Best practices in data visualization

Data Science for Biologists, Fall 2021

Guiding principle

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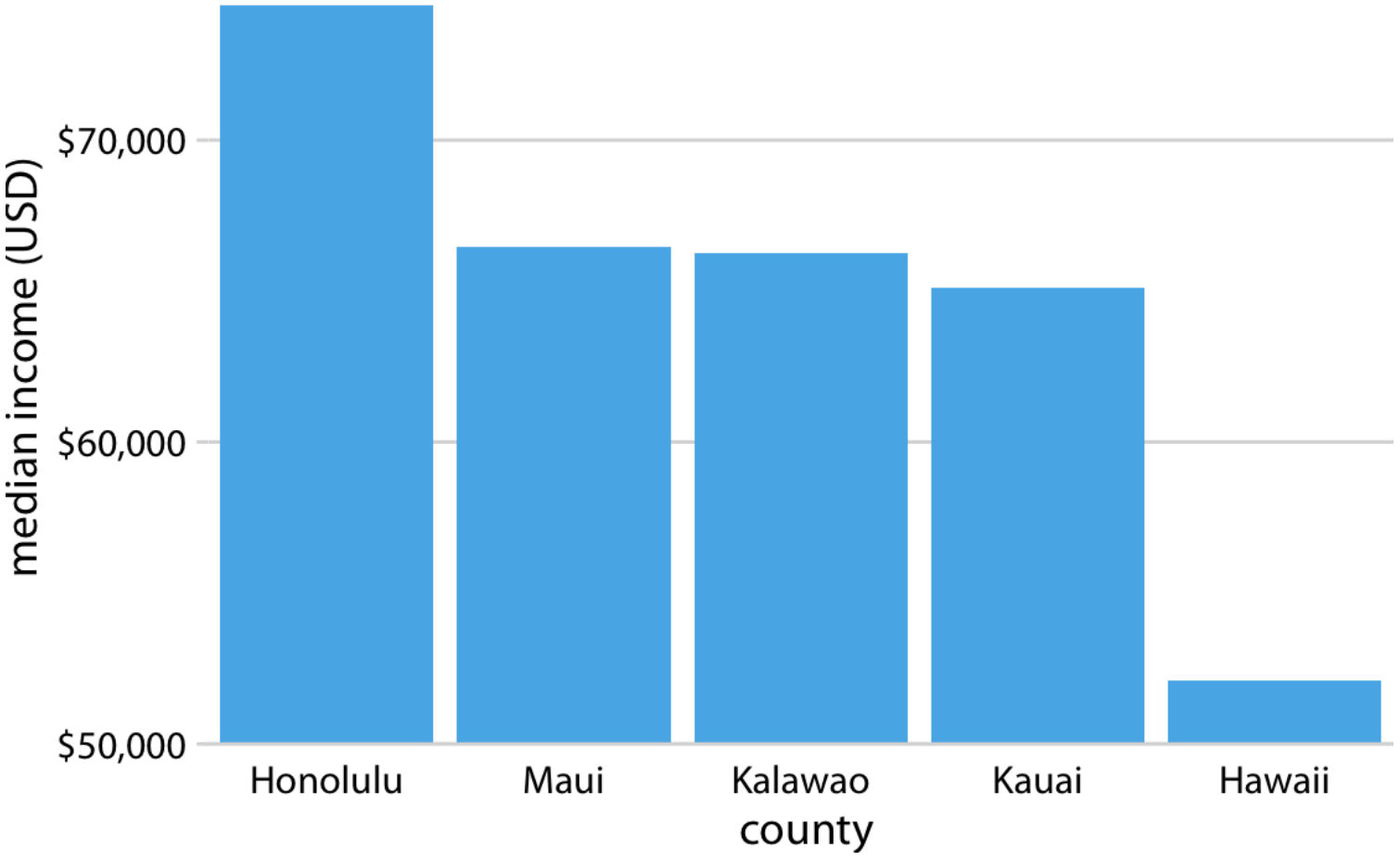
We do not want to create plots that are...

- **factually misleading**
- **factually incorrect**
- **impossible or overly difficult to interpret**
- **so ugly that you don't even want to try interpreting them**

All figures (except the `msleep` figures) in the following slides are from Fundamentals of Data Visualization, unless otherwise stated.



Median income in the five counties of the state of Hawaii. Data source: 2015 Five-Year American Community Survey.

Best Principle: The principle of proportional ink

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Truncating the y-axis is highly misleading.

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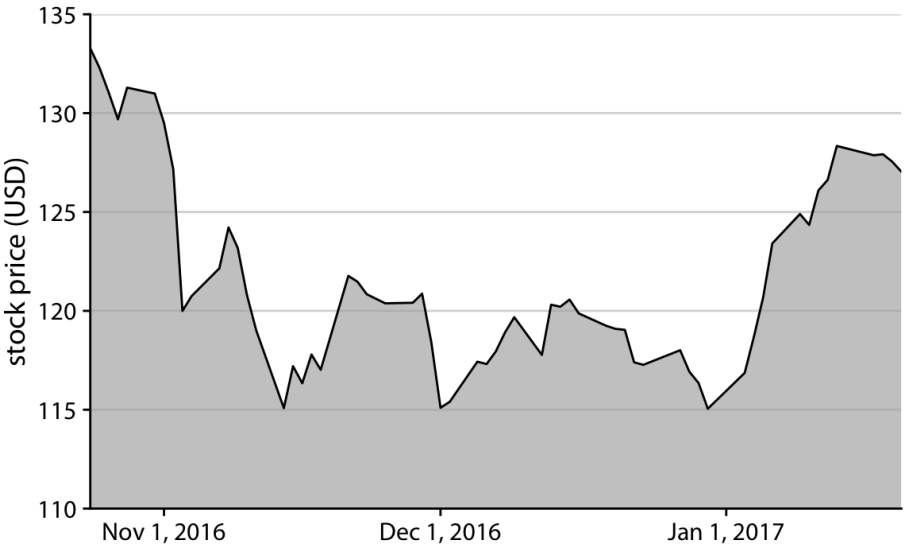
Stock price of Facebook (FB) from Oct. 22, 2016 to Jan. 21, 2017.



