Tidy Data and Summarization

Jameson Watts, Ph.D.

Agenda

1. Review (and upgrade)
2. Tame and tidy data
3. Data Summarization

Review

Filter, arrange, and select

Load the wine dataset and output a tibble of…

1. Pinot Noir
2. from Oregon
3. in descending order by points,
4. and ascending order by price,
5. that only shows points, price and title

Solution

```
wine %>%
  filter(province=="Oregon") %>%
  filter(variety=="Pinot Noir") %>%
  arrange(desc(points), price) %>%
  select(points, price, title)
```

```
## # A tibble: 2,786 x 3
##    points price title
##     <dbl> <dbl> <chr>
##  1     97    65 Ken Wright 2012 Abbott Claim Vineyard Pinot Noir
##  2     96    30 Sineann 2015 TFL Pinot Noir (Willamette Valley)
##  3     96    40 Scott Paul 2009 Dix Pinot Noir (Dundee Hills)
##  4     96    60 Patricia Green Cellars 2015 Estate Vineyard Etzel Block Pi…
##  5     96    63 Ken Wright 2014 Bryce Vineyard Pinot Noir (Ribbon Ridge)
##  6     96    63 Ken Wright 2014 Abbott Claim Vineyard Pinot Noir
##  7     96    65 Ken Wright 2012 Freedom Hill Vineyard Pinot Noir (Willamet…
##  8     96    85 Alloro 2014 Estate Justina Pinot Noir (Chehalem Mountains)
##  9     96    85 The Eyrie Vineyards 2012 Original Vines Estate Pinot Noir …
## 10     96    85 Domaine Drouhin Oregon 2011 Édition Limitée Pinot Noir (Du…
## # … with 2,776 more rows
```

Summarize

What are the mean price and points for Oregon Pinot Noir?

Hint: Use skim()

Solution

```r
library(skimr)
wine %>%
  filter(province=="Oregon") %>%
  filter(variety=="Pinot Noir") %>%
  arrange(desc(points), price) %>%
  select(points, price) %>%
  skim()
```

```
## Skim summary statistics
##  n obs: 2786
##  n variables: 2
##
## ── Variable type:numeric ────────────────────────────────────────────────────────────────────────────────────────
##  variable missing complete    n  mean    sd p0 p25 p50 p75 p100     hist
##    points       0     2786 2786 89.47  2.66 80  88  90  91   97 ▁▁▁▂▅▅▅▅▂▁
##     price       7     2779 2786 44.62 20.19  9  30  42  55  275 ▇▇▁▁▁▁▁▁▁▁
```

Next level…

- and ('&') vs. or ('|')
- not ('!') and not equal ('!=')
- top_n() and top_frac()

Use logical operators and the top_n function to find…

1. the top 10 French or Italian wines by price.
2. showing only points, price and title
3. arranged by points descending.

Solution

```
wine %>%
  filter(country=="France" | country=="Italy") %>%
  top_n(10,price) %>%
  arrange(desc(points)) %>%
  select(points, price, title)
```

```
## # A tibble: 10 x 3
##    points price title
##     <dbl> <dbl> <chr>
##  1    100  1500 Château Lafite Rothschild 2010  Pauillac
##  2    100  1500 Château Cheval Blanc 2010  Saint-Émilion
##  3     98  1900 Château Margaux 2009  Margaux
##  4     97  2000 Château Pétrus 2011  Pomerol
##  5     96  1200 Château Haut-Brion 2009  Pessac-Léognan
##  6     96  1300 Château Mouton Rothschild 2009  Pauillac
##  7     96  2500 Château Pétrus 2014  Pomerol
##  8     96  2500 Domaine du Comte Liger-Belair 2010  La Romanée
##  9     96  2000 Domaine du Comte Liger-Belair 2005  La Romanée
## 10     88  3300 Château les Ormes Sorbet 2013  Médoc
```

More practice

Use logical operators and the top_n function to find…

1. the top 5 Oregon wines by points
2. that aren't Chardonnay
3. Showing only points, price and title
4. arranged by price ascending.

Solution

```
wine %>%
  filter(province=="Oregon") %>%
  filter(variety!="Chardonnay") %>%
  top_n(5,points) %>%
  arrange(price) %>%
  select(points, price, title)
```

```
## # A tibble: 7 x 3
##   points price title
##    <dbl> <dbl> <chr>
## 1     97    65 Ken Wright 2012 Abbott Claim Vineyard Pinot Noir
## 2     99    75 Cayuse 2009 En Chamberlin Vineyard Syrah (Walla Walla Valle…
## 3     99    75 Cayuse 2011 En Chamberlin Vineyard Syrah (Walla Walla Valle…
## 4     98    75 Cayuse 2011 En Cerise Vineyard Syrah (Walla Walla Valley (O…
## 5     97    80 Cayuse 2009 The Widowmaker Cabernet Sauvignon (Walla Walla …
## 6     97    85 Cayuse 2009 Armada Vineyard Syrah (Walla Walla Valley (OR))
## 7     97    90 Cayuse 2011 Widowmaker En Chamberlin Vineyard Cabernet Sauv…
```

- Why are there more than 5 rows?

