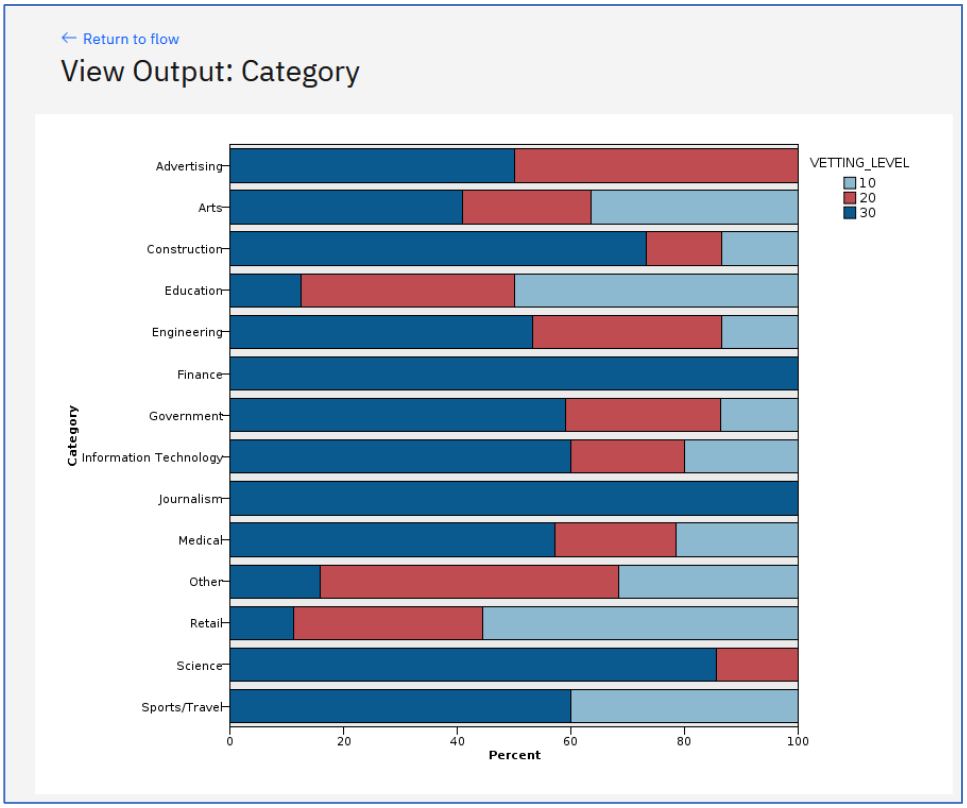
□ **All results**

□ Category
Just now ●

□ Data Audit of [27 fields]
15 minutes ago

□ Table (16 fields, 1,085 rec...
36 minutes ago

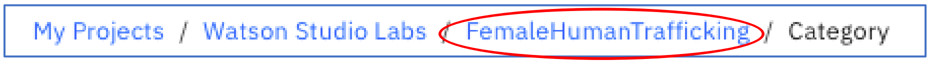
11. We can see from the graph that the VETTING_LEVEL does differ based on Category.



← Return to flow

View Output: Category

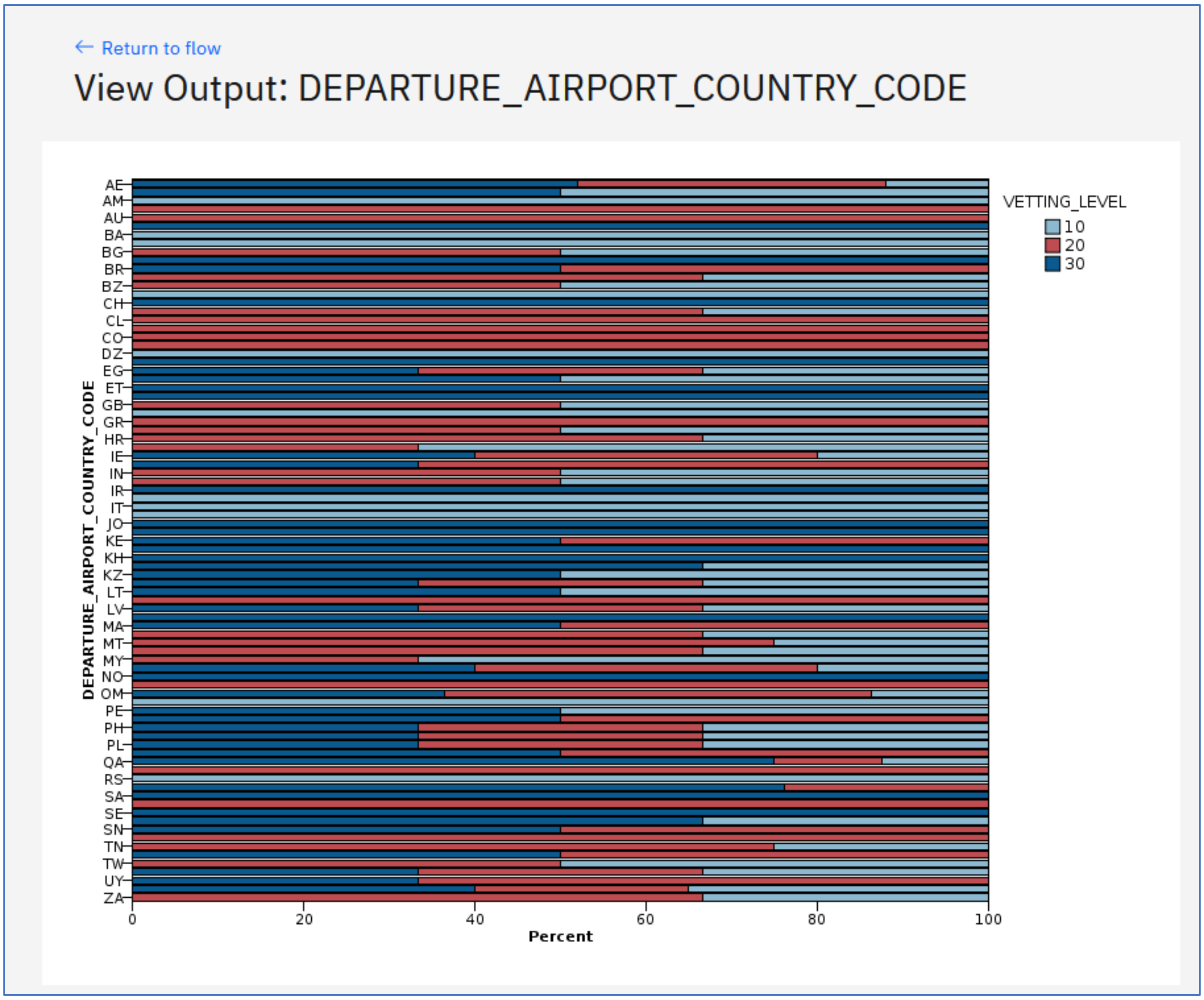
12. Return to the flow by clicking on the FemaleHumanTrafficking breadcrumb at the top or click the close (“x”) icon.



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

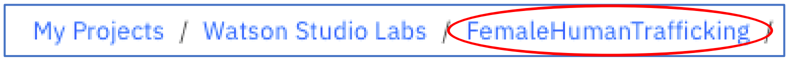
node and replacing **Category** with **DEPARTURE_AIRPORT_COUNTRY_CODE** and clicking Save. Re-run the graph by right clicking on the Distribution node and selecting **Run**. Click on the **DEPARTURE_AIRPORT_COUNTRY_CODE** in the **Outputs** pane to display the graph.



← Return to flow

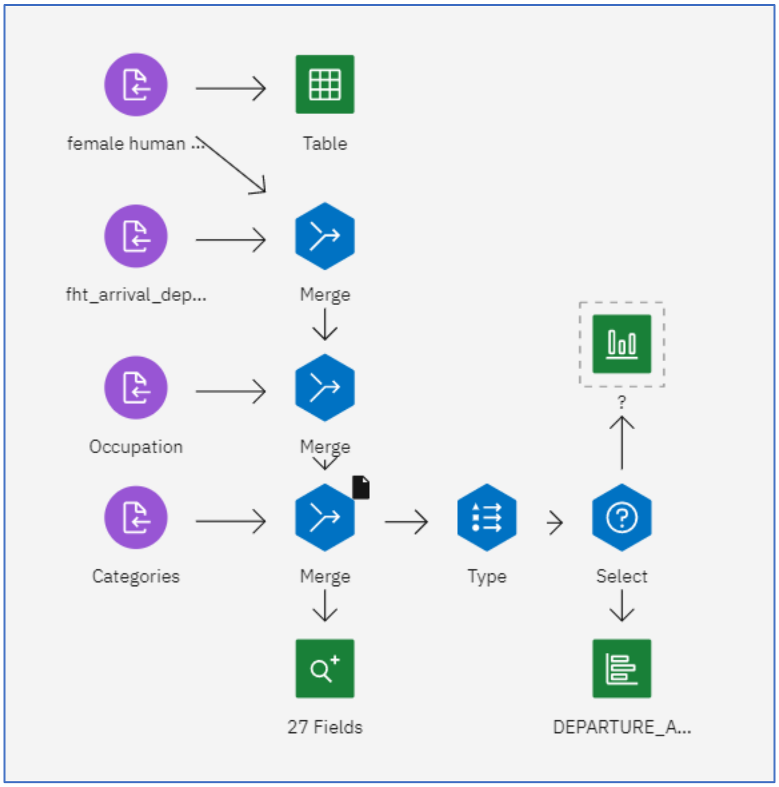
View Output: DEPARTURE_AIRPORT_COUNTRY_CODE

14. Return to the flow by clicking on the FemaleHumanTrafficking breadcrumb at the top or click on the close (“x”) icon.

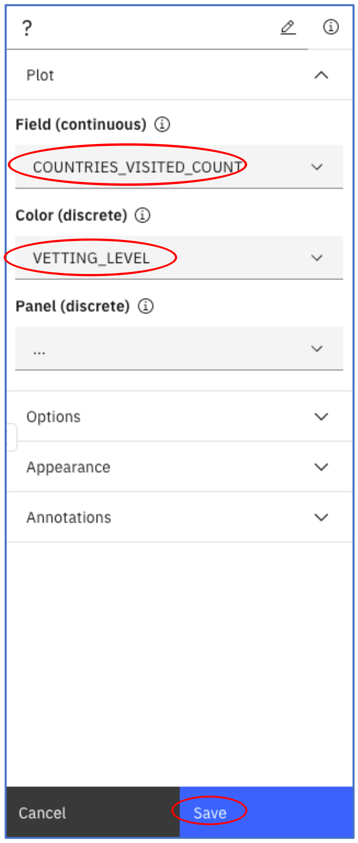


My Projects / Watson Studio Labs / FemaleHumanTrafficking /

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**.

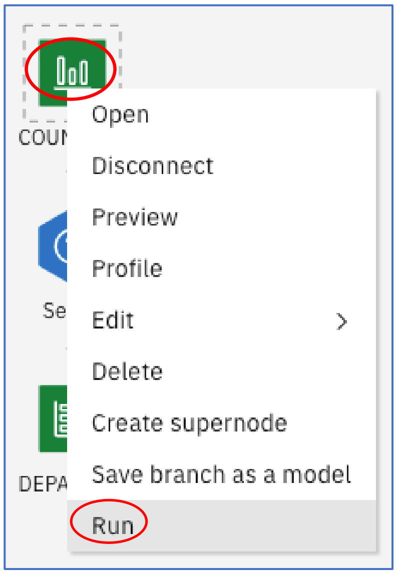


Field (continuous)
COUNTRIES_VISITED_COUNT

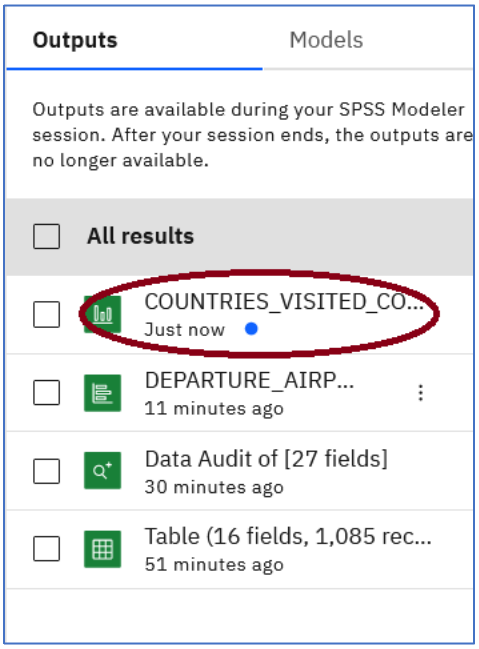
Color (discrete)
VETTING_LEVEL

Panel (discrete)
...

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



18. Click on **COUNTRIES_VISITED_COUNT** under the **Outputs** tab at the right of the screen.



Outputs Models

Outputs are available during your SPSS Modeler session. After your session ends, the outputs are no longer available.

