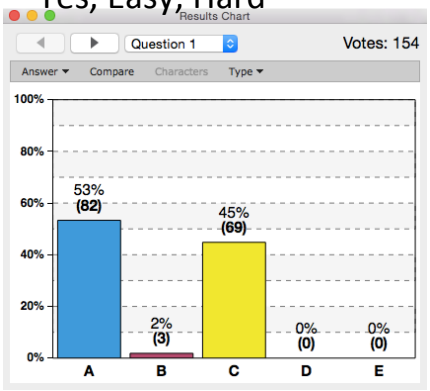
Graphics

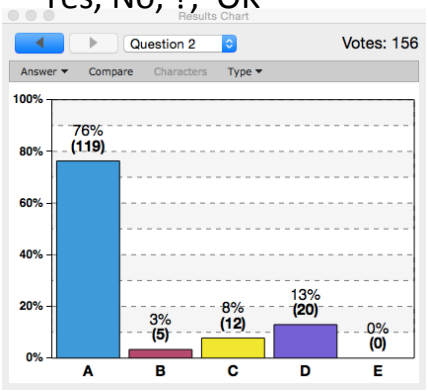
Data Types & Plot Types

Your Opinions

HW 1 reasonable?
Yes, Easy, Hard



More Live Code?
Yes, No, ?, OK



Why is graphics in this course?

- Good graphics today requires the computer
- Visualization enters every step of the data analysis cycle
  - Data cleaning – are there anomalies?
  - Exploration
  - Model checking
  - Reporting results
- Plots can uncover structure in data that can't be detected with numerical summaries
- Important communication skill

Keep in Mind

- Meta Data: The source of information and the selection process for the observations
- Are these data representative of the population that you are trying to generalize to?
- What is a clear and informative way to present the data so that insights are readily discernable?

Review ggplot Components

- The plot object
- Aesthetic mappings
- Layers of Geometric shapes and Statistical summaries – they are paired
- Scales for the aesthetics
- Themes for the other stuff (non data)

Know your data types

The appropriate graphical techniques depend on the kind of data that you are working with

- Quantitative
  - continuous – e.g., height, weight
  - discrete – numeric data with few values, e.g., number of children in family
- Qualitative
  - ordered – categories with an order but no meaningful distance between, e.g., number of stars for a movie rating
  - nominal - categories have no meaningful order, e.g., gender, race

Data Type can depend on

- Units of measurement
- What constitutes a record in the data
- These concepts are connected

What type of data is handedness?

A. Quantitative
B. Qualitative – nominal
C. Qualitative – ordinal
D. Possibly A or B
E. Possibly A or C

What type of data is income?

A. Quantitative
B. Qualitative – nominal
C. Qualitative – ordinal
D. Possibly A or B
E. Possibly A or C

Individual report the activities performed with left hand (write, eat, bat, sweep, etc.) and these are counted

What type of data is handedness?

A. Quantitative – discrete
B. Quantitative – contin
C. Qualitative – nominal
D. Qualitative – ordinal

Family income reported in a survey, choose from brackets, e.g. < $30,000, $30,000 - $45,000, etc

What type of data is income?

A. Quantitative – discrete
B. Quantitative - contin
C. Qualitative – nominal
D. Qualitative – ordinal

Consider sex as reported in the DAWN survey

What type of data?

A. Quantitative
B. Qualitative – nominal
C. Qualitative – ordinal

Consider sex as reported in World Bank Data on Countries

What type of data?

A. Quantitative
B. Qualitative – nominal
C. Qualitative – ordinal

Different Plots for Different Data Types

```
load(url("http://www.stat.berkeley.edu/
users/nolan/data/babiesLab133.rda"))
```

Kaiser Study

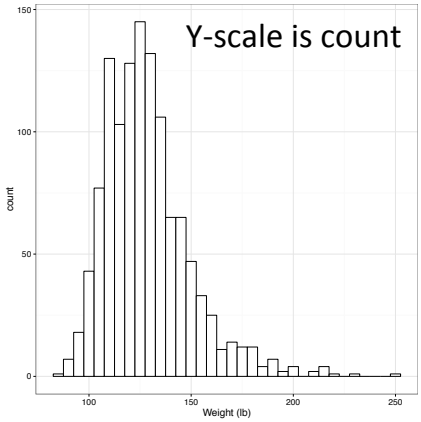
- Oakland Kaiser mothers
- 1960s
- Measure the babies weight (in ounces) at birth
- All babies:
  - Male
  - Single births (no twins, etc.)
  - Survived 28 days

