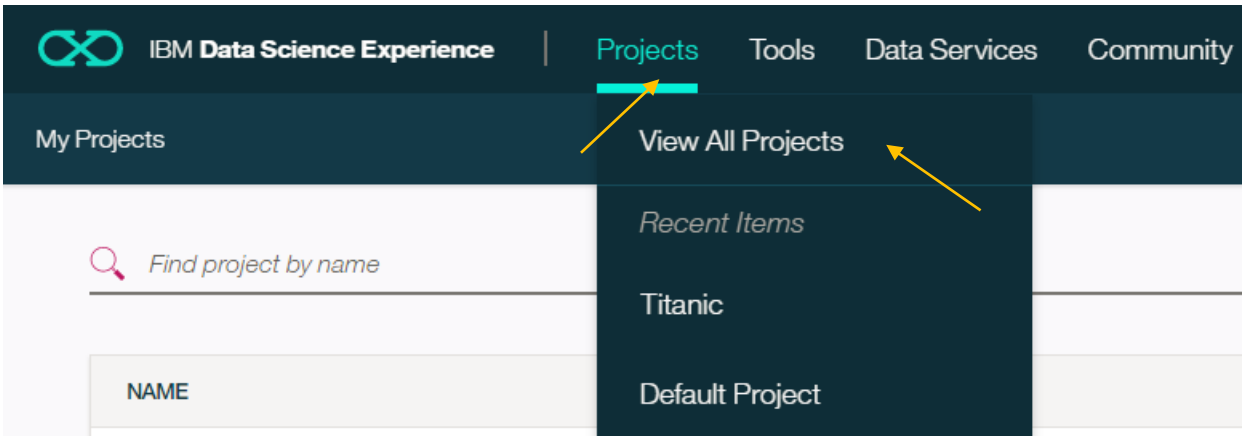
Data Science Experience SPSS Modeler Overview

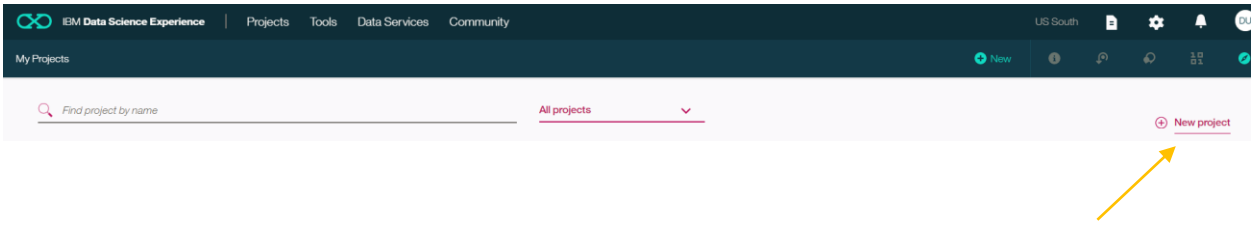
This lab will introduce the SPSS Modeler capability using the Titanic dataset. The lab will guide the development of an SPSS Modeler stream that will prepare the input data for modeling in order to run a machine learning algorithm predicting survivability of a passenger on the Titanic.

Step 1: Create a new Project

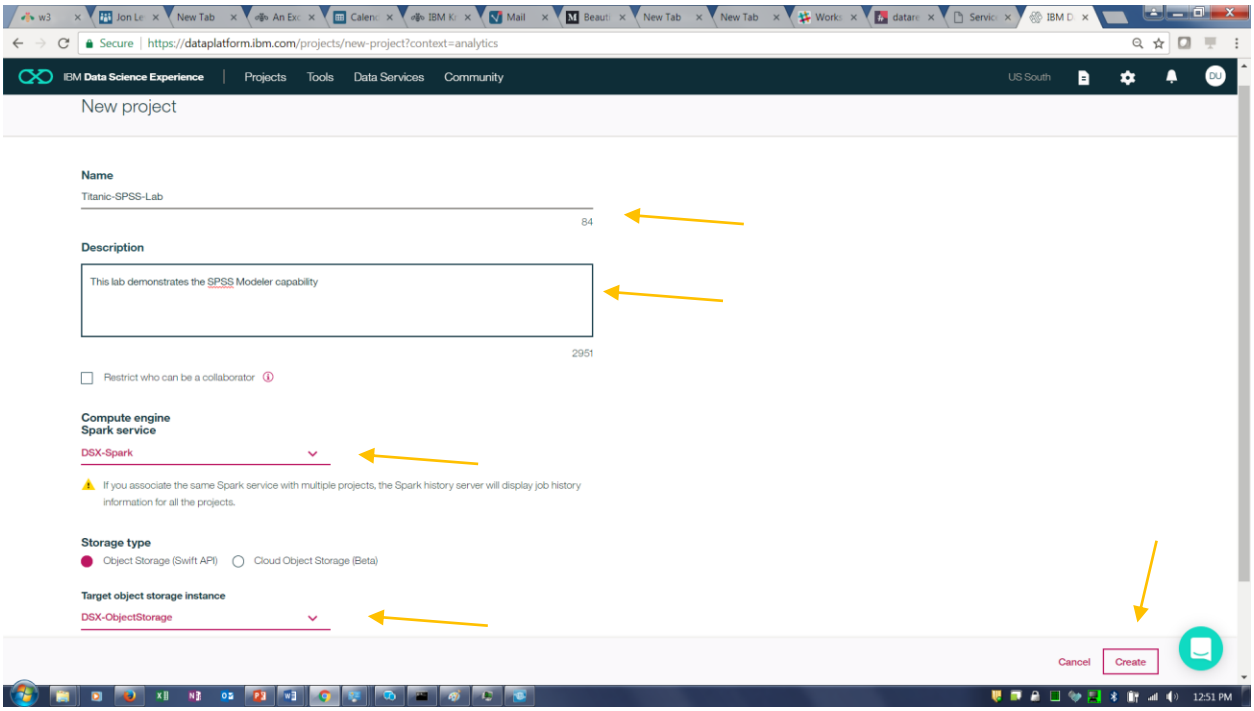
1. Click on the **Projects** tab and then **View All Projects**.



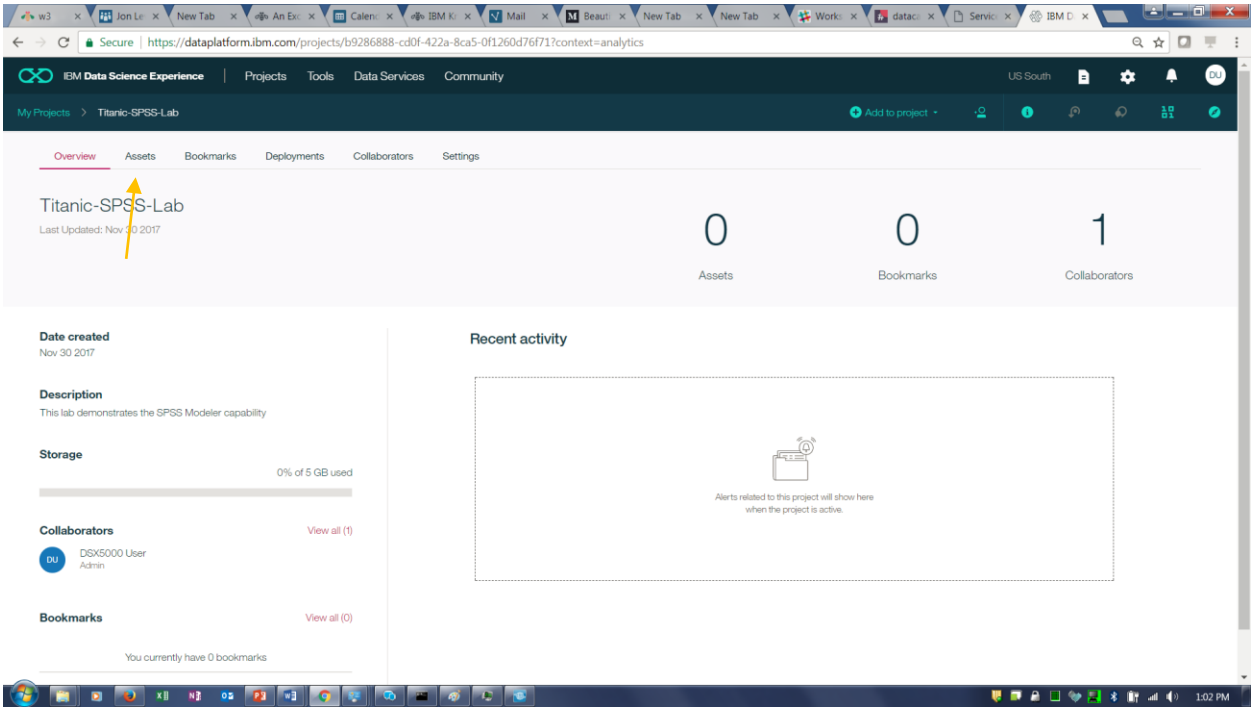
2. Click on **New project**.



3. Enter a project **Name** (eg Titanic), optionally a **Description**, take the defaults for **Spark service**, and **Storage type**. Click on **Create**.



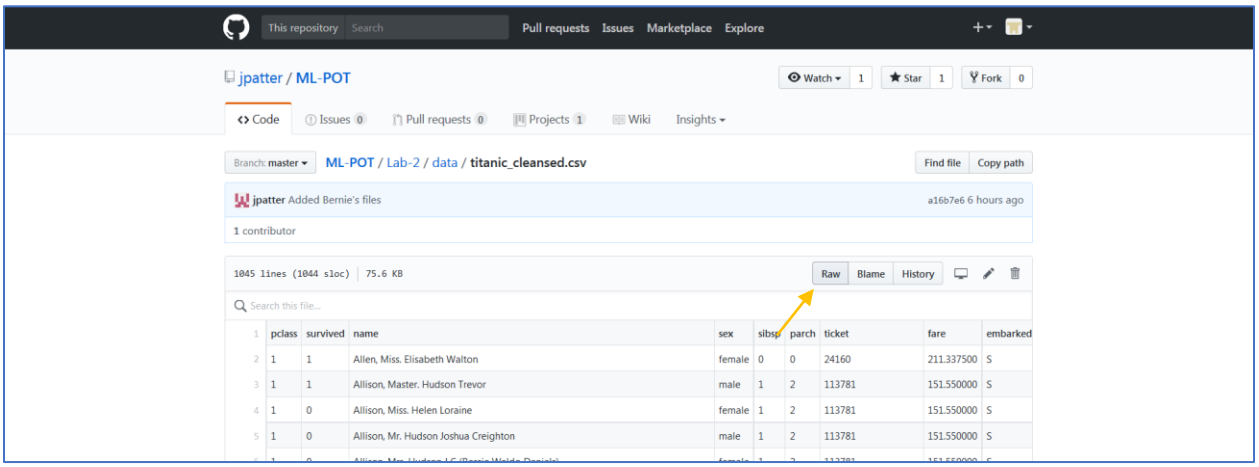
4. You should be on the Project Overview screen. Click on the Asset tab.



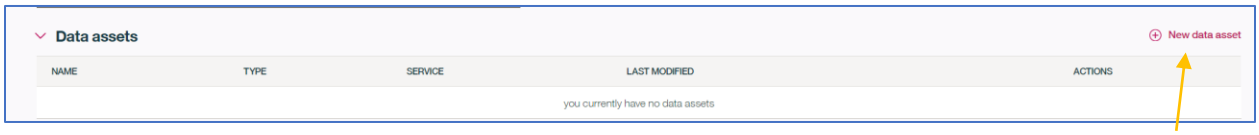
Step 2: Adding a Data Asset to the Titanic project

1. Download the Titanic data file from [Titanic Data Set]

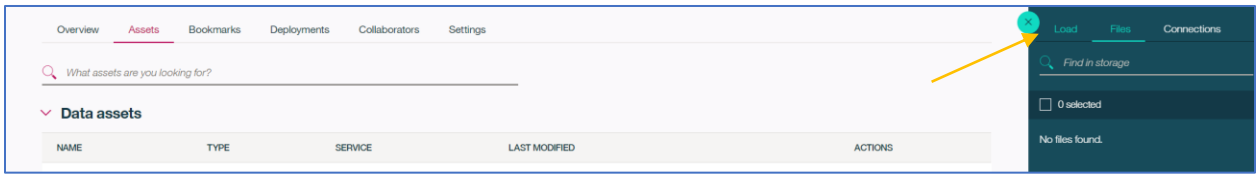
   Right click on Raw, and click on Save link as ….



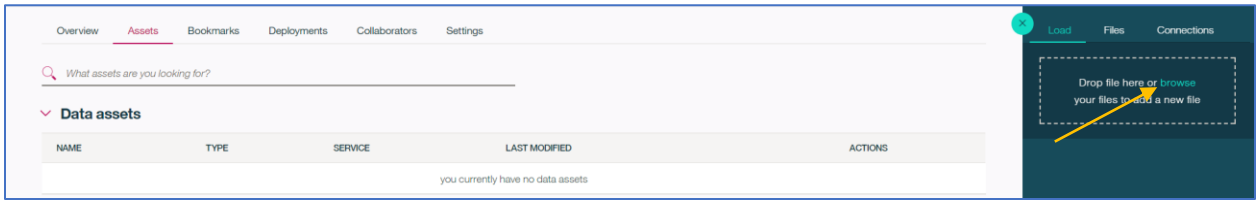
2. Go back to the Titanic project. Click on **New data asset.**



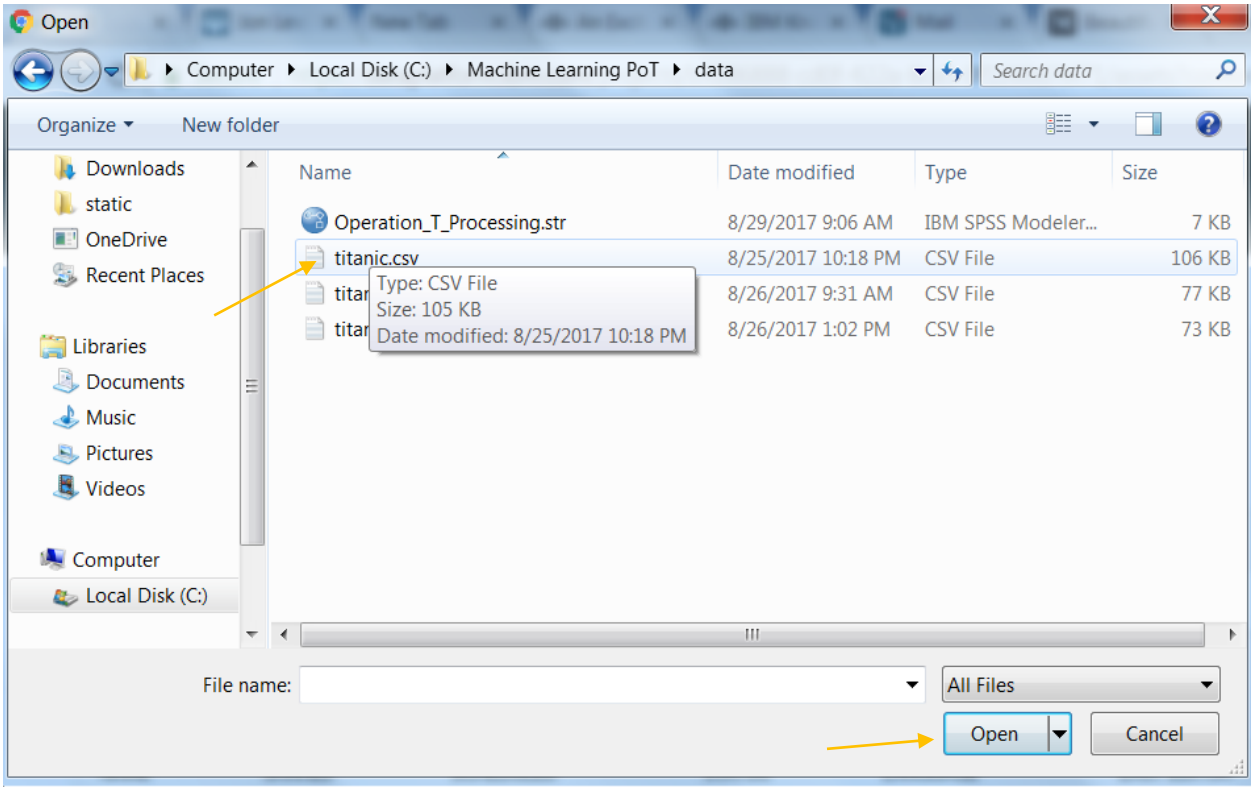
3. Click on the **Load** tab.



