Lecture 2:
When You Need Graphs
and
How We See Graphs
and
Merging

January 26, 2026

Course Administration

1. Tutorial 1 quiz
2. Questions/issues with readings?
3. Make sure you're signed up for Piazza – email me if you are not
4. One-page proposal is due next week

Course Administration

1. Tutorial 1 quiz
2. Questions/issues with readings?
3. Make sure you're signed up for Piazza – email me if you are not
4. One-page proposal is due next week
5. Be sure to check online listing for good/bad/ugly
   - Linked in pinned email on Piazza
   - I changed dates for one of you to even up
   - If you're joining the class, make sure you sign up
   - Let me know if this poses problems
   - Each week, I will always name who is next
6. Anything else?

Next Week's Good Bad and Ugly

Finders, post link Wed. by noon. Find a graph relating to one of the principles we're discussing today.

Finder	Commenter
Sawyer	Samantha

Add yourself ASAP if you're not on the google sheet.

Plan for Today

1. Few reading
2. Merging
3. R questions

1. Few:
Visual Perception and Graphical Communication

When Should You Use Tables vs. Graphs?

- Tables are for when

When Should You Use Tables vs. Graphs?

- Tables are for when
  - you care about the **actual numbers**
  - you have **very** few numbers

When Should You Use Tables vs. Graphs?

- Tables are for when
  - you care about the **actual numbers**
  - you have **very** few numbers
- Graphs are for when

When Should You Use Tables vs. Graphs?

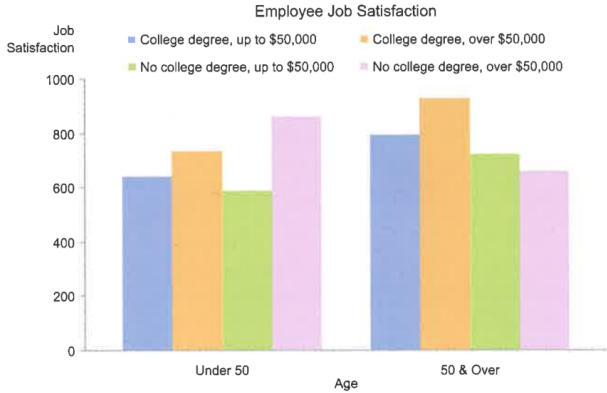
- Tables are for when
  - you care about the **actual numbers**
  - you have **very** few numbers
- Graphs are for when
  - you care about trends or general tendencies
  - you have more numbers than a table can support
  - the exact values are not critical
  - you wish to highlight a particular relationship

Starting with the Table

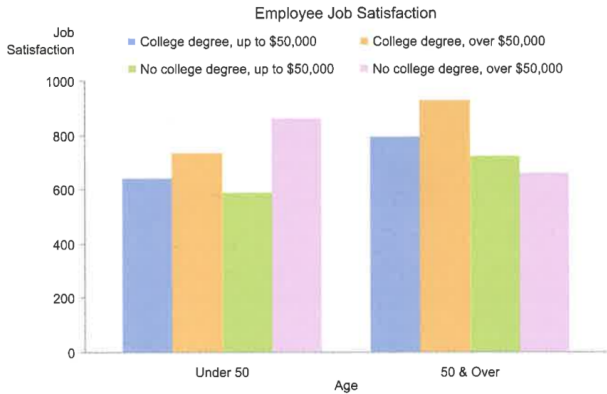
Income	College Degrees		No College Degrees	
	Under 50	50 & Over	Under 50	50 & Over
Up to $50,000	643	793	590	724
Over $50,000	735	928	863	662

