Distributions: part one

VISUALIZATION BEST PRACTICES IN R

Nick Strayer
Instructor

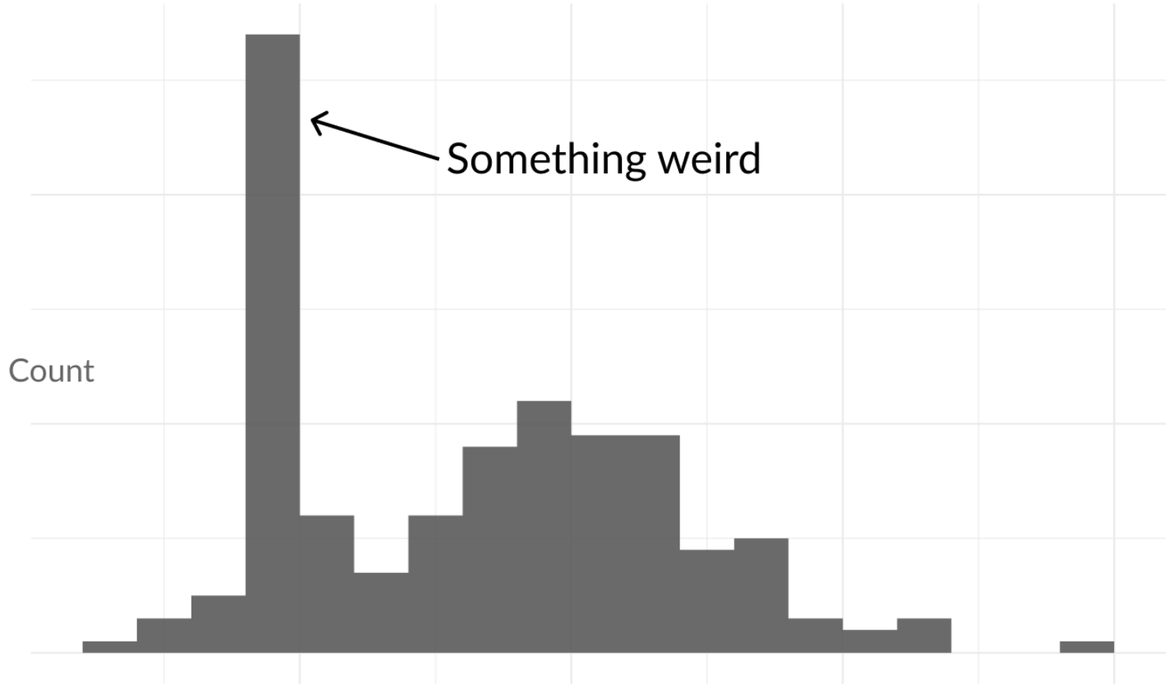
datacamp

What is distribution data?

- Multiple 'observations'
- Usually a sample of some population

Why distributions are important

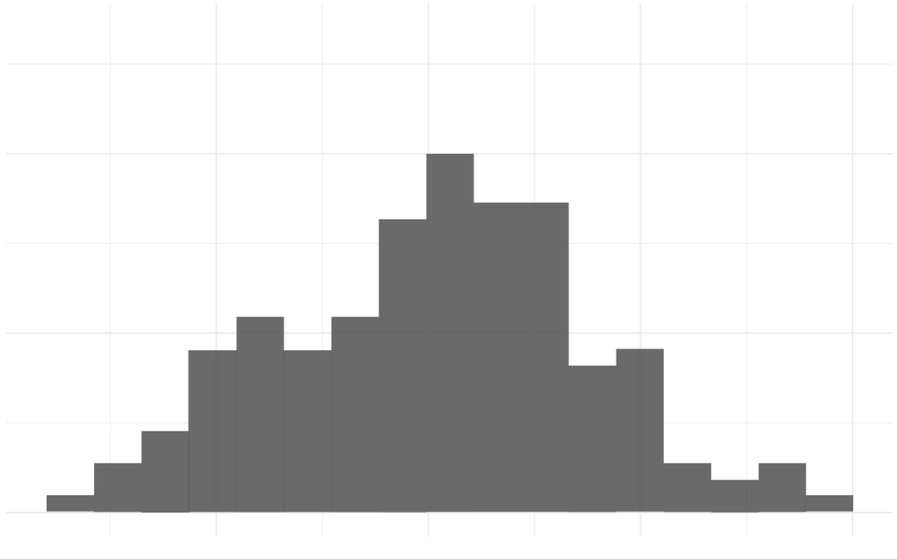
- Data collection or cleaning errors can become apparent
- Could indicate the need to control for a variable in a model
- Being true to the data



Standard plots

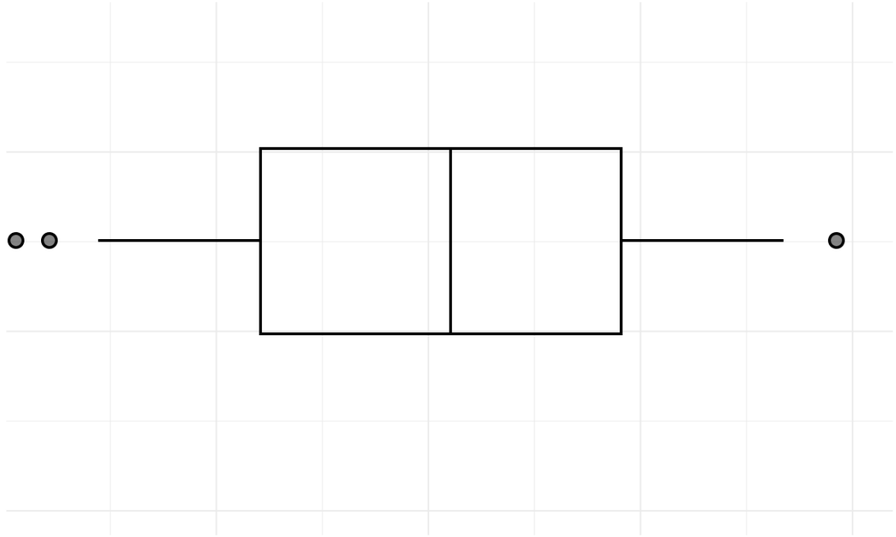
Histogram

- Good for one distribution at a time
- This chapter



boxplot

- For comparing multiple distributions
- Next chapter



Maryland speeding data

- Speeding tickets given in Mongomery County, Maryland for 2017
- Retrieved from **data.montgomerycountymd.gov**