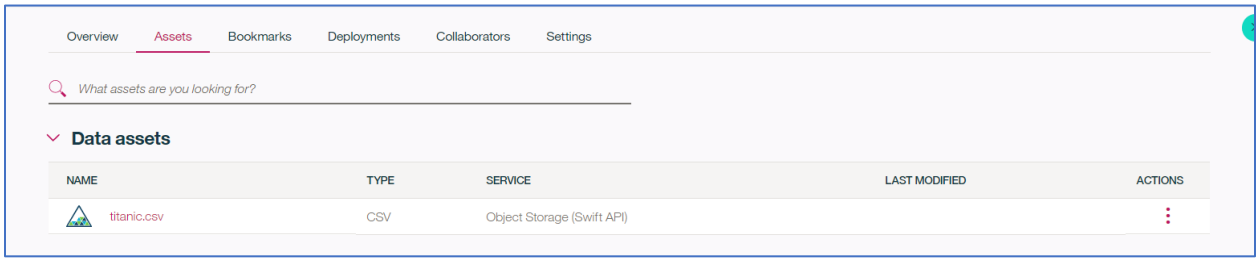
4. Click on **browse**.



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



6. The file is added as a Data Asset.



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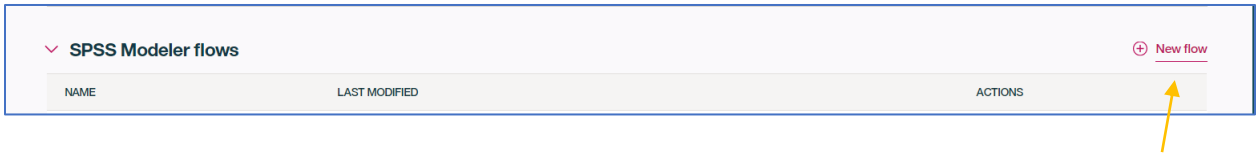
Step 3: Create a Model to predict survival

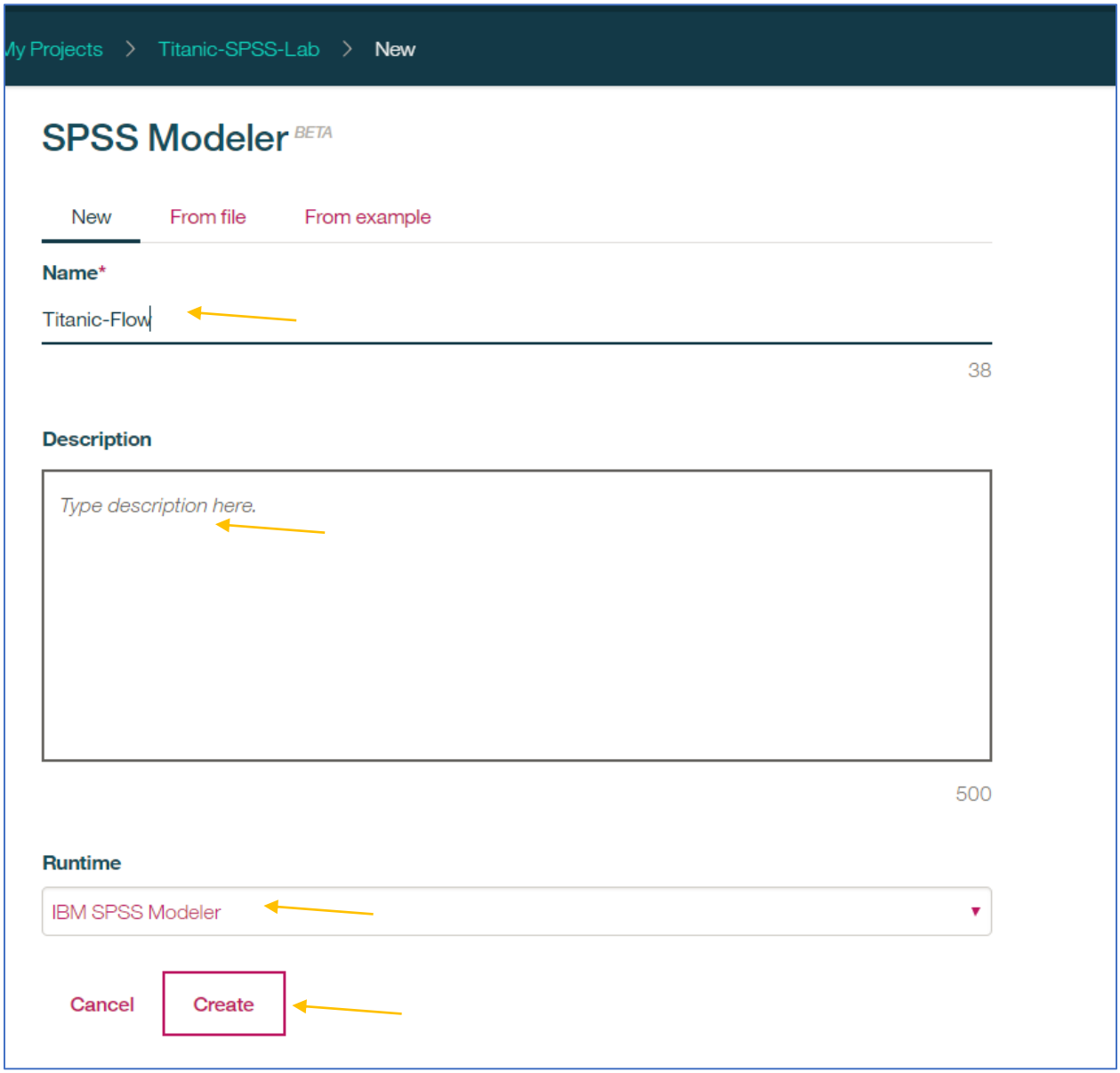
In this section, we will create a Machine Learning flow using SPSS nodes. Documentation describing the nodes is available at https://dataplatform.ibm.com/docs/content/analyze-data/ml-canvas-spss.html?context=analytics.

Step 3.1 Create a New Flow and Load the Data

1. In project Titanic, click on **New flow** in the SPSS Modeler flows section.

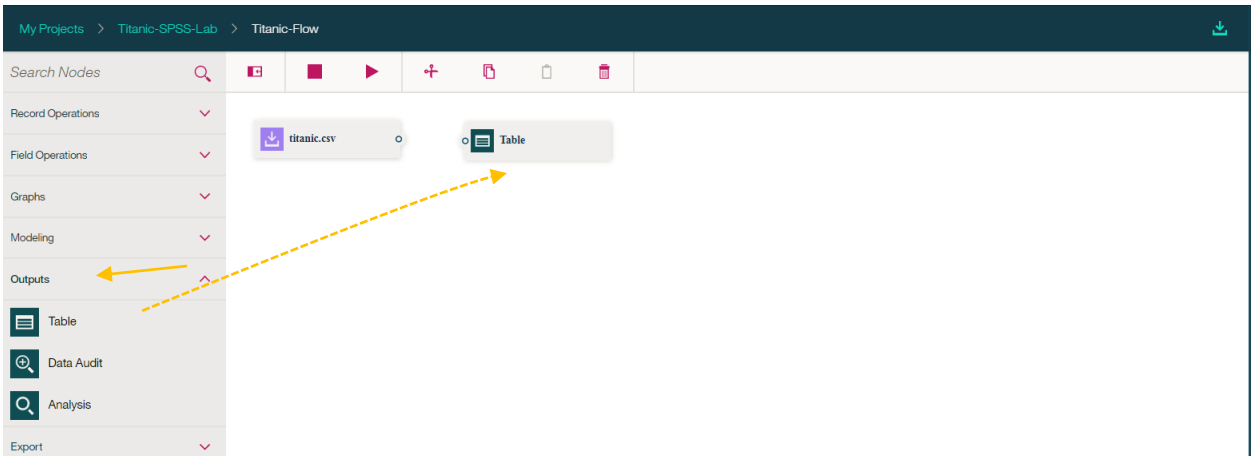


2. Enter a **Name** for the flow, optionally enter a **Description**, select IBM SPSS Modeler for the **Runtime**, and click on **Create.**

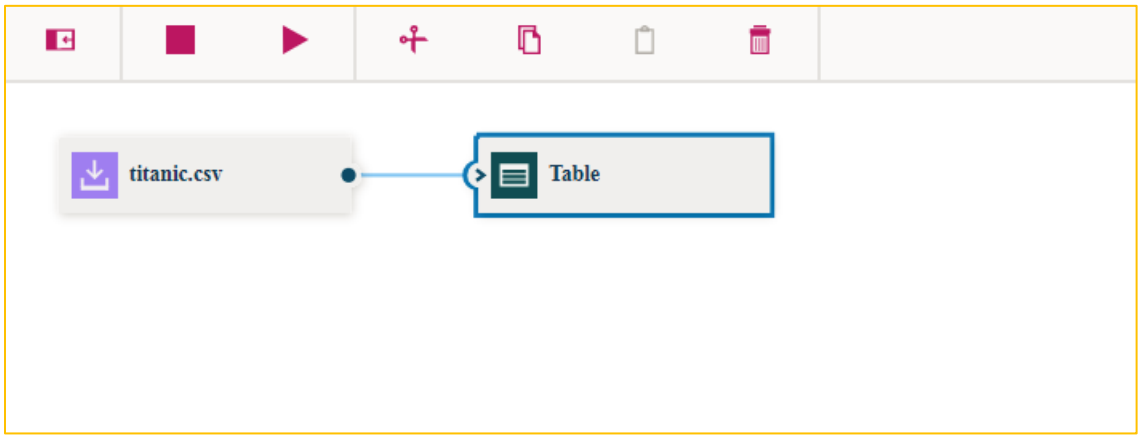


3. This opens the Flow Editor. Click on the titanic.csv file and hold the left mouse key and drag the file onto the left side of the canvas. Release the left mouse key.

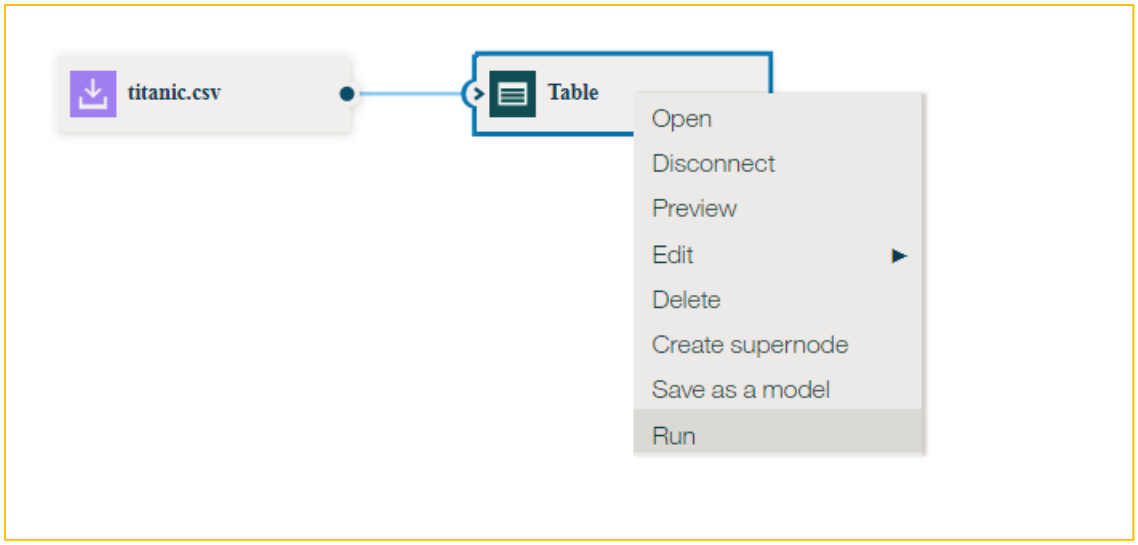
4. Click on the Outputs menu item in the Node Palette on the left and then click on the Table icon and drag the icon to the right of the titanic.csv icon. The SPSS Table node will display the contents of the csv file. If the Node Palette is not visible, click on the Node Palette icon 



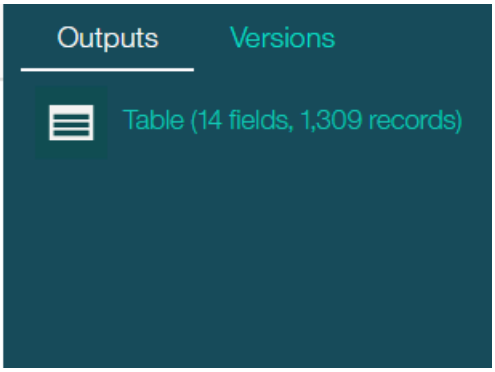
5. Connect the right side of the titanic.csv icon to the left side of the Table icon. This is accomplished by clicking on the little circle at the right side of the titanic.csv icon holding the left mouse key and dragging the mouse to the little circle on the left side of the Table icon, and then releasing 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.



