

```
@media print { .has-continuation { display: block !important; } }
```

class: title-slide

Data viz and the grammar of graphics

Data Science for Biologists, Fall 2021

Reminder: The "Types of Plots" App is here for you!!

- Access from anywhere: https://sjspielman.shinyapps.io/types_of_plots
- Access from your RStudio Cloud project:

```
library(ds4b.materials) # Load the library if not already loaded  
launch_app("types_of_plots") # Launch the app once library is loaded
```

Grammar

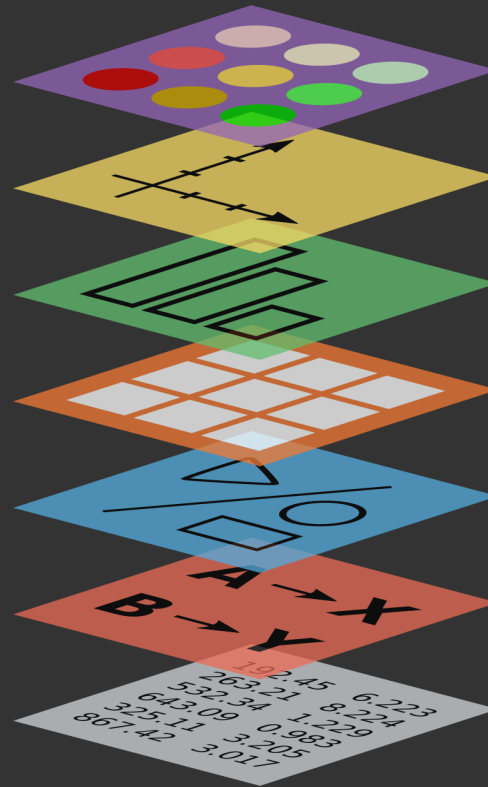
The dog runs in a park.

The runs in park dog a.

Runs dog park in a the.

In park a the runs dog.

Theme
Coordinates
Statistics
Facets
Geometries
Aesthetics
Data



Aesthetics --> *aesthetic mappings*

The 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				

The dataset

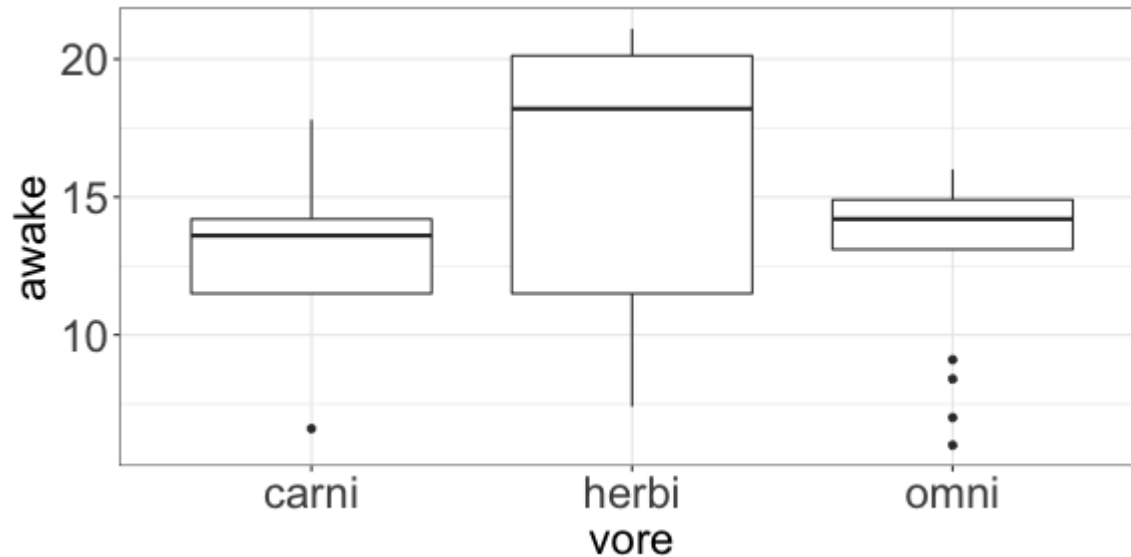
```
summary(msleep_subvore)
```

```
##          name          vore          awake          brainwt
## Length:46          carni: 9      Min.      : 6.00      Min.      :0.000140
## Class :character    herbi:20     1st Qu.:11.50     1st Qu.:0.005125
## Mode  :character    omni :17     Median :14.25     Median :0.016500
##                                     Mean   :14.39     Mean   :0.339623
##                                     3rd Qu.:17.70     3rd Qu.:0.173500
##                                     Max.    :21.10     Max.    :5.712000
##          bodywt
## Min.      : 0.005
## 1st Qu.: 0.542
## Median : 2.788
## Mean   : 245.575
## 3rd Qu.: 47.525
## Max.    :6654.000
```

```
unique(msleep_subvore$name)
```

```
## [1] "Owl monkey" "Greater short-tailed shrew"
## [3] "Cow" "Dog"
## [5] "Roe deer" "Goat"
## [7] "Guinea pig" "Chinchilla"
## [9] "Star-nosed mole" "African giant pouched rat"
## [11] "Lesser short-tailed shrew" "Long-nosed armadillo"
## [13] "Tree hyrax" "North American Opossum"
## [15] "Asian elephant" "Horse"
## [17] "Donkey" "European hedgehog"
## [19] "Patas monkey" "Domestic cat"
## [21] "Galago" "Gray seal"
## [23] "Gray hyrax" "Human"
## [25] "African elephant" "Macaque"
## [27] "Golden hamster" "House mouse"
## [29] "Slow loris" "Rabbit"
## [31] "Sheep" "Chimpanzee"
## [33] "Jaguar" "Baboon"
## [35] "Laboratory rat" "Squirrel monkey"
## [37] "Cotton rat" "Arctic ground squirrel"
## [39] "Thirteen-lined ground squirrel" "Pig"
## [41] "Brazilian tapir" "Tenrec"
## [43] "Tree shrew" "Genet"
## [45] "Arctic fox" "Red fox"
```

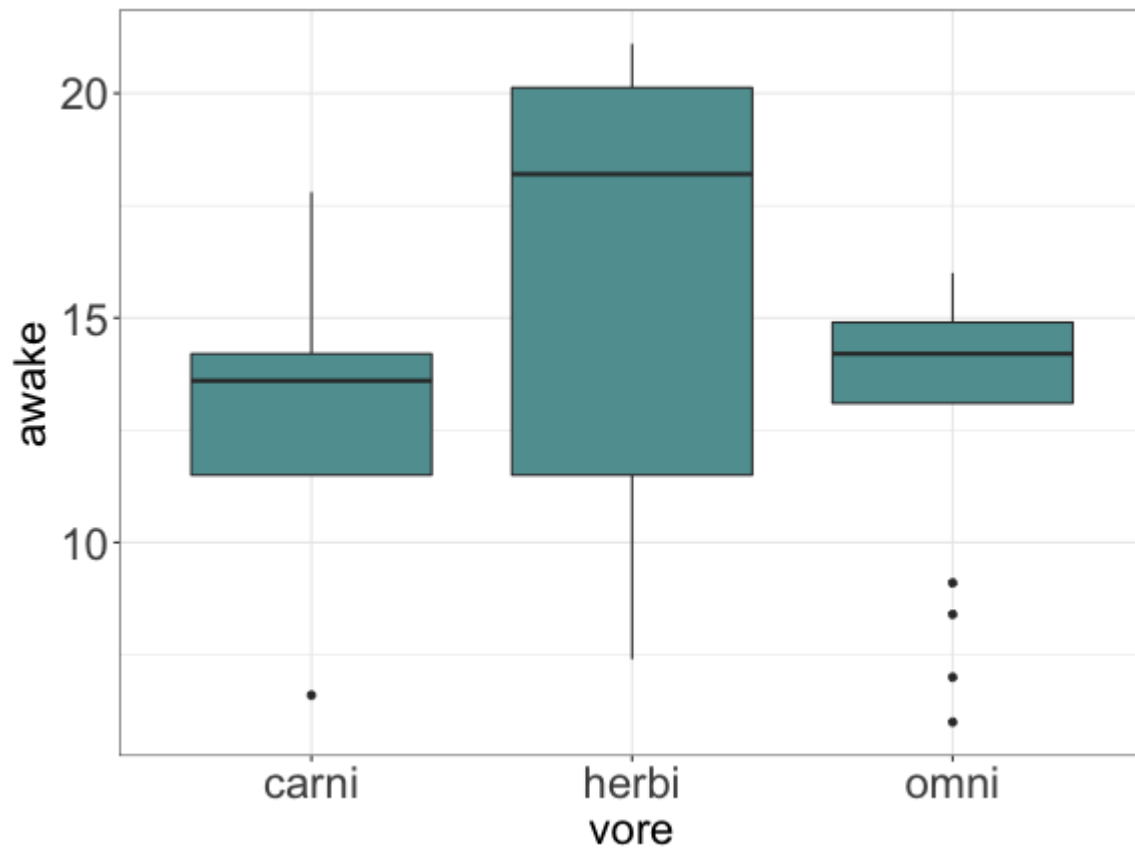
Identifying components of a plot

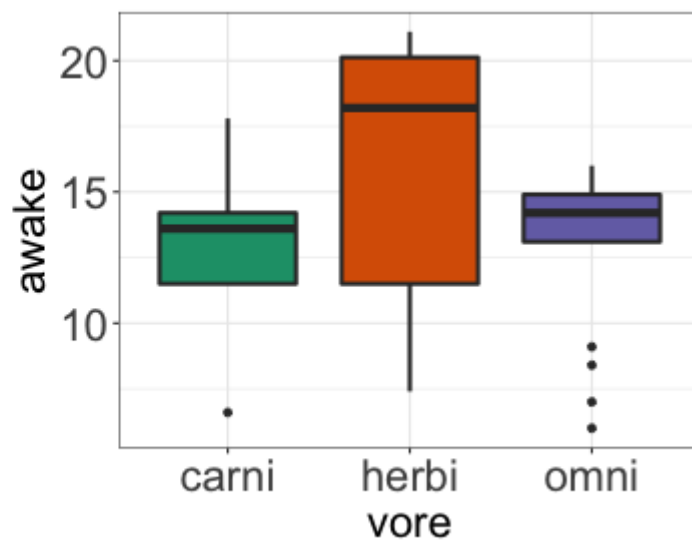
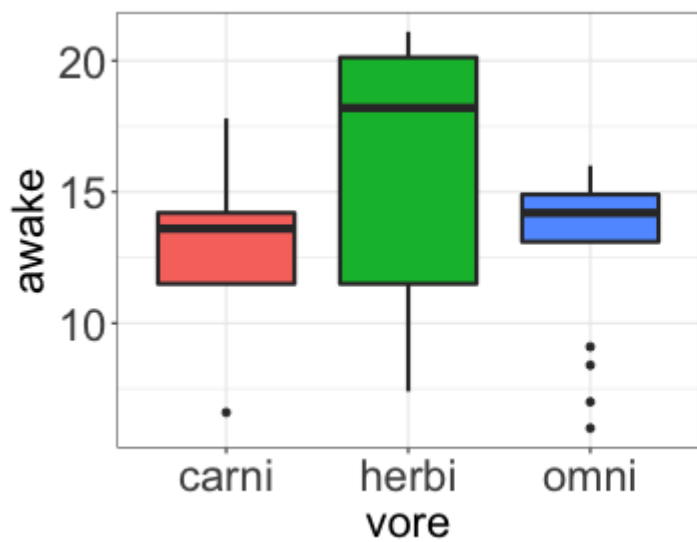


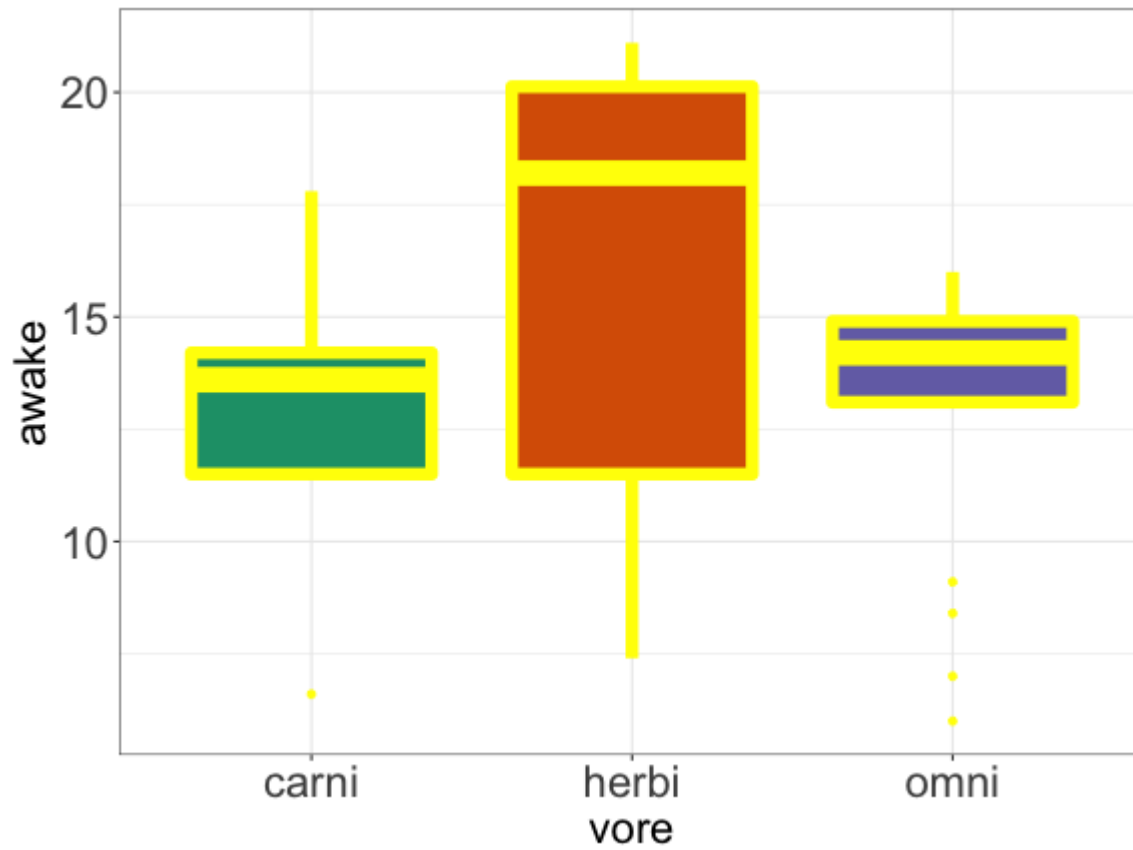
Aesthetics: How is the data *mapped onto* visual components of the plot?

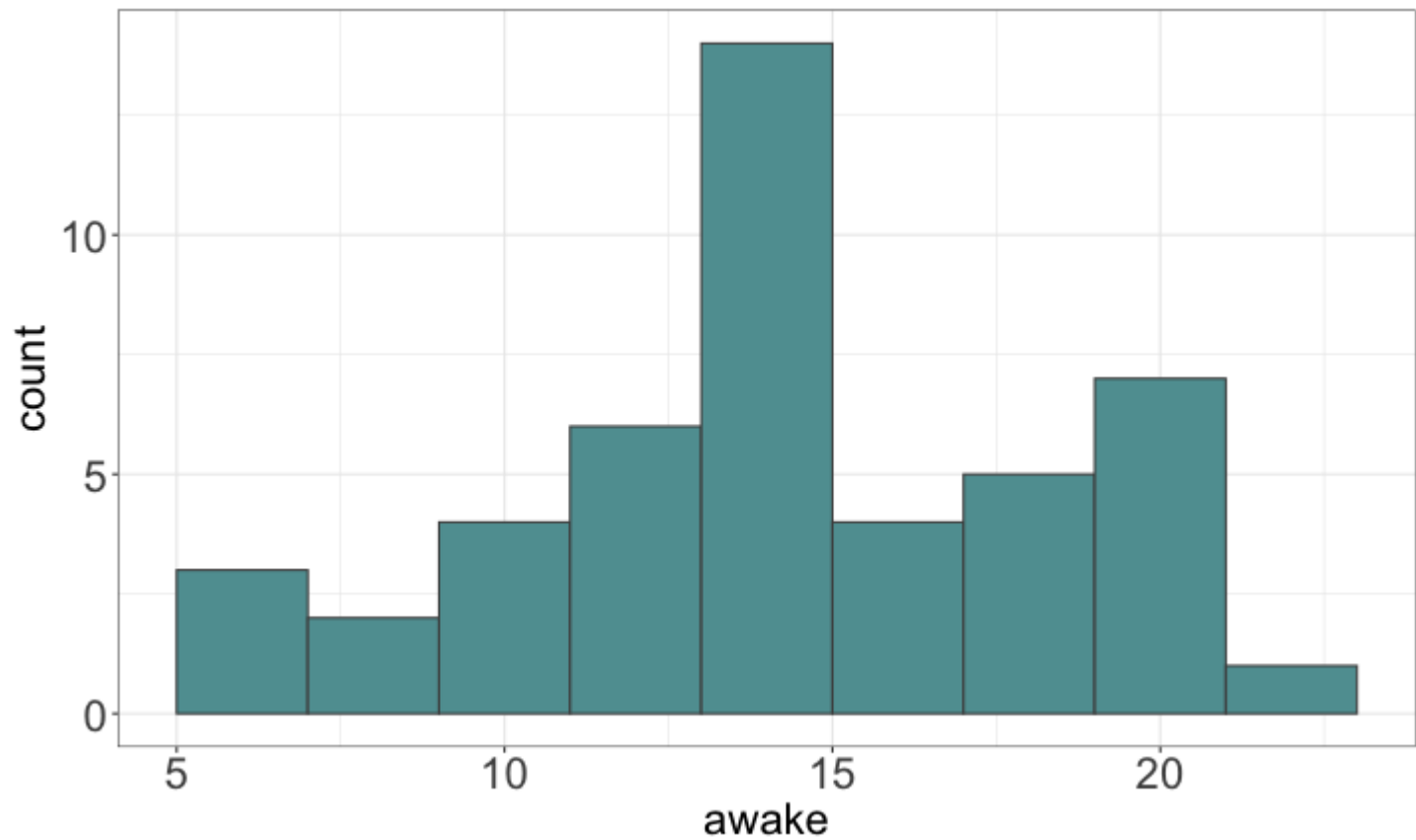
- X-axis?
- Y-axis?
- Colors? Shapes? Sizes?

