

Abstract geometric lines in the top left corner, consisting of several overlapping, irregular polygons and lines in a light beige color.

POWER BI

BEYOND THE DASHBOARD

NCRAAO Conference – June 17, 2025

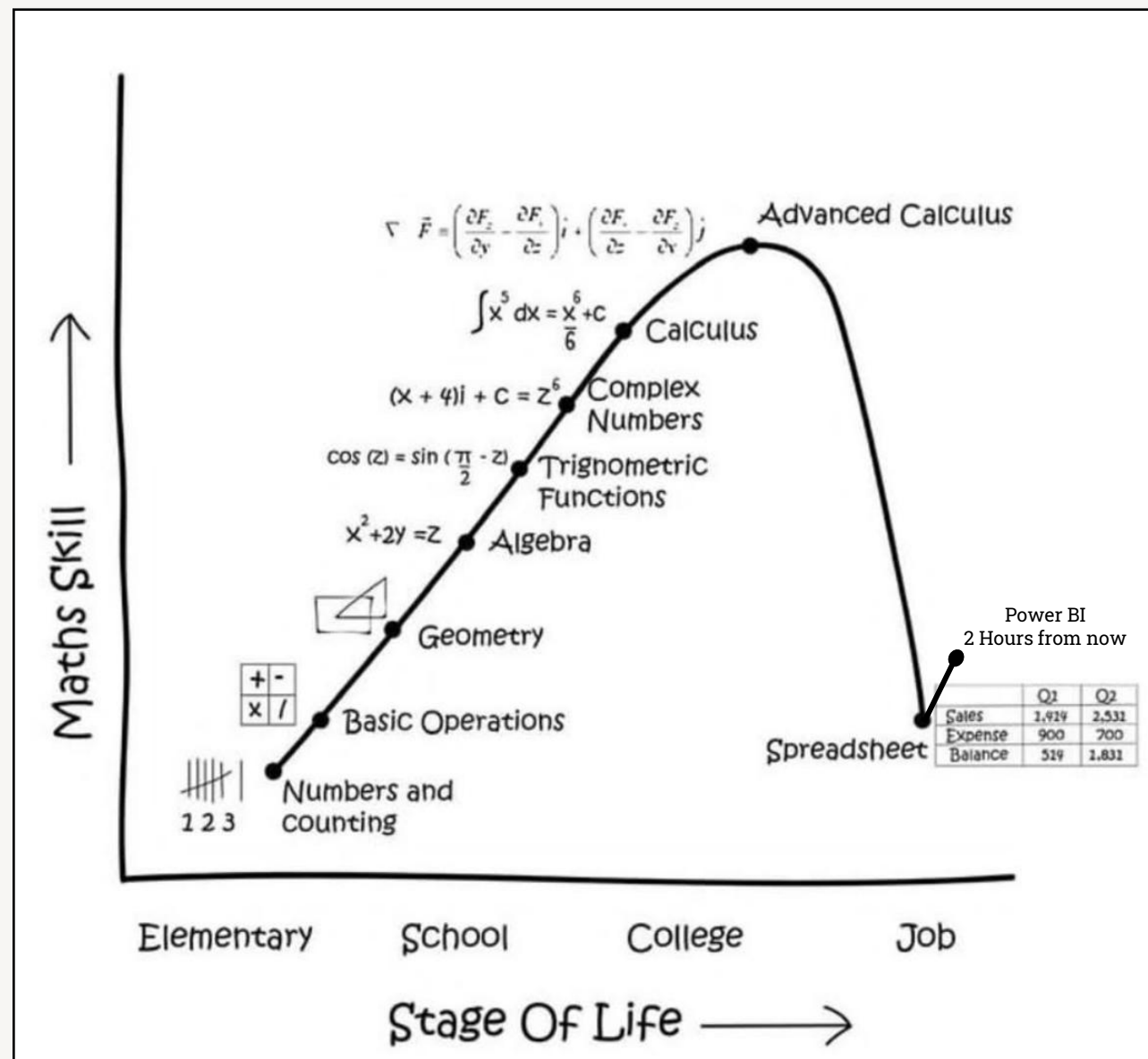
RYAN JANZEN, CAE, RMA



EMPORIA, KANSAS



First Place in the Best Tasting Municipal Water Category for 2025



AGENDA

- What is Power BI?
- The Basics
- DAX Functions for Appraisers
- Analysis Tool
- Other Applications



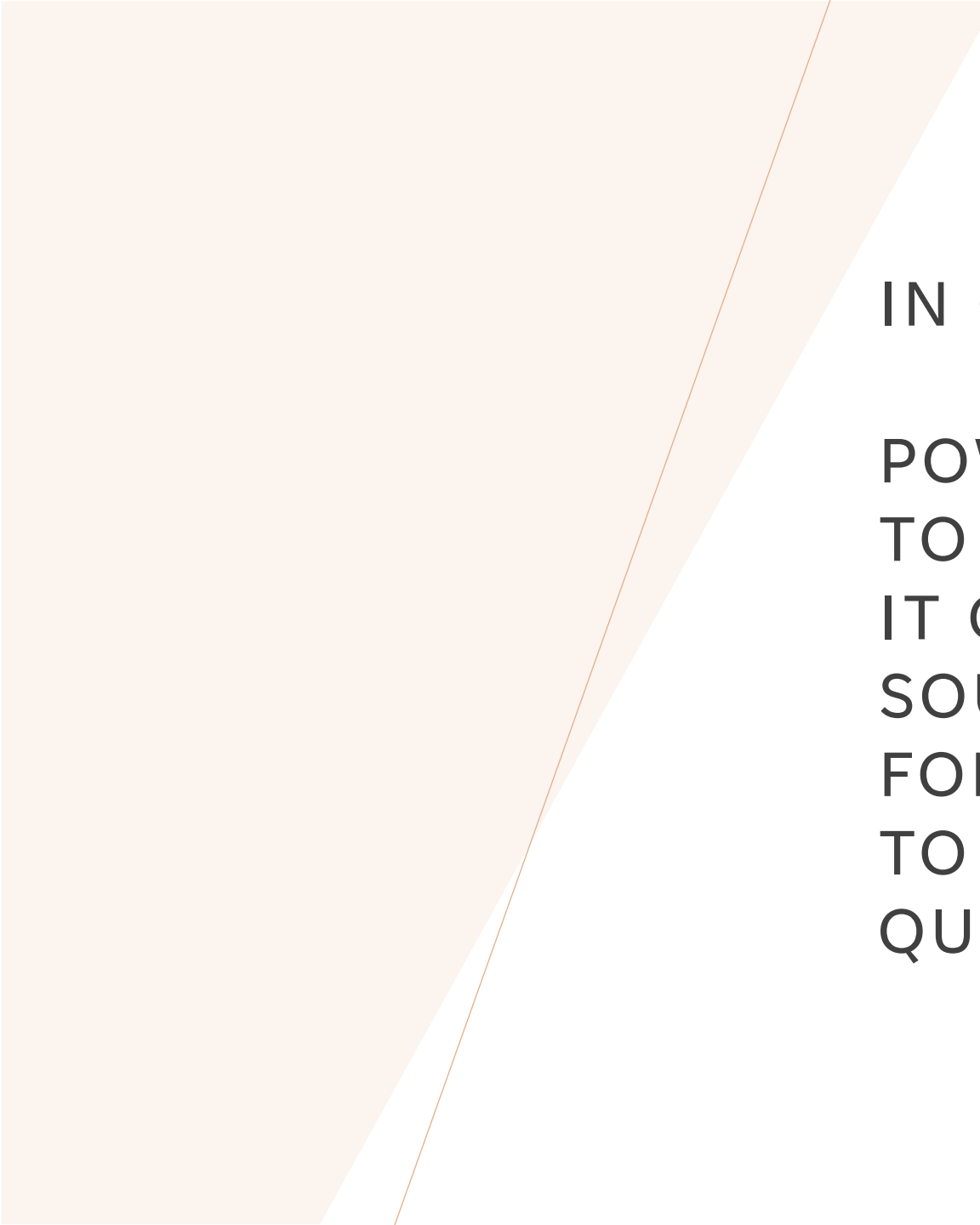
WHAT IS POWER BI?



POWER BI IS A COLLECTION OF
SOFTWARE SERVICES, APPS,
AND CONNECTORS THAT WORK
TOGETHER TO TURN YOUR
UNRELATED SOURCES OF DATA
INTO COHERENT, VISUALLY
IMMERSIVE, AND INTERACTIVE
INSIGHTS.

- Microsoft

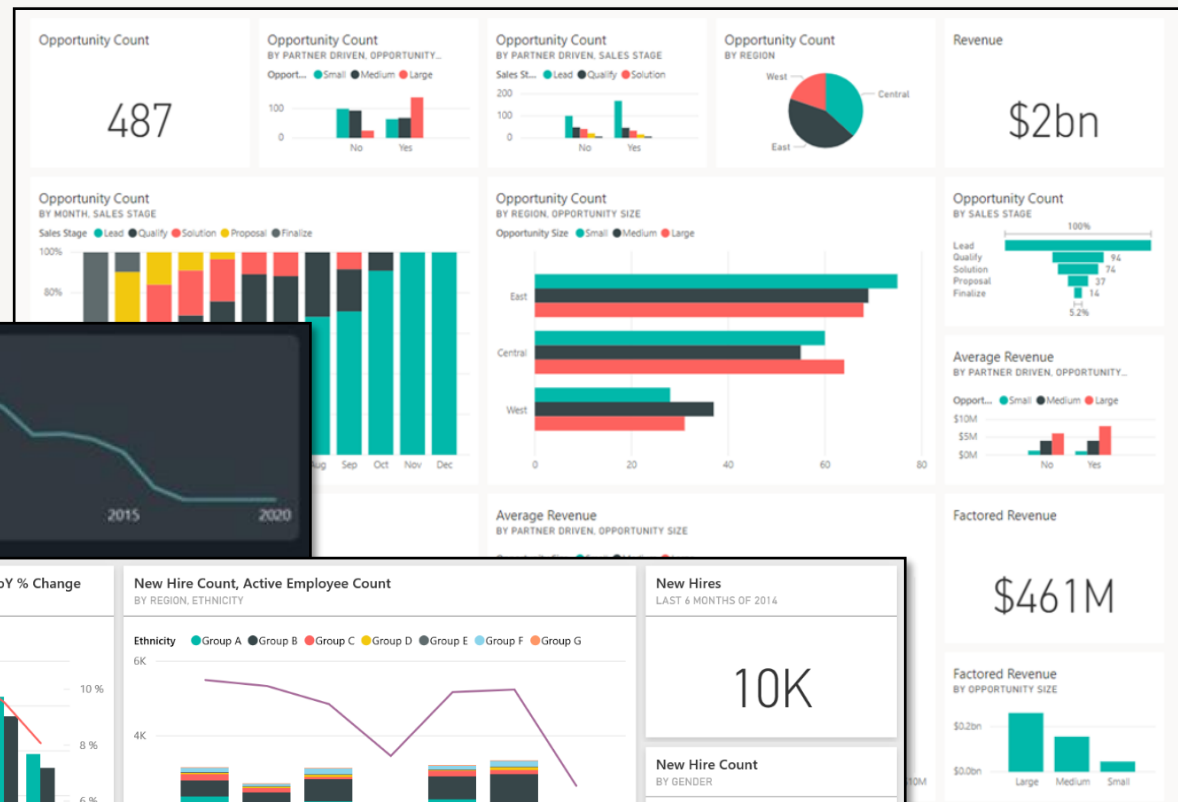
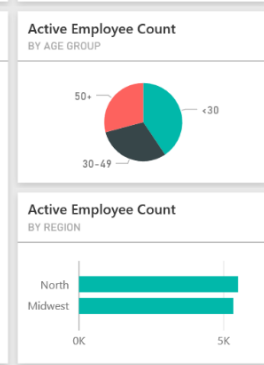
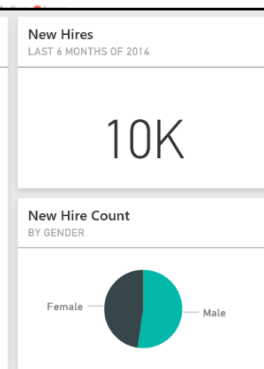
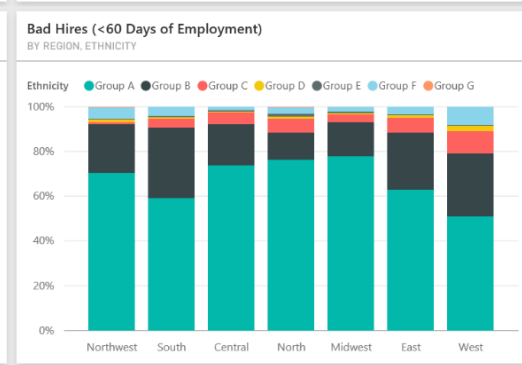
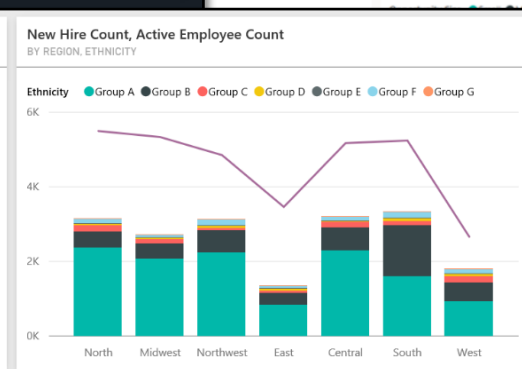
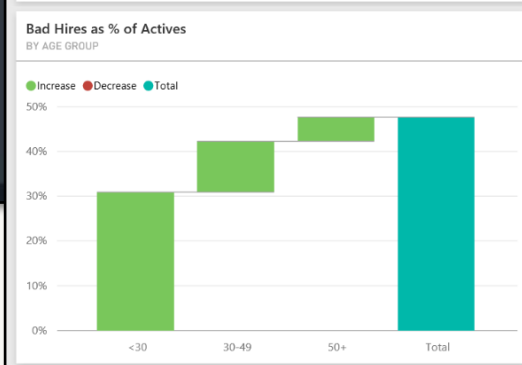
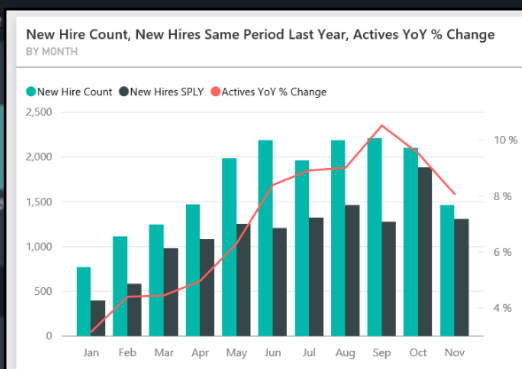
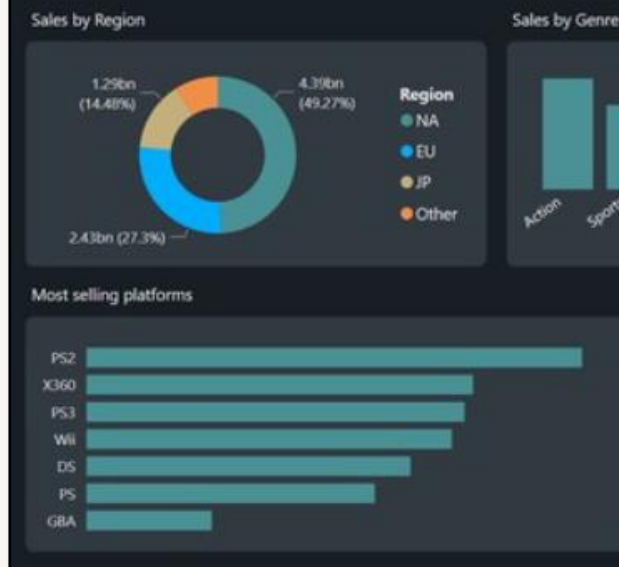
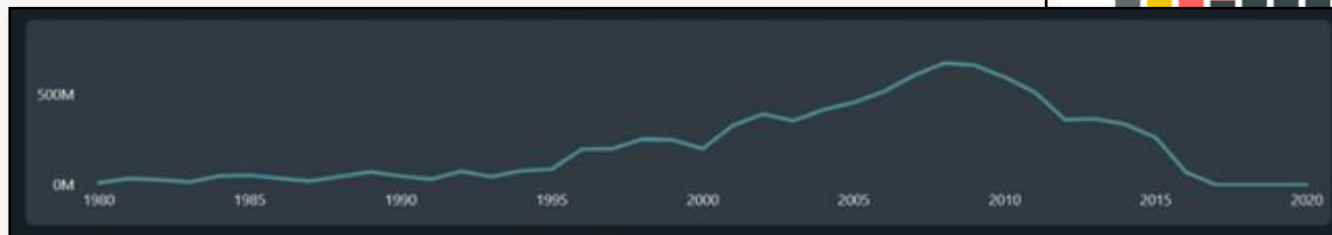




