Welcome to AEM 2850!

Week 1

AEM 2850: R for Business Analytics
Cornell Dyson
Spring 2022

Acknowledgements: Andrew Heiss, Claus Wilke

Plan for today

Why take R for Business Analytics?

Summary of key class details

Facts, truth, and beauty

Data, truth, and beauty

Beautiful visualizations

Why take R for Business Analytics?

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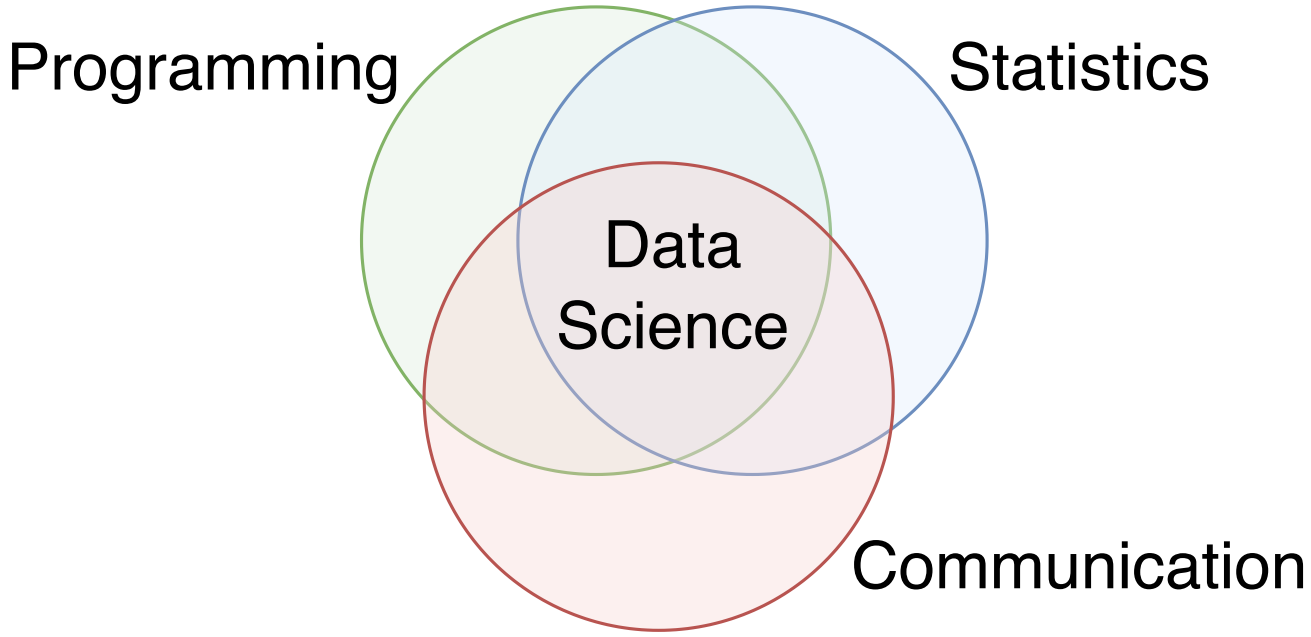
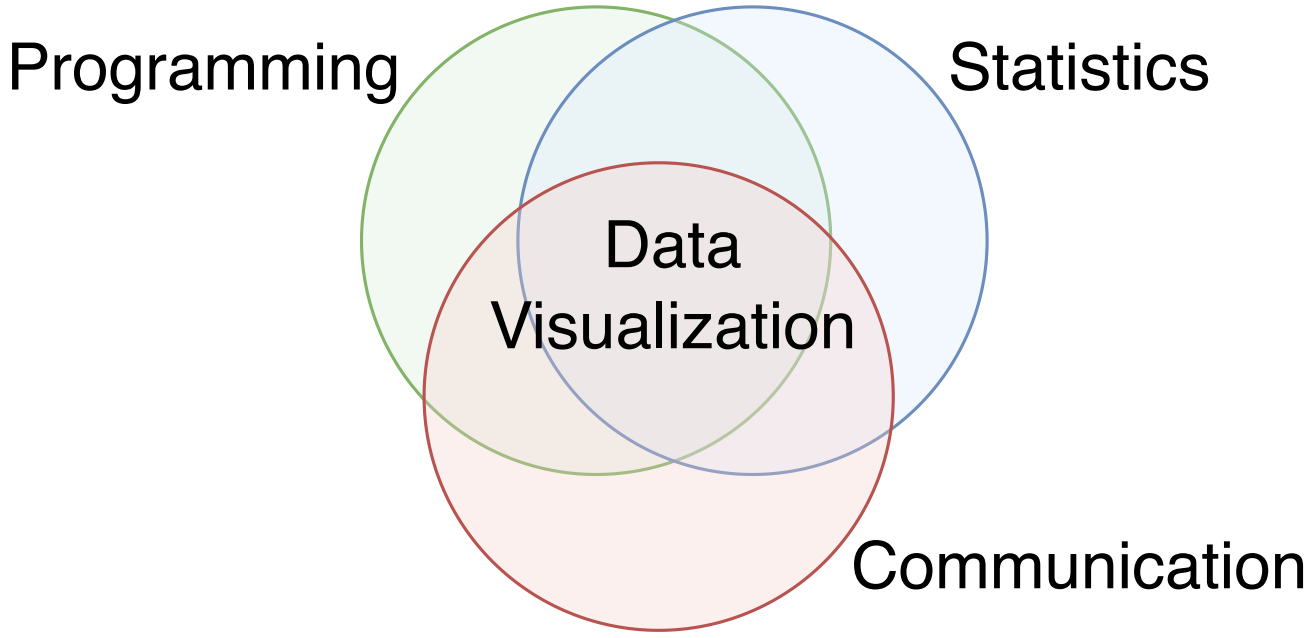
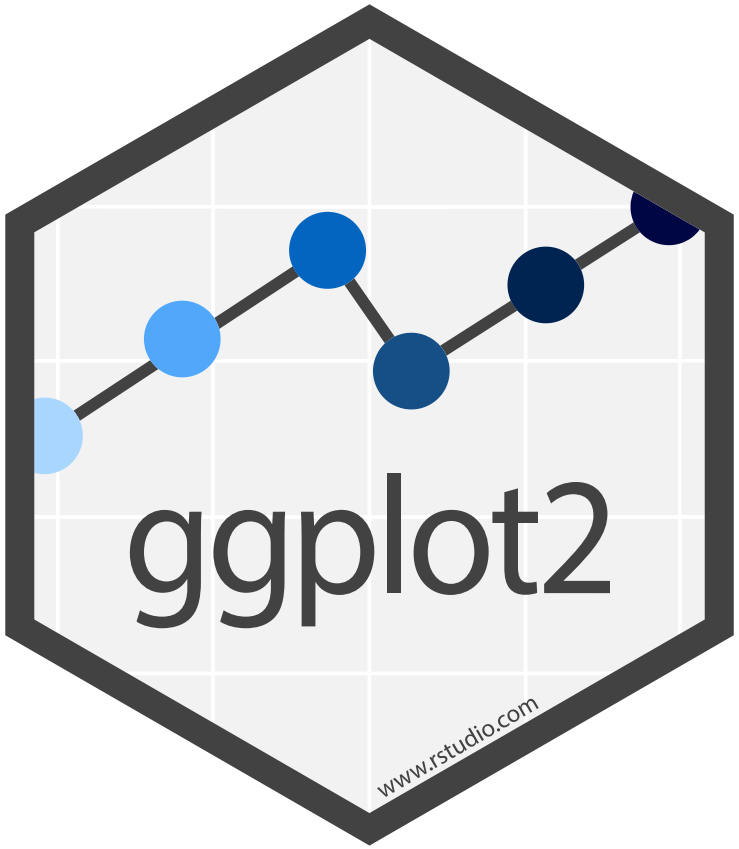


