

MICROSOFT POWER BI PL-300 PREPARATION

POINTS TO REMEMBER

BY ABU BAKAR N. ALVI (POWER BI TRAINER)

SECTION 1:

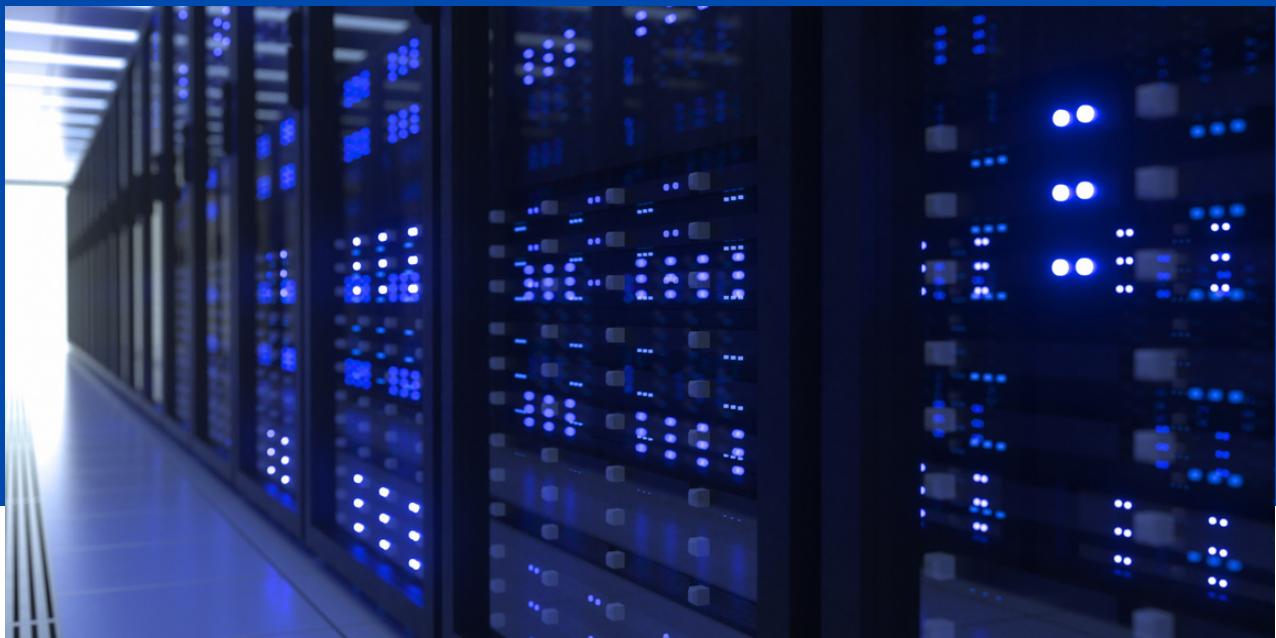
GET DATA FROM DATA SOURCES



- O1** There are more than 100 connectors in Power Query through which you can connect to data sources, either on-premises, in the cloud or Web
- O2** If a connector is not available for a data source, Power Query SDK can be used to create a custom connector
- O3** The various authentication methods available for data sources include Basic, Windows, Database, Microsoft Account, OAuth2, API key and Anonymous.
- O4** There is a Data Privacy Firewall in Power Query that prevents unintentional leakage of data between different data sources during the merge or append operations
- O5** Privacy levels (public, organizational, private) in Power Query are used to control how data from different sources can be combined (merged or appended), preventing potential leaks or unwanted exposure

SECTION 1:

GET DATA FROM DATA SOURCES



06 Connectivity modes include Import, DirectQuery and Live Connection (only for PBI datasets and Analysis Services)

07 Dataset modes include Import, DirectQuery, Live Connection and Composite (Mixed)

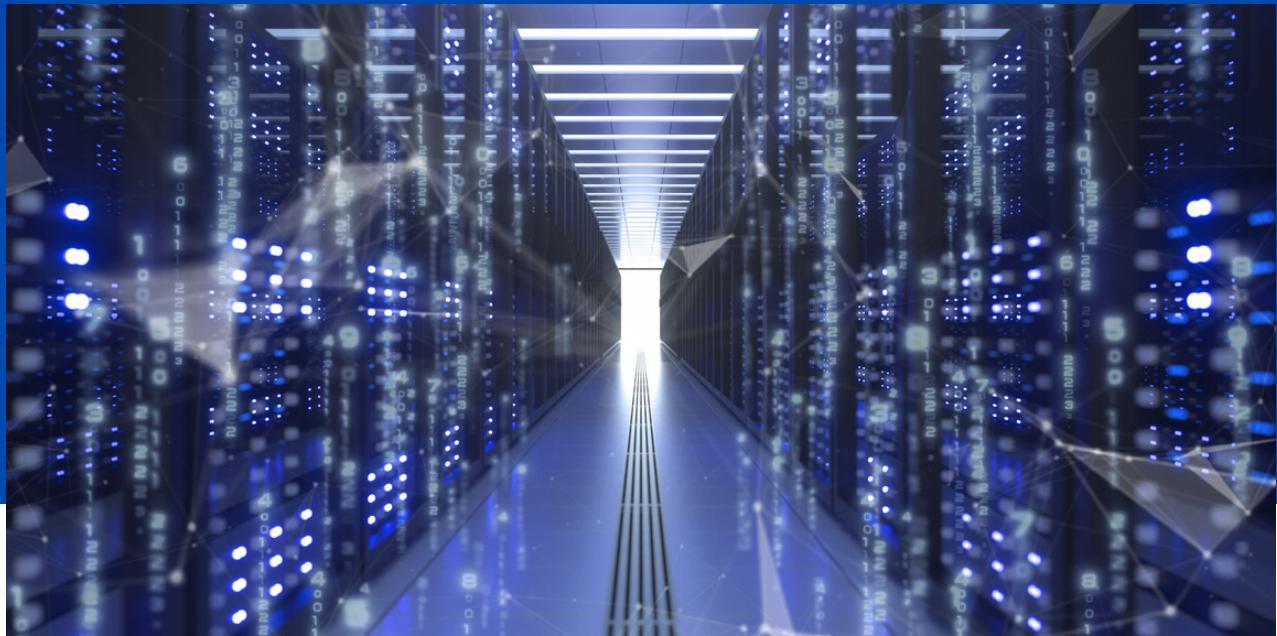
08 Table Storage Modes include Import, DirectQuery, Live connection and Dual

09 Hybrid Tables refer to tables that have both import and DirectQuery partitions and are only used in Composite or Mixed datasets

10 Changing the Storage mode of a table to Import is an irreversible operation. For Dual storage mode tables, Power BI determines the most efficient mode to use

SECTION 1:

GET DATA FROM DATA SOURCES



11

A shared dataset is a dataset that is shared between multiple reports. You can connect to a shared dataset from within Power BI Desktop via Live connection, which can be changed to DirectQuery.

12

Parameters in Power Query can be used to change the data source dynamically (For example, database name, the Excel file path, address of the data source, table names, Excel sheets etc.)