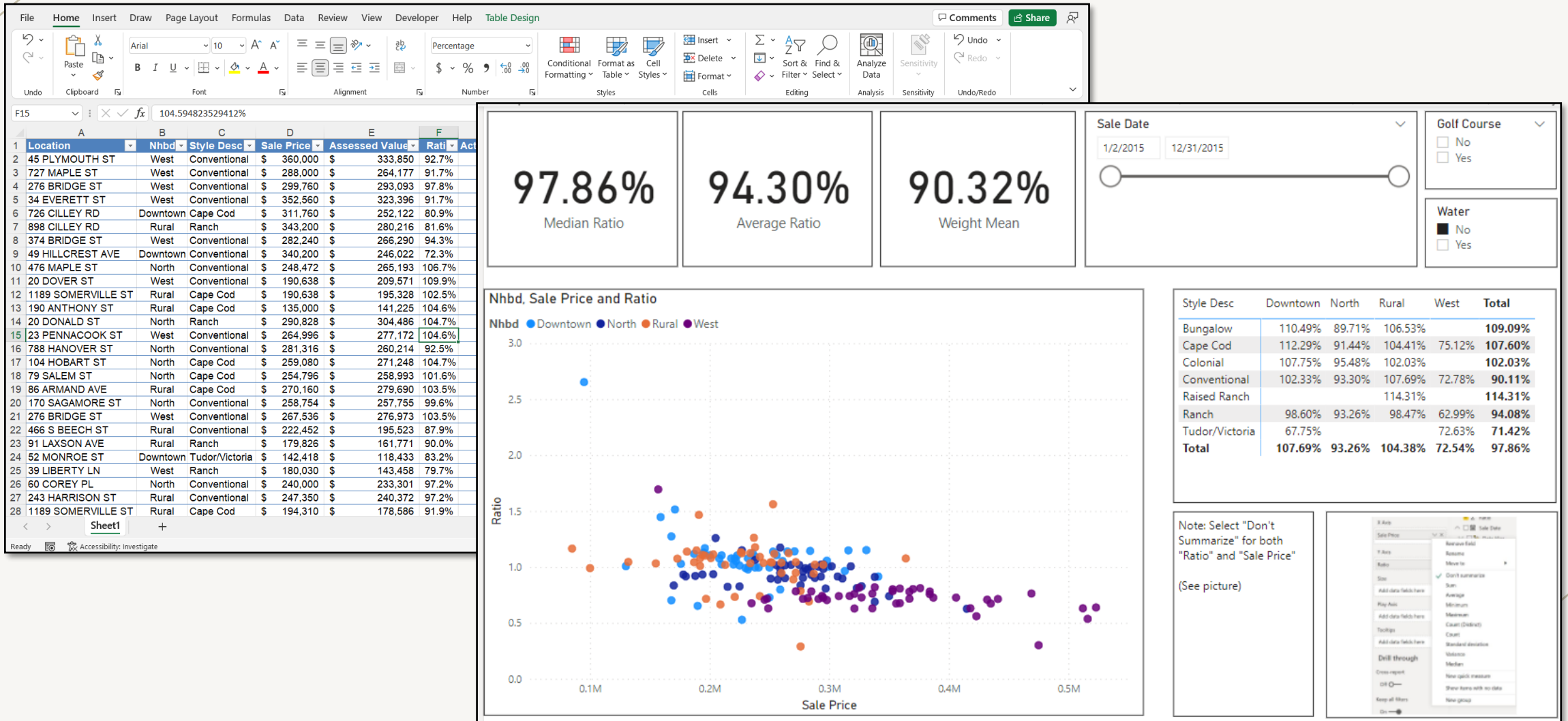
IN OTHER WORDS...

POWER BI UTILIZES **DASHBOARDS**
TO **VISUALLY** REPRESENT DATA.
IT CAN COMBINE MULTIPLE DATA
SOURCES INTO ONE **INTERACTIVE**
FORMAT THAT ALLOWS THE USER
TO DRAW CONCLUSIONS MORE
QUICKLY.

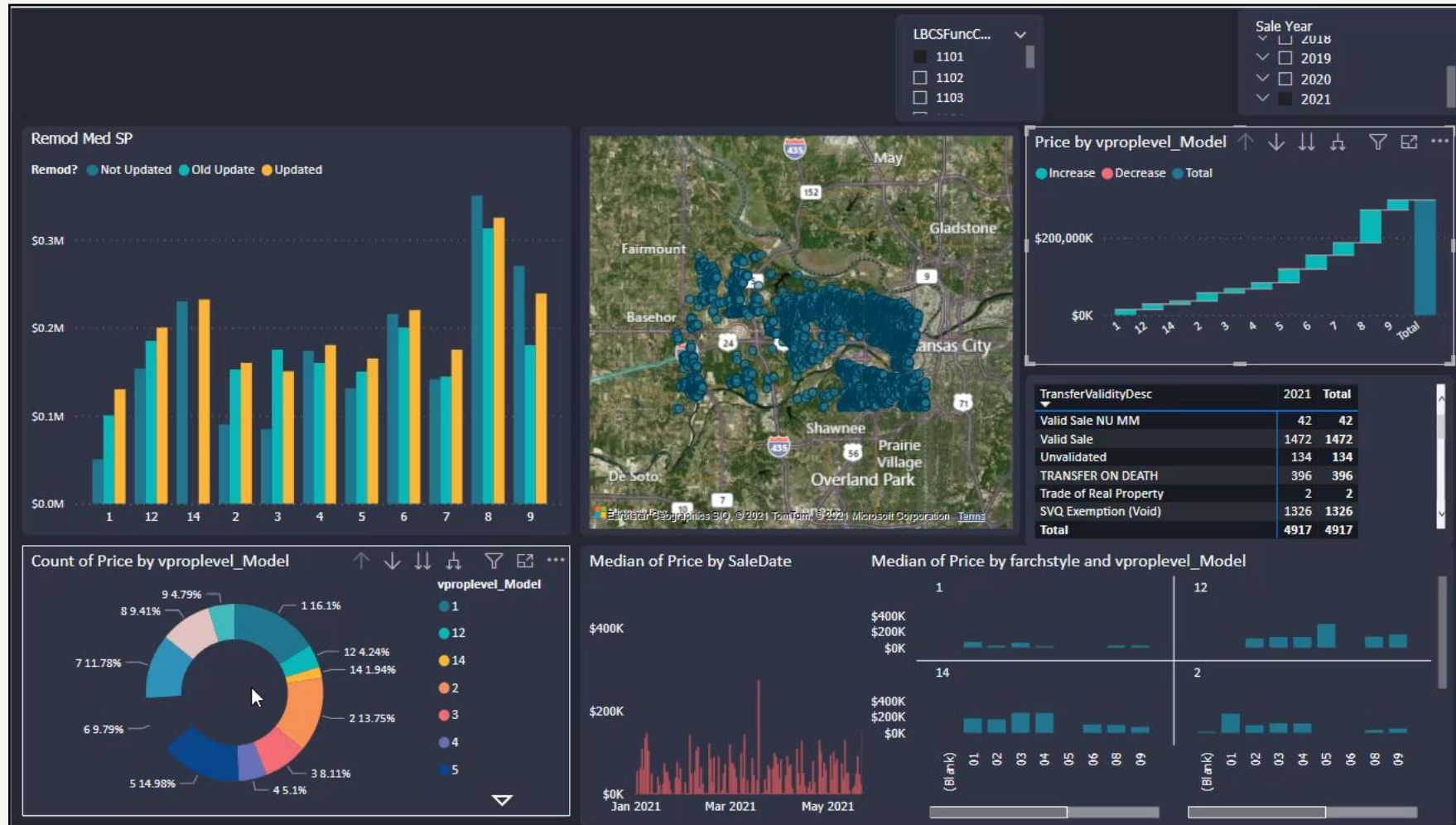
DASHBOARDS



VISUALIZATION



INTERACTIVE





WORKING WITH POWER BI

ADDING POWER BI

Power BI

Microsoft Fabric

Free account	Power BI Pro	Power BI Premium Per User	Power BI Embedded
Free	\$14.00 user/month, paid yearly	\$24.00 user/month, paid yearly	Variable
Try for free	Buy now	Buy now	See pricing Contact sales
Create rich, interactive reports that put visual analytics at your fingertips. • Included in Microsoft Fabric free account • No credit card required • Upgrade to Pro or Premium to share reports	Access Power BI reports shared with you and publish your own for an even bigger impact. • Publish and share Power BI reports • Included in Microsoft 365 E5 and Office 365 E5 • Available to buy now with a credit card¹	License data professionals with access to enterprise-scale features.² • Includes all the features available with Power BI Pro • Access larger model sizes • More frequent refreshes • Available to buy now with a credit card¹	Create customer-facing reports, dashboards, and analytics in your own applications. • Brand Power BI reports as your own • Automate monitoring, management, and deployment • Reduce developer overhead

ADDING POWER BI

 Microsoft

[Power Platform](#) [Power BI](#) [About Power Platform](#) [Solutions](#) [Products](#) [Pricing](#) [Partners](#) [Resources](#)

Get the Power BI tools and apps you need

 Gain a 360° view of your data and easily connect, shape, and share data insights with Power BI.

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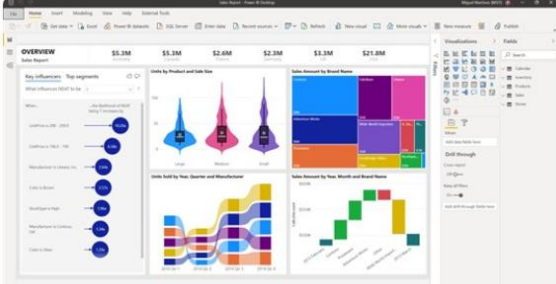
 **Power BI Desktop**
Microsoft Corporation
4.8 ★ 11K ratings Business

Power BI Desktop puts visual analytics at your fingertips. With this powerful authoring tool, you can create...

Open

 Everyone

Screenshots



BUILDING A DASHBOARD

The screenshot displays the Microsoft Power BI Desktop interface. The ribbon at the top includes tabs for File, Home, Insert, Modeling, View, and Help. The Home tab is active, showing various icons for data import (Get data, Excel, Power BI, SQL, Enter data, Dataverse, Recent sources), data transformation (Transform data, Refresh data), visualization creation (New visual, Text box, More visuals), calculations (New measure, Quick measure), and sharing (Publish, Share). The left navigation pane shows icons for Reports, Datasets, and Dataflows. The main workspace area contains the text "Add data to your report" and "Once loaded, your data will appear in the Fields pane." Below this text are four buttons: "Import data from Excel", "Import data from SQL Server", "Paste data into a blank table", and "Try a sample dataset". A link "Get data from another source →" is also present. The right-hand pane is divided into "Visualizations" and "Fields" sections. The Visualizations section shows a grid of chart types (Bar, Line, Pie, etc.) and options for Values, Drill through, Cross-report, and Keep all filters. The Fields section is currently empty.

File Home Insert Modeling View Help

Get data Excel Power BI SQL Enter data Dataverse Recent sources

Transform data Refresh data New visual Text box More visuals

New measure Quick measure Sensitivity Share

Visualizations

Build visual

Filters

Fields

Add data to your report

Once loaded, your data will appear in the Fields pane.

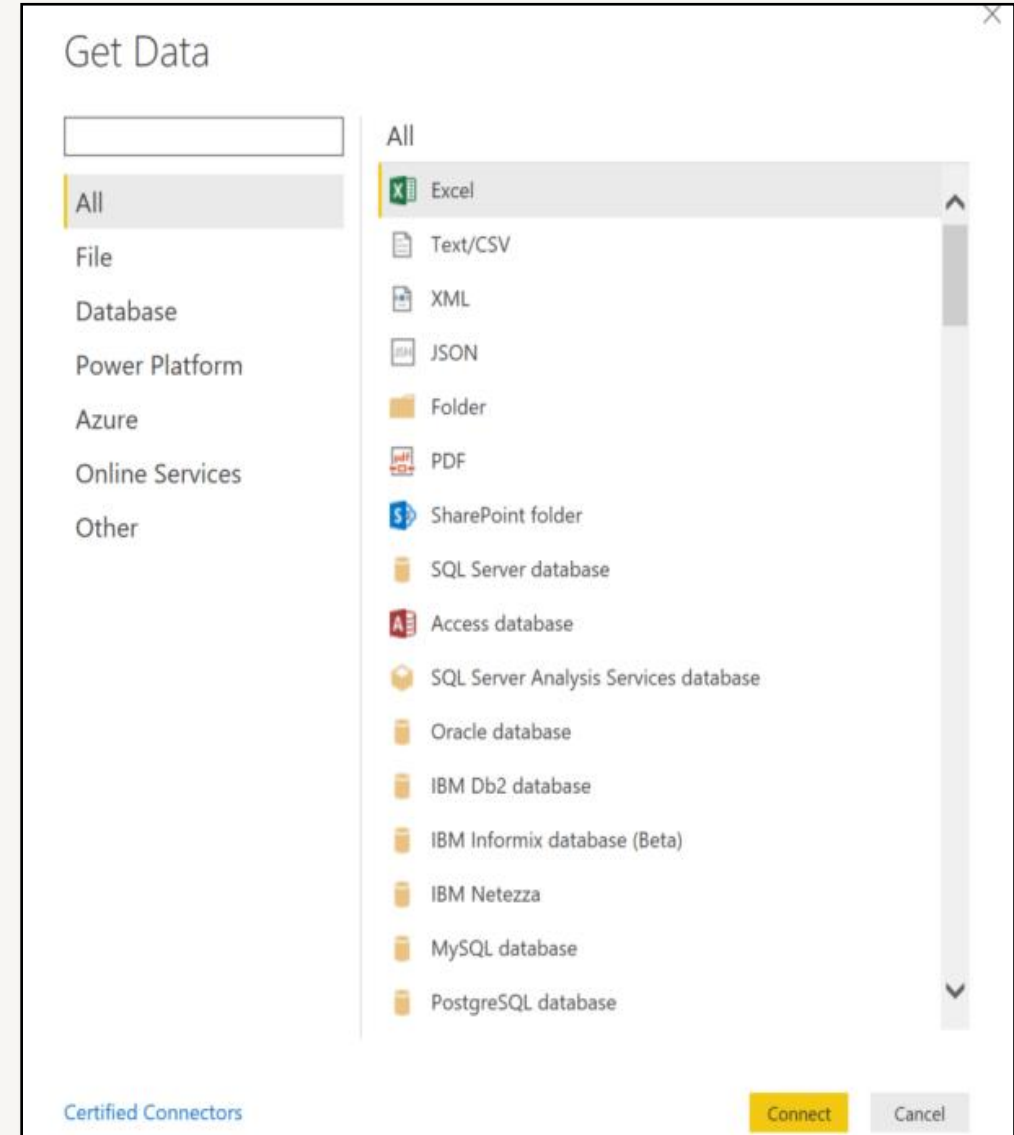
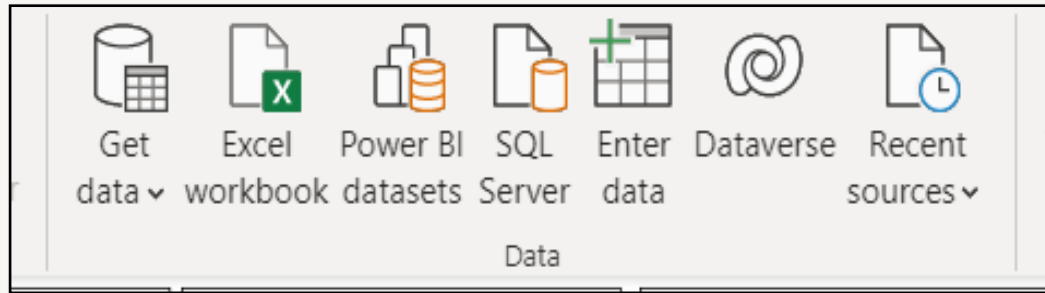
Import data from Excel Import data from SQL Server Paste data into a blank table Try a sample dataset

[Get data from another source →](#)

Page 1

Page 1 of 1

CONNECT DATA



CONNECT DATA

Navigator

Display Options ▾

📁 Downtown Row Sales.xlsx [1]

📄 Sheet1

Sheet1

FileHomeTransformAdd ColumnViewToolsHelp

Close & Apply ▾

New Source ▾

Recent Sources ▾

Enter Data

Data source settings

Manage Parameters ▾

Refresh Preview ▾

Properties

Advanced Editor

Choose Columns ▾

Remove Columns ▾

Keep Rows ▾

Remove Rows ▾

Sort

Split Column ▾

Group By

Data Type: Text ▾

Use First Row as Headers ▾

Replace Values

Merge Queries ▾

Append Queries ▾

Combine Files

Combine

Text Analytics

Vision

Azure Machine Learning

AI Insights

Queries [1]

Sheet1

This preview may be up to 19 days old.