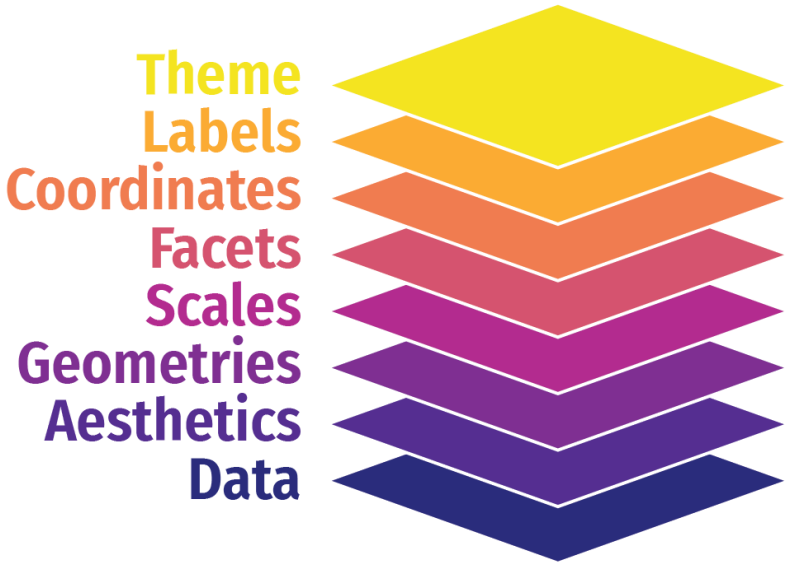
Why take R for Business Analytics?