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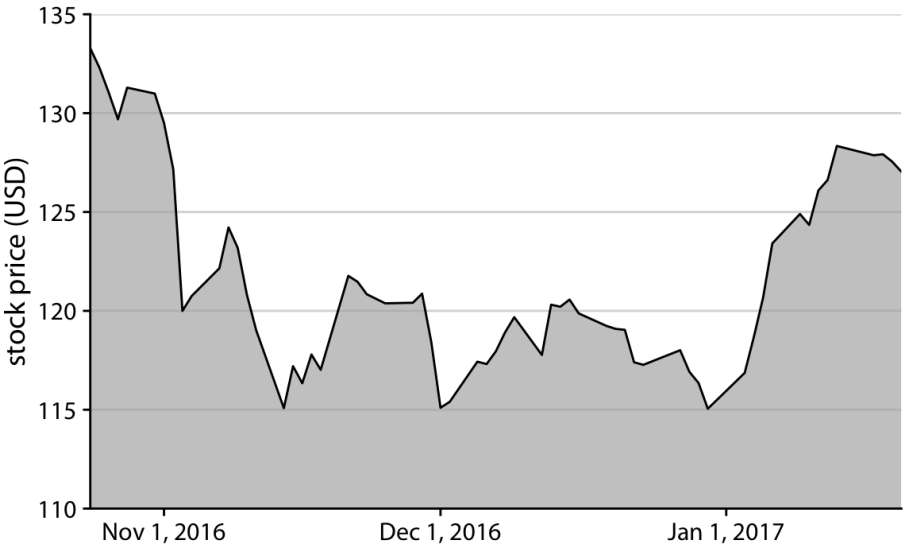
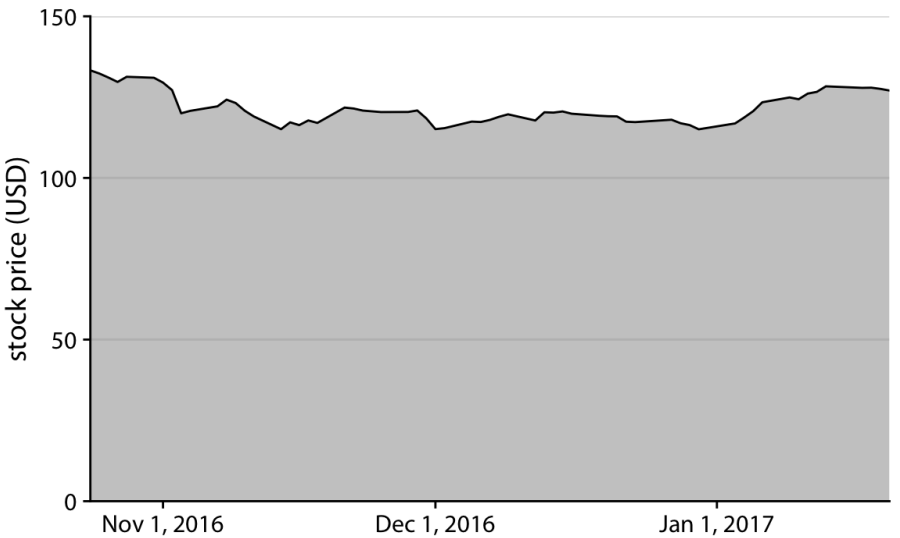
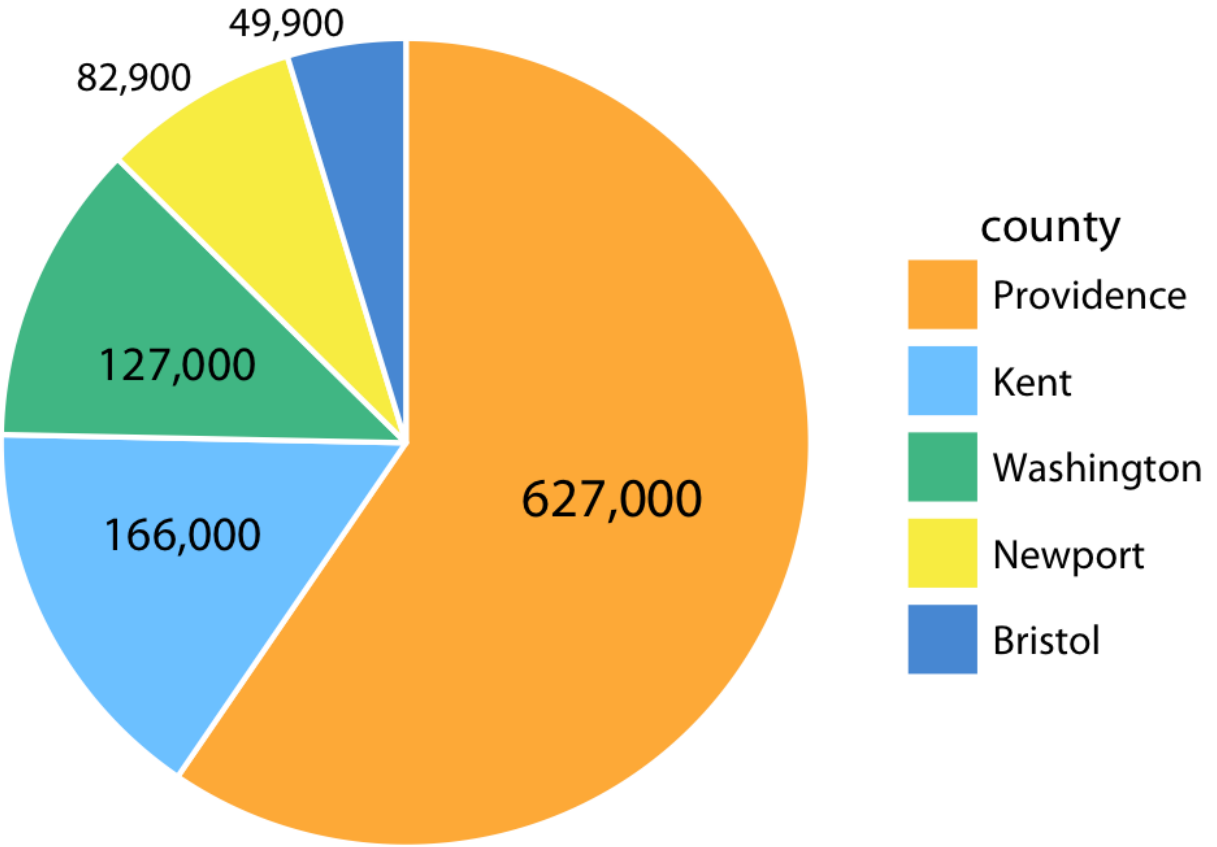


