



L3HARRIS

FAST. FORWARD.

LEVERAGE BUSINESS INTELLIGENCE TOOLS FOR CREATIVE DATA EXPLORATION

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PROPRIETARY INFORMATION



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Interface and workflow

Creative Data Exploration in Power BI

Power Query for data manipulation

Data Analysis Expressions (DAX) for advanced calculations

Visuals, measures, and Python integration

From Exploration to Presentation

Cleanup, polishing, and navigation

Additional Resources

Q&A



Presenters

Ryan Lowenstein

B.S. Mathematics 2024

Joined as a Data Architect in
June 2024

Support Cost Engineering
with tool creation

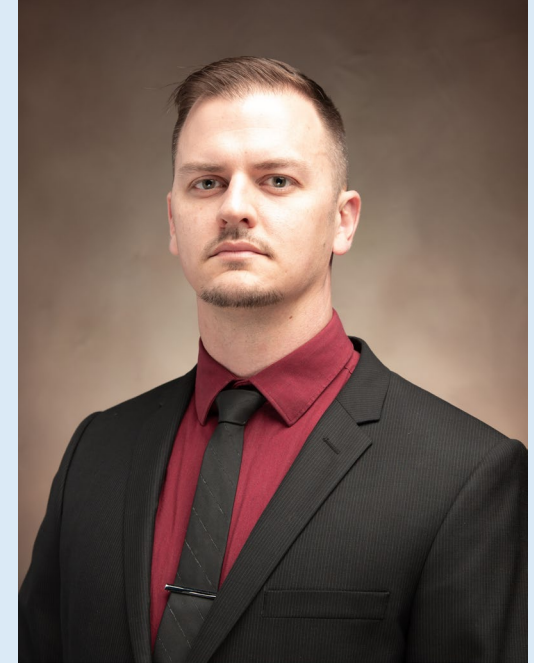


Kyle Lowder

B.S. Aerospace Engineering
2009

15 years of experience in
Aerospace design,
manufacturing, and systems
integration

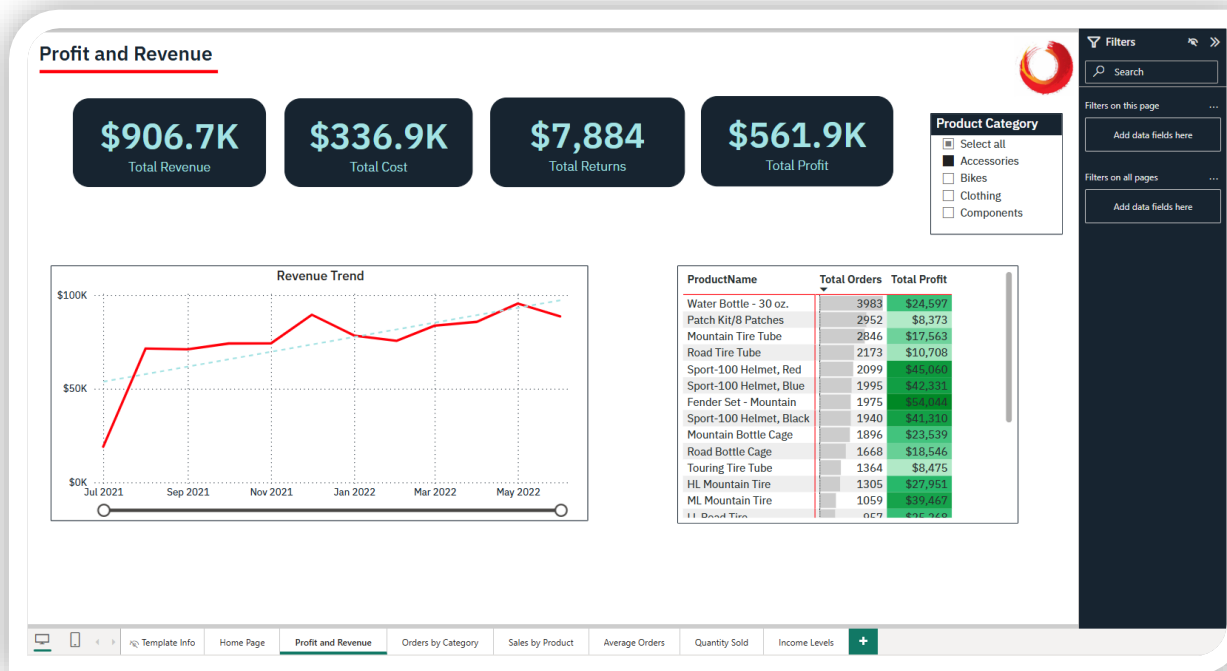
Cost engineering and analysis
portfolio >\$5B





Executive Summary

Microsoft **Power BI** (“Business Integration”) is a **highly intuitive** data processing and reporting tool capable of exploring **massive datasets** and **advanced visualizations**.



Gather and transform data with Power Query.

- Automatic/repeatable data refresh
- Sophisticated source data cleanup and transformation

Develop advanced analysis with DAX

- Powerful Excel-similar calculation language
- Create new data fields from multiple sources
- Calculations that interact with visual selections

Visually interact with data

- Intuitive basics akin to Pivot Tables/Charts
- Advanced charts with dynamic calculations
- Polish results for dashboards and presentations