Even more practice

Use logical operators and top_frac functions to find…

1. the top 5% by points
2. of Oregon wines
3. that are neither Pinot Noir nor Chardonnay
4. Showing only points, price and title
5. arranged by points descending and price ascending.

Solution

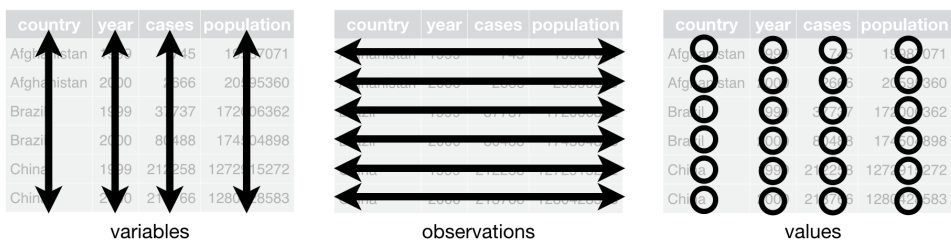
```
wine %>%
  filter(province=="Oregon") %>%
  filter(variety != "Pinot Noir" & variety != "Chardonnay") %>%
  top_frac(.01,points) %>%
  select(points, price, title) %>%
  arrange(desc(points), price)
```

```
## # A tibble: 26 x 3
##    points price title
##     <dbl> <dbl> <chr>
##  1     99    75 Cayuse 2009 En Chamberlin Vineyard Syrah (Walla Walla Vall…
##  2     99    75 Cayuse 2011 En Chamberlin Vineyard Syrah (Walla Walla Vall…
##  3     98    75 Cayuse 2011 En Cerise Vineyard Syrah (Walla Walla Valley (…
##  4     97    80 Cayuse 2009 The Widowmaker Cabernet Sauvignon (Walla Walla…
##  5     97    85 Cayuse 2009 Armada Vineyard Syrah (Walla Walla Valley (OR))
##  6     97    90 Cayuse 2011 Widowmaker En Chamberlin Vineyard Cabernet Sau…
##  7     96    32 Trisaetum 2016 Ribbon Ridge Estate Dry Riesling (Ribbon Ri…
##  8     96    38 Trisaetum 2015 Estates Reserve Riesling (Willamette Valley)
##  9     96    70 Cayuse 2012 Cailloux Vineyard Viognier (Walla Walla Valley…
## 10     96    75 Cayuse 2009 Camaspelo Cabernet Sauvignon-Merlot (Walla Wal…
## # … with 16 more rows
```

Tame and tidy data

Philosophy (review)

- Tame data is data with understandable column names and well-formatted values
- Tidy data is data with:
  - Each variable must have its own column
  - Each observation must have its own row
  - Each value must have its own cell



This is often the difference between data that is considered “long” and data that is considered “wide.”

Image credit: https://rstudio-pubs-static.s3.amazonaws.com/396363_adaf67178eab4bd793bd9dd17dda70b3.html

Different data types

*Each column must contain values of the **SAME** type

- Numeric (integers, fractions)
- Character (Words)
- Factor (Categories)
- Date (also includes time)
- Logical (true or false, 1 or 0)

See here for more information.

New dataframes

So far, we've been piping operations from a single dataframe. But what if you want to save the result for later?

```
wine_oregon <- wine %>%
  filter(province=="Oregon")

wine_oregon
```

```
## # A tibble: 5,373 x 14
##       X1 country description designation points price province region_1
##    <dbl> <chr>   <chr>       <chr>        <dbl> <dbl> <chr>    <chr>
##  1     2 US      Tart and s… <NA>            87    14 Oregon   Willame…
##  2     4 US      Much like … Vintner's …     87    65 Oregon   Willame…
##  3    21 US      A sleek mi… <NA>            87    20 Oregon   Oregon
##  4    35 US      As with ma… Hyland          86    50 Oregon   McMinnv…
##  5    41 US      A stiff, t… <NA>            86    22 Oregon   Willame…
##  6    78 US      Some rosés… Rosé of         86    25 Oregon   Eola-Am…
##  7   173 US      This wine … <NA>            91    38 Oregon   Willame…
##  8   233 US      There is a… Reserve         85    28 Oregon   Willame…
##  9   248 US      This seems… Estate Sin…     85    45 Oregon   Willame…
## 10   251 US      Spicy and … Papillon E…     85    22 Oregon   Willame…
## # … with 5,363 more rows, and 6 more variables: region_2 <chr>,
## #   taster_name <chr>, taster_twitter_handle <chr>, title <chr>,
## #   variety <chr>, winery <chr>
```