Few, Chapter 3, Figure 3.13

Version One of a Set of Numbers



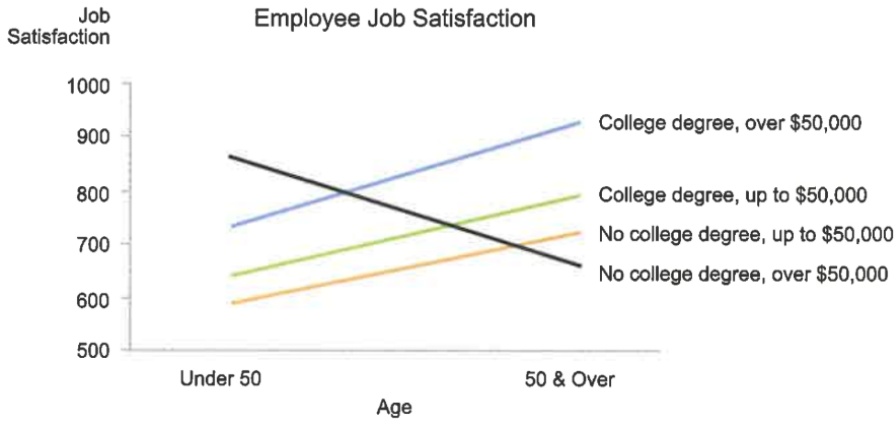
Version One of a Set of Numbers



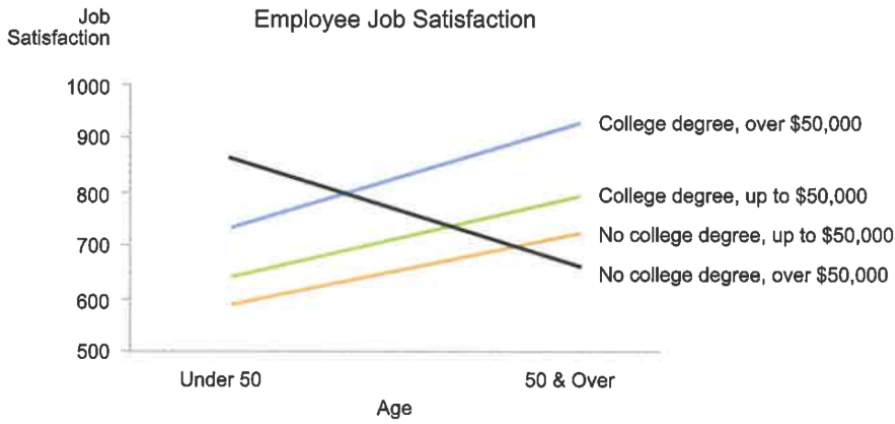
What do you think the point of this picture is?

Few, Chapter 3, Figure 3.15

Version Two of the Same Set of Numbers



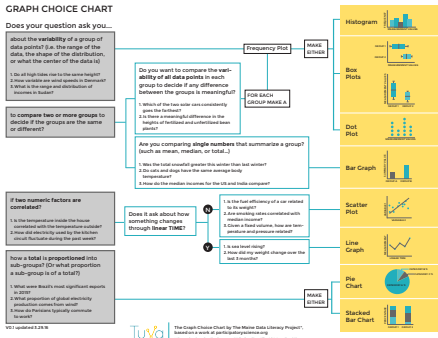
Version Two of the Same Set of Numbers



And the point of this picture?

Few, Chapter 3, Figure 3.14

Choose the Graph that Leads the Reader to Your Answer



- Chart is for when you know what you want to say
- Before than, do exploratory analysis

Few Chapter 5: Drawing Attention

1. Memory
2. Preattentive processing
   - form
   - color
   - spatial position
3. Applying to design
4. Gestalt principles of visual perception

Memory

Three types of memory

1. iconic memory

Memory

Three types of memory

1. iconic memory
   - where preattentive processing works

Memory

Three types of memory

1. iconic memory
   - where preattentive processing works
2. working memory

Memory

Three types of memory

1. iconic memory
   - where preattentive processing works
2. working memory
   - what the viewer needs to keep in mind to understand your figure

Memory

Three types of memory

1. iconic memory
   - where preattentive processing works
2. working memory
   - what the viewer needs to keep in mind to understand your figure
3. long-term memory

Memory

Three types of memory

1. iconic memory
   - where preattentive processing works
2. working memory
   - what the viewer needs to keep in mind to understand your figure
3. long-term memory
   - where you want conclusion of your figure to sit

Memory

Three types of memory

1. iconic memory
   - where preattentive processing works
2. working memory
   - what the viewer needs to keep in mind to understand your figure
3. long-term memory
   - where you want conclusion of your figure to sit

Working memory

- We don't have much of it

Memory

Three types of memory

1. iconic memory
   - where preattentive processing works
2. working memory
   - what the viewer needs to keep in mind to understand your figure
3. long-term memory
   - where you want conclusion of your figure to sit

Working memory

- We don't have much of it
- People can remember 3 to 4 visual encodings for a chart
- Therefore, more than about 4 identifiers makes the graph difficult

Why is this so important? Find the 5s.

