

# RECAP: CALCULATED COLUMNS VS. MEASURES



# CALCULATED COLUMNS

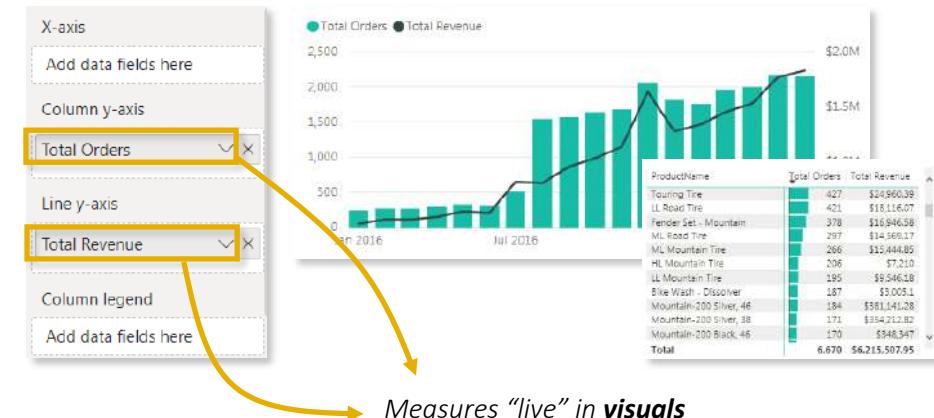
- Values are calculated based on information from each row of a table (**row context**)
  - Appends static values to each row in a table and stores them in the model (*which increases file size*)
  - Recalculate on data source refresh or when changes are made to component columns
  - Primarily used for **filtering** data in reports

	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Parent = IF('Customer Lookup'[Total Children]>0,"Yes","No")				
	Birth Date	Marital Status	Email Address	Annual Income	Total Children	Education Level	Parent
	9/3/1943	M	emma32@adventure-works.com	70000	5	Bachelors	Yes
	5/14/1967	M	barry20@adventure-works.com	40000	5	High school	Yes
	8/5/1945	M	martha13@adventure-works.com	70000	5	High School	Yes
	6/4/1946	S	tamara16@adventure-works.com	40000	5	High School	Yes
	10/16/1970	S	gerald21@adventure-works.com	130000	5	Bachelors	Yes
	5/10/1945	M	alexia8@adventure-works.com	40000	5	High School	Yes
	9/24/1938	M	jack53@adventure-works.com	70000	5	Graduate Degree	Yes
	7/21/1959	S	ricky1@adventure-works.com	100000	5	Bachelors	Yes
	1/6/1962	M	keith4@adventure-works.com	70000	5	Partial College	Yes
	8/15/1962	M	latoya19@adventure-works.com	70000	5	Bachelors	Yes
	1/26/1967	S	mical11@adventure-works.com	70000	5	Bachelors	Yes
	3/8/1946	M	mindy22@adventure-works.com	80000	5	Partial College	Yes
	6/11/1960	M	teresa9@adventure-works.com	70000	5	Partial College	Yes

*Calculated columns “live” in tables*

# MEASURES

- Values are calculated based on information from any filters in the report (**filter context**)
  - Does not create new data in the tables themselves (*doesn't increase file size*)
  - Recalculate in response to any change to filters within the report
  - Primarily used for **aggregating values** in report visuals

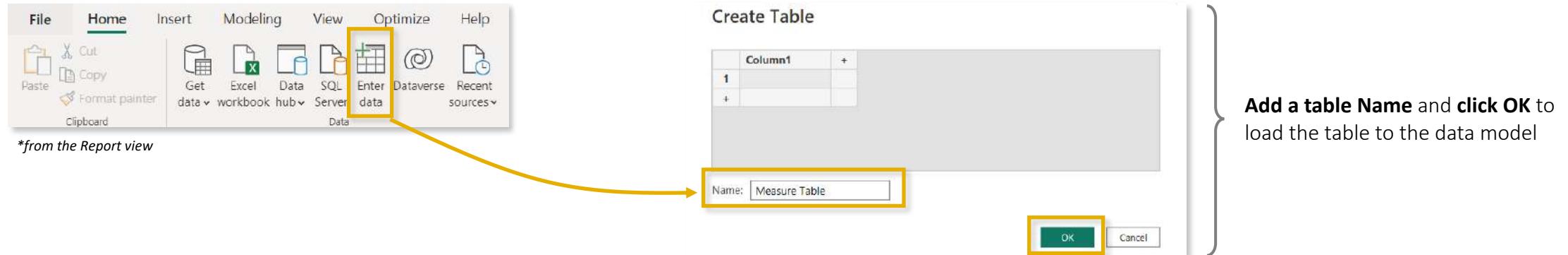




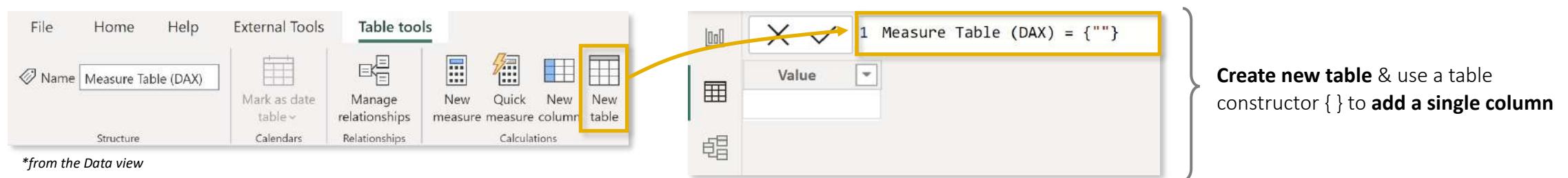
# PRO TIP: MEASURE TABLES

It's a common best practice to **create a dedicated table to store your measures**; this will help you stay organized, find measures quickly, and allow you to group related measures into folders

**Option 1: Enter Data into Power Query** (loads the table to the data model – table is visible in Power Query)



**Option 2:** Create a **calculated table** using **DAX** directly in the model (table is not visible in Power Query)





# FILTER CONTEXT

Measures are evaluated based on **filter context**, which means that they recalculate whenever the fields or filters around them change

Top 10 Products	Orders	Revenue	Return %
Water Bottle - 30 oz.	3,983	\$39,755	1.95%
Patch Kit/8 Patches	2,952	\$13,506	1.61%
Mountain Tire Tube	2,846	\$28,333	1.64%
Road Tire Tube	2,173	\$17,265	1.55%
Sport-100 Helmet, Red	2,099	\$73,444	3.33%
AWC Logo Cap	2,062	\$35,865	1.11%
Sport-100 Helmet, Blue	1,995	\$67,112	3.31%
Fender Set - Mountain	1,975	\$87,041	1.36%
Sport-100 Helmet, Black	1,940	\$65,262	2.68%
Mountain Bottle Cage	1,896	\$38,062	2.02%
<b>Total</b>	<b>15,587</b>	<b>\$465,644</b>	<b>1.85%</b>

For this value in the matrix (2,846), the **Orders** measure is calculated based on the following filter context: *Products[Product Name] = “Mountain Tire Tube”*

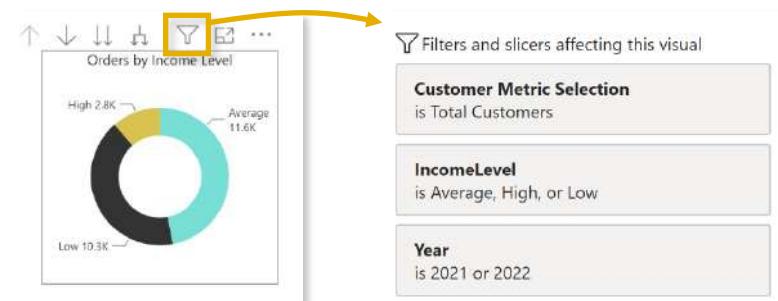
- This allows the measure to return the total order quantity for each product specifically (or whatever context the row and column labels dictate – years, countries, categories, customer names, etc.)

This total (15,587) does **NOT** calculate by summing the values above; it evaluates as an independent measure with **no filter context** applied

- IMPORTANT:** Every measure value in a report evaluates **independently** (like an island) and calculates based on its own filter context



**PRO TIP:** Clicking the **filter icon** will show you the filters currently applied to a selected visual



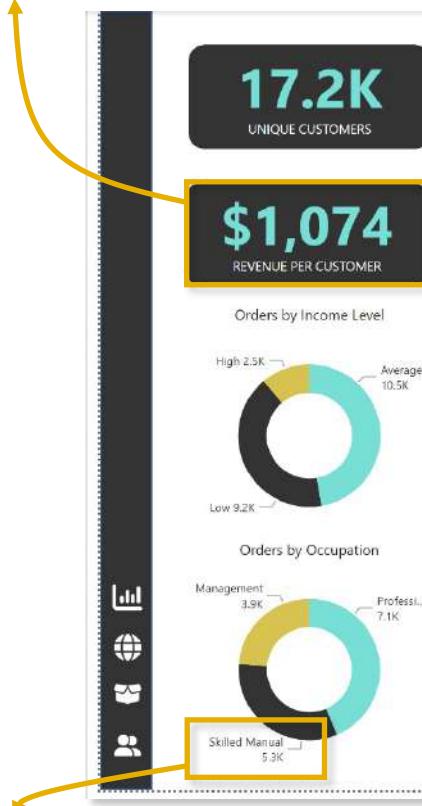


# EXAMPLE: FILTER CONTEXT

MEASURE: Revenue Per Customer

FILTER CONTEXT:

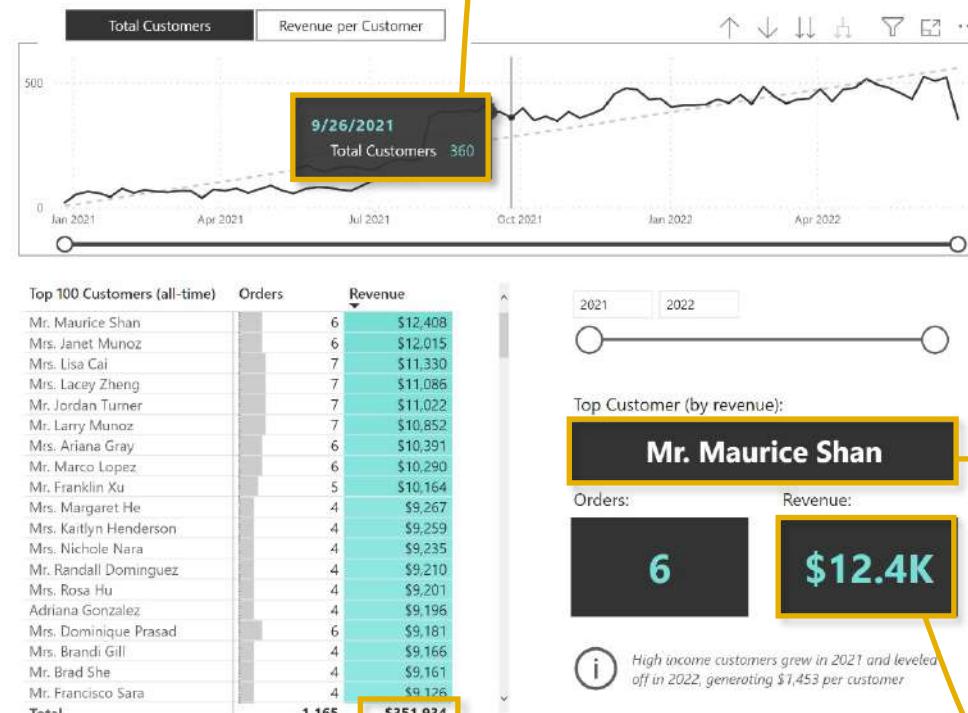
- *Calendar[Year] = 2021 or 2022*



MEASURE: Total Orders

FILTER CONTEXT:

- *Calendar[Year] = 2021 or 2022*
- *Customers[Occupation] = Skilled Manual*



MEASURE: Total Revenue

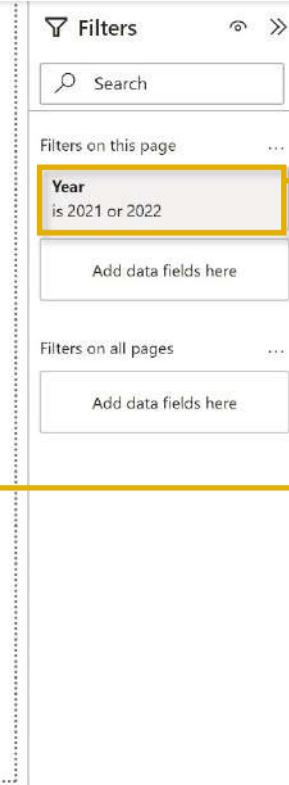
FILTER CONTEXT:

- *Calendar[Year] = 2021 or 2022*
- *Customer[Full Name] = Top 100 by Total Orders*

MEASURE: Total Customers

FILTER CONTEXT:

- *Calendar[Date] = September 26, 2021*



This is a **page-level filter**, which impacts **ALL** visuals on this report page (*more on this later!*)

COLUMN: Customer Full Name

FILTER CONTEXT:

- *Calendar[Year] = 2021 or 2022*
- *Customer[Full Name] = Top 1 by Total Revenue*

MEASURE: Total Revenue

FILTER CONTEXT:

- *Calendar[Year] = 2021 or 2022*
- *Customer[Full Name] = Mr. Maurice Shan*

# STEP-BY-STEP MEASURE CALCULATION



Product	Color	Quantity Sold
1	Black	10,590
2	Red	4,011
3	Yellow	4,638

- How exactly is this measure value calculated?

- **NOTE:** This all happens *instantly* behind the scenes, every time the filter context changes

# STEP 1

**Filter context is detected & applied**



Product	Color	Quantity Sold
Shirt	Black	10,590
Pants	Red	4,011
Hat	Yellow	4,638

'Product Lookup'[Product Color] = "Black"

# STEP 2

**Filters flow “downstream” to related tables**



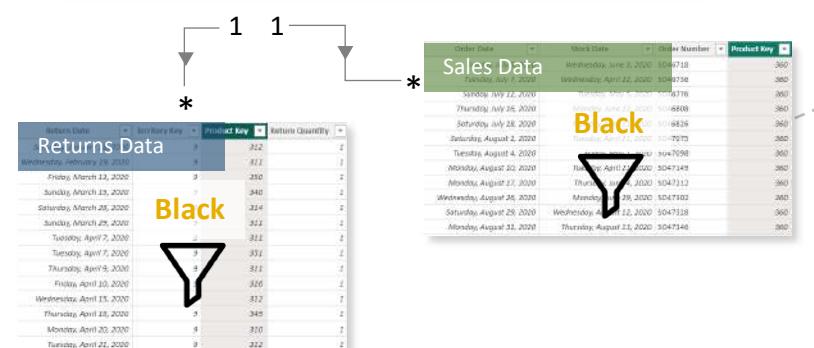
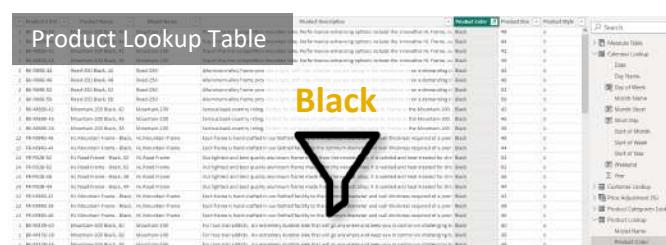
Product Lookup Table		Product ID	Product Name	Product Type	Product Status
P-10000-A1	Head-01 Black	001	Black	Headphones	Normal
P-10000-B2	Head-02 White	002	White	Headphones	Normal
P-10000-C3	Head-03 Blue	003	Blue	Headphones	Normal
P-10000-D4	Head-04 Red	004	Red	Headphones	Normal
P-10000-E5	Head-05 Green	005	Green	Headphones	Normal
P-10000-F6	Head-06 Yellow	006	Yellow	Headphones	Normal
P-10000-G7	Head-07 Orange	007	Orange	Headphones	Normal
P-10000-H8	Head-08 Purple	008	Purple	Headphones	Normal
P-10000-I9	Head-09 Pink	009	Pink	Headphones	Normal
P-10000-J10	Head-10 Grey	010	Grey	Headphones	Normal
P-10000-K11	Microphone-01 Blue	011	Blue	Microphones	Normal
P-10000-L12	Microphone-02 Red	012	Red	Microphones	Normal
P-10000-M13	Microphone-03 Green	013	Green	Microphones	Normal
P-10000-N14	Microphone-04 Orange	014	Orange	Microphones	Normal
P-10000-O15	Microphone-05 Purple	015	Purple	Microphones	Normal
P-10000-P16	Microphone-06 Yellow	016	Yellow	Microphones	Normal
P-10000-Q17	Microphone-07 White	017	White	Microphones	Normal
P-10000-R18	Microphone-08 Black	018	Black	Microphones	Normal
P-10000-S19	Microphone-09 Pink	019	Pink	Microphones	Normal
P-10000-T20	Microphone-10 Brown	020	Brown	Microphones	Normal
P-10000-U21	Microphone-11 White	021	White	Microphones	Normal
P-10000-V22	Microphone-12 Black	022	Black	Microphones	Normal
P-10000-W23	Microphone-13 Orange	023	Orange	Microphones	Normal
P-10000-X24	Microphone-14 Purple	024	Purple	Microphones	Normal
P-10000-Y25	Microphone-15 Yellow	025	Yellow	Microphones	Normal
P-10000-Z26	Microphone-16 Red	026	Red	Microphones	Normal
P-10000-A27	Microphone-17 Green	027	Green	Microphones	Normal
P-10000-B28	Microphone-18 Blue	028	Blue	Microphones	Normal
P-10000-C29	Microphone-19 White	029	White	Microphones	Normal
P-10000-D30	Microphone-20 Black	030	Black	Microphones	Normal
P-10000-E31	Microphone-21 Orange	031	Orange	Microphones	Normal
P-10000-F32	Microphone-22 Purple	032	Purple	Microphones	Normal
P-10000-G33	Microphone-23 Yellow	033	Yellow	Microphones	Normal
P-10000-H34	Microphone-24 Red	034	Red	Microphones	Normal
P-10000-I35	Microphone-25 Green	035	Green	Microphones	Normal
P-10000-J36	Microphone-26 Blue	036	Blue	Microphones	Normal
P-10000-K37	Microphone-27 White	037	White	Microphones	Normal
P-10000-L38	Microphone-28 Black	038	Black	Microphones	Normal
P-10000-M39	Microphone-29 Orange	039	Orange	Microphones	Normal
P-10000-N40	Microphone-30 Purple	040	Purple	Microphones	Normal
P-10000-O41	Microphone-31 Yellow	041	Yellow	Microphones	Normal
P-10000-P42	Microphone-32 Red	042	Red	Microphones	Normal
P-10000-Q43	Microphone-33 Green	043	Green	Microphones	Normal
P-10000-R44	Microphone-34 Blue	044	Blue	Microphones	Normal
P-10000-S45	Microphone-35 White	045	White	Microphones	Normal
P-10000-T46	Microphone-36 Black	046	Black	Microphones	Normal
P-10000-U47	Microphone-37 Orange	047	Orange	Microphones	Normal
P-10000-V48	Microphone-38 Purple	048	Purple	Microphones	Normal
P-10000-W49	Microphone-39 Yellow	049	Yellow	Microphones	Normal
P-10000-X50	Microphone-40 Red	050	Red	Microphones	Normal
P-10000-Y51	Microphone-41 Green	051	Green	Microphones	Normal
P-10000-Z52	Microphone-42 Blue	052	Blue	Microphones	Normal
P-10000-A53	Microphone-43 White	053	White	Microphones	Normal
P-10000-B54	Microphone-44 Black	054	Black	Microphones	Normal
P-10000-C55	Microphone-45 Orange	055	Orange	Microphones	Normal
P-10000-D56	Microphone-46 Purple	056	Purple	Microphones	Normal
P-10000-E57	Microphone-47 Yellow	057	Yellow	Microphones	Normal
P-10000-F58	Microphone-48 Red	058	Red	Microphones	Normal
P-10000-G59	Microphone-49 Green	059	Green	Microphones	Normal
P-10000-H60	Microphone-50 Blue	060	Blue	Microphones	Normal
P-10000-I61	Microphone-51 White	061	White	Microphones	Normal
P-10000-J62	Microphone-52 Black	062	Black	Microphones	Normal
P-10000-K63	Microphone-53 Orange	063	Orange	Microphones	Normal
P-10000-L64	Microphone-54 Purple	064	Purple	Microphones	Normal
P-10000-M65	Microphone-55 Yellow	065	Yellow	Microphones	Normal
P-10000-N66	Microphone-56 Red	066	Red	Microphones	Normal
P-10000-O67	Microphone-57 Green	067	Green	Microphones	Normal
P-10000-P68	Microphone-58 Blue	068	Blue	Microphones	Normal
P-10000-Q69	Microphone-59 White	069	White	Microphones	Normal
P-10000-R70	Microphone-60 Black	070	Black	Microphones	Normal
P-10000-S71	Microphone-61 Orange	071	Orange	Microphones	Normal
P-10000-T72	Microphone-62 Purple	072	Purple	Microphones	Normal
P-10000-U73	Microphone-63 Yellow	073	Yellow	Microphones	Normal
P-10000-V74	Microphone-64 Red	074	Red	Microphones	Normal
P-10000-W75	Microphone-65 Green	075	Green	Microphones	Normal
P-10000-X76	Microphone-66 Blue	076	Blue	Microphones	Normal
P-10000-Y77	Microphone-67 White	077	White	Microphones	Normal
P-10000-Z78	Microphone-68 Black	078	Black	Microphones	Normal
P-10000-A79	Microphone-69 Orange	079	Orange	Microphones	Normal
P-10000-B80	Microphone-70 Purple	080	Purple	Microphones	Normal
P-10000-C81	Microphone-71 Yellow	081	Yellow	Microphones	Normal
P-10000-D82	Microphone-72 Red	082	Red	Microphones	Normal
P-10000-E83	Microphone-73 Green	083	Green	Microphones	Normal
P-10000-F84	Microphone-74 Blue	084	Blue	Microphones	Normal
P-10000-G85	Microphone-75 White	085	White	Microphones	Normal
P-10000-H86	Microphone-76 Black	086	Black	Microphones	Normal
P-10000-I87	Microphone-77 Orange	087	Orange	Microphones	Normal
P-10000-J88	Microphone-78 Purple	088	Purple	Microphones	Normal
P-10000-K89	Microphone-79 Yellow	089	Yellow	Microphones	Normal
P-10000-L90	Microphone-80 Red	090	Red	Microphones	Normal
P-10000-M91	Microphone-81 Green	091	Green	Microphones	Normal
P-10000-N92	Microphone-82 Blue	092	Blue	Microphones	Normal
P-10000-O93	Microphone-83 White	093	White	Microphones	Normal
P-10000-P94	Microphone-84 Black	094	Black	Microphones	Normal
P-10000-Q95	Microphone-85 Orange	095	Orange	Microphones	Normal
P-10000-R96	Microphone-86 Purple	096	Purple	Microphones	Normal
P-10000-S97	Microphone-87 Yellow	097	Yellow	Microphones	Normal
P-10000-T98	Microphone-88 Red	098	Red	Microphones	Normal
P-10000-U99	Microphone-89 Green	099	Green	Microphones	Normal
P-10000-V100	Microphone-90 Blue	100	Blue	Microphones	Normal
P-10000-W101	Microphone-91 White	101	White	Microphones	Normal
P-10000-X102	Microphone-92 Black	102	Black	Microphones	Normal
P-10000-Y103	Microphone-93 Orange	103	Orange	Microphones	Normal
P-10000-Z104	Microphone-94 Purple	104	Purple	Microphones	Normal
P-10000-A105	Microphone-95 Yellow	105	Yellow	Microphones	Normal
P-10000-B106	Microphone-96 Red	106	Red	Microphones	Normal
P-10000-C107	Microphone-97 Green	107	Green	Microphones	Normal
P-10000-D108	Microphone-98 Blue	108	Blue	Microphones	Normal
P-10000-E109	Microphone-99 White	109	White	Microphones	Normal
P-10000-F110	Microphone-100 Black	110	Black	Microphones	Normal
P-10000-G111	Microphone-101 Orange	111	Orange	Microphones	Normal
P-10000-H112	Microphone-102 Purple	112	Purple	Microphones	Normal
P-10000-I113	Microphone-103 Yellow	113	Yellow	Microphones	Normal
P-10000-J114	Microphone-104 Red	114	Red	Microphones	Normal
P-10000-K115	Microphone-105 Green	115	Green	Microphones	Normal
P-10000-L116	Microphone-106 Blue	116	Blue	Microphones	Normal
P-10000-M117	Microphone-107 White	117	White	Microphones	Normal
P-10000-N118	Microphone-108 Black	118	Black	Microphones	Normal
P-10000-O119	Microphone-109 Orange	119	Orange	Microphones	Normal
P-10000-P120	Microphone-110 Purple	120	Purple	Microphones	Normal
P-10000-Q121	Microphone-111 Yellow	121	Yellow	Microphones	Normal
P-10000-R122	Microphone-112 Red	122	Red	Microphones	Normal
P-10000-S123	Microphone-113 Green	123	Green	Microphones	Normal
P-10000-T124	Microphone-114 Blue	124	Blue	Microphones	Normal
P-10000-U125	Microphone-115 White	125	White	Microphones	Normal
P-10000-V126	Microphone-116 Black	126	Black	Microphones	Normal
P-10000-W127	Microphone-117 Orange	127	Orange	Microphones	Normal
P-10000-X128	Microphone-118 Purple	128	Purple	Microphones	Normal
P-10000-Y129	Microphone-119 Yellow	129	Yellow	Microphones	Normal
P-10000-Z130	Microphone-120 Red	130	Red	Microphones	Normal
P-10000-A131	Microphone-121 Green	131	Green	Microphones	Normal
P-10000-B132	Microphone-122 Blue	132	Blue	Microphones	Normal
P-10000-C133	Microphone-123 White	133	White	Microphones	Normal
P-10000-D134	Microphone-124 Black	134	Black	Microphones	Normal
P-10000-E135	Microphone-125 Orange	135	Orange	Microphones	Normal
P-10000-F136	Microphone-126 Purple	136	Purple	Microphones	Normal
P-10000-G137	Microphone-127 Yellow	137	Yellow	Microphones	Normal
P-10000-H138	Microphone-128 Red	138	Red	Microphones	Normal
P-10000-I139	Microphone-129 Green	139	Green	Microphones	Normal
P-10000-J140	Microphone-130 Blue	140	Blue	Microphones	Normal
P-10000-K141	Microphone-131 White	141	White	Microphones	Normal
P-10000-L142	Microphone-132 Black	142	Black	Microphones	Normal
P-10000-M143	Microphone-133 Orange	143	Orange	Microphones	Normal
P-10000-N144	Microphone-134 Purple	144	Purple	Microphones	Normal
P-10000-O145	Microphone-135 Yellow	145	Yellow	Microphones	Normal
P-10000-P146	Microphone-136 Red	146	Red	Microphones	Normal
P-10000-Q147	Microphone-137 Green	147	Green	Microphones	Normal
P-10000-R148	Microphone-138 Blue	148	Blue	Microphones	Normal
P-10000-S149	Microphone-139 White	149	White	Microphones	Normal
P-10000-T150	Microphone-140 Black	150	Black	Microphones	Normal
P-10000-U151	Microphone-141 Orange	151	Orange	Microphones	Normal
P-10000-V152	Microphone-142 Purple	152	Purple	Microphones	Normal
P-10000-W153	Microphone-143 Yellow	153	Yellow	Microphones	Normal
P-10000-X154	Microphone-144 Red	154	Red	Microphones	Normal
P-10000-Y155	Microphone-145 Green	155	Green	Microphones	Normal
P-10000-Z156	Microphone-146 Blue	156	Blue	Microphones	Normal
P-10000-A157	Microphone-147 White	157	White	Microphones	Normal
P-10000-B158	Microphone-148 Black	158	Black	Microphones	Normal
P-10000-C159	Microphone-149 Orange	159	Orange	Microphones	Normal
P-10000-D160	Microphone-150 Purple	160	Purple	Microphones	Normal
P-10000-E161	Microphone-151 Yellow	161	Yellow	Microphones	Normal
P-10000-F162	Microphone-152 Red	162	Red	Microphones	Normal
P-10000-G163	Microphone-153 Green	163	Green	Microphones	Normal
P-10000-H164	Microphone-154 Blue	164	Blue	Microphones	Normal
P-10000-I165	Microphone-155 White	165	White	Microphones	Normal
P-10000-J166	Microphone-156 Black	166	Black	Microphones	Normal
P-10000-K167	Microphone-157 Orange	167	Orange	Microphones	Normal
P-10000-L168	Microphone-158 Purple	168	Purple	Microphones	Normal
P-10000-M169	Microphone-159 Yellow	169	Yellow	Microphones	Normal
P-10000-N170	Microphone-160 Red	170	Red	Microphones	Normal
P-10000-O171	Microphone-161 Green	171	Green	Microphones	Normal
P-10000-P172	Microphone-162 Blue	172	Blue	Microphones	Normal
P-10000-Q173	Microphone-163 White	173	White	Microphones	Normal
P-10000-R174	Microphone-164 Black	174	Black	Microphones	Normal
P-10000-S175	Microphone-165 Orange	175	Orange	Microphones	Normal
P-10000-T176	Microphone-166 Purple	176	Purple	Microphones	Normal
P-10000-U177	Microphone-167 Yellow	177	Yellow	Microphones	Normal
P-10000-V178	Microphone-168 Red	178	Red	Microphones	Normal
P-10000-W179	Microphone-169 Green	179	Green	Microphones	Normal
P-10000-X180	Microphone-170 Blue	180	Blue	Microphones	Normal
P-10000-Y181	Microphone-171 White	181	White	Microphones	Normal
P-10000-Z182	Microphone-172 Black	182	Black	Microphones	Normal
P-10000-A183	Microphone-173 Orange	183	Orange	Microphones	Normal
P-10000-B184	Microphone-174 Purple	184	Purple	Microphones	Normal
P-10000-C185	Microphone-175 Yellow	185	Yellow	Microphones	Normal
P-10000-D186	Microphone-176 Red	186	Red	Microphones	Normal
P-10000-E187	Microphone-177 Green	187	Green	Microphones	Normal
P-10000-F188	Microphone-178 Blue	188	Blue	Microphones	Normal
P-10000-G189	Microphone-179 White	189	White	Microphones	Normal
P-10000-H190	Microphone-180 Black	190	Black	Microphones	Normal
P-10000-I191	Microphone-181 Orange	191	Orange	Microphones	Normal
P-10000-J192	Microphone-182 Purple	192	Purple	Microphones	Normal
P-10000-K193	Microphone-183 Yellow	193	Yellow	Microphones	Normal
P-10000-L194	Microphone-184 Red	194	Red	Microphones	Normal
P-10000-M195	Microphone-185 Green	195	Green	Microphones	Normal
P-10000-N196	Microphone-186 Blue	196	Blue	Microphones	Normal
P-10000-O197	Microphone-187 White	197	White	Microphones	Normal
P-10000-P198	Microphone-188 Black	198	Black	Microphones	Normal
P-10000-Q199	Microphone-189 Orange	199	Orange	Microphones	Normal
P-10000-R200	Microphone-190 Purple	200	Purple	Microphones	Normal
P-10000-S201	Microphone-191 Yellow	201	Yellow	Microphones	Normal
P-10000-T202	Microphone-192 Red	202	Red	Microphones	Normal
P-10000-U203	Microphone-193 Green	203	Green	Microphones	Normal
P-10000-V204	Microphone-194 Blue	204	Blue	Microphones	Normal
P-10000-W205	Microphone-195 White	205	White	Microphones	Normal
P-10000-X206	Microphone-196 Black	206	Black	Microphones	Normal
P-10000-Y207	Microphone-197 Orange	207	Orange	Microphones	Normal
P-10000-Z208	Microphone-198 Purple	208	Purple	Microphones	Normal
P-10000-A209	Microphone-199 Yellow	209	Yellow	Microphones	Normal
P-10000-B210	Microphone-200 Red	210	Red	Microphones	Normal
P-10000-C211	Microphone-201 Green	211	Green	Microphones	Normal
P-10000-D212	Microphone-202 Blue	212	Blue	Microphones	