8. Double click on the Table selection above 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
1	1	Allen, Miss. Elisabeth	female	29	0	0	24160	211.3375	B5	S	2
1	1	Allison, Master. Huds	male	0.9167	1	2	113781	151.55	C22 C26	S	11
1	0	Allison, Miss. Helen L	female	2	1	2	113781	151.55	C22 C26	S	
1	0	Allison, Mr. Hudson J	male	30	1	2	113781	151.55	C22 C26	S	
1	0	Allison, Mrs. Hudson	female	25	1	2	113781	151.55	C22 C26	S	
1	1	Anderson, Mr. Harry	male	48	0	0	19952	26.55	E12	S	3
1	1	Andrews, Miss. Korn	female	63	1	0	13502	77.9583	D7	S	10
1	0	Andrews, Mr. Thoma	male	39	0	0	112050	0	A36	S	
1	1	Appleton, Mrs. Edwa	female	53	2	0	11769	51.4792	C101	S	D
1	0	Artagaveytia, Mr. Ra	male	71	0	0	PC 17609	49.5042		C	
1	0	Astor, Col. John Jac	male	47	1	0	PC 17757	227.525	C62 C64	C	
1	1	Astor, Mrs. John Jac	female	18	1	0	PC 17757	227.525	C62 C64	C	4
1	1	Aubart, Mme. Leonti	female	24	0	0	PC 17477	69.3	B35	C	9
1	1	Barber, Miss. Ellen "N	female	26	0	0	19877	78.85		S	6
1	1	Barkworth, Mr. Alger	male	80	0	0	27042	30	A23	S	B

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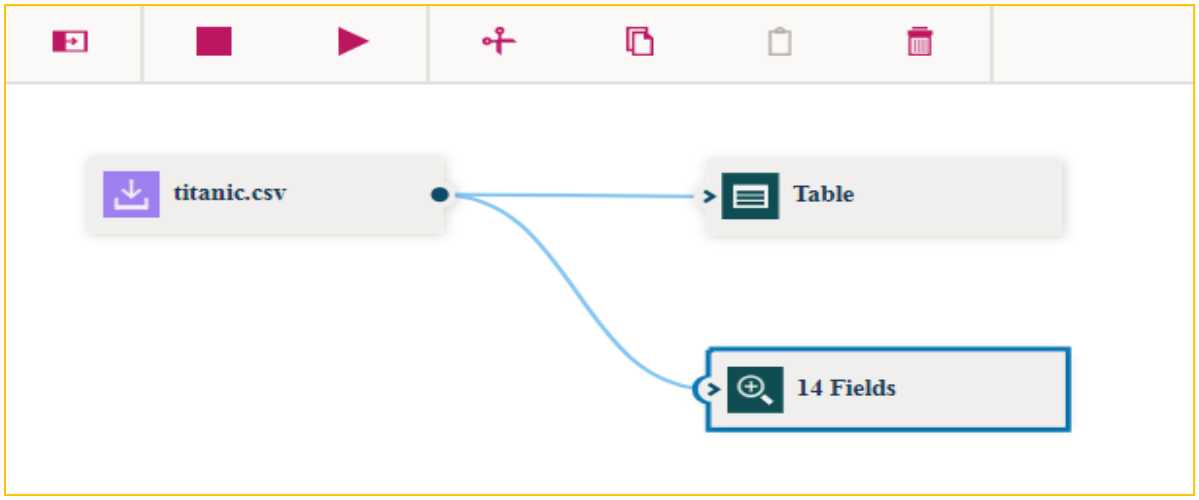
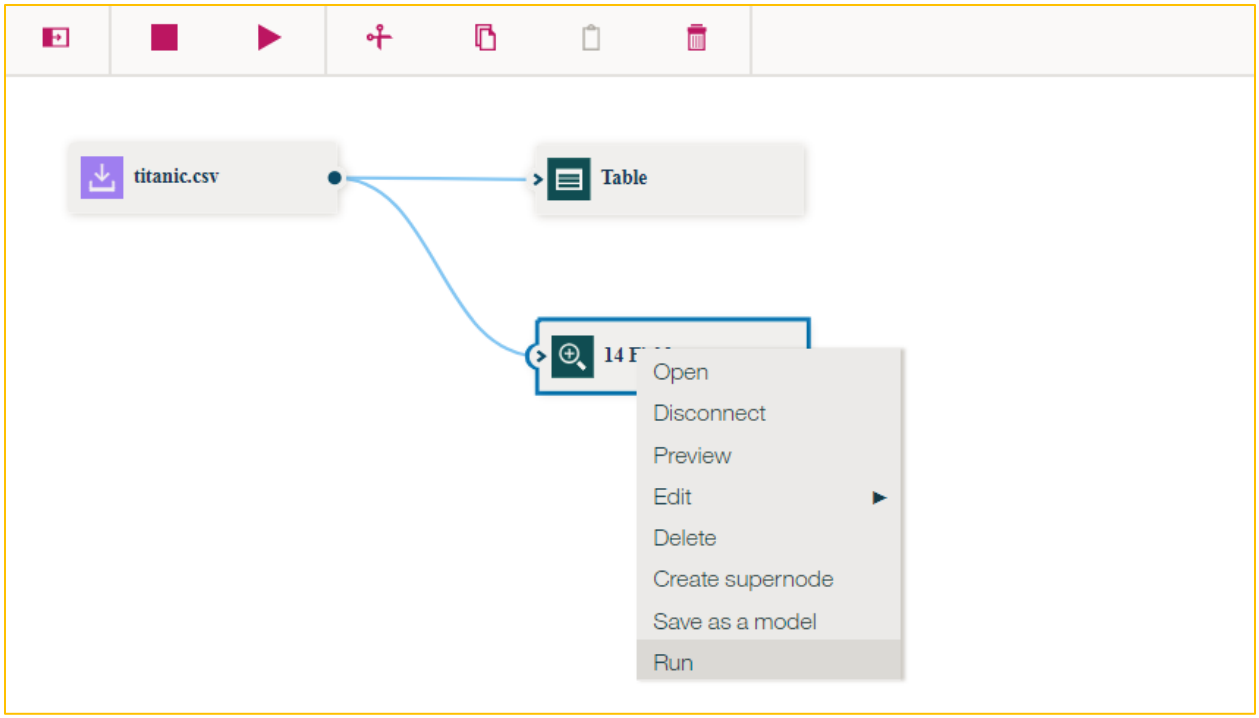
Step 3.2 Explore the Data using the Data Audit Node

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.

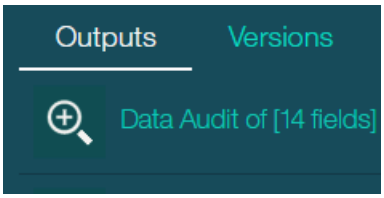
1. Add a **Data Audit** node to the flow clicking on the **Outputs** menu item in the Node Palette, and then dragging the **Data Audit** node to underneath the titanic.csv node. If the Node Palette is not visible, click on the Node Palette icon . Connect the titanic.csv node to the Data Audit node. The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



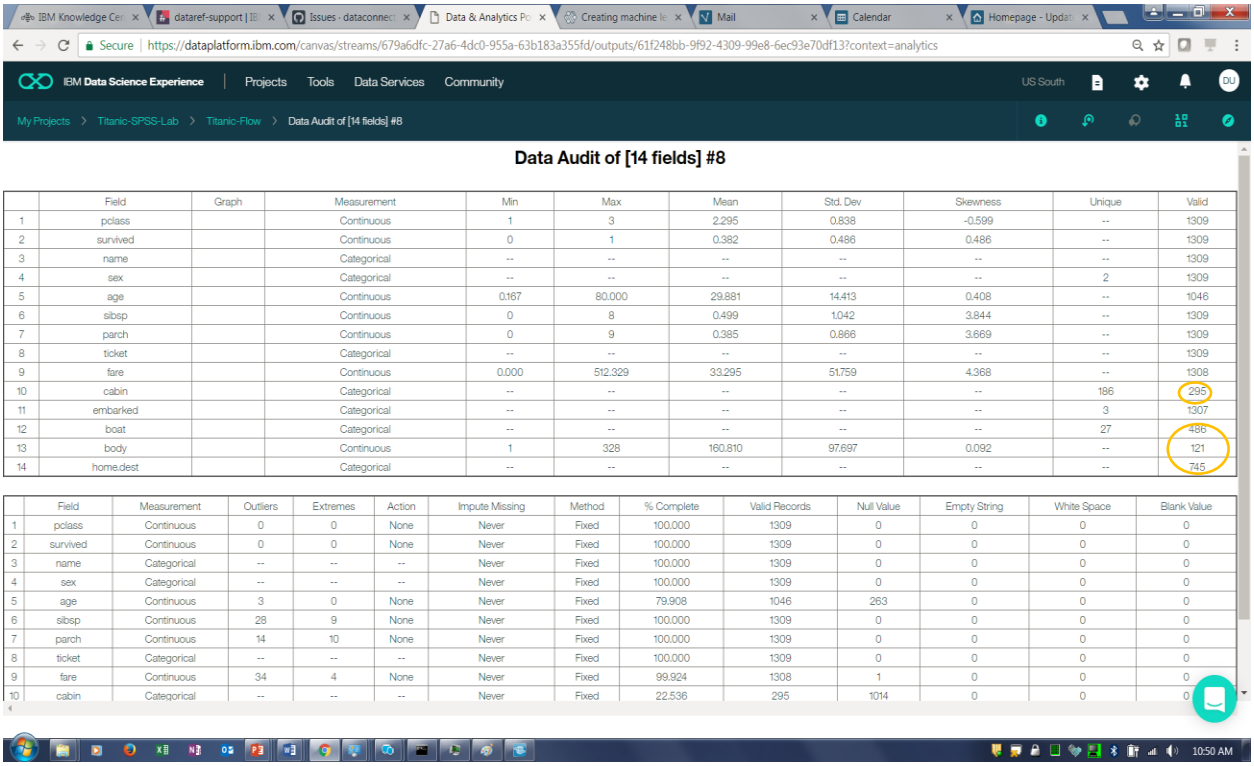
2. Right click on the **Data Audit** node and click **Run**.



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.



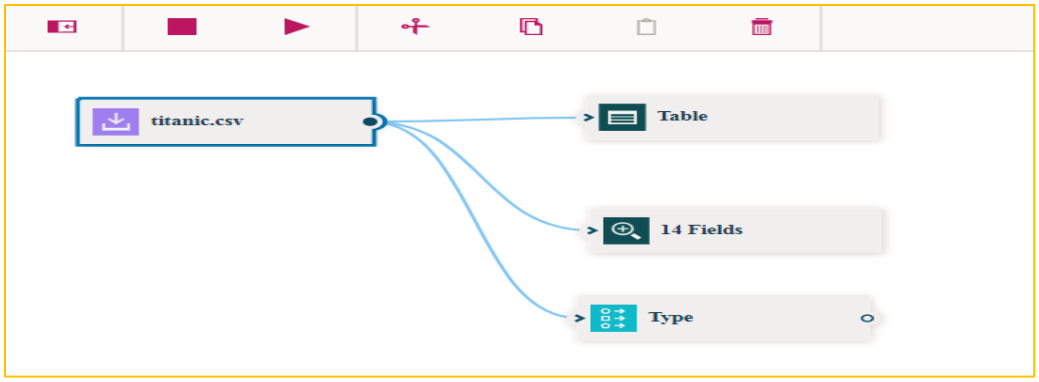
4. Double click on the **Data Audit of [14 fields]** to view the Data Audit output. We can see that several fields have many missing values (cabin, boat,body,home.dest). These fields will be removed using a **Filter** node below. Other fields have only a few missing values (fare, embarked, age). The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



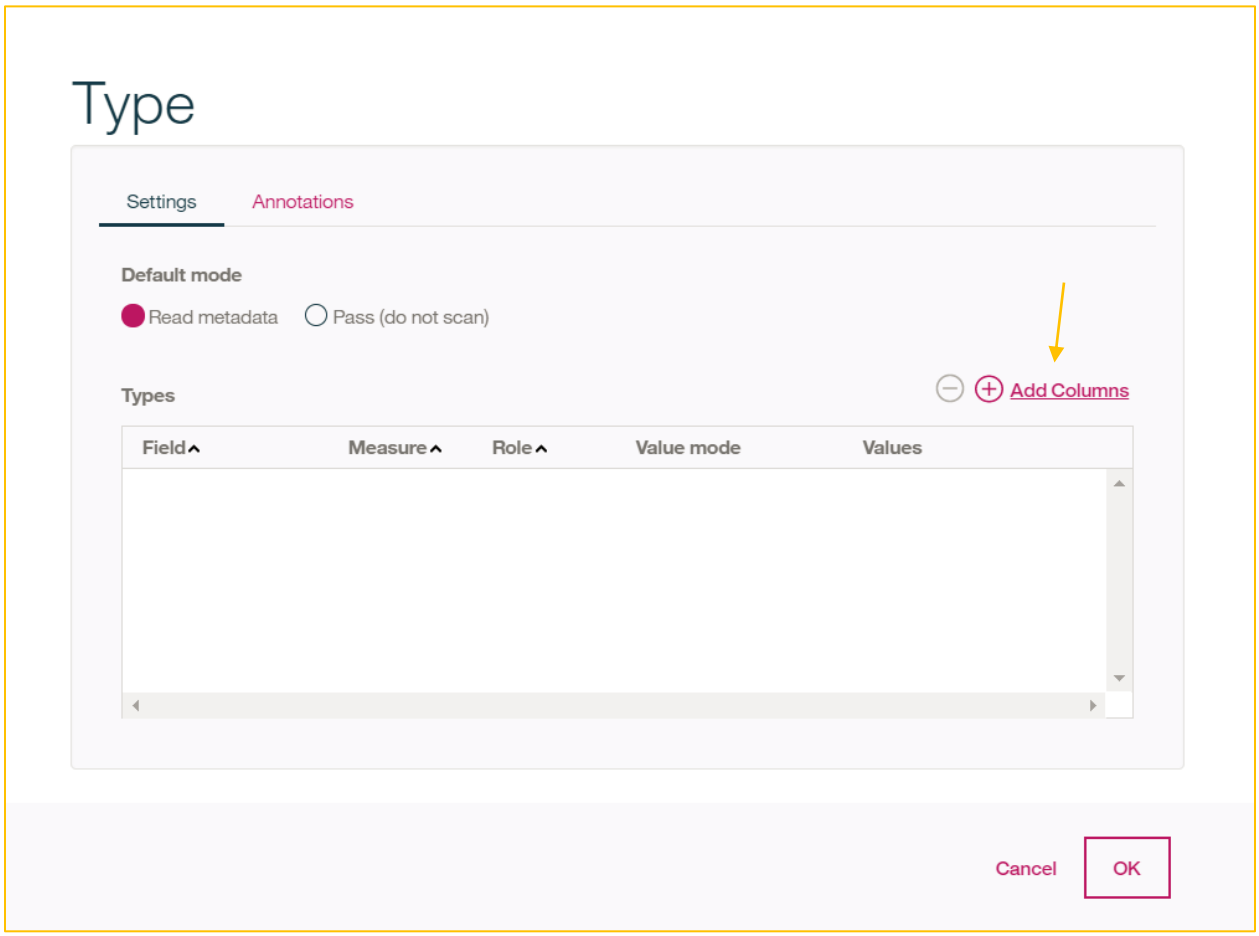
Step 3.3 Explore the Data using Graph Nodes.

The SPSS desktop version has a rich graphical icon set. Currently, the DSX version has only 4 graph nodes in the beta version. 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 "Ordered Set" and "Flag" respectively.

