Spice up your Analysis with Advanced Methodologies

Improving Valuation Quality

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What's the Purpose?

Using advanced methodologies to create fair and equitable values for your constituents.

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What's the Purpose?

The Three Approaches to Value

- Cost
- Market
- Income

Enhancements to the approaches to value

- Build Models to Reconcile Value
- Determine adjustments using regression (rather than just the ratio studies)
- Perform a more informed analysis using AI tools

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Enhance Your Analysis

There are a few different ways to enhance your analysis and spice up your results:

Sales Ratio Studies and Exploratory Analysis of Market Areas

- Conduct analysis using statistics
- Use resulting interactive visual context to further evaluate results and summaries
- Use the results to define specialized areas of analysis and stratifications

Market Segmentation Analysis

- Using location to ensure properties are property classified (NEED MORE DETAIL)

Time Trend Analysis

- Utilize Time Trend analysis methodologies to understand economic trends

Calibration of the Three Approaches to Value

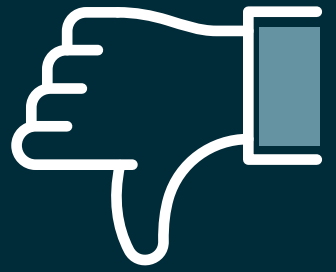
- Utilize Regression to enhance your valuation cost and/or income models

Do I Learn How to Fish? Or Order Takeout?

Bring in an Expert to Train Your Staff

Pros:

- Retained Knowledge
- Internal Cross Training
- One and Done



Cons:

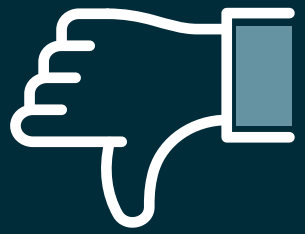
- Learning Curve
- Time Commitment

Do I Learn How to Fish? Or Order Takeout?

Bring in an Expert to Complete the Project

Pros:

- Keep your staff free
- Complete multiple projects at once
- No learning curve or extended training needs
- One-time projects get set up for the future



Cons:

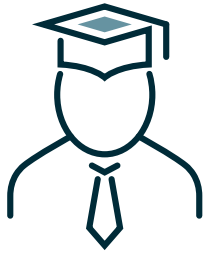
- No internal office knowledge

Required Tools and Knowledge

What are some of the basics I need to create accurate models?

Software

- Insights for ArcGIS for visualizing data and results of the analysis
- Regression Tools
  - Purchase Options
    - SPSS
    - SAS (JMP)
  - Open-Source Options
    - R
    - Python



Knowledge

- Coding for R & Python
- Conceptual and Theoretical Considerations

Data

- Available Data extract for subject and sales data

Case Study and Impact

Case Study: Texas Jurisdiction

Purpose: Utilize Multiple Regression analysis to define adjustments for comp selection

- Provide comp grids to residents throughout the county as a means of transparency
  - Understand data and potential variables for use in models
  - Market area delineation and calibration using market basket value approach to building location factors
  - Develop model specification and test goodness of fit and residual output in R
  - Rebuild model specs within CAMA system and run against all properties within each market area
  - QA analysis with Insights to compare market indicated value through market approach, regression point estimates, cost value , as well as previous year value
  - Iterate and adjust as necessary