Introduction to Power BI

Quick Start to Power BI Interface



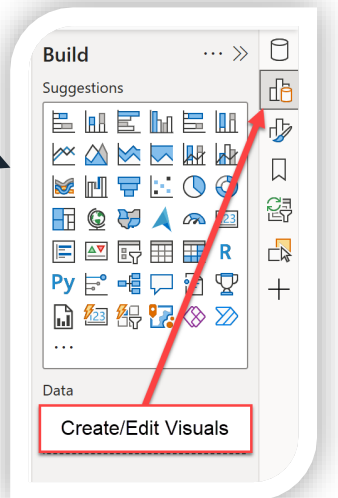
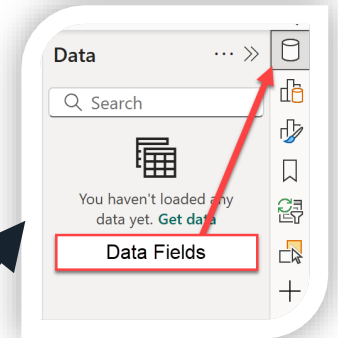
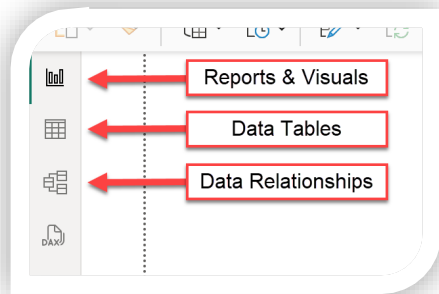
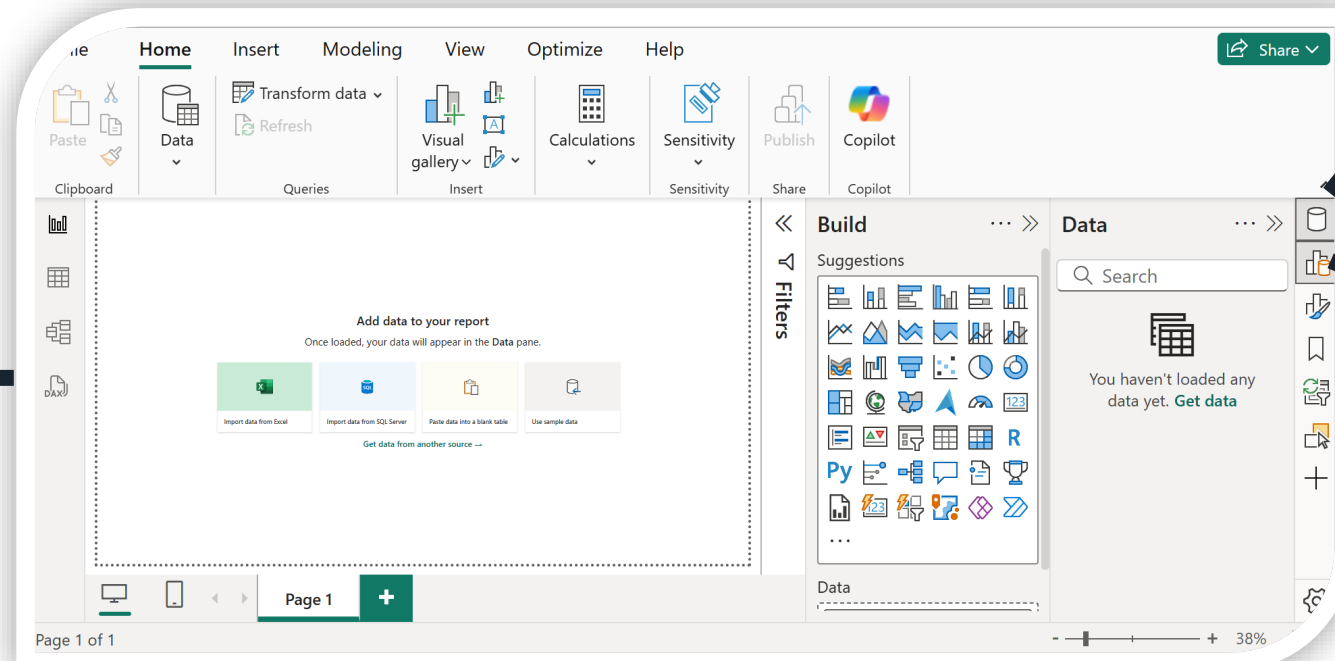
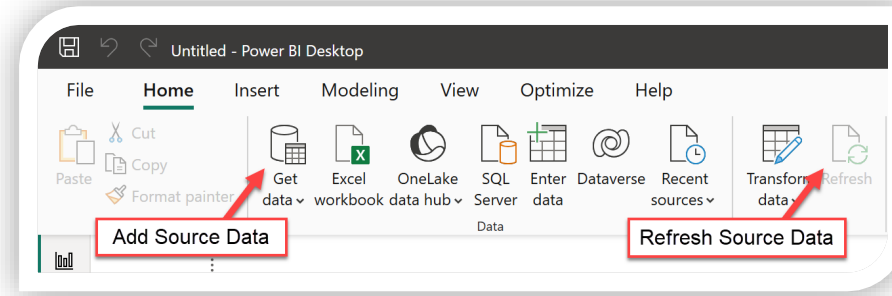
Power BI has four main workflow components:

- 1. Import Data with Power Query.**
- 2. Build relationships between data with Relationships.**
- 3. Analyze the data with DAX formulas.**
- 4. Display and explore data with Visuals.**



Overview of Power BI GUI

- **Left panel:** Reports, Tables, Model
- **Ribbon:** Get data, Refresh data
- **Right panel:** Tables, Visuals, Format





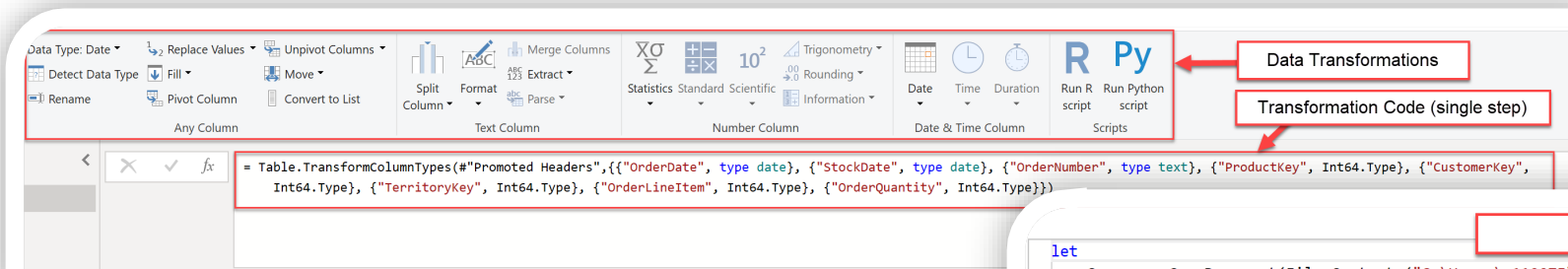
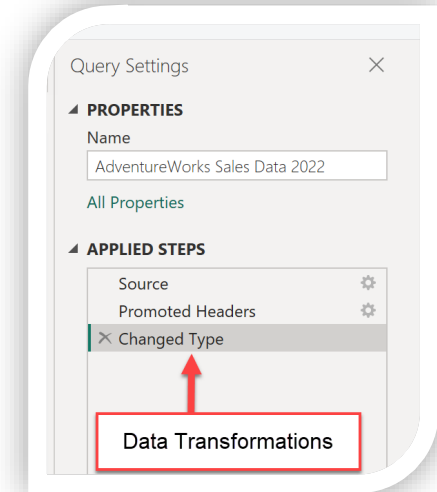
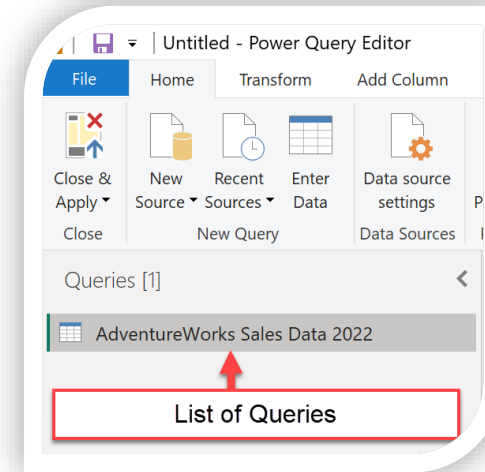
Intro to Power Query