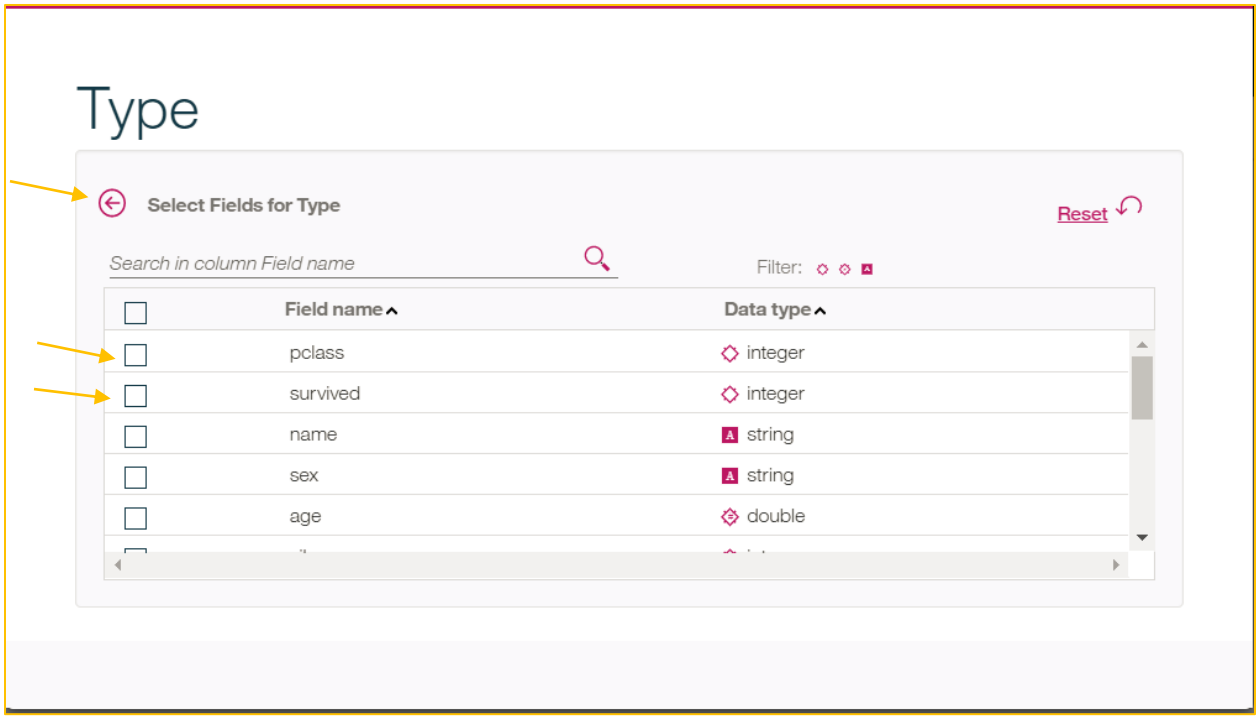
1. Add a **Type** node to the flow by clicking on the **Field Operations** menu item in the Node Palette and then drag the **Type** node underneath the **Data Audit** node. If the Node Palette is not visible, click on the Node Palette icon . Connect the titanic.csv node to the **Type** node. The canvas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



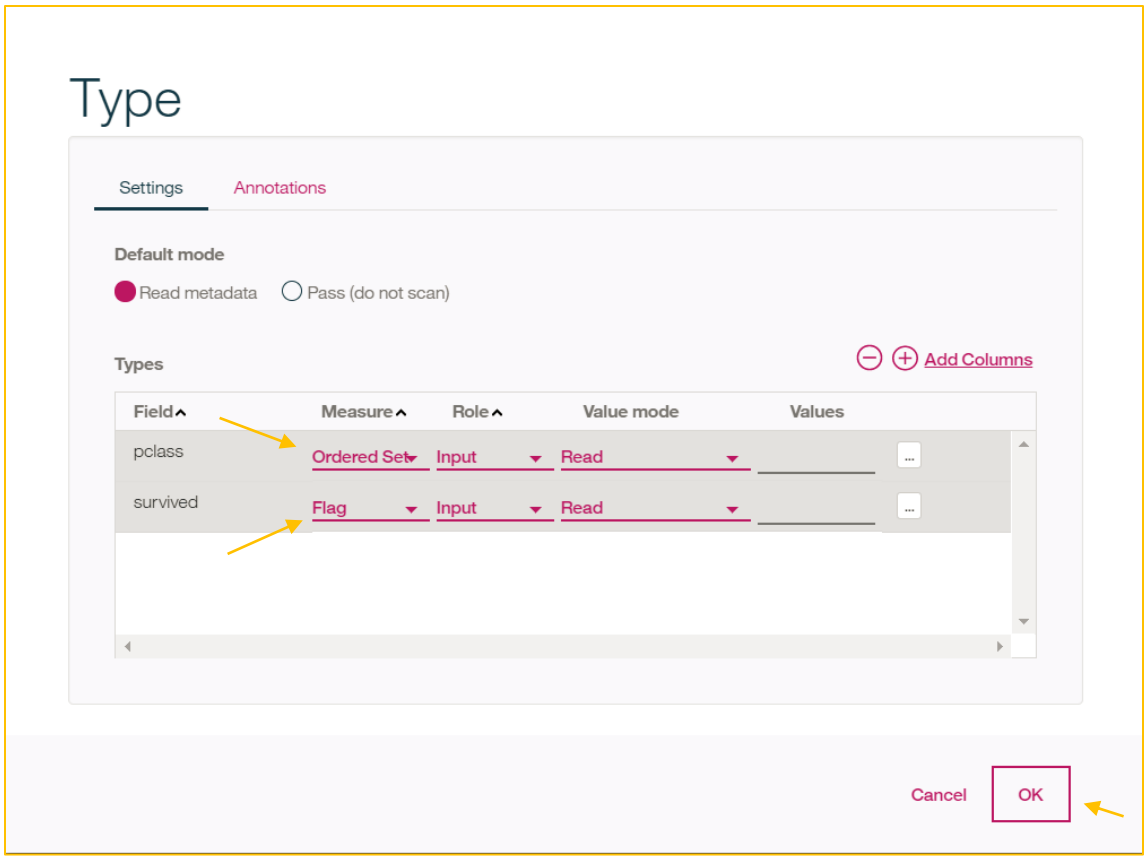
2. Double click on the **Type** node. Click on **Add Columns**.



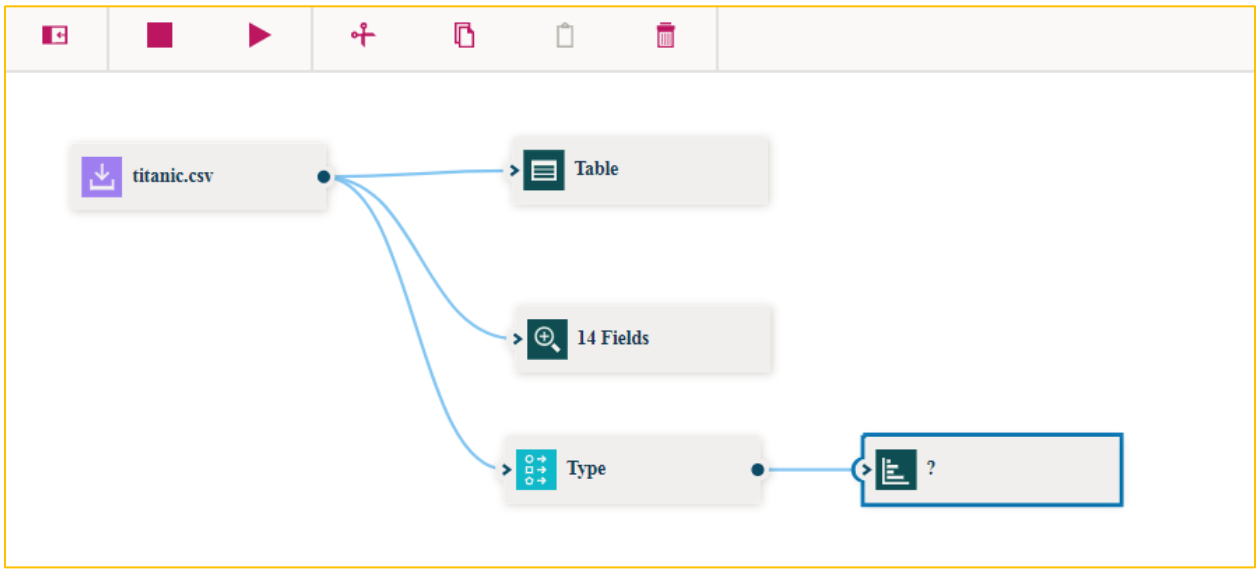
3. Click on the checkboxes adjacent to the pclass and survived fields, and then click on the left arrow next to **Select Fields for Type**.



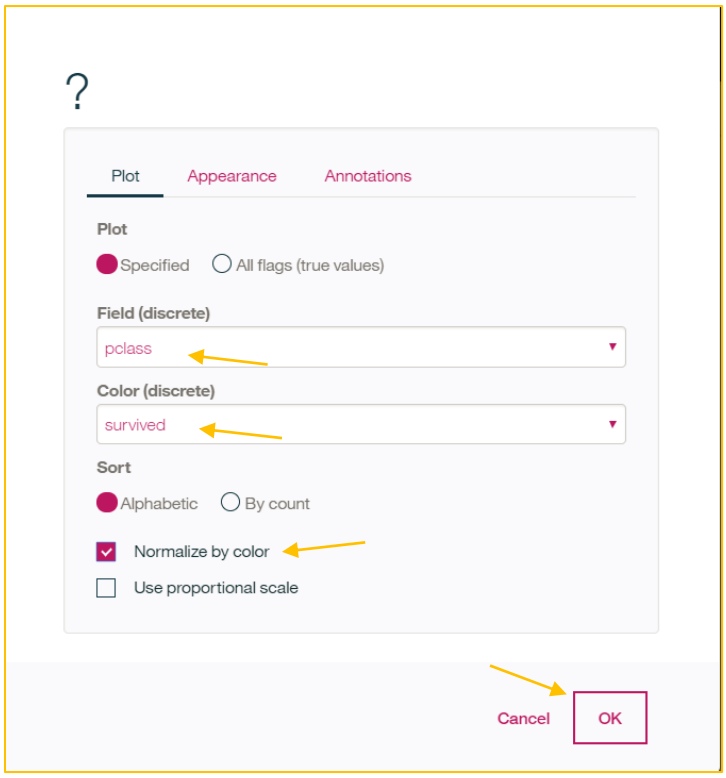
4. Click on the measurement level field for pclass and select **Ordered Set**. Click on the measurement level field for survived and select **Flag**. Click on **OK**.



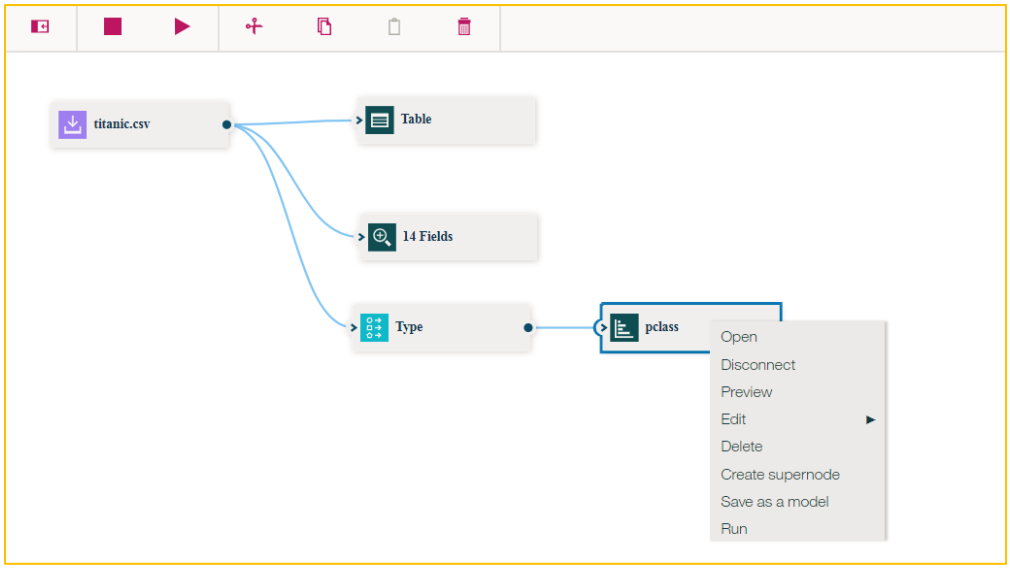
5. Add a **Distribution** node to the flow by clicking on the **Graph** menu item and then dragging the **Distribution** node to the canvas to the right of the **Type** node. If the Node Palette is not visible, click on the Node Palette icon . Connect the **Type** node to the **Distribution** node. The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



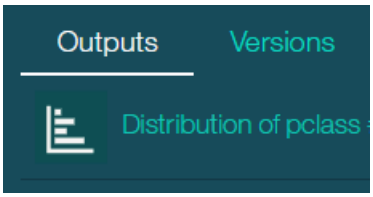
6. Double click on the Distribution Node. In the Field (discrete) dropdown, select pclass. In the Color (discrete) dropdown, select survived. Click on the normalize by color checkbox, and then click OK.



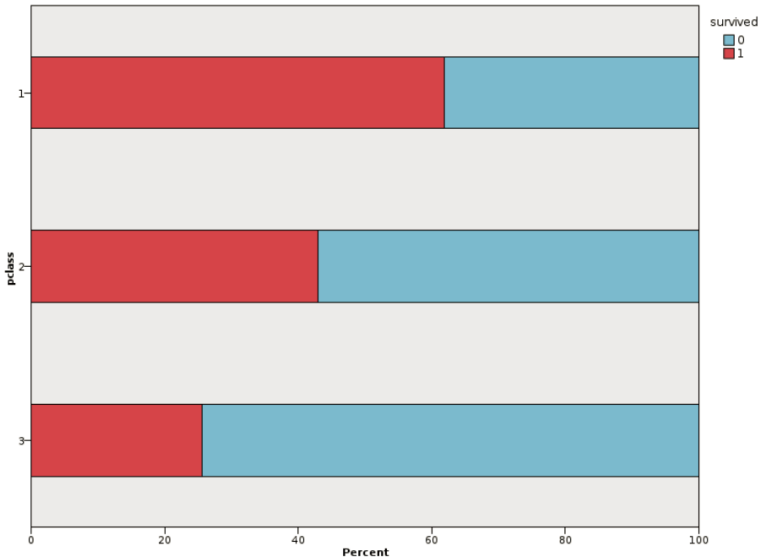
7. Right click on the Distribution node, and select Run.



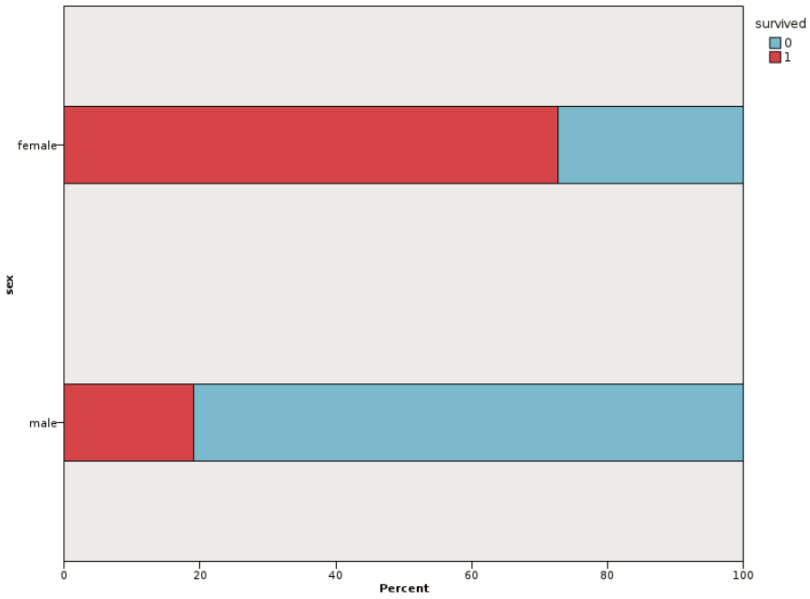
8. The Distribution of pclass output will appear under the **Outputs** tab on the right hand side of the screen.