13

Parameters are also used for passing values to custom functions in Power Query. You can pass any value or list query (a query whose output is a list) to the parameter

14

Power BI Data Source (PBIDS) files ease the process of passing credentials to a data source. When opened, these prompt the user for credentials to authenticate and connect to the data source

15

Power BI template (PBIT) files contain information about queries, query parameters, data model including the schema, relationships, measures, Report pages, visuals and other visual elements.

SECTION 2

CLEAN THE DATA



O1 Column Quality focuses on Valid values, Errors and Empty rows for all the columns of a query

O2 Column Distribution focuses on distinct values, unique values (which appear only once) for all the columns of a query

O3 Column Profile returns the minimum, maximum, average, standard deviation, count, null count, distinct count of a column

O4 Table.schema() and Table.profile() M functions also provide similar information as provided by the Column Quality, Column Distribution and Column Profiling options in Power Query Editor

O5 To resolve inconsistencies in the data, you can rename queries, remove columns, keep top / bottom / range of rows / duplicate rows, remove top / bottom / alternate / duplicate rows,

SECTION 2

CLEAN THE DATA



To resolve inconsistencies, unexpected and null values

Important M-language functions for this purpose are

- Text.Trim -> Removes all the leading and trailing whitespaces from the text
- Text.Clean -> Removes all the control characters from the text
- Text.Upper -> Converts all characters in the text to uppercase
- Text.Lower -> Converts all characters in the text to lowercase

To replace any part of the text in a column, you can either use "Replace Value" from Power Query Editor or use Text.Replace() M function to replace old value with new value. This can be done for null values too

Table.ReplaceValue() M function does the same job of replacing old value with new value for any column of the table

You have the option to keep errors, remove errors or replace errors. Removing errors will drop the entire row.

While checking errors, if you click the white space in the cell then Query Editor shows information about error on bottom of the cell. If you click the Error hyperlink then Query Editor creates an Applied Step in Query settings

SECTION 2

CLEAN THE DATA

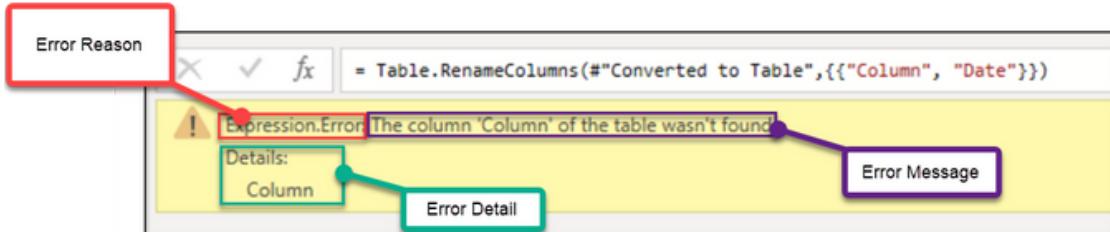


Power Query Errors

In Power Query, you can encounter two types of errors

- Step Level Errors
- Cell Level Errors

A step-level error prevents the query from loading and displays the error components in a yellow pane



- Query timeout Error -> happens with RDBMS, pull less data to resolve
- Data not formatted as Table -> Format Excel data using Ctrl + T
- Could not find file -> Source file location changes or permissions change
- DataSource.Error -> Source inaccessible due to credentials or location
- Column of table not found -> Reference column does not exist
- Formula.Firewall Error -> Trying to combine different data sources against privacy settings

SECTION 2

CLEAN THE DATA



Power Query Errors

A cell-level error won't prevent the query from loading, but displays error values as Error in the cell

The screenshot shows the Microsoft Power Query Editor interface. A table is displayed with four rows:

t23_id	A_C Account	t23_Sales	New Label
1	A		12 Error
2	B		25 Error
3	D		12 Error
4	E		53 Error

A yellow callout box at the bottom left provides details about the error:

Expression.Error: We cannot apply operator & to types Text and Number.
Details:
Operator:&
Left:Total Sales is:
Right:=25

- Data type conversion Error -> some values in the column cannot be converted to a specific data type
- Operations Error -> Trying to apply an operation that is not supported
- Nested values shown as errors -> Occurs when working with nested structured values (such as tables, lists, or records).. Could be due to data privacy settings or the column has been declared having Any datatype. Resolving data source privacy settings or data type removes the error.

SECTION 3

TRANSFORM AND LOAD THE DATA



O1 For each column, ensure that the selected data type represents the data and supports the mathematical / logical operation to be done using the column.

O2 Choosing the appropriate column data type can have impact on performance and storage, particularly with large datasets

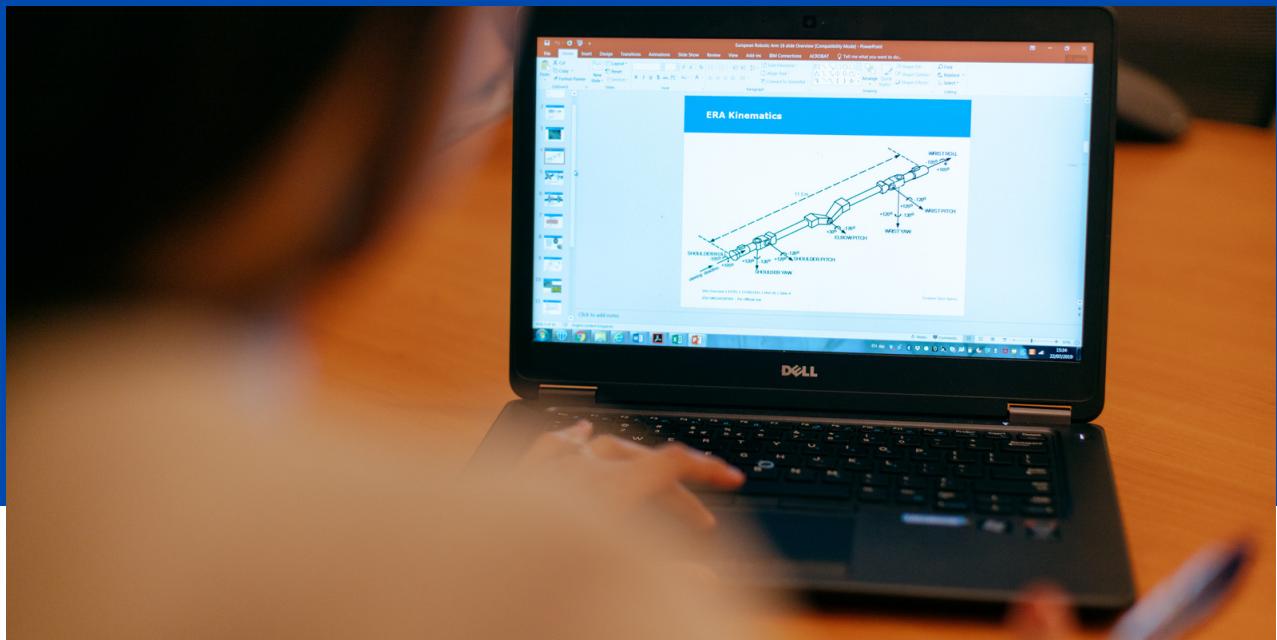
O3 Create and transform columns in Power Query using various M functions and Power Query Editor options. Remember to verify the results after each operation.

