Watson Studio SPSS Modeler Overview

Overview

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 Titanic dataset. 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 survivability of a passenger on the Titanic.

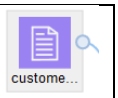
Introduction

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: **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	
Data preparation operations are blue	
Algorithms are green	
The models that are created based on algorithms are orange	
Different types of output (graphs, tables, external files) are black	
The nodes with a star icon are called "supernodes" because they contain several	

nodes. Supernodes are used for visual organization of the flow.	

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.

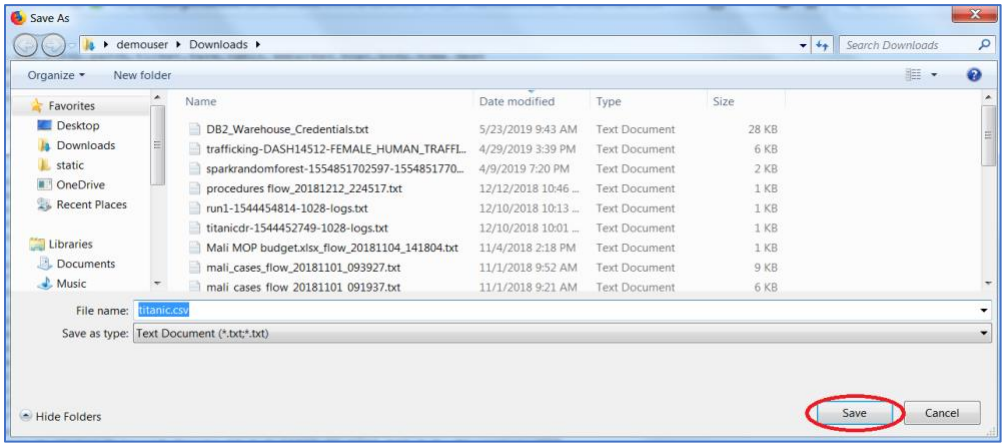
Lab Steps

Step 1: Adding a Data Asset to the Watson Studio Labs project

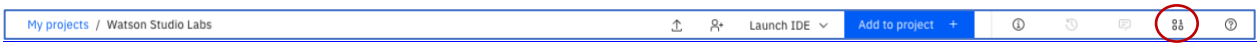
This step can be skipped if the titanic.csv file was already downloaded in a previous lab.

1. Download the Titanic data file from the following location by clicking here.
2. Right-click on the screen and click on Save Page As …

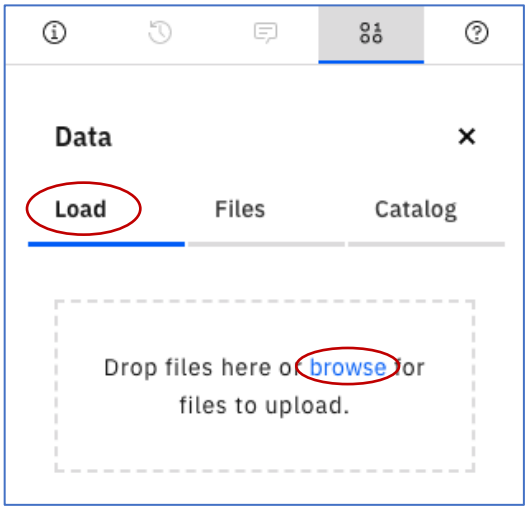
3. Click on **Save** to save the titanic.csv file.



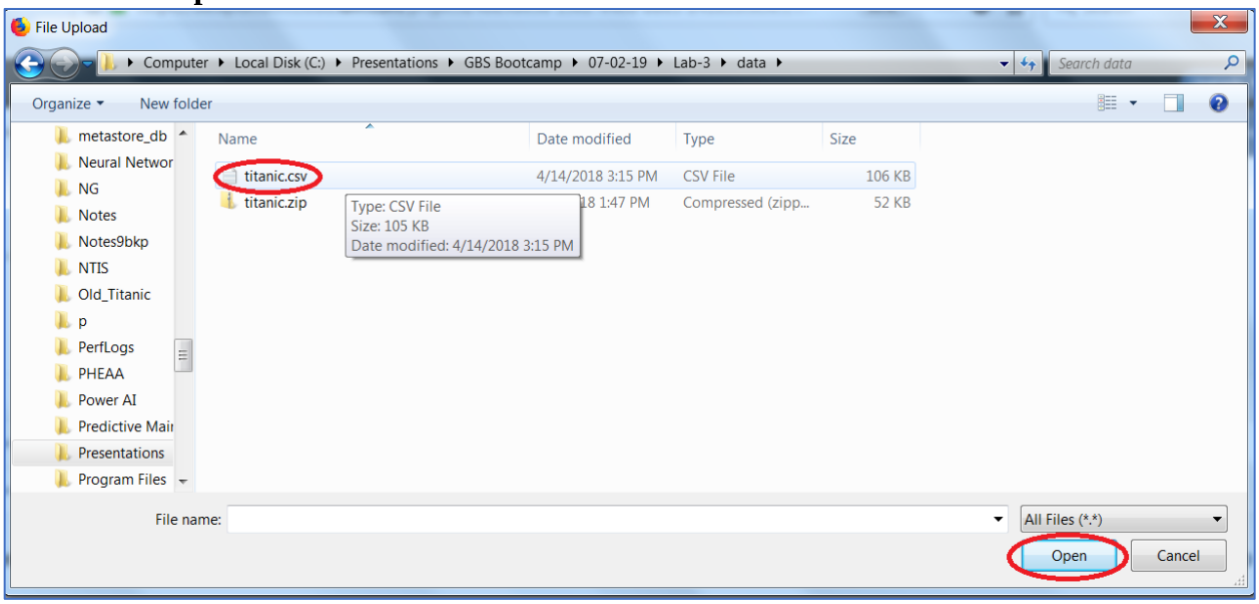
4. Go back to your Watson Studio Labs project. Click on the icon.



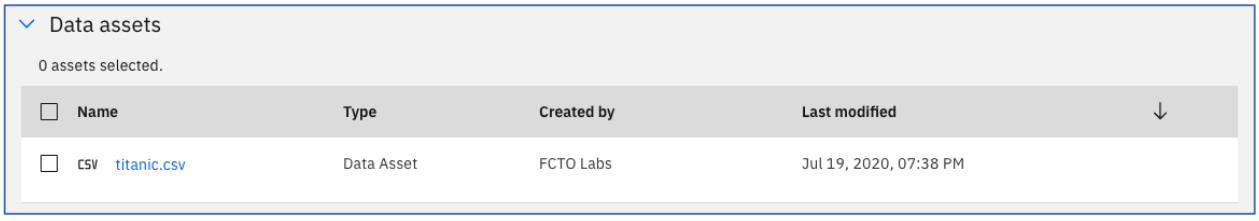
5. Click on the **Load** tab and then click on **browse**. If you don't see the **Load** tab, click on the icon again.



6. Go to the folder where the titanic_csv file is stored. Select the titanic.csv file and then click **Open**.



7. The file is now added as a Data Asset.

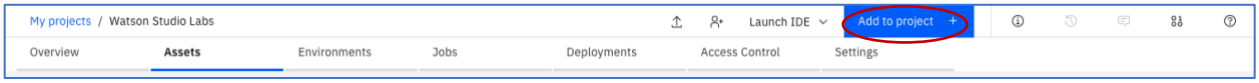


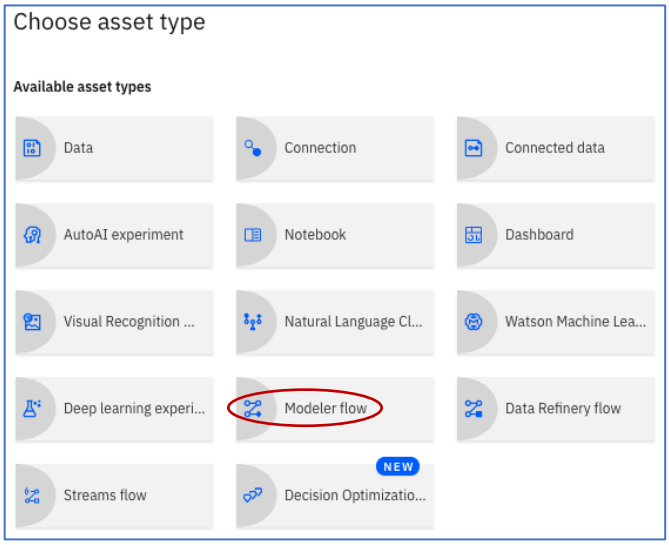
Step 2: Create a Model to predict survival

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

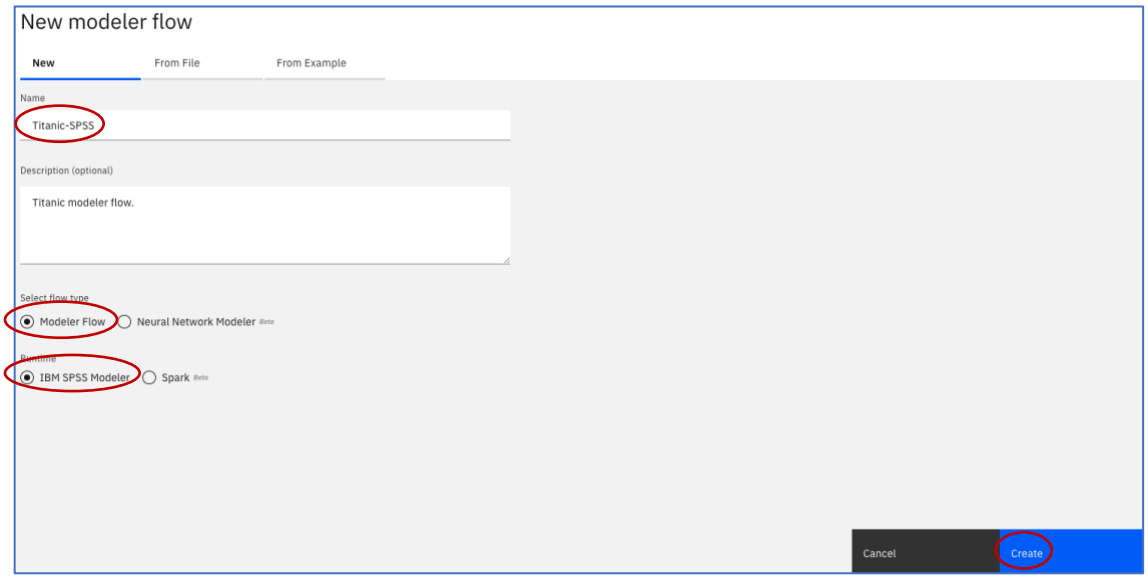
Step 2.1 Create a New Flow and Load the Data

1. In the Watson Studio project, click on **Add to project** and select **Modeler flow** section.

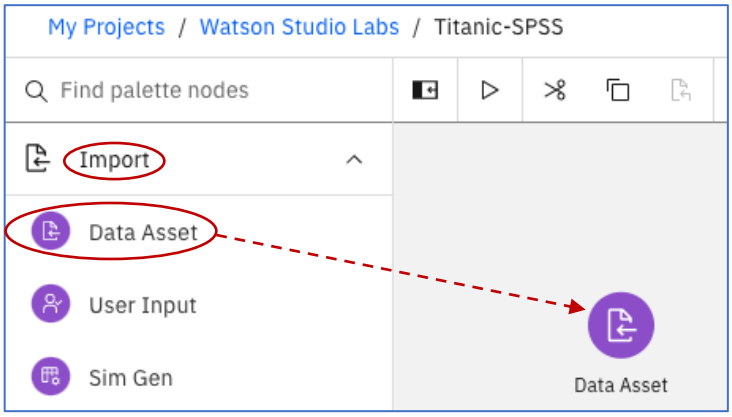




2. Enter a **Name** for the flow, optionally enter a **Description**, click on Modeler Flow for the **flow type** (should be the default), click on IBM SPSS Modeler for the **Runtime** (should be the default), and click on **Create.**

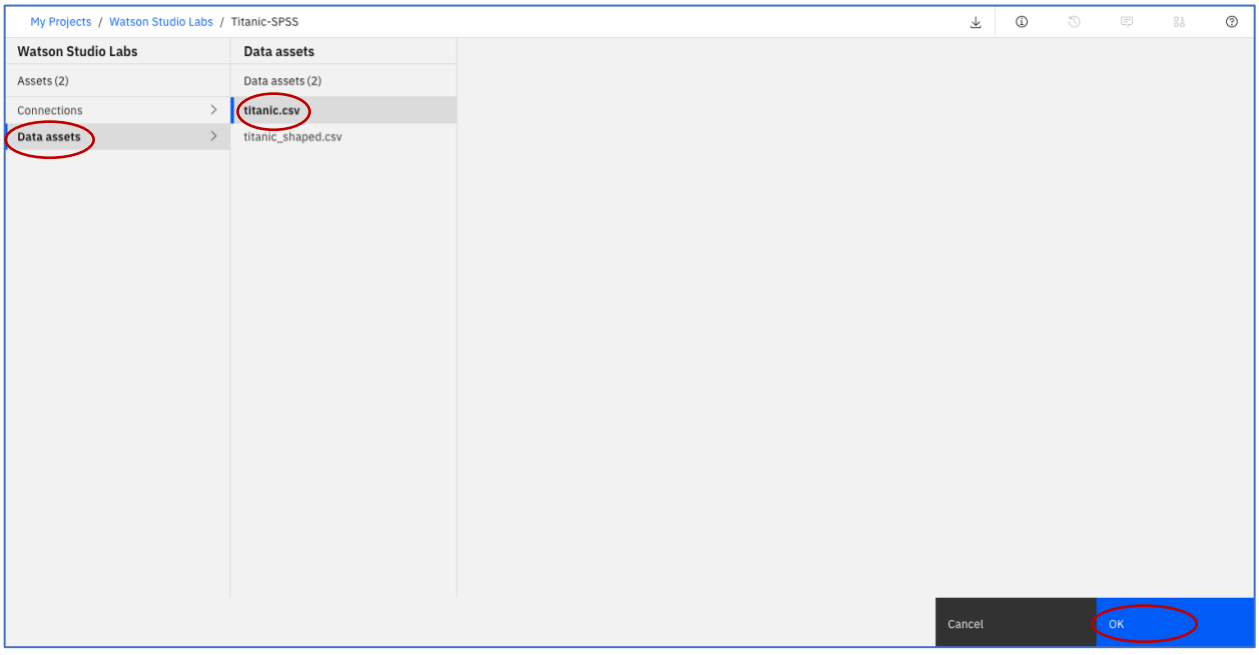


3. This opens the Flow Editor. Note the appearance of the SPSS icons in the system have changed from what is documented here. Click on **Import** and then **Data Asset** and hold the left mouse key on the Data Asset icon and **drag it onto the left side of the canvas**. Release the left mouse key.