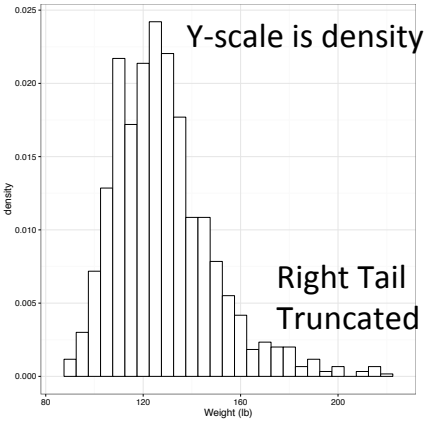
Information collected on mother's and their babies

- Birth weight (ounces)
- Gestation (weeks)
- Parity - total number of previous pregnancies
- Mother's height and weight
- Mother's smoking status
- Mother's age, race, education level, income
- Father's information and more…

One Quantitative Variable

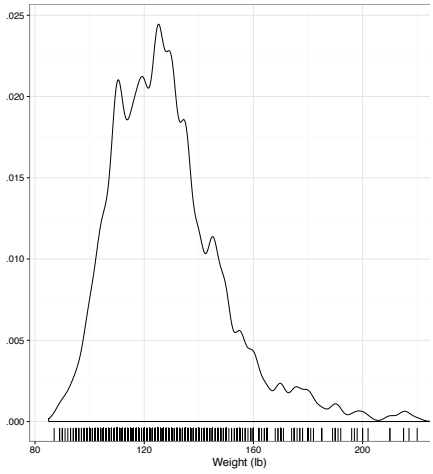
Histogram – Mother's weight





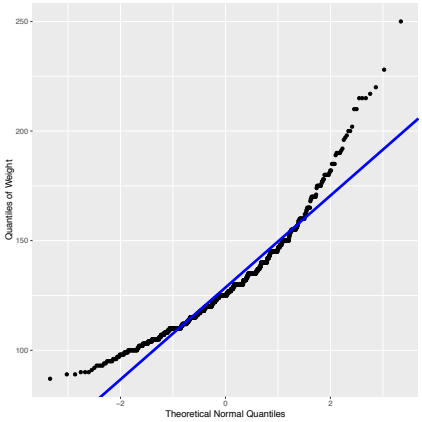
What is the difference between these 2 histograms?

Density curve



- Band width is small so see fluctuations in individual values
- Rug plot thickness matches these little peaks

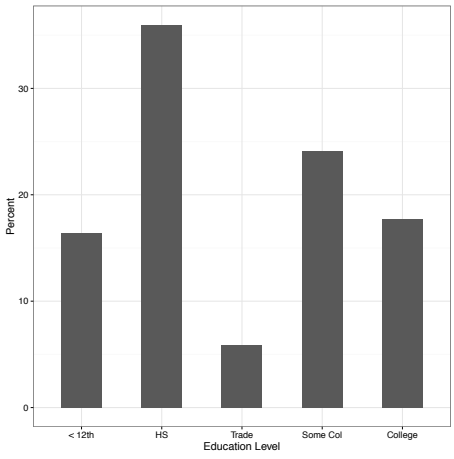
Quantile Plot

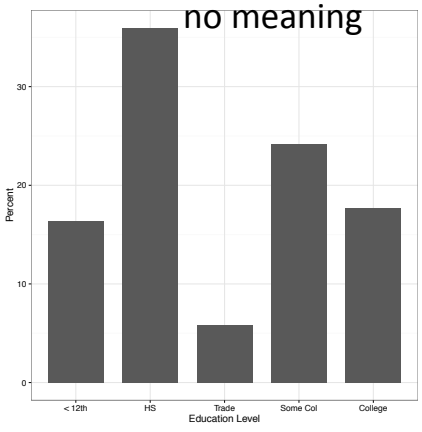


- Compare the distribution to a theoretical one
- Upward curve for small values indicates a short left tail
- Upward curve for large values indicates a long right tail