## STEP 3

**Measure evaluates against the filtered table**



```
1 Quantity Sold =  
2 SUM(  
3 |     'Sales Data'[Order Quantity]  
4 )
```



Sum of values in the **Order Quantity** column of the **Sales Data** table, filtered to rows where the product color is **Black**

= 10,590



# DAX SYNTAX

## MEASURE NAME

- Measures are always surrounded by brackets (i.e. **[Total Quantity]**) when referenced in formulas, so spaces are OK

Total Quantity: = **SUM(Transactions[quantity])**

## FUNCTION NAME

- Calculated columns don't always use functions, but measures do:
  - In a **Calculated Column**, **=Transactions[quantity]** returns the value from the quantity column in each row (*since it evaluates one row at a time*)
  - In a **Measure**, **=Transactions[quantity]** will return an **error** since Power BI doesn't know how to translate that as a single value – you need some sort of aggregation

Referenced  
**TABLE NAME**

Referenced  
**COLUMN NAME**

This is a “**fully qualified**” column, since it’s preceded by the table name.

**NOTE:** Table names with spaces must be surrounded by **single quotes**:

- Without a space: **Transactions[quantity]**
- With a space: **'Transactions Table'[quantity]**



## PRO TIP:

**Column** references use fully qualified names (i.e. **'Table'[Column]**)

**Measure** references just use the measure name (i.e. **[Measure]**) and can be called by typing an open square bracket “ [ ”



# DAX OPERATORS

Arithmetic Operator	Meaning	Example
+	Addition	$2 + 7$
-	Subtraction	$5 - 3$
*	Multiplication	$2 * 6$
/	Division	$4 / 2$
$\wedge$	Exponent	$2 \wedge 5$

Pay attention to these!

Comparison Operator	Meaning	Example
=	Equal to	[City] = "Boston"
>	Greater than	[Quantity] > 10
<	Less than	[Quantity] < 10
$\geq$	Greater than or equal to	[Unit Price] $\geq$ 2.5
$\leq$	Less than or equal to	[Unit Price] $\leq$ 2.5
$\neq$	Not equal to	[Country] $\neq$ "Mexico"

Text/Logical Operator	Meaning	Example
&	Concatenates two values to produce one text string	[City] & " " & [State]
<b>&amp;&amp;</b>	Create an AND condition between two logical expressions	([State] = "MA") && ([Quantity] > 10)
(double pipe)	Create an OR condition between two logical expressions	([State] = "MA")    ([State] = "CT")
IN	Creates a logical OR condition based on a given list (using curly brackets)	'Store Lookup'[State] IN { "MA", "CT", "NY" }

\*Head to <https://learn.microsoft.com> for more information about DAX syntax, operators, troubleshooting, etc.



# COMMON FUNCTION CATEGORIES

MATH & STATS Functions	LOGICAL Functions	TEXT Functions	FILTER Functions	TABLE Functions	DATE & TIME Functions	RELATIONSHIP Functions
<p><i>Functions used for <b>aggregation</b> or iterative, row-level calculations</i></p> <p><b>Common Examples:</b></p> <ul style="list-style-type: none"><li>• SUM</li><li>• AVERAGE</li><li>• MAX/MIN</li><li>• DIVIDE</li><li>• COUNT/COUNTA</li><li>• COUNTROWS</li><li>• DISTINCTCOUNT</li></ul> <p><b>Iterator Functions:</b></p> <ul style="list-style-type: none"><li>• SUMX</li><li>• AVERAGEX</li><li>• MAXX/MINX</li><li>• RANKX</li><li>• COUNTX</li></ul>	<p><i>Functions that use <b>conditional expressions</b> (IF/THEN statements)</i></p> <p><b>Common Examples:</b></p> <ul style="list-style-type: none"><li>• IF</li><li>• IFERROR</li><li>• AND</li><li>• OR</li><li>• NOT</li><li>• SWITCH</li><li>• TRUE</li><li>• FALSE</li></ul>	<p><i>Functions used to manipulate <b>text strings</b> or <b>value formats</b></i></p> <p><b>Common Examples:</b></p> <ul style="list-style-type: none"><li>• CONCATENATE</li><li>• COMBINEVALUES</li><li>• FORMAT</li><li>• LEFT/MID/RIGHT</li><li>• UPPER/LOWER</li><li>• LEN</li><li>• SEARCH/FIND</li><li>• REPLACE</li><li>• SUBSTITUTE</li><li>• TRIM</li></ul>	<p><i>Functions used to <b>manipulate table</b> and <b>filter contexts</b></i></p> <p><b>Common Examples:</b></p> <ul style="list-style-type: none"><li>• CALCULATE</li><li>• FILTER</li><li>• ALL</li><li>• ALLEXCEPT</li><li>• ALLSELECTED</li><li>• KEEPFILTERS</li><li>• REMOVEFILTERS</li><li>• SELECTEDVALUE</li></ul>	<p><i>Functions that <b>create</b> or <b>manipulate tables</b> and output tables vs. scalar values</i></p> <p><b>Common Examples:</b></p> <ul style="list-style-type: none"><li>• SUMMARIZE</li><li>• ADDCOLUMNS</li><li>• GENERATESERIES</li><li>• DISTINCT</li><li>• VALUES</li><li>• UNION</li><li>• INTERSECT</li><li>• TOPN</li></ul>	<p><i>Functions used to <b>manipulate date &amp; time values</b> or handle time intelligence calculations</i></p> <p><b>Common Examples:</b></p> <ul style="list-style-type: none"><li>• DATE</li><li>• DATEDIFF</li><li>• YEARFRAC</li><li>• YEAR/MONTH</li><li>• DAY/HOUR</li><li>• TODAY/NOW</li><li>• WEEKDAY</li><li>• WEEKNUM</li><li>• NETWORKDAYS</li></ul> <p><b>Time Intelligence:</b></p> <ul style="list-style-type: none"><li>• DATESYTD</li><li>• DATESMTD</li><li>• DATEADD</li><li>• DATESBETWEEN</li></ul>	<p><i>Functions used to <b>manage &amp; modify table relationships</b></i></p> <p><b>Common Examples:</b></p> <ul style="list-style-type: none"><li>• RELATED</li><li>• RELATEDTABLE</li><li>• CROSSFILTER</li><li>• USERELATIONSHIP</li></ul>

**\*Note:** This is *NOT* a comprehensive list. DAX contains more than 250 different functions!



# BASIC MATH & STATS FUNCTIONS

SUM

Evaluates the sum of a column

=SUM(Column**Name**)

AVERAGE

Returns the average (arithmetic mean) of all the numbers in a column

=AVERAGE(Column**Name**)

MAX

Returns the largest value in a column or between two scalar expressions

=MAX(Column**NameOrScalar1**, [Scalar**2**])

MIN

Returns the smallest value in a column or between two scalar expressions

=MIN(Column**NameOrScalar1**, [Scalar**2**])

DIVIDE

Performs division and returns the alternate result (or blank) if DIV/0

=DIVIDE(Numerator, Denominator, [AlternateResult])



# COUNTING FUNCTIONS

**COUNT**

Counts the number of non-empty cells in a column  
(excluding Boolean values)

=**COUNT**(ColumnName)

**COUNTA**

Counts the number of non-empty cells in a column  
(including Boolean values)

=**COUNTA**(ColumnName)

**DISTINCTCOUNT**

Counts the number of distinct values in a column

=**DISTINCTCOUNT**(ColumnName)

**COUNTROWS**

Counts the number of rows in the specified table,  
or a table defined by an expression

=**COUNTROWS**([Table])



# ASSIGNMENT: MATH & STATS

  NEW MESSAGE

From: **Dianne A. Xu** (Senior Analyst)  
Subject: **Help with a few measures**

Hey there, excited to start working with you!  
I'll need to pull some high-level metrics from our model to share with leadership, and I could use some help with the calculations.  
For now, could you please create one measure to calculate the total number of distinct customers, and a second measure that we can use to calculate return rate (quantity returned / quantity sold)? Thank you!

-Dianne

Reply Forward

## Key Objectives

1. Create a measure named **Total Customers**, to calculate the number of distinct AdventureWorks customers who made a transaction
2. Create a measure named **Return Rate**, defined as quantity returned divided by quantity sold



# SOLUTION: MATH & STATS

 NEW MESSAGE

From: **Dianne A. Xu** (Senior Analyst)

Subject: **Help with a few measures**

Hey there, excited to start working with you!

I'll need to pull some high-level metrics from our model to share with leadership, and I could use some help with the calculations.

For now, could you please create one measure to calculate the total number of distinct customers, and a second measure that we can use to calculate return rate (quantity returned / quantity sold)? Thank you!

-Dianne

Reply Forward

## *Solution Preview*

```
1 Total Customers =  
2 DISTINCTCOUNT(  
3     'Sales Data'[Customer Key]  
4 )
```

```
1 Return Rate =  
2 DIVIDE(  
3     [Quantity Returned],  
4     [Quantity Sold],  
5     "No Sales"  
6 )
```



# BASIC LOGICAL FUNCTIONS

IF

Checks if a given condition is met and returns one value if the condition is TRUE, and another if the condition is FALSE

=**IF**(LogicalTest, ResultIfTrue, [ResultIfFalse])

IFERROR

Evaluates an expression and returns a specified value if it returns an error, otherwise returns the expression itself

=**IFERROR**(Value, ValueIfError)

SWITCH

Evaluates an expression against a list of values and returns one of multiple possible expressions

=**SWITCH**(Expression, Value1, Result1, ..., [Else])

AND

Checks whether both arguments are TRUE to return TRUE, otherwise returns FALSE

=**AND**(Logical1, Logical2)

OR

Checks whether any argument is TRUE to return TRUE, otherwise returns FALSE

=**OR**(Logical1, Logical2)

*Note: Use the **&&** and **||** operators to include more than two conditions*



# SWITCH

## SWITCH

Evaluates an expression against a list of values and returns one of multiple possible expressions

=**SWITCH**(Expression, Value1, Result1, ..., [Else])

Any **DAX expression** that returns a single scalar value, evaluated multiples times

*Examples:*

- *Calendar[Month ID]*
- *'Product Lookup'[category]*

List of **values** produced by the expression, each paired with a result to return for rows/cases that match

*Examples:*

```
=SWITCH( Calendar[Month ID],  
        1, "January",  
        2, "February" )
```

Value returned if the expression doesn't match any value argument



### PRO TIP

**SWITCH(TRUE)** is a common DAX pattern to replace multiple nested IF statements

# ASSIGNMENT: LOGICAL FUNCTIONS



  NEW MESSAGE

From: **Dianne A. Xu** (Senior Analyst)  
Subject: **Customer segmentation fields**

Hey there!

Ethan has been working with the DS team on a customer segmentation analysis, and came back to us with a few requests.

Could you please add some new columns in our customer table to identify “priority” customers, segment customers based on income level, and group some of the education categories?

I've attached the logic to use, but reach out with any questions!

-Dianne

Reply Forward

## Key Objectives

1. Create a calculated column in the Customer Lookup table named **Customer Priority**:
  - If the customer is a parent and has an annual income > \$100,000, Customer Priority = **Priority**
  - Otherwise, Customer Priority = **Standard**
2. Create a calculated column in the Customer Lookup table named **Income Level**:
  - If annual income is >= \$150,000, **Very High**
  - If annual income is >= \$100,000, **High**
  - If annual income is >= \$50,000, **Average**
  - Otherwise, Income Level = **Low**

# ASSIGNMENT: LOGICAL FUNCTIONS



 NEW MESSAGE

From: **Dianne A. Xu** (Senior Analyst)

Subject: **Customer segmentation fields**

Hey there!

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Could you please add some new columns in our customer table to identify “priority” customers, segment customers based on income level, and group some of the education categories?

I've attached the logic to use, but reach out with any questions!

-Dianne

Reply   Forward

## Key Objectives

**BONUS:** Use a SWITCH function\* to create another column named **Education Category**:

- If EducationLevel is High School or Partial High School, Education Category = **High School**
- If EducationLevel is Bachelors or Partial College, Education Category = **Undergrad**
- If EducationLevel is Graduate Degree, Education Category = **Graduate**

\*You can use the “data groups” tool to do this too!



# SOLUTION: LOGICAL FUNCTIONS

  NEW MESSAGE

From: Dianne A. Xu (Senior Analyst)  
Subject: Customer segmentation fields

Hey there!

Ethan has been working with the DS team on a customer segmentation analysis, and came back to us with a few requests.

Could you please add some new columns in our customer table to identify “priority” customers, segment customers based on income level, and group some of the education categories?

I've attached the logic to use, but reach out with any questions!

-Dianne

Reply Forward

## Solution Preview

```
1 Customer Priority =  
2 IF(  
3     'Customer Lookup'[AnnualIncome] > 100000 &&  
4     'Customer Lookup'[Is Parent?] = "Yes",  
5     "Priority",  
6     "Standard"  
7 )
```

```
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",  
5 "Low")))
```

```
1 Education Category =  
2 SWITCH('Customer Lookup'[EducationLevel],  
3 "High School", "High School",  
4 "Partial High School", "High School",  
5 "Bachelors", "Undergrad",  
6 "Partial College", "Undergrad",  
7 "Graduate Degree", "Graduate")
```



# TEXT FUNCTIONS

**LEN**

Returns the number of characters in a string

=**LEN**(Text)

**Note:** Use the & operator as a shortcut, or to combine more than two strings

**CONCATENATE**

Joins two text strings into one

=**CONCATENATE**(Text1, Text2)

**UPPER/LOWER**

Converts a string to upper or lower case

=**UPPER/LOWER** (Text)

**LEFT/RIGHT/MID**

Returns a number of characters from the start/middle/end of a text string

=**LEFT/RIGHT**(Text, [NumChars])

=**MID**(Text, StartPosition, NumChars)

**SUBSTITUTE**

Replaces an instance of existing text with new text in a string

=**SUBSTITUTE**(Text, OldText, NewText, [InstanceNumber])

**SEARCH**

Returns the position where a specified string or character is found, reading left to right

=**SEARCH**(FindText, WithinText, [StartPosition], [NotFoundValue])



# ASSIGNMENT: TEXT



 NEW MESSAGE

From: **Dianne A. Xu** (Senior Analyst)

Subject: **Couple random requests**

Good morning!

Hoping you can help with a couple quick updates to the model:

- 1) Ethan wants to make the month abbreviations ALL CAPS to make them more readable in our reports.
- 2) The product team asked us to break out the SKU category into its own field, which we can define as any characters before the first hyphen (“-”) in the ProductSKU column.

Thanks, reach out with any questions!

Reply Forward

---

## ***Key Objectives***

---

1. Update the **Month Short** column in the Calendar Lookup table to extract and capitalize the first 3 characters of the month name
2. Create a new column in the Product Lookup table named **SKU Category**, to return any number of characters before the first hyphen in the ProductSKU column



# SOLUTION: TEXT

 NEW MESSAGE

From: **Dianne A. Xu** (Senior Analyst)

Subject: **Couple random requests**

Good morning!

Hoping you can help with a couple quick updates to the model:

- 1) Ethan wants to make the month abbreviations ALL CAPS to make them more readable in our reports.
- 2) The product team asked us to break out the SKU category into its own field, which we can define as any characters before the first hyphen (“-”) in the ProductSKU column.

Thanks, reach out with any questions!