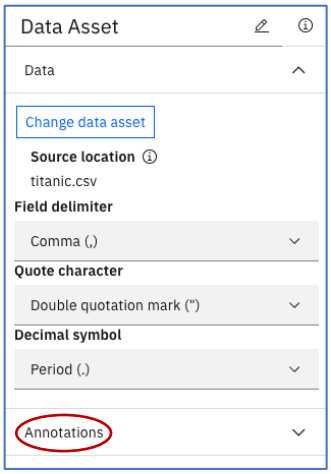


4. Double click on the **Data Asset**. In the window pane on the right-hand-side click on **Change data asset**.

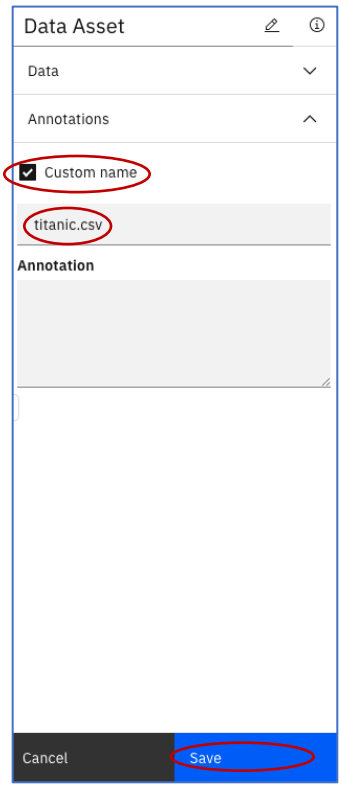
5. Click on **Data assets**, **titanic.csv** and click **OK**.



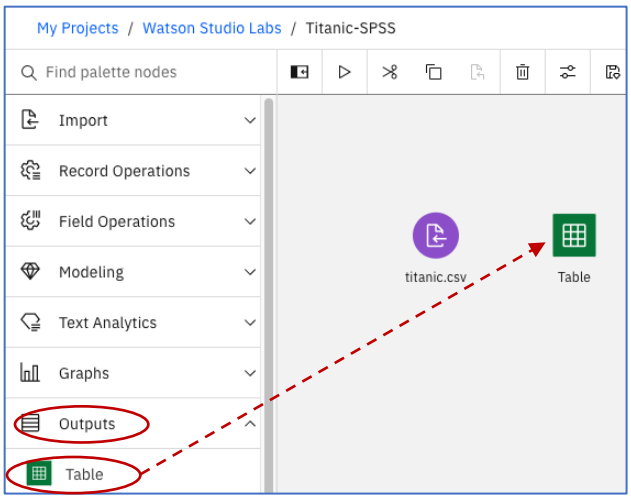
6. Click on **Annotation.**



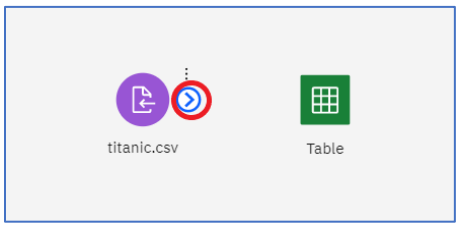
7. Click on **Custom name**, and type **titanic.csv**, and click on **Save**.

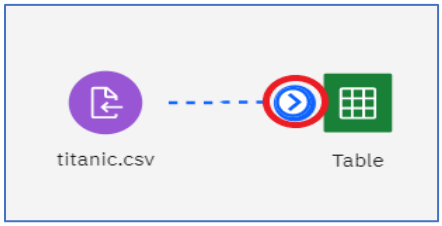


8. Click on the **Outputs** menu item in the Node Palette on the left and then click on the **Table** icon and drag the icon to the right of the titanic.csv icon. The SPSS Table node will display the contents of the csv file. If the Node Palette is not visible, click on the Node Palette icon

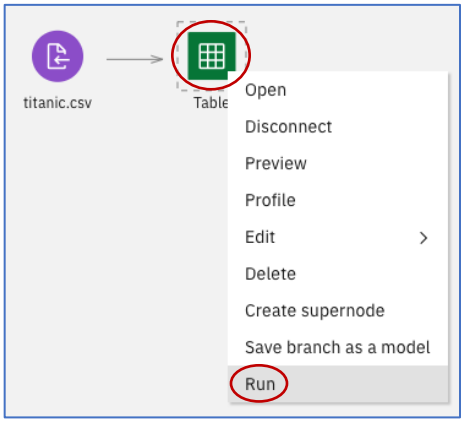


9. Connect the right side of the titanic.csv icon to the left side of the Table icon. This is accomplished by clicking on the arrow  at the right side of the titanic.csv icon holding the left mouse key and dragging the arrow until it is on top of the circle that appears on the left side of the Table icon, and then releasing the left mouse key. This is the new way that connections are made in the revised SPSS Modeler interface.

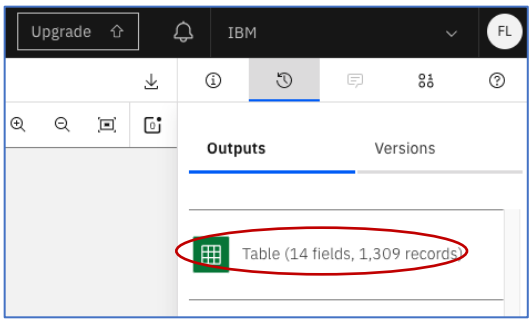




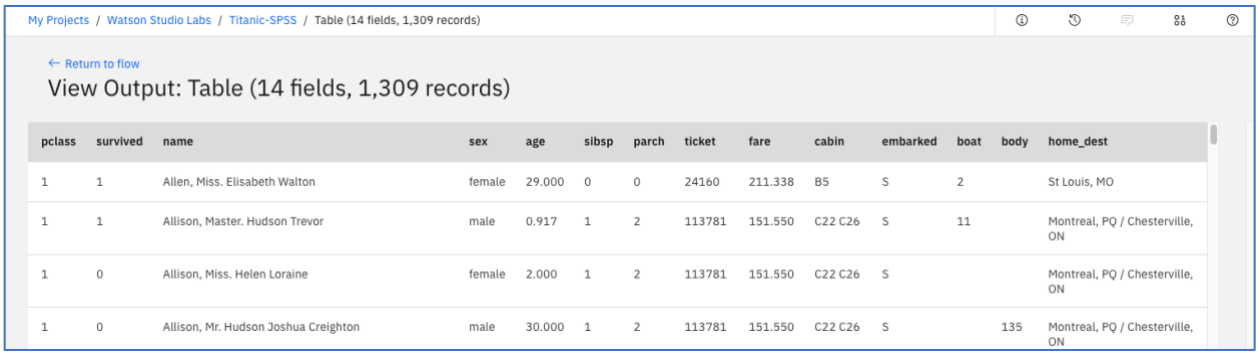
10. Right click on the **Table** icon and select **Run**.



11. 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  icon.



12. Double click on the Table selection and the contents of the titanic.csv will be displayed. Each row contains information on a passenger on the Titanic. We will use this data to make predictions on survivability.



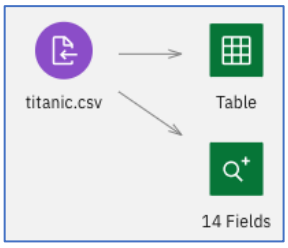
pclass	survived	name	sex	age	sibsp	parch	ticket	fare	cabin	embarked	boat	body	home_dest
1	1	Allen, Miss. Elisabeth Walton	female	29.000	0	0	24160	211.338	B5	S	2		St Louis, MO
1	1	Allison, Master. Hudson Trevor	male	0.917	1	2	113781	151.550	C22 C26	S	11		Montreal, PQ / Chesterville, ON
1	0	Allison, Miss. Helen Loraine	female	2.000	1	2	113781	151.550	C22 C26	S			Montreal, PQ / Chesterville, ON
1	0	Allison, Mr. Hudson Joshua Creighton	male	30.000	1	2	113781	151.550	C22 C26	S		135	Montreal, PQ / Chesterville, ON

13. Return to the SPSS canvas by clicking on Titanic-SPSS (or what you named the flow) in the breadcrumb area.

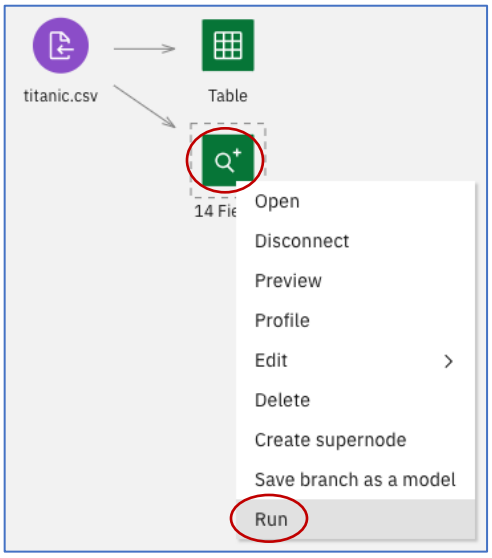
Step 2.2 Explore the Data using the Data Audit Node

Perusing through the data in the table, we can see that there are missing values. The SPSS Modeler has a Data Audit node that provides profiling information on the input data that is useful for cleansing the data. It provides a comprehensive first look at the data, including summary statistics, as well as information about outliers, missing values, and extremes.

