



Data Visualization for Spatial Analysis

Lauren Bennett, PhD

Flora Vale

**GIS
INSPIRING
WHAT'S
NEXT**

Data visualization as part of the spatial analysis workflow

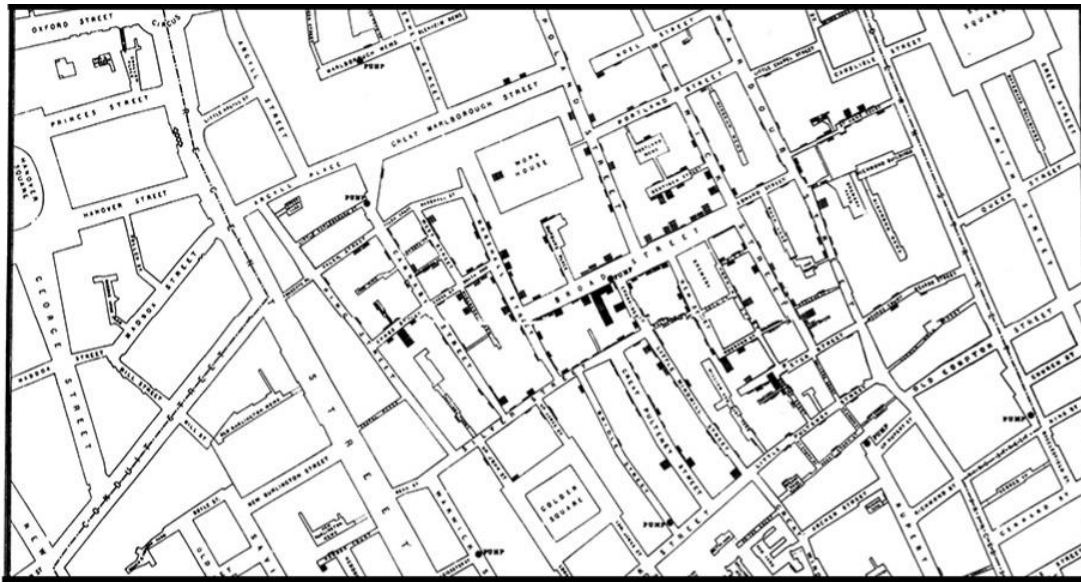
Explore data

Interpret analysis results

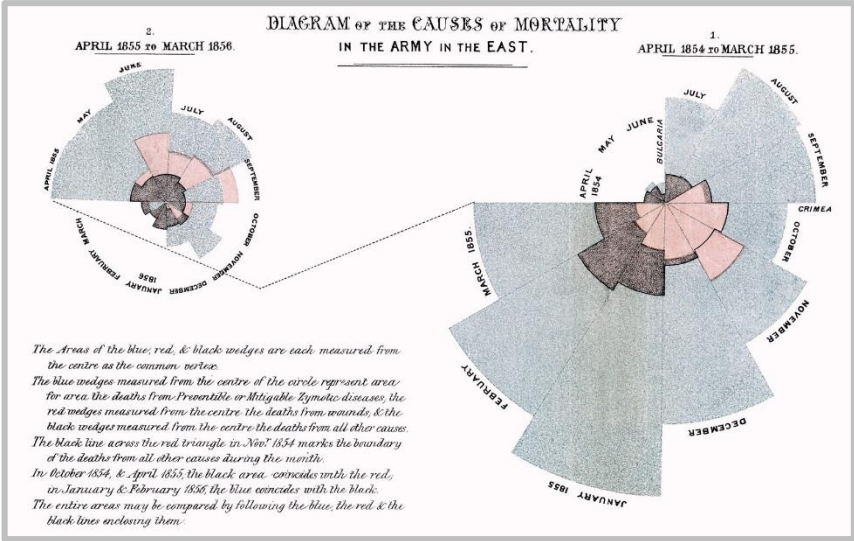
Communicate findings

What is data visualization?

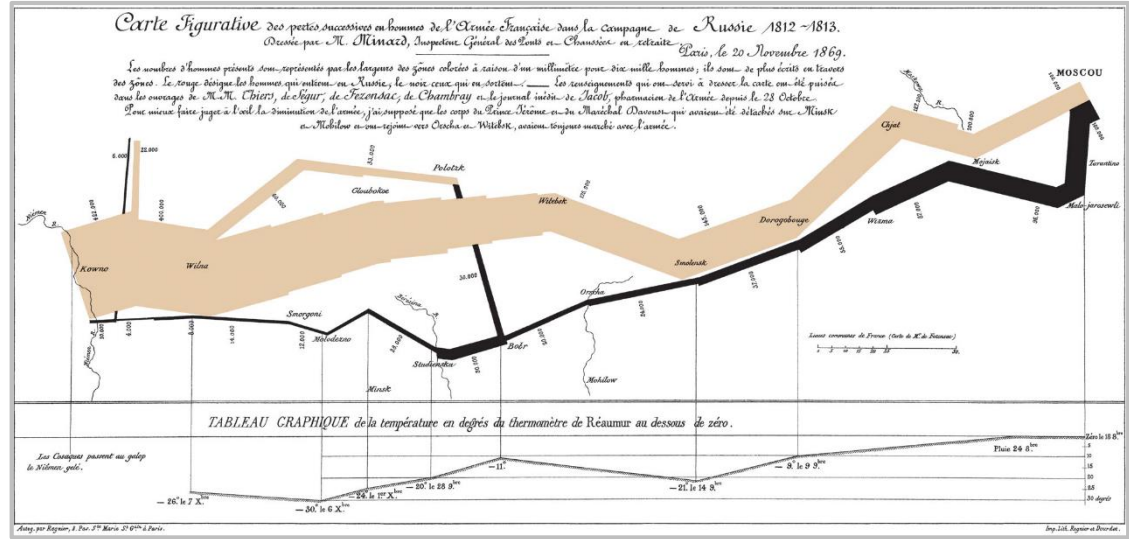




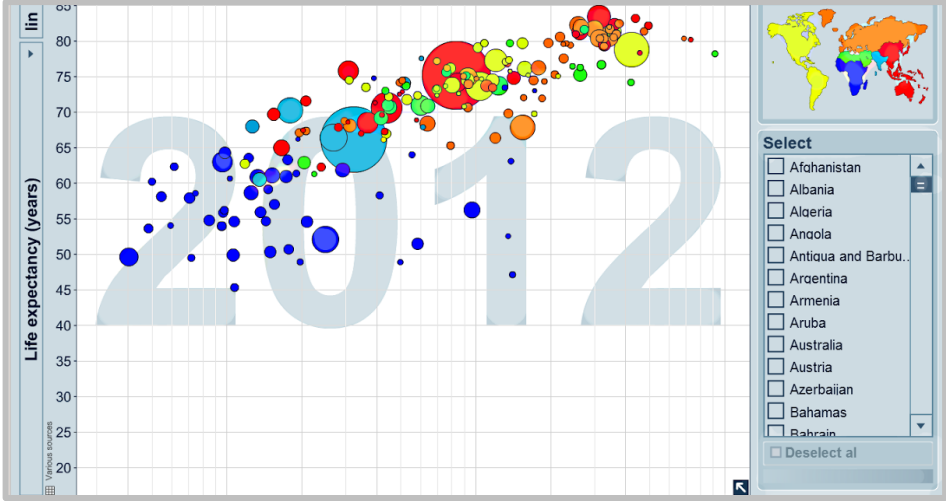
Dr. John Snow's Map of London Cholera Outbreak of 1854



Florence Nightingale's Rose Diagram of the Causes of Mortality in the Army of the East of 1859



Charles Minard's Flow Map of Napoleon's Russian Campaign of 1812



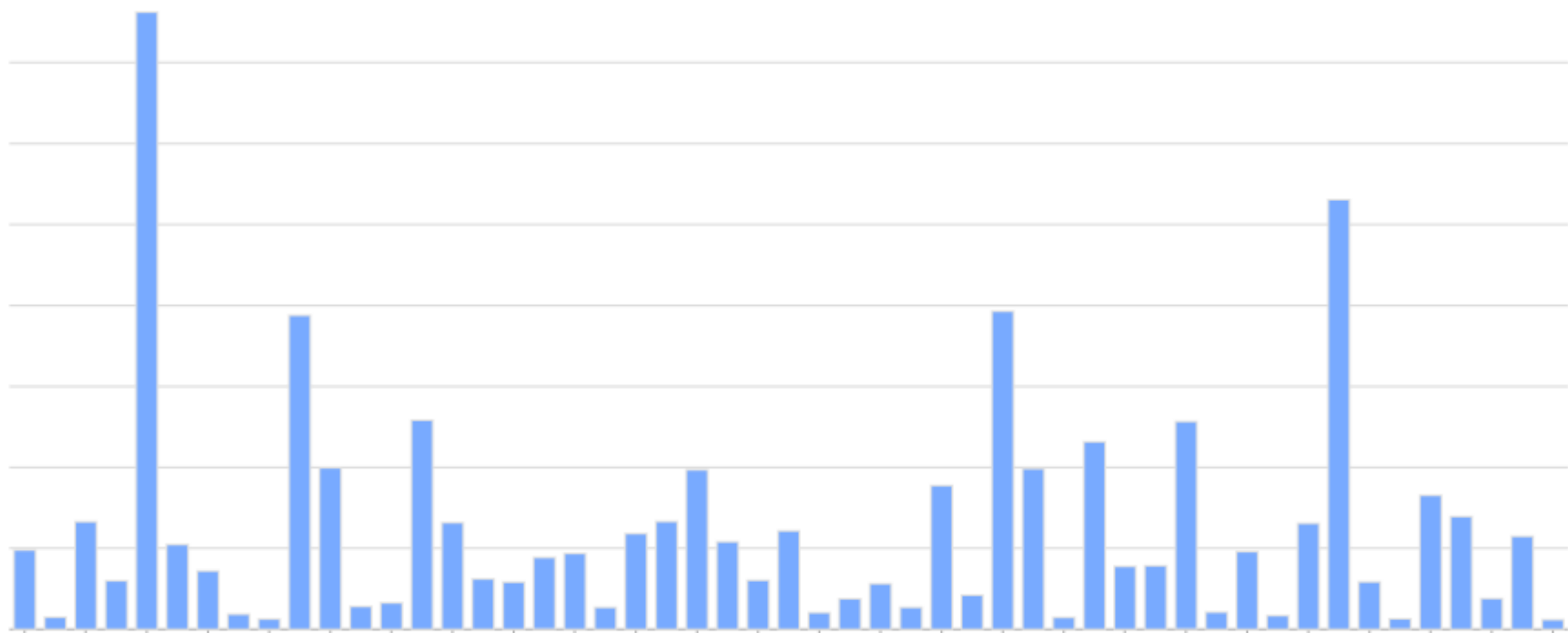
Hans Rosling's Animated Visualization of Global Life Expectancy Over Time from his 2006 TED Talk

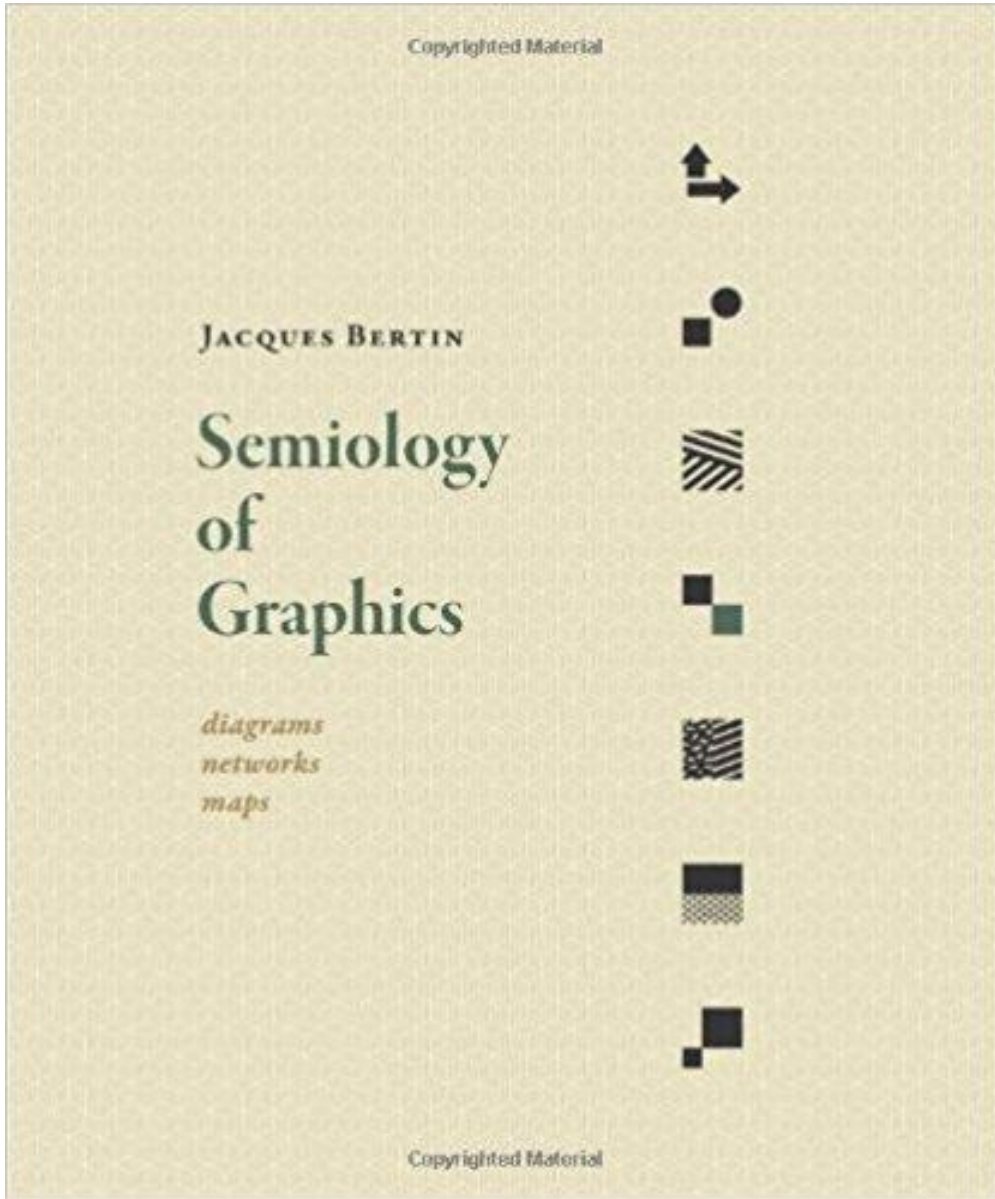
Why visualize data?

Convert slow reasoning tasks
into fast perception tasks



1399683	635200		2908933	2106392
	5401748			
6962578		8875318	8275961	4885854
	3922722			
1019462		6581982	6074504	3018484
	1336265			
1345609		2815039		
	3111844	2917750	6636256	9978939
	6656872	38120066	3880520	4796559
724027				
	1877879	11575704	9913774	2995330
844322				
	19631599	12914651	6539407	4681639
587106			26538203	19383475
	12817894	629120		
				9853722
5731663		927030	5903286	
	3601157			
		1885932	5235100	742404
1628760	1050228		4419036	





Position



Size



Shape



Value



Hue

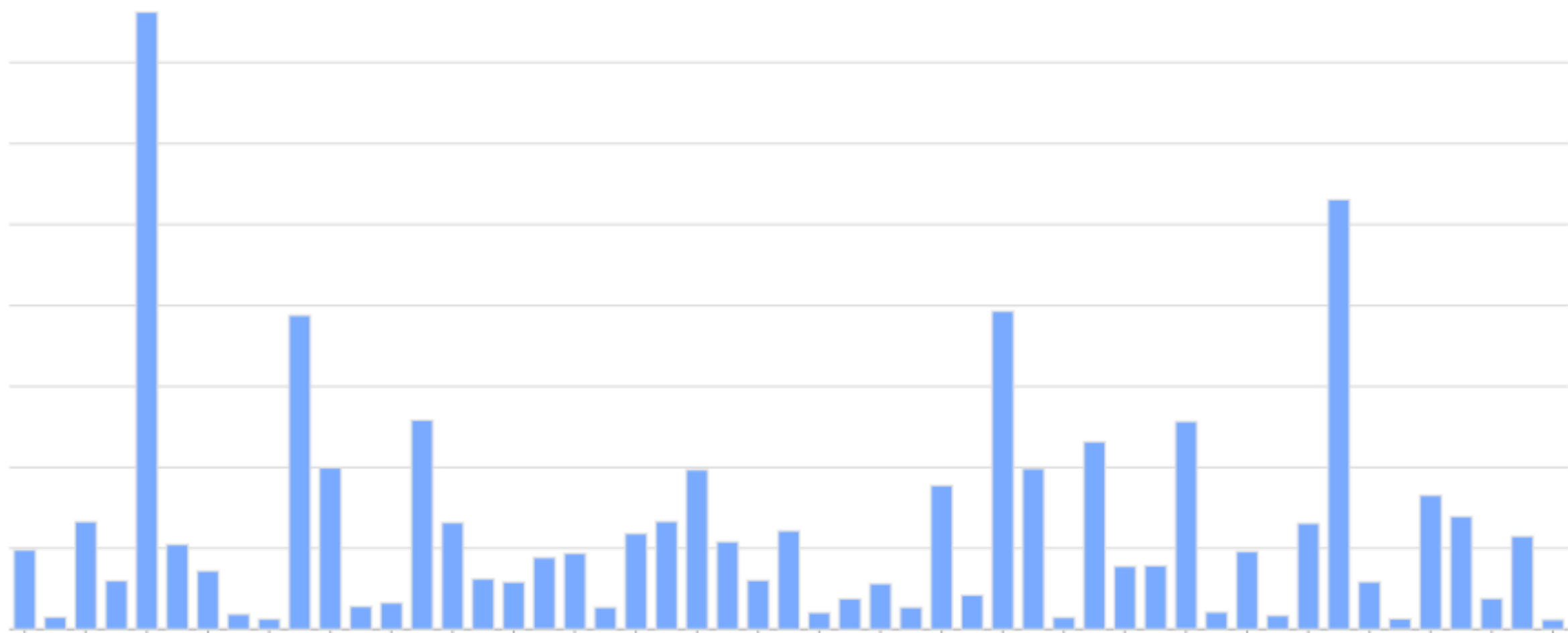


Orientation



Texture




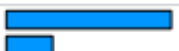










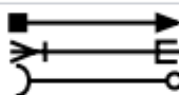



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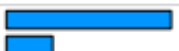










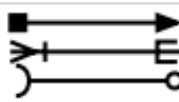

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Properties and Best Uses of Visual Encodings