Refresh

Table.TransformColumnTypes

#"Promoted Headers",{{"QUICK REF", type text}, {"Property Number", type text}, {"Situs Address",

	Sale Date	NMFVD	Sale Price	TASP	Occ	YEAR BUILT
1	2/12/2020	58	75000	89490	528	1940
2	2/5/2021	46	57500	66310	597	1871
3	4/5/2021	44	55000	63060	597	1900
4	5/7/2021	43	78500	89740	597	1910
5	5/25/2021	43	160000	182910	597	1922
6	8/2/2021	40	80000	90660	597	1915
7	8/20/2021	40	53000	60060	597	1900
8	9/23/2021	39	100000	112990	597	1900
9	10/6/2021	38	96000	108150	597	1870
10	11/3/2021	37	103000	115690	597	1920
11	12/13/2021	36	65000	72790	597	1961
12	12/27/2021	36	369500	369500	344	1875
13	8/23/2022	28	120000	131190	459	1900
14	9/2/2022	27	105000	114440	459	1890
15	12/15/2022	24	259900	280670	459	1924
16	1/3/2023	23	176500	190020	597	1877
17	7/21/2023	17	23000	24300	459	1910
18	8/3/2023	16	200000	210660	597	1900
19	8/24/2023	16	165000	173790	459	1890
20	8/29/2023	16	136000	143250	597	1890
21	9/1/2023	16	124000	130610	597	1888
22	8/5/2024	4	135000	136800	459	1857
23	8/19/2024	4	100000	101330	597	1920

Query Settings

PROPERTIES

Name

Sheet1

All Properties

APPLIED STEPS

Source

Navigation

Promoted Headers

✕ Changed Type

CONNECT DATA

File **Home** **Insert** **Modeling** **View** **Optimize** **Help**

Clipboard **Queries** **Insert** **Calculations** **Sensitivity** **Share** **Copilot**

Build visuals with your data
Select or drag fields from the **Data** pane onto the report canvas.

Visualizations
Build visual

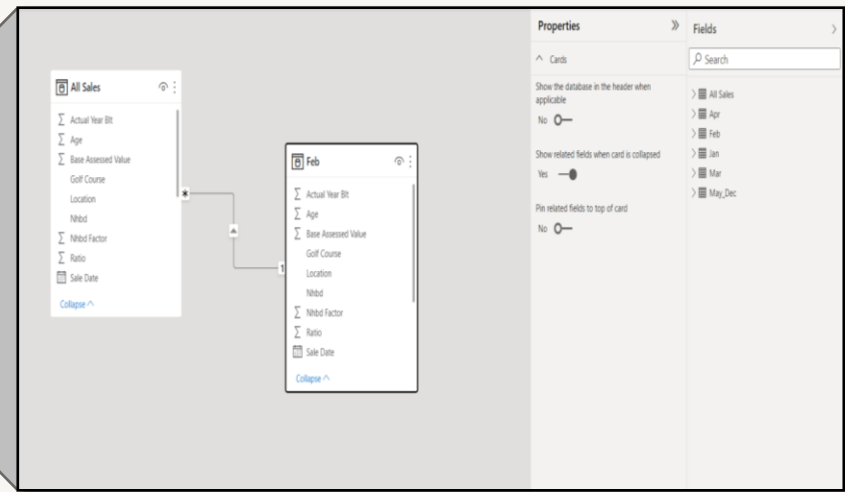
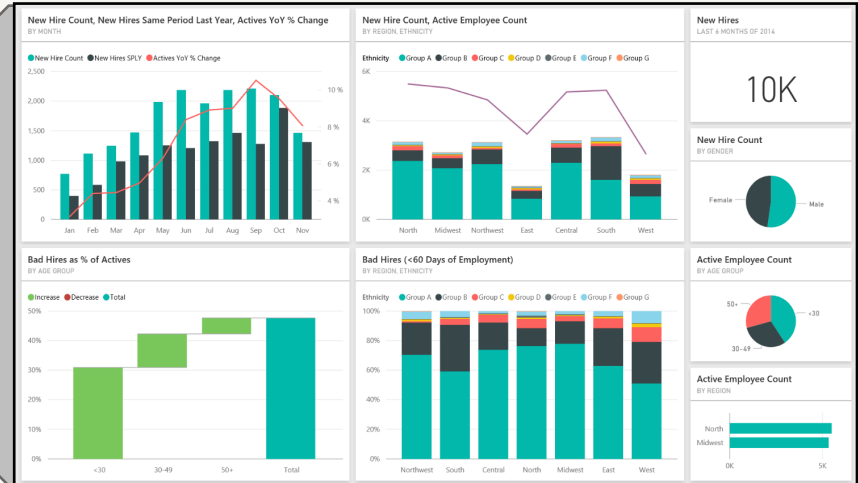
Data
Search

Sheet1

- ☐ FUN
- ☐ INVEST CLASS
- ☐ Σ NBHD
- ☐ Σ NMFVD
- ☐ Σ Occ
- ☐ PHY
- ☐ Property Number
- ☐ Σ PY INC Value
- ☐ QUICK REF
- ☐ RANK
- ☒ Sale Date
- ☐ Σ Sale Price
- ☐ Situs Address
- ☐ Σ SQ FT
- ☐ Σ TASP
- ☐ Σ Trend
- ☐ Σ Type
- ☐ Σ Val
- ☐ Σ YEAR BUILT

Page 1

Location	Nbhd	Style Desc	Sale Price	Base Assessed Value	Nbhd Factor	Style Factor	Ratio	Actual Year Bld	Age	Sale Date	Sale Month	Golf Course	Water
842 CONCORD ST	North	Conventional	288000	179000	2	1	0.830212703957447	1966	49	Monday, April 6, 2013	April	No	No
761 BELMONT ST	West	Conventional	384000	300000	2	1	0.78125	1920	95	Sunday, April 12, 2013	April	No	No
276 BRIDGE ST	West	Conventional	516000	277000	2	1	0.536621705426357	1960	55	Monday, April 23, 2013	April	No	No
788 HANOVER ST	North	Conventional	425000	260000	2	1	0.620306024096386	1991	24	Saturday, April 18, 2013	April	No	No
363 HARRISON ST	Rural	Conventional	294000	263000	2	1	1.12293162393182	1971	44	Saturday, April 18, 2013	April	No	No
36 ROSDALE AVE	West	Conventional	253000	283000	2	1	0.802699756713882	1975	40	Friday, April 24, 2013	April	No	No
90 CLOUGH AVE	Rural	Conventional	394000	390000	2	1	1.07961267692306	1999	16	Tuesday, April 28, 2013	April	No	No
142 CONCORD ST	North	Conventional	240000	155000	2	1	0.650666666666667	1964	49	Wednesday, February 21, 2013	February	No	No
7 BEECH ST	Downtown	Conventional	310000	381000	2	1	1.151057401051269	1972	43	Wednesday, February 28, 2013	February	No	No
39 HAMBLET ST	West	Conventional	261000	239000	2	1	0.763456140350677	2006	7	Friday, February 20, 2013	February	No	No
143 LINCOLN ST	West	Conventional	262000	204000	2	1	0.724040435339149	2000	13	Saturday, February 23, 2013	February	No	No
773 HANOVER ST	North	Conventional	294000	181000	2	1	0.610266666666667	1972	41	Sunday, February 24, 2013	February	No	No
604 HALL ST	Downtown	Conventional	220000	225000	2	1	1.02272727272727	1973	42	Monday, February 25, 2013	February	No	No
50 WATSON ST	Downtown	Conventional	130000	151000	2	1	1.00769230769231	1999	20	Thursday, January 8, 2013	January	No	No
219 VOUTTE ST	Rural	Conventional	227000	255000	2	1	1.12394801762115	2004	11	Friday, March 6, 2013	March	No	No
753 RAMMON ST	West	Conventional	308000	228000	2	1	0.74025974025974	1999	56	Monday, March 9, 2013	March	No	No
12 DUTTON ST	West	Conventional	489000	358000	2	1	0.763126226012793	1999	76	Friday, March 11, 2013	March	No	No
91 PROUT AVE	West	Conventional	327000	258000	2	1	0.72762674617797	2002	13	Sunday, March 22, 2013	March	No	No
117 WEBSTER ST	West	Conventional	386000	256000	2	1	0.763364763364762	1962	53	Tuesday, March 24, 2013	March	No	No
368 LAUREL ST	West	Conventional	376000	303000	2	1	0.8111702117093957	1960	55	Friday, March 27, 2013	March	No	No
374 BRIDGE ST	West	Conventional	257000	266000	2	1	1.06426715192357	1993	82	Thursday, May 7, 2013	May	No	No
49 HILLCREST AVE	Downtown	Conventional	223000	246000	2	1	1.10513901343291	1966	49	Friday, May 15, 2013	May	No	No
45 MORRISON ST	North	Conventional	275000	280000	2	1	1.01818181818182	1964	51	Tuesday, May 20, 2013	May	No	No
7 BEECH ST	Downtown	Conventional	356000	363000	2	1	1.14679417723129	1972	43	Wednesday, May 27, 2013	May	No	No
727 MAPLE ST	West	Conventional	426000	264000	2	1	0.61570947369421	1996	17	Sunday, May 31, 2013	May	No	No
46 PLYMOUTH ST	West	Conventional	324000	394000	2	1	0.848011169999847	1964	51	Thursday, June 4, 2013	June	No	No
107 MAPLE ST	North	Conventional	268000	273000	2	1	1.01861675642792	1965	50	Friday, June 5, 2013	June	No	No



Properties

Cards

Show the database in the header when applicable

No

Show related fields when card is collapsed

Yes

Pin related fields to top of card

No

Fields

Search

All Sales

Apr

Feb

Jan

Mar

May_Dec

CANVAS VIEW – DATA TABLE

File	Home	Help	Table tools
Name	All Sales	Mark as date table	Manage relationships
Structure	Calendars	Relationships	Calculations
		New measure	Quick measure
		New column	New table

Location	Nhbd	Style Desc	Sale Price	Base Assessed Value	Nhbd Factor	Style Factor	Ratio	Actual Year Blt	Age	Sale Date	Sale Month	Golf Course	Water
3 CONCORD ST	North	Conventional	188000	173000	1	1	0.920212765957447	1966	49	Monday, April 6, 2015	April	No	No
761 BELMONT ST	West	Conventional	384000	300000	1	1	0.78125	1920	95	Sunday, April 12, 2015	April	No	No
276 BRIDGE ST	West	Conventional	516000	277000	1	1	0.536821705426357	1960	55	Monday, April 13, 2015	April	No	No
788 HANOVER ST	North	Conventional	415000	260000	1	1	0.626506024096386	1991	24	Saturday, April 18, 2015	April	No	No
243 HARRISON ST	Rural	Conventional	234000	263000	1	1	1.12393162393162	1971	44	Saturday, April 18, 2015	April	No	No
26 ROSEDALE AVE	West	Conventional	353000	283000	1	1	0.801699716713881	1975	40	Friday, April 24, 2015	April	No	No
60 CLOUGH AVE	Rural	Conventional	364000	392000	1	1	1.07692307692308	1999	16	Tuesday, April 28, 2015	April	No	No
342 CONCORD ST	North	Conventional	180000	165000	1	1	0.916666666666667	1966	49	Wednesday, February 11, 2015	February	No	No
7 BEECH ST	Downtown	Conventional	331000	381000	1	1	1.15105740181269	1972	43	Wednesday, February 18, 2015	February	No	No
39 HAMBLET ST	West	Conventional	285000	223000	1	1	0.782456140350877	2008	7	Friday, February 20, 2015	February	No	No
745 UNION ST	West	Conventional	282000	204000	1	1	0.723404255319149	2000	15	Saturday, February 21, 2015	February	No	No
773 HANOVER ST	North	Conventional	194000	181000	1	1	0.93298969072165	1972	43	Sunday, February 22, 2015	February	No	No
604 HALL ST	Downtown	Conventional	220000	225000	1	1	1.02272727272727	1973	42	Monday, February 23, 2015	February	No	No
30 WATSON ST	Downtown	Conventional	130000	131000	1	1	1.00769230769231	1995	20	Thursday, January 8, 2015	January	No	No
219 JOLIETTE ST	Rural	Conventional	227000	255000	1	1	1.12334801762115	2004	11	Friday, March 6, 2015	March	No	No
753 RIMMON ST	West	Conventional	308000	228000	1	1	0.74025974025974	1959	56	Monday, March 9, 2015	March	No	No
12 DUTTON ST	West	Conventional	469000	358000	1	1	0.763326226012793	1939	76	Friday, March 13, 2015	March	No	No
91 PROUT AVE	West	Conventional	327000	238000	1	1	0.72782874617737	2002	13	Sunday, March 22, 2015	March	No	No
117 WEBSTER ST	West	Conventional	336000	256000	1	1	0.761904761904762	1962	53	Tuesday, March 24, 2015	March	No	No
168 LAUREL ST	West	Conventional	376000	305000	1	1	0.811170212765957	1960	55	Friday, March 27, 2015	March	No	No
374 BRIDGE ST	West	Conventional	157000	266000	1	1	1.69426751592357	1933	82	Thursday, May 7, 2015	May	No	No
49 HILLCREST AVE	Downtown	Conventional	223000	246000	1	1	1.10313901345291	1966	49	Friday, May 15, 2015	May	No	No
45 MORRISON ST	North	Conventional	275000	280000	1	1	1.01818181818182	1964	51	Tuesday, May 26, 2015	May	No	No
7 BEECH ST	Downtown	Conventional	316000	363000	1	1	1.14873417721519	1972	43	Wednesday, May 27, 2015	May	No	No
727 MAPLE ST	West	Conventional	418000	264000	1	1	0.631578947368421	1998	17	Sunday, May 31, 2015	May	No	No
45 PLYMOUTH ST	West	Conventional	523000	334000	1	1	0.638623326959847	1964	51	Thursday, June 4, 2015	June	No	No
707 MAPLE ST	North	Conventional	268000	273000	1	1	1.01865671641791	1965	50	Friday, June 5, 2015	June	No	No

Fields

Search

All Sales

Apr

Feb

Jan

Mar

May_Dec

CANVAS VIEW - LINK DATA TABLES

The screenshot displays the Power BI Canvas View interface for linking data tables. The ribbon at the top includes tabs for File, Home, and Help. The Home tab is active, showing various data source and query options. The main canvas area shows two data tables: 'All Sales' and 'Feb'. The 'All Sales' table is on the left, and the 'Feb' table is on the right. A red double-headed arrow indicates the relationship between the two tables. The 'Feb' table has a '1' next to it, indicating a one-to-many relationship. The 'All Sales' table has a list of fields: Actual Year Blt, Age, Base Assessed Value, Golf Course, Location, Nhbd, Nhbd Factor, Ratio, and Sale Date. The 'Feb' table has a list of fields: Actual Year Blt, Age, Base Assessed Value, Golf Course, Location, Nhbd, Nhbd Factor, Ratio, and Sale Date. The 'Feb' table is highlighted with a red border. The right sidebar shows the 'Properties' and 'Fields' panes. The 'Fields' pane has a search bar and a list of fields: All Sales, Apr, Feb, Jan, Mar, and May_Dec. The 'Properties' pane shows settings for 'Cards', including 'Show the database in the header when applicable' (set to No) and 'Show related fields when card is collapsed' (set to Yes). The 'Pin related fields to top of card' setting is also set to No.

