

Power BI for the Business Analyst

Introduction to Power BI

A Skillwave Product

with content from

EXcelerator BI


Power BI Solutions for Business

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Power BI Solutions for Business

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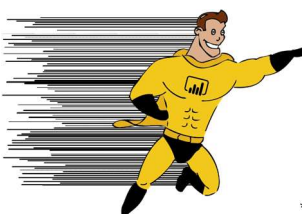
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Why Power BI is So Great


Data Capacity



Speed

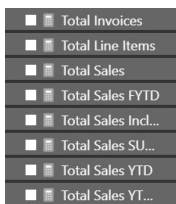


Accessible* to Excel Users

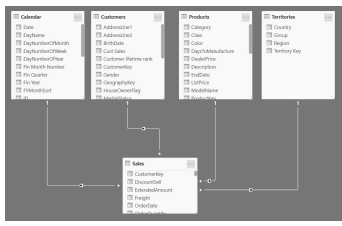



* But you will likely need some formal learning to get started

Focuses on Reuse



Works over multiple tables



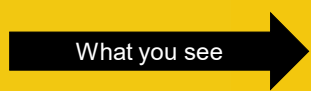


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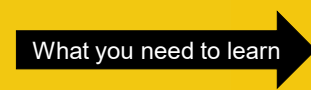
3

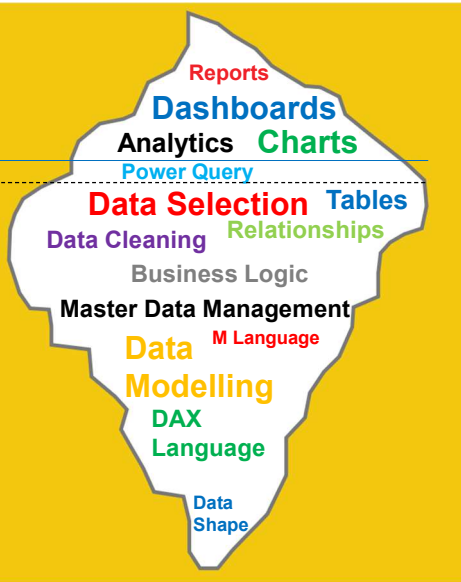
Yet Power BI is Deceptive


What you see



What you need to learn

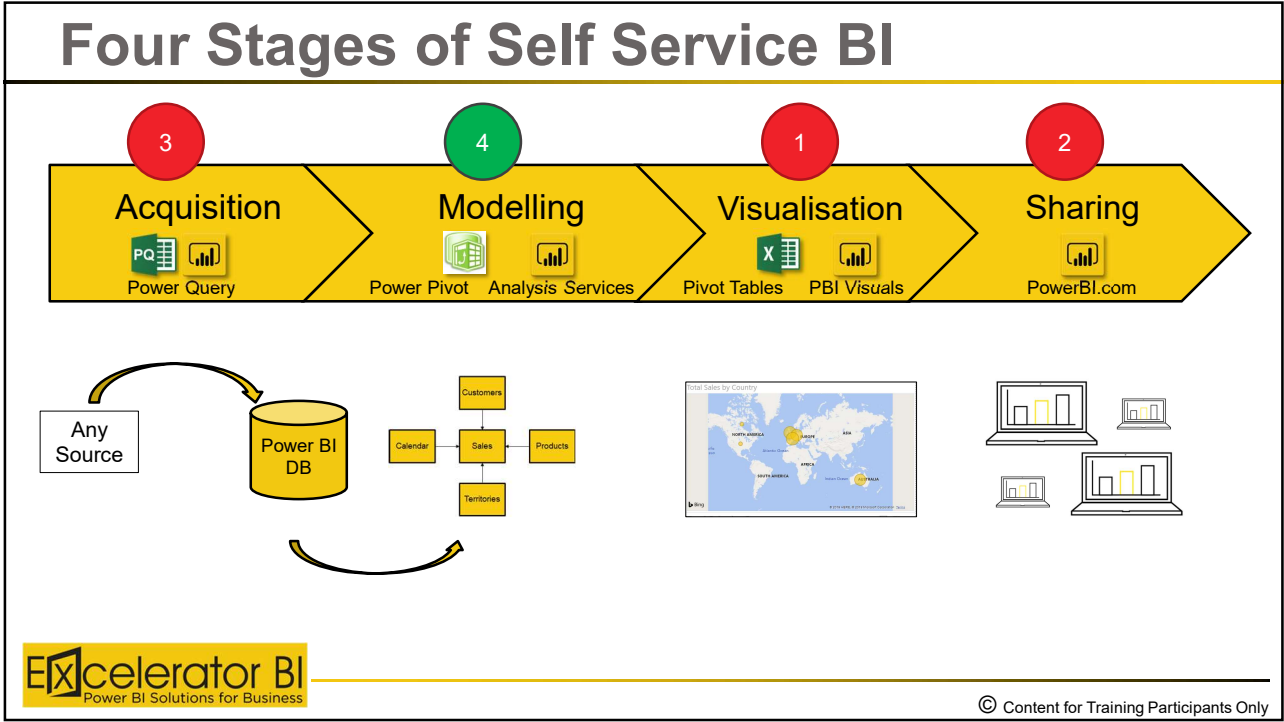






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Introduction to Adventure Works Sample Database

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Introduction to Adventure Works*

Tax Invoice / Receipt
Adventure Works
Australia

| OrderNo.: SO57418 | | 4/11/2003 |
|--------------------------|--------------------------------|-------------|
| Bill To: Jon Yang | | |
| Cust No.: 11000 | | |
| Item | Description | Amount |
| 573 | Touring-1000 Blue, 46 | \$ 2,384.07 |
| 541 | Touring Tire | \$ 28.99 |
| 530 | Touring Tire Tube | \$ 4.99 |
| 214 | Sport-100 Helmet, Red | \$ 34.99 |
| 488 | Short-Sleeve Classic Jersey, S | \$ 53.99 |
| Subtotal: | | \$ 2,507.03 |
| Total ex tax: | | \$ 2,507.03 |
| Tax (8%): | | \$ 200.56 |
| Total Inc tax: | | \$ 2,707.59 |

Adventure Works – Sales Table

| ProductKey | OrderDate | CustomerKey | SalesOrderNumber | OrderQuantity | UnitPrice | ExtendedAmount |
|------------|--------------------------|-------------|------------------|---------------|-----------|----------------|
| 605 | Tuesday, 4 November 2003 | 22170 | SO57417 | 1 | 539.99 | 539.99 |
| 538 | Tuesday, 4 November 2003 | 22170 | SO57417 | 1 | 21.49 | 21.49 |
| 480 | Tuesday, 4 November 2003 | 22170 | SO57417 | 1 | 2.29 | 2.29 |
| 573 | Tuesday, 4 November 2003 | 11000 | SO57418 | 1 | 2384.07 | 2384.07 |
| 541 | Tuesday, 4 November 2003 | 11000 | SO57418 | 1 | 28.99 | 28.99 |
| 530 | Tuesday, 4 November 2003 | 11000 | SO57418 | 1 | 4.99 | 4.99 |
| 214 | Tuesday, 4 November 2003 | 11000 | SO57418 | 1 | 34.99 | 34.99 |
| 488 | Tuesday, 4 November 2003 | 11000 | SO57418 | 1 | 53.99 | 53.99 |
| 599 | Tuesday, 4 November 2003 | 15833 | SO57419 | 1 | 539.99 | 539.99 |
| 363 | Tuesday, 4 November 2003 | 12689 | SO57420 | 1 | 2294.99 | 2294.99 |
| 485 | Tuesday, 4 November 2003 | 12689 | SO57420 | 1 | 21.98 | 21.98 |
| 478 | Tuesday, 4 November 2003 | 12689 | SO57420 | 1 | 9.99 | 9.99 |
| 477 | Tuesday, 4 November 2003 | 12689 | SO57420 | 1 | 4.99 | 4.99 |
| 563 | Tuesday, 4 November 2003 | 25064 | SO57421 | 1 | 2384.07 | 2384.07 |



