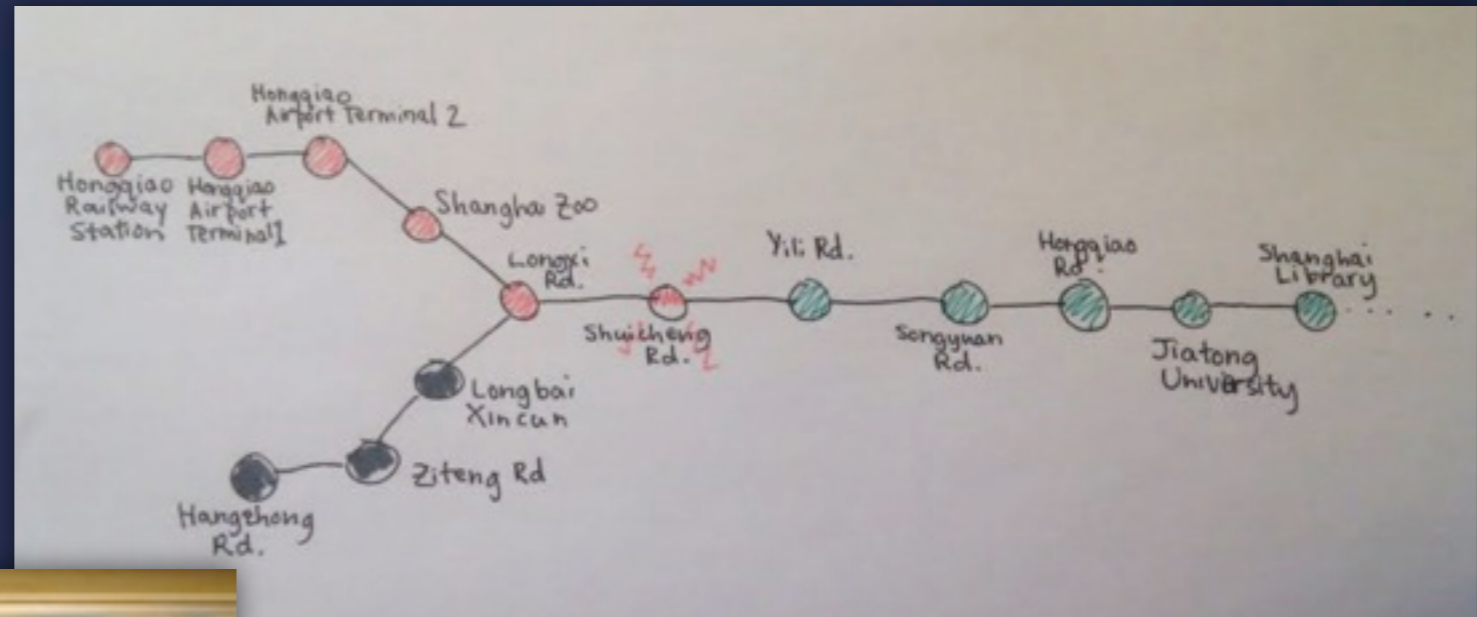


Multivariate Data Visualizations

Beyond 2D. Also: Exploratory Data Analysis

Jan 31, 2012 – Michael Porath

Feedback Assignment 1



Feedback Assignment 1



Feedback Assignment 1



Feedback Assignment 1

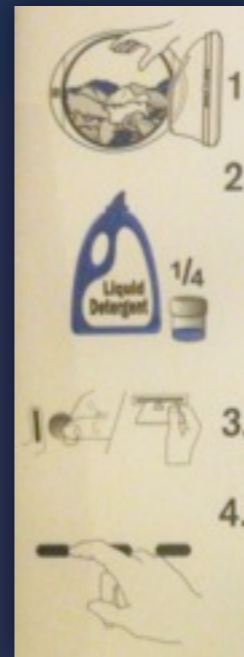
Quick Start Guide

● Recommends replacing your washer inlet hoses every 5 years.

<p>1 Add suggested amount of detergent for the selected load size.</p> <p>Small Load = </p> <p>Medium Load = </p> <p>Large Load = </p> <p><small>Always reference your user's manual and garment care label for additional information.</small></p>	<p>2 Select wash cycle based on colors. Add options based on the load type and/or soil level.</p> <p>Whites = HOT </p> <p>Colors = WARM </p> <p>Dark = COLD </p>	<p>3 Close Lid and Start</p> <p>- Close Lid - Push "START"</p> <p>OR</p> <p>- Close Lid - Pull to START</p>
--	---	--

WARNING FOR PERSONAL SAFETY

DO NOT reach into washer until all moving parts have stopped.
DO NOT wash fabrics soiled with flammable liquids or cleaning solvents.
DO NOT mix chlorine Bleach with ammonia or acids.
Mixing these can produce a toxic gas.



free clear

Powerful Clean. Gentle on Skin.

✓ All stainlifters safely lift away tough dirt and stains
✓ Specially designed for people with sensitive skin
✓ Free of Perfumes and Dyes, Hypoallergenic
✓ Allergen fighters

Safe for all washing machines.

how much to use:

Line 3 = large load (1.9 oz or just over half a cap)
Line 2 = normal load (1.5 oz or just under half a cap)

For pre-treating: small amount directly on the stain before the stain is put inside the machine. Don't forget to pre-treat the inside seam!

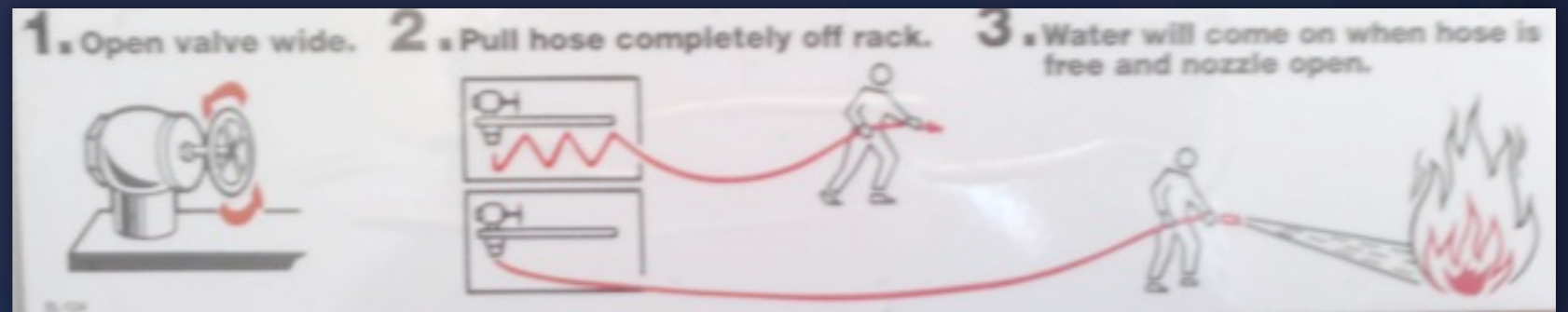
safe for hand washables, for use with bleach and for sensitive skin. free clear helps remove two of the top everyday allergens as well as certain fragrances. free clear is not intended to be used on delicate fabrics.

INGREDIENTS: Biodegradable surfactants (and other ingredients), buffering agent, stabilizer, fragrance, preservative.

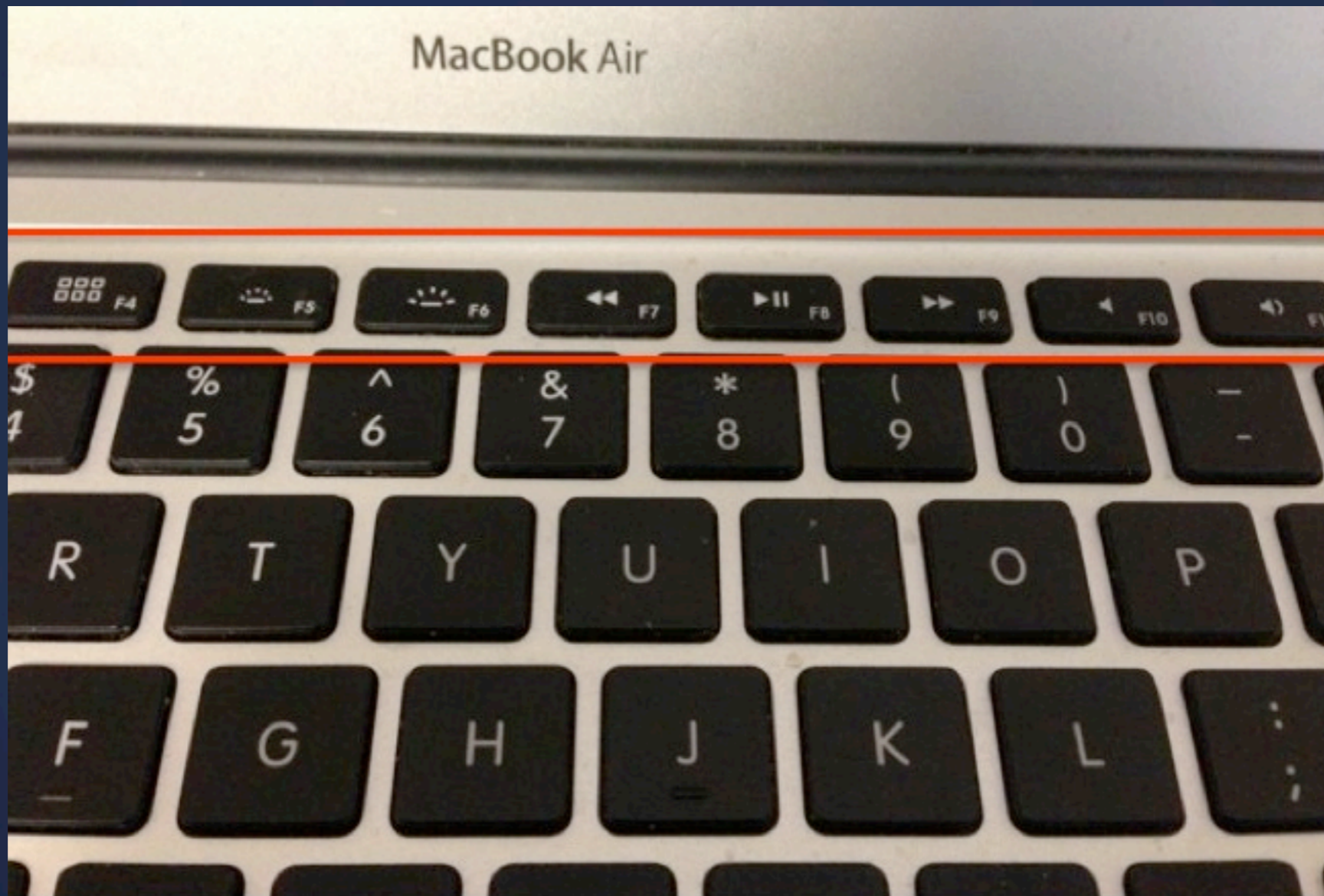
This product does not contain phosphates. This product is biodegradable and safe for the environment.