Example	Encoding	Ordered	Useful values	Quantitative	Ordinal	Categorical	Relational
	position, placement	yes	infinite	Good	Good	Good	Good
1, 2, 3; A, B, C	text labels	optional (alphabetical or numbered)	infinite	Good	Good	Good	Good
	length	yes	many	Good	Good		
	size, area	yes	many	Good	Good		
	angle	yes	medium/few	Good	Good		
	pattern density	yes	few	Good	Good		
	weight, boldness	yes	few		Good		
	saturation, brightness	yes	few		Good		
	color	no	few (< 20)			Good	
	shape, icon	no	medium			Good	
	pattern texture	no	medium			Good	
	enclosure, connection	no	infinite			Good	Good
	line pattern	no	few				Good
	line endings	no	few				Good
	line weight	yes	few		Good		


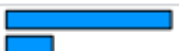










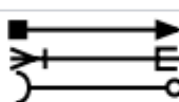



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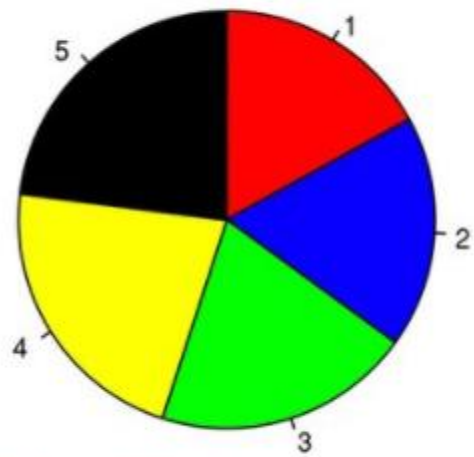
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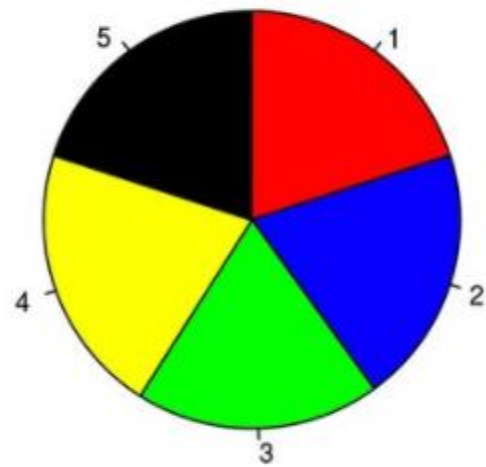
Good Viz vs Bad Viz



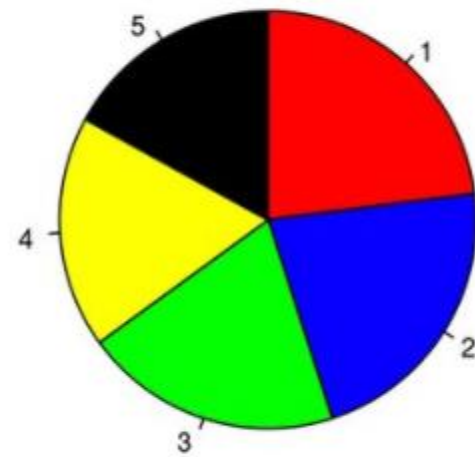
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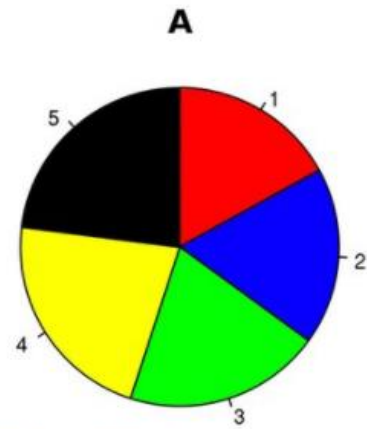
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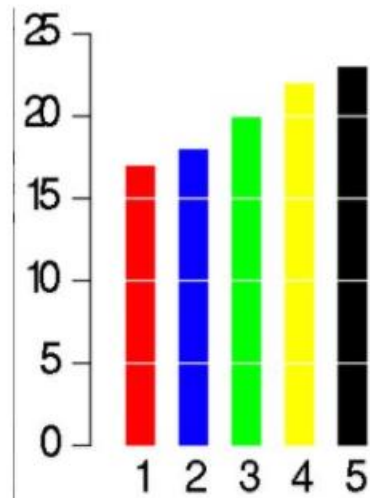
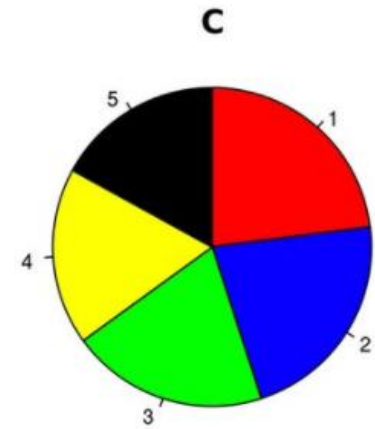
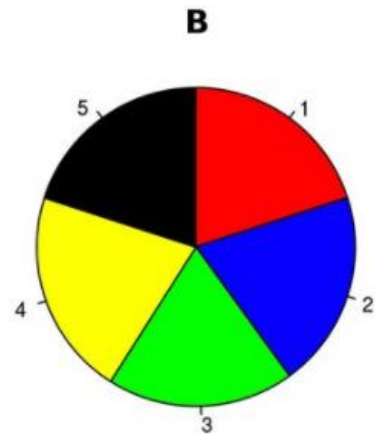
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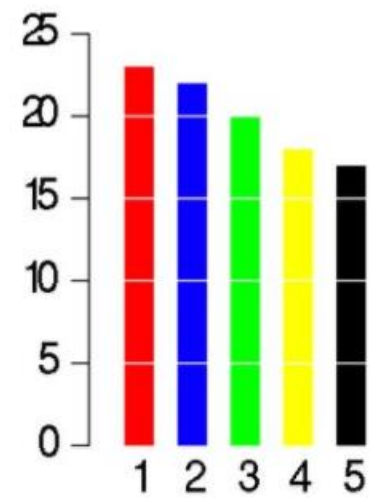
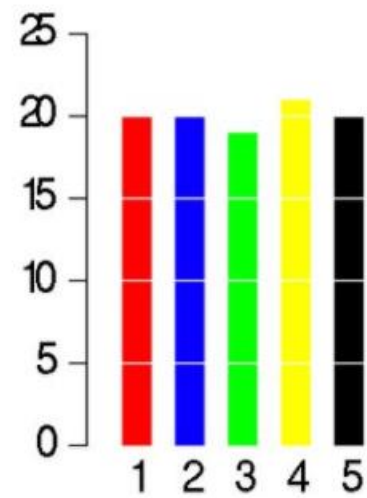
Public Domain/ Wikipedia



Public Domain/ Wikipedia

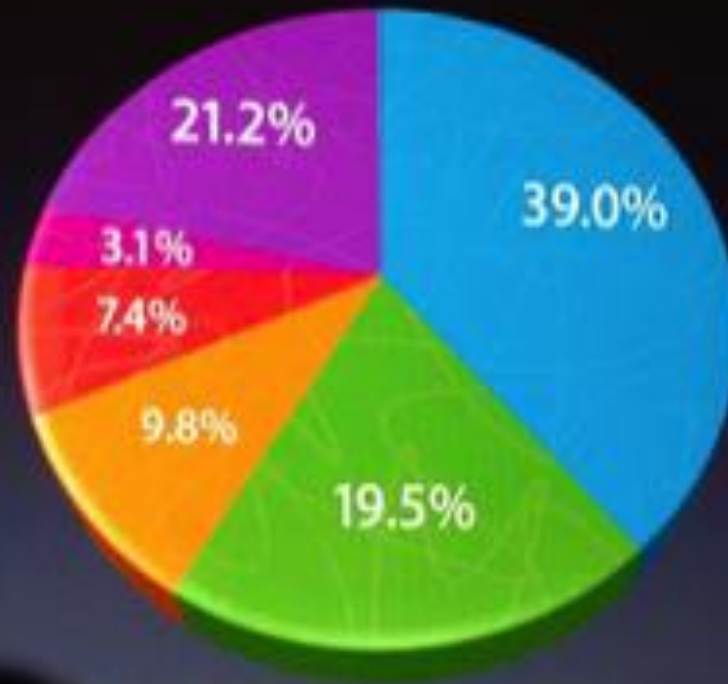


Public Domain/ Wikipedia

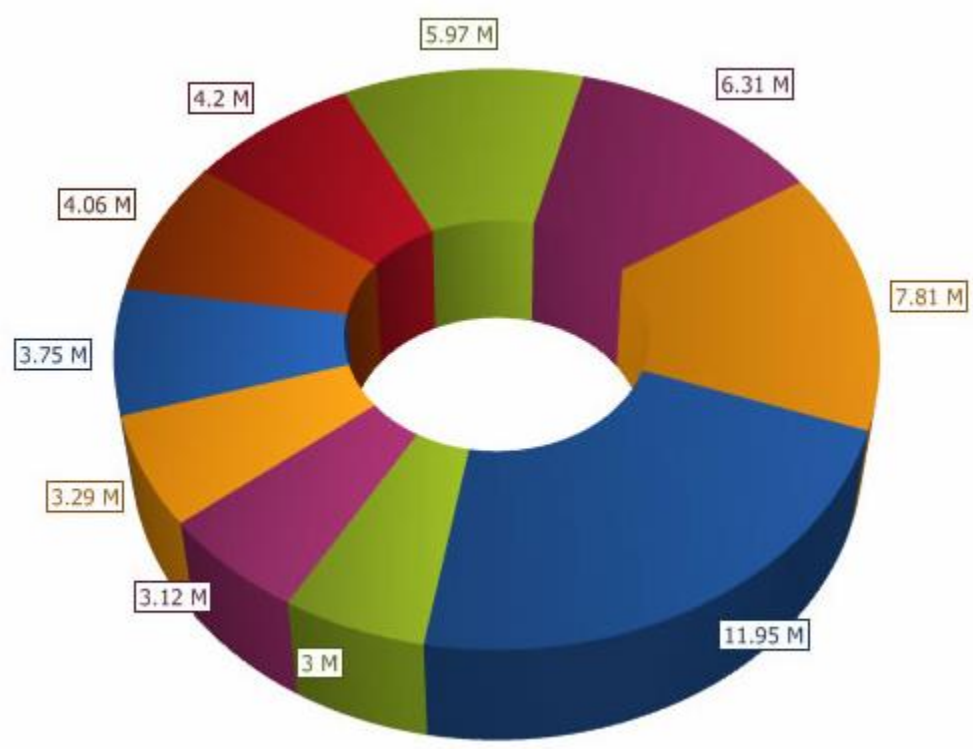


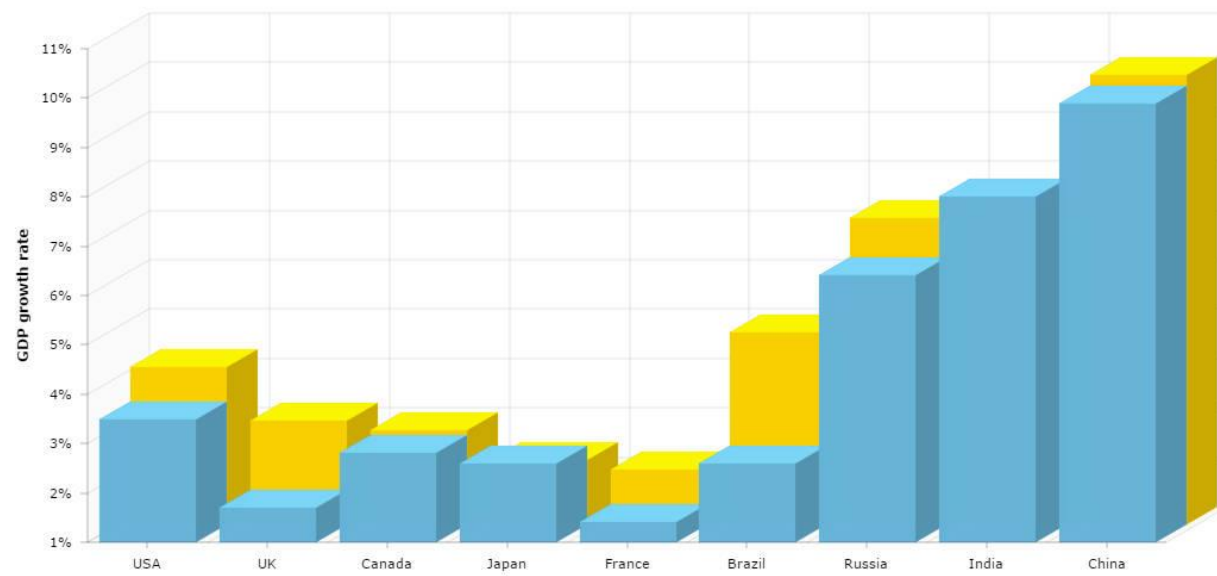
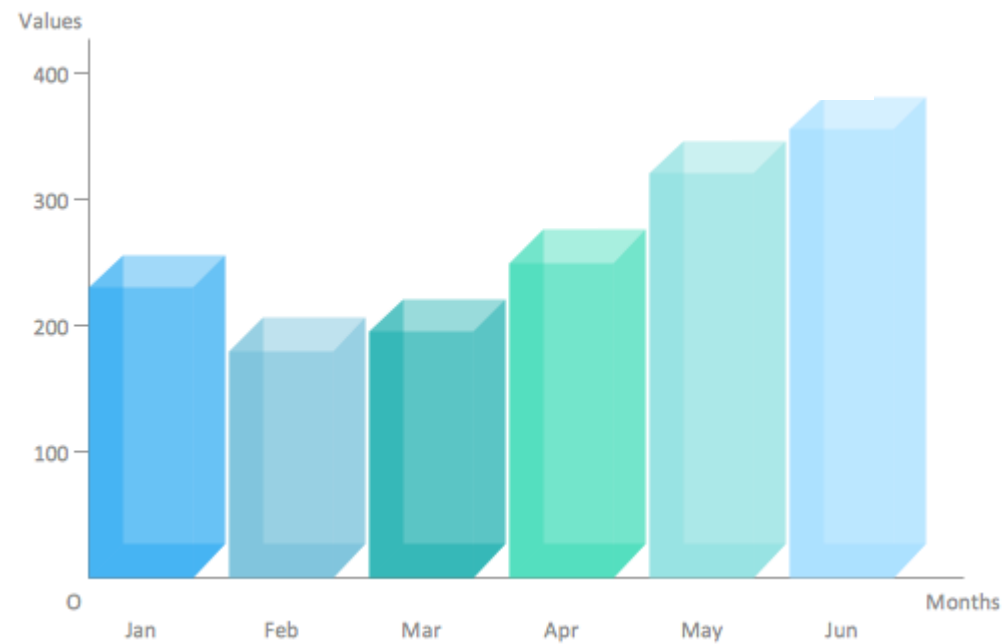
U.S. SmartPhone Marketshare

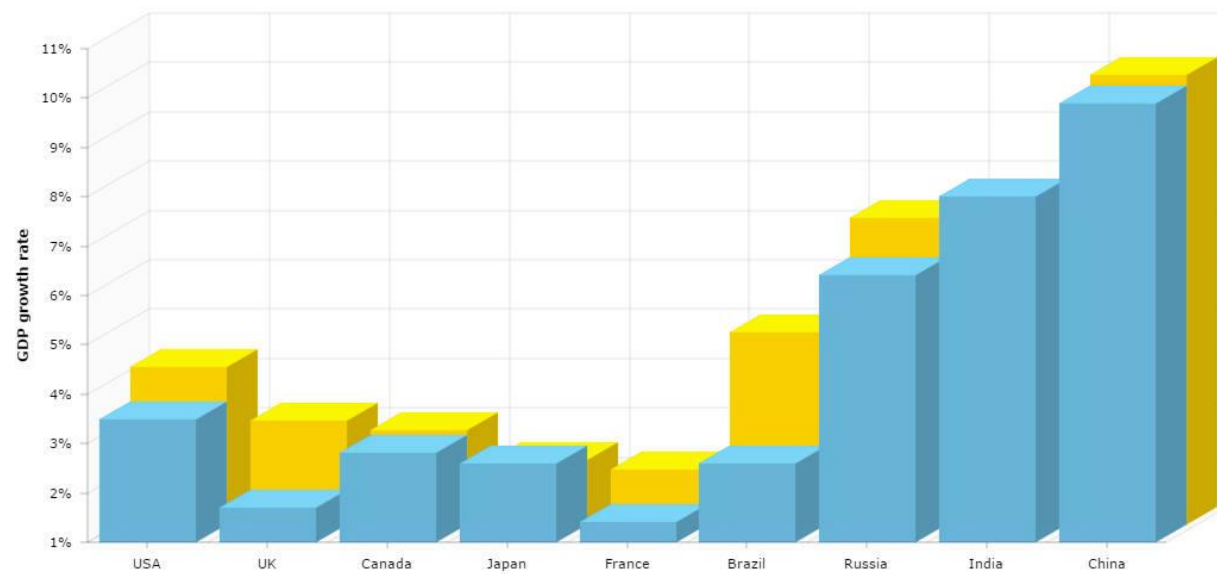
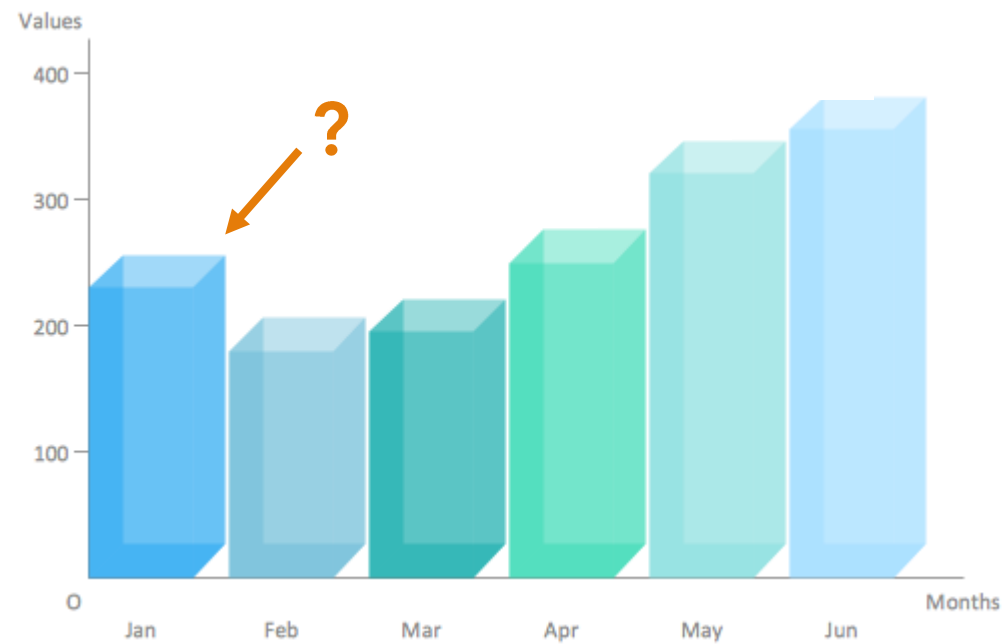
- RIM
- Apple
- Palm
- Motorola
- Nokia
- Other