CANVAS VIEW – REPORT VIEW

The screenshot displays the Power BI Canvas View interface. The top ribbon includes tabs for File, Home, Insert, Modeling, View, and Help. The Home tab is active, showing various icons for data sources, visualizations, and calculations. A red circle highlights the 'Visuals' icon in the left-hand pane. The main canvas area contains the text 'Build visuals with your data' and 'Select or drag fields from the Fields pane onto the report canvas.' Below this text is a diagram showing a dashed box representing a visual and a list of fields. On the right side, there is a 'Fields' pane with a list of fields, including 'SaleDate', 'SalePrice', 'SaleValidityCode', 'SaleYear', and 'SitusAddress'. A red box highlights the 'SaleDate' field in the Fields pane. Above the Fields pane is a large grid of visual icons, including bar charts, line charts, pie charts, and maps. The bottom status bar shows 'Page 1 of 1' and a zoom level of 83%.

File Home Insert Modeling View Help

Paste Cut Copy Format painter Clipboard

Get data Excel Power BI SQL Enter Data Dataserve Recent sources Transform Refresh data Queries New visual Text box More visuals Insert New measure Quick measure Sensitivity Publish

Build visuals with your data

Select or drag fields from the Fields pane onto the report canvas.

Fields

Drill through Cross-report Keep all filters Add drill-through fields here

☐ $\sum$ ftlcalc
☐ $\sum$ fyrblt
☐ $\sum$ NbhdCode
☐ NbhdDesc
☐ QuickRefID
> ☐ SaleDate
☐ $\sum$ SalePrice
☐ $\sum$ SaleValidityCode
☐ $\sum$ SaleYear
☐ SitusAddress

Page 1 of 1 83%

CREATE REPORT

File **Home** **Insert** **Modeling** **View** **Help**

New page **New visual** **More visuals** **Q&A** **Key influencers** **Decomposition tree** **Smart narrative** **Paginated report** **Power Apps** **Power Automate (preview)** **Text box** **Buttons** **Shapes** **Image** **Add a sparkline**

Pages Visuals AI visuals Power Platform Elements Sparklines

Build visuals with your data
Select or drag fields from the **Fields** pane onto the report canvas.

Visualizations **Fields**

Build visual

Filters

Values
Add data fields here

Drill through
Cross-report **Off**
Keep all filters **On**
Add drill-through fields here

Fields
Search

ResCompFinder

- ☐ Σ Bed
- ☐ BSMT Type
- ☐ CDU
- ☐ Σ Full Bath
- ☐ Σ Half Bath
- ☐ Σ Living Units
- ☐ Measure
- ☐ NBHD
- ☐ NBHD Description
- ☐ PH Cond
- ☐ Quality
- ☐ Quick Ref
- ☐ Res Type
- ☐ Sale Date
- ☐ Σ Sale Price
- ☐ Sale Year
- ☐ Situs Address
- ☐ SP/TLA
- ☐ Style
- ☐ Σ TLA
- ☐ Validity
- ☐ Σ YR Built

Page 1

CREATE REPORT

\$125,500
Median of Sale Price

\$139,132
Average of Sale P...

\$4,000
Min of Sale Price

\$615,000
Max of Sale Price

\$93
Median of SP/TLA

\$98
Average of SP/TLA

\$3
Min of SP/TLA

\$538
Max of SP/TLA

Quick Ref	Situs Address	Sale Date	Sale Price	SP/TLA
R3704	987 ROAD 220, Emporia, KS 66801	8/31/2019	\$425,000	\$166
R3700	976 ROAD 220, Emporia, KS 66801	5/4/2021	\$274,900	\$191
R6119	957 WHILDIN, Emporia, KS 66801	4/16/2018	\$108,500	\$61
R5930	947 WHITTIER, Emporia, KS 66801	3/6/2019	\$107,000	\$107
R5930	947 WHITTIER, Emporia, KS 66801	6/4/2019	\$111,000	\$111
R6898	947 OXFORD DRIVE, Emporia, KS 66801	6/24/2020	\$151,000	\$85
R6898	947 OXFORD DRIVE, Emporia, KS 66801	11/4/2021	\$161,000	\$90
R5929	945 WHITTIER, Emporia, KS 66801	10/14/2021	\$137,900	\$115
R7295	942 CAPEFIELD, Emporia, KS 66801	8/14/2019	\$257,000	\$207

Sale Date

1/4/2018 4/21/2022

Quality

☐ 1.15
☐ 1.33
☐ 1.67
☐ 2
☐ 2.33

CDU

☐ 1
☐ 10
☐ 11
☐ 12
☐ 13

PH C...

☐ 1
☐ 1.25
☐ 1.4
☐ 1.5
☐ 1.75

Bed

110

Full Bath

6

BSMT...

☐ 1
☐ 2
☐ 3
☐ 4
☐ 5

YR Built

18702021

Living Units

111

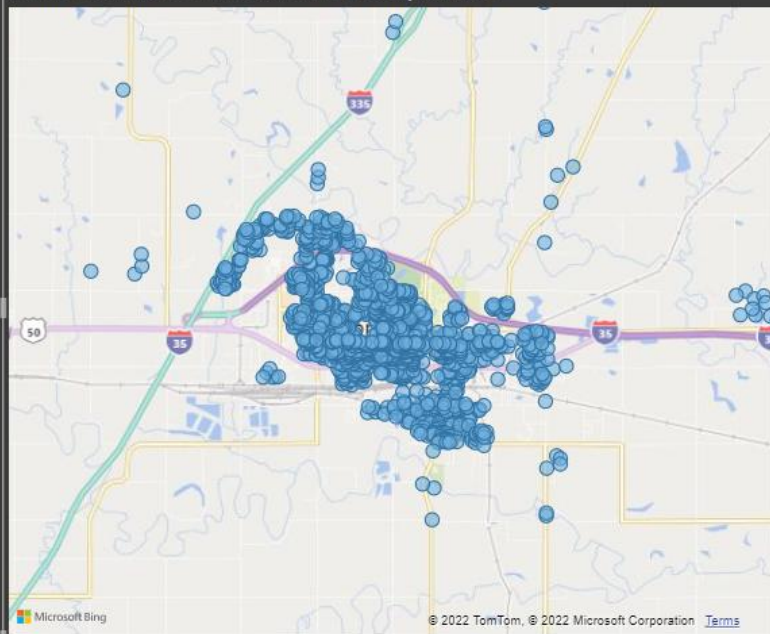
NBHD

☐ Select all
☐ (Blank)
☐ 100
☐ 105
☐ 110

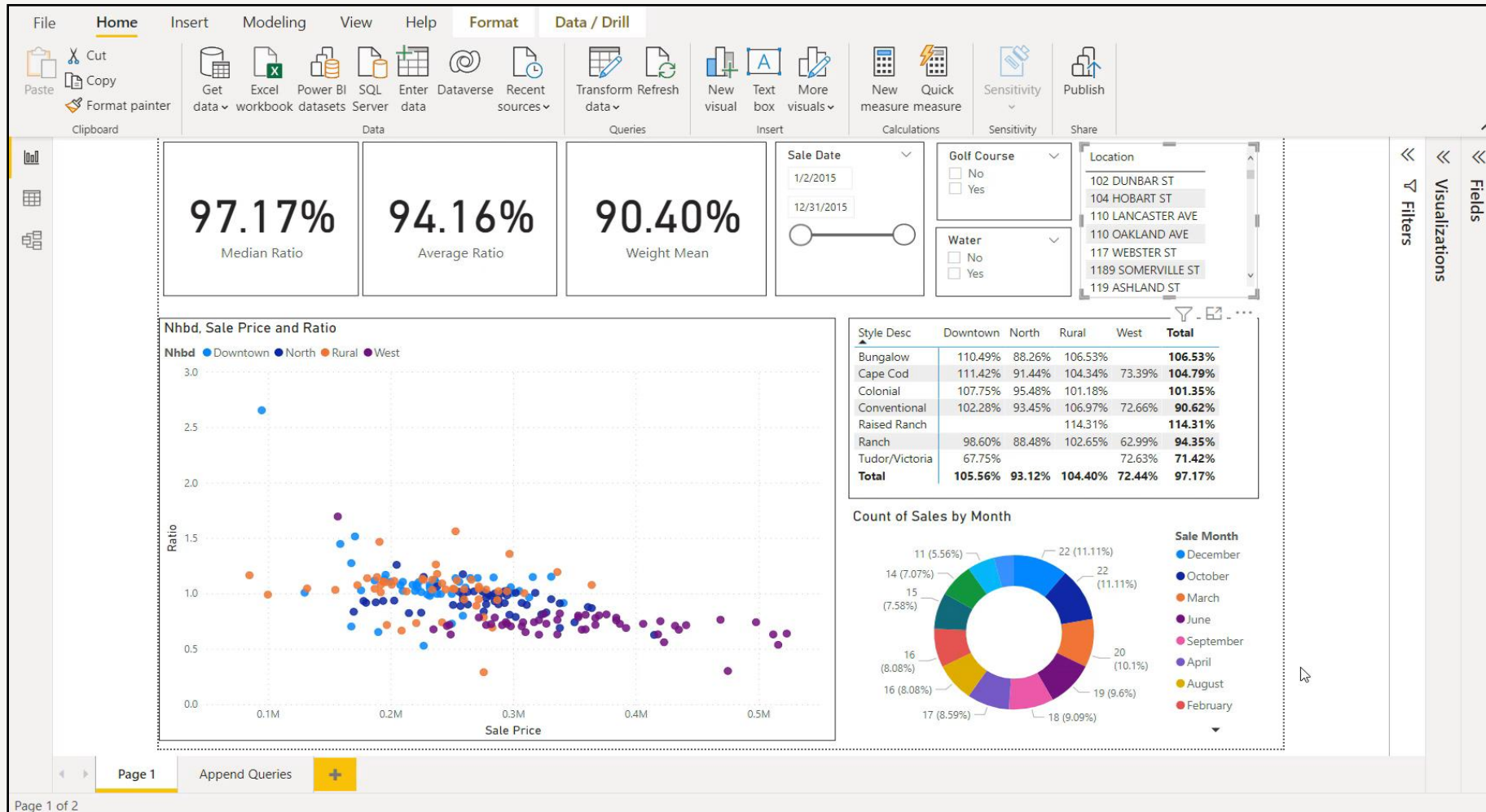
TLA

4405204

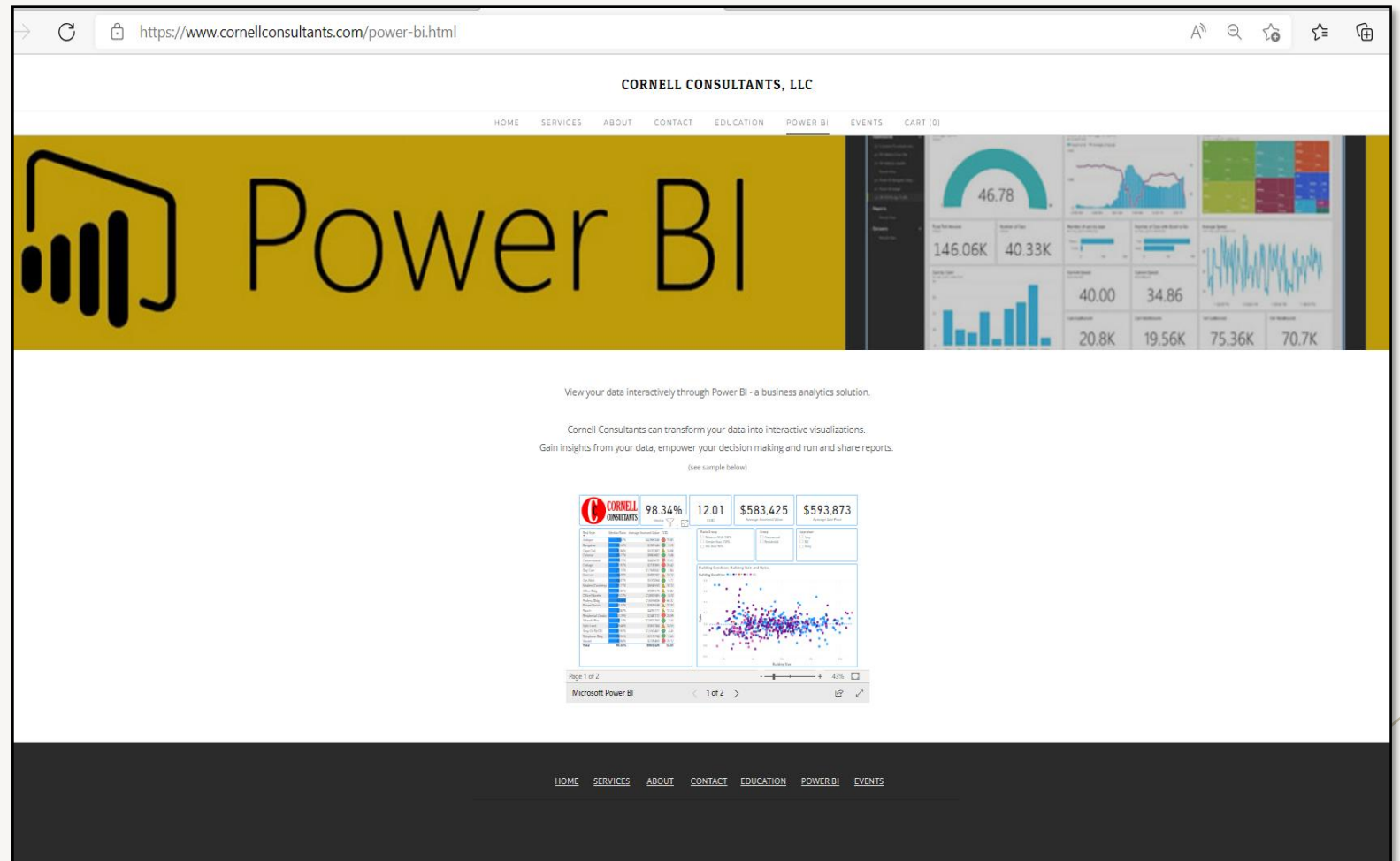
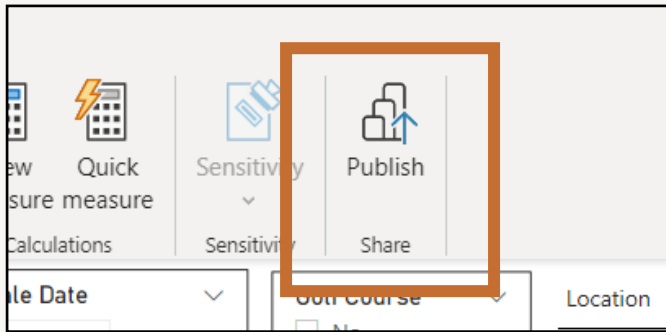
Situs Location of Residential Comparable