Reply Forward

## *Solution Preview*

```
1 Month Short =
2 UPPER(
3   LEFT(
4     'Calendar Lookup'[Month Name],
5     3
6   )
7 )
```

```
1 SKU Category =
2 LEFT(
3   'Product Lookup'[Product SKU],
4   SEARCH(
5     "-",
6     'Product Lookup'[Product SKU]
7   )
8   -1
9 )
```



# BASIC DATE & TIME FUNCTIONS

**TODAY/NOW**

Returns the current date or exact time

=**TODAY/NOW()**

**DAY/MONTH/YEAR**

Returns the day of the month (1-31), month of the year (1-12), or year of a given date

=**DAY/MONTH/YEAR**(Date)

**HOUR/MINUTE/SECOND**

Returns the hour (0-23), minute (0-59), or second (0-59) of a given datetime value

=**HOUR/MINUTE/SECOND**(Datetime)

**WEEKDAY/WEEKNUM**

Returns a weekday number from 1 (Sunday) to 7 (Saturday), or the week # of the year

=**WEEKDAY/WEEKNUM**(Date, [ReturnType])

**EOMONTH**

Returns the date of the last day of the month, +/- a specified number of months

=**EOMONTH**(StartDate, Months)

**DATEDIFF**

Returns the difference between two dates, based on a given interval (day, hour, year, etc.)

=**DATEDIFF**(Date1, Date2, Interval)



# ASSIGNMENT: DATE & TIME



 NEW MESSAGE

From: **Dianne A. Xu** (Senior Analyst)

Subject: **Customer birth years**

Hey there, super easy one for you.

The customer segmentation project got me wondering if there are any interesting patterns or insights based on customer age.

Could you please add a field in our customer table to extract only the year from the birthdate field?

Thanks!  
-Dianne

Reply Forward

## Key Objectives

1. Create a new column in the Customer Lookup table named **Birth Year**, to extract only the year from the BirthDate column



# SOLUTION: DATE & TIME

  NEW MESSAGE

From: **Dianne A. Xu** (Senior Analyst)  
Subject: **Customer birth years**

Hey there, super easy one for you.

The customer segmentation project got me wondering if there are any interesting patterns or insights based on customer age.

Could you please add a field in our customer table to extract only the year from the birthdate field?

Thanks!  
-Dianne

Reply Forward

## *Solution Preview*

```
1 Birth Year =  
2 YEAR(  
3     'Customer Lookup'[BirthDate]  
4 )
```



# RELATED

## RELATED()

Returns related values in each row of a table based on relationships with other tables

=RELATED(Column**Name**)

The **column** from a related table containing the values you want to retrieve

*Examples:*

- 'Product Lookup'[Product Name]
- 'Territory Lookup'[Country]



### HEY THIS IS IMPORTANT!

RELATED works like a **VLOOKUP** function in Excel – it uses the relationship between tables (*defined by primary and foreign keys*) to pull values from one table into a new column of another.

Since this function requires row context, it can only be used as a **calculated column** or as part of an **iterator function** that cycles through all rows in a table (*FILTER, SUMX, MAXX, etc.*)



### PRO TIP:

Instead of using RELATED to create extra columns (which increases file size), **nest it within measures like FILTER or SUMX**



# CALCULATE

## CALCULATE()

Evaluates an expression in a context that is modified by filters

=CALCULATE(Expression, [Filter1], [Filter2],...)

Name of an **existing measure** or a **DAX formula** for a valid measure

**Examples:**

- *[Total Orders]*
- *SUM('Returns Data'[Return Quantity])*

A Boolean (True/False) expression or a table expression that defines a filter

**Note:** these require fixed values or aggregation functions that return a scalar value (you cannot create filters based on measures)

**Examples:**

- *'Territory Lookup'[Country] = "USA"*
- *Calendar[Year] <> MAX(Calendar[Year])*



### PRO TIP:

Think of CALCULATE as a **filter modifier**; it allows you to overrule existing report filters and “force” new filter context



# EXAMPLE: CALCULATE

X ✓ 1 Red Sales = CALCULATE( [Quantity Sold], 'Product Lookup'[Product Color] = "Red" )

Here we've defined a new measure named **Red Sales**, which evaluates the **Quantity Sold** measure under a filter context where the product color is "**Red**"

Product Color	Quantity Sold	Red Sales
Black	10,590	4,011
Multi	5,756	4,011
Red	4,011	4,011
Silver	3,257	4,011
<b>Total</b>	<b>23,614</b>	<b>4,011</b>

Note how we see *the same repeated values* for each product color, and even the total!



## HEY THIS IS IMPORTANT!

The **CALCULATE** function **modifies and overrules any competing filter context!**

In this matrix, the "Black" row has competing filter context: Product Color = **Black** (from the row label) and Product Color= "**Red**" (from the CALCULATE function)

Both can't be true at the same time, so the "**Red**" filter from CALCULATE takes priority



# EXAMPLE: CALCULATE

# CALCULATE

## **Filters are modified by CALCULATE**

[Product Color] = "Red"

# STEP 1

## Filter context is detected & applied

Product Color	Quantity Sold	Red Sales
Black	10,590	4,011
Red	4,011	4,011
Silver	3,257	4,011

'Product Lookup'[**Product Color**] = "Black"



If the measure being evaluated contains a **CALCULATE** function, filter context is *overwritten* between **Step 1 & Step 2**

## STEP 2

**Filters flow “downstream”  
to related tables**



STEP 3

**Measure evaluates against the filtered table**

```
1 Quantity Sold =  
2 SUM( 'Sales Data'[Order Quantity] )
```

*Sum of the **Order Quantity** column in the **Sales Data** table, filtered to rows where the product color is “**Red**”*

$$= 4,011$$



# DAX MEASURE TOTALS

Measure totals may seem incorrect or inconsistent depending on how they are calculated, because they **don't simply add up the visible values in the report**



*Total Returns look right, but  
shouldn't Total Orders be 37,888??  
-Anonymous confused man*

Category Name	Total Returns	Total Orders
Accessories	1,115	16,983
Bikes	427	13,929
Clothing	267	6,976
<b>Total</b>	<b>1,809</b>	<b>25,164</b>

## PRO TIP:

Understand EXACTLY how your measures calculate and **what they are designed to measure**

```
1 Total Orders =  
2 DISTINCTCOUNT(  
3 | 'Sales Data'[Order Number]  
4 )
```

[Total Orders] counts **distinct orders** in the Sales Data table

Order Date	Stock Date	Order Number	Product Key
Thursday, June 30, 2022	Thursday, April 07, 2022	S074140	568
Thursday, June 30, 2022	Friday, March 04, 2022	S074140	477
Thursday, June 30, 2022	Monday, May 30, 2022	S074140	223
Thursday, June 30, 2022	Friday, April 29, 2022	S074141	604
Thursday, June 30, 2022	Wednesday, May 04, 2022	S074141	471
Thursday, June 30, 2022	Monday, May 30, 2022	S074142	383
Thursday, June 30, 2022	Friday, March 18, 2022	S074142	490
Thursday, June 30, 2022	Tuesday, March 15, 2022	S074143	479
Thursday, June 30, 2022	Friday, April 08, 2022	S074143	606
Thursday, June 30, 2022	Tuesday, March 22, 2022	S074143	477
Thursday, June 30, 2022	Thursday, June 02, 2022	S074143	462
Thursday, June 30, 2022	Monday, April 25, 2022	S074144	574
Thursday, June 30, 2022	Sunday, April 24, 2022	S074144	220
Thursday, June 30, 2022	Monday, March 14, 2022	S074145	561
Thursday, June 30, 2022	Tuesday, June 14, 2022	S074146	584
Thursday, June 30, 2022	Friday, March 18, 2022	S074147	605
Thursday, June 30, 2022	Sunday, May 29, 2022	S074147	538
Thursday, June 30, 2022	Thursday, March 24, 2022	S074147	490

Order **S074144** included **two products**: a bike and a helmet.

That counts as **1** distinct order for the Total and **1** distinct order for BOTH **Accessories & Bikes**

With no filter context, there are **25,164** total distinct orders



# ASSIGNMENT: CALCULATE



**NEW MESSAGE**

From: **Dianne A. Xu** (Senior Analyst)

Subject: **URGENT: Bike returns**

Hey there,

Apparently George (our Product VP) has been speaking with some of the store managers, and they've raised concerns about the number of bike returns they are seeing recently.

Can you please create a measure to calculate total returns for bikes specifically, and let me know what you see? Volume alone won't tell the full story, so let's calculate the return *rate* for bikes as well, and see how it's trending before responding to George.

Need this ASAP – thank you!

**Reply**    **Forward**

## Key Objectives

1. Create a new measure named **Bike Returns** to calculate the total quantity of bikes returned
2. Create a matrix to show **Bike Returns** (values) by **Start of Month** (rows). What do you notice about the volume of bike returns over time?
3. Create a new measure named **Bike Sales** to calculate the total quantity of bikes sold, and add it to the matrix. What do you notice?
4. Create a new measure named **Bike Return Rate** using either CALCULATE or DIVIDE, and add it to the matrix
5. How would you respond to the Product VP's concerns about rising bike returns?



# SOLUTION: CALCULATE

  NEW MESSAGE

From: **Dianne A. Xu** (Senior Analyst)  
Subject: **URGENT: Bike returns**

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Can you please create a measure to calculate total returns for bikes specifically, and let me know what you see? Volume alone won't tell the full story, so let's calculate the return *rate* for bikes as well, and see how it's trending before responding to George.

Need this ASAP – thank you!

Reply Forward

## *Solution Preview*

```
1 Bike Returns =  
2 CALCULATE(  
3     [Total Returns],  
4     'Product Categories Lookup'[Category Name] = "Bikes"  
5 )
```

```
1 Bike Sales =  
2 CALCULATE(  
3     [Quantity Sold],  
4     'Product Categories Lookup'[Category Name] = "Bikes"  
5 )
```

```
1 Bike Return Rate =  
2 CALCULATE(  
3     [Return Rate],  
4     'Product Categories Lookup'[Category Name] = "Bikes"  
5 )
```

*(Solution continued on next slide)*



# SOLUTION: CALCULATE

  NEW MESSAGE

From: **Dianne A. Xu** (Senior Analyst)

Subject: **URGENT: Bike returns**

Hey there,

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Need this ASAP – thank you!

Reply Forward

## Solution Preview

6/1/2021	8	312	2.564%
7/1/2021	12	506	2.372%
8/1/2021	14	485	2.887%
9/1/2021	22	575	3.826%
10/1/2021	26	612	4.248%
11/1/2021	25	688	3.634%
12/1/2021	26	1038	2.505%
1/1/2022	14	766	1.828%
2/1/2022	22	806	2.730%
3/1/2022	27	888	3.041%
4/1/2022	38	956	3.975%
5/1/2022	36	1116	3.226%
6/1/2022	34	1157	2.939%
<b>Total</b>	<b>429</b>	<b>13929</b>	<b>3.080%</b>

The volume of bike returns has risen over time, but so has the number of bikes being sold.

When we look at the rate of returns as a percent of sales, we don't see a concerning trend.



# ALL

ALL

Returns all rows in a table, or all values in a column, ignoring any filters that have been applied

=**ALL**(Table or Column, [Column2], [Column3],...)

The **table** or **column** that you want to clear filters on

**Examples:**

- *Transactions*
- *Products[Category]*

**Additional columns** that you want to clear filters on (optional)

- Cannot specify columns if your first parameter is a **table**
- All columns must include the **table name** and come from the **same table**

**Examples:**

- *'Customer Lookup'[City], 'Customer Lookup'[Country]*
- *Products[Product Name]*

## PRO TIP:



Instead of adding filter context, **the ALL function removes it**. This is often used in “**% of Total**” calculations, when the denominator needs to remain fixed regardless of filter context.



# ASSIGNMENT: CALCULATE & ALL

  NEW MESSAGE

From: Dianne A. Xu (Senior Analyst)

Subject: Return analysis follow-up

Hey again,

Thanks for the quick turnaround on that bike return analysis – crisis averted!

That got me thinking about how we could start analyzing the return data in our reports. Could you please help me create two new measures, one to calculate ALL returns (regardless of filter context), and another that divides Total Returns by All Returns?

That should allow us to see the % of returns by different products and product categories.

Reply Forward

## Key Objectives

1. Create a new measure named **All Returns** to calculate the total number of returns, regardless of filter context
2. Create a new measure named **% of All Returns** that divides Total Returns by All Returns
3. Create a matrix to show % of All Returns (values) by product Category Name (rows). Which category accounts for the largest percentage of returns? The smallest?



# SOLUTION: CALCULATE & ALL

 NEW MESSAGE

From: Dianne A. Xu (Senior Analyst)

Subject: Return analysis follow-up

Hey again,

Thanks for the quick turnaround on that bike return analysis – crisis averted!

That got me thinking about how we could start analyzing the return data in our reports. Could you please help me create two new measures, one to calculate ALL returns (regardless of filter context), and another that divides Total Returns by All Returns?

That should allow us to see the % of returns by different products and product categories.

Reply    Forward

## Solution Preview

```
1 All Returns =  
2 CALCULATE(  
3     [Total Returns],  
4     ALL(  
5         'Returns Data'  
6     ))  
7 )
```

```
1 % of All Returns =  
2 DIVIDE(  
3     [Total Returns],  
4     [All Returns]  
5 )
```

Category Name	% of All Returns
Bikes	23.60%
Clothing	14.76%
Accessories	61.64%
<b>Total</b>	<b>100.00%</b>



# FILTER

## FILTER

Returns a table that represents a subset of another table or expression

=**FILTER**(Table, FilterExpression)

Table to be filtered

Examples:

- Territory Lookup
- Customer Lookup

A Boolean (True/False) filter expression to be evaluated for each row of the table

Examples:

- 'Territory Lookup'[Country] = "USA"
- Calendar[Year] = 1998
- Products[Price] > [Overall Avg Price]

### HEY THIS IS IMPORTANT!

FILTER is used to add new filter context, and can handle **more complex filter expressions** than CALCULATE (by referencing measures, for example)

Since FILTER returns an entire table, it's often **nested within other functions**, like CALCULATE or SUMX



### PRO TIP:



Since FILTER **iterates through each row in a table**, it can be slow and computationally expensive; only use FILTER if a simple CALCULATE function won't get the job done!



# ITERATOR FUNCTIONS

**Iterator** (or “X”) **functions** allow you to loop through the same expression on each row of a table, then apply some sort of aggregation to the results (SUM, MAX, etc.)

=**SUMX**(Table, Expression)

Aggregation to apply to calculated rows\*

Table in which the expression will be evaluated

Expression to be evaluated for each row of the given table

**Examples:**

- SUMX
- COUNTX
- AVERAGEX
- RANKX
- MAXX/MINX

**Examples:**

- Sales
- FILTER(Sales,  
RELATED(Products[Category])="Clothing")

**Examples:**

- [Total Orders]
- Sales[Retail Price] \* Sales[Quantity]



## PRO TIP:

Imagine that iterator functions **add a temporary new column** to a table, calculate a value in each row based on the given expression, then aggregate the values within that temporary column (similar to **SUMPRODUCT** in Excel)

\*In this example we're looking at **SUMX**, but other iterator functions follow a similar syntax



# ASSIGNMENT: ITERATORS

 NEW MESSAGE

From: **Dianne A. Xu** (Senior Analyst)

Subject: **Profit calculation – HELP!**

Hey,

Ethan asked for a quick analysis of company profit over the past few years, but I'm struggling with the calculation.

We need a measure that multiplies order quantity by product cost, but I'd like to do it without adding redundant columns to our Sales table.

Could you take a stab at this please?

-Dianne

Reply Forward

## Key Objectives

1. Create a new measure named **Total Cost** that multiplies the order quantities in the Sales Data table by the product cost in the Product Lookup table, then calculates the sum
2. Create a new measure named **Total Profit** (revenue minus cost)
3. Create a matrix to show Total Profit (values) by Year (rows). How much profit has AdventureWorks earned so far in 2022?



# SOLUTION: ITERATORS

 NEW MESSAGE

From: **Dianne A. Xu** (Senior Analyst)

Subject: **Profit calculation – HELP!**

Hey,

Ethan asked for a quick analysis of company profit over the past few years, but I'm struggling with the calculation.

We need a measure that multiplies order quantity by product cost, but I'd like to do it without adding redundant columns to our Sales table.

Could you take a stab at this please?

-Dianne

**Reply** **Forward**

## Solution Preview

```
1 Total Cost =  
2 SUMX(  
3     'Sales Data',  
4     'Sales Data'[Order Quantity]  
5     *  
6     RELATED(  
7         'Product Lookup'[Product Cost]  
8     )  
9 )
```

```
1 Total Profit =  
2 [Total Revenue] - [Total Cost]
```

Year	Total Profit
2020	\$2,601,606
2021	\$3,967,023
2022	\$3,888,952
<b>Total</b>	<b>\$10,457,581</b>



# TIME INTELLIGENCE

**Time Intelligence** patterns are used to calculate common date-based comparisons

Performance  
To-Date

=**CALCULATE**(Measure, **DATESYTD**(Calendar[Date]))

Use **DATESYTD** for Years, **DATESQTD** for Quarters, **DATESMTD** for Months

Previous  
Period

=**CALCULATE**(Measure, **DATEADD**(Calendar[Date], -1, **MONTH**))

Select an interval (**DAY**, **MONTH**, **QUARTER**, or **YEAR**) and the  
# of intervals to compare (e.g. previous month, rolling 10-day)

Running  
Total

=**CALCULATE**(Measure,  
**DATESINPERIOD**(Calendar[Date], **MAX**(Calendar[Date]), -10, **DAY**))



## PRO TIP:

To calculate a **moving average**, use the running total calculation above and **divide by the number of intervals**

# ASSIGNMENT: TIME INTELLIGENCE



  NEW MESSAGE

From: Dianne A. Xu (Senior Analyst)  
Subject: Time Intelligence Measures

Hey there, need a big favor!  
The leadership team has been asking a lot of questions about month-over-month and year-over-year comparisons, and I've been pulling the numbers pretty manually.  
Could you please add the following list of measures, to make these metrics easier to track and share with stakeholders?  
Thank you!  
-Dianne

Reply Forward

## Key Objectives

Add the following measures to the model:

1. **Previous Month Returns**
2. **Previous Month Orders**
3. **Previous Month Profit**
4. **Order Target** (10% increase over previous month)
5. **Profit Target** (10% increase over previous month)
6. **90-day Rolling Profit**



# SOLUTION: TIME INTELLIGENCE

 NEW MESSAGE

From: **Dianne A. Xu** (Senior Analyst)

Subject: **Time Intelligence Measures**

Hey there, need a big favor!

The leadership team has been asking a lot of questions about month-over-month and year-over-year comparisons, and I've been pulling the numbers pretty manually.

Could you please add the following list of measures, to make these metrics easier to track and share with stakeholders?

Thank you!

-Dianne

**Reply** **Forward**

## *Solution Preview*

```
1 Previous Month Orders =  
2 CALCULATE(  
3     [Total Orders],  
4     DATEADD(  
5         'Calendar Lookup'[Date],  
6         -1,  
7         MONTH  
8     )  
9 )
```

```
1 90-day Rolling Profit =  
2 CALCULATE(  
3     [Total Profit],  
4     DATESINPERIOD(  
5         'Calendar Lookup'[Date],  
6         LASTDATE(  
7             'Calendar Lookup'[Date]  
8         ),  
9         -90,  
10        DAY  
11    )  
12 )
```

```
1 Order Target =  
2 [Previous Month Orders] * 1.1
```



# DAX BEST PRACTICES



## Know when to use calculated columns vs. measures

- *Use calculated columns for filtering, and measures for aggregating values*



## Use explicit measures, even for simple calculations

- *Explicit measures can be referenced anywhere, and nested within other measures*



## Use fully-qualified column references in measures

- *This makes your DAX more readable, and differentiates column references from measure references*



## Move column calculations “upstream” when possible

- *Adding calculated columns at the source or in Power Query improves report speed and efficiency*



## Minimize the use of “expensive” iterator functions

- *Use iterators with caution, especially if you are working with large tables or complex models*

# VISUALIZING DATA

# VISUALIZING DATA



In this section we'll **build dynamic interactive reports**, introduce visualization best practices, and explore features like bookmarks, drillthrough filters, parameters, tooltips, and more

## TOPICS WE'LL COVER:

Data Viz Best Practices

Formatting & Filtering

Bookmarks

Report Interactions

User Roles

Parameters

Custom Tooltips

Mobile Layouts

## GOALS FOR THIS SECTION:

- Review frameworks and best practices for visualizing data and designing effective reports and dashboards
- Explore tools and techniques for inserting, formatting and filtering visuals in the Power BI Report view
- Add interactivity using tools like bookmarks, slicer panels, parameters, tooltips, and report navigation
- Learn how to configure row-level security with user roles
- Optimize reports for mobile viewing using custom layouts



# THREE KEY QUESTIONS

---

**1**

What **TYPE OF DATA** are you working with?

- Geospatial? Time-series? Hierarchical? Financial?
- 

**2**

What do you want to **COMMUNICATE**?

- Comparison? Composition? Relationship? Distribution?
- 

**3**

Who is the **END USER** and what do they need?

- Analyst? Manager? Executive? General public?