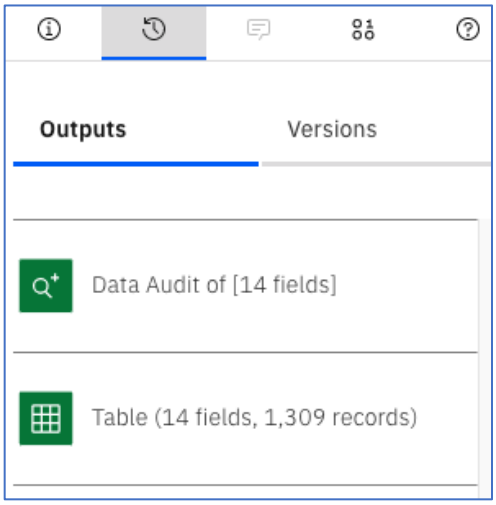
1. Add a **Data Audit** node to the flow by clicking on the **Outputs** menu item in the Node Palette, and then dragging the **Data Audit** node to underneath the Table node. If the Node Palette is not visible, click on the Node Palette icon . Connect the titanic.csv node to the Data Audit node. The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



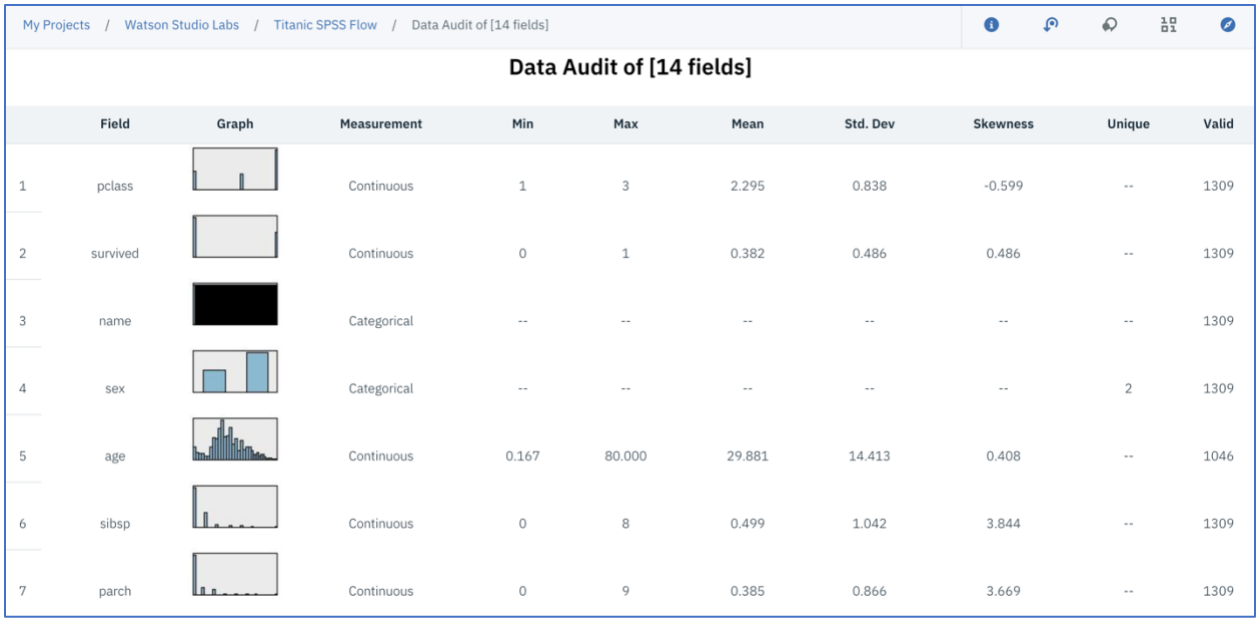
2. Right click on the **Data Audit** node and click **Run**.



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  icon.



4. Double click on the **Data Audit of [14 fields]** to view the Data Audit output. We can see that several fields have many missing values (cabin, boat,body,home_dest). These fields will be removed using a **Filter** node below. Other fields have only a few missing values (fare, embarked, age). The rows containing the missing values will be removed using a **Select** node below.



Data Audit of [14 fields]

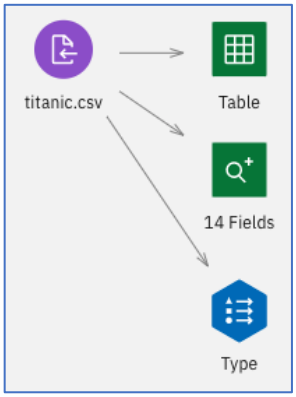
	Field	Graph	Measurement	Min	Max	Mean	Std. Dev	Skewness	Unique	Valid
1	pclass		Continuous	1	3	2.295	0.838	-0.599	--	1309
2	survived		Continuous	0	1	0.382	0.486	0.486	--	1309
3	name		Categorical	--	--	--	--	--	--	1309
4	sex		Categorical	--	--	--	--	--	2	1309
5	age		Continuous	0.167	80.000	29.881	14.413	0.408	--	1046
6	sibsp		Continuous	0	8	0.499	1.042	3.844	--	1309
7	parch		Continuous	0	9	0.385	0.866	3.669	--	1309

5. Return to the SPSS canvas by clicking on the Titanic SPSS (or what you named the flow) in the breadcrumb area.

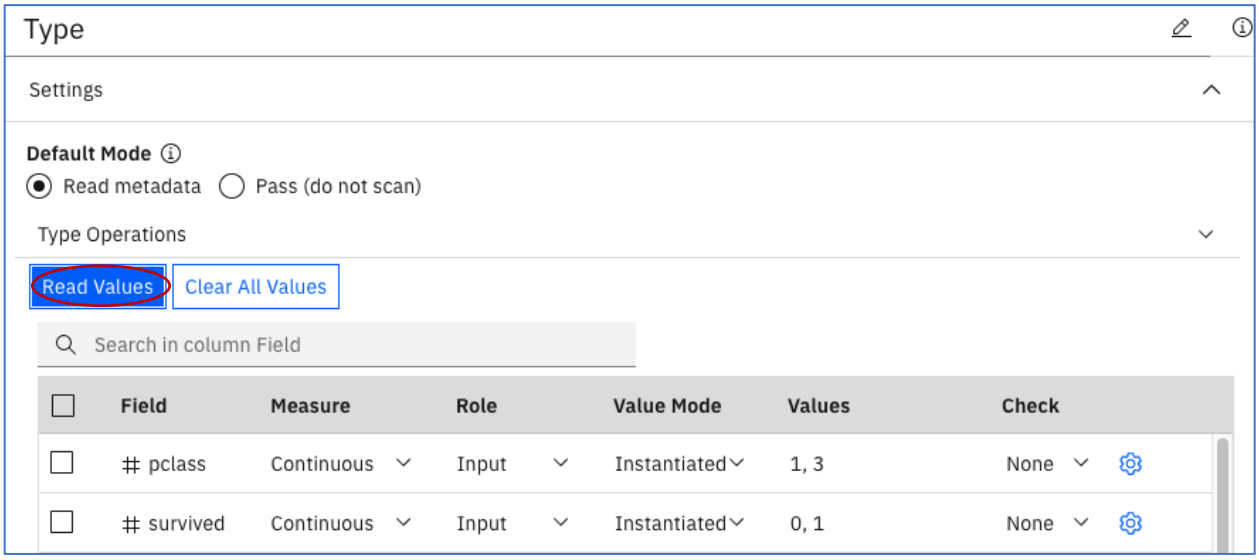
Step 2.3 Explore the Data using Graph Nodes.

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 Titanic Data Set. 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 "pclass" and "survived fields" that was derived as "Continuous" (by scanning the data values) to "Ordinal" and "Flag" respectively.

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 underneath the **Data Audit** node. If the Node Palette is not visible, click on the Node Palette icon . Connect the titanic.csv node to the **Type** node. The canvas should appear as below.

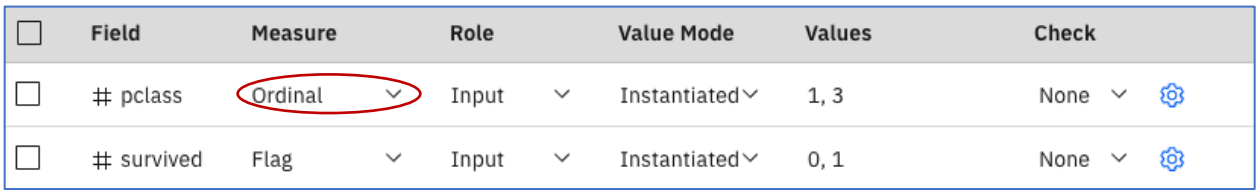


2. Double click on the **Type** node. This will open a **Type** menu pallet on the right side of the screen.
3. Click on **Read Values**.

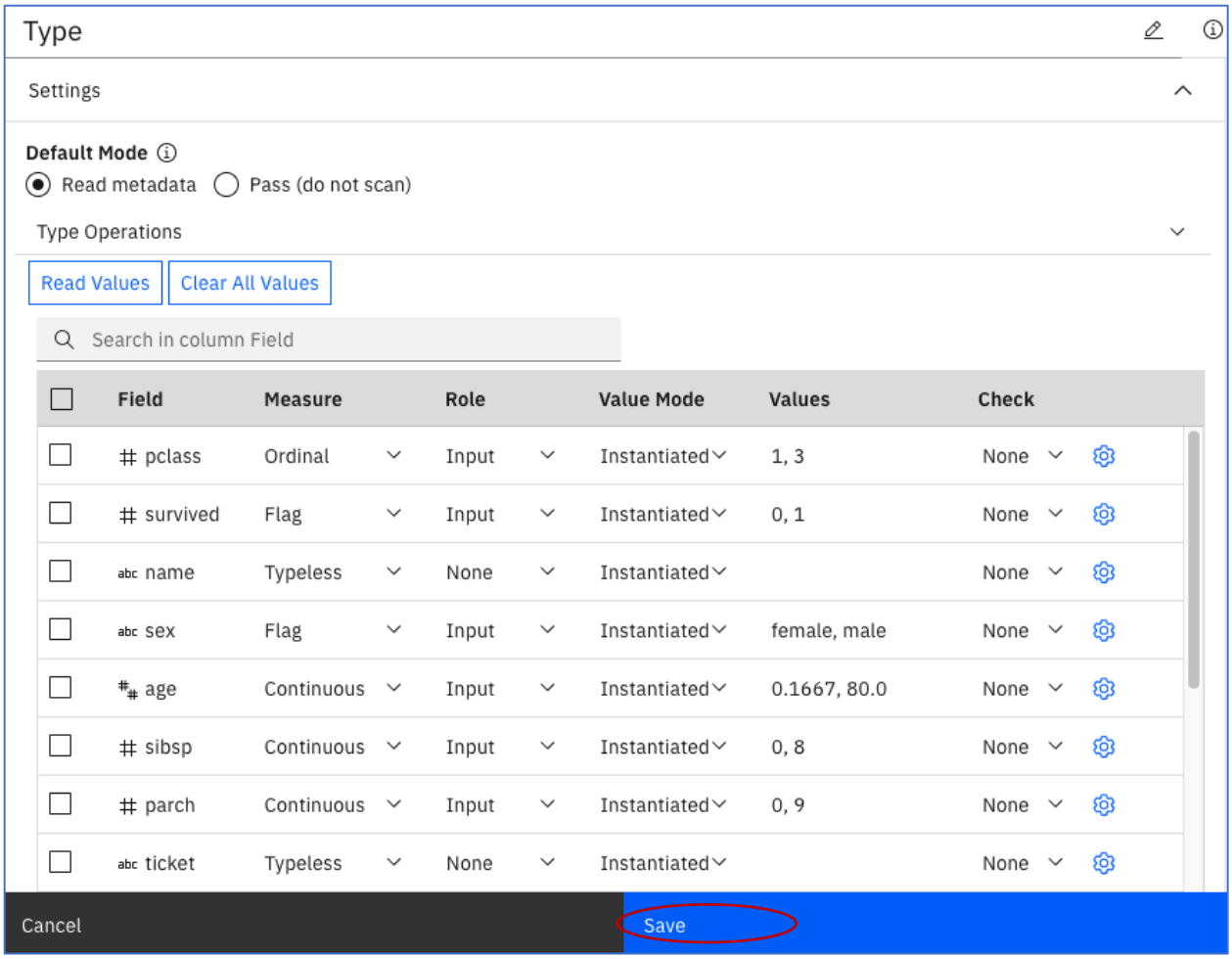


4. Select the dropdown in the Measure column next to **Survived**. Change the Measure from Continuous to **Flag**.

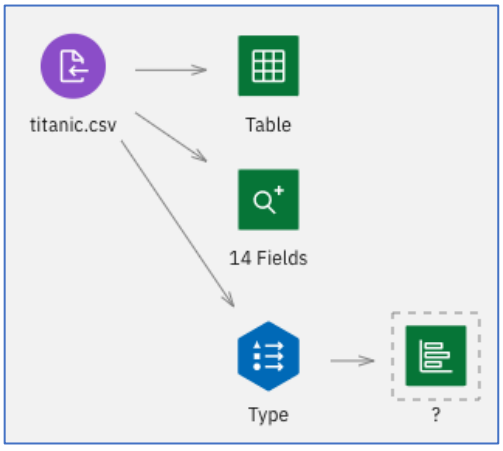
5. Using the same process, change the Measure of **pclass** to **ordinal**.



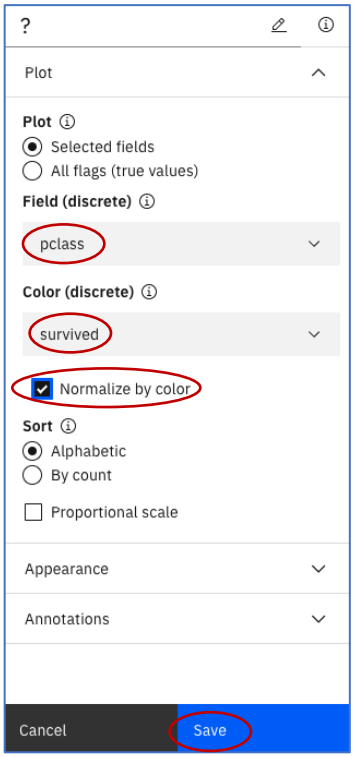
6. Click **Save**.