GUI

- **Left panel: Queries**
- **Ribbon: Functions, Code entry bar, Advanced editor**
- **Right panel: Wizard/step navigator**

Select data to import

Close & Apply



```

let
    Source = Csv.Document(File.Contents("C:\Users\u112075\OneDrive - L3Harris - GCCHigh\Shared Documents - {EXT}\CAS} Cost Engineering and Analytics Department\00_Presentations\External to SAS\ICEAA\2025 ICEAA Conference\Power BI\Source Data\AdventureWorks Sales Data 2022.csv"),[Delimiter=",", Columns=8, Encoding=1252, QuoteStyle=QuoteStyle.None]),
    #"Promoted Headers" = Table.PromoteHeaders(Source, [PromoteAllScalars=true]),
    #"Changed Type" = Table.TransformColumnTypes(#"Promoted Headers",{{"OrderDate", type date}, {"StockDate", type date}, {"OrderNumber", type text}, {"ProductKey", Int64.Type}, {"CustomerKey", Int64.Type}, {"TerritoryKey", Int64.Type}, {"OrderLineItem", Int64.Type}, {"OrderQuantity", Int64.Type}})
in
    #"Changed Type"
    
```



Intro to Visualizations

- **Insert any type of visual** (table, pie, line, etc), and use as many as you want.
- **Interact with the visuals** by clicking on elements (rows, points, etc) and see the other visuals dynamically respond.
- **Add polishing features** like backgrounds, headers, graphics, etc. (We'll show this in later slides.)

The screenshot displays the Microsoft Power BI Desktop interface. The ribbon at the top includes tabs for Home, Insert, Modeling, View, Optimize, and Help. The main workspace contains two visualizations: a list of names and a summary table.

Full Name
Abby Rana
Adriana Gonzalez
Aidan Hayes
Alejandro Beck
Alexa Cox
Alexa Watson
Alexander Jackson
Alexandra Evans
Alexandria Stewart
Alisha Liu
Alisha Shan
Amanda Perry
Andrea Wright
Angela Butler
Angela Perry
Anna Griffin
Anna Murphy
Arthur Rodriguez
Barbara Ma
Barry Perez
Benjamin Jackson
Brandon Kumar
Brett Gonzalez
Brianna Wood
Candice Chow
Caroline Bryant

OrderNumber	Sum of OrderQuantity
SO51561	4
SO69157	2
Total	6

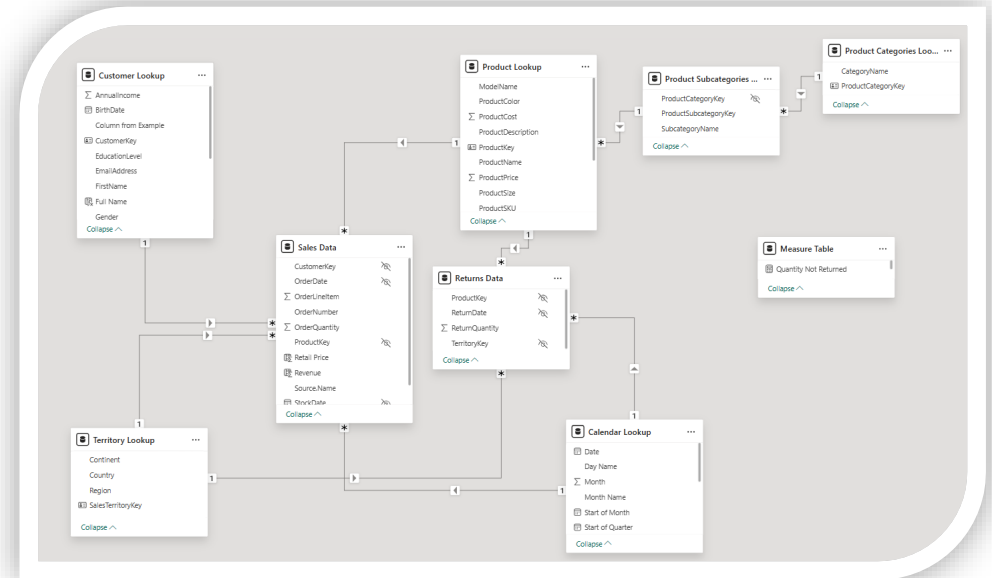
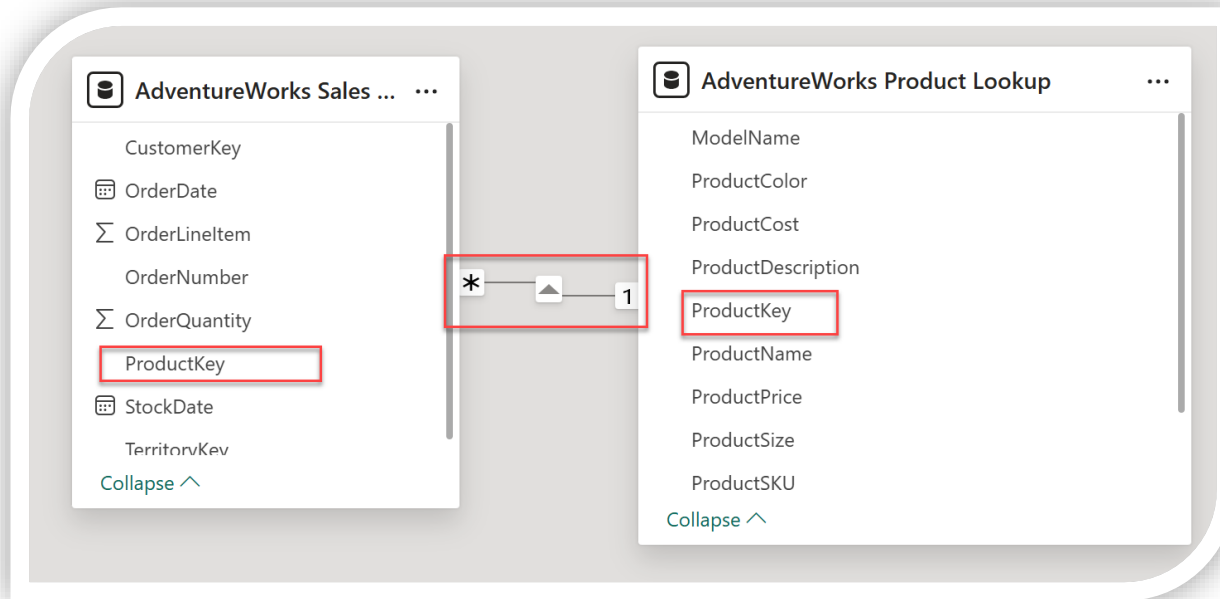
The interface also shows a 'Filters' pane on the right with a search bar and a 'Data' pane with a search bar and a list of data fields including OrderLineItem, OrderNumber, OrderQuantity, Retail Price, Revenue, SourceName, and Territory Lookup. The bottom status bar indicates 'Page 9 of 9' and 'Page 1' is selected.