Spread and Gather

These are functions to reshape your data. Let's first summarize the wine data by country and save it to a new dataframe

```
wine_country <- wine %>%
  filter(variety=="Cabernet Sauvignon" | variety=="Chardonnay" | variety=="Pinot Gris" | variety =="Syrah") %>%
  group_by(country, variety) %>%
  summarize(points = mean(points))

wine_country
```

```
## # A tibble: 90 x 3
## # Groups:   country [32]
##    country   variety            points
##    <chr>     <chr>               <dbl>
##  1 Argentina Cabernet Sauvignon   86.0
##  2 Argentina Chardonnay           84.9
##  3 Argentina Pinot Gris           84.9
##  4 Argentina Syrah                85.8
##  5 Australia Cabernet Sauvignon   89.3
##  6 Australia Chardonnay           87.3
##  7 Australia Pinot Gris           87.4
##  8 Australia Syrah                91.6
##  9 Austria   Cabernet Sauvignon   87.4
## 10 Austria   Chardonnay           90.3
## # … with 80 more rows
```

Note: Don't stress about the group_by and summarize functions. I'll get to that.

Spread (from long to wide)

Now let's spread it out so that I've got one column for each variety of wine

```
wine_wide <- wine_country %>%
  spread(variety, points)
wine_wide
```

```
## # A tibble: 32 x 5
## # Groups:   country [32]
##    country   `Cabernet Sauvignon` Chardonnay `Pinot Gris` Syrah
##    <chr>                    <dbl>      <dbl>        <dbl> <dbl>
##  1 Argentina                 86.0       84.9         84.9  85.8
##  2 Australia                 89.3       87.3         87.4  91.6
##  3 Austria                   87.4       90.3         90.1  89
##  4 Brazil                    83         83.8         NA    NA
##  5 Bulgaria                  87.8       88.5         NA    89
##  6 Canada                    90         88.9         90.2  91.1
##  7 Chile                     86.7       85.1         NA    88.0
##  8 Croatia                   NA         NA           83    NA
##  9 England                   NA         92.4         NA    NA
## 10 France                    85.4       89.3         89.6  89.9
## # … with 22 more rows
```

Gather (from wide to long)

Then gather it back up into the original

```
wine_long <- wine_wide %>%
  gather("variety", "points", 2:5)

wine_long
```

```
## # A tibble: 128 x 3
## # Groups:   country [32]
##    country   variety            points
##    <chr>     <chr>               <dbl>
##  1 Argentina Cabernet Sauvignon   86.0
##  2 Australia Cabernet Sauvignon   89.3
##  3 Austria   Cabernet Sauvignon   87.4
##  4 Brazil    Cabernet Sauvignon   83
##  5 Bulgaria  Cabernet Sauvignon   87.8
##  6 Canada    Cabernet Sauvignon   90
##  7 Chile     Cabernet Sauvignon   86.7
##  8 Croatia   Cabernet Sauvignon   NA
##  9 England   Cabernet Sauvignon   NA
## 10 France    Cabernet Sauvignon   85.4
## # … with 118 more rows
```

Why are there more rows than the original?

Data summarization

Basics

Data summarization involves

- Describing data with numerical summaries
- Visualizing data with graphical summaries

…however, there is a difference in how we describe the data depending on whether it is

- discrete, or
- continuous

Describing discrete data

```
wine %>%
  count(country)
```

```
## # A tibble: 44 x 2
##    country                    n
##    <chr>                  <int>
##  1 Argentina               3800
##  2 Armenia                    2
##  3 Australia               2329
##  4 Austria                 3345
##  5 Bosnia and Herzegovina     2
##  6 Brazil                    52
##  7 Bulgaria                 141
##  8 Canada                   257
##  9 Chile                   4472
## 10 China                      1
## # … with 34 more rows
```

A ‘tidy’ pivot table

```
wine %>%
  count(country, variety)
```

```
## # A tibble: 1,644 x 3
##    country   variety                              n
##    <chr>     <chr>                            <int>
##  1 Argentina Barbera                              1
##  2 Argentina Bonarda                            105
##  3 Argentina Bordeaux-style Red Blend            89
##  4 Argentina Bordeaux-style White Blend           1
##  5 Argentina Cabernet Blend                       8
##  6 Argentina Cabernet Franc                      64
##  7 Argentina Cabernet Franc-Cabernet Sauvignon    3
##  8 Argentina Cabernet Franc-Malbec                4
##  9 Argentina Cabernet Sauvignon                 540
## 10 Argentina Cabernet Sauvignon-Cabernet Franc    1
## # … with 1,634 more rows
```

Exercise

Use filter and count to figure out which country has more Chardonnay, France or the US.

