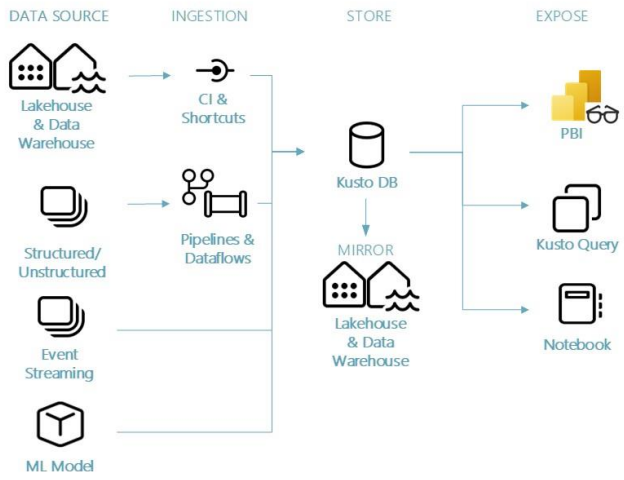
End-to-End Scenario Tutorial

Real-time Analytics

Updated : Feb 2024

Real-time Analytics

- **Ingestion**
  Lakehouse & Datawarehouse via Continuous Ingestion & Shortcuts (See LH/DW scenarios for populating LH/DW), Event Streaming (Event Hub, Kafka, etc) and ML Models connected directly, and Pipelines/Dataflows for all other data.
- **Storage**
  KQL Database, and Lakehouse/Data Warehouse via Mirroring
- **Exposure**
  In PBI via See Through Mode, Notebook via Spark/KQL, or direct via KQL Queryset



Contents

Introduction

What is Fabric?

Fabric provides a one-stop shop for all the analytical needs for every enterprise. It covers the complete spectrum of services including data movement, data lake, data engineering, data integration and data science, real time analytics, and business intelligence. With Fabric, there is no need to stitch together different services from multiple vendors. Instead, the customer enjoys an end-to-end, highly integrated, single comprehensive product that is easy to understand, onboard, create and operate. There is no other product on the market that offers the breadth, depth, and level of integration that Fabric offers. Additionally, Microsoft Purview is included by default in every tenant to meet compliance and governance needs.

To get an overview over the components and concepts of Fabric read *Fabric - Overview and Concepts.*

The purpose of this tutorial

While many concepts in Fabric may be familiar to data and analytics professionals it can be challenging to apply those concepts in a new environment. This tutorial has been designed to walk step-by-step through an end-to-end scenario from data acquisition to data consumption to build a basic understanding of the Fabric UX, the various workloads and their integration points, and the Fabric professional and citizen developer experiences.

The tutorials are not intended to be a reference architecture, an exhaustive list of features and functionality, or a recommendation of specific best practices.

Real-time Analytics

Real-time Analytics is a portfolio of capabilities that provides end-to-end analytics streaming solution across Fabric experiences. It supplies high velocity, low latency data analysis, and is optimized for time-series data, including automatic partitioning and indexing of any data format and structure, such as structured data, semi-structured (JSON), and free text.

Real-time Analytics delivers high performance when it comes to your increasing volume of data. It accommodates datasets as small as a few gigabytes or as large as several petabytes and allows you to explore data from different sources and a variety of data formats.

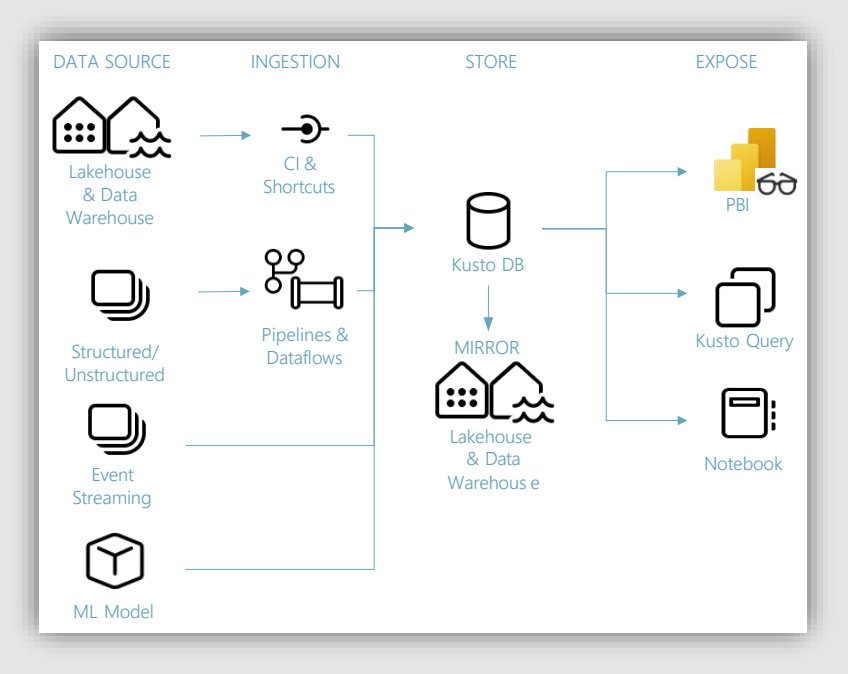


Figure 1: End-to-end Scenario - Real-time Analytics

Real-time Analytics includes integration with other Fabric experiences such as Lakehouse, Data Warehouse, Pipelines, Dataflows and Event Streaming on data sources and ingestion side. On the data exposition and consumption, Real-time analytics integrates with Power BI, and Notebooks.

You can use Real-time Analytics for a range of solutions, such as IoT analytics and log analytics, and in several scenarios including manufacturing operations, oil and gas, automotive, and more.

In this tutorial, you learn how to:

- Create a KQL Database
- Create Eventstream
- Stream data from Eventstream to KQL Database
- Check your data with sample queries
- Save queries as a KQL Queryset
- Create a Power BI report
- Create a OneLake shortcut

Scenario

This tutorial is based on a *sample on New York Yellow Taxi trip data*. The dataset contains trip records of New York's yellow taxis. The yellow taxi trip records include fields capturing pick-up and drop-off dates/times, pick-up and drop-off locations, trip distances, itemized fares, rate types, payment types, and driver-reported passenger counts. You'll use the streaming and query capabilities of Real-time Analytics to answer key questions about the trip statistics, taxi demand in the boroughs of New York and related insights.

Prerequisites

- Power BI Premium subscription. For more information, see *How to purchase Power BI Premium*.
- Workspace

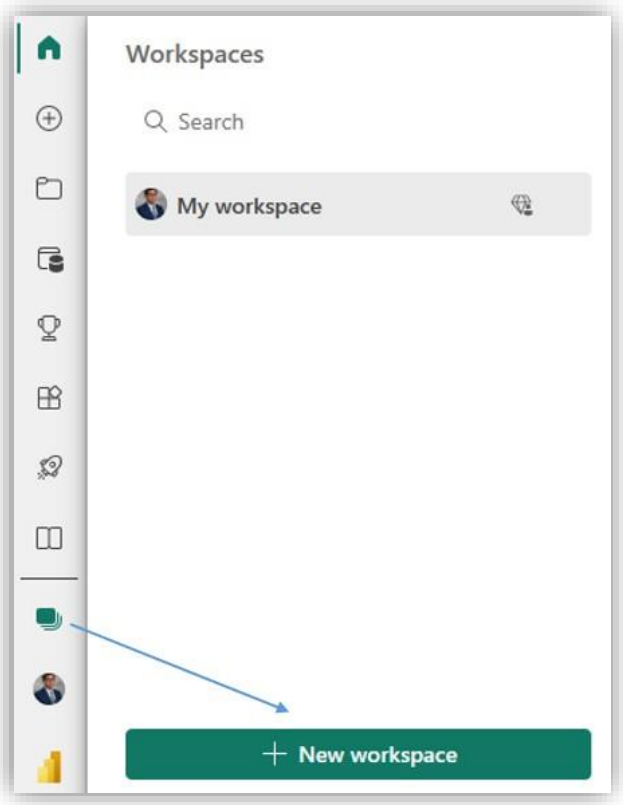
Module 1: Create a Fabric workspace

Before you can begin building the real-time analytics solution, you will need to enable Project Fabric on your Power BI tenant and create a workspace where you will build out the remainder of the tutorial. In this module, you will learn to:

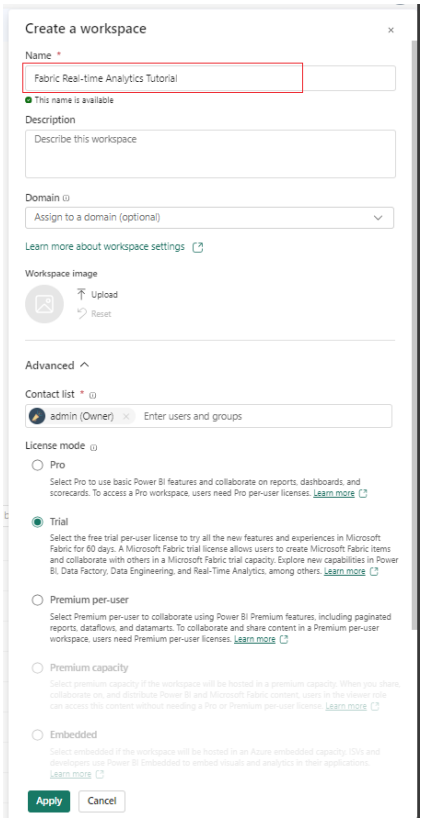
- Create a Fabric workspace

In this step, you create a Fabric workspace in the Power BI service. The workspace will contain all the artifacts needed for real-time analytics including KQL Database, Eventstream, Power BI datasets, and reports.