48921652097520589

Why is this so important? Find the 5s.

48921652097520589

And now find the 5s.

4892165209752058**9**

Preattentive Processing

Why is this so important? Find the 5s.

48921652097520589

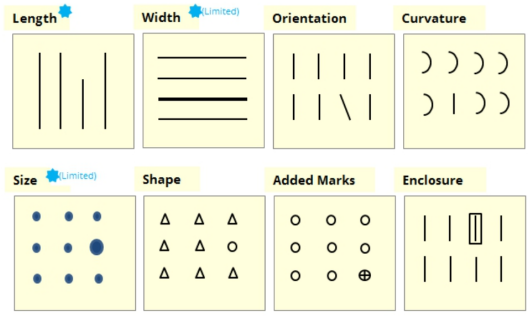
And now find the 5s.

4892165209752058**9**

Use preattentive processing to point out what **you** think is important.

Form
Color
Spatial Position

Form



Taken from https://daydreamingnumbers.com/blog/preattentive-attributes-example/

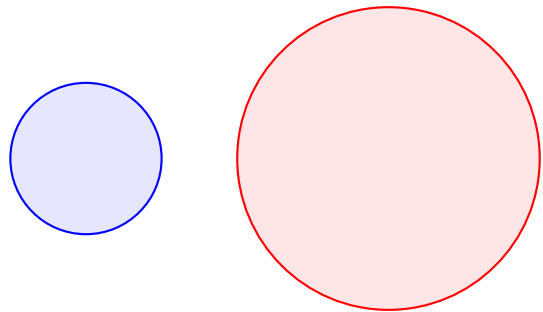
But Beware of 2-D Size

Why?

But Beware of 2-D Size

Why?

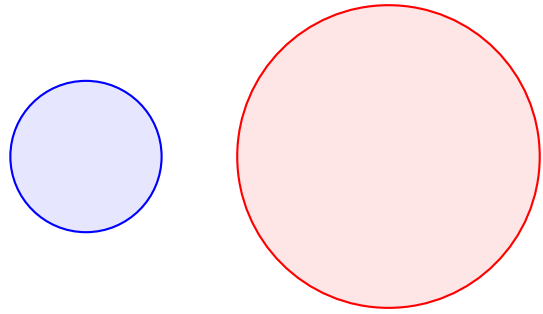
- People have a very hard time judging the relative size of 2-D objects
- How much bigger is the red circle than the blue circle?
- Changing both length and width is a 2-D change
- Avoid unless you have a specific reason to do this



But Beware of 2-D Size

Why?

- People have a very hard time judging the relative size of 2-D objects
- How much bigger is the red circle than the blue circle?
- Changing both length and width is a 2-D change
- Avoid unless you have a specific reason to do this

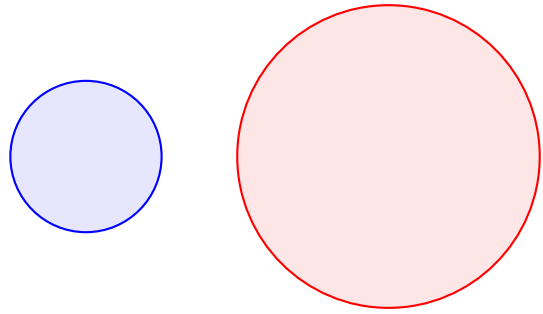


How much bigger is the small circle than the larger one?

But Beware of 2-D Size

Why?

- People have a very hard time judging the relative size of 2-D objects
- How much bigger is the red circle than the blue circle?
- Changing both length and width is a 2-D change
- Avoid unless you have a specific reason to do this



How much bigger is the small circle than the larger one? 4x

Color

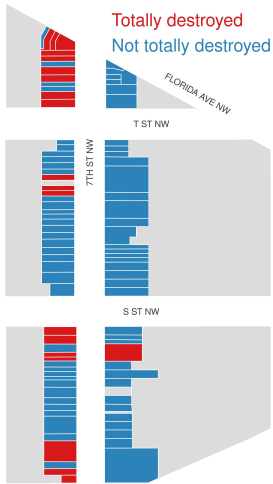
1. Hue
   - What you think of as “color”
   - Blue, Green, etc
2. Saturation
   - full color to white
3. Lightness
   - or brightness, full color to dark

Color

1. Hue
   - What you think of as “color”
   - Blue, Green, etc
2. Saturation
   - full color to white
3. Lightness
   - or brightness, full color to dark

Contrasting hues stand out. Intense colors stand out.