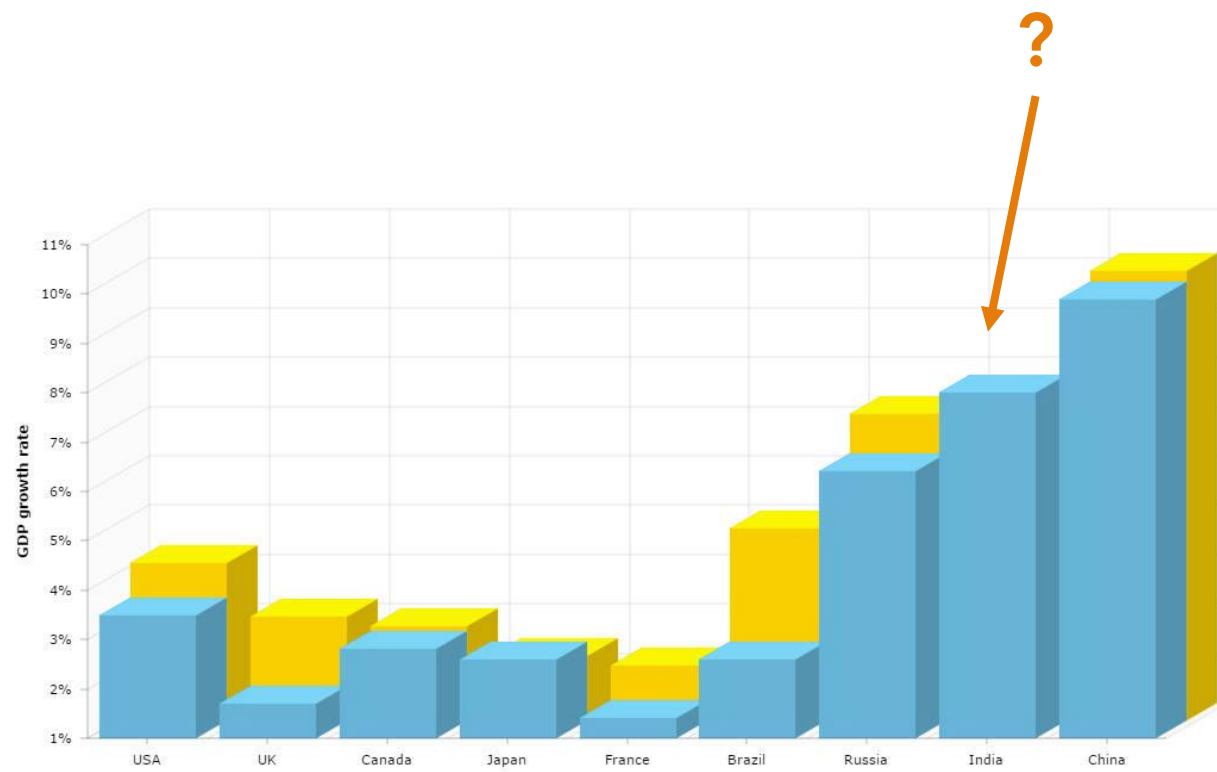
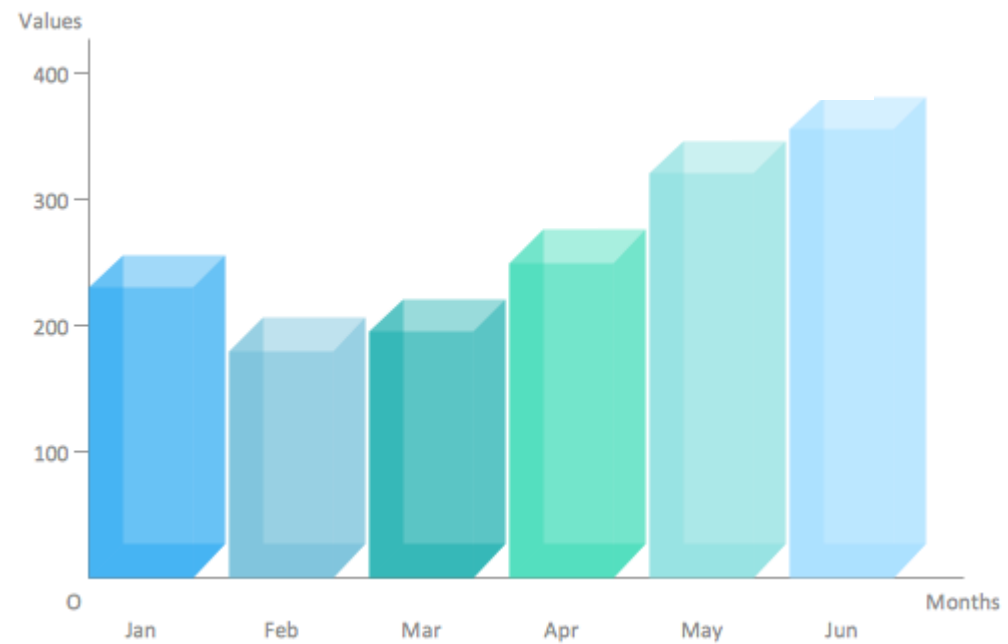


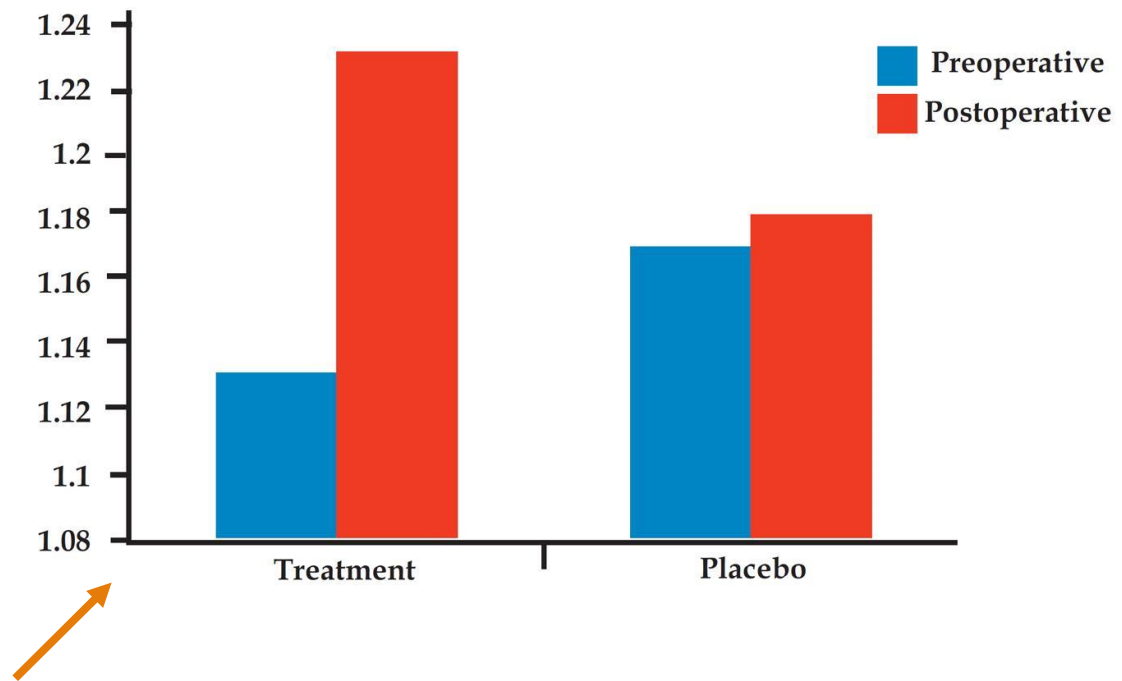
Engage Gartner for

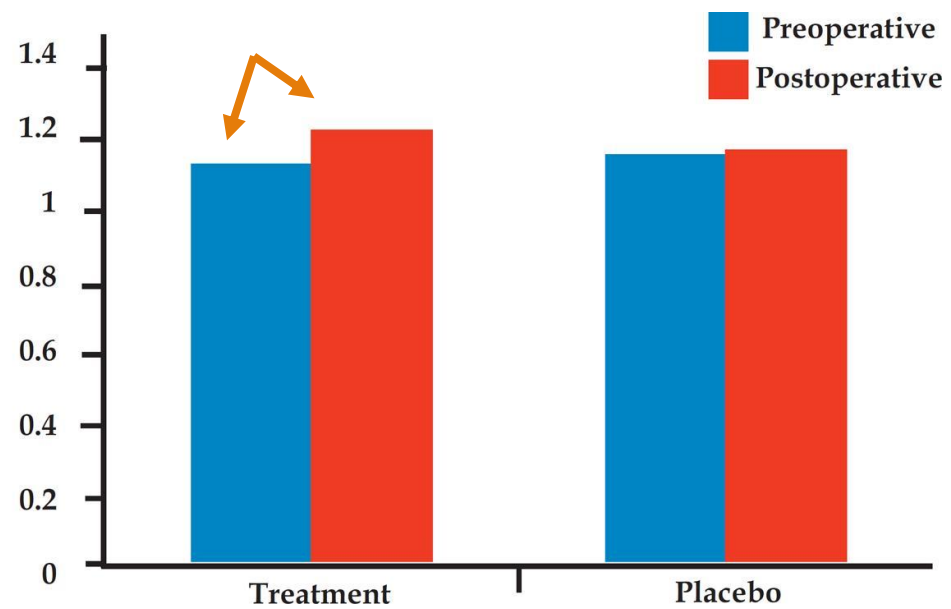
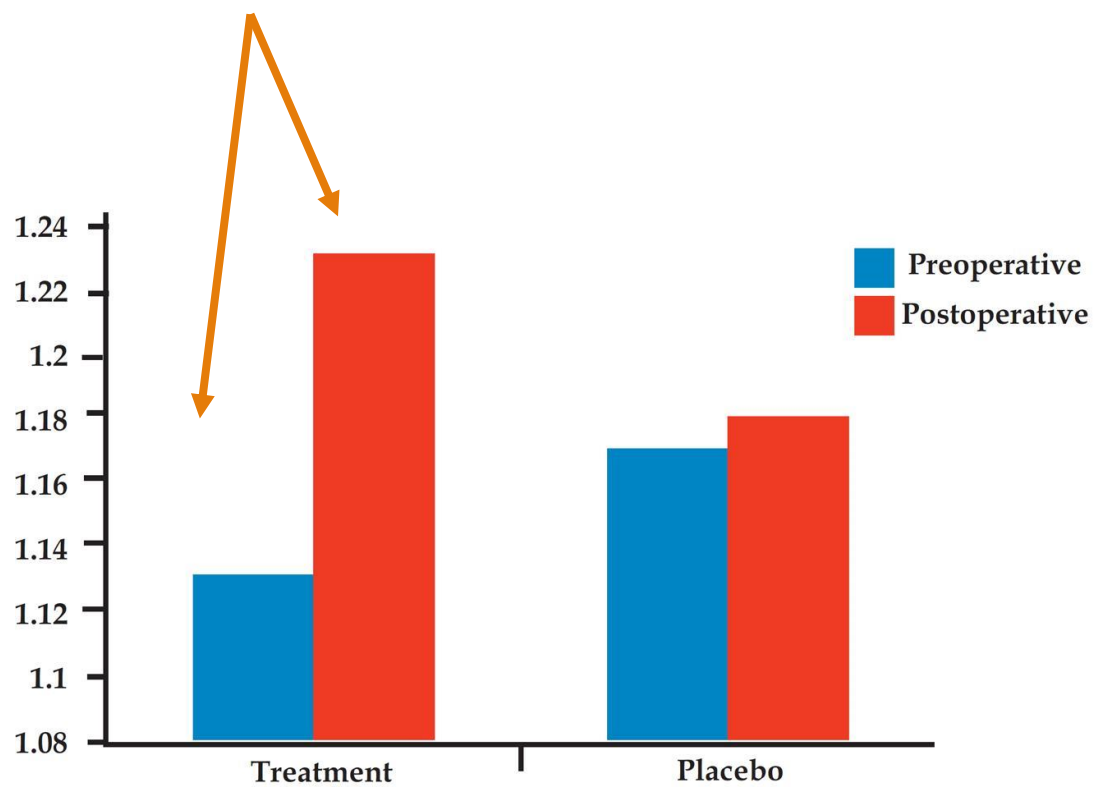