O4 Use 'Reference' when you want to create a new query based on existing transformations while preserving the original query. Changes to the original query impact the referenced queries

O5 Use 'Duplicate' when you want a copy of the original query to modify independently. 'Duplicate' creates an entirely separate instance of data with all the "Applied Steps" of the original query.

SECTION 3

TRANSFORM AND LOAD THE DATA



06 For appending, table structures (number of columns and data types) should be identical. Validate the operation to ensure data integrity

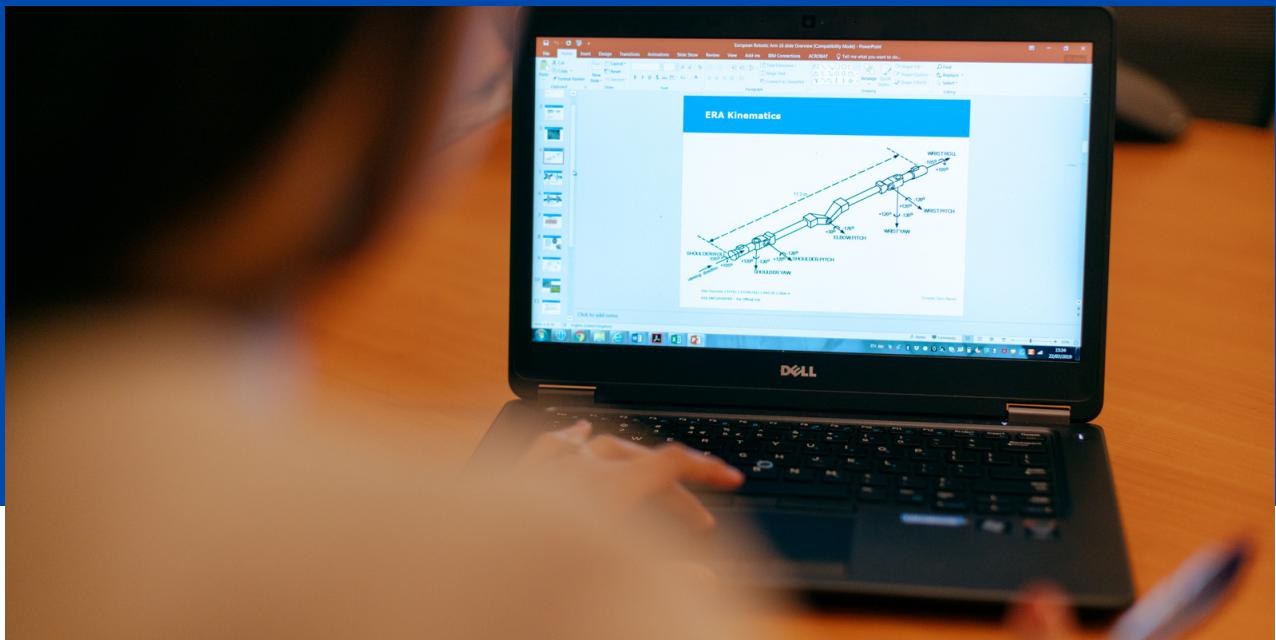
07 For merging, columns must be comparable. Understand different join types (inner, left, right, full) to correctly combine data based on shared values. Fuzzy matching results help understand the data integrity

08 You must remember the use of these important M query functions for query transformation

- Table.AddColumn -> Adds a new column to a table.
- Table.TransformColumns -> Perform transformations on one or more columns in a table.
- Table.SelectRows -> Used to filter rows from table based on a condition
- Table.Combine -> Used to append tables (union)
- Table.Join -> Used to merge tables (join) based on join type. Default is inner join
- Table.Group -> Used to groups the rows of a table by values in one or more columns and aggregate the data in the remaining columns.

SECTION 3

TRANSFORM AND LOAD THE DATA



- 09** Each Dimension table should have a unique key and other descriptive attributes. Try to make dimension tables "short and wide"
- 10** Each Fact table should have quantitative columns and foreign keys of all Dimension tables to build relationships. Try to make Fact tables "long and thin" and ideally should contain just numbers in each column
- 11** Keys should be unique identifiers within Dimension tables as duplication can violate the Star schema. Keeping data type of keys as numbers in both Dimension and Fact tables leads to better performance
- 12** Custom columns can be used to create new columns for building relationships between tables where an appropriate key is not available
- 13** Uncheck "Enable Load" if a query is not required as part of the data model in Power BI. Unselect "Include in Report Refresh" for queries where data does not change on refresh. Such queries are excluded from automatic refresh in Power BI Service as well.

SECTION 4

DESIGN AND IMPLEMENT A DATA MODEL



O1 In Power BI Model view, the featured table option, if turned ON, allows the featured table to appear in the Excel Data Types Gallery

O2 In Power BI Model view, Synonyms are used to identify the column when you are using the Q&A feature in PBI Desktop or PBI Service

O3 If you have a Date table in the data warehouse that has organization specific date information, then try and use that in your data model. Otherwise create a custom date table in Power Query editor.

O4 The best custom date table code can be found at this link
<https://analysthub.enterprisedna.co/apps/m-code?id=tbzgomoa>

O5 "Mark as date table" option will remove the autogenerated hierarchies. Also turn OFF the Auto Date/Time feature in Power BI settings for improved performance

SECTION 4

DESIGN AND IMPLEMENT A DATA MODEL



06 DAX functions CALENDARAUTO() or CALENDAR() can also be used to build a common date table, but this is the least desirable option

07 Cardinality defines the nature of the relationship between tables (one-to-one, one-to-many / many-to-one, many-to-many). For star schema models, ideally all relationships should be one-to-many

08 For all one-to-many relationships in a star schema model, the cross filter direction should be from the one side of the relationship to the many side indicating that 'dimension tables filter the fact tables'

09 Bi-directional cross filtering can introduce multiple filtering paths through the data which can create ambiguous results

10 To setup RLS in Power BI Desktop

- Manage Roles by creating static or dynamic rules -> Add Table Filter DAX expressions for the roles -> Enable bi-directional cross filtering (if required)
- Validate the roles and check functionality

