

Governed MLOps Workshop

Validate and Monitor AI Models

with Watson OpenScale

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Introduction

A key component of an AI Governance solution is the ability to validate and monitor AI models for accuracy, fairness, explainability and drift. These capabilities deliver trustworthy AI which business leaders can safely adopt in their business processes and customer engagements. With multiple client engagements, we have found that having the confidence to trust AI models is just as important, and sometime even more important, than the performance of the AI models. Watson OpenScale, a component of Watson Studio and Cloud Pak for Data, is one of the critical components to deliver trustworthy AI and enable monitoring of AI models for fairness, explainability and drift.

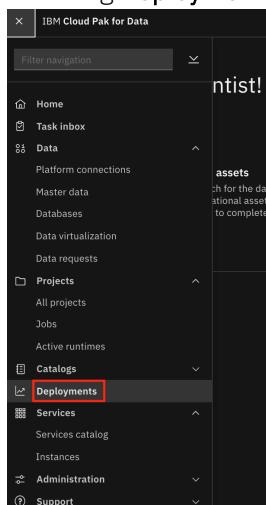
Next, we show how to leverage Watson OpenScale to monitor the churn prediction model we deployed to WML (in previous module).

Watson OpenScale Setup

Deployment Space Access for Admin

Before working with OpenScale, you need to make sure that the admin user has been given access to the deployment space(s) where the AI models have been deployed. In this lab, we're assuming the admin user is the one running model validation in Watson OpenScale. In practice, however, it can be another data science team responsible for this task. Either way, the user(s) responsible for AI model validation should be explicitly given access to the churnUATspace deployment space where the model was deployed.

- 1- Log into Cloud Pak for Data as **datascientist** user.
- 2- Navigate to your Deployment space by clicking on the Navigation menu (top left hamburger icon) and selecting **Deployments** (annotated with red rectangle).



- 3- On the Deployments page, select the **Spaces** tab (annotated with red oval) and click the **churnUATspace** (annotated with red oval).

The screenshot shows the 'Deployments' page with the 'Spaces' tab selected. There are two deployment spaces listed: 'churnUATspace' and 'churndev'. The 'churnUATspace' row has a red arrow pointing to its name.

Name	Last modified	Your role	Collaborators	Tags	Online deployments	Jobs
churnUATspace	Jan 22, 2022 6:13 PM	Admin	0		1	0
churndev	Jan 22, 2022 4:12 PM	Admin	0		1	0

- 4- On the churnUATspace page, click the **Manage** tab (annotated with red oval), then select the **Access control** (annotated with red rectangle) and click the Add collaborators drop down and select **Add users** (annotated with red arrow).

The screenshot shows the 'churnUATspace' page with the 'Manage' tab selected. Under the 'Access control' section, there is a list of users. A red arrow points to the 'Add users' button in the 'Add collaborators' dropdown menu.

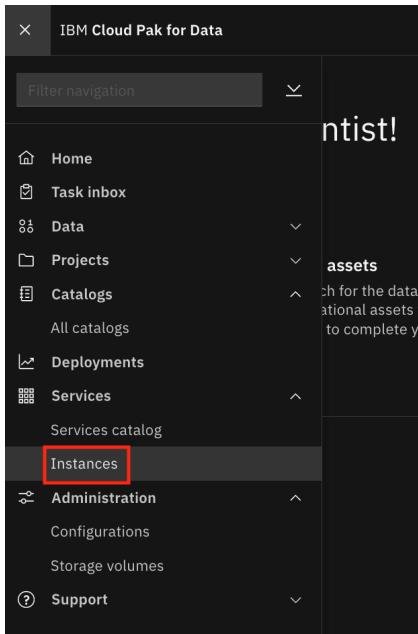
- 5- Click the check box next to **admin** user (annotated with red arrow) and select the role as **Editor** (annotated with red oval). Click **Add**.

The screenshot shows the 'Add users as collaborators' dialog. It lists 10 users, with one user named 'admin' selected. A red arrow points to the checkbox next to the 'admin' user. To the right, a dropdown menu shows the 'Editor' role selected, indicated by a red oval.

Configure Watson OpenScale

In this section, you step through the configuration of Watson OpenScale for validating the deployed churn prediction model in the churnUATspace deployment space.

- If logged in as **datascientist** user, log out and log into Cloud Pak for Data as **admin** user.
- Navigate to the service instance on your Cloud Pak for Data cluster by clicking on the Navigation menu (top left hamburger icon) and selecting **Services → Instances**.



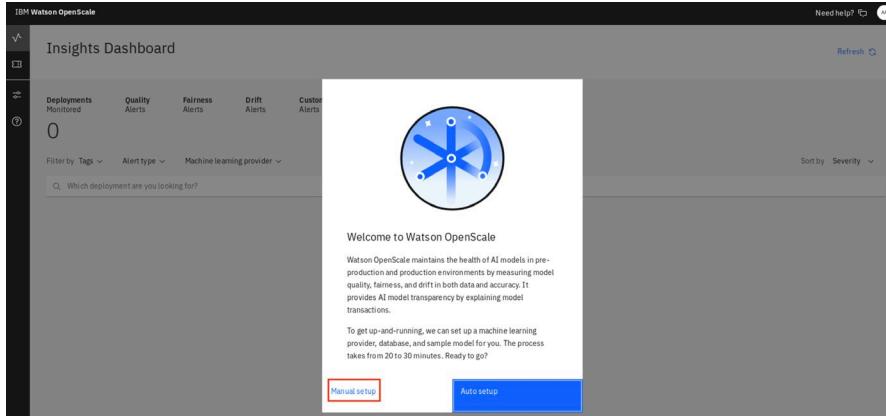
- 3- On the Instances page, find the **openscale-defaultinstance** (annotated with red rectangle) click the open drop down (annotated with red arrow) and click **Open** (annotated with red oval).

The screenshot shows the 'Instances' page with a list of existing instances. The instance named 'openscale-defaultinstance' is highlighted with a red rectangle. A red arrow points to the 'Open' button in the context menu that appears when clicking on the three-dot ellipsis next to this row. The table columns include Name, Type, Created by, vCPU requests, Memory requests (GiB), Users, Status, and Created on.

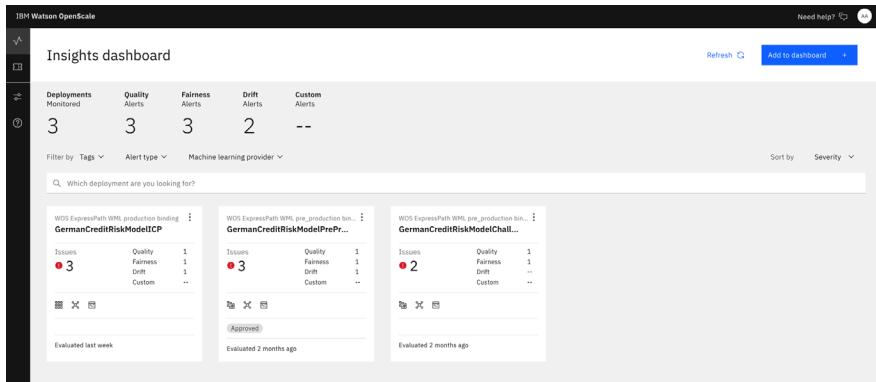
Name	Type	Created by	vCPU requests	Memory requests (GiB)	Users	Status	Created on	Actions
m0m-cr	mdm	admin	60.56	110.02 Gi	1	Green	Oct 28, 2021	⋮
D00-1	db2oltp	admin	2.20	5.75 Gi	1	Green	Oct 28, 2021	⋮
data-virtualization	dv	admin	11.60	38.70 Gi	5	Green	Oct 28, 2021	⋮
openscale-defaultinstance IBM Watson OpenScale	aios	admin	0.00	0.00 Gi	1	Green	Oct 27, 2021	⋮
data-management-console	dmc	admin	3.70	9.50 Gi	1	Green	Oct 27, 2021	⋮

- 4- When Watson OpenScale launches the first time, you would see a landing page with proposition to run **Auto setup**. Auto setup automatically trains, deploys, and sets up monitoring of three machine learning models. Each of these models is trained on German Credit Risk dataset to predict likelihood of customer loan default. These models can be used to get acquainted with Watson OpenScale and see all its capabilities without manual monitoring setup. In general, it is useful to leverage Auto setup to get acquainted with OpenScale and demo its capabilities.