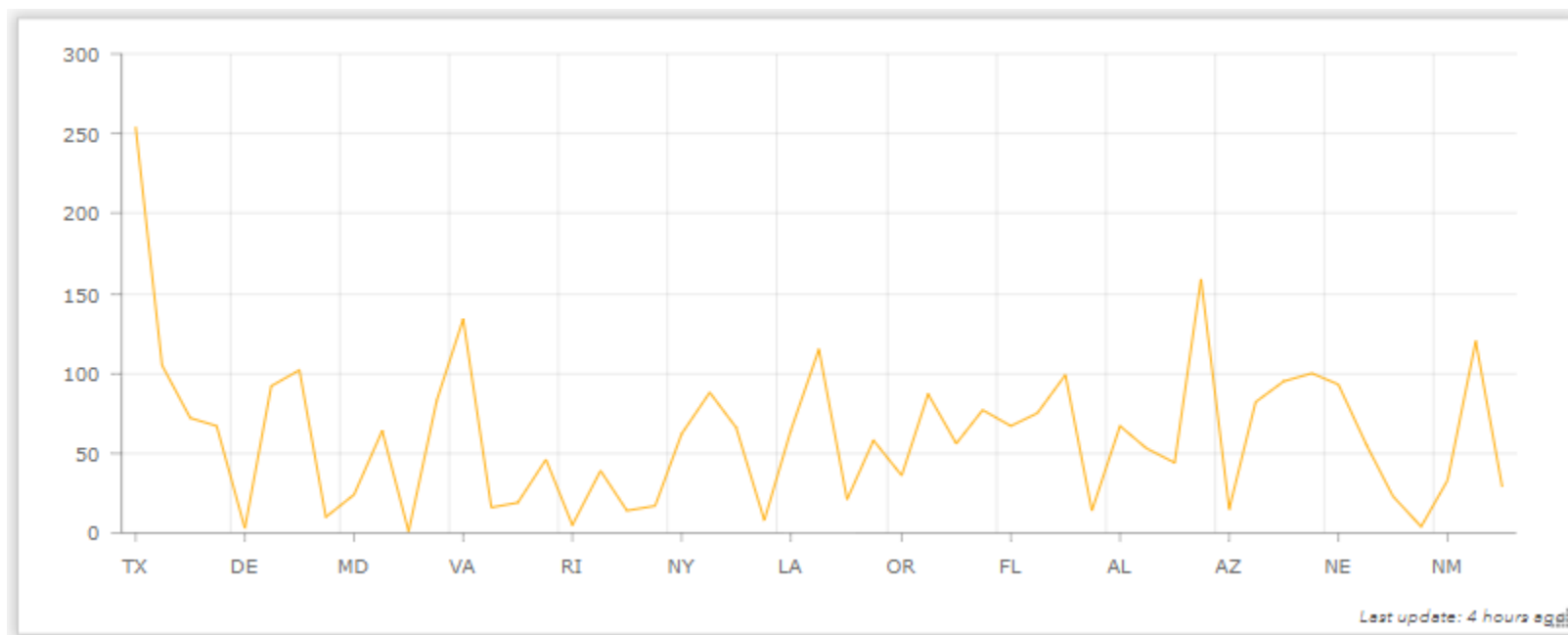


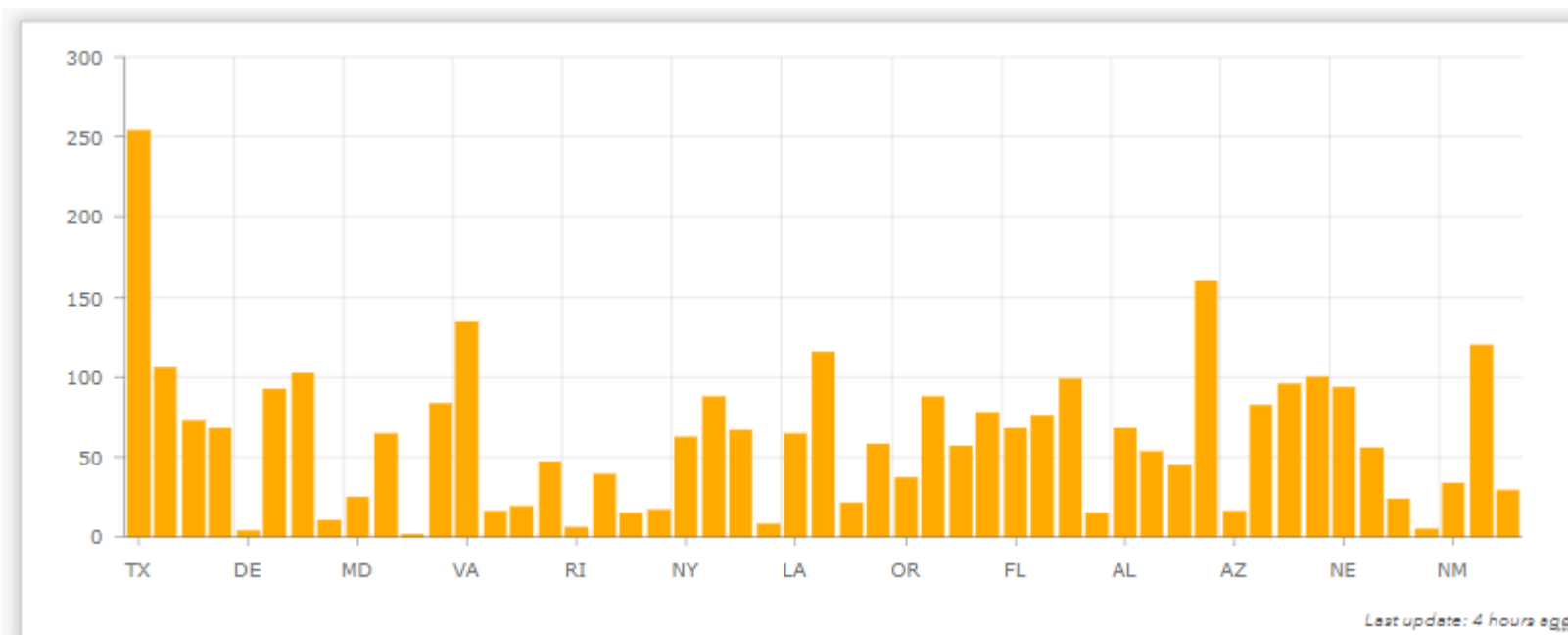
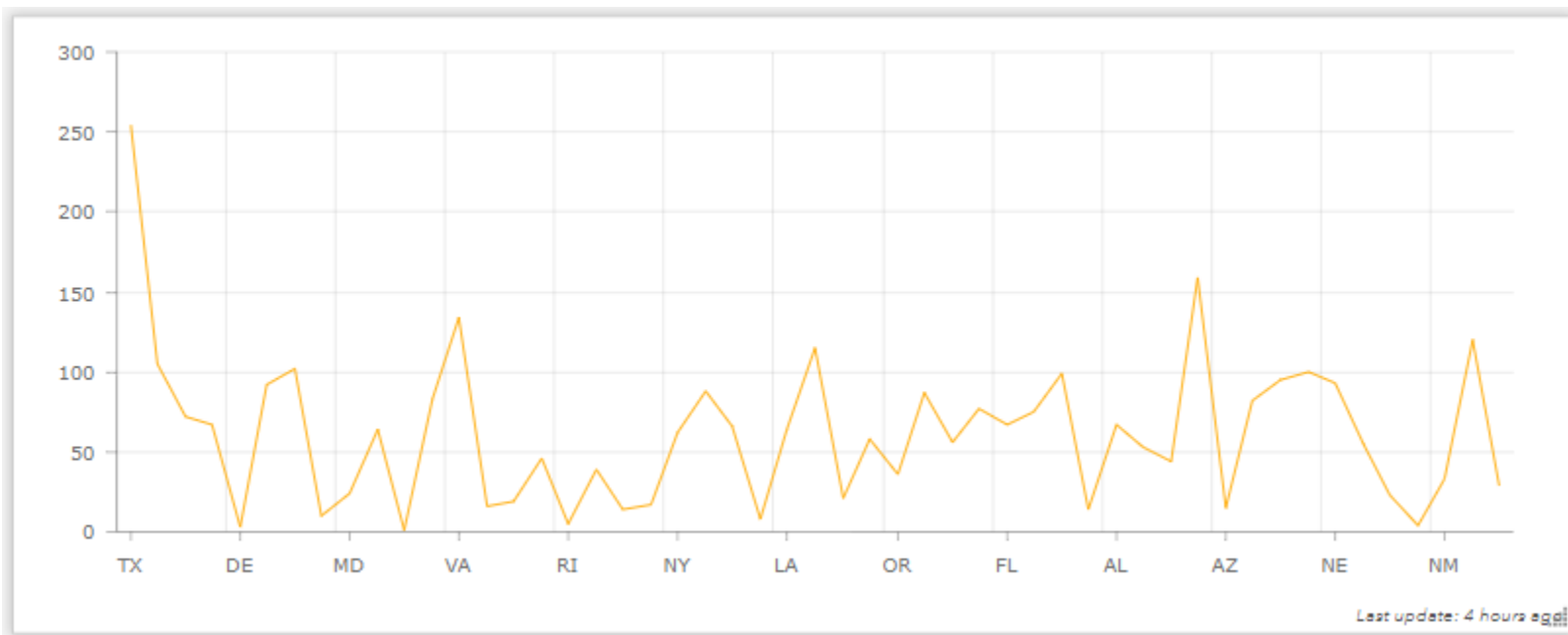












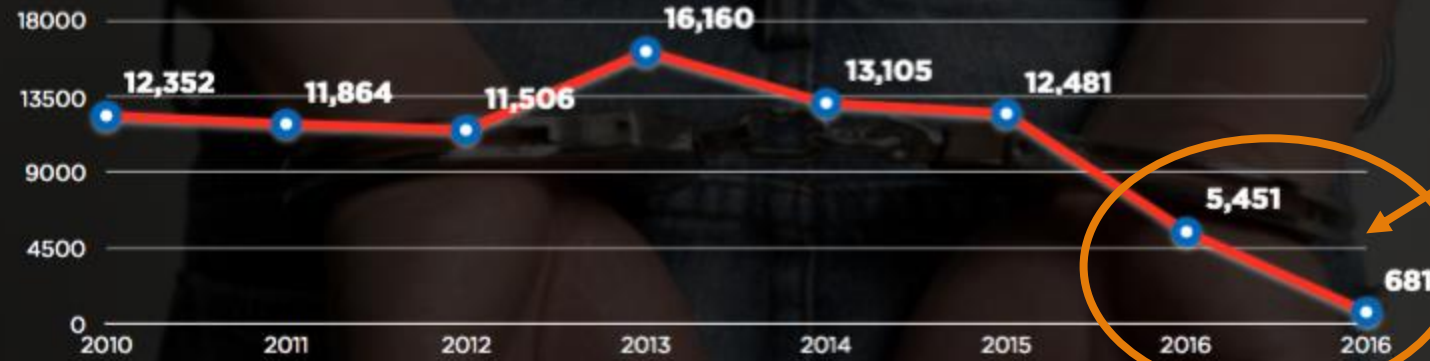
NUMBER OF MURDER AND HOMICIDE CASES REPORTED (2010- AUG 3, 2016)



	2010	2011	2012	2013	2014	2015	2016 JAN-JUNE	2016 JULY 1 - AUG3
Total Murder + Homicide	12, 352	11,864	11,506	16,160	13,105	12,481	5,451	681
Average/ Daily	34	32	32	44	36	34	30	20

Source: PNP Directorate for investigative and detective management

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Visualizations to support spatial analysis

Distributions and frequency

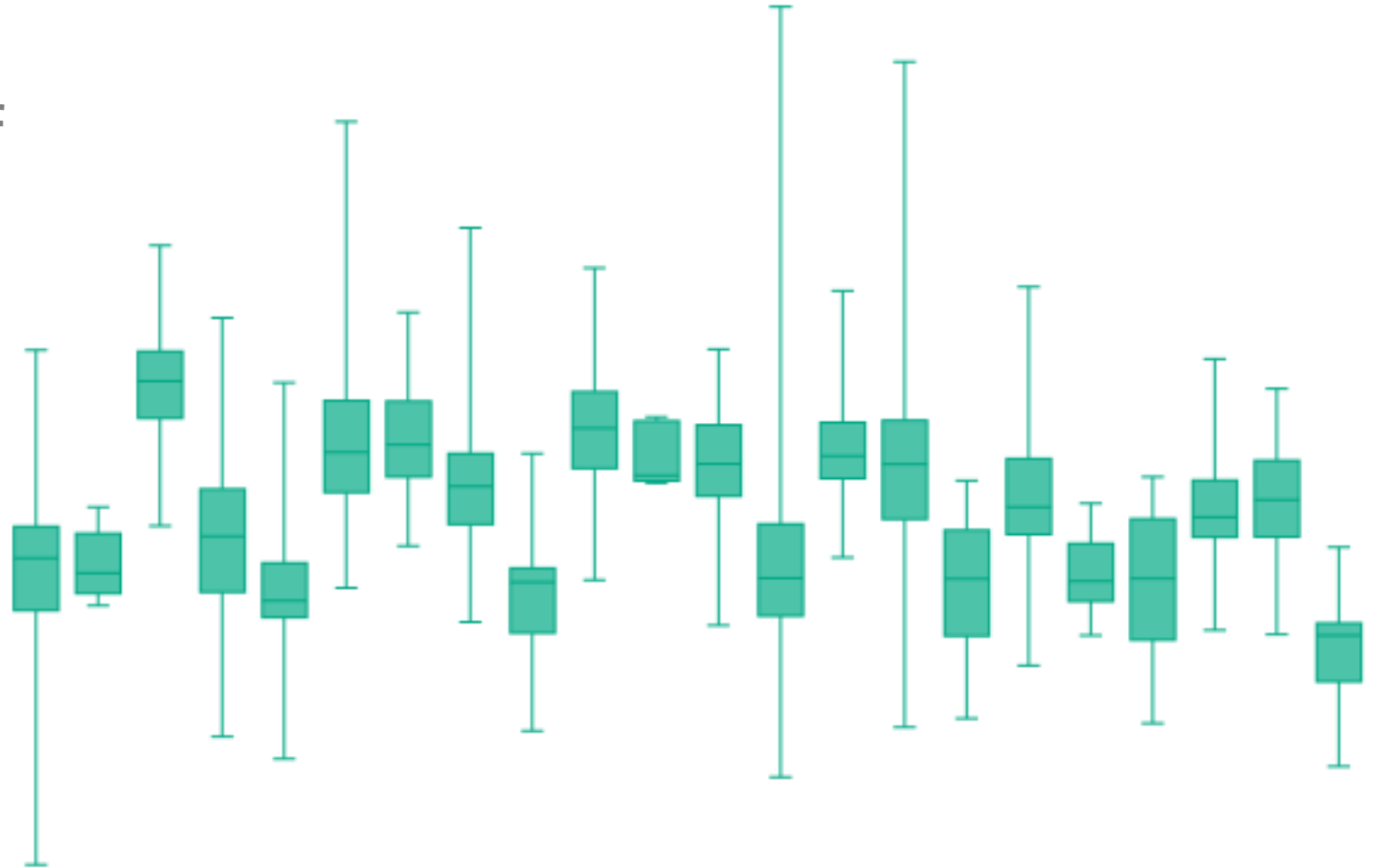
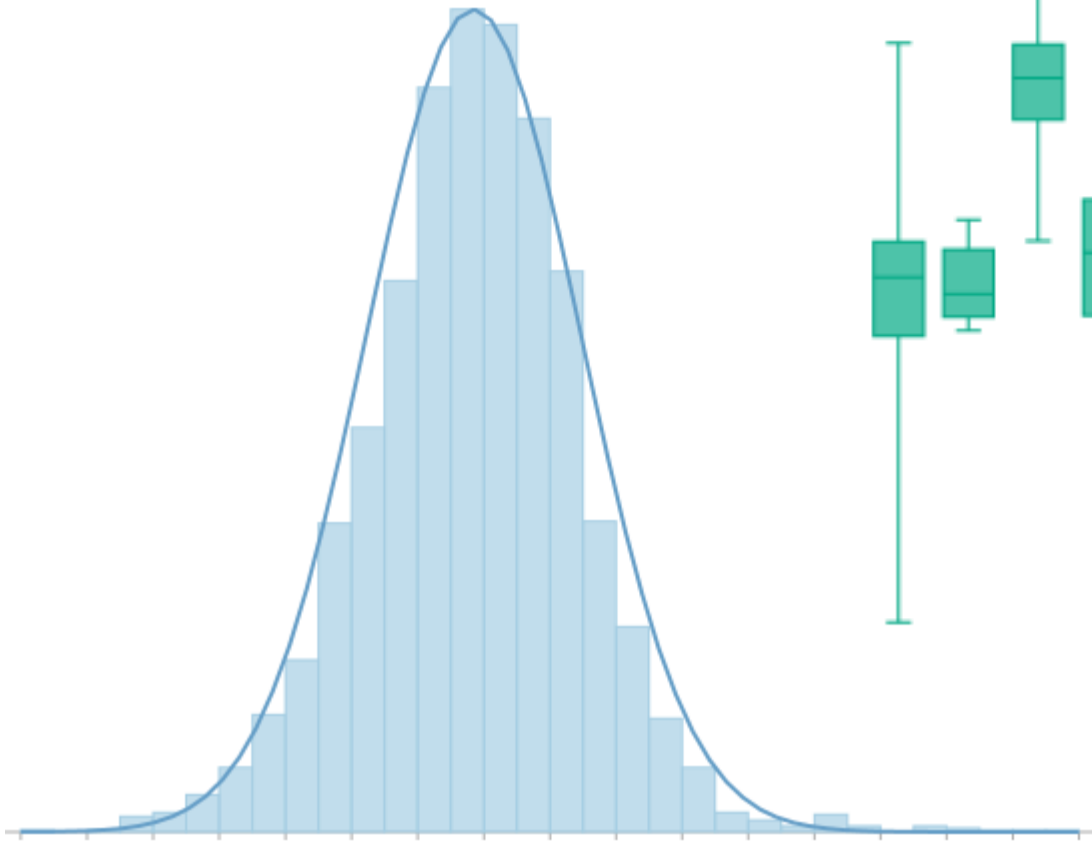
Category comparisons

Relationships and correlations

Change over time or distance

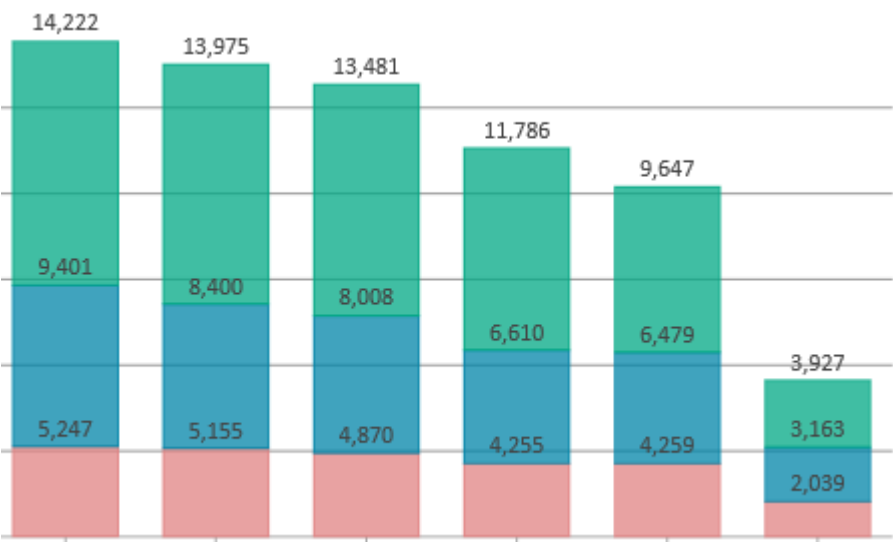
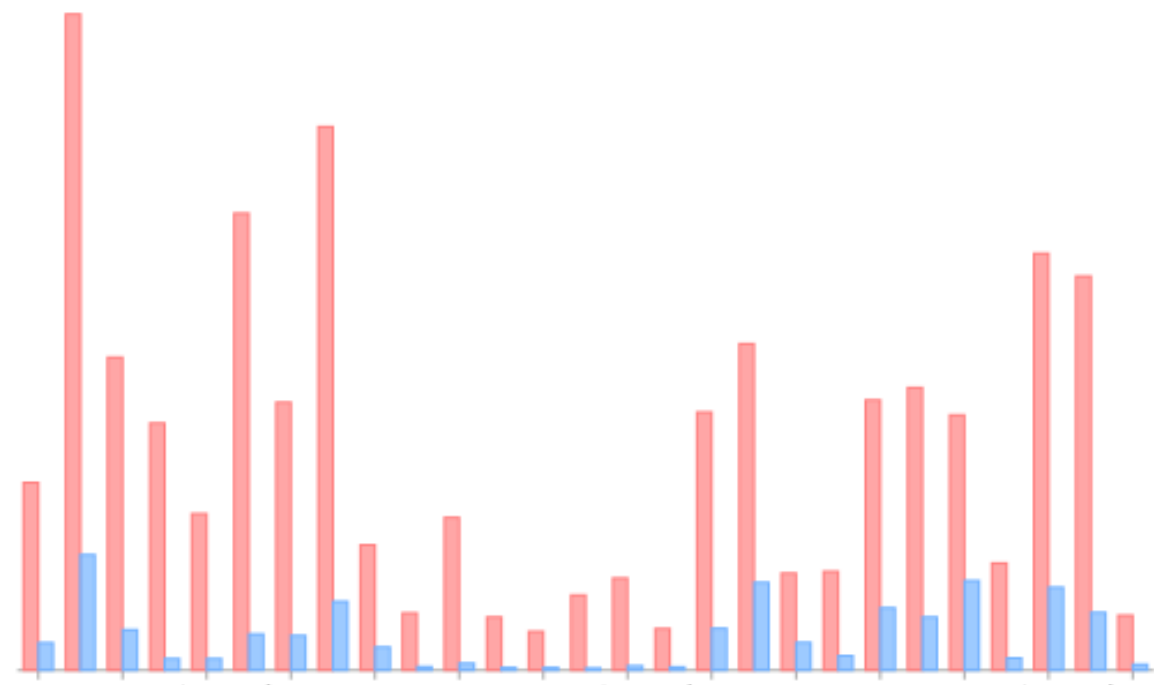
Distributions

Understanding the shape of numerical data



Categories

Summarizing and comparing amounts across categorical data



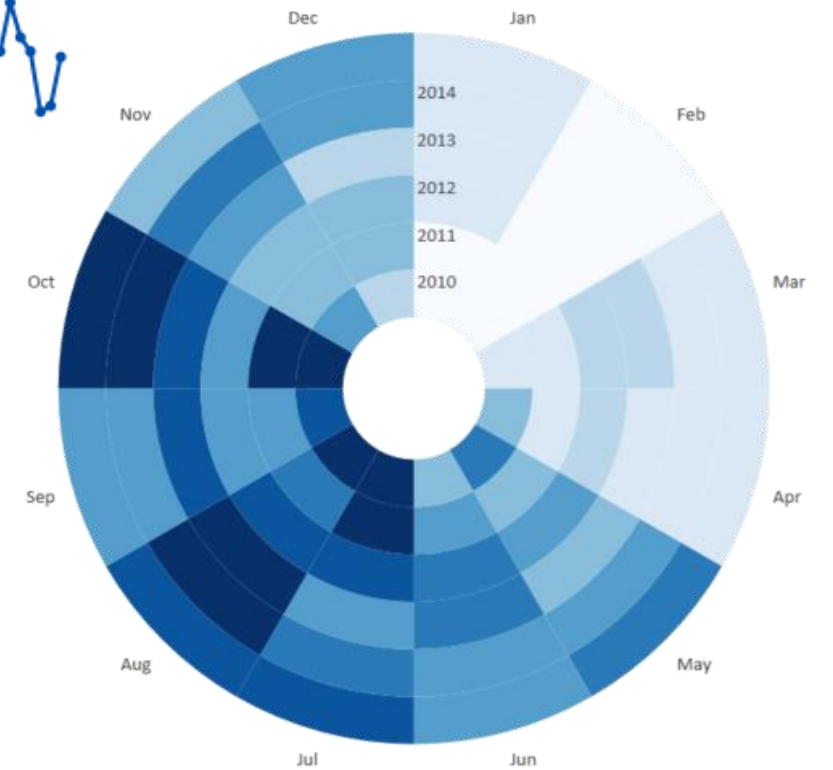
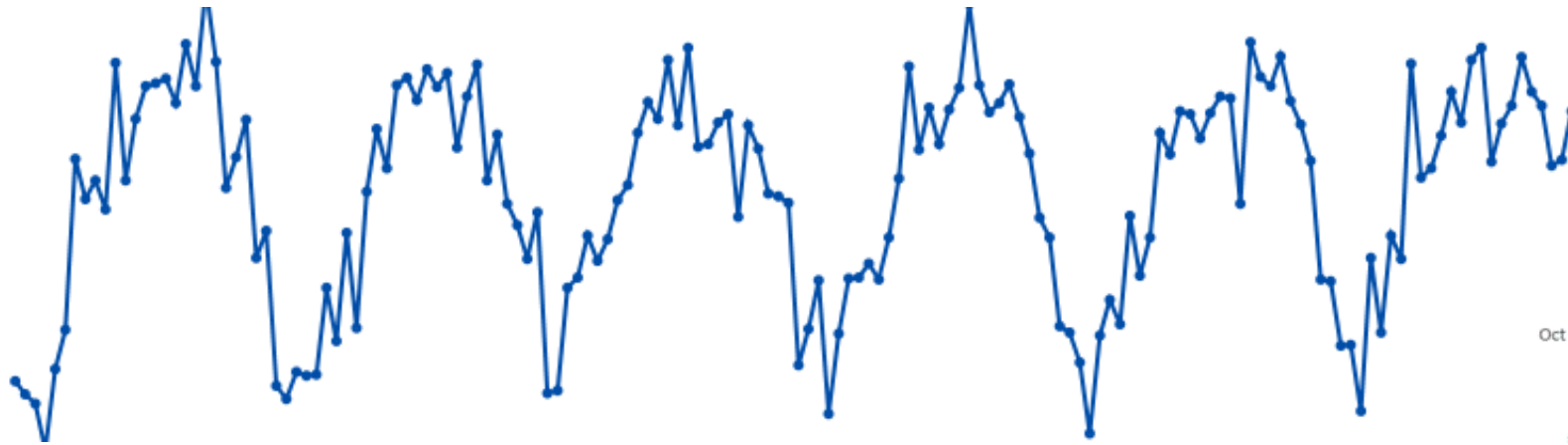
Relationships