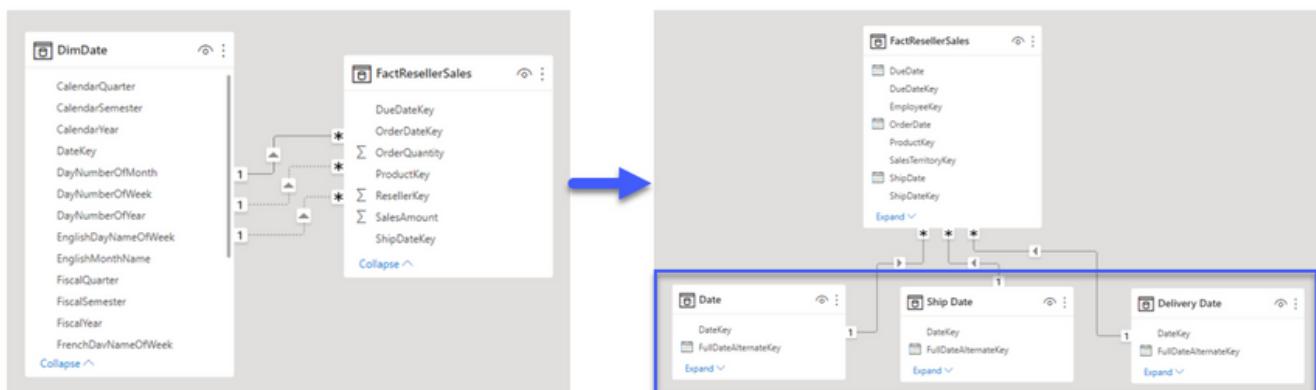
SECTION 4

DESIGN AND IMPLEMENT A DATA MODEL



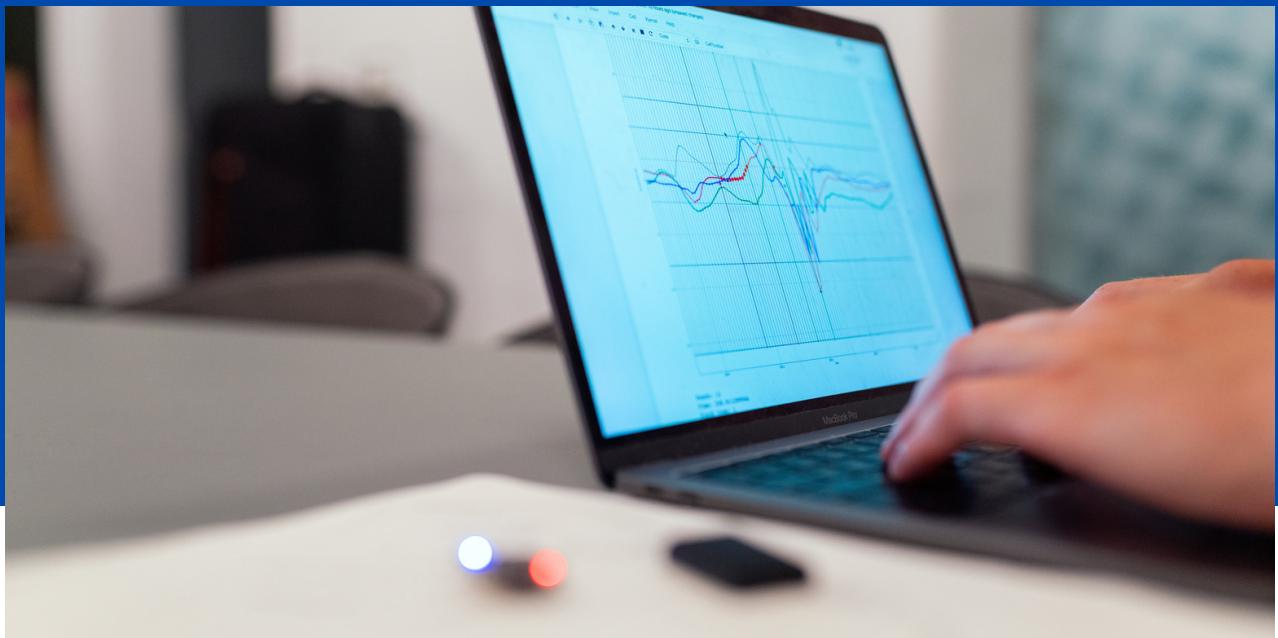
11

A role-playing dimension is a dimension that can filter related facts differently. Multiple date tables are created, where each date table is acting as a dimension and allows simultaneous filtering by different date roles.



SECTION 5

OPTIMIZE MODEL PERFORMANCE



- O1** In a Power BI Data Model, high-cardinality columns can significantly impact performance as these increase the size of the data model
- O2** The VertiPaq engine offers best compression for numeric data types, so whenever possible try and choose numeric data types with reasonable precision.
- O3** Datetime columns have a lot of unique values, and it is better to split the datetime column to a date and time column
- O4** Columns which are not used for either reporting or building relationships should be removed from the data model as these only increase the size of the data model
- O5** Similarly, only bring in the rows in the data model, especially for Fact table, which are necessary for data analysis. Bringing in rows that are not part of the data analysis only increase the size of the data model.

SECTION 5

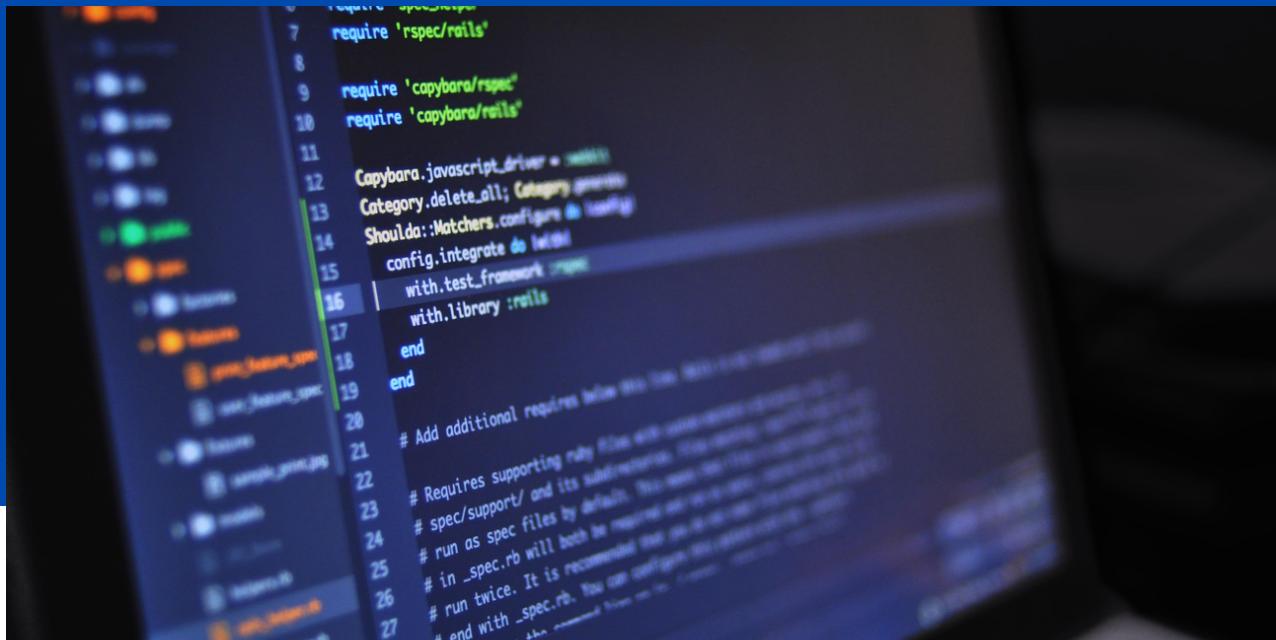
OPTIMIZE MODEL PERFORMANCE



- 06** One of the most effective techniques to reduce the size of the data model and improve performance is to raise the grain of the Fact table.
- 07** Loading pre-summarized data not only reduces the size of the data model but also improves the query performance. Another useful technique is the use of Aggregations, but it only works in DirectQuery and the aggregated tables have import storage mode.
- 08** For composite models, set dimension tables storage mode as Dual, Fact table as Direct Query and Aggregated tables in Import mode.
- 09** Performance Analyzer shows time spent (duration) for each visual based on these elements
- DAX query - Time between the visual sending the query, and for Analysis Services to return the results
 - Visual display - Time required for the visual to appear on the screen, including time required to retrieve any web images or geocoding
 - Other - Time required by the visual for preparing queries, waiting for other visuals to complete, or performing other background processing