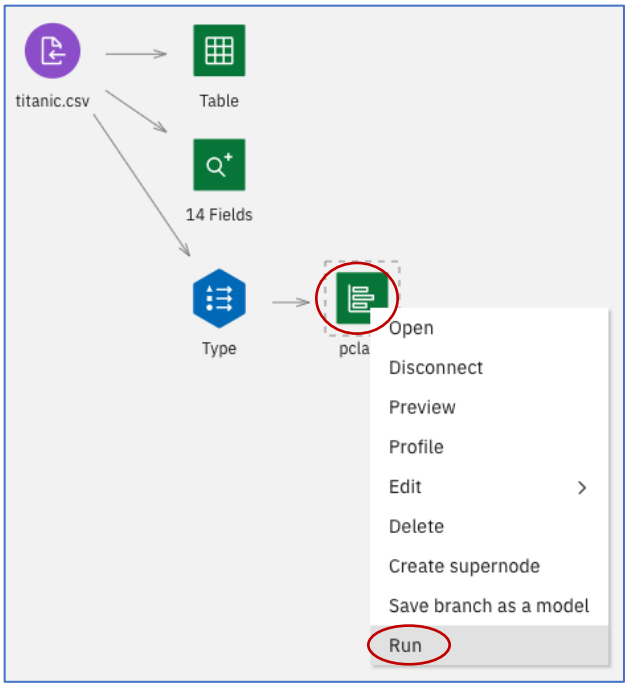
7. Add a **Distribution** node to the flow by clicking on the **Graph** menu item and then dragging the **Distribution** node to the canvas to the right of the **Type** node. If the Node Palette is not visible, click on the Node Palette icon . Connect the **Type** node to the **Distribution** node. The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



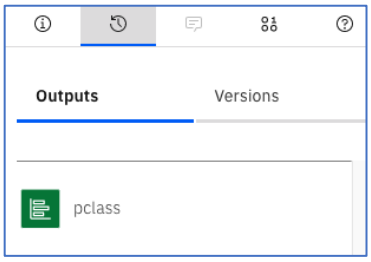
8. Double click on the Distribution Node. Click on the **Plot** dropdown. In the **Field (discrete)** dropdown, select **pclass**. In the Color (discrete) dropdown, select **survived**. Click on the **normalize by color** checkbox, and then click **Save**.



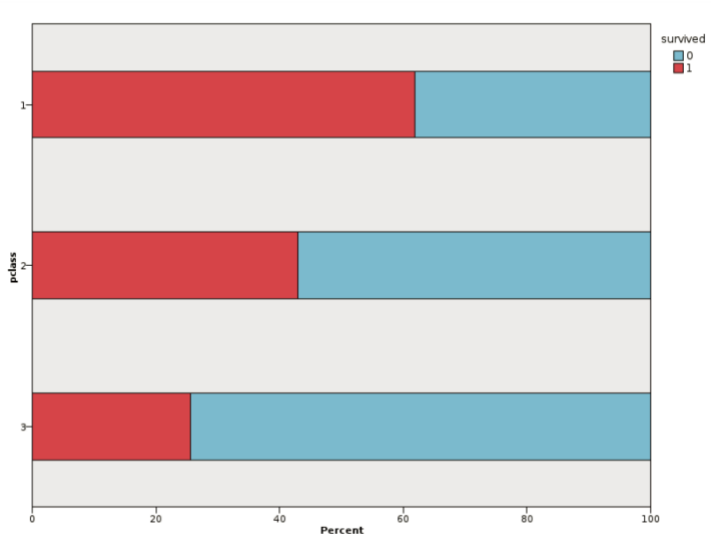
9. Right click on the Distribution node and select **Run**.



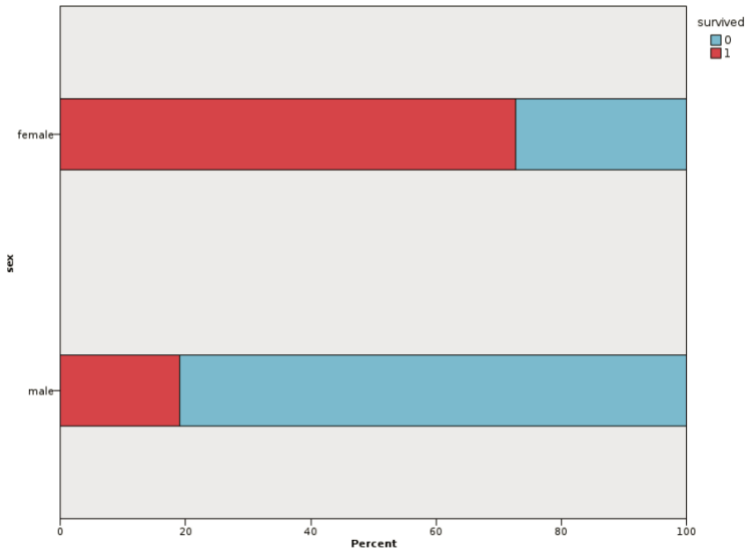
10. The Distribution of pclass output will appear under the **Outputs** tab.



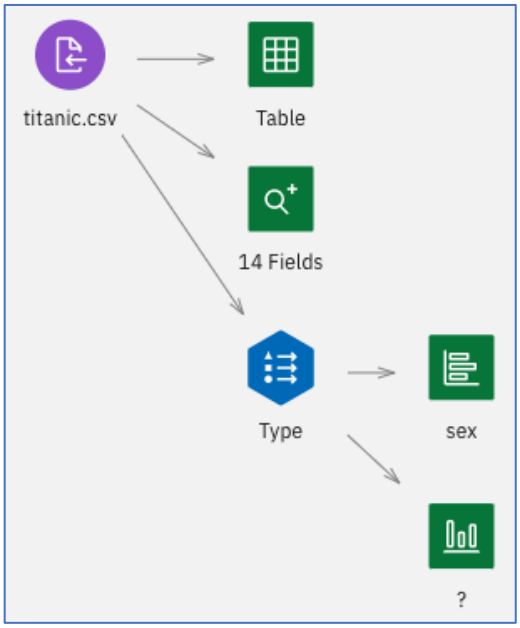
11. Double click on the **Distribution of pclass** to view the graph. We can see from the graph that the likelihood of surviving is correlated to the passenger class. The first-class passengers have the highest rate of survivability. **Note if you see a graph with green bars, instead of the one below, redo Steps 9-11**



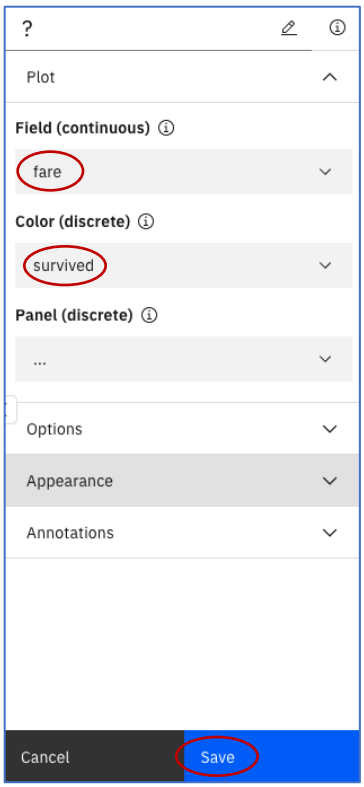
12. Return to the SPSS canvas by clicking on **Titanic SPSS** in the breadcrumb area. You can change the distribution graph to show the survivability by gender by double clicking on the Distribution node and replacing **pclass** with **sex** and clicking Save. Re-run the graph by right clicking on the Distribution node and selecting Run. Double click on the **sex** to display the graph.



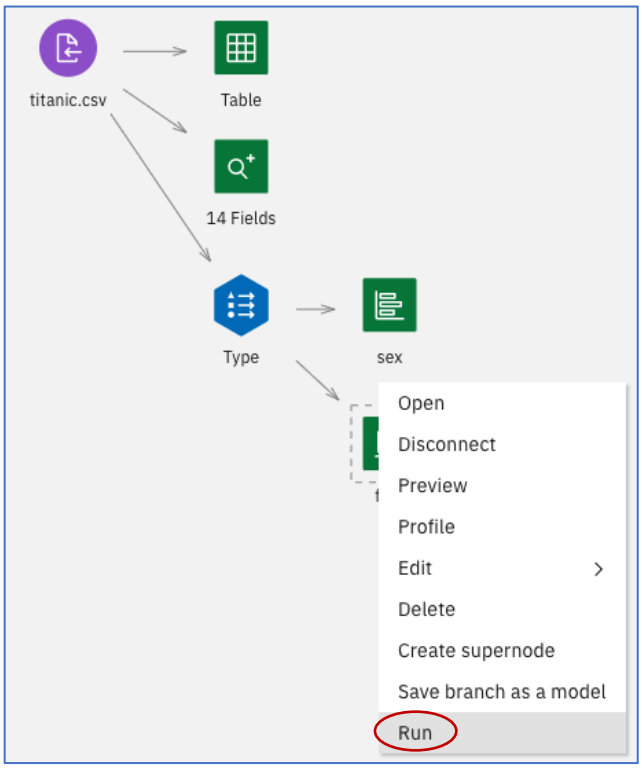
13. Return to the SPSS canvas by clicking on **Titanic SPSS** in the breadcrumb area. Add a **Histogram** node to the flow by clicking on the **Graphs** menu item and then dragging the **Histogram** node to the canvas underneath the **Distribution** node. If the Node Palette is not visible, click on the Node Palette icon . Connect the **Type** node to the **Histogram** node. The canvas should appear as below. The ? indicates that the fields to be plotted have not been identified.



14. Double click on the **Histogram** node. Click on the **Plot** dropdown. Select **fare** from the Field (continuous) dropdown. Select **survived** from the Color (discrete) dropdown. Click on **Save**.

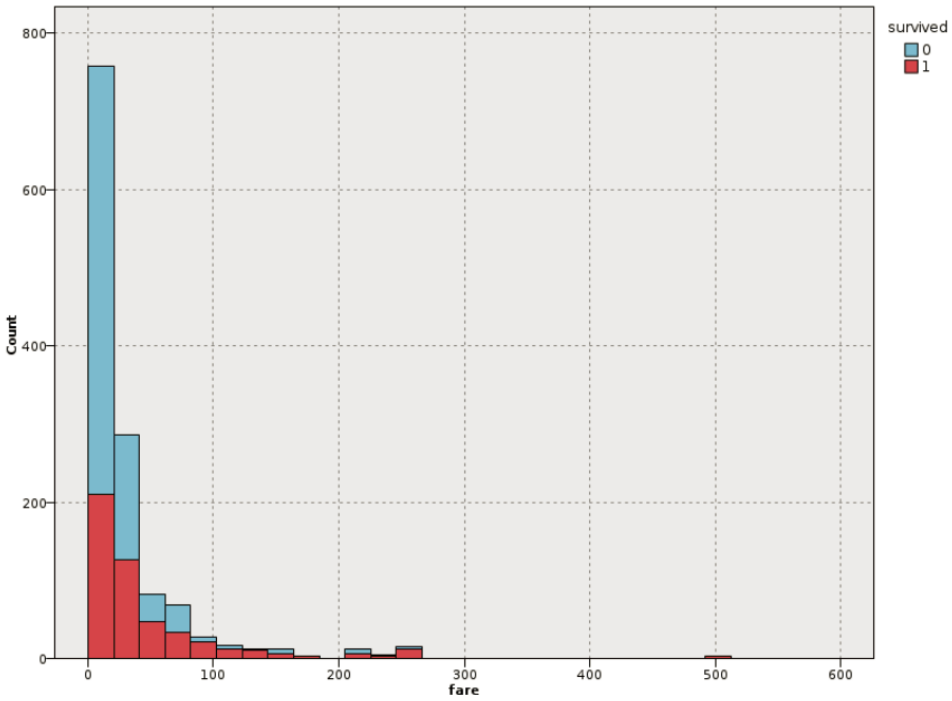


15. Right click on the **Histogram** node and select **Run**.

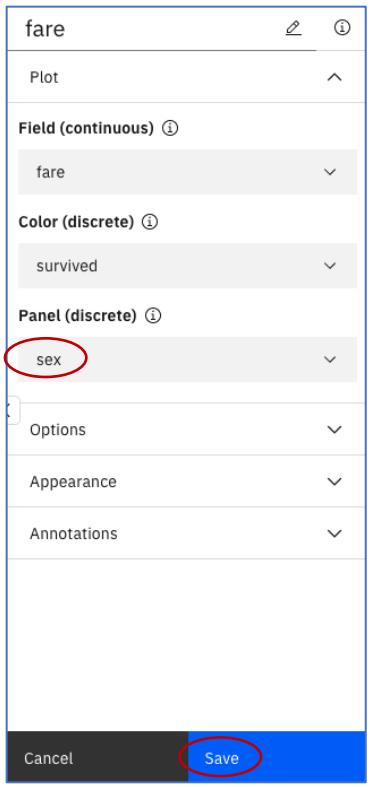


16. Double click on the Histogram of fare 

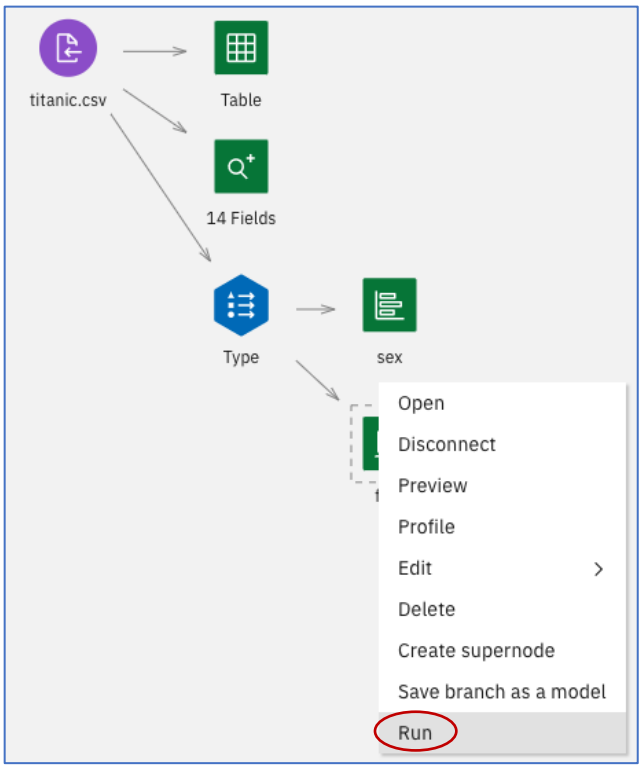
under the Outputs tab at the right of the screen.