INTERACT AND SHARE



INTERACT AND SHARE





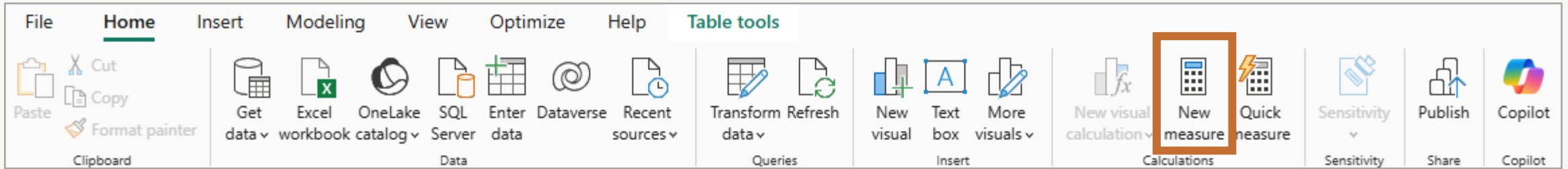


DAX FUNCTIONS

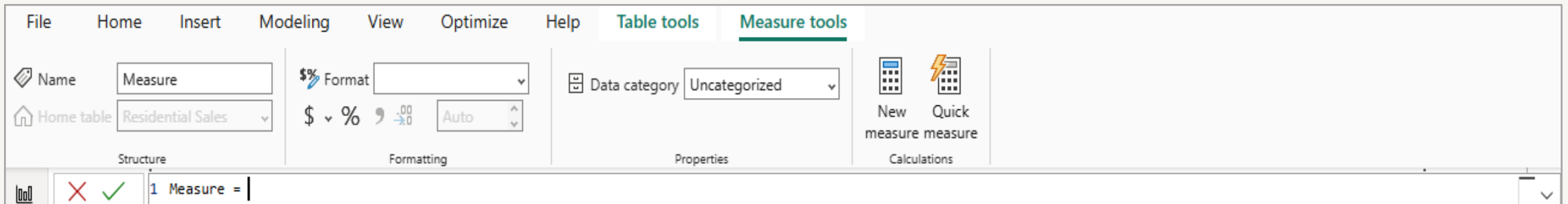
DAX

- DAX – Data Analysis Expressions
- Set of functions, operators, and constants that can be used for data visualization, modeling and analysis
- Allows users to write efficient, flexible computations
- DAX Library includes over 250 functions that can be combined to create calculations
- Functions can be categorized in to various types, for example
 - Aggregation Functions – SUM, AVERAGE, COUNT
 - Logical Functions – IF, SWITCH, AND, OR
 - Statistical Functions – LINEST, RANKEQ, PERCENTILE.EXC

CREATING A DAX MEASURE



- On the Power BI Toolbar, click “New measure”
 - Can be found on “Home” or “Modeling” tabs



- The “Measure tools” Tab will appear

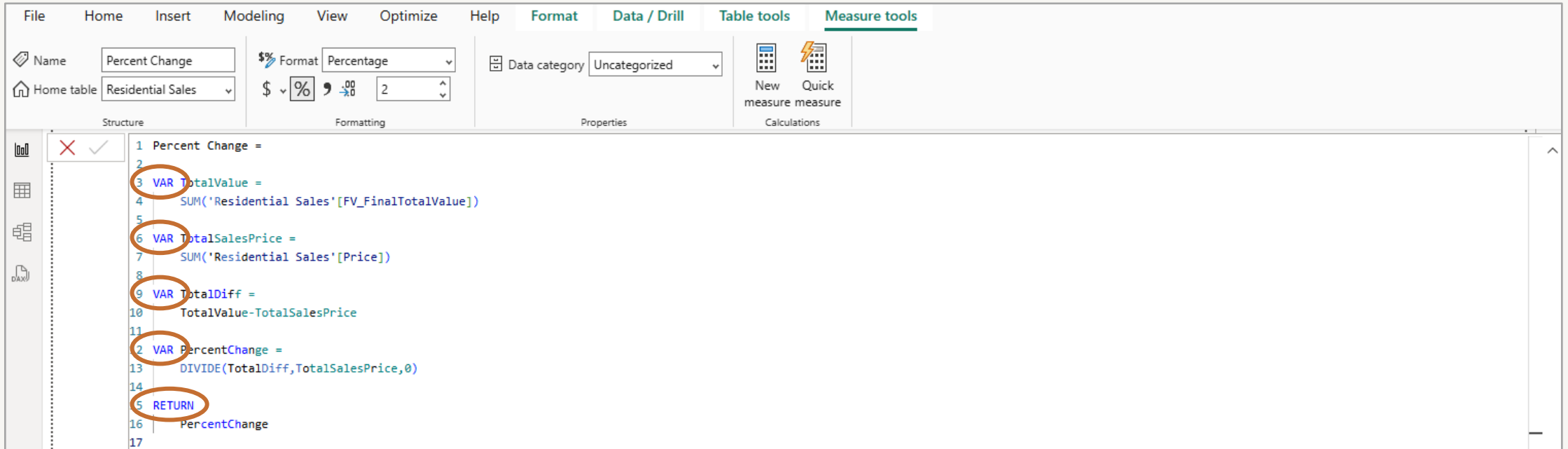
CREATING A DAX MEASURE

The screenshot shows the 'Measure tools' tab in the Excel ribbon. The 'Name' field is set to 'Measure', 'Home table' is 'Residential Sales', and 'Data category' is 'Uncategorized'. The formula bar shows '1 Measure ='.

- First – Name the Measure
- Next – Enter Function (i.e. SUM, AVERAGE, MEDIAN)
- Finally – Follow prompts and enter related tables, column names, or constants

The screenshot shows the 'Measure tools' tab in the Excel ribbon. The 'Name' field is set to 'Median Sales Ratio', 'Home table' is 'Residential Sales', and 'Data category' is 'Uncategorized'. The formula bar shows '1 Median Sales Ratio = MEDIAN('Residential Sales'[Sales Ratio])'.

CREATING A COMPLEX DAX MEASURE



- More complex functions can be written with helper variables with the keyword VAR
- This can make complex functions more readable and efficient
- Each step in the calculation can be defined as new variable VAR
- Once the calculation is complete utilize the RETURN call to display the desired output



DAX FOR APPRAISERS

- Sales Ratio
 - Median and Average
 - Minimum and Maximum
 - Coefficient of Dispersion (COD)
 - Weighted Mean
 - Price Related Differential (PRD)
 - Standard Deviation
 - Confidence Intervals and Confidence Levels
 - Outlier Detection
- 

RATIO FUNCTIONS

Sales Ratio

```
1 Sales Ratio = 'Residential Sales'[FV_FinalTotalValue]/'Residential Sales'[Price]
```

Calculate Sales Ratio by Dividing
Appraised or Market Value by Sales Price

This calculation can be made in the worksheet before it is imported into Power BI, but making the calculation with a measure in Power BI may save a step in prepping data for import

Median

```
1 Median Sales Ratio = MEDIAN('Residential Sales'[Sales Ratio])
```

Calculate Median Sales Ratio

Mean/Average

```
1 Average Sales Ratio = AVERAGE('Residential Sales'[Sales Ratio])
```

Calculate Average Sales Ratio

RATIO FUNCTIONS

Minimum

```
1 Minimum Sales Ratio = MIN('Residential Sales'[Sales Ratio])
```

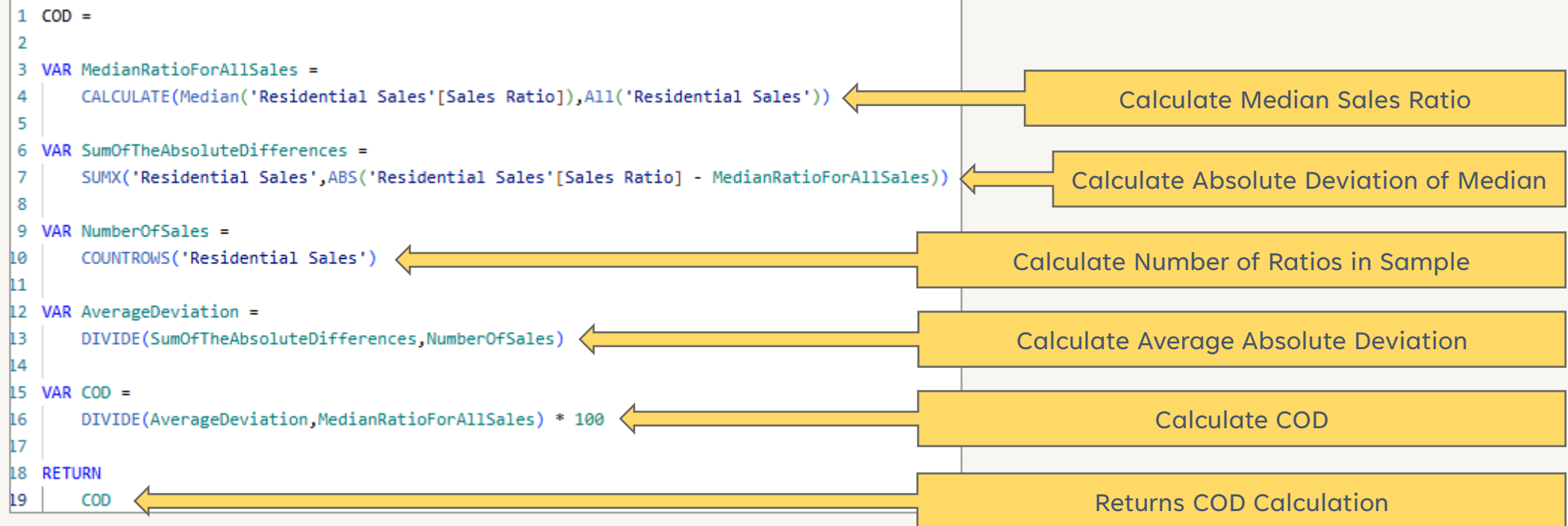
Calculate Minimum Sales Ratio

Maximum

```
1 Maximum Sales Ratio = MAX('Residential Sales'[Sales Ratio])
```

Calculate Maximum Sales Ratio

COD FUNCTION



WEIGHTED MEAN FUNCTION

```
1 Weighted Mean = SUM('Residential Sales'[FV_FinalTotalValue])/SUM('Residential Sales'[Price])
```

Calculate Weighted Mean Ratio as a single calculation, by dividing the sum of the total appraised values by the sum of the total sales price

OR

```
1 Weighted Mean Ratio =
```

```
2
```

```
3 VAR SumOfAppraised =
```

```
4   SUMX('Residential Sales',[FV_FinalTotalValue])
```

```
5
```

```
6 VAR SumOfSales =
```

```
7   SUMX('Residential Sales',[Price])
```

```
8
```

```
9 VAR WeightedMeanRatio =
```

```
10  DIVIDE(SumOfAppraised,SumOfSales)
```

```
11
```

```
12 RETURN
```

```
13  WeightedMeanRatio
```

Calculate the sum of the total appraised values

Calculate the sum of the total sales price

Divide the sum of the appraised by the sum of the sales price

Return the Weighted Mean Ratio

PRD FUNCTION

```
1 Average Sales Ratio = AVERAGE('Residential Sales'[Sales Ratio])
```

Calculate Average Sales Ratio

```
1 Weighted Mean = SUM('Residential Sales'[FV_FinalTotalValue])/SUM('Residential Sales'[Price])
```

Calculate Weighted Mean Ratio

```
1 PRD = 'Residential Sales'[Average Sales Ratio]/'Residential Sales'[Weighted Mean]
```

Calculate PRD

OR

```
1 Price Related Differential =
```

```
2
```

```
3 VAR AverageSalesRatio =
```

```
4   AVERAGE('Residential Sales'[Sales Ratio])
```

```
5
```

```
6 VAR WeightedMean =
```

```
7   (SUM('Residential Sales'[FV_FinalTotalValue]))/(SUM('Residential Sales'[Price]))
```

```
8
```

```
9 VAR PriceRelatedDifferential =
```

```
10  DIVIDE(AverageSalesRatio,WeightedMean)
```

```
11
```

```
12 RETURN
```

```
13  PriceRelatedDifferential
```

Calculate Average Sales Ratio

Calculate Weighted Mean Ratio

Calculate PRD

Returns PRD Calculation

STANDARD DEVIATION FUNCTION

```
1 Standard Deviation = STDEV.P('Residential Sales'[Sales Ratio])
```

Calculate the Standard Deviation

```
1 +2 Standard Deviation =
```

```
2
```

```
3 VAR TwoDev =
```

```
4   CALCULATE([Standard Deviation] * 2)
```

```
5
```

```
6 VAR PlusTwoDev =
```

```
7   CALCULATE([Average Sales Ratio] + TwoDev)
```

```
8
```

```
9 RETURN
```

```
10 PlusTwoDev
```

Call Standard Deviation Measure and Multiply by 2

Add 2 Standard Deviations to the Average

Return Result within +2 Standard Deviations of the Average

```
1 -2 Standard Deviation =
```

```
2
```

```
3 VAR TwoDev =
```

```
4   CALCULATE([Standard Deviation] * 2)
```

```
5
```

```
6 VAR MinusTwoDev =
```

```
7   CALCULATE([Average Sales Ratio] - TwoDev)
```

```
8
```

```
9 RETURN
```

```
10 MinusTwoDev
```

Call Standard Deviation Measure and Multiply by 2

Subtract 2 Standard Deviations from the Average

Return Result within -2 Standard Deviations of the Average

*When data is normally distributed, 95% of the results will fall within 2 standard deviations of the mean/average

CONFIDENCE INTERVAL FUNCTION

```
1 Rent Confidence Interval =  
2  
3 VAR RentStanDev =  
4   STDEV.p(DowntownRow[PGI PER SF])  
5  
6 VAR RentCount =  
7   COUNT(DowntownRow[PGI PER SF])  
8  
9 VAR RentConfidenceInterval =  
10  CONFIDENCE.NORM(0.05,RentStanDev,RentCount)  
11  
12 RETURN  
13  RentConfidenceInterval
```

Calculate the Standard Deviation

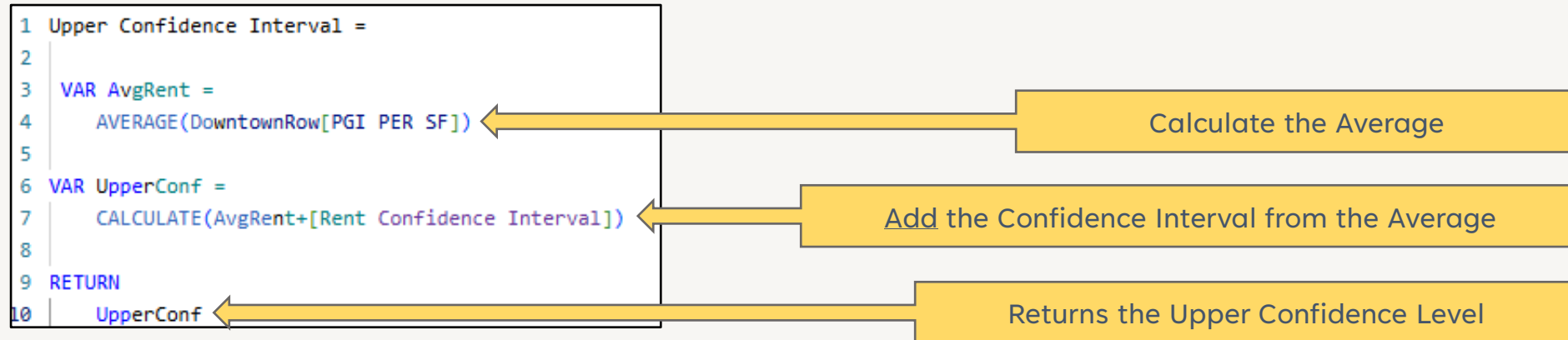
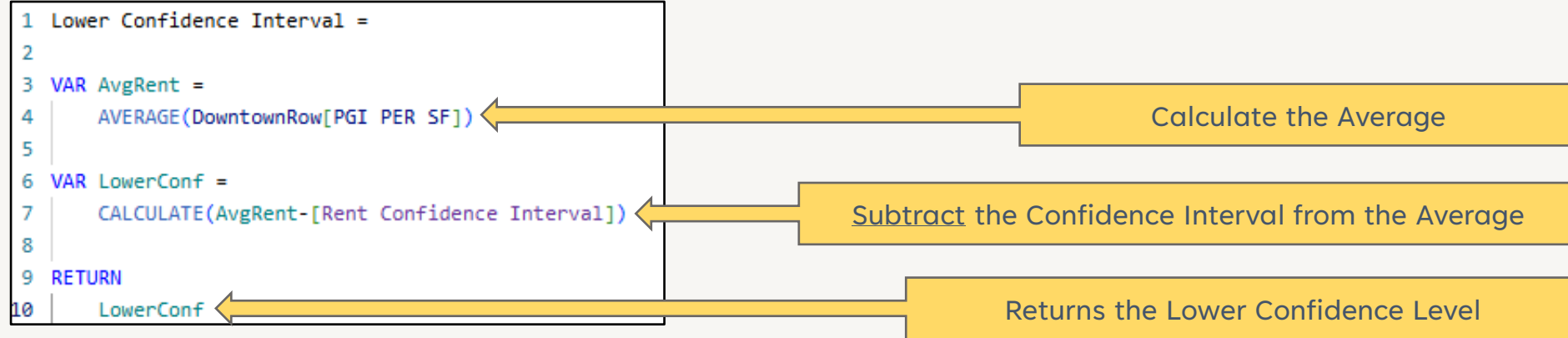
Calculate the count in the data set