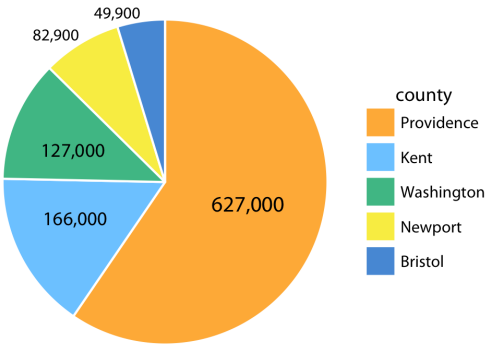


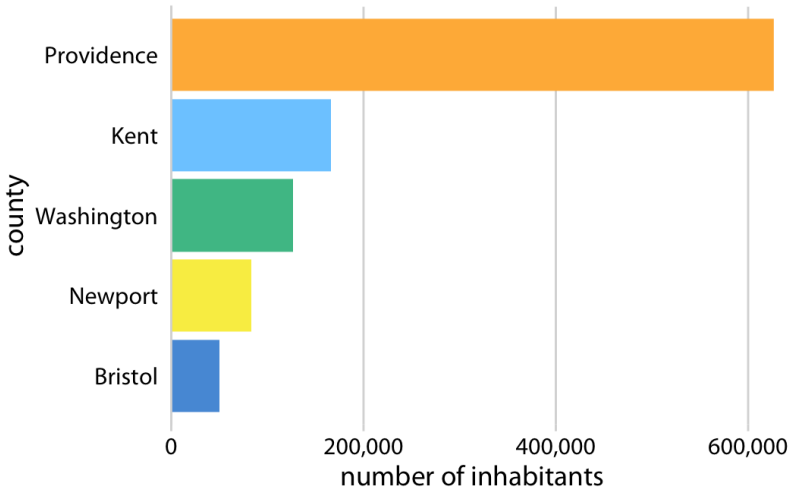
A new kind of plot: Pie charts

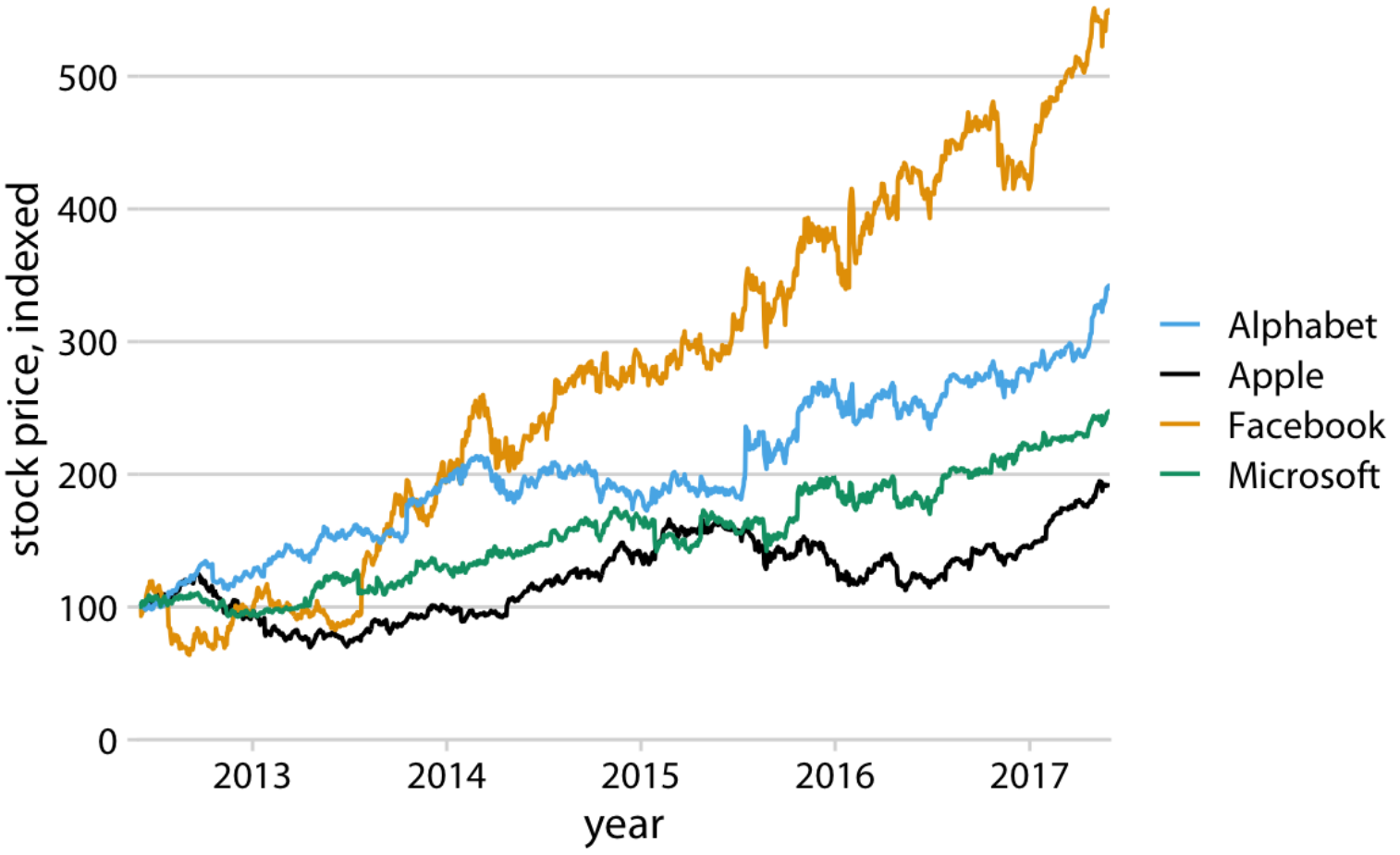


Best Principle: Don't use pie charts.

Pies are sized based on relative *area*. Human eyes are really bad at properly perceiving area.

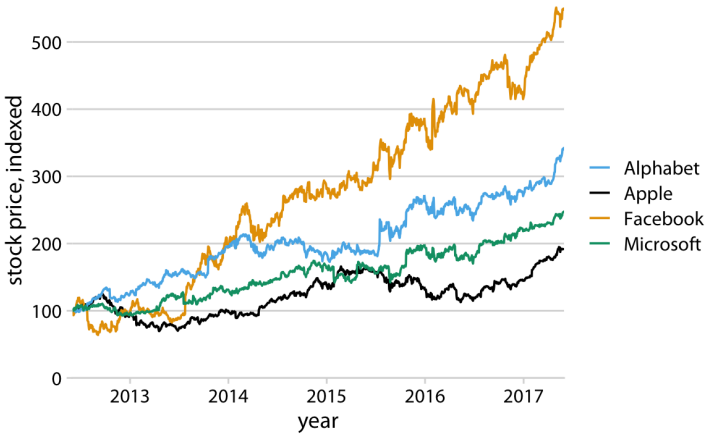






Stock price over time for four major tech companies. The stock price for each company has been normalized to equal 100 in June 2012. Data source: Yahoo Finance.

Best Principle: Make your viewer's life easy



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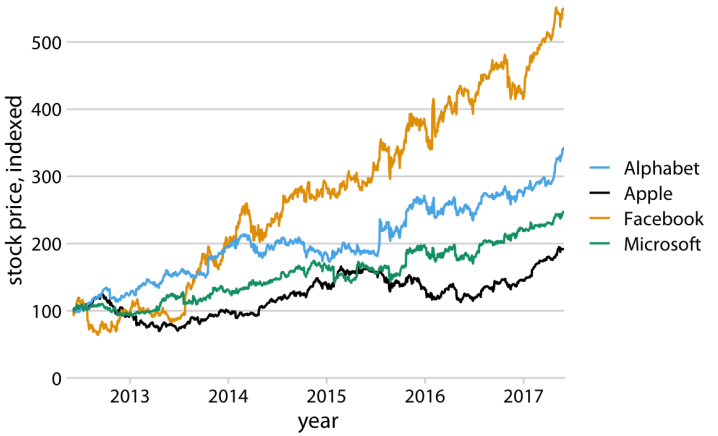
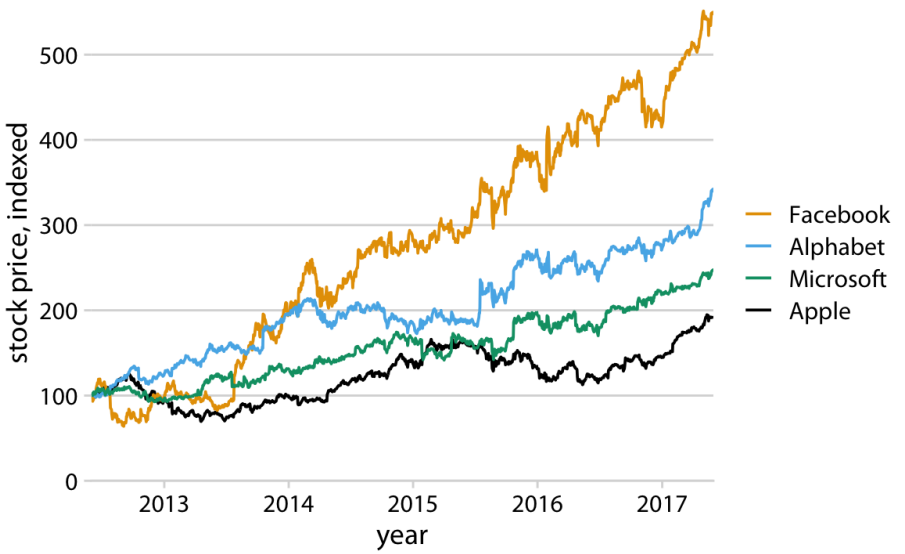
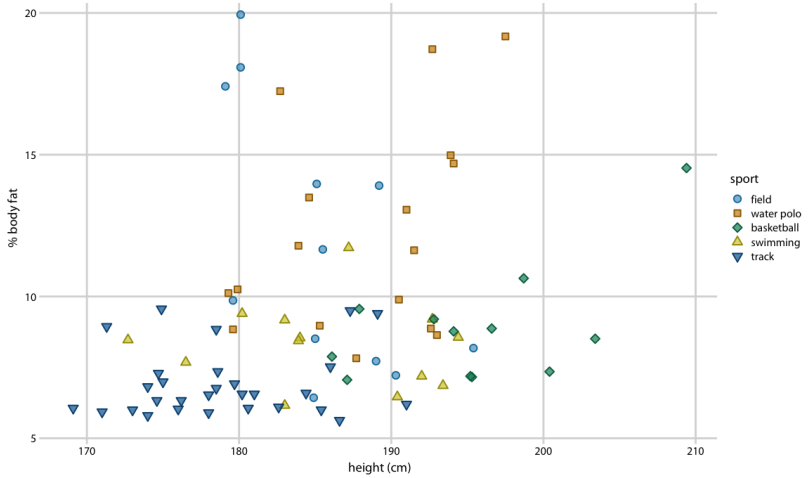
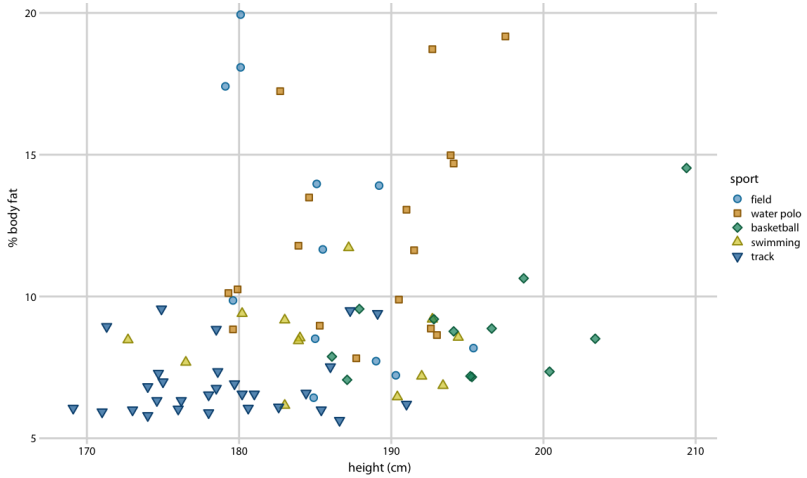