Solution

```
wine %>%
  filter(country=="France" | country=="US") %>%
  filter(variety=="Chardonnay") %>%
  count(country)
```

```
## # A tibble: 2 x 2
##   country     n
##   <chr>   <int>
## 1 France   2808
## 2 US       6801
```

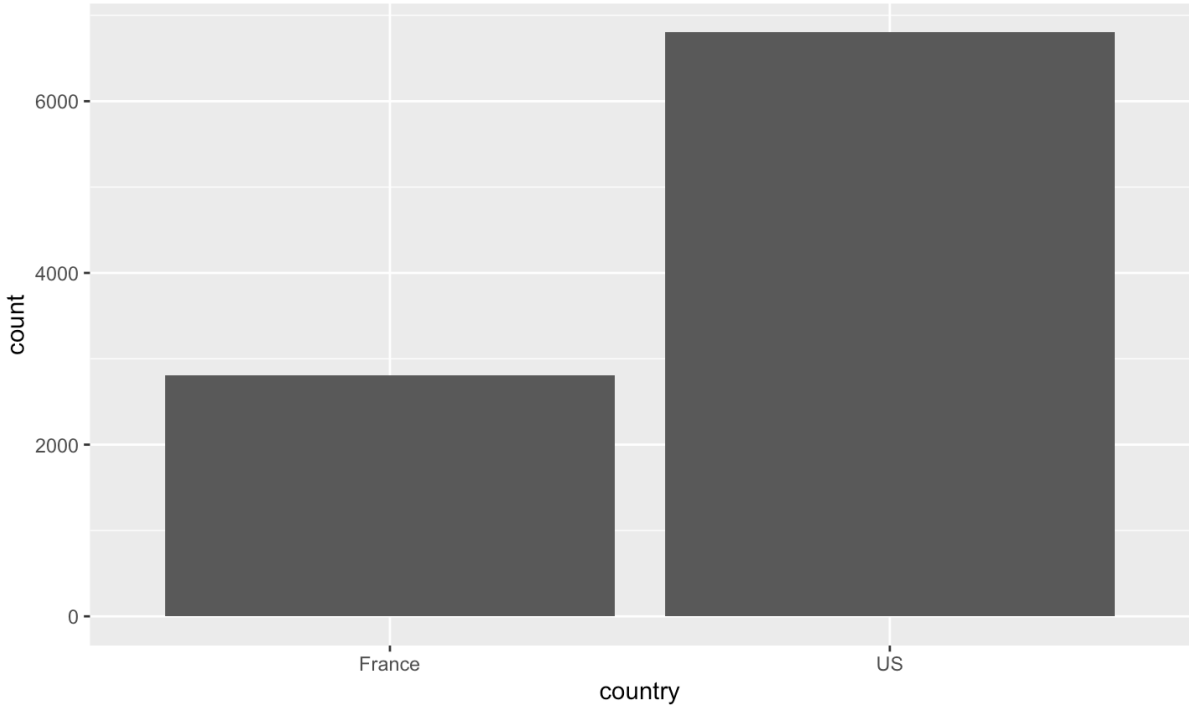
Visualization basics

ggplot2 requires the following:

1. Data – Data to visualize.
2. Aesthetics – Mapping graphical elements to data.
3. Geometries – Or “geom,” the graphic representing the data.

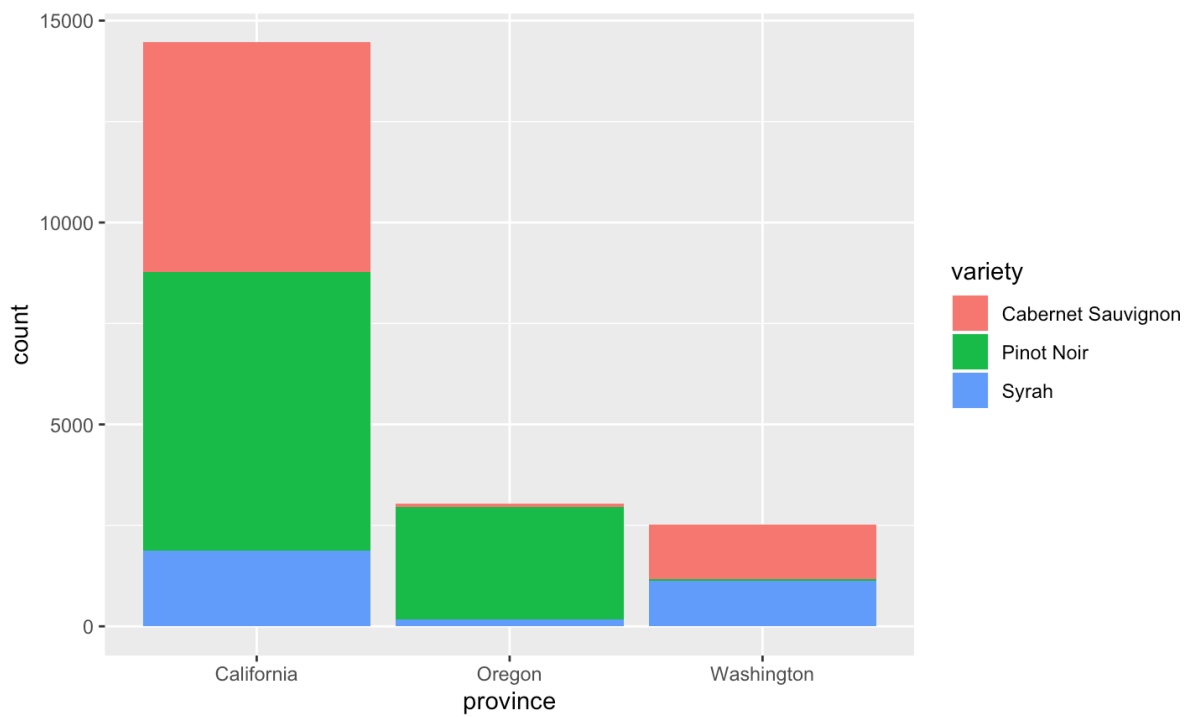
Visualizing discrete data

```
wine %>%
  filter(country=="France" | country=="US") %>%
  filter(variety=="Chardonnay") %>%
  ggplot(aes(x=country)) +
    geom_bar()
```