*simplified version

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Totalling the Adventure Works Sales Data

| Order Quantity | Unit Price | Extended Amount |
|---------------------|------------|------------------------|
| 3 | \$3.00 | \$9.00 |
| 2 | \$4.00 | \$8.00 |
| 1 | \$6.00 | \$6.00 |
| Total Quantity 6 | | Total Sales \$23.00 |



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Introduction to Building Reports

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Data Visualisation




Acquisition

Modelling

Visualisation

Sharing

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Adding Logo and Title to Report

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Adding a Visual to the Report

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Visual Fields Options & Tooltips

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Adding a Visual using Q&A Feature

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Visual Headers

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Data Hierarchies

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Formatting Features



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Repurposing an Existing Visual




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Cross Filtering

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Slicers and Filters

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Adding a Visual to Display a Single Value





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More Formatting Features





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Adding a Visual from Visualizations Pane

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Analytics Features in Power BI

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AI Capability of Power BI

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Bookmarks and Buttons

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Summary


Acquisition

Modelling

Visualisation

Sharing

- Opened a desktop file
- Covered a cross section of different visuals
- Drill through hierarchies
- Understanding Slicers and Filters
- Repurposing Visuals
- Cross filter interactions
- Date hierarchies
- Analytics Features
- Explain the Increase
- Bookmarks
- Buttons

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Creating a New Report in the Same Workbook

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Visual to Display Top 20 Customers



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Conditional Formatting



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Build another Report

AcquisitionModellingVisualisationSharing

AdventureWorks Top 20 Customers

| CustomerKey | Name | Total Sales | OrderQuantity |
|-------------|-------------------|-------------|---------------|
| 12301 | Nichole Nara | \$13,295 | 13 |
| 12132 | Kaitlyn Henderson | \$13,294 | 14 |
| 12308 | Margaret He | \$13,268 | 14 |
| 12131 | Randall Dominguez | \$13,266 | 11 |
| 12300 | Adriana Gonzalez | \$13,243 | 10 |
| 12321 | Rosa Hu | \$13,216 | 15 |
| 12124 | Brandi Gill | \$13,196 | 12 |
| 12307 | Brad She | \$13,173 | 11 |
| 12296 | Francisco Sara | \$13,165 | 12 |
| 11433 | Maurice Shan | \$12,910 | 12 |
| 11439 | Janet Munoz | \$12,489 | 14 |
| 11241 | Lisa Cai | \$11,469 | 25 |
| 11417 | Lacey Zheng | \$11,248 | 17 |
| 11420 | Jordan Turner | \$11,201 | 17 |
| 11242 | Larry Munoz | \$11,068 | 12 |
| 12655 | Larry Vazquez | \$10,900 | 11 |
| 13263 | Kate Anand | \$10,872 | 12 |
| 12323 | Lawrence Alonso | \$10,837 | 11 |
| Total | | \$243,753 | 263 |

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Drill through Report

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Build a Drill Through Report



Lisa Cai

| Year | Quarter | Month | Day | Inv | Qty | Total Sales | Total Margin |
|-------|---------|----------|-----|---------|-----|-------------|--------------|
| 2003 | Qtr 1 | March | 14 | SO49675 | 1 | \$2,049 | \$943 |
| 2003 | Qtr 3 | July | 2 | SO51192 | 1 | \$2,330 | \$1,065 |
| 2003 | Qtr 4 | October | 6 | SO55623 | 1 | \$708 | \$325 |
| 2003 | Qtr 4 | November | 13 | SO57891 | 1 | \$811 | \$324 |
| 2003 | Qtr 4 | December | 31 | SO61171 | 1 | \$554 | \$205 |
| 2004 | Qtr 1 | February | 20 | SO64592 | 1 | \$2,588 | \$1,026 |
| 2004 | Qtr 2 | May | 1 | SO69624 | 1 | \$2,428 | \$926 |
| Total | | | | | | \$11,469 | \$4,815 |

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Bookmarks and Buttons Revisited



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Tool Tip Report (Custom Tool Tips)



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Custom Tool Tips

Steps to create a tool tip


1. Create a new blank page and rename as desired
2. Format\Page Information\Tooltip\On
3. Format\Page Size\Type\Tooltip
4. View Menu\Page View\Actual Size
5. To control Tooltip
 1. Push: Drag column to the Fields\Tool Tip Fields area.
 2. Pull: Go to a visual and edit the tooltip settings to point to the tooltip report




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Mobile Layout




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An Introduction to Sharing Power BI Reports