Calculate the Confidence Interval

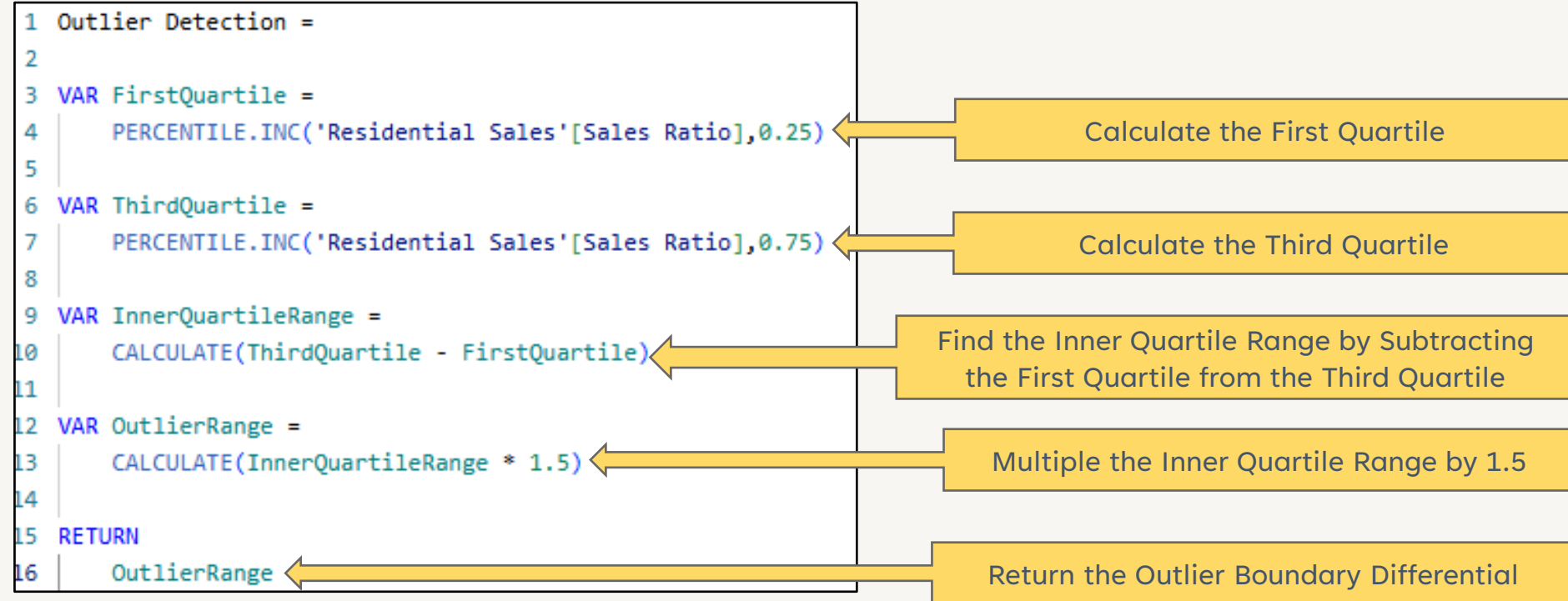
*The 0.05 represents the level of confidence, in this case its calculated at 95%

Calculate the Confidence Level

CONFIDENCE LEVEL FUNCTION



OUTLIER DETECTION FUNCTION



Refer to the IAAO Standard on Ratio Studies for more information on the $1.5 \times \text{IQR}$ technique of identifying/trimming outliers

OUTLIER DETECTION FUNCTION

```
1 Lower Outlier Trim =  
2  
3 VAR FirstQuartile =  
4   PERCENTILE.INC('Residential Sales'[Sales Ratio],0.25)  
5  
6 VAR LowerOutlier =  
7   CALCULATE(FirstQuartile - [Outlier Detection])  
8  
9 RETURN  
10  LowerOutlier
```

Calculate the First Quartile

Subtract the Outlier Differential from the First Quartile

Return the Lower Outlier Range

```
1 Upper Outlier Trim =  
2  
3 VAR ThirdQuartile =  
4   PERCENTILE.INC('Residential Sales'[Sales Ratio],0.75)  
5  
6 VAR UpperOutlier =  
7   CALCULATE(ThirdQuartile + [Outlier Detection])  
8  
9 RETURN  
10  UpperOutlier
```

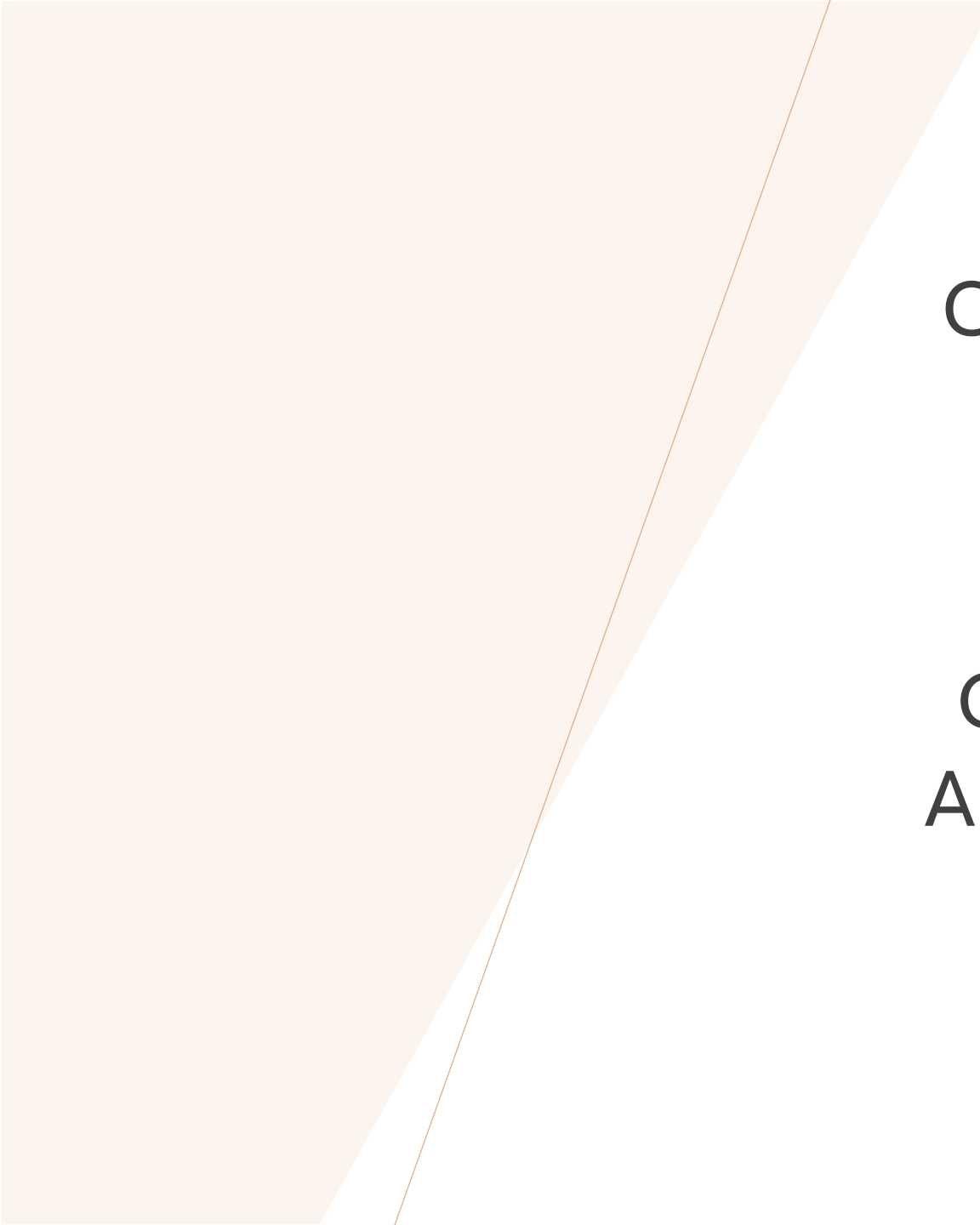
Calculate the Third Quartile

Add the Outlier Differential to the Third Quartile

Return the Upper Outlier Range

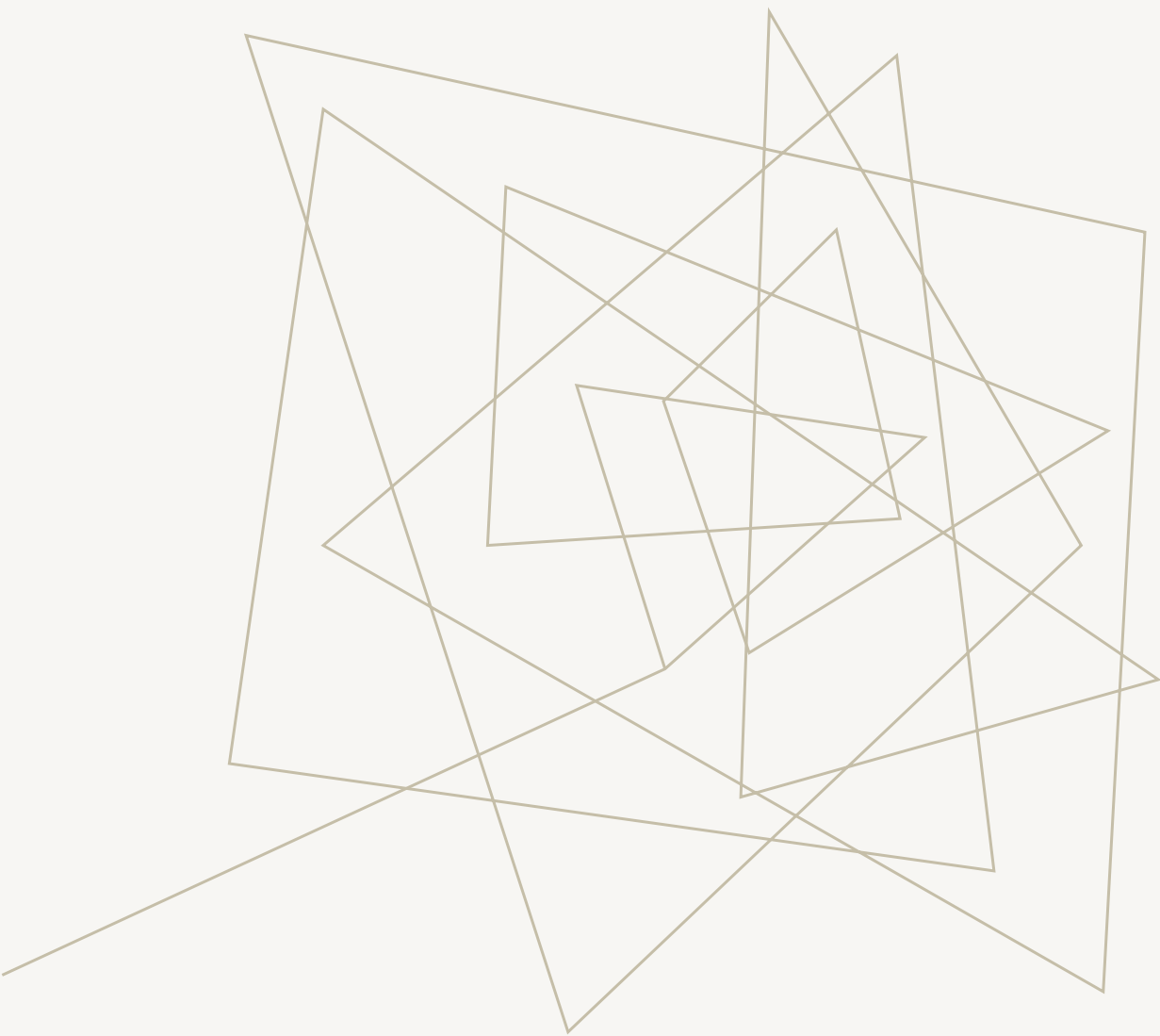
GIVE ME MORE!





CAN POWER BI BE MORE
THAN A DATA
VISUALIZATION TOOL?

CAN IT ALSO BE A DATA
ANALYSIS AND VALUTION
TOOL?



REGRESSION ANALYSIS

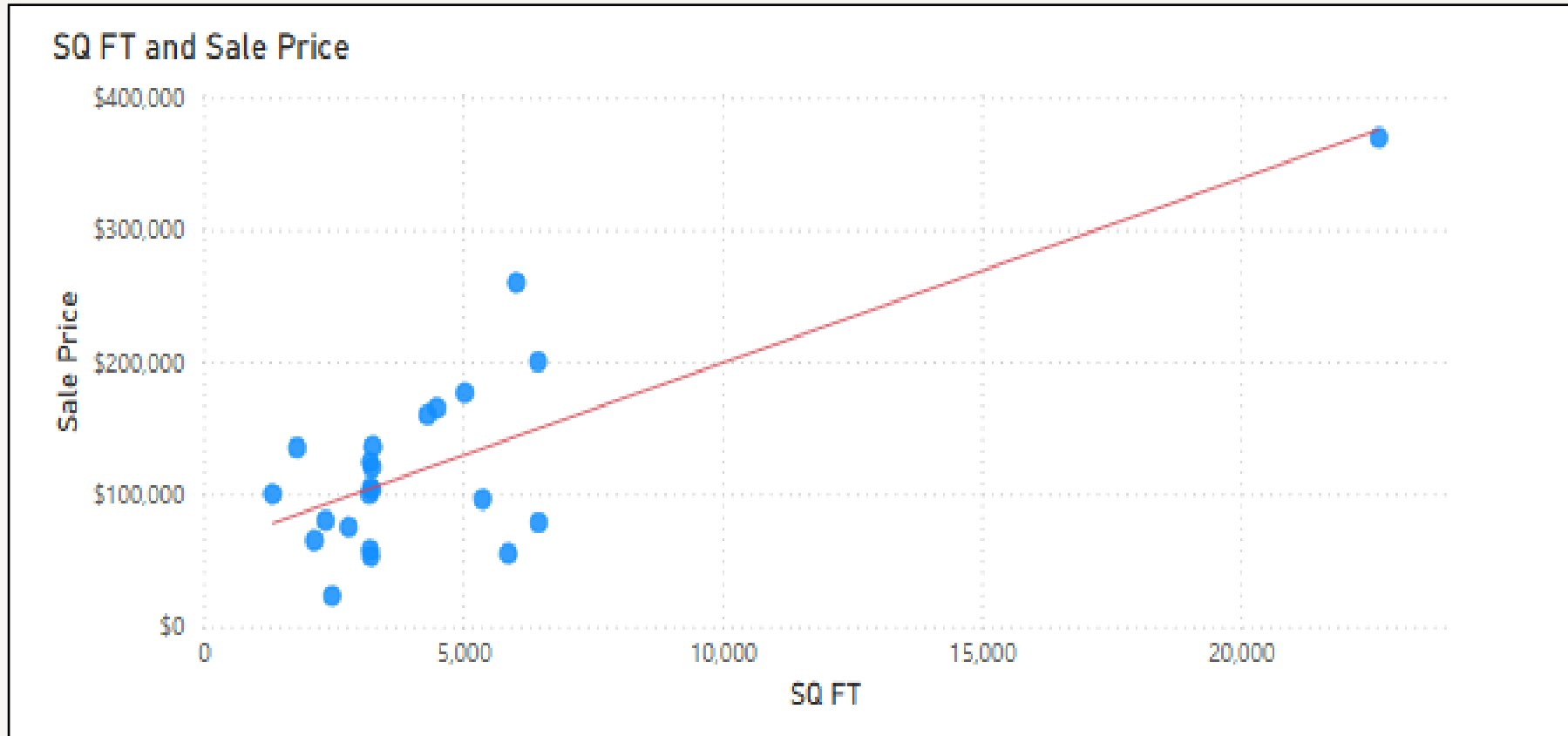
WHAT IS REGRESSION

- Statistical model used to estimate the relationship between a dependent variable and one or more independent variables
- Linear Regression
 - Use one variable
 - $Y = \text{constant} + (\text{coefficient} * X)$, better known as $Y = MX + C$
- Multiple Regression
 - Uses two or more variables
 - $Y = \text{constant} + (\text{coefficient}_1 * X_1) + (\text{coefficient}_2 * X_2) + \dots + (\text{coefficient}_n * X_n)$