Create Model Specifications and Diagnostics

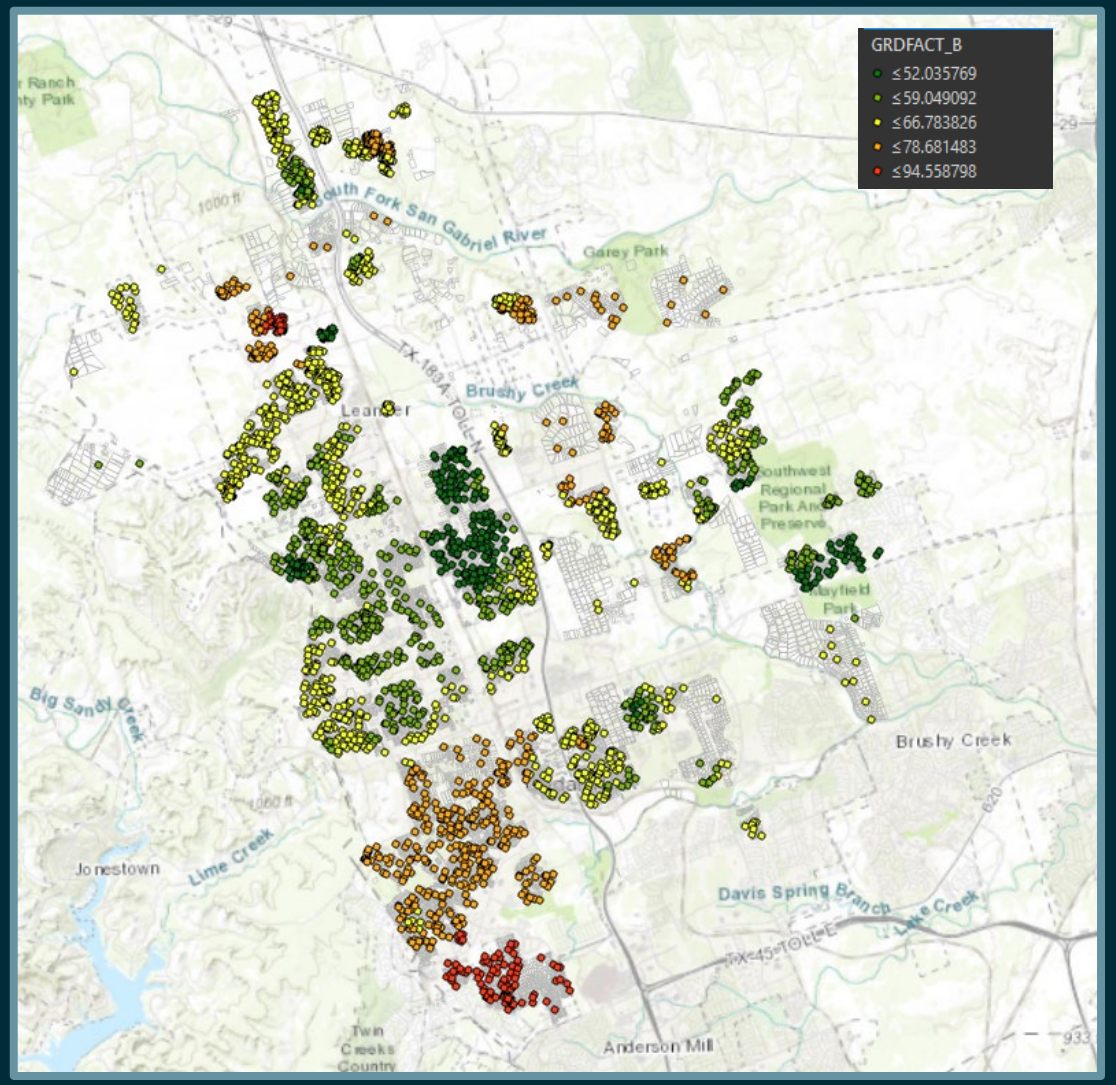
COUNT	Median	MEAN	WTDMEAN	COD	PRD	PRB	PRB_CI_LOW	PRB_CI_UP	PRB_SIG	PRB_SE	PRB_TV
2857	1.006122	1.007449	1	6.905279	1.007449	-0.02005686	-0.02718286	-0.01293085	0.000003799797	0.004330896	-4.631109