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Sharing

```
graph LR; A[Acquisition] --> B[Modelling]; B --> C[Visualisation]; C --> D[Sharing]; style D fill:#FFD700
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Workspaces in Power BI.com



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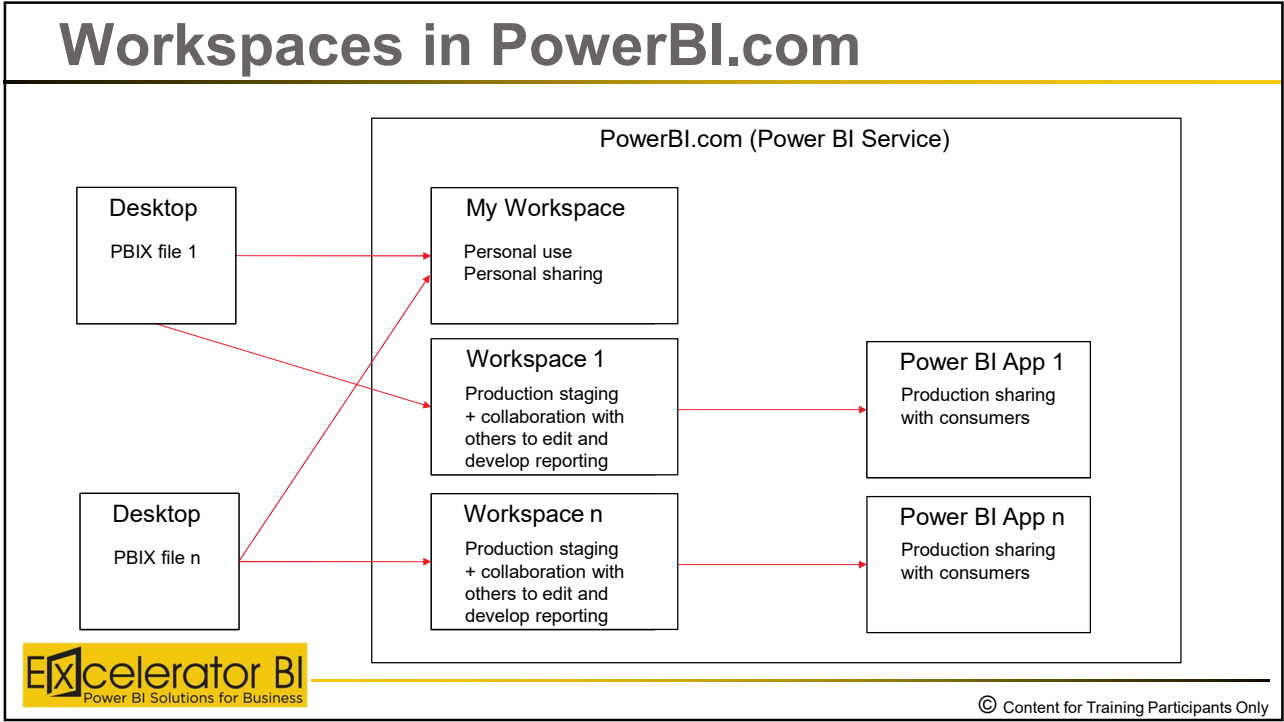


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My Workspace for Personal Use and Personal Sharing

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Creating a Group Workspace

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Creating Reports in Power BI.com

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Editing Reports in Power BI.com

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Providing Access to Group Workspace

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Importing PBIX Files into Power BI.com




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Introduction to Dashboards in Power BI.com




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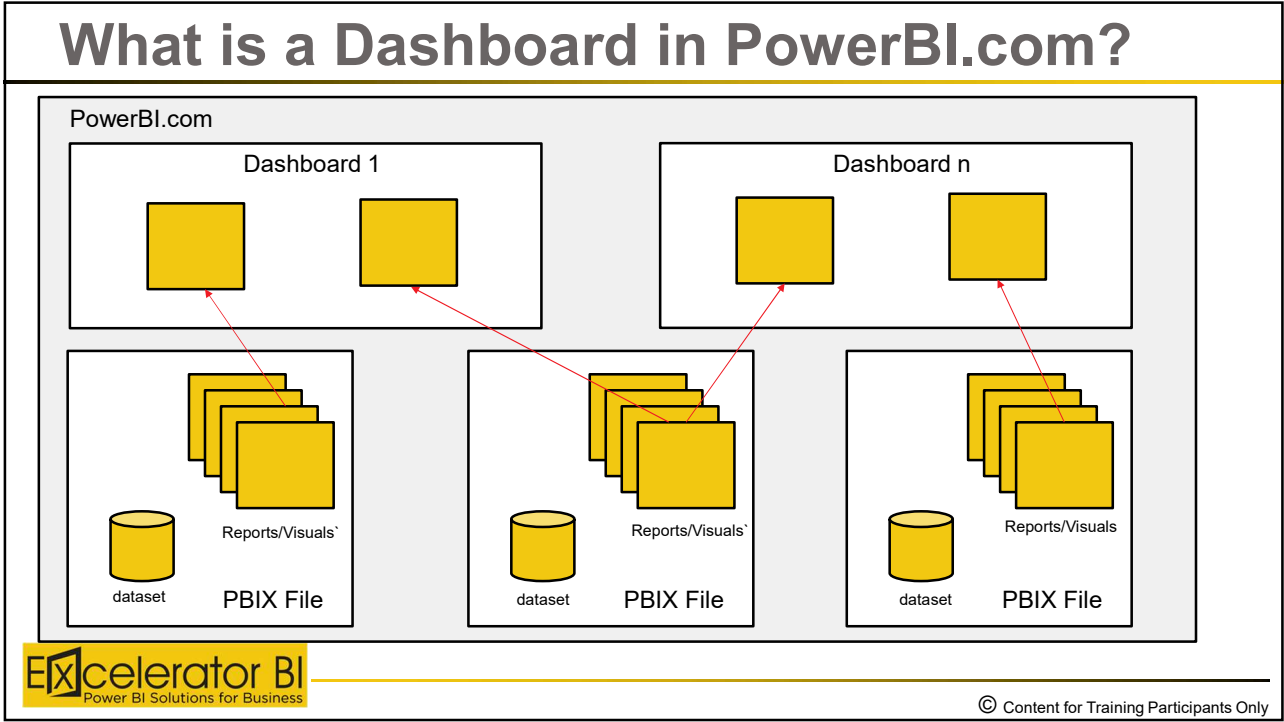
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Creating Dashboards

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Importing Excel Files into Power BI.com

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Quick Insights

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Analyze in Excel

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Adding Comments to Reports

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Subscribing to Emails

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Bookmarks in Power BI.com

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Power BI.com - Other Important Features

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Creating and Sharing Power BI Workspace App

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Mobile App


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Introduction to Power Query

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Data Acquisition

Acquisition

Modelling

Visualisation

Sharing

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Power Query (Get Data)

Data that needs Cleansing

7.3 POPULATION, By state and territory(a)(b)

| Qld | SA | WA | Tas. |
|-------|-------|-------|------|
| '000 | '000 | '000 | '000 |
| 1 496 | 945 | 722 | 344 |
| 1 793 | 1 158 | 991 | 388 |
| 2 266 | 1 308 | 1 269 | 424 |
| 2 899 | 1 432 | 1 613 | 462 |
| 3 562 | 1 505 | 1 874 | 471 |
| 3 995 | 1 553 | 2 017 | 486 |
| 4 091 | 1 568 | 2 059 | 490 |
| 4 196 | 1 586 | 2 113 | 493 |
| 4 309 | 1 604 | 2 177 | 498 |
| 4 425 | 1 625 | 2 244 | 503 |
| 4 506 | 1 644 | 2 291 | 507 |

File Consolidation Exercise

2 Consolidate XLSX

Search 2 Consolida...

Name

2013 AU.xlsx

2013 NZ.xlsx

2014 AU.xlsx

2014 NZ.xlsx



2015 AU.xlsx

2015 NZ.xlsx



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Cleansing Data Using Power Query

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Visualising the Cleansed Data

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Reshaping the Data for Accurate Visualisation




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Visualising the Reshaped Data



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File Consolidation Using Power Query





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Visualising the Consolidated Data



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Power Query Resources

- Power Query Training
 - <http://skillwave.training>
- Review of Ken and Miguel's book
 - <http://exceleratorbi.com.au/m-is-for-data-monkey-book-review/>
- Blog Articles
 - <https://exceleratorbi.com.au/combine-excel-workbooks-power-query-method-1/>
 - <https://powerpivotpro.com/2015/07/consolidated-worksheets-with-power-query/>
 - <https://exceleratorbi.com.au/build-reusable-calendar-table-power-query/>
 - <https://exceleratorbi.com.au/understanding-power-query-combine/>



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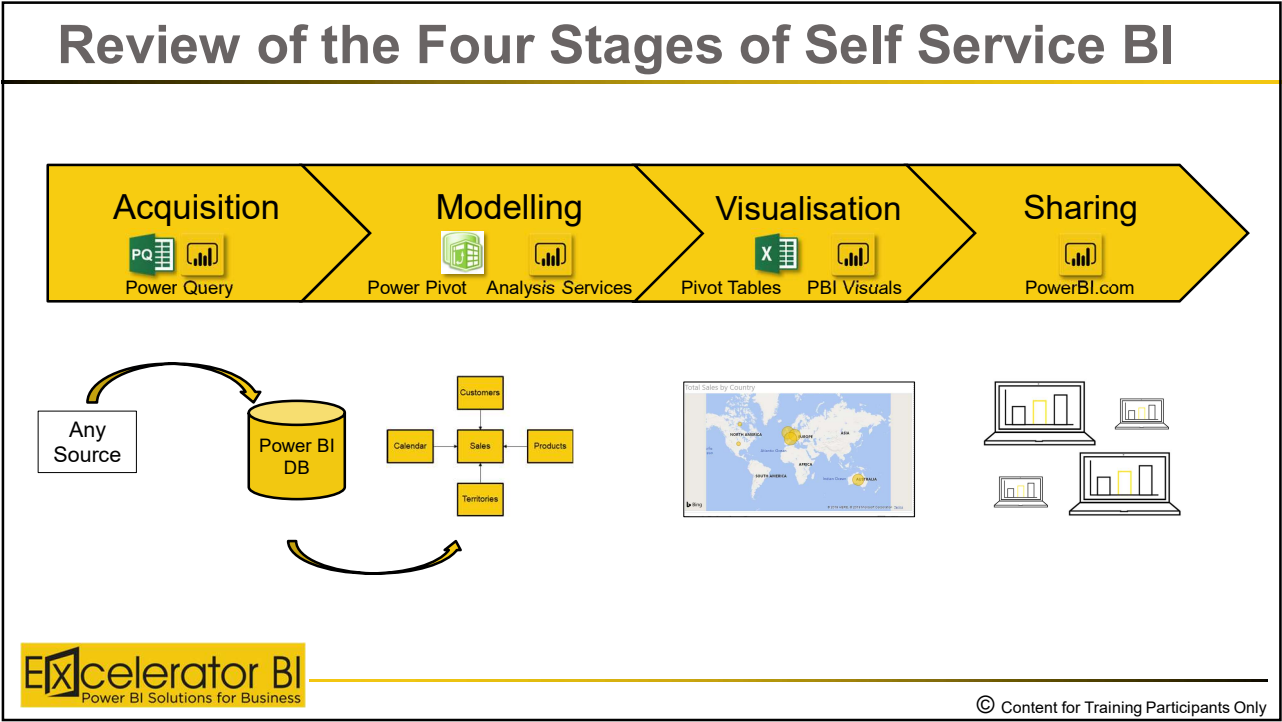
Review of the Four Stages of Self-Service BI



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Introduction to Data Modelling

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Thinking of Data in Tables

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Tables and Scalars


A Table is a Two Dimensional Object

| CustomerKey | Name | Gender | YearlyIncome | NumberChildrenAtHome | Occupation | HouseOwnerFlag | NumberCarsOwned |
|-------------|-------------------|--------|--------------|----------------------|----------------|----------------|-----------------|
| 11000 | Jon Yang | M | \$90,000.00 | 0 | Professional | 1 | 0 |
| 11001 | Eugene Huang | M | \$60,000.00 | 3 | Professional | 0 | 1 |
| 11002 | Ruben Torres | M | \$60,000.00 | 3 | Professional | 1 | 1 |
| 11003 | Christy Zhu | F | \$70,000.00 | 0 | Professional | 0 | 1 |
| 11004 | Elizabeth Johnson | F | \$80,000.00 | 5 | Professional | 1 | 4 |
| 11005 | Julio Ruiz | M | \$70,000.00 | 0 | Professional | 1 | 1 |
| 11006 | Janet Alvarez | F | \$70,000.00 | 0 | Professional | 1 | 1 |
| 11007 | Marco Mehta | M | \$60,000.00 | 3 | Professional | 1 | 2 |
| 11008 | Rob Verhoff | F | \$60,000.00 | 4 | Professional | 1 | 3 |
| 11009 | Shannon Carlson | M | \$70,000.00 | 0 | Professional | 0 | 1 |
| 11010 | Jacquelyn Suarez | F | \$70,000.00 | 0 | Professional | 0 | 1 |
| 11011 | Curtis Lu | M | \$60,000.00 | 4 | Professional | 1 | 4 |
| 11012 | Lauren Walker | F | \$100,000.00 | 0 | Management | 1 | 2 |
| 11013 | Ian Jenkins | M | \$100,000.00 | 0 | Management | 1 | 3 |
| 11014 | Sydney Bennett | F | \$100,000.00 | 0 | Management | 0 | 3 |
| 11015 | Chloe Young | F | \$30,000.00 | 0 | Skilled Manual | 0 | 1 |
| 11016 | Wyatt Hill | M | \$30,000.00 | 0 | Skilled Manual | 1 | 1 |
| 11017 | Shannon Wang | F | \$20,000.00 | 0 | Skilled Manual | 1 | 2 |
| 11018 | Clarence Rai | M | \$30,000.00 | 0 | Clerical | 1 | 2 |
| 11019 | Luke Lal | M | \$40,000.00 | 0 | Skilled Manual | 0 | 2 |
| 11020 | Jordan King | M | \$40,000.00 | 0 | Skilled Manual | 0 | 2 |
| 11021 | Destiny Wilson | F | \$40,000.00 | 0 | Skilled Manual | 0 | 1 |
| 11022 | Ethan Zhang | M | \$40,000.00 | 0 | Skilled Manual | 1 | 1 |
| 11023 | Seth Edwards | M | \$40,000.00 | 0 | Skilled Manual | 1 | 1 |
| 11024 | Russell Xie | M | \$60,000.00 | 0 | Skilled Manual | 1 | 2 |
| 11025 | Alejandro Beck | M | \$10,000.00 | 1 | Clerical | 1 | 2 |
| 11026 | Harold Sai | M | \$30,000.00 | 0 | Clerical | 0 | 2 |

A Scalar is a Single Value

- Examples of scalars
 - 24
 - 5-Jan-2015
 - TRUE
 - Some text
- A scalar can be placed in a single cell in Excel

A scalar tells you 1 piece of information whereas a table contains lots of information but it needs to be 'extracted' from the table.

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What insights can we find in this table?

A Table is a Two Dimensional Object Insights