17. We can see that the higher fares have a higher percentage of survival. We can also see that the histogram is skewed. Skewness will impact the effectiveness of some machine learning techniques. One way to deal with skewness is to do a logarithmic transformation of the data. We will do this transformation in the preparing the data for modeling section below.
18. You can view the above graph separately for male and female passengers. Return to the SPSS canvas by clicking on **Titanic SPSS** in the breadcrumb area. DoubleClick the Histogram icon. In the **Panel (discrete)** select sex, and the click **Save**.

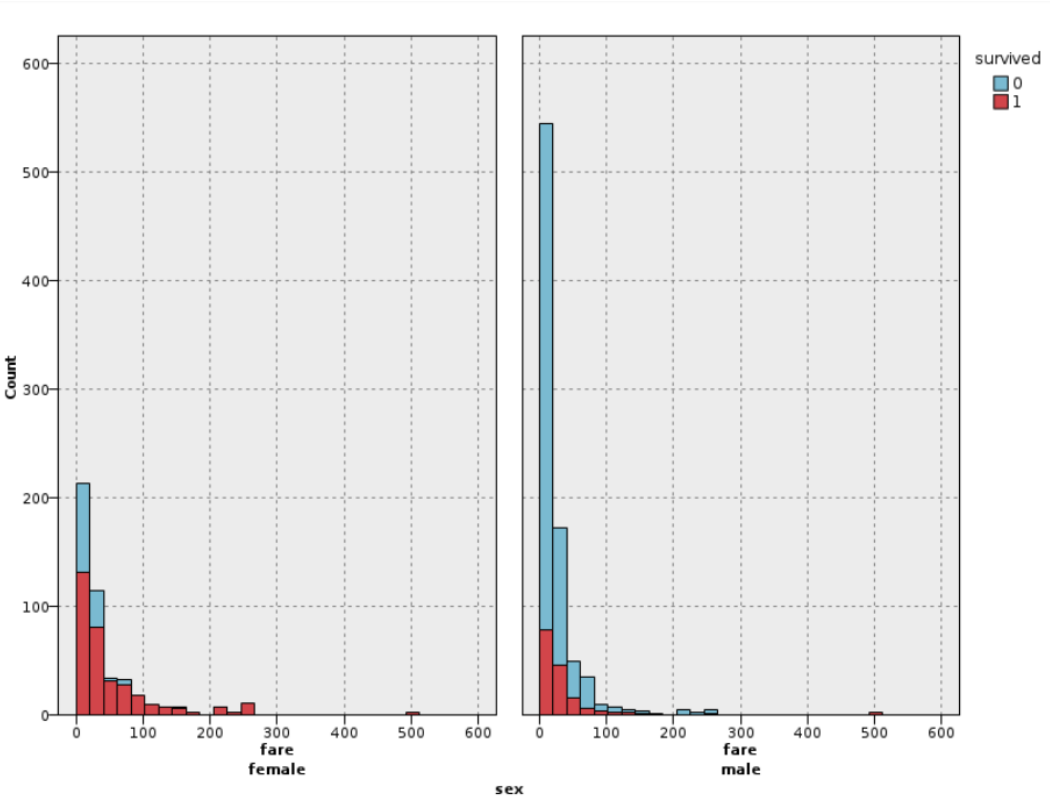


19. Right click on the Histogram and select **Run**.



20. Double click on the Histogram of fare 

under the Outputs tab at the right of the screen.



21. Return to the SPSS canvas by clicking on **Titanic SPSS** in the breadcrumb area.

Step 2.4 Prepare the Data for Modeling

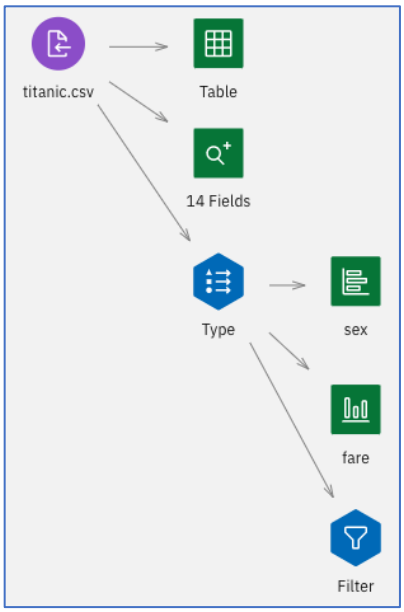
Based on our exploration of the data, there are several transformations that are needed to prepare the data for modeling. This section will introduce, the **Filter** node, the **Select** node, and the **Derive** node that will do the necessary transformations. The **Filter** and **Derive** nodes act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

Filter node – The **Filter** node performs two functions. It specifies fields that can be dropped. It also allows fields to be renamed. We will drop the fields cabin,boat,body, and home_dest.

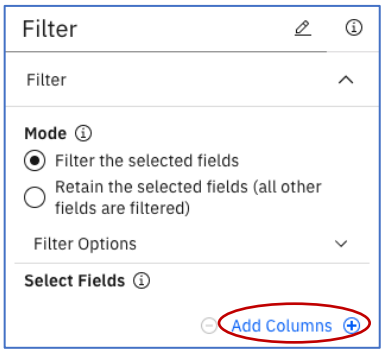
Derive node – The **Derive** node modifies data values or creates new fields from one or more existing fields. We will use the derive node to do a logarithmic transformation of the fare field. We will also use this node to bin the age and fare fields.

Select node – The **Select** node is used to select or discard a subset of records from the data stream based on a specific condition. We will remove the rows where there is missing information in the fare, age, or embarked fields.

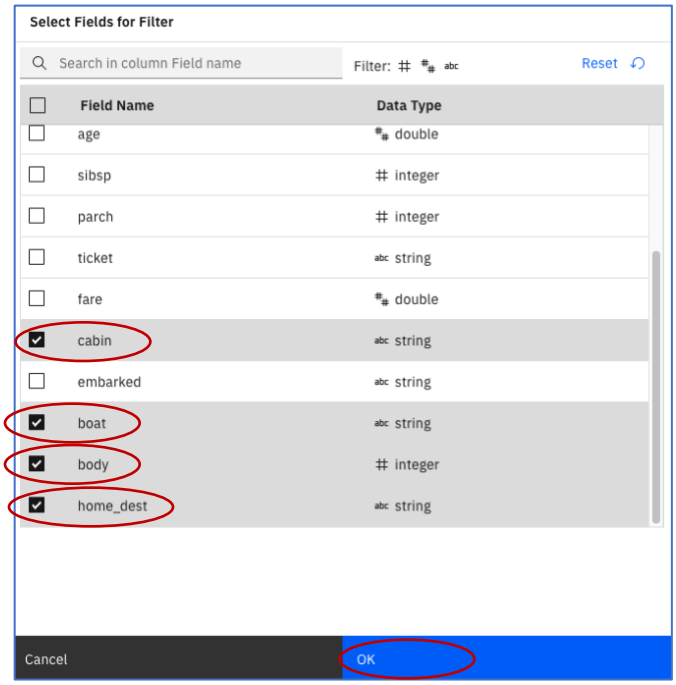
1. Add a **Filter** node to drop fields with many missing values. Add the **Filter** node by clicking on the **Field Operations** menu item in the Node palette and dragging the **Filter** node onto the canvas underneath the fare **Histogram** node. If the Node Palette is not visible, click on the Node Palette icon first. Connect the **Type** node to the **Filter** node. The canvas should appear as below.



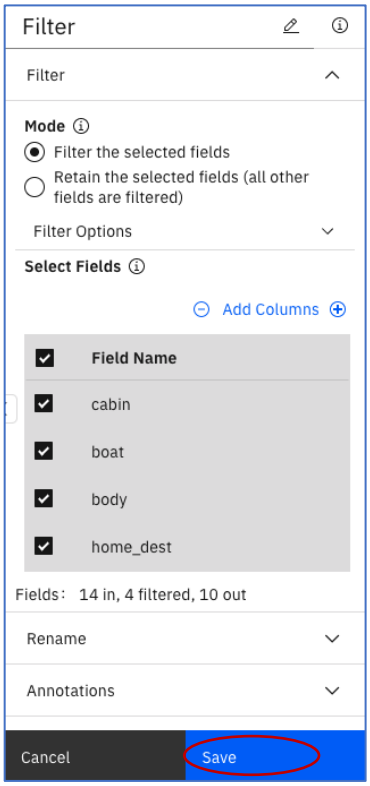
2. Double click on the **Filter** node. Click on the **Filter** dropdown. In the Filter panel, click on **Add Columns**.



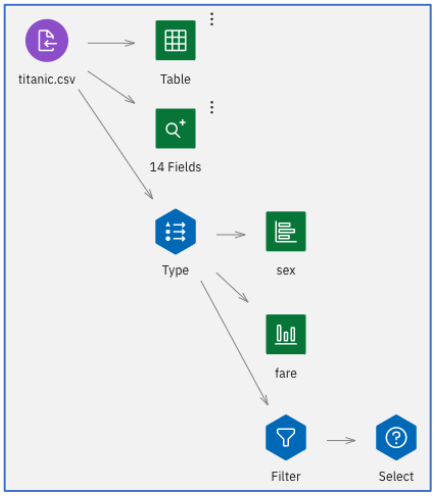
3. Click on the checkboxes adjacent to the **cabin**, **boat**, **body**, and **home_dest** fields, and then click on **OK**. Scroll down if necessary to locate these fields.



4. Click **Save** on the Filter panel.

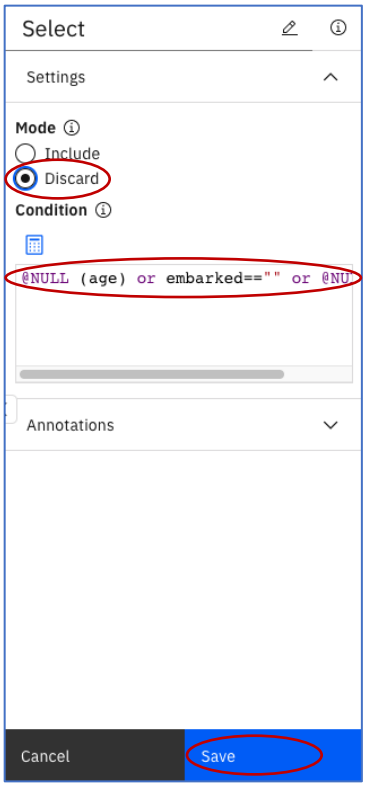


5. Add a **Select** node by clicking on the **Record Operations** menu item in the Node palette, and then dragging the **Select** node to the canvas to the right of the **Filter** node. Connect the **Filter** node to the **Select** node. If the Node Palette is not visible, click on the Node Palette icon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

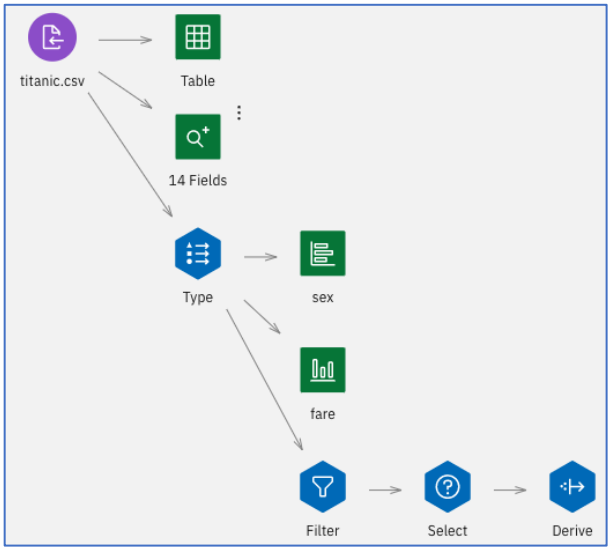


6. Double click on the **Select** node. Click on the **Settings** dropdown. In the **Select** panel, click on the **Discard** radio button, copy and paste (or type) the code shown below in the **Condition text box**, and then click **Save**.