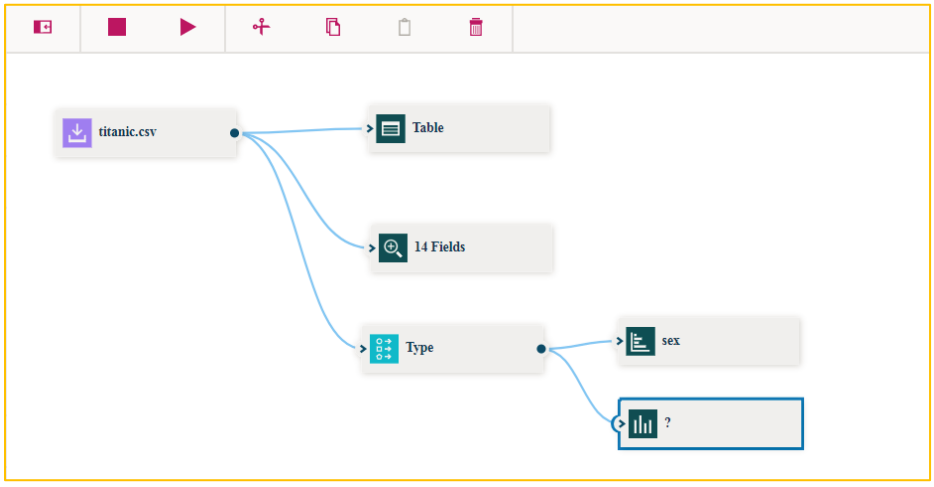
9. Double click on the **Distribution of pclass** #1 to view the graph. We can see from the graph that the likelihood of surviving is correlated to the passenger class. The first class passengers have the highest rate of survivability.



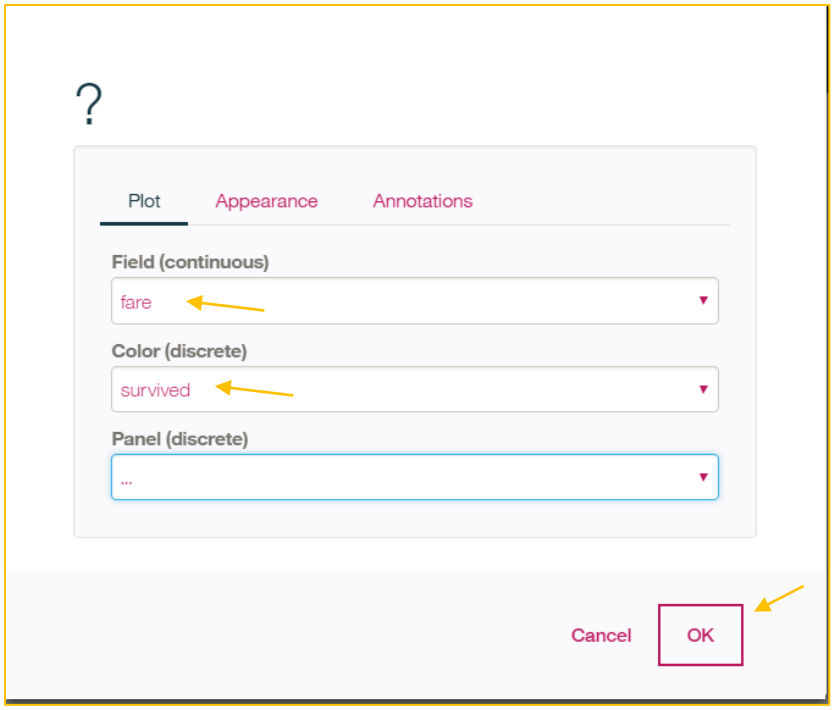
10. You can change the distribution graph to show the survivability by gender by double clicking on the Distribution node and replacing pclass with sex and clicking OK. Re-run the graph by right clicking on the Distribution node and selecting Run. Double click on the Distribution of sex #1 to display the graph.



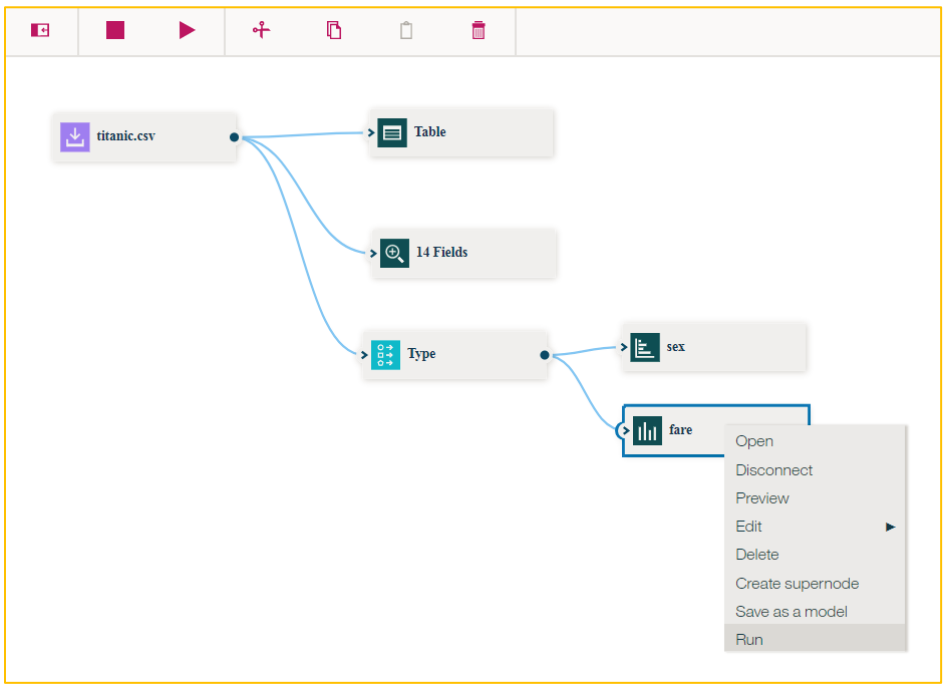
11. Add a **Histogram** node to the flow by clicking on the **Graphs** menu item and then dragging the **Histogram** node to the canvas underneath the **Distribution** node. If the Node Palette is not visible, click on the Node Palette icon . Connect the **Type** node to the **Histogram** node. The canvas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

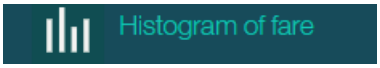


12. Select fare from the Field (continuous) dropdown. Select survived from the Color (discrete) dropdown. Click on OK.

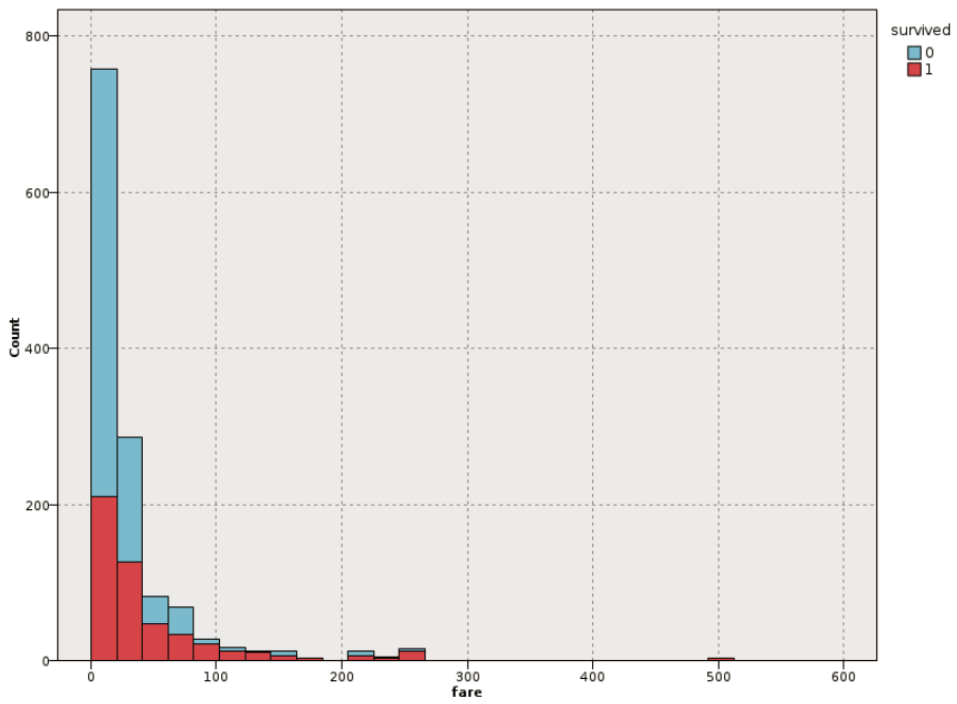


13. Right click on the **Histogram** node and select **Run**.



14. Double click on the Histogram of fare 

under the Outputs tab at the right of the screen.



15. We can 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.

Step 3.4 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.

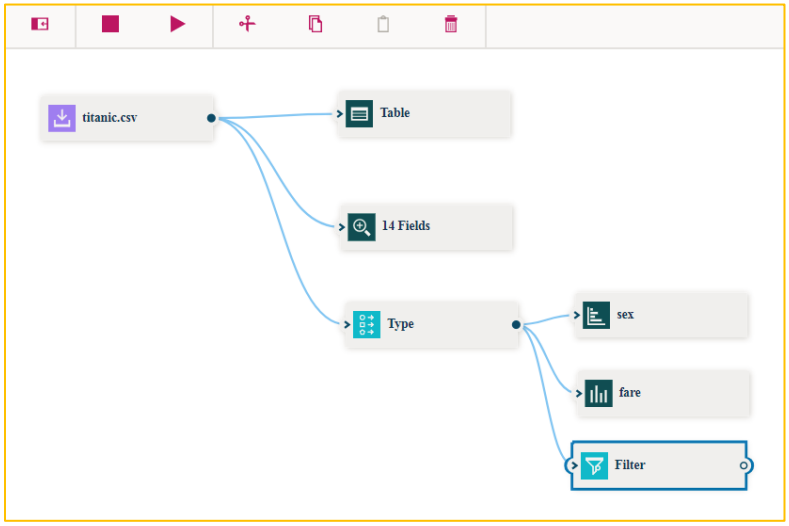
Filter node – The Filter node performs two functions. It specifies fields that can be dropped. It also allows fields to be renamed. We will drop the fields cabin,boat,body, and home.dest.

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.

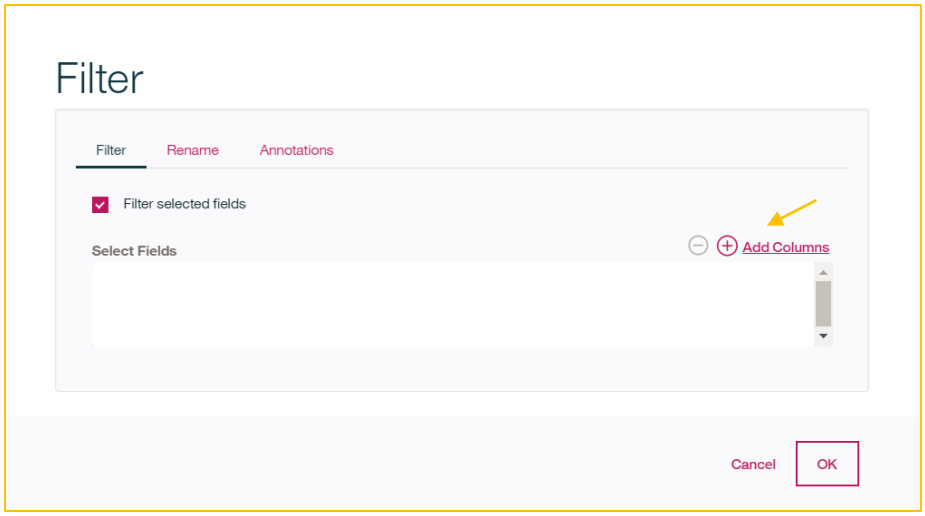
Select node – The Select node is used to select or discard a subset of records from the data stream based on a specific condition. We will remove the rows where there are missing information in the fare, age, or embarked fields.

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**

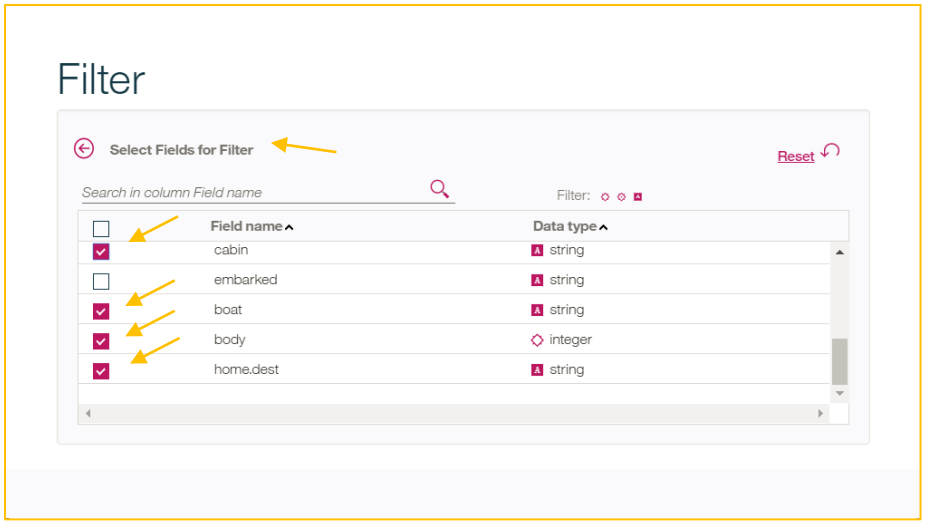
node onto the canvas underneath the fare **Histogram** node. If the Node Palette is not visible, click on the Node Palette icon first. The canvas should appear as below.



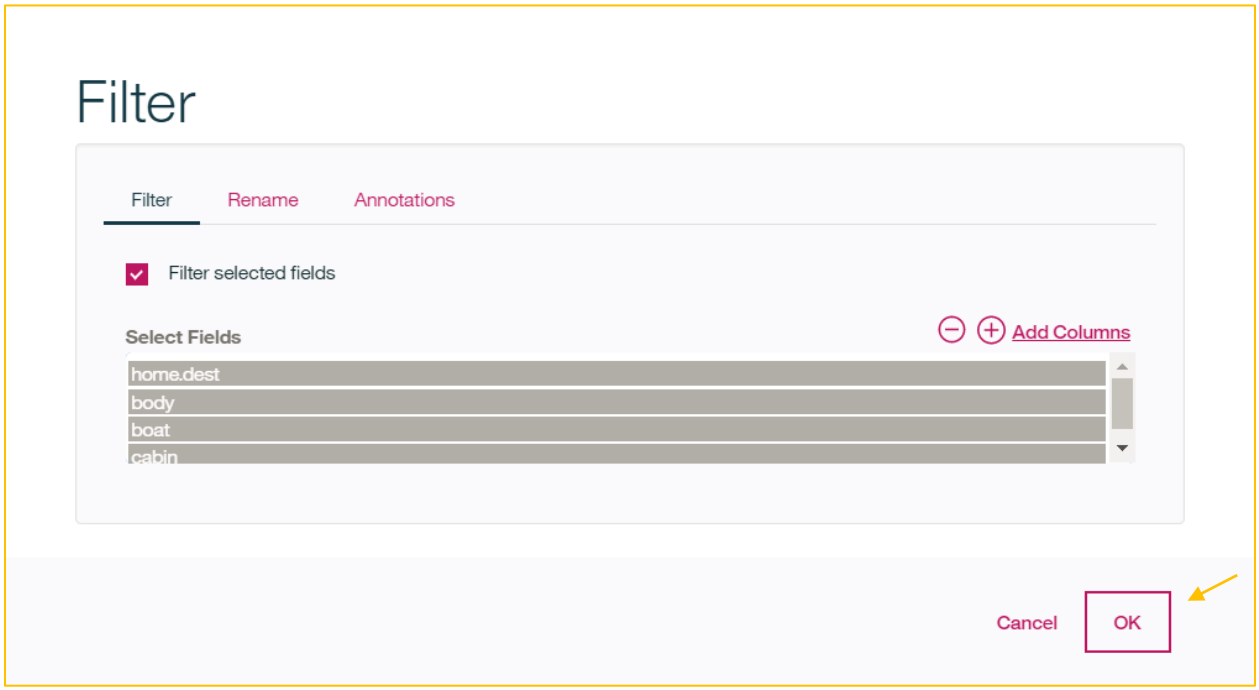
2. Double click on the **Filter** node. In the Filter panel, click on the **Add Columns**.