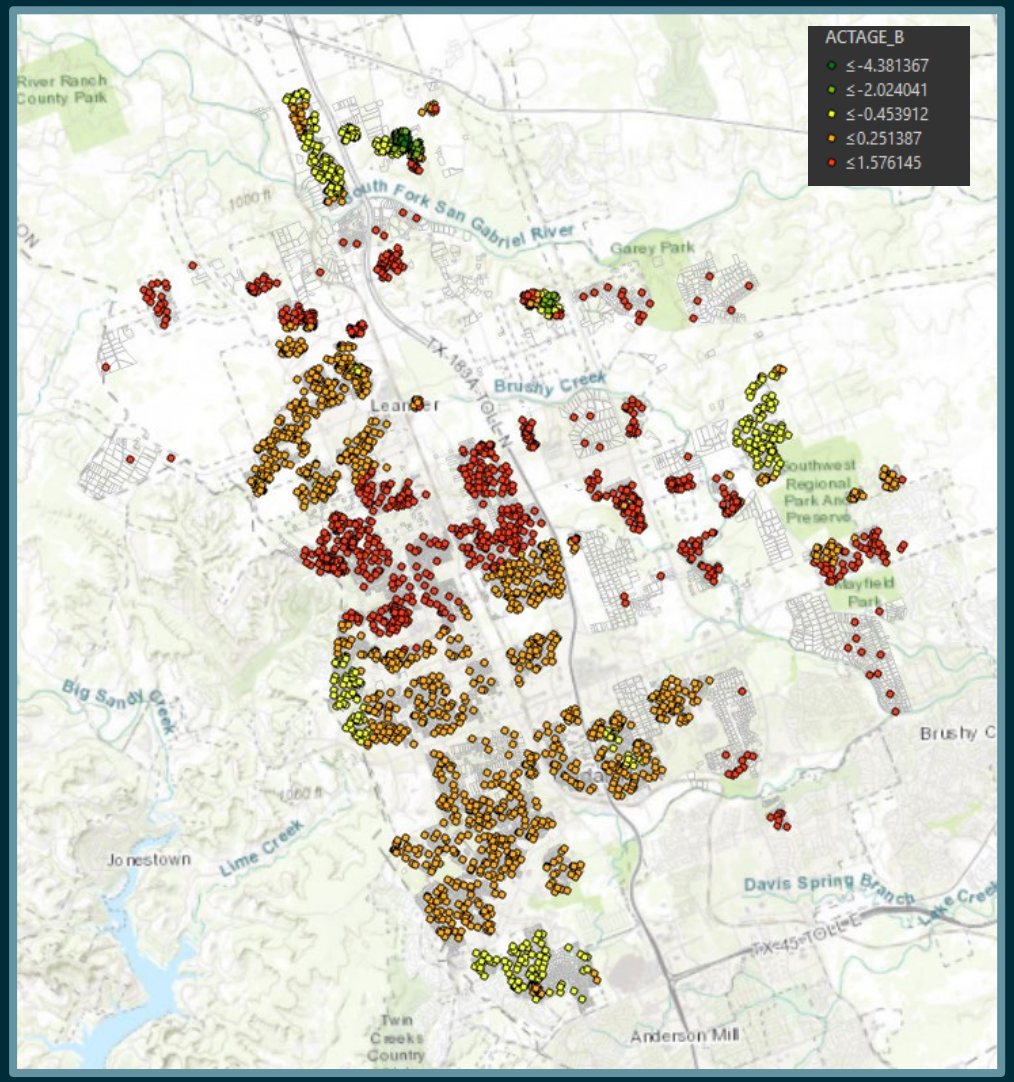
```
lm(formula = PRICE ~ I(GRDFACT * TLA) + LANDVAL + POOL_AREAI +
    I(RMOS * TLA) + I(ACTAGE * TLA) + STHT2 + I(ATTGAR_AREAI *
    ATTGAR_AREA) + I(DETGARAGE_AREAI * DETGARAGE_AREA) + I(OPNPRCH_AREAI *
    OPNPRCH_AREA) + I(PATIO_AREAI * PATIO_AREA), data = moddat)

Residuals:
    Min      1Q  Median      3Q     Max
-150481  -17730   -1775   14412  323292

Coefficients:
                                    Estimate   Std. Error t value            Pr(>|t|)
(Intercept)                     21049.94243   3223.87144   6.529      0.0000000000779 ***
I(GRDFACT * TLA)                   63.67220      1.01296  62.858 < 0.0000000000000002 ***
LANDVAL                             1.31159      0.05320  24.654 < 0.0000000000000002 ***
POOL_AREAI                      49057.50595   5208.77256   9.418 < 0.0000000000000002 ***
I(RMOS * TLA)                      -0.24401      0.07611  -3.206              0.00136 **
I(ACTAGE * TLA)                     0.53420      0.03084  17.319 < 0.0000000000000002 ***
STHT2                          -14252.75941   1414.31169 -10.078 < 0.0000000000000002 ***
I(ATTGAR_AREAI * ATTGAR_AREA)      90.67672      5.79567  15.646 < 0.0000000000000002 ***
I(DETGARAGE_AREAI * DETGARAGE_AREA) 109.83081    7.23462  15.181 < 0.0000000000000002 ***
I(OPNPRCH_AREAI * OPNPRCH_AREA)    57.49810      5.20049  11.056 < 0.0000000000000002 ***
I(PATIO_AREAI * PATIO_AREA)        22.07177      7.83958   2.815              0.00490 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 32480 on 2846 degrees of freedom
Multiple R-squared:  0.8844,    Adjusted R-squared:  0.884
F-statistic:  2177 on 10 and 2846 DF,  p-value: < 0.00000000000000022
```

```
************************************************************************
*        Results of Geographically Weighted Regression                 *
************************************************************************

********************Model calibration information********************
Kernel function: exponential
Adaptive bandwidth: 31 (number of nearest neighbours)
Regression points: the same locations as observations are used.
Distance metric: Great Circle distance metric is used.

****************Summary of GWR coefficient estimates:******************
                                        Min.       1st Qu.        Median       3rd Qu.      Max.
Intercept                        -87677.987988  23546.620091  51999.354981  72777.049940 369369.9179
I.GRDFACT...TLA.                    38.729111     57.177108     60.996004     68.038131     94.5588
LANDVAL                             -2.920850      0.959027      1.297515      1.648869      3.2713
POOL_AREAI                    -131084.490523  22343.769236  39158.872851  51160.392463 234160.7317
I.RMOS...TLA.                       -1.590512     -0.306430     -0.129776      0.057561      0.8554
I.ACTAGE...TLA.                     -7.246389     -0.358693     -0.010653      0.409657      1.5761
STHT2                           -42271.409403 -15493.064569 -10631.085117  -6332.267576  13746.6150
I.ATTGAR_AREAI...ATTGAR_AREA.      -23.781805     40.247439     64.919406     86.310532    211.5765
I.DETGARAGE_AREAI...DETGARAGE_AREA. -39.232537    61.444516     88.790422    134.115137    723.2241
I.OPNPRCH_AREAI...OPNPRCH_AREA.    -38.211585     24.489510     39.098168     58.029831    176.2194
I.PATIO_AREAI...PATIO_AREA.       -524.311777     -1.610071     19.455496     41.346482    790.8665
**********************Diagnostic information**************************
Number of data points: 2857
Effective number of parameters (2trace(S) - trace(S'S)): 696.9723
Effective degrees of freedom (n-2trace(S) + trace(S'S)): 2160.028
AICc (GWR book, Fotheringham, et al. 2002, p. 61, eq 2.33): 65989.92
AIC (GWR book, Fotheringham, et al. 2002,GWR p. 96, eq. 4.22): 65325.8
Residual sum of squares: 1207109355237
R-square value:  0.9535277
Adjusted R-square value:  0.9385256

************************************************************************
Program stops at: 2020-08-06 19:18:45
```