☐ All results

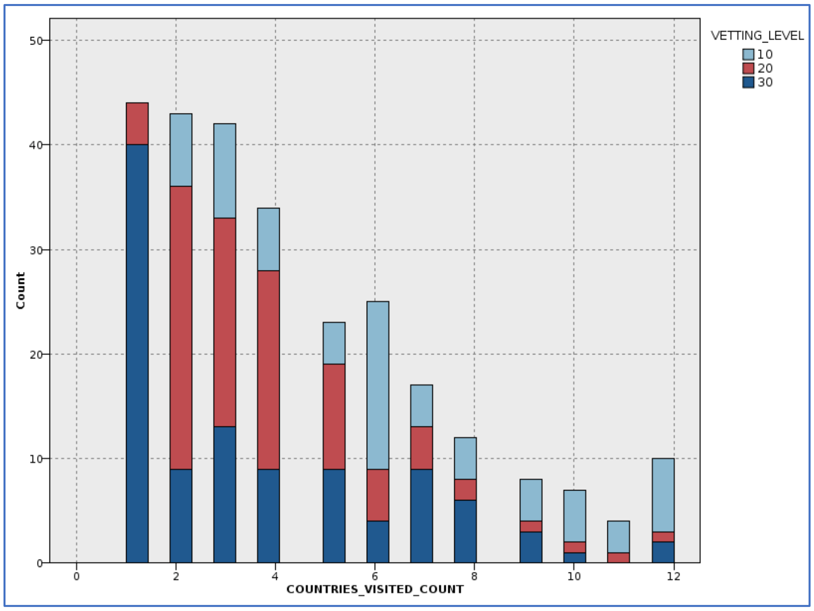
☐ COUNTRIES_VISITED_CO...<br>Just now ●

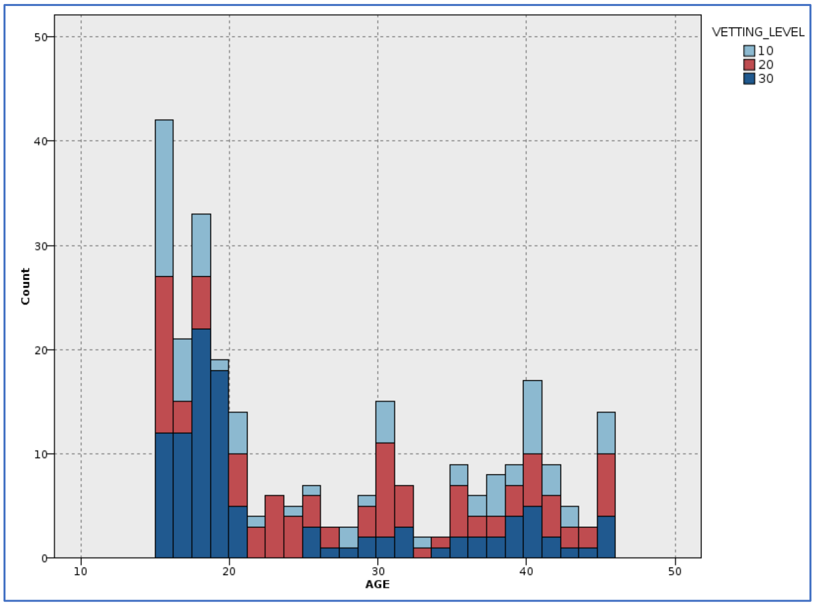
☐ DEPARTURE_AIRP...<br>11 minutes ago ⋮

☐ Data Audit of [27 fields]<br>30 minutes ago

☐ Table (16 fields, 1,085 rec...<br>51 minutes ago

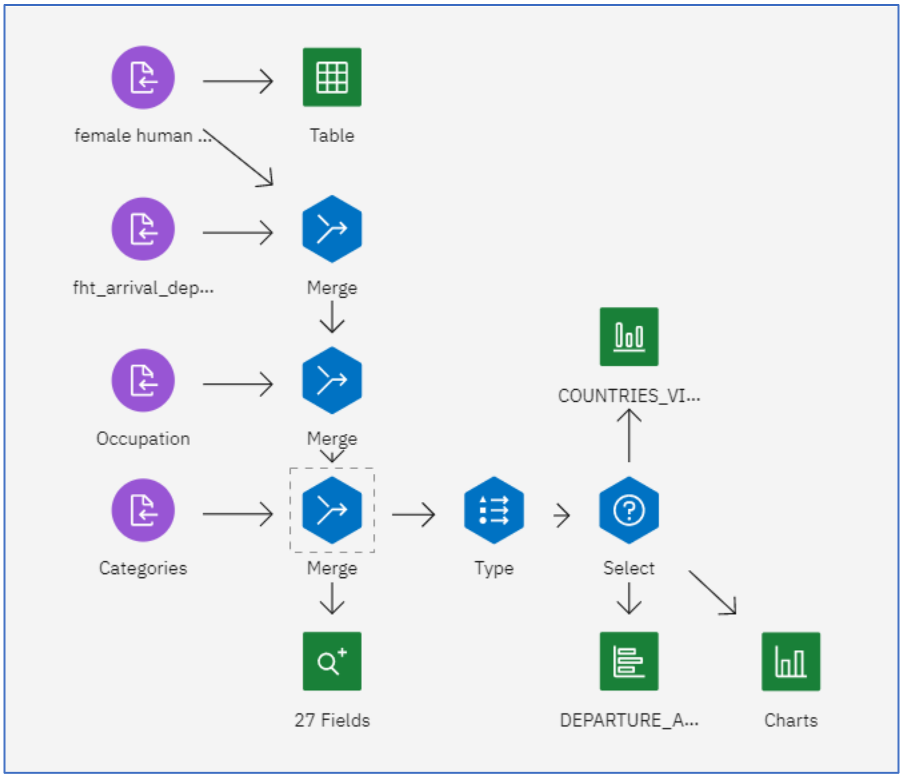
19. The general trend appears to be that the more countries visited, the higher likelihood to be a “High Risk”.  Close the display by clicking on the close (“x”) icon. You can change the histogram to show the **AGE** by **VETTING_LEVEL** by double clicking on the Histogram node and replacing **COUNTRIES_VISITED_COUNT** with **AGE** and clicking **Save**. Re-run the graph by right clicking on the **Histogram** node and selecting **Run**. Click on **AGE** in the **Outputs** pane to display the graph.  Close the display by clicking on the close (“x”) icon.



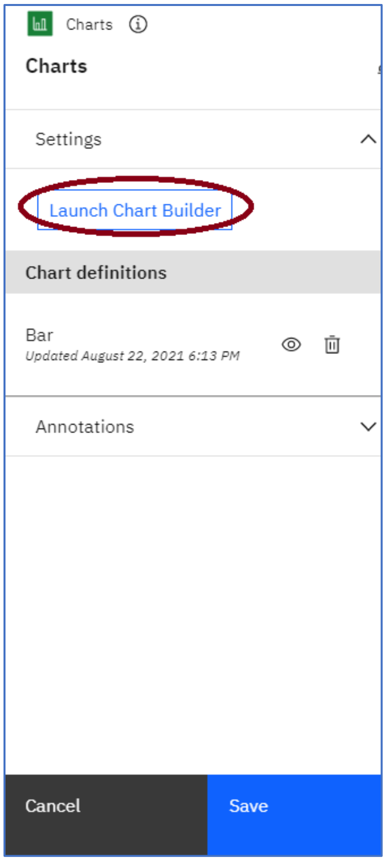


20. A relatively recent addition to the Graphs palette has been the Charts component

Charts This facility has been architected to be embedded in tooling applications. It is the same facility that drives the Visualization in the Data Refinery.  Add a **Chart** node to the flow by clicking on the **Graphs** menu item and then dragging the **Chart** node to the canvas to the right of the **Distribution** node. If the Node Palette is not visible, click on the Node Palette icon . Connect the **Select** node to the **Chart** node. The canvas should appear as below.



21. Double-click on the **Charts** node. Click on **Launch Chart Builder**. Wait until the flow runs.



Charts ⓘ

Charts

Settings

Launch Chart Builder

Chart definitions

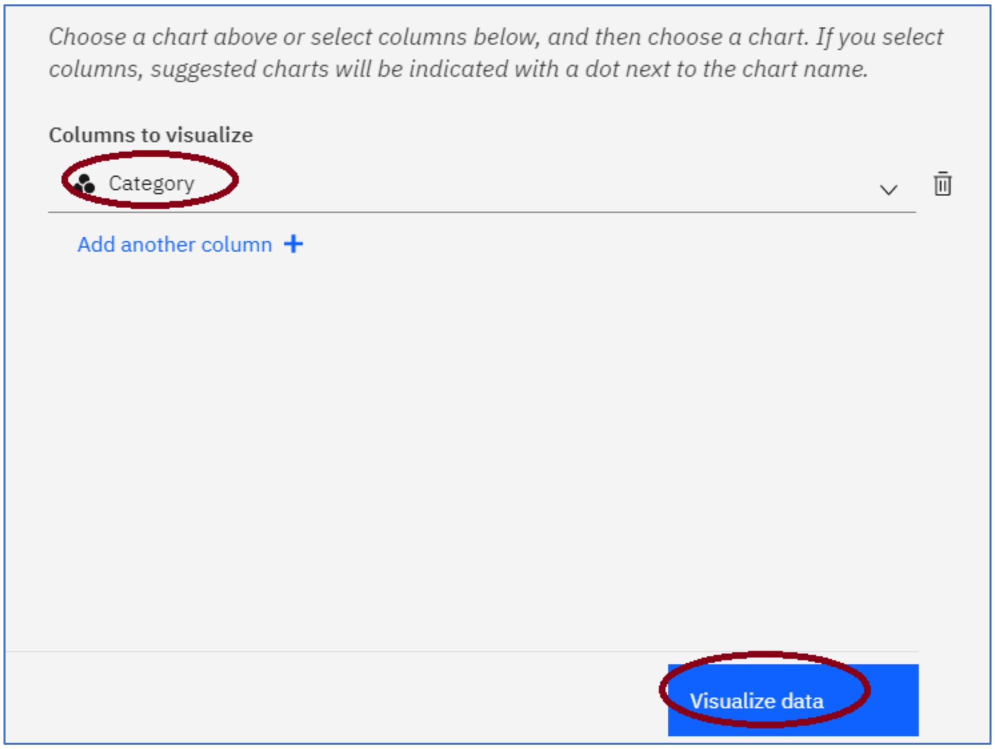
Bar
*Updated August 22, 2021 6:13 PM*

Annotations

Cancel

Save

22. You are now in the Charts facility. Select **Category** as the **Columns to visualize**.



*Choose a chart above or select columns below, and then choose a chart. If you select columns, suggested charts will be indicated with a dot next to the chart name.*