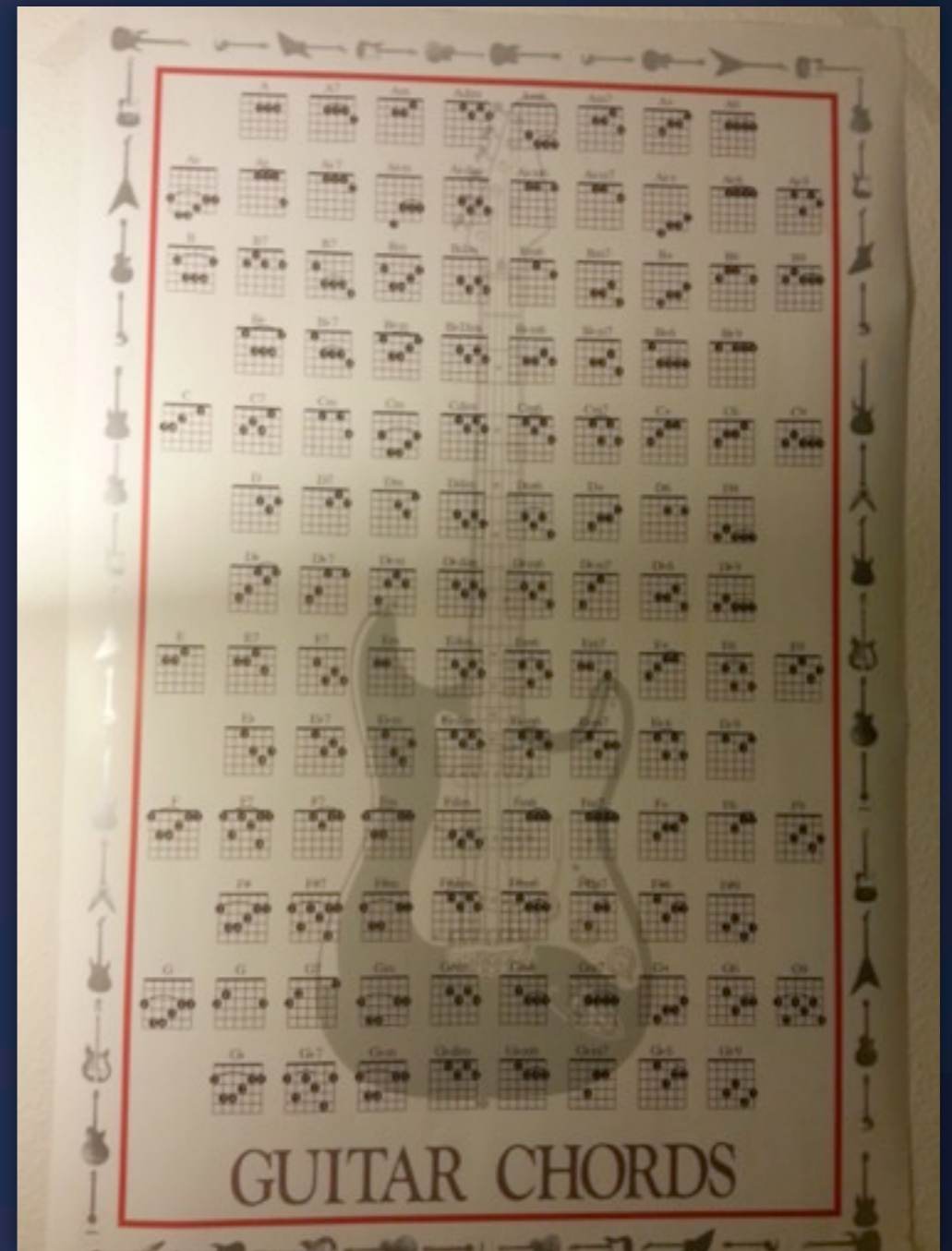
Feedback Assignment 1



Feedback Assignment 1



Feedback Assignment 1



Feedback Assignment 1



Feedback Assignment 1



Last Week

Cube



Attributes

Nominal

Ordinal

Continuous

Data

Mappings



Relational

model

Statistical

model

ID

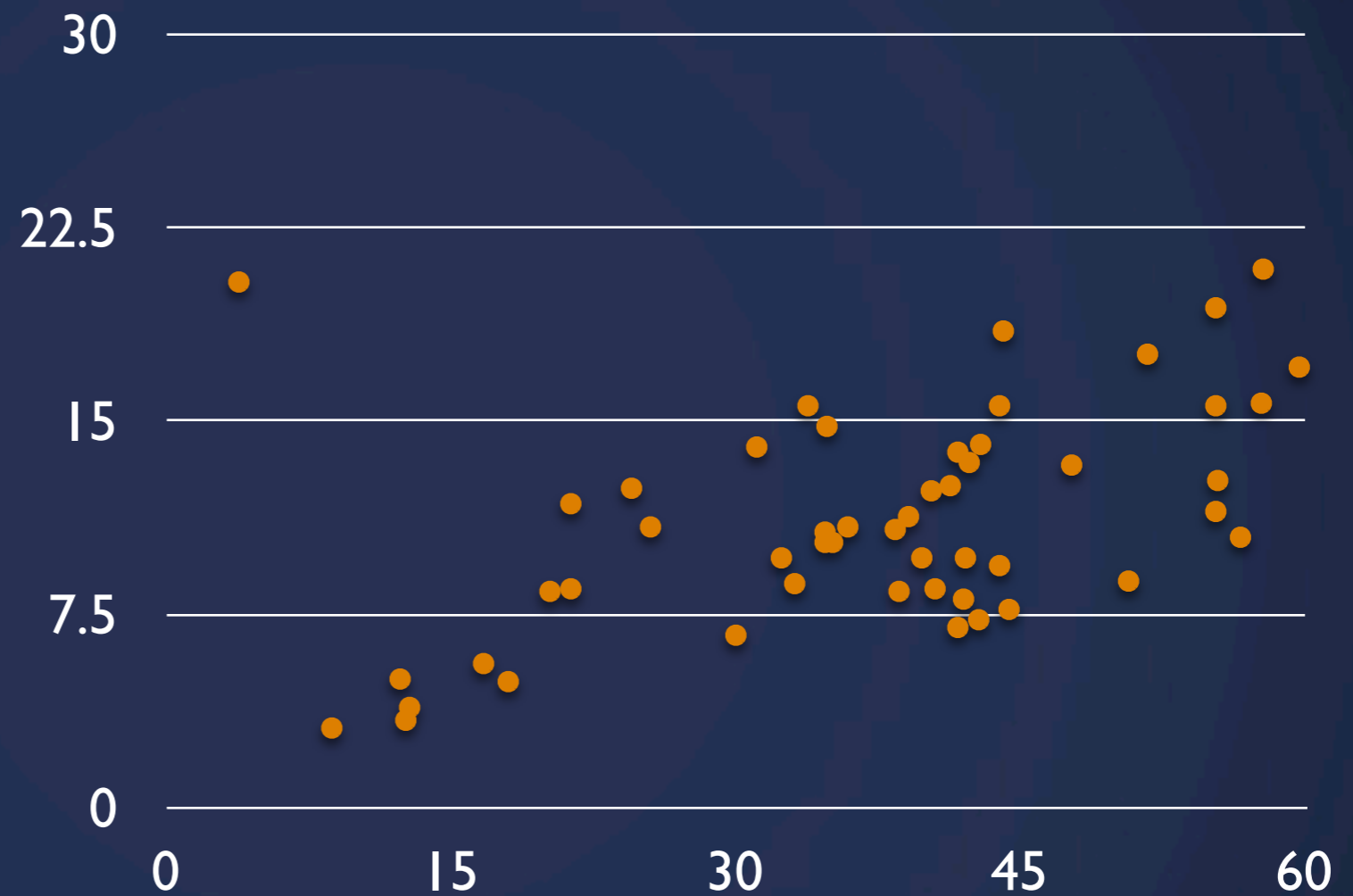
95%

of US households own a car

2D

Gun possession

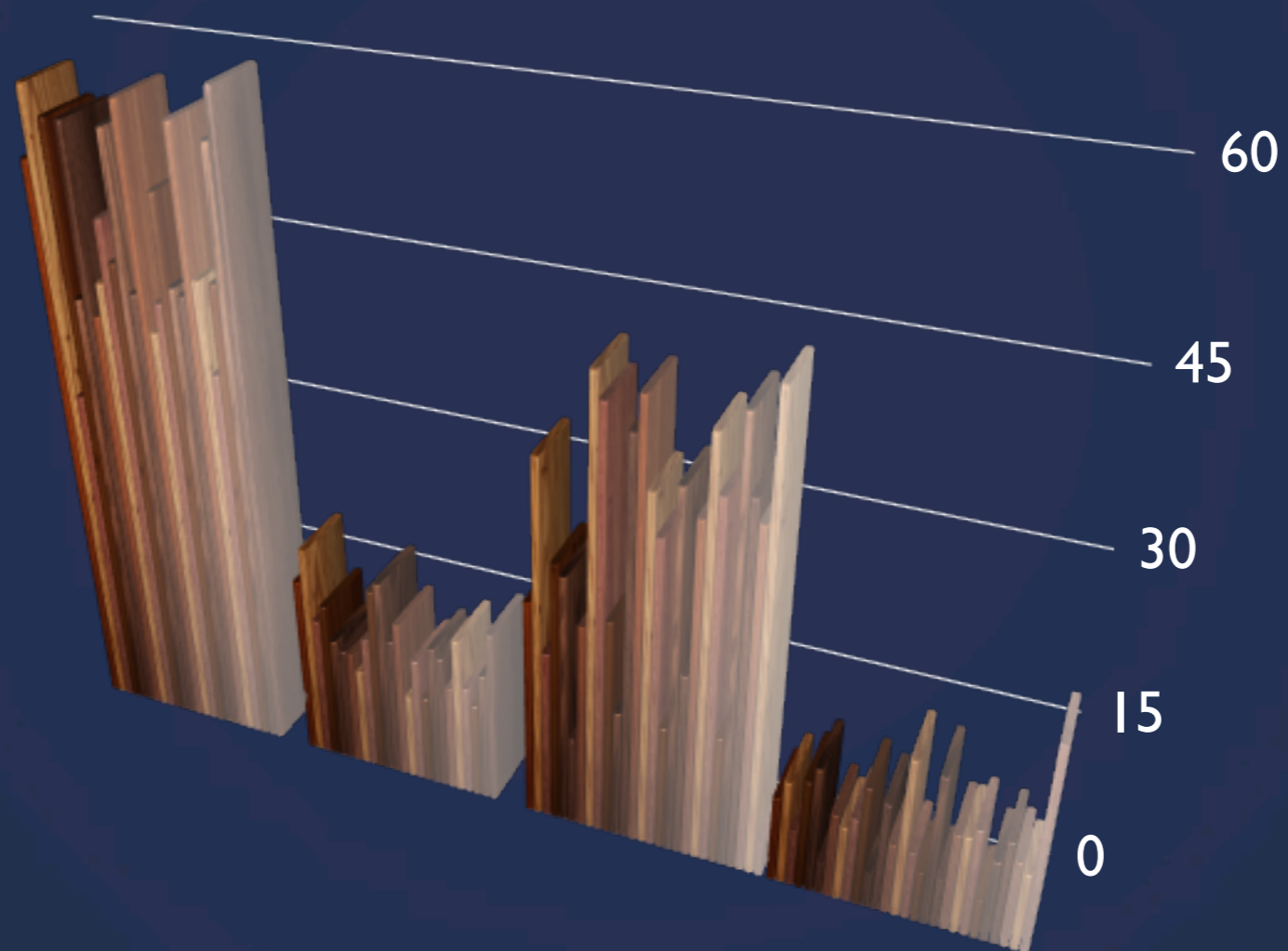
(% of households who own
at least one firearm)



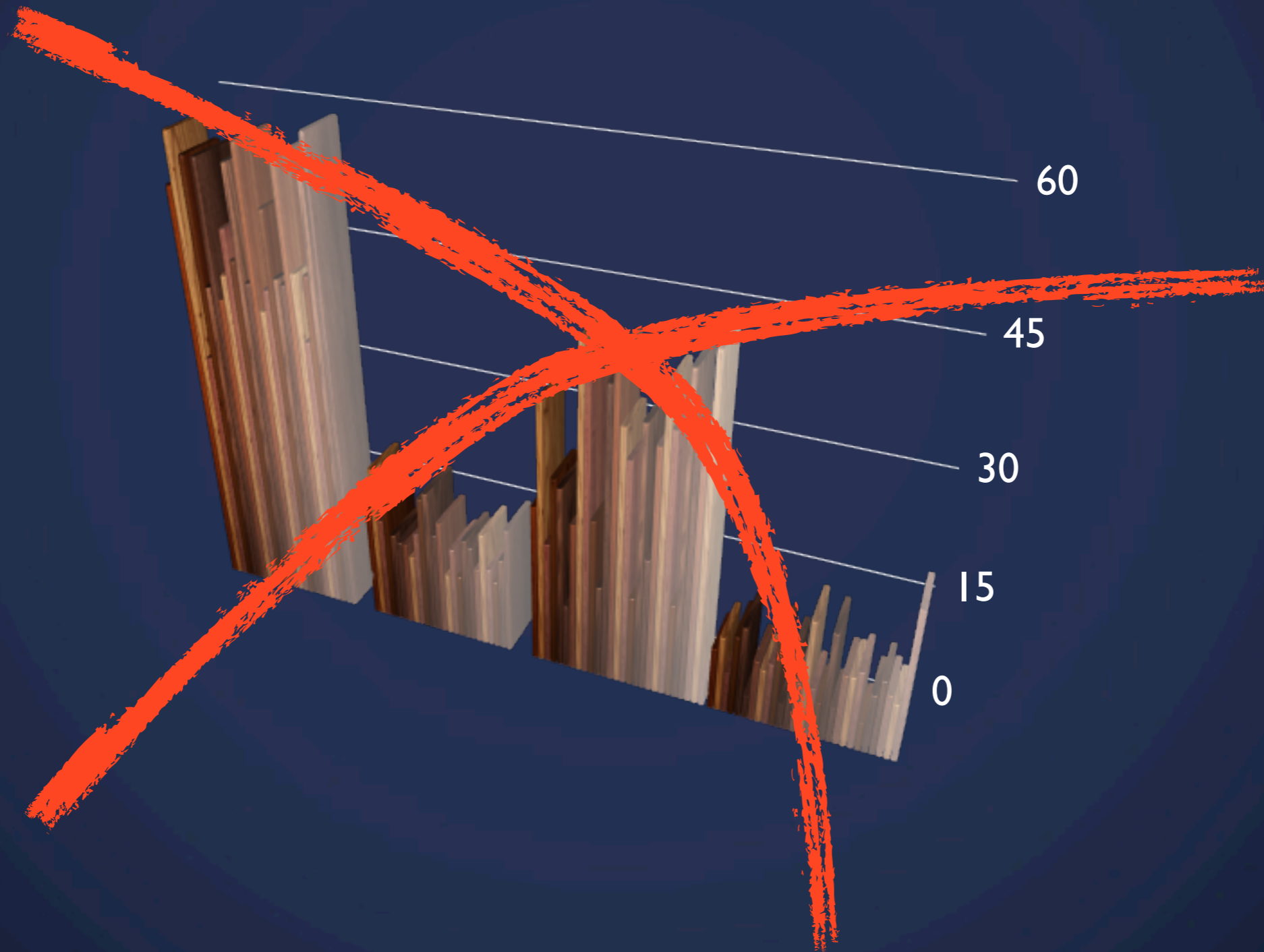
Homicide rate

(deaths per 10,000 population)

3D? nD?



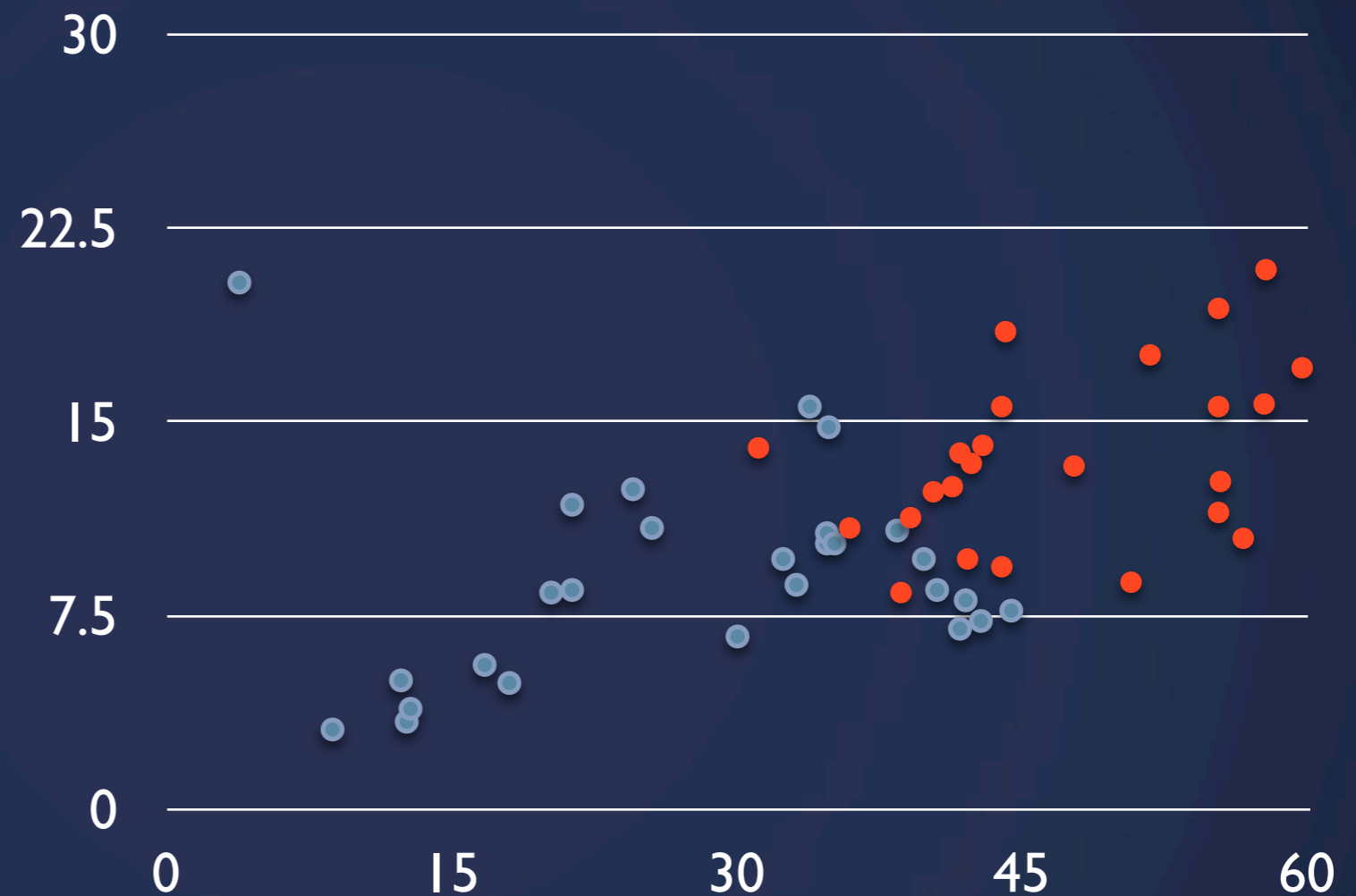
3D? nD?



3D

Gun possession

(% of households who own at least one firearm)



Homicide rate

(deaths per 10,000 population)

- voted Republican in 2008
- voted Democrat in 2008

sources: Washington Post, CDC

Multi Dimensional Data

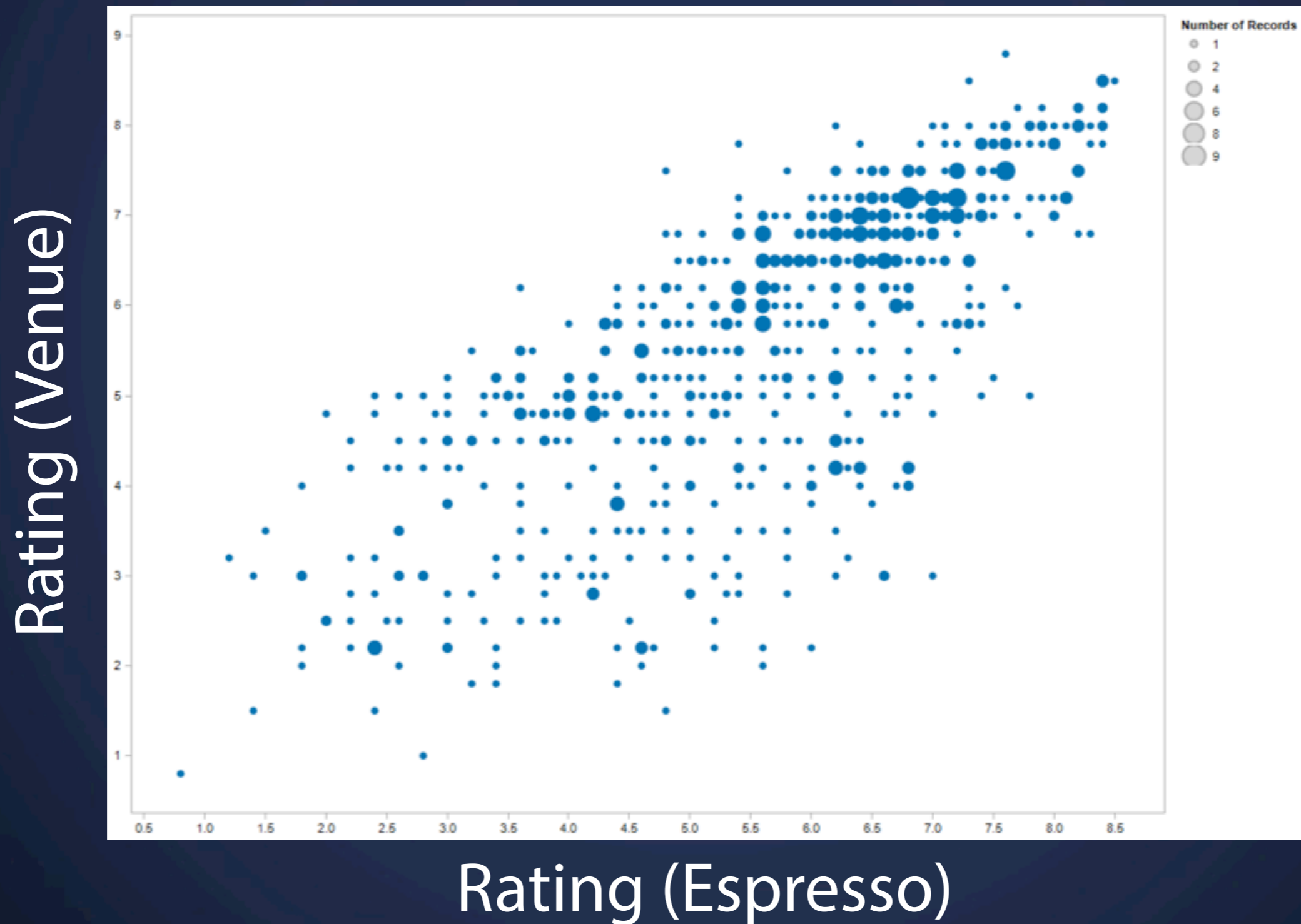
Rating data set of espresso and cafes in San Francisco

Name	Rating
Address	Aroma
Cross Street	Body
City	Brightness
Neighborhood	Crema
Phone	Flavor
Hours	Taster Correction
Establishment	Size
Rating (Coffee)	Primary Taste
Barista	Coffee Beans
Savvy	Cup Manufacturer
Ambiance	Price
Presentation	Last Update
Consistency	First Reviewed
Espresso Machine	ID