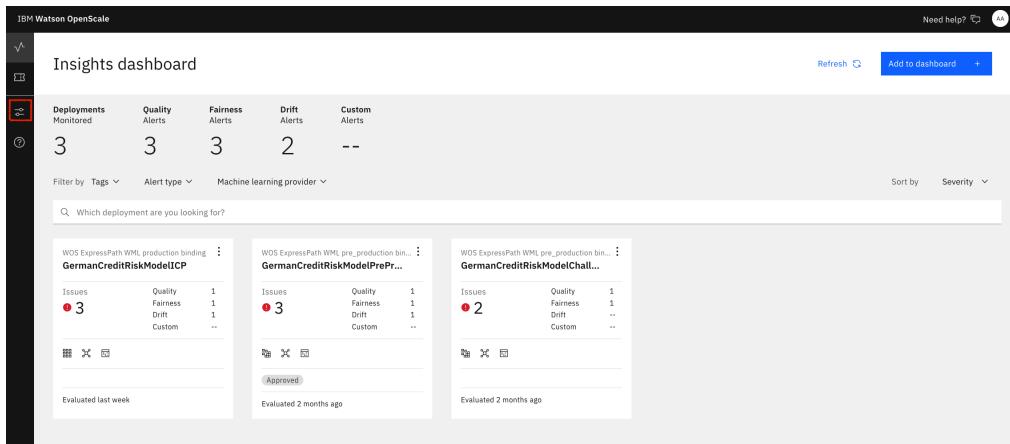
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For this workshop environment, OpenScale has already been configured and setup to monitor three AI models for credit risk prediction. When you log into OpenScale, you will see a dashboard showing the 3 models being monitored as showed in the figure below.



- On the OpenScale dashboard page, select the Configure icon which is the 3rd icon in the left navigation column (annotated with red rectangle).



- Select **Machine learning providers** tab (annotated with red oval) and click **Add machine learning provider** (annotated with red arrow).

The screenshot shows the 'System setup' page of the IBM Watson OpenScale interface. On the left, there's a sidebar with links: 'Database', 'Machine learning providers' (which is highlighted with a red circle), 'Batch support (optional)', 'Integrations (optional)', and 'Users & roles'. The main content area is titled 'Machine learning providers' and contains a 'Description' field with the placeholder 'Watson OpenScale connects to deployed models stored in a machine learning environment.' At the bottom right of this section is a blue button labeled 'Add machine learning provider' with a '+' sign.

- 7- Provide a Name **WML** and Description (Watson Machine Learning provider on Cloud Pak for Data) for the machine learning provider by clicking the pencil icons (annotated with red arrows). Then click the pencil icon next to **Connection**.

The screenshot shows the 'New provider' creation page. In the center, there's a 'New provider' form with a 'Description' field containing the placeholder 'Click edit to enter provider description.' To the left of the form is a link 'Machine learning providers' with a red arrow pointing to its edit icon. Above the form is a 'Back to all providers' link with a red arrow pointing to its edit icon. To the right of the form is a 'Connection' section with a red box around it and a red arrow pointing to its edit icon.

- 8- For the Connection configuration, you need to specify a number of parameters for OpenScale to connect to the Watson Machine Learning as the provider.

- ⇒ Service provider: select **Watson Machine Learning (V2)** service (annotated with red arrow). Watson OpenScale has out of the box support for monitoring machine learning models deployed to:
 - IBM Watson Machine Learning
 - Amazon SageMaker
 - Microsoft Azure ML Studio
 - Microsoft Azure ML Service

Additionally, Watson OpenScale can monitor machine learning models deployed in other environments by using the Custom Environment capability. For this lab, we will select the Watson Machine Learning (V2) service to monitor the model we deployed in the earlier modules.

Service provider

Watson Machine Learning (V2)

- Watson Machine Learning (V2)
- Custom Environment
- Amazon SageMaker
- Microsoft Azure ML Studio
- Microsoft Azure ML Service



Environment type

Pre-production Production

- ⇒ Location: select Local which indicates that the Watson Machine Learning service is running locally on the same Cloud Pak for Data cluster as OpenScale.

Location

Local

- Local
- IBM Cloud
- Cloud Pak for Data

- ⇒ Deployment space: select the **churnUATspace** (annotated with red rectangle). Generally, there may be multiple deployment spaces and you need to select the one where the machine learning model you need to monitor is deployed. You can select the refresh icon (annotated with red arrow) to refresh the list of deployment spaces if they don't automatically update.

Lastly, specify the Environment type as Pre-production.

Click **Save**.

Service provider

Watson Machine Learning (V2)

Location

Local

Deployment space

churnUATspace

churnUATspace

Environment type

Pre-production Production



Cancel

- 9- When the configuration is complete, you will see a new tile for the new machine learning provider you just configured (annotated with red rectangle).

The screenshot shows the 'System setup' page under 'Machine learning providers'. It lists 'WML' with a description 'WML on CPD'. A red box surrounds the WML entry, and a red arrow points to the 'View & edit details' button.

Click on the action menu (annotated with red arrow) and select View & edit details (annotated with red oval) to view the details of the WML machine learning configuration which would appear as follows:

The screenshot shows the detailed view of the WML provider. It includes a back-to-all-providers link, a description of 'Watson Machine Learning on Cloud Pak for Data', and a 'Connection' section. The 'Connection' section is highlighted with a blue box. It contains fields for Service provider (Watson Machine Learning (V2)), Location (Local), URL (https://aopenscale-ibm-aios-nginx-internal.cpd-instance), Space (churnUATspace), and Environment type (Pre-production).

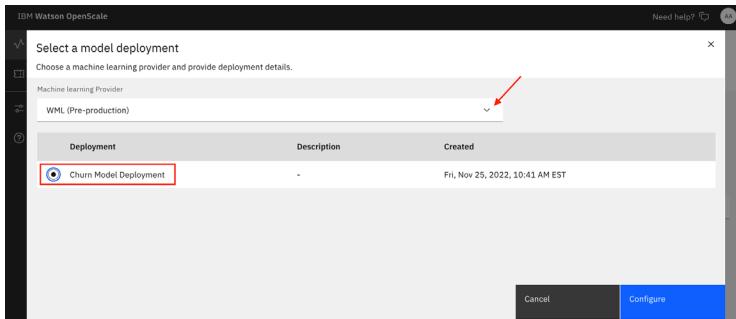
10- Next, click on the Insights dashboard icon (first icon in the left navigation column; annotated with red circle). Then click on Add to dashboard (annotated with red arrow) to select the model you would like to monitor.

The screenshot shows the Insights Dashboard. It displays deployment monitoring statistics: 0 Monitored Deployments, 0 Quality Alerts, 0 Fairness Alerts, 0 Drift Alerts, and 0 Custom Alerts. A red arrow points to the 'Add to dashboard' button in the top right corner.

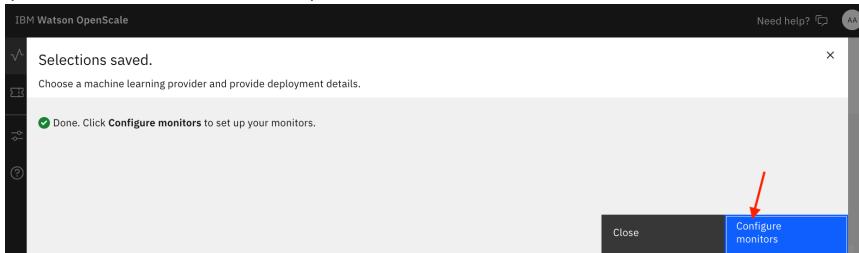
11- From the Machine learning Provider drop down (annotated with red arrow), select **WML (Pre-production)**. Watson OpenScale will pull all the deployed models of the selected machine learning provider. Of the list of deployed models, select the **Churn Model Deployment** model you would like to monitor (annotated with red rectangle).

After selecting the model, click **Configure** which becomes active once a model is selected.

**** Note that the list of models you will see may be different from what is in the figure below.**

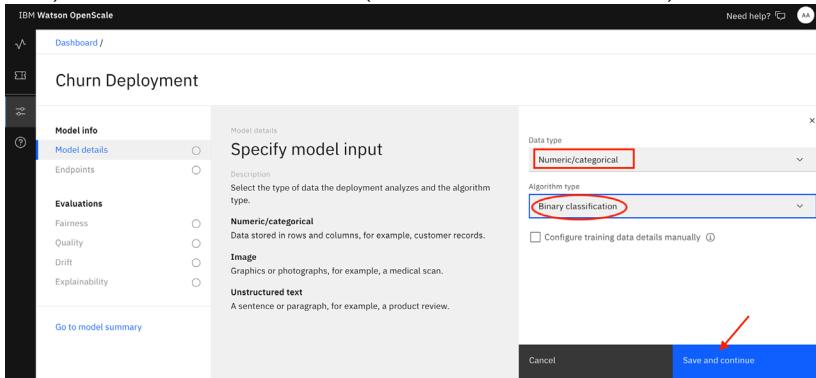


- 12- You should see a “Selections saved” message as shown below. Click **Configure monitors** (annotated with red arrow).



- 13- First step in configuring monitors is to provide model details. Specifically, we need to provide information on the model input and output as well as the training data.