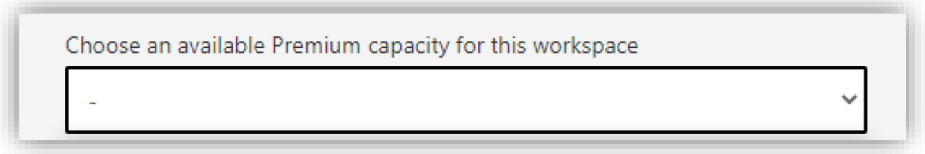
1. Sign in to Fabric .
2. Select **Workspaces > New Workspace**.



3. Fill out the **Create a workspace** form as follows:
   a. **Name:** Enter *Fabric Real-time Analytics Tutorial*, and some characters for uniqueness.
   b. **Description**: Optionally, enter a description for the workspace.



4. Expand the **Advanced** section.
5. Choose **Fabric capacity** in the **License Mode** section.
6. Choose a Fabric capacity you have access to**.**



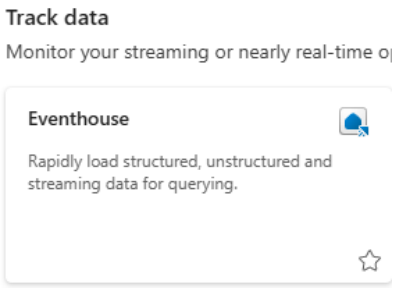
7. Select **Apply.** The workspace will be created and opened.

Module 2: Build your first Real-time Analytics solution in Fabric

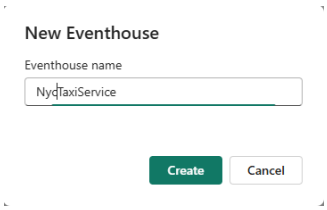
The intent of this module is to quickly build end to end journey of building a real-time analytics solution, ingesting streaming data from Eventstream and then using the KQL Database for creating a real-time refreshing Power BI report.

Create an Evenhosue

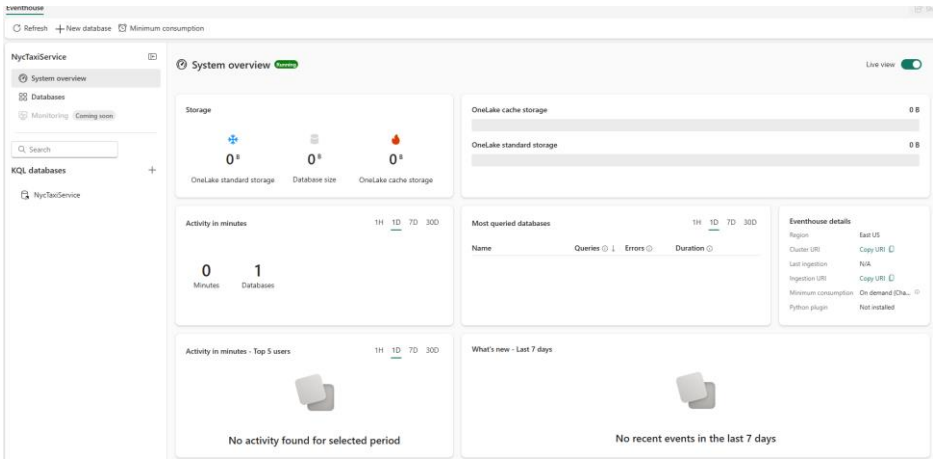
1. In the upper left corner of the Fabric Workspace home page, select **New > Eventhouse**



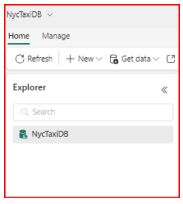
2. On the **New Eventhouse** dialog, enter a ***unique name***.
3. Select **Create**.



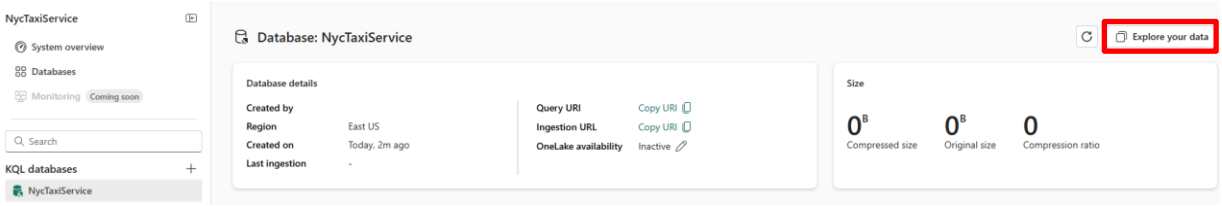
4. When provisioning is complete the KQL database editor landing page will be shown.



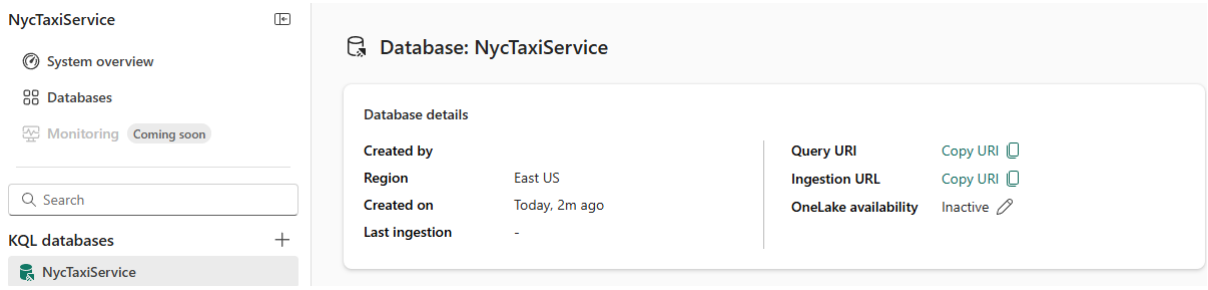
5. Select the **Database** in the Object tree.



6. Select **Explore your data** located in the upper right corner.



7. Enable availability in Onelake (replace **NycTaxiService** with your database's name). In the **Database details** card, select the **pencil** icon.

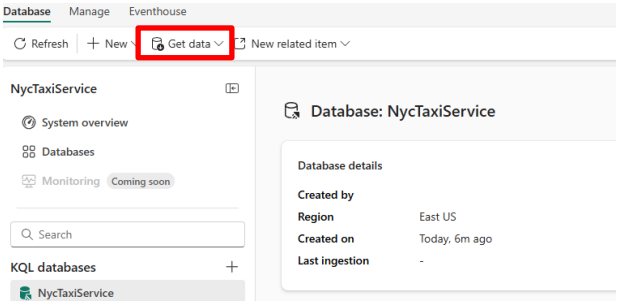


Toggle the button to **Active** and select **Done**

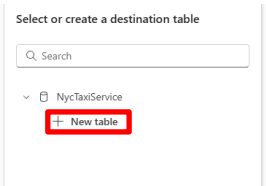
Upload data

1. Return to the Real-Time Analytics home page. The **Home** icon directs you to the home page of the experience you're currently using within Fabric.

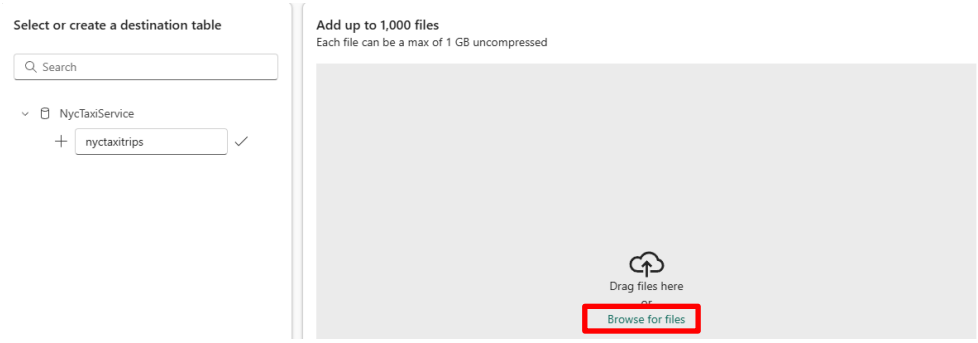
2. In the **Eventhouse** section, select **Get data, then select 'Local File' in the drop-down list.**



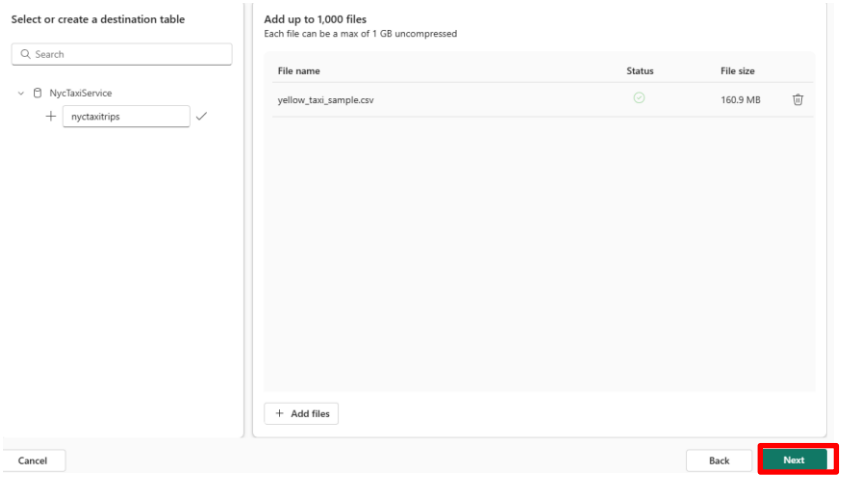
3. Under your database, click on '**New table**'.