Geometries: What *shapes* aka *geometric objects* are displayed in the plot?
(Often AKA: What type of plot?)

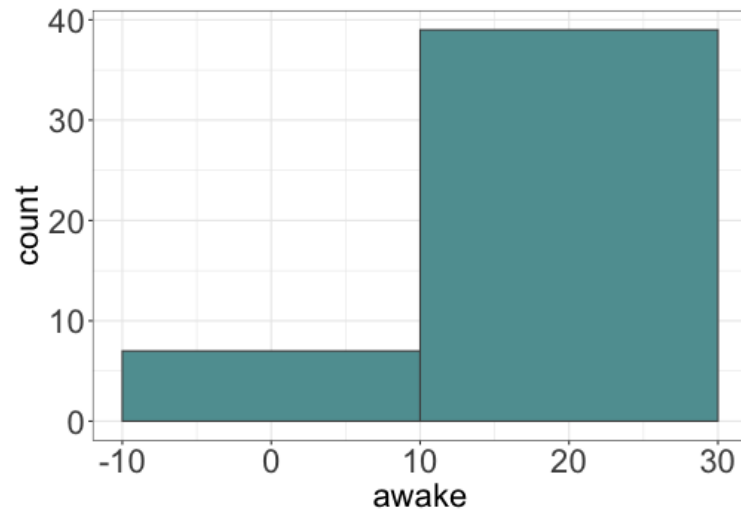
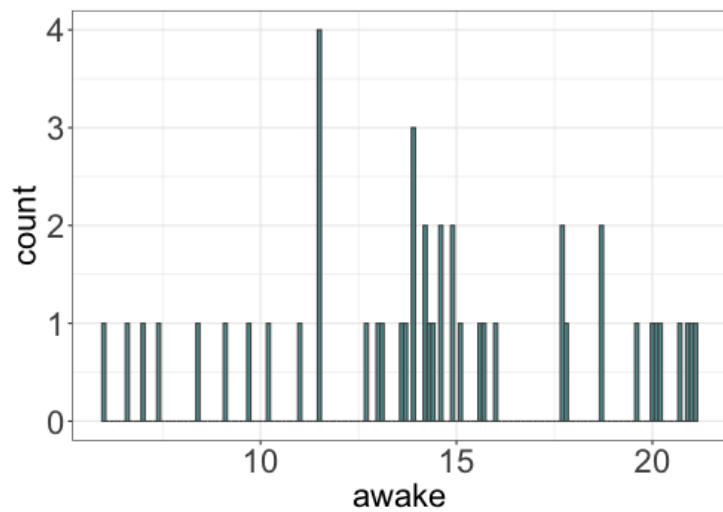
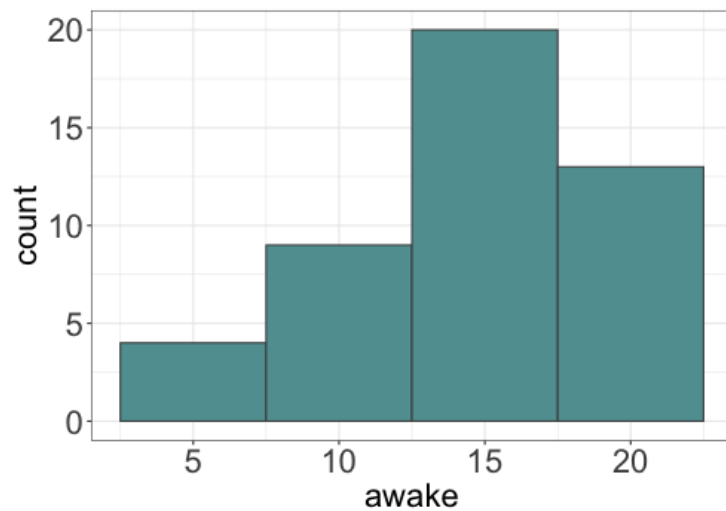
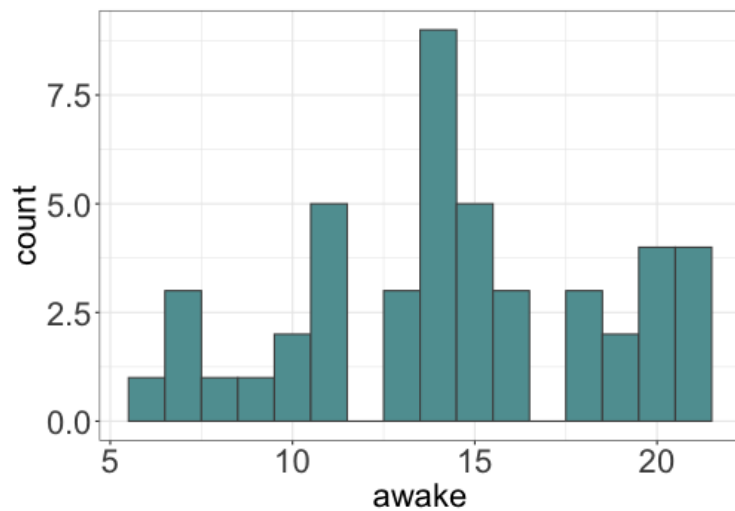


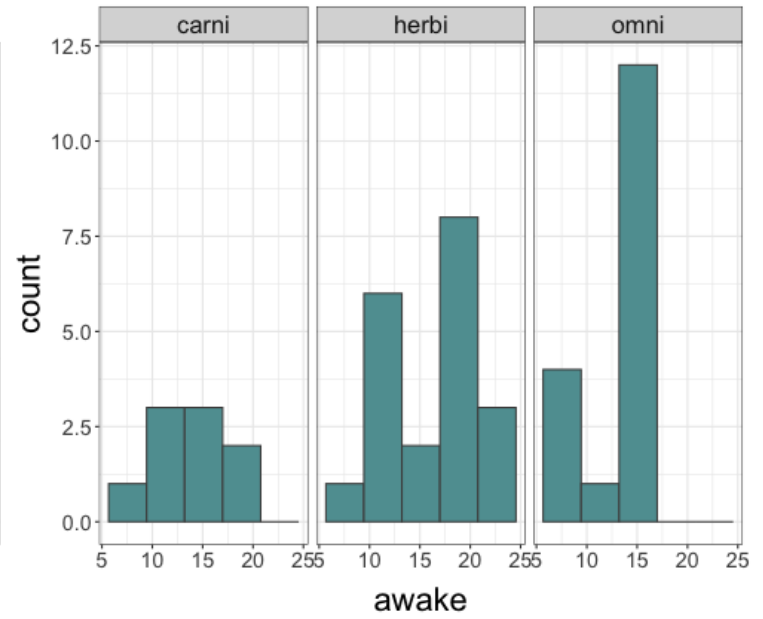
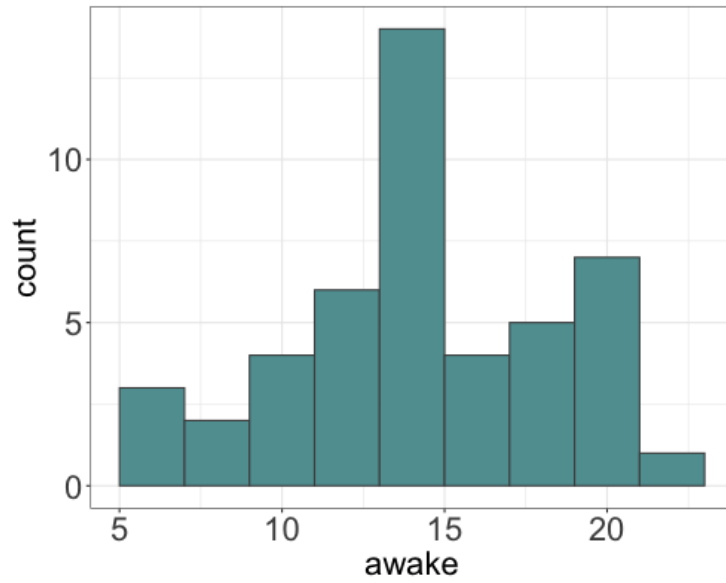


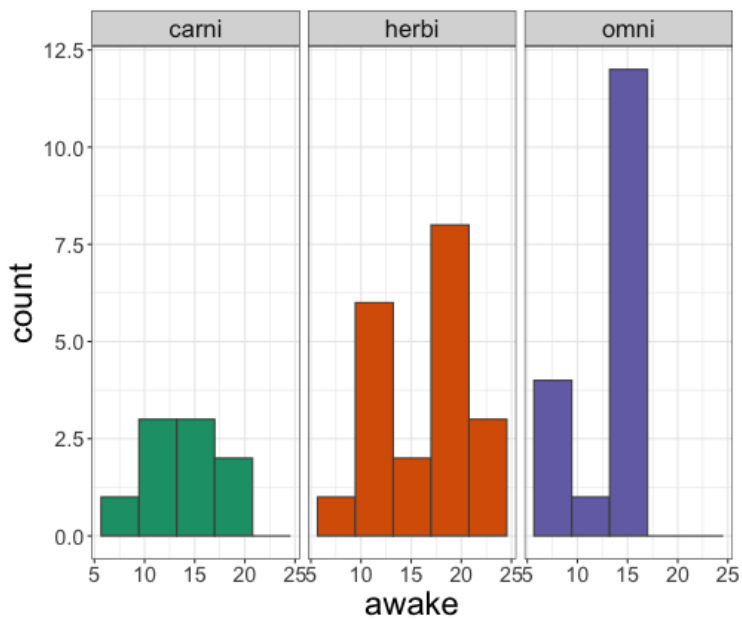
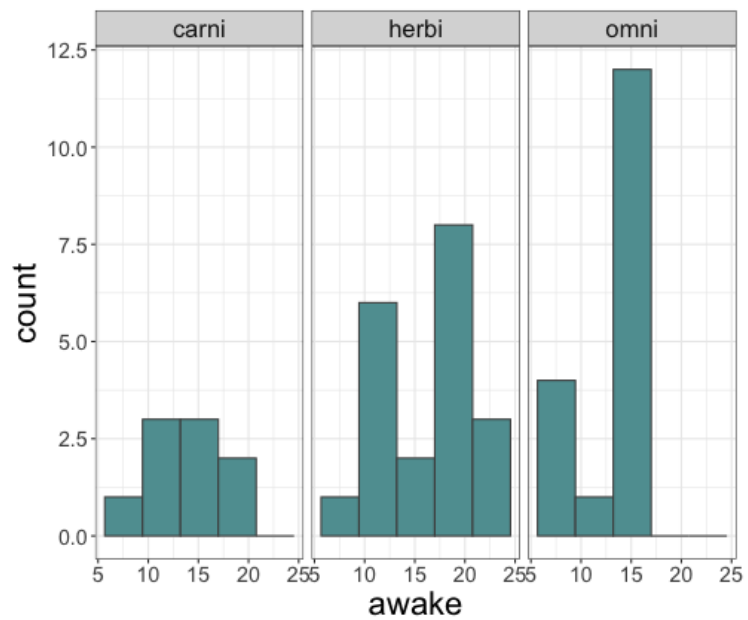


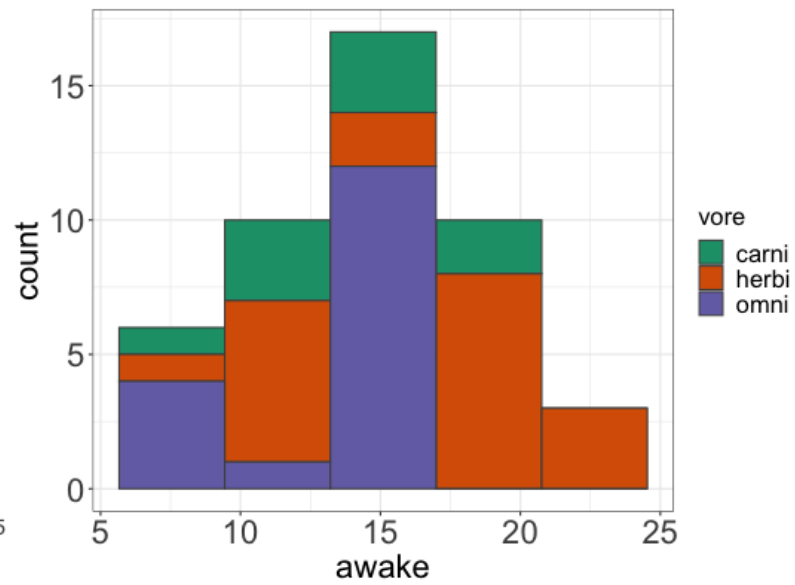
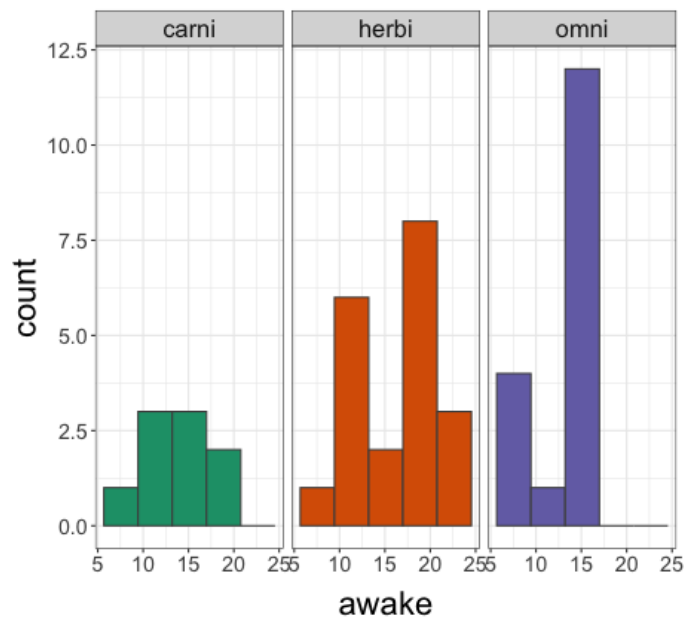


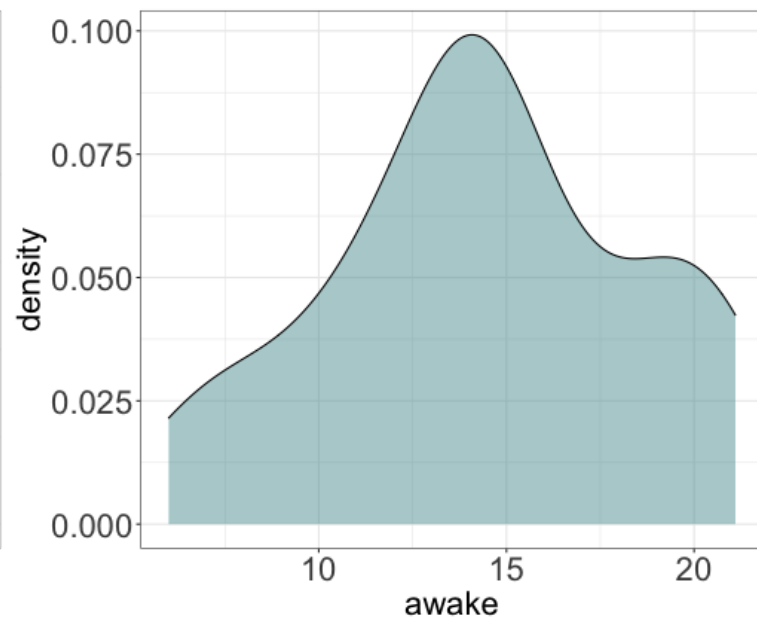
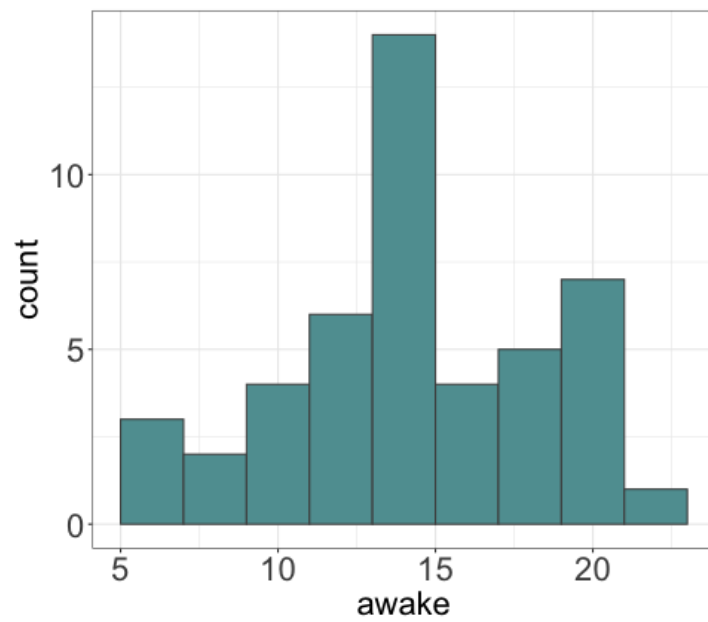
```
## [1] 6.0 6.6 7.0 7.4 8.4 9.1 9.7 10.2 11.0 11.5 11.5 11.5 11.5 12.7
## [16] 13.1 13.6 13.7 13.9 13.9 13.9 14.2 14.2 14.3 14.4 14.6 14.6 14.9 14.9
## [31] 15.6 15.7 16.0 17.7 17.7 17.8 18.7 18.7 19.6 20.0 20.1 20.2 20.7 20.9
## [46] 21.1
```