Click on the pencil icon in the Model Input section and specify data type and algorithm type. For the churn prediction model we are monitoring, select the Data type as Numerical/categorical (annotated with red rectangle) and the Algorithm type as Binary classification (annotated with red oval). Click **Save and continue** (annotated with red arrow).



- 14- Next, click on Training data to provide connection information so Watson OpenScale can connect to the training data and extract the statistics needed for monitoring.

Review Why does OpenScale need access to my training data for more details on why the training data is needed. Some clients prefer not to share their training data and OpenScale supports that by requesting the clients provide training data statistics information which they can obtain by running through a custom notebook that is available on github.

Watson OpenScale supports reading training data from Db2 or Cloud Object Storage (COS). The Restricted option is when the client wants to provide only training data statistics by executing the custom notebook.

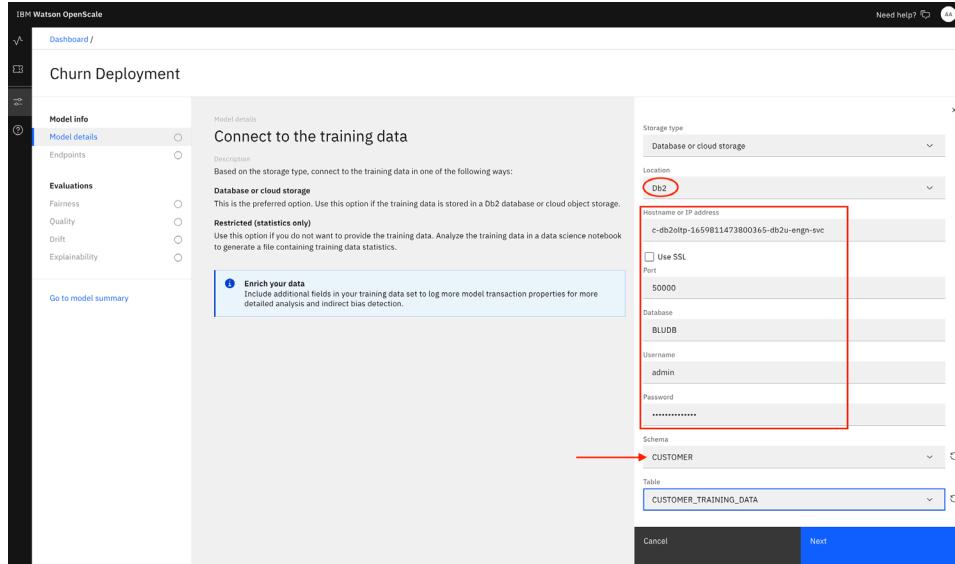
Provide the information for OpenScale to access the training data.

- ⇒ Storage type: select Database or cloud storage
 - ⇒ Location: select Db2 (annotated with red oval)
- Provide the connection details for your Db2 instance running on the same Cloud Pak for Data cluster.

```
"hostname": c-db2oltp-1683678931053869-db2u-engn-svc
"port": 50000
"Database": BLUDB,
"username": admin,
"password": YOUR_ADMIN_PASSWORD
```

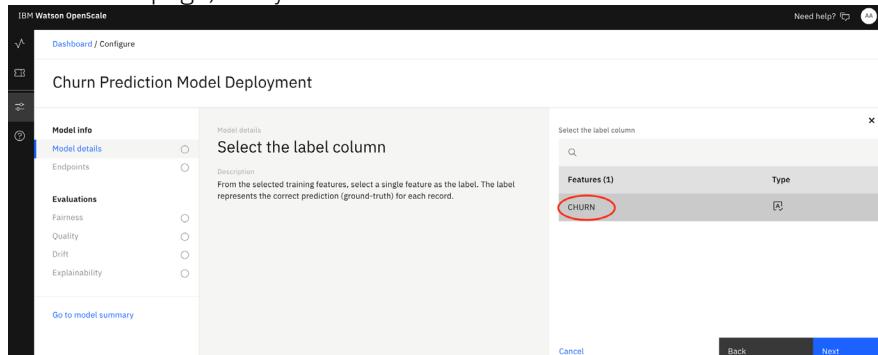
After providing the connection information (annotated with red rectangle), click Connect to verify the credentials are correct. Once connection is successful, select:

- ⇒ Schema: select **CUSTOMER** (annotated with red arrow)
- ⇒ Table: select **CUSTOMER_TRAINING_DATA** (annotated with blue rectangle)



Click **Next**.

15- On the next page, verify the label column as the **CHURN** column and click **Next**.



16- For training features, accept the default which selects all the features and click **Next**.

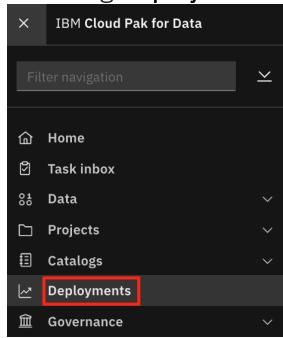
- 17- Next, you should see the following page “Examining model output” and as explained on that page, we need to send a scoring request to the deployed ML model so Watson OpenScale can be prepared for tracking and storing the transactions processed by this ML model.

For Watson Machine Learning, Automatic logging option is supported and is probably the easiest method to enable Watson OpenScale to understand the schema of the input payload and output response.

In OpenScale, select **Automatic logging**.

In a second browser tab, navigate to your model deployment in Cloud Pak for Data to run one transaction of inference against the model so OpenScale can detect the schema. Please make sure to open another browser tab for this step so it is easier to continue with OpenScale configuration in the next step (step 18) in the previous browser tab where OpenScale is already open.

- Log into Cloud Pak for Data as **admin** user.
- Navigate to deployments by clicking the Navigation menu (top left hamburger icon) and selecting **Deployments** (annotated with red rectangle).



- On the Deployments page, select the **Spaces** tab (annotated with red oval) and click the **churnUATspace** (annotated with red arrow).

The screenshot shows the 'Spaces' tab selected in the navigation bar. Below it, a table lists a single space named 'churnUATspace'. A red arrow points to the 'Name' column of this row.

Name	Last modified	Your role	Collaborators	Tags	Online deployments	Jobs
churnUATspace	Jan 22, 2022 6:13 PM	Editor	AA DD		1	0

- d- On the churnUATspace page, click the **Deployments** tab (annotated with red oval) and select the name of your deployment **Churn Model Deployment** (annotated with red arrow).

The screenshot shows the 'Deployments' tab selected in the navigation bar. Below it, a table lists one deployment named 'Churn Model Deployment'. A red arrow points to the 'Name' column of this row.

Name	Type	Status	Asset	Tags	Last modified
Churn Model Deployment	Online	Deployed	Churn Model		Nov 25, 2022 10:41 AM

- e- On the deployment page, click the **Test** tab (annotated with red oval). Then provide a sample payload in JSON format by clicking **JSON input** tab (annotated with red arrow). Click **Predict** button (annotated with red rectangle) to have the trained ML model predict the likelihood of the customer to churn based on the provided feature values.
 Note please be careful with copy/paste as sometimes new line breaks can cause formatting errors. Feel free to use the OpenScale Logging Payload Sample boxnote to copy/paste from.

```
{
  "input_data": [
    {
      "fields": ["ID", "LONGDISTANCE", "INTERNATIONAL", "LOCAL", "DROPPED", "PAYMETHOD", "LOCALBILLTYPE", "LONGDISTANCEBILLTYPE", "USAGE", "RATEPLAN", "GENDER", "STATUS", "CHILDREN", "ESTINCOME", "CAROWNER", "AGE"],
      "values": [[1, 28, 0, 60, 0, "Auto", "FreeLocal", "Standard", 89, 4, "F", "M", 1, 23000, "N", 45]]
    }
  ]
}
```

The screenshot shows the 'Churn Model Deployment' page in the IBM Cloud Pak for Data interface. The 'Test' tab is selected. In the 'Enter input data' section, there are two buttons: 'Text input' and 'JSON Input', with a red arrow pointing to 'JSON Input'. Below these buttons is a text area containing JSON input data. At the bottom right of the input area is a 'Predict' button, which is also highlighted with a red rectangle.

- 18- Navigate back to the previous browser tab where OpenScale was open and click **Check Now** button and you should get a message indicating that **Logging is active** (annotated with red rectangle). If you don't see this message, give it a few seconds and click Check Now again. Click **Next**.

The screenshot shows the 'Scoring method' configuration page in OpenScale. It has a dropdown menu set to 'Automatic logging'. Below the dropdown, a message box contains the text 'Logging is active Click Next', which is highlighted with a red rectangle. At the bottom, there are 'Back' and 'Next' buttons, with the 'Next' button being blue and highlighted with a red arrow.