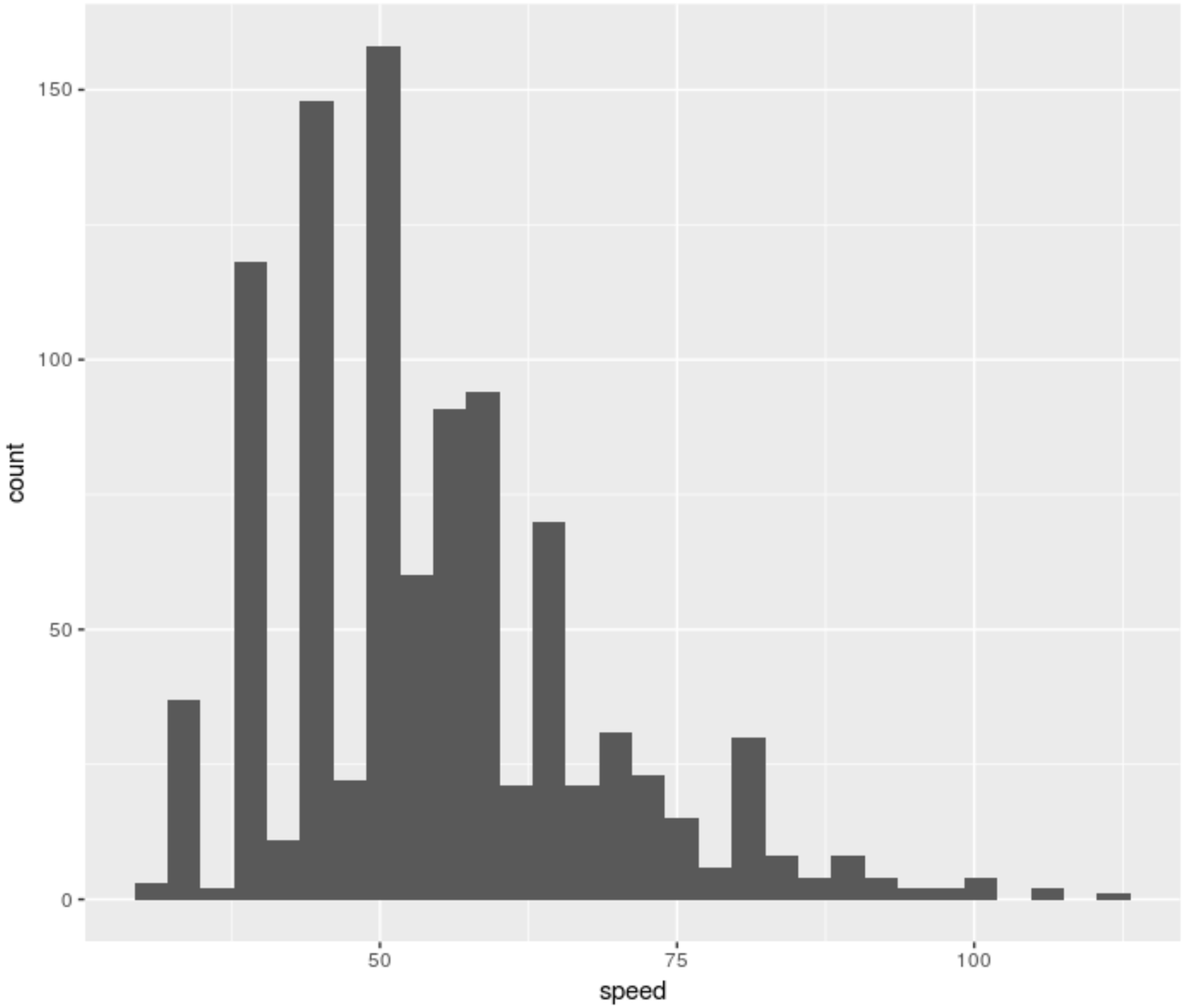
```
md_speeding
```

```
# A tibble: 10,499 x 15
   work_zone vehicle_type vehicle_year vehicle_color race     gender driver_state speed_limit speed
   <lgl>     <chr>                <int> <chr>         <chr>    <chr>  <chr>              <int> <int>
 1 F         Automobile            2003 BLUE          HISPANIC F      MD                    30    39
 2 F         Automobile            2017 GREY          HISPANIC M      MD                    35    45
 3 F         Automobile            2016 WHITE         WHITE    M      MD                    35    50
 4 F         Automobile            2006 RED           HISPANIC M      MD                    35    60
 5 F         Automobile            2013 GREY          OTHER    F      MD                    40    49
 6 F         Automobile            2017 RED           WHITE    M      MD                    40    49
 7 F         Automobile            2003 GREY          BLACK    M      MD                    40    49
 8 F         Automobile            2004 GREY          OTHER    M      MD                    40    49
 9 F         Automobile            2000 WHITE         ASIAN    M      MD                    55    90
10 F         Automobile            2007 BLACK         BLACK    F      MD                    35    59
# ... with 10,489 more rows, and 6 more variables: day_of_week <chr>, day_of_month <int>,
#   month <chr>, hour_of_day <dbl>, speed_over <int>, percentage_over_limit <dbl>
```

Making a histogram in ggplot2

- `geom_histogram()`
- Automatically bins data for you
- Just supply `x` `aes` thetic

```
md_speeding %>%
  filter(vehicle_color == 'BLUE') %>%
  ggplot(aes(x = speed)) +
  geom_histogram()
```


150
100
50
0
count
50
75
100
speed

Let's make some histograms!