   @NULL (age) or embarked=="" or @NULL(fare)

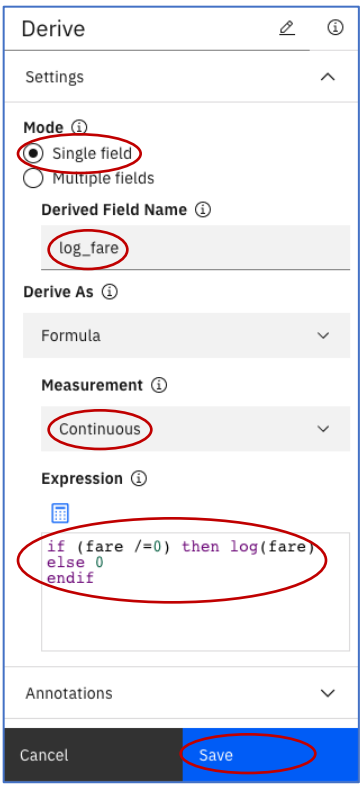


7. Add a **Derive** node to the canvas by clicking on the **Field Operations** menu item in the Node palette, and then dragging the **Derive node** onto the canvas to the right of the **Select** node. If the Node Palette is not visible, click on the Node Palette icon first. Connect the **Select** node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



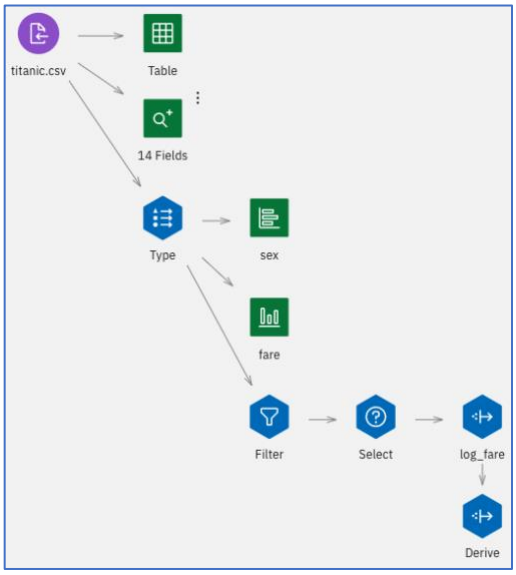
8. Double click on the **Derive** node. Click on the **Settings** Dropdown. Click on the **Single** radio button, enter log_fare for the **Derive** field, select **Continuous** for the measurement, copy and paste (or type) the following code in the **Expression** text box, and click Save.

```
if (fare /=0) then log(fare)

else 0

endif
```



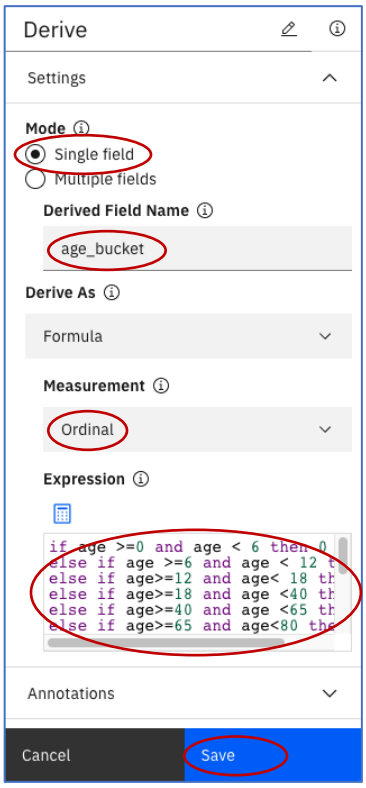
9. Binning of continuous fields is a technique sometimes used in preparing data for modeling. We will bin the age field, and the log_fare field. Add a **Derive** node by clicking on the **Field Operations** menu item in the Node palette and dragging the **Derive** node on the canvas underneath the log_fare **Derive** node.

   If the Node Palette is not visible, click on the Node Palette icon first. Connect the log_fare **Derive** node to the newly added **Derive** node. The canvas should appear as below.

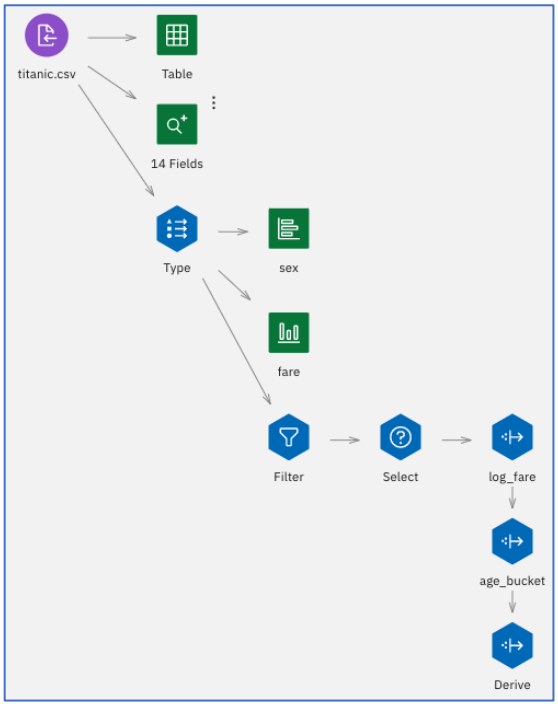


10. Double click on the **Derive** node. Click on the **Settings** dropdown. Click on the **Single** radio button, enter age_bucket for the **Derive** field, select **Ordinal** for the **Measurement,** copy and paste the following code in the **Expression** text box, and then click **Save**.

```
if age >=0 and age < 6 then 0
else if age >=6 and age < 12 then 1
else if age>=12 and age< 18 then 2
else if age>=18 and age <40 then 3
else if age>=40 and age <65 then 4
else if age>=65 and age<80 then 5
else 6
endif
endif
endif
endif
endif
endif
```

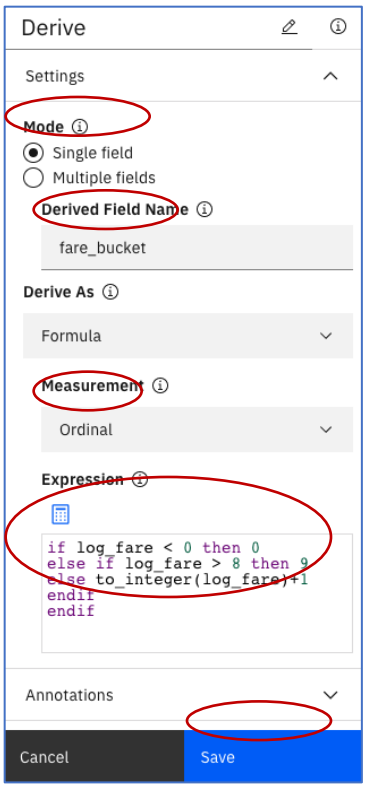


11. Add a **Derive** node by clicking on the Field Operations menu item in the Node palette and dragging the **Derive** node onto the canvas underneath the age_bucket **Derive** node. You can click on the **zoom to fit** icon in the top right to fit the flow to the canvas. Connect the age_bucket **Derive** node to the newly created **Derive** Node. The canvas should appear as below.



12. Double click the **Derive** node. In the **Derive** panel, click on the **Single** radio button, enter fare_bucket in the **Derive** field, click on Ordinal for the **Measurement**, copy and paste (or type) the following code in the **Expression** text box, and click on **Save**.

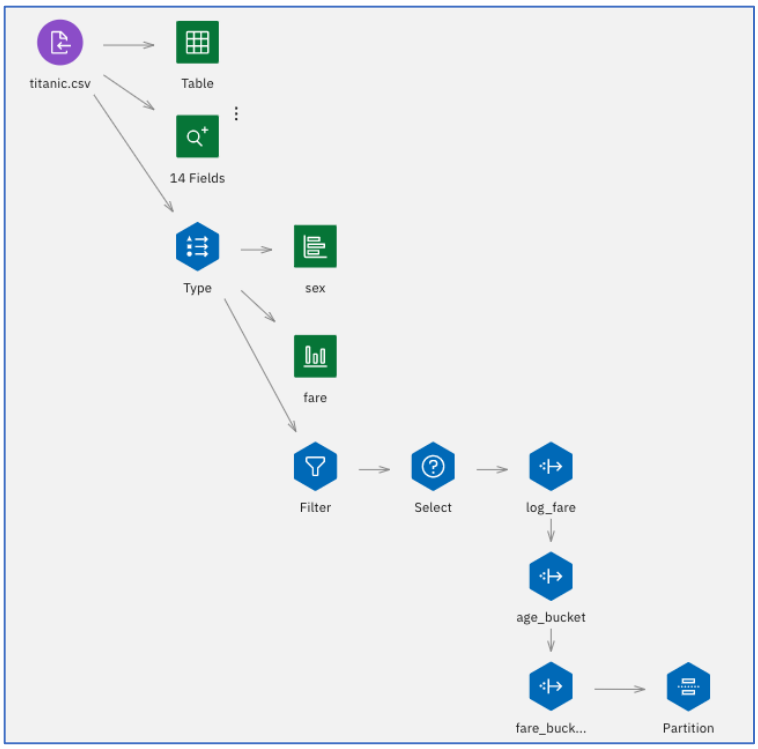
```
if log_fare < 0 then 0
else if log_fare > 8 then 9
else to_integer(log_fare)+1
endif
endif
```



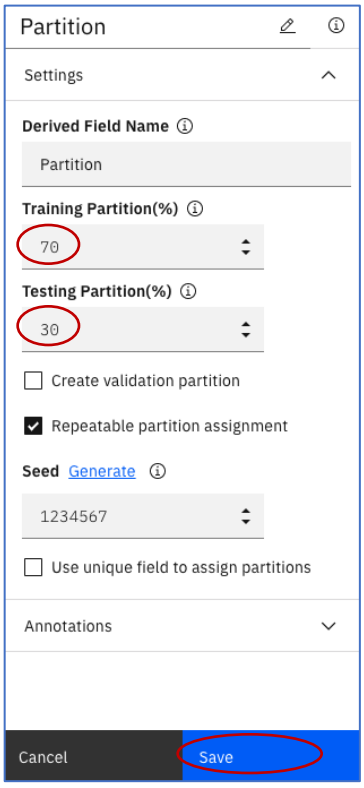
Step 2.5 Modeling and Evaluation

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 type the new data fields that were created. Then we will add a **Logistic** node and use the Training set to train the model. Finally, we will add an **Analysis** node to evaluate the results.

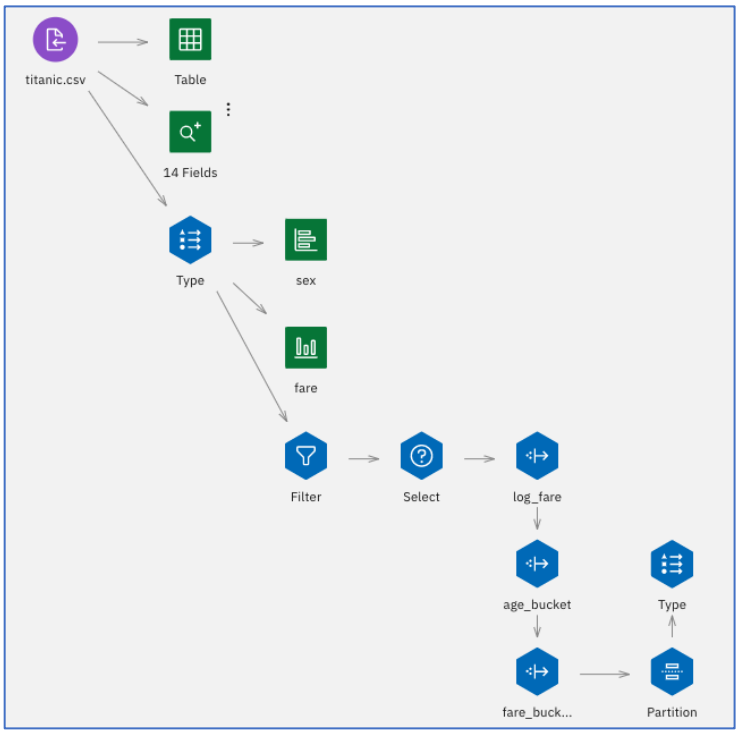
1. Add a **Partition** node by clicking on the Field Operations menu item in the Node palette and dragging the **Partition** node onto the canvas to the right of the fare_bucket **Derive** node. Connect the fare_bucket **Derive** node to the **Partition** node. The canvas should appear as below.