Explore correlations and trends



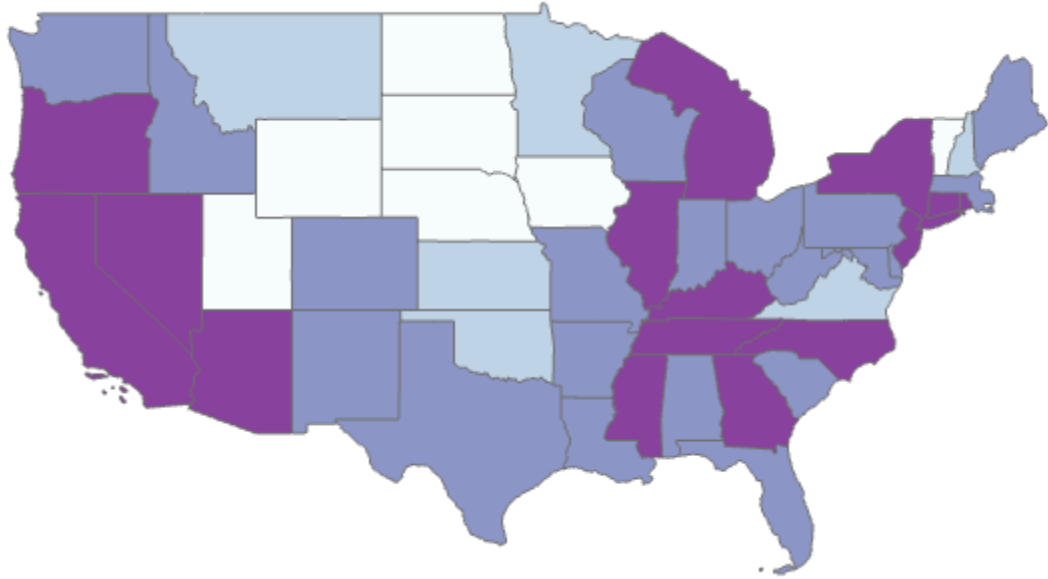
Change

Visualizing trends and cycles over time or distance

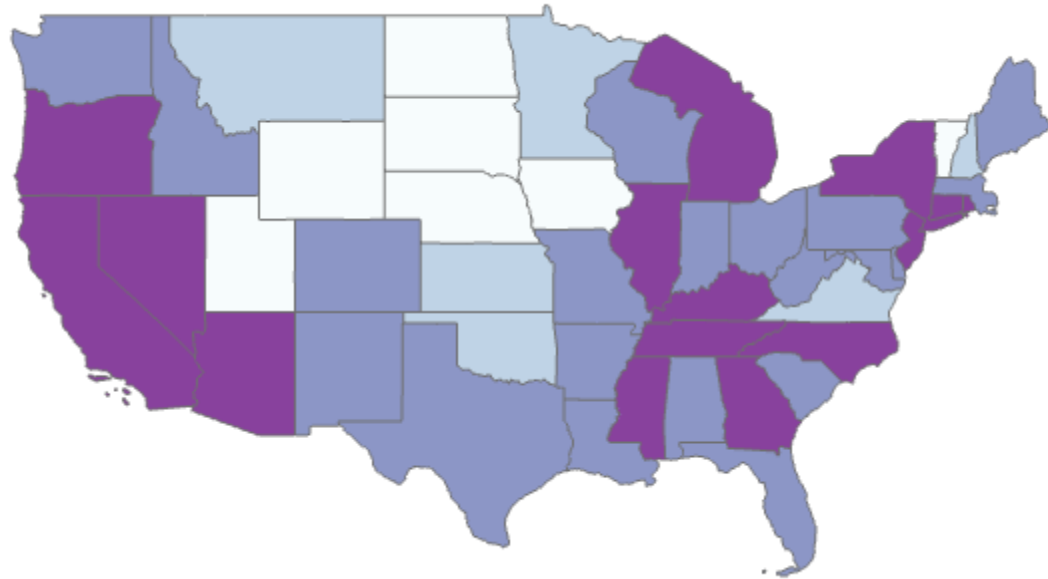


**When a map (alone)
isn't the best option...**

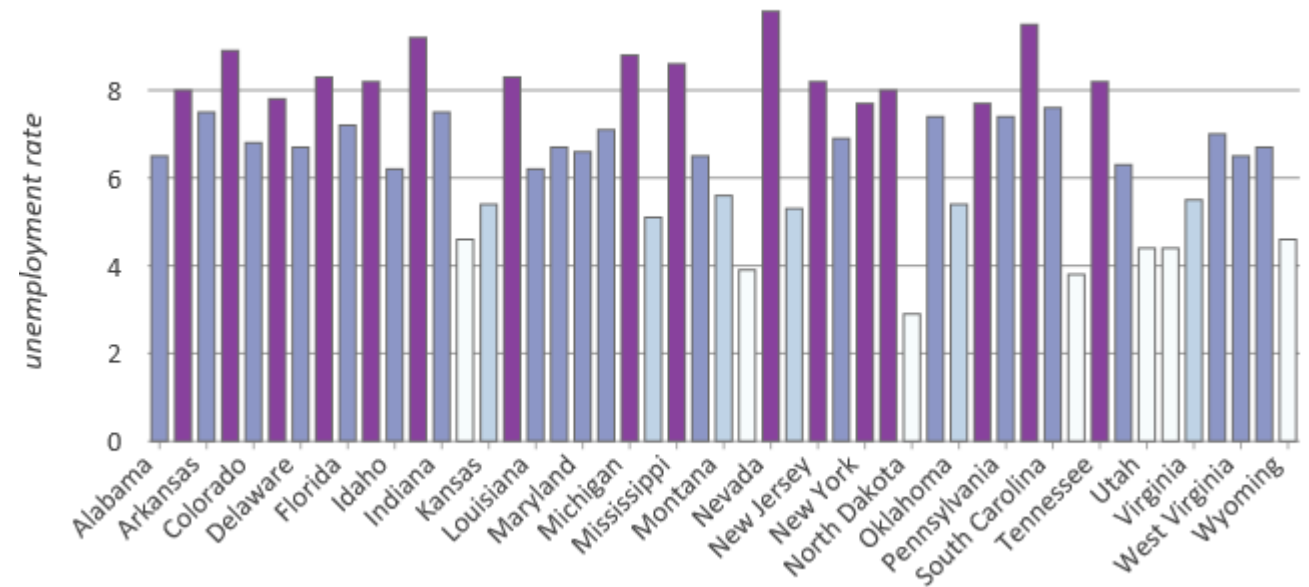
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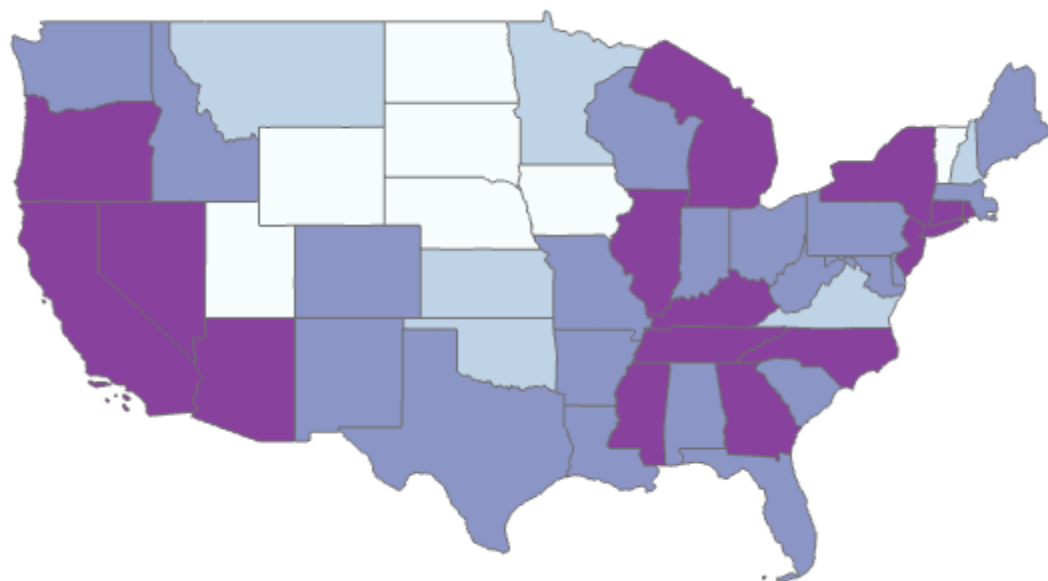
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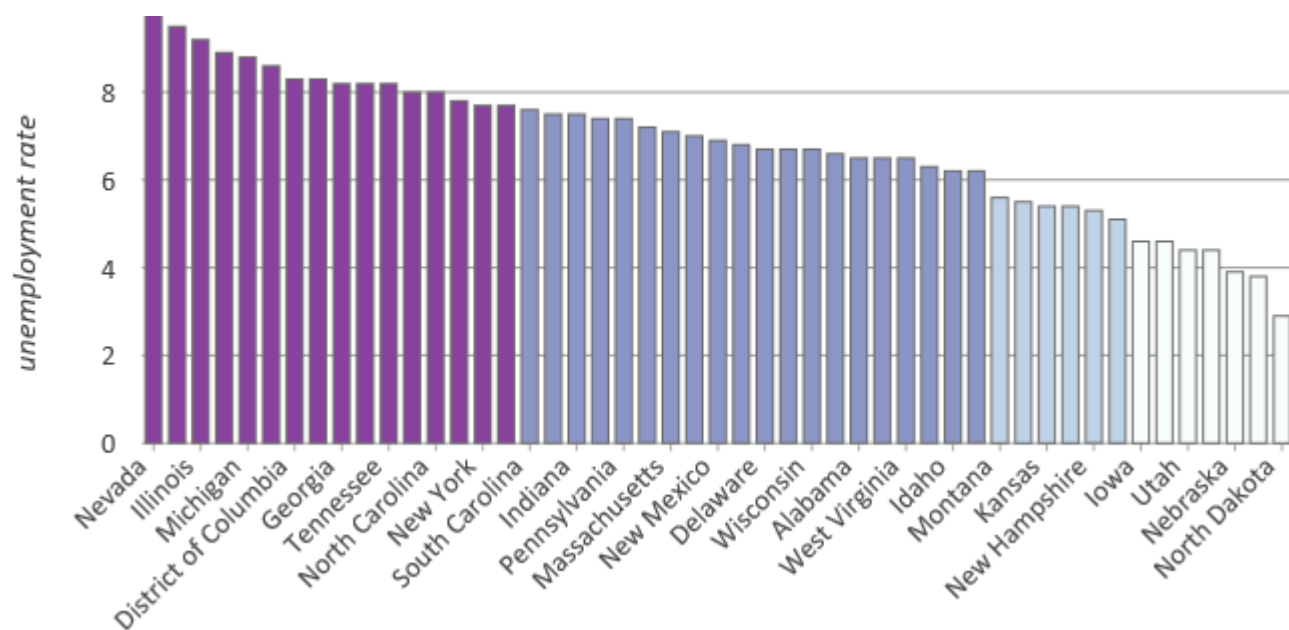
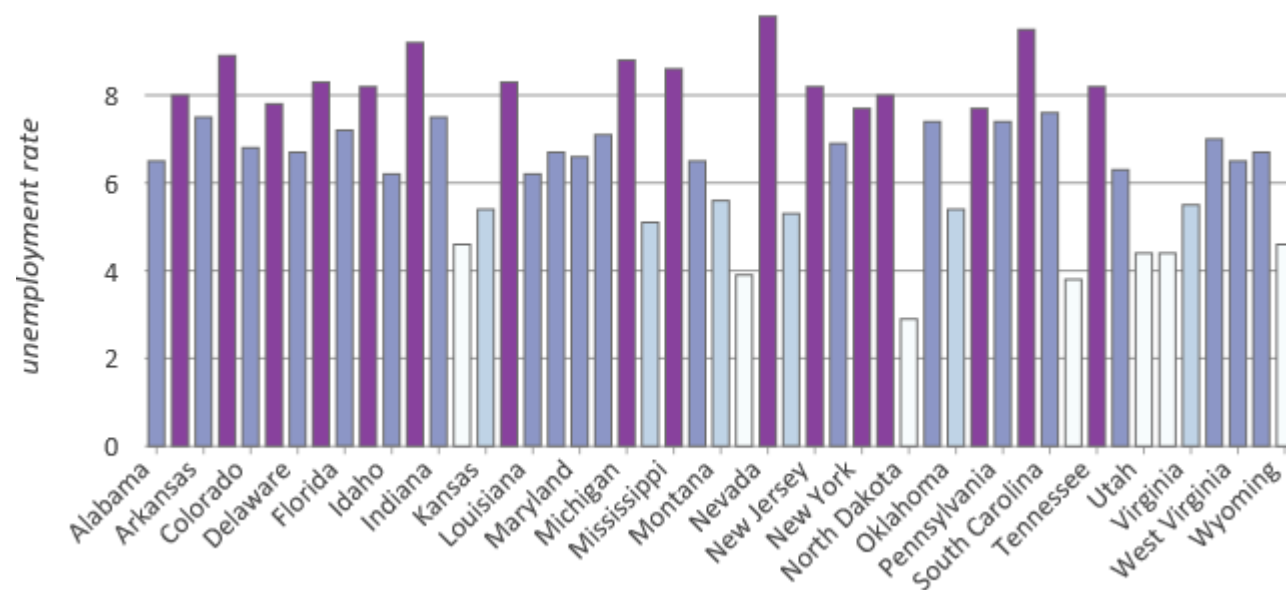
Comparison of unemployment rate by State



When a map (alone) isn't the best option...



Comparison of unemployment rate by State



When a map (alone) isn't the best option...

I

10	8.04
8	6.95
13	7.58
9	8.81
11	8.33
14	9.96
6	7.24
4	4.26
12	10.84
7	4.82
5	5.68

II

10	9.14
8	8.14
13	8.74
9	8.77
11	9.26
14	8.1
6	6.13
4	3.1
12	9.13
7	7.26
5	4.74

III

10	7.46
8	6.77
13	12.74
9	7.11
11	7.81
14	8.84
6	6.08
4	5.39
12	8.15
7	6.42
5	5.73