Let's try a more complicated count

```
wine %>%
  filter(province=="Washington" | province=="Oregon" | province=="California") %>%
  filter(variety=="Cabernet Sauvignon" | variety =="Syrah" | variety=="Pinot Noir") %>%
  ggplot(aes(x=province, fill=variety)) +
    geom_bar()
```



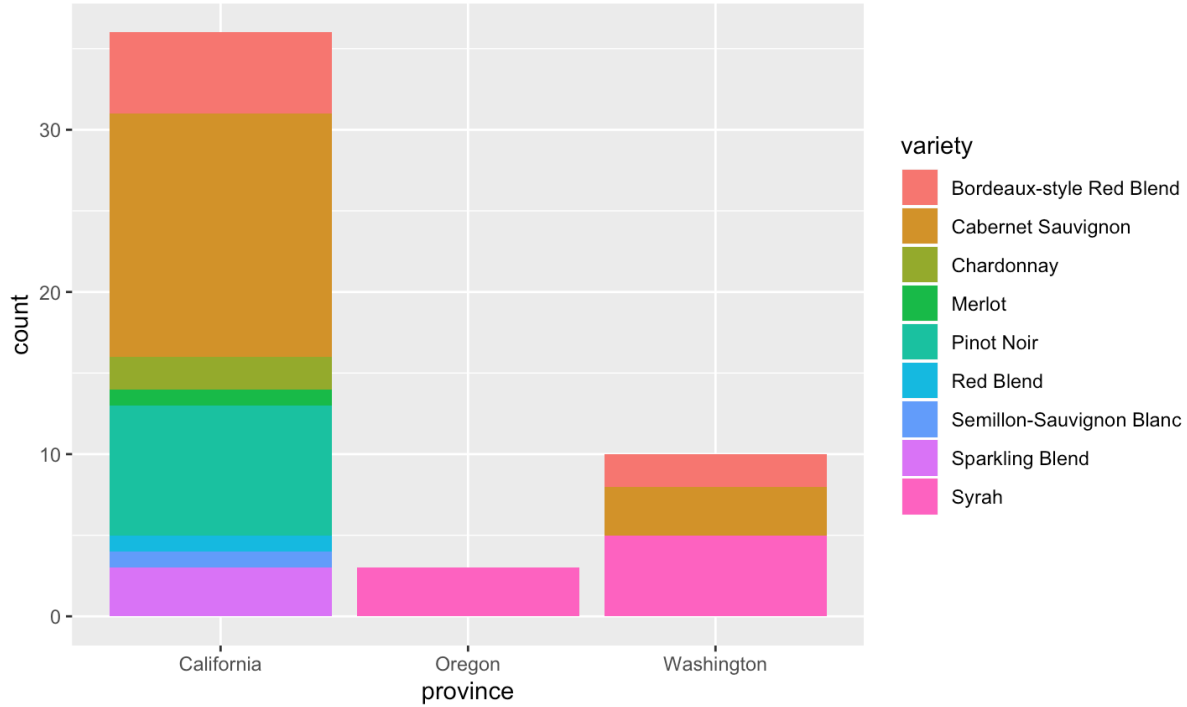
Exercise

Create a stacked bar graph that shows

1. A count of wines
2. with greater than 97 points
3. from California, Oregon and Washington
4. stacked by variety

Solution

```
wine %>%
  filter(points >= 98) %>%
  filter(province=="Washington" | province=="Oregon" | province=="California") %>%
  ggplot(aes(x=province, fill=variety)) +
    geom_bar()
```



Describing continuous data

You can use the summarize function for calculating things like mean, median, variance, min/max, etc.