Using Color and Enclosure to Distinguish



- Quickly pick out two types
- Locate within larger block

Do We Perceive Them Quantitatively?

Type	Attribute
Form	Length
	Width
	Orientation
	Size
	Shape
	Enclosure
Color	Hue
	Intensity
Position	2-D Position

Do We Perceive Them Quantitatively?

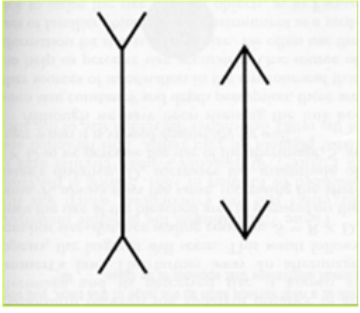
Type	Attribute	Quantitatively Perceived?
Form	Length	Yes
	Width	Yes, but limited
	Orientation	No
	Size	Yes, but limited
	Shape	No
	Enclosure	No
Color	Hue	No
	Intensity	Yes, but limited
Position	2-D Position	Yes

Do We Perceive Them Quantitatively?

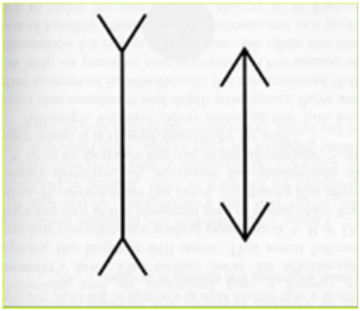
Type	Attribute	Quantitatively Perceived?
Form	Length	Yes
	Width	Yes, but limited
	Orientation	No
	Size	Yes, but limited
	Shape	No
	Enclosure	No
Color	Hue	No
	Intensity	Yes, but limited
Position	2-D Position	Yes

We rely heavily on things that we perceive entirely quantitatively

Context Matters

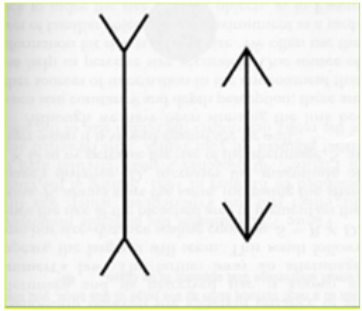


Context Matters



Why?

Context Matters



Why?

Thanks to UC Irvine's Majumder.

Why Context Matters

Why Context Matters

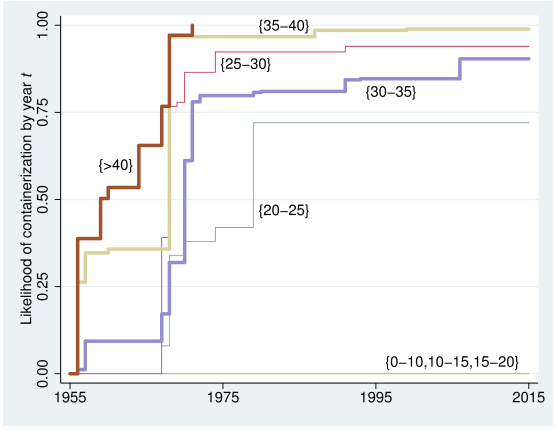
Preattentive processing relies on difference.

Why Context Matters

Preattentive processing relies on difference.

Too many differences obscures any one difference.

Calling Attention



Which principle do I use here?

Gestalt Principles of Visual Perception

- Proximity
- Similarity
- Enclosure
- Closure
- Continuity

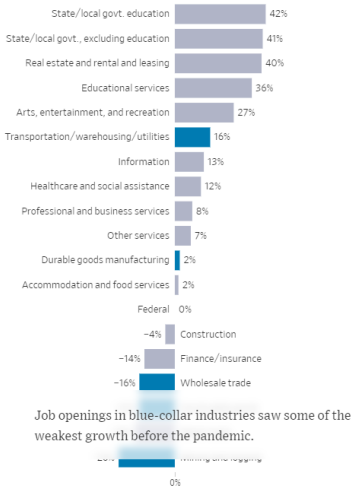
These all generate meaning, whether you intend it or not!