| CustomerKey | Name | Gender | YearlyIncome | NumberChildrenAtHome | Occupation | HouseOwnerFlag | NumberCarsOwned |
|-------------|-------------------|--------|--------------|----------------------|----------------|----------------|-----------------|
| 11000 | Jon Yang | M | \$90,000.00 | 0 | Professional | 1 | 0 |
| 11001 | Eugene Huang | M | \$60,000.00 | 3 | Professional | 0 | 1 |
| 11002 | Ruben Torres | M | \$60,000.00 | 3 | Professional | 1 | 1 |
| 11003 | Christy Zhu | F | \$70,000.00 | 0 | Professional | 0 | 1 |
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| 11015 | Chloe Young | F | \$30,000.00 | 0 | Skilled Manual | 0 | 1 |
| 11016 | Wyatt Hill | M | \$30,000.00 | 0 | Skilled Manual | 1 | 1 |
| 11017 | Shannon Wang | F | \$20,000.00 | 0 | Skilled Manual | 1 | 2 |
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| 11024 | Russell Xie | M | \$60,000.00 | 0 | Skilled Manual | 1 | 2 |
| 11025 | Alejandro Beck | M | \$10,000.00 | 1 | Clerical | 1 | 2 |
| 11026 | Harold Sai | M | \$30,000.00 | 0 | Clerical | 0 | 2 |
| 11027 | Jessie Zhao | M | \$30,000.00 | 0 | Clerical | 1 | 2 |
| 11028 | Jill Jimenez | F | \$30,000.00 | 0 | Clerical | 1 | 2 |
| 11029 | Jimmy Moreno | M | \$30,000.00 | 0 | Clerical | 1 | 2 |
| 11030 | Berthany Yvan | F | \$10,000.00 | 1 | Clerical | 1 | 2 |
| 11031 | Theresa Ramos | F | \$20,000.00 | 0 | Skilled Manual | 1 | 2 |
| 11032 | Denise Stone | F | \$20,000.00 | 0 | Skilled Manual | 1 | 2 |
| 11033 | Jaime Nath | M | \$20,000.00 | 0 | Skilled Manual | 1 | 2 |
| 11034 | Ebony Gonzalez | F | \$20,000.00 | 0 | Skilled Manual | 1 | 2 |

- How many customers
- How many male and female customers
- Total income
- Average income per customer
- Etc



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Review of Adventure Works Sample Database



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Introduction to Adventure Works*

**Tax Invoice / Receipt
Adventure Works
Australia**

| | | | |
|--------------------------|--------------------------------|---------------|-----------|
| OrderNo.: SO57418 | | | 4/11/2003 |
| Bill To: Jon Yang | | | |
| Cust No.: 11000 | | | |
| Item | Description | Amount | |
| 573 | Touring-1000 Blue, 46 | \$ 2,384.07 | |
| 541 | Touring Tire | \$ 28.99 | |
| 530 | Touring Tire Tube | \$ 4.99 | |
| 214 | Sport-100 Helmet, Red | \$ 34.99 | |
| 488 | Short-Sleeve Classic Jersey, S | \$ 53.99 | |
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| 538 | Tuesday, 4 November 2003 | 22170 | SO57417 | 1 | 21.49 | 21.49 |
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| 541 | Tuesday, 4 November 2003 | 11000 | SO57418 | 1 | 28.99 | 28.99 |
| 530 | Tuesday, 4 November 2003 | 11000 | SO57418 | 1 | 4.99 | 4.99 |
| 214 | Tuesday, 4 November 2003 | 11000 | SO57418 | 1 | 34.99 | 34.99 |
| 488 | Tuesday, 4 November 2003 | 11000 | SO57418 | 1 | 53.99 | 53.99 |
| 599 | Tuesday, 4 November 2003 | 15833 | SO57419 | 1 | 539.99 | 539.99 |
| 363 | Tuesday, 4 November 2003 | 12689 | SO57420 | 1 | 2294.99 | 2294.99 |
| 485 | Tuesday, 4 November 2003 | 12689 | SO57420 | 1 | 21.98 | 21.98 |
| 478 | Tuesday, 4 November 2003 | 12689 | SO57420 | 1 | 9.99 | 9.99 |
| 477 | Tuesday, 4 November 2003 | 12689 | SO57420 | 1 | 4.99 | 4.99 |
| 563 | Tuesday, 4 November 2003 | 25064 | SO57421 | 1 | 2384.07 | 2384.07 |



*simplified version

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Totalling the Adventure Works Sales Data

| Order Quantity | Unit Price | Extended Amount |
|---------------------|------------|------------------------|
| 3 | \$3.00 | \$9.00 |
| 2 | \$4.00 | \$8.00 |
| 1 | \$6.00 | \$6.00 |
| Total Quantity 6 | | Total Sales \$23.00 |



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Introduction to Loading Data

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Loading Data

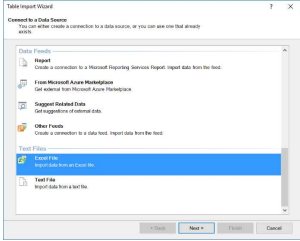
Data Acquisition

Data Modelling


Visualisation & Analysis

Sharing

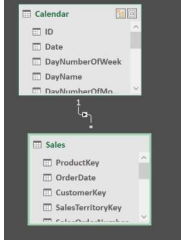
Import data from Excel




Compression



Join Tables



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Loading Data



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Two Types of Power BI Tables

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Concept: Data tables vs. Lookup tables

| CustomerKey | ProductKey | SalesTerritoryKey | OrderDate | ExtendedAmount |
|-------------|------------|-------------------|-----------|----------------|
| 29483 | 360 | 7 | 13/03/03 | 2,049.10 |
| 29482 | 358 | 7 | 22/03/03 | 2,049.10 |
| 29481 | 349 | 8 | 13/02/02 | 3,374.99 |
| 29480 | 217 | 10 | 18/01/04 | 34.99 |
| 29480 | 225 | 10 | 18/01/04 | 8.99 |
| 29480 | 477 | 10 | 18/01/04 | 4.99 |
| 29480 | 479 | 10 | 18/01/04 | 8.99 |
| 29480 | 562 | 10 | 18/01/04 | 2,384.07 |
| 29479 | 358 | 7 | 8/03/03 | 2,049.10 |
| 29478 | 477 | 10 | 28/12/03 | 4.99 |
| 29478 | 479 | 10 | 28/12/03 | 8.99 |
| 29478 | 575 | 10 | 28/12/03 | 2,384.07 |
| 29477 | 222 | 10 | 20/12/03 | 34.99 |
| 29477 | 225 | 10 | 20/12/03 | 8.99 |
| 29477 | 575 | 10 | 20/12/03 | 2,384.07 |
| 29476 | 346 | 8 | 21/01/02 | 3,399.99 |

Data Tables

- Contain the “transactions”
- Sales, Budget, Inventory, etc.
- Sometimes called “fact” tables
- Measures tend to come from data tables
- Can contain many millions of rows
- Each ID column can have multiple entries

| CustomerKey | FirstName | LastName | AddressLine1 | DateFirstPurchase |
|-------------|-----------|----------|----------------------|-------------------|
| 11000 | Jon | Yang | 3761 N. 14th St | 22/07/01 |
| 11001 | Eugene | Huang | 2243 W St. | 18/07/01 |
| 11002 | Ruben | Torres | 5844 Linden Land | 10/07/01 |
| 11003 | Christy | Zhu | 1825 Village Pl. | 1/07/01 |
| 11004 | Elizabeth | Johnson | 7553 Harness Circle | 26/07/01 |
| 11005 | Julio | Ruiz | 7305 Humphrey Drive | 2/07/01 |
| 11006 | Janet | Alvarez | 2612 Berry Dr | 27/07/01 |
| 11007 | Marco | Mehta | 942 Brook Street | 12/07/01 |
| 11008 | Rob | Verhoff | 624 Peabody Road | 28/07/01 |
| 11009 | Shannon | Carlson | 3839 Northgate Road | 30/07/01 |
| 11010 | Jacquelyn | Suarez | 7800 Corrinne Court | 17/07/01 |
| 11011 | Curtis | Lu | 1224 Shoenic | 2/07/01 |
| 11012 | Lauren | Walker | 4785 Scott Street | 17/09/03 |
| 11013 | Ian | Jenkins | 7902 Hudson Ave. | 15/10/03 |
| 11014 | Sydney | Bennett | 9011 Tank Drive | 24/09/03 |
| 11015 | Chloe | Young | 244 Willow Pass Road | 22/07/03 |

Lookup Tables

- Tend to have fewer rows than data tables
- Columns tend to have “Words” rather than “Numbers”
- Calendar, Customers, Stores, Products, etc.
- Sometimes called “dimension,” “reference,” or “master” tables
- Row, Column, Report Filter, and Slicer fields
- Must have a unique ID column



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Concept: Data tables vs. Lookup tables

Data Tables

| Cust # | Date | Product | Qty |
|--------|--------|---------|-----|
| 123 | 4-Jan | ABC | 2 |
| 123 | 4-Jan | XYZ | 1 |
| 123 | 23-Mar | ABC | 2 |
| 456 | 5-Jan | JKL | 1 |
| 456 | 5-Jan | XYZ | 1 |