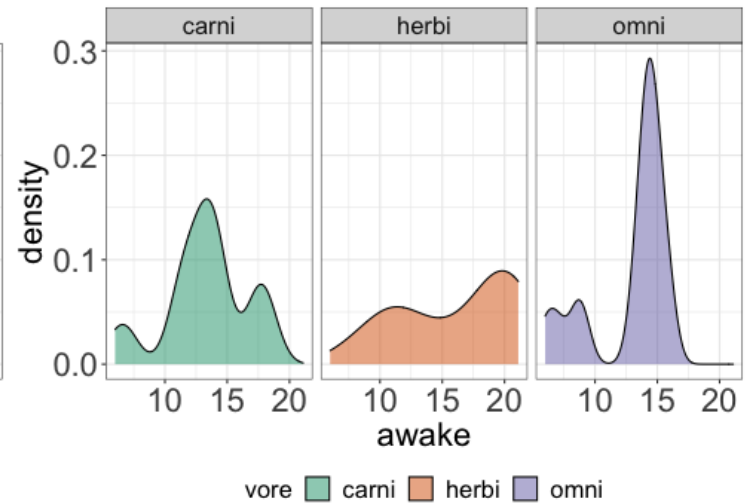
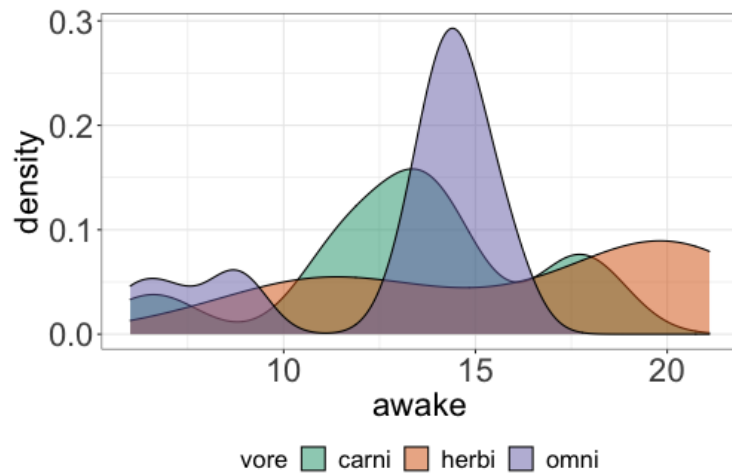
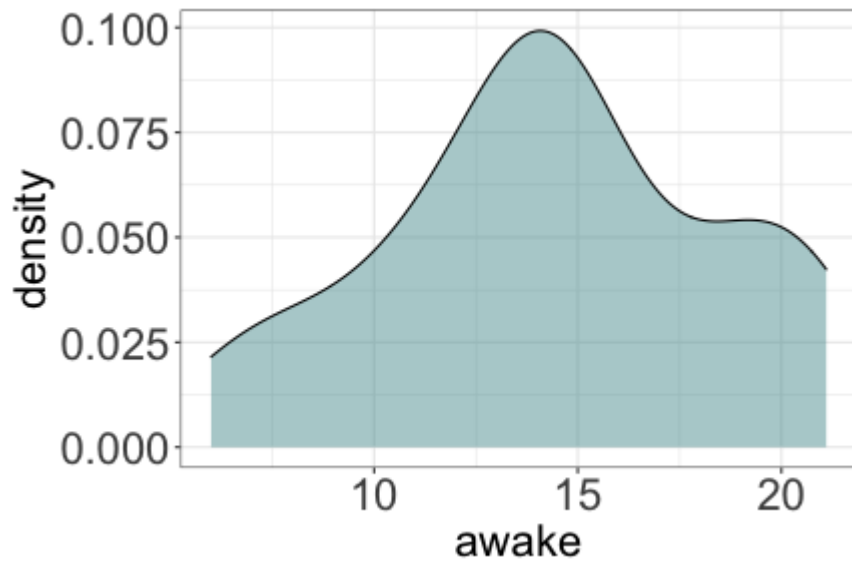


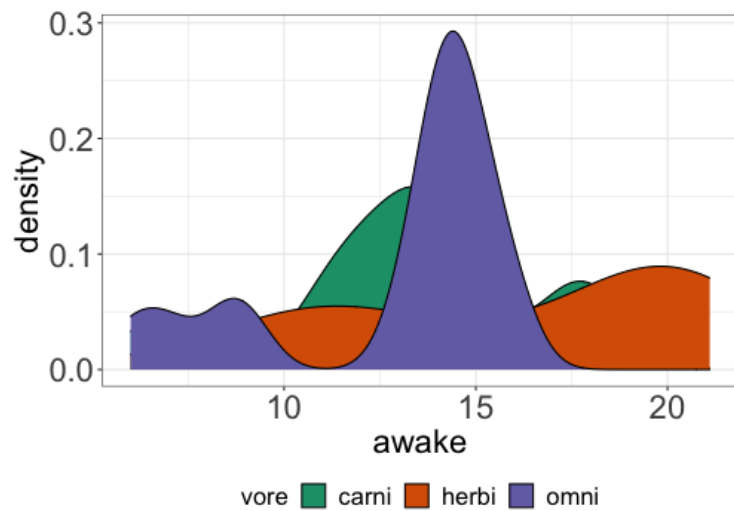
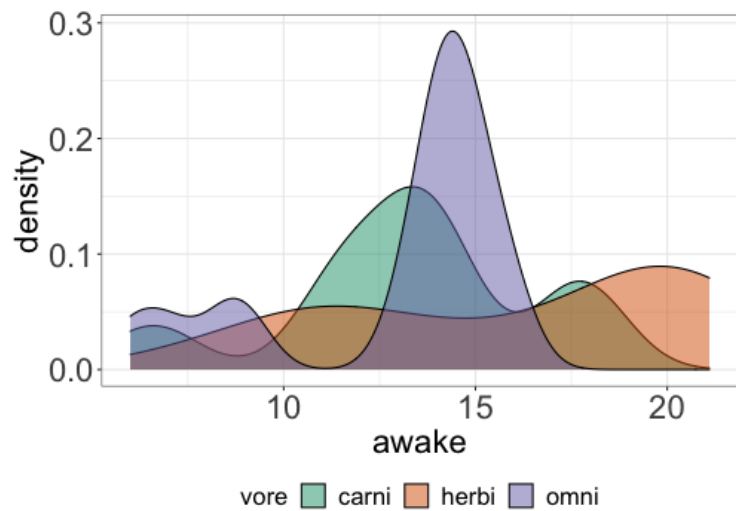


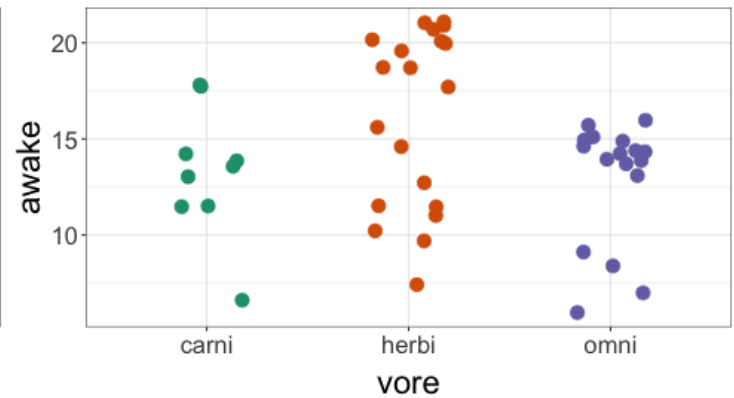
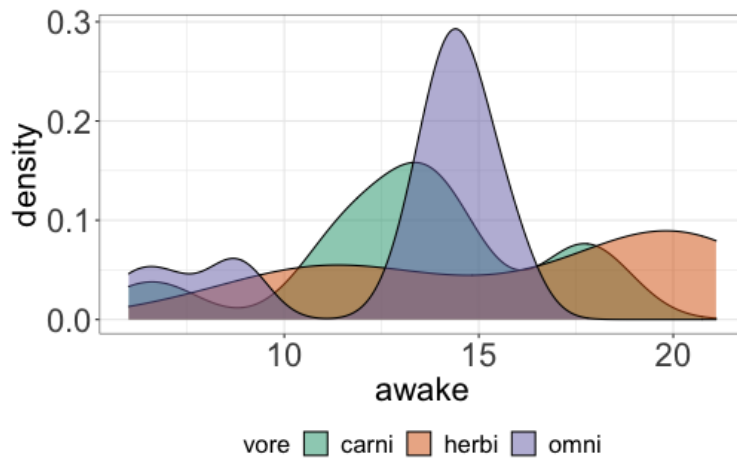
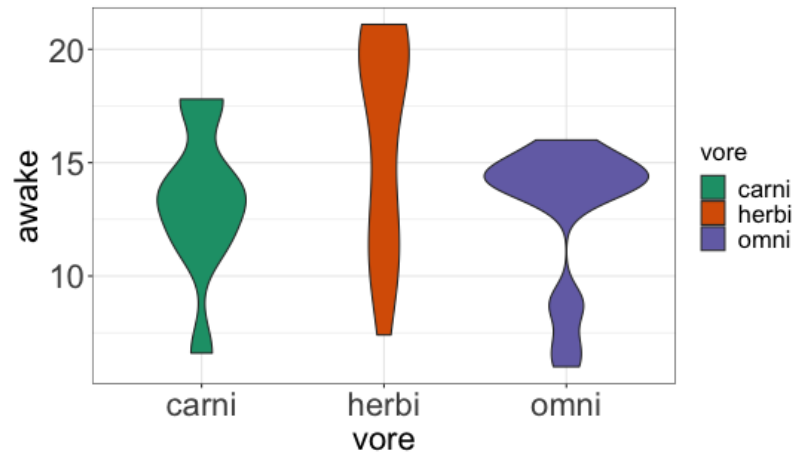
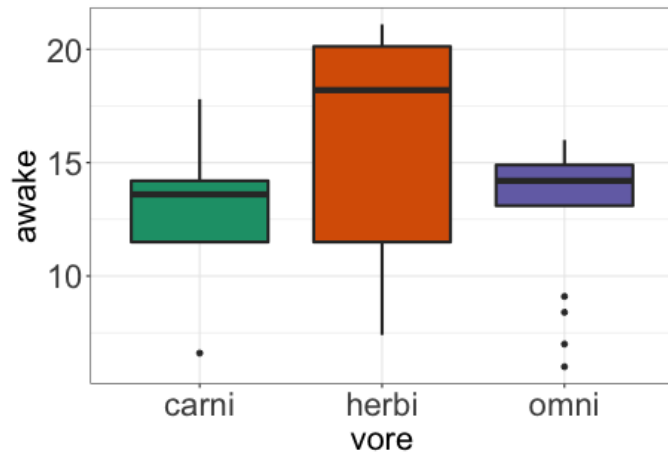


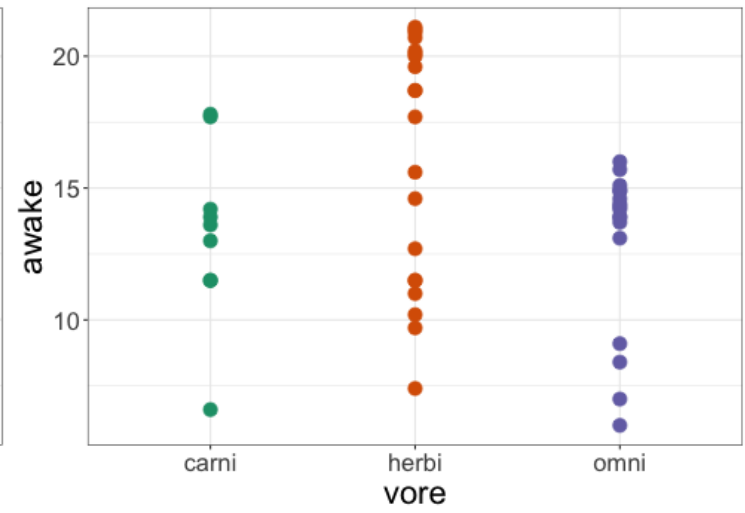
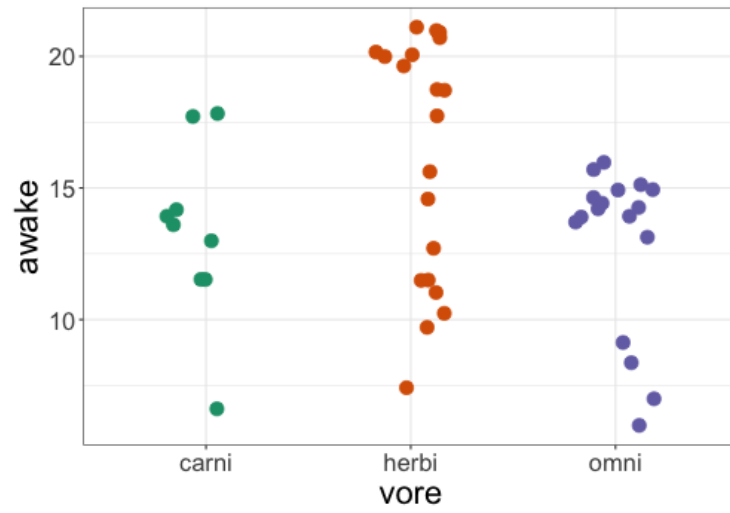