Percent body fat versus height in professional male Australian athletes. (Each point represents one athlete.) Data source: Telford and Cunningham (1991)



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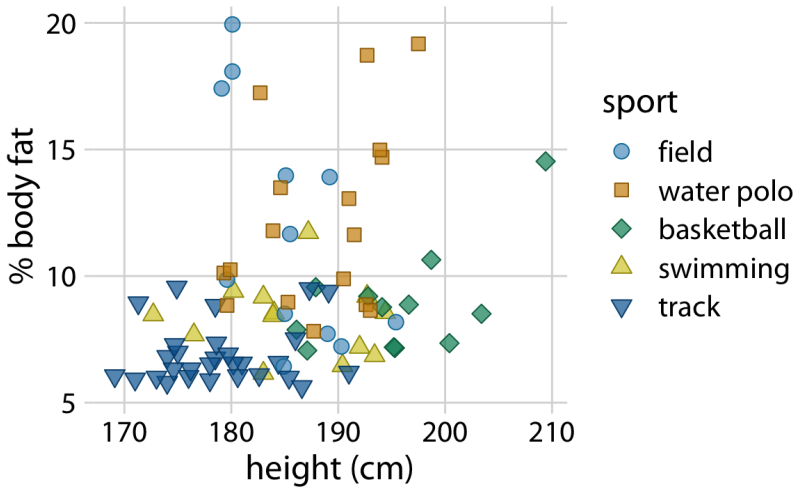
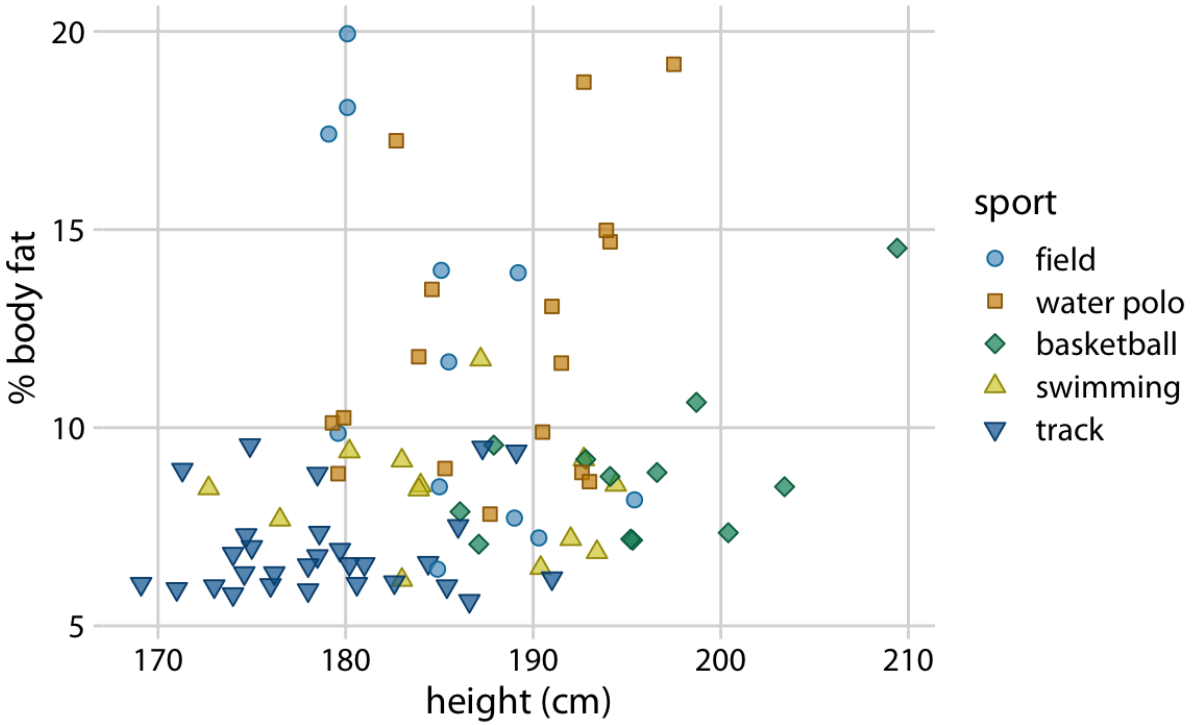


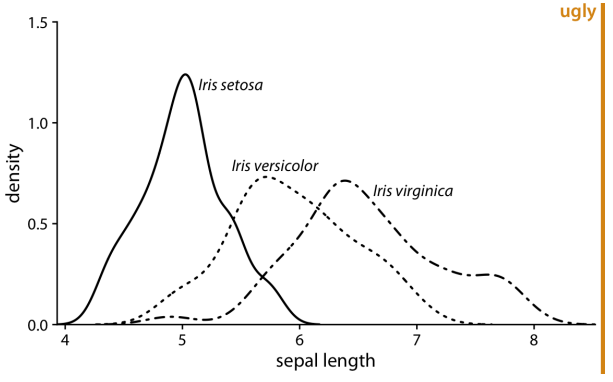
Use trial and error to get the right style

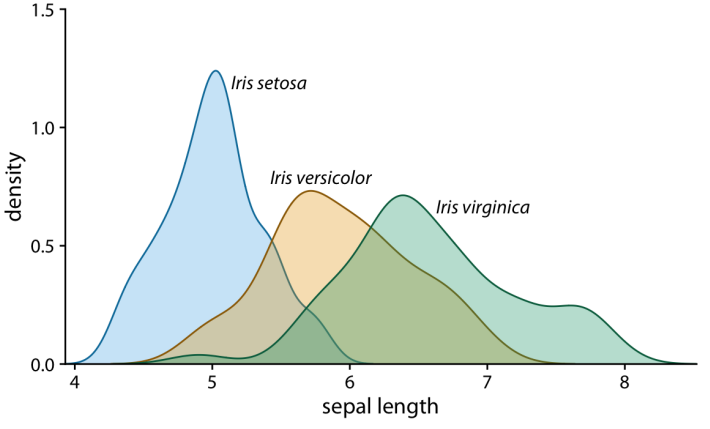
"Goldilocks" text size:

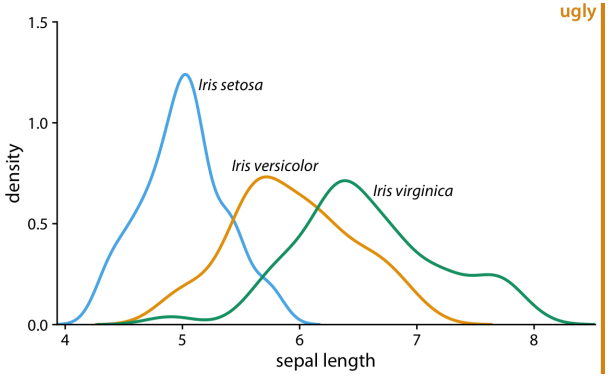


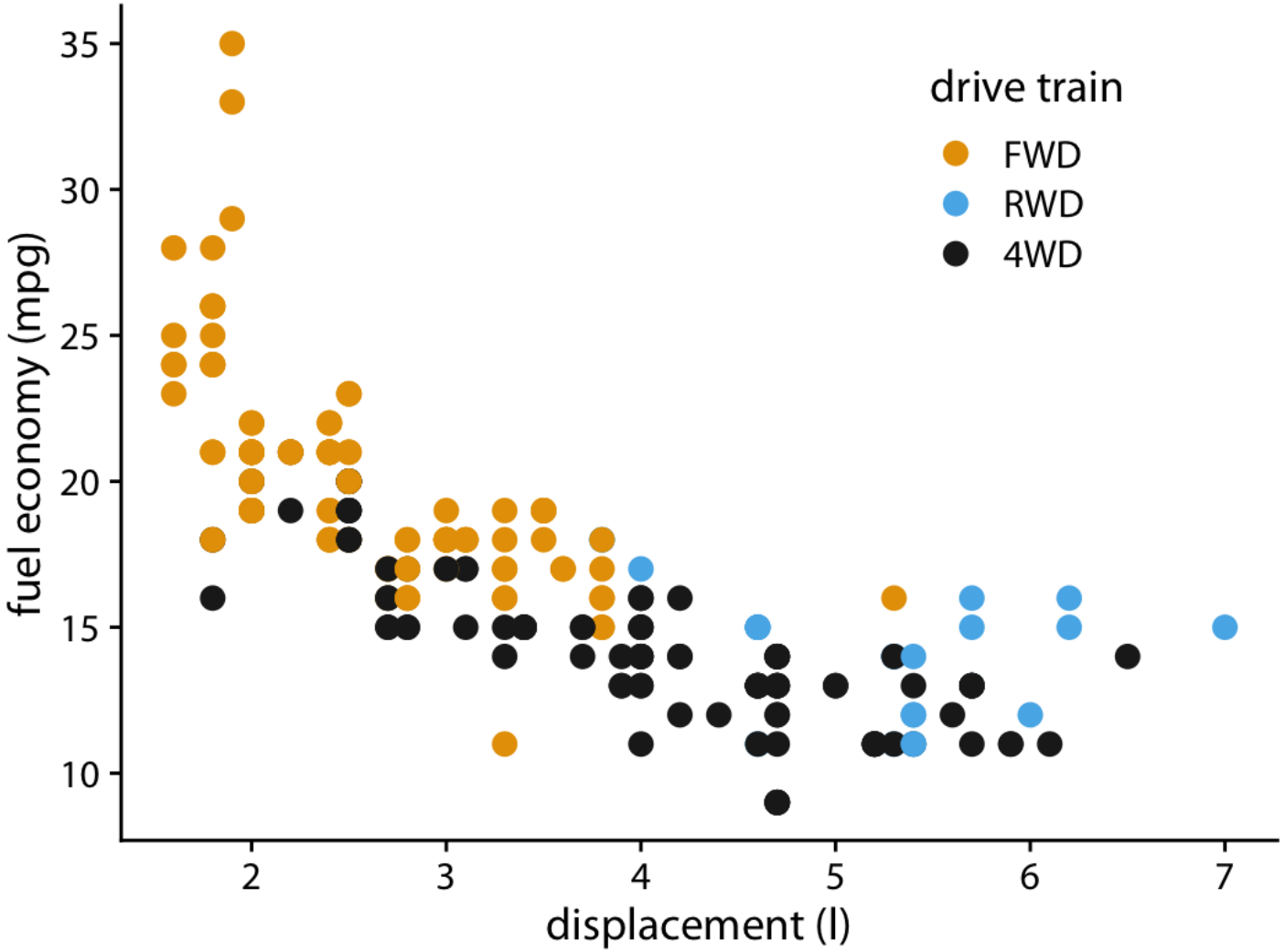
Don't annoy your viewers, either

People are more likely to *want* to interpret aesthetically pleasing figures, BUT not everyone always agrees on what counts as "ugly"!



