



Introduction to Metabase

A Powerful Data Visualization and Analytics Tool

Data Engineering Diploma

What is Metabase?

-  Installing Metabase using Docker on Amazon EC2
-  Connecting your Database to Metabase
-  Data Fundamentals
-  Creating Collections in Metabase
-  Creating Questions in Metabase
-  Creating a Dashboard in Metabase

Agenda.



What is Metabase?

Metabase

- an open-source business intelligence and analytics tool that is used by businesses and organizations of all sizes across industries like healthcare, finance, and e-commerce.
- popular among data analysts, business users, and developers who seek a powerful yet user-friendly tool for data exploration and visualization.

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Installing Metabase using Docker on Amazon EC2

- Launch an EC2 Instance
 - Log in to your AWS Management Console
 - Navigate to EC2 dashboard
 - Click “Launch Instances” and follow the wizard to select an Ubuntu AMI (which is commonly used for Docker) or another suitable AMI
- Connect to the EC2 Instance
 - Once your instance is running, connect to it using SSH
- Install Docker



Installing Metabase using Docker on Amazon EC2

- Download and Run Metabase Docker Container
 - Pull the Metabase Docker image from Docker Hub
docker pull metabase/metabase:latest
 - Run the Metabase Docker container, mapping the container's port 3000 to the host's port 3000, and specifying a volume for data persistence
docker run -d -p 3000:3000 --name metabase metabase/metabase
 - Or, if you want to store the metadata of Metabase in your own database

Bash ▾

```
docker run -d -p 3000:3000 \
-e "MB_DB_TYPE=postgres" \
-e "MB_DB_DBNAME=<metabasea-db>" \
-e "MB_DB_PORT=5432" \
-e "MB_DB_USER=<name>" \
-e "MB_DB_PASS=<password>" \
-e "MB_DB_HOST=<my-database-host>" \
--name metabase metabase/metabase
```



Installing Metabase using Docker on Amazon EC2

- Access Metabase Web Interface
 - Open a web browser and navigate to your EC2 instance's public IP address or DNS name, along with port 3000
https://<your-instance-ip>:3000
 - follow the prompts to configure Metabase (language selection, database setup, admin account)
- Configure Security Groups and Firewall
 - Ensure that your EC2 instance's security group allows incoming traffic on port 3000

* This guide provides a basic overview, and you may need to adjust steps based on your specific requirements. Always refer to the official documentation for Docker and Metabase for the latest and most detailed instructions.

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Connecting your Database to Metabase

Supported databases

The databases listed below have official drivers maintained by the Metabase team. Customers on [paid plans](#) will get official support.

- [Amazon Athena](#)
- [BigQuery](#) (Google Cloud Platform)
- [Druid](#)
- [MongoDB \(version 4.2 or higher\)](#)
- [MySQL \(version 5.7 or higher, as well as MariaDB version 10.2 or higher\)](#)
- [Oracle](#)
- [PostgreSQL](#)
- [Presto](#)
- [Redshift \(Amazon Web Services\)](#)
- [Snowflake](#)
- [SparkSQL](#)
- [SQL Server](#)
- [SQLite](#)
- [Vertica](#)

- * If you don't see your database listed here, see [partner and community drivers](#).
- * As of version 46.6.4, Metabase **no longer supports H2 connections**. But Metabase still ships with an H2 database to include an embedded application database, as well as to provide some sample data out of the box.



Connecting your Database to Metabase

Adding a database connection

- To add a database connection, click on the gear icon  in the top right, and navigate to Admin settings > Databases > Add a database.
- Fill out the fields for that database, and click Save changes at the bottom.
 - The connection settings vary from database to database. For the purpose of learning, we are using the [Snowflake database](#).
- After entering the connection details, click the “Save” button to ensure that the Metabase can connect to your database successfully.

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Data Fundamentals

If you are planning to dive into Metabase, having a solid grasp of some essential database terminology can be incredibly useful.

- **Tables, Columns, Rows**
 - Databases consist of one or more tables. Each table features at least one column and one row. Rows are composed of cells, and each cell holds a value that aligns with its respective column.
- **Columns and Fields**
 - In Metabase, the terms 'Columns' and 'Fields' are commonly used *interchangeably*, particularly when a column contains data from a single field.
 - Column: typically a list of uniform values, often sourced from a single field.
 - Example: the 'product_id' column holds ids.
 - Field: represents a specific data element within a table.
 - Example: the 'product_id' field stores individual identification codes.
- **Keys**
 - A primary key serves as a unique identifier for each row within a table.