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Histogram nuances

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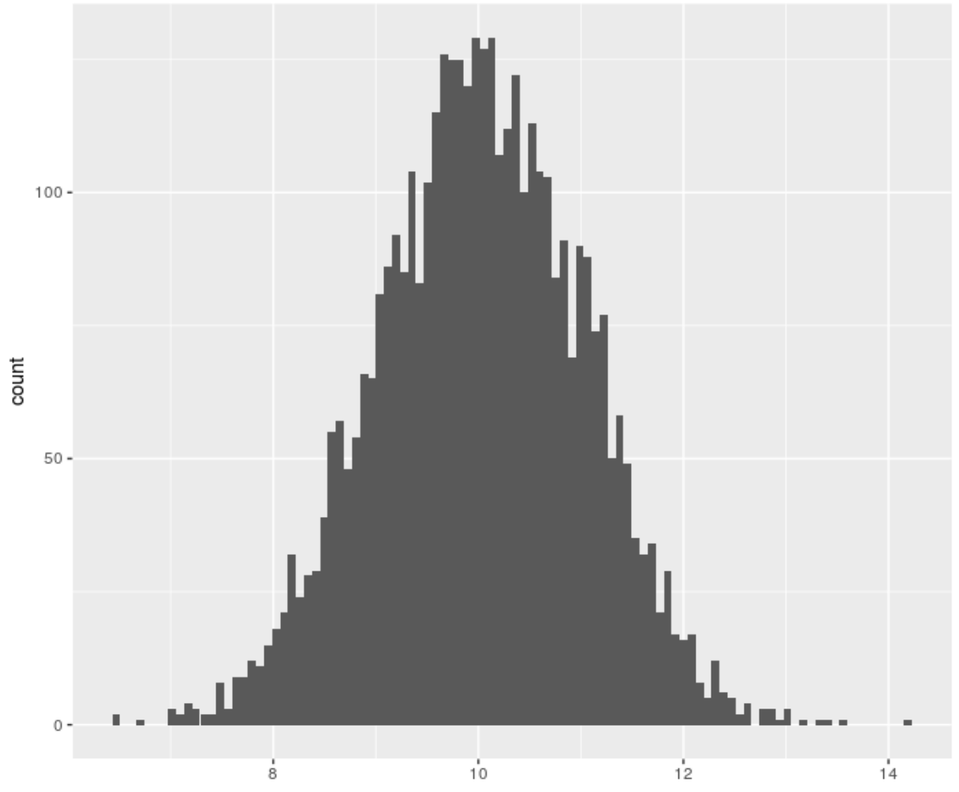
datacamp