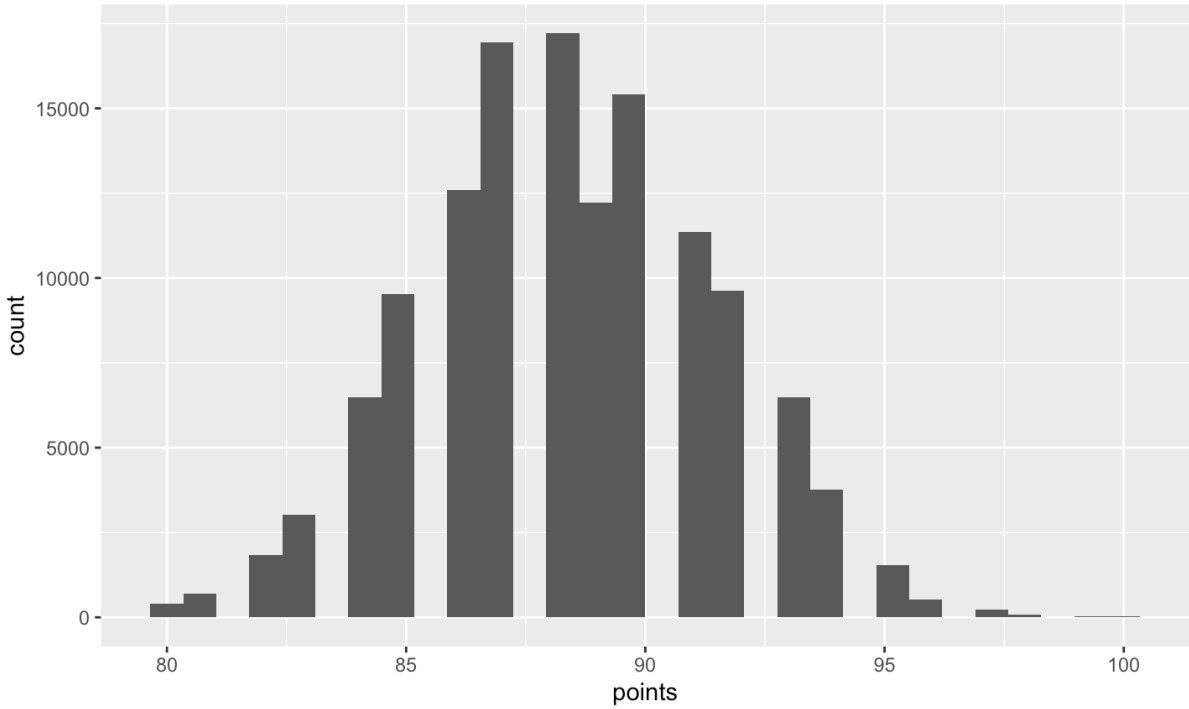
```
wine %>%
  summarize(avg_points=mean(points))
```

```
## # A tibble: 1 x 1
##   avg_points
##        <dbl>
## 1       88.4
```

Visualizing a continuous distribution

Of course that's not very exciting. Let's graph the distribution of points.

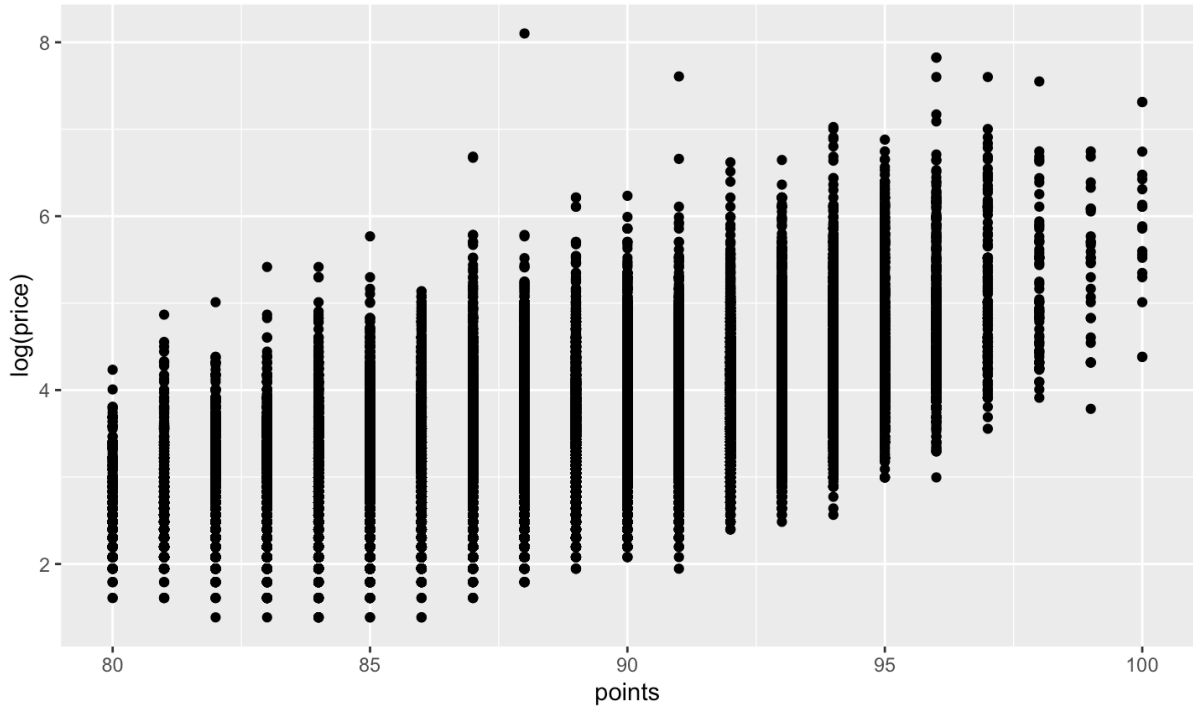
```
wine %>%
  ggplot(aes(x=points)) +
    geom_histogram()
```