Intro to Relationships

Relationships are created between matching fields.

Intuitive functions, similar to common database applications.

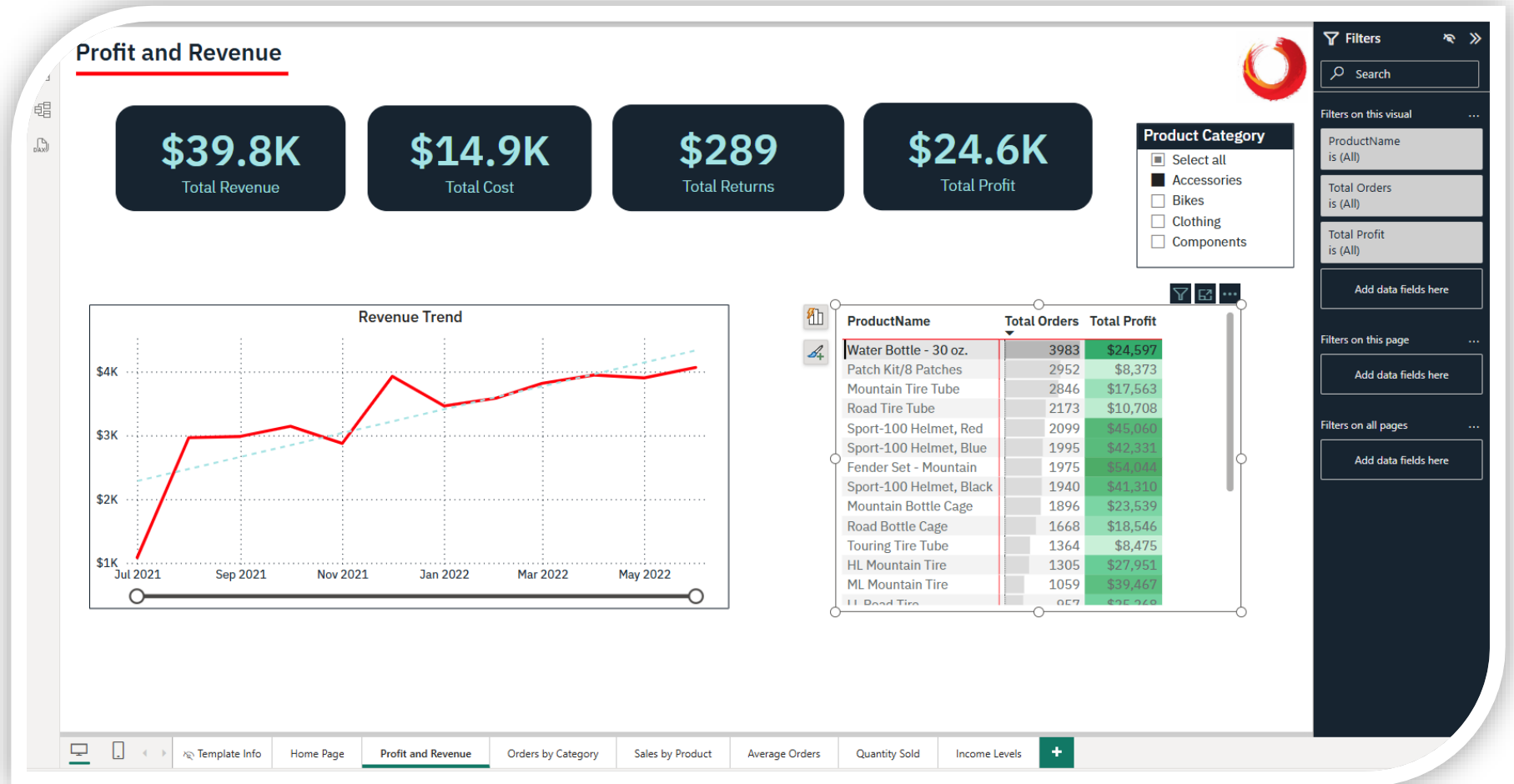




Polished Visuals Across Multiple Datasets

The integrated data can be displayed and cross-filtered as if it is a single dataset.

Here the relationship between the Product Lookup table and the Sales table allows users to browse sales data according to Product Name and Product Category.





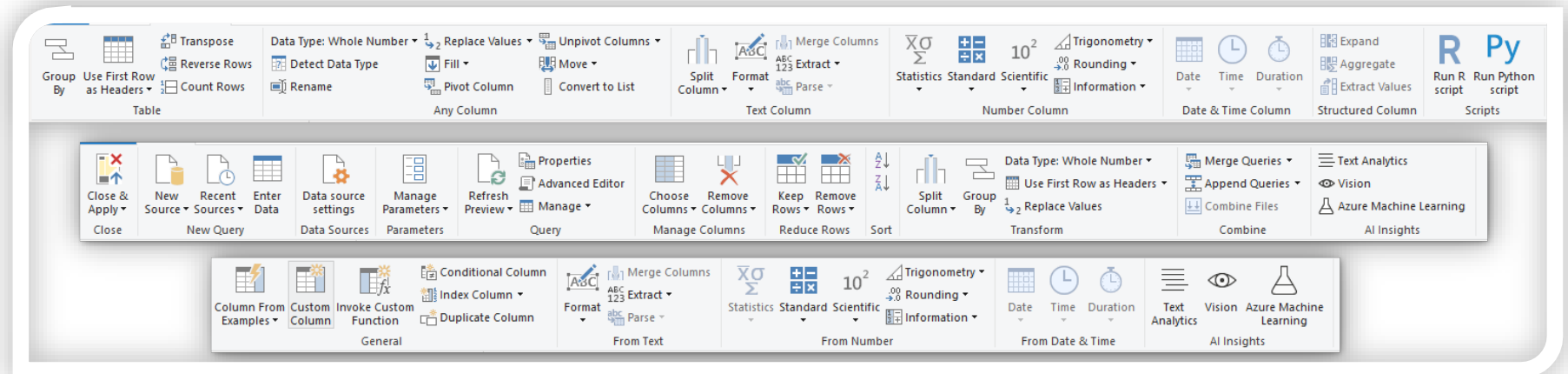
Power Query Capabilities



Extract Transform Load (ETL)

Power Query handles all three parts of the ETL process for Power BI

1. Extract
2. Transform
3. Load





Power Query Example: Column From Example

Power Query includes a new column feature that generates the M code based on the user-provided example value.