Applying These Principles

- WSJ graph on job openings
- My regression results
  - first a set of slides that do a so-so job
  - second a set of slides that do a better (but improvable) job

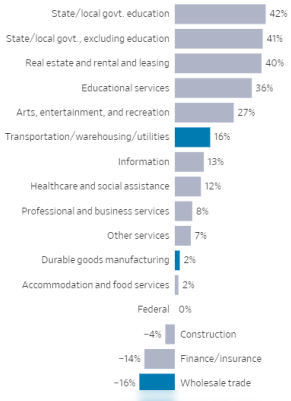
Similarity and Continuity

Change, 1/2018 to 11/2019



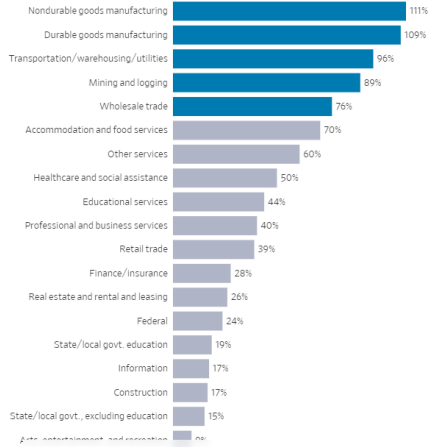
Similarity and Continuity

Change, 1/2018 to 11/2019



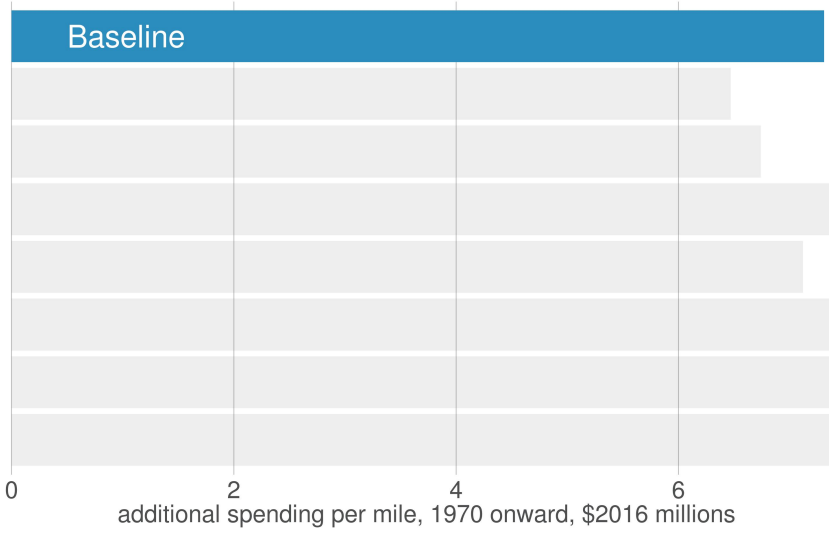
Job openings in blue-collar industries saw some of the weakest growth before the pandemic.