Data Fundamentals

Common Data Types

- String Types (e.g., text, char, varchar)
 - These fields hold text snippets, commonly called "strings". They may include letters, numbers, and special characters.
- Numerical Types (e.g., integer, float, decimal)
 - These fields contain numerical data. Integers hold whole numbers, while float and decimal types can store fractional numbers.
- Temporal Types (e.g., timestamp, date, time)
 - These specialized fields store date and time information, often referred to as "timestamps".
- Boolean Types
 - These fields can have only one of two values, generally True or False.



Data Fundamentals

Data Types

In Metabase, the data type for each field can be viewed by going to the Data Browser. There, you can click on the gray book icon beside the table name to open the Data Reference page. Once on this page, select 'Fields in this table' from the left sidebar. The data types are displayed in the third column for each field.

The screenshot shows the Metabase interface for viewing data types. On the left, the sidebar includes 'Home', 'COLLECTIONS' (with 'Our analytics', 'Your personal collection', and 'demo'), and 'DATA' (with 'Browse data' highlighted). In the center, under 'DATE_DIM', the 'Fields in this table' option is selected (highlighted with a yellow oval). The right panel displays the 'Fields in Date Dim' table with columns: Field name, Field type, and Data type (which is also highlighted with a yellow oval). The table data is as follows:

Field name	Field type	Data type
D Date ID	D_DATE_ID	Aa No field type
Cal Dt	CAL_DT	Calendar
Day Of Wk Desc	DAY_OF_WK_DESC	Aa Category
Wk Num	WK_NUM	# No field type



Data Fundamentals

Metadata

In Metabase, **admins** have the ability to modify the display names, descriptions, and semantic types (commonly referred to as field types) for fields. These adjustments give users additional context regarding the purpose of each field and guide Metabase on how to interpret various fields.

Properly classifying field types allows Metabase to automatically choose the appropriate chart format, generate maps from geographical data, or present URLs as clickable links. A list of available Metabase field types can be found on [this](#) page.

Casting to a Specific Data Type

- Click on the gear icon  in the top right, and navigate to Admin settings > Data Model.
- Locate your database and table.
- Click on the gear icon  at the right of a column's settings box.
- Scroll to cast to a specific data type.
- Select a casting option.

The screenshot shows the Metabase Admin interface with the 'Data Model' tab selected. On the left, there's a sidebar with 'Schemas - BI_NLTX' highlighted. The main area shows a table named 'Weekly Sales Inventory'. A gear icon is circled on the right side of the table columns. The table has columns for 'COLUMN', 'VISIBILITY', and 'TYPE'. One row shows 'WAREHOUSE_SK' with 'Everywhere' visibility and 'No semantic type'.

The screenshot shows the 'Field Settings' interface for the 'Warehouse Sk' field. It highlights the 'Category' casting option under 'Field Type' and the 'A list of all values' filtering option under 'Filtering on this field'.

Field Type
Warehouse Sk | No description for this field yet
Category ▾

Filtering on this field
When this field is used in a filter, what should people use to enter the value they want to filter on?
Field Type | No semantic type ▾
A list of all values ▾

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Creating Collections in Metabase

Congratulations! If you have successfully completed all the steps, you are now ready to begin creating queries and dashboards by utilizing this database as a data source. When creating queries, you will be able to choose the database connection you have just established.

If you are currently on the Admin settings page, click on the “Exit admin” option in the top right corner.

The screenshot shows the Metabase Home page. On the left, there's a sidebar with a "Home" button (highlighted in blue), "COLLECTIONS" section (with "Our analytics" and "Your personal collection" options), and a "DATA" section (with "Browse data" option). At the top right, there's a search bar, a "+ New" button, and a gear icon. The main area has a greeting "Good to see you, WeCloudData". Below it, a message says "Here are some explorations of the RAW schema in Snowflake". There are several cards arranged in a grid:

- Some insights about Catalog Sales
- A summary of Web Sales
- A summary of Call Center
- A glance at Web Site
- A summary of Catalog Returns
- Some insights about Item
- A look at Web Returns
- A look at Promotion
- A look at Customer
- A glance at Store Returns
- Metabase tips



Creating Collections in Metabase

In Metabase, collections are organizational structures used to group related dashboards, questions (queries), and other content together for easier management and navigation. Collections allow you to locally organize your analytics and data visualization assets in a way that makes sense for your specific use case.