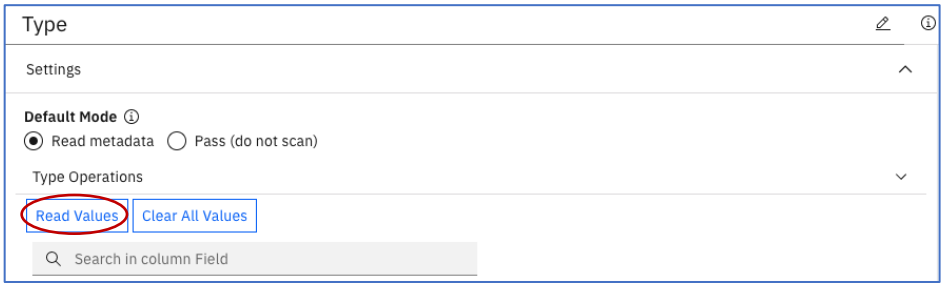
2. Double click on the Partition node. Set the **Training Partition** to 70 and the **Test Partition** to 30. Leave the other defaults and click on **Save**.



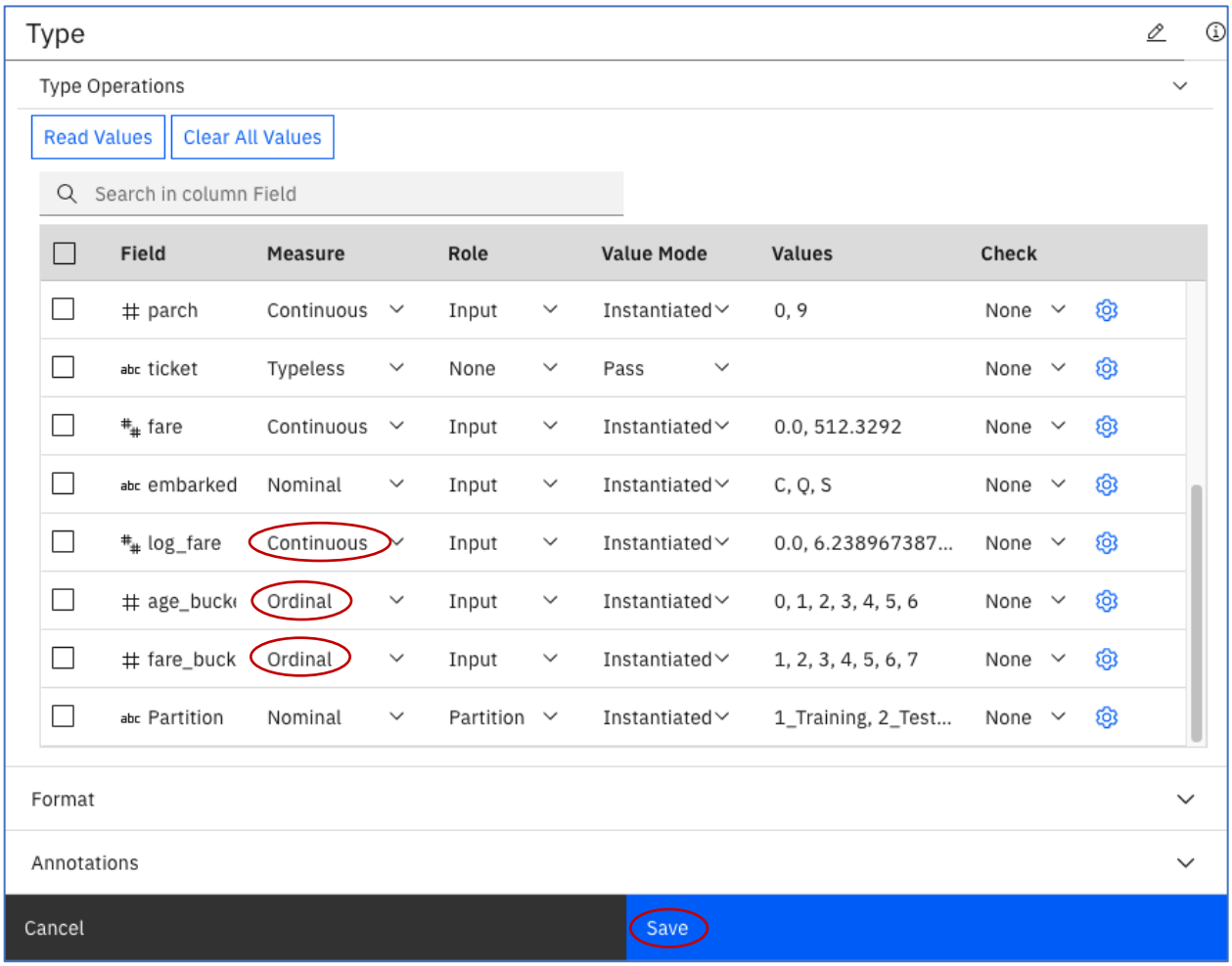
3. Add a **Type** node by clicking on the **Field Operations** in the Node palette and dragging the **Type** node onto the canvas above the **Partition** node. Connect the **Partition** node to the **Type** node. The canvas should appear as below.



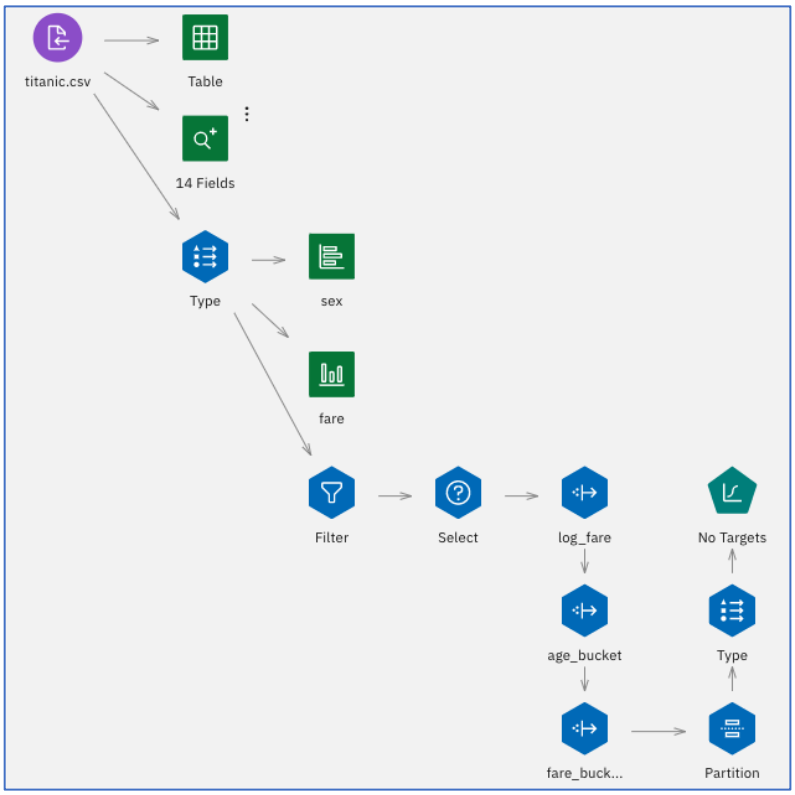
4. Double click on the **Type** node. Click on **Read Values**.



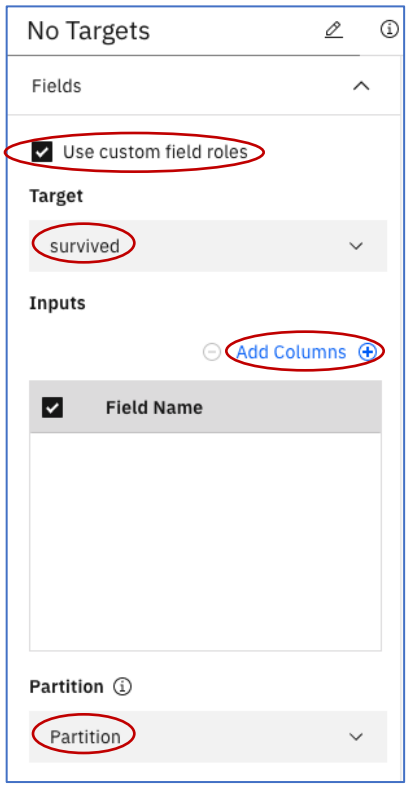
5. For the **log_fare**, select **Continuous** for the Measurement. For the **fare_bucket** field, select **Ordinal** for the Measurement, and for the **age_bucket**, select **Ordinal** for the Measurement, (note these values should already be set correctly) and click **Save**.



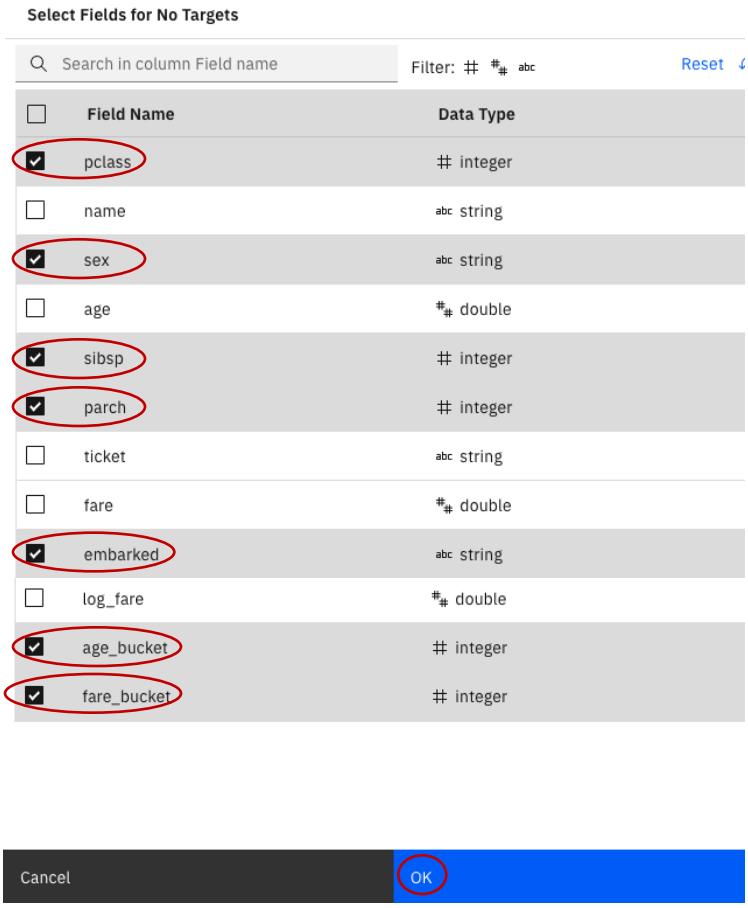
6. Add a **Logistic** node by clicking on the **Modeling** menu item in the Node palette and dragging the **Logistic** node onto the canvas above the **Type** node. Connect the **Type** node to the **Logistic** node. The canvas should appear as below.



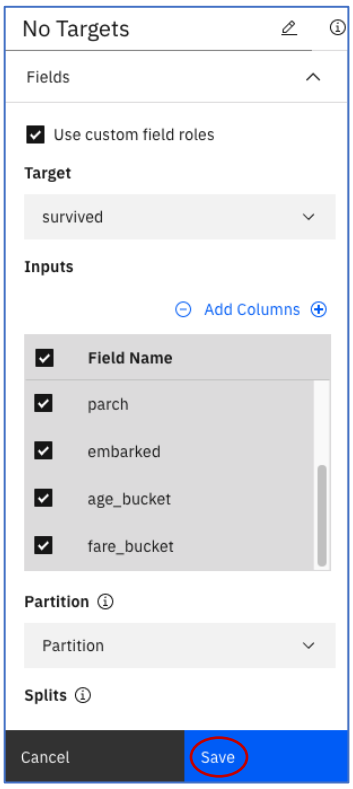
7. Double click on the **Logistic** node. Click on the checkbox next to **Use custom field roles**, select **survived** for the **Target**, select **Partition** for the **Partition**, and click on **Add Columns** to add the input fields.