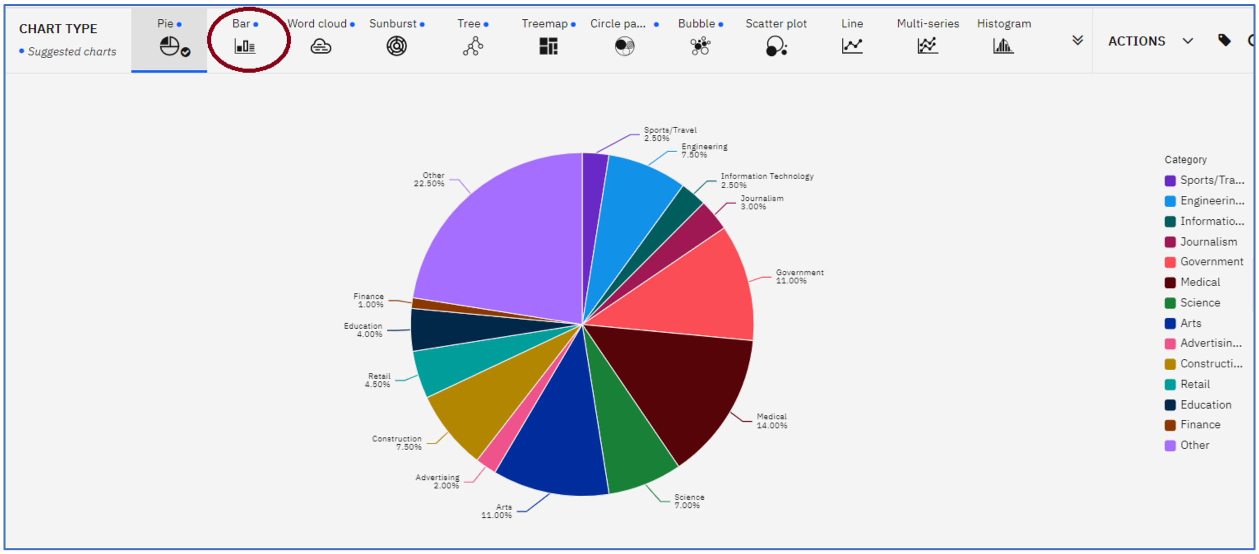
Columns to visualize

Category

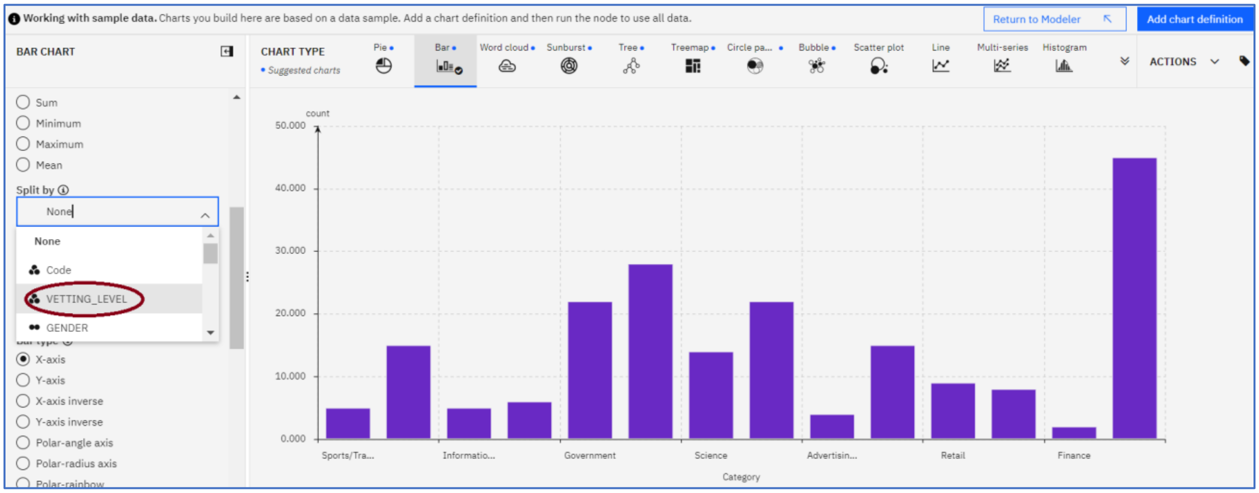
Add another column +

Visualize data

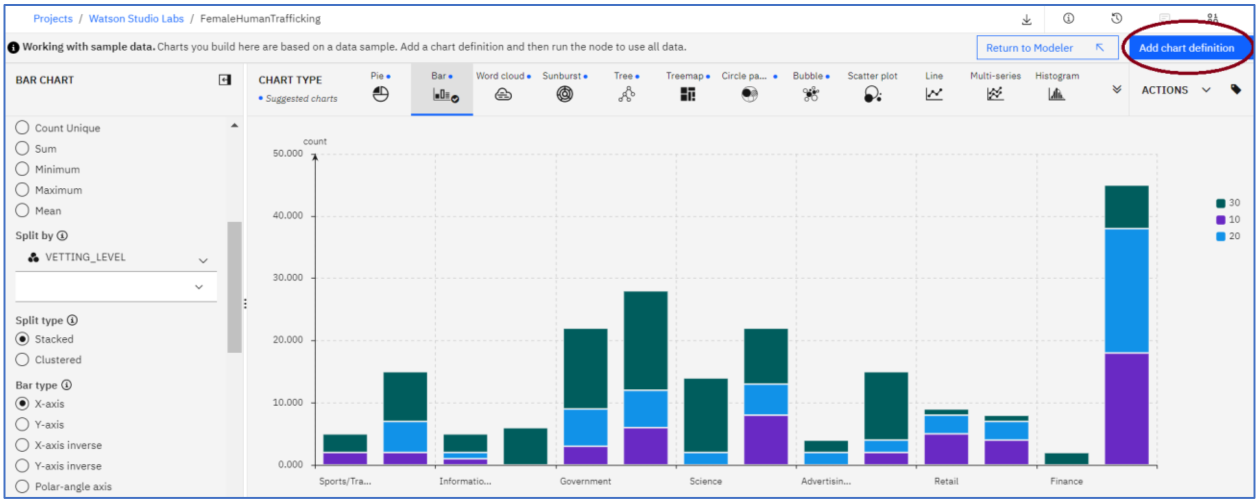
23. A pie chart is chosen by the tool to display the Category data. Click on **Bar**.



24. Click on **VETTING_LEVEL** for the **Split by**.


**Working with sample data.** Charts you build here are based on a data sample. Add a chart definition and then run the node to use all data.

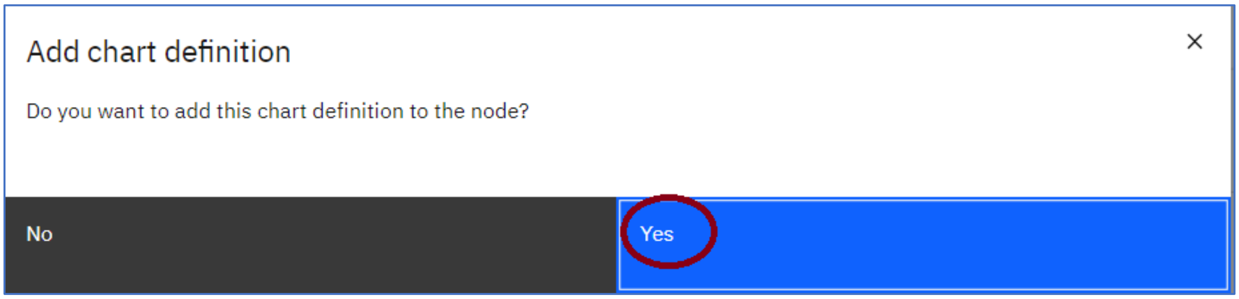
25. You can add the chart definition to be run in the modeler flow. Click on **Add chart definition.**



Projects / Watson Studio Labs / FemaleHumanTrafficking

**Working with sample data.** Charts you build here are based on a data sample. Add a chart definition and then run the node to use all data.

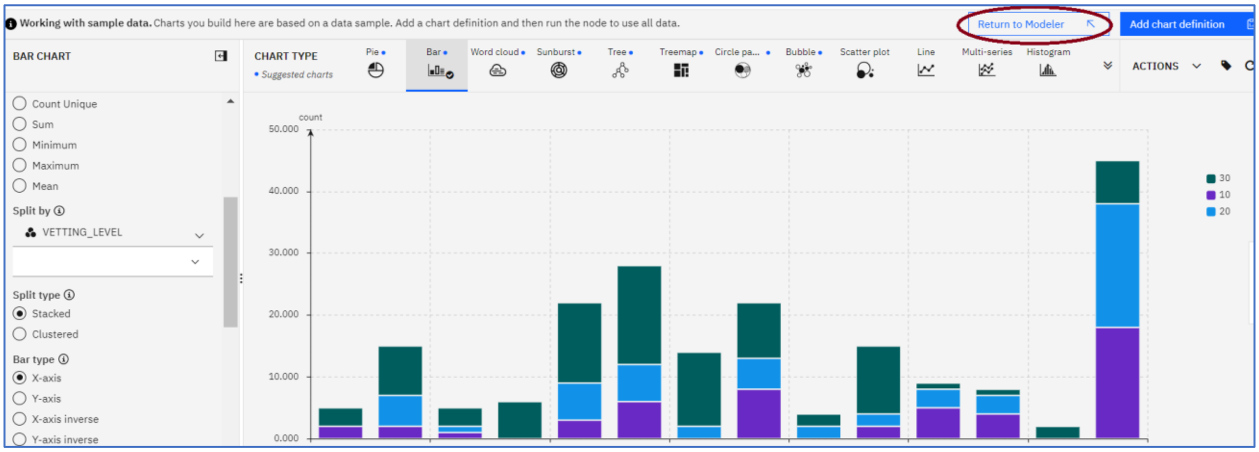
26. Click **Yes** to add the chart definition to the chart node.



Add chart definition

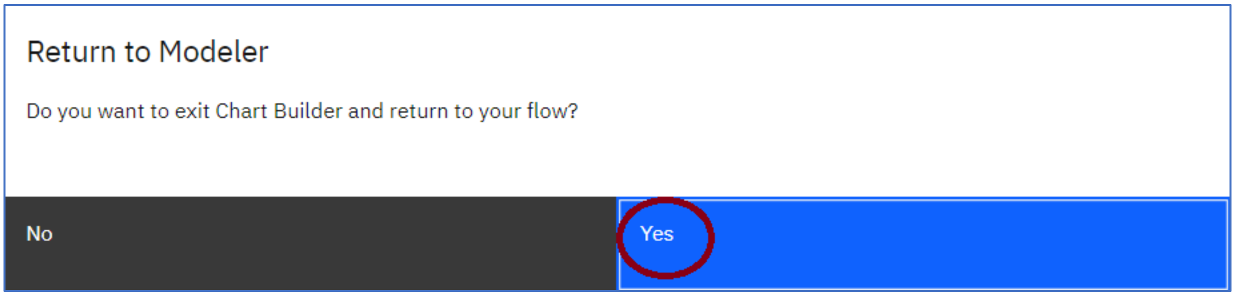
Do you want to add this chart definition to the node?

27. You can continue to visualize the data and add charts to the modeler flow. We will Return to Modeler now.  Click **Return to Modeler**.



**Working with sample data.** Charts you build here are based on a data sample. Add a chart definition and then run the node to use all data.

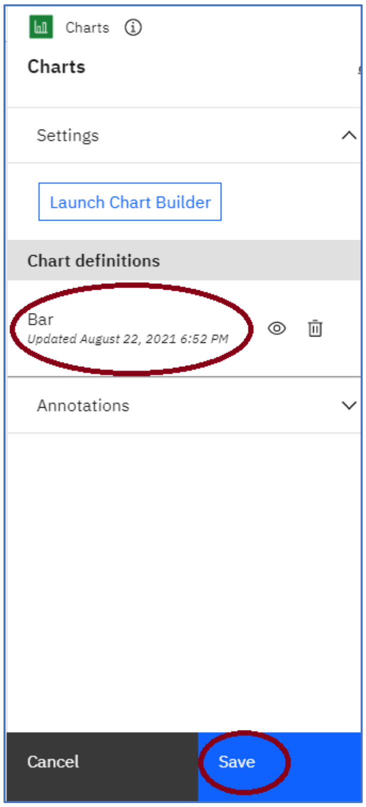
28. Click **Yes**.



Return to Modeler

Do you want to exit Chart Builder and return to your flow?

29. We can see one bar chart has been retained.  Click **Save**.

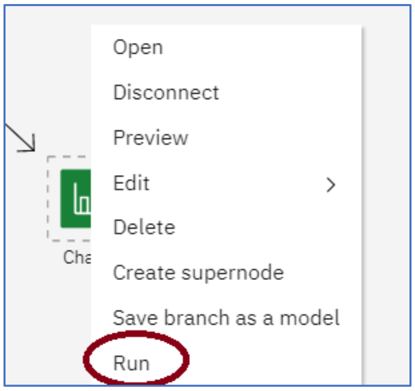


Charts

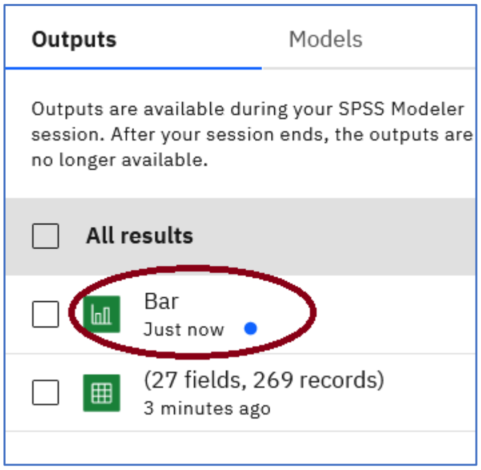
Chart definitions

Bar
*Updated August 22, 2021 6:52 PM*

30. Right-click on the **Chart** node and click **Run**.



31. Click on the **Bar** under the **Outputs** tab at the right of the screen



Outputs Models

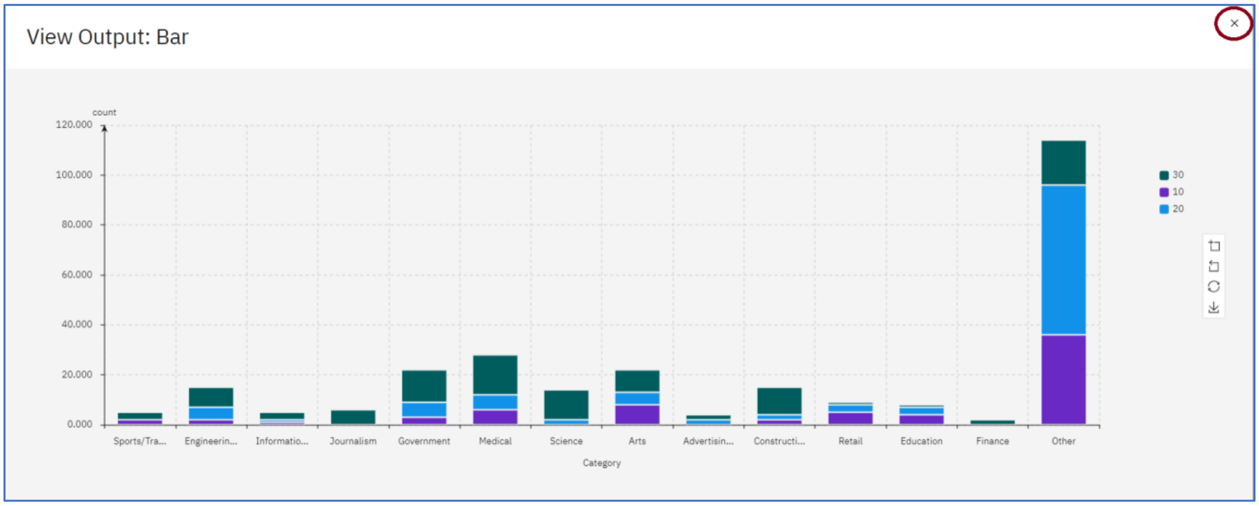
Outputs are available during your SPSS Modeler session. After your session ends, the outputs are no longer available.