For the purpose of learning, our initial step involves creating a collection within 'Our analytics' titled 'TPC-DS project'. Within this collection, we'll proceed to generate two additional collections, known as 'Dashboards' and 'Questions (Queries)', both nested under the 'TPC-DS project' collection.

The image consists of two side-by-side screenshots of the Metabase interface. Both screenshots show a sidebar on the left with 'COLLECTIONS' and 'DATA' sections. The 'COLLECTIONS' section contains 'Our analytics' (selected), 'Your personal collection', and 'New collection'. The 'DATA' section contains 'Browse data'.

Method 1: A yellow arrow points from the text 'Method 1' to a yellow circle around the three-dot menu icon (ellipsis) located above the 'New collection' button. A tooltip-like box is overlaid on the interface, containing the text 'New collection' and 'Other users' personal collections'.

Method 2: A yellow arrow points from the text 'Method 2' to a yellow circle around the '+ New' button located at the top of the main content area. A tooltip-like box is overlaid on the interface, containing the text '+ New'.

The main content area displays a list of collection types: Question, SQL query, Dashboard, Collection, and Model.

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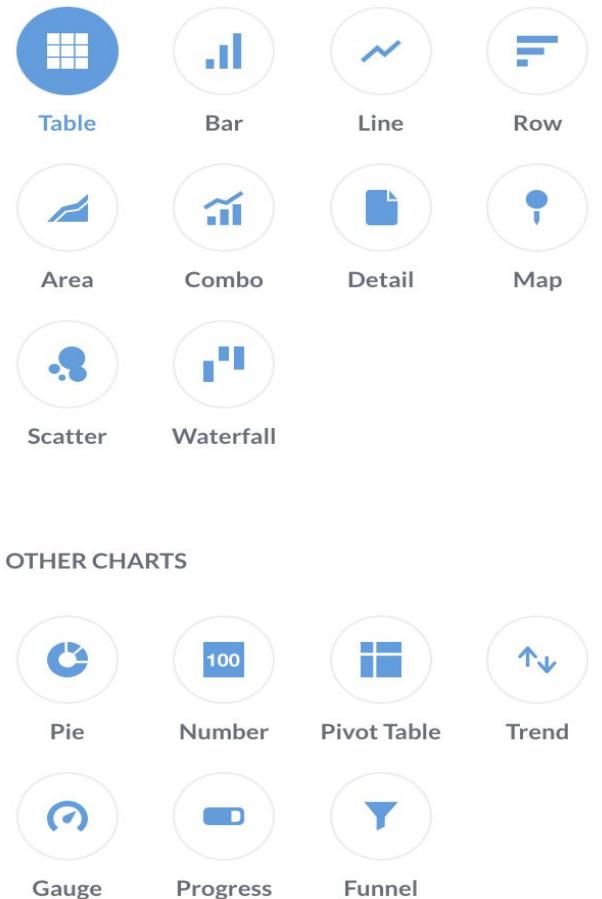
Creating Questions in Metabase

To ask a question in Metabase, click the '+New' button in the top right corner of the main navigation bar, and select either

- **Question (aka. the query builder)**
- **SQL query**

You can initiate a question from one of the following sources:

- **Raw Data**
 - specify both the database and the table within that database
 - **A Saved Question** 
 - The results of any previously saved question can serve as the foundation for a new inquiry.
 - **A Model** 
 - A model is a uniquely crafted saved question designed as an ideal foundation for further questions. These are occasionally referred to as derived tables, as they often aggregate data from several raw tables.
- * Kindly observe that with dbt transformations, building models in Metabase is no longer necessary.



* please check [this](#) page for more information.



Creating Questions in Metabase

Question (aka. the query builder)

- The query builder's notebook editor has three default steps:
 - Picking Data
 - Filtering
 - Summarizing and Grouping By

SQL query

In Metabase's **Query Builder**, you can apply filters directly as you construct queries, while in **SQL queries**, you must explicitly build and map filter conditions to table columns using SQL syntax.