Bar plot - Education Level

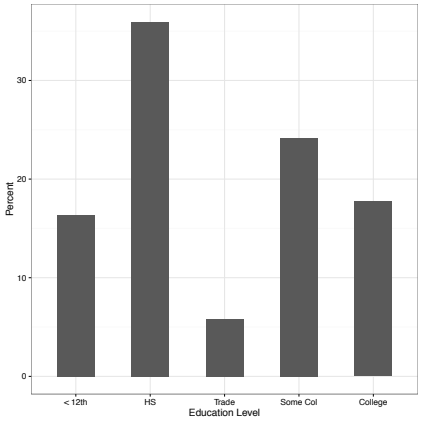
Bar Width – has no meaning

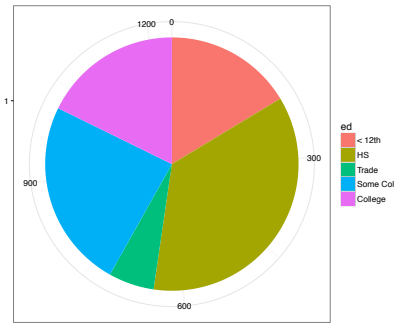




What's the difference between these 2 plots?

Pie chart - Education Level

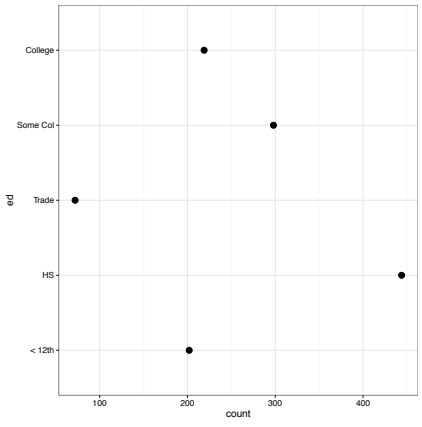




Easier to compare heights of bars than angles

Dot Chart - Education Level

- Width of bars in a bar plot have no meaning
- Dot plot (aka Cleveland) focus on comparison of the values



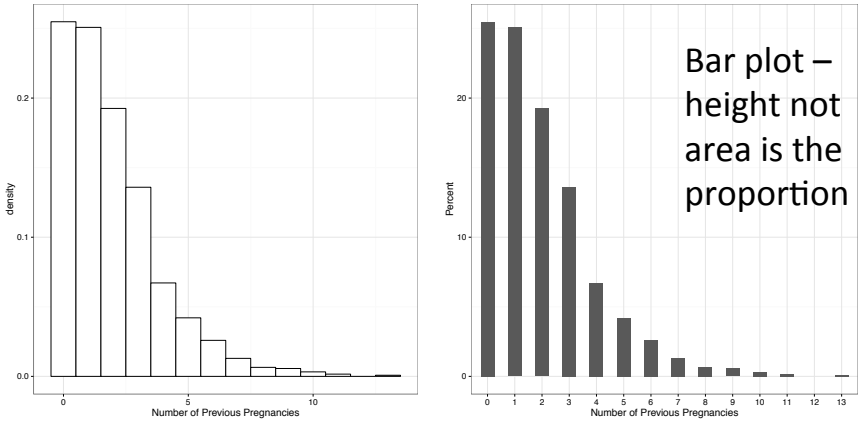
Discrete Quantitative Variable can sometimes look like a Qualitative Variable

Parity: Number of siblings

- This quantitative variable is different from birth weight – there are only a few possible values, i.e., it's not possible to have 2.3 siblings, and it's highly unlikely to have 17

```
> table(infants$parity)
  0   1   2   3   4   5   6   7   8   9  10  11  13
315 310 238 168  83  52  32  16   8   7   4   2   1
```

Number of Previous Pregnancies



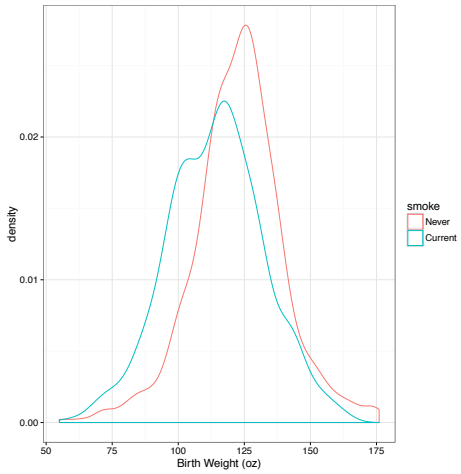
What's the difference between these 2 plots?