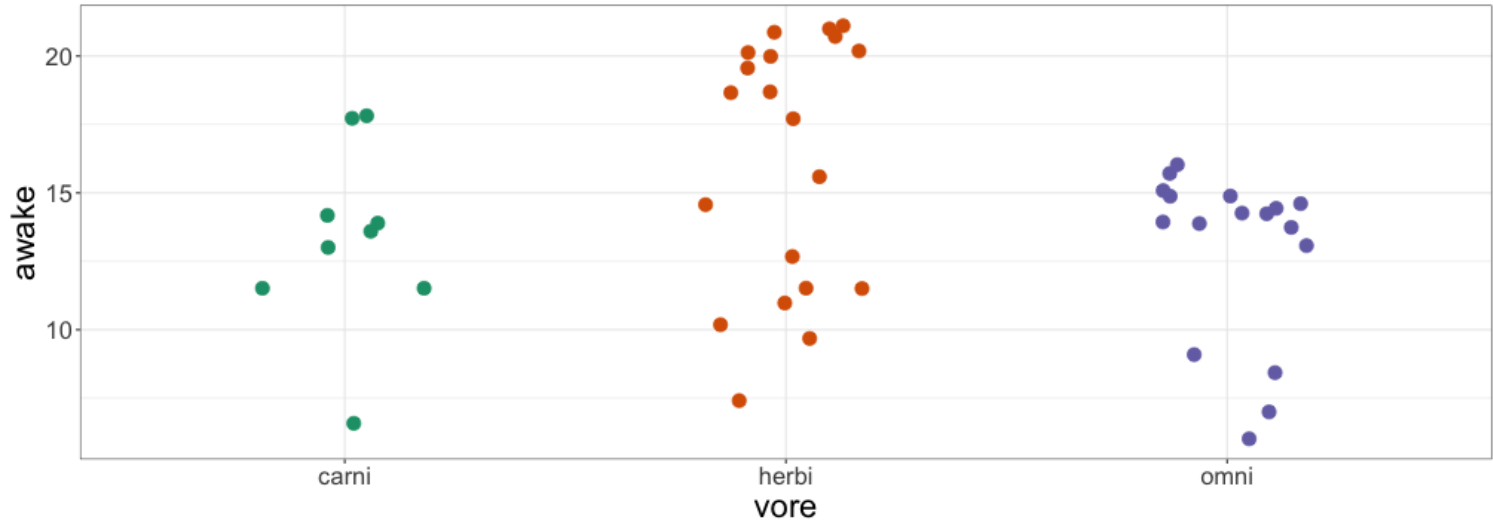






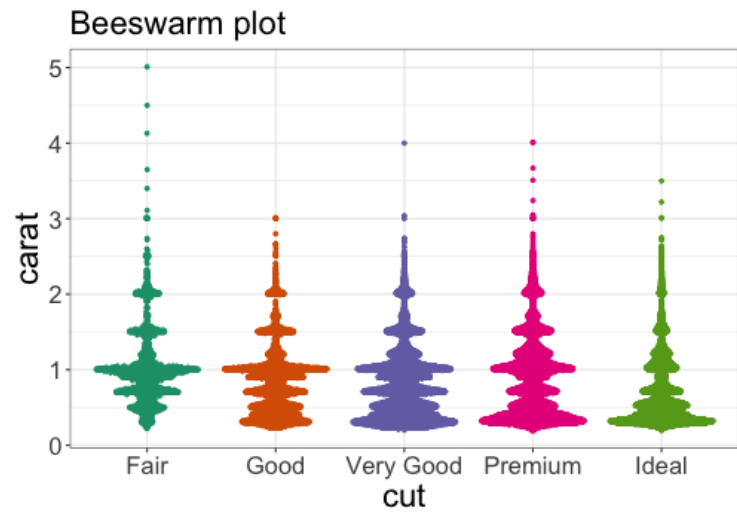
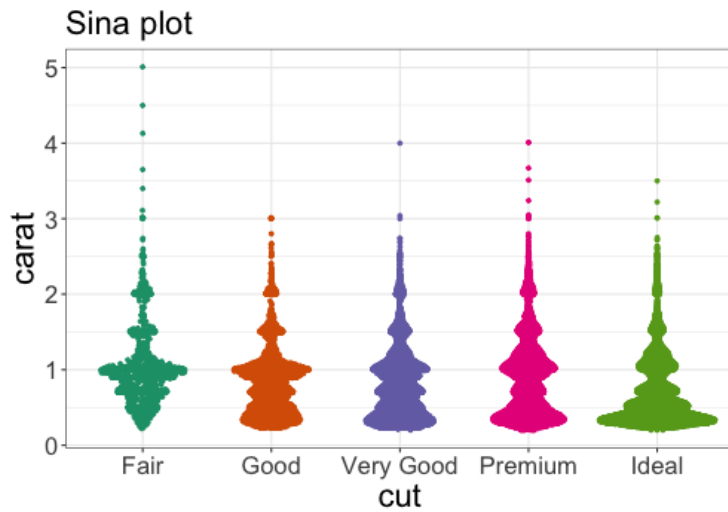
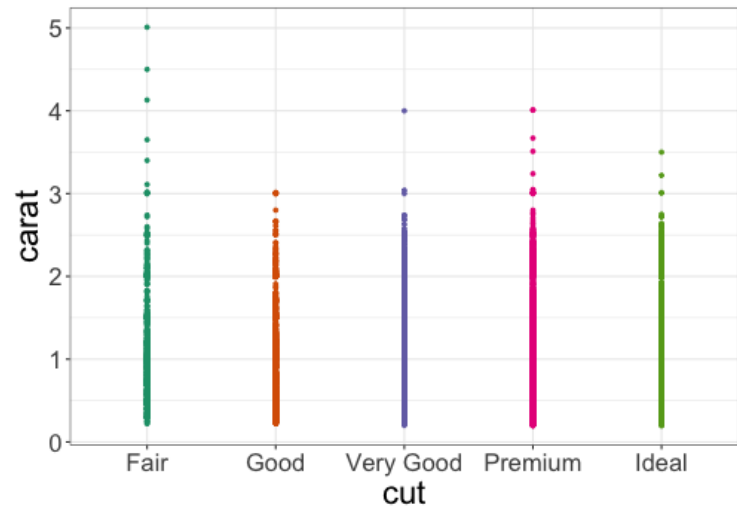
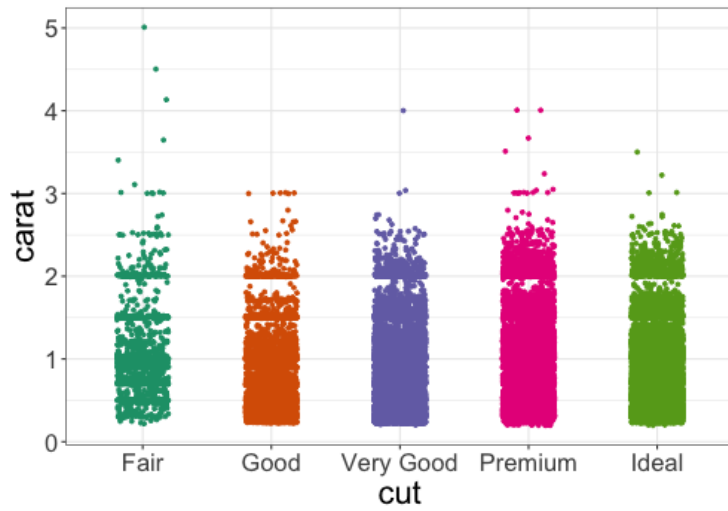


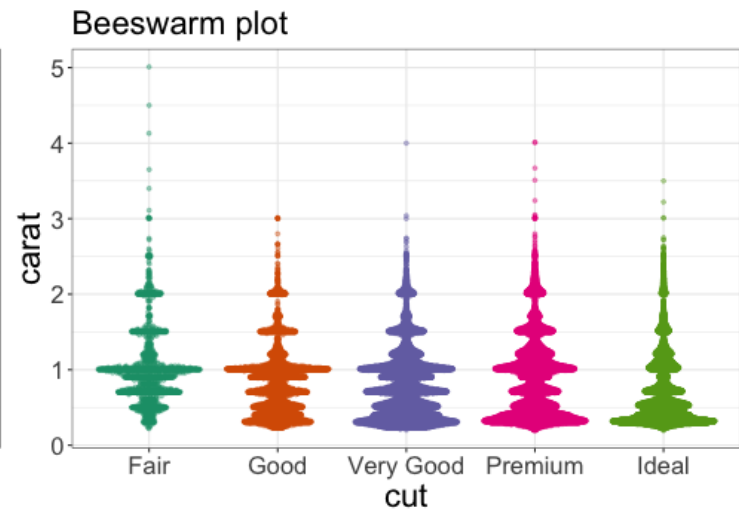
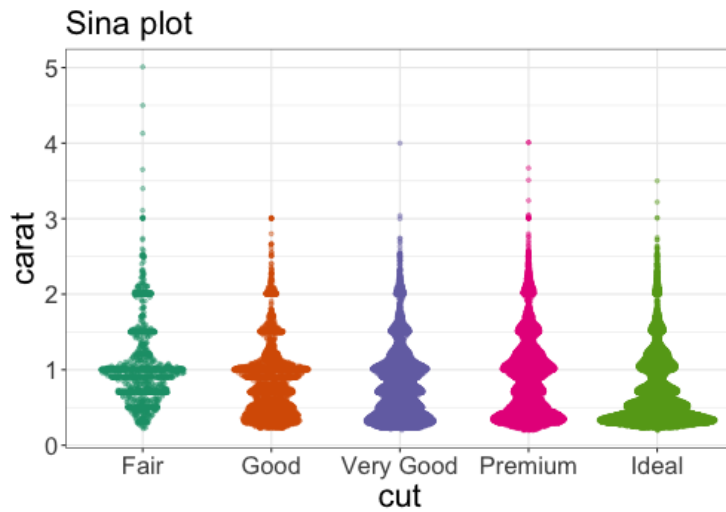
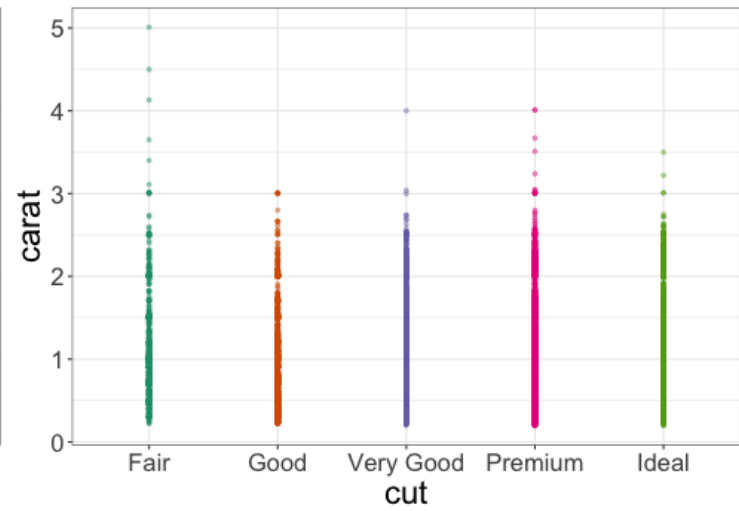
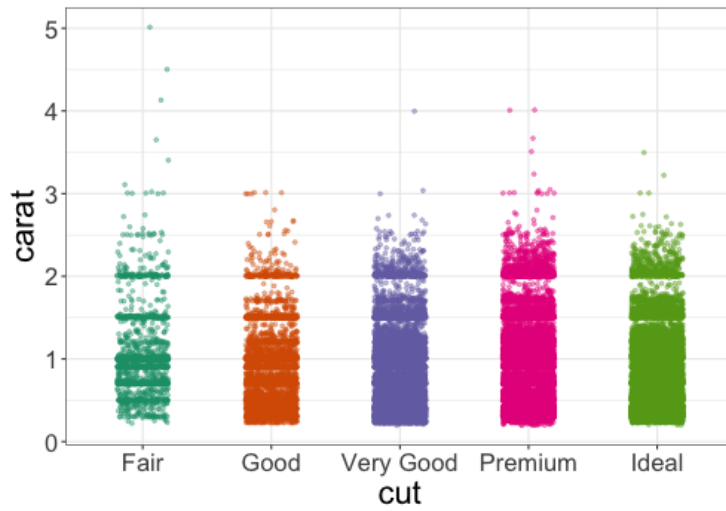
The world is your oyster

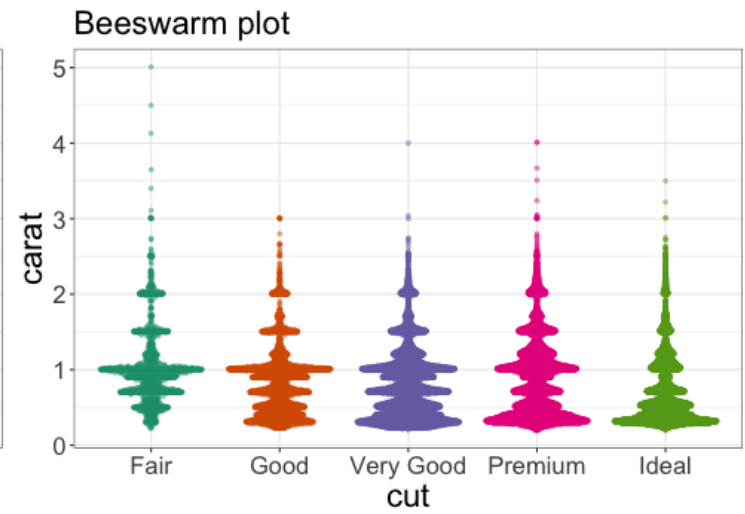
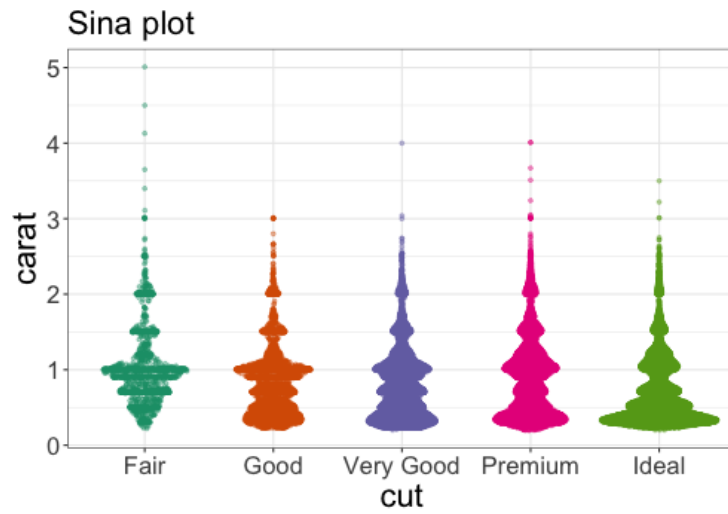


Ok, that wasn't super compelling...

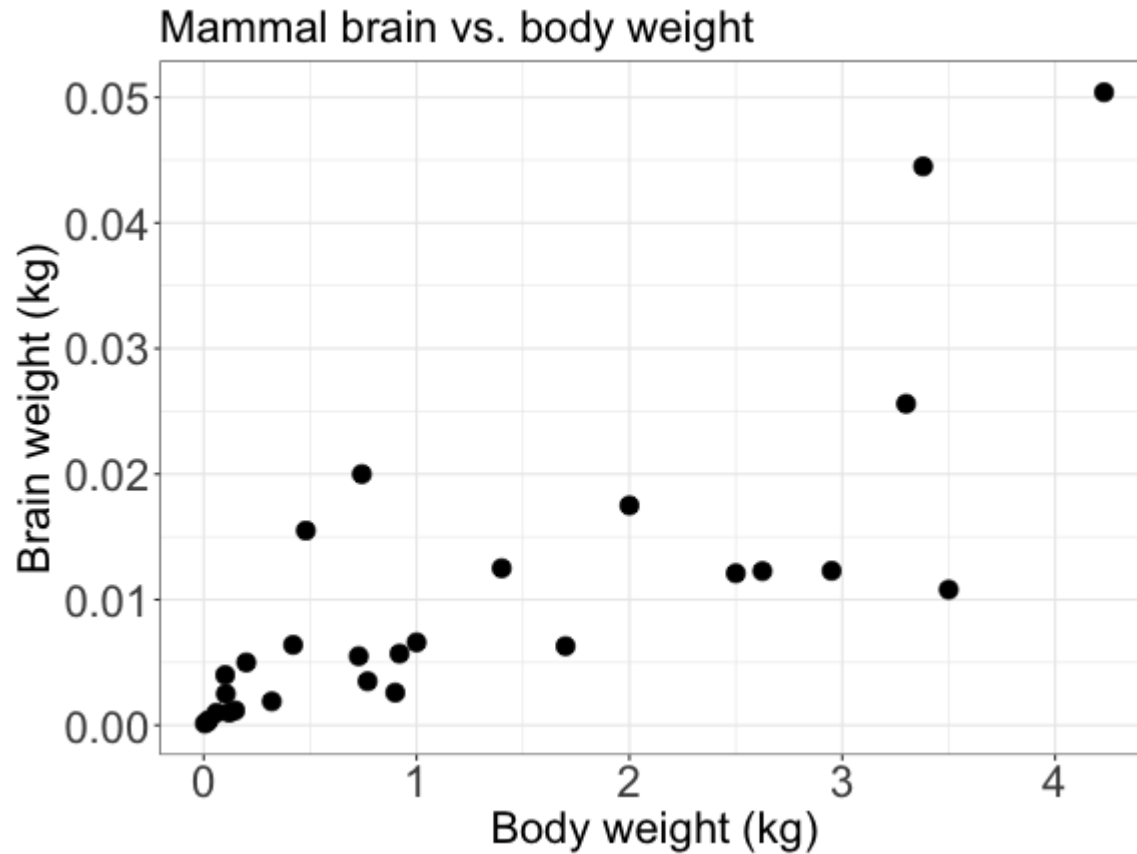
```
## # A tibble: 53,940 × 10
##   carat cut      color clarity depth table price      x      y      z
##   <dbl> <ord>    <ord> <ord>    <dbl> <dbl> <int> <dbl> <dbl> <dbl>
## 1  0.23 Ideal      E      SI2     61.5    55    326  3.95  3.98  2.43
## 2  0.21 Premium    E      SI1     59.8    61    326  3.89  3.84  2.31
## 3  0.23 Good       E      VS1     56.9    65    327  4.05  4.07  2.31
## 4  0.29 Premium    I      VS2     62.4    58    334  4.2   4.23  2.63
## 5  0.31 Good       J      SI2     63.3    58    335  4.34  4.35  2.75
## 6  0.24 Very Good  J      VVS2    62.8    57    336  3.94  3.96  2.48
## 7  0.24 Very Good  I      VVS1    62.3    57    336  3.95  3.98  2.47
## 8  0.26 Very Good  H      SI1     61.9    55    337  4.07  4.11  2.53
## 9  0.22 Fair       E      VS2     65.1    61    337  3.87  3.78  2.49
## 10 0.23 Very Good  H      VS1     59.4    61    338  4     4.05  2.39
## # ... with 53,930 more rows
```