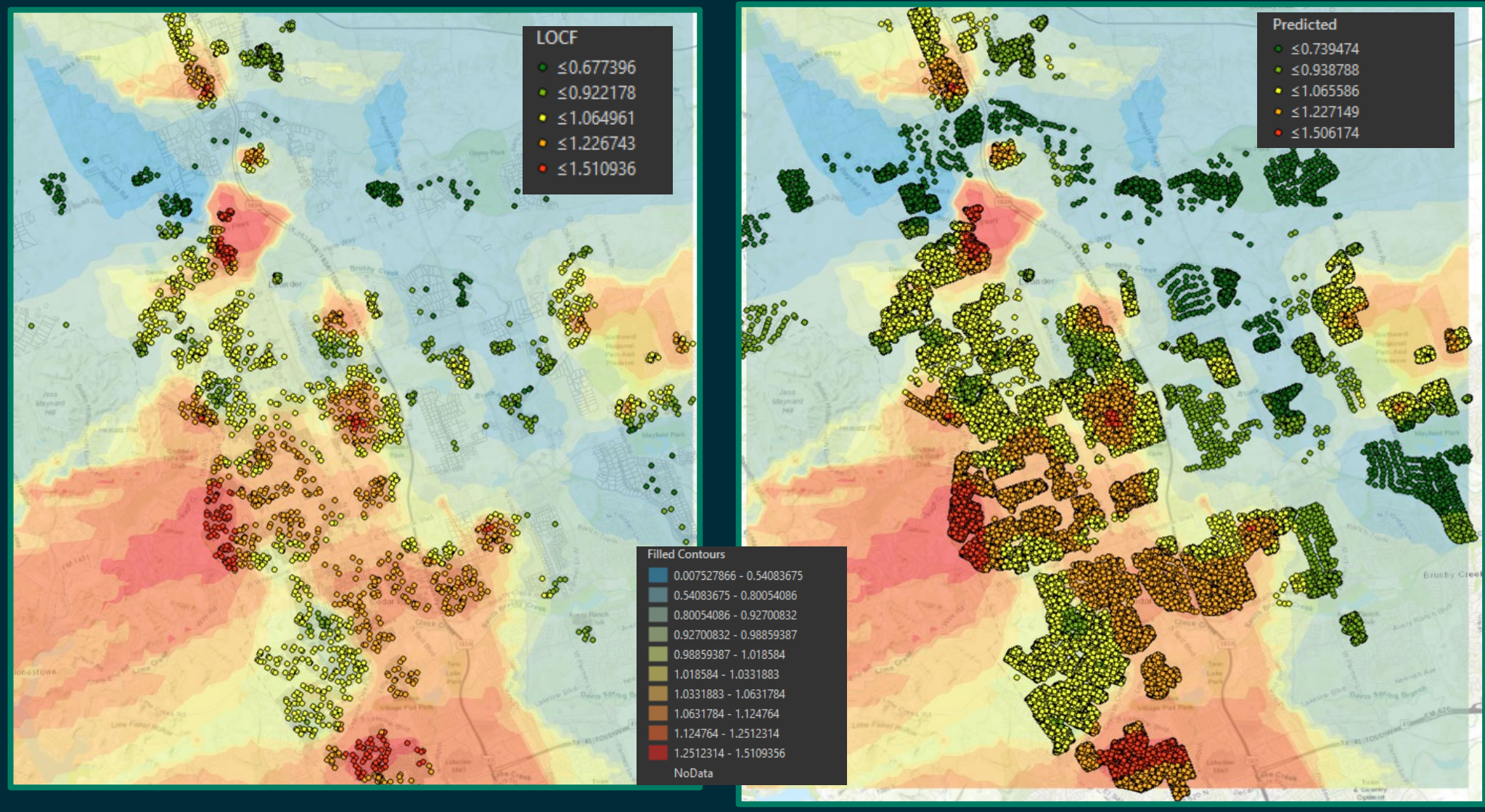
COUNT	Median	MEAN	WTDMEAN	COD	PRD	PRB	PRB_CI_LOW	PRB_CI_UP	PRB_SIG	PRB_SE	PRB_TV
2857	1.001444	1.001842	0.99779	4.277342	1.004061	-0.01844782	-0.02295803	-0.0139376	0.00000000002042376	0.002741127	-6.730013