- 19- On the Specify model output details page, specify the **predictedLabel** as the Prediction (annotated with red rectangle). Please note to map **predictedLabel** (and NOT prediction) to Prediction. Also, note the probability feature is already mapped to Probability (annotated with red oval). OpenScale needs the prediction and probability information for purposes of drift detection, debiasing and explainability.
Click **Save** (annotated with red arrow).

The screenshot shows the 'Specify model output details' step in the IBM Watson OpenScale interface. On the left, a sidebar lists 'Model info', 'Model details' (selected), 'Endpoints', 'Evaluations' (Fairness, Quality, Drift, Explainability), and 'Go to model summary'. The main panel has sections for 'Model details' and 'Specify model output details'. In 'Specify model output details', there are fields for 'Select the prediction column' (PAYMENTHOD_ID) and 'Select the prediction probability column' (predictedLabel). A note says 'Watson OpenScale automatically selected the probability column for this model.' A modal window titled 'Features (11)' lists columns: PAYMENTHOD_ID, LOCALIBILITYTYPE_ID, LONGDISTANCEABILITYTYPE_ID, GENDER_ID, STATUS_ID, CAROWNER_ID, features, rawPrediction, predictedLabel (selected), prediction, and probability. A red box highlights the 'predictedLabel' row, and a red arrow points to the 'Save' button at the bottom right of the modal.

At this point, we provided all the required information to Watson OpenScale to prepare it for monitoring the deployed machine learning model. In the next steps, we configure the monitors for Quality and Fairness.

- 20- Select **Quality** (annotated with red rectangle) and click the pencil icon (annotated with red arrow) to configure quality monitor in Openscale. As explained on the Quality page, Watson OpenScale can monitor the Quality metric which measures the model's ability to correctly predict outcomes that match labeled data.

The screenshot shows the 'Churn Model Deployment' page in the IBM Watson OpenScale interface. The sidebar shows 'Model info', 'Model details' (selected), 'Endpoints', 'Evaluations' (Fairness, Quality, Drift, Explainability), and 'Go to model summary'. The main panel shows a 'Quality' tab selected. A note says 'The Quality monitor evaluates how well your model predicts accurate outcomes. It identifies when model quality declines, so you can retrain your model appropriately.' Below it, another note says 'Note: The Quality metric measures the model's ability to correctly predict outcomes that match labeled data (ground truth) provided by humans. The quality metrics evaluated are standard data science statistics based on model type. [Learn more](#)'.

- 21- Specify the Threshold values to 0.9 for all metrics and click Next. This means that when the metrics go below 0.9, the quality monitor will flag an alert.

Metric	Lower Threshold	Upper Threshold
Area under ROC	0.9	
Area under PR	0.9	
Accuracy	0.9	
True positive rate (TPR)	0.9	
Recall	0.9	
Precision	0.9	
F1-Measure	0.9	
False positive rate (FPR)	0.9	
Logarithmic loss	0.9	

- 22- Next, change the minimum sample size to **100**, and leave the Maximum sample size blank. For this lab, a small sample size is sufficient to illustrate functionality but in practice, you should use larger sample sizes to make sure they're representative of the requests the model receives. Click **Save**.

Minimum sample size	100
Maximum sample size (optional)	10000

- 23- Review Quality monitor configuration summary page (no action in this step).

Quality Metric	Lower Threshold	Upper Threshold
Area under ROC	0.9	
Area under PR	0.9	
Accuracy	0.9	
True positive rate (TPR)	0.9	
Recall	0.9	
Precision	0.9	
F1-Measure	0.9	
False positive rate (FPR)	0.9	
Logarithmic loss	0.9	

Sample size

- Minimum sample size: 100
- Maximum sample size (optional):

- 24- Next, select **Fairness** (annotated with red rectangle in figure below) and click the pencil icon (annotated with red arrow) to select configuration type.

In the fairness monitor, you specify to Watson OpenScale which features to monitor and what are the favorable outcomes. The Watson OpenScale fairness monitor determines whether outcomes that are produced by your model are fair or not for monitored group. When fairness monitoring is enabled, it generates a set of metrics every hour by default. You can generate these metrics on demand by clicking the Check fairness now button or by using the Python client.

Watson OpenScale automatically identifies whether any known protected attributes are present in a model. When Watson OpenScale detects these attributes, it automatically recommends configuring bias monitors for each attribute present, to ensure that bias against these potentially sensitive attributes is tracked in production.

Currently, Watson OpenScale detects and recommends monitors for the following protected attributes (sex, ethnicity, marital status, age, zip code).

The screenshot shows the Watson OpenScale dashboard for a 'Churn Model Deployment'. On the left sidebar, under 'Evaluations', the 'Fairness' tab is selected and highlighted with a red box. The main content area displays the 'Fairness' configuration page. It includes a 'Description' section with instructions about monitoring for bias based on favorable outcomes. To the right, there are four configuration sections: 'Configuration', 'Favorable outcomes', 'Sample size', and 'Metrics', each with an edit icon. A red arrow points to the edit icon in the 'Configuration' section.

25- Select **Configure manually** for the Configuration type and click **Next**.

This screenshot shows a modal dialog titled 'Configuration' from the Watson OpenScale interface. It asks how to configure fairness: 'Configure manually' or 'Upload configuration file'. The 'Configure manually' option is selected and highlighted with a red box. At the bottom of the dialog are 'Cancel' and 'Next' buttons, with 'Next' being highlighted in blue.

26- Next, select the favorable outcomes, specify F (false) as Favorable value and T (true) as Unfavorable value. Click **Next**.

This screenshot shows a modal dialog titled 'Select the favorable outcomes' from the Watson OpenScale interface. It lists two values: 'F' and 'T'. For 'F', the 'Favorable' checkbox is checked and highlighted with a red box. For 'T', the 'Unfavorable' checkbox is checked. At the bottom are 'Cancel' and 'Next' buttons, with 'Next' being highlighted in blue.

27- Next, select the minimum sample size to be **100**. In practice, you may want to select a larger sample size to make sure it is representative.

The screenshot shows the 'Churn Model Deployment' interface in IBM Watson OpenScale. On the left, a sidebar lists 'Model info', 'Endpoints', 'Evaluations' (selected), 'Explainability', and 'Go to model summary'. The main panel displays the 'Fairness' section under 'Evaluations'. A sub-section titled 'Sample size' contains a description: 'Ensure that your minimum sample size is large enough to be accurately represent the variety of requests the deployment receives.' It includes fields for 'Minimum sample size' (set to 100) and 'Maximum sample size (optional)' (set to 10000). At the bottom are 'Back' and 'Next' buttons.

28- Next, on the Metrics page, take a minute to read the explanation of how the metrics are used by the monitors, then accept the default metric which is **Disparate impact** (annotated with red oval) and click **Next**.

The screenshot shows the 'Churn Model Deployment' interface in IBM Watson OpenScale. The 'Metrics' section is highlighted with a red box. It contains a description: 'The Fairness monitor tracks multiple fairness metrics. You can select the metrics that will be monitored across the features in the future, and set up some default thresholds. You can always overwrite the default thresholds when setting up the monitored features. Disparate impact is pre-selected as the default fairness metric.' Below this, there's information about metric thresholds and a note that at least one metric must have a threshold. To the right, a 'Select monitored metrics' panel lists several options, with 'Disparate impact' checked and highlighted with a red oval. Other options include 'Statistical parity difference' and various metrics generated with feedback data. At the bottom are 'Back' and 'Next' buttons.

29- Next, on the thresholds page, specify the suggested defaults of 80 and 120 and click **Next**.

The screenshot shows the 'Churn Model Deployment' interface in IBM Watson OpenScale. The 'Metrics' section is displayed. The 'Disparate impact' thresholds are shown: 'Lower threshold for fairness value' is set to 80 and 'Upper threshold for fairness value' is set to 120. Below this, a note states '(Difference metrics are not selected.)'. At the bottom are 'Back' and 'Next' buttons.

- 30- Next, on “Select the fields to monitor” page, keep the recommended selections of GENDER and AGE features to monitor and click Next. These would be the features to be monitored for fairness. Note that Watson OpenScale analyzes the training data we provided and automatically recommends which features to monitor.

The screenshot shows the 'Churn Prediction Deployment' page in Watson OpenScale. The left sidebar has sections for Model info, Endpoints, Evaluations (with Fairness selected), Quality, Drift, Explainability, and Go to model summary. The main content area is titled 'Fairness' and contains a sub-section 'Select the fields to monitor'. It includes a 'Description' text block and a list of fields with checkboxes. Two checkboxes are checked: 'GENDER' and 'AGE'. A red arrow points from the 'Recommended features' callout box to the 'GENDER' checkbox. Another red arrow points from the 'Recommended features' callout box to the 'AGE' checkbox. At the bottom right of the page are 'Back' and 'Next' buttons.