Method of Comparison

- Often, we not only want to better understand a distribution, but we want to compare the distribution for subgroups or to compare against another population or standard
- How do you think the birth weight distribution might vary with smoking status?

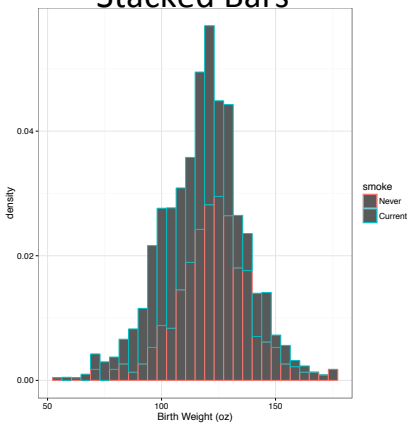
One Quantitative Variable and One Qualitative Variable

Super-posed Density Plots – one per level

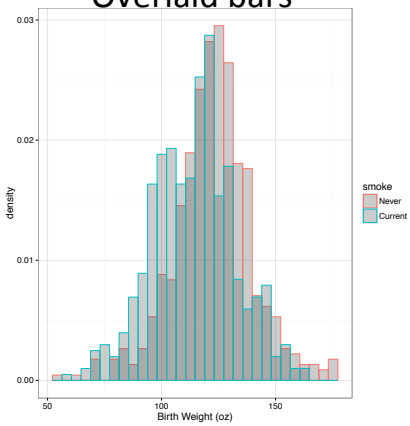


Multiple histograms on 1 plot

Stacked Bars

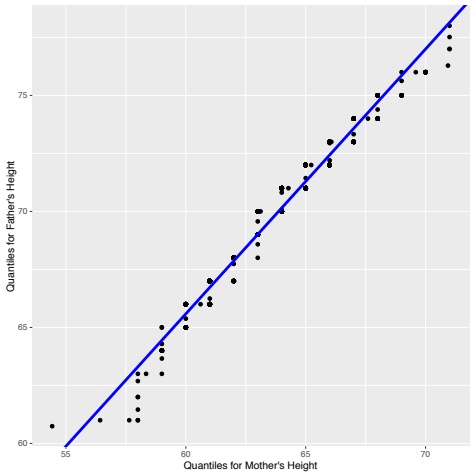


Overlaid bars

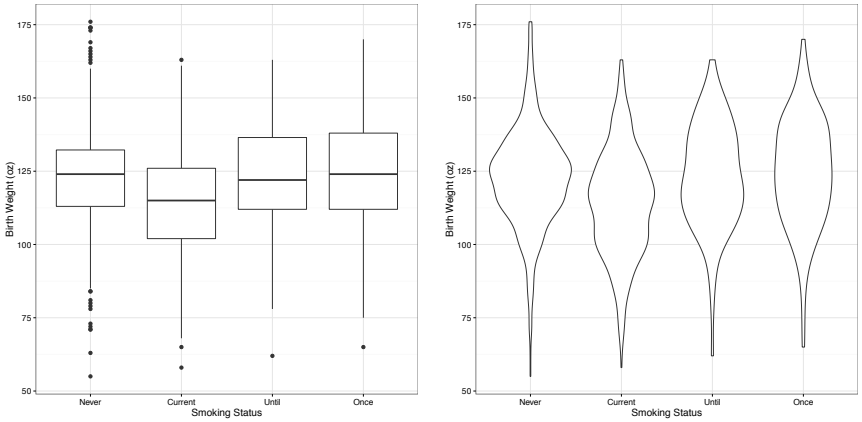


What the difference between these 2 plots?