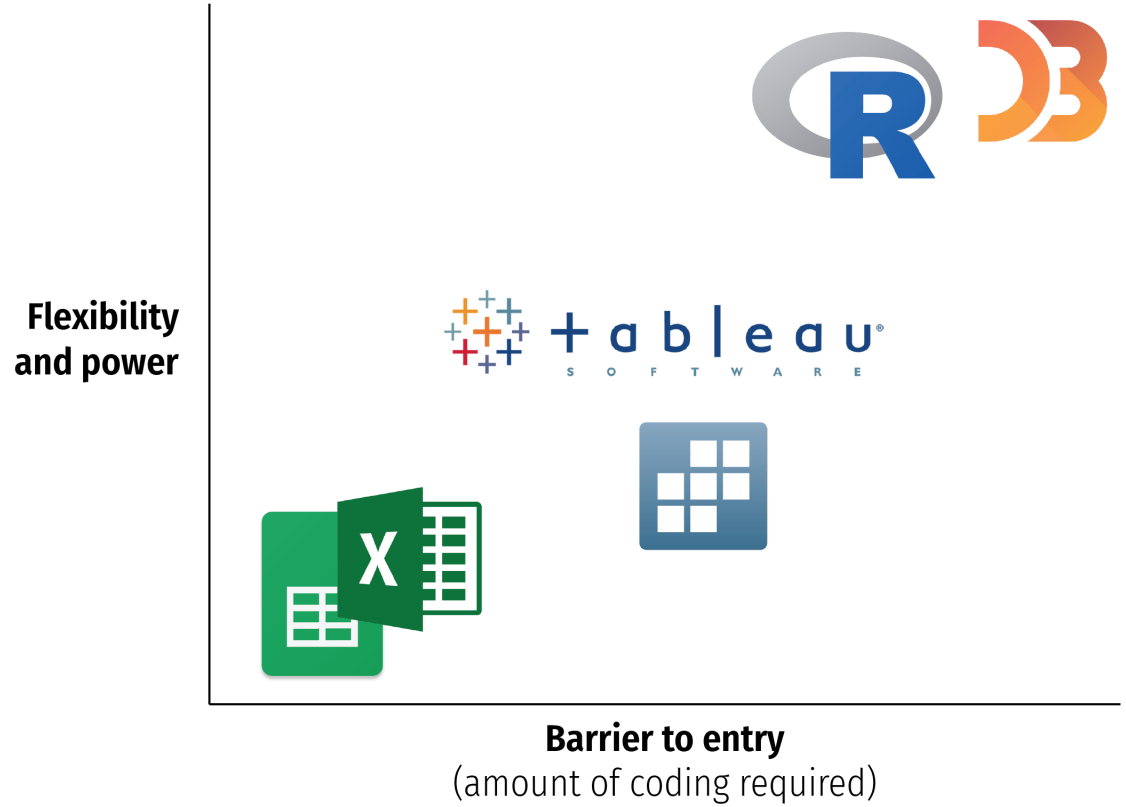
Why R for Business Analytics?

Why R for Data Visualization?





Why R for Data Visualization?



Why R for Life?

Practical tool that could help you get a job and then do said job

Open source

Huge community of users and package developers

Here are a few examples of other things you can do using R:

- Make slides like the ones you're looking at right now
- Build websites like our course site
- Write books like R for Data Science
- Make interactive web apps
- Much, much more

Class details

Preface

1. Your success in this class is important to me
2. This course is a work in progress
3. Get the semester off to a good start: **read the syllabus**!

A bit about me

A bit about our Graduate TA Hui Zhou

A bit about you

Do you have any programming experience? (zoom poll)

First course assignment will be to use `RMarkdown` to fill out a survey to tell us more about you

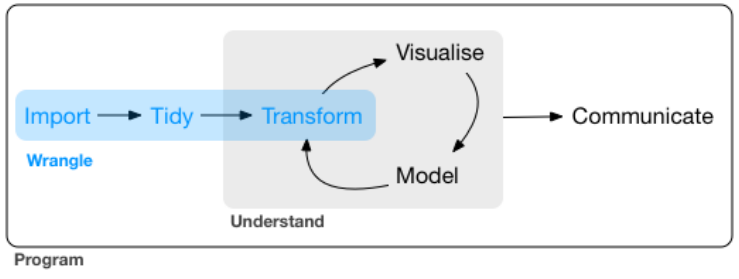
Course objectives

1. Develop basic proficiency in R programming
2. Understand data structures and manipulation
3. Describe effective techniques for data visualization and communication
4. Construct effective data visualizations
5. Utilize course concepts and tools for business applications

Plan for the semester

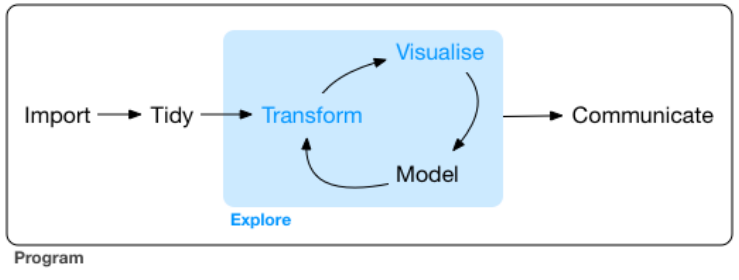
Programming Foundations

R, RStudio, Rmarkdown, and the tidyverse



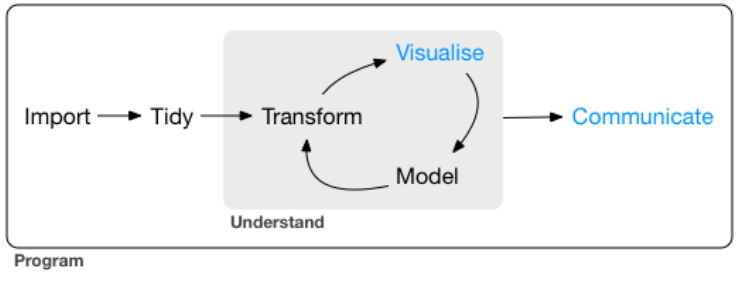
Data Visualization Foundations

the grammar of graphics, ggplot2



Special Topics (as time allows)

annotations, time, space, telling stories with data



Plan for each week

We will follow the same general process each week:

- Do readings listed on the before Tuesday (example: Week 1)
- **Tuesday:** come to class, where I will summarize material for that week's topic
- **Wednesday:** submit reflection on canvas by 11:59pm (starting with Week 2)
- **Thursday:** come to class, where we will work through hands-on examples
- Work on the lab before the next Tuesday's class, attending office hours as needed
- **The following Monday:** submit lab on canvas by 11:59pm (starting with Week 1)

Assignments

We will have frequent, short assignments to develop and cement new skills.