SECTION 5

OPTIMIZE MODEL PERFORMANCE



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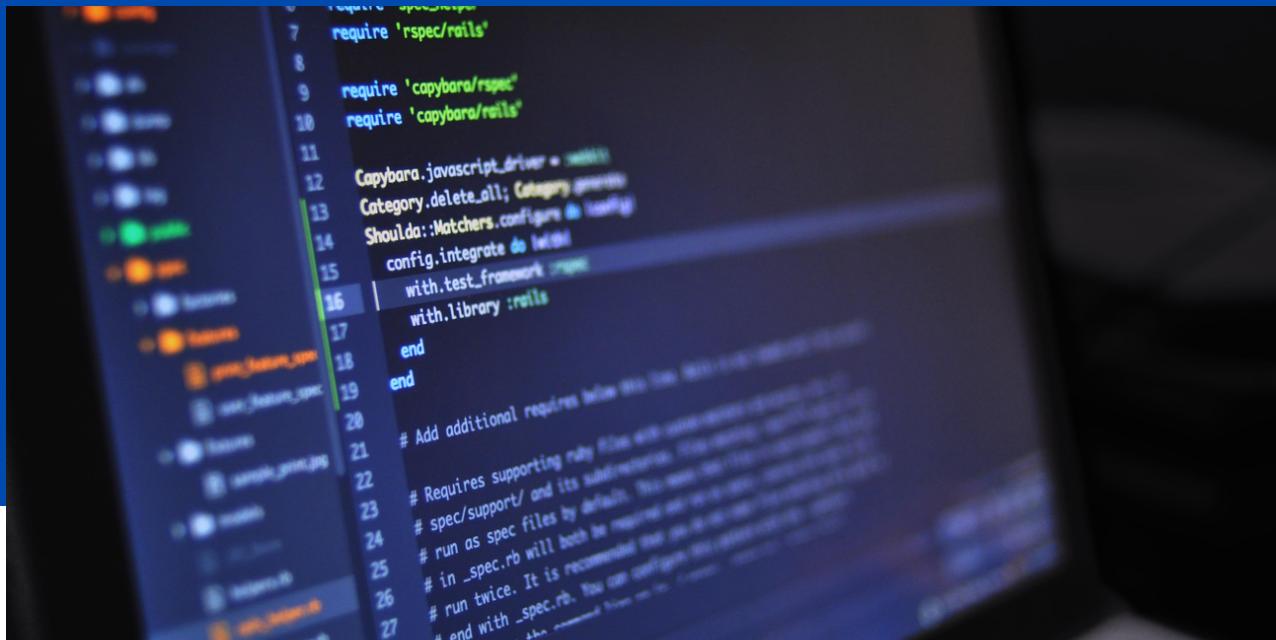
Based on the results of the Performance Analyzer, the order of debugging is shown below

- Report Canvas -> "Other" part shows how long a specific visual had to wait in the execution queue. So if this number is high then reduce the number of visuals or check performance by disabling cross-filtering option between visuals
- DAX Queries -> Use tools like DAX Studio to debug behind the scenes DAX query performance
- Data Model -> Use tools like Tabular Editor to see cardinality, table size, hierarchy size, size of the relationships and compression applied to tables and columns
- Data Source -> Check the performance of the data source



SECTION 5

OPTIMIZE MODEL PERFORMANCE



11

Data Transformation, Loading and Data Modeling are strongly related with each other. Watch these short videos from Enterprise DNA Youtube channel to know more about optimization, performance and best practices

<https://www.youtube.com/watch?v=JHF6gFZhiE>

<https://www.youtube.com/watch?v=EocrvXatsd4>



Data Loading And Transformation - Power BI Best Practices Vol. 1

Enterprise DNA • 16K views • 2 years ago

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Data Modelling - Power BI Best Practices Vol. 2

Enterprise DNA • 11K views • 2 years ago

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SECTION 6

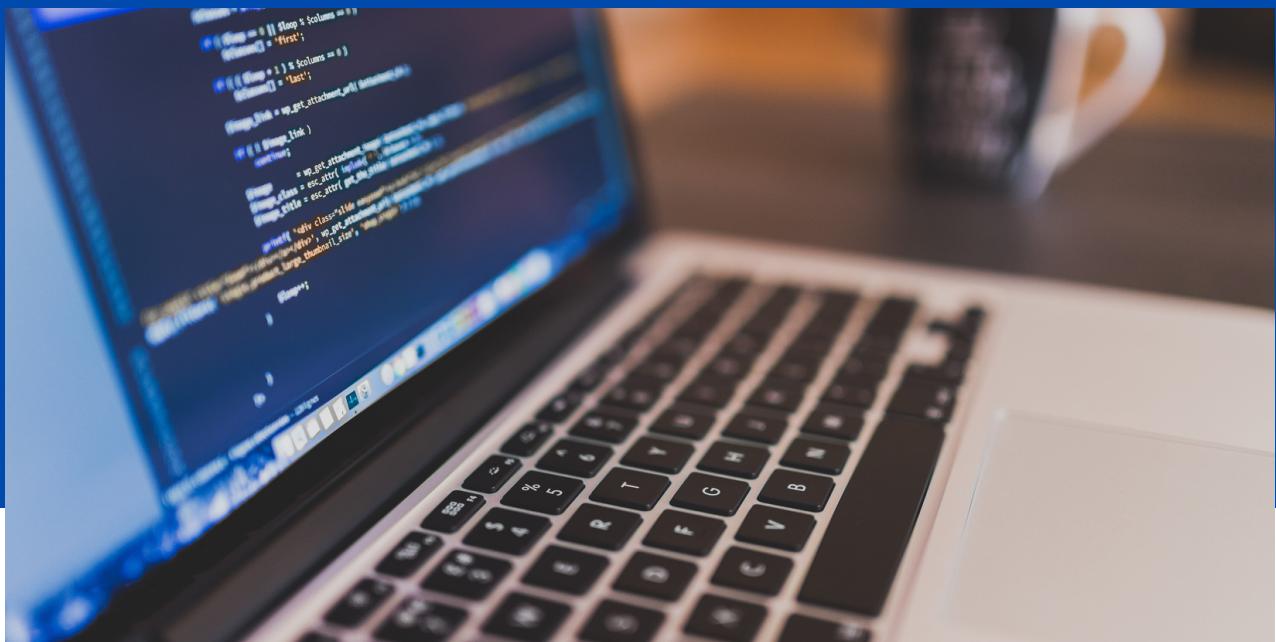
CREATE MODEL CALCULATIONS BY USING DAX



- O1** DAX functions like SUM, MIN, MAX etc. operate on a single column and perform aggregations. Understanding the difference in syntax and operation between these functions and Iterator Functions like SUMX, MINX, MAXX etc. is very important
- O2** Always try to create explicit measures instead of using implicit measures to get maximum benefit through measure branching
- O3** Always try to split a measure calculation using variables VAR as it not only improves performance but also the readability of a measure
- O4** Table functions are used to create calculated tables and are also used as virtual tables in all DAX functions which have 'Table' in the syntax. Make sure you are aware about the syntax, properties and functionality of the following DAX Table functions
 - FILTER
 - VALUES and DISTINCT (Subtle difference between the two)
 - ALL (Also used as a CALCULATE modifier)
 - SUMMARIZE and SUMMARIZECOLUMNS
 - ADDCOLUMNS and SELECTCOLUMNS
 - TOPN, CROSSJOIN, TREATAS