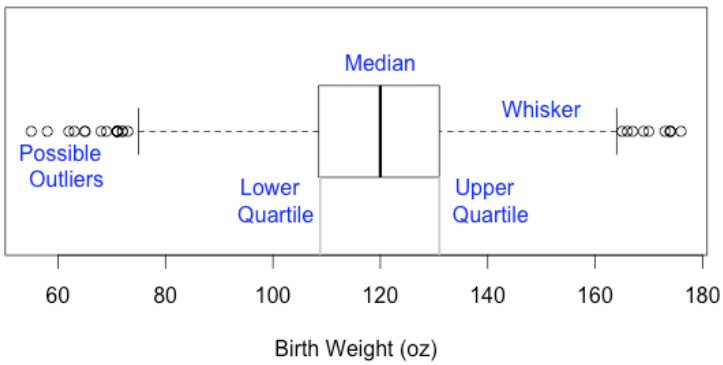
Quantile – Quantile Plot



Side-by-side Boxplots & Violin Plots

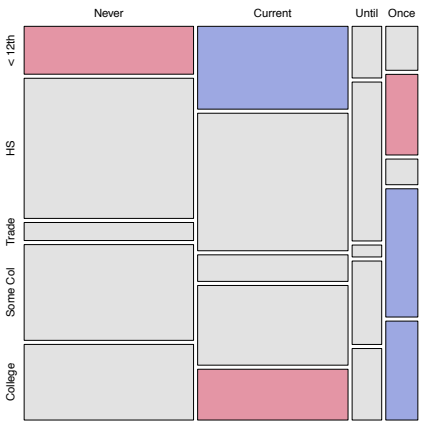


Boxplot Definition



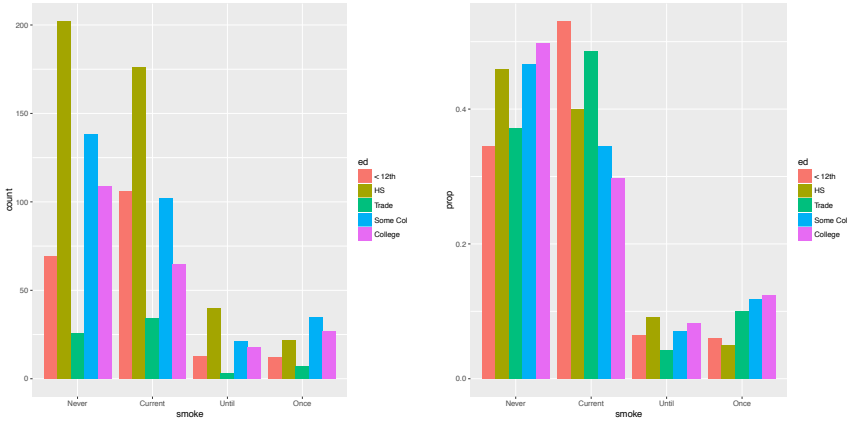
Two Qualitative Variables

Mosaic Plot - Education and Income



Side-by-side Bar Plot

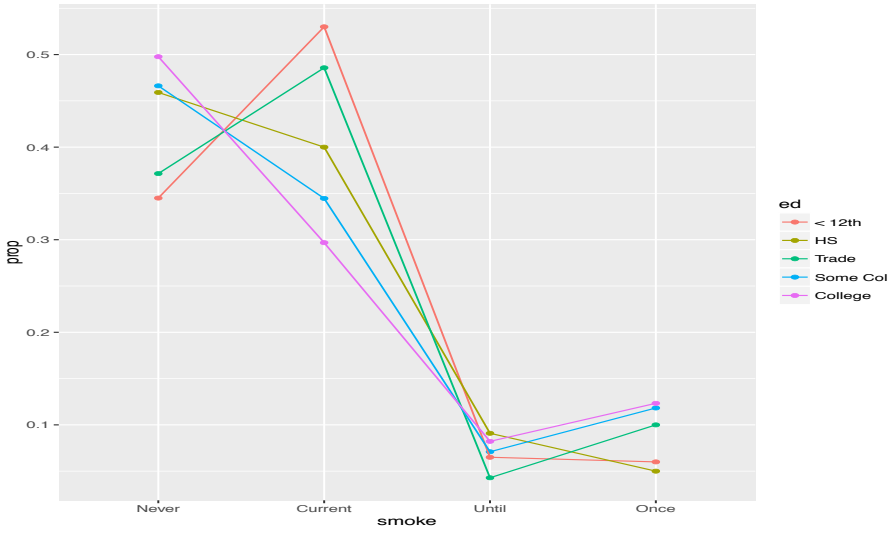
Smoking status normalized within Education level



What the difference between these 2 plots?