□ All results

□ Bar
Just now

□ (27 fields, 269 records)
3 minutes ago

32. The visualization is displayed. Note, when running the visualization through the modeler flow it will be using all the data, not just a sample as was used in the Charts facility. In this case it didn't make a difference since the sample size is larger than the rows in the dataset. Click on **x** to close the window.



View Output: Bar

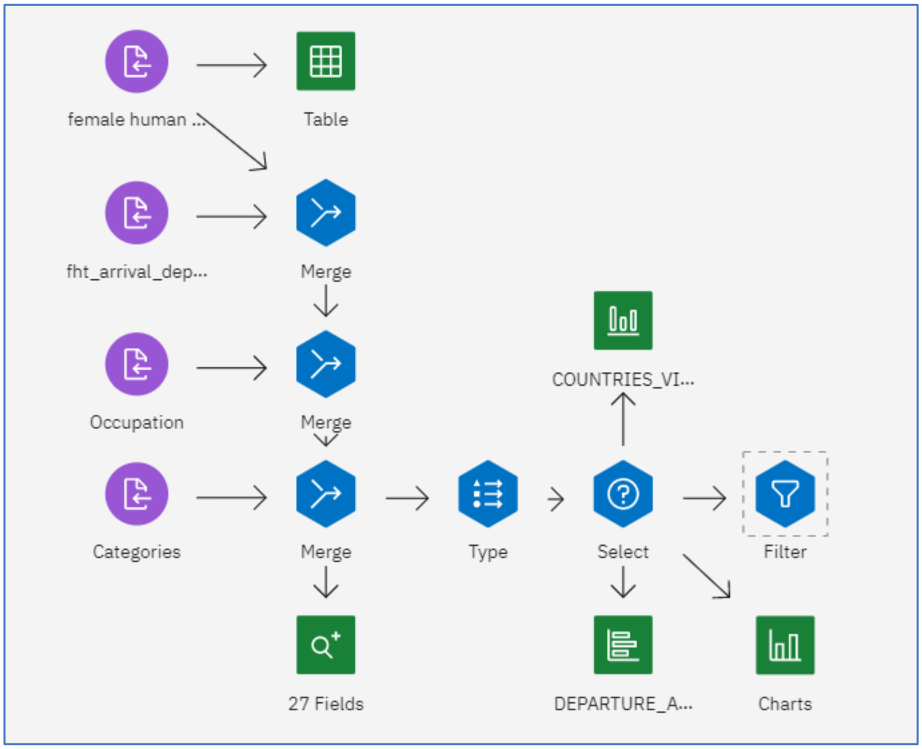
## Step 6 - Prepare the Data for Modeling

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.

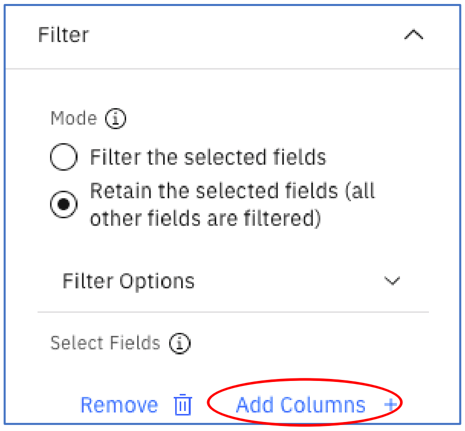
**Filter** node – The **Filter** node performs two functions. It specifies fields that can be dropped or the fields that should be retained. It also allows fields to be renamed. We will retain the following fields – VETTING_LEVEL, COUNTRIES_VISITED_COUNT, ARRIVAL_AIRPORT_REGION, DEPARTURE_AIRPORT_COUNTRY_CODE, 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.**



Filter

Mode ⓘ

○ Filter the selected fields

● Retain the selected fields (all other fields are filtered)

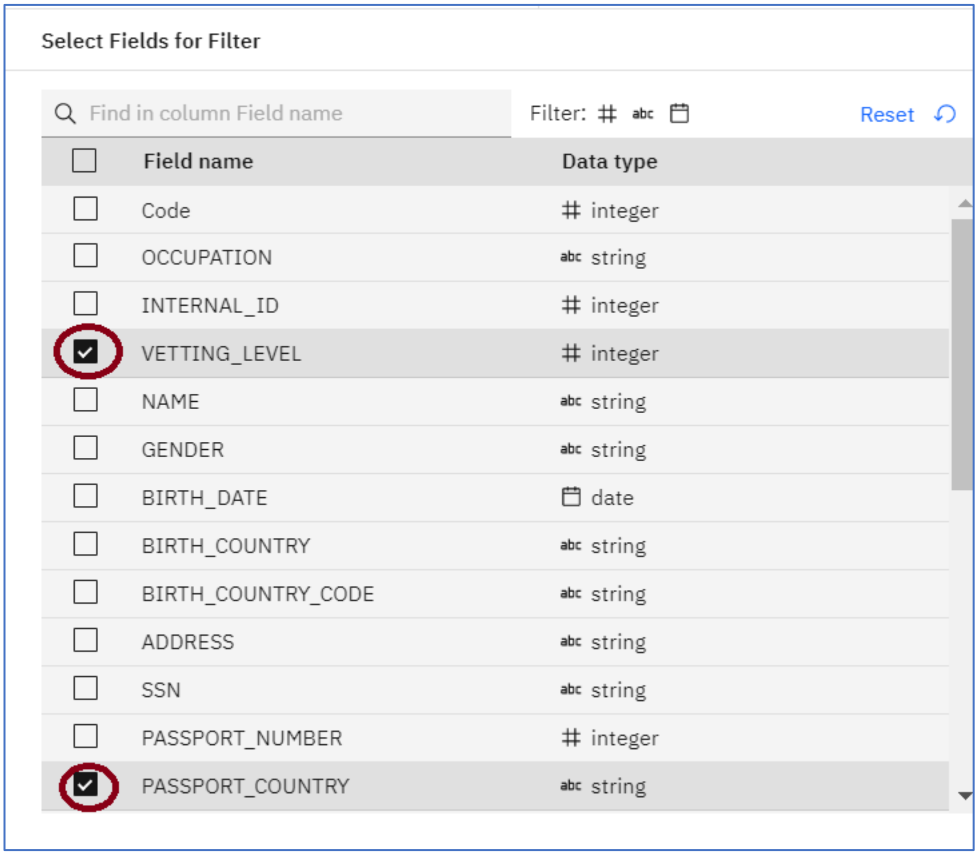
Filter Options

Select Fields ⓘ

Remove 🗑 Add Columns +

3. Scroll down and click on VETTING_LEVEL, PASSPORT_COUNTRY, COUNTRIES_VISITED_COUNT, ARRIVAL_AIRPORT_REGION,

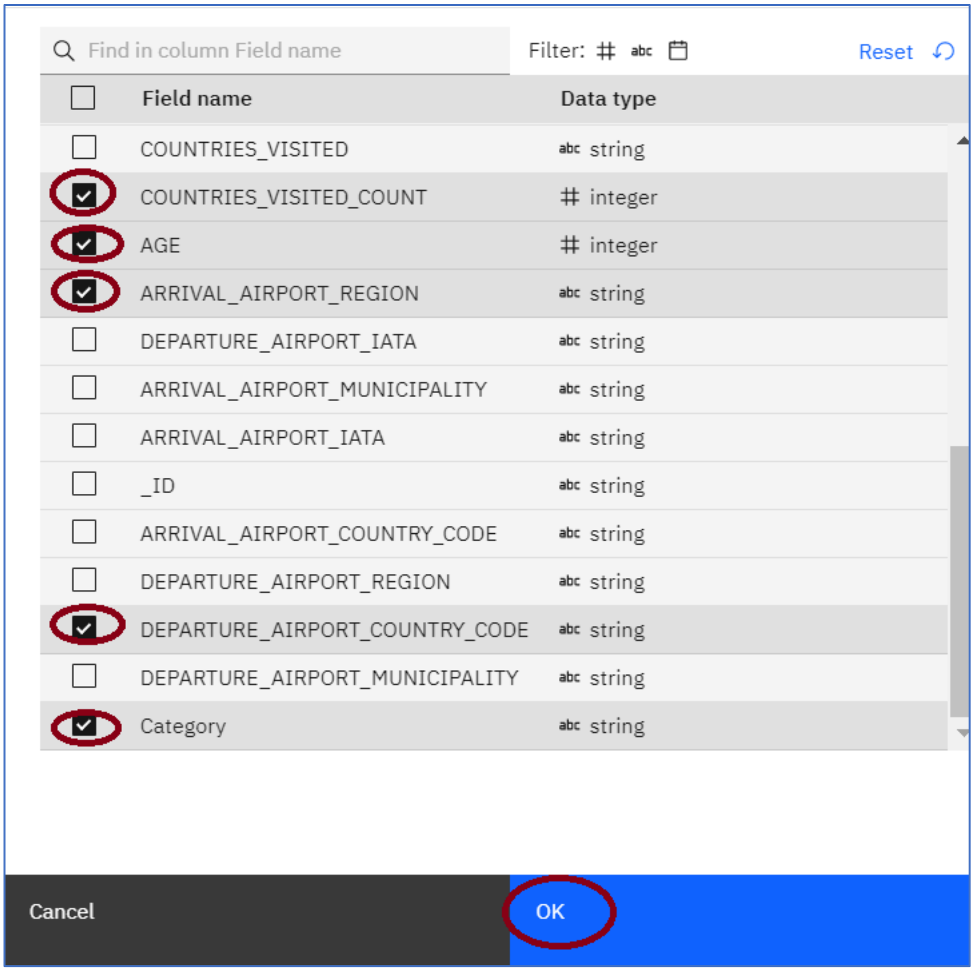
DEPARTURE_AIRPORT_COUNTRY_CODE, AGE, and CATEGORY, then click **OK**. Scroll as required to check all of the above fields.



Select Fields for Filter

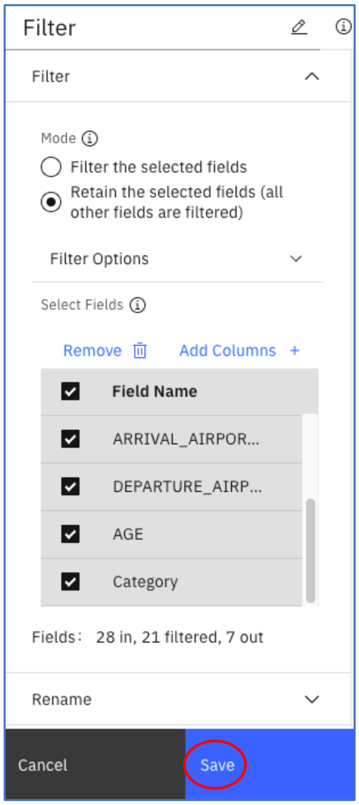
Find in column Field name

| □ | Field name | Data type |
|---|---|---|
| □ | Code | # integer |
| □ | OCCUPATION | abc string |
| □ | INTERNAL_ID | # integer |
| ☑ | VETTING_LEVEL | # integer |
| □ | NAME | abc string |
| □ | GENDER | abc string |
| □ | BIRTH_DATE | date |
| □ | BIRTH_COUNTRY | abc string |
| □ | BIRTH_COUNTRY_CODE | abc string |
| □ | ADDRESS | abc string |
| □ | SSN | abc string |
| □ | PASSPORT_NUMBER | # integer |
| ☑ | PASSPORT_COUNTRY | abc string |



| ☐ | Field name | Data type |
|---|---|---|
| ☐ | COUNTRIES_VISITED | abc string |
| ☑ | COUNTRIES_VISITED_COUNT | # integer |
| ☑ | AGE | # integer |
| ☑ | ARRIVAL_AIRPORT_REGION | abc string |
| ☐ | DEPARTURE_AIRPORT_IATA | abc string |
| ☐ | ARRIVAL_AIRPORT_MUNICIPALITY | abc string |
| ☐ | ARRIVAL_AIRPORT_IATA | abc string |
| ☐ | _ID | abc string |
| ☐ | ARRIVAL_AIRPORT_COUNTRY_CODE | abc string |
| ☐ | DEPARTURE_AIRPORT_REGION | abc string |
| ☑ | DEPARTURE_AIRPORT_COUNTRY_CODE | abc string |
| ☐ | DEPARTURE_AIRPORT_MUNICIPALITY | abc string |
| ☑ | Category | abc string |