Field Filter

Distinguishing Field Filters from simple Text, Number, and Date variables

- Field Filters are optional by default. If no value is given, the SQL query will run as if the Field Filter didn't exist. You do, however, have the option to require a value.
- **Field Filters won't work with table aliases.** Since Field Filters rely on [metadata](#) about columns in your tables (and the specific names of those tables), the filters can't "know" that you've aliased a table. And depending on the database you're using, you may need to include the full schema path in the **FROM** clause.
- Field Filters use a special syntax so they can handle SQL code behind the scenes. You simply supply a Field Filter to a **WHERE** clause (without a column or operator) and the Field Filter will manage the SQL code for you. This allows the code to account for multiple selections people make in the filter widget.



Creating Questions in Metabase

Question (aka. the query builder)

Demo #1: Detect items experiencing low stock levels, along with their corresponding week and warehouse numbers, marked as "True".

- Once you are in the query builder interface, choose the data source from which you want to query. Then select the specific table against which you want to build your query. You'll see something like this:

The screenshot shows the Metabase query builder interface. At the top, it says "Snowflake / BI_NLT / Weekly Sales Inventory". Below that is a "Data" section with a dropdown menu set to "Weekly Sales Inventory". To the right are "Save" and "Share" buttons. Under "Filter", there's a placeholder "Add filters to narrow your answer". In the "Summarize" section, there are two buttons: "Pick the metric you want to see" and "by Pick a column to group by". At the bottom is a "Visualize" button.

- Filter on conditions where LOW_STOCK_FLG_WK is "True".

The screenshot shows the Metabase query builder interface with a filter configuration. On the left, under "Filter", there's a dropdown menu with options: "True" (selected), "False", "Empty", and "Not empty". An arrow points from this dropdown to a "Low Stock Flg Wk is true" checkbox on the right. Below these are "Add filter" and "Add filters to narrow your answer" buttons.

- Summarize the data based on YR_WK_NUM, WAREHOUSE_SK, ITEM_SK, INV_QTY_WK, WKS_SPLY, and LOW_STOCK_FLG_WK.

Summarize

Pick the metric you want to see

by

Yr Wk Num X Warehouse Sk X Item Sk X
Inv Qty Wk X Wks Sply X Low Stock Flg Wk X
+

- Order the results based on the most recent YR_WK_NUM, and sort the values of WAREHOUSE_SK, ITEM_SK, INV_QTY_WK in ascending order.

Sort

↓ Yr Wk Num X ↑ Warehouse Sk X ↑ Item Sk X ↑ Inv Qty Wk X +

- Utilize data as a table with conditional formatting based on the ITEM_SK column.

Weekly Inventory Shortages

Yr Wk Num	Warehouse Sk	Item Sk	Inv Qty Wk	Wks Sply	Low Stock Flg Wk
202,337	1	2,600	0	0	true
202,337	1	3,554	0	0	true
202,337	1	6,134	0	0	true
202,337	1	6,967	0	0	true
202,337	1	8,696	0	0	true



Creating Questions in Metabase

Question (aka. the query builder)

Demo #2: Find the total count of items experiencing weekly inventory shortages, along with their corresponding week and warehouse numbers.

- Create a new question using a previously saved question
- Choose Bar Chart as visualization type

Number of Weekly Inventory Shortages

Data

Weekly Sales Inventory

Filter

Low Stock Flg Wk is true

Distinct(column)

The number of distinct values in this column.

Distinct([Last Name])

column

The column whose distinct values to count.