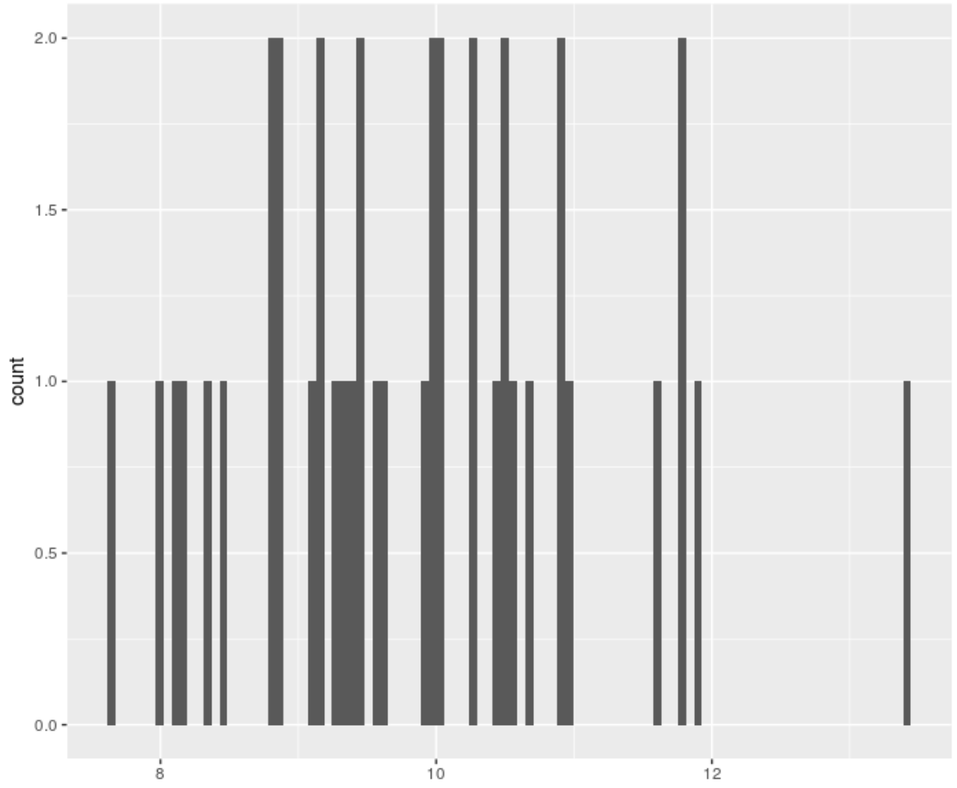
Histogram positives

- Intuitive
- Interpretable



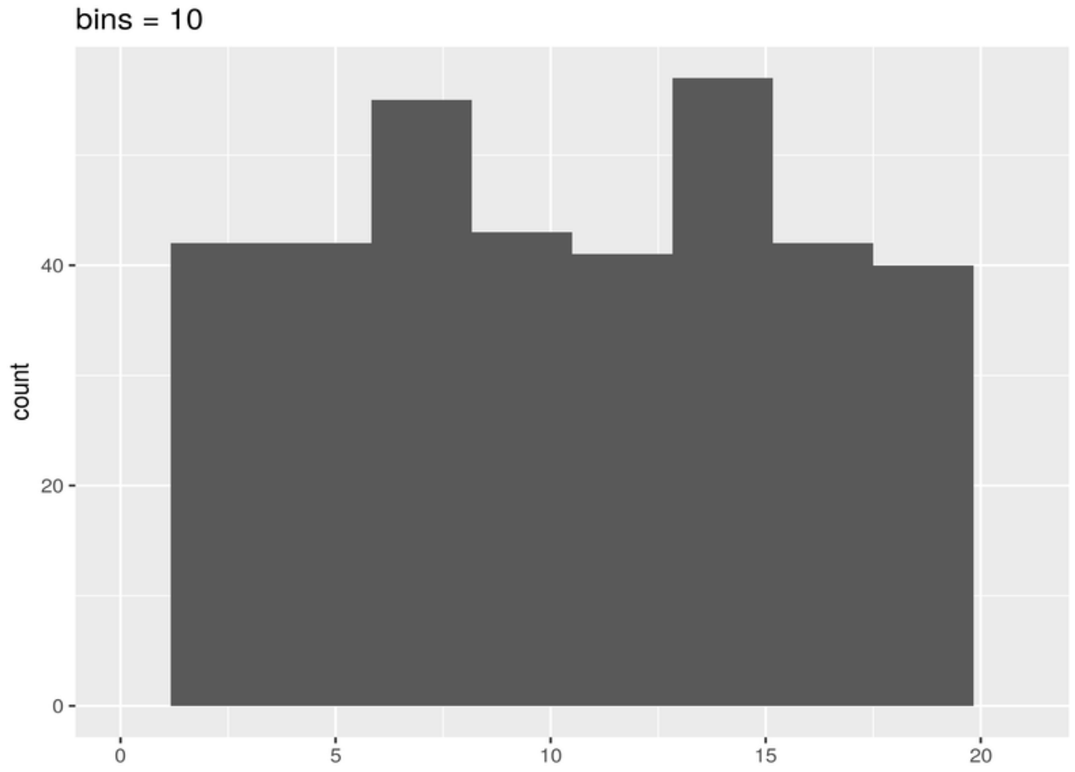
Histogram negatives

- Sensitive to bin placements
- Iffy with small amounts of data



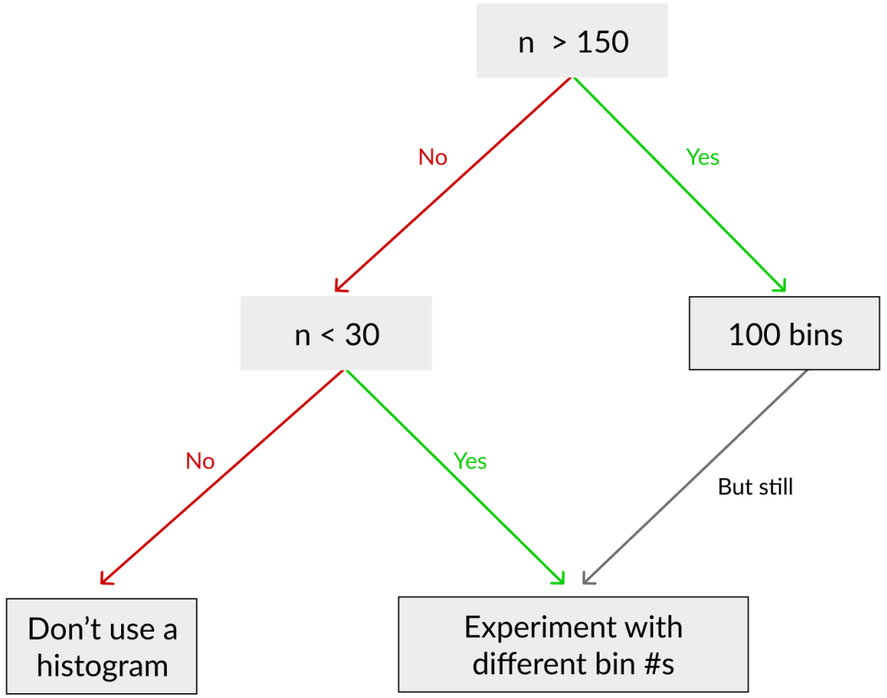
Adjusting number of bins

- Exact same data
- Varying bin-numbers (`geom_histogram(bins = n))`) from 10 to 55