4. Click **Save**.



Filter

Filter

Mode ⓘ

○ Filter the selected fields

● Retain the selected fields (all other fields are filtered)

Filter Options

Select Fields ⓘ

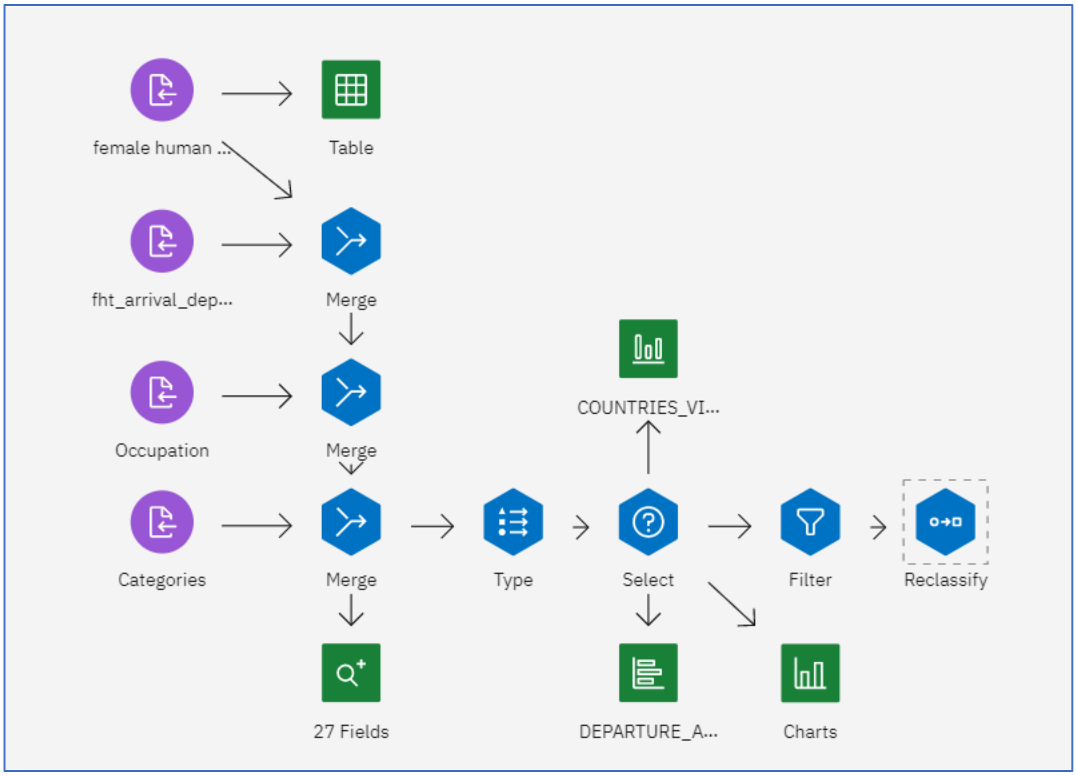
Remove  Add Columns +

| ☑ | Field Name |
|---|---|
| ☑ | ARRIVAL_AIRPOR... |
| ☑ | DEPARTURE_AIRP... |
| ☑ | AGE |
| ☑ | Category |

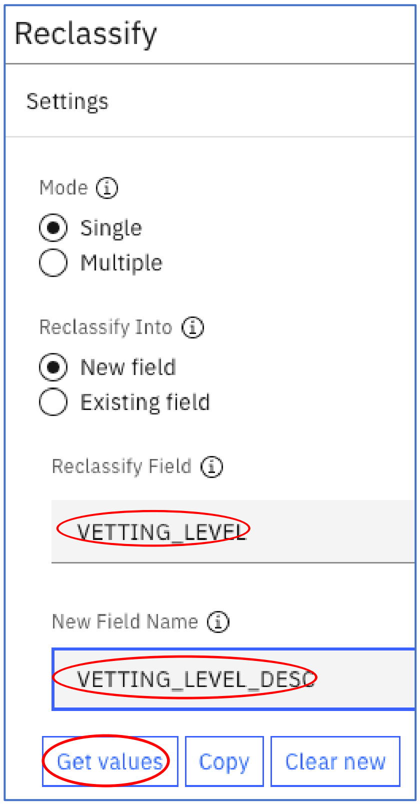
Fields: 28 in, 21 filtered, 7 out

Rename

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 ◧ first. 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**.



Reclassify

Settings

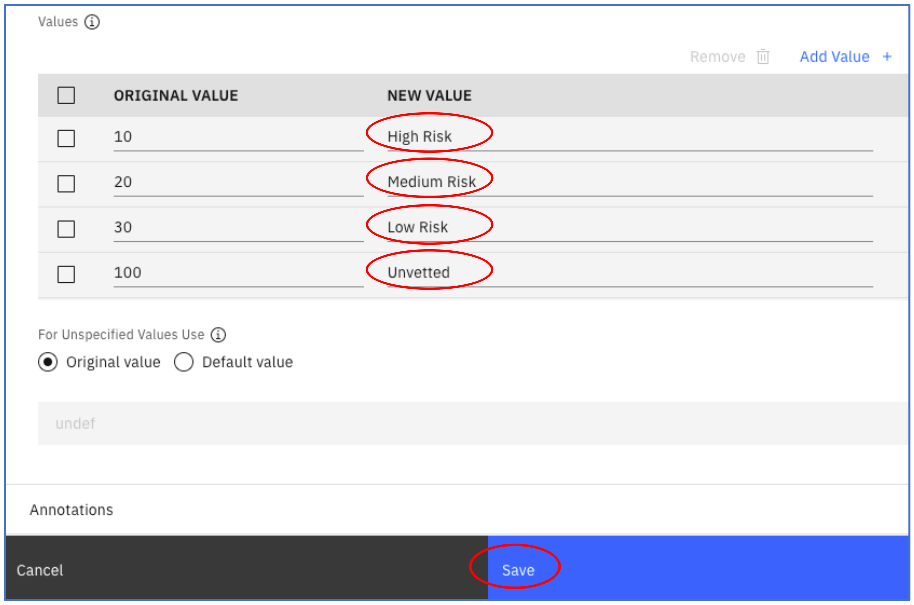
Mode
● Single
○ Multiple

Reclassify Into
● New field
○ Existing field

Reclassify Field
VETTING_LEVEL

New Field Name
VETTING_LEVEL_DESC

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**.



Values

| □ | ORIGINAL VALUE | NEW VALUE |
|---|---|---|
| □ | 10 | High Risk |
| □ | 20 | Medium Risk |
| □ | 30 | Low Risk |
| □ | 100 | Unvetted |

For Unspecified Values Use
● Original value ○ Default value

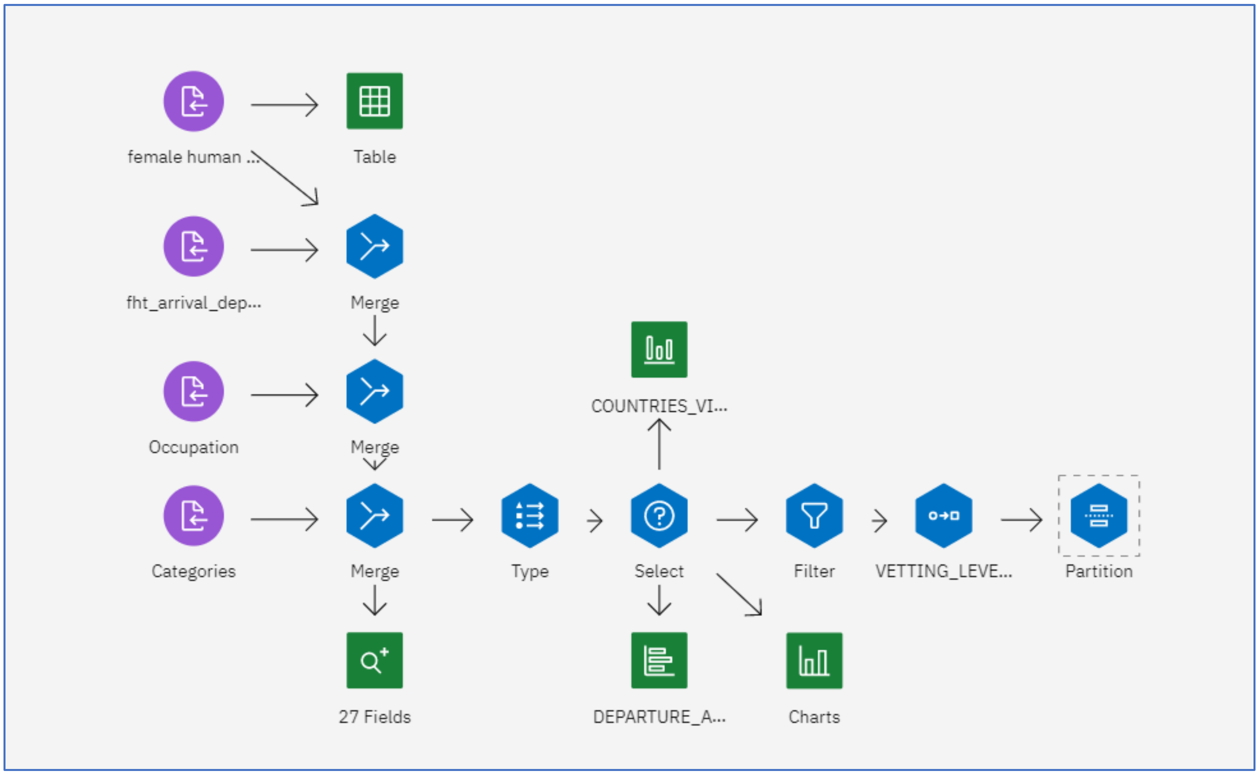
undef

Annotations

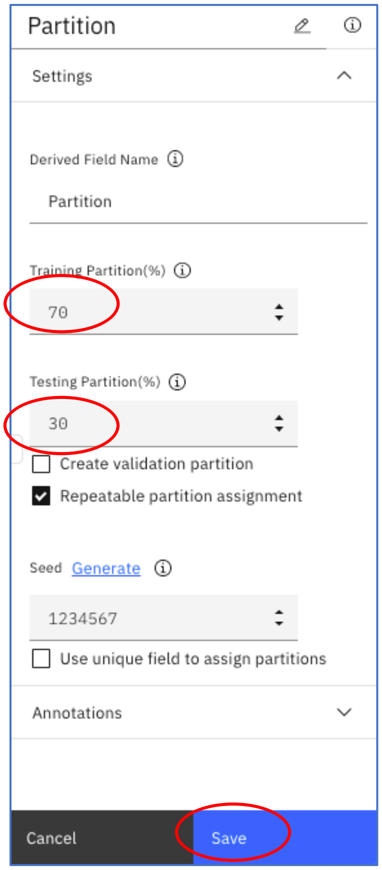
## Step 7 - Modeling and Evaluation

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**.



Derived Field Name: Partition

Training Partition(%): 70

Testing Partition(%): 30

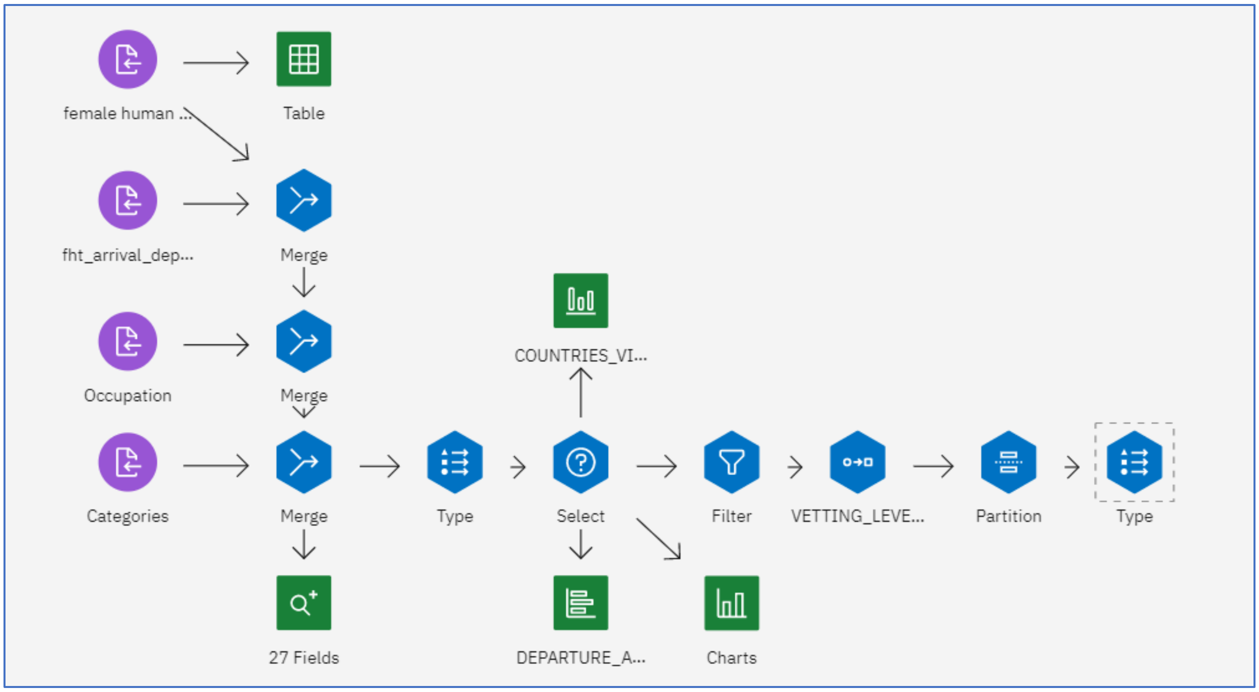
□ Create validation partition

☑ Repeatable partition assignment

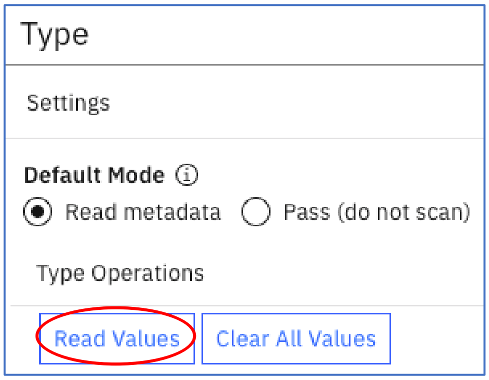
Seed Generate: 1234567

□ Use unique field to assign partitions

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 ◧ first. 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**.