IV

8	6.58
8	5.76
8	7.71
8	8.84
8	8.47
8	7.04
8	5.25
19	12.5
8	5.56
8	7.91
8	6.89

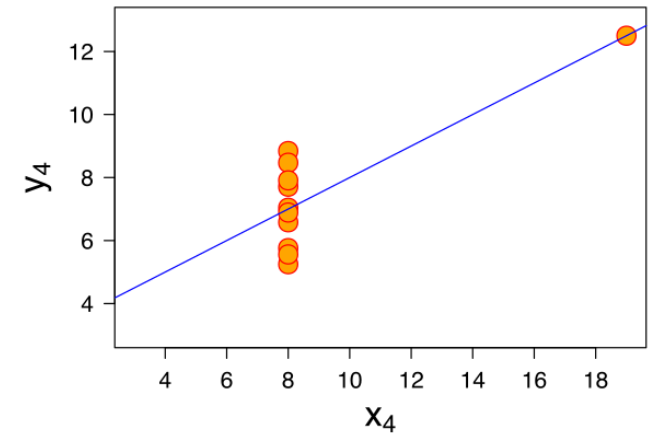
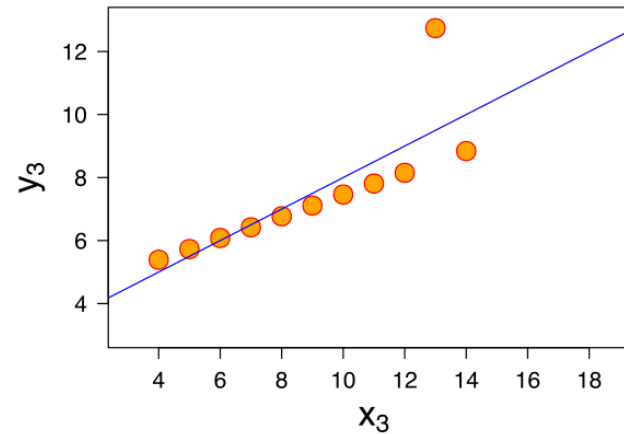
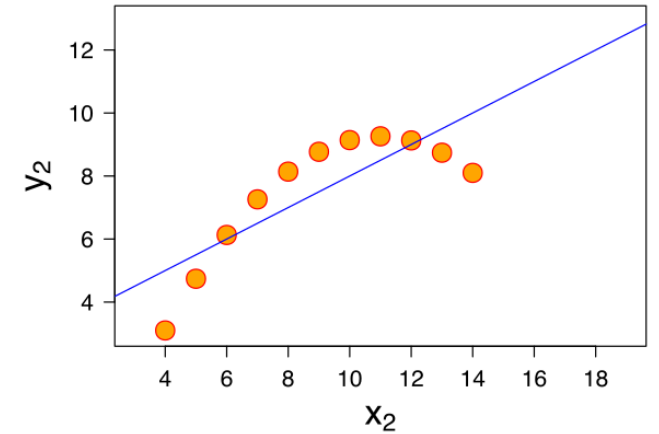
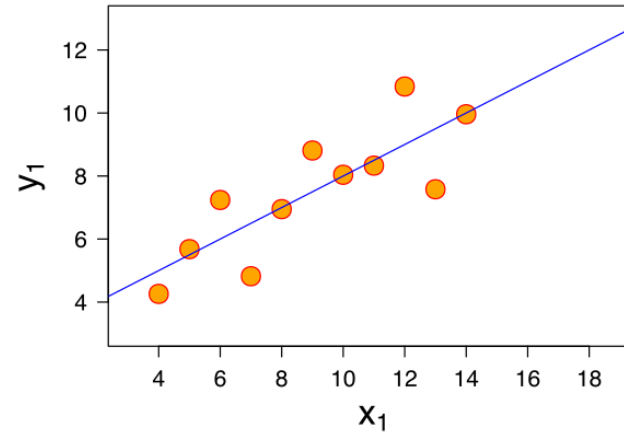
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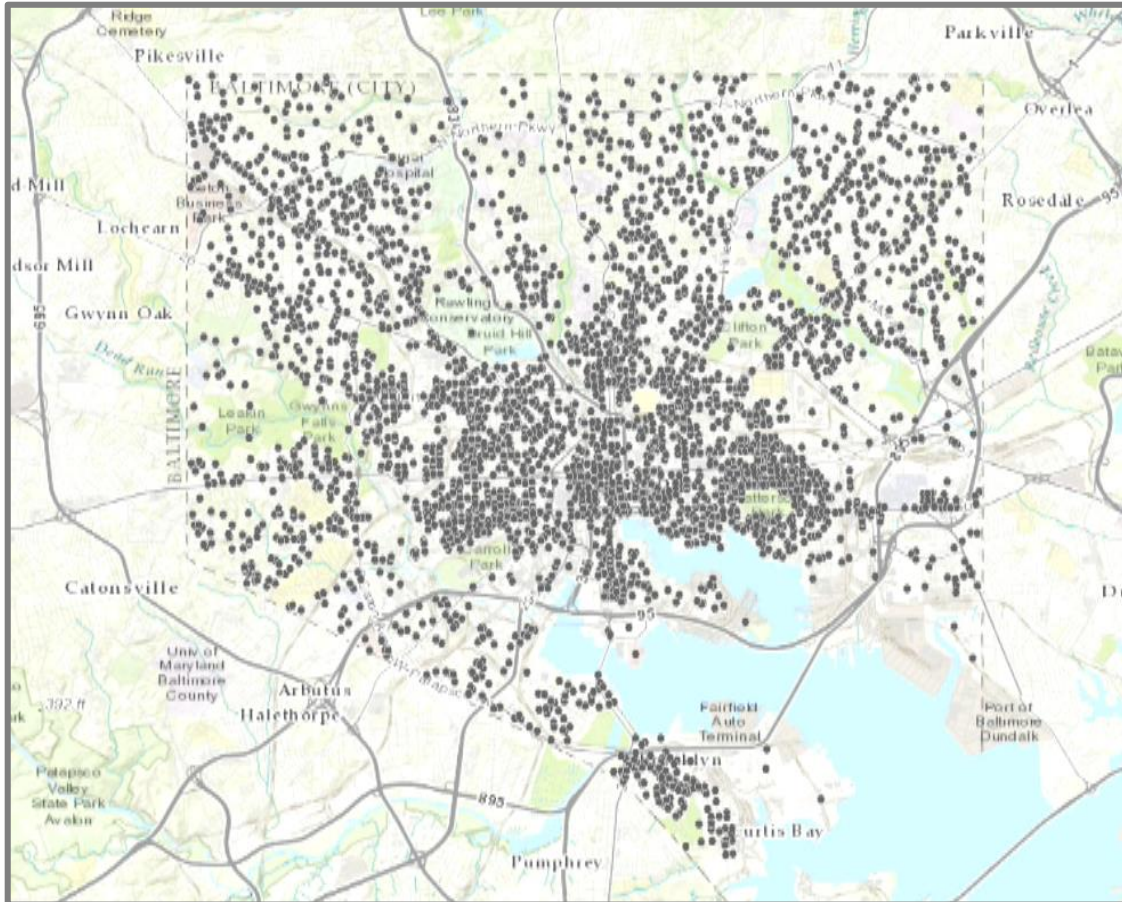
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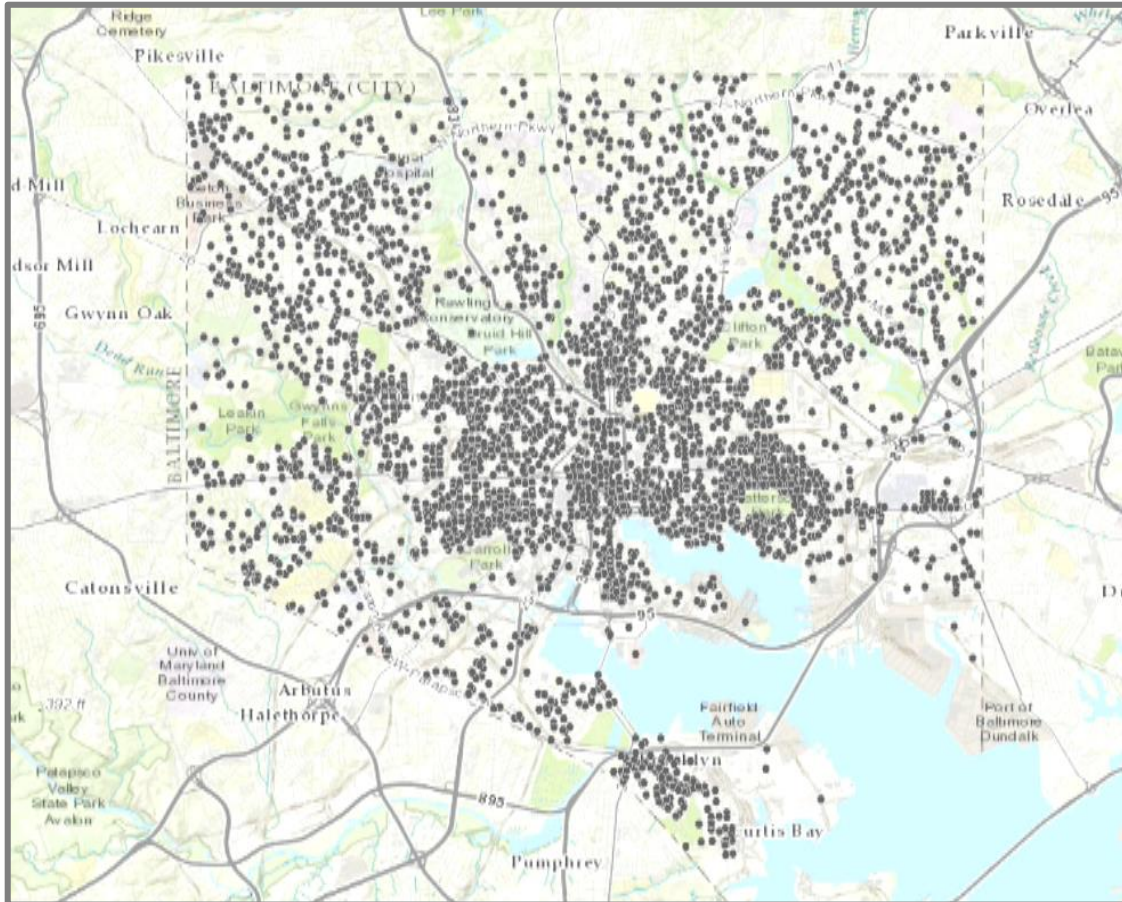
IV	
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8	8.47
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8	5.25
19	12.5
8	5.56
8	7.91
8	6.89



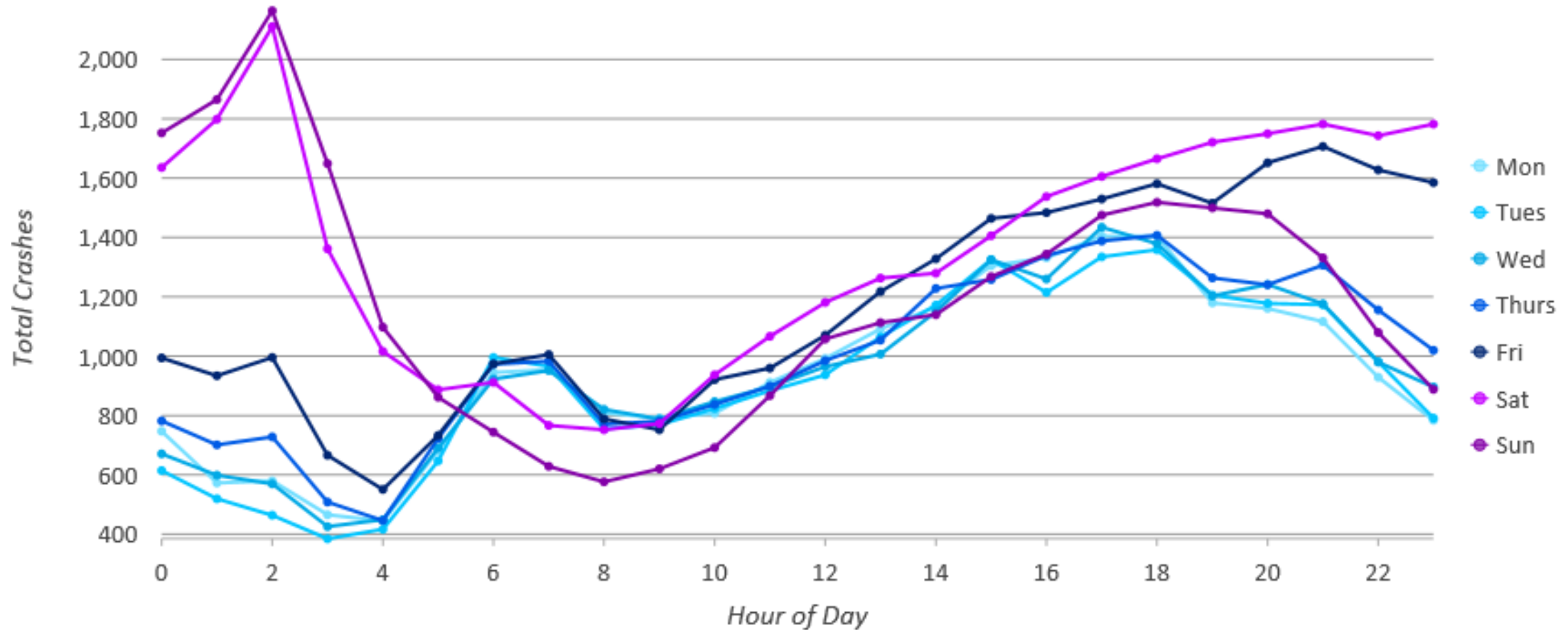
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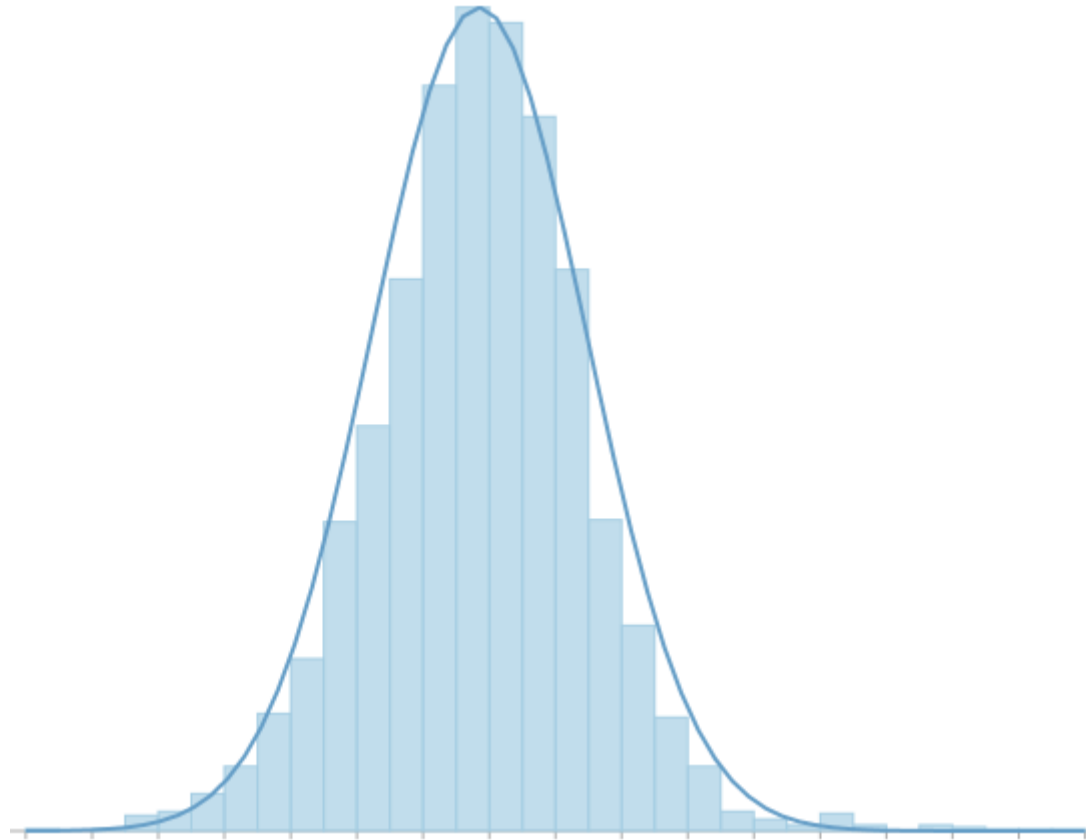
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When a map (alone)
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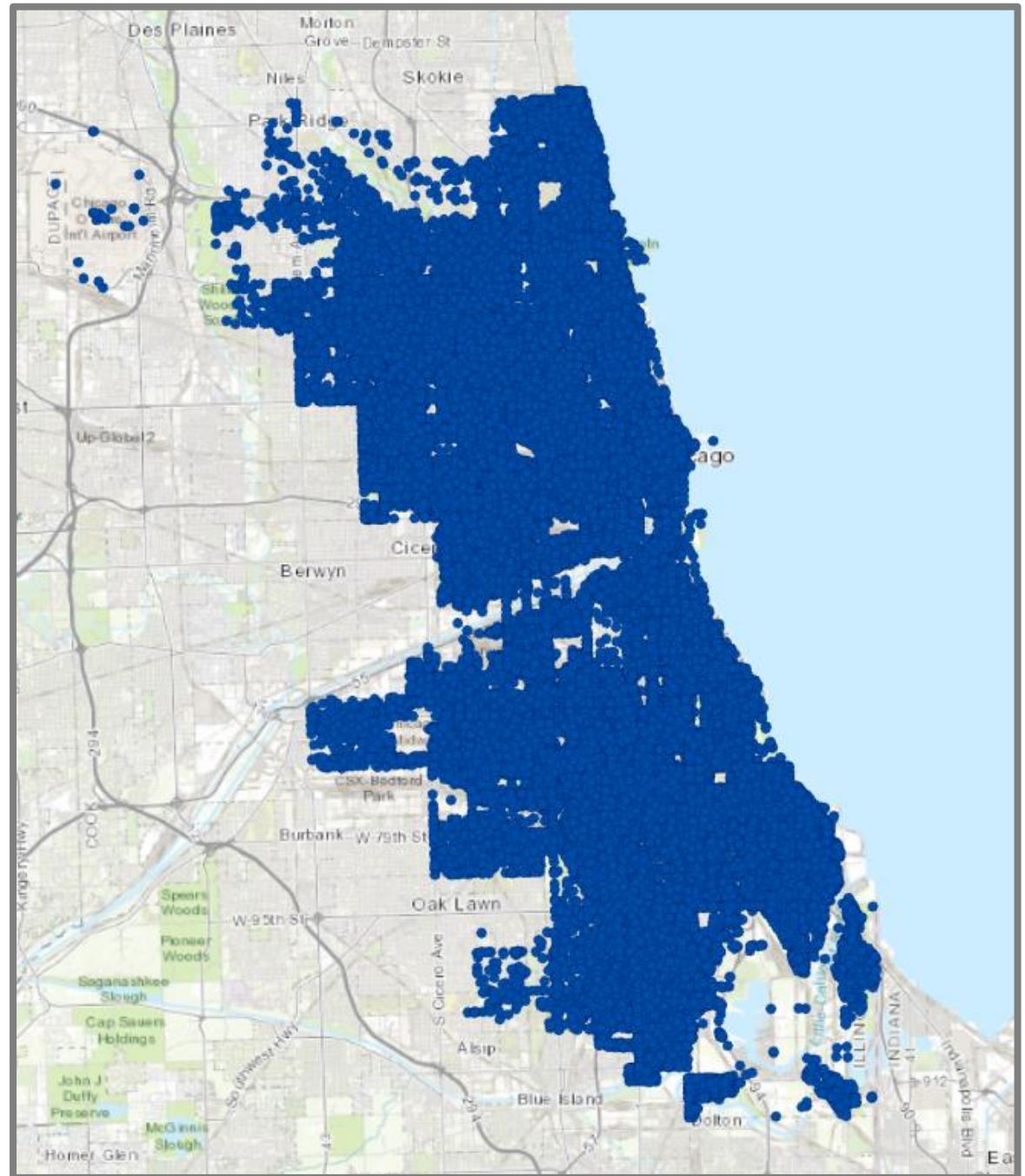