Techniques

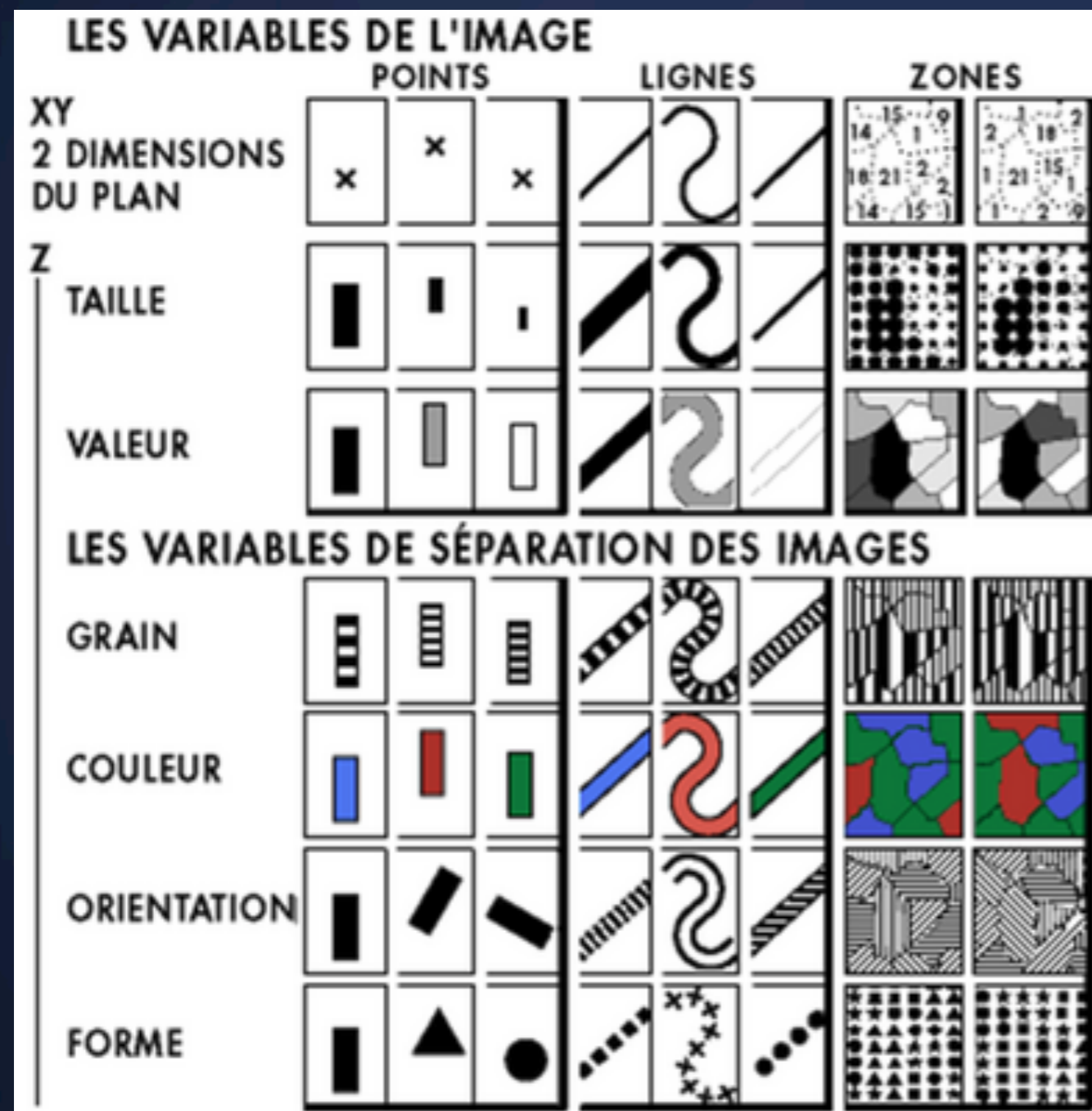
Example

Coffee Ratings for San Francisco Cafes



Recalling Bertin

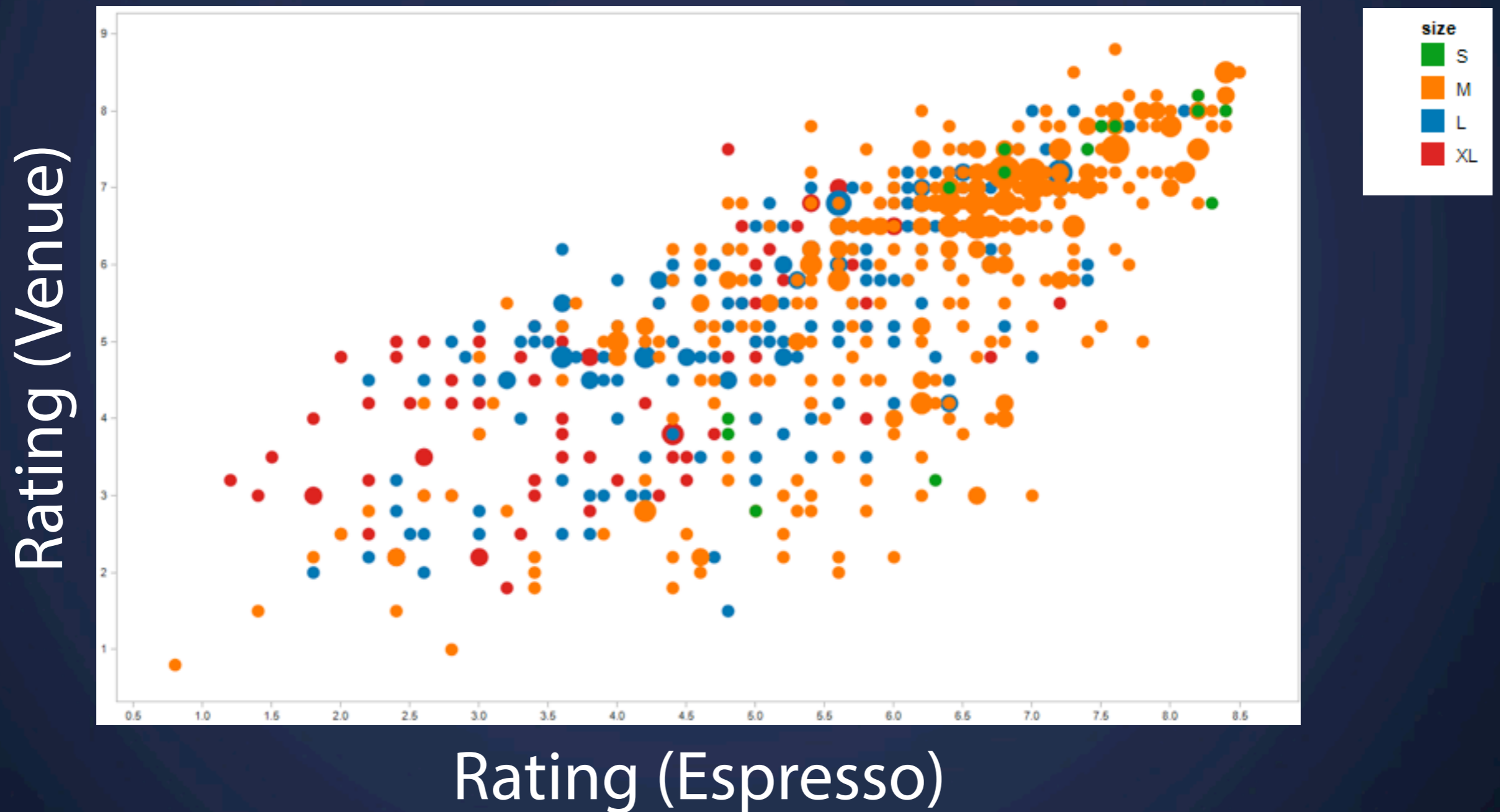
Color, Value, Shape



Position	N	O	Q
Size	N	O	Q
Value	N	O	Q
Texture	N	O	
Color	N		
Orientation	N	O	
Shape	N		

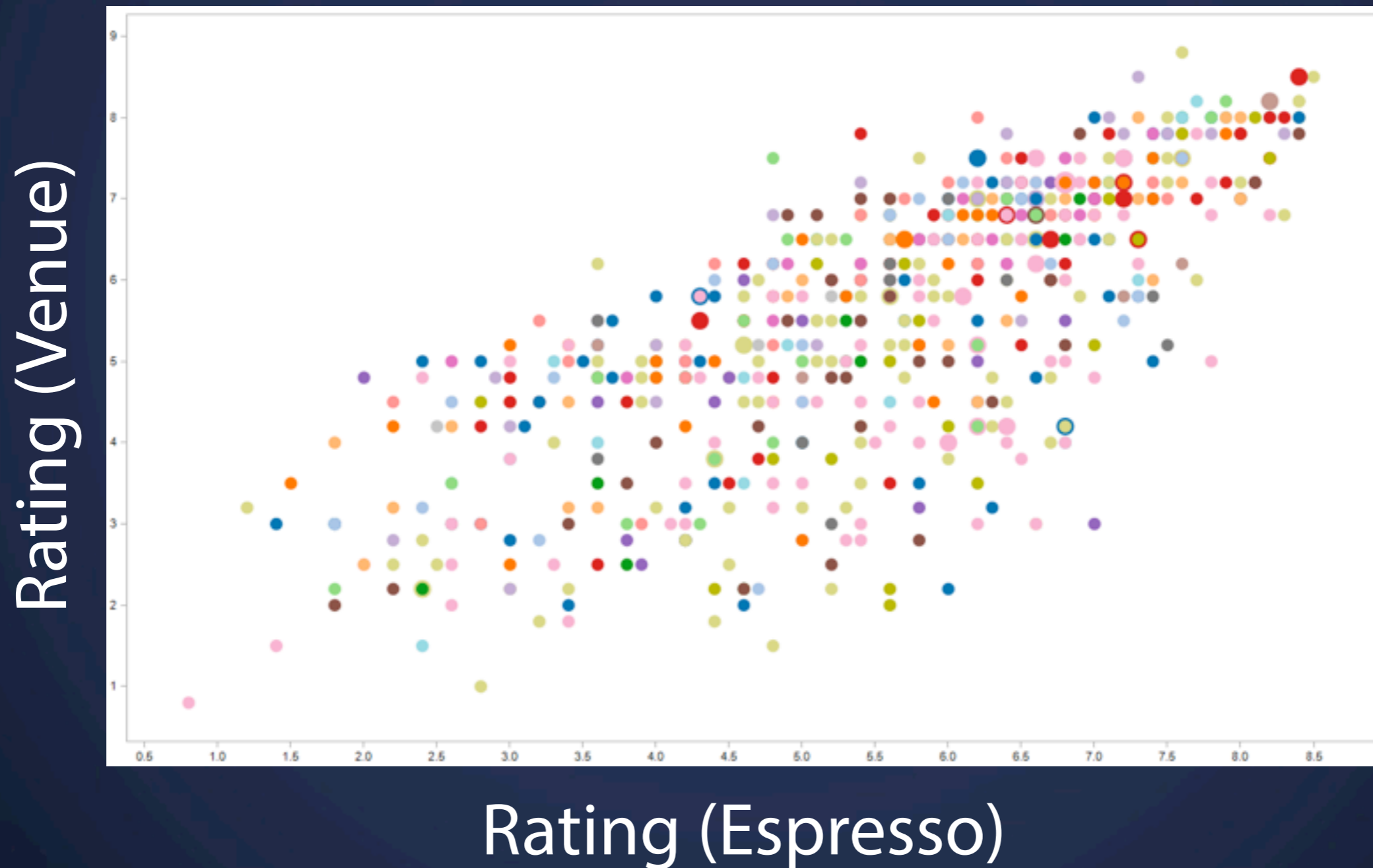
Color

Coffee Ratings for San Francisco Cafes



Color

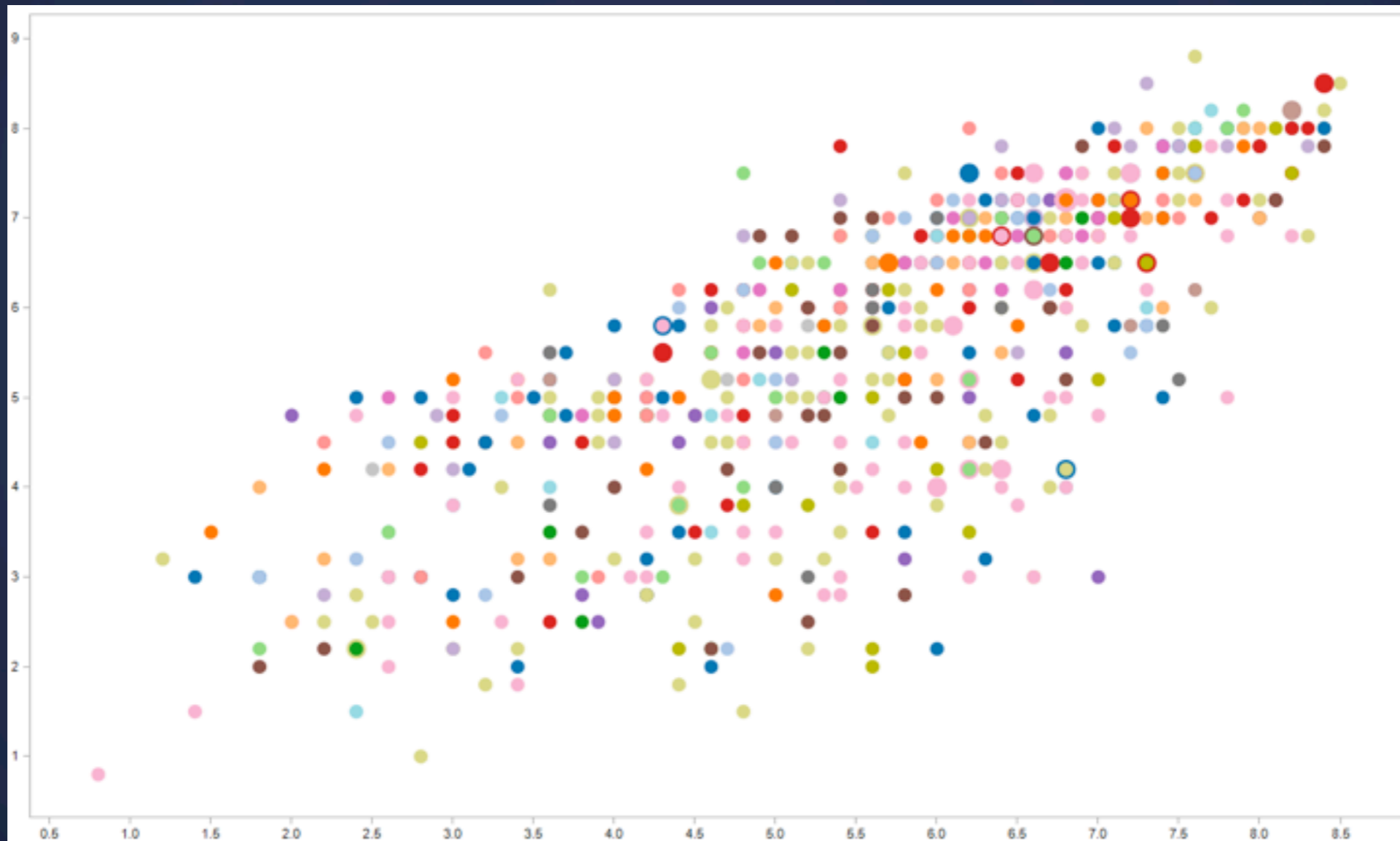
Coffee Ratings for San Francisco Cafes



Color

Coffee Ratings for San Francisco Cafes

Rating (Venue)



Rating (Espresso)

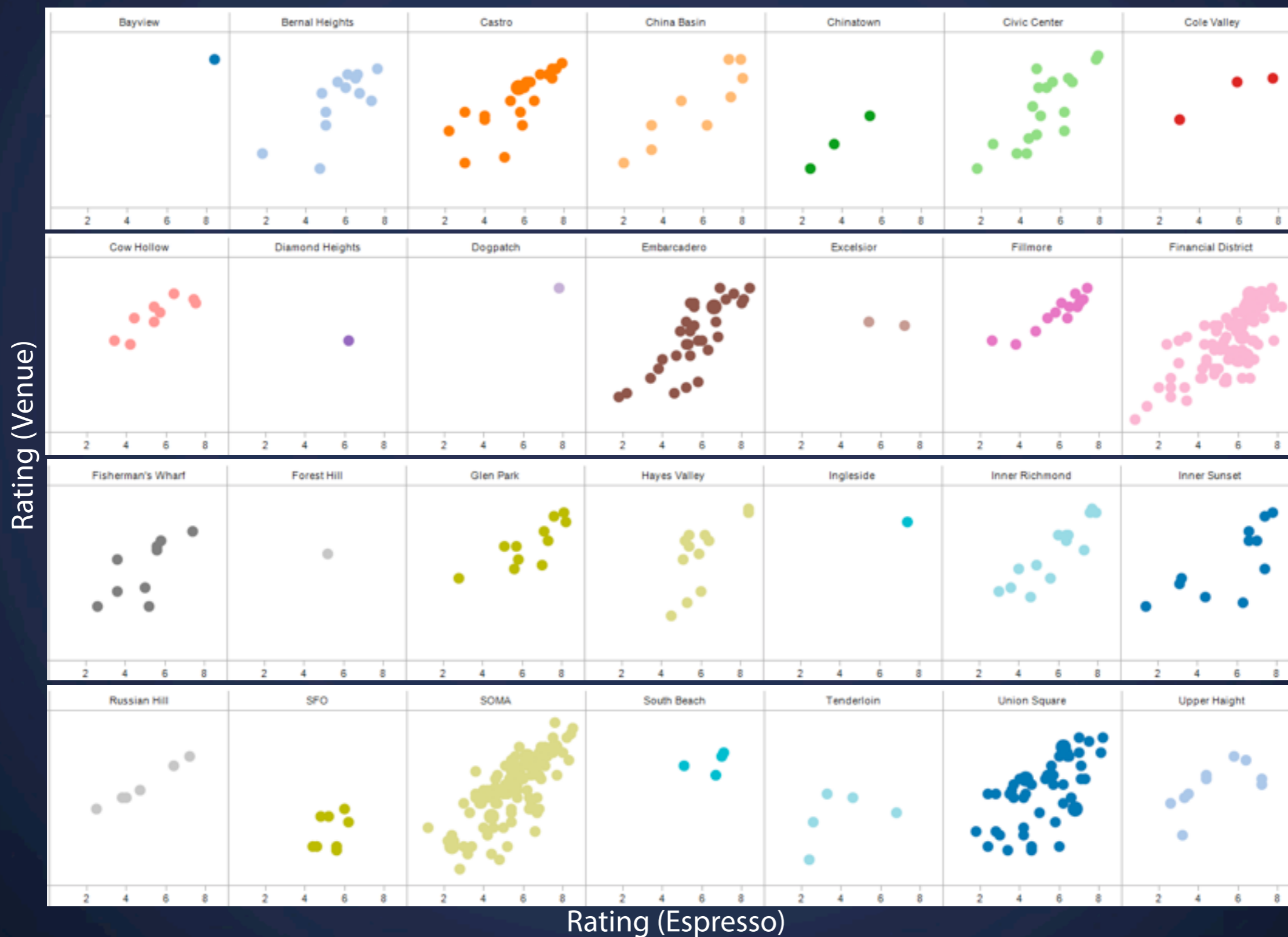
- Bernal Heights
- Castro
- China Basin
- Chinatown
- Civic Center
- Cole Valley
- Cow Hollow
- Diamond Heights
- Dogpatch
- Embarcadero
- Excelsior
- Fillmore
- Financial District
- Fisherman's Wharf
- Forest Hill
- Glen Park
- Hayes Valley
- Ingleside
- Inner Richmond
- Inner Sunset
- Japantown
- Laurel Heights
- Lower Haight
- Marina
- Miraloma
- Mission
- Nob Hill
- Noe Valley
- North Beach
- Outer Richmond
- Outer Sunset
- Pacific Heights
- Potrero Hill
- Presidio Heights
- Russian Hill
- SFO
- SOMA
- South Beach

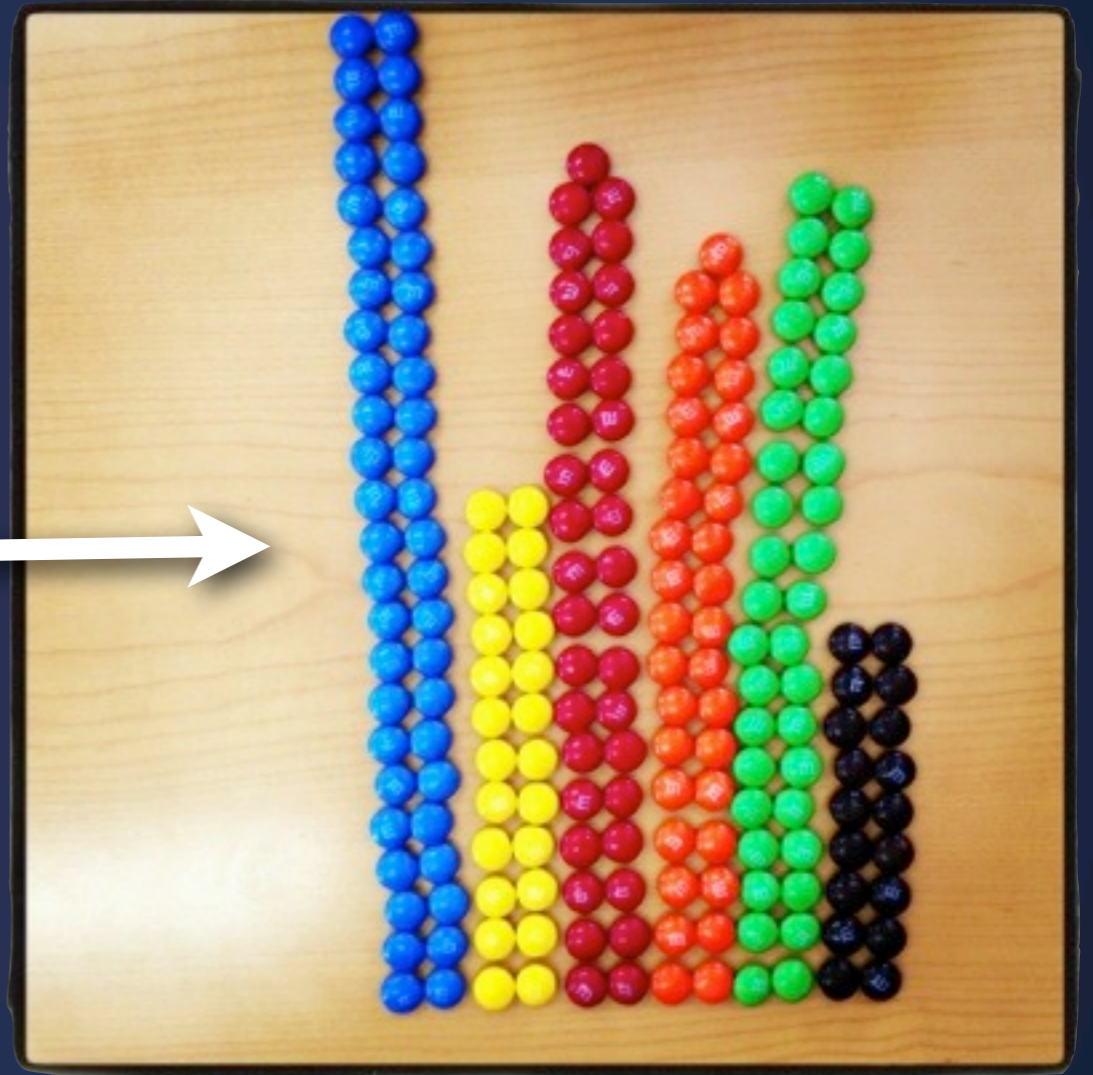
Color?