Change, 1/2020 to 11/2021

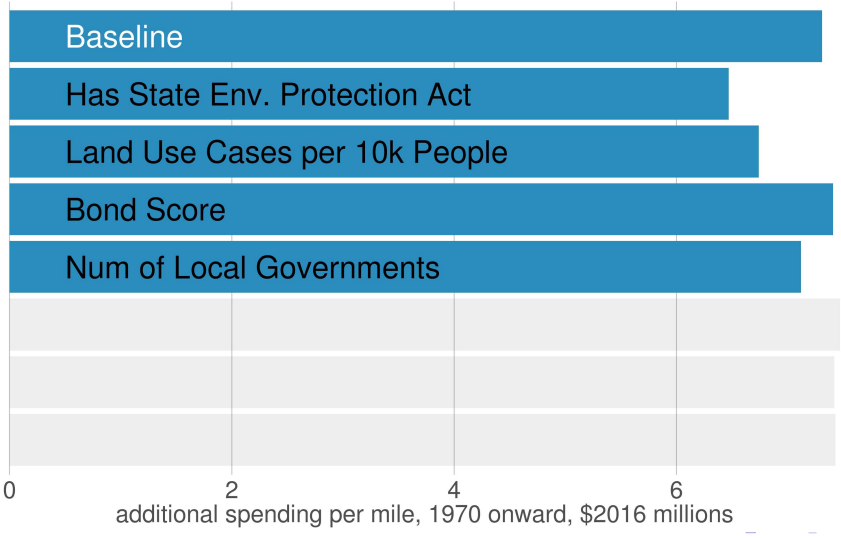


Now, blue-collar job openings are logging the biggest gains.

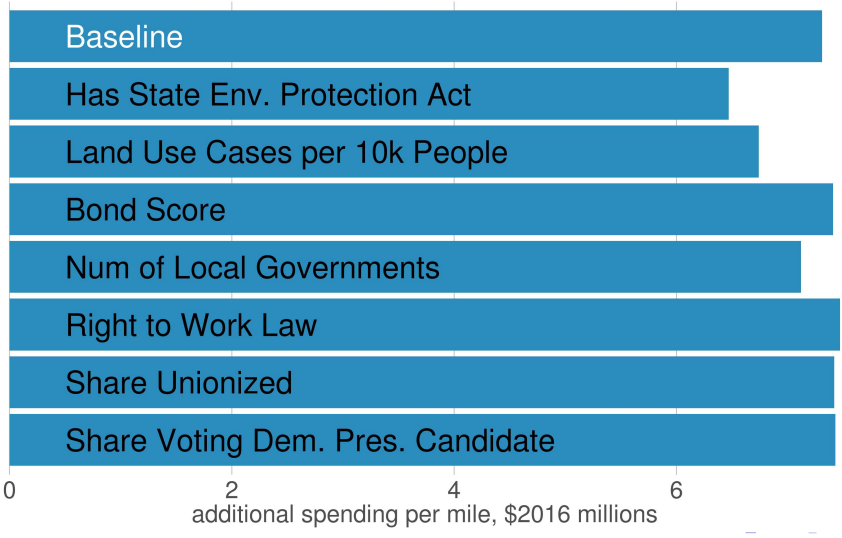
Baseline Increase of $7.3 Million per Mile



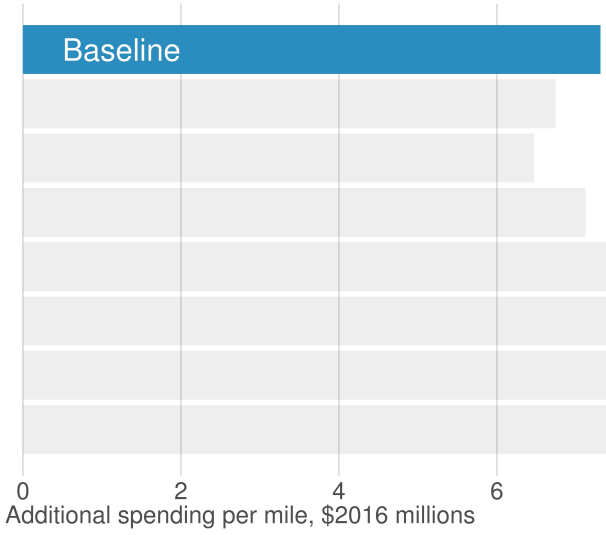
Measures of Government Quality Unrelated to Spending Increase