Type

Settings

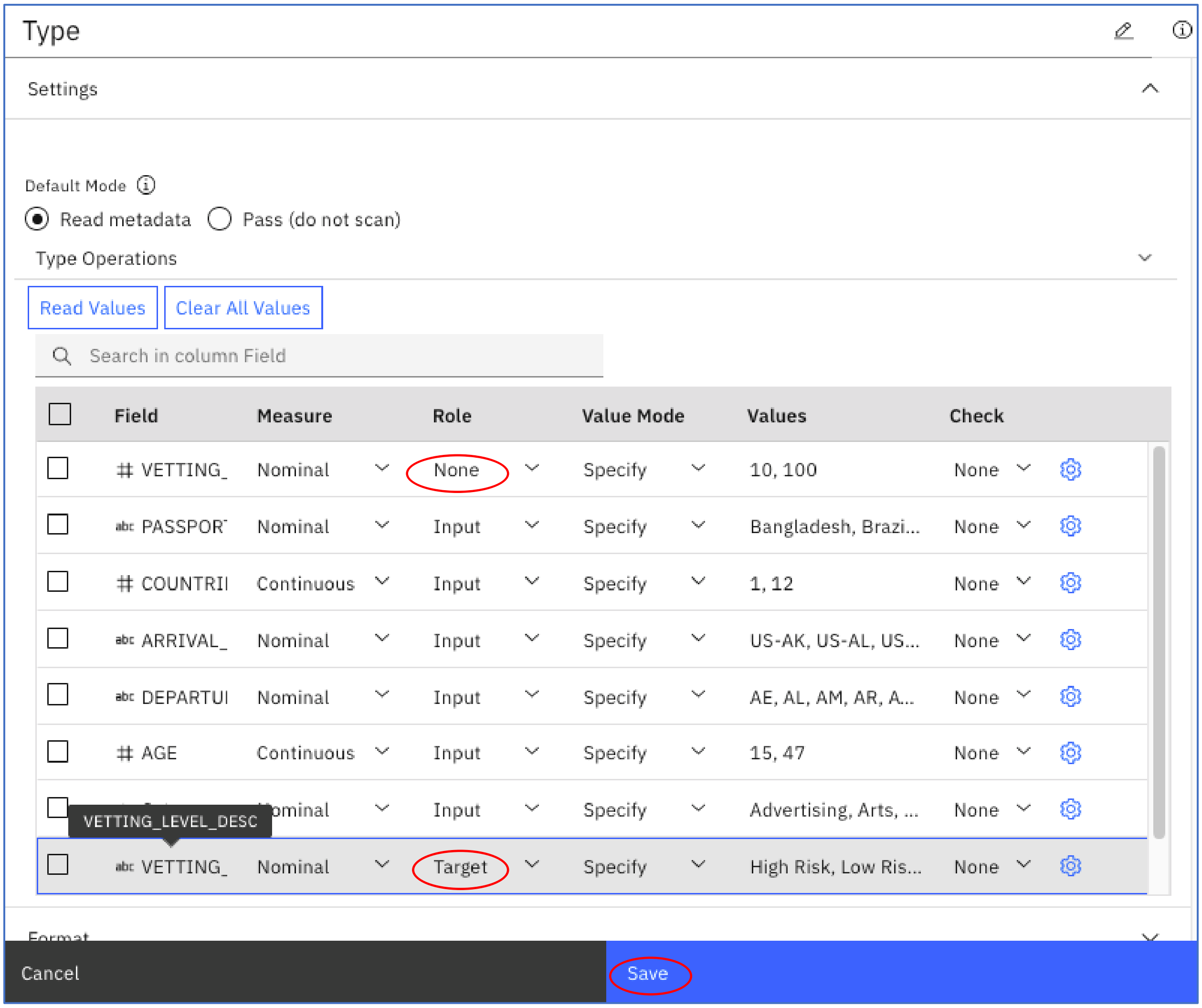
**Default Mode** ⓘ

● Read metadata ○ Pass (do not scan)

Type Operations

Read Values | Clear All 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**.



Type

Settings

Default Mode

● Read metadata ○ Pass (do not scan)

Type Operations

Read Values Clear All Values

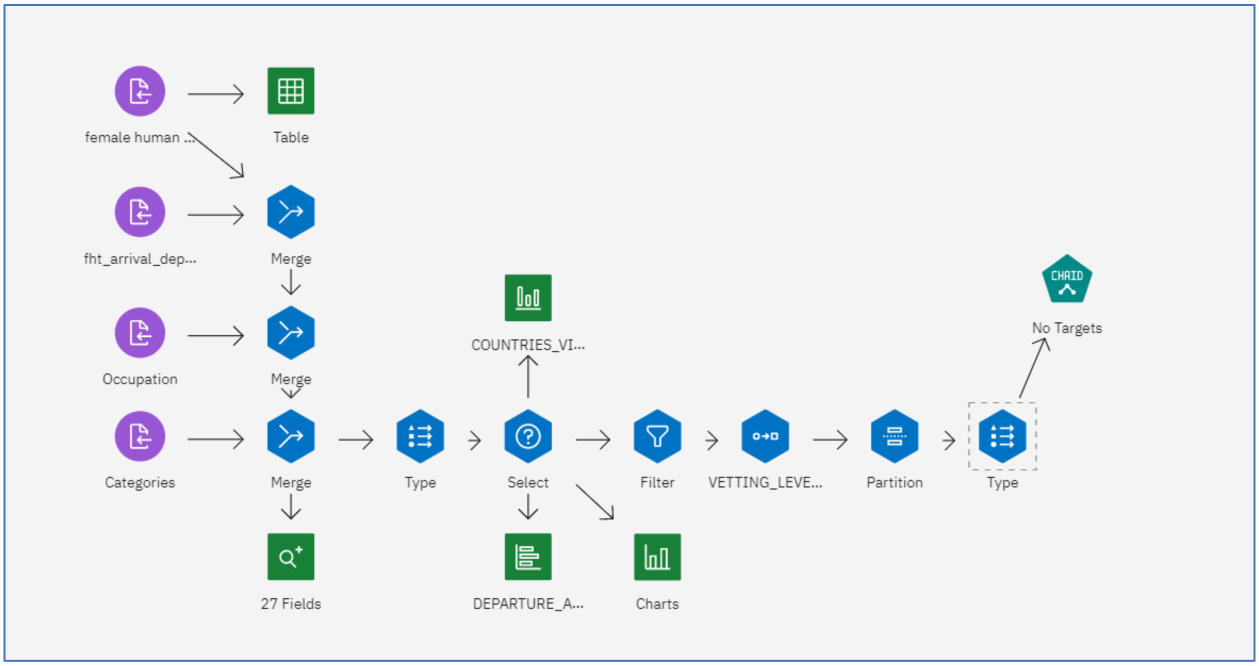
Search in column Field

| □ | Field | Measure | Role | Value Mode | Values | Check |
|---|---|---|---|---|---|---|
| □ | # VETTING_ | Nominal | None | Specify | 10, 100 | None |
| □ | abc PASSPOR | Nominal | Input | Specify | Bangladesh, Brazi... | None |
| □ | # COUNTRI | Continuous | Input | Specify | 1, 12 | None |
| □ | abc ARRIVAL_ | Nominal | Input | Specify | US-AK, US-AL, US... | None |
| □ | abc DEPARTU | Nominal | Input | Specify | AE, AL, AM, AR, A... | None |
| □ | # AGE | Continuous | Input | Specify | 15, 47 | None |
| □ | VETTING_LEVEL_DESC | ominal | Input | Specify | Advertising, Arts, ... | None |
| □ | abc VETTING_ | Nominal | Target | Specify | High Risk, Low Ris... | None |

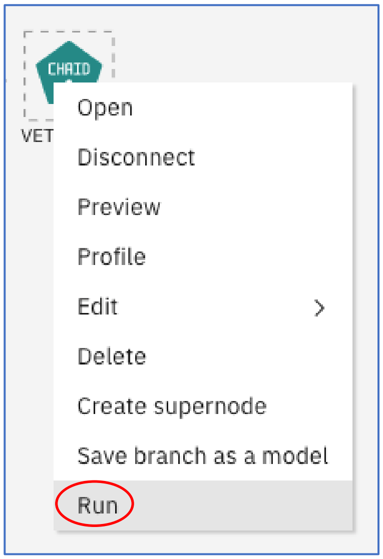
Format

Cancel Save

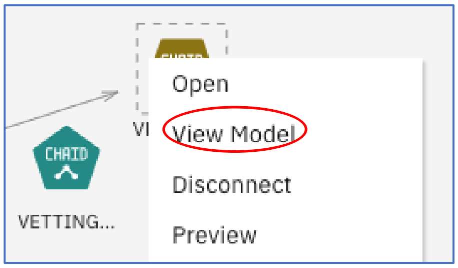
6. Add a **CHAID** node by clicking on the **Modeling** menu item in the Node palette and dragging the **CHAID** node onto the canvas to the right of the **Type** node. Connect the **Type** node to the **CHAID** node. The canvas should appear as below.



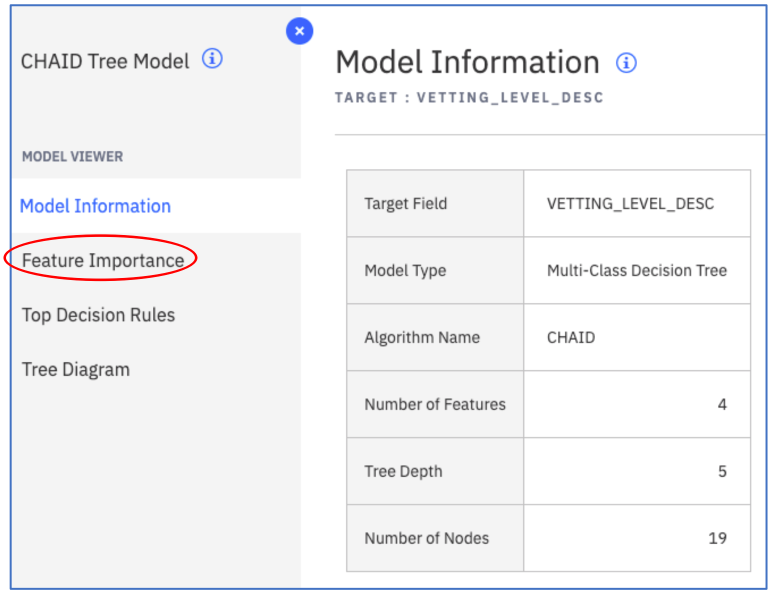
7. Right-click on the CHAID node and click Run.



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**.



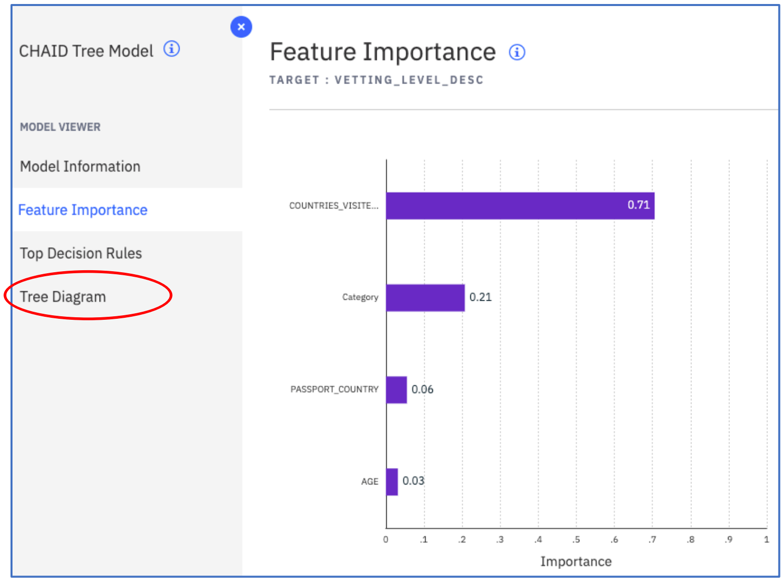
9. Note your results could differ. The Model Information is displayed. Click on **Feature Importance**.