Small Multiples + Color

Coffee Ratings for San Francisco Cafes





Scatterplot Matrix

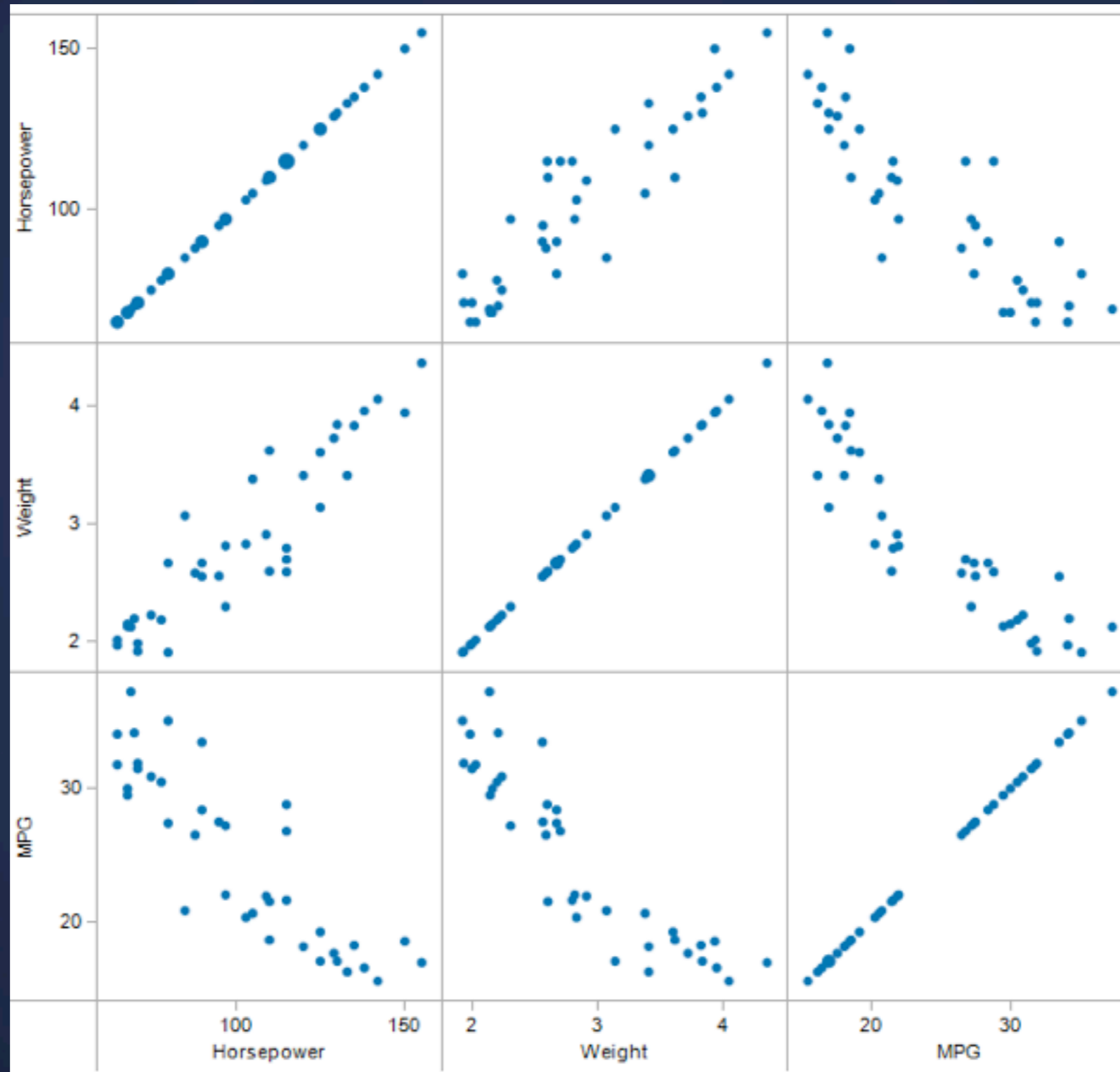
Car Metrics

Table 2.1: Details of the *cars* data table

country	model name	mpg	weight	ratio	hp	disp.	cyl.
USA	Buick Estate Wagon	16.9	4.360	2.73	155	350	8
USA	Ford Country Squire Wagon	15.5	4.054	2.26	142	351	8
USA	Chevy Malibu Wagon	19.2	3.605	2.56	125	267	8
USA	Chrysler LeBaron Wagon	18.5	3.940	2.45	150	360	8
USA	Chevette	30.0	2.155	3.70	68	98	4
Japan	Toyota Corona	27.5	2.560	3.05	95	134	4
Japan	Datsun 510	27.2	2.300	3.54	97	119	4
USA	Dodge Omni	30.9	2.230	3.37	75	105	4
Germany	Audi 5000	20.3	2.830	3.90	103	131	5
Sweden	Volvo 240 GL	17.0	3.140	3.50	125	163	6
Sweden	Saab 99 GLE	21.6	2.795	3.77	115	121	4
France	Peugeot 694 SL	16.2	3.410	3.58	133	163	6
USA	Buick Century Special	20.6	3.380	2.73	105	231	6
USA	Mercury Zephyr	20.8	3.070	3.08	85	200	6
USA	Dodge Aspen	18.6	3.620	2.71	110	225	6
USA	AMC Concord D/L	18.1	3.410	2.73	120	258	6