The screenshot displays the 'Add Column From Examples' dialog in Power Query. The dialog is titled 'Add Column From Examples' and contains the following M code: `Transform: Text.Combine([Prefix], [First Name], [Last Name])`. Below the code is a table with 8 columns: Gender, EmailAddress, AnnualIncome, TotalChildren, EducationLevel, Occupation, HomeOwner, and Merged. The Merged column contains names generated from the example data. The dialog has 'OK' and 'Cancel' buttons.

Gender	EmailAddress	AnnualIncome	TotalChildren	EducationLevel	Occupation	HomeOwner	Merged
1	jon24@adventure-works.com	90000	2	Bachelors	Professional	Y	Mr. Jon Yang
2	eugene10@adventure-works.com	60000	3	Bachelors	Professional	N	Mr. Eugene Huang
3	ruben35@adventure-works.com	60000	3	Bachelors	Professional	Y	Mr. Ruben Torres
4	christy12@adventure-works.com	70000	0	Bachelors	Professional	N	Ms. Christy Zhu
5	elizabeth5@adventure-works.com	80000	5	Bachelors	Professional	Y	Mrs. Elizabeth Johnson
6	julio1@adventure-works.com	70000	0	Bachelors	Professional	Y	Mr. Julio Ruiz
7	marco14@adventure-works.com	60000	3	Bachelors	Professional	Y	Mr. Marco Mehta
8	rob4@adventure-works.com	60000	4	Bachelors	Professional	Y	Mrs. Robin Verhoff
9	shannon38@adventure-works.com	70000	0	Bachelors	Professional	N	Mr. Shannon Carlson
10	jacquelyn20@adventure-works.com	70000	0	Bachelors	Professional	N	Ms. Jacquelyn Suarez
11	curtis9@adventure-works.com	60000	4	Bachelors	Professional	Y	Mr. Curtis Lu
12	lauren41@adventure-works.com	100000	2	Bachelors	Management	Y	Mrs. Lauren Walker
13	ian47@adventure-works.com	100000	2	Bachelors	Management	Y	Mr. Ian Jenkins
14	sydney23@adventure-works.com	100000	3	Bachelors	Management	N	Mrs. Sydney Bennett
15	chloe23@adventure-works.com	30000	0	Partial College	Skilled Manual	N	Ms. Chloe Young
16	wyatt32@adventure-works.com	30000	0	Partial College	Skilled Manual	Y	Mr. Wyatt Hill
17	shannon1@adventure-works.com	20000	4	High School	Skilled Manual	Y	Mrs. Shannon Wang
18	clarence32@adventure-works.com	30000	2	Partial College	Clerical	Y	Mr. Clarence Rai
19	luke18@adventure-works.com	40000	0	High School	Skilled Manual	N	Mr. Luke Lal
20	jordan73@adventure-works.com	40000	0	High School	Skilled Manual	N	Mr. Jordan King
21	destiny7@adventure-works.com	40000	0	Partial College	Skilled Manual	N	Ms. Destiny Wilson
22	ethan20@adventure-works.com	40000	0	Partial College	Skilled Manual	Y	Mr. Ethan Zhang
23	seth46@adventure-works.com	40000	0	Partial College	Skilled Manual	Y	Mr. Seth Edwards
24	russell7@adventure-works.com	60000	0	Partial College	Skilled Manual	Y	Mr. Russell Xie
25	alejandros45@adventure-works.com	10000	2	Partial High School	Clerical	Y	Alejandro Beck
26	harold3@adventure-works.com	30000	2	Partial College	Clerical	N	Mr. Harold Sai
27	jessie16@adventure-works.com	30000	2	Partial College	Clerical	Y	Mr. Jessie Zhao
28	jill13@adventure-works.com	30000	2	Partial College	Clerical	Y	Mrs. Jill Jimenez
29	jimmy9@adventure-works.com	30000	2	Partial College	Clerical	Y	Mr. Jimmy Moreno
30	bethany10@adventure-works.com	10000	2	Partial High School	Clerical	Y	Mrs. Bethany Yuan
31	theresa13@adventure-works.com	20000	4	High School	Skilled Manual	Y	Mrs. Theresa Ramos
32	denise10@adventure-works.com	20000	4	High School	Skilled Manual	Y	Mrs. Denise Stone
33	jaime41@adventure-works.com	20000	4	High School	Skilled Manual	Y	Mr. Jaime Nath
34	ebony19@adventure-works.com	20000	4	High School	Skilled Manual	Y	Mrs. Ebony Gonzalez
35



Power Query Transformation: Unpivot

Handle messy, hard to read data using Unpivot

	Column1	2/1/2025	3/1/2025	4/1/2025	5/1/2025	6/1/2025	7/1/2025
1	Product	1	null	1	null	null	
2	Bike	null	2	9	null	2	
3	Car	null	5	3	null	null	
4	Helicopter	null	null	6	10	null	



	Column1	Attribute	Value
1	Product	2/1/2025	1
2	Product	4/1/2025	1
3	Product	7/1/2025	6
4	Bike	3/1/2025	2
5	Bike	4/1/2025	9
6	Bike	6/1/2025	2
7	Car	3/1/2025	5
8	Car	4/1/2025	3
9	Helicopter	4/1/2025	6
10	Helicopter	5/1/2025	10



Power Query Transformation: Split by Delimiter

Pull out sections of data using a delimiter

- Choose a common character as a delimiter
- Extract sections of the data using that delimiter

The diagram illustrates the 'Split by Delimiter' transformation in Power Query. On the left, a table with one column 'ProductSKU' is shown. An arrow points to the right, where the same data is shown in three columns: 'ProductSKU - Copy.1', 'ProductSKU - Copy.2', and 'ProductSKU - Copy.3'. The original SKUs are split into their constituent parts based on a common character (hyphen), with null values for missing parts.