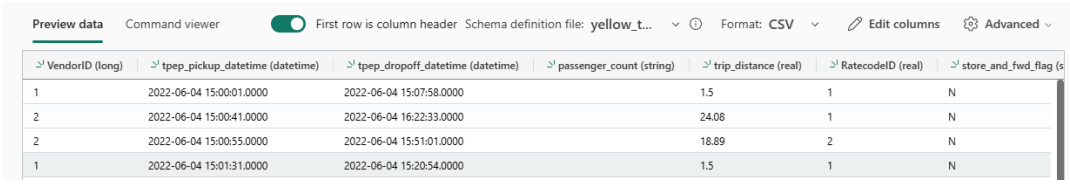
4. Enter 'nyctaxitrips' and then click on 'Browse for files' in the middle of the window. Locate the file 'yellow_taxi_sample.csv' on your computer.



5. Click on 'Next' in the lower right-hand corner once the file is uploaded.



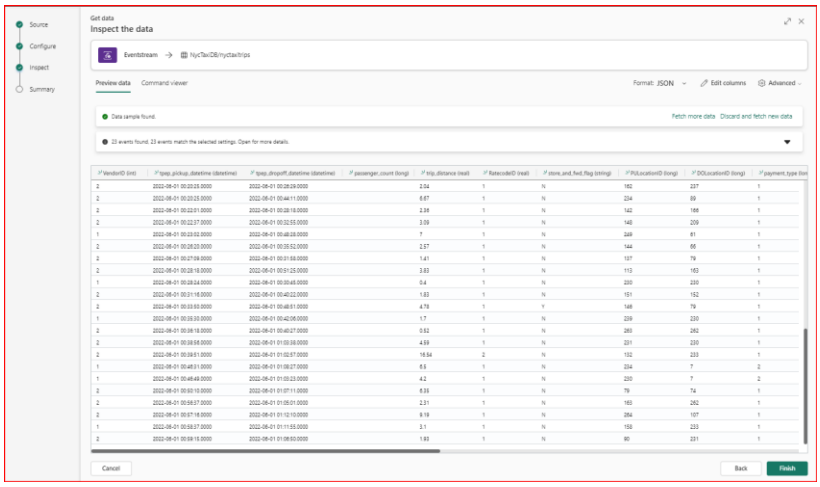
6. In the Inspect tab, choose CSV as the Data format dropdown. Enable First row is column header.



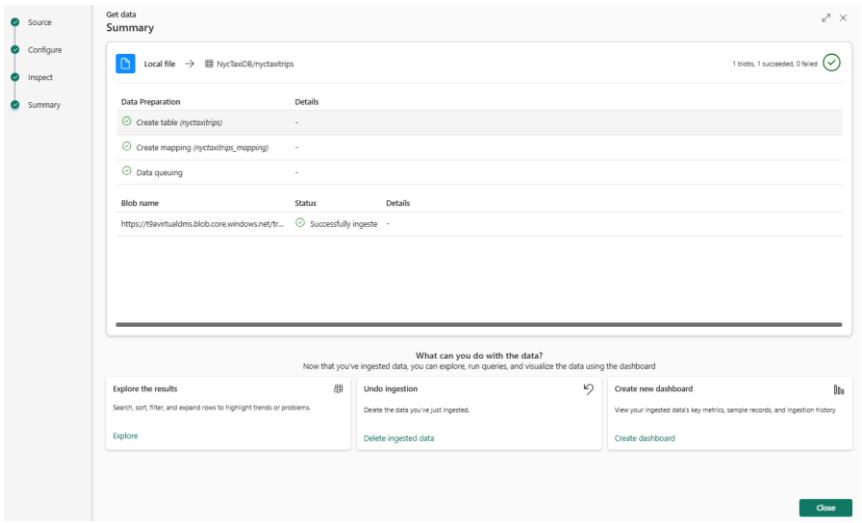
7. After choosing CSV as the Data format, data preview will refresh and show the data in strongly typed columns.
8. We will change the data types for multiple columns. Click on 'Edit columns'.
   a. For the column VendorID column name, **Change data type**, and then choose **int.**
   b. choose datatype as **long** for the columns: passenger_count, PULocationID, DOLocationID
   c. choose datatype as **real** for the following columns: extra, mta_tax, tolls_amount, improvement_surcharge, congestion_charge, airport_fee, trip_distance, fare_amount, tip_amount, total_amount, payment_type

After changing the datatypes of the above columns, Click on **Apply**

2. Click on Finish

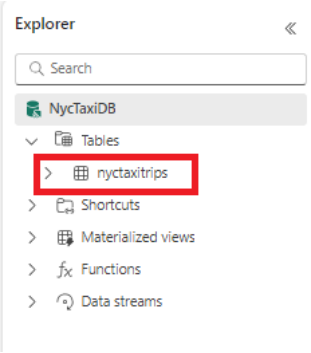


3. In the **Summary** Tab, **Continuous ingestion from local file established** window, all steps will be marked with green check marks when the data connection is successfully created. Click the **Close** button.

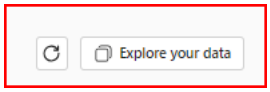


Explore data and build Power BI report

1. Click on 'Refresh' at the top left of the screen.
2. In the object tree for the KQL database, select the table **nytaxitrips.**



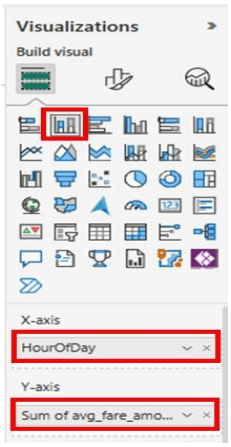
3. In the top right corner, select **Explore your data**.



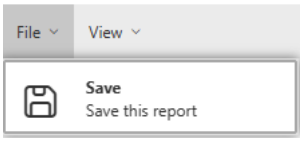
4. Paste the following query in the query editor and select **Run**

```
//Calculate average fare amount by the hour of the day. nyctaxitrips
| summarize avg(fare_amount) by HourOfDay = hourofday(tpep_dropoff_datetime)
```

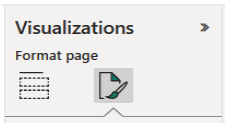
5. Click on **Power BI** in the upper right-hand corner**.** An empty PowerBI report editing window will open.
6. Select **Stacked Column Chart** in the Visualizations pane. Drag **HourOfDay** field to X-axis and **avg_fare_amount** to Y-axis.



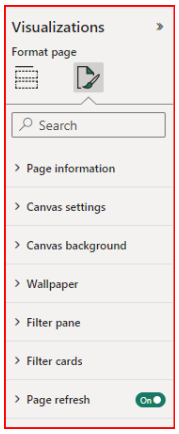
7. Select **File** menu and then **Save** in the top left corner



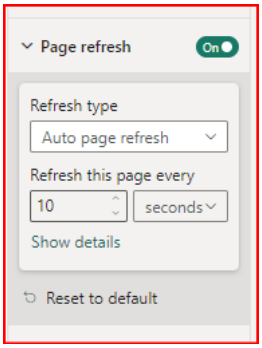
8. Enter **nyctaxitripstats** in the **Name your file in Power BI** field, and choose your workspace.
9. Once the report is saved, click on the link **Open the file in Power BI to view, edit, and get a shareable link**.
10. Click on **Edit** button to edit the Power BI report.
11. Click on an Empty Space in the Canvas, Choose **Format page.**



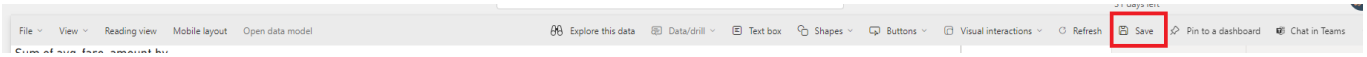
12. Toggle **Page Refresh** to **On**



13. Expand **Page Refresh** and set the refresh interval to 10 seconds. Please note: Refresh interval will be limited by the Admin interval. Refresh interval can only be greater than or equal to the Admin interval.