Analyze Coefficients Over Space

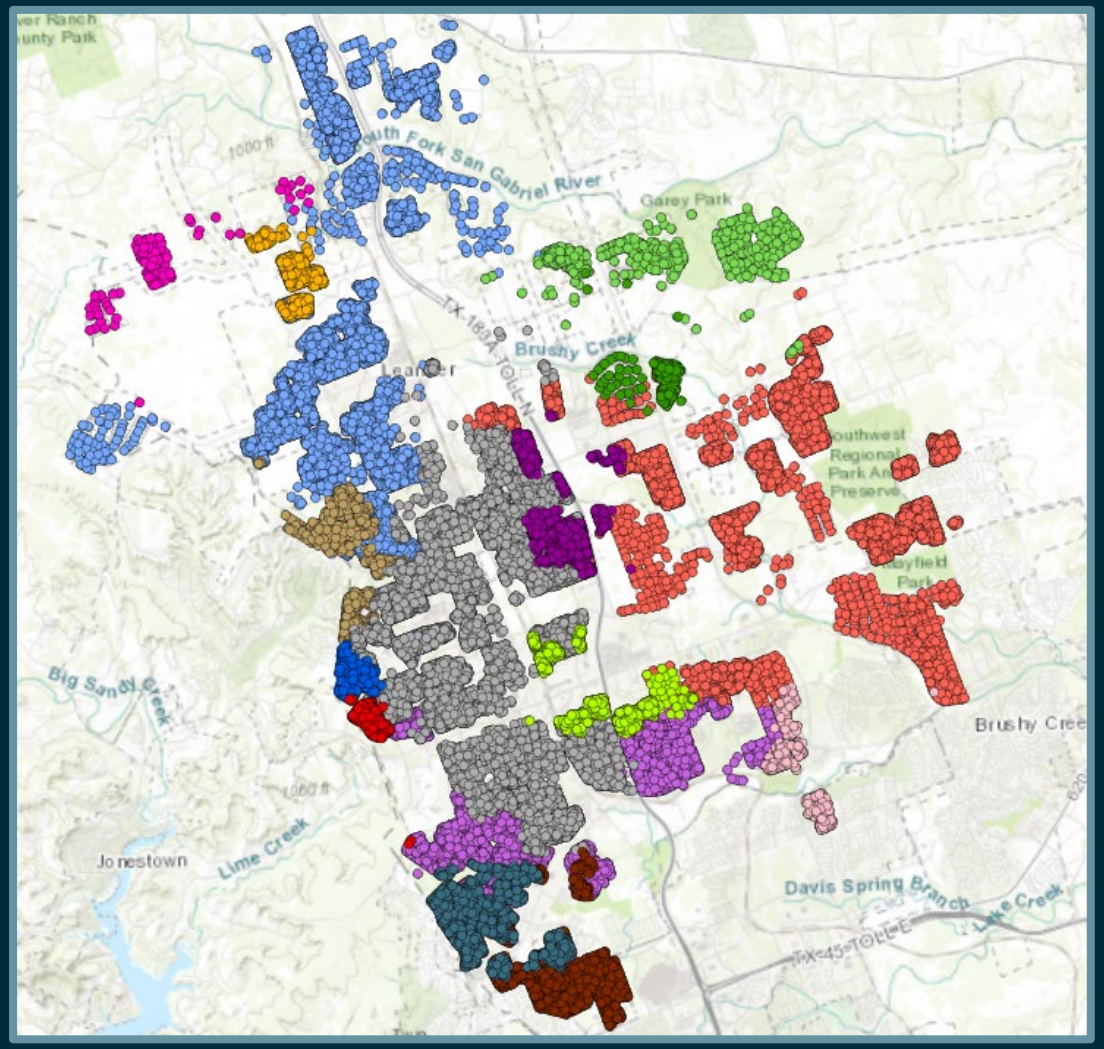


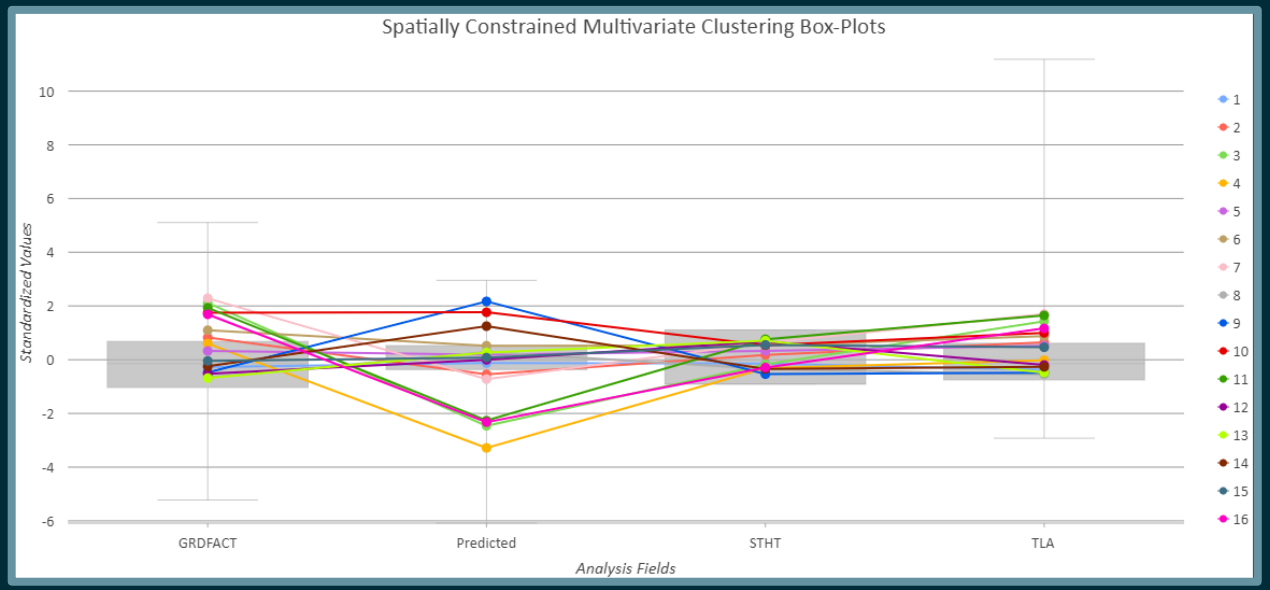


Build Location Factors

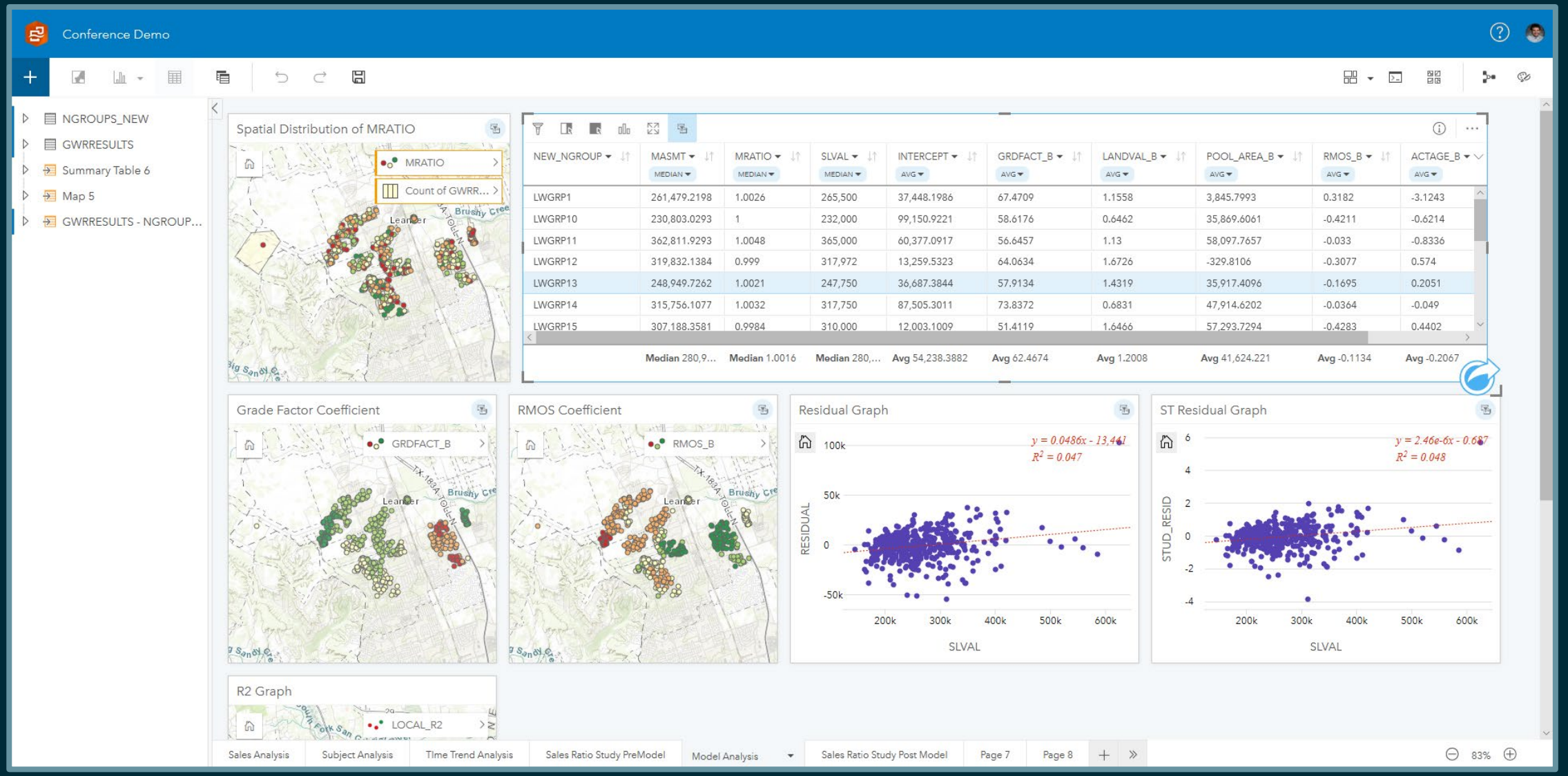


Grouping Analysis



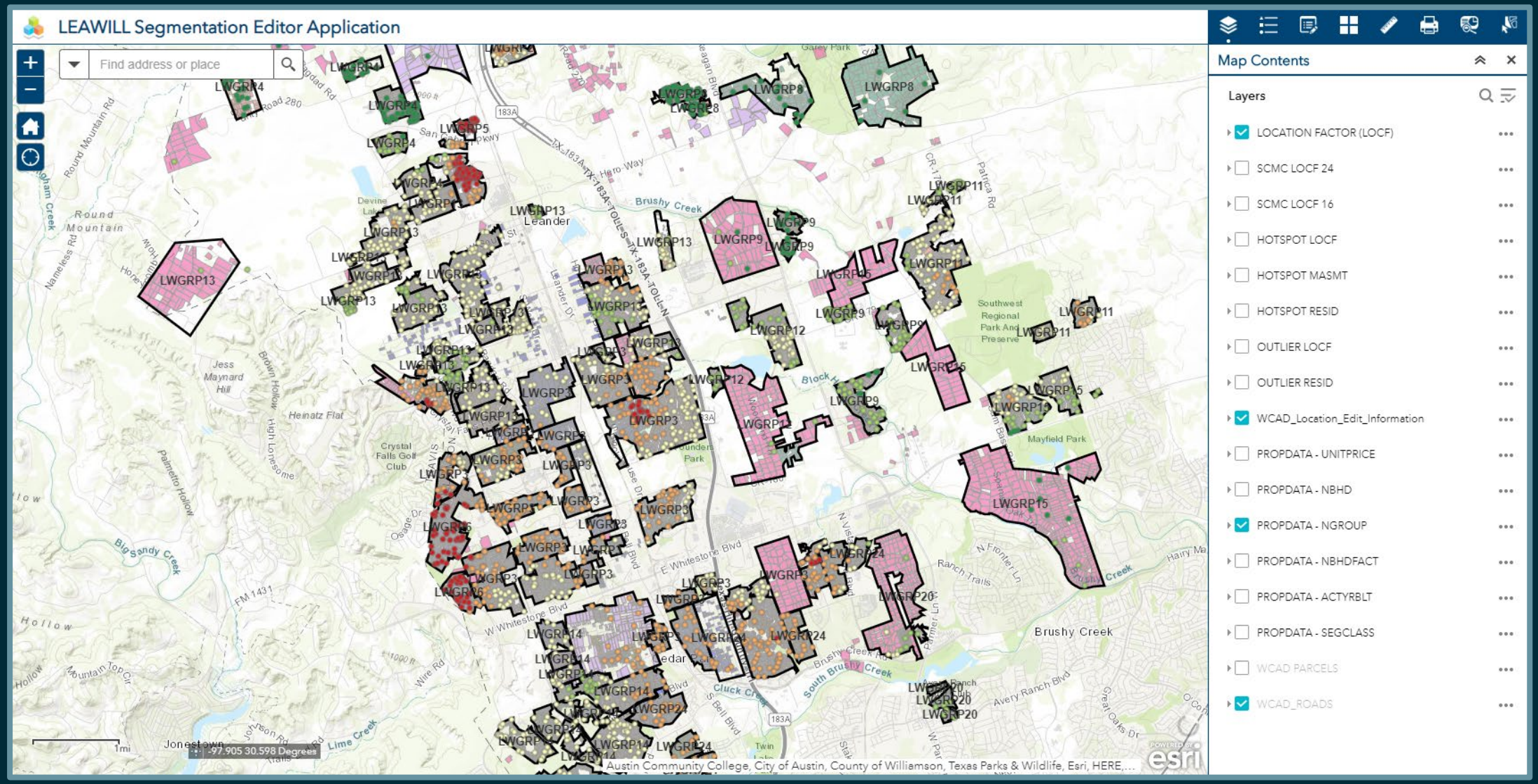


Results of Analysis in Meaningful Visual Graphics



NEW_NGROUP	MASMT (MEDIAN)	MRATIO (MEDIAN)	SLVAL (MEDIAN)	INTERCEPT (AVG)	GRDFACT_B (AVG)	LANDVAL_B (AVG)	POOL_AREA_B (AVG)	RMOS_B (AVG)	ACTAGE_B (AVG)
LWGRP1	261,479.2198	1.0026	265,500	37,448.1986	67.4709	1.1558	3,845.7993	0.3182	-3.1243
LWGRP10	230,803.0293	1	232,000	99,150.9221	58.6176	0.6462	35,869.6061	-0.4211	-0.6214
LWGRP11	362,811.9293	1.0048	365,000	60,377.0917	56.6457	1.13	58,097.7657	-0.033	-0.8336
LWGRP12	319,832.1384	0.999	317,972	13,259.5323	64.0634	1.6726	-329.8106	-0.3077	0.574
LWGRP13	248,949.7262	1.0021	247,750	36,687.3844	57.9134	1.4319	35,917.4096	-0.1695	0.2051
LWGRP14	315,756.1077	1.0032	317,750	87,505.3011	73.8372	0.6831	47,914.6202	-0.0364	-0.049