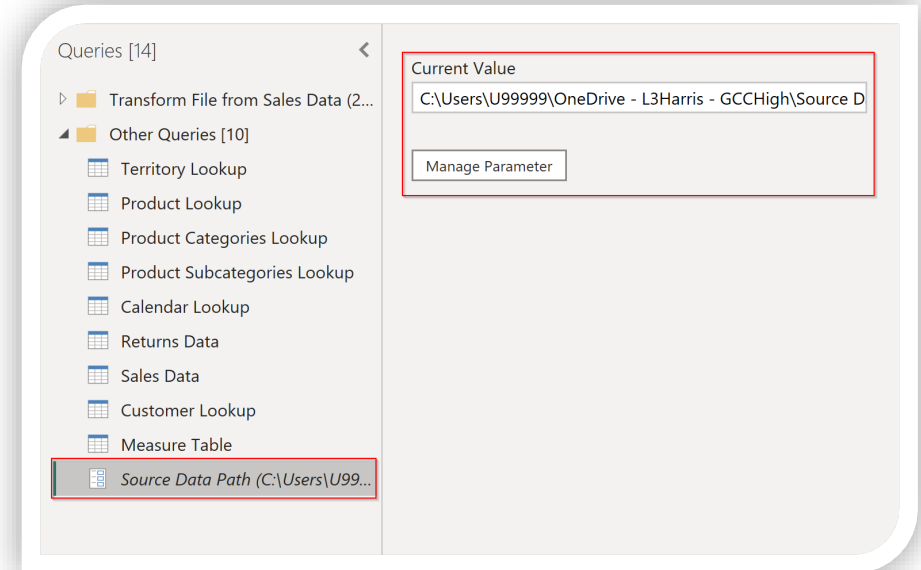
ProductSKU	ProductSKU - Copy.1	ProductSKU - Copy.2	ProductSKU - Copy.3
HL-U509-R	HL	U509	R
HL-U509	HL	U509	null
SO-B909-M	SO	B909	M
SO-B909-L	SO	B909	L
HL-U509-B	HL	U509	B
CA-1098	CA	1098	null
LJ-0192-S	LJ	0192	S
LJ-0192-M	LJ	0192	M

Power Query Transformation: M Code Editing



M Code offers fast and customizable data manipulation

- Type custom lines
- Copy & Paste
- Parameters



Customer Lookup

Parameter

Display Options

```
let
Source = Csv.Document(File.Contents("#Source Data Path" & "\AdventureWorks Customer Lookup.csv"),[Delimiter=",", Columns=13, Encoding=1252, QuoteStyle=QuoteStyle.None]),
#"Promoted Headers" = Table.PromoteHeaders(Source, [PromoteAllScalars=true]),
#"Changed Type" = Table.TransformColumnTypes("#Promoted Headers",{{"CustomerKey", Int64.Type}, {"Prefix", type text}, {"FirstName", type text}, {"LastName", type text}, {"BirthDate", type date}, {"MaritalStatus",
type text}, {"Gender", type text}, {"EmailAddress", type text}, {"AnnualIncome", Int64.Type}, {"TotalChildren", Int64.Type}, {"EducationLevel", type text}, {"Occupation", type text}, {"HomeOwner", type text}}}),
#"Removed Errors" = Table.RemoveRowsWithErrors("#Changed Type", {"CustomerKey"}),
#"Filtered Rows" = Table.SelectRows("#Removed Errors", each [CustomerKey] <> null and [CustomerKey] <> ""),
#"Capital First Letter" = Table.TransformColumns("#Filtered Rows", {{"Prefix", Text.Proper}, {"FirstName", Text.Proper}, {"LastName", Text.Proper}}),
#"Inserted Merged Column" = Table.AddColumn("#Capital First Letter", "Merged", each Text.Combine({Text.Proper([Prefix]), " ", [FirstName], " ", [LastName]}), type text),
#"Renamed Columns" = Table.RenameColumns("#Inserted Merged Column",{{"Merged", "Column from Example"}})
in
#"Renamed Columns"
```



Data Analysis Expressions (DAX)



DAX Introduction

- **DAX are expressions and formulas to analyze and calculate data**
- **Used in calculated columns, measures, calculated tables, and row-level security**
- **Some formulas mirror results of Excel formulas and Power Query capabilities**



Calculated Columns

Use DAX to add calculated data columns to tables. Basic examples:

- If/then statements

```
1 Income Level =
2 IF('Customer Lookup'[AnnualIncome] >= 150000, "Very High",
3 IF('Customer Lookup'[AnnualIncome] >= 100000, "High",
4 IF('Customer Lookup'[AnnualIncome] > 50000, "Average", "Low")))
```

Income Level	AnnualIncome
Average	60000
Average	70000
Average	80000
Average	90000
High	100000
High	110000
High	120000
High	130000
Low	10000
Low	20000
Low	30000
Low	40000
Low	50000
Very High	150000
Very High	160000
Very High	170000

- Concatenate columns

```
1 Full Name = 'Customer Lookup'[Prefix] & " " & 'Customer Lookup'[FirstName] & " " & 'Customer Lookup'[LastName]
```

Full Name
Mr. Shannon Carlson
Mr. Jessie Liu
Mr. Ruben Kapoor
Mr. Ruben Muñoz
Mr. Joe Rana
Mr. Jarrod Suri
Mr. Dustin Goldstein
Mr. Clayton Jai
Mr. Irving Schmidt
Mr. Alan Huang
Mr. Brendan Raji
Mr. Gregory Becker
Mr. Marco Vance
Mr. Alejandro Hu
Mr. Shane Fernandez
Mr. Jay Raman
Mr. Damien Ye



Measures Examples

Measures are formulas created using DAX that change based on filter context.

```
1 Quantity Not Returned = [Quantity Sold] - [Quantity Returned]
```

```
1 Quantity Returned = SUM('Returns Data'[ReturnQuantity])
```

```
1 Return Rate = [Quantity Returned]/[Quantity Sold]
```

```
1 Total Cost = SUMX('Sales Data', 'Sales Data'[OrderQuantity] * Related('Product Lookup'[ProductCost]))
```

```
1 Total Cost average per Date =  
2 AVERAGEX(  
3 |   KEEPFILTERS(VALUE('Calendar Lookup'[Date])),  
4 |   CALCULATE([Total Cost])  
5 )
```



Dynamic Calculations with Quick Measures

Measures can also be created with the Quick Measure wizard, without using DAX.

The screenshot displays the Power BI Desktop interface with the Quick Measure wizard open. The wizard is configured to create a measure named "Total Cost average per Date" based on the "Total Cost" field, averaged by "Date". The background shows a dashboard with two KPI cards: "25K Total Orders" and "\$15.87K Total Cost average per Date". Below the KPI cards are two charts: a horizontal bar chart titled "Total Orders average per Date by CategoryName" and a pie chart titled "Total Orders average per Date by CategoryName".