Visualizing two continuous variables

…or the relationship between points and price

```
wine %>%
  ggplot(aes(x=points, y=log(price))) +
  geom_point()
```



Combining discrete and continuous variables

Somtimes, we want to summarize by a category

```
wine %>%
  filter(country=="US") %>%
  filter(!is.na(price)) %>%
  group_by(province) %>%
  summarize(
    count = n(),
    average_points=mean(points),
    average_price=mean(price)) %>%
  filter(count>100) %>%
  arrange(desc(average_points))
```

```
## # A tibble: 7 x 4
##   province   count average_points average_price
##   <chr>      <int>          <dbl>         <dbl>
## 1 Oregon      5359           89.1          36.5
## 2 Washington  8583           89.0          32.4
## 3 California 36104           88.6          39.0
## 4 New York    2676           87.2          22.8
## 5 Idaho        190           86.6          20.8
## 6 Michigan     111           86.2          32.4
## 7 Virginia     770           85.6          27.0
```

Note: the count() function used previously is just a wrapper around summarize(count=n())

Exercise

Create a tibble that shows

1. US wines
2. grouped by province and variety,
3. summarized on count and max price
4. with a count greater than 100
5. sorted by count descending

Hint: don't forget to filter out the 'NA' prices

Solution

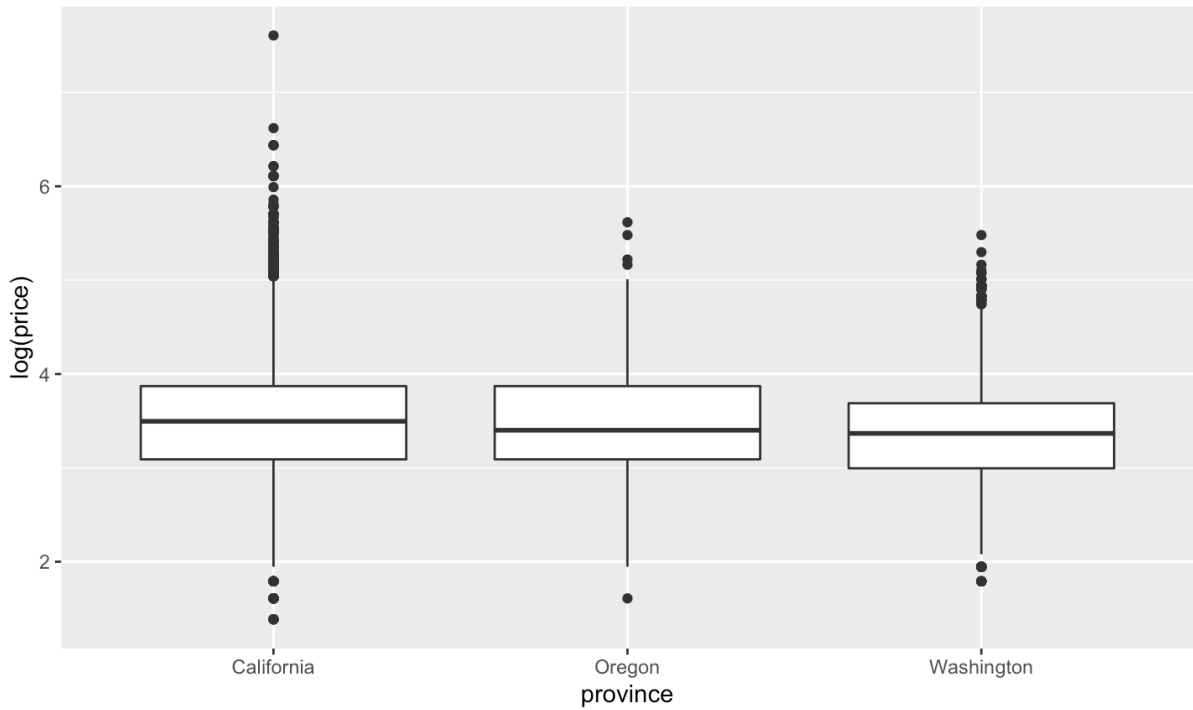
```
wine %>%
  filter(country=="US") %>%
  filter(!is.na(price)) %>%
  group_by(province, variety) %>%
  summarize(
    count = n(),
    max_price=max(price)) %>%
  filter(count>100) %>%
  arrange(desc(count))
```

```
## # A tibble: 64 x 4
## # Groups:   province [5]
##    province   variety            count max_price
##    <chr>      <chr>              <int>     <dbl>
##  1 California Pinot Noir          6875       155
##  2 California Cabernet Sauvignon  5668       625
##  3 California Chardonnay          5157      2013
##  4 Oregon     Pinot Noir          2779       275
##  5 California Zinfandel           2633       100
##  6 California Syrah               1862       750
##  7 California Sauvignon Blanc     1801        75
##  8 California Red Blend           1791       290
##  9 California Merlot              1390       200
## 10 Washington Cabernet Sauvignon  1356       160
## # … with 54 more rows
```