- 31- Next, for the AGE feature, specify the reference and monitored groups. Again, Watson OpenScale automatically recommends which group should be the reference and which group(s) should be monitored by analyzing the training data. Accept the default selections by Watson OpenScale.
****Note**** Check the How it works section in the documentation to better understand how fairness of the model is computed by OpenScale.

The screenshot shows the 'Churn Model Deployment' page in Watson OpenScale. The left sidebar has sections for Model info, Endpoints, Evaluations (with Fairness selected), Quality, Drift, Explainability (with General settings selected), and Go to model summary. The main content area is titled 'Fairness' and contains a sub-section 'Specify the monitored groups for [AGE]'. It includes a 'Description' text block and a table for setting monitored and reference groups. The table has columns for 'Values', 'Monitored', 'Reference', and 'Recommended'. The 'Recommended' column shows 'Monitored' for values 12.34-23.313333 and 23.313334-38.413333, and 'Reference' for 38.413334-52.973333. A red arrow points from the 'Recommended groups' callout box to the 'Monitored' checkboxes. At the bottom right of the page are 'Back' and 'Next' buttons.

- 32- Next, accept the default thresholds for AGE feature and click Next.

- 33- Next, for the GENDER feature, specify the reference and monitored groups as F (Monitored) and M (Reference). Specify the fairness alert threshold to be 95 and click Save.

- 34- Next, accept the default thresholds for GENDER feature and click Save.

- 35- Review the configuration information on the “Fairness summary” page.

The screenshot shows the IBM Watson OpenScale dashboard for a 'Churn Model Deployment'. On the left sidebar, under 'Evaluations', the 'Fairness' tab is selected and highlighted with a red rectangle. A red arrow points to the edit icon next to the 'Configuration' section. The main content area displays the 'Fairness' configuration page, which includes sections for 'Description', 'Configuration file', 'Favorable outcomes' (with F and T listed), and 'Sample size' (set to 100).

****Optional**** You could also configure the Drift monitors. However, we will skip that step for this lab mainly because of time limitations. For details on Drift monitors, check the Drift documentation page.

- 36- Next, you will configure Explainability in Watson OpenScale. Under Explainability in the left navigate panel, select **General settings** (annotated with red rectangle) and click the pencil icon annotated with red arrow) to select which explainability method to apply.

The screenshot shows the IBM Watson OpenScale dashboard for a 'Churn Model Deployment'. On the left sidebar, under 'Explainability', the 'General settings' tab is selected and highlighted with a red rectangle. A red arrow points to the edit icon next to the 'Explanation method' section. The main content area displays the 'General settings' page for Explainability, which includes sections for 'Description', 'Explanation method' (with a note to click the edit icon), 'Controllable features', and 'Language support'.

- 37- On the Explanation method page, enable SHAP global explanation by switching the toggle to **On** (annotated with red oval) and also select **SHAP** for local explanation method. You can hover over the information icon (annotated with red arrow) for a short explanation and comparison between SHAP and LIME methods. For better understanding these algorithms and when to use them, click the **Learn more about these algorithms** hyperlink (annotated with red rectangle) to navigate to the documentation page which provides more details on these algorithms. Click **Next**.

The screenshot shows the 'Churn Model Deployment' page in IBM Watson OpenScale. In the 'Explainability' section, under 'General settings', the 'SHAP' option is selected. A modal window titled 'Explanation method' is open, showing a toggle switch for 'SHAP global explanation' which is turned 'On'. Below it, a dropdown menu for 'Local explanation method' lists 'SHAP (Kernel Explainer)' and 'LIME (enhanced)'. A red circle highlights the 'On' button for SHAP global explanation, and a red arrow points to the dropdown menu.

- 38- On the Controllable features page, review the description of what is meant by controllable features. Keep all the features enabled and click **Save**.

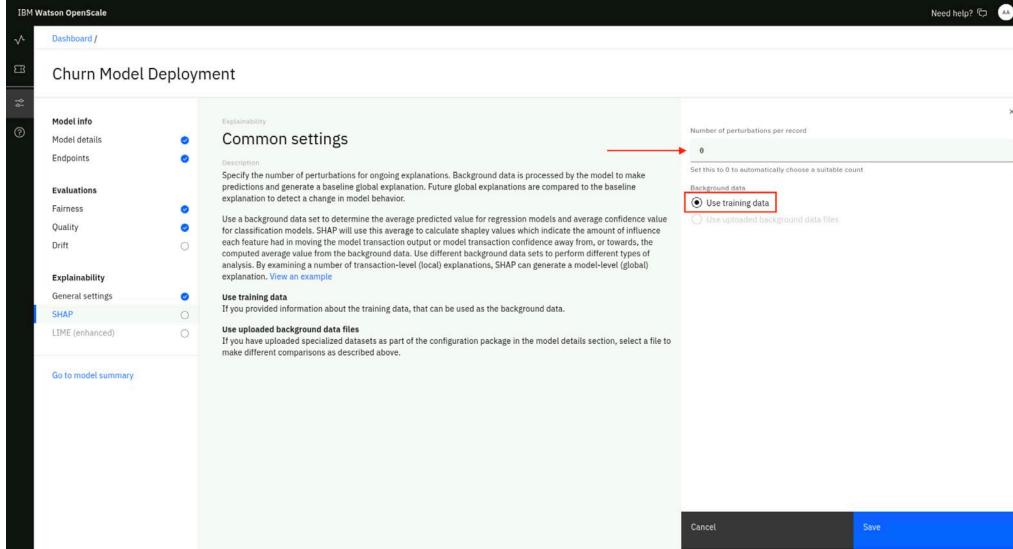
The screenshot shows the 'Churn Model Deployment' page in IBM Watson OpenScale. In the 'Explainability' section, under 'General settings', the 'SHAP' option is selected. A modal window titled 'Controllable features' is open, displaying a table with a list of features: ID, LONGDISTANCE, INTERNATIONAL, LOCAL, DROPPED, PAYMETHOD, LOCALBILTYPE, LONGDISTANCEBILTYPE, USAGE, RATEPLAN, and GENDER. All features have their 'Controllable' toggle switches turned 'On'. A red rectangle highlights the 'SHAP' option in the sidebar, and a red arrow points to the 'Save' button at the bottom right of the modal.

- 39- Next, under Explainability section, click **SHAP** (annotated with red rectangle) and click the pencil icon (annotated with red arrow) to edit SHAP settings.

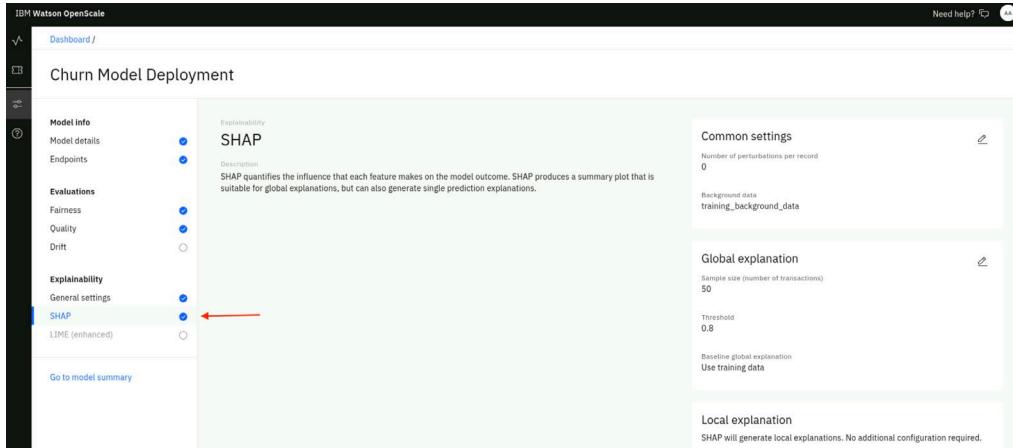
The screenshot shows the 'Churn Model Deployment' page in IBM Watson OpenScale. In the 'Explainability' section, under 'General settings', the 'SHAP' option is selected. The main content area displays three sections: 'Common settings', 'Global explanation', and 'Local explanation'. The 'Common settings' section contains the text 'To configure SHAP explanation, click the edit icon.' with a red arrow pointing to the edit icon. A red rectangle highlights the 'SHAP' option in the sidebar.

40- Accept the defaults for Common Settings and click Save.

- ⇒ 0 for number of perturbations which indicates that Watson OpenScale would automatically choose a suitable count.
- ⇒ Use training data for Background data (annotated with red rectangle).



41- Wait for the SHAP configuration to be complete which is verified by the check mark next to SHAP (annotated with red arrow).



42- You have successfully completed Watson Openscale configuration for fairness, accuracy, and explainability to monitor the customer churn prediction machine learning model.

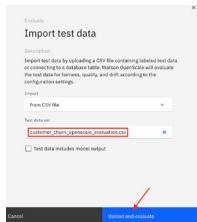
In practice, as your machine learning model is accessed by applications, Watson Openscale will monitor those scoring events and provide a dashboard (as well as APIs) that business/MLOps users can leverage to detect undesirable behavior and establish trust in the AI models.