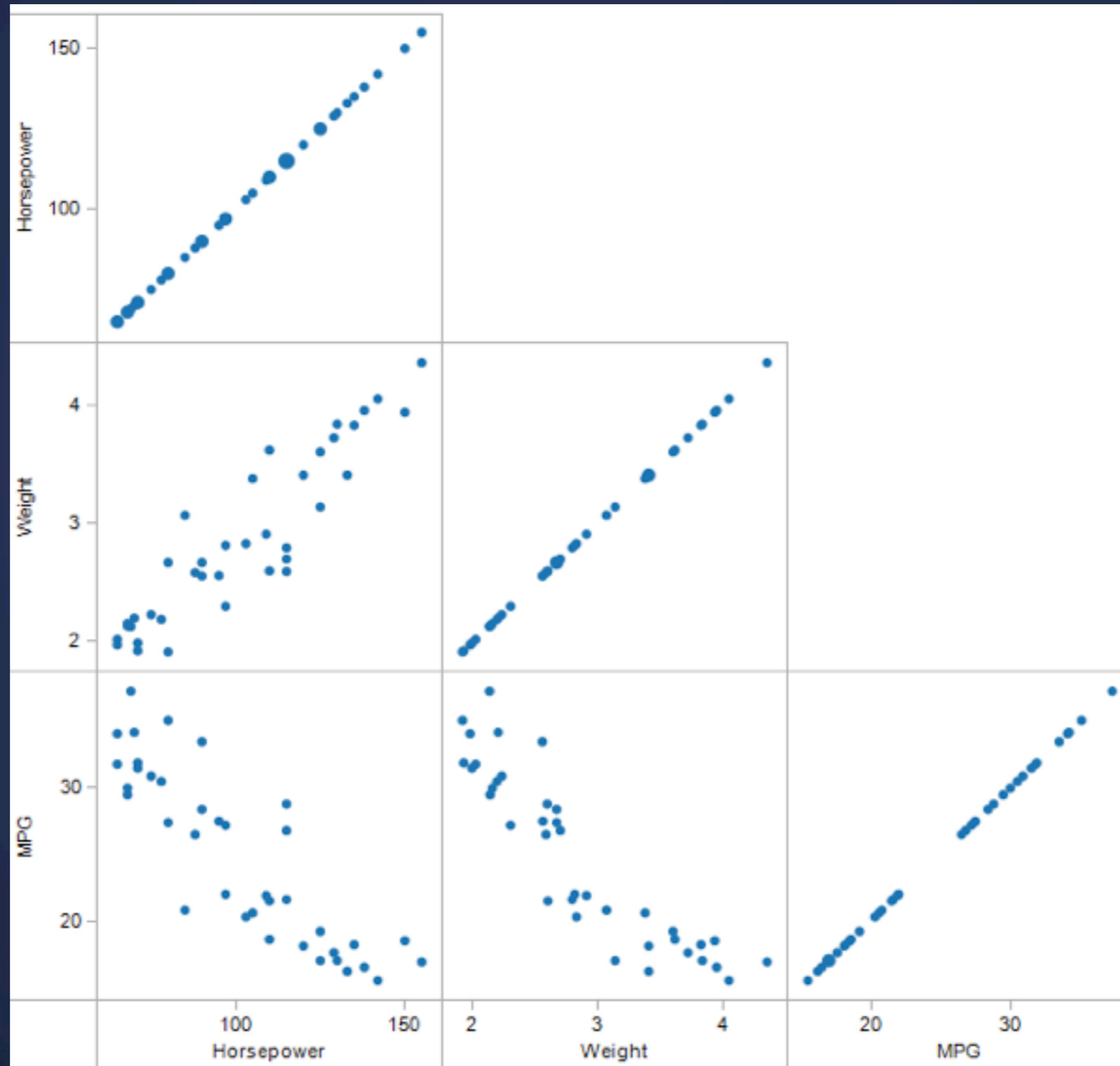
Scatterplot Matrix

Car Metrics



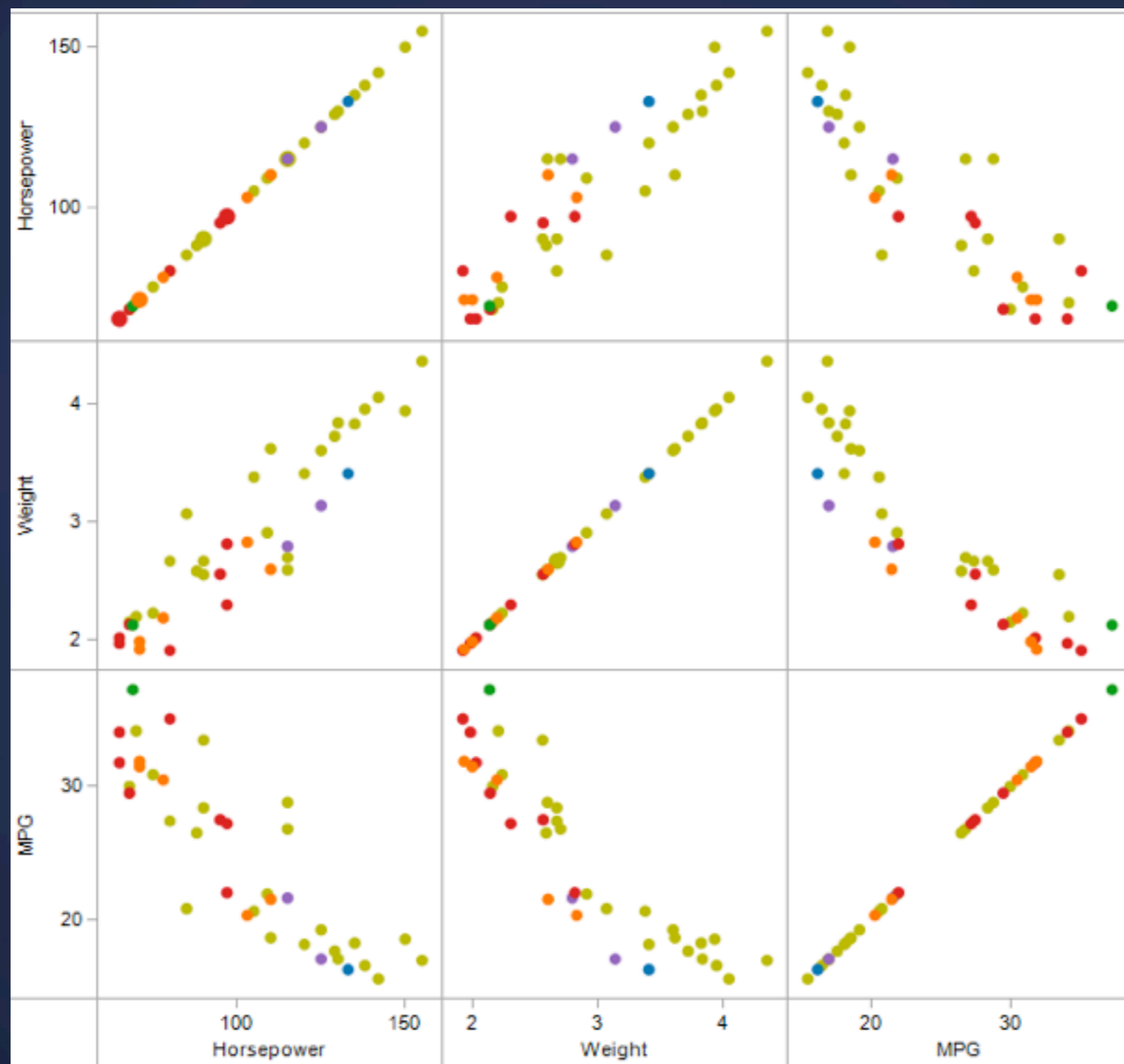
Scatterplot Matrix

Car Metrics



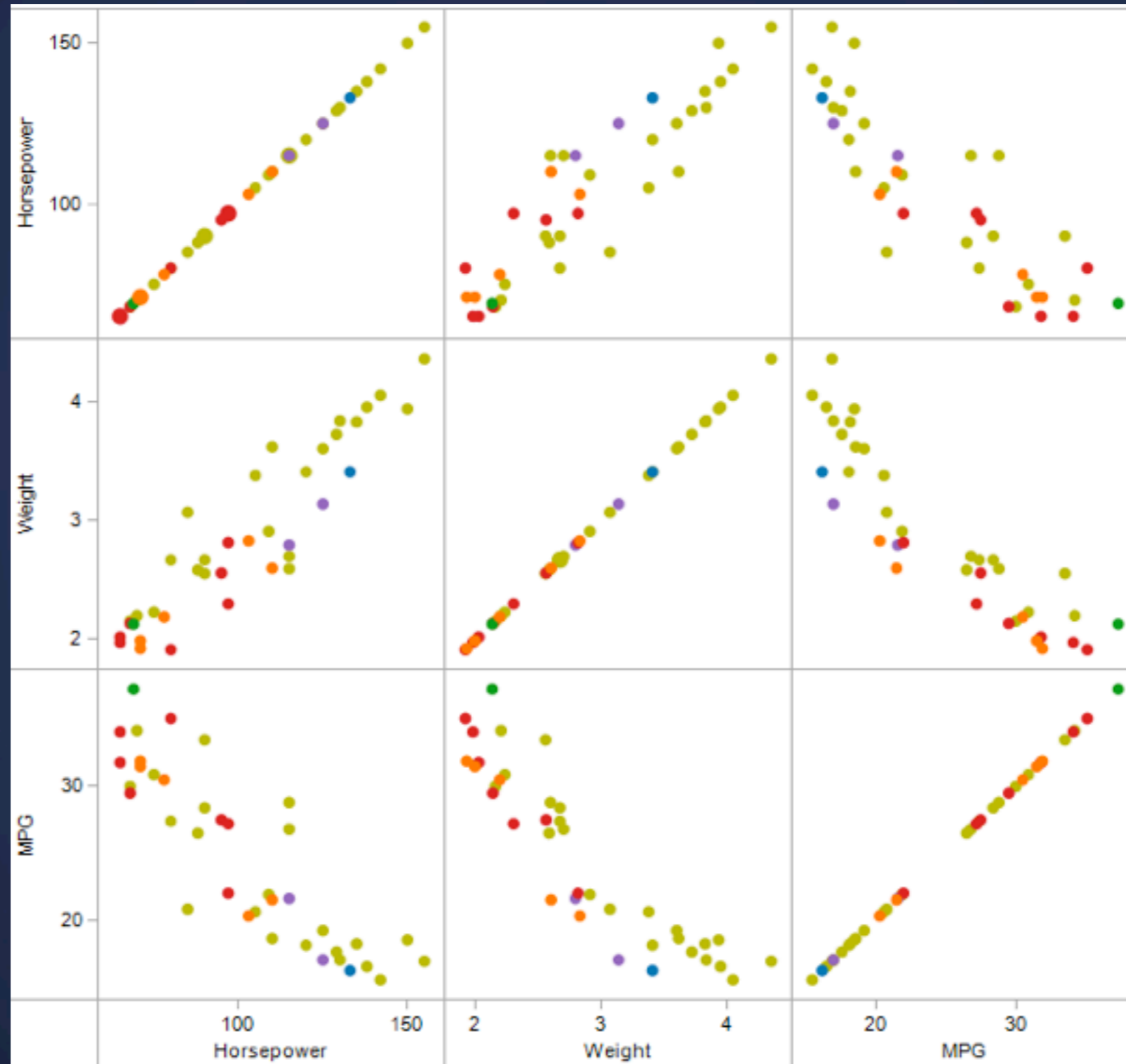
Scatterplot Matrix

Car Metrics



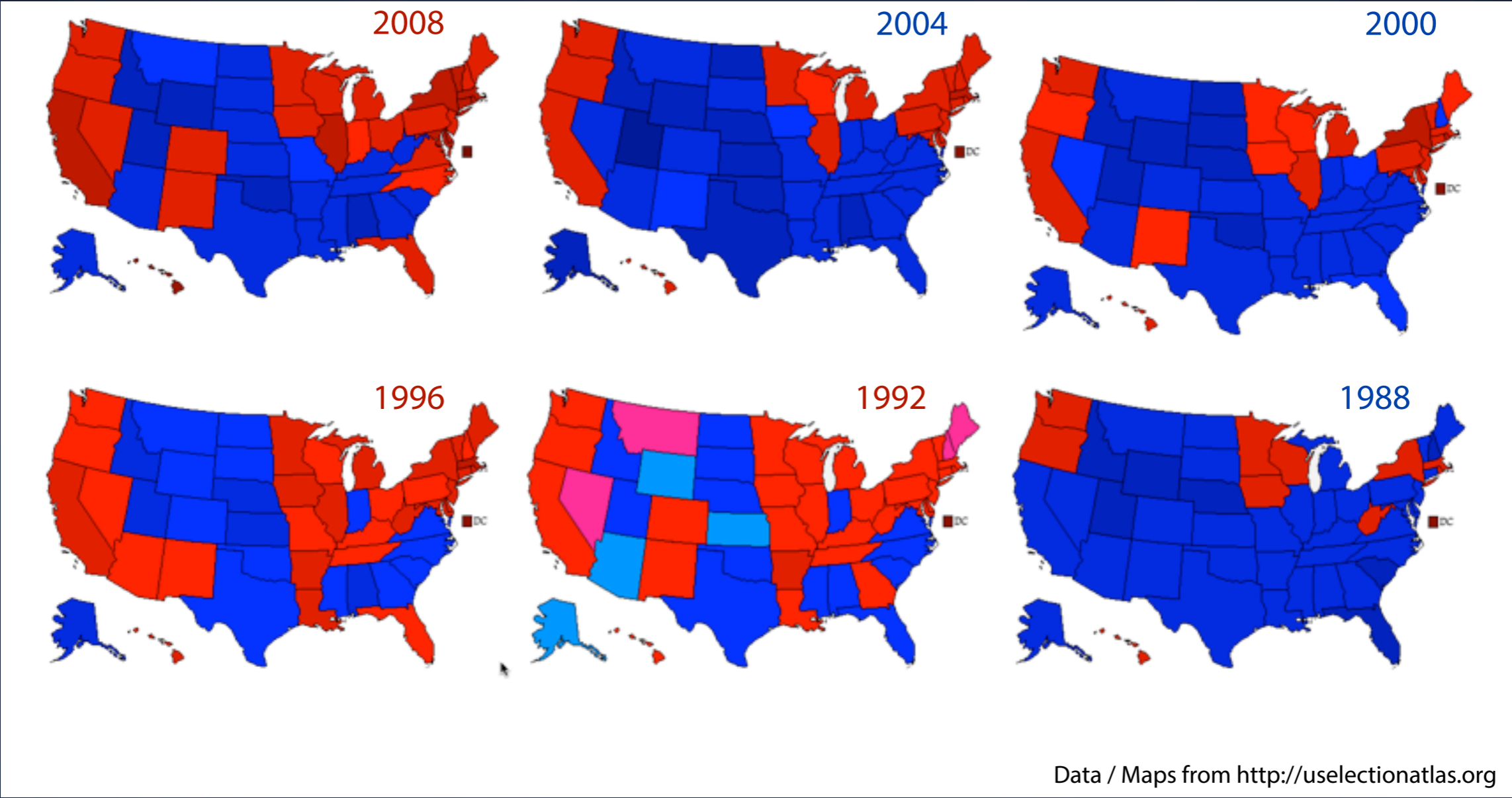
Scatterplot Matrix

Car Metrics



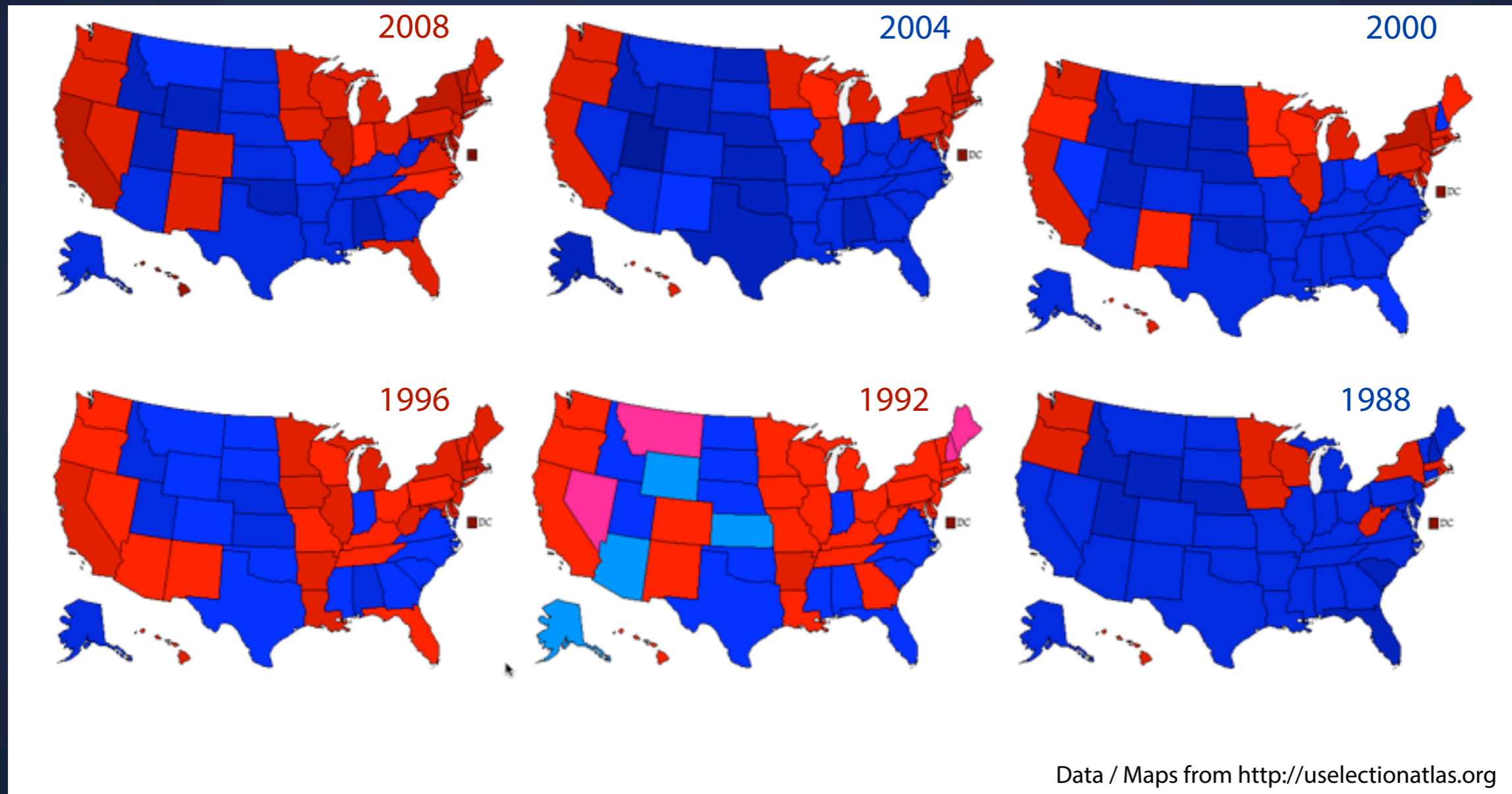
Electoral Maps

Small multiples along a timeline



Electoral Maps

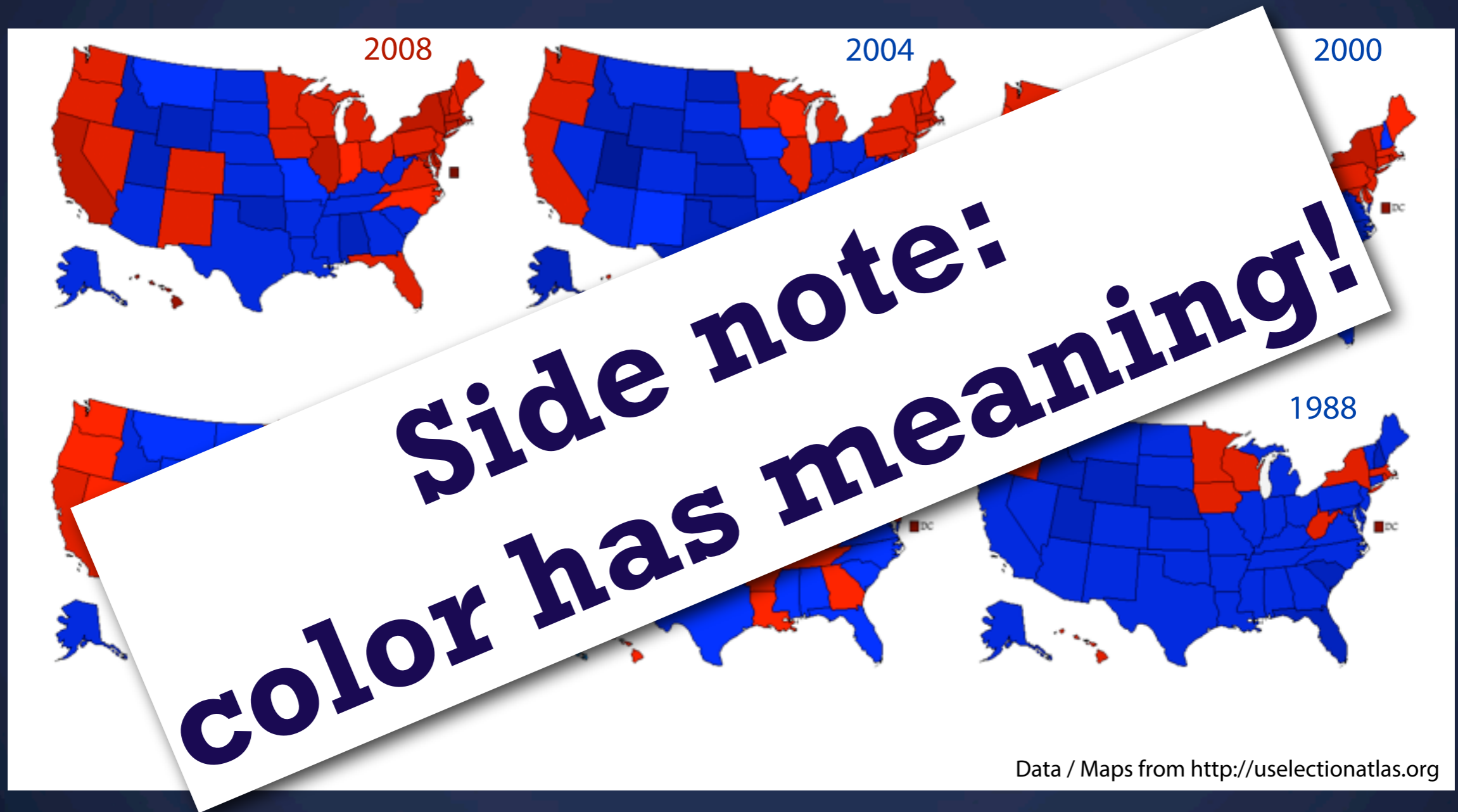
Small multiples along a timeline



Democrats vs Republicans?

Electoral Maps





















Small multiples along a timeline



Democrats vs **Republicans?**

Iconic / Realistic representations

Game Controllers

Console Standards						
						
Tandy 1 Stick 1 Button	Atari 2600 1 Stick 1 Button	Tennis 1 Knob 1 Button	ColecoVision 1 Stick 2 Buttons 1 Number Pad	ColecoVision 1 Stick 4 Buttons 1 Number Pad	Atari 5200 1 Stick 4 Buttons 3 Options 1 Number Pad	NES 1 D-Pad 2 Buttons 2 Options
						
Sega Master System 1 D-Pad 2 Buttons	Genesis 1 D-Pad 3 Buttons 1 Option	SNES 1 D-Pad 4 Buttons 2 Shoulders 2 Options	Sega CD 1 D-Pad 6 Buttons 2 Options	N64 1 D-Pad 1 Stick 6 Buttons 3 Shoulders 1 Option	Dreamcast 1 D-Pad 1 Stick 4 Buttons 2 Shoulders 1 Option	
						
Playstation 2 1 D-Pad 2 Sticks 4 Buttons 4 Shoulders 3 Options	Gamecube 1 D-Pad 2 Sticks 4 Buttons 3 Shoulders 1 Option	X-Box Old 1 D-Pad 2 Sticks 6 Buttons 2 Shoulders 2 Options	X-Box New 1 D-Pad 2 Sticks 6 Buttons 2 Shoulders 2 Options	X-Box 360 1 D-Pad 2 Sticks 6 Buttons 2 Shoulders 2 Options	Wii Mote 1 D-Pad 3 Buttons 4 Options 1 Shoulder Motion Sensitive	Wii Arcade 1 D-Pad 2 Sticks 4 Buttons 4 Shoulders 3 Options
					Wii Mote 1 Stick 2 Shoulders Motion Sensitive	



Chernoff's Faces

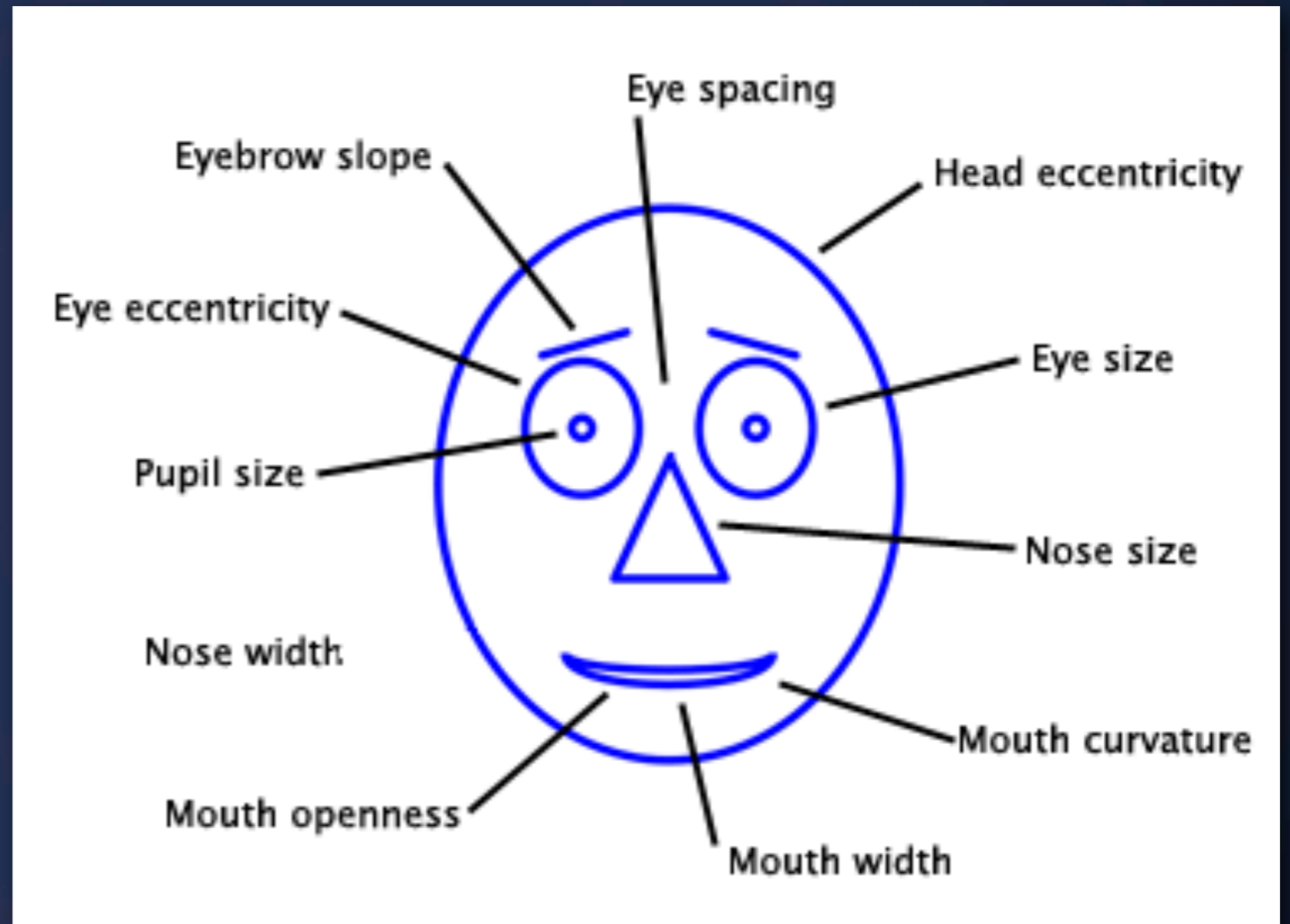
- Herman Chernoff (1973)
- Different faces are easy for us to recognize/differentiate