Quick Measure Wizard Configuration:

- Name:** Total Cost average per Date
- Format:** Currency
- Data category:** Uncategorized
- Base value:** Total Cost
- Category:** Date
- Calculation:** Average per category

Dashboard Data:

- KPI 1:** 25K Total Orders
- KPI 2:** \$15.87K Total Cost average per Date

Horizontal Bar Chart: Total Orders average per Date by CategoryName

CategoryName	Total Orders average per Date
Accessories	47
Clothing	19
Bikes	15

Pie Chart: Total Orders average per Date by CategoryName

CategoryName	Percentage
Accessories	57.49% (47)
Clothing	23.62% (19)
Bikes	18.89% (15)



Advanced Reporting Features

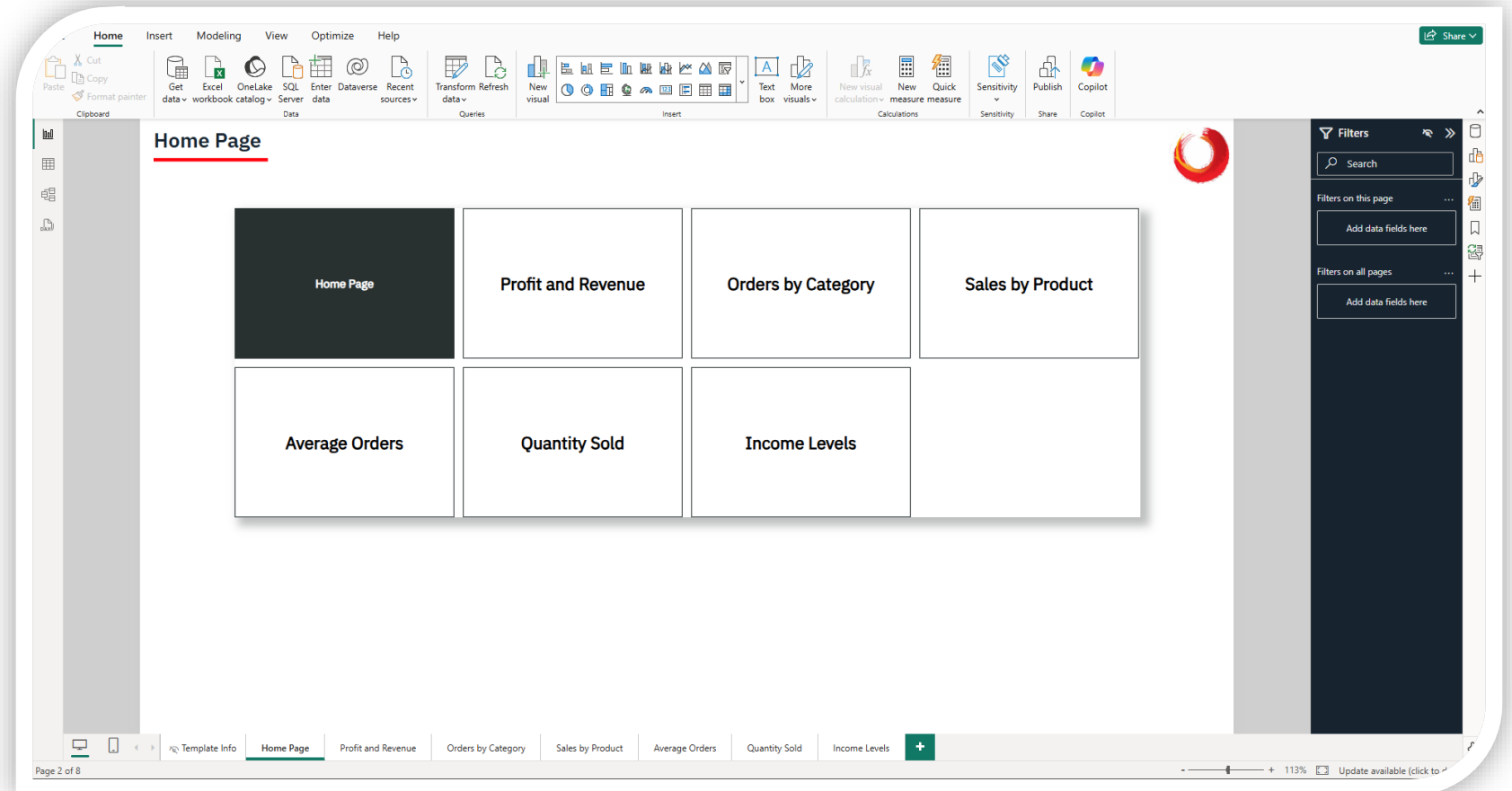
- Polish reports with headers, logos, and interactive buttons.
- Create advanced graphing and visuals with Python.



Polishing: Buttons, Logos, Page Navigator

Power BI includes many interactive elements like buttons, page navigators, and slicers.

Create and share themes (.json) and templates (.pbix) for quick re-use across projects.