# THREE KEY QUESTIONS

## 1 What **TYPE OF DATA** are you working with?

 Time-series

 Financial

 Geospatial

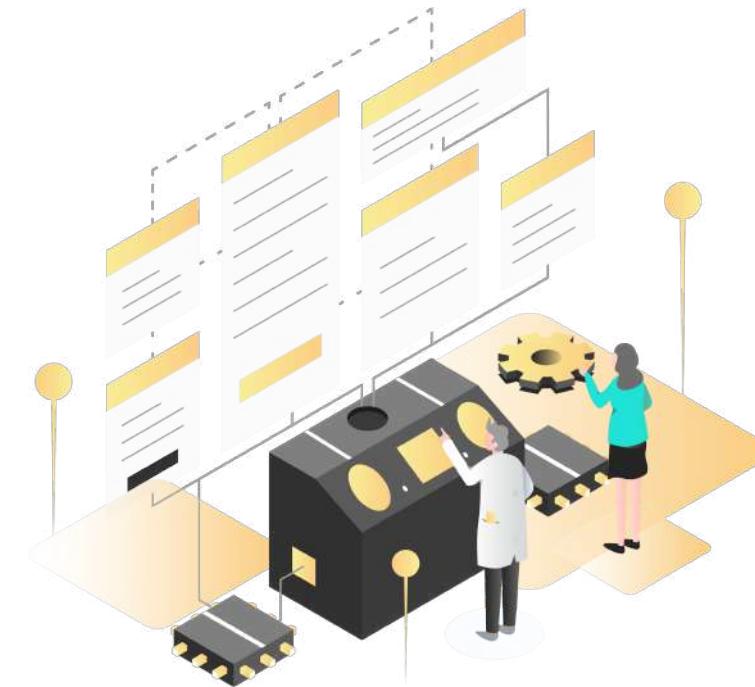
 Textual

 Categorical

 Funnel

 Hierarchical

 Survey

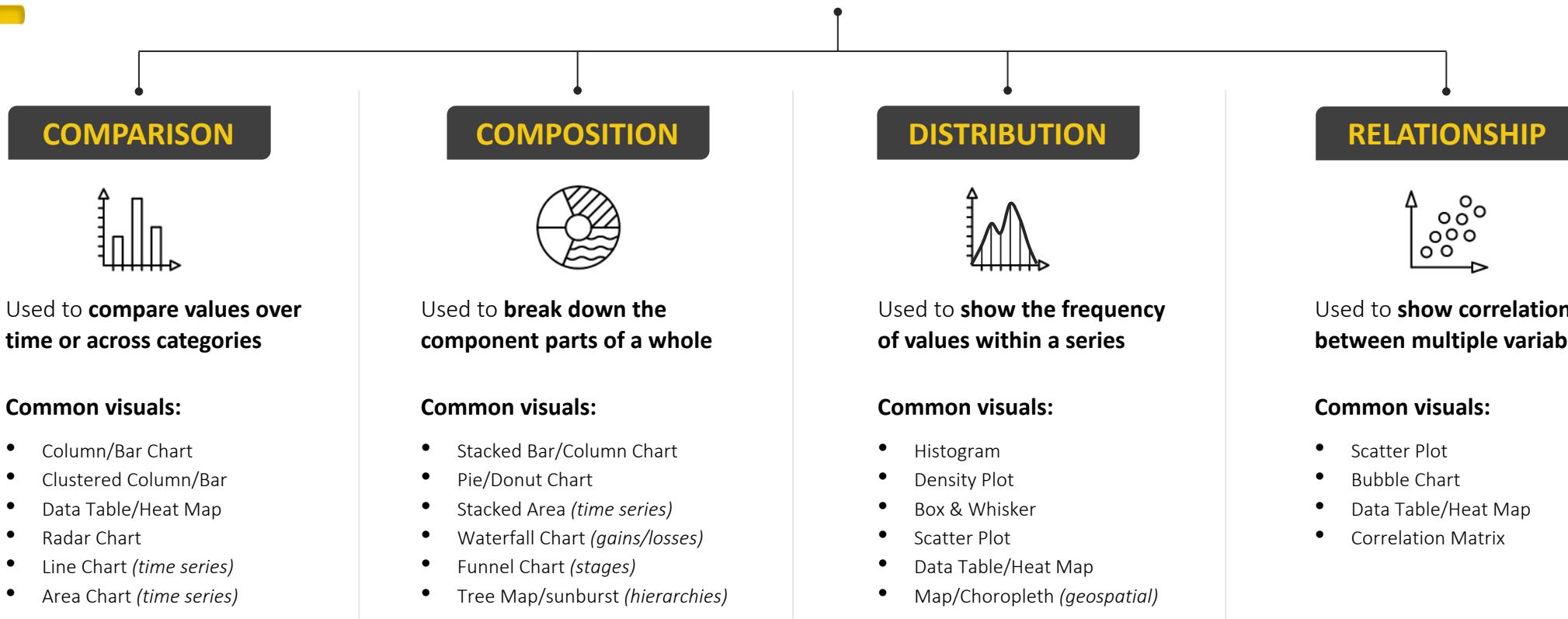


The type of data you're working with often determines **which type of visual will best represent it**; for example, using maps to represent geospatial data, line charts for time-series data, or tree maps for hierarchical data



# THREE KEY QUESTIONS

## 2 What do you want to **COMMUNICATE?**



**Keep it simple!** While there are *hundreds* of charts to choose from, basic options like bars and columns, line charts, histograms and scatterplots often tell the simplest and clearest story



# THREE KEY QUESTIONS

## 3 Who is the **END USER** and what do they need?

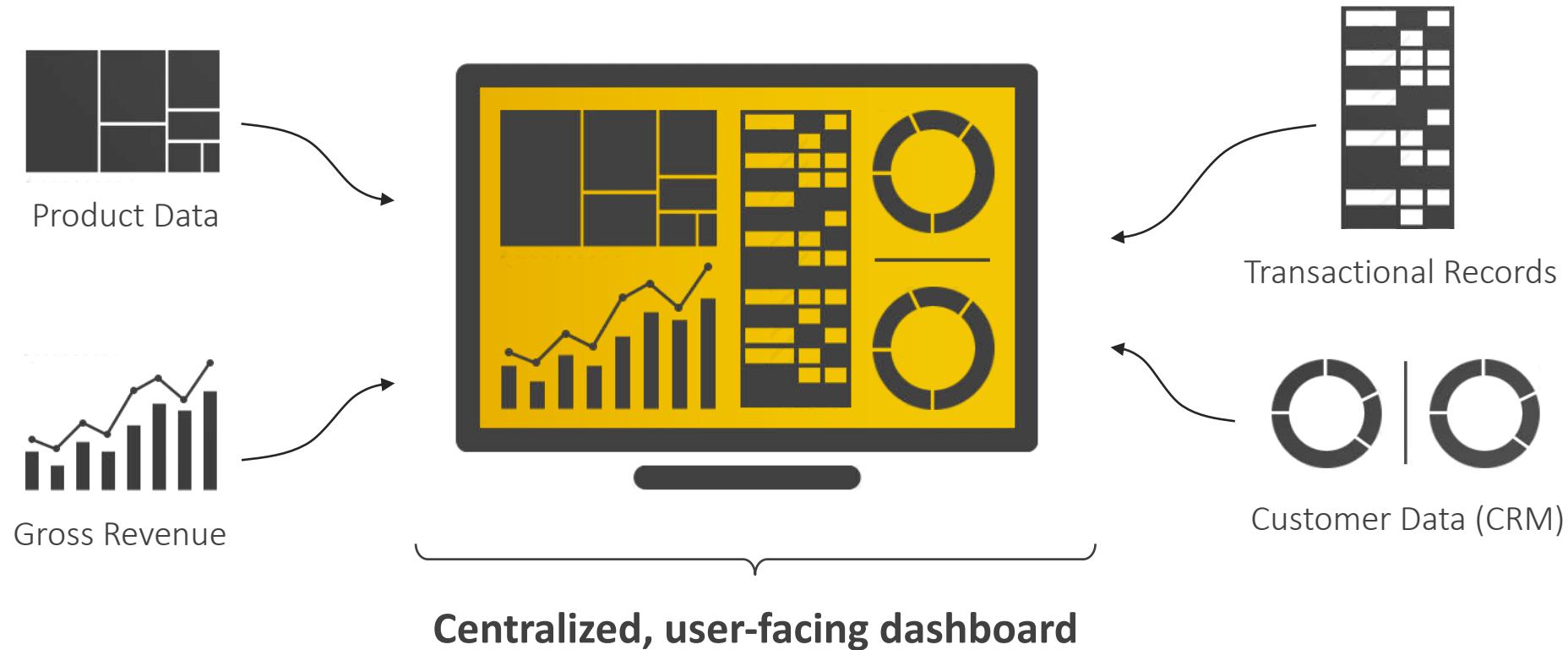


How you visualize and present your data is a function of **who will be consuming it**; a fellow analyst may want to see granular details, while managers and executives often prefer topline KPIs and clear, data-driven insights



# ANALYTICS DASHBOARDS

**Dashboards** are analytics tools designed to consolidate data from multiple sources, track key metrics at a glance, and facilitate data-driven storytelling and decision making



# DASHBOARD DESIGN FRAMEWORK



- 1 Define the purpose
- 2 Choose the right metrics
- 3 Present the data effectively
- 4 Eliminate clutter & noise
- 5 Use layout to focus attention
- 6 Tell a clear story

A well-designed dashboard should **serve a distinct purpose for a distinct audience**, use **clear and effective metrics and visuals**, and provide a simple, intuitive user experience.



## Key questions to consider:

- Who are the **end-users** of your dashboard?
- What are their **key business goals** and objectives?
- What are the **most important questions** they need answers to?
- How can I present information **as clearly as possible**?

**“Perfection is achieved not when there is nothing more to add, but when there is nothing left to take away”**

Antoine de Saint-Exupery



# THE REPORT VIEW

**Report View**

**Report Canvas**

**Insert Menu (Add pages, visuals, buttons, shapes, images, etc.)**

**Report Pages (each tab is a blank report canvas)**

**Panes (Data, Format, Bookmarks, Selection)**

**Filter Pane (Page-level, report-level, visual-level filters)**

**View Options (Zoom, fit to page)**

The screenshot illustrates the Microsoft Power BI Report View interface. The main area displays a dashboard with various visualizations, including a line chart showing weekly revenue from January 2020 to January 2022, and several summary tiles for Revenue (\$24.9M), Profit (\$10.5M), Orders (25.2K), and Return Rate (2.2%). The left sidebar contains a navigation menu with tabs like Exec Dashboard, Map, Product Detail, Customer Detail, Category Tooltip, AI: Q&A, AI: Decomposition Tree, and AI: Key Influencers. Below the sidebar is a navigation bar with tabs for Page 1 of 8, Exec Dashboard, Map, Product Detail, Customer Detail, Category Tooltip, AI: Q&A, AI: Decomposition Tree, AI: Key Influencers, and a plus sign. The top ribbon has the Insert tab selected, with a callout pointing to the 'Insert' menu. A large orange box highlights the central report canvas area. To the right, a pane is open showing filters and a filter pane. At the bottom, there's a navigation bar with tabs and a zoom control.

**Report Pages (each tab is a blank report canvas)**

**View Options (Zoom, fit to page)**

**Report View**

**Report Canvas**

**Insert Menu (Add pages, visuals, buttons, shapes, images, etc.)**

**Report Pages (each tab is a blank report canvas)**

**Panes (Data, Format, Bookmarks, Selection)**

**Filter Pane (Page-level, report-level, visual-level filters)**

**View Options (Zoom, fit to page)**



# ASSIGNMENT: CARDS



**NEW MESSAGE**

From: **Victor Ignatius Zabel (BI Analyst)**

Subject: **Let's get visual!**

Hey there!

We've kicked off the visualization work for our Power BI dashboard, and I'm hoping you can help.

For now I'd love for you to focus on building out the **Customer Detail** report. Can you start by adding some KPIs to show total customers and revenue per customer?

-Vic

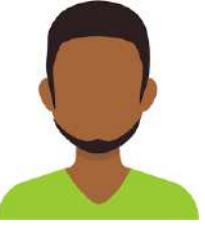
**Reply**    **Forward**

## Key Objectives

1. Insert a **card** in the **Customer Detail** report page to show **Total Customers**, and rename the field "UNIQUE CUSTOMERS"
2. Add a background shape and match the formatting of the cards in the **Exec Dashboard** tab
3. Copy and paste to create a second card showing **Average Revenue per Customer**, and rename the field "REVENUE PER CUSTOMER"



# SOLUTION: CARDS

  NEW MESSAGE

From: **Victor Ignatius Zabel** (BI Analyst)  
Subject: Let's get visual!

Hey there!  
We've kicked off the visualization work for our Power BI dashboard, and I'm hoping you can help.  
For now I'd love for you to focus on building out the **Customer Detail** report. Can you start by adding some KPIs to show total customers and revenue per customer?

-Vic

Reply Forward

## *Solution Preview*





# BUILDING & FORMATTING CHARTS

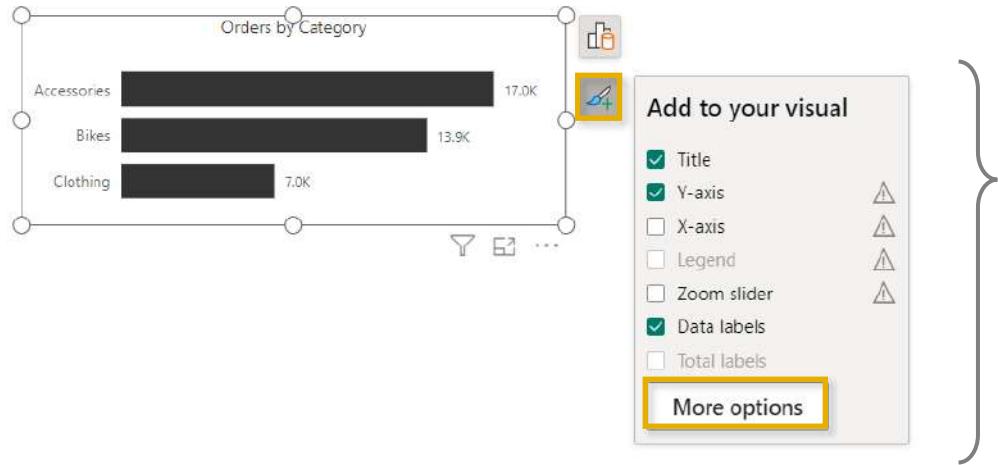
The screenshot shows the Power BI interface with a bar chart titled "Orders by Category". The chart displays three categories: Accessories (17.0K), Bikes (13.9K), and Clothing (7.0K). To the right of the chart is the "Build a visual" contextual menu. This menu includes sections for "Visual types" (with a "Suggest a type" button), "Y-axis" (set to "Category Name"), "X-axis" (set to "Total Orders"), "Legend" (with a "+Add data" button), "Small multiples" (with a "+Add data" button), and "Tooltips" (set to "Total Revenue"). A yellow arrow points from the "Select data" pane on the left to the "+Add data" button in the X-axis section of the menu. The "Select data" pane lists various data sources such as Measure Table, Calendar Lookup, and Sales Data.

The **Build** menu allows you to change the visual type, auto-suggest visuals, and add data to customize chart components (*x-axis, y-axis, legend, tooltips, etc.*)

- This is a **contextual menu**, so you will only see options which are relevant to the selected visual
- You can build visuals by either inserting a specific chart type and adding data, or by dragging a field from the Data pane onto the canvas

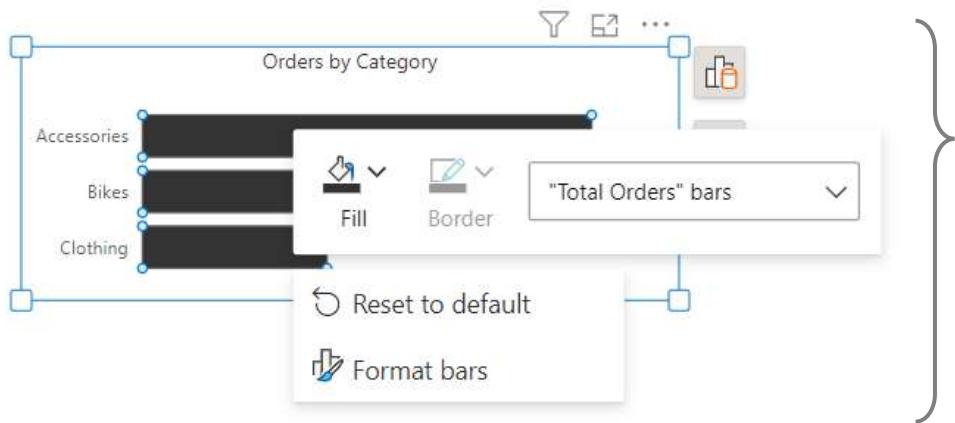


# BUILDING & FORMATTING CHARTS



The **Format** menu allows you to quickly add common chart elements (*title, axis labels, data labels, legends, etc.*) and access additional options and properties in the Format pane

- This is a **contextual menu**, so you will only see options which are relevant to the selected visual

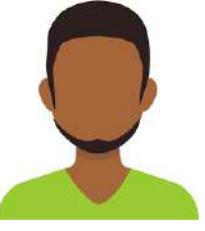


Enable **on-object formatting** by double-clicking the chart object (or right-click > format), which allows you to select and edit individual chart elements

- On-object formatting is only available for certain visuals (bar, column, line, area, combo & scatter)



# ASSIGNMENT: LINE CHARTS

  NEW MESSAGE

From: **Victor Ignatius Zabel** (BI Analyst)

Subject: **Customer count by week**

Nice work on those cards!

Next up let's add a weekly line chart to show how our customer base is trending over time.

Please add a zoom bar to make it interactive, and format the tooltips to match the line chart in the Exec Dashboard.

Thanks!

-Vic

[Reply](#) [Forward](#)

## Key Objectives

1. Add a **line chart** to the **Customer Detail** report showing **Total Customers** by week
2. Add a **trend line** and a **zoom slider** to the x-axis
3. Enable **tooltips**, and format to match line chart in the **Exec Dashboard** tab



# SOLUTION: LINE CHARTS

  NEW MESSAGE

From: **Victor Ignatius Zabel (BI Analyst)**

Subject: **Customer count by week**

Nice work on those cards!

Next up let's add a weekly line chart to show how our customer base is trending over time.

Please add a zoom bar to make it interactive, and format the tooltips to match the line chart in the Exec Dashboard.

Thanks!

-Vic

Reply Forward

## *Solution Preview*





# FILTERING OPTIONS

The Filters pane in Power BI is shown on the left. It has three main sections: "Filters on this visual", "Filters on this page", and "Filters on all pages". Each section contains a search bar and an "Add data fields here" button. The entire pane is highlighted with a yellow border.

There are **3 types of filters** accessible from the **Filters** pane\*:

1. **Visual-level** filters apply to specific visuals
2. **Page-level** filters apply to all visuals on the report page
3. **Report-level** filters apply to all visuals across all report pages

*\*Drillthrough filters can be configured in the page formatting pane – more on that later!*

Basic Options

Filter type: Basic filtering

Search:

Select all

Accessories: 1

Bikes: 1

Clothing: 1

Components: 1

Top N Options

Filter type: Top N

Show items: Top  2

By value:

Apply filter

Advanced (Values)

Show items when the value

Advanced (Text)

Filter type: Advanced filtering

Show items when the value

Filters can be configured using basic **selections**, **logical operators**, or **Top N** conditions



# ASSIGNMENT: DONUT CHARTS



**NEW MESSAGE**

From: **Victor Ignatius Zabel** (BI Analyst)

Subject: **Customer demographics**

Good morning!

Just got a note from Ethan to see if we can build some demographic info into the customer report.

Let's add a couple donut charts to show the composition of customers by income level and occupation. We'll want to limit to just a few segments (maybe 3?) and do some formatting to match the rest of the dashboard.

Thanks, you rock!

-Vic

**Reply**    **Forward**

## Key Objectives

1. Add a **donut chart** to the **Customer Detail** report showing **Total Orders** by **Income Level**
2. Add a **chart title**, turn off the **legend**, and update the **data labels** to show the category and value (font size 8, 1 decimal place)
3. Update the colors of the slices to match the screenshot in the solution preview
4. Add a **visual-level filter** to exclude customers with a "Very High" income level
5. Copy the chart to show **Total Orders** by **Occupation**, and add a **visual-level filter** to display the three occupations with the most orders (*bonus points if you use a Top N filter!*)



# SOLUTION: DONUT CHARTS

  NEW MESSAGE

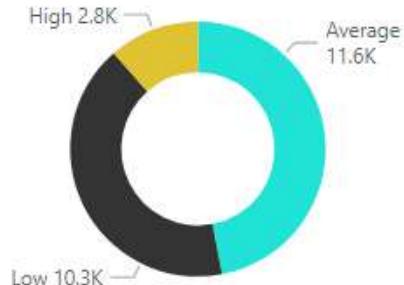
From: **Victor Ignatius Zabel** (BI Analyst)  
Subject: Customer demographics

Good morning!  
Just got a note from Ethan to see if we can build some demographic info into the customer report.  
Let's add a couple donut charts to show the composition of customers by income level and occupation. We'll want to limit to just a few segments (maybe 3?) and do some formatting to match the rest of the dashboard.  
Thanks, you rock!  
-Vic

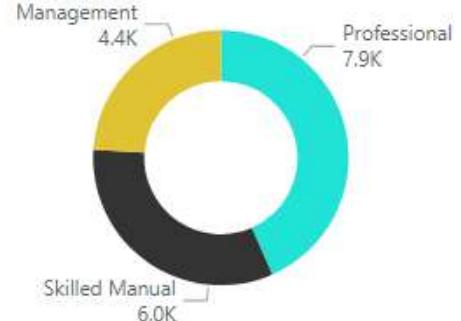
[Reply](#) [Forward](#)

## Solution Preview

Orders by Income Level



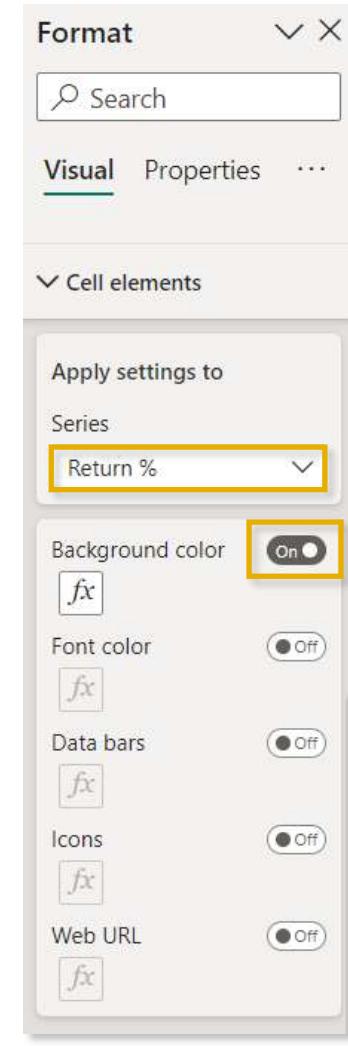
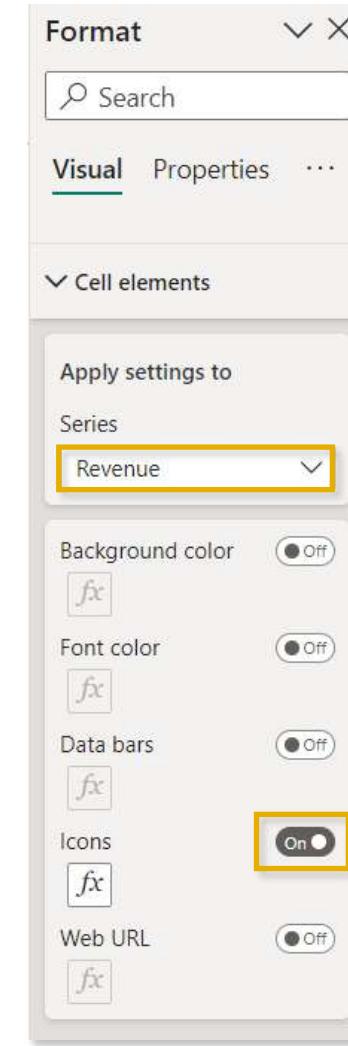
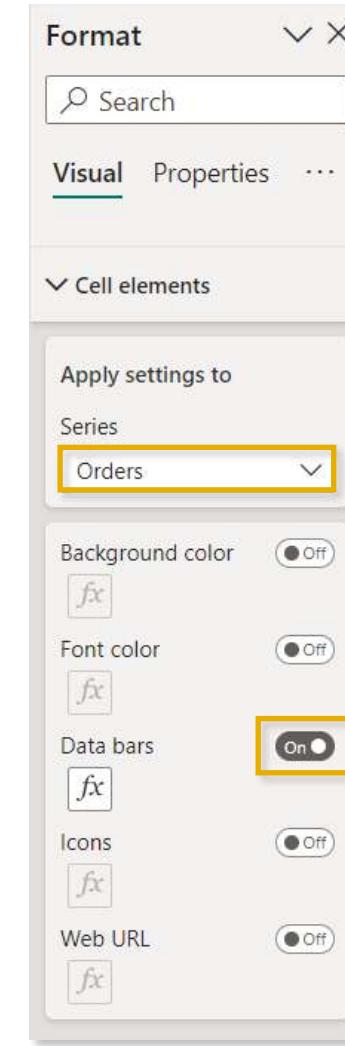
Orders by Occupation





# CONDITIONAL FORMATTING

Top 10 Products	Orders	Revenue	Return %
Water Bottle - 30 oz.	3,983	\$39,755	1.95%
Patch Kit/8 Patches	2,952	\$13,506	1.61%
Mountain Tire Tube	2,846	\$28,333	1.64%
Road Tire Tube	2,173	\$17,265	1.55%
Sport-100 Helmet, Red	2,099	\$73,444	3.33%
AWC Logo Cap	2,062	\$35,865	1.11%
Sport-100 Helmet, Blue	1,995	\$67,112	3.31%
Fender Set - Mountain	1,975	\$87,041	1.36%
Sport-100 Helmet, Black	1,940	\$65,262	2.68%
Mountain Bottle Cage	1,896	\$38,062	2.02%



**Conditional formatting** allows you to dynamically format Table or Matrix visuals based on cell values

- Conditionally formatting options can be found in the **Format** pane, under **Cell elements**
- Options include background color, font color, data bars, icons, or Web URL



# ASSIGNMENT: TABLES



**NEW MESSAGE**

From: **Victor Ignatius Zabel** (BI Analyst)

Subject: **Top customer table**

Hey there, this customer report is really coming together! Since the management team needs a way to identify high-value customers, let's add a table to our report showing customer keys, full names, orders, and revenue. Probably makes sense to add some conditional formatting and limit to the top 100 customers for now.

Thanks!

-Vic

**Reply**    **Forward**

## Key Objectives

1. Add a **table** to the **Customer Detail** report to show **Customer Key**, **Full Name**, **Total Orders** (as “Orders”) and **Total Revenue** (as “Revenue”)
2. Use conditional formatting to add light gray **data bars** to the orders column and a white > blue **color scale** to the revenue column
3. Add a **visual-level filter (Top N)** to show the 100 customers with the most orders, and add a **chart title** (“Top 100 Customers”)
4. **Sort** the table descending by orders



# SOLUTION: TABLES

  NEW MESSAGE

From: **Victor Ignatius Zabel (BI Analyst)**

Subject: **Top customer table**

Hey there, this customer report is really coming together!