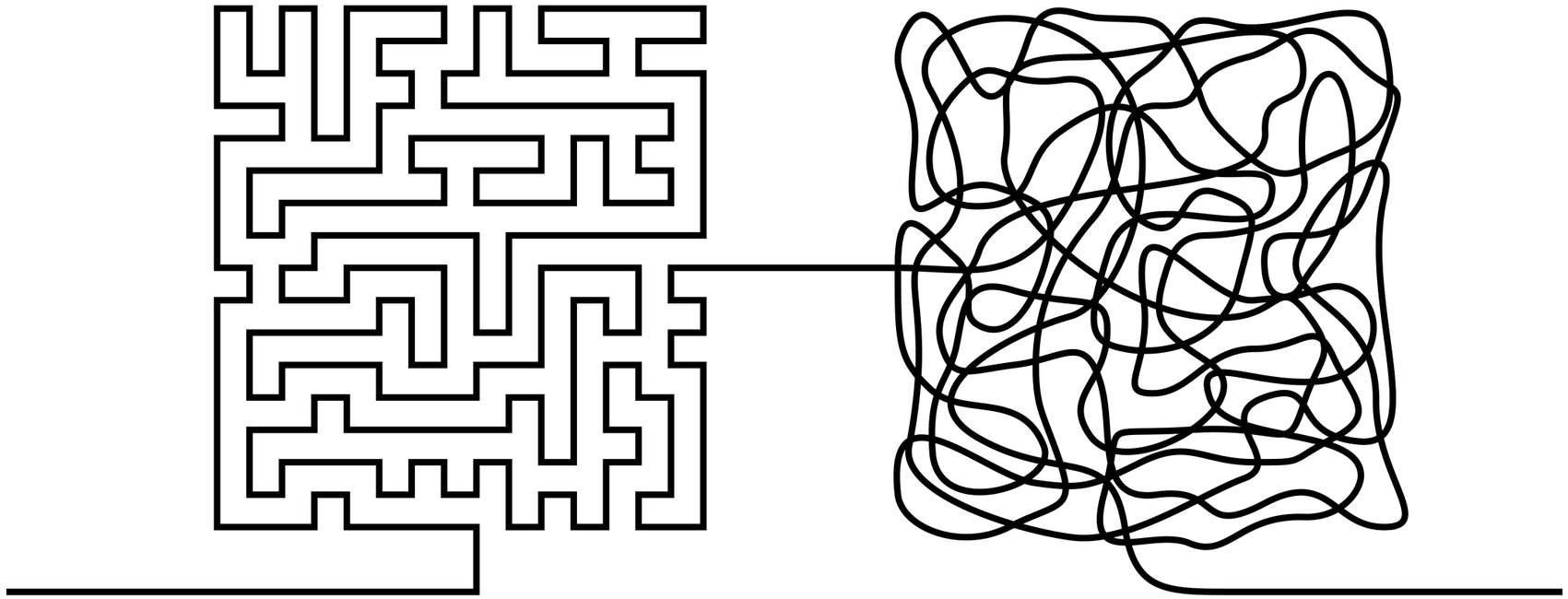
Bin number best practices

- If `length(data$x) > 150` → `bins = 100`
- Otherwise, play around to get a good sense of the data



Reality

- Beware of digit preferences
- Data from automated sources are less likely to be problematic



Let's improve some histograms!

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The kernel density estimator

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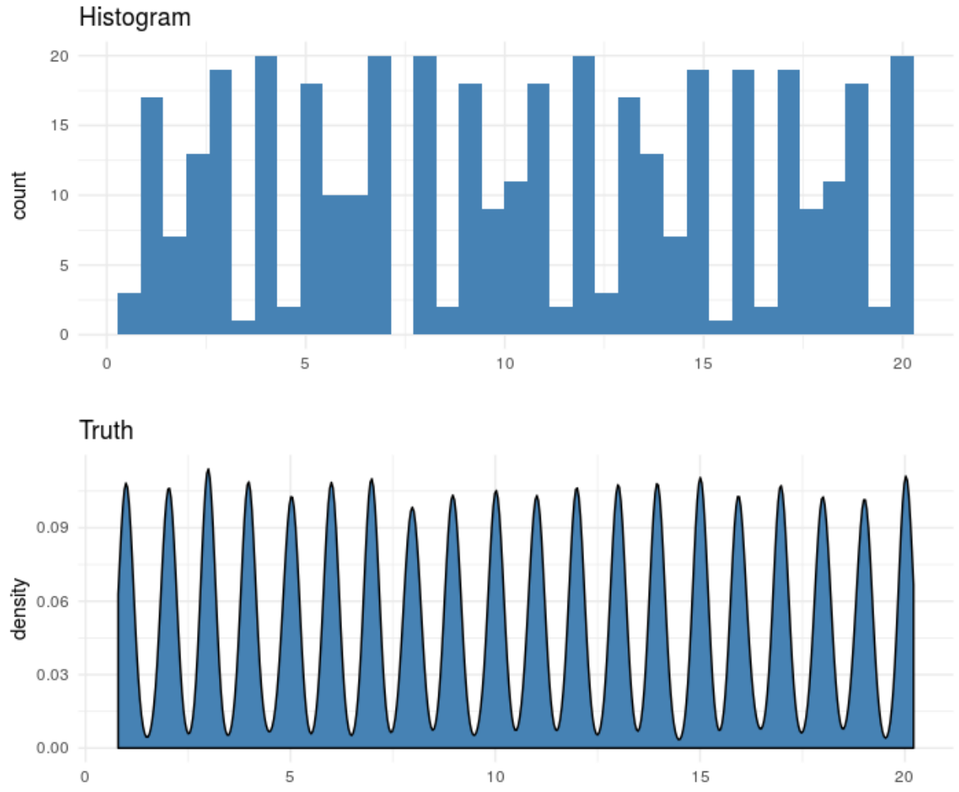
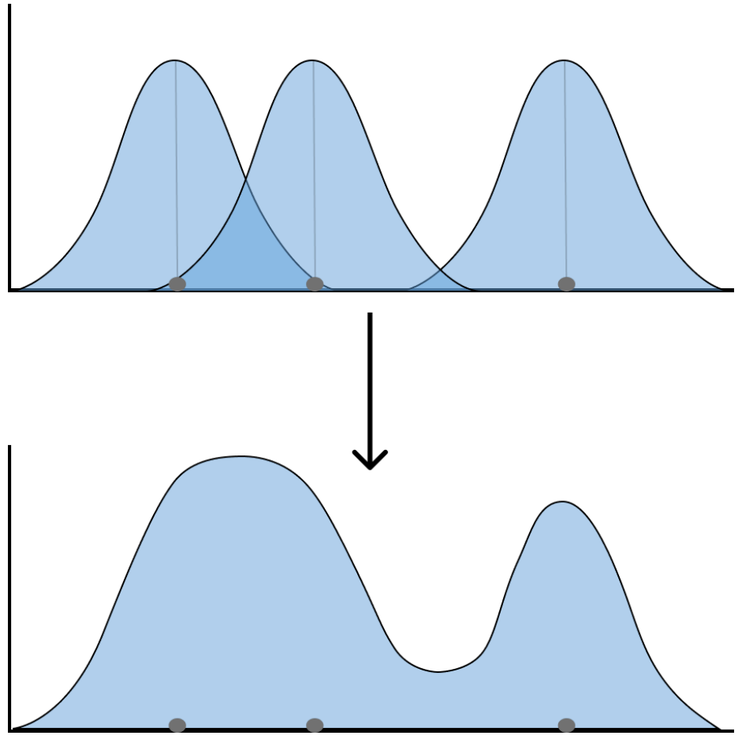
Where histograms struggle