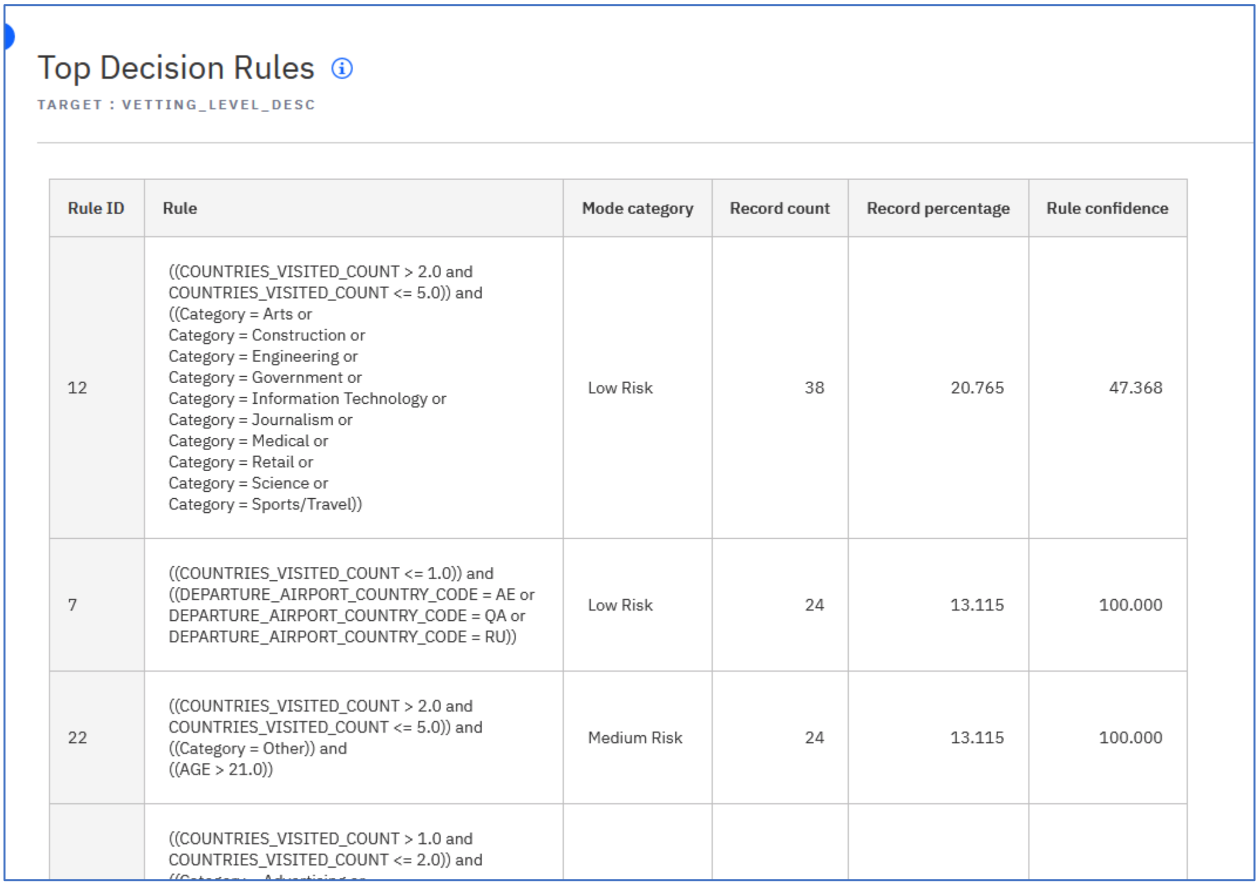
Model Information
TARGET : VETTING_LEVEL_DESC

| | |
|---|---|
| Target Field | VETTING_LEVEL_DESC |
| Model Type | Multi-Class Decision Tree |
| Algorithm Name | CHAID |
| Number of Features | 4 |
| Tree Depth | 5 |
| Number of Nodes | 19 |

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



11. The Top Decision Rules are shown below.

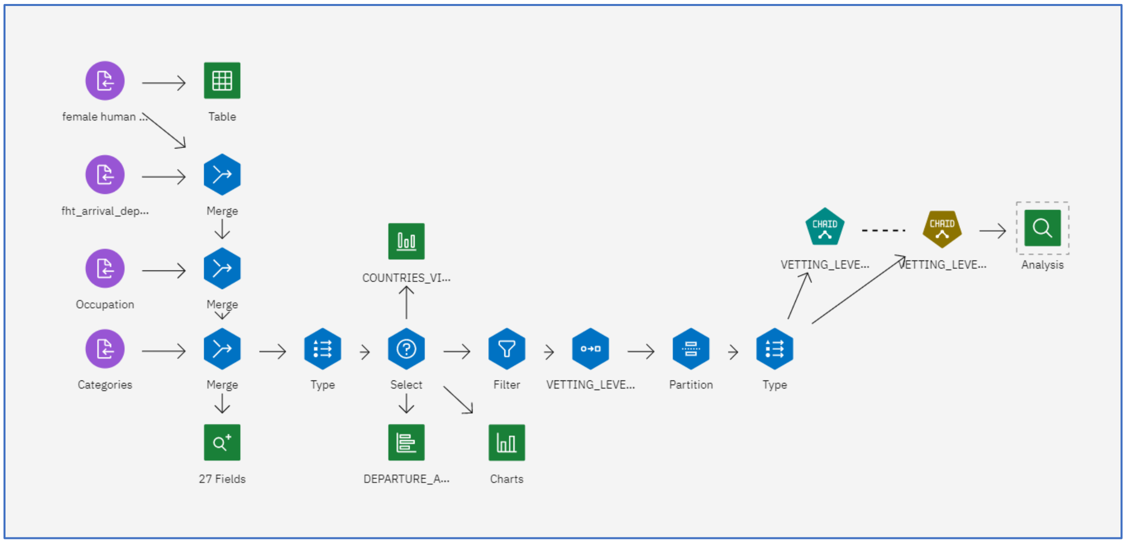


## Top Decision Rules

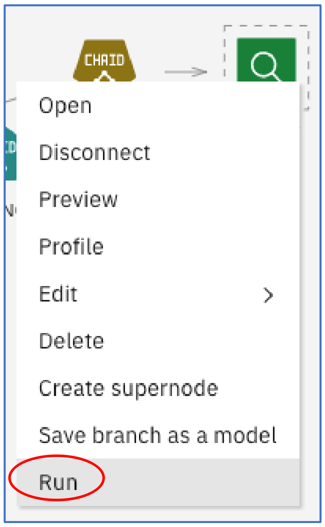
TARGET : VETTING_LEVEL_DESC

| Rule ID | Rule | Mode category | Record count | Record percentage | Rule confidence |
|---|---|---|---|---|---|
| 12 | ((COUNTRIES_VISITED_COUNT > 2.0 and COUNTRIES_VISITED_COUNT <= 5.0)) and ((Category = Arts or Category = Construction or Category = Engineering or Category = Government or Category = Information Technology or Category = Journalism or Category = Medical or Category = Retail or Category = Science or Category = Sports/Travel)) | Low Risk | 38 | 20.765 | 47.368 |
| 7 | ((COUNTRIES_VISITED_COUNT <= 1.0)) and ((DEPARTURE_AIRPORT_COUNTRY_CODE = AE or DEPARTURE_AIRPORT_COUNTRY_CODE = QA or DEPARTURE_AIRPORT_COUNTRY_CODE = RU)) | Low Risk | 24 | 13.115 | 100.000 |
| 22 | ((COUNTRIES_VISITED_COUNT > 2.0 and COUNTRIES_VISITED_COUNT <= 5.0)) and ((Category = Other)) and ((AGE > 21.0)) | Medium Risk | 24 | 13.115 | 100.000 |
|  | ((COUNTRIES_VISITED_COUNT > 1.0 and COUNTRIES_VISITED_COUNT <= 2.0)) and ((Category = Advertising or |  |  |  |  |

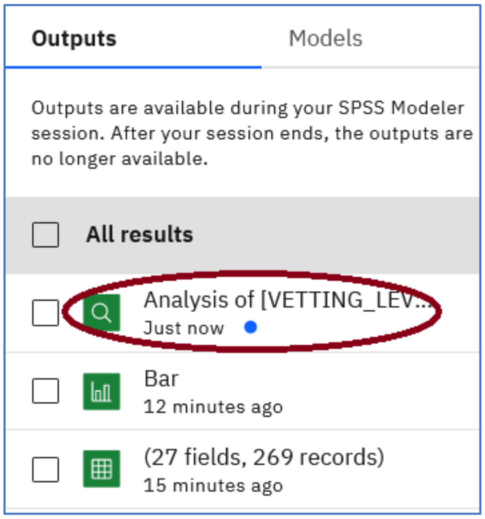
7. Close the display by clicking on the close (“x”) icon. Add an Analysis node by clicking on the Output menu item in the Node palette and dragging the Analysis node onto the canvas to the right of the CHAID Model node. Connect the CHAID Model node to the Analysis node. The canvas should appear as below.  The canvas should appear as below.



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



9. Click on the Analysis results in the Output area.  Note your results can differ.



Outputs are available during your SPSS Modeler session. After your session ends, the outputs are no longer available.

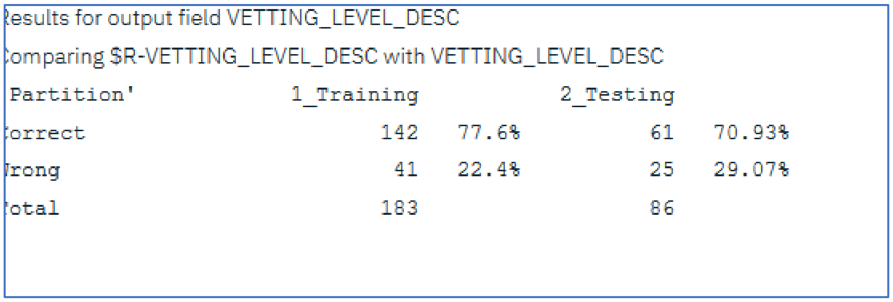
☐ All results

☐ Analysis of [VETTING_LEV...
Just now ●

☐ Bar
12 minutes ago

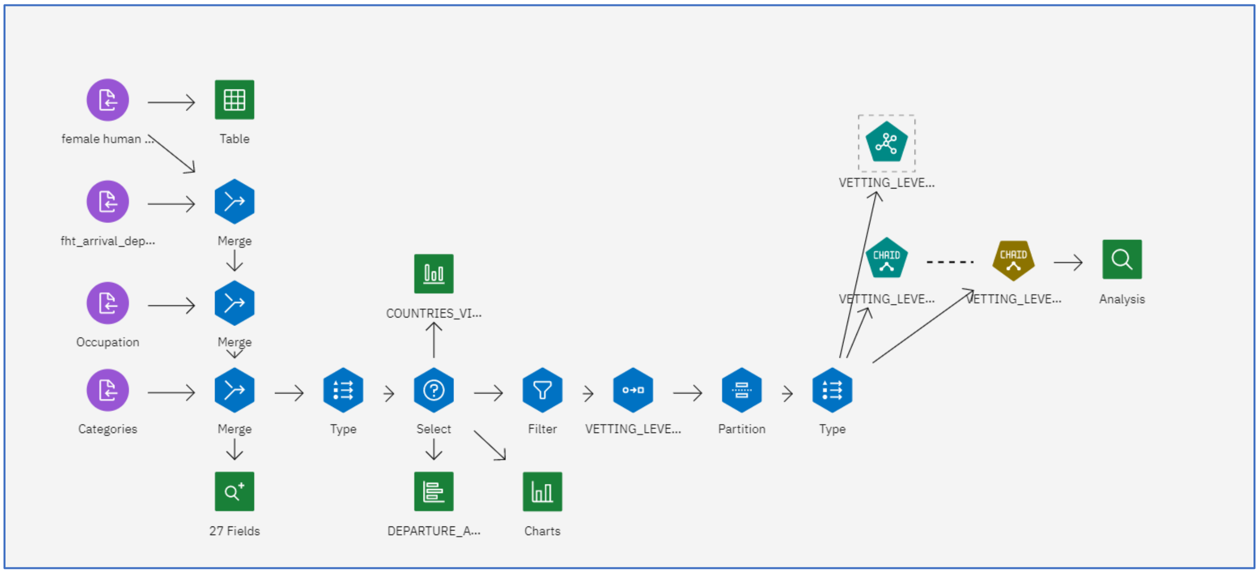
☐ (27 fields, 269 records)
15 minutes ago