14. Save your report.



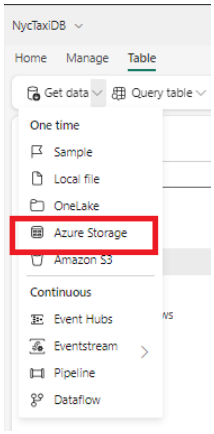
With this tutorial, you have now built an auto-refreshing Power BI report that is querying streaming data arriving in KQL Database from Eventstream.

Module 3: Extending the real-time analytics solution

Get dimension data from Azure Storage

In this module, you are going to ingest Location available in Azure storage. This data contains additional information on the pick-up locations and drop-off locations used in the trips dataset. Real-time analytics reads and ingests data directly from the blob storage without requiring any other intermediary service.

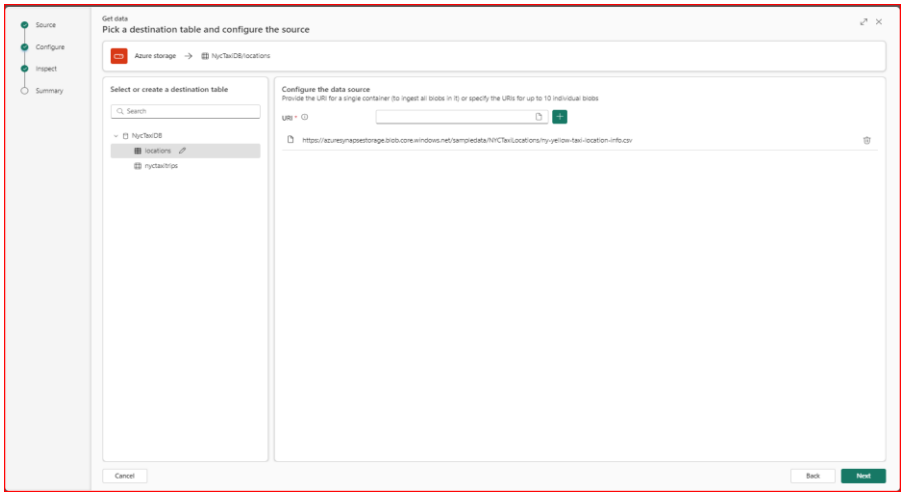
1. Navigate to KQL Database **NycTaxiService** located in your workspace.
2. From within the KQL Database, select **Get Data** > **Azure Storage**.



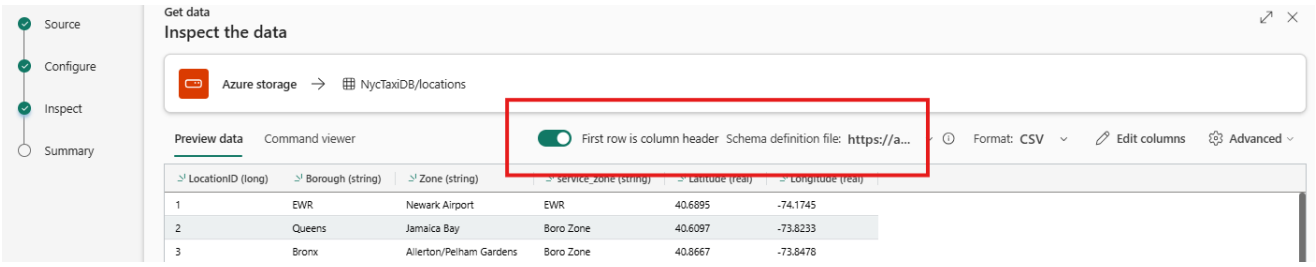
Destination tab

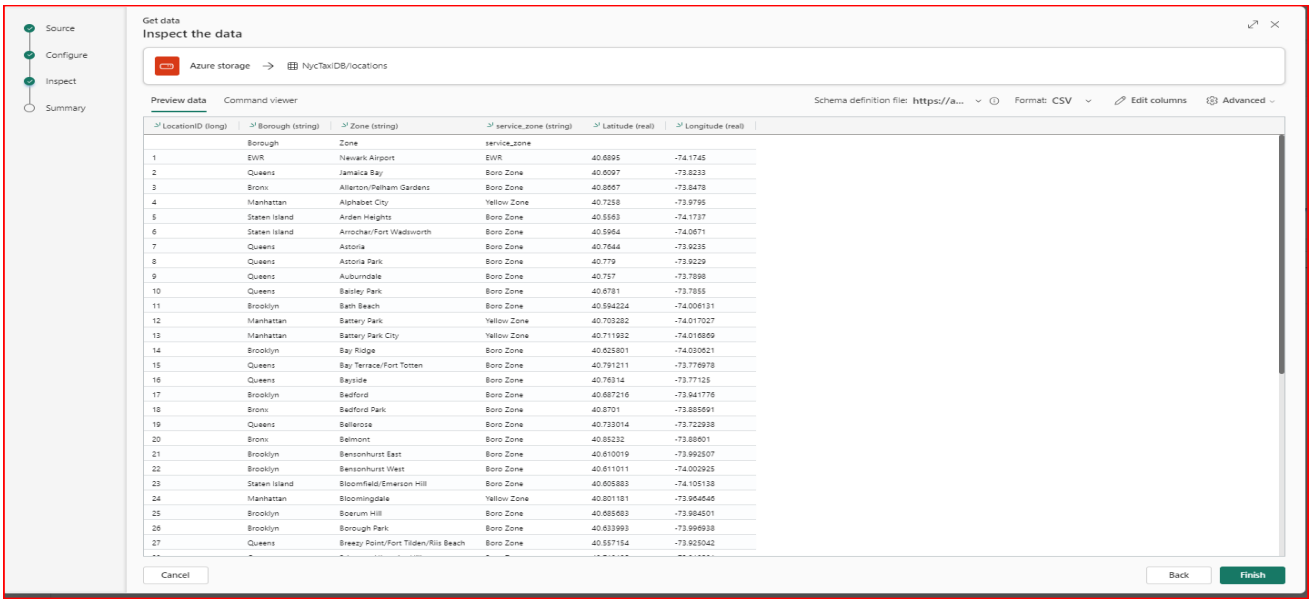
In the section '**Select or create a destination table'**, your **Database** is auto populated with the name of the selected KQL database.

3. Under **Table**, make sure that **New table** is selected, and enter ***locations*** as your table name.



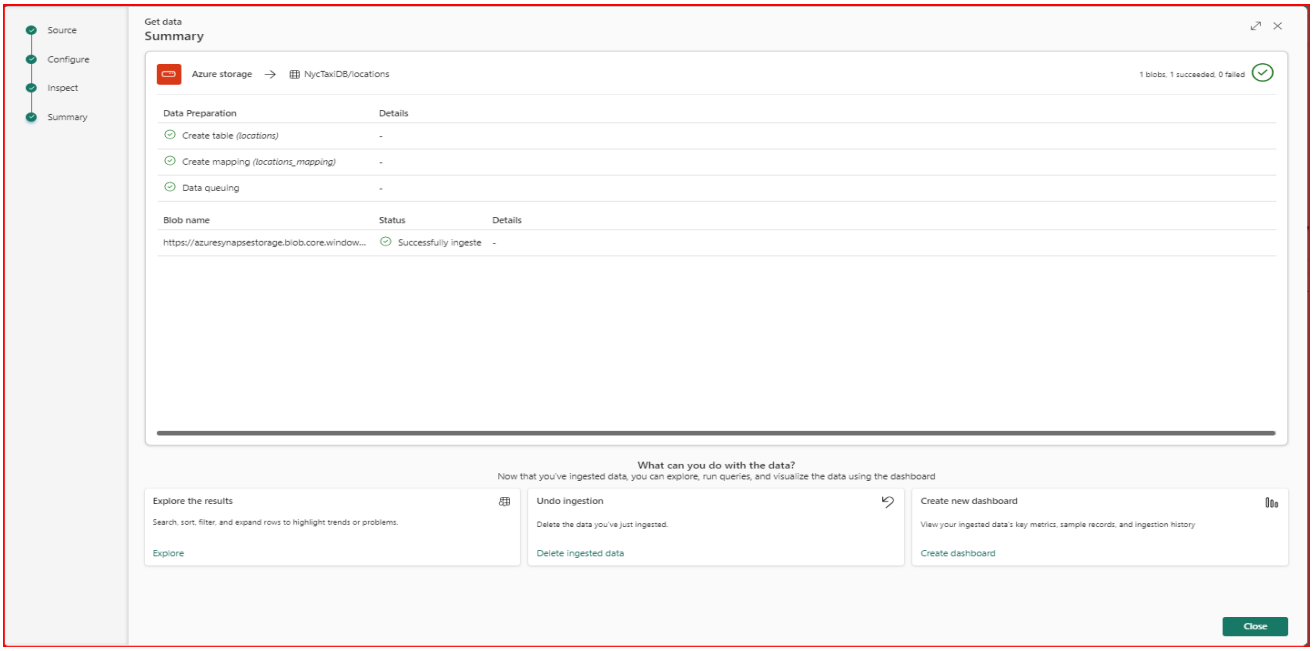
4. URI : **https://csarealtimedemo.blob.core.windows.net/sampledata/NYCTaxiLocations/ny-yellow-taxi-location-info.csv** click on **+** icon and click **Next :**
5. Enable 'First row is column header'
6. In the **Inspect tab**, click on **Finish**





7. Summary tab

   In the **Data ingestion is in progress** window, all steps will be marked with green check marks when the data has been successfully ingested. The data from Azure Storage will begin streaming automatically into your table.