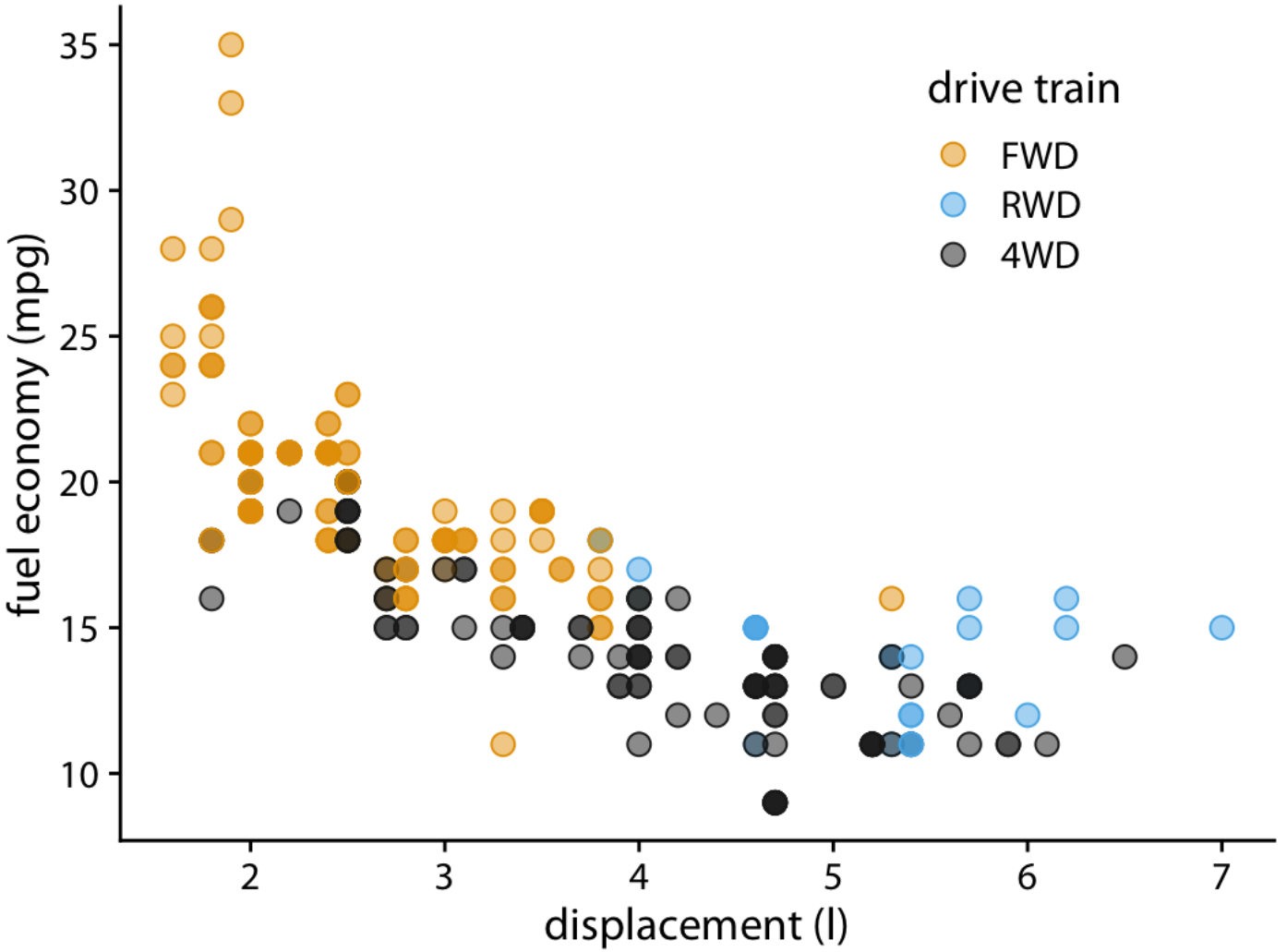


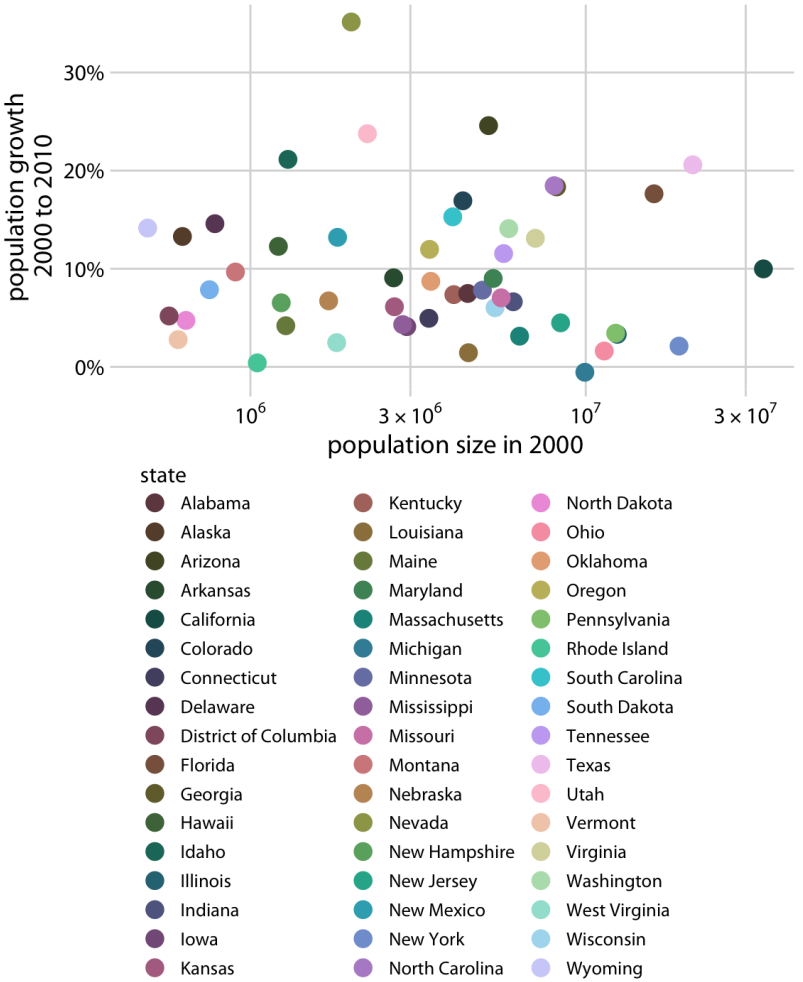




City fuel economy versus engine displacement, for popular cars released between 1999 and 2008. Each point represents one car. The point color

Best Principle: Make sure your data is visible

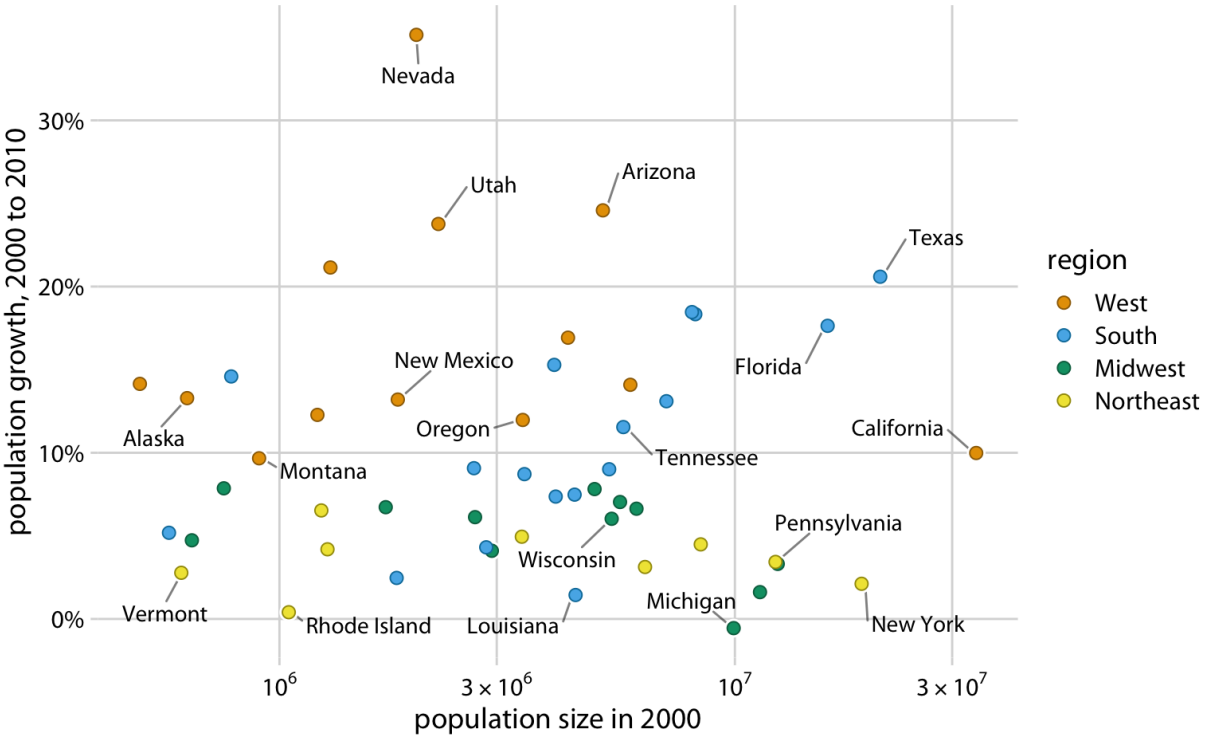




Population growth from 2000 to 2010 versus population size in 2000, for all 50 U.S. states and the District of Columbia. Every state is marked in a different color. Data source: U.S. Census Bureau

Best principle: More is not better (less is more?)

One possible solution to the "busy-ness":

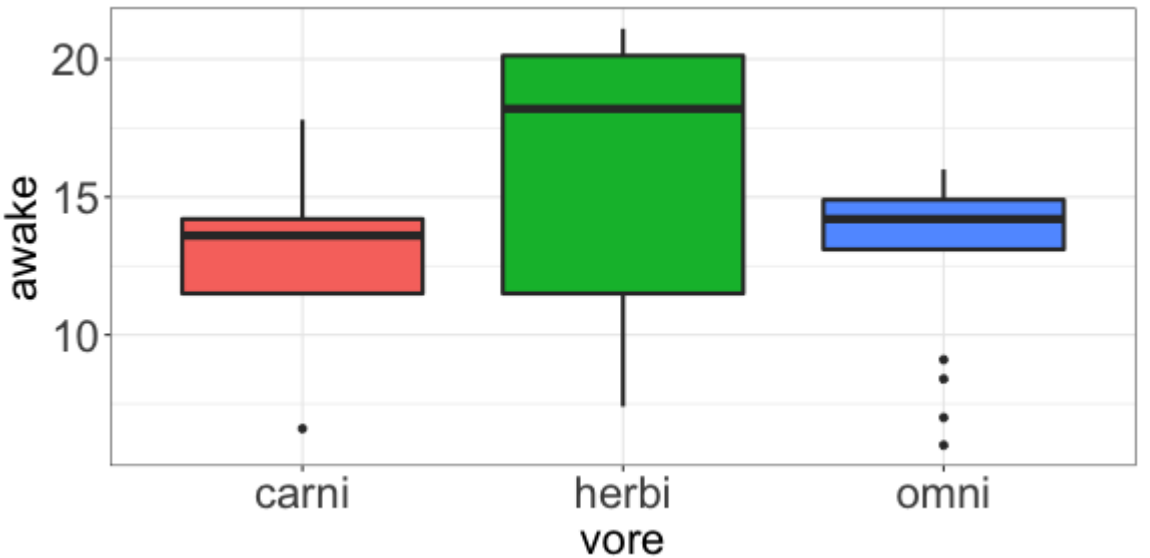


Recall this dataset:

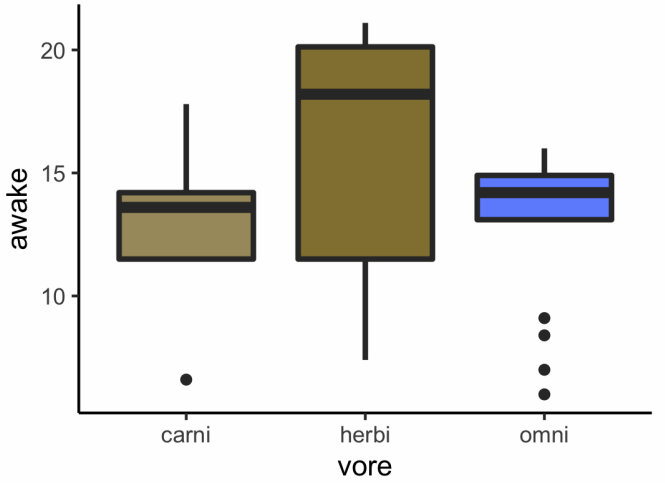
```
msleep_subvore
```

```
## # A tibble: 46 × 5
##    name                          vore  awake brainwt  bodywt
##    <chr>                         <fct> <dbl>   <dbl>   <dbl>
##  1 Owl monkey                    omni    7   0.0155    0.48
##  2 Greater short-tailed shrew    omni    9.1 0.00029   0.019
##  3 Cow                           herbi  20   0.423   600
##  4 Dog                           carni  13.9 0.07     14
##  5 Roe deer                      herbi  21   0.0982   14.8
##  6 Goat                          herbi  18.7 0.115    33.5
##  7 Guinea pig                    herbi  14.6 0.0055    0.728
##  8 Chinchilla                    herbi  11.5 0.0064    0.42
##  9 Star-nosed mole               omni   13.7 0.001     0.06
## 10 African giant pouched rat     omni   15.7 0.0066    1
## # … with 36 more rows
```

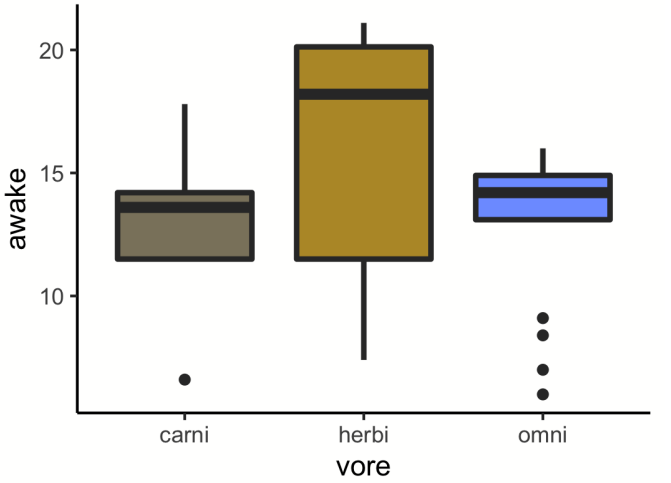
How many hours do the different "vores" spend awake?



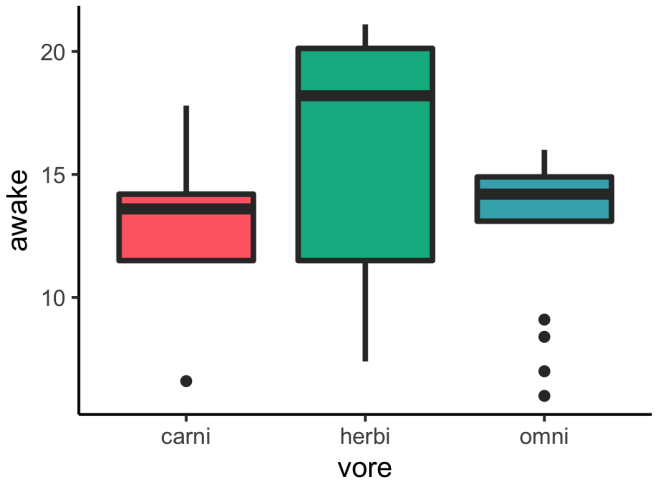
Deutanomaly



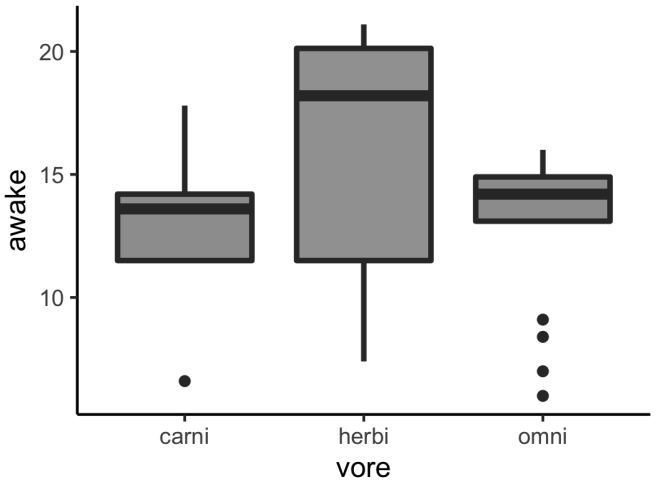
Protanomaly



Tritanomaly

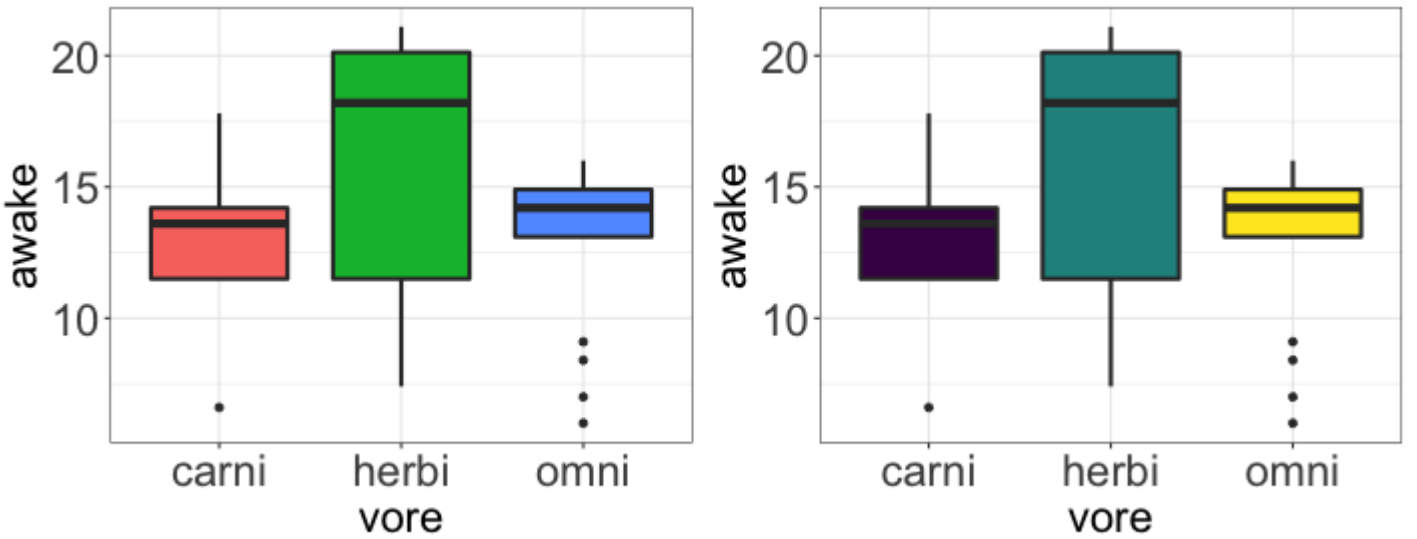


Desaturated



Best Principle: Ensure a colorblind-friendly palette

> In this example, color differentiation is not *needed* to interpret the plot. In other cases when colors are needed, always check that your plot is accessible.