Demo

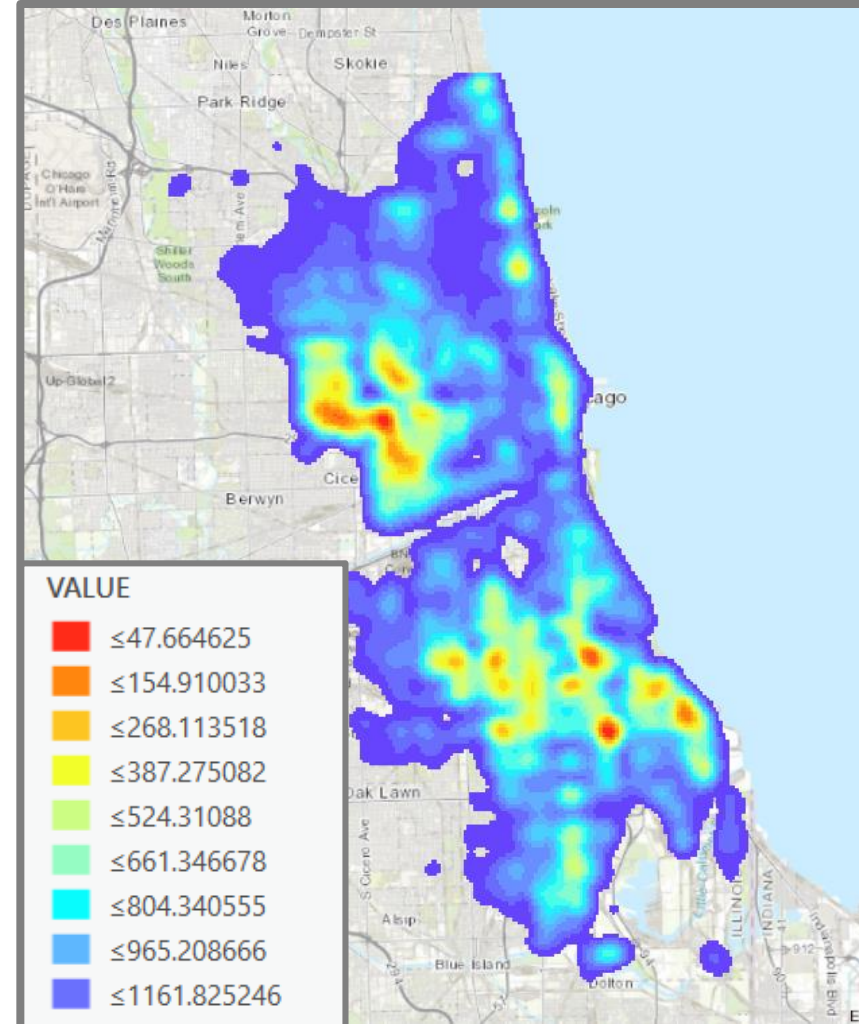
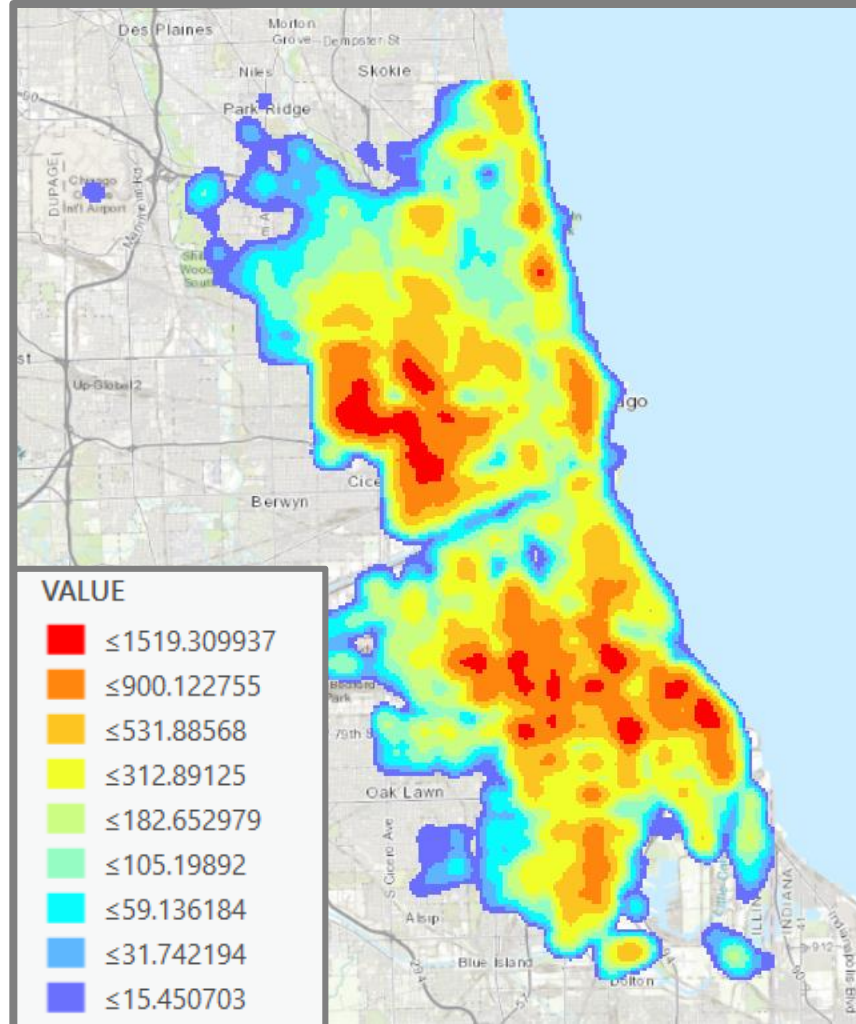


When we need more
than just a map...

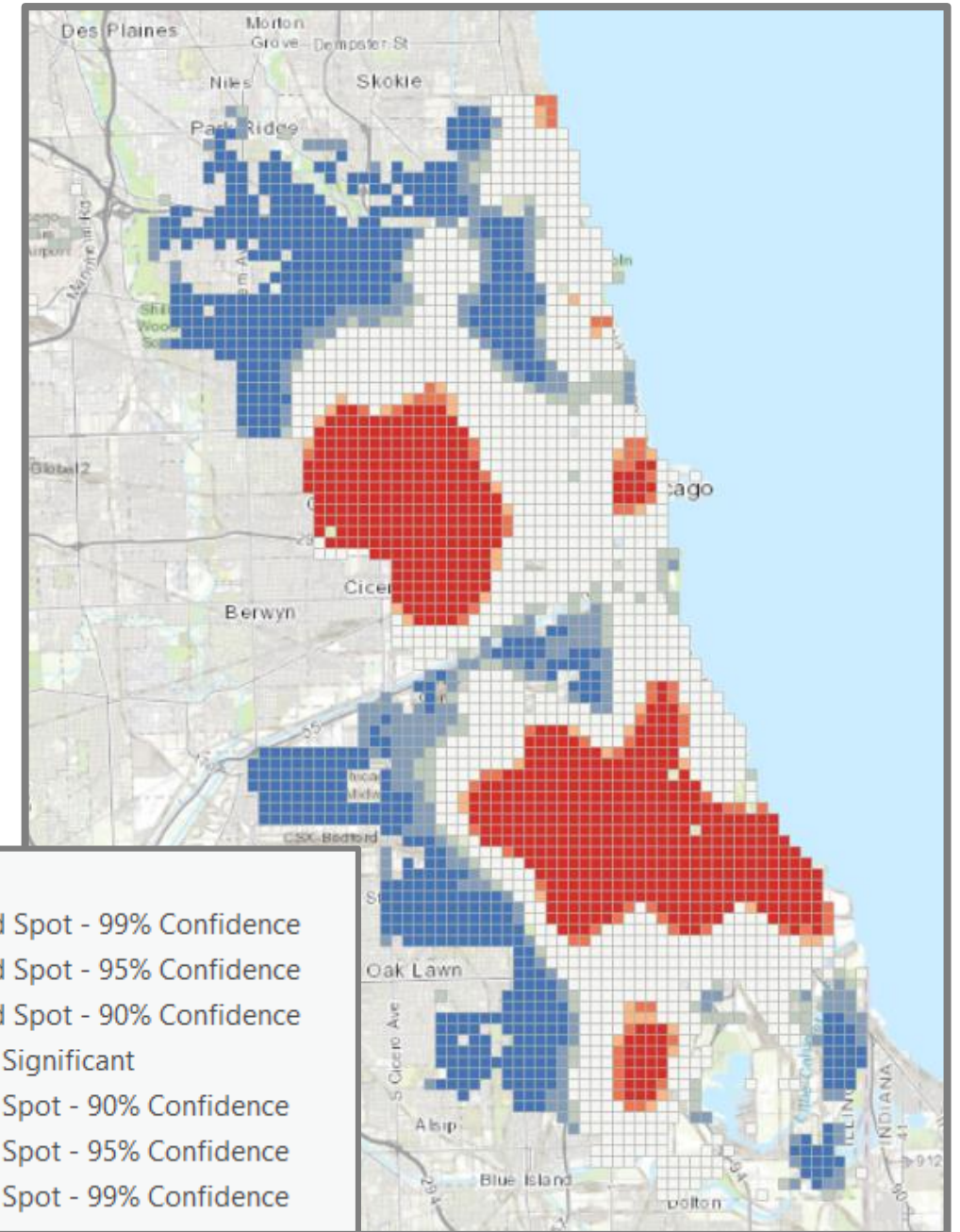
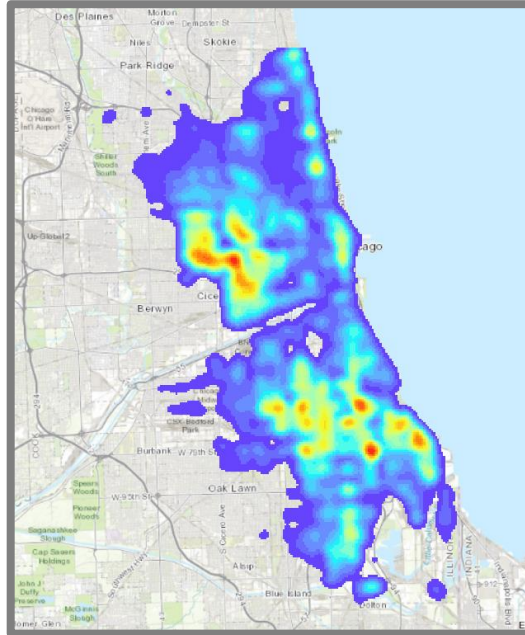
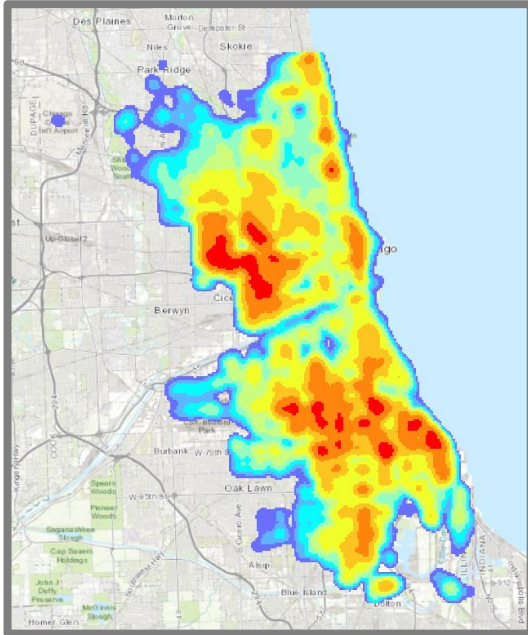
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than just a map...



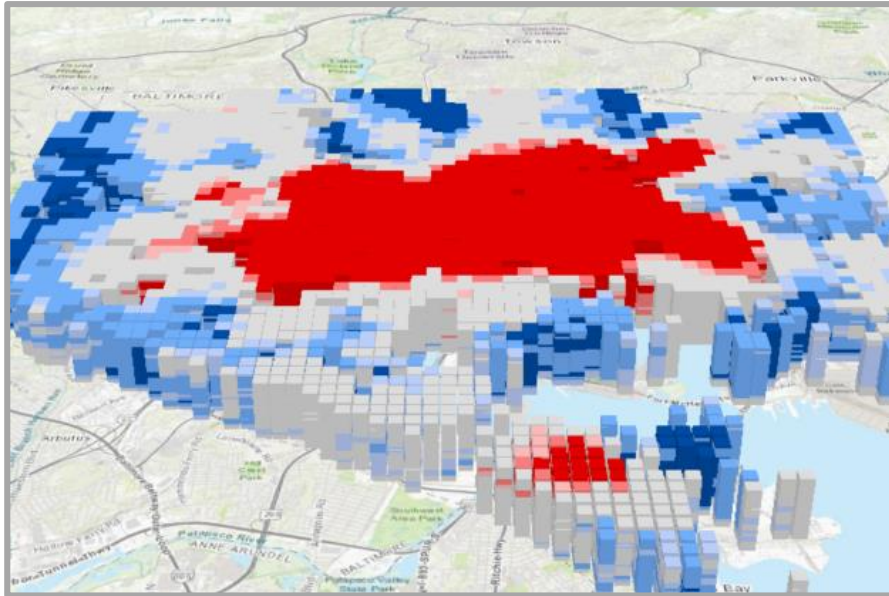
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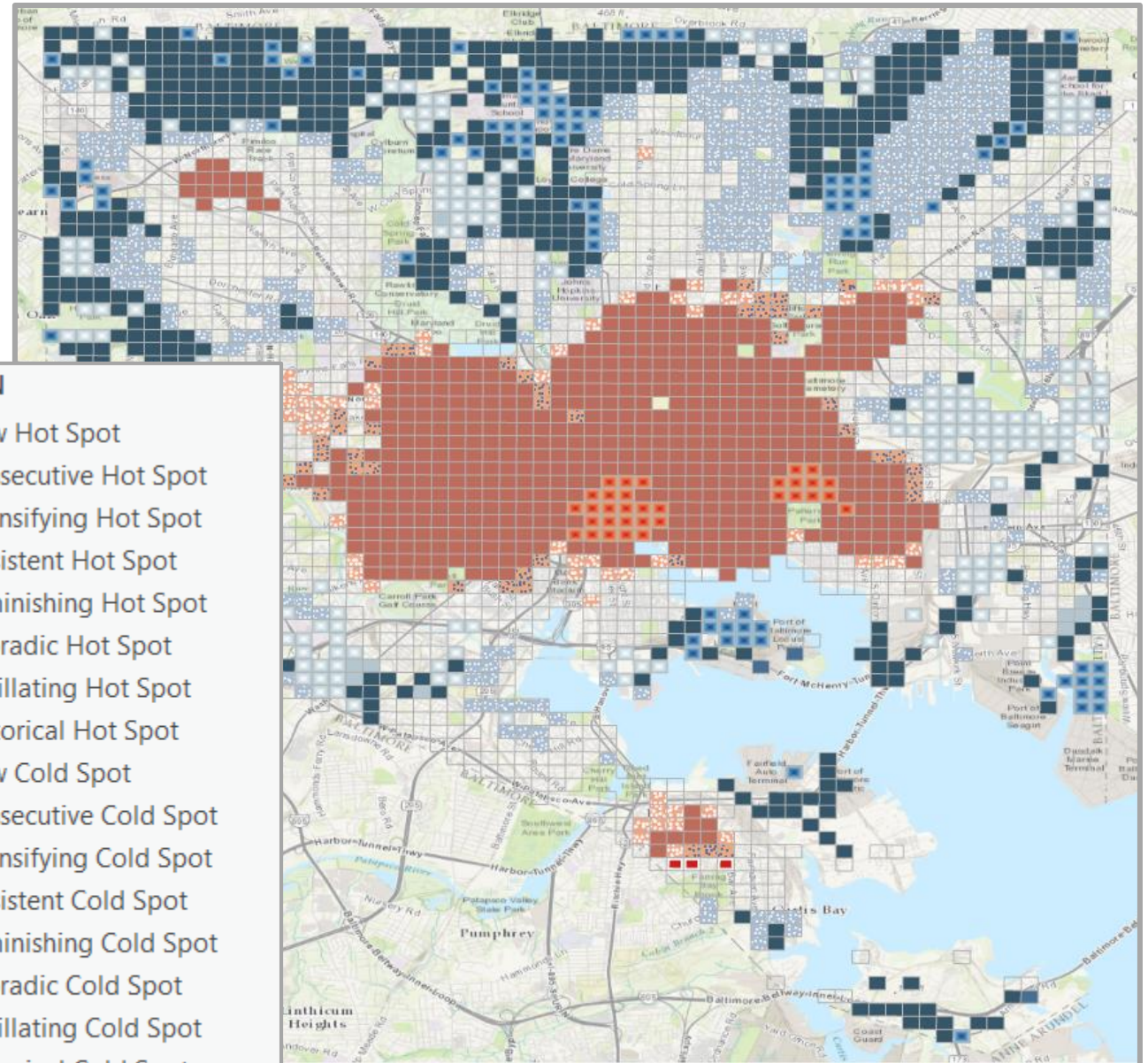


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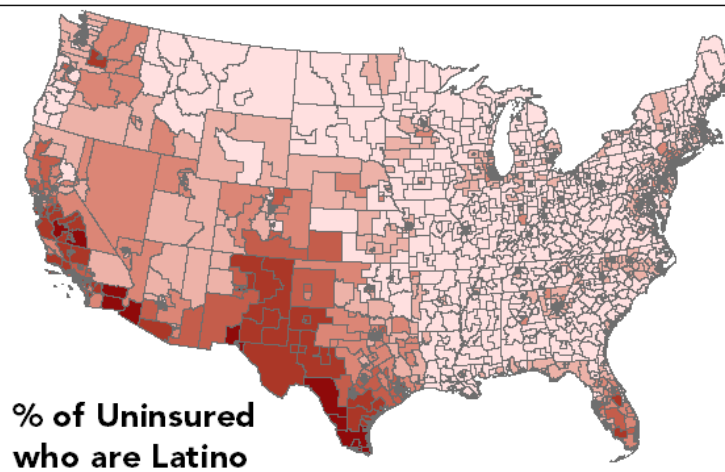
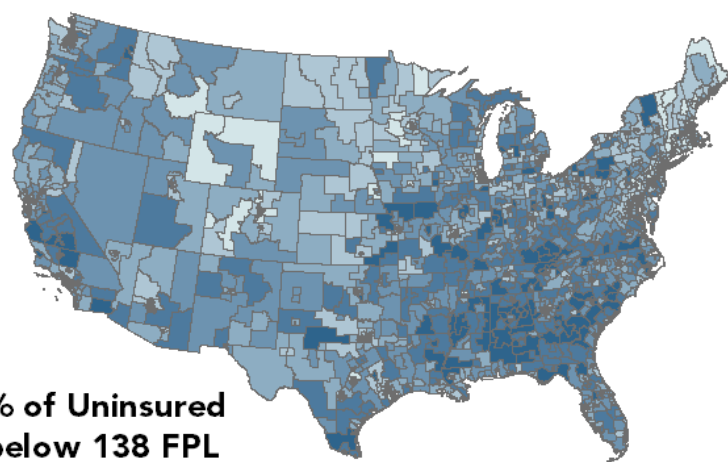
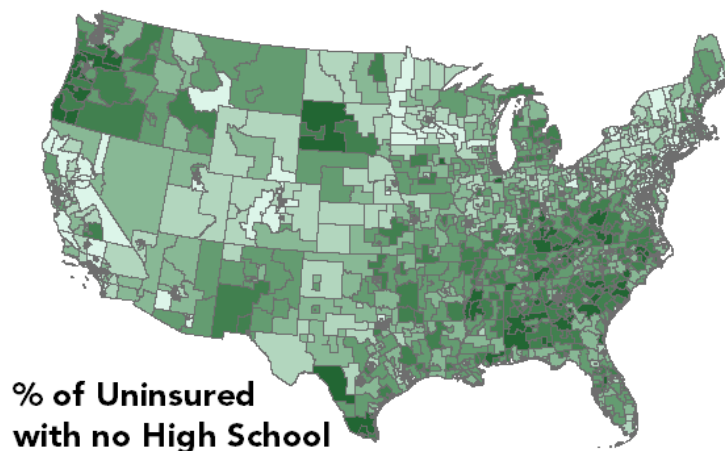
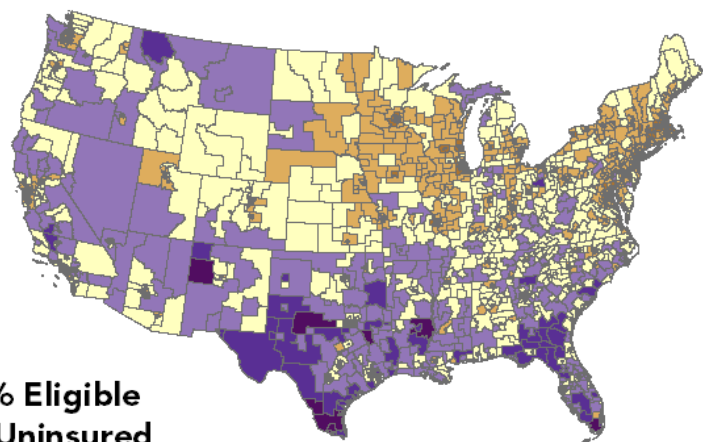