No prelims, no final exam.

- **Reflections** are short weekly writing assignments, intended as an easy way to get points and a nudge to engage with readings
- **Labs** are short weekly homework assignments that require you to practice programming
- **Projects** are intended to synthesize and reinforce individual skills, and to provide examples of their application to business and life more generally

Assignment	Points	Percent
Reflections (14 x 5 points each)	70	16%
Labs (14 x 10 points each)	140	32%
Mini project 1	50	11%
Mini project 2	50	11%
Final project	130	30%

Contacting us

Office hours:

- Mondays 1:30pm - 3:30pm: TA Hui Zhou at cornell.zoom.us/j/4786955504
- Tuesdays 11:00am - 12:00pm: Prof. Gerarden using the class zoom link
- Other times by appointment: Prof. Gerarden, at aem2850.youcanbook.me

Email:

You can also reach us by email. The best approach is to email both of us at the same time. You can do that with one click here. Please read the syllabus for tips on how to make the most of email.

Course websites

Site for accessing course materials: (↓)

aem2850.toddgerarden.com

Site for submitting work: (↑)

canvas.cornell.edu/courses/38623

- viewing announcements
- viewing grades
- for convenience, you can also view and navigate the course site through canvas (Home, Syllabus)

Sucking

> "The bad news is whenever you're learning a new tool, for a long time you're going to suck. It's going to be very frustrating.
>
> But, the good news is that that is typical, it's something that happens to everyone, and it's only temporary.
>
> Unfortunately, there is no way to go from knowing nothing about a subject to knowing something about a subject and being an expert in it without going through a period of great frustration and much suckiness.
>
> But remember, when you're getting frustrated, that's a good thing, that's temporary, keep pushing through, and in time [it] will become second nature."

Hadley Wickham, author of `ggplot2`, *R for Data Science*, and much more

I *promise* you can succeed in this class. Don't hesitate to get help from me, TAs, office hours, and your peers.

Questions about the class?

Facts, truth, and beauty

What is truth?

Core principles of the universe?

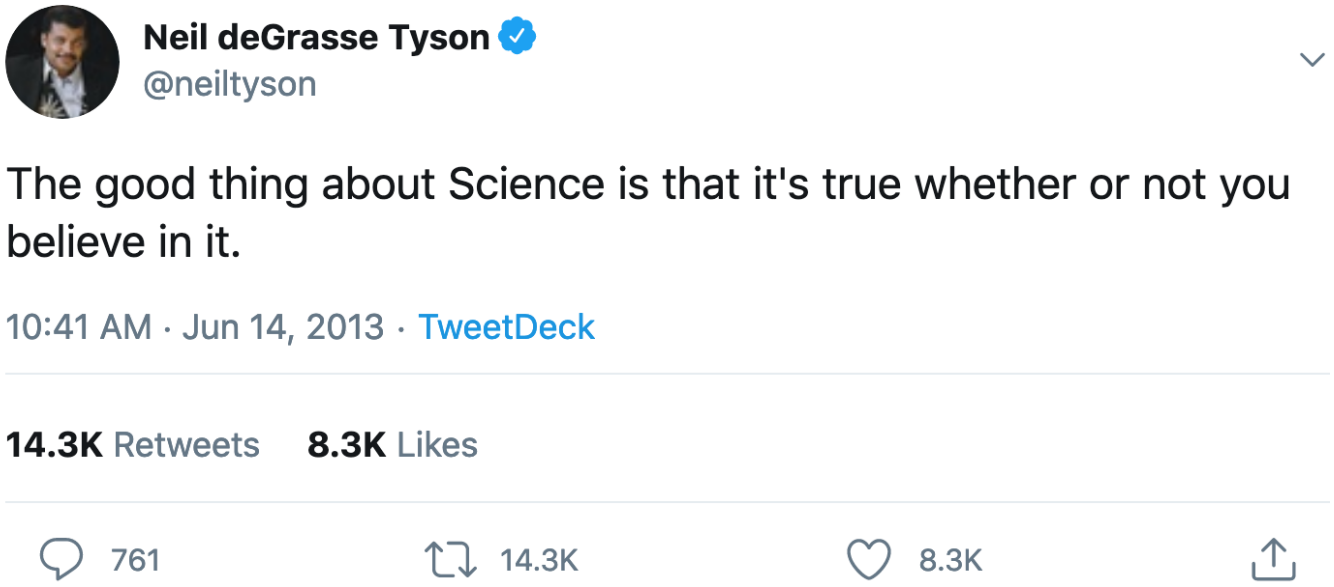
Underlying trends in society?

Something transcendental?

Reality?

How do we find truth?

Science!



But wait!

Beware of scientism!

"... promotion of science as the best or only objective means by which society should determine normative and epistemological values"

Science is not the only way

Art

Music

Literature

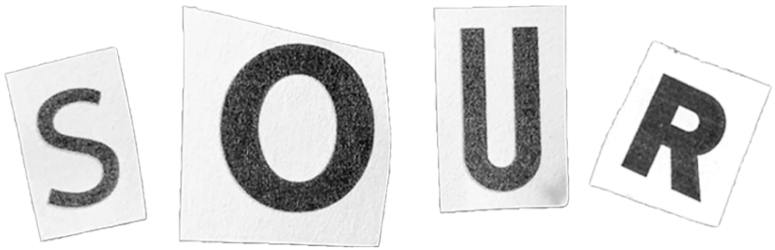
Religion

Nature

In chat: Name one thing that is not factual...