Since the management team needs a way to identify high-value customers, let's add a table to our report showing customer keys, full names, orders, and revenue.

Probably makes sense to add some conditional formatting and limit to the top 100 customers for now.

Thanks!

-Vic

Reply Forward

## *Solution Preview*

Top 100 Customers			
Customer Key	Full Name	Orders	Revenue
11091	Mr. Dalton Perez	26	\$1,513
11223	Mrs. Hailey Patterson	26	\$1,616
11300	Mr. Fernando Barnes	26	\$1,839
11330	Mr. Ryan Thompson	26	\$1,597
11331	Mrs. Samantha Jenkins	26	\$1,740
11185	Mrs. Ashley Henderson	25	\$1,717
11200	Mr. Jason Griffin	25	\$1,614
11176	Mr. Mason Roberts	24	\$1,526
11262	Mrs. Jennifer Simmons	24	\$1,465
11277	Mr. Charles Jackson	24	\$1,777
11287	Mr. Henry Garcia	24	\$1,443
11566	Ms. April Shan	24	\$1,424
11711	Mr. Daniel Davis	24	\$1,404
11276	Mrs. Nancy Chapman	23	\$1,111
11203	Mr. Luis Diaz	17	\$1,002
11215	Mrs. Ana Perry	17	\$1,336
11078	Ms. Gina Martin	16	\$991
Total		1,272	\$615,328



# ASSIGNMENT: TOP N TEXT CARDS



**NEW MESSAGE**

From: **Victor Ignatius Zabel (BI Analyst)**

Subject: **Top customers by revenue**

Hey,

Ethan is loving the customer report so far – great job!

He mentioned that he'd like to highlight top customers based on *revenue* as well, so I'm thinking we could add some text cards to show the top customer name, along with total revenue and the number of orders placed.

We'll be offering some coupons based on how much customers have spent in the past, so accuracy is critical here!

-Vic

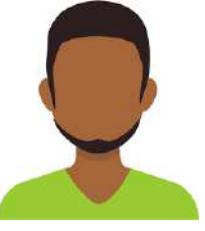
**Reply**    **Forward**

## Key Objectives

1. Add a **card** to the **Customer Detail** report to show **Full Name**
2. Add a **visual-level filter (Top N)** to show the top customer (Full Name) in terms of **Total Revenue**
  - What do you notice when you filter the report for low income customers?  
*(Hint: check your value against the table)*
  - How could you modify the Top N filter to correct this?
3. Copy and paste the card (x2) to show **Total Orders** and **Total Revenue** for the top customer
4. Add **text boxes** for titles and adjust formatting to match the solution preview



# SOLUTION: TOP N TEXT CARDS

 NEW MESSAGE

From: **Victor Ignatius Zabel** (BI Analyst)

Subject: **Top customers by revenue**

Hey,

Ethan is loving the customer report so far – great job!

He mentioned that he'd like to highlight top customers based on *revenue* as well, so I'm thinking we could add some text cards to show the top customer name, along with total revenue and the number of orders placed.

We'll be offering some coupons based on how much customers have spent in the past, so accuracy is critical here!

-Vic

Reply Forward

## *Solution Preview*

Top Customer (by revenue):

**Mr. Maurice Shan**

Orders:

**6**

Revenue:

**\$12.4K**

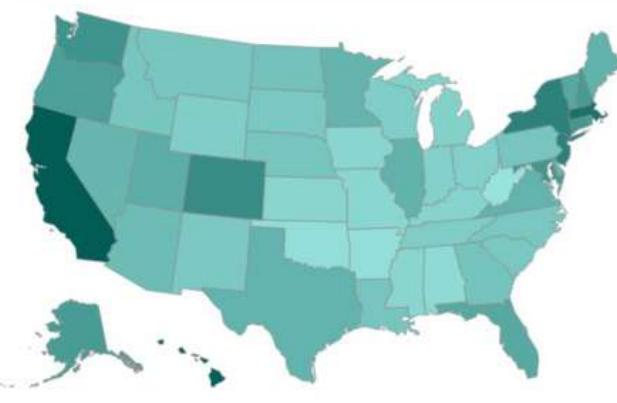


# MAP VISUALS

## Map



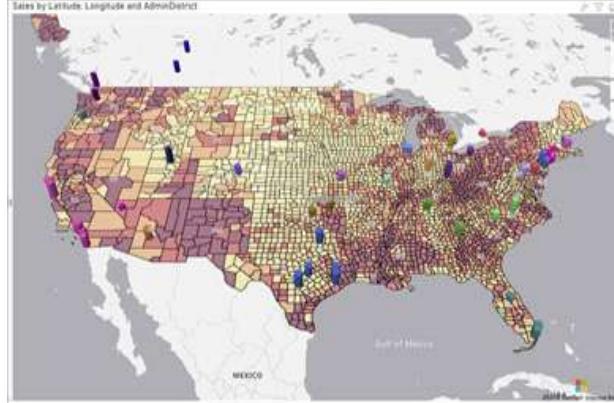
## Shape map



## Filled map



## Azure map



Power BI includes several types of **map visuals** powered by Bing Maps

Tips for creating accurate maps:

1. Assign **categories** to geospatial fields
2. Add **multiple location** fields
3. Use **latitude/longitude** when possible



### HEY THIS IS IMPORTANT!

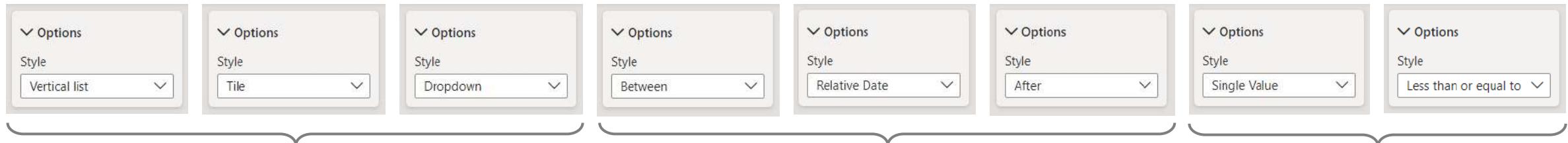
An administrator may need to **enable maps in your tenant settings** in order to use them in Power BI Service



# SLICERS

**Slicers** are visual filters which affect all other visuals on a report page (by default)

- Slicers can take many formats depending on the data type, including **lists**, **dropdowns**, **tiles**, **ranges**, and more



**Categorical/Text options**

IncomeLevel

- Average
- High
- Low
- Very High

Continent, Country, Region

- Europe
  - France
  - Germany
  - United Kingdom
- North America
- Pacific

**Date/Time options**

Date

1/1/2020 6/30/2022

Last 11 Months

3/18/2022 - 2/17/2023

Date

1/1/2020 6/30/2022

**Numeric Range options**

Price Adjustment (%)

0.20

Price Adjustment (%)

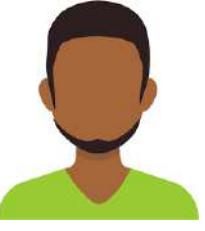
-1.00 0.50

**PRO TIP:**  
Use **Apply/Clear All Slicers** buttons for more filtering control





# ASSIGNMENT: SLICERS



## NEW MESSAGE

From: **Victor Ignatius Zabel** (BI Analyst)

Subject: **Year slicer for customer report**

Hey there, quick request when you get a sec...  
Could you please add a slicer to the customer report, so that users can filter the entire page by year?  
No preference for which specific type of slicer you use, as long as managers can filter customers for a specific year or across multiple years.  
Thanks!  
-Vic

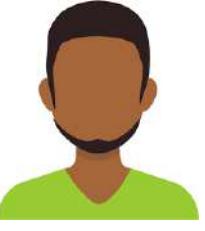
[Reply](#) [Forward](#)

## Key Objectives

1. Add a **slicer** to filter the **Customer Detail** report page by **Year**
2. Add a **visual-level filter** to exclude blanks
3. Choose any **slicer style** that allows users to filter individual years or across multiple years



# SOLUTION: SLICERS

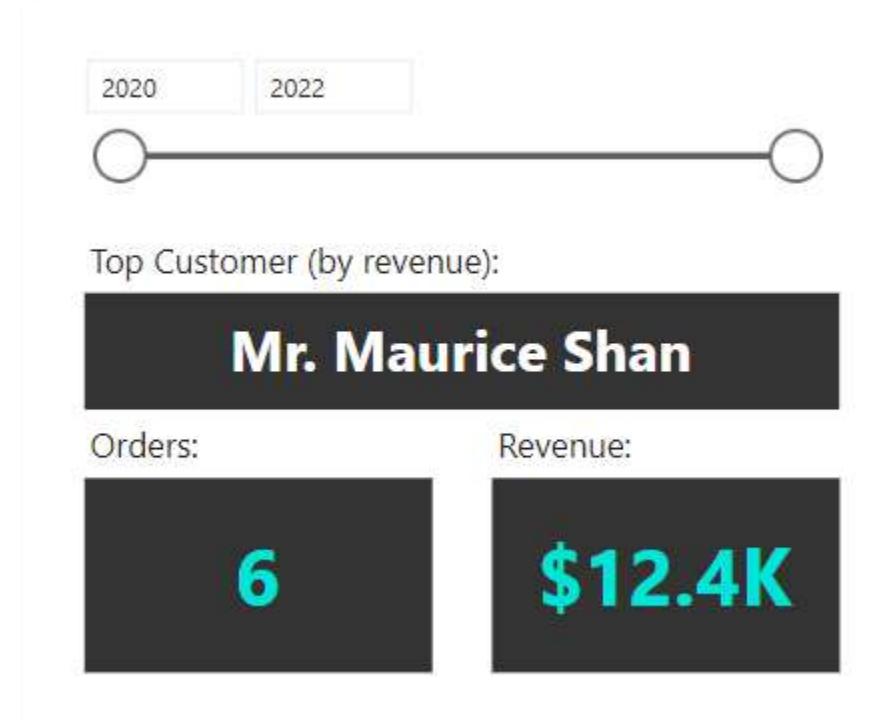
  NEW MESSAGE

From: **Victor Ignatius Zabel (BI Analyst)**  
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Could you please add a slicer to the customer report, so that users can filter the entire page by year?  
No preference for which specific type of slicer you use, as long as managers can filter customers for a specific year or across multiple years.  
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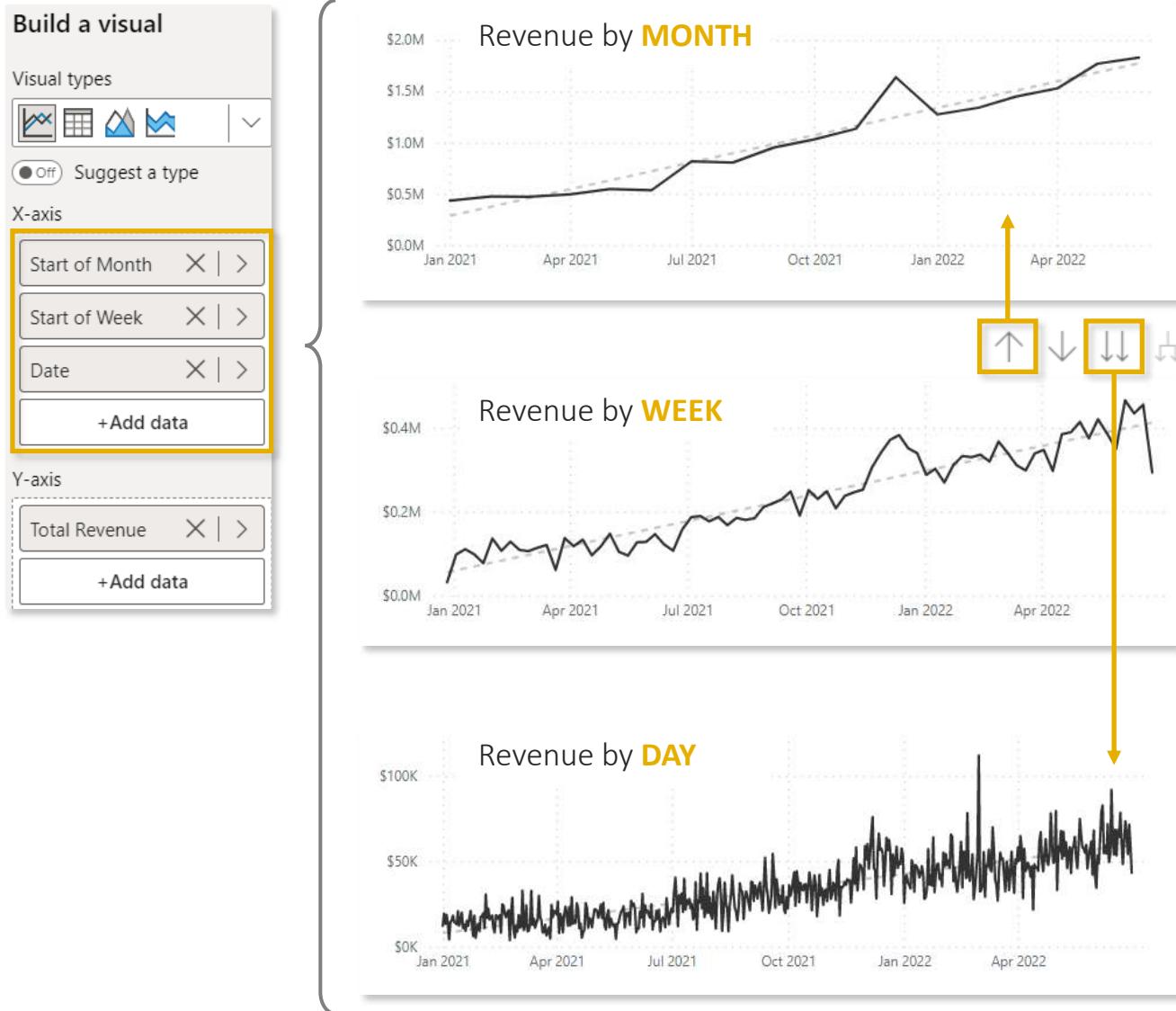
[Reply](#) [Forward](#)

## *Solution Preview*





# DRILL UP & DRILL DOWN



**Drill Up** and **Drill Down** tools allow you to switch between different levels of granularity

- In this example users can “drill up” from **weekly** to **monthly**, or “drill down” to **daily**
- The single down arrow activates **drill mode**, allowing users to drill by clicking data points
- The forked down arrow **expands each level** of the hierarchy (used in matrix visuals)

## PRO TIP:

Use **location hierarchies** and enable drill mode to create interactive map visuals



# ASSIGNMENT: DRILL DOWN



**NEW MESSAGE**

From: **Victor Ignatius Zabel (BI Analyst)**

Subject: **Dynamic time periods**

Hey again, just got some feedback from the managers about our customer report.

Chad loves the weekly trending chart, but Thad wants to see the data by *day* and Vlad was hoping for an *annual* breakdown.

Instead of building multiple versions of the same line chart, could you please make it interactive so that Chad, Thad and Vlad get the views they want?

Thanks!

-Vic

**Reply**    **Forward**

## Key Objectives

1. In the **Customer Detail** report, update the X-axis of the line chart to pull in **Date Hierarchy**
2. Use the chart header to **drill up** and **drill down** to explore trends at each level of granularity
3. Test **drill mode** to change the granularity by selecting individual data points in the chart
  - Why do some weeks look very low?
4. Turn off drill mode and show the chart at a weekly level of granularity by default



# SOLUTION: DRILL DOWN





## NEW MESSAGE

From: **Victor Ignatius Zabel (BI Analyst)**

Subject: **Dynamic time periods**

Hey again, just got some feedback from the managers about our customer report.

Chad loves the weekly trending chart, but Thad wants to see the data by *day* and Vlad was hoping for an *annual* breakdown.

Instead of building multiple versions of the same line chart, could you please make it interactive so that Chad, Thad and Vlad get the views they want?

Thanks!

-Vic

Reply

Forward





# DRILL THROUGH FILTERS

Drill through filters allow users to navigate to a specific report page, pre-filtered on the item selected

- Here we've created a **Product Detail** page, set the type to **Drillthrough**, and configured drill through from **Product Name**
- This means that users can right-click any instance of product name (i.e. in a matrix visual) and use the Drill through option to navigate straight to the Product Detail report filtered on that product (in this case "Mountain Tire Tube")

The screenshot illustrates the configuration of a drill-through filter between a matrix visual and a detailed report page.

**Matrix Visual (Left):** A "Top 10 Products" matrix with columns: Orders, Revenue, and Return %. The "Mountain Tire Tube" row is highlighted. A context menu is open at this row, with the "Drill through" option selected and its target "Product Detail" highlighted.

**Report Page (Center):** The "Product Detail" page for "Mountain Tire Tube". It features three donut charts: "Monthly Orders vs. Target" (275), "Monthly Revenue vs. Target" (\$2,735), and "Monthly Profit vs. Target" (\$1,710). Below the charts is a line chart showing "Price Adjustment (%)".

**Format Panel (Right):** The "Format" pane is open, showing the "Page type" is set to "Drillthrough". The "Drill through from" section is expanded, showing the "Product Name" filter is selected, and a button "+Add data" is visible.

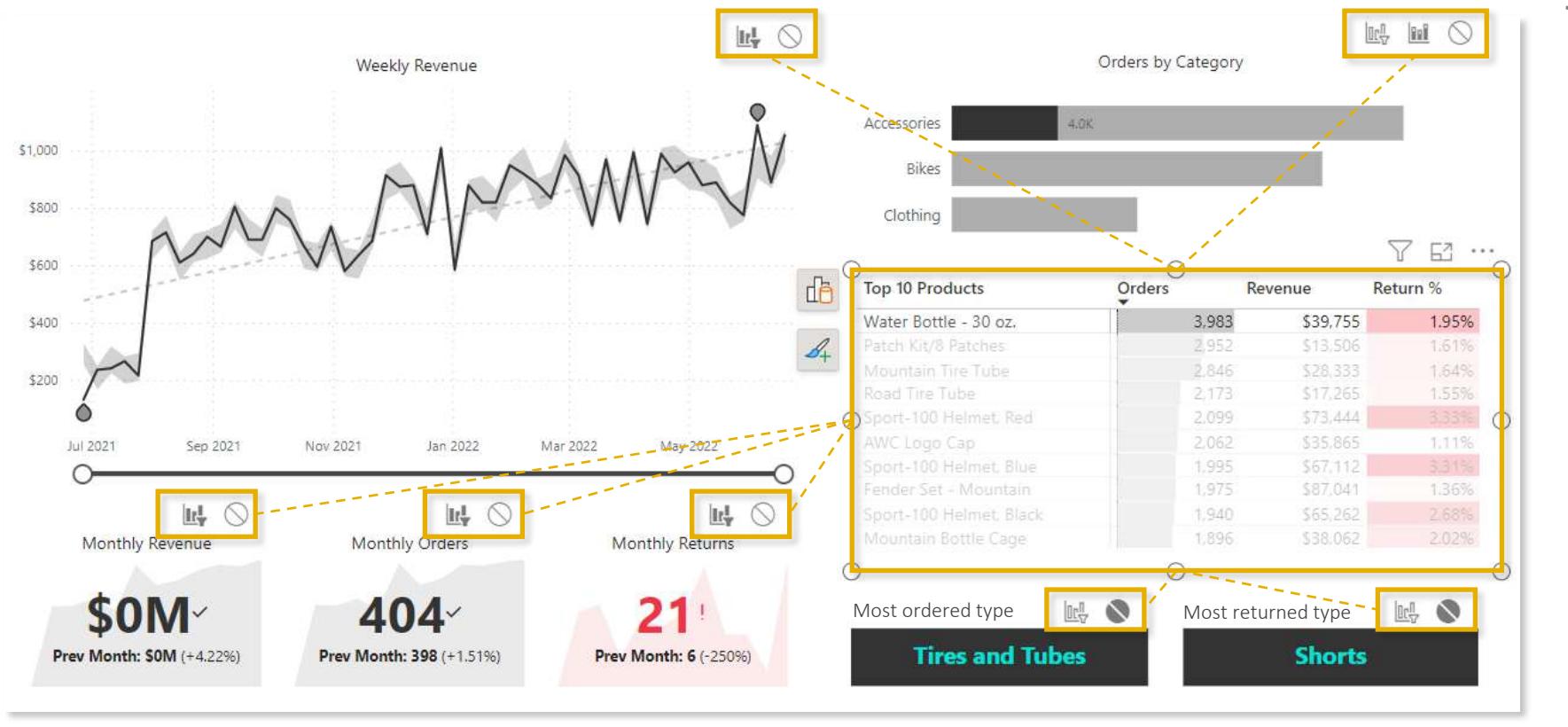


# REPORT INTERACTIONS

Edit **report interactions** to customize how filters applied to one visual impact other visuals on the page

- Cross-filter options include **filter** (⬇️), **highlight** (⬆️) and **none** (🚫), depending on the visual type

Format > **Edit Interactions**



In this example, selecting a product in the matrix visual:

- **Filters** the line chart & KPIs
- **Highlights** the bar chart
- **Doesn't impact** the text cards



# ASSIGNMENT: REPORT INTERACTIONS



**NEW MESSAGE**

From: **Victor Ignatius Zabel (BI Analyst)**

Subject: **Weird report interactions**

Hey there,

I was playing with the customer report this morning and noticed some odd visual interactions. For example, selecting a specific customer shouldn't filter the line chart, and probably shouldn't filter the donut charts either.

Could you please take a pass through the report interactions and update any that seem off?

Thanks!

-Vic

**Reply**    **Forward**

## Key Objectives

1. On the **Customer Detail** tab, edit the **report interactions** based on the following logic:
  - When a filter is applied to the line chart, the donut charts should **filter** (not highlight)
  - When a filter is applied to the table, the line chart and donuts should **not filter**
  - The slicer should **filter all visuals** on the report page



# SOLUTION: REPORT INTERACTIONS



**NEW MESSAGE**

From: **Victor Ignatius Zabel (BI Analyst)**

Subject: **Weird report interactions**

Hey there,

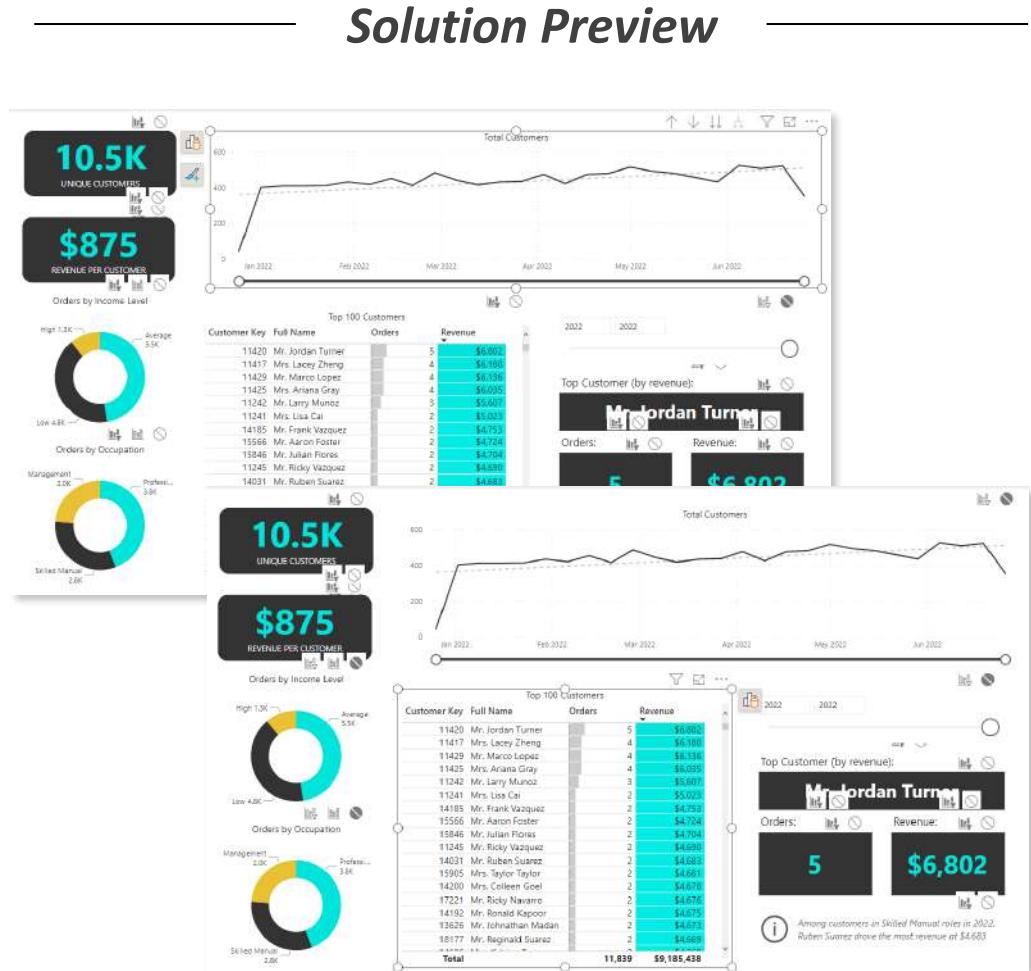
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Thanks!