REGRESSION IN POWER BI

- DAX Functions LINEST and LINESTX
- LINEST Function
 - Uses the Least Squares method to calculate a straight line that best fits the given data
 - Returns a table describing the line
 - The equation for the line is of the form: $Y = \text{Slope}_1 * X_1 + \text{Slope}_2 * X_2 + \dots + \text{Intercept}$
- LINESTX Function
 - Uses the Least Squares method to calculate a straight line that best fits the given data
 - Returns a table describing the line
 - The data result from expressions evaluated for each row in a table
 - The equation for the line is of the form: $Y = \text{Slope}_1 * X_1 + \text{Slope}_2 * X_2 + \dots + \text{Intercept}$

LINSTX FUNCTION EXAMPLE



File

Home

Help

Table tools

Paste

Cut

Copy

Get data

Excel workbook

OneLake catalog

SQL Server

Enter data

Dataaverse

Recent sources

Transform data

Refresh data

Manage relationships

New measure

Quick measure

New column

New table

Manage roles

View as

Sensitivity

Share

Clipboard

Data

Queries

Relationships

Calculations

Security

Sensitivity

Share

QUICK REF

Property Number

Situs Address

NBHD

Trend

Val

Type

Sale Date

NMFVD

Sale Price

TASP

Occ

YEAR BUILT

SQ FT

RANK

PHY

FUN

INVEST CLASS

PY INC Value

M

R12198

056-195-15-0-10-35-003.00-0

120 COMMERCIAL, Emporia, KS 66801

970

0.3330%

0

2

2/12/2020

58

\$75,000

\$89,490

528

1940

2,800

FR+

GD

FR

B

\$91,300

R12292

056-195-15-0-20-01-007.00-0

507 COMMERCIAL, Emporia, KS 66801

960

0.3330%

0

2

2/5/2021

46

\$57,500

\$66,310

597

1871

3,214

AV

FR

FR

C

\$83,400

R12067

056-195-15-0-10-21-010.00-0

312 COMMERCIAL, Emporia, KS 66801

960

0.3330%

3

2

4/5/2021

44

\$55,000

\$63,060

597

1900

5,873

AV-

AV

PR

C

\$57,500

R12483

056-195-15-0-20-15-010.00-0

325 COMMERCIAL, Emporia, KS 66801

960

0.3330%

3

2

5/7/2021

43

\$78,500

\$89,740

597

1910

6,460

AV

AV

PR

C

\$76,200

R9488

056-192-10-0-30-29-008.00-0

715 COMMERCIAL, Emporia, KS 66801

960

0.3330%

3

2

5/25/2021

43

\$160,000

\$182,910

597

1922

4,322

AV

GD

AV

A

\$168,500

R12583

056-195-15-0-20-28-009.00-0

201 COMMERCIAL, Emporia, KS 66801

970

0.3330%

0

2

8/2/2021

40

\$80,000

\$90,660

597

1915

2,350

AV

AV

AV

C

\$61,000

R12063

056-195-15-0-10-21-006.00-0

322 COMMERCIAL, Emporia, KS 66801

960

0.3330%

0

2

8/20/2021

40

\$53,000

\$60,060

597

1900

3,226

AV

AV

FR

C

\$83,800

R10063

056-192-10-0-40-36-005.00-0

616 COMMERCIAL, Emporia, KS 66801

960

0.3330%

3

2

9/23/2021

39

\$100,000

\$112,990

597

1900

3,197

AV

GD+

AV

B

\$104,300

R12471

056-195-15-0-20-14-015.00-0

417 COMMERCIAL, Emporia, KS 66801

960

0.3330%

0

2

10/6/2021

38

\$96,000

\$108,150

597

1870

5,380

AV

AV

FR

C

\$96,200

R10051

056-192-10-0-40-35-008.00-0

708 COMMERCIAL, Emporia, KS 66801

960

0.3330%

3

2

11/3/2021

37

\$103,000

\$115,690

597

1920

3,250

AV

GD

AV

A

\$141,000

R12754

056-195-15-0-20-42-012.00-0

9 COMMERCIAL, Emporia, KS 66801

970

0.3330%

0

2

12/13/2021

36

\$65,000

\$72,790

597

1961

2,136

AV

AV-

FR

C

\$55,500

R12307

056-195-15-0-20-02-009.00-0

517 MERCHANT, Emporia, KS 66801

960

0.0000%

3

2

12/27/2021

36

\$369,500

\$369,500

344

1875

22,670

AV

GD

PR

B

\$349,700

R12060

056-195-15-0-10-21-004.00-0

330 COMMERCIAL, Emporia, KS 66801

960

0.3330%

3

2

8/23/2022

28

\$120,000

\$131,190

459

1900

3,250

AV

GD

AV

B

\$106,100

R12474

056-195-15-0-20-15-001.00-0

331 COMMERCIAL, Emporia, KS 66801

960

0.3330%

0

2

9/2/2022

27

\$105,000

\$114,440

459

1890

3,225

AV

AV

AV

B

\$105,200

R9299

056-192-10-0-30-14-006.00-0

1025 COMMERCIAL, Emporia, KS 66801

960

0.3330%

0

2

12/15/2022

24

\$259,900

\$280,670

459

1924

6,033

AV

AV

AV

B

\$255,900

R10060

056-192-10-0-40-36-003.00-0

624 COMMERCIAL, Emporia, KS 66801

960

0.3330%

3

2

1/3/2023

23

\$176,500

\$190,020

597

1877

5,039

AV

EX

GD

A

\$169,300

R12467

056-195-15-0-20-14-011.00-0

409 COMMERCIAL, Emporia, KS 66801

960

0.3330%

3

2

7/21/2023

17

\$23,000

\$24,300

459

1910

2,475

AV

AV

FR

C

\$64,200

R12290

056-195-15-0-20-01-005.00-0

501 COMMERCIAL, Emporia, KS 66801

960

0.3330%

0

2

8/3/2023

16

\$200,000

\$210,660

597

1900

6,448

AV

AV+

FR

B

\$210,300

R11917

056-195-15-0-10-07-017.01-0

504 COMMERCIAL, Emporia, KS 66801

960

0.3330%

3

2

8/24/2023

16

\$165,000

\$173,790

459

1890

4,500

AV

GD

AV

C

\$115,200

R11916

056-195-15-0-10-07-017.00-0

502 COMMERCIAL, Emporia, KS 66801

960

0.3330%

3

2

8/29/2023

16

\$136,000

\$143,250

597

1890

3,265

AV

AV+

AV

B

\$106,500

R12484

056-195-15-0-20-15-011.00-0

329 COMMERCIAL, Emporia, KS 66801

960

0.3330%

0

2

9/1/2023

16

\$124,000

\$130,610

597

1888

3,217

AV

AV+

AV

C

\$83,500

R11900

056-195-15-0-10-07-001.00-0

23 E SIXTH, Emporia, KS 66801

960

0.3330%

0

2

8/5/2024

4

\$135,000

\$136,800

459

1857

1,800

AV

GD

AV

C

\$46,700

R9492

056-192-10-0-30-29-012.00-0

725 COMMERCIAL, Emporia, KS 66801

960

0.3330%

0

2

8/19/2024

4

\$100,000

\$101,330

597

1920

1,330

AV

GD+

AV

C

\$34,500

Table: DTR Sales (23 rows)

Data

Search

DowntownRow

COLLECTED INCOME

EXP PER SF

FUN

INS.

INVEST CLASS

Lower Confidence Interval

MarketPGI

MarketRent Value

MGMT

MGMT RATIO

OCC PERCENT

OTHER

PGI

PGI PER SF

PHY

QUICK REF

R&M

RANK

Rent Confidence Interval

RES

SQ FT

TOTAL EXP

Upper Confidence Interval

UTIL

YEAR BUILT

YEAR INFO PROVIDED

DTR Cap Rate

Cap Rate

ETR

INVEST CLASS

Market NOI per SF

LINESTX FUNCTION EXAMPLE

1 Linear = LINESTX('DTR Sales','DTR Sales'[Sale Price],'DTR Sales'[SQ FT])									
Slope1	Intercept	StandardErrorSlope1	StandardErrorIntercept	CoefficientOfDetermination	StandardError	FStatistic	DegreesOfFreedom	RegressionSumOfSquares	ResidualSumOfSquares
13.9551675700994	59356.0012198834	2.50745341576387	15456.4872362893	0.595955742480078	49542.808889685	30.9745043003477	21	76026608355.4622	51544288166.2769

Slope

13.955

Intercept

59,356

Coefficient of Determination (R-Squared)

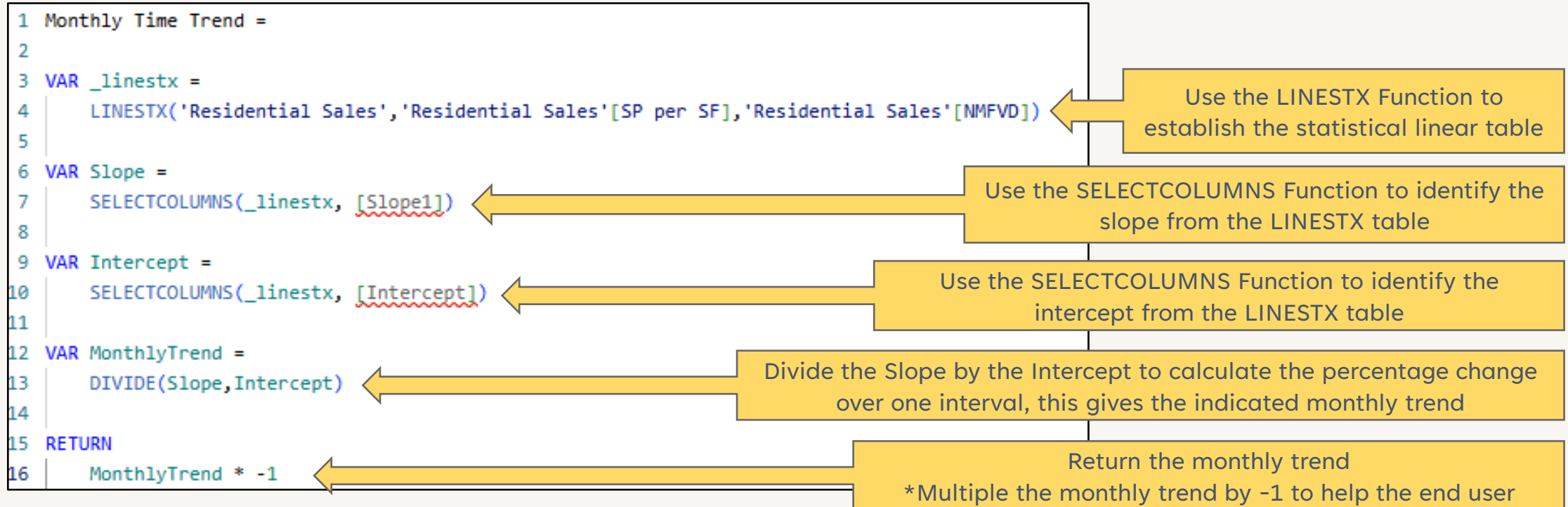
0.5959 or 59.59%

F Statistic

30.9745



LINESTX FUNCTION FOR TIME TREND



Market inflation indicates a negative market trend, market deflation indicates a positive market trend

By returning the MonthlyTrend * -1 it allows for a more logical display of the market condition factor

LINESTX FUNCTION FOR TIME TREND

```
1 Annual Time Trend = [Monthly Time Trend] * 12
```

Annualize Monthly Time Trend by
multiplying by 12

0.25%

Monthly Time Trend

2.97%

Annual Time Trend

- The LINESTX Function allows for a dynamic dashboard that can be sliced in varying ways to determine the most applicable method of applying a time trend
- Furthermore, the nature of Power BI allows for this dashboard to be refreshed and updated regularly to more easily monitor the market

COEFFICIENT OF DETERMINATION/R-SQUARED

- The Coefficient of Determination is the same as the R-Squared Value
 - This value represents how well the trend line represents the data
 - Ideally, this value is 1.00 or 100%

```
1 R Squared =  
2  
3 VAR _linestx =  
4 | LINESTX('Residential Sales','Residential Sales'[SP per SF],'Residential Sales'[NMFVD])  
5 |  
6 VAR RSquared =  
7 | SELECTCOLUMNS(_linestx, [CoefficientOfDetermination])  
8 |  
9 RETURN  
10 | RSquared * 100
```

Use the LINESTX Function to establish the statistical linear table

Use the SELECTCOLUMNS Function to identify the Coefficient of Determination from the LINESTX table

Return the Coefficient of Determination
*Multiple by 100 to present the result is a more familiar format