Learn more

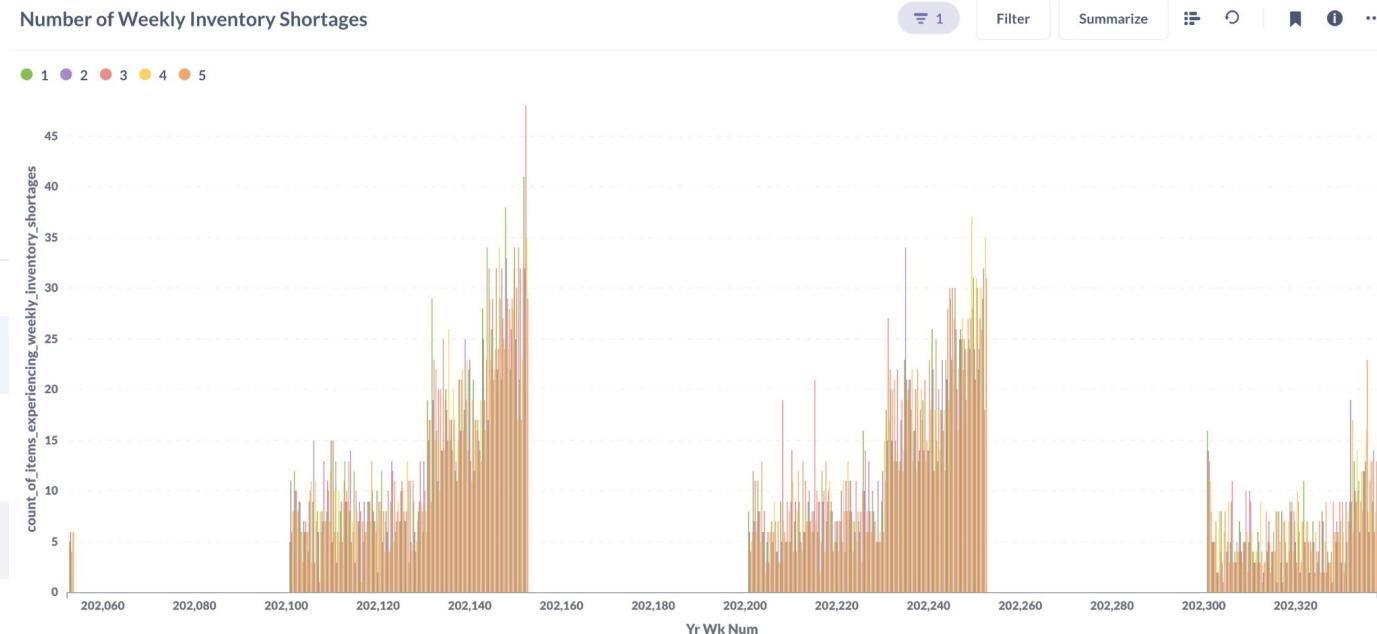
Custom Expression

= Distinct([Item Sk])

count_of_items_experiencing_weekly_inventory_shortages

Done

Filter Summarize Join data Sort Row limit Custom column Visualize





Creating Questions in Metabase

Question (aka. the query builder)

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- Field Filters use a special syntax so they can handle SQL code behind the scenes. You simply supply a Field Filter to a **WHERE** clause (without a column or operator) and the Field Filter will manage the SQL code for you. This allows the code to account for multiple selections people make in the filter widget.



Creating Questions in Metabase

SQL query

After clicking 'SQL query', you'll see an editor where you can write and run queries in SQL or your database's native querying language.

Demo: Identify the highest performing items of the week by analyzing sales amounts and quantities. Order the results based on the most recent YR_WK_NUM, and sort the value for the number of TOP_SELL_RANKING in ascending order.

Snowflake ▾

```
1 with cte as (
2     select
3         YR_WK_NUM
4         , ITEM_SK
5         , sum(coalesce(SUM_AMT_WK, 0)) as sum_wk_amt
6         , sum(coalesce(SUM_QTY_WK, 0)) as sum_wk_qty
7         , rank() over (partition by YR_WK_NUM order by sum(coalesce(SUM_AMT_WK, 0)) desc, sum(coalesce(SUM_QTY_WK,0)) desc) as top_sell_ranking
8     from
9         BI_NLTX.WEEKLY_SALES_INVENTORY
10    group by
11        1, 2
12 )
13 select
14     *
15 from
16     cte
17 order by
18     1 desc, 5
```

↻

YR_WK_NUM	ITEM_SK	SUM_WK_AMT	SUM_WK_QTY	TOP_SELL_RANKING
202,332	1,891	36,242.93	314	1
202,332	5,609	35,505.62	234	2
202,332	13,298	30,984.18	329	3
202,332	2,521	30,674.34	162	4

Visualization

Showing first 2,000 rows

WeCloudData



Creating Questions in Metabase

How To Use Optional Filters in an SQL Query?