Validate AI Model with Watson OpenScale

Now that the AI model deployment is configured in Watson Openscale, execute the following steps to evaluate the model:

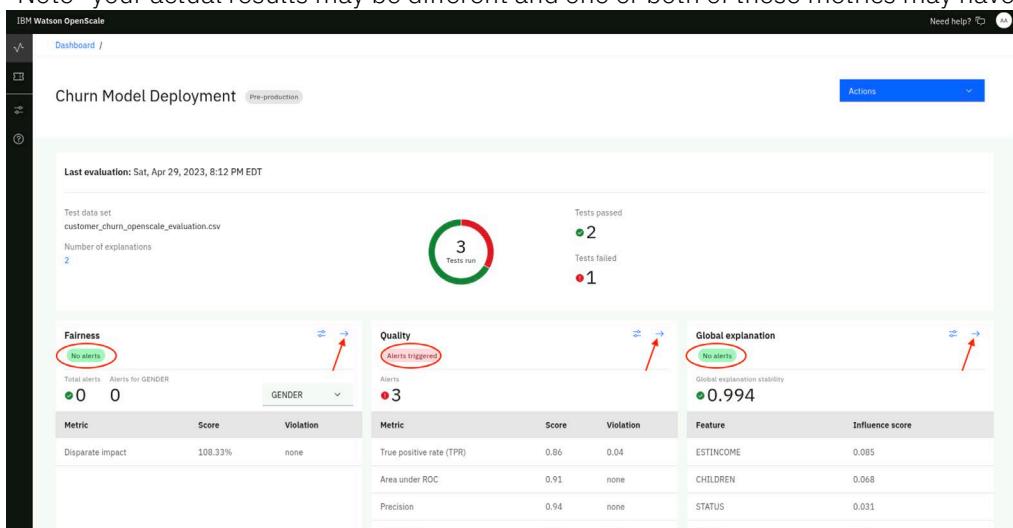
- 43- Navigate back to the Insights dashboard and select the Churn Model Deployment model. Next, you will run an evaluation in OpenScale to evaluate the performance of the model you have deployed. On the Churn Model Deployment dashboard, click **Actions** drop down menu (annotated with red arrow) and select **Evaluate now** (annotated with red rectangle).

- 44- On the Import test data page, choose **from CSV file** (annotated with red arrow) and click **browse** to select the customer_churn_openscale_evaluation.csv file (annotated with red rectangle) and click **Upload and evaluate** (annotated with red arrow).



- 45- OpenScale will upload the data, run scoring against it and compare the model prediction to the labeled result to compute an overall quality score. It will also run the Fairness monitor to detect any fairness violations. Additionally, because you've selected SHAP for global explanation, that would be run as well. Once the evaluation completes, you get a quick view in the dashboard of the Fairness, Quality, and Global explanation results. In the example below, it shows no alerts (annotated with red oval) for Fairness or Global explanation meaning the model meets or exceeds the required thresholds set for those monitors. However, it shows 3 alerts for Quality indicating the configured thresholds have violations. To investigate the Fairness or Quality results further, click on the arrow next to each monitor (annotated with red arrow).

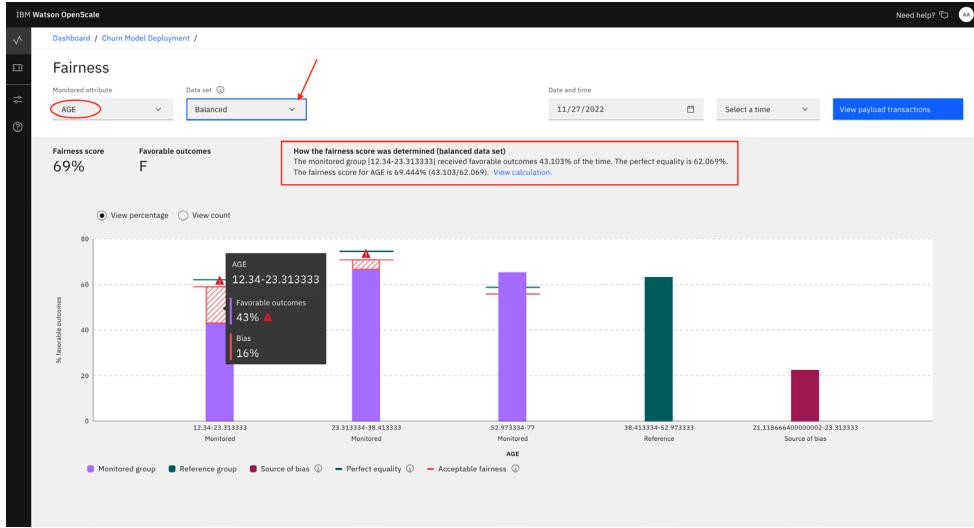
Note your actual results may be different and one or both of these metrics may have an alert.



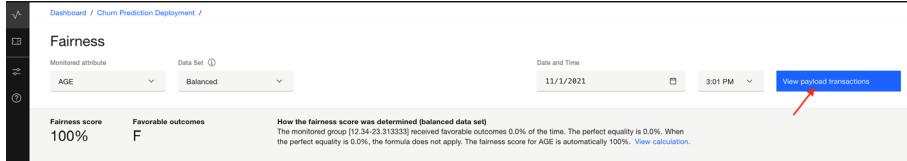
- 46- Click the arrow next to the Quality monitor to review the quality results further.

Quality									
Area under ROC	Area under PR	Accuracy	True positive rate (TPR)	False positive rate (FPR)	Recall	Precision	F1-Measure	Logarithmic loss	
1	0.99	1	1	0.01	1	0.99	1	0.05	
Prediction									
			0.0		1.0			Total	
Actual			0.0	171	1			172	
			1.0	0	111			111	
Total			171		112			283	

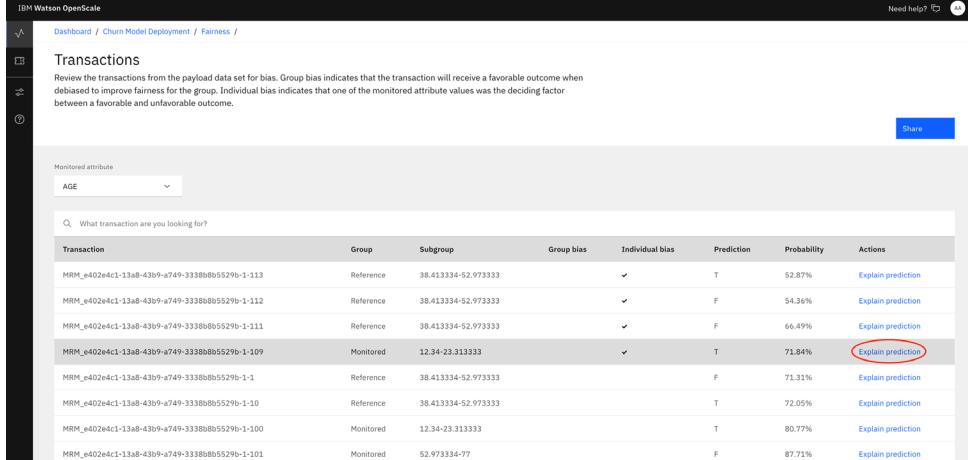
- 47- Navigate back to the model dashboard and click the arrow next to the Fairness monitor. Review the fairness results. Spend a few minutes on this dashboard and explore the different Monitored attributes, AGE and GENDER (annotated with red oval) and different Data set selections, Balanced, Payload, Training, Debiased (annotated with red arrow). Also note the natural language description explaining the results (annotated with red rectangle). For example, the 12.34-23.32 monitored age group has 43% favorable outcomes vs. 63% favorable outcomes for the 38.41-52.97 reference age group. (Your results may be different).