Visualizing discrete and continuous

Sometimes we want to visualize a continuous variable by category as a boxplot

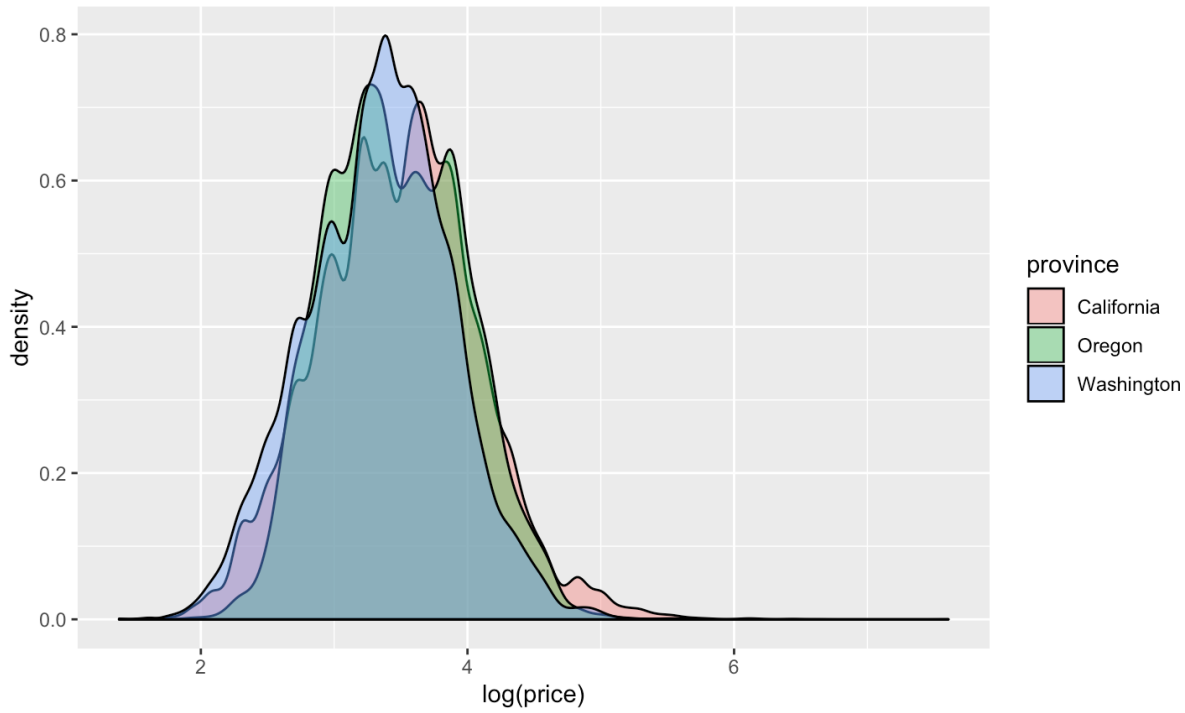
```
wine %>%
  filter(province=="California" | province=="Oregon" | province=="Washington") %>%
  ggplot(aes(x=province, y=log(price))) +
    geom_boxplot()
```



Visualizing discrete and continuous (cont'd)

…or as a density function

```
wine %>%
  filter(province=="California" | province=="Oregon" | province=="Washington") %>%
  ggplot(aes(x=log(price), fill=province)) +
    geom_density(alpha = 0.4)
```



Long exercise

Gather in groups of 3ish and…

1. Choose a driver
2. Choose a country
3. Summarize the wine data from that country (numerically and visually)
4. Write comments about what you find in the markdown
5. Make sure “echo=FALSE” on your chunks
6. Knit to HTML and email me the file.