| ... | | | |

Lookup Tables

| Cust # | Cust Name | Address | Age |
|--------|-----------|-----------------|-----|
| 123 | Peter | 34 Long Street | 36 |
| 456 | Jenny | 27 Short Street | 52 |
| ... | | | |

| Date | Day Name | Month | Year |
|--------|----------|-------|------|
| 4-Jan | Thu | Jan | 2018 |
| 5-Jan | Fri | Jan | 2018 |
| ... | | | |
| 23-Mar | Fri | Mar | 2018 |

| Product # | Product Name | Description | Size |
|-----------|---------------|-------------------|------|
| ABC | 65 cm MB Tube | Inflatable tube | 65 |
| JKL | Pro Helmet | Polystyrene cove | XL |
| XYZ | Mountain Bike | Full size male mc | 26 |
| ... | | | |



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Relationships in Power BI

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Data Compression

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Default Aggregations in Power BI

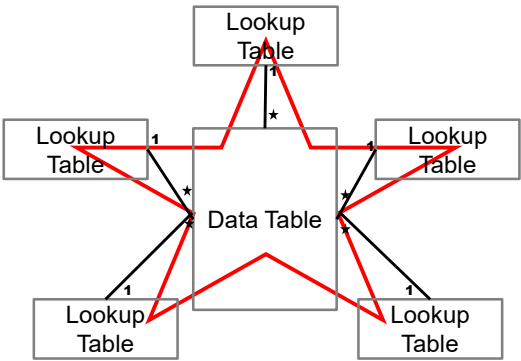
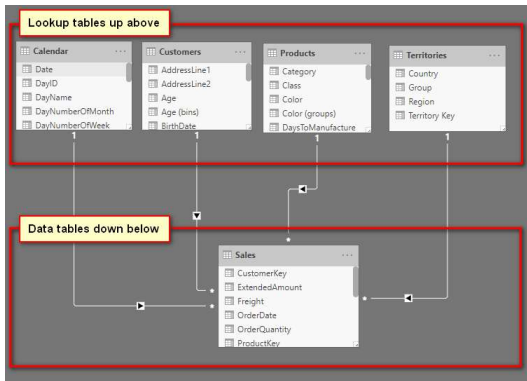
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Star Schema





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Planning Your Data Model

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First Create a High Level Model Plan

Who

What

When

Where

1. Review the transactions

2. Remove repeating columns

3. Ask

1. Who

2. What

3. When


4. Where

4. Load the tables

5. Join the tables

Transactions

The training data is prepared for you. When you do it yourself with your own data, you will need to start with a high level plan for your data structure.

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Best Practices and Tips

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Best practice notes & tips


Data Acquisition

Data Modelling

Visualisation & Analysis

Sharing

- Aim for single noun names for your tables
 - Sales
 - Products
 - Customers etc
- Remove prefixes (eg dim, fct) from your table names
- Only bring in the columns of data you need
- Place your lookup tables at the top, and the data tables underneath.
- Resize default fonts <https://exceleratorbi.com.au/changing-defaults-in-power-bi/>

 <https://exceleratorbi.com.au/best-practices-power-pivot-power-query-power-bi/>

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Measures and Calculated Columns



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Writing DAX Formulas, and Why?

Measures


| Year | Total Sales | Total Service Fee | Total Sales inc Service Fee |
|-------|--------------|-------------------|-----------------------------|
| 2001 | \$3,266,374 | \$65,327 | \$3,331,701 |
| 2002 | \$6,530,344 | \$130,607 | \$6,660,950 |
| 2003 | \$9,791,060 | \$195,821 | \$9,986,882 |
| 2004 | \$9,770,900 | \$195,418 | \$9,966,318 |
| Total | \$29,358,677 | \$587,174 | \$29,945,851 |

Calculated Columns

| Fin Year | Fin Month Number | Day Type |
|----------|------------------|----------|
| 2002 | 1 | Weekday |
| 2002 | 1 | Weekend |
| 2002 | 1 | Weekend |
| 2002 | 1 | Weekend |
| 2002 | 1 | Weekend |
| 2002 | 1 | Weekend |
| 2002 | 1 | Weekday |

Portability and Reuse

| Category | Total Sales inc Service Fee |
|-------------------|-----------------------------|
| Accessories | \$714,775 |
| Bike Racks | \$40,147 |
| Bike Stands | \$40,383 |
| Bottles and Cages | \$57,934 |
| Cleaners | \$7,363 |
| Fenders | \$47,552 |
| Helmets | \$229,842 |
| Hydration Packs | \$41,114 |
| Tires and Tubes | \$250,440 |
| Bikes | \$28,884,508 |
| Mountain Bikes | \$10,151,815 |
| Road Bikes | \$14,810,996 |
| Touring Bikes | \$3,921,697 |
| Total | \$29,945,851 |



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Compare: Calc Columns vs Measures

Calculated columns:

- Must have a column to use in row/column/filter/slicer.
- Results are pre-calculated and stored
 - Take up memory and disk space.

Measures:

- Can only be used in the Values area of a visual.
- Never pre-calculated, always built on the fly.

When in doubt, use a measure in preference to a calculated column



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DAX Functions



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New DAX Functions

- DISTINCTCOUNT ()
- COUNTROWS ()
- DIVIDE()



1. Good Calculated Column.pbix

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Why to Write DAX Formulas?



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Practice Exercises

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Some exercises for you

Create the following measures

Data Acquisition

Data Modelling

Visualisation & Analysis

Sharing

[Total Customers] in our customer database

- Tip - Use the customer table

[Total Customers that Purchased]

- Tip – use the Sales table, not the Customer table


Only use the functions we have learnt so far today:
**SUM, DISTINCTCOUNT
COUNTROWS, DIVIDE**

For those customers that have actually purchased - don't use AVERAGE()

[Avg Invoices per Customer that Purchased]

[Avg Sales per Customer that Purchased]


| Category | Total Sales | Total Customers | Total Customers that Purchased | Avg Invoices per Customer that Purchased | Avg Sales per Customer that Purchased |
|--------------|---------------------|-----------------|--------------------------------|--|---------------------------------------|
| Accessories | \$700,760 | 18,484 | 15,114 | 1.2 | \$46.36 |
| Bikes | \$28,318,145 | 18,484 | 9,132 | 1.7 | \$3,100.98 |
| Clothing | \$339,773 | 18,484 | 6,852 | 1.1 | \$49.59 |
| Components | | 18,484 | | | |
| Total | \$29,358,677 | 18,484 | 18,484 | 1.5 | \$1,588.33 |

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Answers to Practice Exercises



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Answers to exercises

Data Acquisition

Data Modelling

Visualisation & Analysis

Sharing


Total Customers =
COUNTROWS(customers)

| Category | Total Sales | Total Customers | Total Customers that Purchased | Avg Invoices per Customer that Purchased | Avg Sales per Customer that Purchased |
|-------------|--------------|-----------------|--------------------------------|--|---------------------------------------|
| Accessories | \$700,760 | 18,484 | 15,114 | 1.2 | \$46.36 |
| Bikes | \$28,318,145 | 18,484 | 9,132 | 1.7 | \$3,100.98 |
| Clothing | \$339,773 | 18,484 | 6,852 | 1.1 | \$49.59 |
| Components | | 18,484 | | | |
| Total | \$29,358,677 | 18,484 | 18,484 | 1.5 | \$1,588.33 |

Total Customers that Purchased =
DISTINCTCOUNT(Sales[customerkey])

Average Invoices per Customer that Purchased =
DIVIDE([Total Invoices] , [Total Customers that Purchased])

Average Sales per Customer that Purchased =
DIVIDE([Total Sales] , [Total Customers that Purchased])





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Accurate Visualisation of Data Insights

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Answers to exercises

Data Acquisition


Data Modelling

Visualisation & Analysis

Sharing

What is going on here?