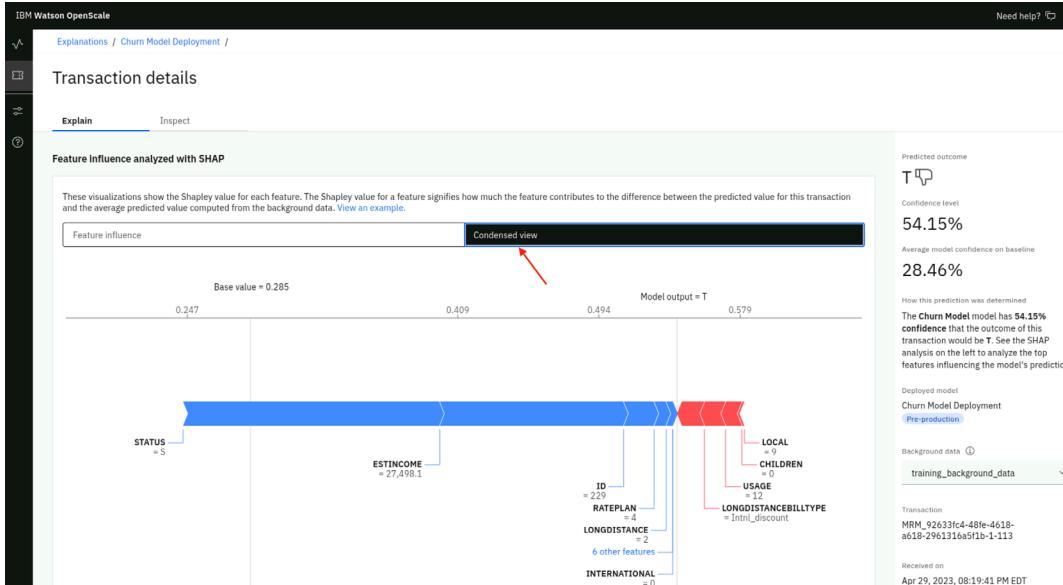
- 48- Click the **View payload transactions** (annotated with red arrow) to review the details of the transactions that were scored.



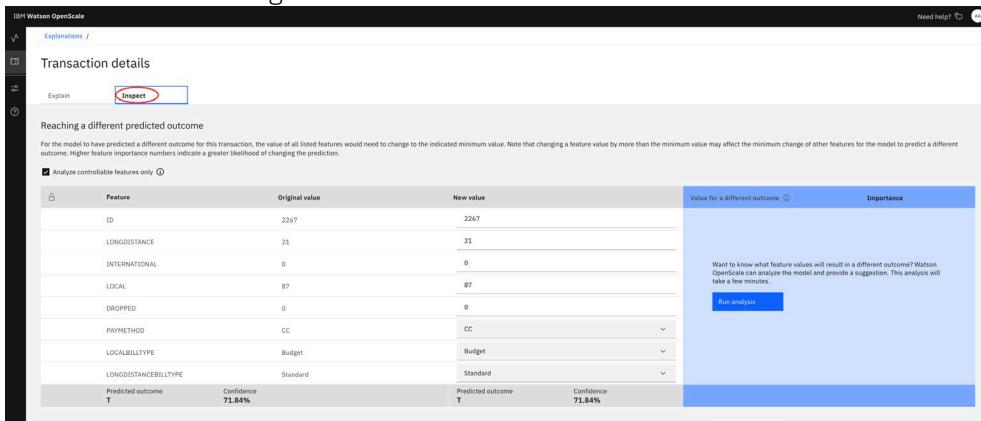
- 49- On the Transactions page, review the results. Click the **Explain prediction** (annotated with red oval) for one or more of these transactions to better understand how the model reached the output prediction.



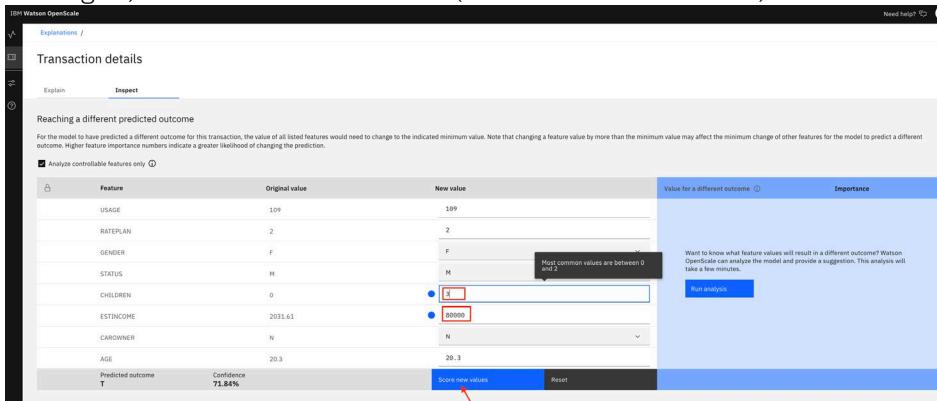
- 50- On the Explanations page, review the various features and how they contributed to the output prediction for this record. Select **Condensed view** (annotated with red arrow) for a different view of the feature influence on the prediction.



- 51- Click the **Inspect** tab (annotated with red oval) which allows you to run what-if analysis to understand what changes in the feature values could lead to different outcomes.



- 52- Try changing some of the values to see how it affects the likelihood of churning. Specifically, scroll down and change the ESTINCOME to 80000 and the CHILDREN to 3 (annotated with red rectangles) and click Score new value (annotated with red arrow).



- 53- Note how the prediction changes from T, customer likely to churn (annotated with red oval) to F, customer unlikely to churn (annotated with red rectangle).

Optional You can also click Run analysis (annotated with red arrow) to better understand what features can lead to different outcome.

The screenshot shows the IBM Watson OpenScale interface. At the top, it says "IBM Watson OpenScale" and "Explanations / Transaction details". Below that, there are two tabs: "Explain" and "Inspect", with "Inspect" being the active tab. A sub-section titled "Reaching a different predicted outcome" is displayed, stating: "For the model to have predicted a different outcome for this transaction, the value of all listed features would need to change to the indicated minimum value. Note that changing a feature value by more than the minimum value may affect the minimum change of other features for the model to predict a different outcome. Higher feature importance numbers indicate a greater likelihood of changing the prediction." There is a checkbox labeled "Analyze controllable features only". Below this is a table with columns "Feature", "Original value", "New value", and "Importance". The table includes rows for USAGE, RATEPLAN, GENDER, STATUS, CHILDREN, ESTINCOME, CAROWNER, and AGE. The "Importance" column for AGE is highlighted with a red circle. At the bottom of the table, it says "Predicted outcome T Confidence 73.84%" and "Run analysis". To the right of the table, there is a blue panel with the heading "Value for a different outcome" and a sub-section "Want to know what feature values will result in a different outcome? Watson OpenScale can analyze the model and provide a suggestion. This analysis will take a few minutes." A blue button labeled "Run analysis" is shown with a red arrow pointing to it.

Review AI Model Lifecycle in Model Inventory

At this point, the validation team has run through the process of validating that the AI model deployment in churnUATspace (pre-prod) meets the expected enterprise requirements for quality, fairness and explainability. As the model owner, you can review the status in the model inventory.

- 1- Log out as admin and log back into Cloud Pak for Data as **datascientist** user.
- 2- Navigate to the Model inventory by clicking the navigation menu and selecting **Model inventory** (annotated with red arrow) under **Catalogs** (annotated with red rectangle).

The screenshot shows the IBM Cloud Pak for Data navigation menu. The left sidebar has sections like Home, Task inbox, Data, Projects, Catalogs, Model inventory, Governance, Deployments, Services, Administration, Storage volumes, and Support. The "Catalogs" section is highlighted with a red rectangle, and the "Model inventory" item under it is annotated with a red arrow.

- 3- On the Model Inventory page, find the **Customer Churn Prediction** model use case (annotated with red rectangle) and click **View details** (annotated with red arrow).

The screenshot shows the Model inventory page. At the top, there is a search bar and a "New model use case" button. Below that, there is a table with columns for "Platform assets catalog", "Status", "Business terms", and "Tags". The first row, "Customer Churn Prediction", is highlighted with a red rectangle and has a red arrow pointing to the "View details" button. Other rows include MODEN-016 (Approved), MODEN-015 (Awaiting Approval), MODEN-014 (Proposed), MODEN-013 (Status: Status), MODEN-012 (Status: Status), MODEN-011 (Status: Status), and MODEN-010 (Status: Status). Each row has a "View details" button at the bottom.

- 4- On the Customer Churn Prediction use case, select the **Asset** tab (annotated with red oval). Note that the Churn Model is now in Validate state (annotated with red rectangle) and the **Evaluated** tag (annotated with red arrow) which was added to indicate that the Churn Model has been evaluated. Also note that the model inventory also highlights that the model has some warnings identified by the red exclamation mark (annotated with blue arrow). This effectively communicates that the model needs to be reviewed and possibly retrained to address these violations.

Click the **Churn Model Deployment** under Validate state to review the details of the model deployment.

The screenshot shows the 'Asset' tab selected in the navigation bar. The main area displays a 'Model tracking' section with four stages: Develop, Deploy, Validate, and Operate. The 'Validate' stage is highlighted with a red rectangle and contains a tree view of models. One node, 'Churn Model Deployment', has a red arrow pointing to it labeled 'Evaluated'. In the 'Model inventory' section, there is a red exclamation mark icon with a blue arrow pointing to it, indicating a warning.

- 5- Observe the collected quality and fairness results (annotated with red rectangles) that are obtained from OpenScale evaluation that was run earlier. Click Cancel after reviewing the results.