...but still reveals truth

the office



What does this have to do with AEM 2850?

Truth does not require science or facts

Facts alone do not necessarily reveal truth

Truth comes from aesthetic combination of **content** and **form**

There is no single ideal combination of **content** and **form** for all **audiences**

Keep this in mind as a guiding principle for analyzing, visualizing, and communicating data

Data, truth, and beauty

Just show me the data!

```
head(my_data, 10)
```

```
## # A tibble: 10 × 2
##        x     y
##    <dbl> <dbl>
##  1  55.4  97.2
##  2  51.5  96.0
##  3  46.2  94.5
##  4  42.8  91.4
##  5  40.8  88.3
##  6  38.7  84.9
##  7  35.6  79.9
##  8  33.1  77.6
##  9  29.0  74.5
## 10  26.2  71.4
```

```
mean(my_data$x)
```

```
## [1] 54.26327
```

Seems reasonable

```
mean(my_data$y)
```

```
## [1] 47.83225
```

Seems reasonable

```
cor(my_data$x, my_data$y)
```

```
## [1] -0.06447185
```

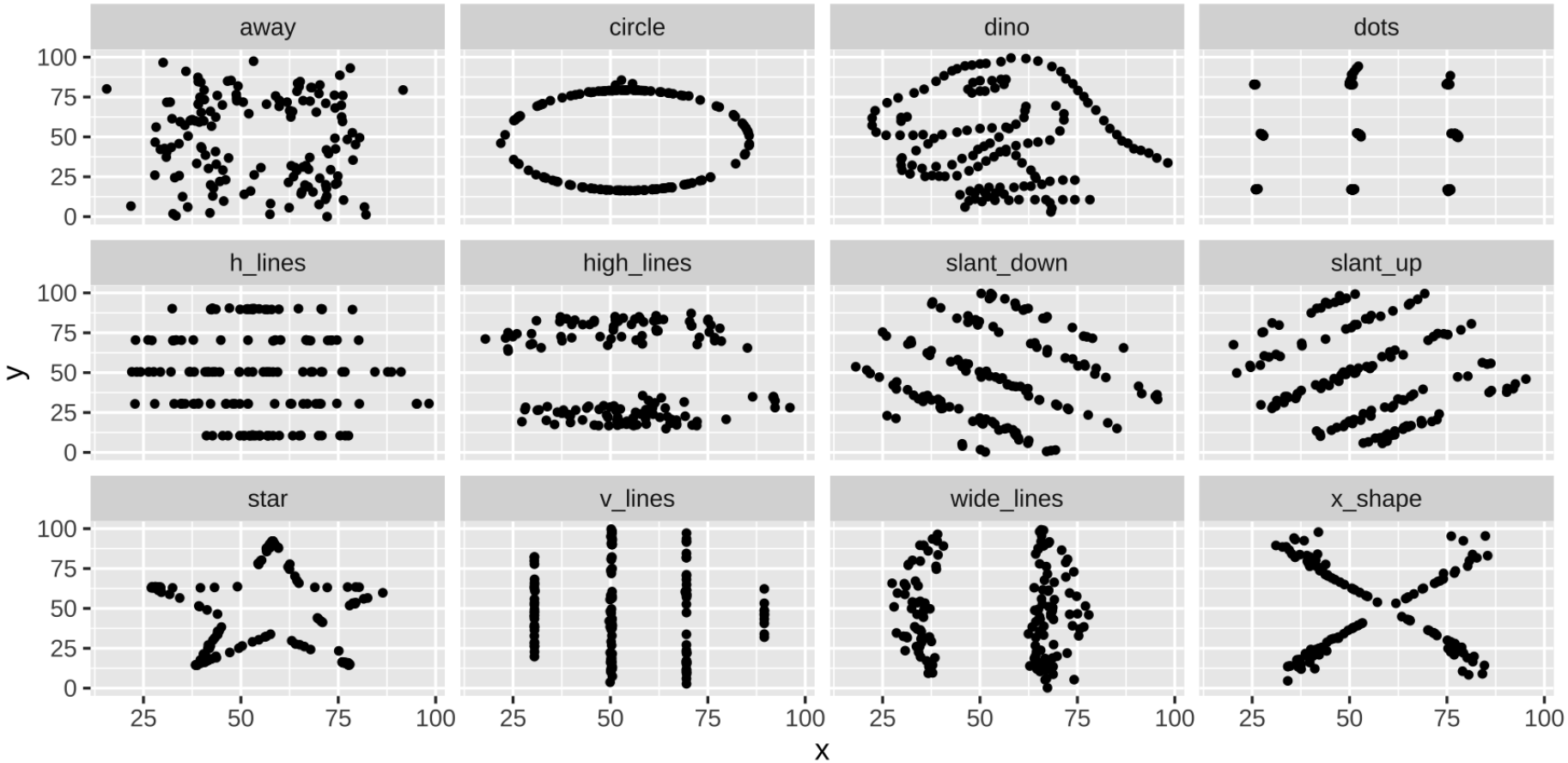
No correlation

Oh no!

The Datasaurus Dozen

Raw data is not enough

Each of these has the same mean, standard deviation, variance, and correlation



Beautiful visualizations

What makes a great visualization?