To make a filter optional, you can include it in your SQL query within a **WHERE** clause using **[[...]]** to denote that it is optional.

```
Snowflake
Aa Filter name
1 select
2   column_name
3 from
4   table_name
5 where 1=1
6   [[ and {{filter_name}} ]]
```

Here's where your results will appear

Variables

SETTINGS HELP

Variable name: **filter_name**

Variable type: **Text**

Filter widget label: **Filter name**

How should users filter on this variable?
 Dropdown list
 Search box
 Input box

Required?:

Variable type: **Field Filter**

Field to map to (required): Select...

You'll need to **select the type of variable** you want to use from among text, number, date, or field filter.

If you opt for a field filter as the variable type, you'll also be required to specify the database table and column to which it should be mapped.



Creating Questions in Metabase

SQL query (cont.)

Demo: Identify the highest performing items of the week by analyzing sales amounts and quantities. Order the results based on the most recent YR_WK_NUM, and sort the value for the number of TOP_SELL_RANKING in ascending order.

The screenshot shows the Metabase interface with an SQL query on the left and its configuration on the right.

SQL Query:

```
1 with cte as (
2     select
3         YR_WK_NUM
4         , ITEM_SK
5         , sum(coalesce(SUM_AMT_WK, 0)) as sum_wk_amt
6         , sum(coalesce(SUM_QTY_WK, 0)) as sum_wk_qty
7         , rank() over (partition by YR_WK_NUM order by sum(coalesce(SUM_AMT_WK, 0)) desc, sum(coalesce(SUM_QTY_WK, 0)) desc) as top_sell_ranking
8     from
9         BI_NLTX.WEEKLY_SALES_INVENTORY
10    where 1=1
11        [[and {{warehouse_sk}}]]
12    group by
13        1, 2
14 )
15 select
16    *
17  from
18      cte
19  where 1=1
20      [[and top_sell_ranking<={{top_sell_rk}}]]
21  order by
22      1 desc, 5
```

Filter Configuration (Warehouse sk):

- Variable name: warehouse_sk
- Variable type: Field Filter
- Field to map to: BI_NLTX > WEEKLY SALES INVENTORY Warehouse Sk
- Filter widget type: String
- Filter widget label: Warehouse sk
- Required?:
- Default filter widget value: 5

Filter Configuration (Top sell rk):

- Variable name: top_sell_rk
- Variable type: Number
- Filter widget label: Top sell rk
- Required?:
- Default filter widget value: 5

Question Configuration:

- How should users filter on this variable? Dropdown list
- Required?:

WeCloudData



Creating Questions in Metabase

SQL query (cont.)

Demo: Identify the highest performing items of the week by analyzing sales amounts and quantities. Order the results based on the most recent YR_WK_NUM, and sort the value for the number of TOP_SELL_RANKING in ascending order.

In our demo, we want to utilize data as a table with conditional formatting based on the TOP_SELL_RANKING column.

< Table options

Columns Conditional Formatting

This question is written in SQL. Top sell rk 5 X Warehouse sk

Which columns should be affected? TOP_SELL_RANKING

Formatting style Color range

Colors

Start the range at Smallest value in this column

End the range at Largest value in this column

Add rule Done

Visualization

YR_WK_NUM	ITEM_SK	SUM_WK_AMT	SUM_WK_QTY	TOP_SELL_RANKING
202,332	1,891	36,242.93	314	1
202,332	5,609	35,505.62	234	2
202,332	13,298	30,984.18	329	3
202,332	2,521	30,674.34	162	4
202,332	236	29,337.21	220	5
202,331	3,013	34,408.4	189	1
202,331	14,264	31,794.49	274	2
202,331	4,159	31,435.25	265	3
202,331	16,363	29,223.45	155	4
202,331	8,605	27,826.15	342	5
202,330	1,247	27,464.64	168	1
202,330	1,580	26,143	192	2
202,330	13,526	25,583.19	219	3
202,330	10,993	24,253.72	211	4
202,330	4,843	22,402.22	142	5

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Creating a Dashboard in Metabase

Create a New Dashboard

- Go to the Metabase homepage.
- Click on the '+ New' and then select 'Dashboard' button from the top navigation bar.
- Give your dashboard a name and description, and then click 'Create'.

Add Saved Questions to Dashboard

- On your new dashboard page, click on the icon to edit the dashboard.
- Click on the and you will be taken to a page where you can select from your saved questions.
- Add the questions you want to include on your dashboard.