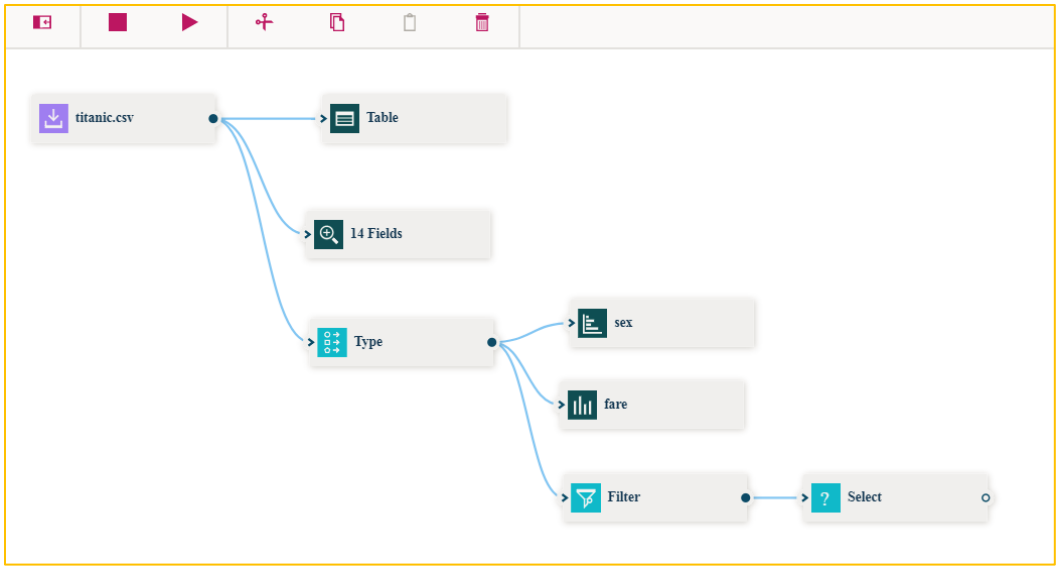
3. Click on the checkboxes adjacent to the **cabin**, **boat**, **body**, and **home.dest** fields, and then click on **Select Fields for Filter**.



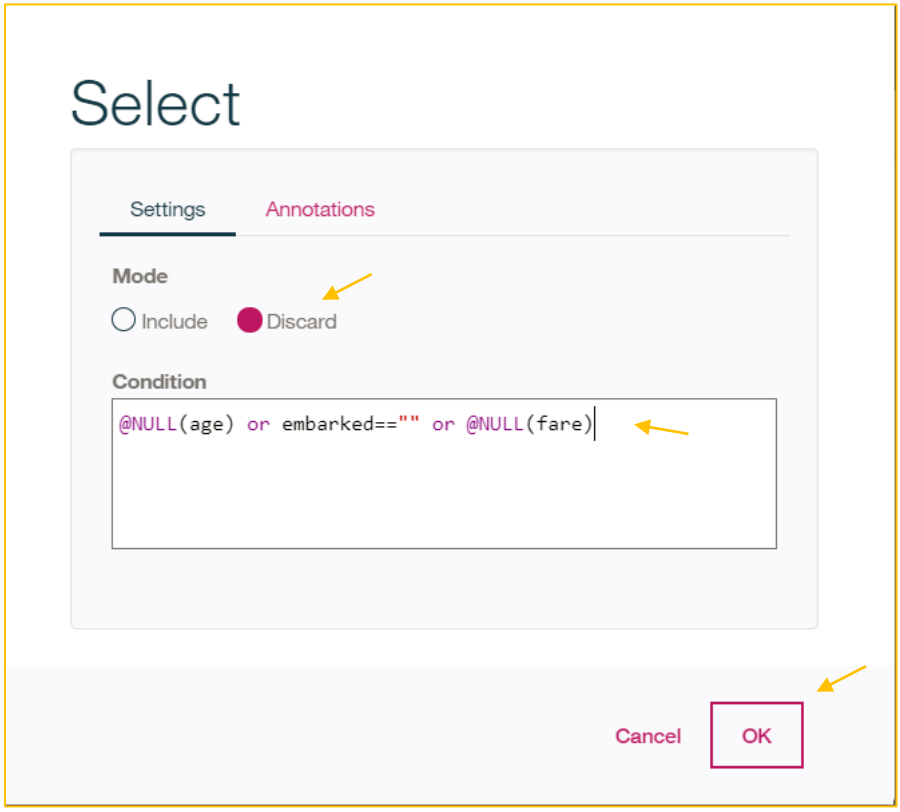
4. Click **OK** on the Filter panel.



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.

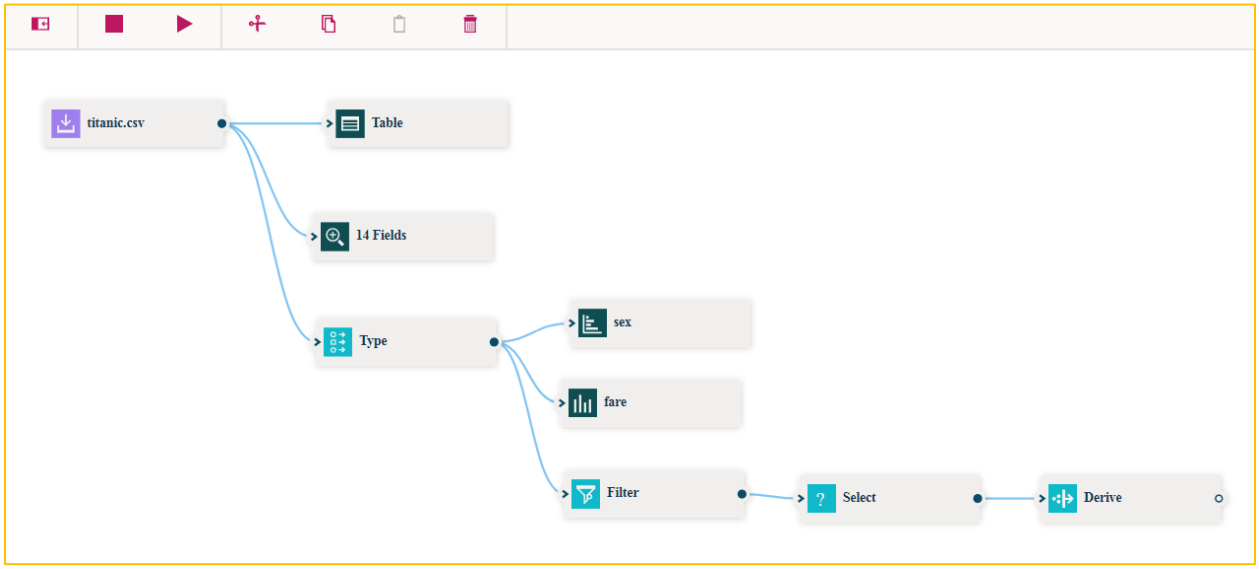


6. Double click on the **Select** node. In the **Select** panel, click on the **Discard** radio button, and re-type in the code shown below in the **Condition text box**, and then click **OK**.



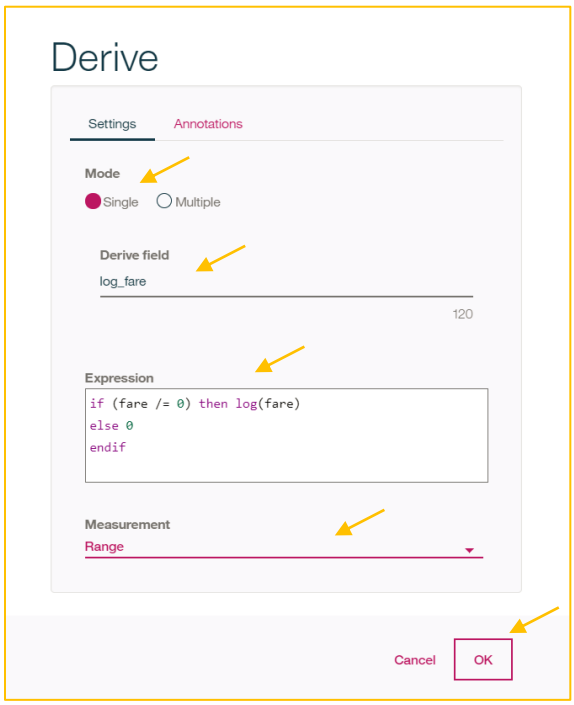
7. Add a **Derive** node to the canvas by clicking on the **Field Operations** menu item in the Node palette, and then dragging the **Derive node** onto the canvas to the right of the

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.

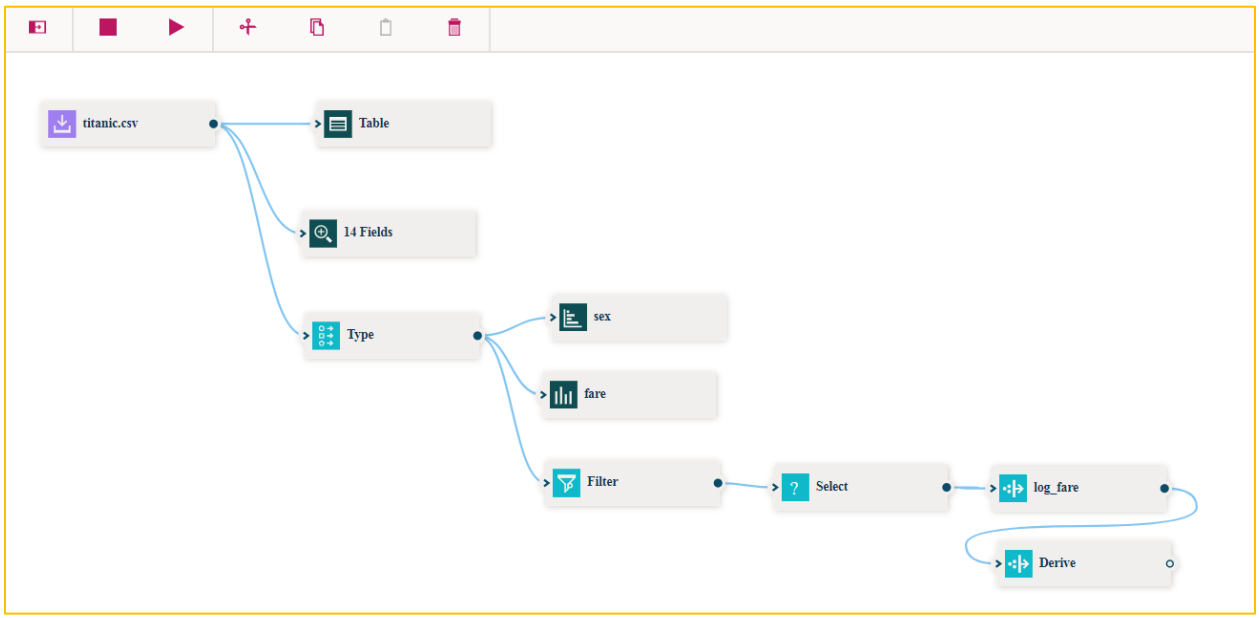


8. Double click on the **Derive** node. Click on the **Single** radio button, enter log_fare for the **Derive** field, enter the following code in the **Expression** text box, select **Range** for the measurement and click OK.