The screenshot shows the 'Evaluation results' page for the 'Churn Model Deployment'. It displays various performance metrics under two sections: 'Quality' and 'Fairness'. The 'Quality' section includes metrics like True positive rate (TPR), Area under ROC, Precision, F1-measure, Accuracy, Logarithmic loss, False positive rate (FPR), Area under PR, Recall, and Test records. The 'Fairness' section includes GENDER Fairness, GENDER group with the lower score, AGE Fairness, and AGE group with the lowest score. Both sections are highlighted with red rectangles.

Approve Model for Production

In practice, the datascientist user would go back and re-train/develop the AI model while accounting for quality and fairness at design time. For this lab, we will ignore these violations and have the admin user (who is validating the model) navigate back to Watson OpenScale and approve the model for production.

- 6- Log out as datascientist user and log back into Cloud Pak for Data as the **admin** user.
 7- Navigate back to Watson OpenScale as you did earlier.

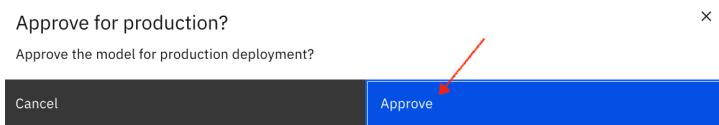
- 8- On the Watson OpenScale Insights dashboard, click the **Churn Model Deployment** tile (annotated with red rectangle).

Deployment	Monitored	Quality Alerts	Fairness Alerts	Drift Alerts	Custom Alerts
WML Churn Model Deployment	4	7	4	2	--

- 9- On the Churn Model Deployment page, click the **Actions drop-down** (annotated with red arrow) and select **Approve for production** (annotated with red rectangle).

Please note that in practice, this model would NOT be approved for production because Watson OpenScale identified quality and fairness violations. However, for purposes of this lab, we'll ignore those for now and proceed with next steps assuming the model shows no violations.

- 10- On the Approve for production pop-up, click Approve (annotated with red arrow).



- 11- Verify you see the green status message of the model being Approved for production deployment (annotated with red arrow).

The screenshot shows a UI component for 'Churn Model Deployment' in 'Pre-production' mode. A green success message box contains the text: 'Approved Model is approved for production deployment.' A red arrow points to this message box.

Verify AI Model State Update in Model Inventory

- 1- Navigate back to the Cloud Pak for Data landing page, log out as admin and log back in as dataScientist user.
- 2- Navigate to the Model inventory as you did earlier.
- 3- On the Model Inventory page, find the **Customer Churn Prediction** model use case (annotated with red rectangle) and click **View details** (annotated with red arrow).

The screenshot shows the 'Model inventory' page in 'IBM Cloud Pak for Data'. It lists various model use cases. One entry, 'Customer Churn Prediction', is highlighted with a red rectangle. Below it, under 'Status', it says 'Approved'. At the bottom, there is a 'View details' button with a red arrow pointing to it.

- 4- On the Customer Churn Prediction model use case, select the **Asset** tab (annotated with red oval) and note that the Churn Model has the **Approved** tag (annotated with red arrow) added under the **Validate** state (annotated with red rectangle). Click the Churn Model Deployment under Validate state to review the details of the model deployment.

The screenshot shows the 'Customer Churn Prediction' model use case in the 'Asset' tab. The 'Validate' state is highlighted with a red rectangle. Inside this state, the 'Churn Model Deployment' entry is also highlighted with a red rectangle. To its right, a red arrow points to the 'Approved' tag under the 'Operate' state. The right sidebar provides detailed information about the asset, including its description, owner, privacy settings, and source information.

Verify AI Model Updates in OpenPages

- In a different window, navigate to OpenPages if it is still open. If closed, log back into Cloud Pak for Data as admin user, navigate to Services ➔ Instances and then click the link to launch OpenPages. In OpenPages, navigate to Model Entries, either from Home dashboard view or from navigation menu (top left) ➔ Inventory ➔ Model Entries, then select the **Customer Churn Prediction** model entry (annotated with red rectangle).

The screenshot shows the IBM OpenPages interface with the title bar "IBM OpenPages". Below it, the navigation bar includes "Model Entries", "Customer C...", and "MOD_00000...". The main content area is titled "Model Entries (17)". A search bar and filter options ("Default Filter", "New") are at the top right. The table lists several model entries, with the first one, "Customer Churn Prediction", highlighted by a red rectangle. The table columns include Name, Purpose, Description, Status, and Risk Level. The "Customer Churn Prediction" entry has a detailed description below it: "Telecoms are harnessing AI's powerful analytical capabilities to combat instances of fraud. AI and machine learning algorithms can detect anomalies in real-time, effectively reducing telecom-related fraudulent activities, such as unauthorized network access and fake profiles. The system can automatically block access to the fraudster as soon as suspicious activity is detected, minimizing the damage. With industry estimates indicating that 80% of operators are targeted by scammers on a daily basis – amounting to billions in losses every year – this AI application is...".

- On the Customer Churn Prediction model entry, scroll down and click **MOD_0000001** model (annotated with red rectangle) to launch that.

The screenshot shows the "Customer Churn Prediction" model entry page. The top navigation bar includes "Model Entry" and the model name. The main content area is titled "Customer Churn Prediction". It has tabs for "Task", "Activity", and "Admin". The "Task" tab is active. It contains sections for "General", "Associated Models", and "Deployments". The "General" section shows details like Name (Customer Churn Prediction), Status (Approved), Purpose (Predict likelihood of customers to churn), Risk Level (High), and a description. The "Associated Models" section shows a table with one row, where the "MOD_0000001" model is highlighted by a red rectangle. The "Deployments" section is partially visible at the bottom.

- On the MOD_0000001 page, scroll down to the **Associations** section (annotated with red rectangle), click the **Deployments** tab (annotated with red oval) and select the **Churn Model Deployment** (annotated with red arrow) to review the latest status and metrics of the deployment.

The screenshot shows the IBM OpenPages interface with the title 'MOD_0000001'. The 'Task' tab is selected. In the 'Associations' section, there is a table with columns 'Name' and 'Description'. A row for 'Churn Model Deployment' is highlighted with a blue background. A red arrow points to this row. In the 'Metrics' section, there is a table with columns 'Name', 'Description', 'Value', 'Breach Status', and 'Value Date'. Several rows are listed, including 'accuracy', 'area_under_pr', 'area_under_roc', 'f1_measure', 'fairness_score', 'false_positive_rate', 'global_explanation_stability', and 'log_loss'. The 'fairness_score' row has a green 'Breach Status' button. A red rectangle highlights the entire 'Metrics' table.

- 4- On the Churn Model Deployment page, scroll down to the **Associations → Metrics** section (annotated with red oval) and review the various metrics (annotated with red rectangle) which were auto-populated by OpenScale around quality, fairness, and explainability (**automation**). This is critical because this connects the technical metrics obtained by the data science validation and monitoring tools to the governance/compliance tools so that the model owners can confidently decide whether to adopt the model in production or not. In the example below, the quality metrics report a Red breach status (quality below threshold) while the fairness metrics report a Green status for the Gender feature.

The screenshot shows the 'Churn Model Deployment' page. The 'Metrics' section is highlighted with a red oval. The table in this section lists various metrics with their descriptions, values, breach statuses, and value dates. The 'fairness_score' metric is highlighted with a red rectangle. The 'Breach Status' column for most metrics is 'Red', except for 'fairness_score' which is 'Green'.

Name	Description	Value	Breach Status	Value Date
accuracy	Watson OpenScale quality metric for 'accuracy'	0.8833922	Red	5/21/2023
area_under_pr	Watson OpenScale quality metric for 'area_under_pr'	0.83150685	Red	5/21/2023
area_under_roc	Watson OpenScale quality metric for 'area_under_roc'	0.8721192	Red	5/21/2023
f1_measure	Watson OpenScale quality metric for 'f1_measure'	0.8465116	Red	5/21/2023
fairness_score	Watson OpenScale fairness_score metric for 'GENDER'	1.00	Green	5/21/2023
false_positive_rate	Watson OpenScale quality metric for 'false_positive_rate'	0.07558139	Green	5/21/2023
global_explanation_stability	Watson OpenScale explainability metric for 'global_explanation_stability'	0.9966774	Green	5/21/2023
log_loss	Watson OpenScale quality metric for 'log_loss'	0.3943444	Green	5/21/2023

5-

Summary

This lab illustrated how you can leverage Watson OpenScale capabilities to deliver trustworthy AI by running model evaluation to validate that Quality, Fairness, and Drift metrics are within the configured thresholds. Additionally, MLOps engineers, data scientists, and business users can trigger explanation of individual transactions to gain confidence in the predictions of the model.

Lastly, you've seen how the integration works between the various services and how the state of the AI model is tracked in the Model inventory when it is evaluated and approved in Watson OpenScale by the model validation team.