- Data with multiple strong peaks
- Small data



Kernel density plots

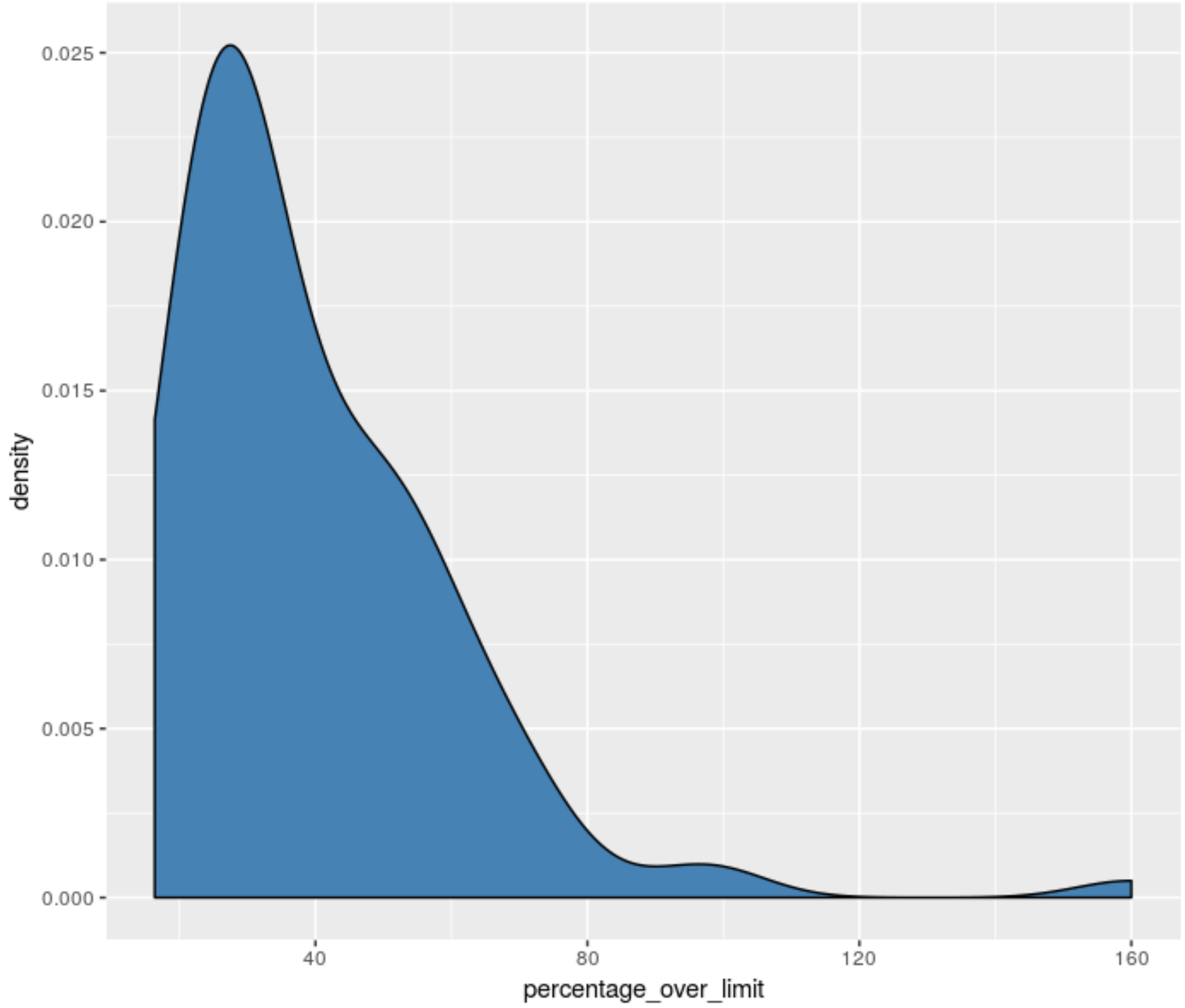
- Place "kernel" on top of every data point
- Add up heights of all overlapping kernels