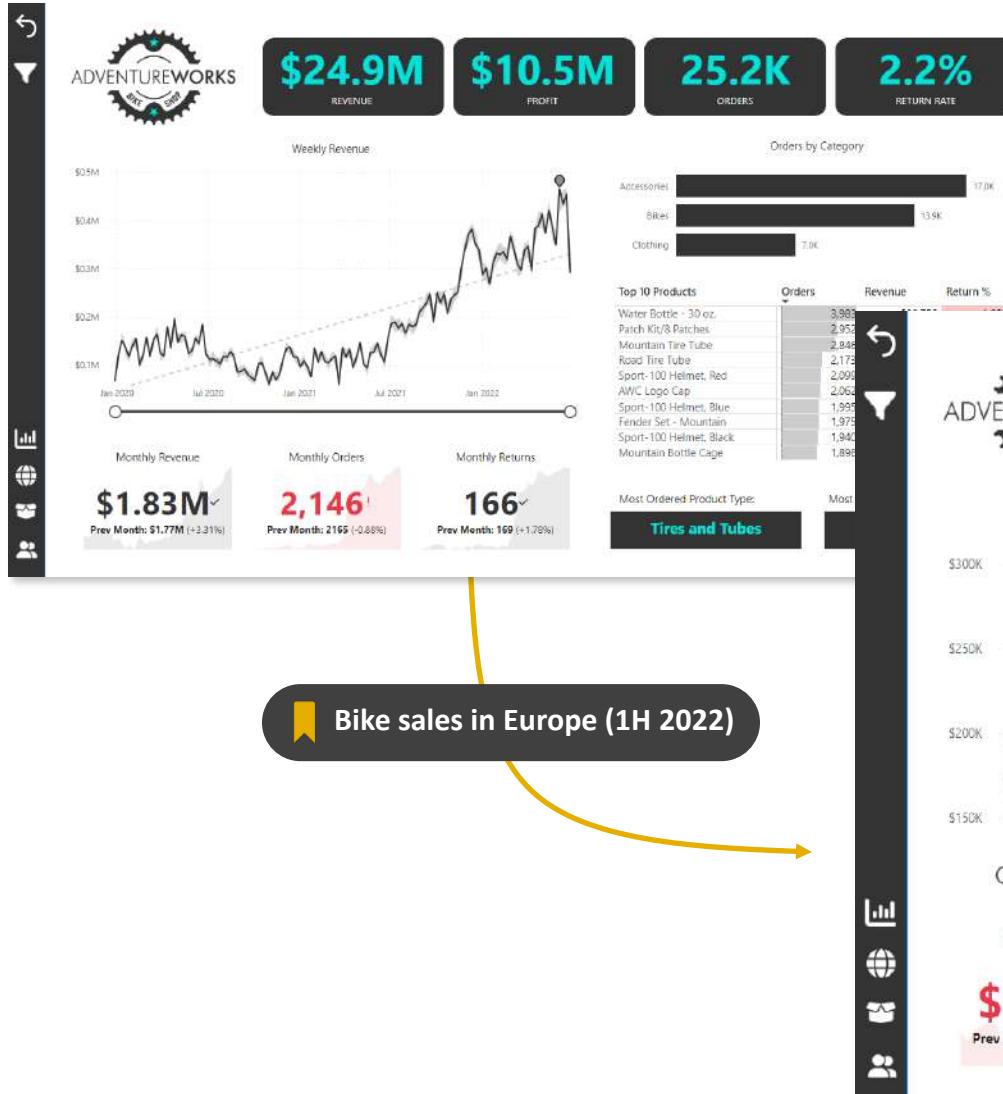
-Vic

**Reply**    **Forward**



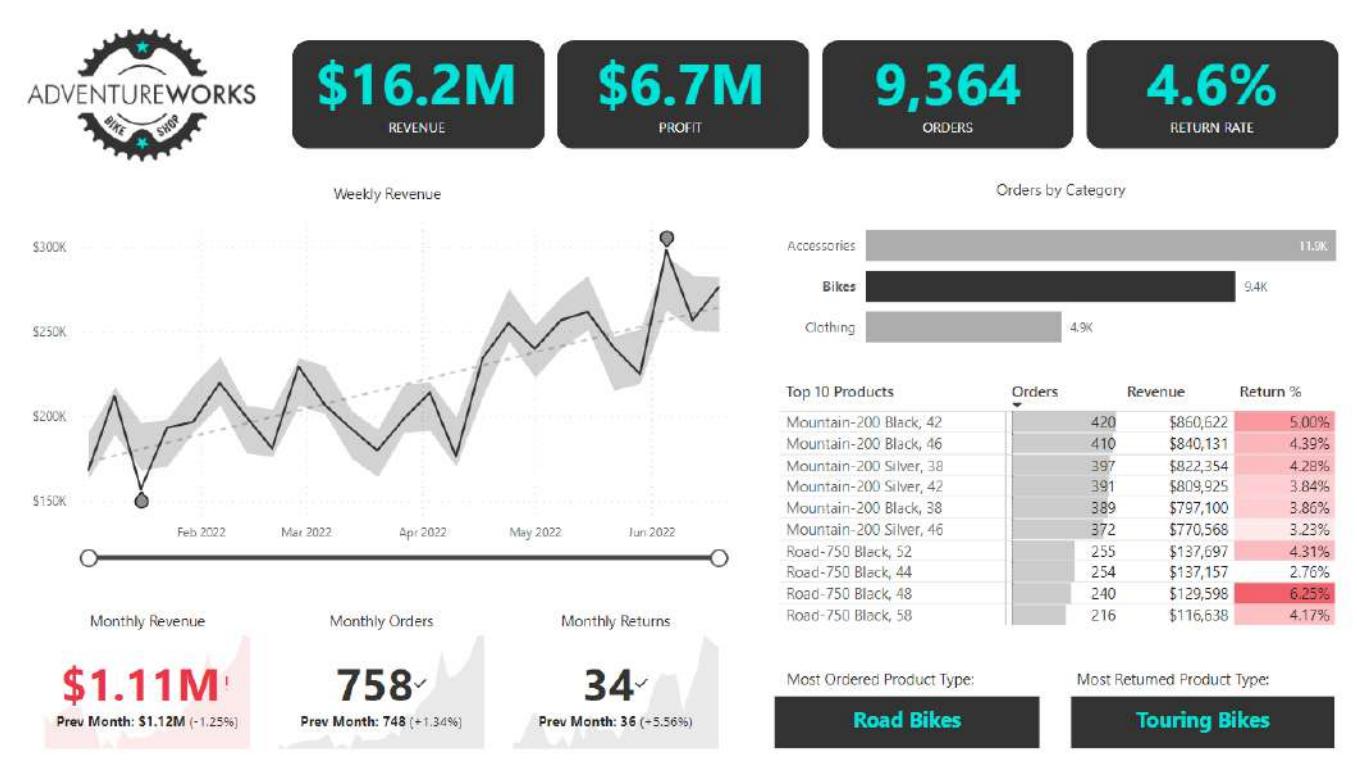


# BOOKMARKS



**Bookmarks** capture the current state of a page, and allow users to return to that state using report actions

- Bookmarks are commonly used for clearing filters, highlighting specific insights, navigating reports, etc.





# ASSIGNMENT: BOOKMARKS



**NEW MESSAGE**

From: **Victor Ignatius Zabel** (BI Analyst)

Subject: **Finding anything interesting?**

Hey,

Now that you're getting pretty familiar with our customer data, are you noticing any interesting insights or trends that might be worth explicitly calling out in the report?

This could be a great way for us to use bookmarks to draw attention to some specific stories in the dashboard. While we're at it, let's add another one to clear all filters from the page.

Let me know what you think!

-Vic

**Reply**    **Forward**

## Key Objectives

1. Explore the **Customer Detail** report by adjusting filters until you find an interesting insight or trend (*this can be anything you choose!*)
2. Add a new **bookmark** to capture the current state of the report, and name it “Customer Insight”
3. Insert an **Information button** and add text to the button style to summarize what you’ve found
4. Assign a **bookmark action** to the button, and link to the Customer Insight bookmark you created
5. Create a second bookmark named “Clear all Customer Filters” which returns the page to an unfiltered state, and link it to a **Reset button**
6. Test both bookmarks using **CTRL-click**



# SOLUTION: BOOKMARKS

  NEW MESSAGE

From: **Victor Ignatius Zabel** (BI Analyst)

Subject: **Finding anything interesting?**

Hey,

Now that you're getting pretty familiar with our customer data, are you noticing any interesting insights or trends that might be worth explicitly calling out in the report?

This could be a great way for us to use bookmarks to draw attention to some specific stories in the dashboard. While we're at it, let's add another one to clear all filters from the page.

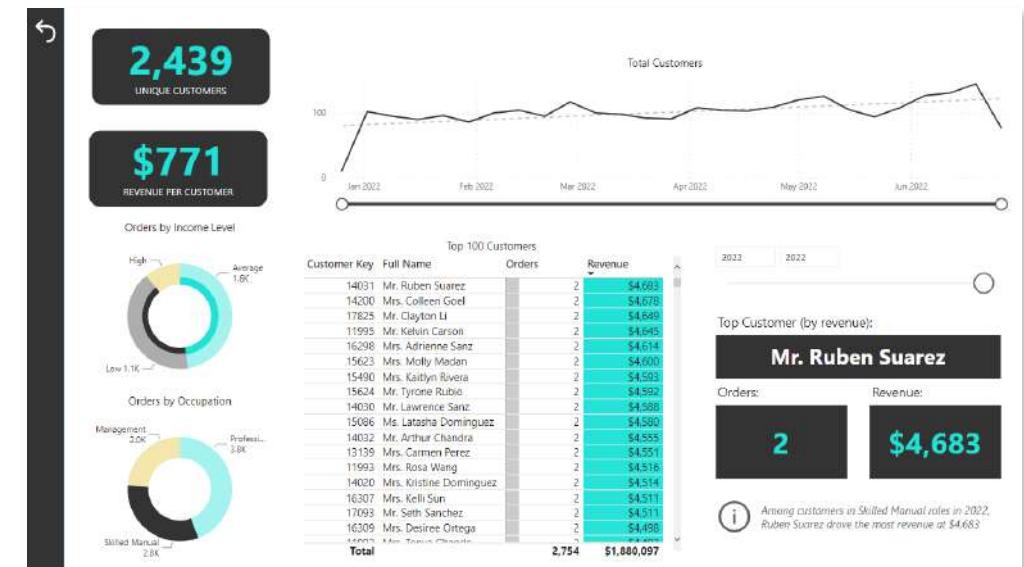
Let me know what you think!

-Vic

[Reply](#) [Forward](#)

## Solution Preview

**Example:** Among customers in Skilled Manual roles in 2022, Ruben Suarez drove the most revenue at \$4,683





# PARAMETERS

**Parameters** allow you to create variables which can be referenced in measures and controlled via slicers

## Numeric range parameters

Typically used for scenario testing, where users adjust numerical inputs to see the impact on a given output

## Fields parameters

Typically used to allow users to dynamically change the metrics or dimensions displayed in a report visual

The screenshot shows two side-by-side dialog boxes for creating parameters in Power BI.

**Left Dialog (Numeric range parameter):**

- Modeling ribbon:** The "Modeling" tab is selected.
- What will your variable adjust?**: Set to "Numeric range".
- Name:** Price Adjustment (%)
- Data type:** Decimal number
- Minimum:** -1
- Maximum:** 1
- Increment:** 0.1
- Default:** 0
- Add slicer to this page**: Checked
- Create** and **Cancel** buttons at the bottom.

**Right Dialog (Fields parameter):**

- Modeling ribbon:** The "Modeling" tab is selected.
- What will your variable adjust?**: Set to "Fields".
- Name:** Y-Axis Dynamic Value
- Add and reorder fields** section:
  - Total Cost
  - Total Revenue
  - Total Profit
- Fields** section:
  - Search input field
  - List of available fields:
    - Measure Table
    - Calendar Lookup
    - Customer Lookup
    - Price Adjustment (%)
    - Product Categories Lookup
    - Product Lookup
    - Product Subcategories Lookup
    - Returns Data
    - Rolling Calendar
    - Sales Data
    - Territory Lookup
- Add slicer to this page**: Checked
- Create** and **Cancel** buttons at the bottom.



# EXAMPLE: NUMERIC RANGE PARAMETER

Parameters

Add parameters to visuals and DAX expressions so people can use slicers to adjust the inputs and see different outcomes. [Learn more](#)

What will your variable adjust?

Numeric range

Name: Price Adjustment (%)

Data type: Decimal number

Minimum: -1

Maximum: 1

Increment: 0.1

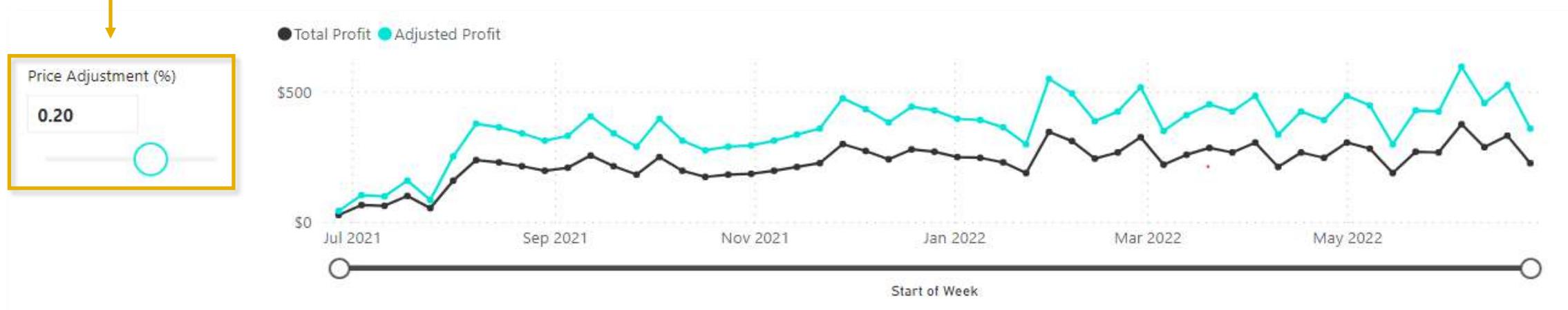
Default: 0

When you create a numeric parameter, Power BI generates **two new measures**: one to define the parameter and another to capture the selected value:

Parameter = `GENERATESERIES(-1, 1, 0.1)`

Parameter Value = `SELECTEDVALUE(Parameter[Parameter], 0)`

Here we've created a parameter named **Price Adjustment %**, added it as a slicer, and created measures to calculate **Adjusted Profit** based on the parameter value





# EXAMPLE: FIELDS PARAMETER

Parameters

Add parameters to visuals and DAX expressions so people can use slicers to adjust the inputs and see different outcomes. [Learn more](#)

What will your variable adjust?

Fields

Name

Metric Selection

Add and reorder fields

- Total Orders
- Total Revenue
- Total Profit
- Total Returns
- Return Rate

Add slicer to this page

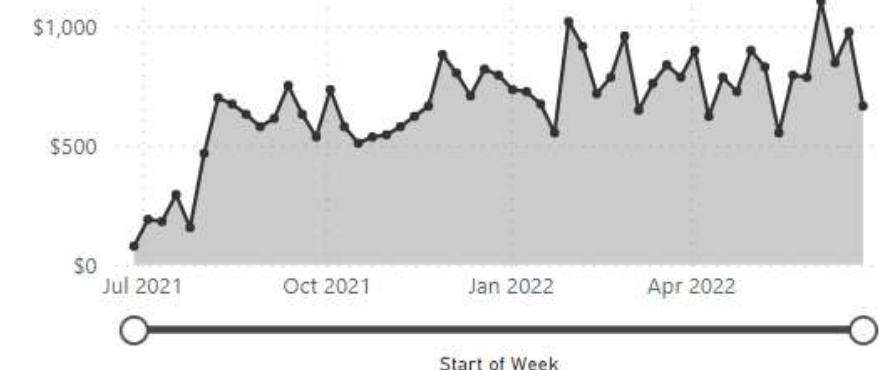
**Create** **Cancel**

When you create a fields parameter, Power BI **adds a report slicer** and **generates a new measure** to capture the selected value:

```
1 Metric Selection = {  
2     ("Total Orders", NAMEOF('Measure Table'[Total Orders]), 0),  
3     ("Total Revenue", NAMEOF('Measure Table'[Total Revenue]), 1),  
4     ("Total Profit", NAMEOF('Measure Table'[Total Profit]), 2),  
5     ("Total Returns", NAMEOF('Measure Table'[Total Returns]), 3),  
6     ("Return Rate", NAMEOF('Measure Table'[Return Rate]), 4)  
7 }
```

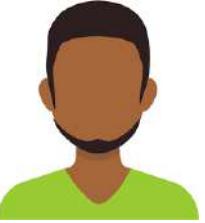
Here we've created a parameter named **Metric Selection** and added it to the Y-axis to let users dynamically change the metric shown

- Metric Selection
- Total Orders
  - Total Revenue
  - Total Profit
  - Total Returns
  - Return Rate





# ASSIGNMENT: FIELDS PARAMETERS



**NEW MESSAGE**

From: **Victor Ignatius Zabel (BI Analyst)**

Subject: **More line chart updates**

Good news and bad news...

The good news is that Chad, Thad and Vlad LOVE the drill options in the line chart – nice work!

The bad news is that now they can't align on what's the best metric to show. Chad likes seeing total customers, but Vlad is pushing for revenue per customer.

What do you think we should do?

-Vic

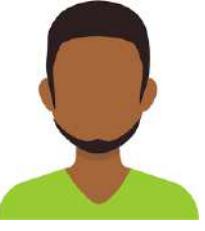
**Reply**    **Forward**

## Key Objectives

1. Add a new **Fields parameter** named “Customer Metric Selection”, which includes **Total Customers** and **Average Revenue per Customer**
2. Add the parameter as a slicer to the **Customer Detail** report, change the slicer style to **Tile**, turn off the **header**, update to **single select**, and resize to create a horizontal layout
3. Select the DAX measure automatically created, and update the text from “Average Revenue per Customer” to “Revenue per Customer”
4. Update the line chart Y-Axis to use the **Customer Metric Selection** parameter, remove the chart title, and update the line colors to match the solution preview



# SOLUTION: FIELDS PARAMETERS

  NEW MESSAGE

From: **Victor Ignatius Zabel (BI Analyst)**  
Subject: **More line chart updates**

Good news and bad news...

The good news is that Chad, Thad and Vlad LOVE the drill options in the line chart – nice work!

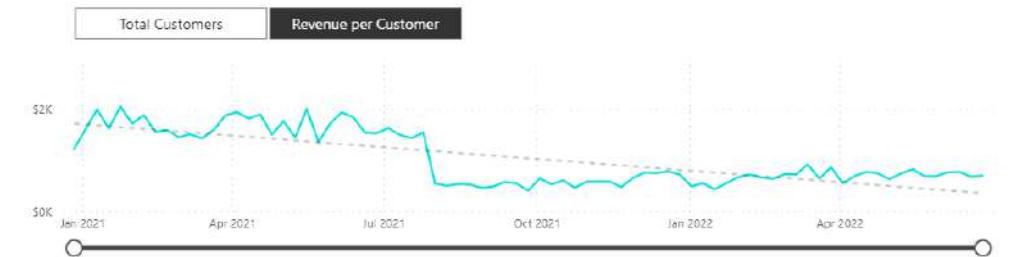
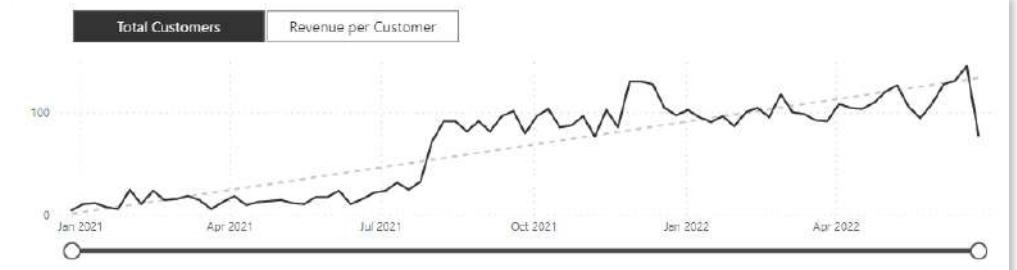
The bad news is that now they can't align on what's the best metric to show. Chad likes seeing total customers, but Vlad is pushing for revenue per customer.

What do you think we should do?

-Vic

Reply Forward

## *Solution Preview*





# PRO TIP: CUSTOM TOOLTIPS

Create **custom tooltips** by designing a new report page, setting the page type to **Tooltip**, and configuring a visual to use the “Report page” tooltip type

*Category Tooltip report page*

This screenshot shows a report page titled "Category Tooltip report page". It features a chart titled "Weekly Orders" with a teal line showing order volume from 2020 to 2022. To the left of the chart is a summary box with the following data:

Total Revenue	\$24,914,567
Total Profit	\$10,457,581
Total Orders	25,164
Total Returns	1,809
Return Rate	2.17%

Below the chart is a "Format" panel with "Page information" settings:

- Name: Category Tooltip
- Type: Tooltip
- Keep all filters: On
- Show tooltip on: +Add data

This screenshot shows a main dashboard with a chart titled "Weekly Orders" for the "Accessories" category. A tooltip is displayed over the chart, showing detailed metrics for the category:

Total Revenue	\$9,051,607
Total Profit	\$3,740,773
Total Orders	5,345
Total Returns	427
Return Rate	8.03%

The tooltip is highlighted with a yellow box. An arrow points from the "Properties" tab of the "Format" panel on the right to the tooltip area.

The "Format" panel on the right shows the "Properties" tab selected. Under the "Tooltips" section, the "Type" dropdown is set to "Report page" and the "Page" dropdown is set to "Category Tooltip".

## PRO TIP:

Keep your published reports clean by **hiding your tooltip pages**

\*Copyright Maven Analytics, LLC



# IMPORTING CUSTOM VISUALS

Power BI offers a library of **custom visuals** (via **AppSource**) from Microsoft-certified partners and developers, which can be imported into the visualizations pane

The screenshot shows the Power BI desktop application. The 'Insert' tab is active in the ribbon. In the 'Visuals' section of the ribbon, there is a 'More visuals' dropdown. A yellow box highlights the 'From AppSource' option in this dropdown. A yellow arrow points from this box to a screenshot of the Microsoft AppSource website, specifically the 'Apps for Power BI visuals' page. The screenshot shows the 'Supermetrics Charts – Tile grid map' visual by Supermetrics, which is described as creating heatmap tiles of the same shape and size. It includes a sample image showing a grid of colored squares with numerical values.

**HEY THIS IS IMPORTANT!**  
You need a **Power BI account** to browse or import custom visuals from the AppSource marketplace



# MANAGING & VIEWING ROLES

Manage security roles

Create new security roles and use filters to define row-level data restrictions.

Roles

Region	Action
Europe	...
North America	...
Pacific	...