   if (fare /=0) then log(fare) else 0 endif



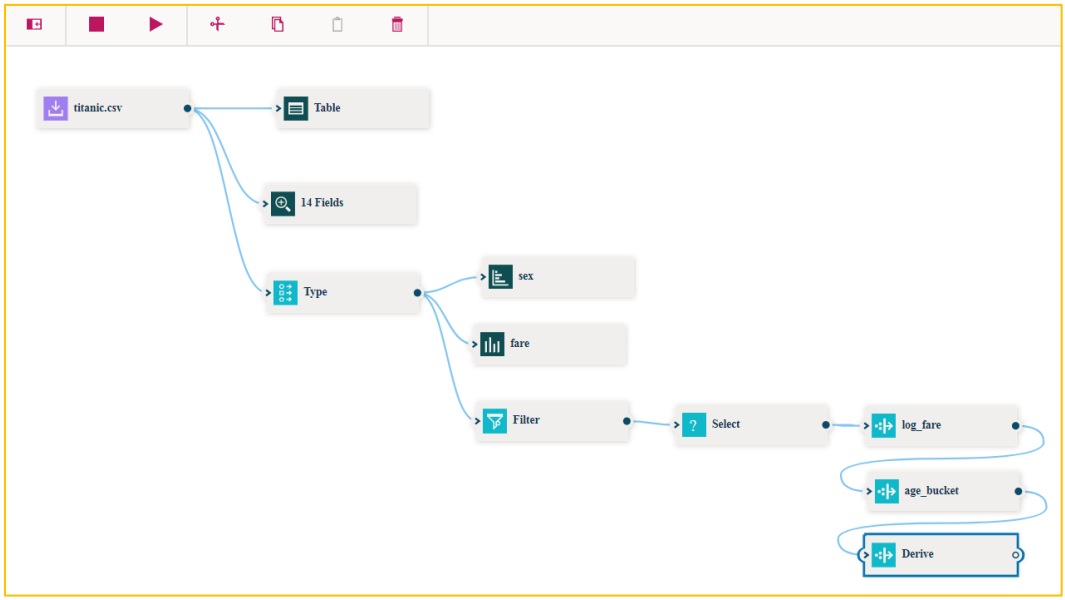
9. Binning of continuous fields is a technique sometimes used in preparing data for modeling. We will bin the age field, and the log_fare field. Add a **Derive** node by clicking on the **Field Operations** menu item in the Node palette and dragging the **Derive** node on the canvas underneath the log_fare **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 **Single** radio button, enter age_bucket for the **Derive** field, enter the following code in the **Expression** text box, select OrderedSet for the **Measurement**, and the click **OK**.

```
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. Connect the age_bucket **Derive** node to the newly created **Derive** Node. The canvas should appear as below.



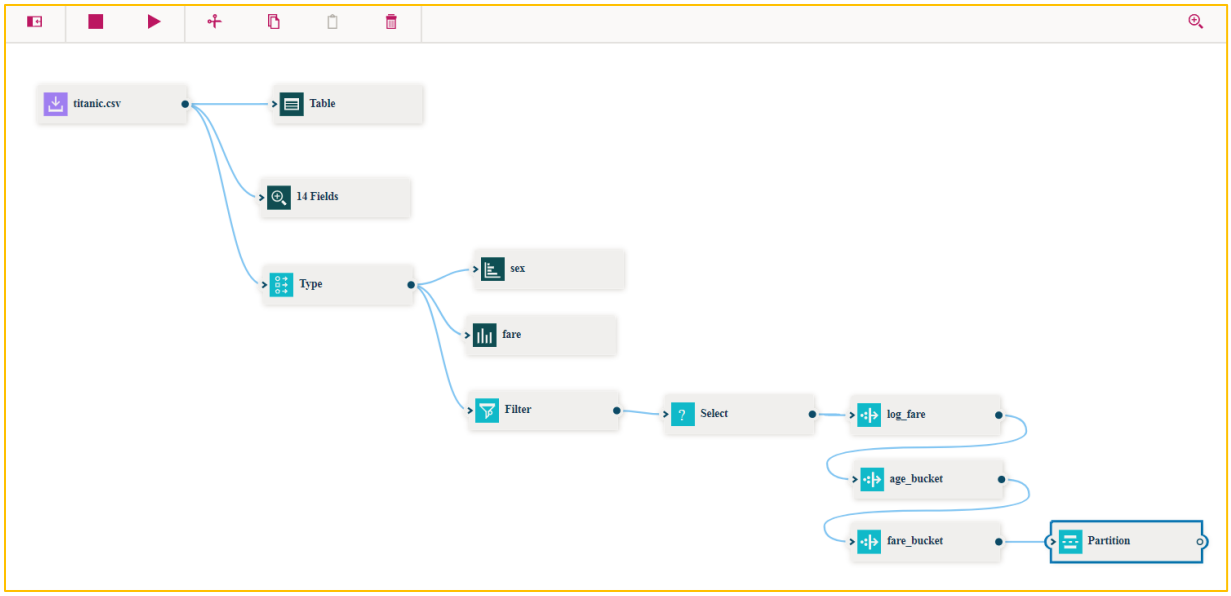
12. Double click the **Derive** node. In the **Derive** panel, click on the **Single** radio button, enter fare_bucket in the **Derive** field, enter the following code in the **Expression** text box, click on OrderedSet for the **Measurement**, and click on **OK**.

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

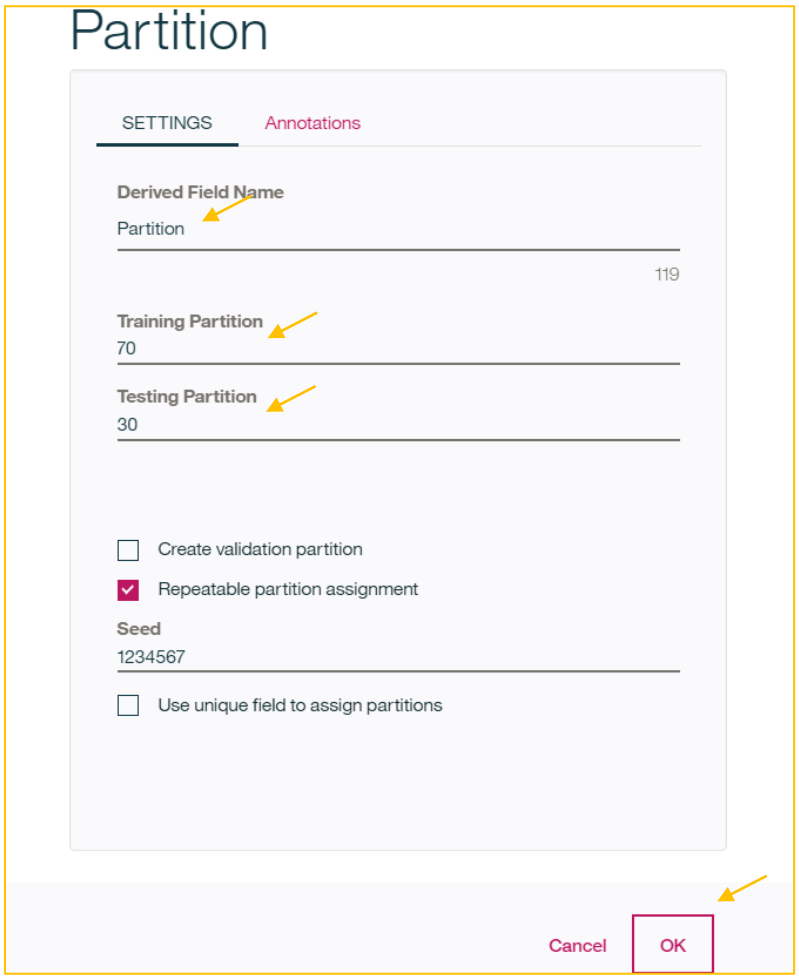
Step 3.5 Modeling and Evaluation

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 Regression** node, and use the Training set to train the model. Finally, we will add an **Analysis** node to evaluate the results.

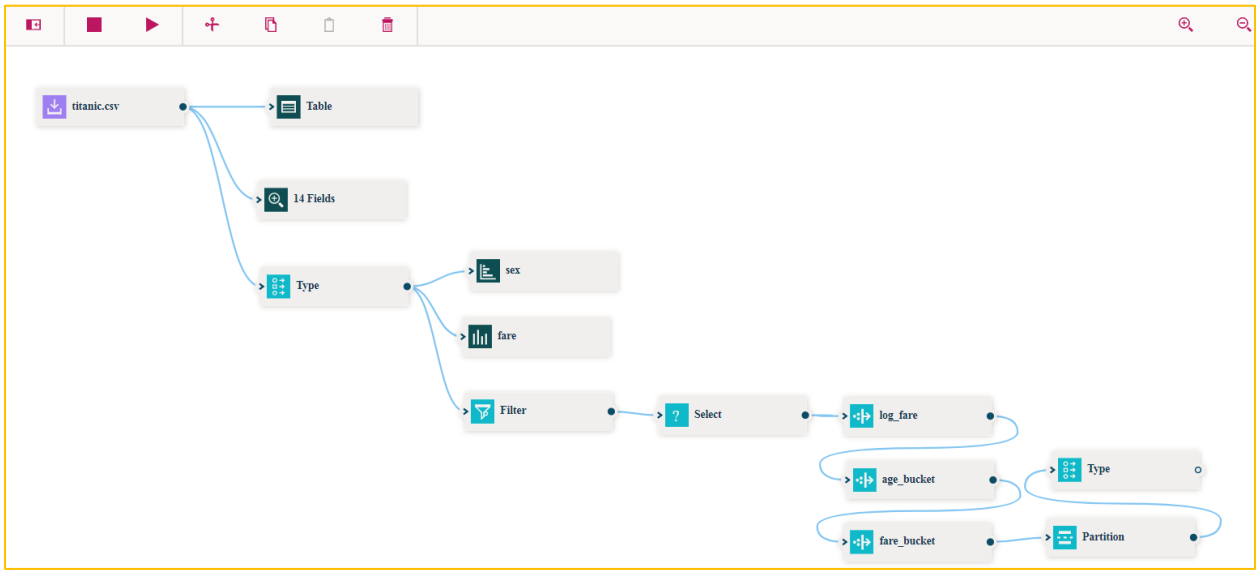
1. Add a **Partition** node by clicking on the Field Operations menu item in the Node palette and dragging the **Partition** node onto the canvas to the right of the fare_bucket **Derive** node. Connect the fare_bucket **Derive** node to the **Partition** node. The canvas should appear as below.



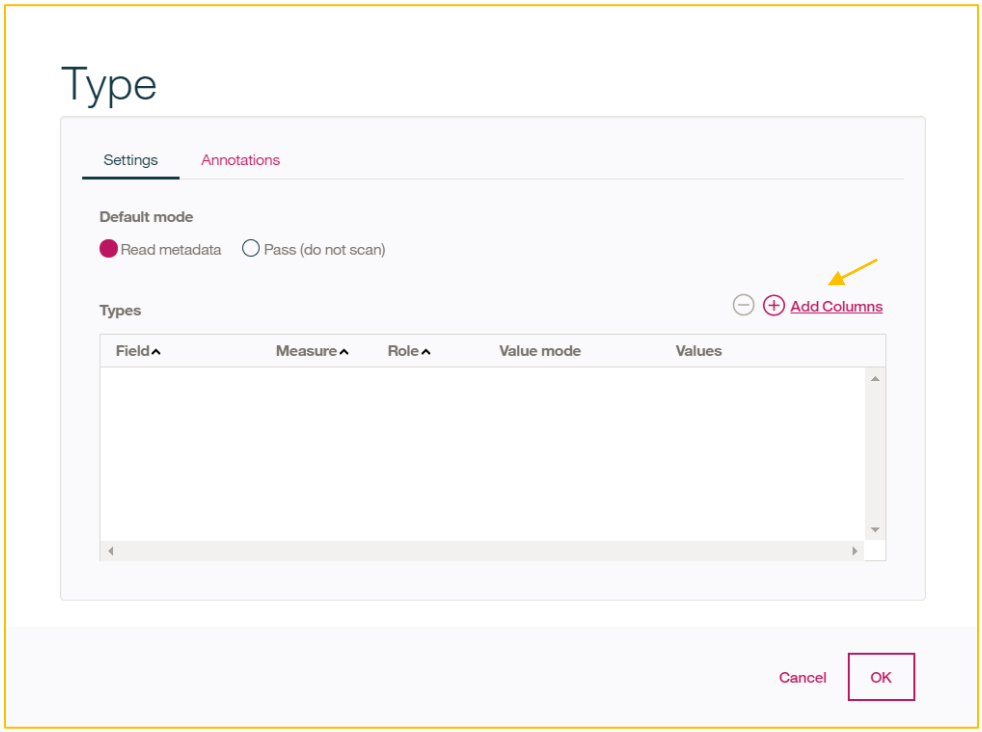
2. Double click on the Partition node. Set the Training Partition to 70 and the Test Partition to 30. Leave the other defaults, and click on OK.



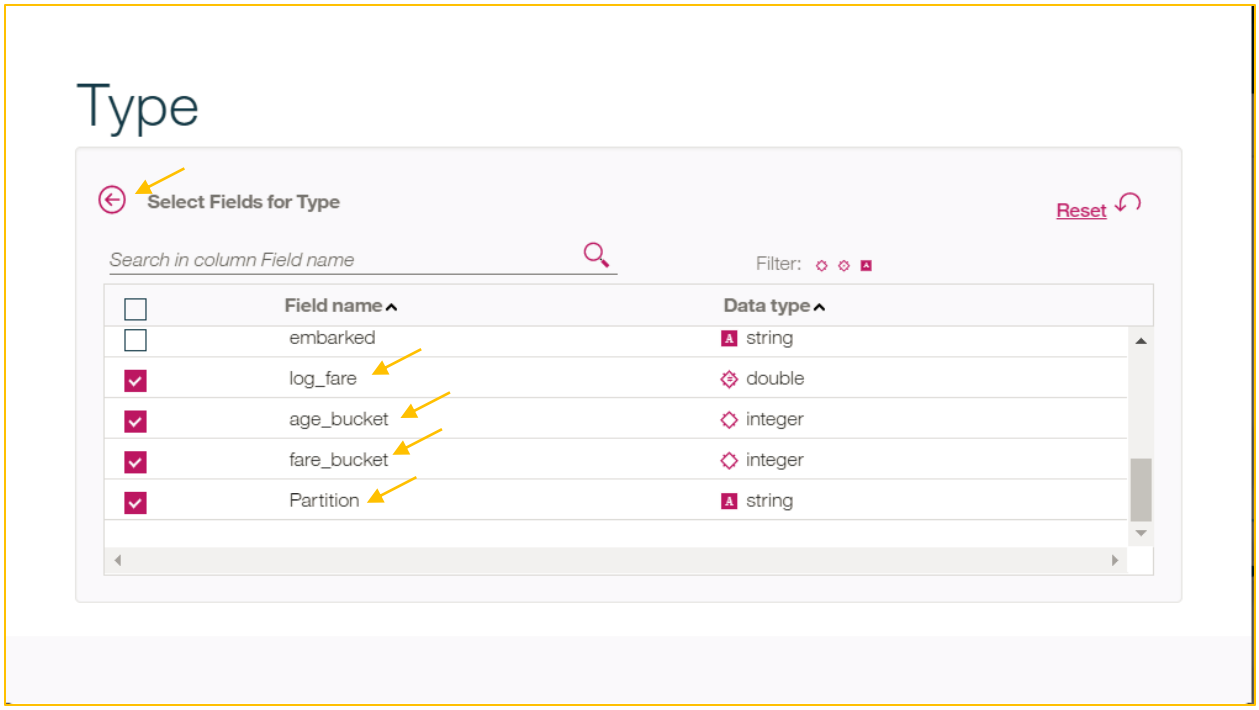
3. Add a **Type** node by clicking on the **Field Operations** in the Node palette and dragging the **Type** node onto the canvas above the **Partition** node. Connect the **Partition** node to the **Type** node. The canvas should appear as below.



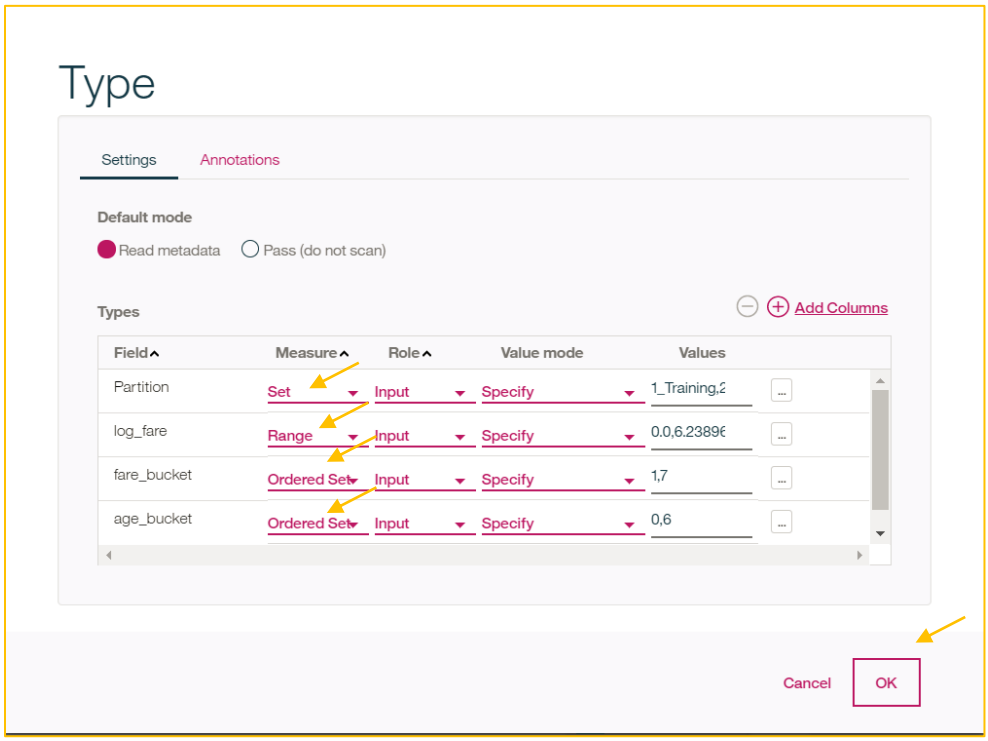
4. Double click on the **Type** node. Click on **Add Columns**.



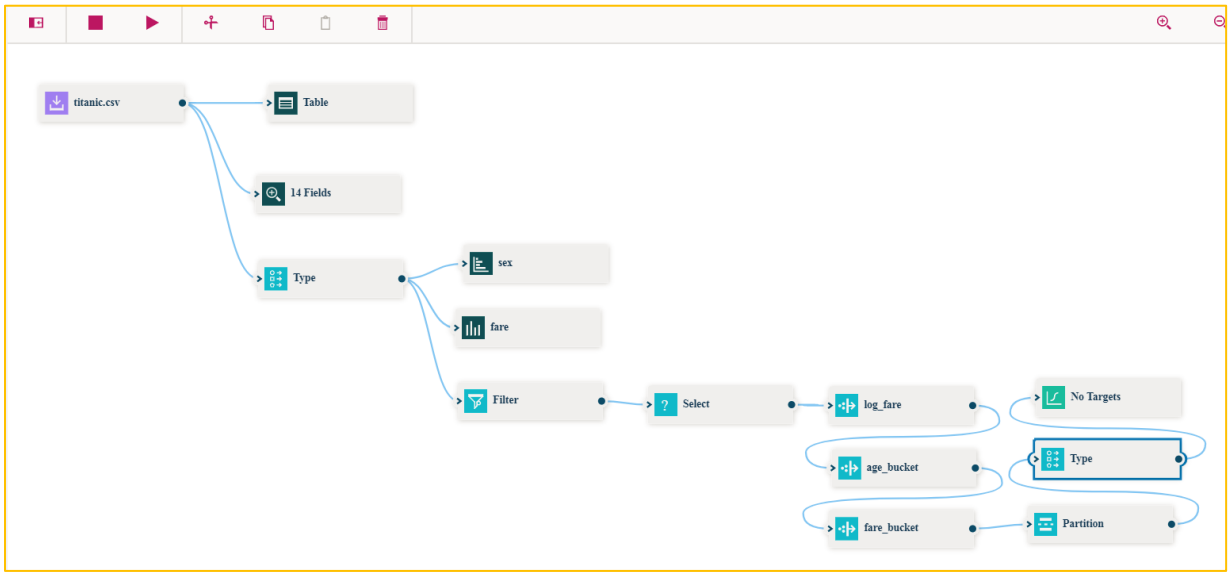
5. Click on checkboxes adjacent to the log_fare, age_bucket, fare_bucket, and Partition fields. Click on Select Fields for Type.



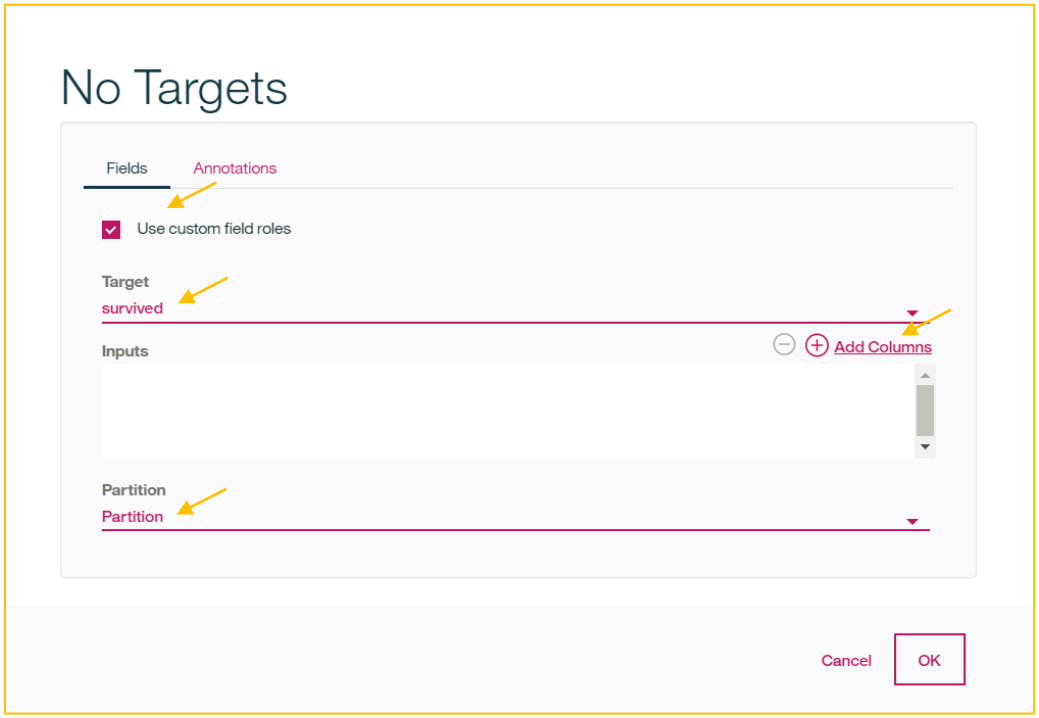