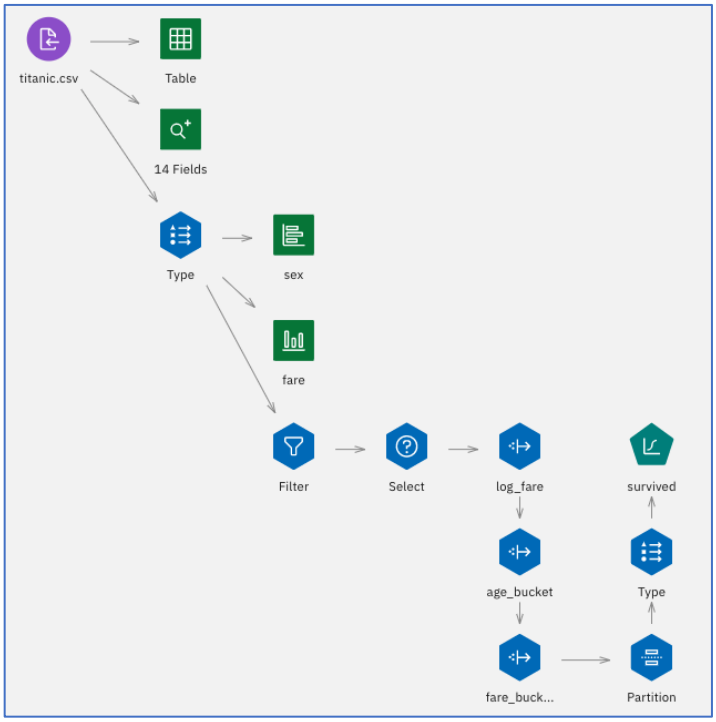
8. Click on the checkboxes next to **pclass**, **sex**, **sibsp**, **parch**, **embarked**, **age_bucket**, **fare_bucket** fields (you have to scroll down), and then click **OK**



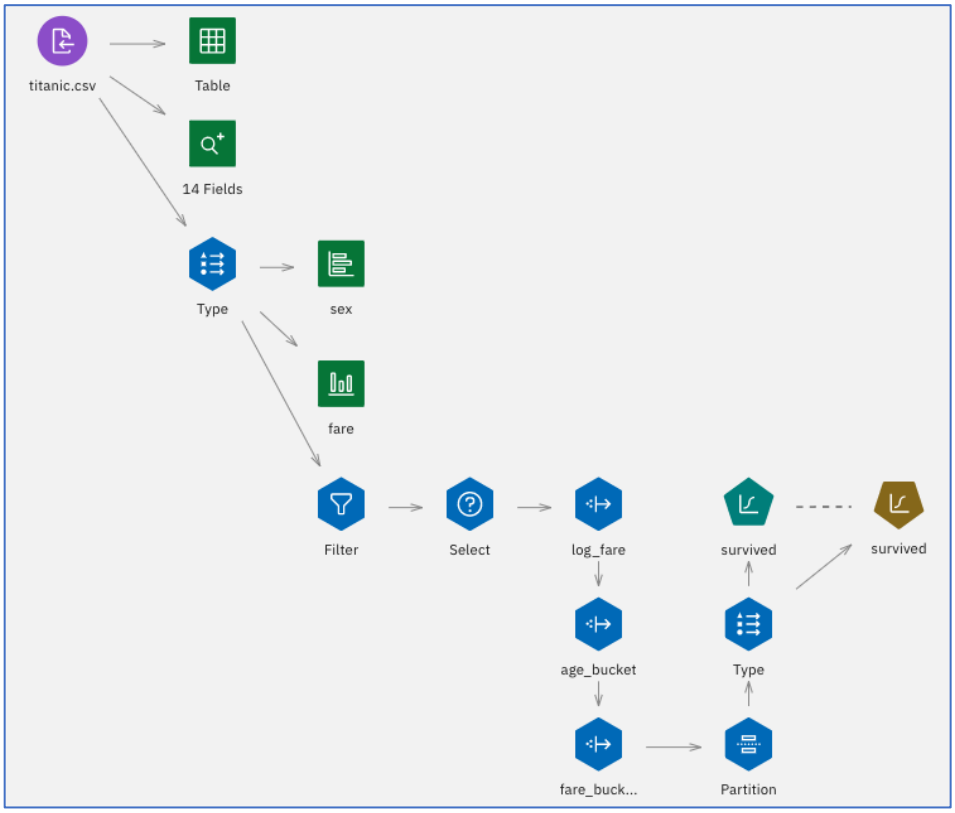
9. Click **Save**.



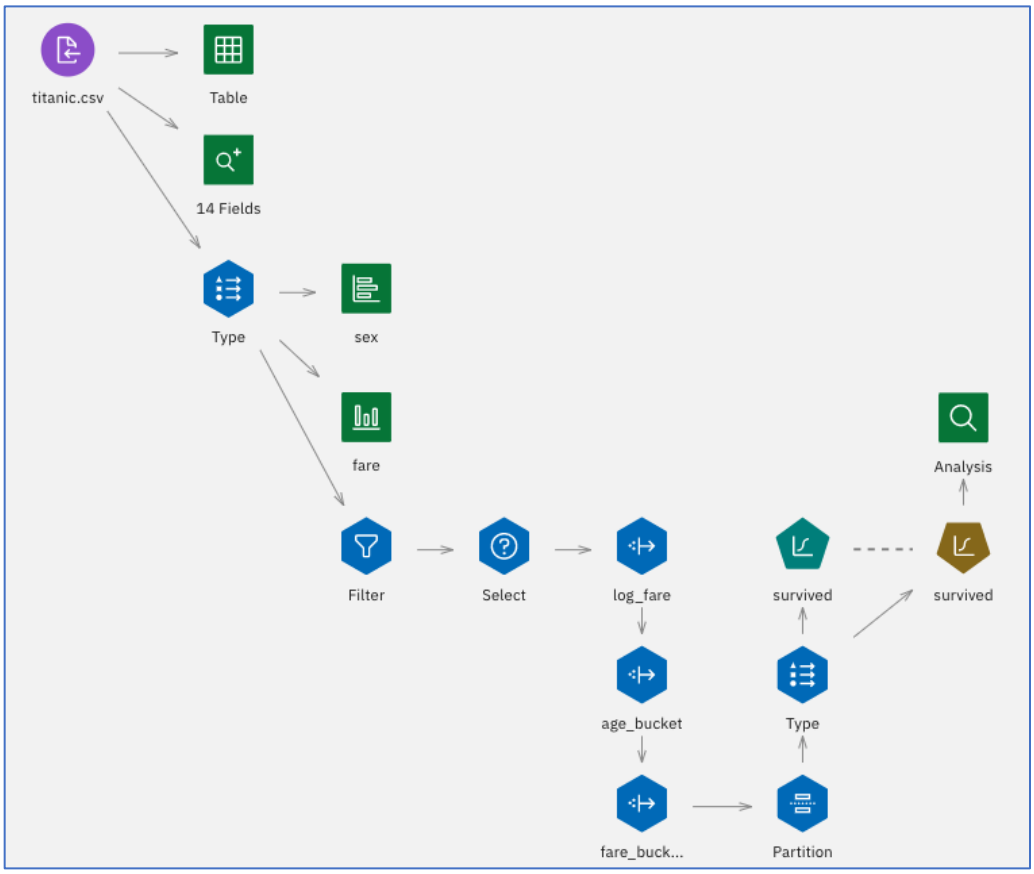
The canvas should appear as below.



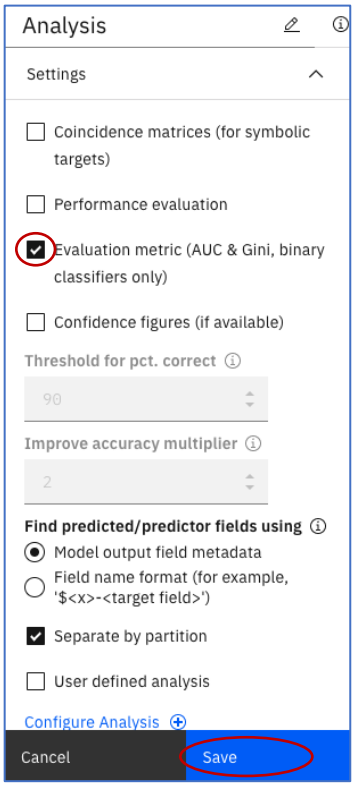
10. Right click on the **Logistic** node and then click **Run**. A **Logistic** "nugget will be created" connected by a dotted line to the **Logistic** node. Note, it may be hidden under another node. Drag the nugget and place it above the **Logistic** node. The canvas should appear as below.



11. Add an **Analysis** node by clicking on the **Outputs** menu item in the Node palette and dragging the **Analysis** node onto the canvas above the nugget icon. Connect the nugget icon to the **Analysis** node. The canvas should appear as below.



12. Double click on the Analysis node. Click on the **Settings** dropdown. Click on the **Evaluation metric** checkbox and click on **Save**.



13. Right click on the Analysis node and select Run. After completion, double click on the Analysis link in the Outputs tab on the right side of the screen. The results should be similar to those shown below.

Results for output field survived

Individual Models

Comparing $L-survived with survived

'Partition'	1_Training		2_Testing	
Correct	579	78.99%	246	79.35%
Wrong	154	21.01%	64	20.65%
Total	733		310	

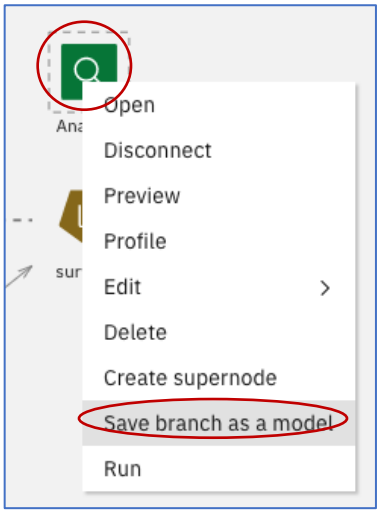
Evaluation Metrics

'Partition'	1_Training		2_Testing	
Model	AUC	Gini	AUC	Gini
$L-survived	0.858	0.716	0.855	0.709

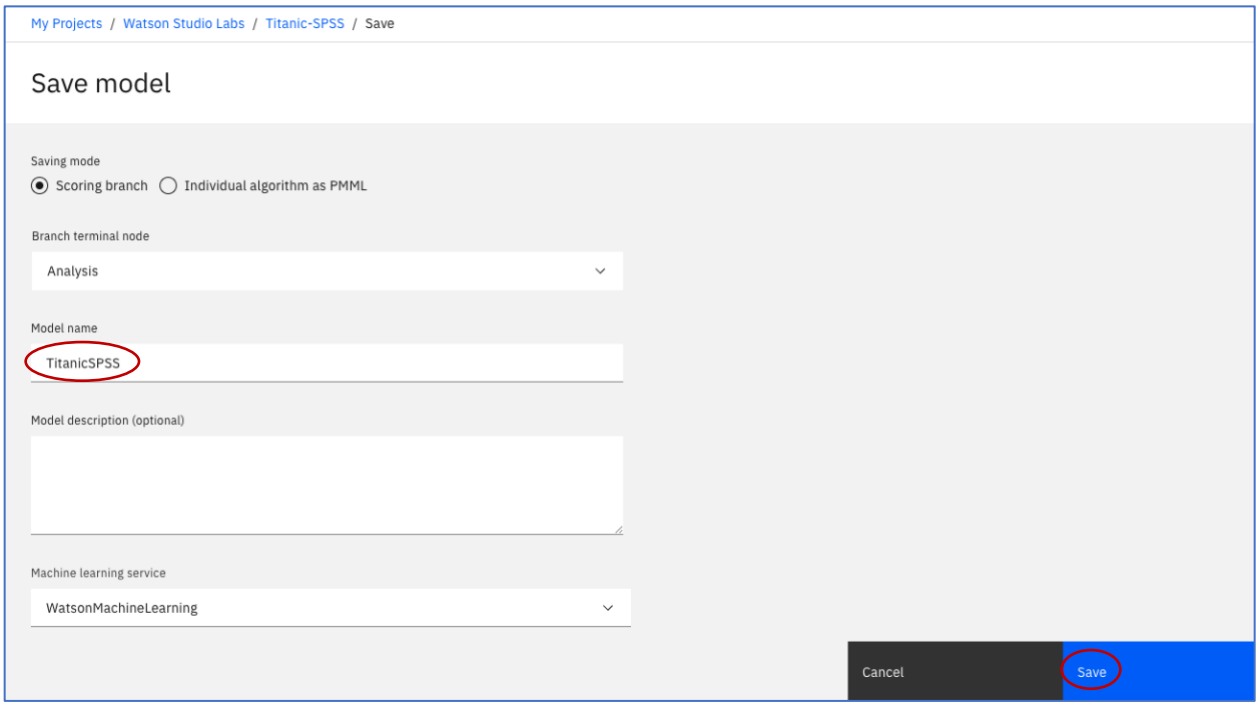
Step 2.6 Saving a Model

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.

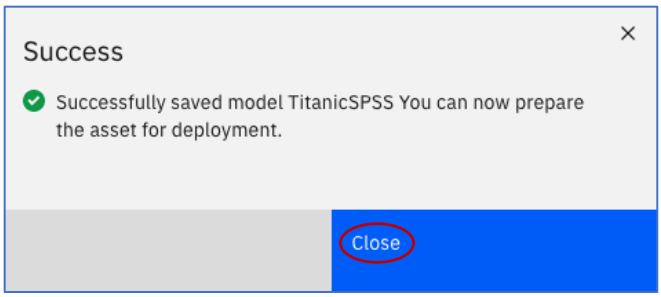
1. Right click on the Analysis node and then click on **Save branch as a model**.



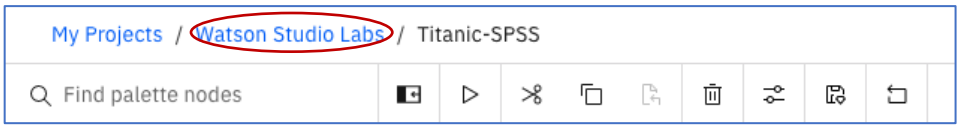
2. Type in "**TitanicSPSS**" as the Model Name and click **Save**.



3. Click **Close**.



4. Navigate to your project "assets" page. In this example, click on **Watson Studio Labs**.



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.