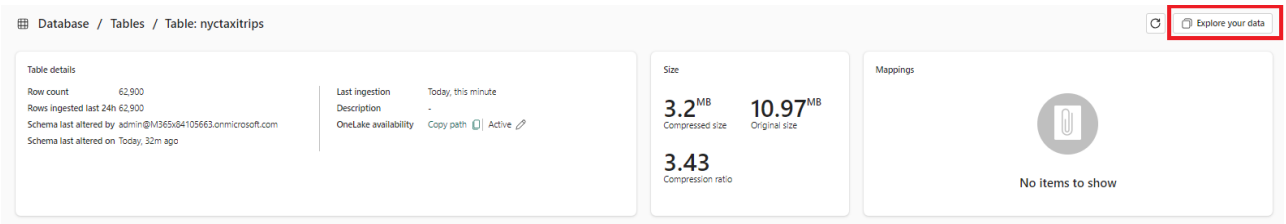


Now that you've got data in your database, click **Close**. You're going to check your data with sample queries.

Query data

In the following step, you'll use the advanced data analysis capabilities of Kusto Query language to query your telemetry data.

1. Select **Explore your data** on the right-hand side of your database-editor.

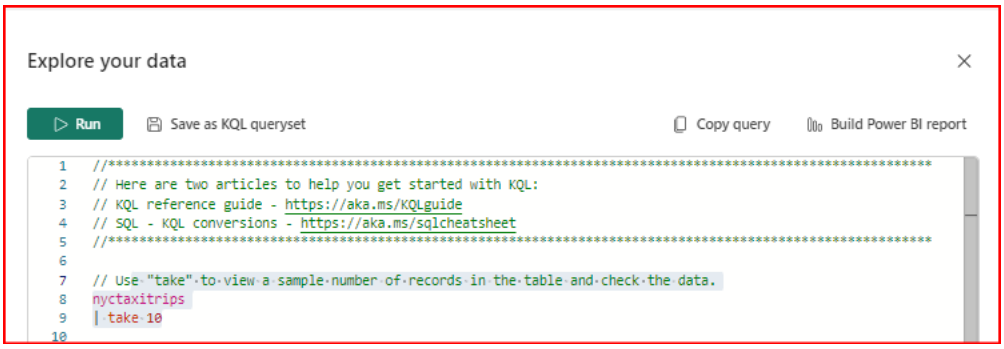


Note: The numbers in the screen capture above may look different in your database editor page.

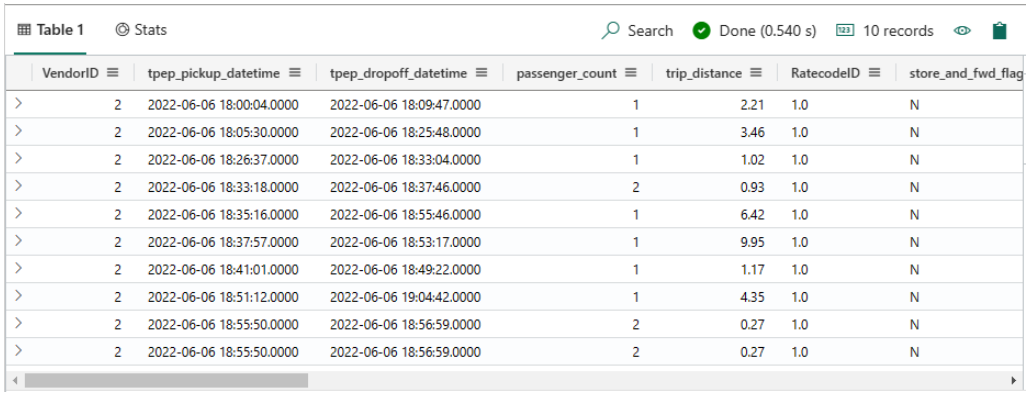
2. Let's take a look at the data itself. Paste the following query in **Explore your data** window to take 10 random records from your data.

Query to be pasted →

```
nyctaxitrips
| take 10
```



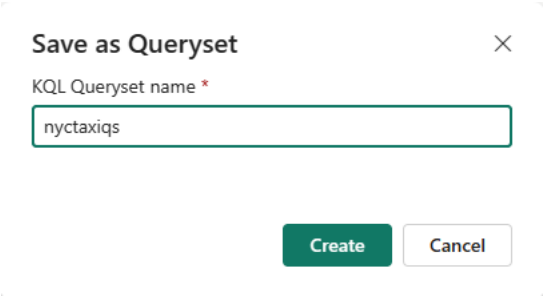
3. Select **Run.**



VendorID	tpep_pickup_datetime	tpep_dropoff_datetime	passenger_count	trip_distance	RatecodeID	store_and_fwd_flag
2	2022-06-06 18:00:04.0000	2022-06-06 18:09:47.0000	1	2.21	1.0	N
2	2022-06-06 18:05:30.0000	2022-06-06 18:25:48.0000	1	3.46	1.0	N
2	2022-06-06 18:26:37.0000	2022-06-06 18:33:04.0000	1	1.02	1.0	N
2	2022-06-06 18:33:18.0000	2022-06-06 18:37:46.0000	2	0.93	1.0	N
2	2022-06-06 18:35:16.0000	2022-06-06 18:55:46.0000	1	6.42	1.0	N
2	2022-06-06 18:37:57.0000	2022-06-06 18:53:17.0000	1	9.95	1.0	N
2	2022-06-06 18:41:01.0000	2022-06-06 18:49:22.0000	1	1.17	1.0	N
2	2022-06-06 18:51:12.0000	2022-06-06 19:04:42.0000	1	4.35	1.0	N
2	2022-06-06 18:55:50.0000	2022-06-06 18:56:59.0000	2	0.27	1.0	N
2	2022-06-06 18:55:50.0000	2022-06-06 18:56:59.0000	2	0.27	1.0	N

4. Select **Save as KQL Query Set** to save this and future queries for later use.

5. Under **KQL Queryset name**, enter *nyctaxiqs*, then select **Create**.



'Explore your data' enables you to run some quick queries to understand your data. This query can be saved as a KQL Queryset and persisted in the workspace as an item. Query set autosaves the queries as you type them and lets you resume from the point where you had stopped. In the next module, you will work with the KQL Queryset. Saving the quick query as KQL Query Set will automatically open your **KQL Queryset** with the queries that you wrote in the query editor.

Explore data further in the KQL Queryset

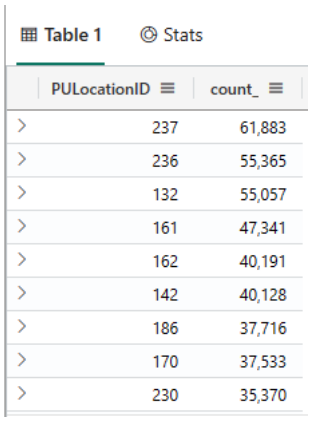
In this module, you are going to write queries using *Kusto Query Language* to explore the data that you have ingested from the Event hub and blob storage. Kusto Query Language is a powerful tool to explore your data and discover patterns, identify anomalies and outliers, create statistical modeling, and more. The query uses schema entities that are organized in a hierarchy similar to SQLs: databases, tables, and columns. Kusto query is a read-only request to process data and return results. The request is stated in plain text, using a data-flow model that is easy to read, author, and automate. Kusto queries are made of one or more query statements. You are going to write some simple Kusto queries to get familiar with the language and discover its power and simplicity.

Run the following queries in the new KQL Queryset you have created. Copy/paste each query into your environment, select the query and then select **Run**.

1. The following query returns the top 10 pickup locations in New York City for Yellow Taxis.

Query to be pasted →

```
//Top 10 pickup locations
nyctaxitrips
| summarize count() by PULocationID
| top 10 by count_
```



Note: Result of the query may not exactly match the screenshot provided as you are ingesting streaming data.

2. We will run the same query as in the previous step with an addition of looking up the corresponding zones of the top 10 pickup locations by using the 'locations' table.