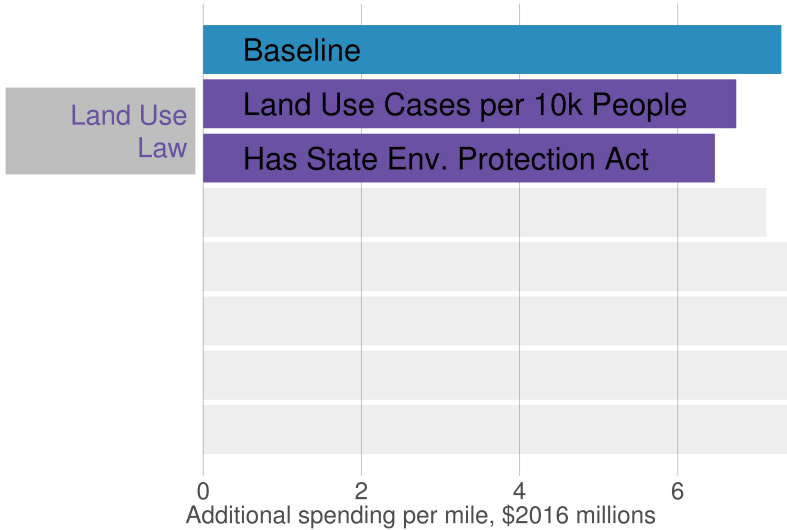
Measures of Labor Strength Unrelated to Spending Increase



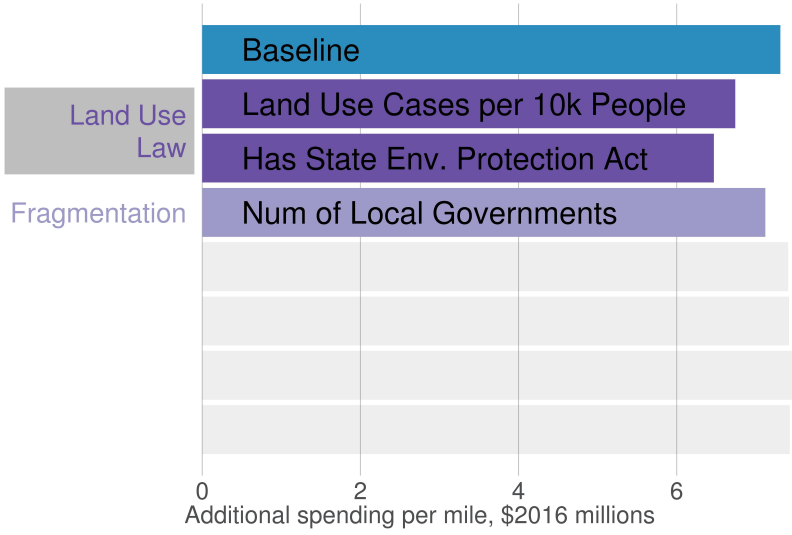
Using the Principles of Proximity and Similarity



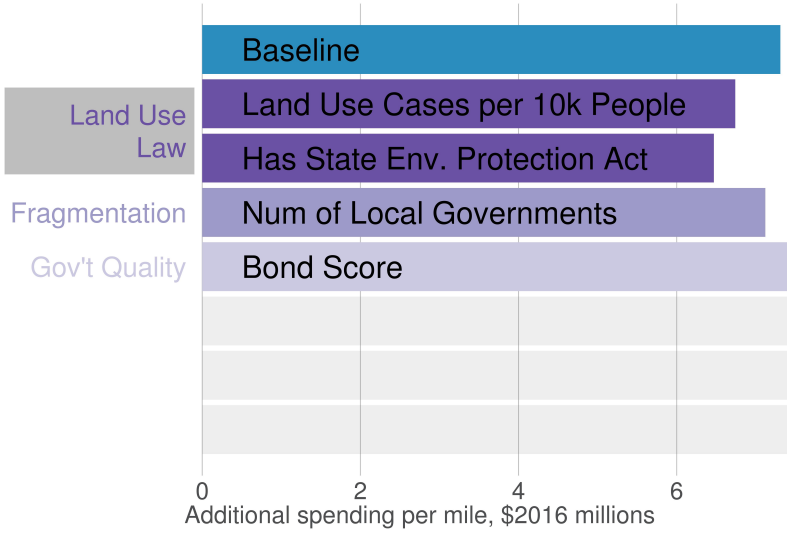
Using the Principles of Proximity and Similarity