SECTION 6

CREATE MODEL CALCULATIONS BY USING DAX



05

The most used DAX function is CALCULATE and almost at the heart of any DAX pattern. Make sure you understand the syntax, limitations, properties and some common patterns using CALCULATE.

06

Time Intelligence DAX Functions and Time Intelligence patterns are very important. Most of these DAX Functions have subtle differences and mainly differ based on the period (Day, Month, Quarter, Year). Some of the important Time Intelligence Functions are

- TOTALYTD, TOTALQTD, TOTALMTD
- DATESYTD, DATESQTD, DATESMTD
- DATEADD
- SAMEPERIODLASTYEAR
- PARALLELPERIOD
- DATESBETWEEN, DATESINPERIOD
- FIRSTDATE, LASTDATE
- PREVIOUSDAY and functions for Month, Quarter and Year
- NEXTDAY and functions for Month, Quarter and Year
- STARTOFMONTH and functions for Quarter and Year
- ENDOFMONT and functions for Quarter and Year (Not to be confused with EOMONTH)

SECTION 6

CREATE MODEL CALCULATIONS BY USING DAX



07 Time Intelligence DAX patterns compute results for a period and any measure can be used inside these patterns. Some of the important Time Intelligence DAX patterns that you should recognize are

- Running Total
- Moving Average
- Performance-to-Date
- Previous Period

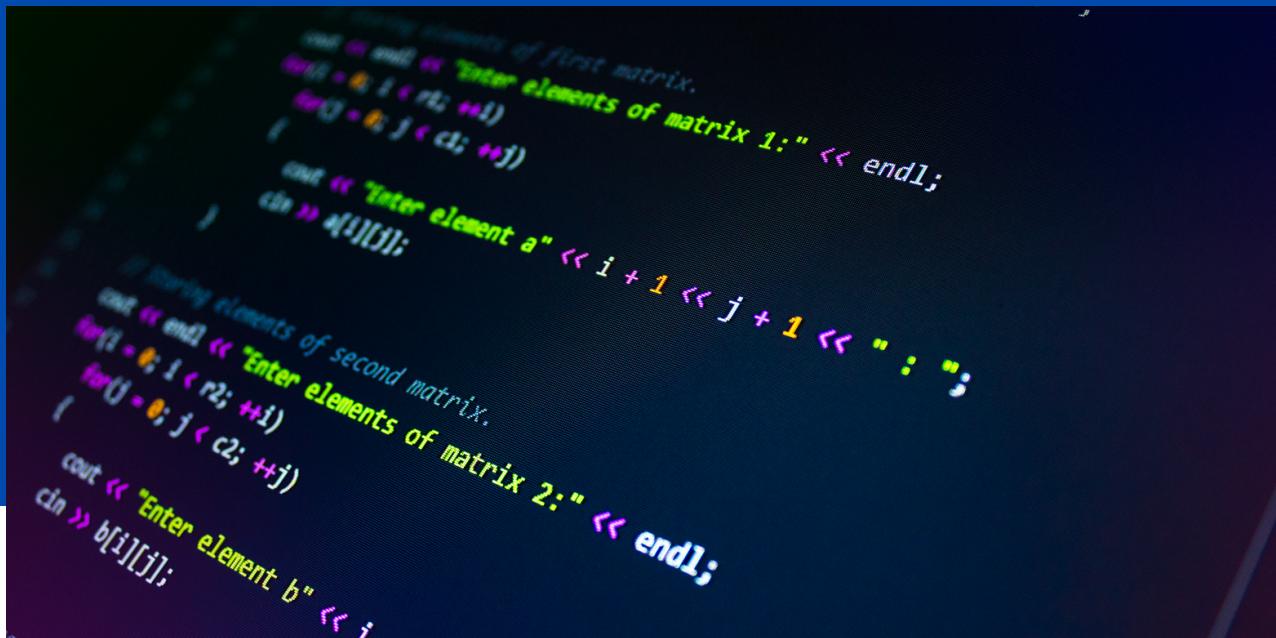
08 Semi-additive measures are unlike normal summation measures as these deal with inventory balances and closing balances. LASTDATE function can be used inside of CALCULATE for this purpose.

09 DAX functions are also important for using the relationships of the data model and also manipulating the cross filter direction. These functions are

- RELATED and RELATEDTABLE
- USERELATIONSHIP
- CROSSFILTER
- TREATAS

SECTION 5

OPTIMIZE MODEL PERFORMANCE



10

For creating measures using the Quick measures option, 'Base value' is the value on which measure has to be created and 'Field' refers to category for which it has to be created

11

In addition to the points mentioned above, it is strongly advised to remember the best practices related to DAX Programming to ensure optimal performance. Watch this video from Enterprise DNA YouTube channel to learn more about the best practices related to DAX Programming