Making a KDE in ggplot

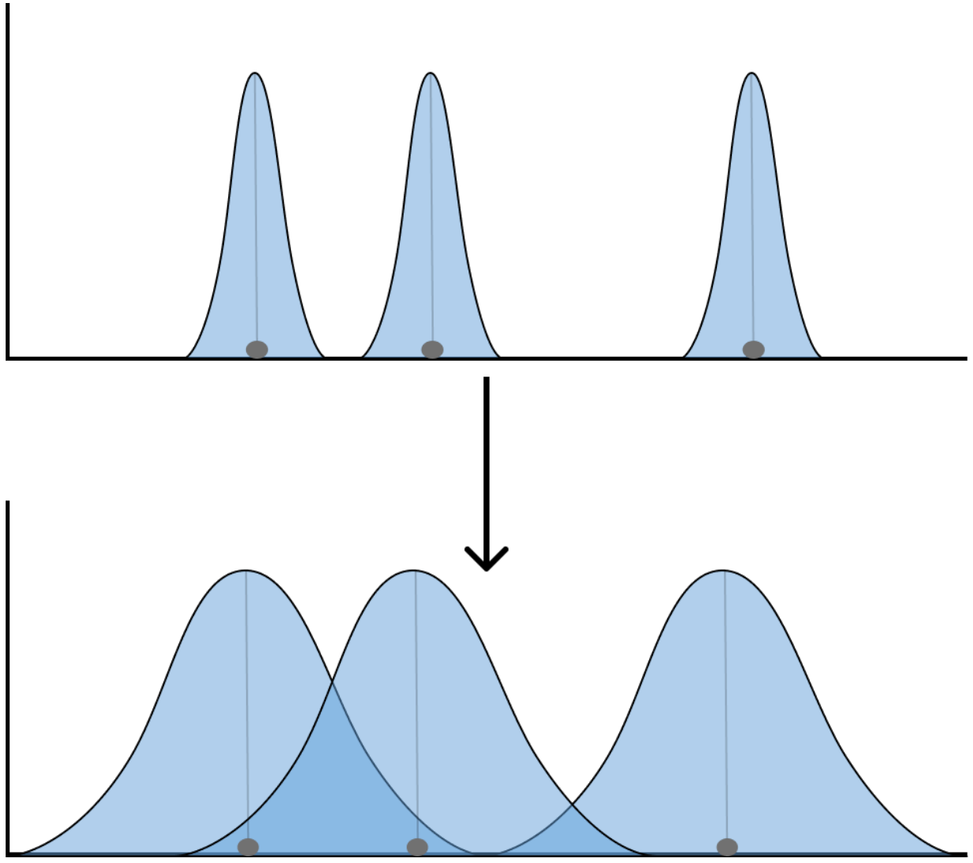
- Just swap `geom_histogram()` for `geom_density()`

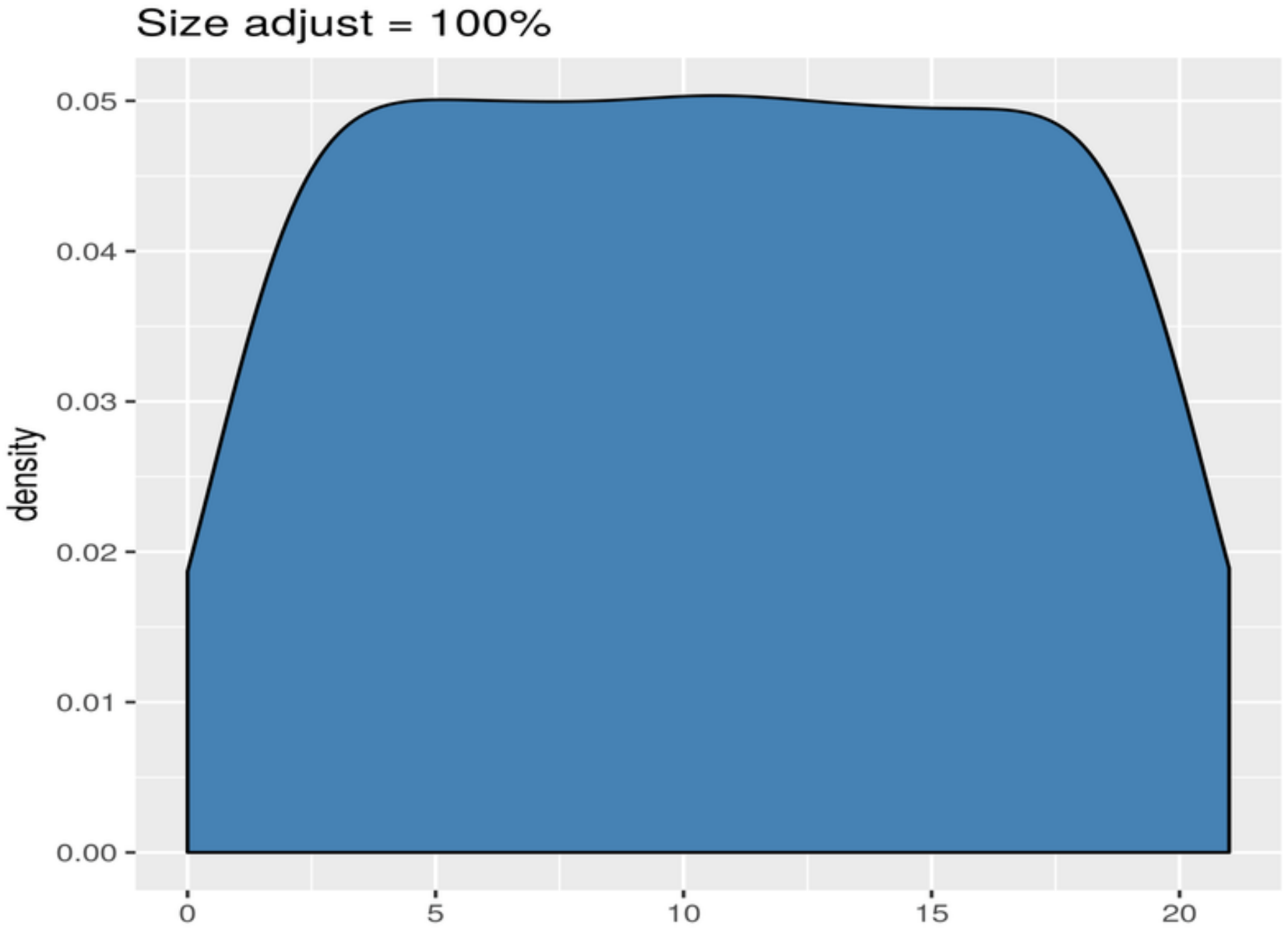
```
sample_n(md_speeding, 100) %>%
  ggplot(aes(x = percentage_over_limit)) +
  # Swap out geom_histogram()
    geom_density(
      # Fill in curve with color
      fill = 'steelblue',
      # Standard deviation of kernel
      bw = 8
    )
```