Truthful

Functional

Beautiful

Insightful

Enlightening

Alberto Cairo, *The Truthful Art*

What makes a great visualization?

"Graphical excellence is the **well-designed presentation of interesting data**—a matter of substance, of statistics, and of design … [It] consists of complex ideas communicated with clarity, precision, and efficiency. … [It] is that which **gives to the viewer the greatest number of ideas in the shortest time with the least ink in the smallest space** … [It] is nearly always multivariate … And graphical excellence requires **telling the truth about the data**."

Edward Tufte, *The Visual Display of Quantitative Information*, p. 51

What makes a great visualization?

Good aesthetics

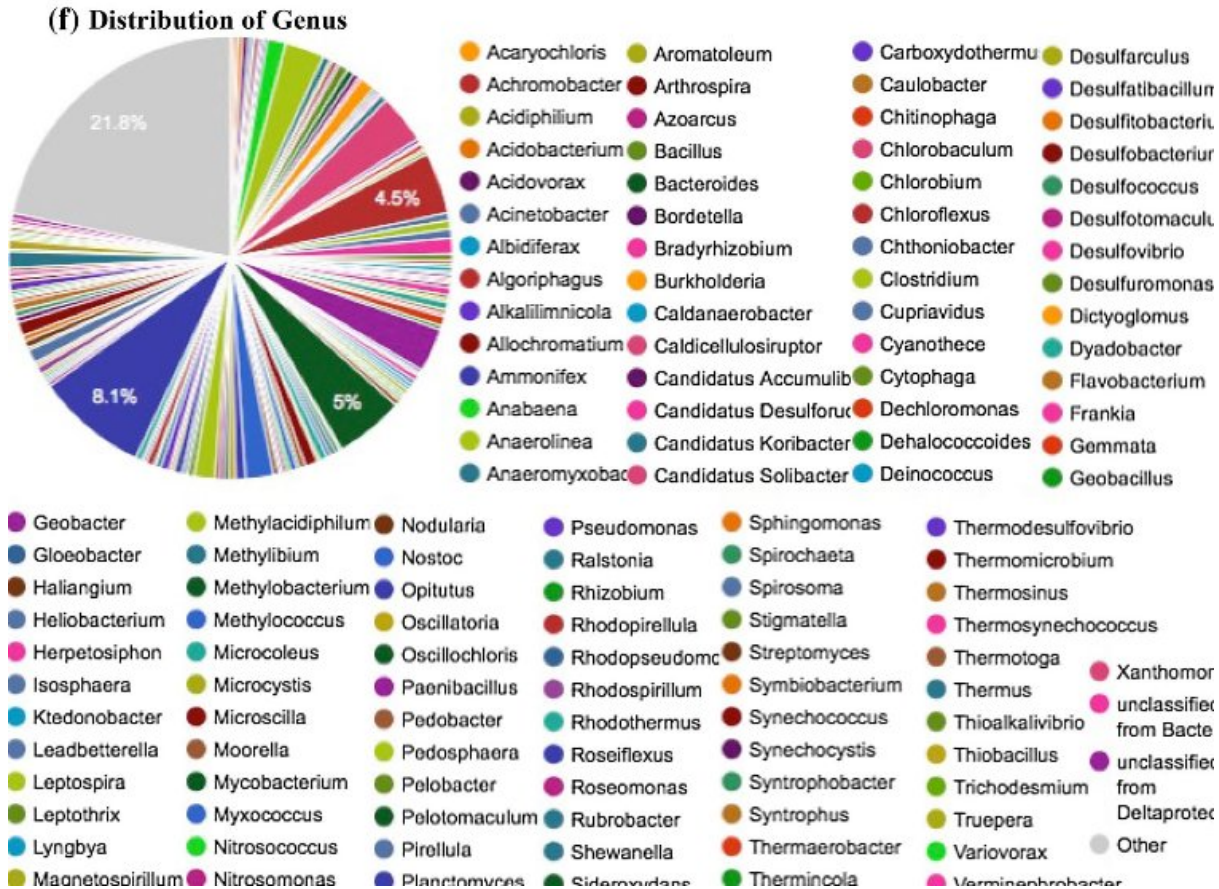
No substantive issues

No perceptual issues

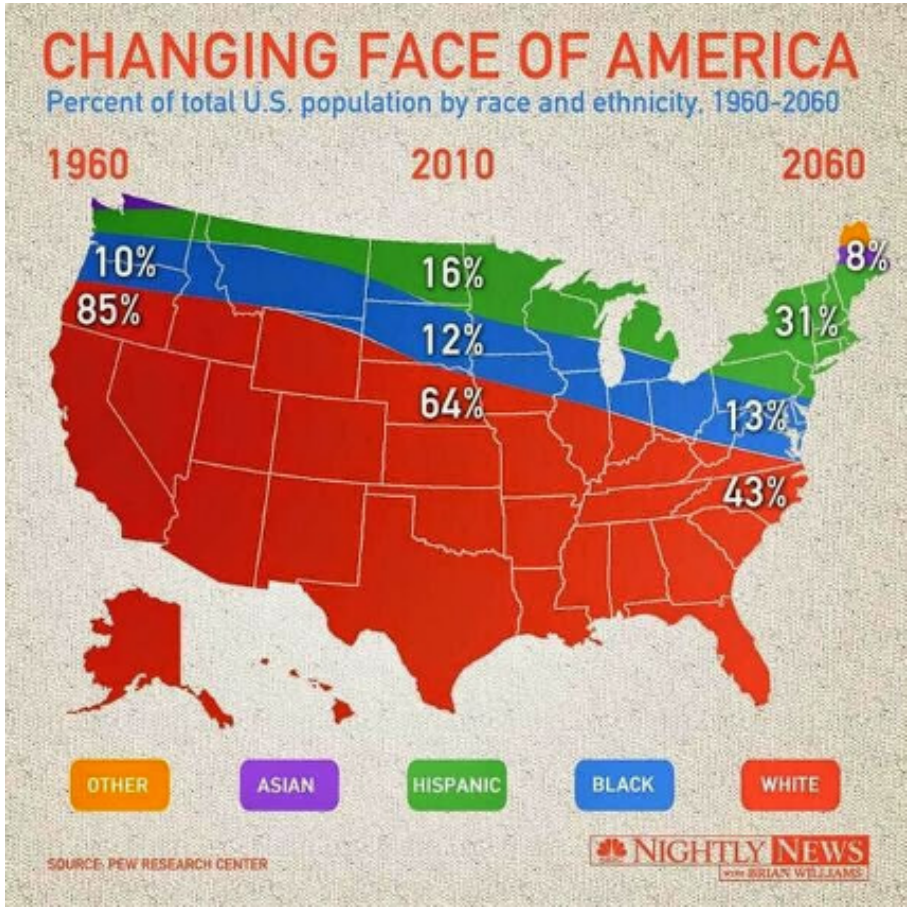
Honesty + good judgment

Kieran Healy, *Data Visualization: A Practical Introduction*

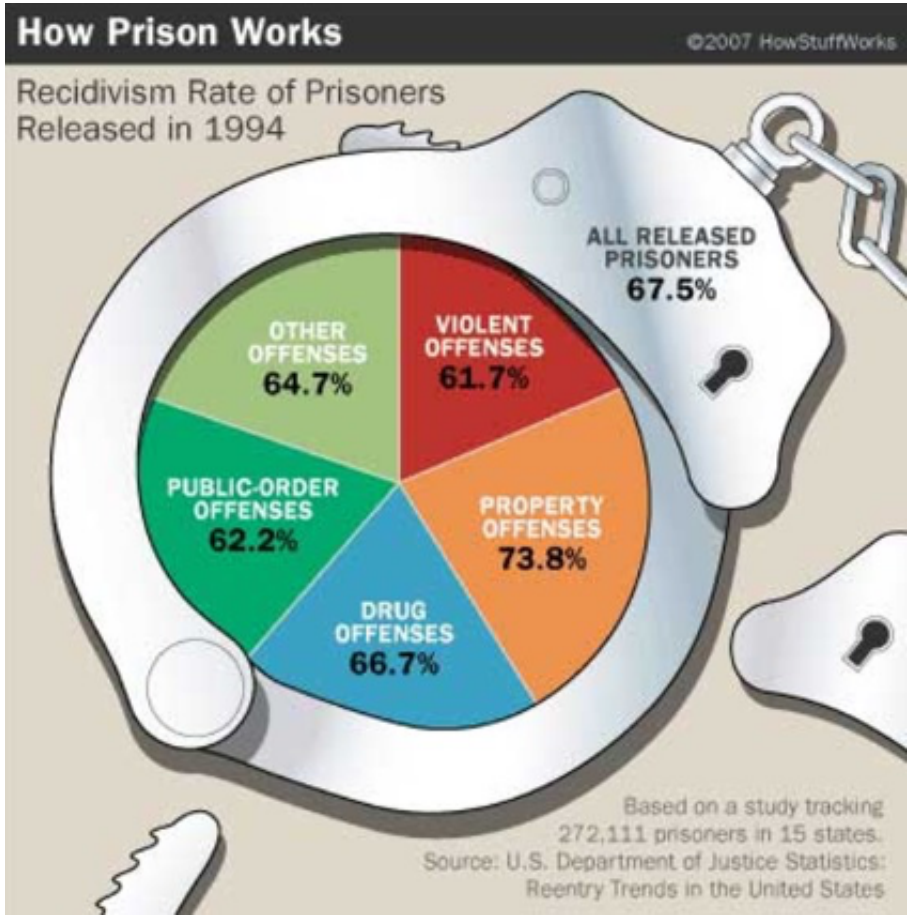
What's wrong?