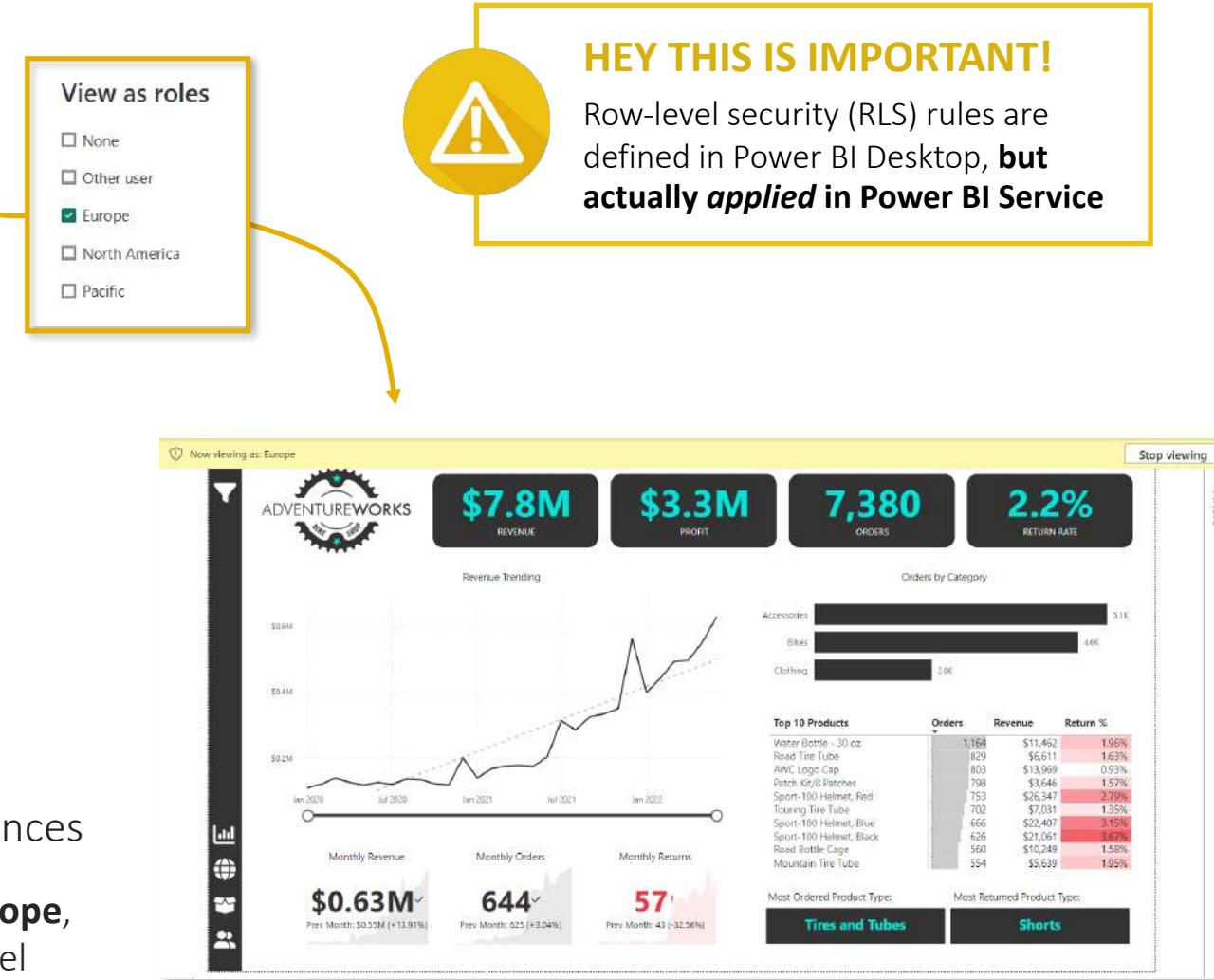
Select tables

- Customer Met...
- Measure Table
- Price Adjustme...
- Product Categ...
- Product Lookup
- Product Metric...
- Product Subca...
- Returns Data
- Rolling Calendar
- Sales Data
- Territory Lookup

Filter data

Show data when...  
All of these rules are true  
Continent Equals North America

Switch to DAX editor



**Roles** allow you to define row-level security rules, and create filtered views to restrict access for specific audiences

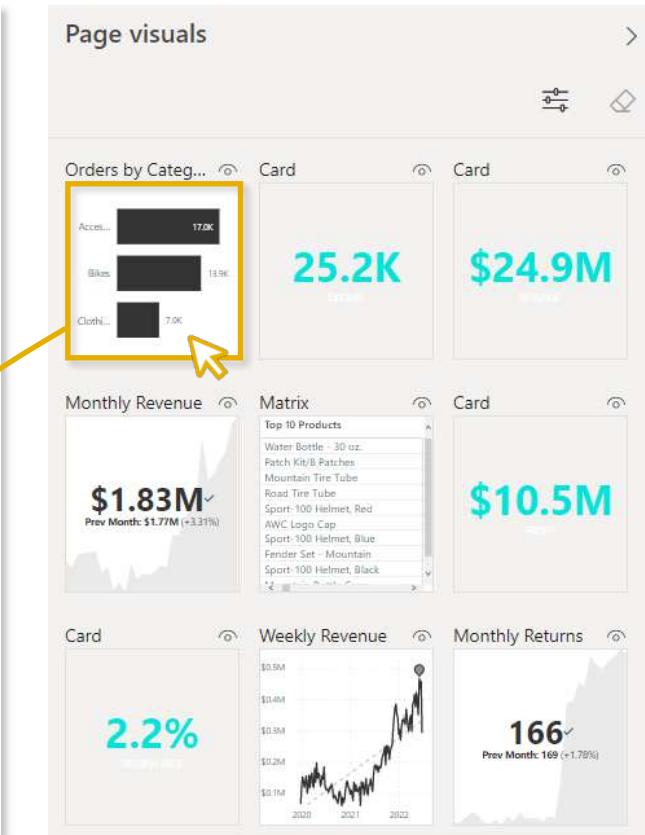
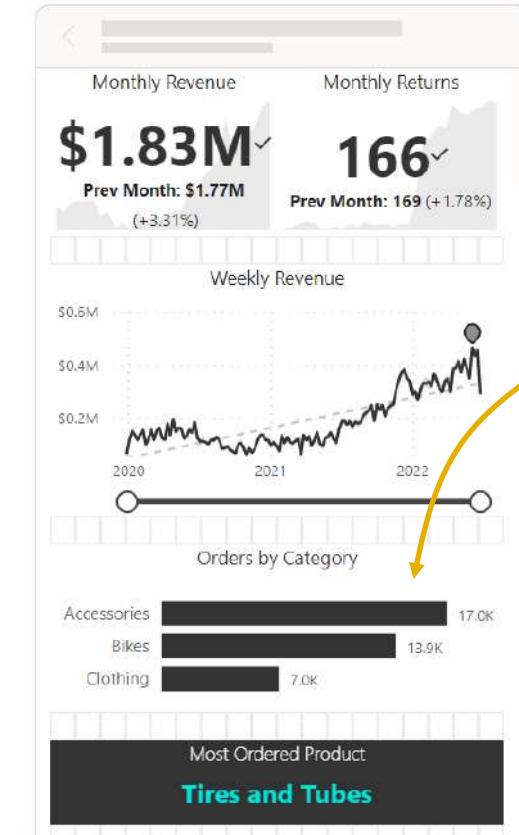
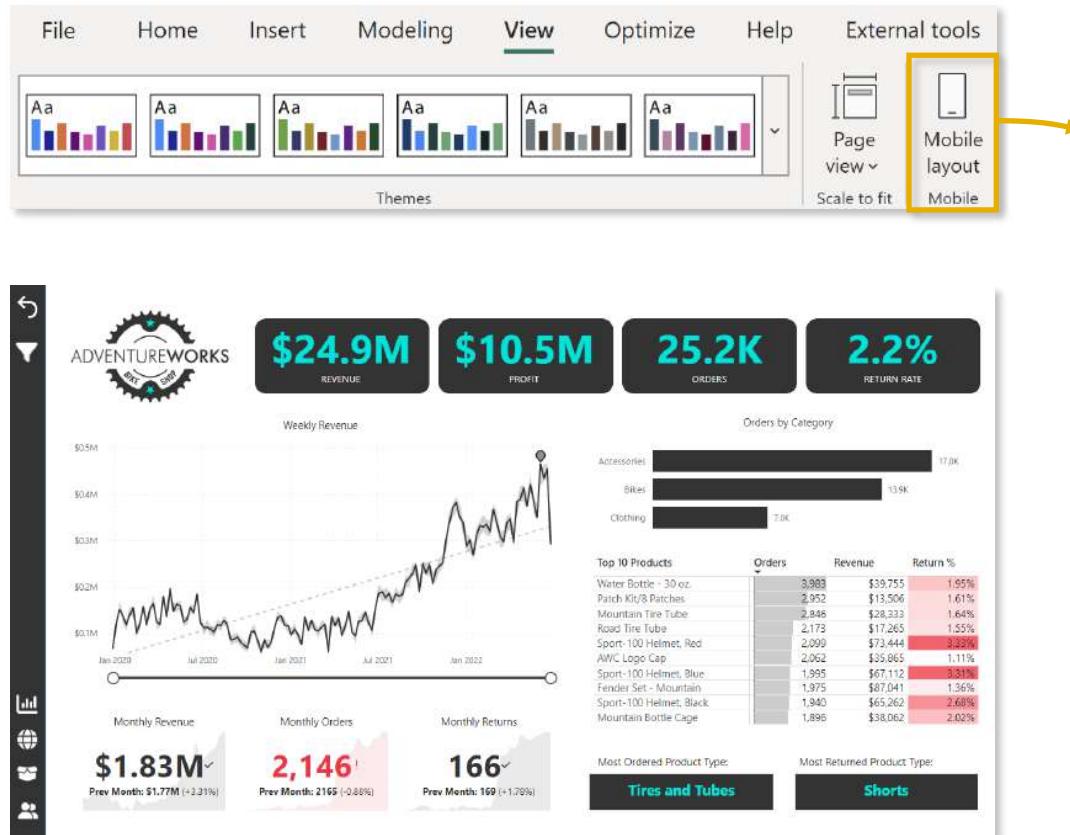
- Here we've created views for territory managers (**Europe**, **N. America**, **Pacific**), which filters records in the model



# MOBILE LAYOUT

**Mobile layout** allows you to design mobile-specific versions of report pages by assembling visuals into new layouts

- **NOTE:** This is designed to optimize reports for viewing on the Power BI mobile app (after publishing to Power BI Service)





# DATA VISUALIZATION BEST PRACTICES

## ★ Always ask yourself the three key questions

- *What type of data are you visualizing, what are you communicating, and who is the end user?*

## ★ Strive for clarity and simplicity above all else

- *"Perfection is achieved not when there's nothing more to add, but when there's nothing left to take away"*

## ★ Focus on creating clear narratives and intuitive user experiences

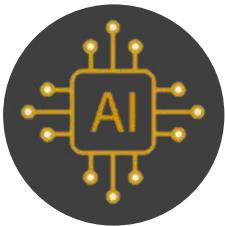
- *Use bookmarks, drillthroughs, tooltips and navigation buttons to seamlessly guide users through reports*

## ★ Create optimized layouts for mobile viewers

- *Create custom mobile layouts if you plan to publish reports to Power BI Service or use the Power BI app*

# ARTIFICIAL INTELLIGENCE

# ARTIFICIAL INTELLIGENCE



In this section we'll explore Power BI's artificial intelligence features, including anomaly detection, smart narratives, natural language Q&A, decomposition trees, and more

## TOPICS WE'LL COVER:

Anomaly Detection

Smart Narrative

Q&A Visual

Decomposition Tree

Key Influencers

Top Segments

## GOALS FOR THIS SECTION:

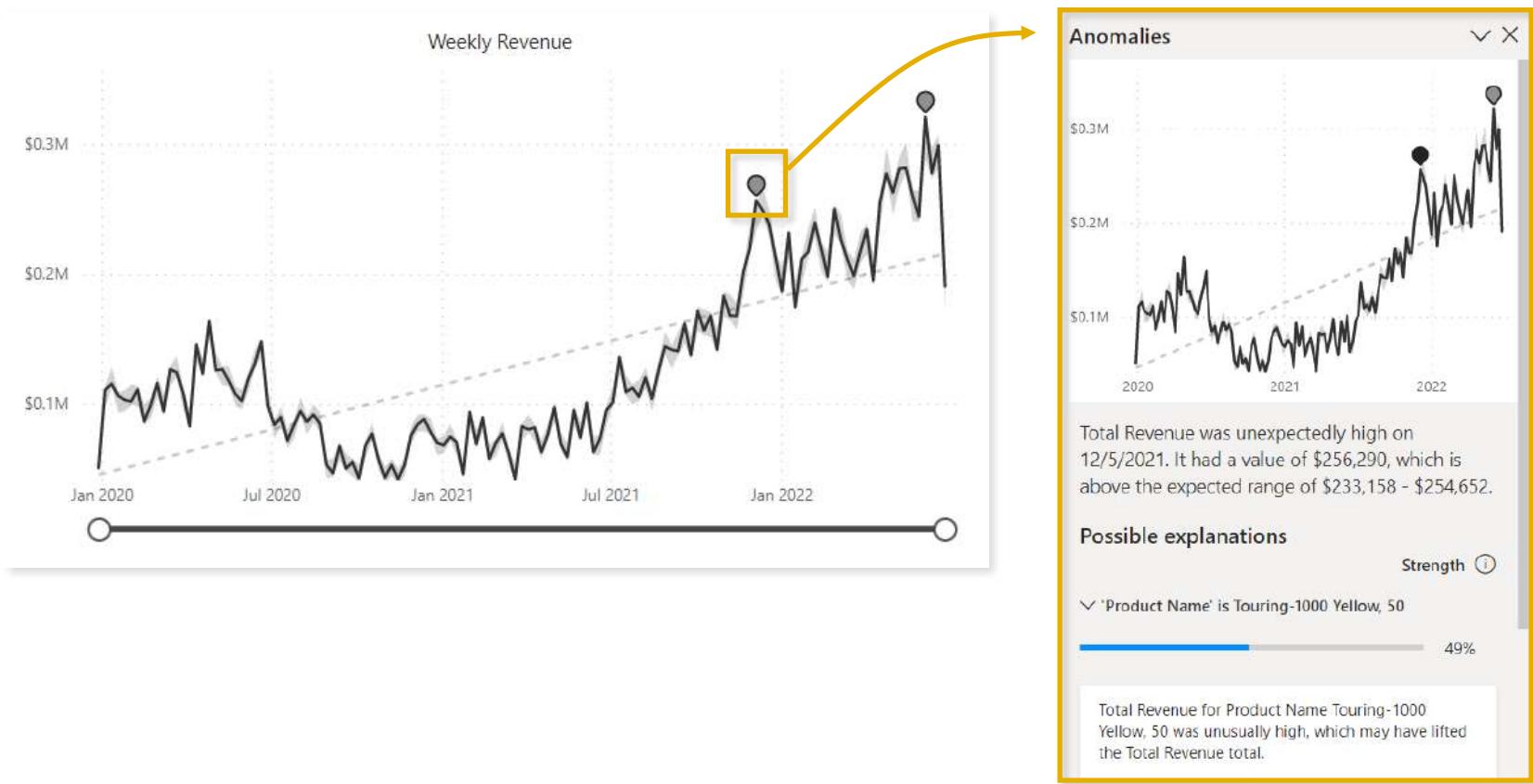
- Explore AI-generated insights using smart narratives and anomaly detection
- Build and train Q&A visuals to allow users to explore Power BI models using natural language queries
- Learn how to use decomposition trees for data exploration and root cause analysis
- Use key influencer visuals to identify the underlying factors that drive specific outcomes for the business



# ANOMALY DETECTION

**Anomaly detection** is used to automatically detect and explain anomalies in time series data

- The anomaly detection feature adds “flags” to existing line charts, which link to AI-generated explanations and summaries



## Limitations:

- Only supported for line charts with a time-series field on the X-axis
- Does not support charts with legends, multiple values, or a secondary axis
- Cannot be applied at the same time as forecasts
- Not compatible with drill up/drill down
- Requires at least four data points



# SMART NARRATIVES

**Smart narratives** create customizable, AI-generated text summaries based on report pages or visuals

- Smart narratives react to report filters like any other visual, and can be updated with custom, dynamic values

Selected Product:  
**Patch Kit/8 Patches**

Monthly Orders vs. Target: 265

Monthly Revenue vs. Target: \$1,225

Monthly Profit vs. Target: \$765

Total Profit: ● Total Profit    ● Adjusted Profit

Price Adjustment (%): 0.00

Return Rate

Metric Selection:  Total Orders  Total Revenue  Total Profit  Total Returns  Return Rate

Report Summary: Total orders for Patch Kit/8 Patches were 265 this month. All metrics trended up between Sunday, June 27, 2021 and Sunday, June 26, 2022, each increasing by 3.200.00%. Return Rate had two high anomalies on Sunday, July 4, 2021 (8.00%) and Sunday, July 25, 2021 (9.52%).

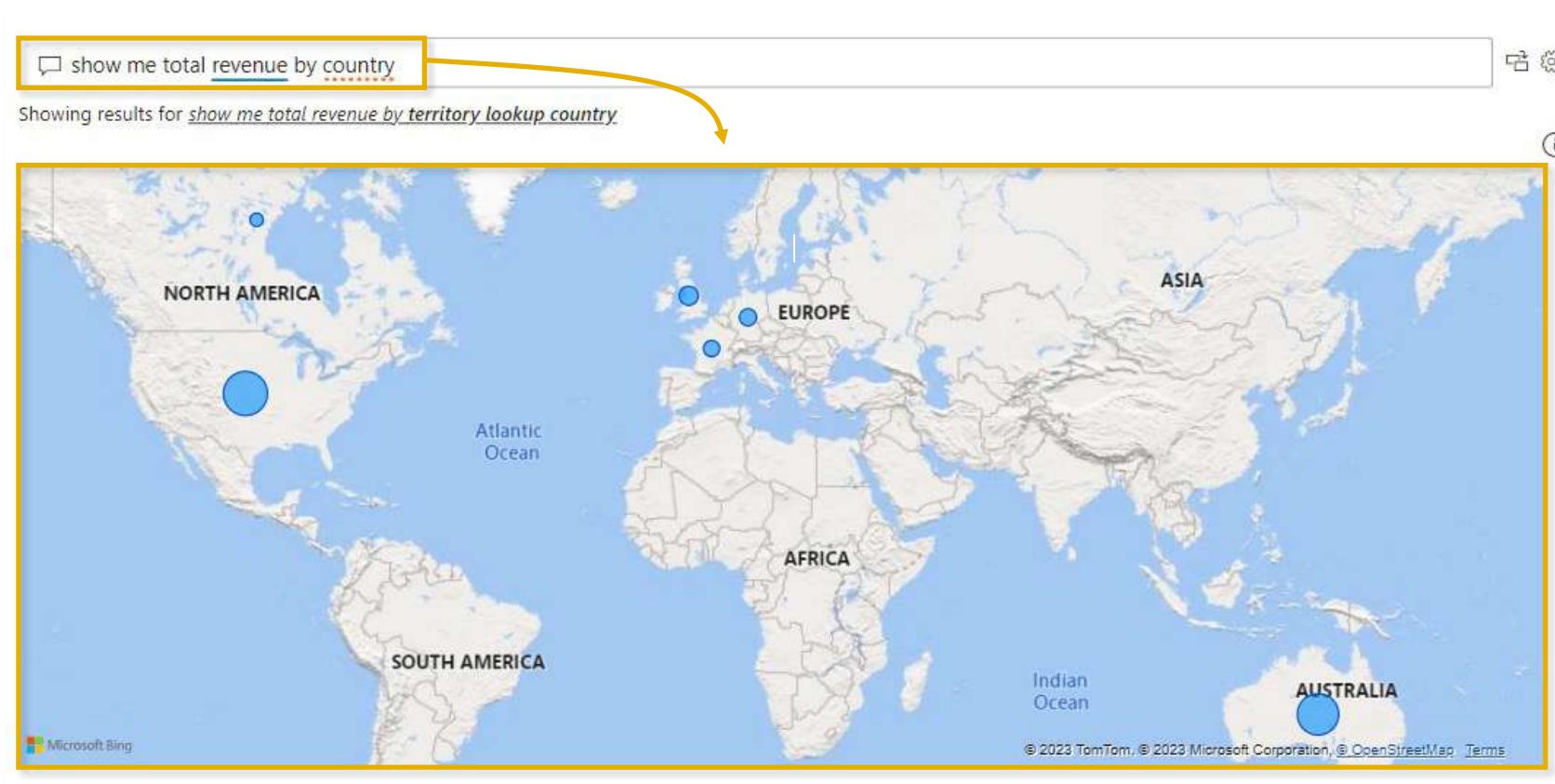
Create a dynamic value that updates with your data  
How would you calculate this value  
current product  
Result  
Patch Kit/8 Patches  
\$%  
Name your value  
# Product  
Save Cancel



# Q&A VISUALS

**Q&A visuals** allow users to explore and visualize data using intuitive, natural language prompts

- Q&A visuals are only as useful as the data model behind them, and typically require significant “training” to be effective

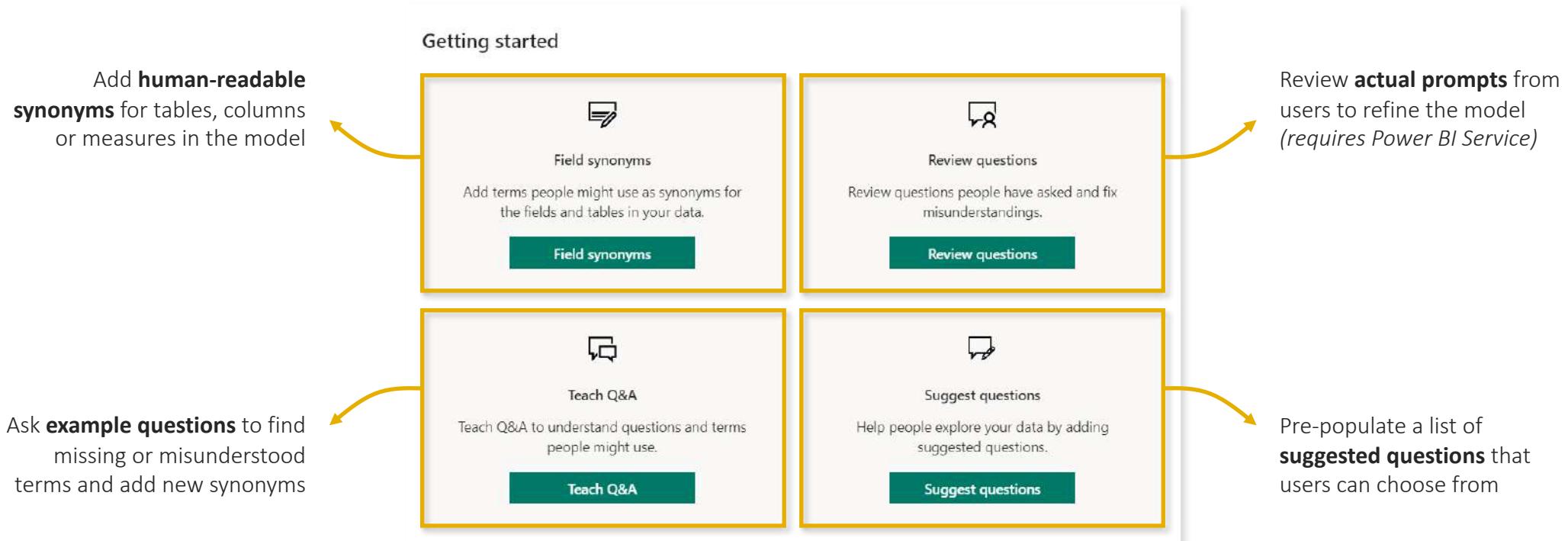




# Q&A TRAINING

**Q&A visuals** allow users to explore and visualize data using intuitive, natural language prompts

- Q&A visuals are only as useful as the data model behind them, and typically require significant “training” to be effective