0.25%

Monthly Time Trend

0.17

R Squared

2.97%

Annual Time Trend

571

Sale Count

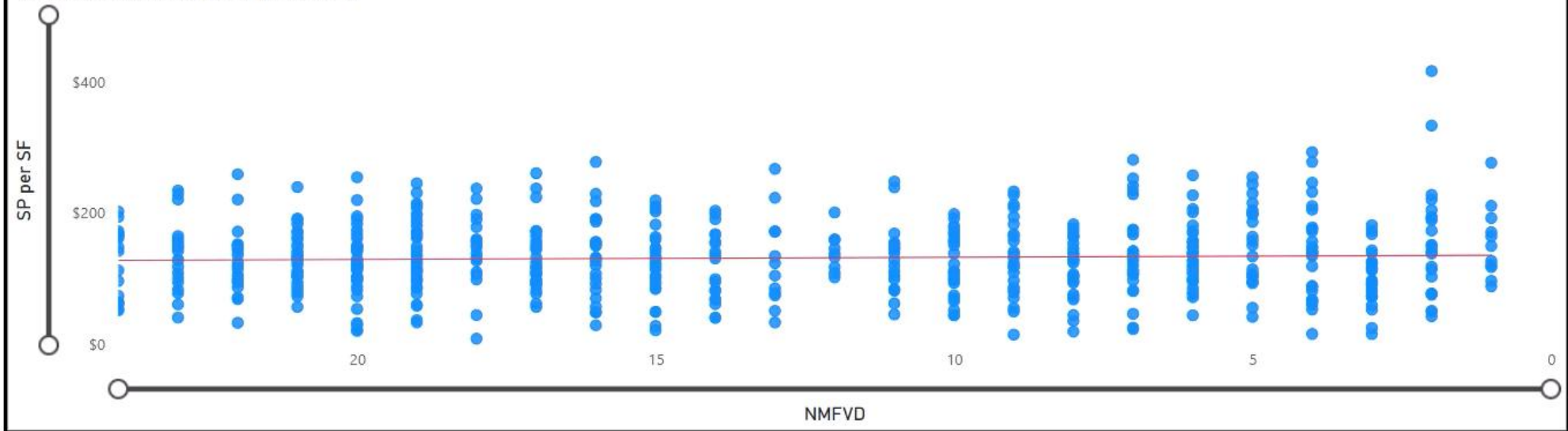
CDU

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8
- ☐ 9

NbhdCode

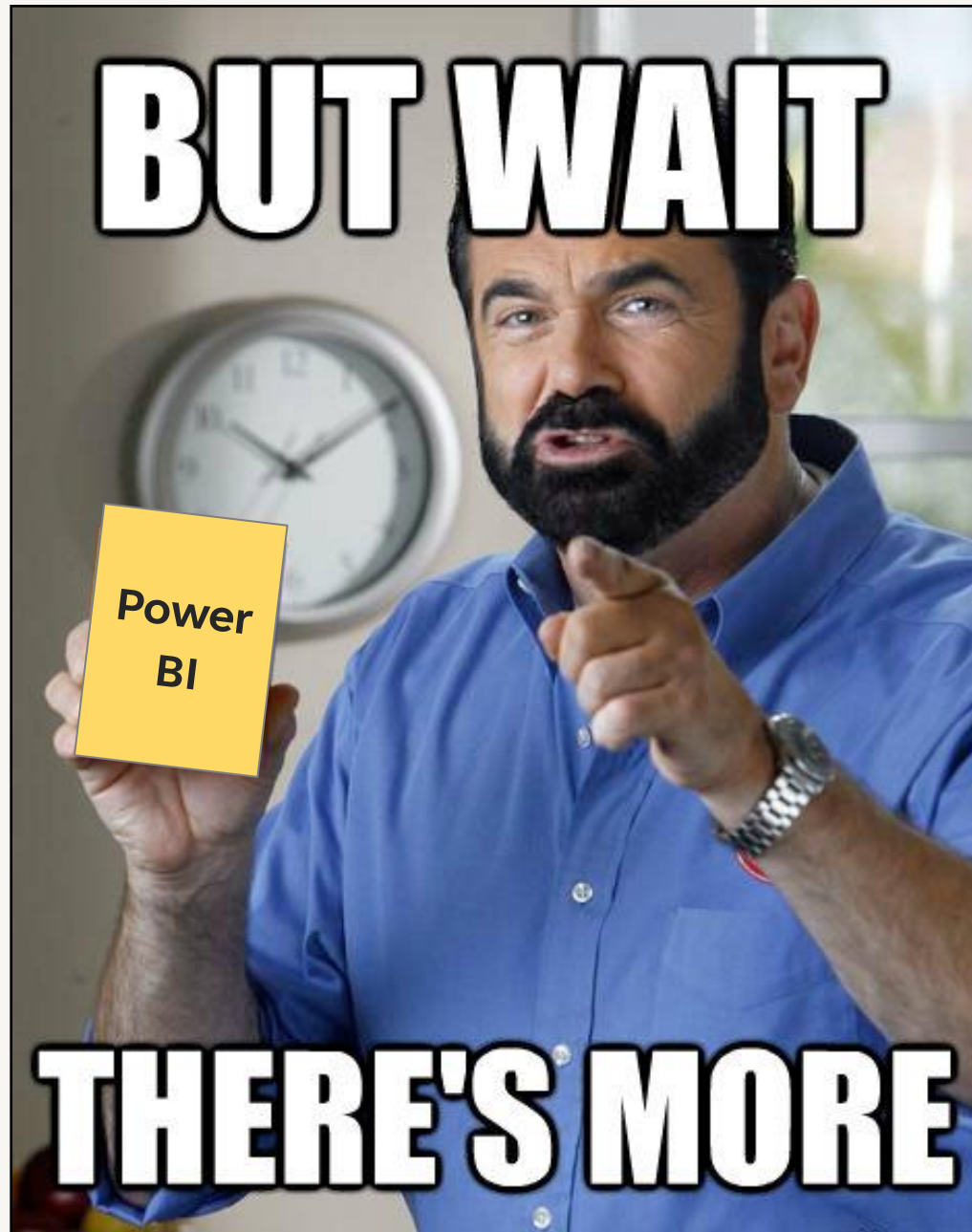
- ☐ 100
- ☐ 105
- ☐ 110
- ☐ 115.1
- ☐ 115.2
- ☐ 115.3
- ☐ 115.4
- ☐ 120
- ☐ 125

Trend by Sale Price per Square Foot



OTHER REGRESSION CAPABILITIES IN POWER BI

- Can Power BI handle other, nonlinear trend lines (exponential, logarithmic, etc.)?
 - YES!
 - By introducing more complex DAX functions other lines can be achieved
- Can Power BI handle Multiple Regression Analysis Functions?
 - YES!
 - By incorporating an R or Python script multiple regression can be completed in Power BI





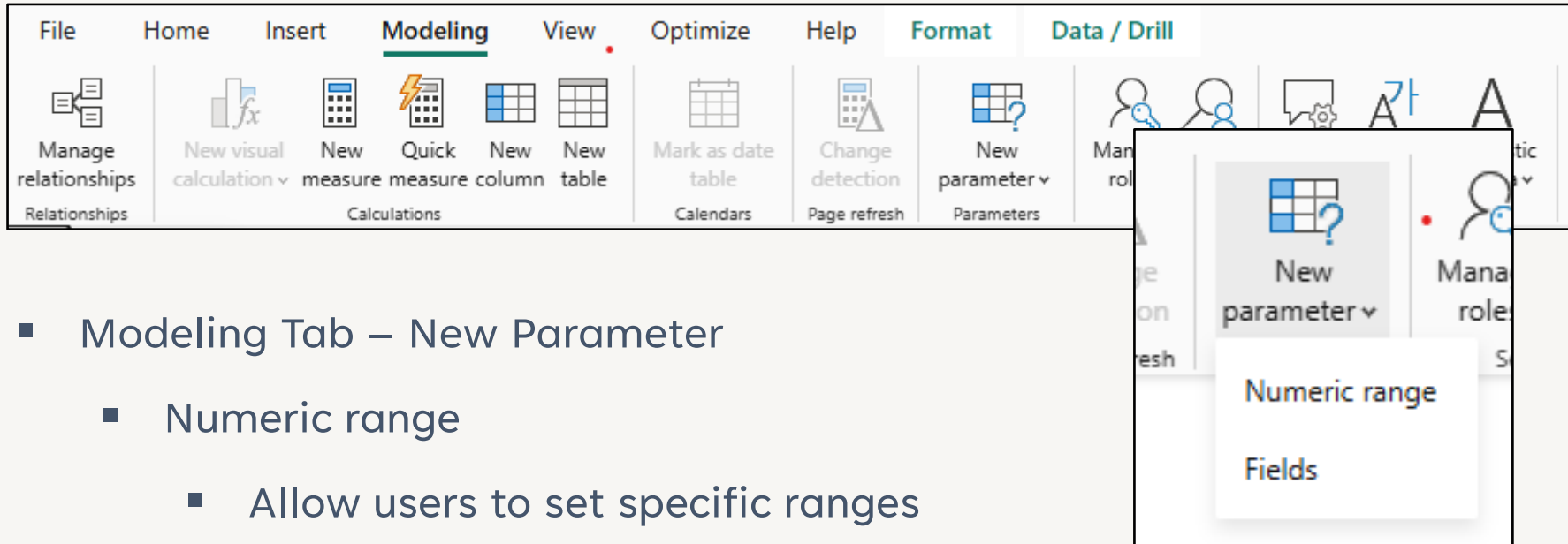
PARAMETERS



PARAMETERS

- Allows users to input variable values that can change how the data is presented in the reports
 - This can be used to test conclusions and get results in real time
 - This feature enhances the report and increases the its interactivity by making the platform more dynamic
- 

ADDING PARAMETERS



- Modeling Tab – New Parameter
 - Numeric range
 - Allow users to set specific ranges
 - Fields
 - Allow user to change the measures analyzed in the report

ADDING PARAMETERS

- Adding a “Numeric Range” Parameter
 - Name
 - Name the new measure
 - Data Type
 - Whole number or decimal number
 - Minimum/Maximum
 - Sets the range of the slicer
 - Increment
 - Amount lost or added as slicer is adjusted

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

Parameter

Data type

Whole number

Minimum

0

Maximum

20

Increment

1

Default

☒ Add slicer to this page

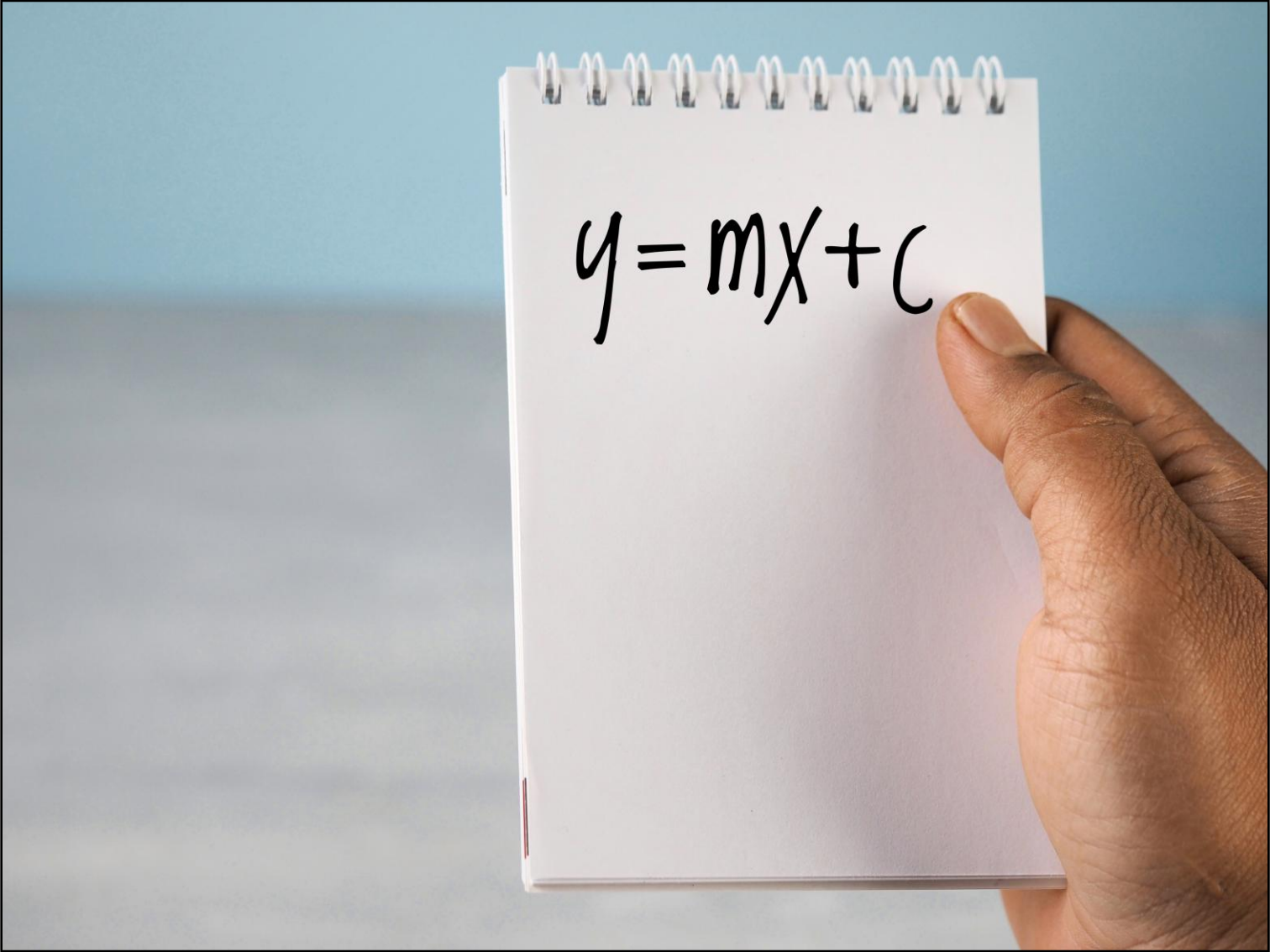
Create Cancel

ADDING PARAMETERS

- New Parameter measure is created
 - Minimum value range
 - Maximum value range
 - Increment
- Slicer can be adjusted to change parameter within range
- Its just a value, not tied to any specific data or measure

```
1 MarketRent = GENERATESERIES(0, 20, 0.25)
```



A hand is holding a small, spiral-bound notepad. The notepad is white with a silver spiral binding at the top. The equation $y = mx + c$ is written in black ink on the notepad. The background is a blurred landscape with a blue sky and a greyish ground.
$$y = mx + c$$

USE PARAMETER TO FIND VALUE

```
1 MKT Value =  
2  
3 VAR Slope =  
4 |   SELECTCOLUMNS('Linear SP/SF', [Slope1])  
5 |  
6 VAR Intercept =  
7 |   SELECTCOLUMNS('Linear SP/SF', [Intercept])  
8 |  
9 RETURN  
10 |   Intercept + Slope * 'SF Parameter'[SF Parameter Value]
```

Use the SELECTCOLUMNS Function to identify the Slope from the LINESTX table

Use the SELECTCOLUMNS Function to identify the Intercept from the LINESTX table

Use the parameter that was created and the formula $Y=MX+C$, where M is the Slope, C is the Intercept, and X is the Parameter

122,433

MKT Value

4,520

SF Parameter Value

\$13.96

Slope

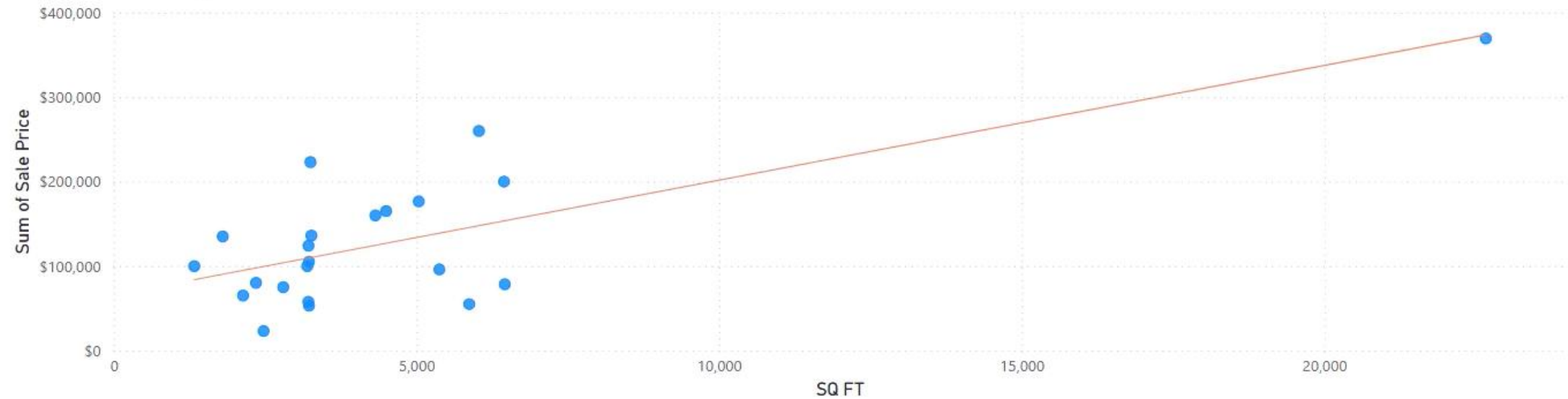
\$59,356

Intercept

SF Parameter

4520

Sum of Sale Price by SQ FT





FINAL THOUGHTS

WRAP IT UP

- Power BI is easy to work with drag-and-drop features
- As your comfort level grows, find more to use it for
- DAX functions don't need to be scary
- Using Power BI to help with simple regression can be helpful for visualizing and slicing data
- Power BI can be leveraged in analysis and valuation applications

RESOURCES

- Generative AI and Large Language Models (LLMs)
 - Chat GTP
 - Copilot
- You Tube
 - Guy is Cube
 - Learnit Training
 - Leila Gharani
- Cornell Consultants, LLC
 - David Cornell, MAI, CAE

A series of thin, light brown lines forming an abstract geometric pattern in the top left corner of the page. The lines intersect to create various triangular and polygonal shapes.

THANK YOU

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