| Category | Total Sales | Total Customers | Total Customers that Purchased | Avg Invoices per Customer that Purchased | Avg Sales per Customer that Purchased |
|--------------|---------------------|-----------------|--------------------------------|--|---------------------------------------|
| Accessories | \$700,760 | 18,484 | 15,114 | 1.2 | \$46.36 |
| Bikes | \$28,318,145 | 18,484 | 9,132 | 1.7 | \$3,100.98 |
| Clothing | \$339,773 | 18,484 | 6,852 | 1.1 | \$49.59 |
| Components | | 18,484 | | | |
| Total | \$29,358,677 | 18,484 | 18,484 | 1.5 | \$1,588.33 |

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Filter Behaviour

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Bidirectional Filtering


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The CALCULATE Function

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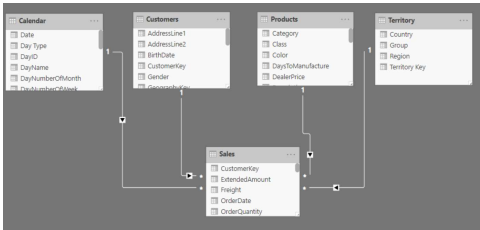



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Multiple tables and CALCULATE

- Leveraging multiple tables in a single model
- CALCULATE () – your new best friend
- Debugging your DAX Formulas



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2. Simple Functions.pbix

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The CALCULATE () function



Changing the **natural filter behaviour*** of a visualisation

| Country | Total Sales▼ | % Sales of Bikes |
|----------------|--------------|------------------|
| United States | \$9,389,790 | 95.8% |
| Australia | \$9,061,001 | 97.7% |
| United Kingdom | \$3,391,712 | 96.8% |
| Germany | \$2,894,312 | 97.0% |
| France | \$2,644,018 | 96.6% |
| Canada | \$1,977,845 | 92.1% |
| Total | \$29,358,677 | 96.5% |



* Technical term is "filter context"

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CALCULATE()

The most important function in DAX (it can change the natural filter behaviour)

=CALCULATE(<measure expression>, <filter1>, <filter2>,...)

Zero, 1 or more filters

<simple filter>

Table[Column] = <fixed value>

<table filter>

eg: Products

eg: ALL(Products), FILTER()

CALCULATE() can add, remove, or modify filters, then it re-runs the filter propagation engine.



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Function: **CALCULATE()**

Data Acquisition

Data Modelling

Visualisation & Analysis

Sharing


=CALCULATE(<measure expression>, <filter1>, <filter2>,...)

<measure expression>
Name of an existing measure, or formula that is valid for a measure
eg: [Total Sales]
eg: SUM(Sales[ExtendedAmount])

<simple filter>
A simple filter expression like Table[Column] = <fixed value>
eg: Products[Category]="Bikes", Calendar[Year]=2003
eg: SalesTable[ExtendedAmount]>=100

or **<table filter>**
eg: Products
eg: ALL(Products), FILTER()

Operation
Like SUMIF(), but more like "anything IF"
Modifies the filter context, but ONLY for this measure!


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Debugging Your DAX Formulas

6 Step Process

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Data Acquisition

Data Modelling

Visualisation & Analysis

Sharing

Debugging Your DAX Formulas

The 6 Step Process

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6 Step Process for Debugging DAX Formulas

1 Detect Initial Filters

| Day Type | Country | 2001 | 2002 | 2003 | 2004 | Total |
|----------|----------------|-------------|-------------|-------------|-------------|-------------|
| Weekday | Australia | \$447,158 | \$690,280 | \$996,041 | \$859,125 | \$2,992,604 |
| | Canada | \$48,420 | \$200,459 | \$189,935 | \$210,302 | \$648,115 |
| | France | \$66,620 | \$155,434 | \$304,789 | \$238,098 | \$764,923 |
| Weekend | Germany | \$179,794 | \$201,623 | \$338,924 | \$892,661 | \$1,513,762 |
| | United Kingdom | \$92,575 | \$205,044 | \$374,421 | \$367,090 | \$1,039,530 |
| | United States | \$386,286 | \$370,091 | \$804,663 | \$1,060,386 | \$2,901,426 |
| | Total | \$1,113,762 | \$2,001,191 | \$5,051,473 | \$3,093,925 | \$9,260,261 |

- Select a single cell in a visual.
- Determine ALL filters that are affecting this cell.
 - Rows
 - Columns
 - Slicers
 - Filters
 - Cross Filters from other visuals
- These are the "Initial" set of filters.

2 Apply Filters from CALCULATE

If there is a filter applied by a calculate then add, modify, remove filters as appropriate. This is then the final set of filters. Note that a CALCULATE could be in the formula in the selected cell or in another formula referenced by the cell.

3 Filter All Required Tables

One by one, apply these filters in the data model.

4 Follow the Relationships

If the tables receiving the filters in step 3 are joined, follow the relationships in the direction indicated.

5 Complete the Calculation

Then and only then do you complete the calculation on the "filtered copy" of the data model.

6 Return the Result to the Cell

Get the result and return it to the cell.

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Walkthrough of Live Examples

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Excel


Chart

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Thinking like the Power BI engine

(aka “troubleshooting your formulas”)



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Filter Behaviour Revisited



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| Category | Country | Total Sales |
|--------------------------------------|----------------|---------------------|
| <input type="checkbox"/> Accessories | Australia | \$9,051,766 |
| <input type="checkbox"/> Bikes | Canada | \$1,966,991 |
| <input type="checkbox"/> Clothing | France | \$2,640,526 |
| <input type="checkbox"/> Components | Germany | \$2,890,708 |
| | United Kingdom | \$3,387,491 |
| | United States | \$9,370,355 |
| | Total | \$29,307,837 |

Filter First

Calculation Second

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Filters

Territory[Country]="Australia"

| Category | Country | Total Sales |
|--------------------------------------|----------------|---------------------|
| <input type="checkbox"/> Accessories | Australia | \$9,051,766 |
| <input type="checkbox"/> Bikes | Canada | \$1,966,991 |
| <input type="checkbox"/> Clothing | France | \$2,640,526 |
| <input type="checkbox"/> Components | Germany | \$2,890,708 |
| | United Kingdom | \$3,387,491 |
| | United States | \$9,370,355 |
| | Total | \$29,307,837 |

First Apply Filters

Then Calculate Expression

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Filters

Territory[Country]="Australia"

Products[Category]="Bikes"

Category

Accessories

Bikes

Clothing

Components

Country

Australia

Canada

France

Germany

United Kingdom

United States

Total

Total Sales

\$8,852,050

\$1,821,302

\$2,553,576

\$2,808,514

\$3,282,843

\$8,999,860

\$28,318,145

Calendar

Customers

Products

Territory

Sales

First

Apply Filters

Then

Calculate

Expression

Ex

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123

Filters

Territory[Country]="Australia"

Category

Accessories

Bikes

Clothing

Components

Country

Australia

Canada

France