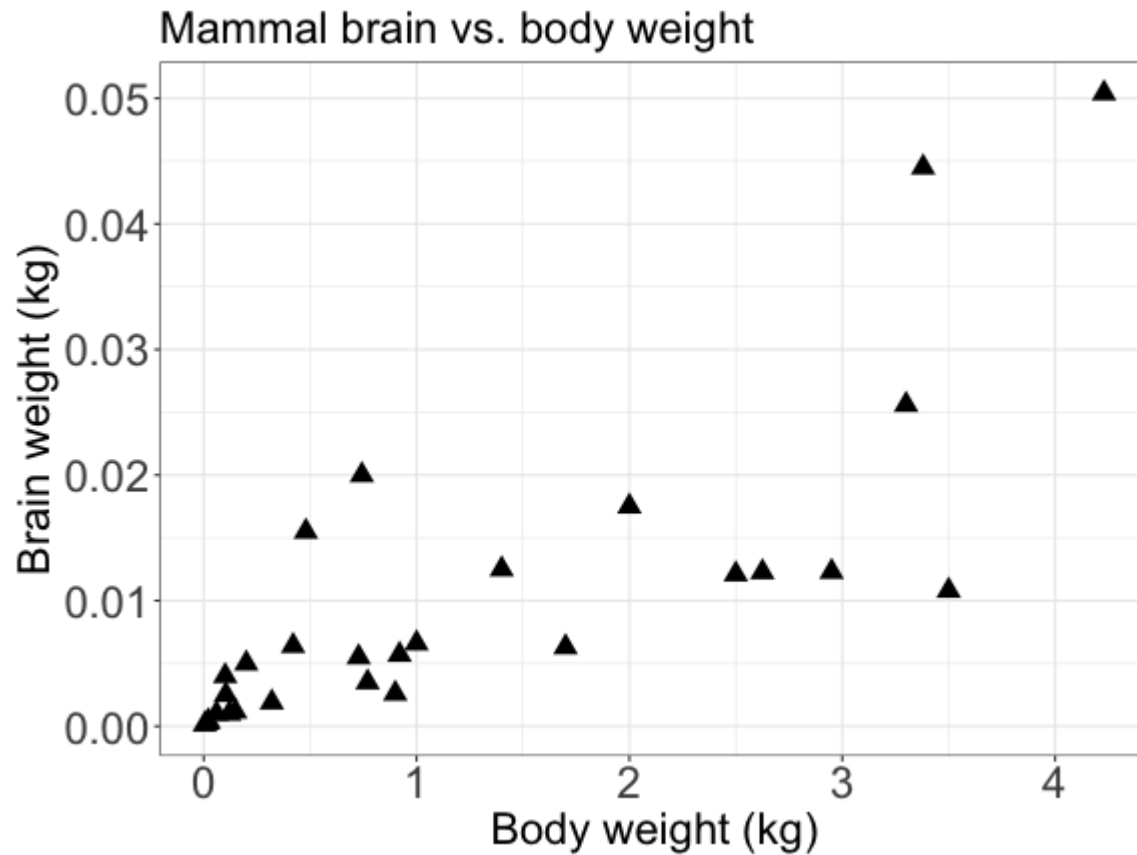



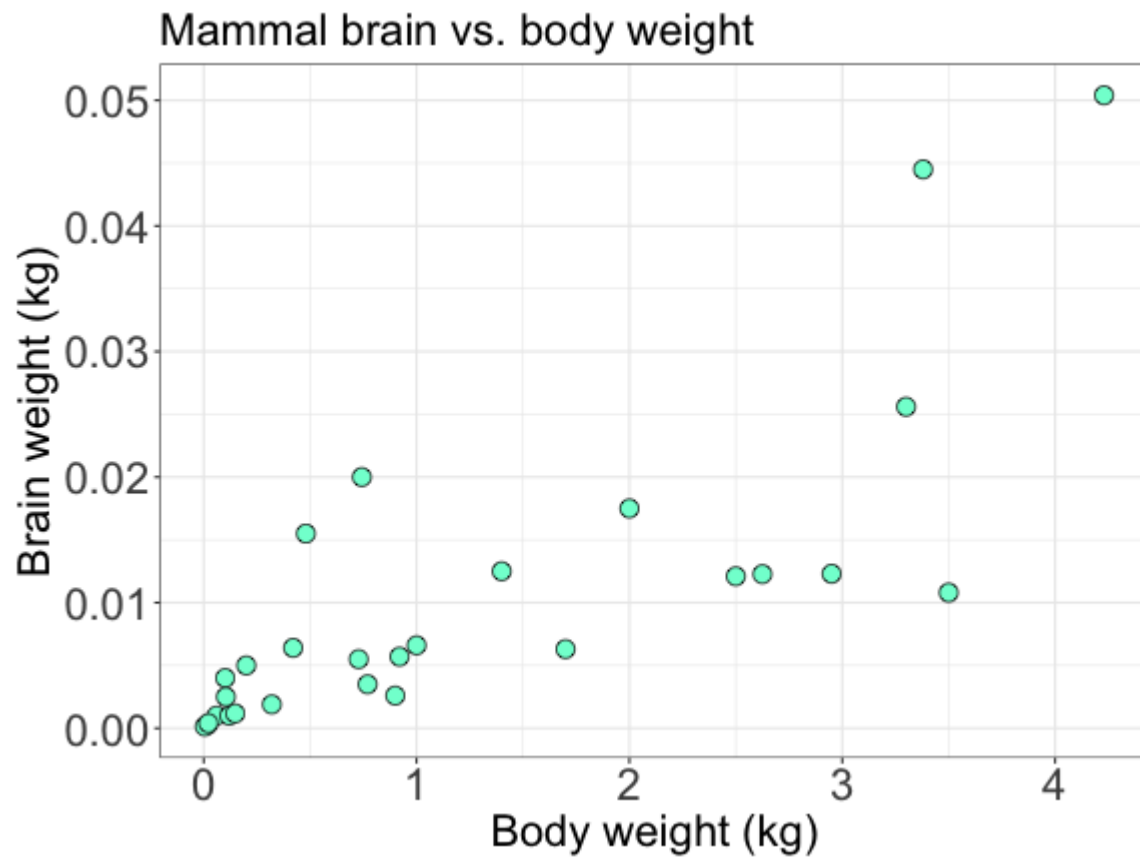


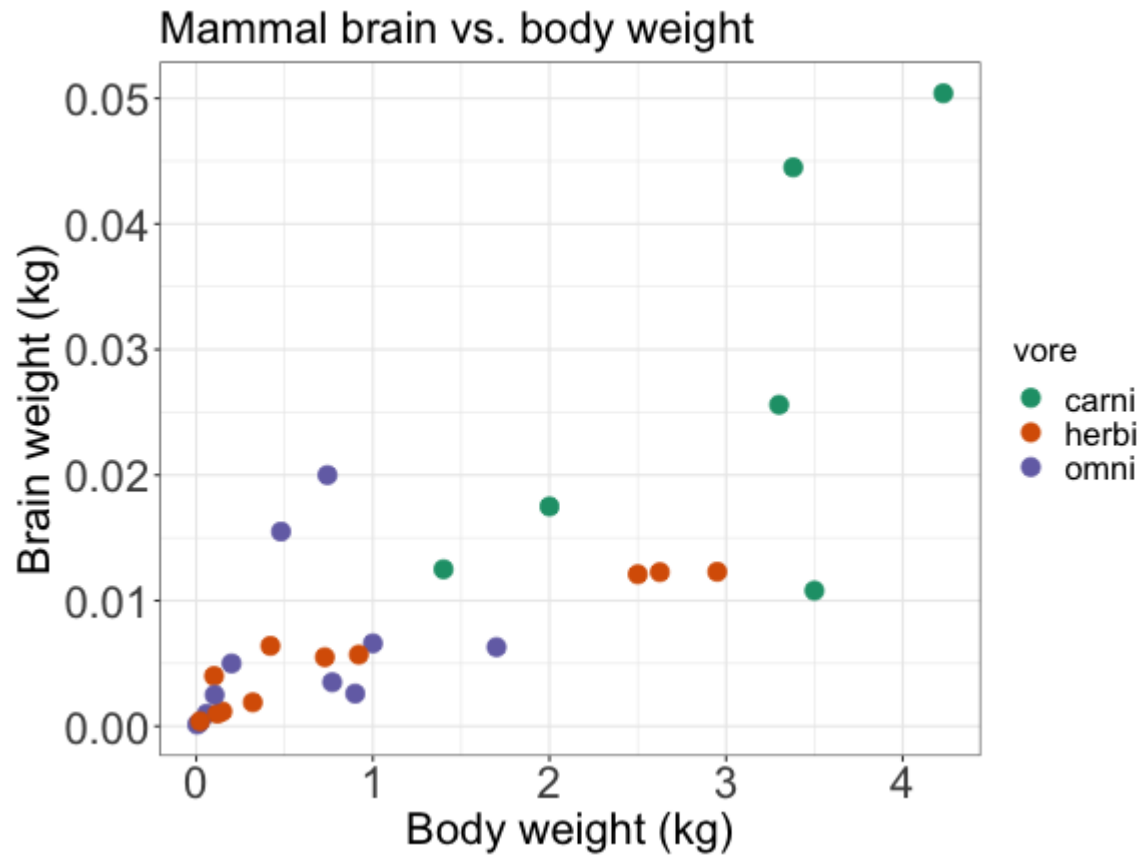


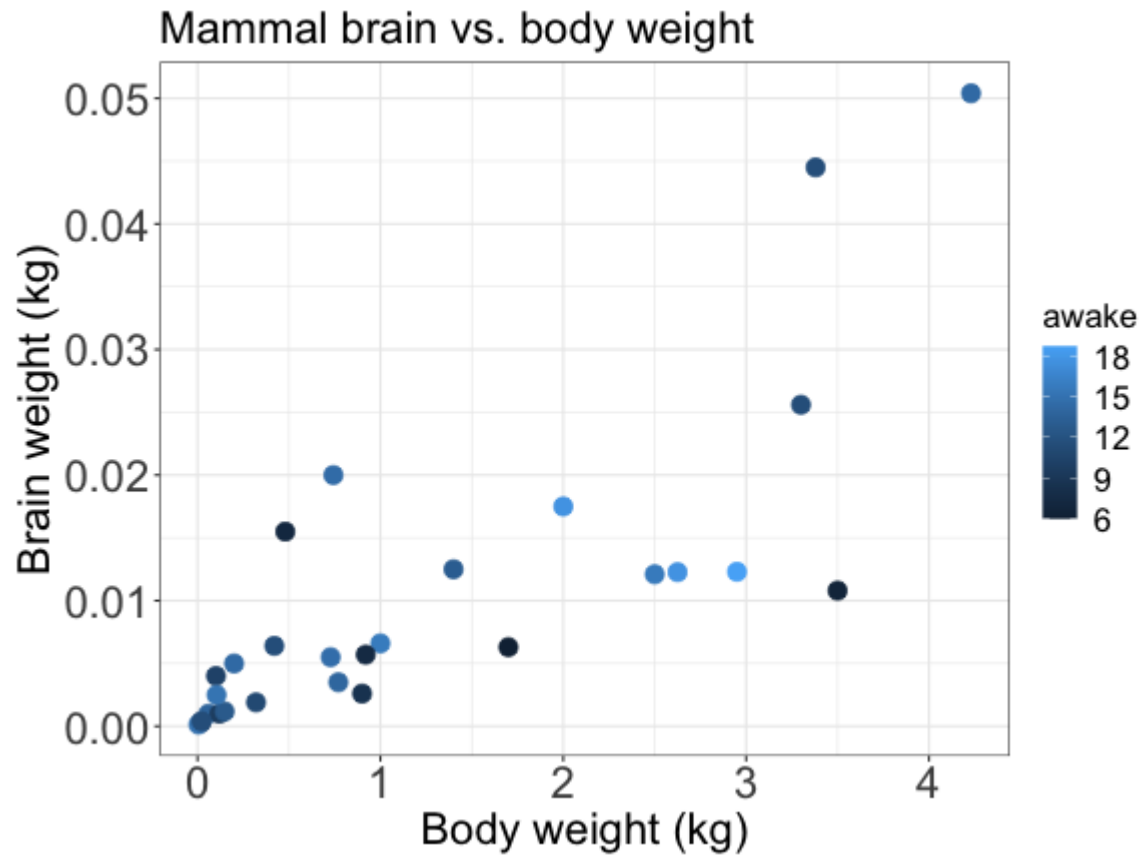
Onto scatterplots!

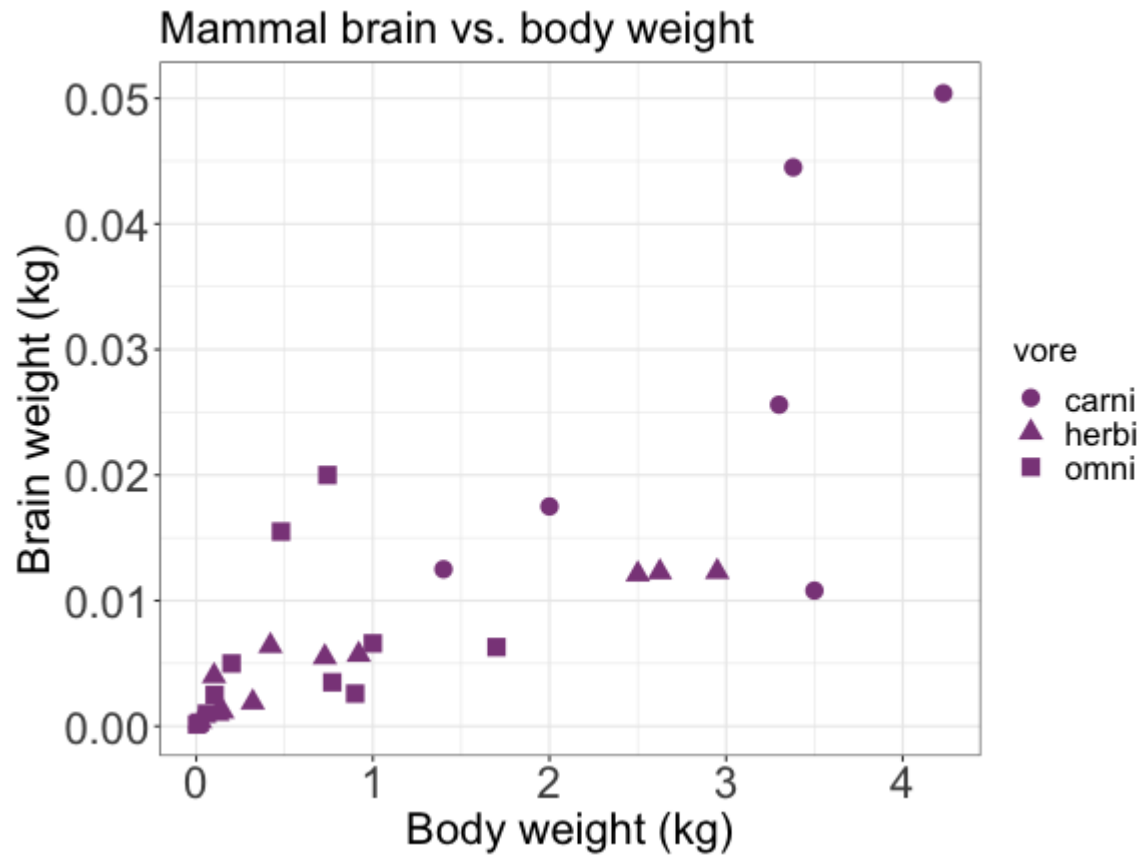


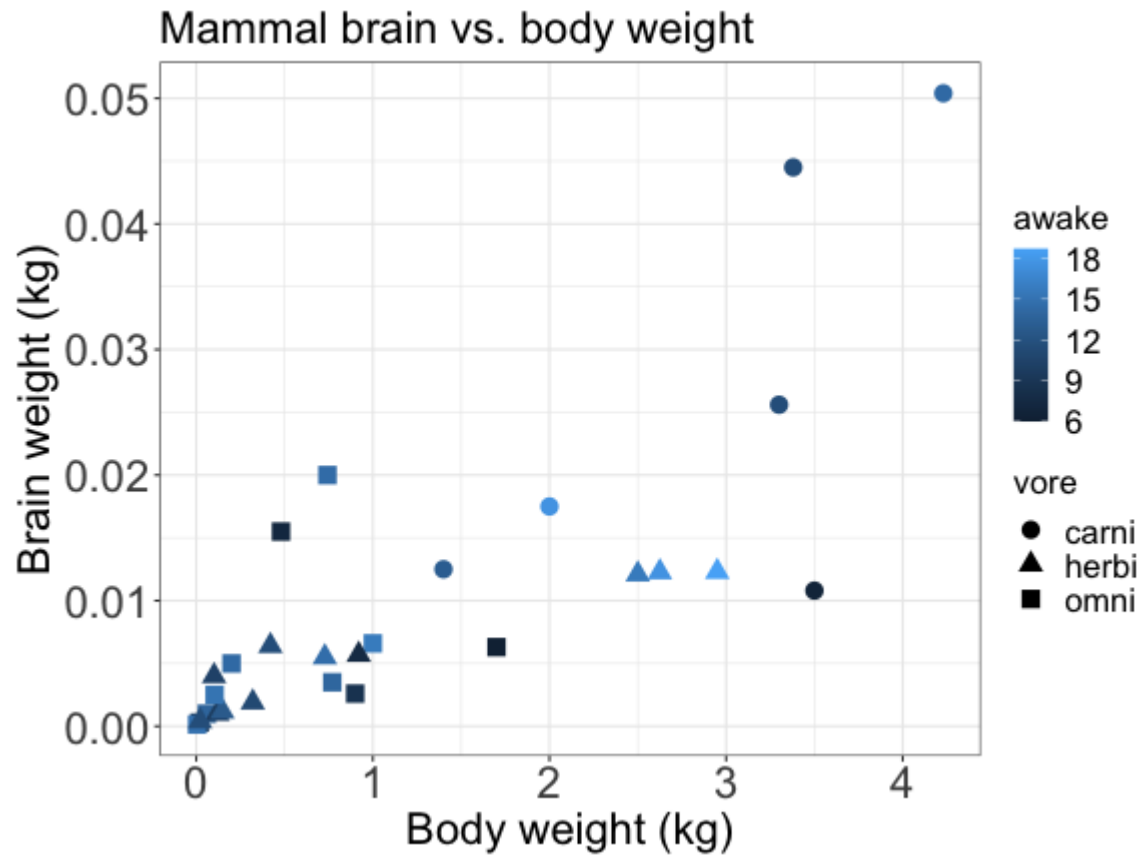




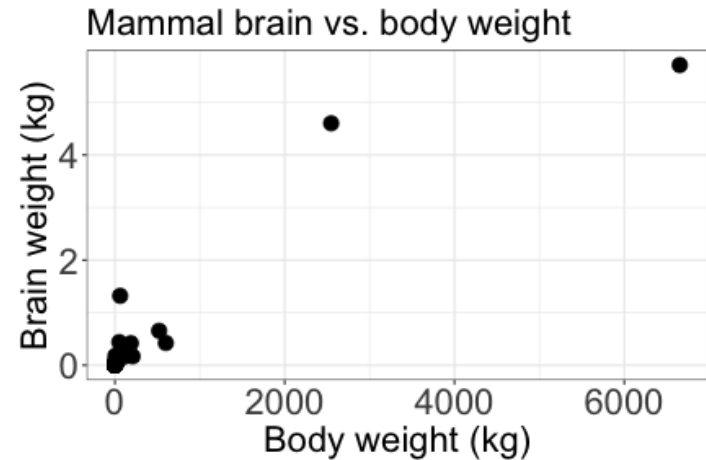
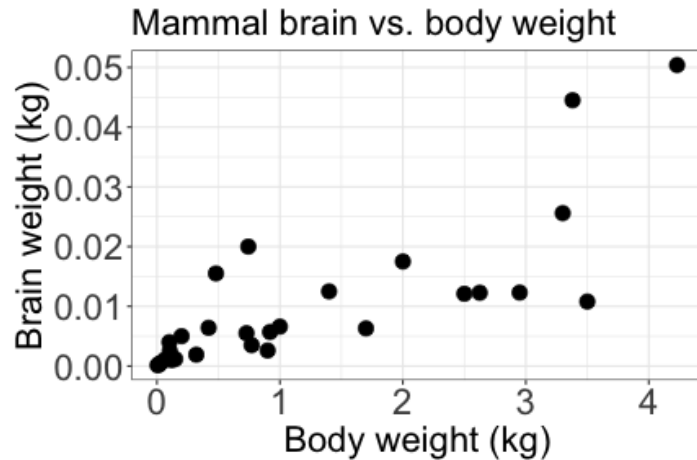