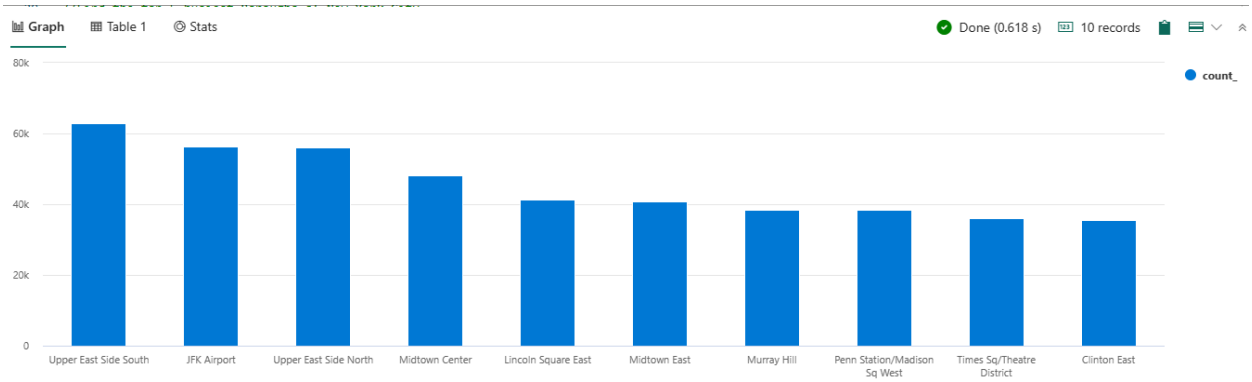
Query to be pasted ➔

```
//For the same top 10 locations, lookup the NYC zones --> Top 10 zones
nyctaxitrips
| lookup (locations) on $left.PULocationID == $right.LocationID
| summarize count() by Zone
| top 10 by count_
| render columnchart
```

Graph | Table 1 | Stats

Zone	count_
Upper East Side South	62,942
JFK Airport	56,417
Upper East Side North	56,052
Midtown Center	48,263
Lincoln Square East	41,236
Midtown East	40,895
Murray Hill	38,479
Penn Station/Madison Sq West	38,324
Times Sq/Theatre District	36,167
Clinton East	35,622

Note: Result of the query may not exactly match the screenshot provided as you are ingesting streaming data

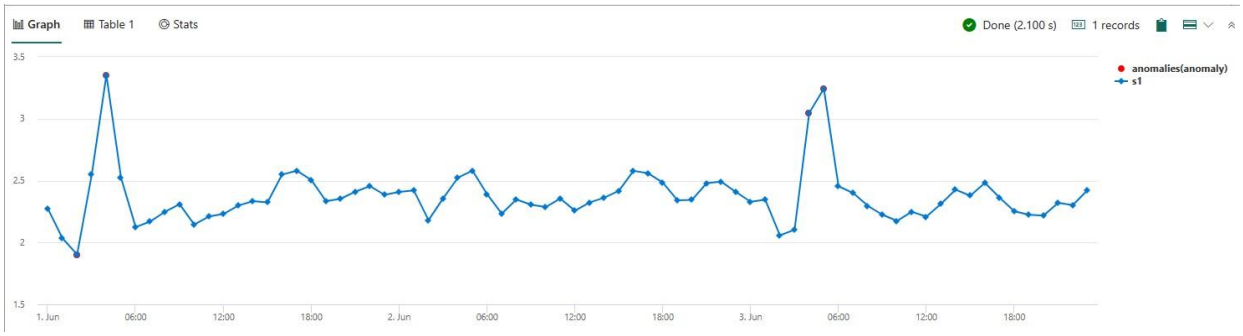


3. Let's check anomalies in the tips that have been given by the customers in the Manhattan borough. Hover over the red dots to see the values.

Query to be pasted ➔

```
//Find anomalies in the tips given by the customers
nyctaxitrips
| lookup (locations) on $left.PULocationID==$right.LocationID
| where Borough == "Manhattan"
| make-series s1 = avg(tip_amount) on tpep_pickup_datetime from datetime(2022-06-01) to
datetime(2022-06- 04) step 1h
| extend anomalies = series_decompose_anomalies(s1)
| render anomalychart with (anomalycolumns=anomalies)
```

Note: Result of the query may not exactly match the screenshot provided as you are ingesting streaming data.

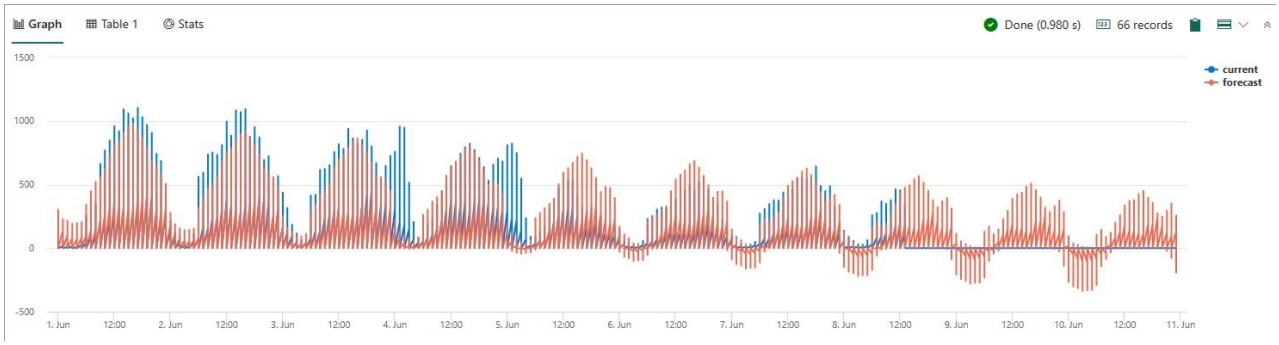


4. To ensure that the sufficient taxis are plying in the Manhattan borough, let's forecast the number of taxis needed per hour.

Query to be pasted ➔

```
//Forecast the number of trips that will begin from Manhattan to line up the taxis in that borough
nyctaxitrips
| lookup (locations) on $left.PULocationID==$right.LocationID
| where Borough == "Manhattan"
| make-series s1 = count() on tpep_pickup_datetime from datetime(2022-06-01) to datetime(2022-06-08)+3d step 1h by PULocationID
| extend forecast = series_decompose_forecast(s1, 24*3)
| render timechart
```

Note: Result of the query may not exactly match the screenshot provided below as you are ingesting streaming data.



Build Power BI report

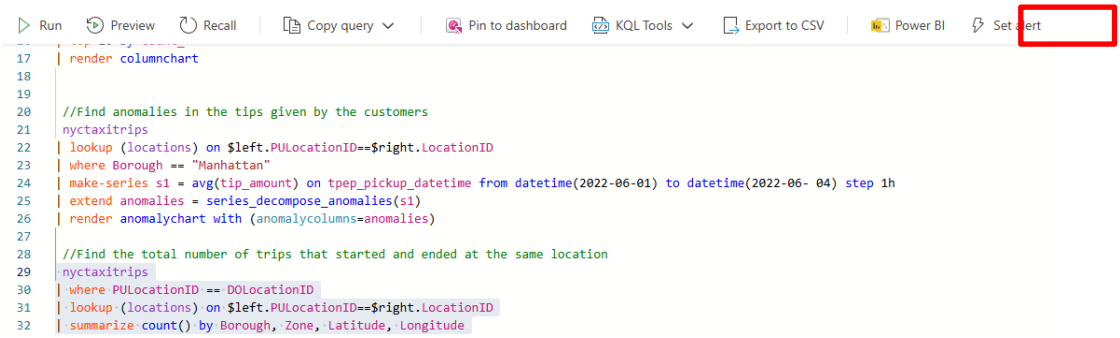
A Power BI report is a multi-perspective view into a dataset, with visuals that represent findings and insights from that dataset.

1. Continuing the in same queryset, paste the following query. The output of this query will be used as the dataset for building the Power BI report.

Query to be pasted ➔

```
//Find the total number of trips that started and ended at the same location
nyctaxitrips
| where PULocationID == DOLocationID
| lookup (locations) on $left.PULocationID==$right.LocationID
| summarize count() by Borough, Zone, Latitude, Longitude
```