Germany

United Kingdom

United States

Total

Total Sales

\$9,051,766

\$1,966,991

\$2,640,526

\$2,890,708

\$3,387,491

\$9,370,355

\$29,307,837

Total Bike Sales

\$8,852,050

\$1,821,302

\$2,553,576

\$2,808,514

\$3,282,843

\$8,999,860

\$28,318,145

Calendar

Customers

Products

Territory

Sales

First

Apply Filters

Then

Calculate

Expression

Ex

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CALCULATE([Total Sales], Products[Category]="Bikes")

Filters

Products[Category]="Accessories"

?

| Category | Total Sales | Total Bike Sales |
|--------------|---------------------|---------------------|
| Accessories | \$667,015 | \$28,318,145 |
| Bikes | \$28,318,145 | \$28,318,145 |
| Clothing | \$322,677 | \$28,318,145 |
| Components | | \$28,318,145 |
| Total | \$29,307,837 | \$28,318,145 |

**First
Apply Filters**

**Then
Calculate
Expression**

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Key Points

`=CALCULATE(
[Total Sales],
Products[Category] = "Bikes"
)`

Replaces the filter from the visual with a new filter.

| Category | Total Sales | Total Sales from Bikes |
|--------------|---------------------|------------------------|
| Accessories | \$700,760 | \$28,318,145 |
| Bikes | \$28,318,145 | \$28,318,145 |
| Clothing | \$339,773 | \$28,318,145 |
| Components | | \$28,318,145 |
| Total | \$29,358,677 | \$28,318,145 |

`=CALCULATE(
[Total Sales],
KEEPFILTERS(Products[Category] = "Bikes")
)`

Keeps the filter from the visual and adds a new filter.

| Category | Total Sales | Total Sales from Bikes |
|--------------|---------------------|------------------------|
| Accessories | \$700,760 | |
| Bikes | \$28,318,145 | \$28,318,145 |
| Clothing | \$339,773 | |
| Total | \$29,358,677 | \$28,318,145 |

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KEEPFILTERS Function




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Percentage of Totals Problem

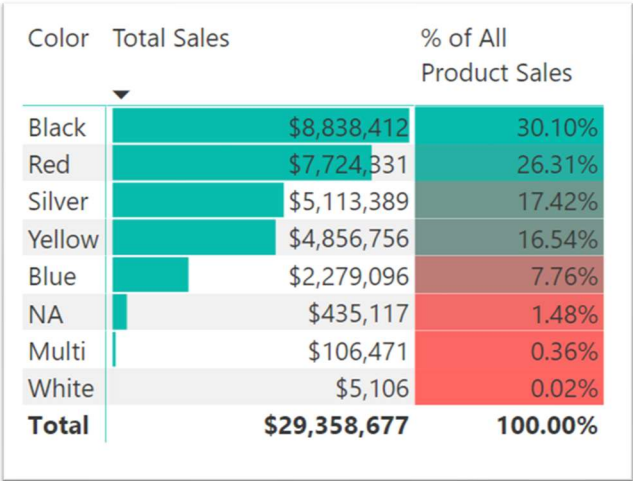
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Measures cont.

ALL(), percentage of totals, and "cancelling filters"



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The ALL Function



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CALCULATE()

The most important function in DAX (it can change the natural filter behaviour)

=CALCULATE(<measure expression>, <filter1>, <filter2>,...)

Zero, 1 or more filters

<simple filter>

Table[Column] = <fixed value>

<table filter>

eg: Products

eg: ALL(Products), FILTER()

CALCULATE() can add, remove, or modify filters, then it re-runs the filter propagation engine.



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Alternatives in Using ALL Function



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Enhancing the Readability of the Data Model



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Practice Exercises



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Exercises for you



Create some new measures to produce the following table

| Occupation | Total Sales ▼ | Total All Customer Sales | % of All Customer Sales |
|----------------|---------------|--------------------------|-------------------------|
| Professional | \$9,907,977 | \$29,358,677 | 33.7% |
| Skilled Manual | \$6,440,081 | \$29,358,677 | 21.9% |
| Management | \$5,467,862 | \$29,358,677 | 18.6% |
| Clerical | \$4,684,787 | \$29,358,677 | 16.0% |
| Manual | \$2,857,971 | \$29,358,677 | 9.7% |
| Total | \$29,358,677 | \$29,358,677 | 100.0% |

If you finish the first one (tricky)

| Region | Total Sales ▼ | % of All Region Sales |
|----------------|---------------|-----------------------|
| Australia | \$9,061,001 | 30.9% |
| Southwest | \$5,718,151 | 19.5% |
| Northwest | \$3,649,867 | 12.4% |
| United Kingdom | \$3,391,712 | 11.6% |
| Germany | \$2,894,312 | 9.9% |
| France | \$2,644,018 | 9.0% |
| Canada | \$1,977,845 | 6.7% |
| Southeast | \$12,239 | 0.0% |
| Northeast | \$6,532 | 0.0% |
| Central | \$3,001 | 0.0% |
| Total | \$29,358,677 | 100.0% |



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Answers to Practice Exercises



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Exercises for you



Create some new measures to produce the following table

| Occupation | Total Sales ▼ | Total All Customer Sales | % of All Customer Sales |
|----------------|---------------|--------------------------|-------------------------|
| Professional | \$9,907,977 | \$29,358,677 | 33.7% |
| Skilled Manual | \$6,440,081 | \$29,358,677 | 21.9% |
| Management | \$5,467,862 | \$29,358,677 | 18.6% |
| Clerical | \$4,684,787 | \$29,358,677 | 16.0% |
| Manual | \$2,857,971 | \$29,358,677 | 9.7% |
| Total | \$29,358,677 | \$29,358,677 | 100.0% |

Total Sales to All Customers
= CALCULATE([Total Sales], All(Customers))

% of All Customer Sales
= DIVIDE ([Total Sales], [Total Sales to All Customers])

If you finish the first one (tricky)

| Region | Total Sales ▼ | % of All Region Sales |
|----------------|---------------|-----------------------|
| Australia | \$9,061,001 | 30.9% |
| Southwest | \$5,718,151 | 19.5% |
| Northwest | \$3,649,867 | 12.4% |
| United Kingdom | \$3,391,712 | 11.6% |
| Germany | \$2,894,312 | 9.9% |
| France | \$2,644,018 | 9.0% |
| Canada | \$1,977,845 | 6.7% |
| Southeast | \$12,239 | 0.0% |
| Northeast | \$6,532 | 0.0% |
| Central | \$3,001 | 0.0% |
| Total | \$29,358,677 | 100.0% |

Total Sales to All Regions
= CALCULATE([Total Sales], All(Territory[Region]))

% of All Region Sales
= DIVIDE ([Total Sales], [Total Sales to All Regions])



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Introduction to Time Intelligence



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Time Intelligence

Data Acquisition


Data Modelling

Visualisation & Analysis

Sharing

- Introduction to Time Intelligence: Date/Calendar Tables
- Running totals such as Year to Date
- Change versus Prior Month/Year Etc.

| Year | MonthName ▲ | Total Sales | Total Sales YTD |
|------|--------------|--------------------|--------------------|
| 2001 | July | \$473,388 | \$473,388 |
| | August | \$506,192 | \$979,580 |
| | September | \$473,943 | \$1,453,523 |
| | October | \$513,329 | \$1,966,852 |
| | November | \$543,993 | \$2,510,846 |
| | December | \$755,528 | \$3,266,374 |
| | Total | \$3,266,374 | \$3,266,374 |
| 2002 | January | \$596,747 | \$596,747 |
| | February | \$550,817 | \$1,147,563 |
| | March | \$644,135 | \$1,791,698 |
| | April | \$663,692 | \$2,455,391 |
| | May | \$673,556 | \$3,128,947 |
| | June | \$676,764 | \$3,805,711 |
| | July | \$500,365 | \$4,306,076 |
| | August | \$546,001 | \$4,852,077 |
| | September | \$350,467 | \$5,202,544 |
| | October | \$415,390 | \$5,617,934 |
| | November | \$335,095 | \$5,953,030 |
| | December | \$577,314 | \$6,530,344 |

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Three Types of Time Intelligence

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3 Types of Time Intelligence

Auto Time Intelligence