10. Accuracy results are displayed for the CHAID algorithm. Close the display by clicking on the close (“x”) icon.

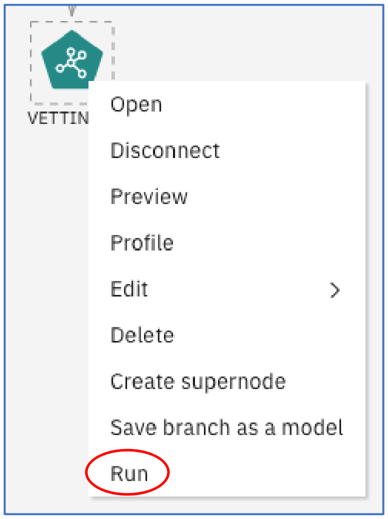


```
esults for output field VETTING_LEVEL_DESC
omparing $R-VETTING_LEVEL_DESC with VETTING_LEVEL_DESC
Partition'           1_Training          2_Testing
orrect                      142   77.6%          61   70.93%
rong                         41   22.4%          25   29.07%
otal                        183                  86
```

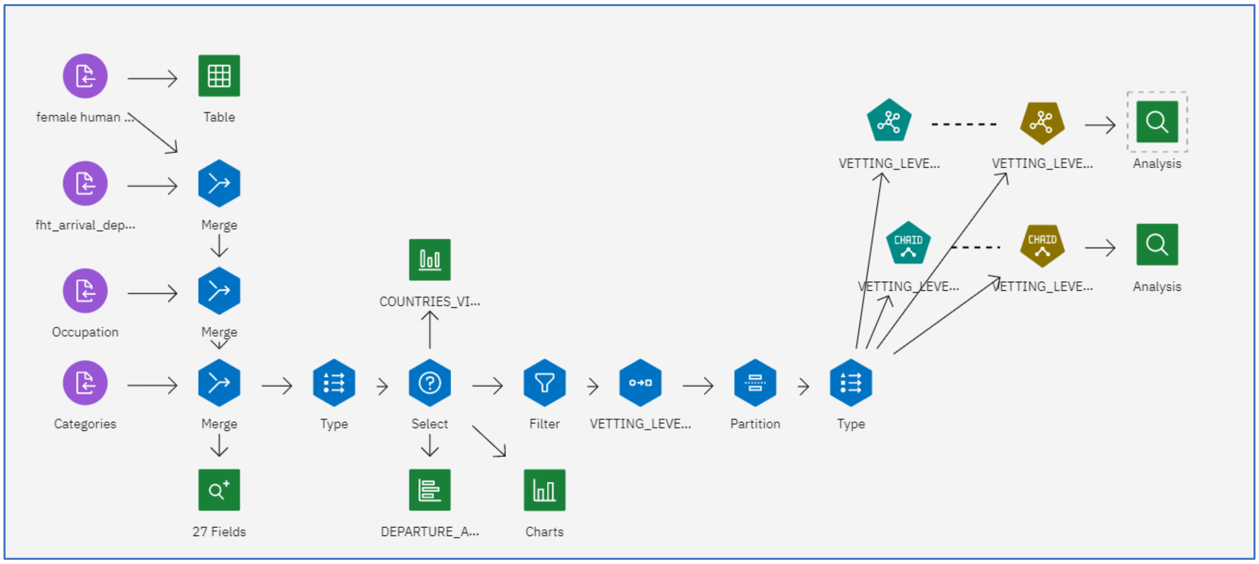
6. Add a **Random Forest** node by clicking on the **Modeling** menu item in the Node palette and dragging the **Random Forest** node onto the canvas above the **CHAID** node. Connect the **Type** node to the **Random Forest** node. The canvas should appear as below.



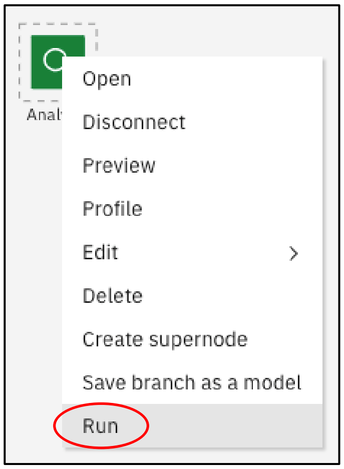
7. Right-click the **Random Forest** node and click **Run**.



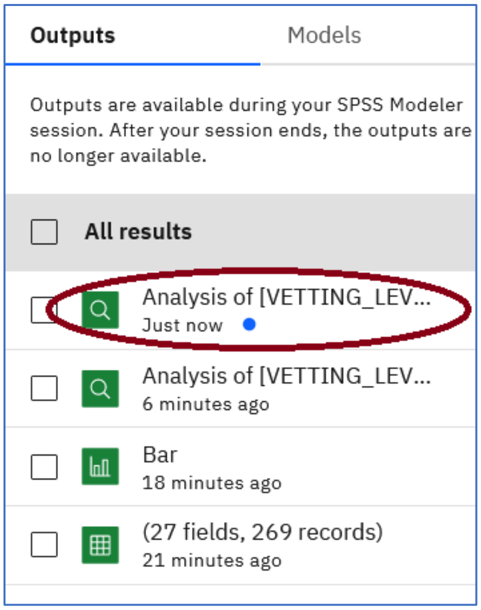
8. A **Random Forest Model** node is created. Clear the messages if displayed. Drag the generated **Random Forest Model** node to the right of the **Random Forest** node. The **Random Forest Model** node does not have a **View Model** option. Add an **Analysis** node to the right of the **Random Forest 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.



Outputs are available during your SPSS Modeler session. After your session ends, the outputs are no longer available.

□ All results

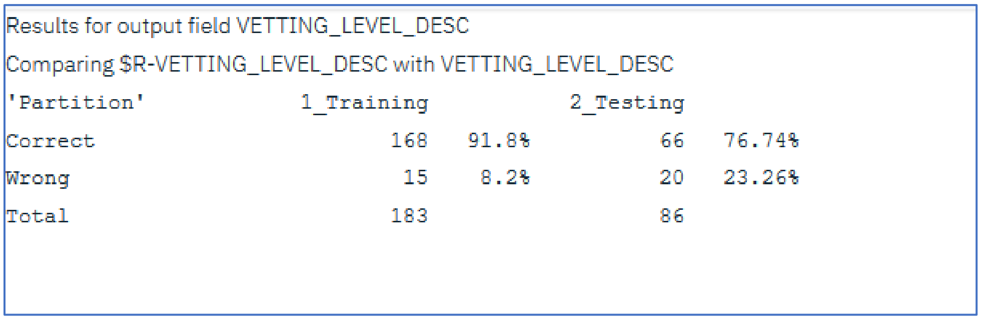
□ Analysis of [VETTING_LEV...
Just now ●

□ Analysis of [VETTING_LEV...
6 minutes ago

□ Bar
18 minutes ago

□ (27 fields, 269 records)
21 minutes ago

11. The results appear below. Based on the results, the Random Forest model is overfitting given the disparity between training and testing results. Click on the close ("x") icon to remove the display.

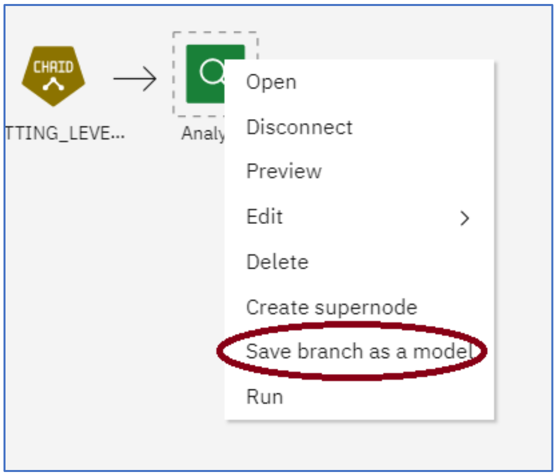


```
Results for output field VETTING_LEVEL_DESC
Comparing $R-VETTING_LEVEL_DESC with VETTING_LEVEL_DESC
'Partition'           1_Training              2_Testing
Correct                      168    91.8%            66    76.74%
Wrong                         15     8.2%            20    23.26%
Total                        183                     86
```

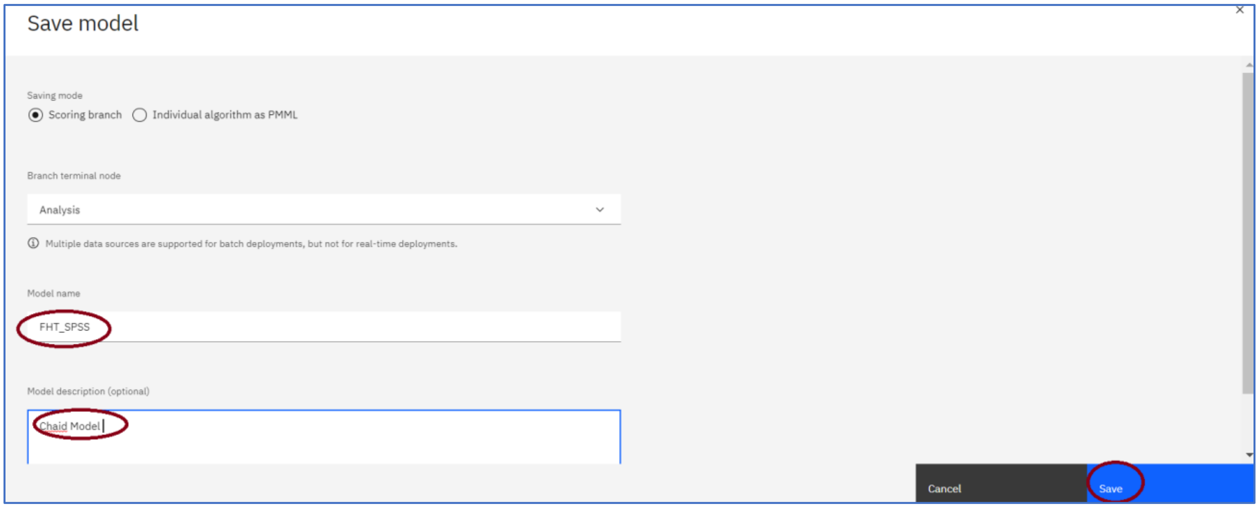
## Step 8 - Saving a Model

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. Since the Random Forest model was badly overfitting the data, we choose to save the CHAID model (also overfitted but not as badly). Note, that we need to collect more data to avoid the overfitting.

1. Right click on the CHAID 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**.



Save model

Saving mode

● Scoring branch ○ Individual algorithm as PMML

Branch terminal node

Analysis

ⓘ Multiple data sources are supported for batch deployments, but not for real-time deployments.

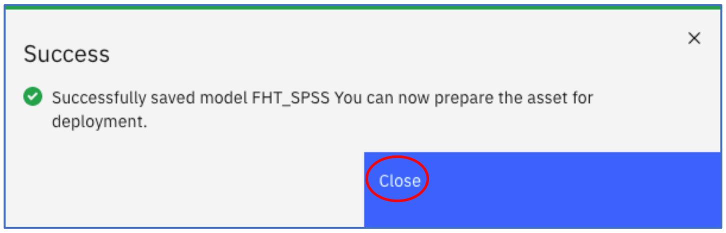
Model name

FHT_SPSS

Model description (optional)

Chaid Model

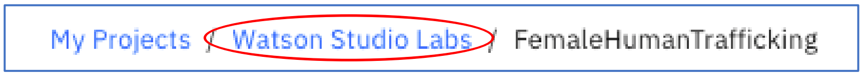
3. Click **Close**.



Success

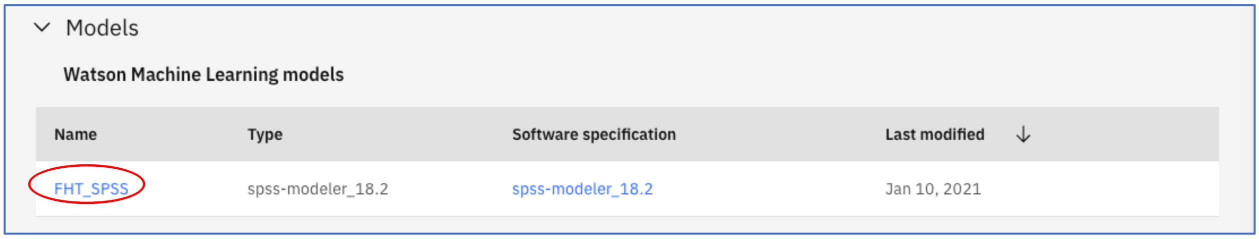
Successfully saved model FHT_SPSS You can now prepare the asset for deployment.

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.



Models

Watson Machine Learning models

| Name | Type | Software specification | Last modified ↓ |
|---|---|---|---|
| FHT_SPSS | spss-modeler_18.2 | spss-modeler_18.2 | Jan 10, 2021 |

# 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.