(f) Distribution of Genus
21.8%
4.5%
8.1%
5%
Acaryochloris
Achromobacter
Acidiphilium
Acidobacterium
Acidovorax
Acinetobacter
Albidiferax
Algoriphagus
Alkalilimnicola
Allochromatium
Ammonifex
Anabaena
Anaerolinea
Anaeromyxobac
Aromatoleum
Arthrospira
Azoarcus
Bacillus
Bacteroides
Bordetella
Bradyrhizobium
Burkholderia
Caldanaerobacter
Caldicellulosiruptor
Candidatus Accumulib
Candidatus Desulforuc
Candidatus Koribacter
Candidatus Solibacter
Carboxydothermu
Caulobacter
Chitinophaga
Chlorobaculum
Chlorobium
Chloroflexus
Chthoniobacter
Clostridium
Cupriavidus
Cyanothece
Cytophaga
Dechloromonas
Dehalococcoides
Deinococcus
Desulfarculus
Desulfatibacillun
Desulfitobacteriu
Desulfobacteriur
Desulfococcus
Desulfotomaculu
Desulfovibrio
Desulfuromonas
Dictyoglomus
Dyadobacter
Flavobacterium
Frankia
Gemmata
Geobacillus
Geobacter
Gloeobacter
Haliangium
Heliobacterium
Herpetosiphon
Isosphaera
Ktedonobacter
Leadbetterella
Leptospira
Leptothrix
Lyngbya
Magnetospirillum
Methylacidiphilum
Methylibium
Methylobacterium
Methylococcus
Microcoleus
Microcystis
Microscilla
Moorella
Mycobacterium
Myxococcus
Nitrosococcus
Nitrosomonas
Nodularia
Nostoc
Opitutus
Oscillatoria
Oscillochloris
Paenibacillus
Pedobacter
Pedosphaera
Pelobacter
Pelotomaculum
Pirellula
Planctomyces
Pseudomonas
Ralstonia
Rhizobium
Rhodopirellula
Rhodopseudomc
Rhodospirillum
Rhodothermus
Roseiflexus
Roseomonas
Rubrobacter
Shewanella
Sideroxydans
Sphingomonas
Spirochaeta
Spirosoma
Stigmatella
Streptomyces
Symbiobacterium
Synechococcus
Synechocystis
Syntrophobacter
Syntrophus
Thermaerobacter
Thermincola
Thermodesulfovibrio
Thermomicrobium
Thermosinus
Thermosynechococcus
Thermotoga
Thermus
Thioalkalivibrio
Thiobacillus
Trichodesmium
Truepera
Variovorax
Xanthomor
unclassifiec
from Bacte
unclassifiec
from
Deltaprotec
Other

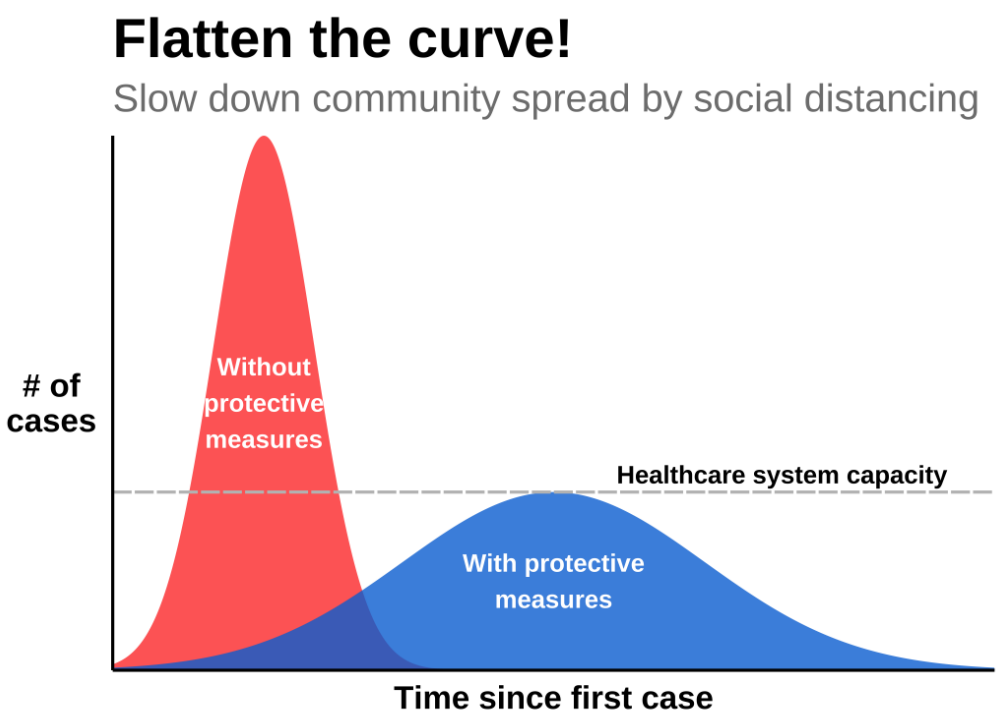
What's wrong?


CHANGING FACE OF AMERICA
Percent of total U.S. population by race and ethnicity, 1960-2060
1960
2010
2060
10%
85%
16%
12%
64%
8%
31%
13%
43%
OTHER
ASIAN
HISPANIC
BLACK
WHITE
SOURCE: PEW RESEARCH CENTER
NIGHTLY NEWS
with BRIAN WILLIAMS

What's wrong?


How Prison Works
©2007 HowStuffWorks
Recidivism Rate of Prisoners Released in 1994
ALL RELEASED PRISONERS 67.5%
OTHER OFFENSES 64.7%
VIOLENT OFFENSES 61.7%
PUBLIC-ORDER OFFENSES 62.2%
PROPERTY OFFENSES 73.8%
DRUG OFFENSES 66.7%
Based on a study tracking 272,111 prisoners in 15 states.
Source: U.S. Department of Justice Statistics: Reentry Trends in the United States

What's right?



Thread by Carl T. Bergstrom

Plan for the rest of this week

Office hours:

- Tuesdays 11:00am - 12:00pm: Prof. Gerarden using the class zoom link
- Other times by appointment: Prof. Gerarden, at aem2850.youcanbook.me

Thursday:

- Intro to `R`, `RStudio`, and `RMarkdown`
- You will need your computer for coding exercises
- Keep an eye out for a canvas announcement with instructions for getting set up on RStudio.cloud