2. Select the query and then select **Power BI on the top ribbon.**



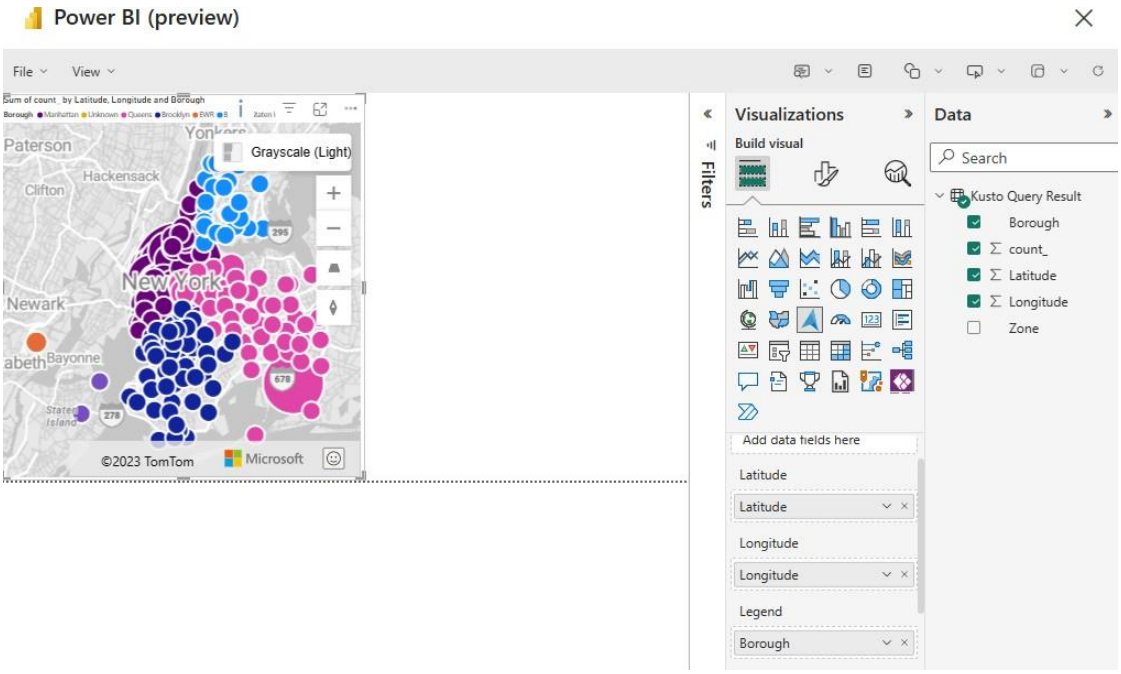
Power BI report editor will open with the result of the query available as a table with the name Kusto Query Result.

Note:

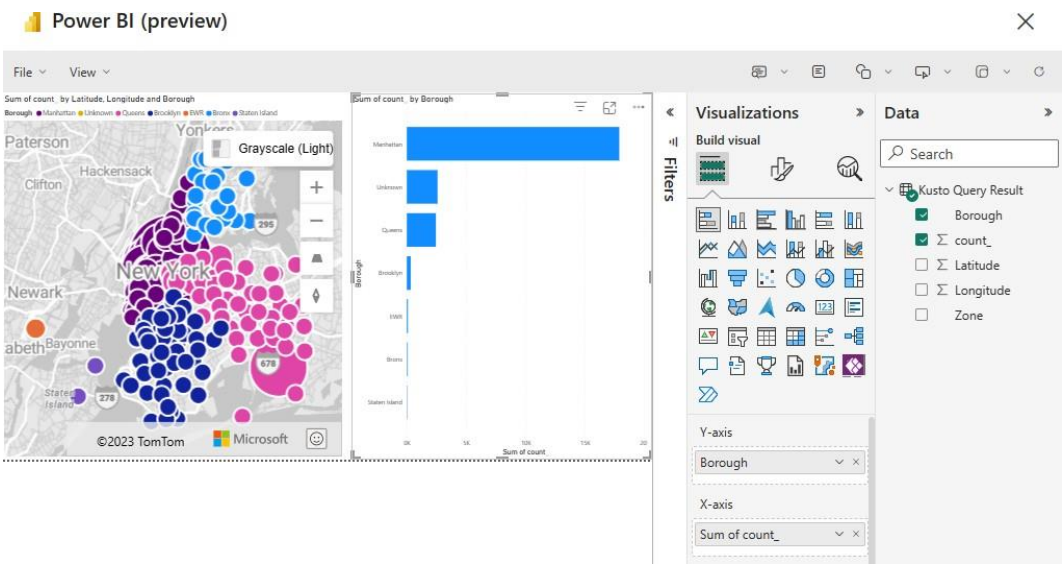
(a) When you build a report, a dataset is created and saved in your workspace. You can create multiple reports from a single dataset. (b) Result of the query may not exactly match the screenshot provided below as you are ingesting streaming data.

If you delete the dataset, your reports will also be removed.

3. In the report editor, choose **Azure Maps** as the visual, drag **Latitude** field to Latitude, **Longitude** field to Longitude, **Borough** field to Legend, and **count_** field to Size.

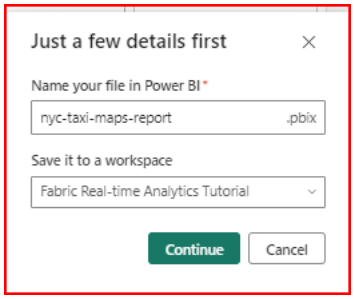


4. Add a **Stacked Bar Chart** to the canvas. Drag **Borough** field to Y-Axis and **count_** to the X-axis



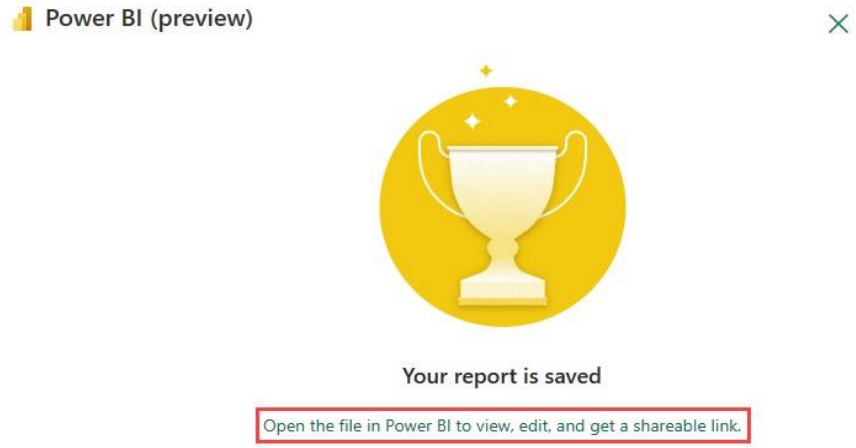
5. Click File > Save

6. Under **Name your file in Power BI**, enter *nyc-taxi-maps-report*.



7. Select the workspace in which you want to save this report. The report can be saved in a different workspace than the one you started in.

8. Select **Open the file in Power BI to view, edit, and get a shareable link** to view and edit your report.

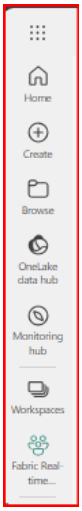


Create OneLake shortcut

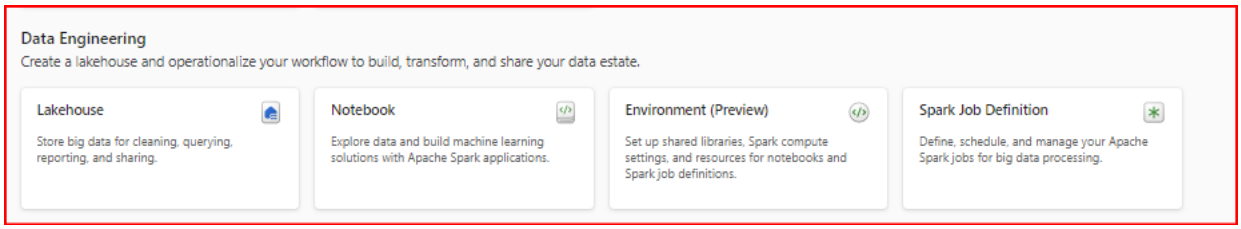
Now that you have finished exploring your data, you may want to access the underlying data from other Fabric experiences.

OneLake is a single, unified, logical data lake for Fabric to store lakehouses, warehouses and other items. Shortcuts are embedded references within OneLake that point to other files' store locations. The embedded reference makes it appear as though the files and folders are stored locally but in reality; they exist in another storage location. Once you create a shortcut, you can access your data in all of Fabric's experiences. Shortcuts can be updated or removed from your items, but these changes will not affect the original data and its source.

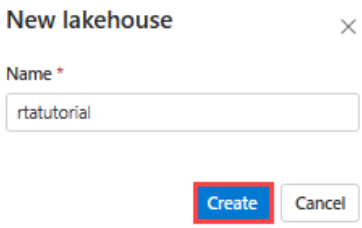
1. Select **Create** in the **Navigation pane**.



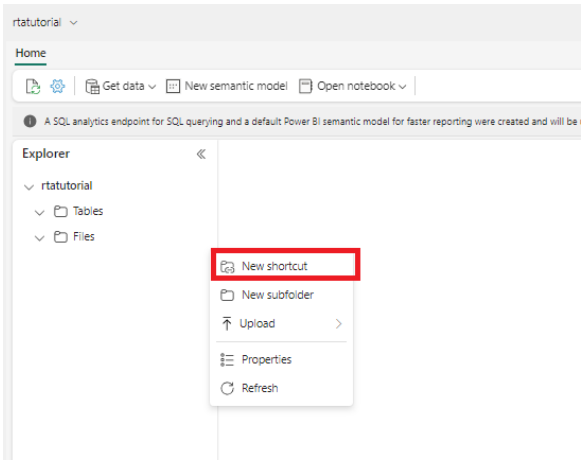
2. Under **Data engineering**, select **Lakehouse**.