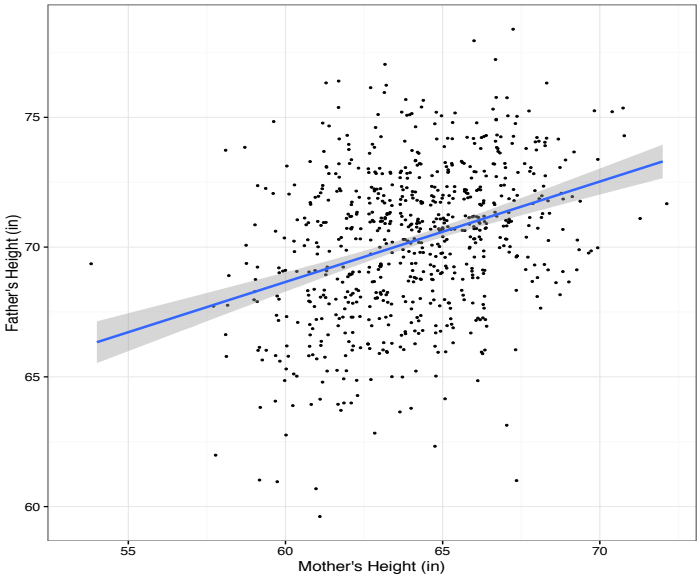
Interaction Plot

Smoking status normalized within Education level



Two Quantitative Variables

Scatter Plot and Smooths



This smooth is a linear fit

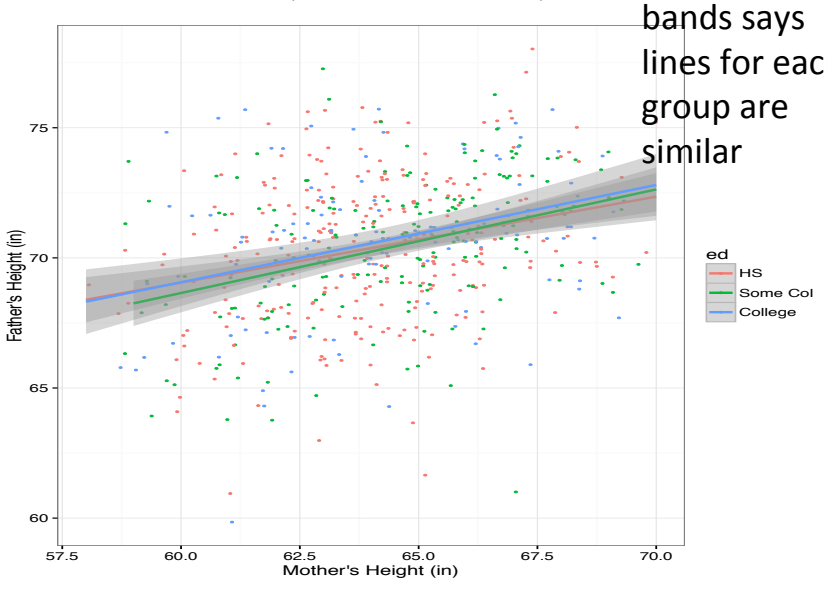
Gray bands give a sense of accuracy of linear fit

Relationships between more than 2 variables

- Qualitative information can be conveyed in plots through color, plotting symbol, juxtaposed panels

2 Quant + 1 Qual

Overlap in Gray bands says lines for each group are similar



Summary of graph relationships between two variables

- Two Qualitative variables
  - Mosaic plot, side-by-side barplots (watch normalization)
- One Quantitative and one Qualitative
  - Side-by-side boxplots, violin plots, dotcharts, super-posed density curves, qq-plot
- Two Quantitative variables
  - Scatter plot, line plot, smooths

Check the code posted to
Lecture Code on bcourses
to see how these plots were made