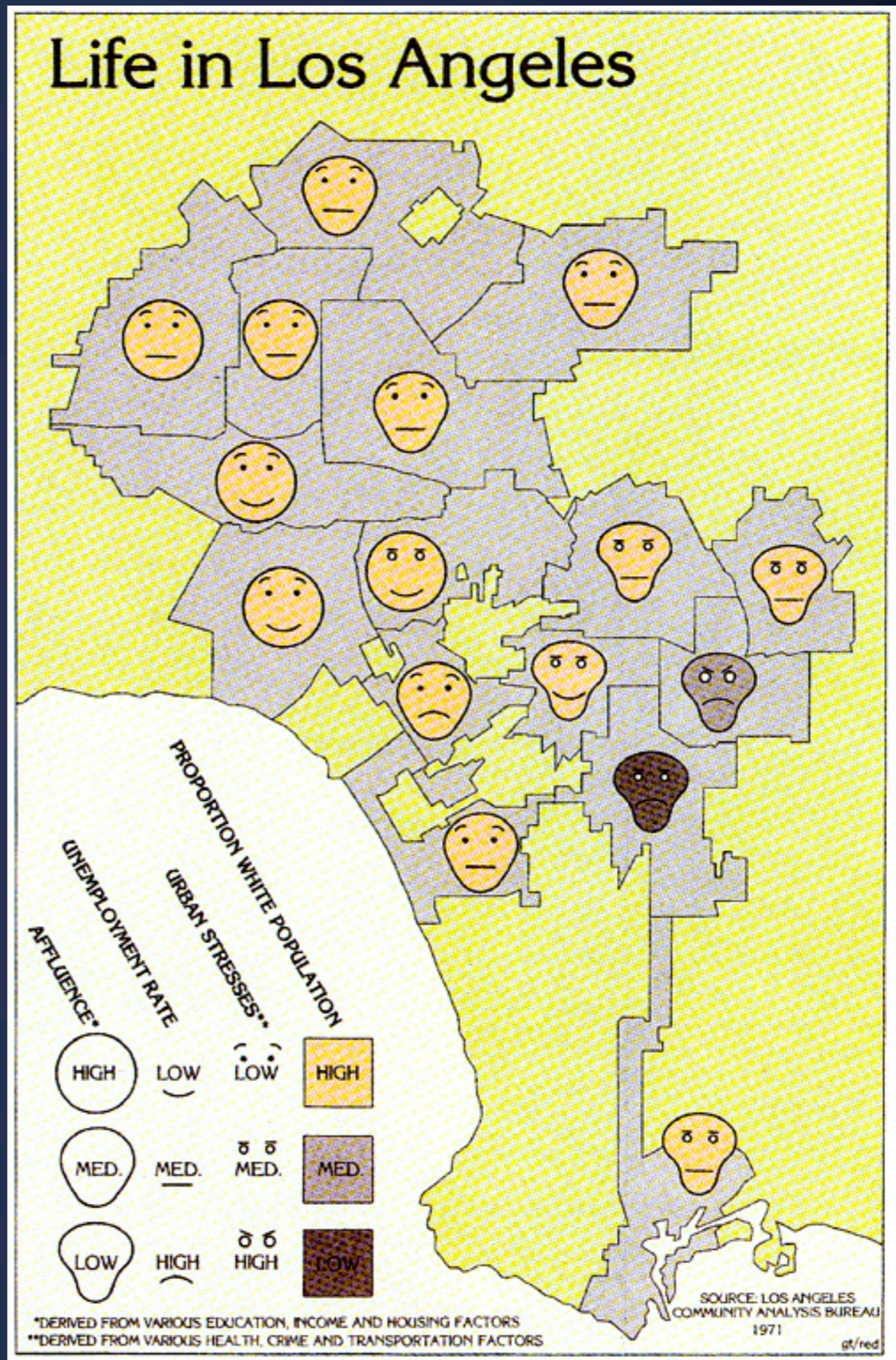
Chernoff's Faces

Decreasing order of perception

- Area of face
- Shape of face
- Length of nose
- Location of mouth
- Curve of smile
- Width of mouth
- Location, separation, angle, shape and width of eyes
- Location of pupil
- Location, angle, width of eyebrows



Chernoff's Faces



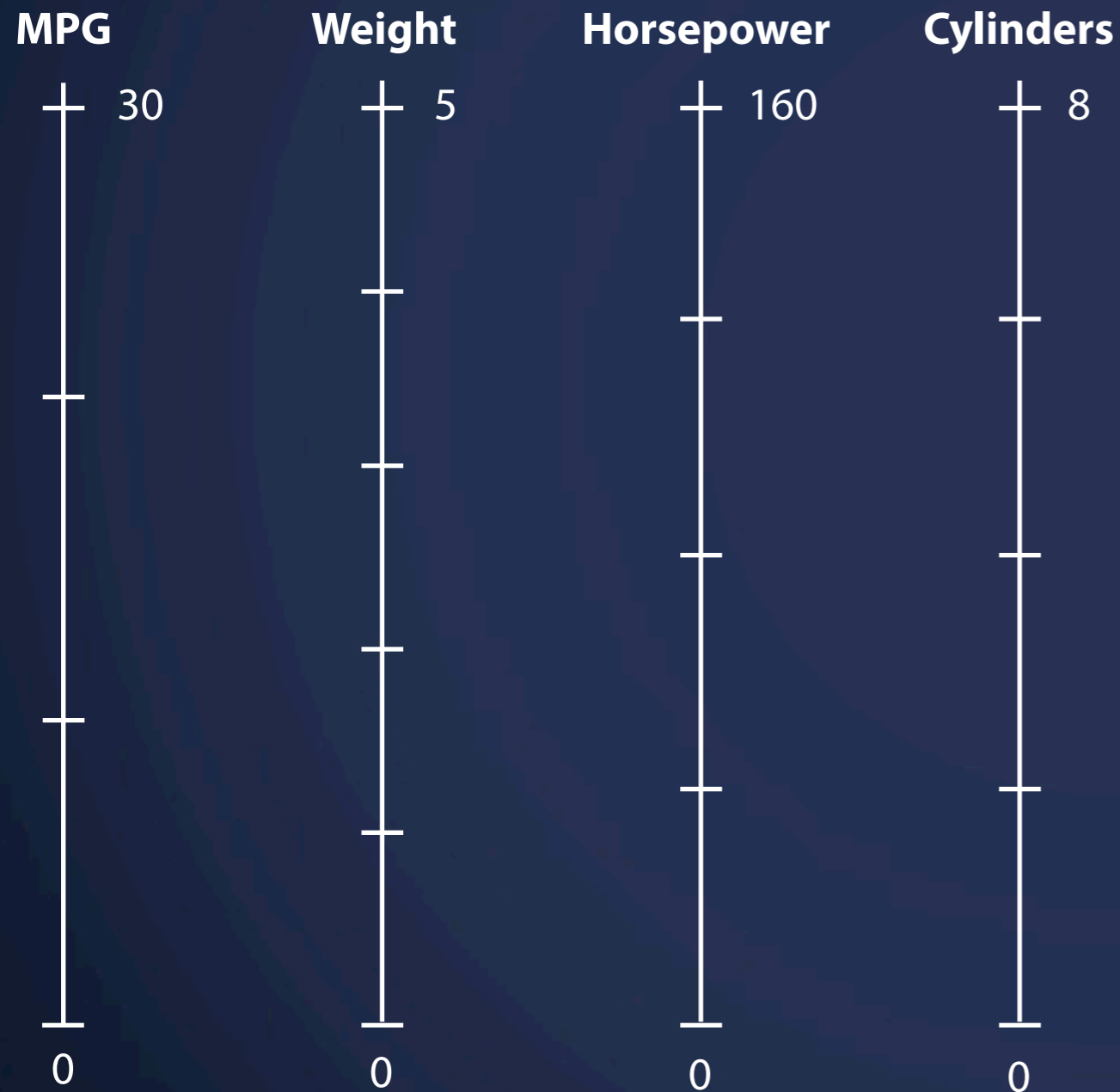
Parallel Coordinates

3 different data points (cars) with 4 variables each

Country	Car	MPG	Weight	Horsepower	Cylinders
U.S.	Buick Estate Wagon	16.9	4.36	155	8
Japan	Toyota Corona	27.5	2.56	95	4
Sweden	Volvo 240 GL	17	3.14	125	6

Parallel Coordinates

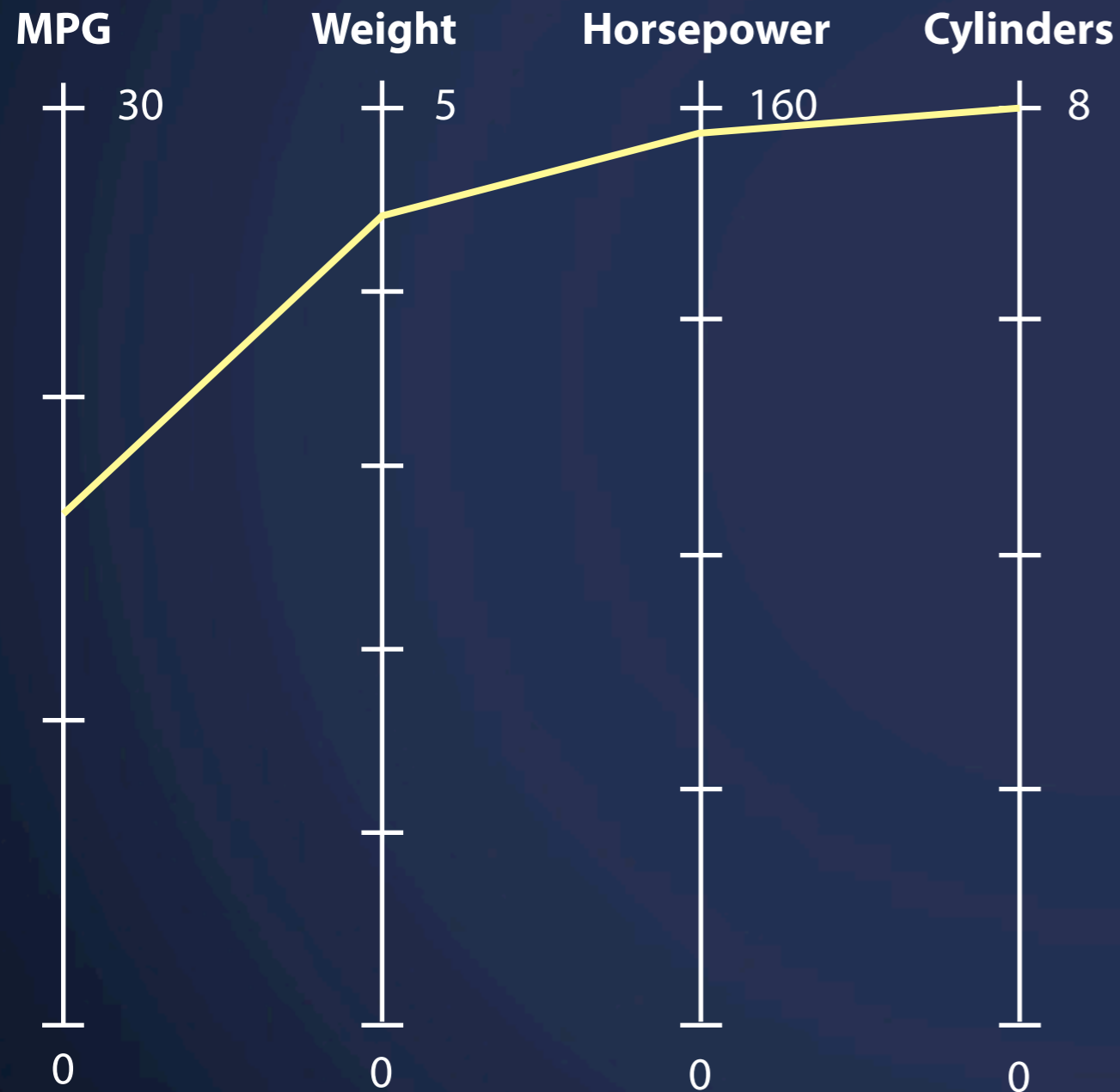
Construction



Country	Car	MPG	Weight	Horsepower	Cylinders

Parallel Coordinates

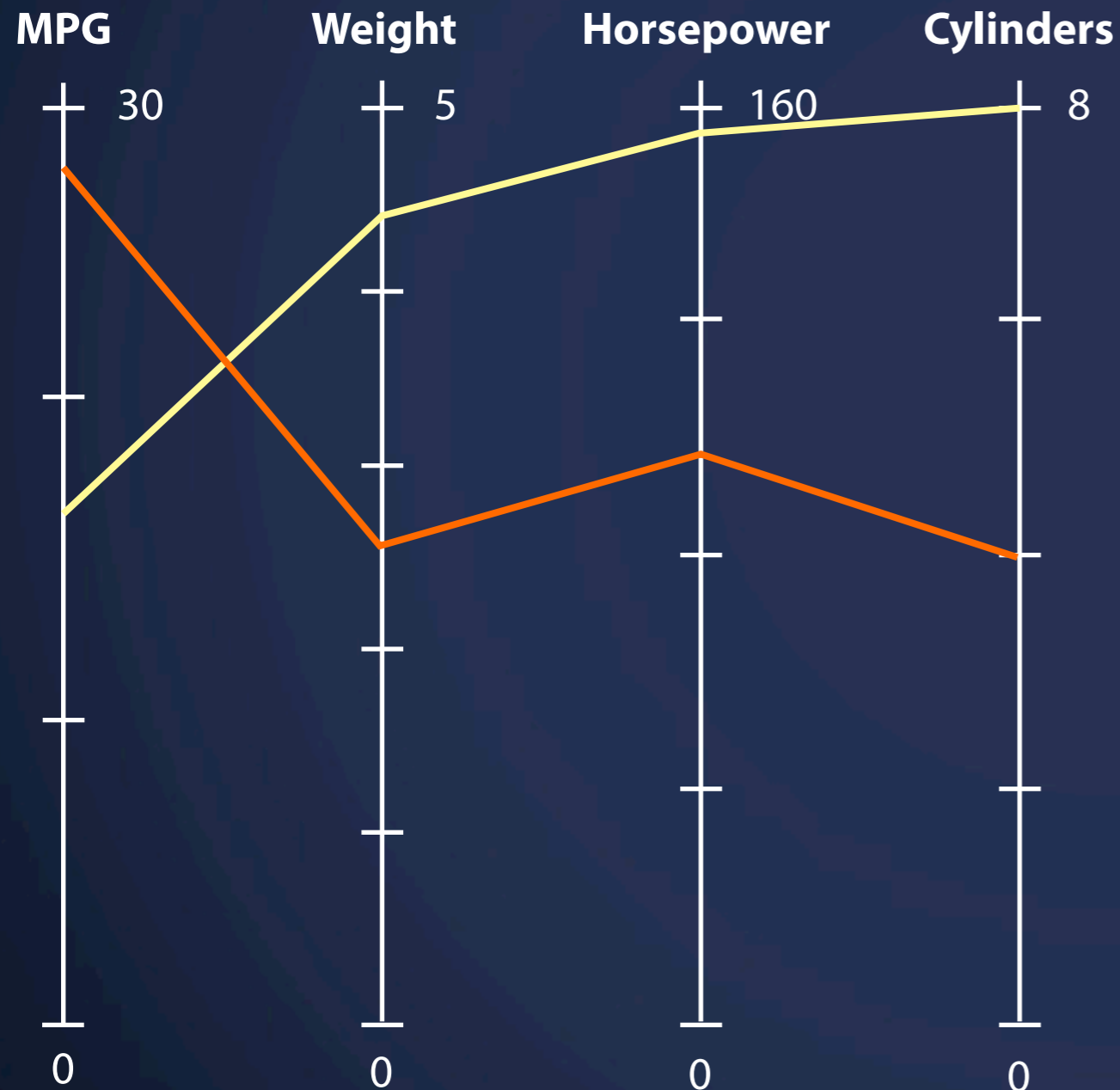
Construction



Country	Car	MPG	Weight	Horsepower	Cylinders
U.S.	Buick Estate Wagon	16.9	4.36	155	8