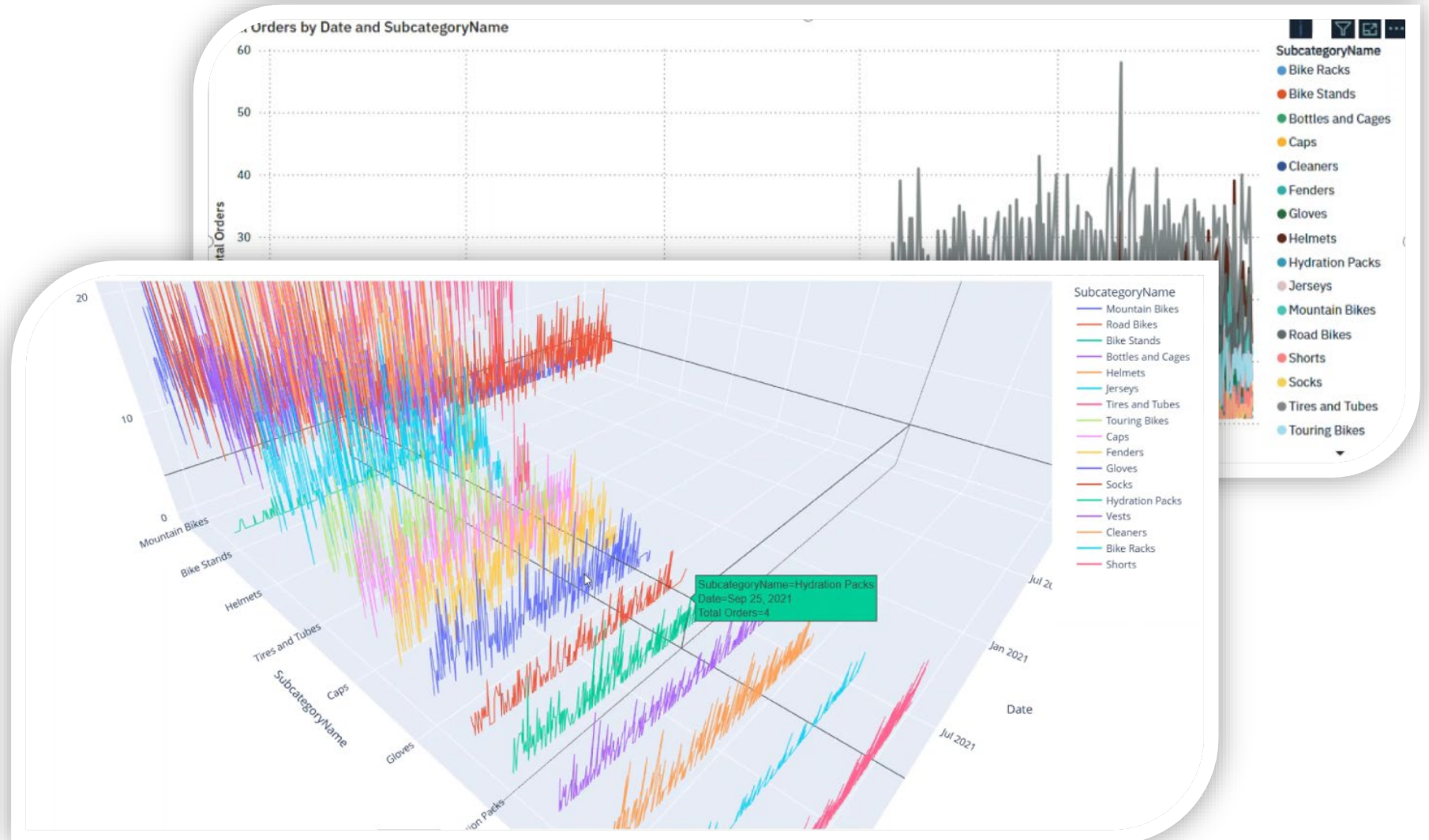




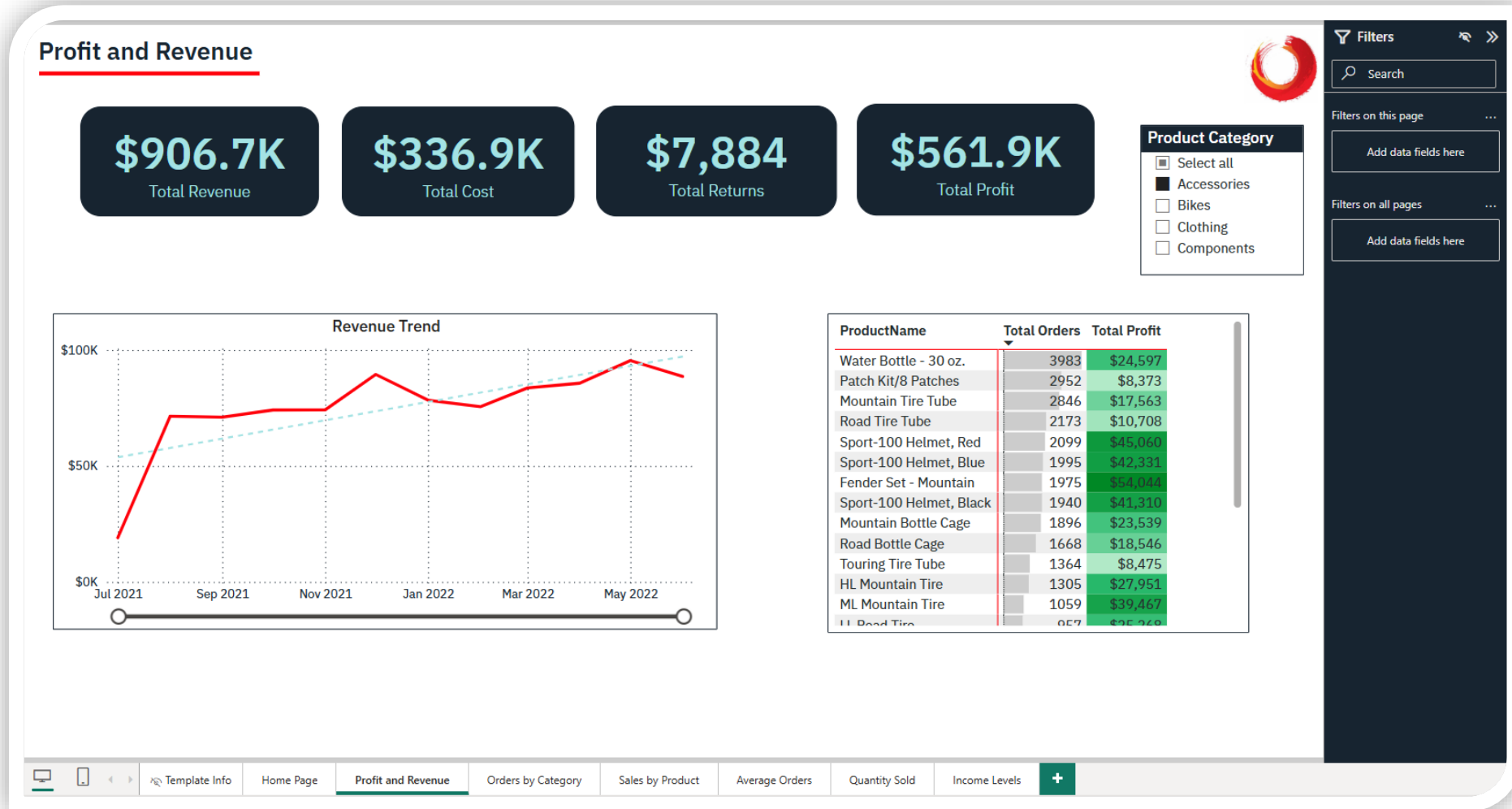
Advanced Graphing and Visualization with Python

Power BI has native support for Python plotting.

Use Python libraries to generate custom plots and curves, including advanced 3D graphics for complex datasets.



Wrapup & Questions



Additional Resources



Udemy Course: Microsoft Power BI Desktop for Business Intelligence

- Course offers example data that was used for this presentation
- Covers everything from the basics to advanced techniques in every area of Power BI