<https://www.youtube.com/watch?v=NtZnlOP3MoY>



DAX Calculations - Power BI Best Practices Vol. 3

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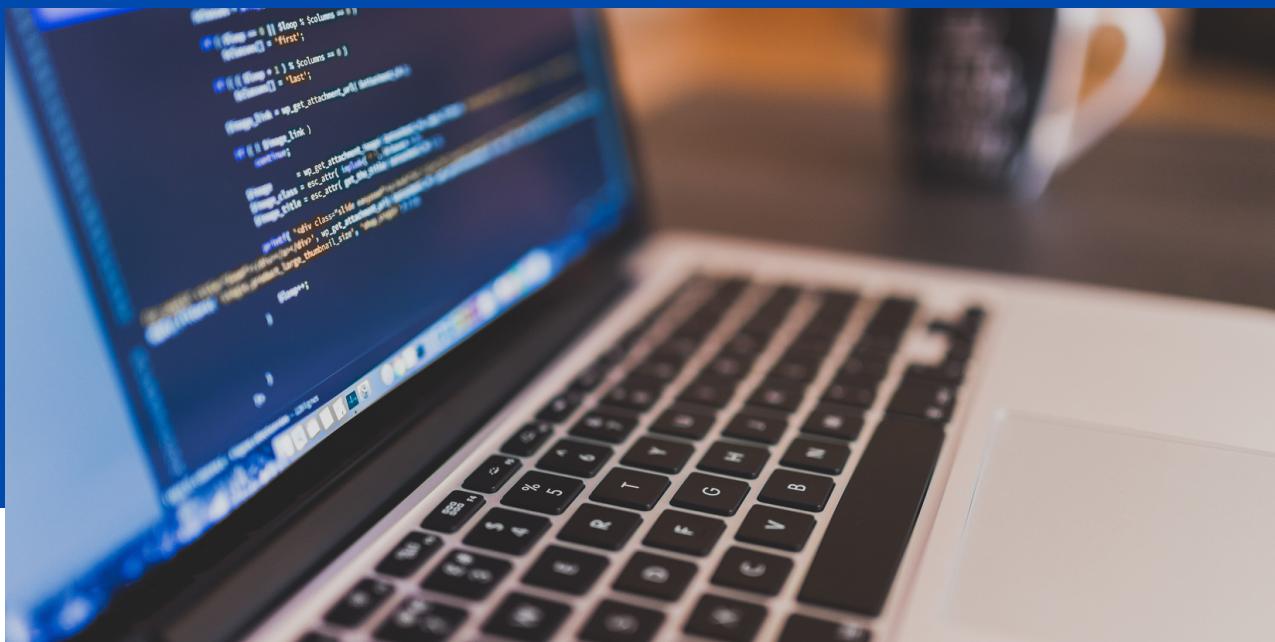
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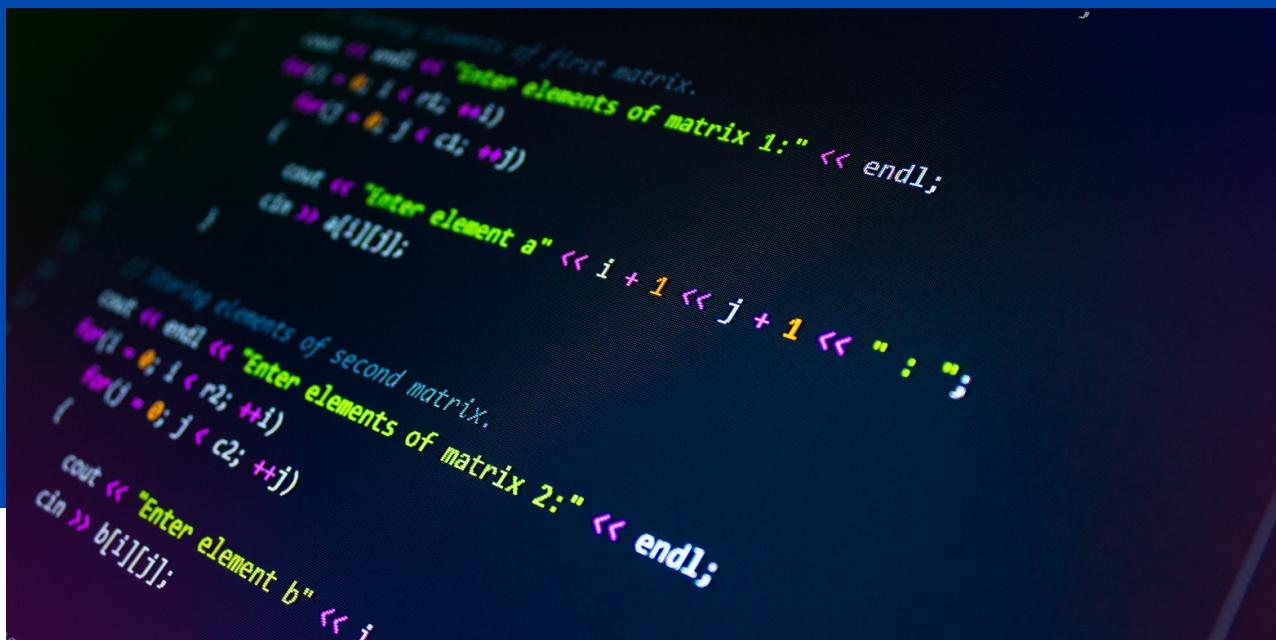
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- USERELATIONSHIP
- CROSSFILTER
- TREATAS

SECTION 6

CREATE MODEL CALCULATIONS BY USING DAX



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SECTION 7

CREATE REPORTS



- O1** Funnel charts are used to show sequential flow between different stages of a process or workflow. These must not be used as a replacement for bar charts to show categorical data
- O2** Ribbon charts are useful in showing the change in ranking between categories over time. These, however, should not be used to show large number of categories as the visual becomes difficult to understand
- O3** Waterfall charts are excellent in visualizing changes over time or across different categories. Positive or negative change is best captured in these charts
- O4** If the 'Field value' option is being used for conditional formatting of colors, then the DAX measure must return a hex color code value ranging between '#oooooooo' to '#ffffff'
- O5** Multiple categorical values can be added to a slicer visual to make hierarchical slicers. Visual level filters do not effect the slicers on the report canvas.

SECTION 7

CREATE REPORTS



06 The 'Analyze in Excel' feature allows you to analyze data in Excel, either with Excel PivotTables or Excel tables from Power BI Service. You must have at least 'Contributor' role in the workspace.

07 There are 2 settings in Power BI admin portal under the tenant settings which must be enabled for this functionality to work. These are

- Allow XMLA endpoints and Analyze in Excel with on-premises datasets
- Users can work with Power BI datasets in Excel using a live connection

08 When choosing to export data of a visual using Excel with live connection, you can use the 'Summarized data' option to analyze aggregated data up to 500,000 rows.

09 For a Power BI report that's built on a live connection to a data source, the measures added in Power BI will not be accessible in 'Export with live connection' option to export data from a visual

10 Power BI datasets using a Live connection with Analysis Service (both AAS and SSAS) do not support Analyze in Excel option

SECTION 7

CREATE REPORTS



11 Paginated reports are used to create pixel-perfect artifacts involving sales invoices, receipts, purchase orders, and tabular data for high resolution rendering requirements

12 In addition to above, paginated reports are used where Power BI visuals fail to meet the requirements of printing on paper or generating an e-receipt for all records in a table or matrix visual.

13 Built-in, accessible and customizable themes can be applied to Power BI reports and dashboards in both Power BI Desktop and Power BI Service

14 In the custom JSON theme file, color classes are used to set the structural colors for elements in the report, such as axis gridlines, highlight colors, and background colors for visual elements

15 In the custom JSON theme file, table and matrix grid outline color can be specified using the 'tableAccent' color class.