6. For the **Partition** field, select **Set** for the **Measurement**. For the log_fare, select **Range** for the **Measurement**. For the fare_bucket field, select **OrderedSet** for the **Measurement**, and for the age_bucket, select **OrderedSet** for the **Measurement**, and click **OK**.



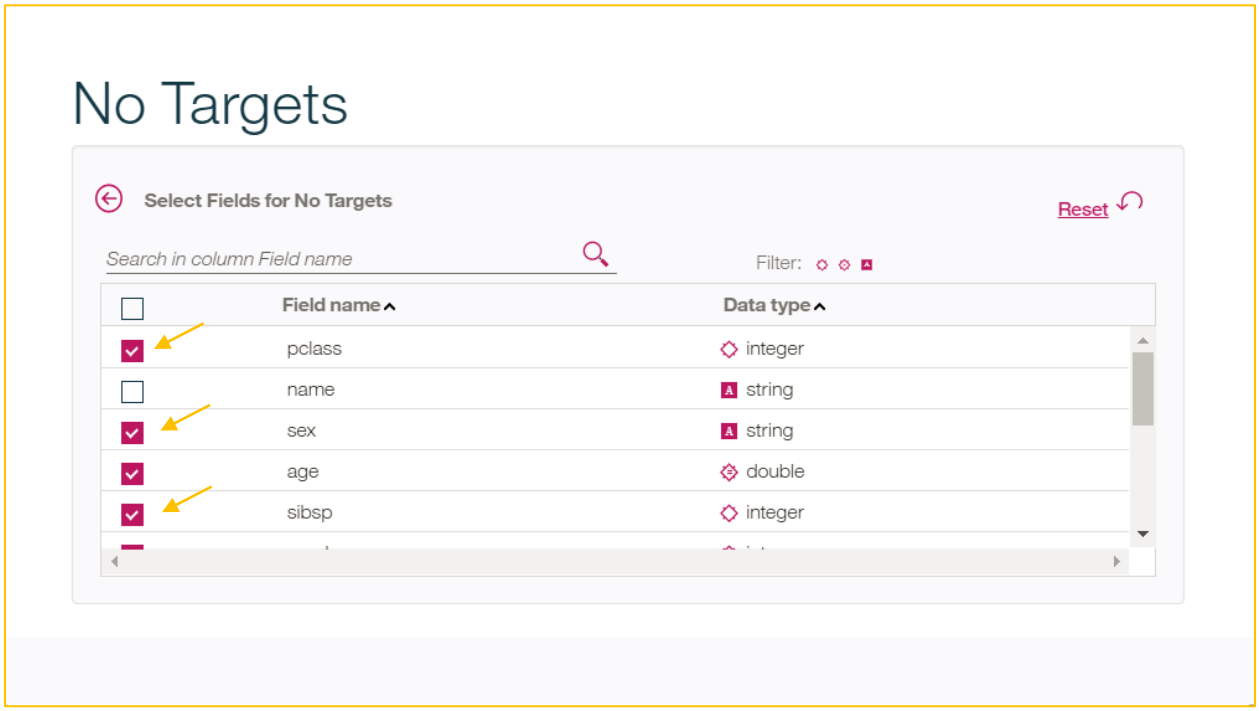
7. Add a **Logistic Regression** node by clicking on the **Modeling** menu item in the Node palette and dragging the **Logistic** node onto the canvas above the **Type** node. Connect the **Type** node to the **Logistic Regression** node. The canvas should appear as below.



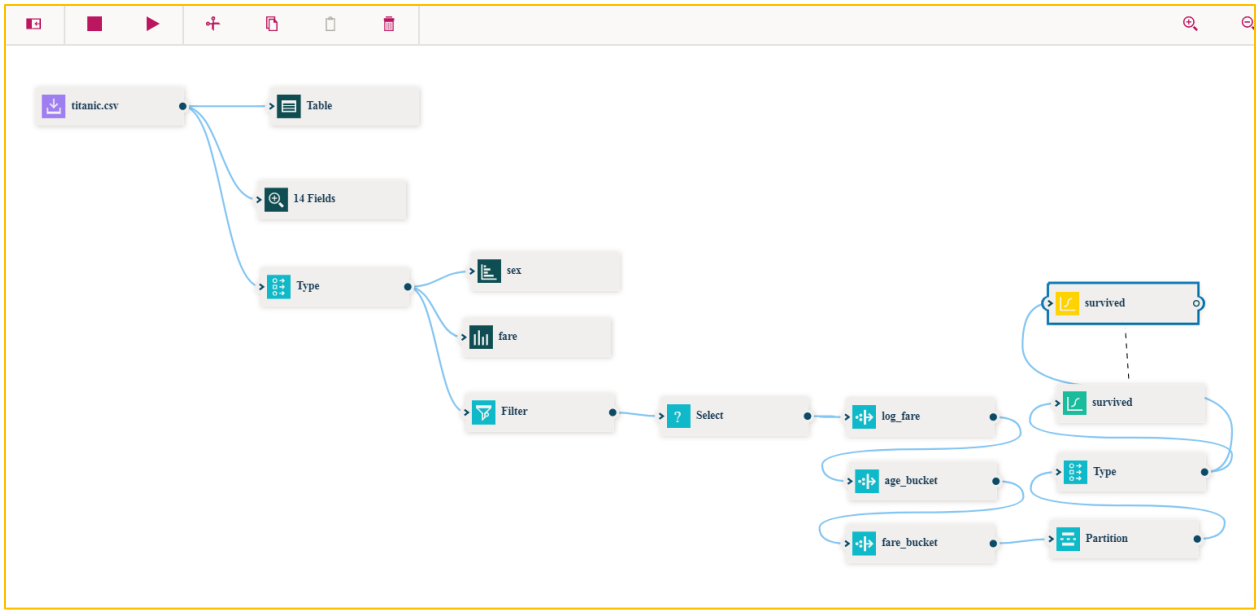
8. Double click on the **Logistic Regression** node. Click on the checkbox next to **Use custom field roles**, select **survived** for the **Target**, select **Partition** for the **Partition**, and click on **Add Columns** to add the input fields.



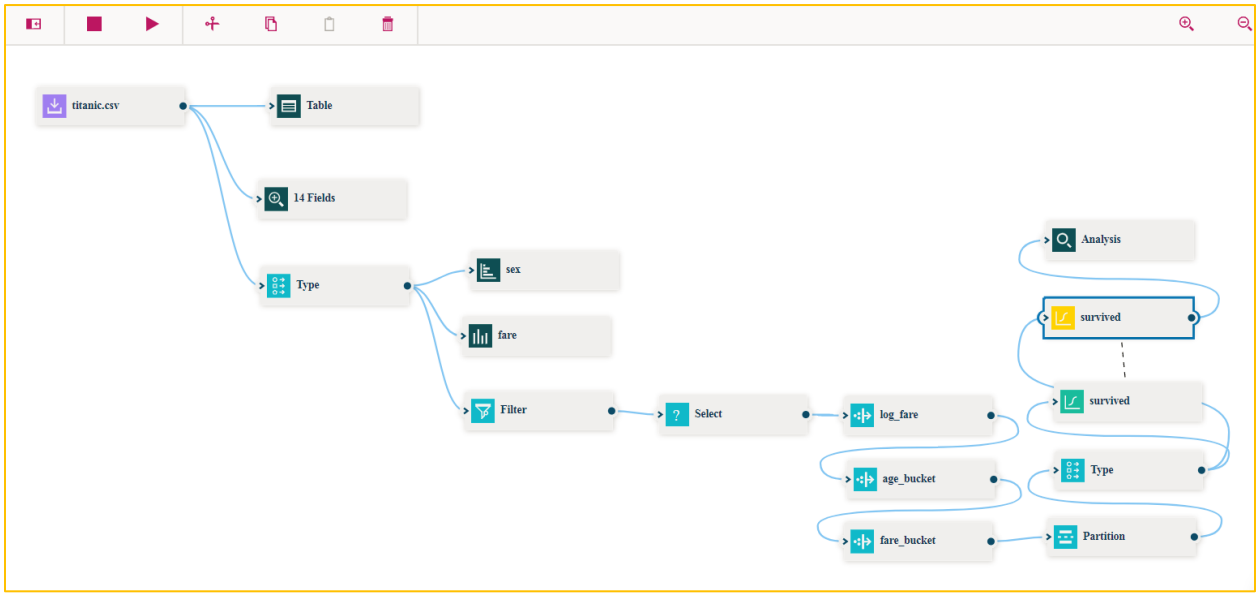
9. Click on the checkboxes next to pclass, sex, sibsp, parch, embarked, age_bucket, fare_bucket fields, and then click the arrow to the left of the **Select Fields for No Targets**. Note that both the age field and the fare field appear to get automatically checked when the selection is made for age_bucket and fare_bucket. This appears to be a bug.



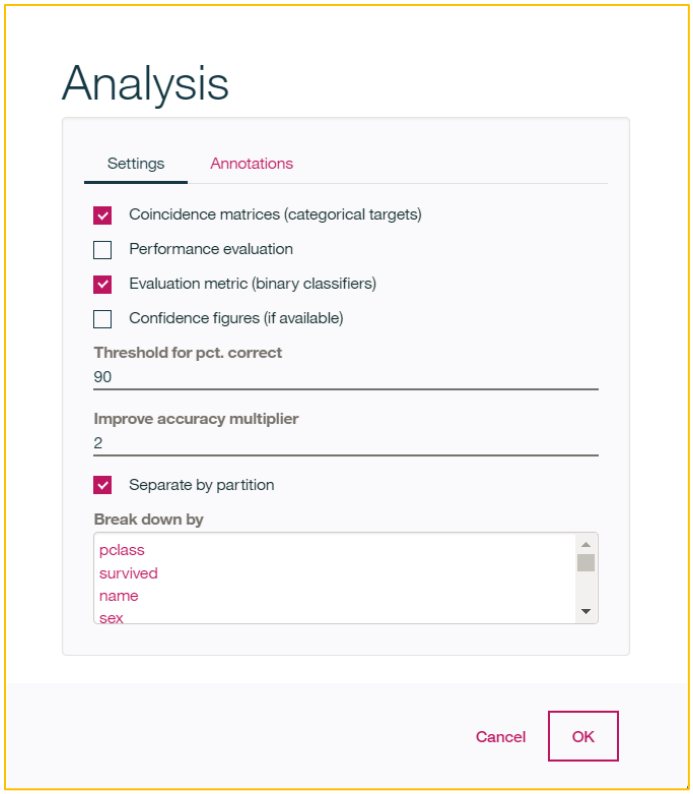
10. Right click on the **Logistic Regression** node and then click **Run**. A **Logistic Regression** "nugget will be created" connected by a dotted line to the **Logistic Regression** node. Drag the nugget and place it above the **Logistic Regression** node. The canvas should appear as below.

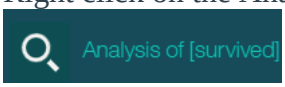


11. Add an **Analysis** node by clicking on the **Outputs** menu item in the Node palette and dragging the **Analysis** node onto the canvas above the nugget icon. Connect the nugget icon to the **Analysis** node. The canvas should appear as below.



12. Double click on the Analysis node. Click on the Coincidence matrices checkbox, click on the Evaluation metric checkbox, click on the Separation by partition checkbox and click on OK.



13. Right click on the Analysis node, and select Run. After completion, double click on the 

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	587	80.08%	251	80.97%
Wrong	146	19.92%	59	19.03%
Total	733		310	

Coincidence Matrix for $L-survived (rows show actuals)

'Partition' = 1_Training	0	1
0	369	62
1	84	218

'Partition' = 2_Testing	0	1
0	159	28
1	31	92

Evaluation Metrics

'Partition'	1_Training		2_Testing	
Model	AUC	Gini	AUC	Gini
$L-survived	0.855	0.709	0.857	0.714