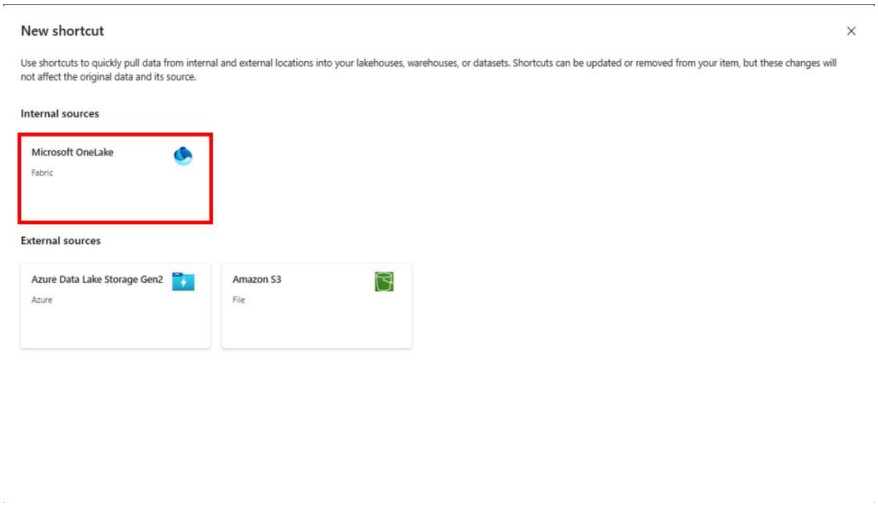
3. Enter *rtatutorial* as your Lakehouse name, then select **Create**.



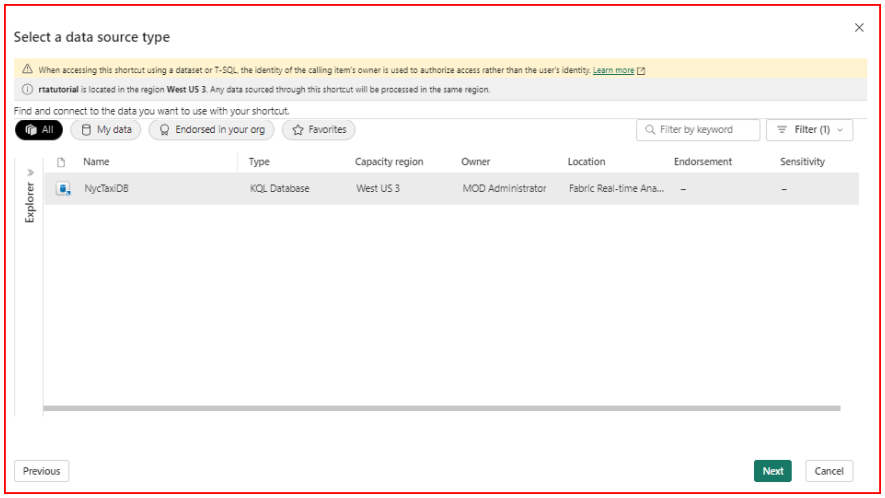
1. In Lakehouse Explorer, navigate to **Files**, select "**…**", select **New Shortcut** from the menu.



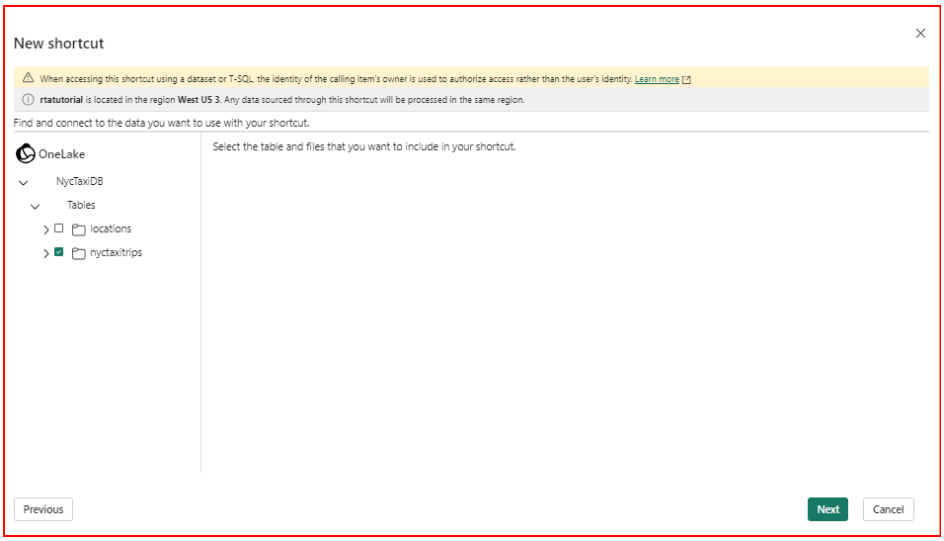
1. Under **Internal sources**, select **OneLake**.



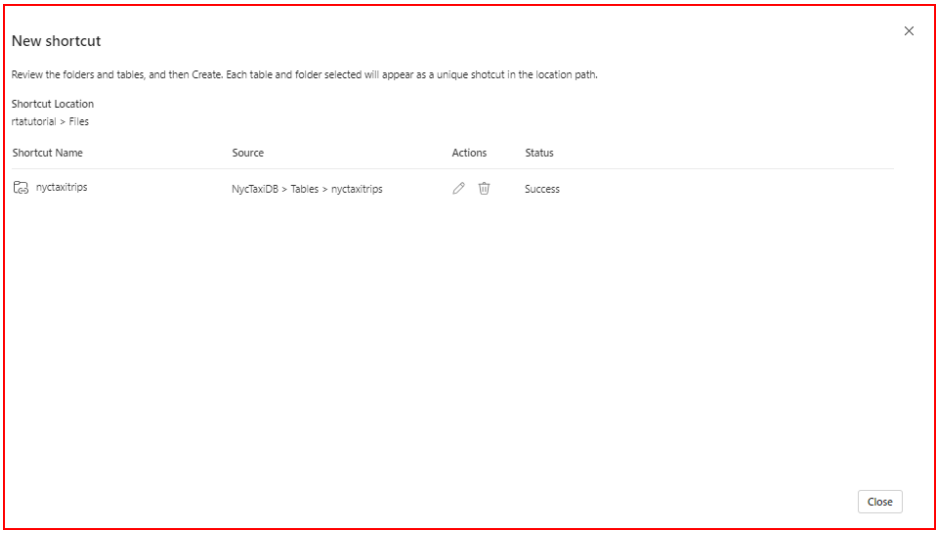
2. In **Select a data source type**, Filter KQL Database and select ***your KQL Database***, then select **Next** to connect the data to your shortcut.



3. To connect the table with the data from Eventstream, select **>** to expand the tables in the left-hand pane, then select the table titled **nyctaxitrips**.



4. Select **Create** to create the shortcut. The Lakehouse will automatically refresh. Click on Close.

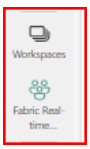


The Lakehouse shortcut has been created. Without additional management, you now have one logical copy of your data in the Lakehouse that you can use in other Fabric experiences, such as Notebooks and Spark jobs.

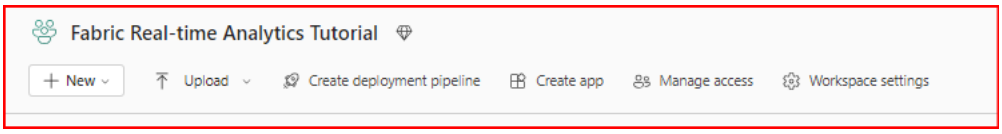
Module 4: Clean up resources

You can delete individual reports, eventstreams, KQL databases, KQL querysets, and other items or remove the entire workspace.

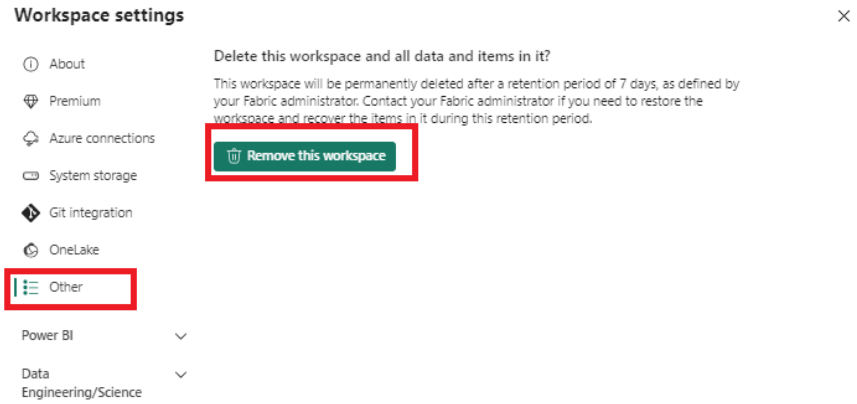
1. Select Fabric Real-time Analytics Solution Tutorial in the left-hand navigation menu to return to the workspace artifact view



2. Below the workspace name and description at the top of the workspace header, select Workspace settings.



3. Select **Other > Remove this workspace**



4. Select **Delete** on the warning.