Parallel Coordinates

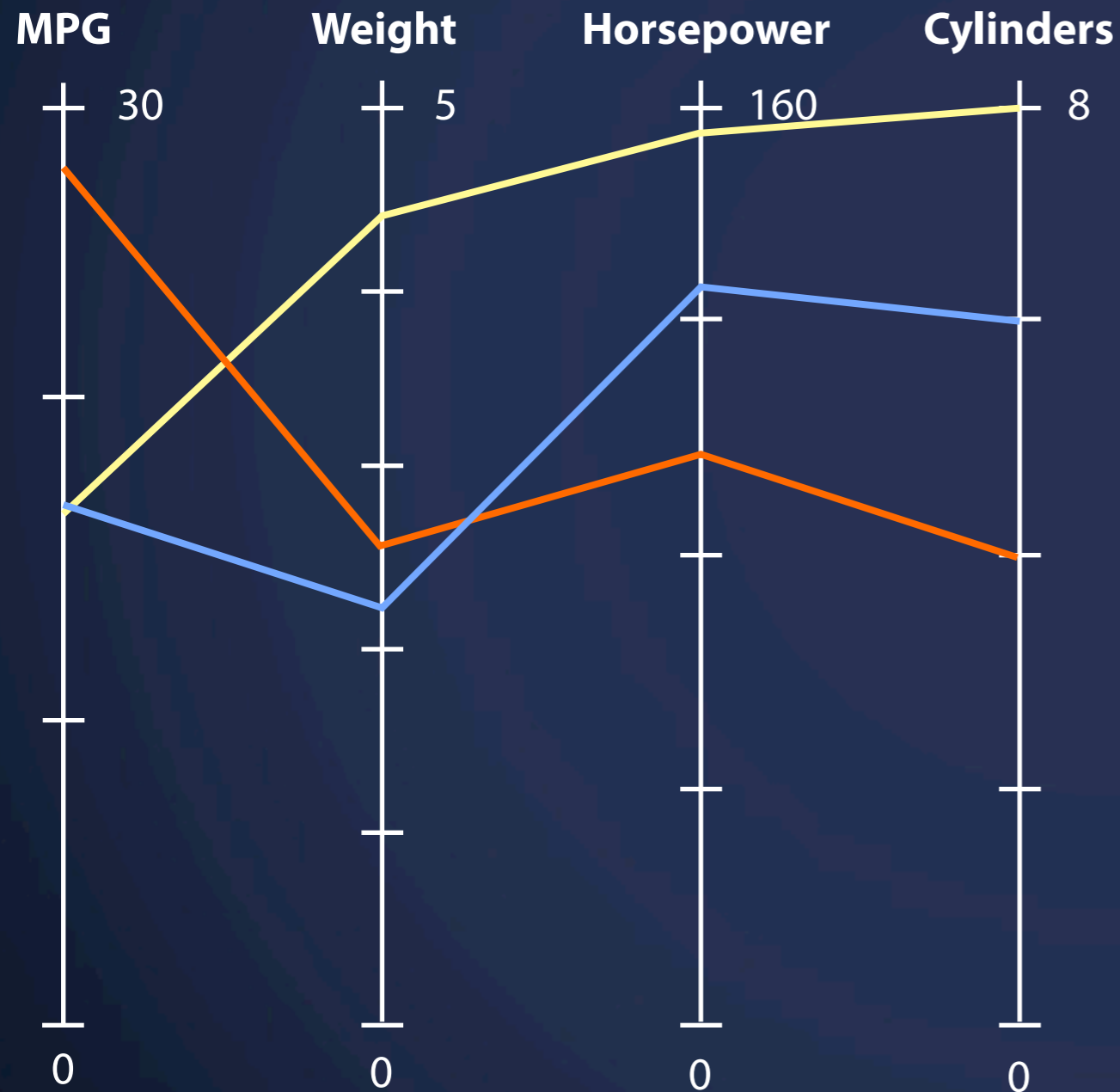
Construction



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Parallel Coordinates

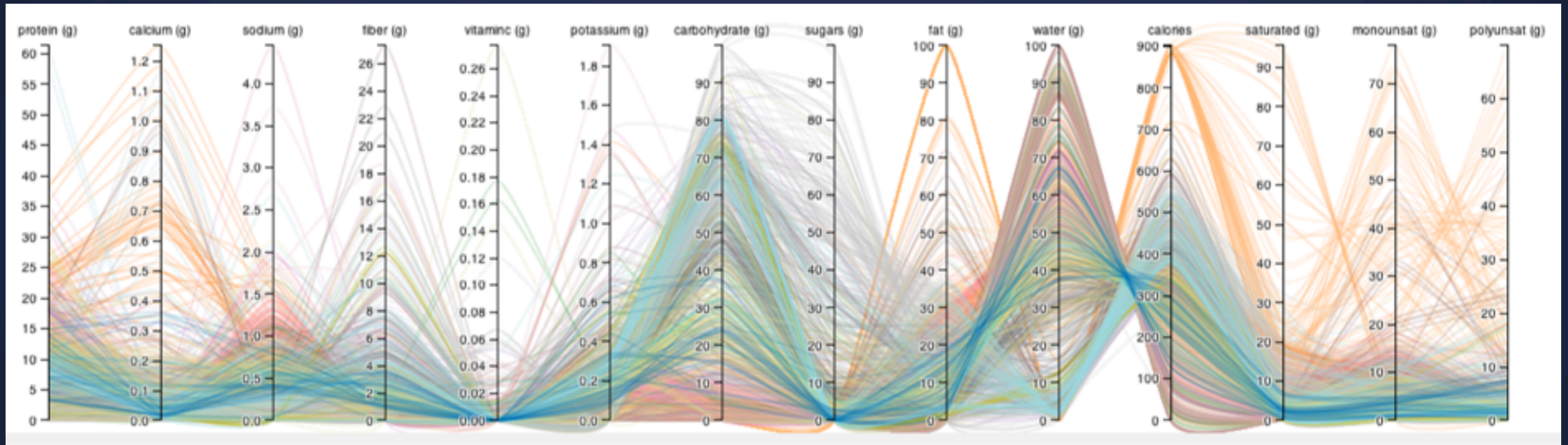
Construction



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Parallel Coordinates

Example

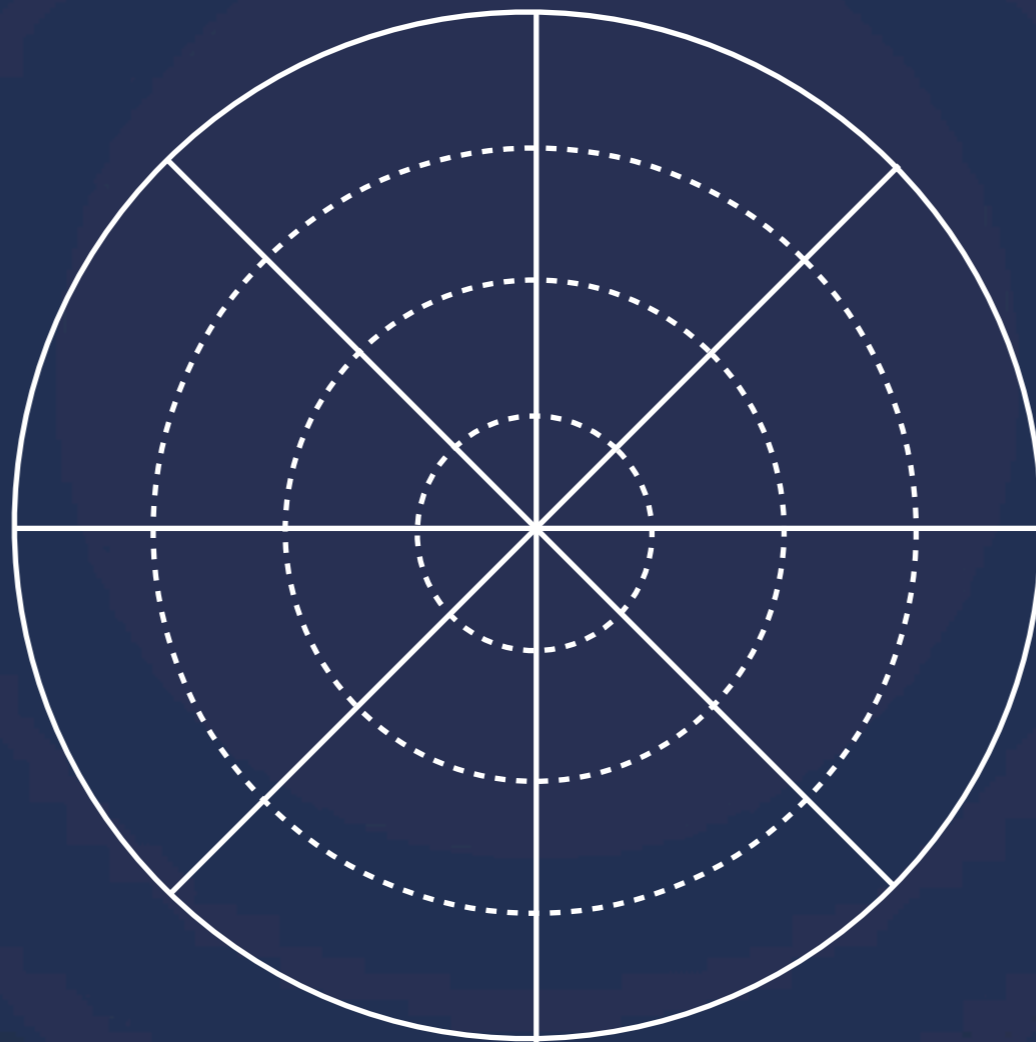


Kai Chang

<http://exposedata.com/parallel/>

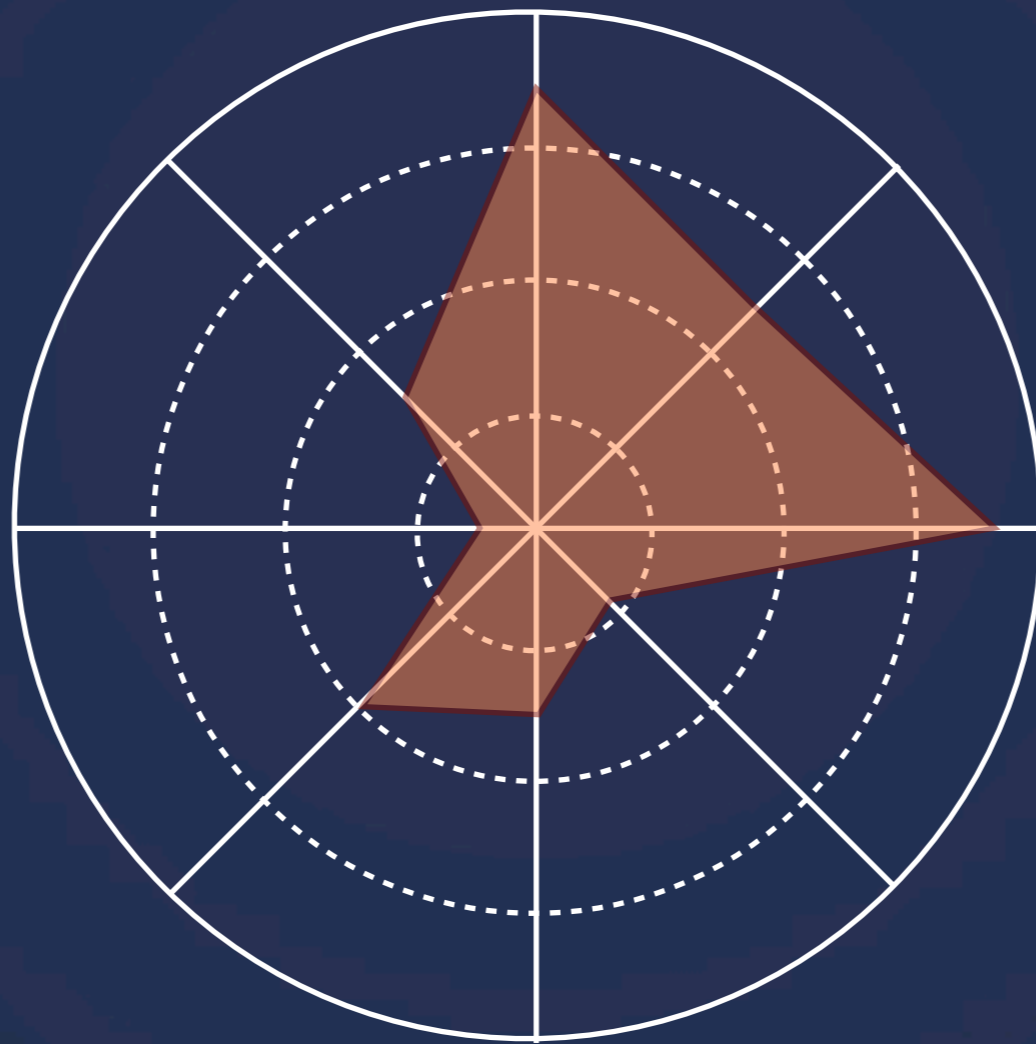
Star Glyphs (Spider / Radar chart)

Dimensions along polar coordinate



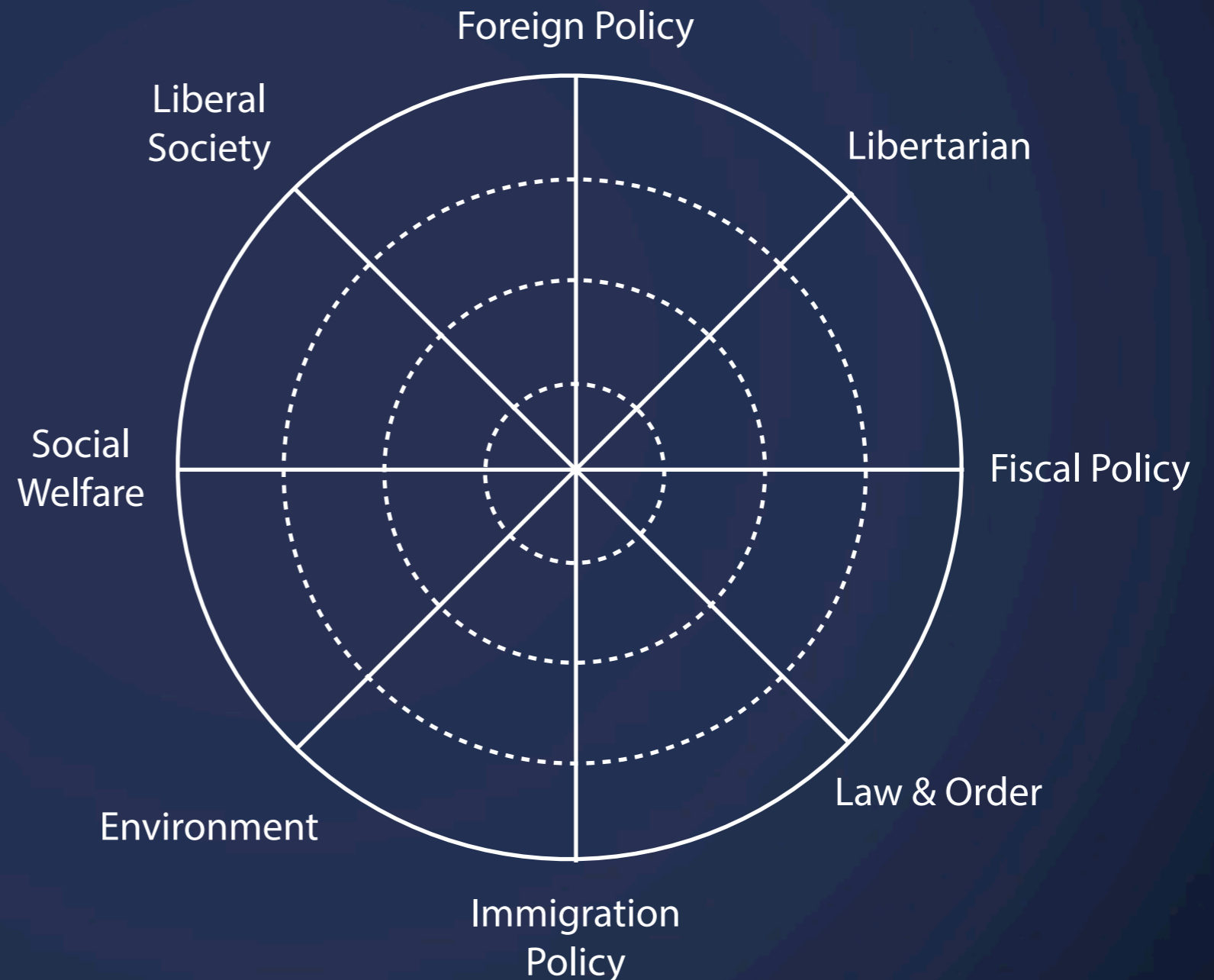
Star Glyphs (Spider / Radar chart)

Dimensions along polar coordinate



Star Glyphs (Spider / Radar chart)

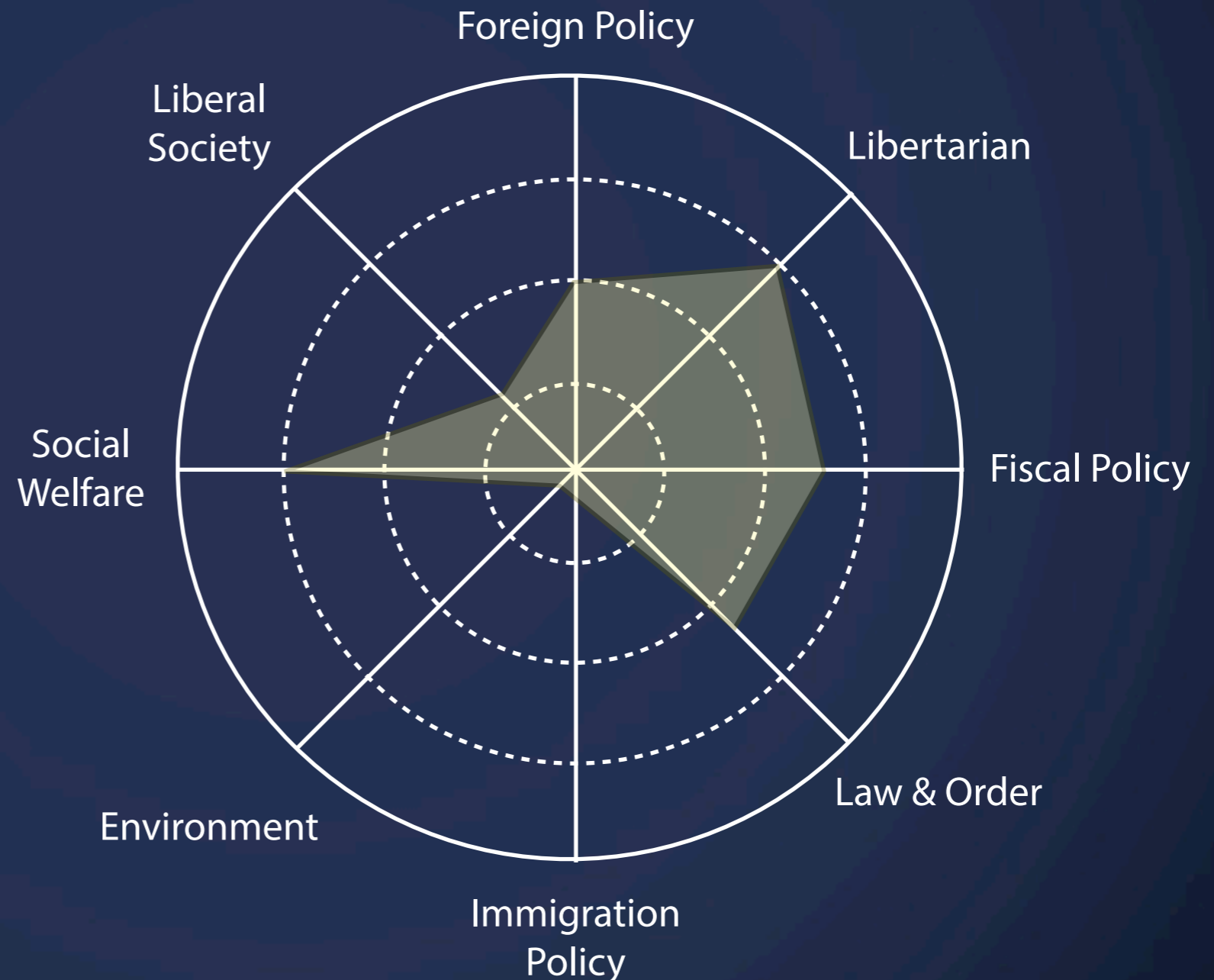
E.g. Political candidate profiles



Star Glyphs (Spider / Radar chart)