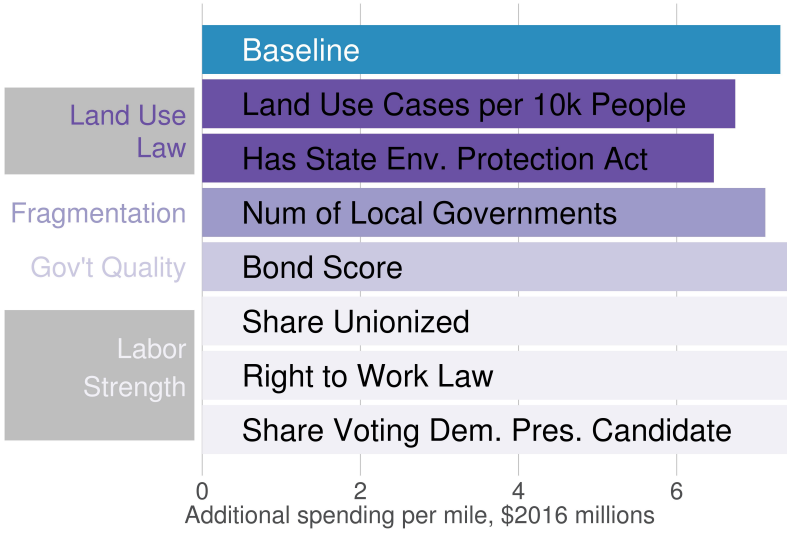
Using the Principles of Proximity and Similarity



Using the Principles of Proximity and Similarity



Using the Principles of Proximity and Similarity



2. R: Merging

Why Do You Need to Know How to Merge?

If you want to say something about data in more than one dataset, you must merge!

What is a Merge?

You want to put together

Dataset A – One obs/ID

ID	Income
A	50
B	100

Dataset B – One obs/ID

ID	Pool
A	TRUE
B	FALSE

How many rows should the merged dataset have?

What is a Merge?

You want to put together

Dataset A – One obs/ID

ID	Income
A	50
B	100

Dataset B – One obs/ID

ID	Pool
A	TRUE
B	FALSE

How many rows should the merged dataset have?

Into

ID	Income	Pool
A	50	TRUE
B	100	FALSE

This is a 1 to 1 merge.

What is a Many to 1 Merge?

You want to put together

Dataset A – One obs/ID

ID	Income
A	50
B	100

Dataset B – many obs/ID

ID	Pool	Year
A	TRUE	2020
B	FALSE	2020
A	TRUE	2021
B	TRUE	2021

What is a Many to 1 Merge?

You want to put together

Dataset A – One obs/ID

ID	Income
A	50
B	100

Dataset B – many obs/ID

ID	Pool	Year
A	TRUE	2020
B	FALSE	2020
A	TRUE	2021
B	TRUE	2021

How many rows and columns should it have?

What is a Many to 1 Merge?

You want to put together

Dataset A – One obs/ID

ID	Income
A	50
B	100

Dataset B – many obs/ID

ID	Pool	Year
A	TRUE	2020
B	FALSE	2020
A	TRUE	2021
B	TRUE	2021

How many rows and columns should it have?

ID	Pool	Year	Income
A	TRUE	2020	50
B	FALSE	2020	100
A	TRUE	2021	50
B	TRUE	2021	100

What is a Many to Many Merge?

A mess!

What is a Many to Many Merge?

A mess!

Dataset A

ID	Income
A	50
A	60
B	100

Dataset B

ID	Pool	Year
A	TRUE	2020
B	FALSE	2020
A	TRUE	2021
B	TRUE	2021

What is a Many to Many Merge?

A mess!

Dataset A

ID	Income
A	50
A	60
B	100

Dataset B

ID	Pool	Year
A	TRUE	2020
B	FALSE	2020
A	TRUE	2021
B	TRUE	2021

There is no logical path to merge A and B.

What is a Many to Many Merge?

A mess!

Dataset A

ID	Income
A	50
A	60
B	100

Dataset B

ID	Pool	Year
A	TRUE	2020
B	FALSE	2020
A	TRUE	2021
B	TRUE	2021

There is no logical path to merge A and B. Very probably something is wrong with A.

Merging in R

Trying a Few R Features

- Time permitting, work through a merge example
- Work on tutorial
- Make a .R script for whole tutorial
- Plus questions at end
- I will be here till 5:20 – please stay and ask questions

Next Lecture

- Be ready for quiz on Tutorial 2
- Read Few: Chapter 6, pages 87-95; Chapter 9; and Chapter 10, pages 210-217 (on bars)
- Read Chang Chapter 3
- Read two linked articles from *WSJ* – let me know if you need a pdf
- Turn in policy brief proposal