PATTERN

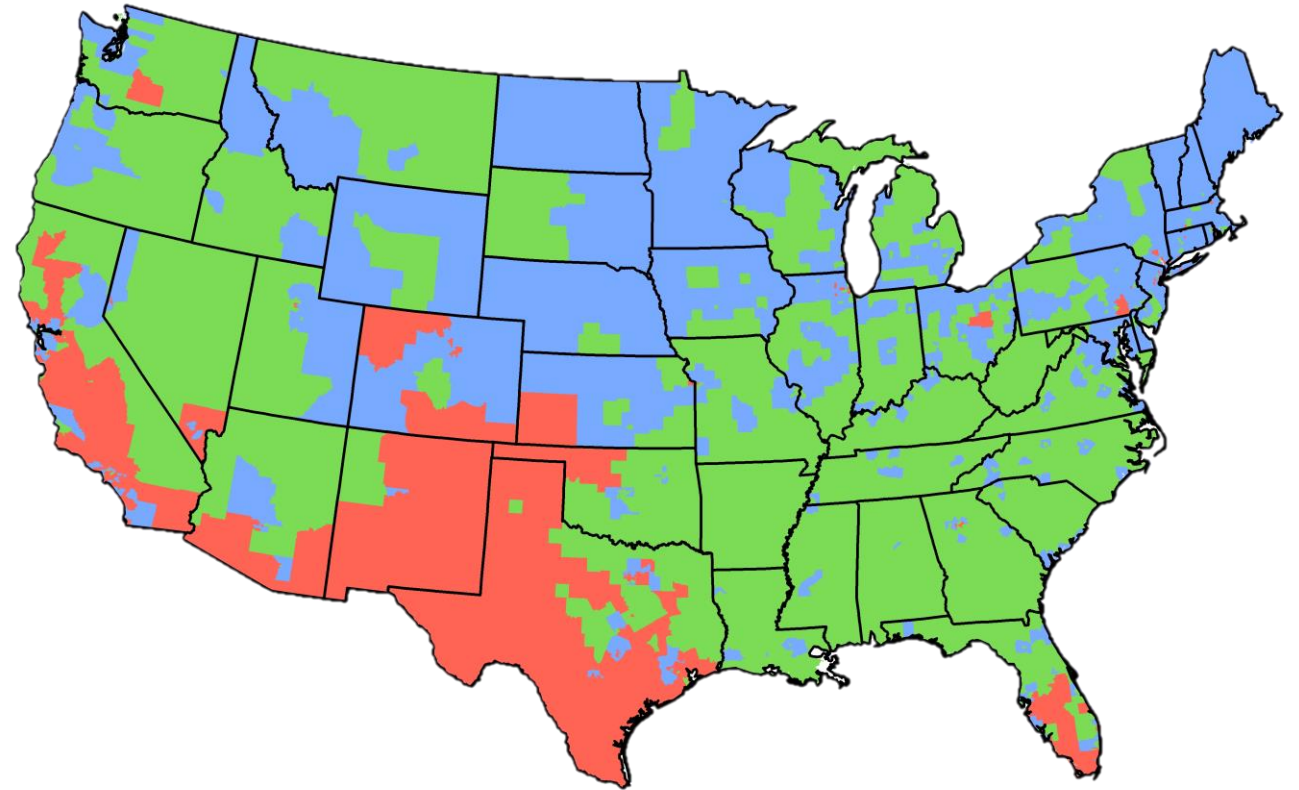
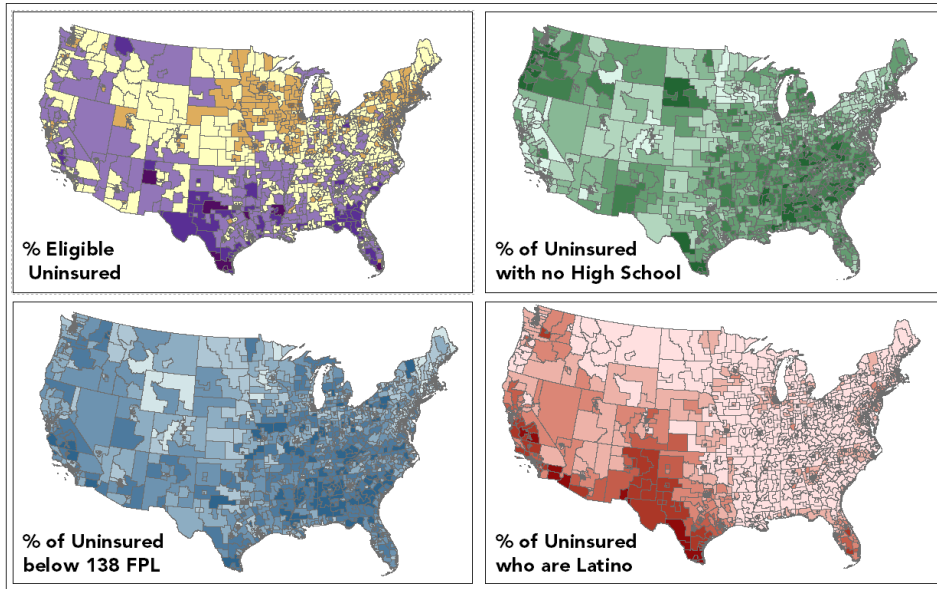
-  New Hot Spot
-  Consecutive Hot Spot
-  Intensifying Hot Spot
-  Persistent Hot Spot
-  Diminishing Hot Spot
-  Sporadic Hot Spot
-  Oscillating Hot Spot
-  Historical Hot Spot
-  New Cold Spot
-  Consecutive Cold Spot
-  Intensifying Cold Spot
-  Persistent Cold Spot
-  Diminishing Cold Spot
-  Sporadic Cold Spot
-  Oscillating Cold Spot
-  Historical Cold Spot
-  No trend detected



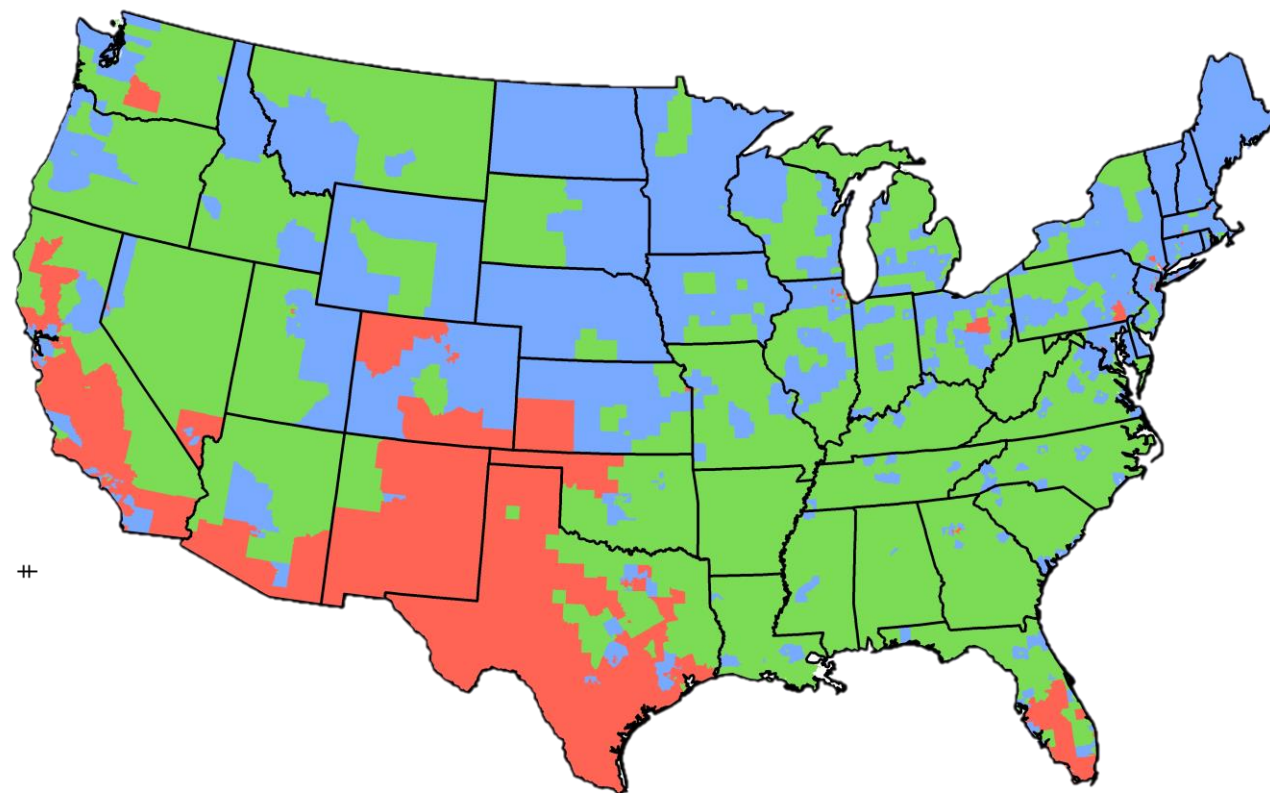
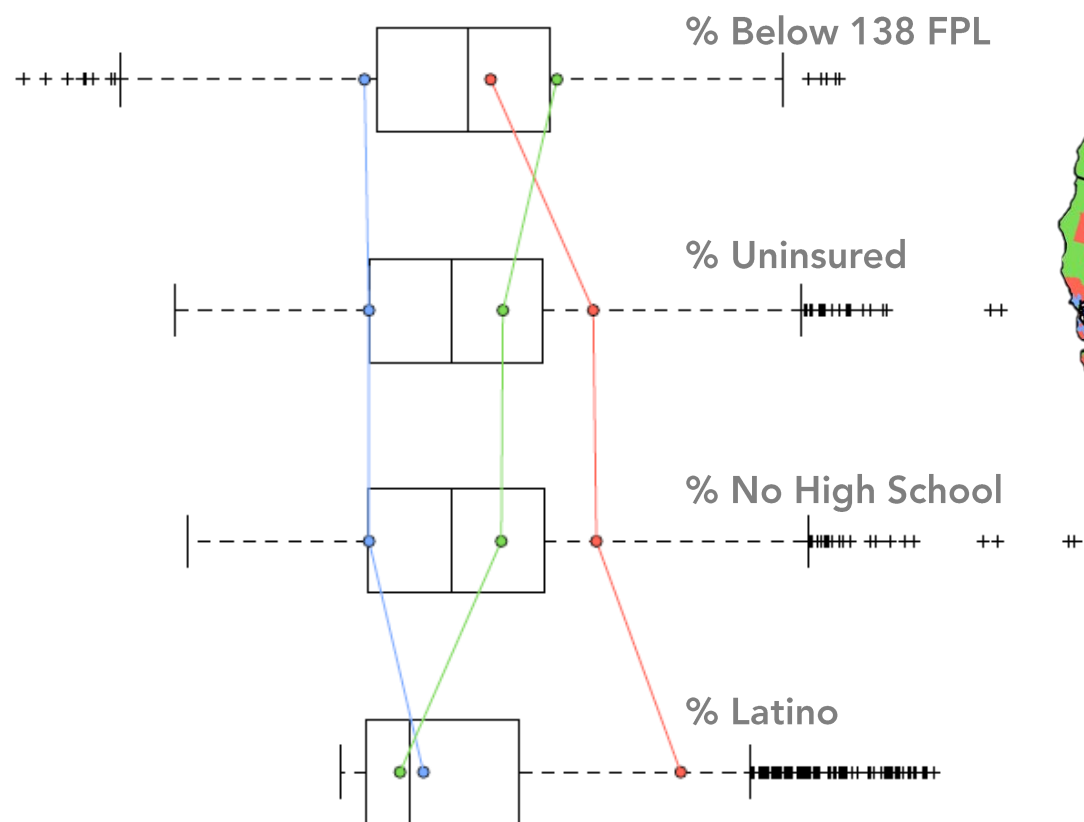
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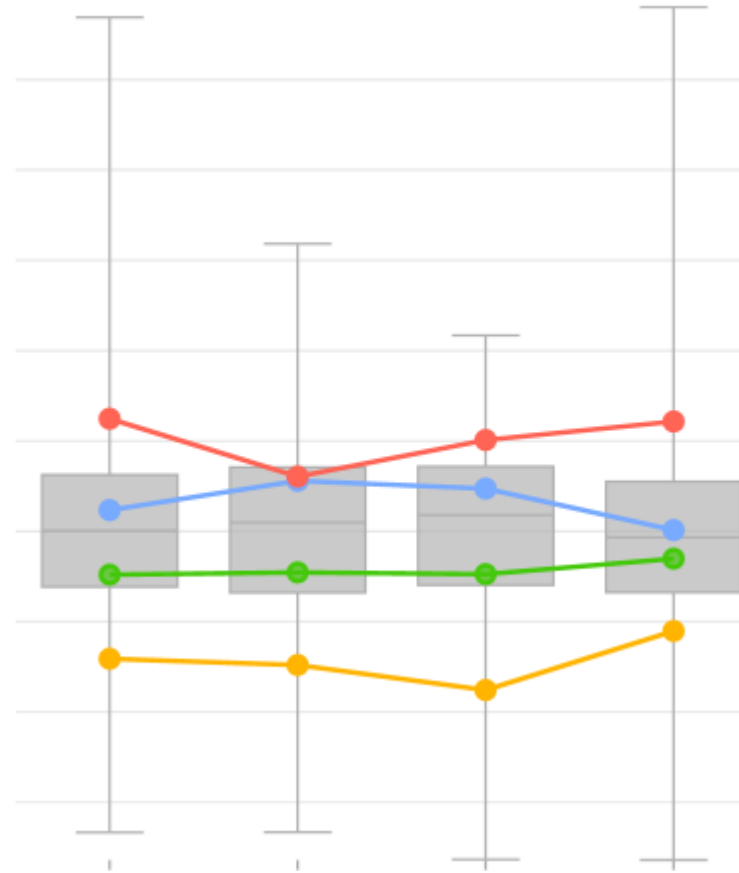
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Demo



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TUESDAY

8:30a From Means and Medians to Machine Learning: Spatial Statistics Basics and Innovations 15B

10a Data Visualization for Spatial Analysis 10

2:30p Spatial Data Mining I: Essentials of Cluster Analysis 15B

4p From Means and Medians to Machine Learning: Spatial Statistics Basics and Innovations 15B

WEDNESDAY

10a Spatial Data Mining II: A Deep Dive Into Space-Time Analysis Room 29C

2:30p Spatial Data Mining I: Essentials of Cluster Analysis Room 15A

4p Spatial Data Mining II: A Deep Dive Into Space-Time Analysis Room 31B

THURSDAY

10a Data Visualization for Spatial Analysis 07A/B

1p Beyond Where: Modeling Spatial Relationships and Making Predictions 17B

4p Beyond Where: Modeling Spatial Relationships and Making Predictions 17A



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fvale@esri.com

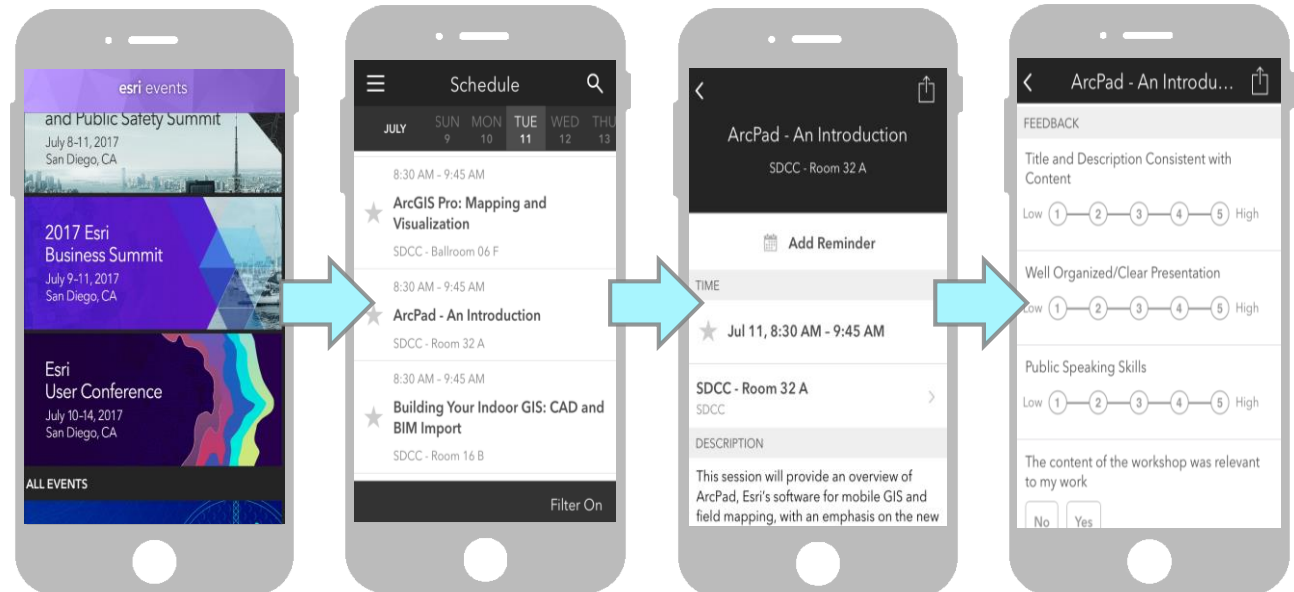
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