- Automatically creates a calendar table for every date field.
- Easy to get started but limited capability.
- Can make your files really large.

Inbuilt Intelligence

- You must have a day level calendar table in your data model.
- Only works with standard calendar.

Custom Intelligence

- You must have a calendar table, but can be any granularity.
- Most flexible and can do anything you want.
- Hardest to learn, but you can learn it.



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Rules of a Date Table



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Rules of a date table



Rules only apply if you want to use inbuilt Time Intelligence

- Must have a calendar table
- Calendar table must have contiguous date range
 - Don't skip any days
- Good date tables
 - Have all the columns that you will want to use in your filters and formulae.
 - Have numeric sort columns to control the way text is displayed
- Gregorian Calendar only (not 445)
 - Can have any financial year you specify



<http://exceleratorbi.com.au/power-pivot-calendar-tables/>

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Removing Aggregations on Calendar Columns



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Sorting Calendar Values

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Auto Time Intelligence

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Running Totals

TOTALYTD Function

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Change vs Prior Year/Month

SAMEPERIODLASTYEAR and DATEADD Functions

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The FILTER Function

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Time for a new function

FILTER()

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function: FILTER()



FILTER(<table expression>, <single, *rich* filter test>)

<table expression>

- Name of a table, or formula expression that evaluates to a table
- ex: Calendar
- ex: VALUES(Calendar[Year])
- ex: ALL(Calendar[Year])

<single rich filter test>

- Anything that evaluates to True or False
- ex: [Total Sales Measure] < 50
- ex : SUM(SalesTable[ExtendedAmount]) > BudgetTable[Column1]
- ex : NOT(ISBLANK([Total Sales Measure]))
- ex : Table[Column1] <= Table[Column2] * 1.1
- ex: [Total Sales Measure] < 50 && [Total Sales Measure] > 0

Operation

- Steps through every row (or value) in <table expression>
- Evaluates <rich filter test> at each step, in the context of that current row/value
- Only keeps rows that return True



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CALCULATE()

The most important function in DAX (it can change the natural filter behaviour)

=CALCULATE(<measure expression>, <filter1>, <filter2>,...)

Zero, 1 or more filters

<simple filter>

Table[Column] = <fixed value>

<table filter>

eg: Products
eg: ALL(Products), FILTER()


CALCULATE() can add, remove, or modify filters, then it re-runs the filter propagation engine.




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Filter Function is like a Calculated Column

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The FILTER() function

You can consider the FILTER() function as being like a virtual calculated column

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FILTER Function Pattern to get Business Insights


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Counting things that didn't happen


Back to Power BI

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Introduction to Multiple Data Tables

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Multiple Data Tables

- Add a second table of data
- Join the tables
- Create measures to derive business insights

| Country | Total Sales | Total Support Tickets | Total Tickets per \$100,000 turn over | Total Support Minutes |
|----------------|--------------|-----------------------|---------------------------------------|-----------------------|
| United States | \$9,389,790 | 4,349 | 46.3 | 158,623 |
| Australia | \$9,061,001 | 1,797 | 19.8 | 66,725 |
| United Kingdom | \$3,391,712 | 1,798 | 53.0 | 67,888 |
| Germany | \$2,894,312 | 1,553 | 53.7 | 55,962 |
| France | \$2,644,018 | 1,559 | 59.0 | 57,644 |
| Canada | \$1,977,845 | 1,548 | 78.3 | 56,834 |
| Total | \$29,358,677 | 12,604 | 42.9 | 463,676 |

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Loading and Connecting a Second Data Table

Data Tables Connected to Common Lookup Tables

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Deriving Business Insights from 2 Data Tables

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What-if Analysis in Power BI



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What If Analysis

- Create a user input slicer
- Change the results in the report based on user input

| | | | | |
|--|--|-------------------------|--|--|
| Rate | | \$1.00 Selected Rate | | |
| <input type="checkbox"/> 0.70 | | | | |
| <input type="checkbox"/> 0.75 | | | | |
| <input type="checkbox"/> 0.80 | | | | |
| <input type="checkbox"/> 0.85 | | | | |
| <input type="checkbox"/> 0.90 | | | | |
| <input type="checkbox"/> 0.95 | | | | |
| <input checked="" type="checkbox"/> 1.00 | | | | |
| <input type="checkbox"/> 1.05 | | | | |
| <input type="checkbox"/> 1.10 | | | | |
| <input type="checkbox"/> 1.15 | | | | |
| <input type="checkbox"/> 1.20 | | | | |
| <input type="checkbox"/> 1.25 | | | | |

| Category | Total Sales | Total Call Minutes | Total Service Cost |
|--------------|---------------------|--------------------|--------------------|
| Bikes | \$28,318,145 | 199,696 | \$199,696 |
| Accessories | \$700,760 | 40,349 | \$40,349 |
| Clothing | \$339,773 | 31,302 | \$31,302 |
| Total | \$29,358,677 | 271,347 | \$271,347 |



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Changing Filter Behaviour to Display the Results



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Using Single Value to Display the Results

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Chart Title and Values based on the Selected Measure


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The SWITCH() Function





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Setting up the Chart

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Displaying Short Month Name

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Setting up the Chart - Contd.

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SELECTEDVALUE Function

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The SWITCH Function



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Harvester Measure

Dynamic Chart Title



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Next Steps


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Thanks for learning from me





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What Next?

- Apply your skills in your business scenarios
- Practice for 6 – 18 months
- Enrol to my Advanced Dax course



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