Add Filters to Dashboard

- Click on the to add a filter.
- Choose the type of filter you want to add.
- After adding the filter, you will need to map the filter to the relevant fields in each question by clicking the gear icon beside it.

What do you want to filter?

Time

Date range, relative date, time of day, etc.

Location

City, State, Country, ZIP code.

ID

User ID, Product ID, Event ID, etc.

Number

Subtotal, Age, Price, Quantity, etc.

Text or Category

Name, Rating, Description, etc.



Creating a Dashboard in Metabase

TPC-DS demo dashboard



warehouse number

Top-ranking | Low

Weeks Supply Num

Greetings, this demonstration aims to provide you with a brief tutorial on crafting a dashboard within Metabase. We'll be utilizing both the notebook editor and SQL editor for this tutorial.

Identify the highest and lowest performing items of the week by analyzing sales amounts and quantities.

Items with Highest Weekly Sales

YR_WK_NUM	ITEM_SK	SUM_WK_AMT	SUM_WK_QTY	TOP_SELL_RANKING
202,337	16,255	26,025.1	97	1
202,337	9,775	19,788.31	213	2
202,337	11,389	18,816.93	99	3
202,337	10,429	18,463.29	93	4
202,337	15,025	17,782.5	75	5
202,336	5,779	18,261.85	95	1
202,336	2,072	18,240	96	2
202,336	1,969	16,554.48	92	3
202,336	7,075	15,935.79	87	4

Rows 1-9 of 710

Items with Lowest Weekly Sales

YR_WK_NUM	ITEM_SK	SUM_WK_AMT	SUM_WK_QTY	LEAST_SELL_RANKING
202,337	2,659	0	9	1
202,337	9,074	0	24	2
202,337	17,264	0	26	3
202,337	6,530	0	30	4
202,337	4,573	0	32	5
202,337	5,342	0	70	6
202,337	1,220	0	93	7
202,337	2,191	0.96	1	8
202,337	8,594	4.36	4	9
202,337	2,456	4.56	3	10

Rows 1-10 of 1421

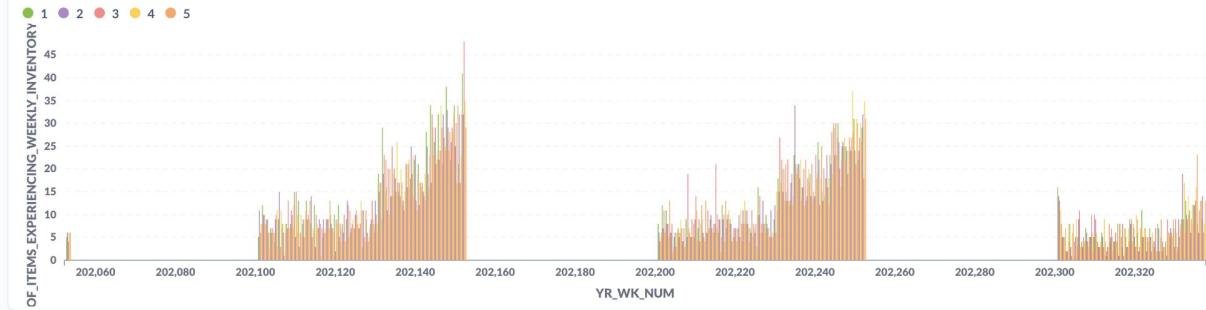
Detect items experiencing low stock levels, along with their corresponding week and warehouse number, marked as "True."

Weekly Inventory Shortages_

YR_WK_NUM	WAREHOUSE_SK	ITEM_SK	INV_QTY_WK	WKS_SPLY	LOW_STOCK_FLG_WK
202,337	1	2,600	0	0	true
202,337	1	3,554	0	0	true
202,337	1	6,134	0	0	true
202,337	1	6,967	0	0	true
202,337	1	8,696	0	0	true
202,337	1	11,137	0	0	true
202,337	1	12,061	0	0	true

Rows 1-7 of first 2000

Number of Weekly Inventory Shortages_



WeCloudData



Useful Resources

- <https://www.metabase.com/learn/>
- <https://www.metabase.com/docs/latest/>
- <https://www.metabase.com/learn/sql-questions/field-filters>
- <https://www.metabase.com/learn/dashboards/custom-destinations>