0.025
0.020
0.015
0.010
0.005
0.000
density
40
80
120
160
percentage_over_limit

A new width to worry about

- Need to adjust the standard deviation of the kernel placed on each point

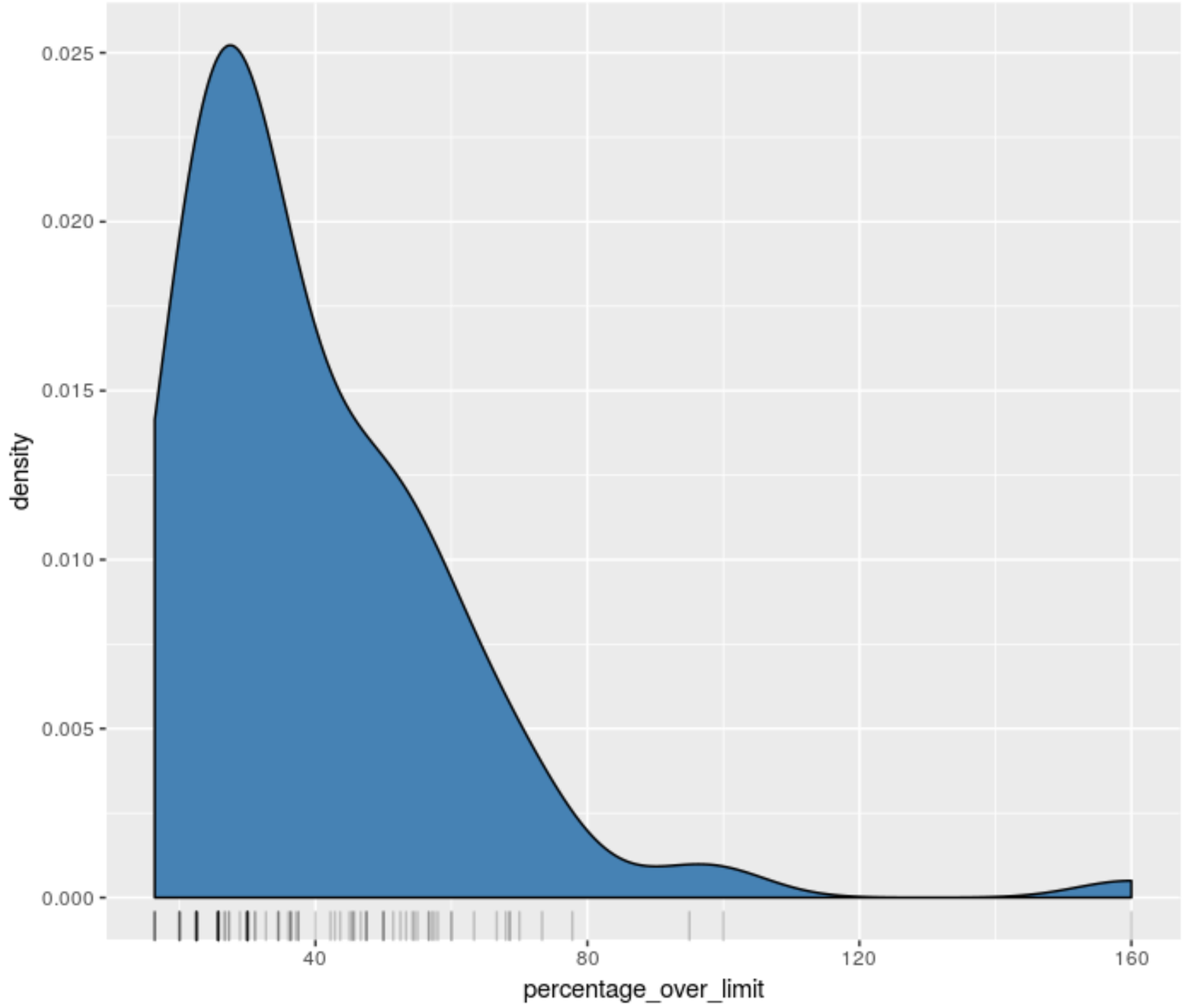



Size adjust = 100%
density
0.05
0.04
0.03
0.02
0.01
0.00
0
5
10
15
20

Show all the data

Use `geom_rug()` to show all data below KDE with lines

```
p <-sample_n(md_speeding, 100) %>%
  ggplot(aes(x = percentage_over_limit)) +
  geom_density(
    fill = 'steelblue', # fill in curve with color
    bw = 8 # standard deviation of kernel
  )
p + geom_rug(alpha = 0.4)
```


0.025
0.020
0.015
0.010
0.005
0.000
density
40
80
120
160
percentage_over_limit

Let's stack some gaussians!

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