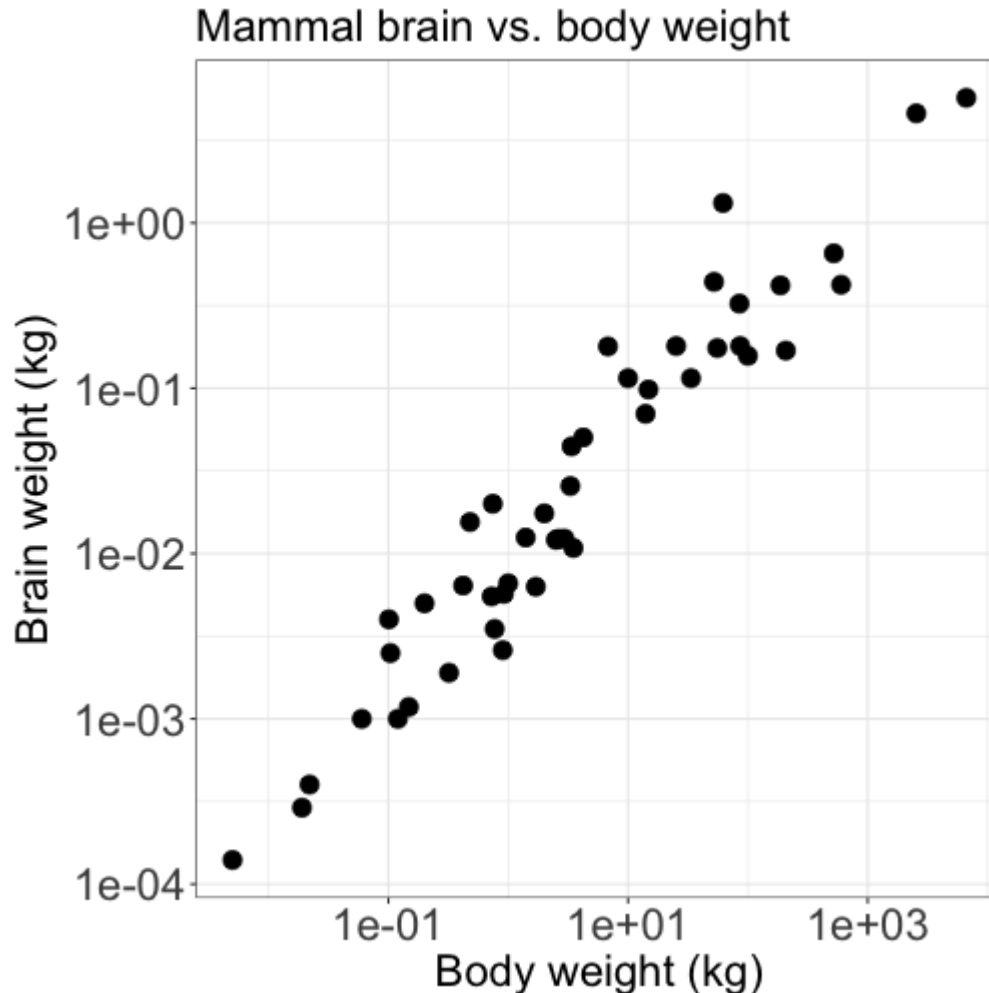




Do the axes look at all "strange" to you?



Use log scales for data with extreme ranges

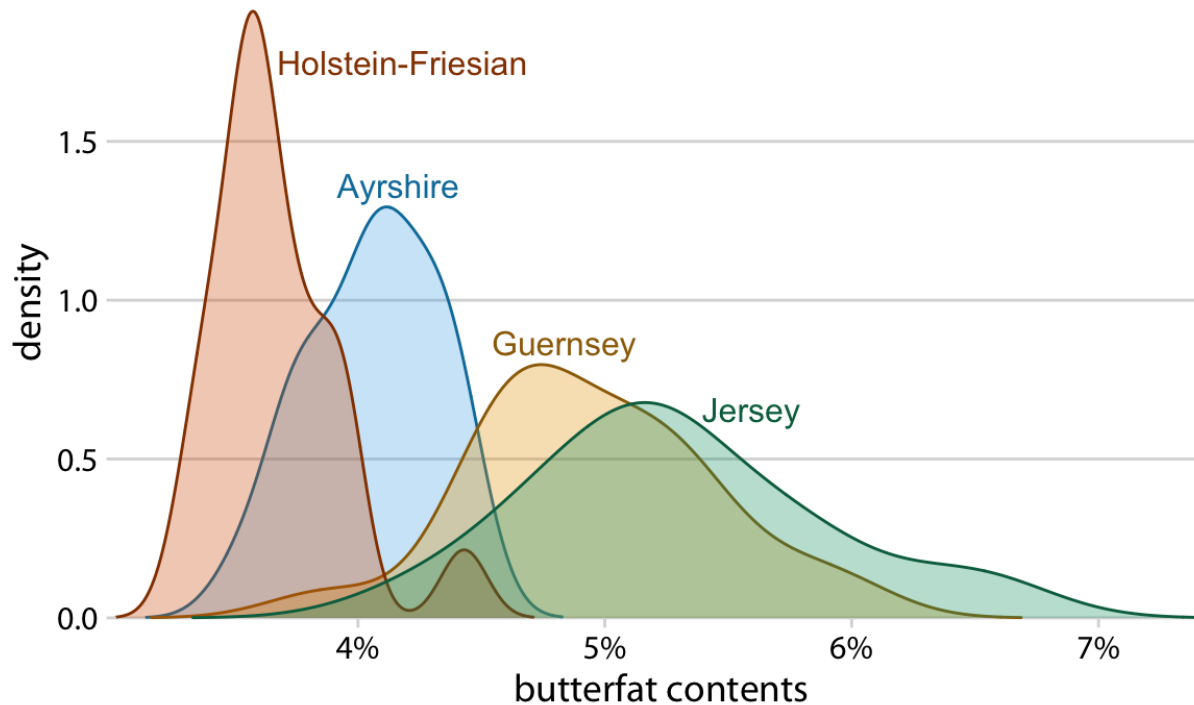


Let's practice

- *Always start with axes:*
 - What variable is on the X-axis? What *type* of data is it? < br>
 - What variable is on the Y-axis? What *type* of data is it?
- Are there colors or fills? Are they "just colors" or are they *aesthetics*?
- What are the geometries in the plot?
- What *interpretations* can we make about the plot? What question(s) does the plot address or not address? (there are MANY right answers here!).
- What might the underlying dataset actually look like? *What variables (columns) are likely present?*

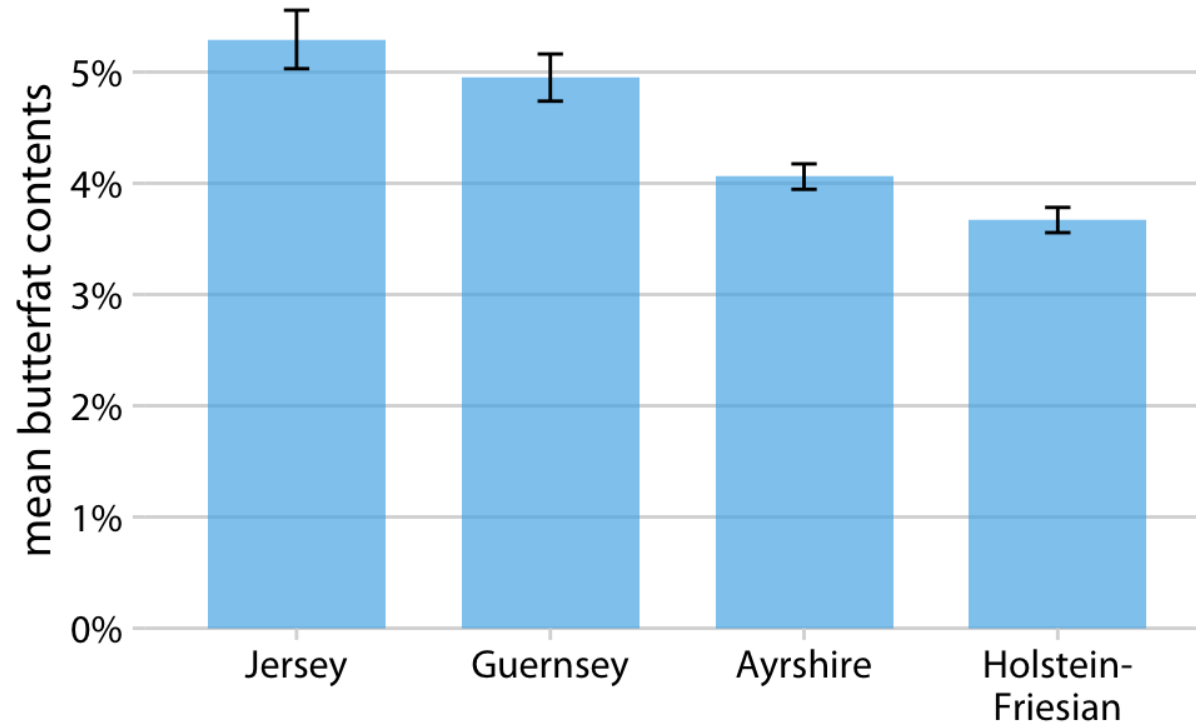
All figures in the following slides are from **Fundamentals of Data Visualization**.

Butterfat from different cows

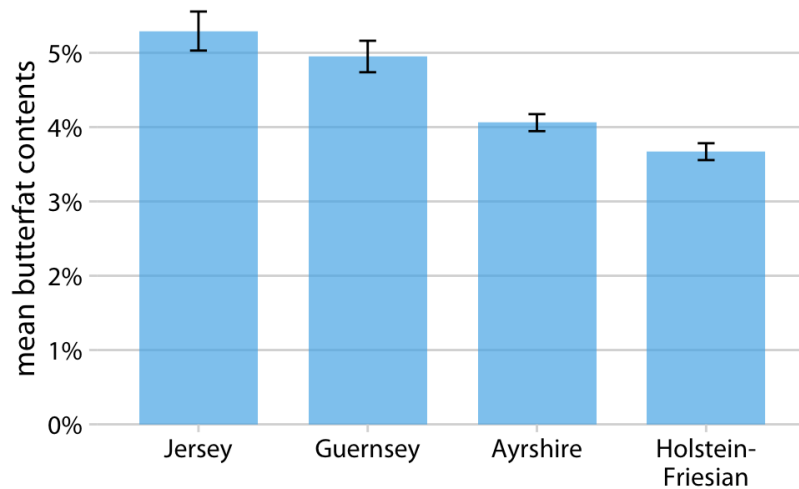
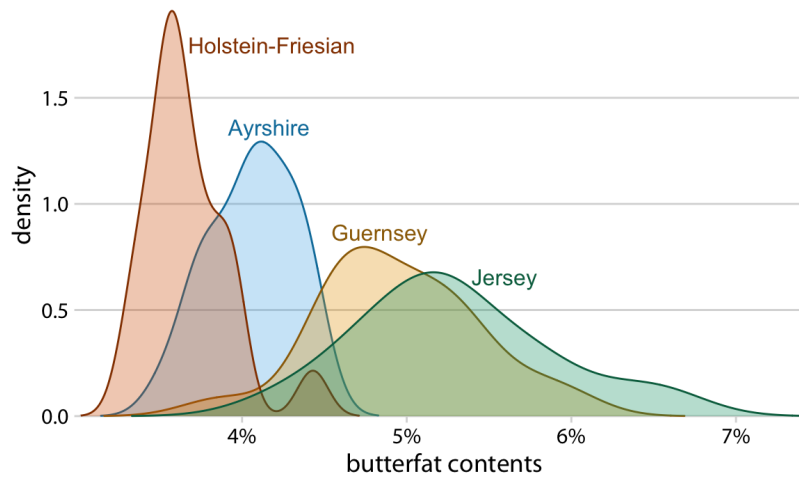


Density estimates of the butterfat percentage in the milk of four cattle breeds.
Data Source: Canadian Record of Performance for Purebred Dairy Cattle.

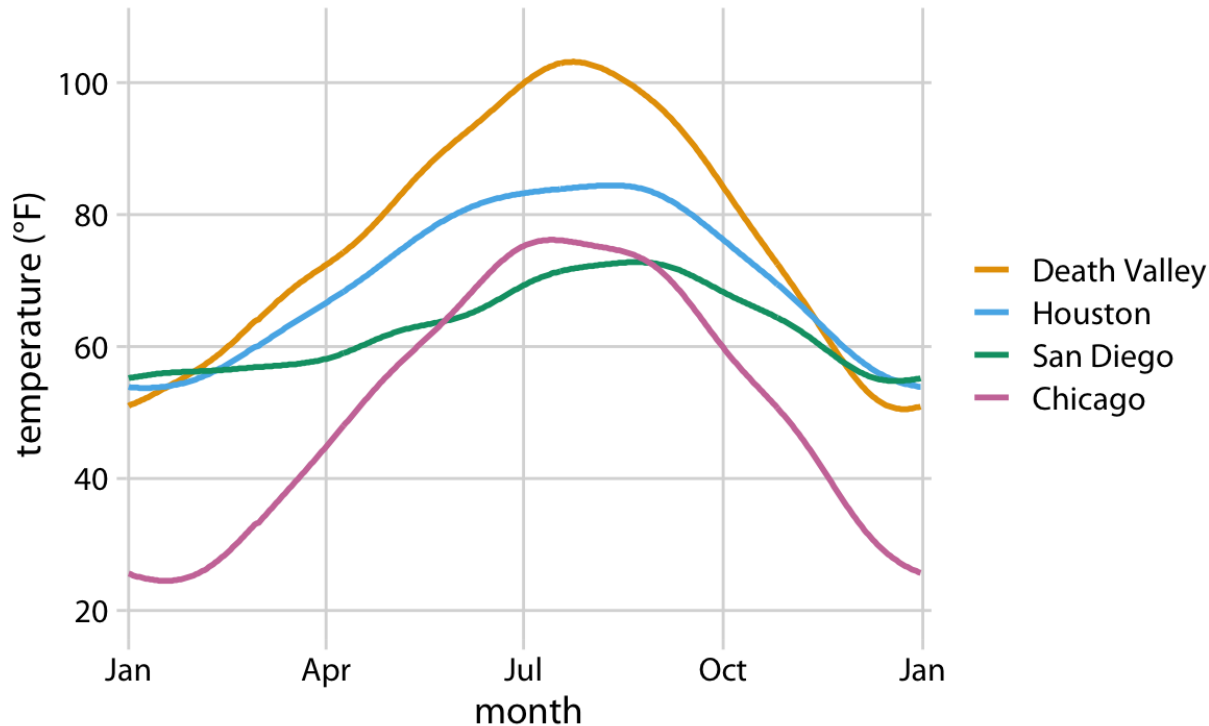
Butterfat from different cows, as bars



Let's compare:

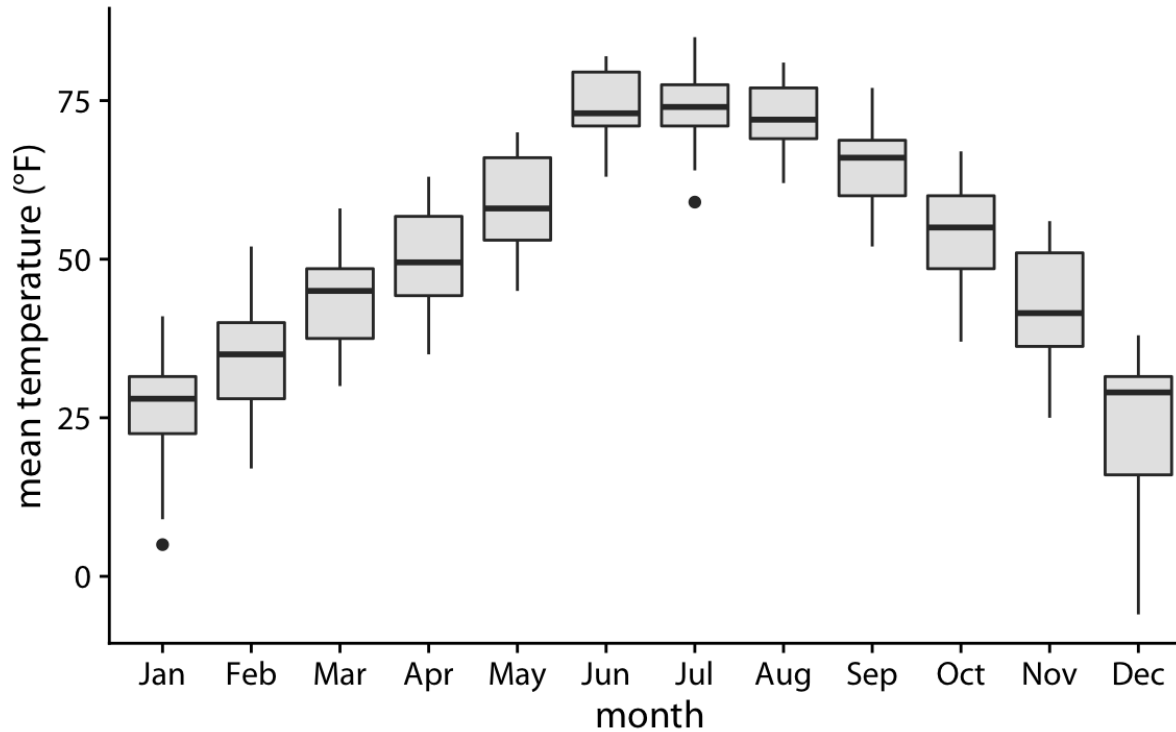


Average daily temperatures

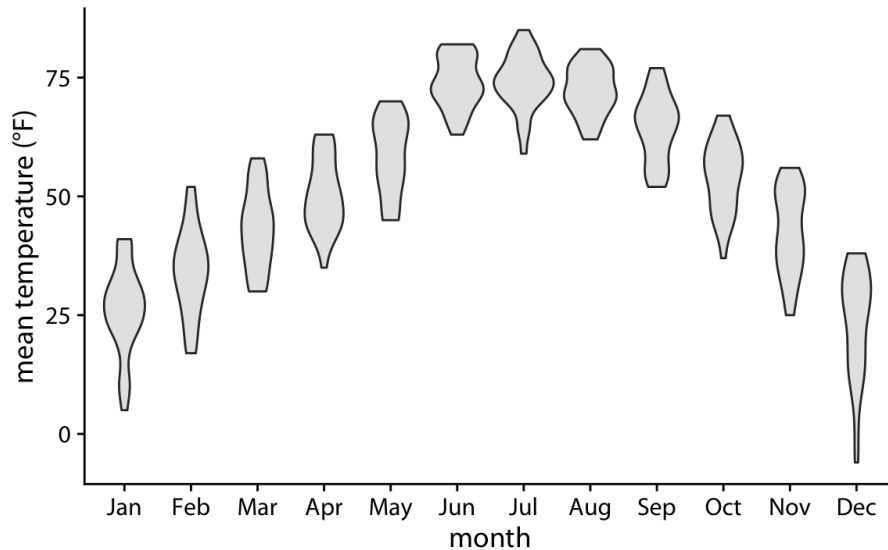
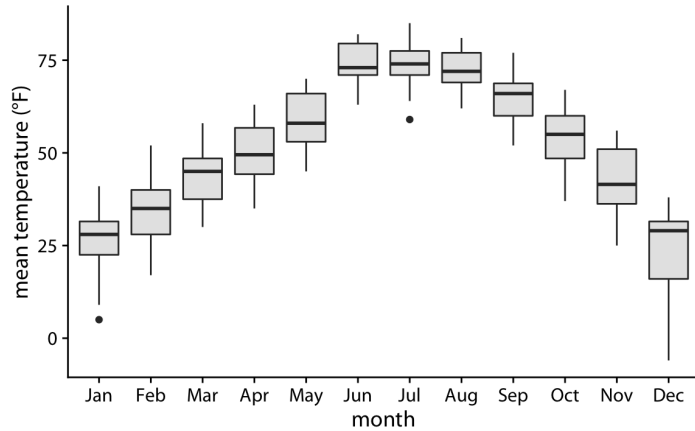


Daily temperature normals for four selected locations in the U.S. Temperature is mapped to the y axis, day of the year to the x axis, and location to line color. Data source: NOAA.

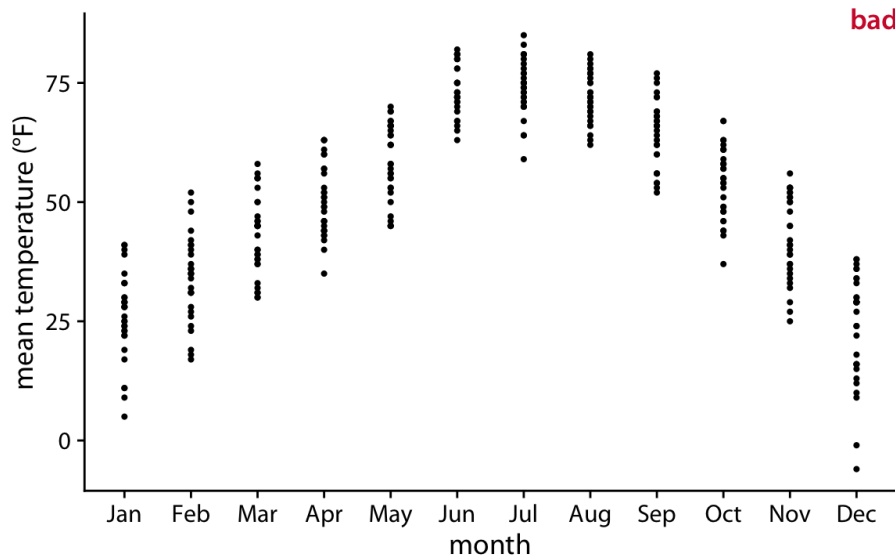
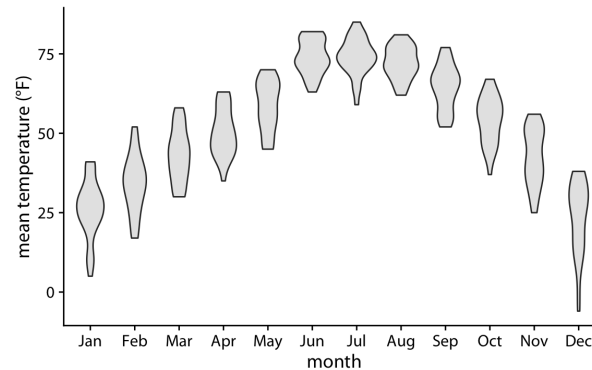
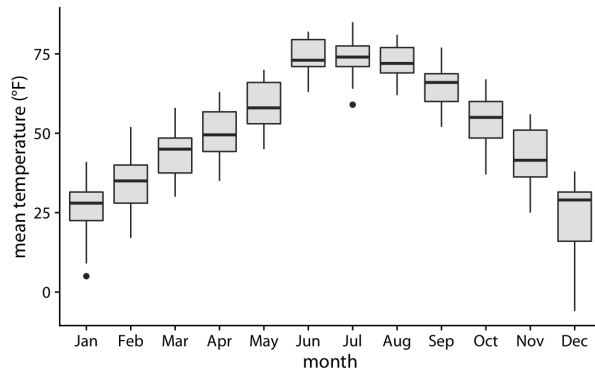
Temperatures in Lincoln, NE in 2016



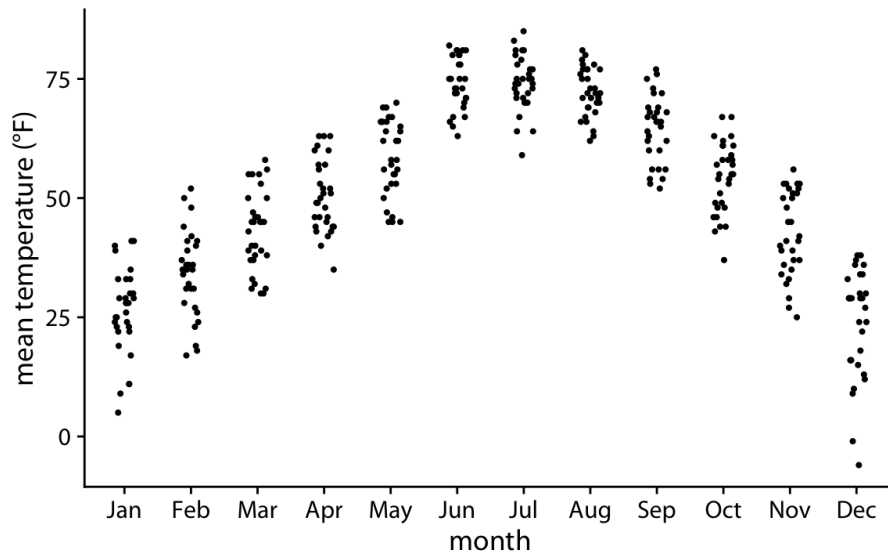
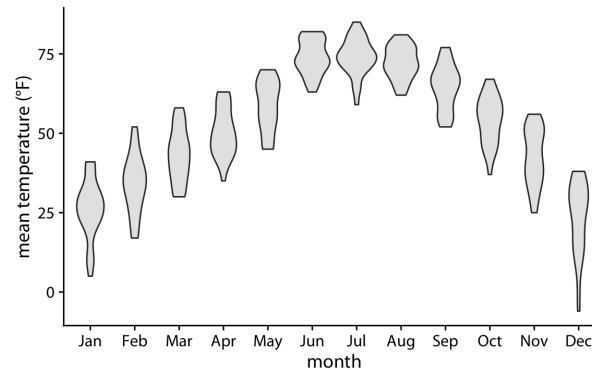
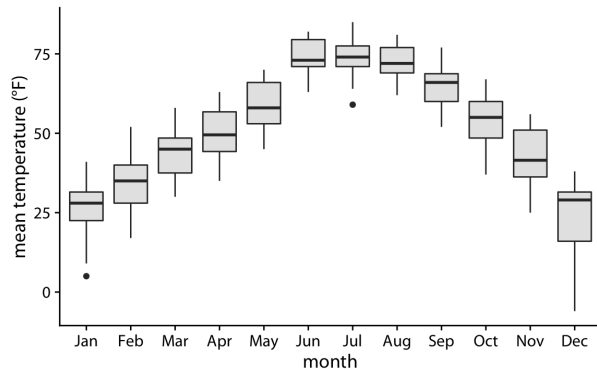
Temperatures in Lincoln, NE in 2016



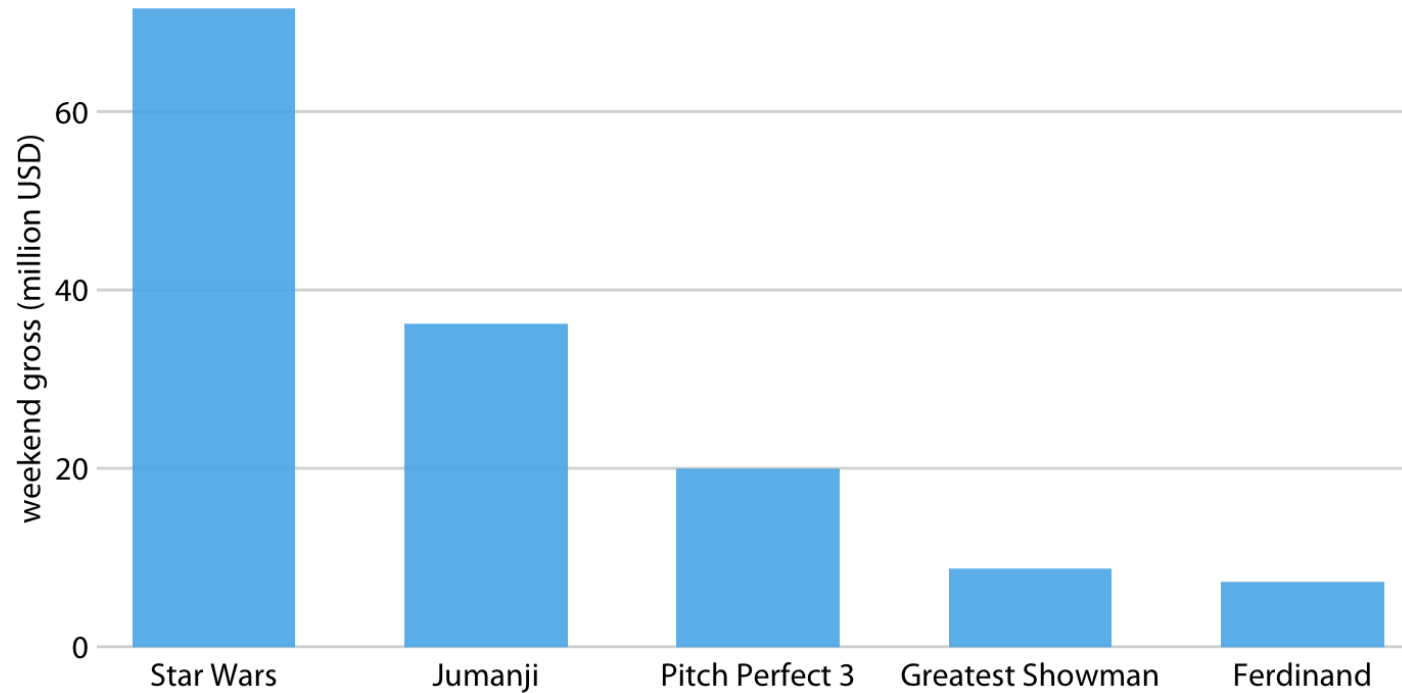
Temperatures in Lincoln, NE in 2016



Temperatures in Lincoln, NE in 2016

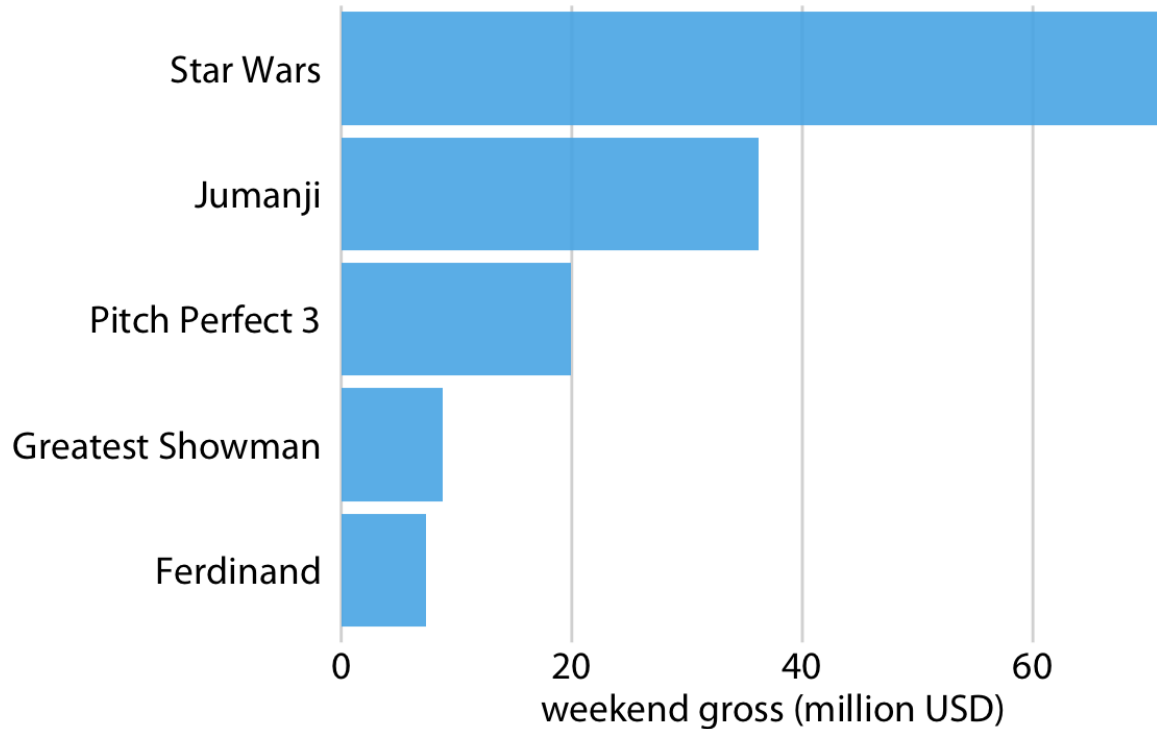


Box office income

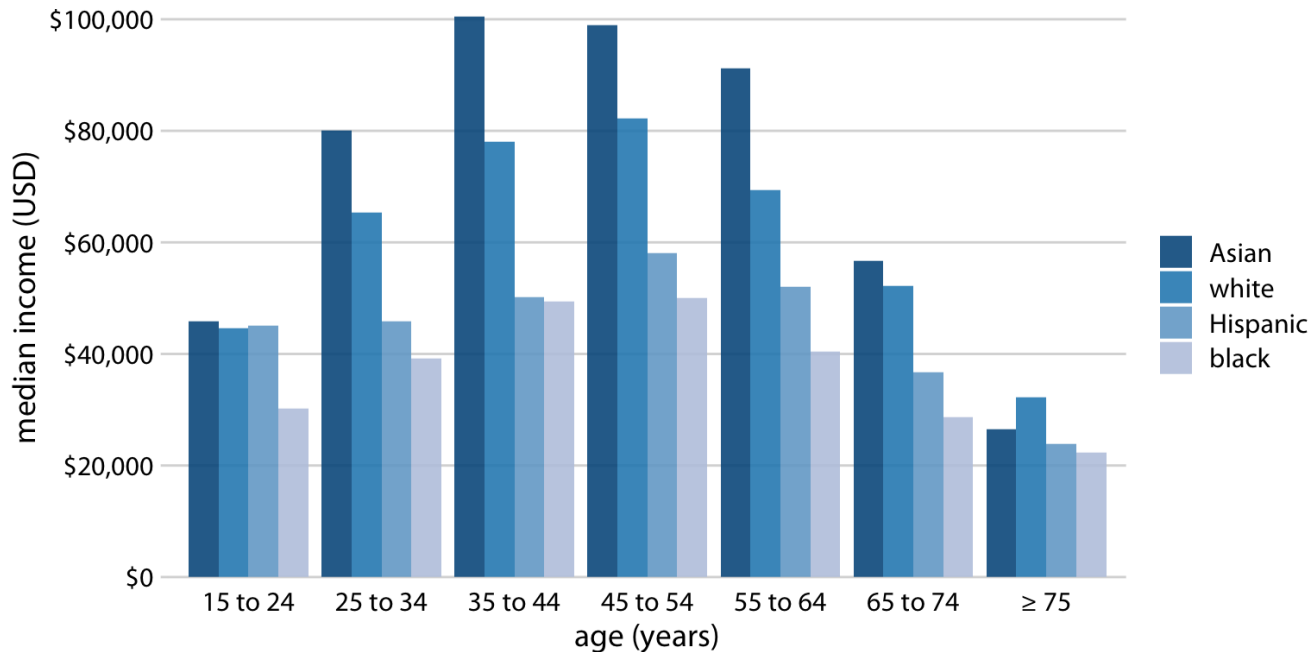


Highest grossing movies for the weekend of December 22-24, 2017. Data source: Box Office Mojo.