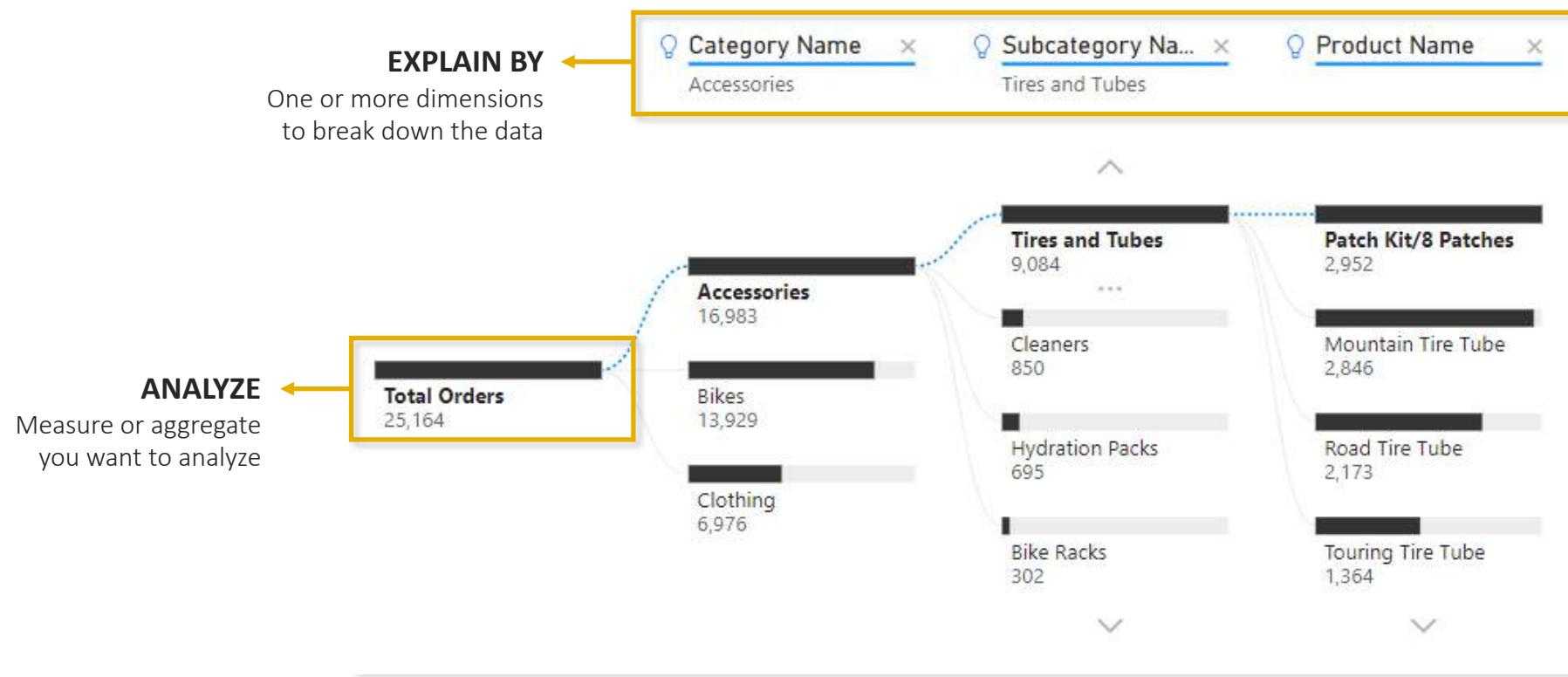




# DECOMPOSITION TREES

**Decomposition trees** allow you to visualize how data is distributed across multiple dimensions

- Decomposition trees can be configured manually for data exploration, or leverage AI to support root cause analysis

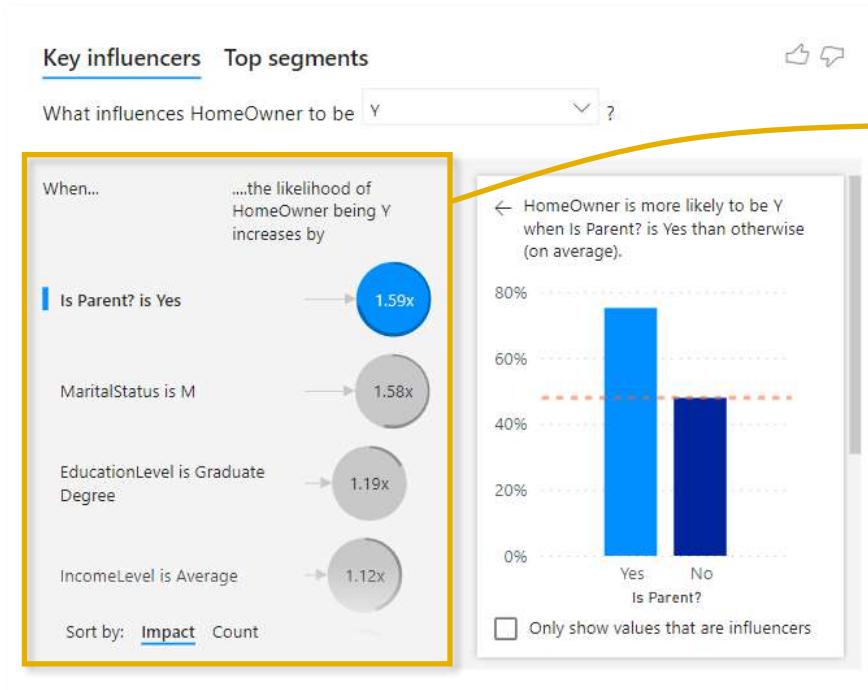




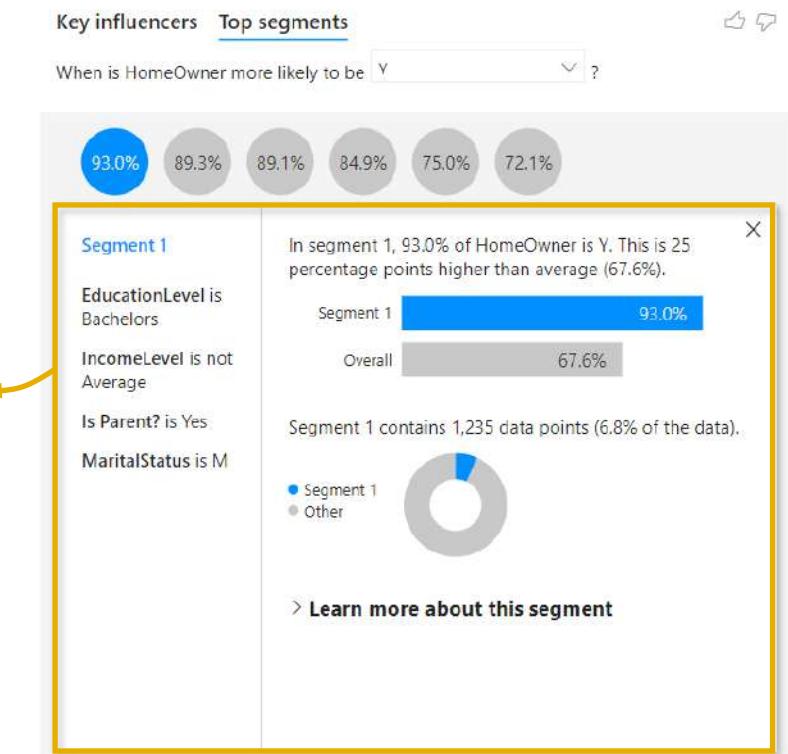
# KEY INFLUENCERS

The **key influencer** visual helps you understand the factors that drive specific metrics or outcomes

- This can be used to analyze categorical or continuous outcomes, or identify top segments based on combinations of factors



Here we're identifying factors that are highly correlated with owning a home; for example, **parents are 1.59X more likely to be homeowners**, all else equal



We can also identify customer segments where this outcome is likely; for example, **93% of married customers with children and a Bachelors degree own a home** (vs. 67.6% overall)

# OPTIMIZATION TOOLS

# PREVIEW: POWER BI OPTIMIZATION



In this section, we'll investigate several native and external tools that can be used to optimize and enhance your Power BI reports

## TOPICS WE'LL COVER:

Optimize Ribbon

Pause Visuals

Optimization Presets

Apply all Slicers

Performance Analyzer

External Tools

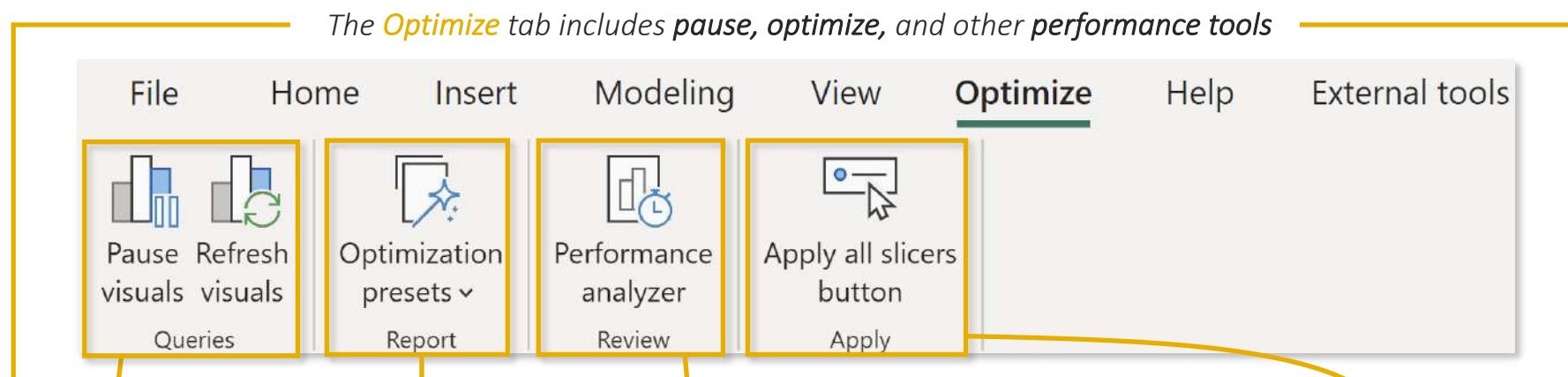
## GOALS FOR THIS SECTION:

- Explore the optimize ribbon tools, features, and use cases
- Understand how and when pausing visuals can aid in report development and creation
- Use Performance Analyzer to measure and compare the impact of report elements on speed and performance
- Explore external tools that can aid in report development, learning, and optimization



# OPTIMIZE RIBBON

The **Optimize ribbon** helps report authoring by allowing developers to pause data source queries, apply preset settings, and view logs that measure report element performance



**Pause or refresh queries** to make updates without processing changes

**Predefined optimization presets** that can be applied based on your reporting scenario

Show **record logs** that measure each elements performance within a report

**Apply** and **clear multiple slicer selections** on a report page at once



# PAUSE VISUALS

**Pause visuals** stops queries from running and is used when you don't want to immediately apply additions or changes made to a report page or visual

The screenshot shows a Microsoft Power BI dashboard titled "ADVENTUREWORKS". At the top, the ribbon has the "Optimize" tab selected. In the "Queries" group, the "Paused visuals" button is highlighted with a yellow box. A banner at the top of the dashboard area says "Visuals are paused. Some edits won't be applied until you refresh or resume visual queries." Below the banner, there are four large summary cards: "REVENUE \$24.9M", "PROFIT \$10.5M", "ORDERS 25.2K", and "RETURN RATE 2.2%". The main content area contains several visualizations: a line chart titled "Weekly Revenue" showing revenue over time from Jan 2020 to Jul 2022; a bar chart titled "Orders by Category" showing orders for Accessories, Bikes, and Clothing; a table titled "Top 10 Products" listing items like Water Bottle - 30 oz., Patch Kit/8 Patches, Mountain Tire Tube, etc.; and two smaller cards at the bottom left: "Monthly Revenue \$1.83M" and "Monthly Orders 2,146". On the right side, there are two more cards: "Most Ordered Product Type: Tires and Tubes" and "Most Returned Product Type: Shorts". The bottom navigation bar includes links like "Exec Dashboard", "Map", "Product Detail", "Customer Detail", "Category Tooltip", "AI: Q&A", "AI: Decomposition Tree", "AI: Key Influence", and a "+" button.

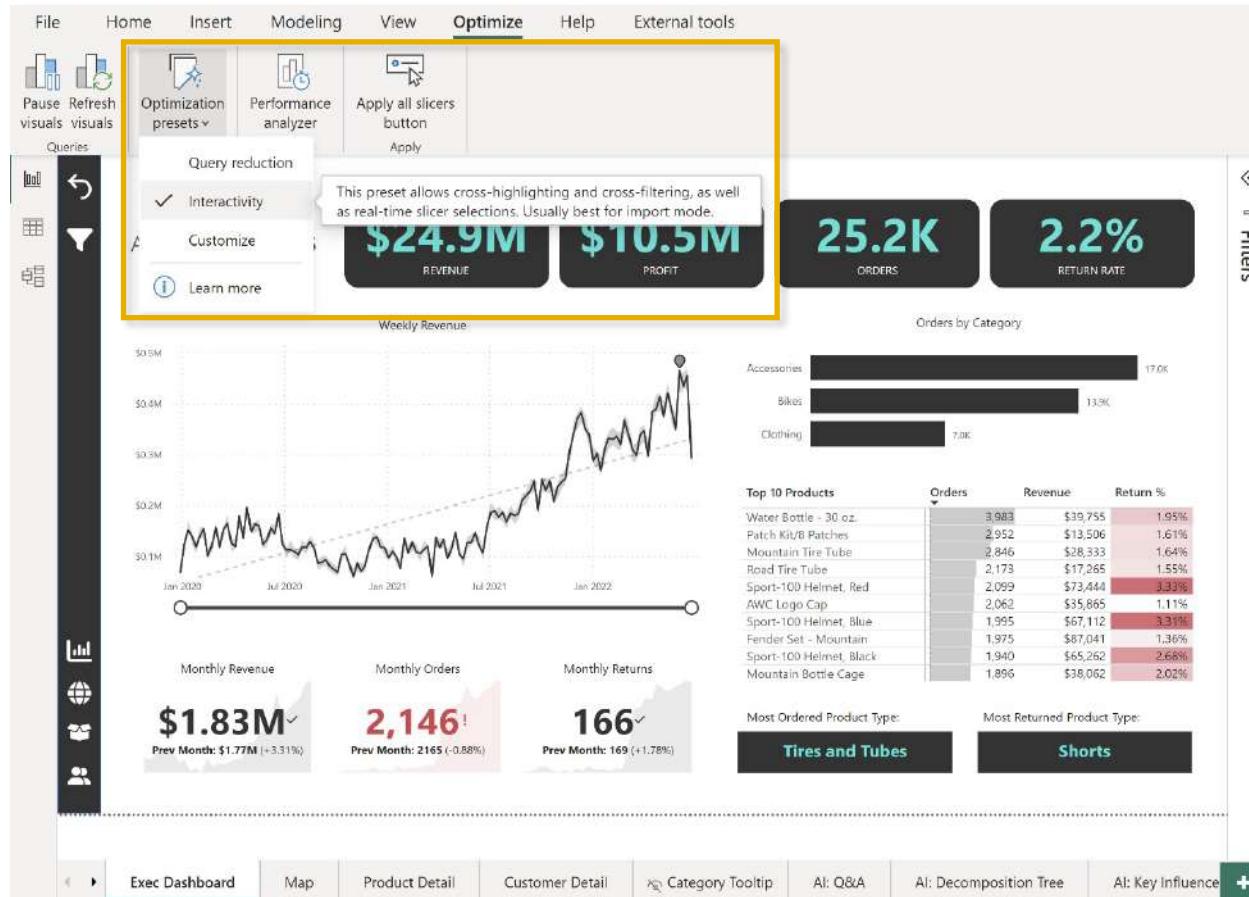
**When paused**, the report:

- Holds all changes & updates and sets them to a **"visual has pending changes"** state
- Shows a banner with **refresh & resume visual queries**
- Adds a **refresh button to individual visuals** allowing you to only refresh that visual
- Allows you to **add, move, and remove columns** and measures without having to wait for visuals to refresh
- **Blocks formatting actions**



# OPTIMIZATION PRESETS

**Optimization presets** allow you to apply different predefined query optimization settings like query reduction, interactive, and custom



## Query Reduction

- Is *best for DirectQuery connections* because it follows the best practices for DirectQuery optimization, turns off cross-highlighting, cross-filtering, and adds an Apply button to the filters pane

## Interactivity

- Is the default setting and *best used for Import mode* because it allows cross-highlighting, cross-filtering, and real-time changes to slicers and filters

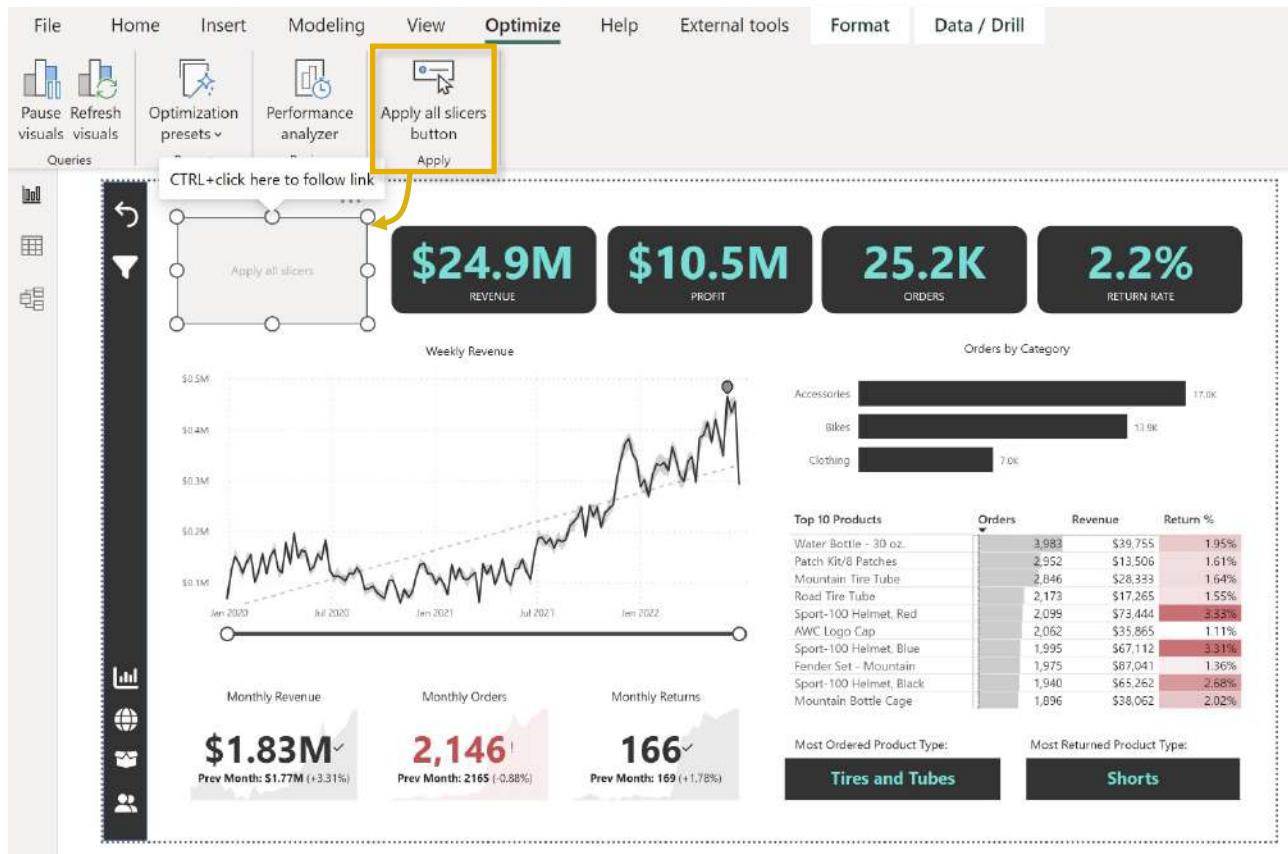
## Customize

- Is best when you want to *choose which query reduction features to use*



# APPLY ALL SLICERS BUTTON

Adding an **apply all slicers** button to your report page tracks all slicer selections and can be used to either apply or clear all slicers at once



## Common scenarios & considerations:

- **Apply multiple slicers** on a report page at once
- **Clear all slicers** on a report page at once
- Apply & clear all slicer buttons **impact all slicers** on the report page (*you can't pick and choose!*)
- You can have as **many of these buttons** as you'd like
- Button can be **added and formatted** just like other buttons in Power BI



# PERFORMANCE ANALYZER

**Performance Analyzer** records user actions (*like Excel's macro recorder*), and tracks the load time (*in milliseconds*) for each step in the process

The screenshot shows a Power BI dashboard for ADVENTUREWORKS. The ribbon has the 'Optimize' tab selected. The main area displays key metrics: Revenue (\$24.9M), Profit (\$10.5M), and Orders (25.2K). Below these are three cards: Monthly Revenue (\$1.83M), Monthly Orders (2,146), and Monthly Returns (166). A line chart shows Weekly Revenue from Jan 2020 to Jun 2022. A sidebar on the right lists Top 10 Products and Most Ordered Product Type (Tires and Tubes). At the bottom, there are links to Exec Dashboard, Map, Product Detail, Customer Detail, and Category Tools.

**Performance analyzer**

- Start recording
- Refresh visuals
- Stop
- Clear
- Export

Name	Duration (ms)
Shape	124
Image	124
Dashboard Icon	123
Map Icon	123
Product Icon	122
Customer Icon	122
Card	329
DAX query	5
Visual display	6
Other	318
Copy query	
Card	356
Card	462
Card	384

Learn more about optimizing your report's performance on our [support site](#). Find help tuning your report from specialist Power BI partners on [AppSource](#).

## DAX Query

- Shows the amount of time it takes for the visual to send the query to the engines, and for the engines to return the result (**Note:** DAX Studio can only help optimize this)

## Visual Display

- Shows the amount of time it takes for the visual to populate, or “draw”, on the screen. Includes time to retrieve web-based and geocoded images

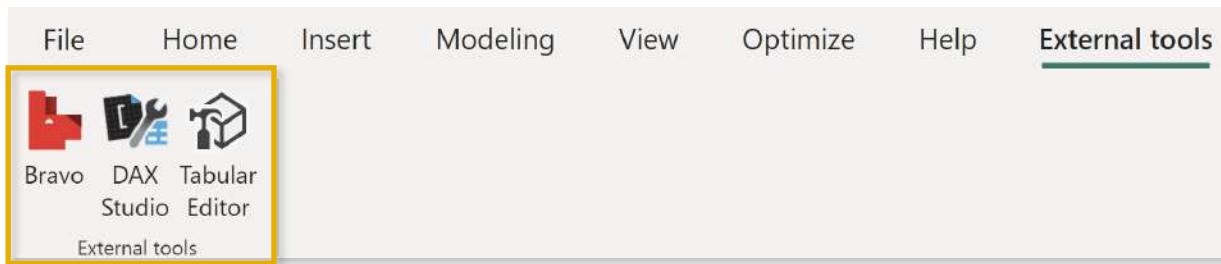
## Other

- Shows the amount of time required by the visual to prepare the query, wait for other visuals to complete their queries and perform other processing tasks



# EXTERNAL TOOLS

**External tools** allows quick access to third-party built tools that are *locally installed* on your computer and *registered* with Power BI Desktop



**External tools** generally fall into one of the following categories:

## Semantic Modeling

These tools extend Power BI's functionality for specific data modeling scenarios like DAX optimization, ALM, and metadata translation

- *DAX Studio*
- *ALM Toolkit*
- *Tabular Editor*
- *Bravo*

## Data Analysis

Includes tools for connecting a PBI data model to a client application, in read-only mode, to query data and perform analysis tasks

- *Python*
- *Excel*
- *Power BI Report Builder*

## Miscellaneous

Some tools are used to make Power BI more useful and accessible but don't connect to the data model

- *PBI.tips tutorials*
- *DAX Guide*
- *PowerBI.tips*