LWGRP15	307,188.3581	0.9984	310,000	12,003.1009	51.4119	1.6466	57,293.7294	-0.4283	0.4402
	Median 280,9...	Median 1.0016	Median 280,...	Avg 54,238.3882	Avg 62.4674	Avg 1.2008	Avg 41,624.221	Avg -0.1134	Avg -0.2067

Drawing Boundaries Based On Analysis



Overall Impact

- **Use of MRA improved the overall performance of valuations.**
  - Able to apply more informed adjustments based on variables used in market model
  - Better uniformity and equity of each market area and submarket area compared to other approaches
  - Provided various means for reconciling valuations (MRA point estimates, GWR point estimates, etc.., Market indicated value, market modified cost, etc.)
- **Updating Neighborhood Groupings and neighborhoods improved the overall effectiveness and reliability of the comp selection model**
- **Less large percentage reductions in utilizing the market approach**
- **Transparency of sending out comp grids to taxpayers provided additional evidence to help cut down on appeals**
  - Appeals upheld with greater support
- **Staff went from not knowing much about modeling to understanding the full process, and able to conduct the process themselves after going through training**

How Does Your Jurisdiction Get Started?

Analyze and understand the data and project

- Exploratory analysis and visualization
- Develop variables and transformations
- Initial ratio studies
- Pilot Study
- Partnership opportunity?
  - Train Staff
  - Consultant Completes
  - Hybrid

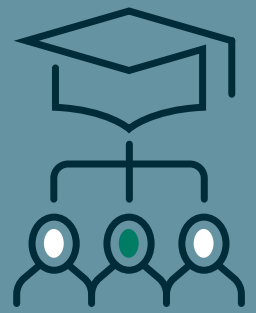
Conduct analysis and iterate as necessary

- OLS Regression
- Geographically Weighted Regression
- Cost analysis
- Advanced ML analysis (Grouping and Clustering)
- Market comp selection weighting and adjustments
- Income analysis
- Custom Analysis

How Does Your Jurisdiction Get Started?

Leverage the power of ESRI Insights to display the output of analysis and help customers understand the results

- Exploratory analysis and visualization
- Sales Ratio Studies
- Modeling
- Other Analysis.



Provide education to jurisdictions to leverage and interpret and apply the results of analysis through:

- One on one education
- Demonstrations of analysis
- Written and verbal documentation
- Other informational articles to help provide conceptual understanding and backing of methodology.

Why use Insights to display results?

Ease of use

- Drag and drop
- Easily change variable types
- Creation of graphs, charts, maps, and custom tables

Interactivity

- Selection, identification and visualization of data
- Cards are always linked if data selected from the same dataset

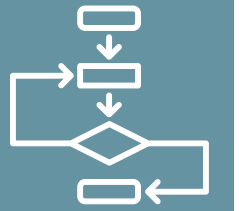
Linking of cards to quickly get an operational view of the data

Dig further into the data for an analytical perspective through analysis tools

- Visualize the results of analysis on cards

Ability to create relationships and join various data sources

Reuse and recreate analysis workflows



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Questions?