Box office income - what's different?

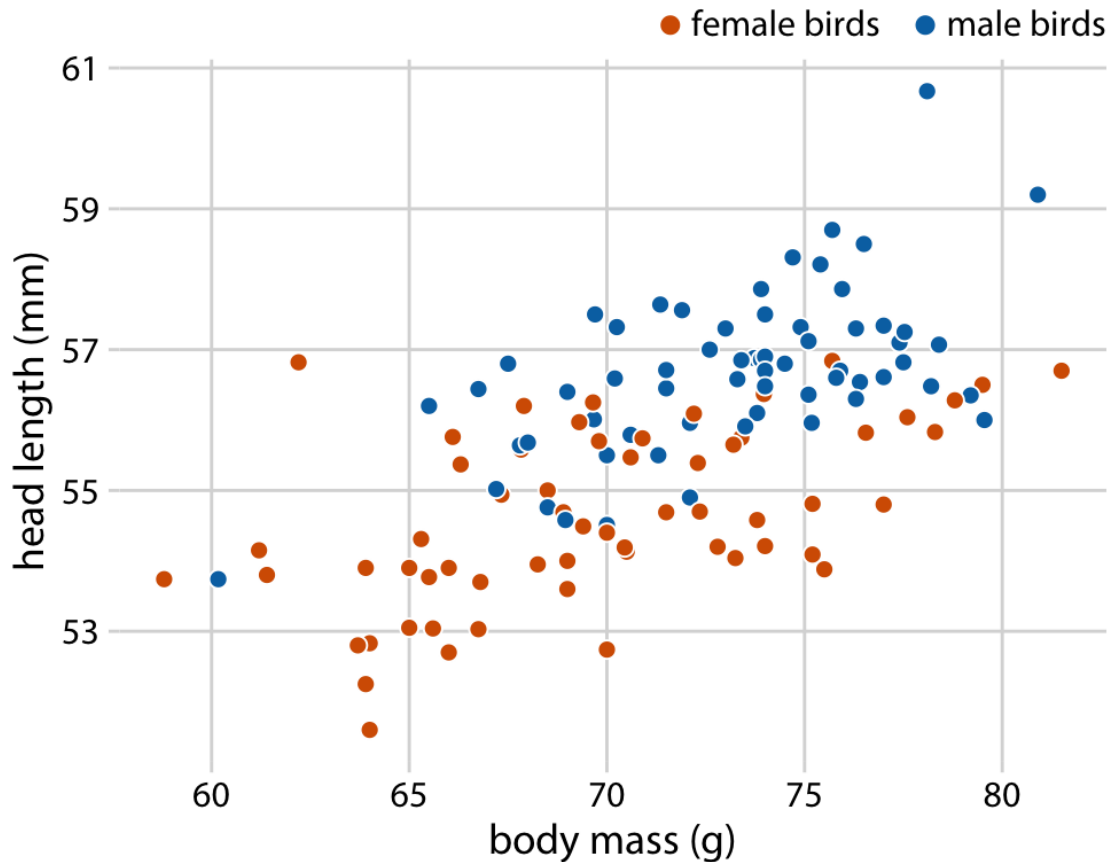


Median household income



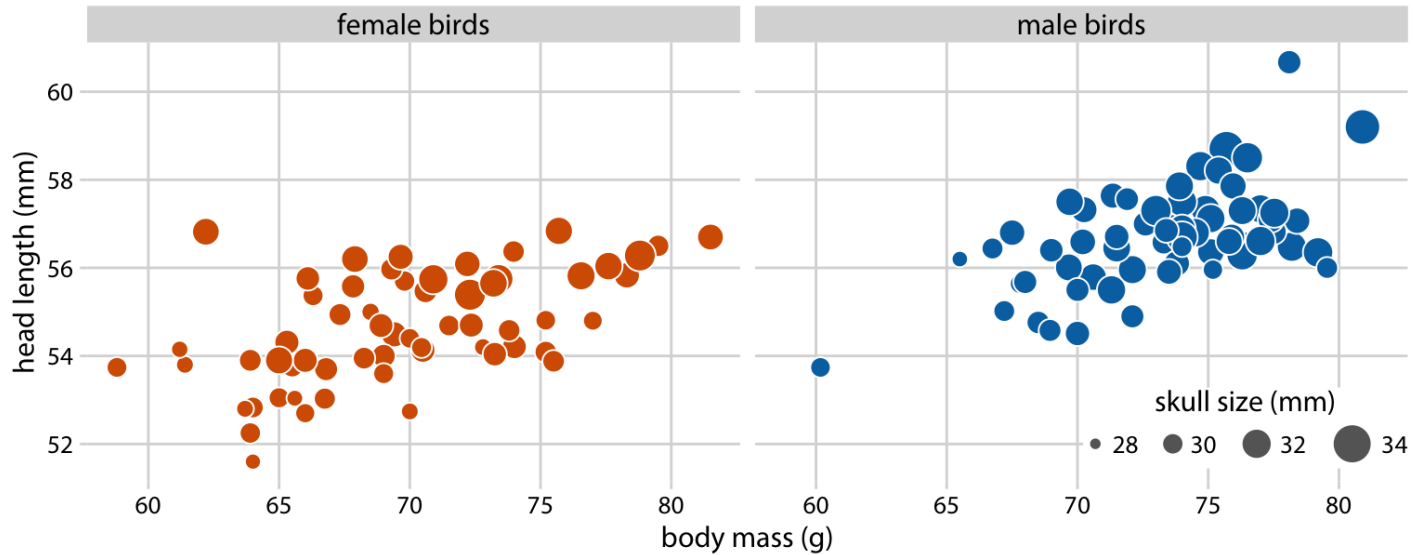
2016 median U.S. annual household income versus age group and race. For each age group there are four bars, corresponding to the median income of Asian, white, Hispanic, and black people, respectively. Data source: United States Census Bureau.

Bluejays

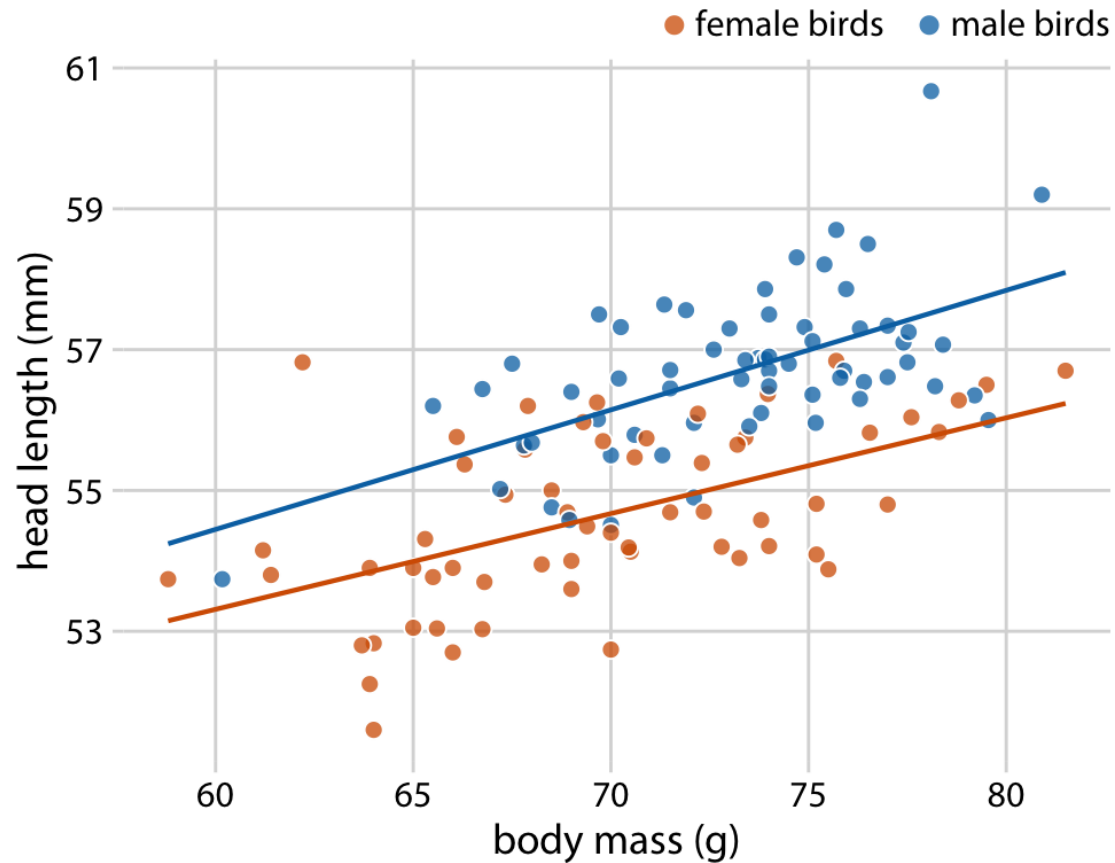


Head length versus body mass for 123 blue jays. The birds' sex is indicated by color. Data source: Keith Tarvin, Oberlin College.

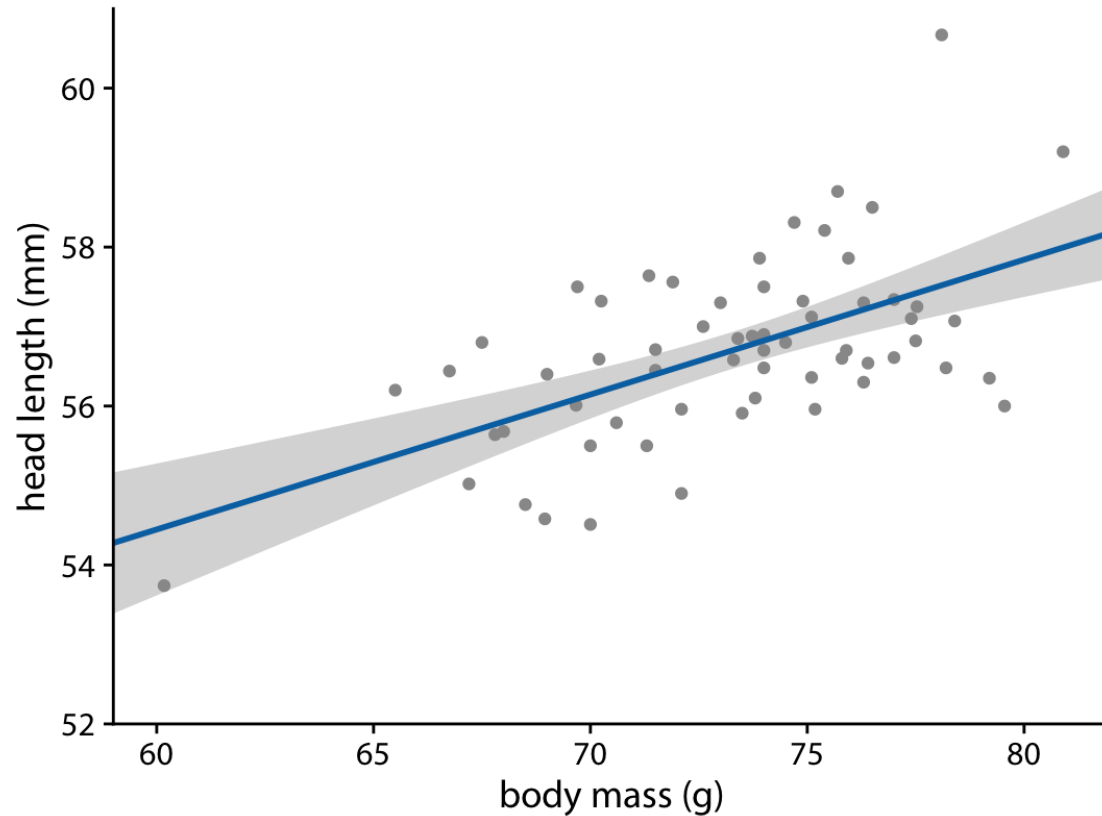
Bluejays, redux 1



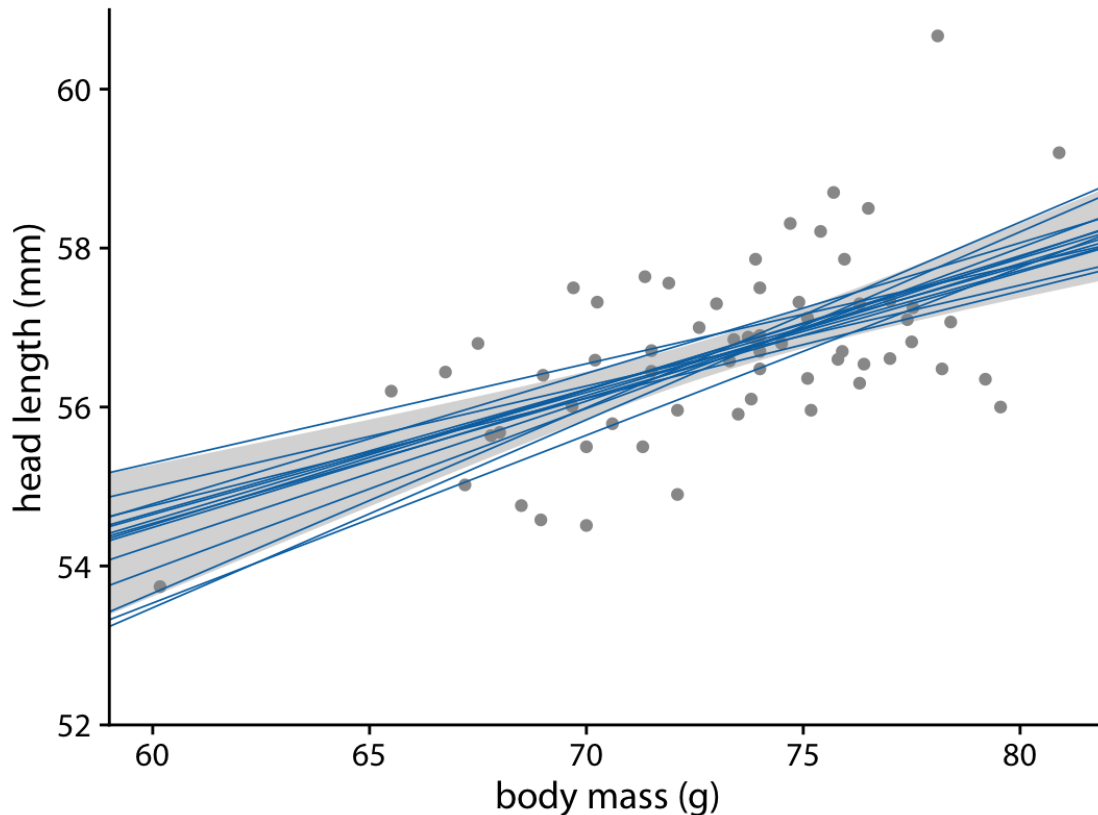
Bluejays, redux 2



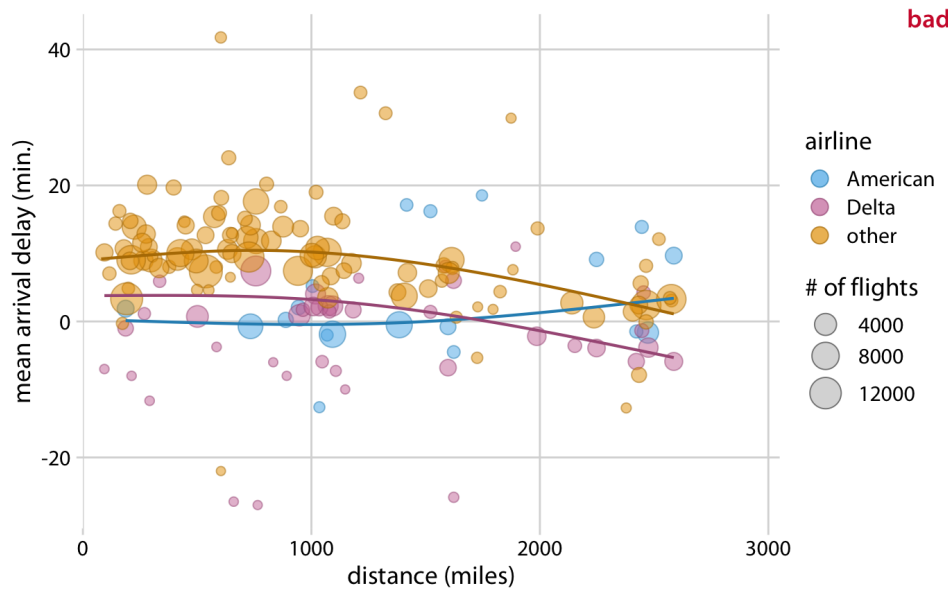
Male bluejays only



Getting an intuition for the *confidence interval*



Airplane delays



Mean arrival delay versus distance from New York City. Data source: U.S. Dept. of Transportation, Bureau of Transportation Statistics.

This figure is labeled as “bad” because it is overly complex. Most readers will find it confusing and will not intuitively grasp what it is the figure is showing.

"Looking cool/smart" is NOT the same as effectively communicating. We'll talk more about data viz style and best practices after we start learning how to plot in R next week!