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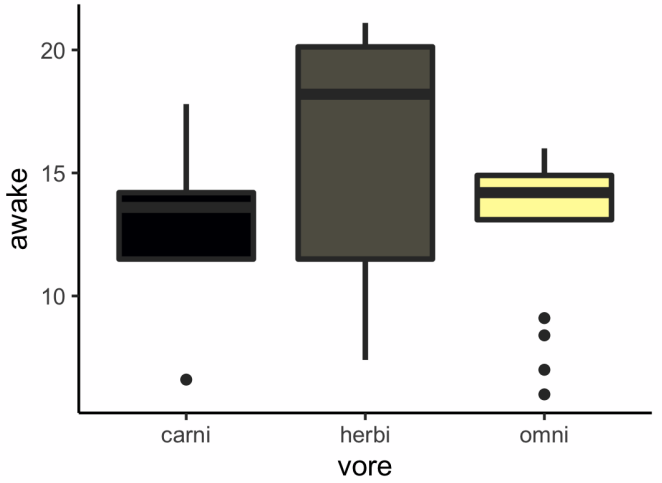

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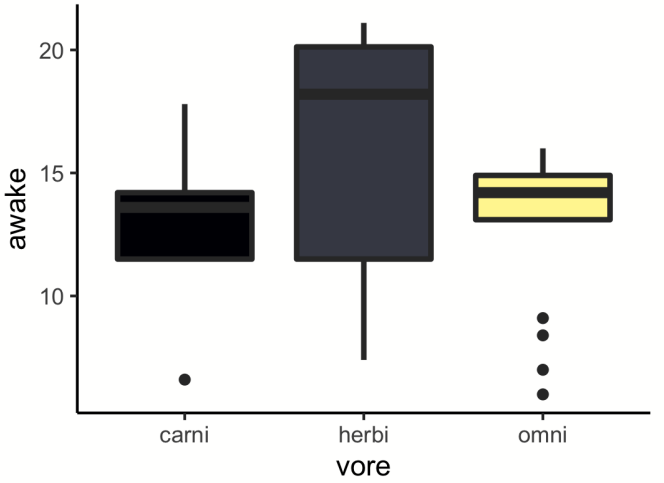

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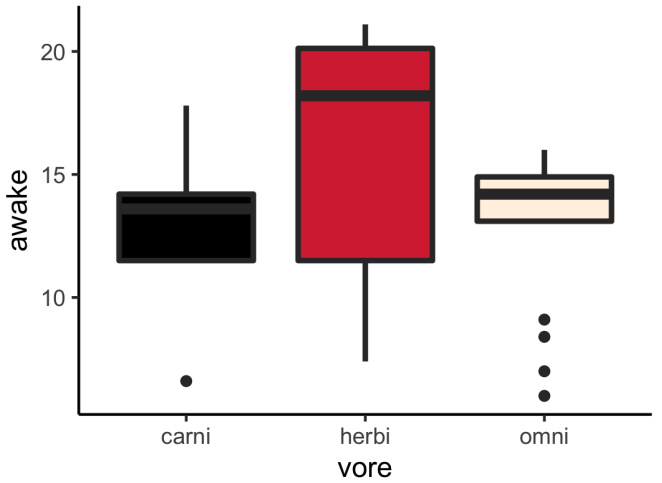

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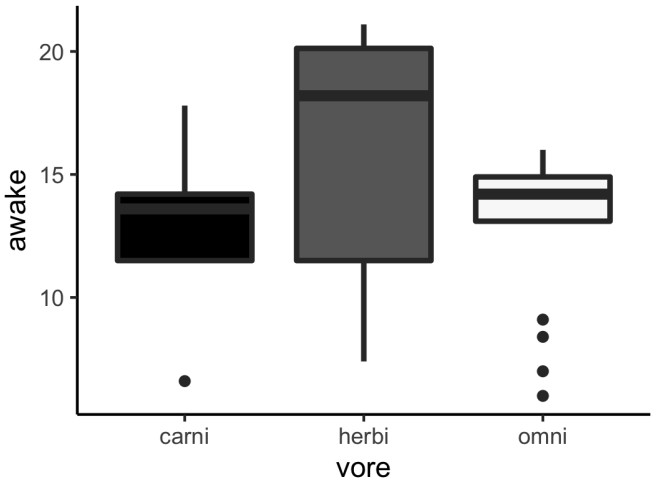
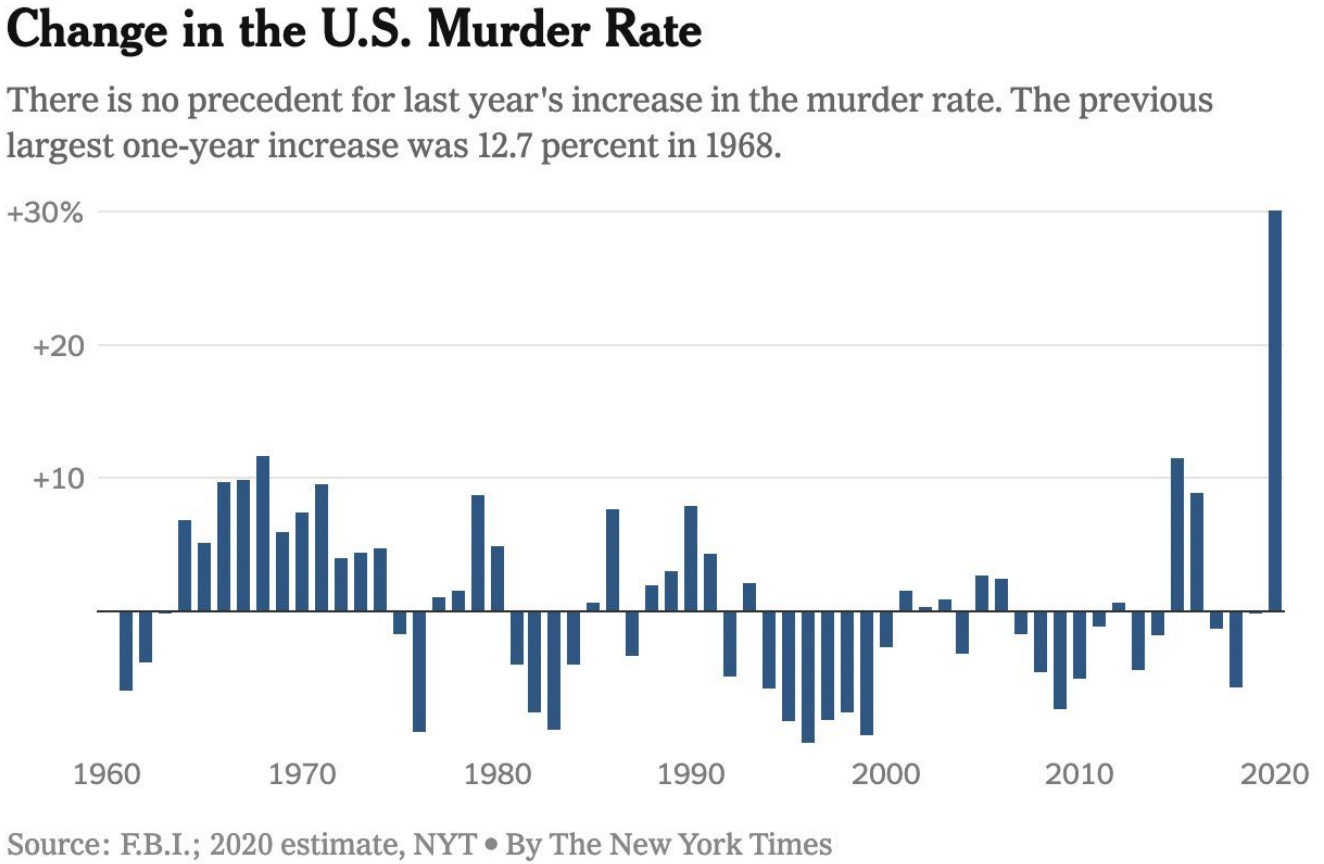


Data visualization and "bullshit"

https://www.callingbullshit.org/

> What do we mean, exactly, by bullshit and calling bullshit? As a first approximation:
>
> Bullshit involves language, statistical figures, data graphics, and other forms of presentation intended to persuade by impressing and overwhelming a reader or listener, with a blatant disregard for truth and logical coherence.
>
> Calling bullshit is a performative utterance, a speech act in which one publicly repudiates something objectionable. The scope of targets is broader than bullshit alone. You can call bullshit on bullshit, but you can also call bullshit on lies, treachery, trickery, or injustice.

What do you conclude happened in 2020?



And now the actual murder rates

Watch and enjoy Part 6 videos for Wednesday!!

https://www.callingbullshit.org/videos.html