SECTION 8

ENHANCE REPORTS FOR USABILITY AND STORYTELLING



- O1** While working with bookmarks in Power BI, it is always recommended to create groups for ease of managing bookmarks and also for creating fascinating storytelling scenarios
- O2** Custom tooltips greatly enhance the information being shown in a visual on the report page by adding additional context
- O3** Filter, highlight and no interaction are the options available while configuring interactions between visuals
- O4** Conditional navigation uses a table that has the name of each report page as a row. A slicer can be used with this table to enable the conditional navigation feature.
- O5** A button can be setup for Page Navigation, Bookmark action, drill-through action, Back action and conditional page navigation
- O6** Custom sorting can be done by creating a calculated column and then using the 'Sort By Column' option

SECTION 8

ENHANCE REPORTS FOR USABILITY AND STORYTELLING



- 07** If a slicer is synced and not visible on the report page, it will still work for visuals on which interaction has been enabled
- 08** Drill Up and Drill down features require a hierarchy in the visual to work. The 'disconnected double arrows' icon takes down the visual to the next level of hierarchy. The 'connected double arrow' icons adds an additional level of hierarchy to the current view
- 09** PBI reports for mobile devices can be configured in both Power BI Desktop and Power BI Service. Designers must ensure that filters and interactive elements are easily usable on mobile devices.
- 10** For Q&A feature to work in reports, data model and field names must be intuitive and clear to facilitate meaningful Q&A interactions with the report users.
- 11** PDF, PowerPoint and Excel are the option for exporting report content in Power BI. When sharing externally, data privacy and security aspects must be kept in mind

SECTION 9

IDENTIFY PATTERNS AND TRENDS



- O1** Outliers are best visualized through the scatter plots. Use DAX functions to calculate measures that can help identify outliers and anomalies
- O2** Grouping is done for categorical columns and binning is done for numerical columns through specifying either bin size or number of bins. Binning helps to highlight trends and distribution patterns
- O3** Clustering uses machine learning to reveal patterns and insights that may not be immediately apparent. It is best visualized in a scatter plot.
- O4** The 'Analyze' feature in Power BI can automatically generate insights and show correlations (if these exist). Using the 'Explain increase / decrease' feature helps understand the factors contributing to change
- O5** In the Key Influencers AI visual, fields that are considered as influencers for 'Analyze' are placed in 'Explain by'. Fields placed in 'Expand by' are never considered as influencers for 'Analyze'. 'Expand by' fields specify the level of detail for 'Analyze' when a measure or summarized column is placed.

SECTION 9

IDENTIFY PATTERNS AND TRENDS



- 06** Reference lines can be used to highlight specific values or ranges in visuals to help in comparison and trend identification.
- 07** Error bars provide a visual representation of variability in data, which can be important in a statistical context.
- 08** Forecasting feature available in line charts can predict future trends based on historical date and time data
- 09** For creating scorecards, the most relevant metrics that align with the business goals are included. Both hard coded values and measures in the reports can be used to track the progress.
- 10** AI visuals can be used to uncover hidden insights, predict trends, or simplify complex data analysis tasks. Interpreting the results of the AI visuals is very important as the quality of underlying data can highly impact the accuracy and outcome of the AI visuals

SECTION 10

CREATE AND MANAGE WORKSPACES AND ASSETS



O1

A shared workspace is created and configured based on either the organizational hierarchy, project based or job function based. Permissions must be set up for secure and controlled access

O2

Viewer, Contributor, Member and Admin are the roles that can be assigned for any shared workspace. Viewer has the lowest permissions while Admin has the highest.

Viewer	Contributor	Member	Admin
View reports and dashboards	All the privileges of the Viewer role plus	All the privileges of the Contributor role plus	All the rights of the Member plus
Cannot access dataflows and datasets or edit any content	Publish, create, edit and delete content. Can re-share previously shared content	Share an asset and publish / modify an app. Also allow others to re-share content	Add or remove other users, including workspace admins
	Cannot add people to new role or modify these in workspace	Add users with lower permissions in workspace	Update or delete workspaces

SECTION 10

CREATE AND MANAGE WORKSPACES AND ASSETS



- 03** When updating an app, test changes before pushing updates and notify app users of updates and changes.
- 04** For distribution, Power BI Reports are normally for individual users, dashboards are for teams and Apps are for organization wide users.
- 05** Sensitivity labels should reflect the confidentiality and sensitivity of the data in the workspace.
- 06** Any content owner, as well as any member with write permissions, can promote the content in the workspace. A Power BI admin can specify content reviewers and setup a method to certify content in the workspace.
- 07** Dashboards in Power BI Service can have visuals from multiple reports in the workspace. By clicking any visual on the dashboard, users are taken to the report from which that particular visual was pinned on the dashboard.

SECTION 10

CREATE AND MANAGE WORKSPACES AND ASSETS



08

Data alerts can be set on dashboard tiles pinned from report visuals.
Only gauges, KPIs, and card visuals support this functionality

09

Power BI sends an alert to the Notification center and, depending upon the configuration of the data alert, an email is also sent. Each alert contains a direct link to the data.

10

Global File options in Power BI Desktop covers the following major settings

- Data Load -> Type detection related to unstructured data sources, allowing data loading in the background, the number of tables to load simultaneously and option to automatically create date hierarchies
- Privacy -> Set or disable privacy levels for each data source
- Security -> Options to consider while connecting with different data sources and using map / filled visuals in Power BI reports
- Diagnostics -> Setting the level and scope of the diagnostic information.
- Preview Features -> Turn on and off features new to Power BI desktop.

SECTION 11

MANAGE DATASETS



- O1** A gateway is needed when a connection to an on-premise data source is required. It is also necessary for scheduled data refreshes from on-premise data sources. DirectQuery or live connection to on-premises databases also need a gateway connection.
- O2** To configure a scheduled dataset refresh in Power BI, a Pro or a Premium license is required. Pro license allows refresh up to 8 times per 24 hours (refresh frequency) and Premium license allows refresh up to 48 times per 24 hours.
- O3** For row level security, roles are based on the data access needs of different user groups in the organization. DAX filter expressions are used to control data visibility based on the user roles.
- O4** Static roles allow to define filtered views for audiences like Territory Managers, Department heads etc. using simple DAX statements like Territory Manager = "Australia"
- O5** Dynamic roles allow to define filtered views for a list of users with the DAX functions USERNAME() or USERPRINCIPALNAME()

SECTION 11

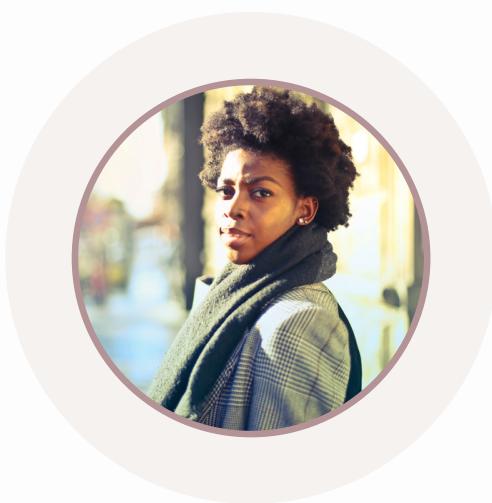
MANAGE DATASETS



06 USERNAME() returns the domain name and username of the current logged in user in the format domain-name\user-name

07 USERPRINCIPALNAME() returns the user's email address like johndoe@dataanalytics.com

08 Access levels (e.g., view, edit, re-share) should be defined based on user roles and responsibilities and then access should be provided through a workspace. While providing access, it must be ensured that there is no compromise on the security or privacy of the data, particularly when dealing with sensitive information.



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