E.g. Political candidate profiles

Candidate 1

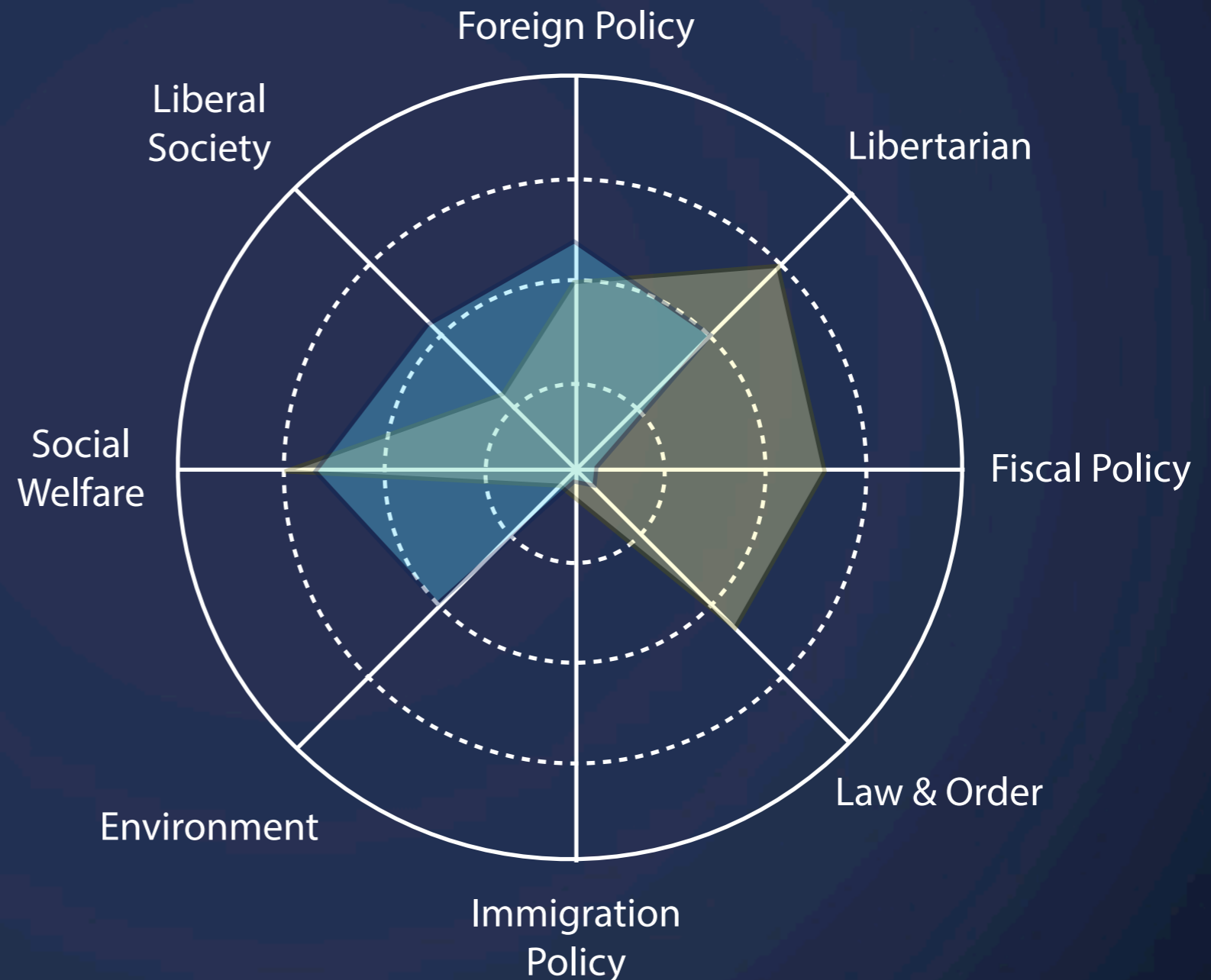


Star Glyphs (Spider / Radar chart)

E.g. Political candidate profiles

Candidate 1

Candidate 2



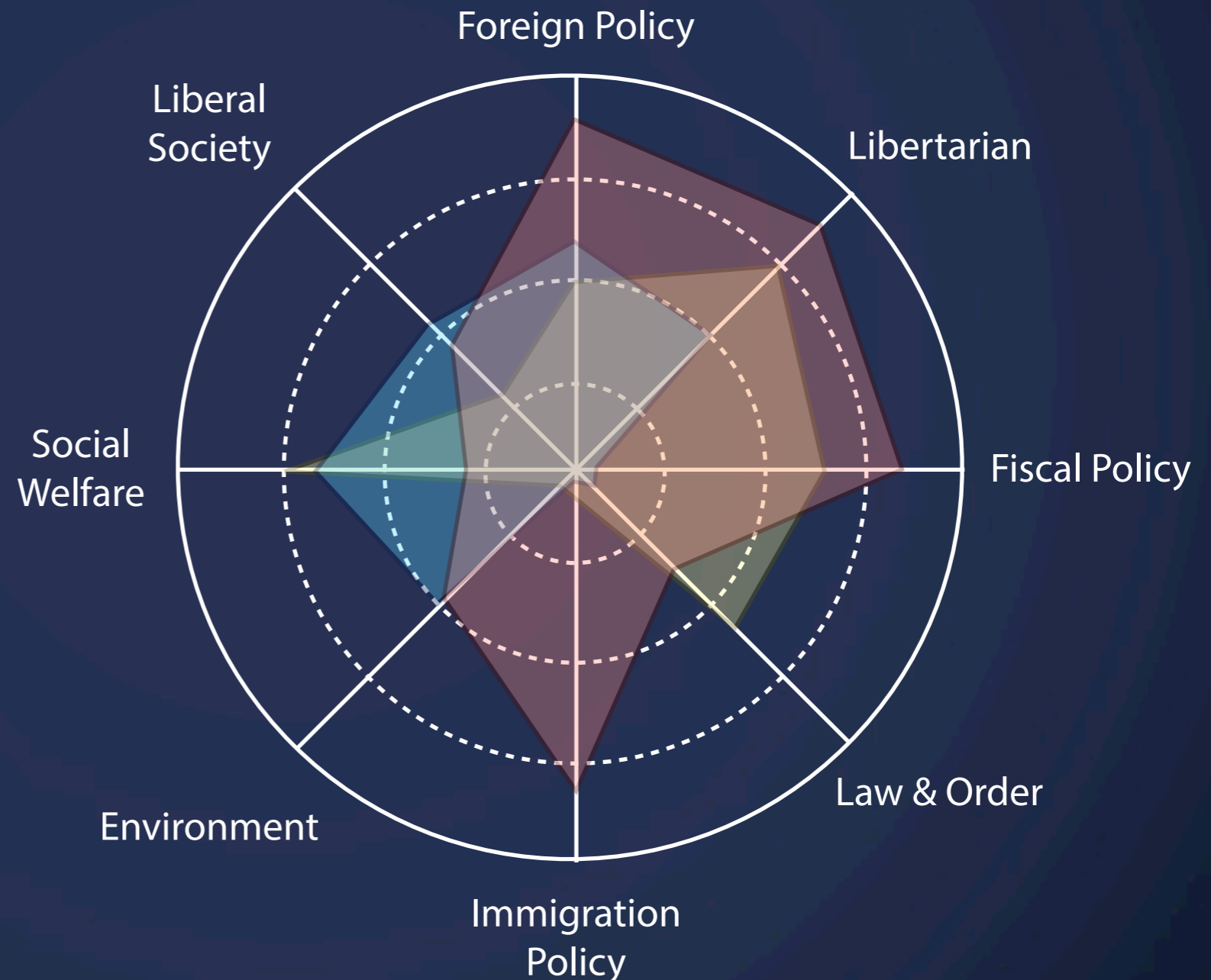
Star Glyphs (Spider / Radar chart)

E.g. Political candidate profiles

Candidate 1

Candidate 2

Candidate 3



Star Glyphs (Spider / Radar chart)

As small multiples

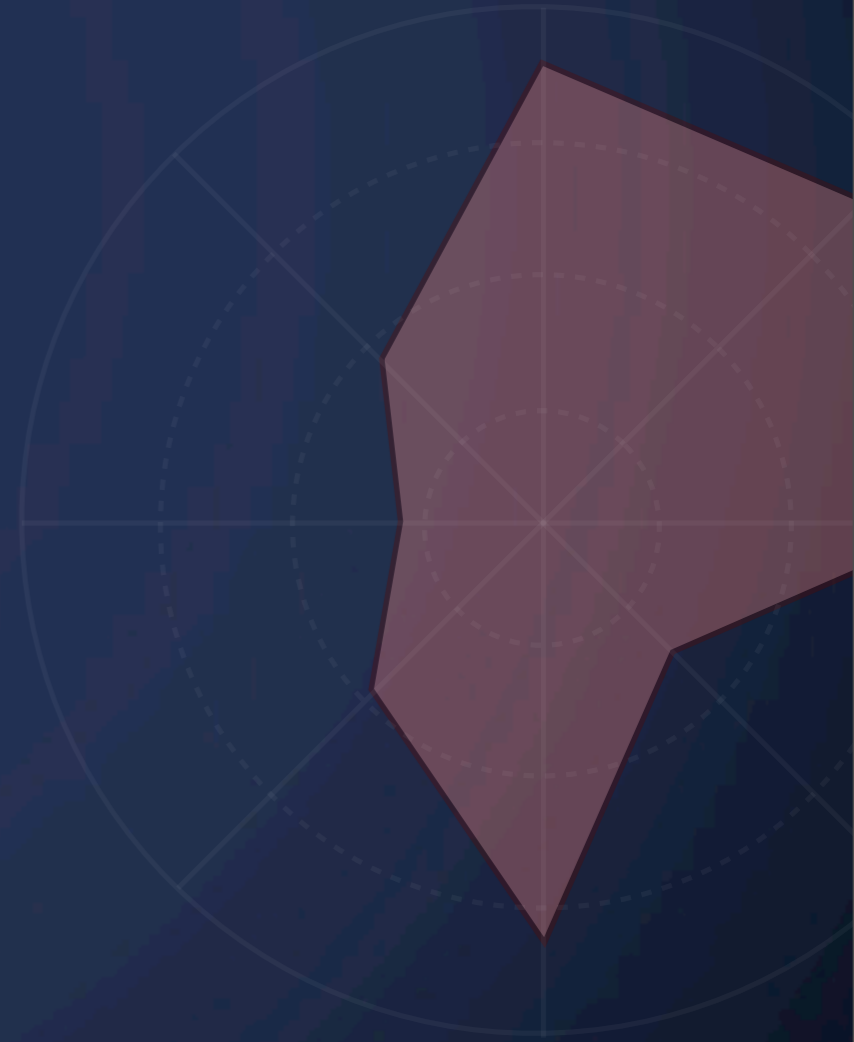
Candidate 1



Candidate 2



Candidate 3



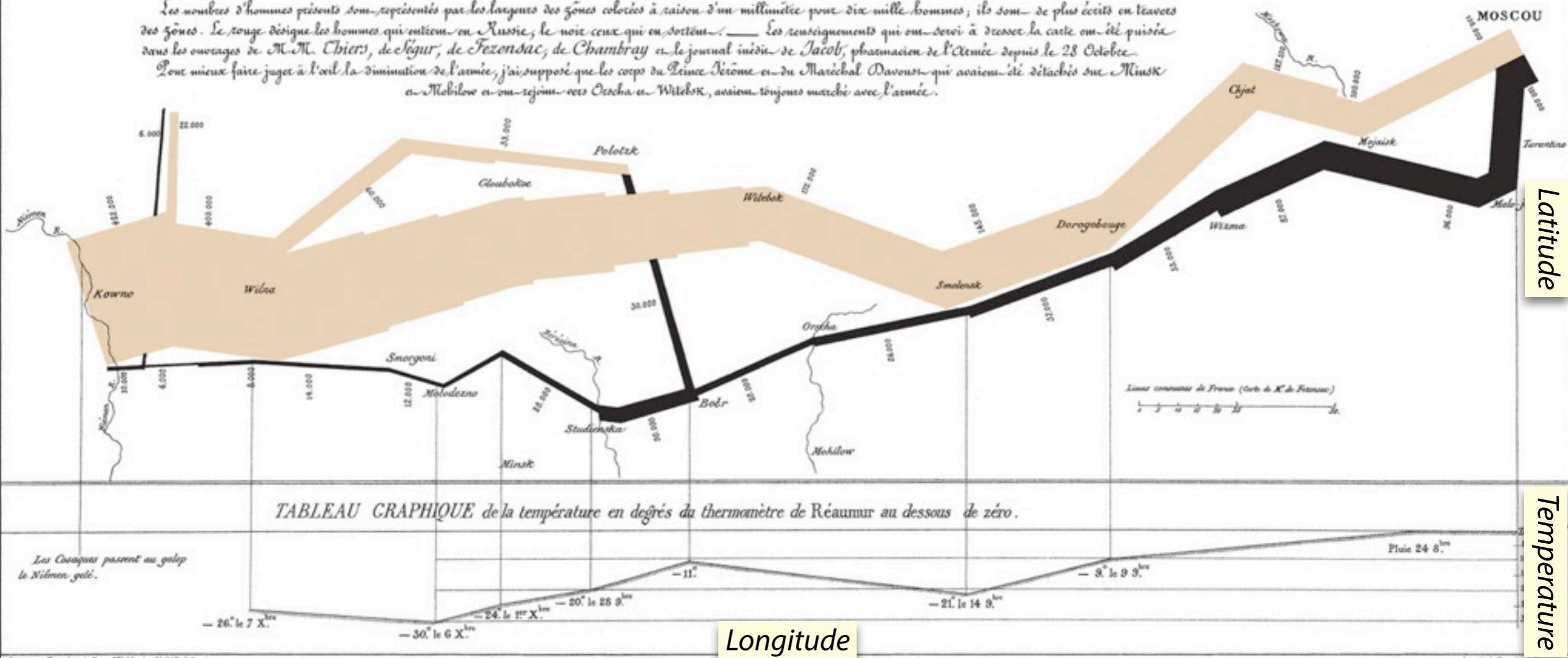
Axis Composition

Example: "The best statistical graphic ever drawn" (Tufte)

Carte Figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.

Dessinée par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite. Paris, le 20 Novembre 1869.

Les nombres d'hommes présents sont représentés par les largeurs des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en travers des zones. Le rouge désigne les hommes qui ont péri en Russie, le noir ceux qui en sont restés. Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. Chiers, de Ségur, de Fezensac, de Chambray et le journal inédit de Jacob, pharmacien de l'Armée depuis le 28 Octobre. Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Jérôme et du Maréchal Davout, qui avaient été détachés sur Minsk et Mohilow et qui rejoignent Orycha et Witebsk, avaient toujours marché avec l'armée.



Latitude

Temperature

Longitude

Anty. par Regnier, à Par. J^{de} Marie St^e O^{de} à Paris.

Imp. Lit. Regnier et Bouché

Exploratory Data Analysis

Analysis – Communication

A continuum

Data
Exploration

Analysis

Communication

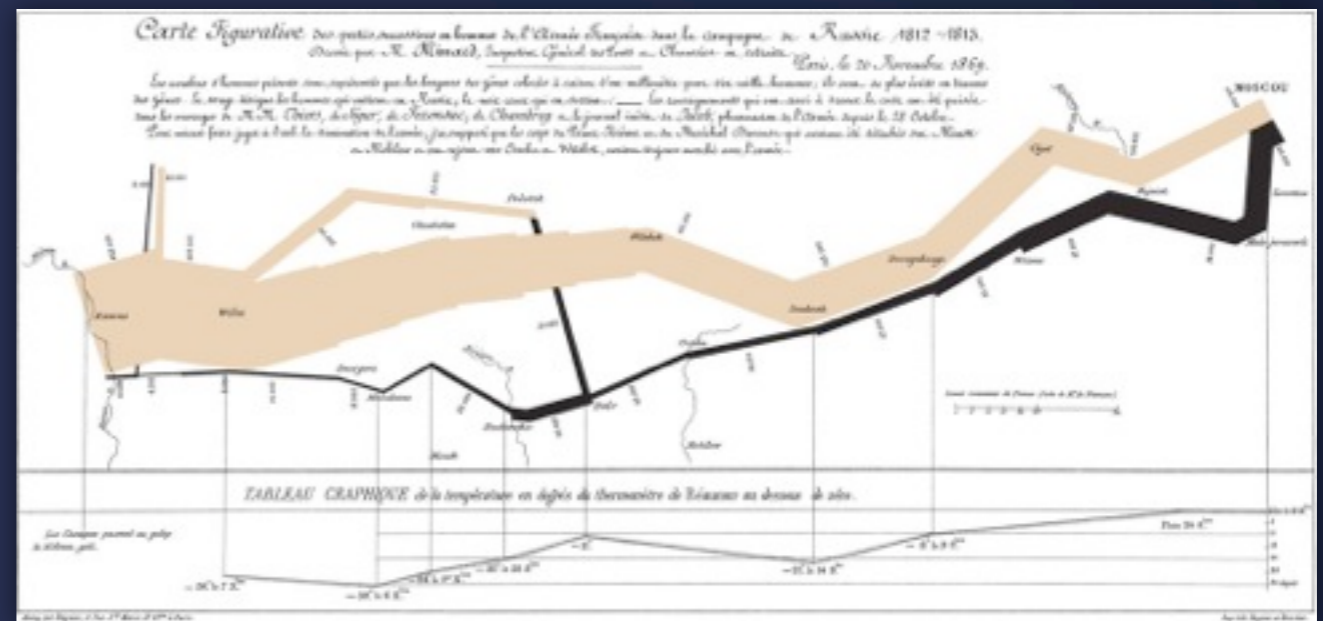
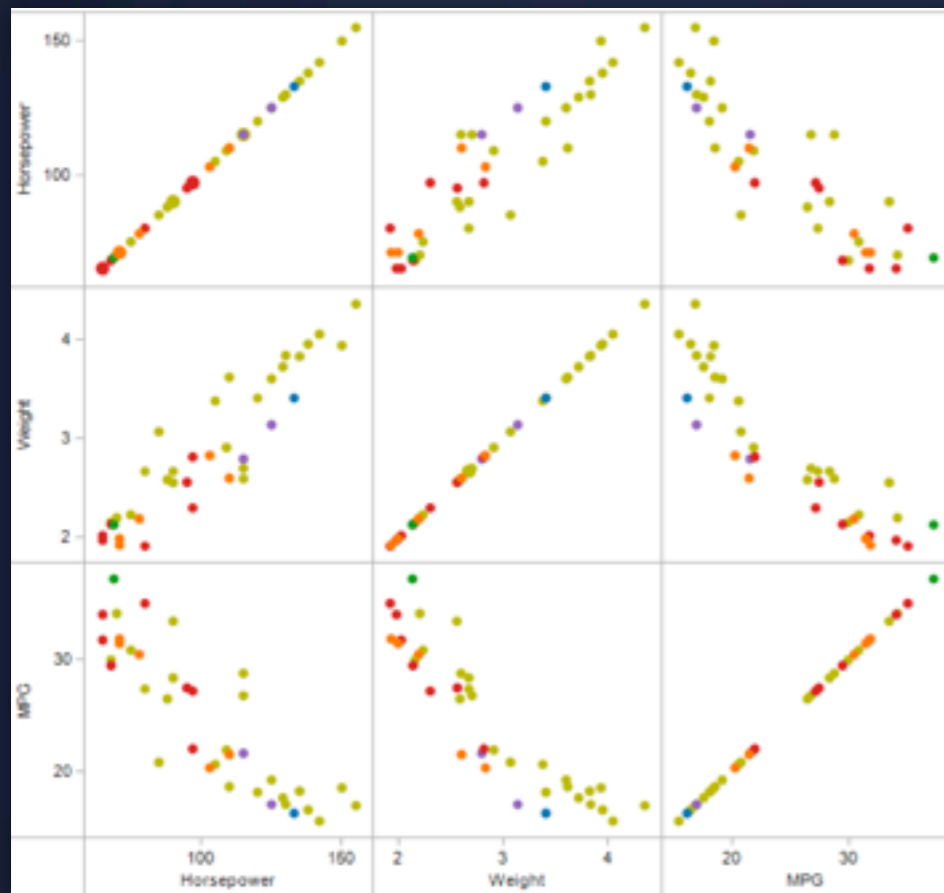


Exploratory

Explanatory

Analysis – Communication

A continuum



Exploratory

Explanatory

Recap

Lab

R / ggplot2

Next Lecture

Dashboards. Guest lecture by Stephen Few