Lecture 6: Visualizing Numerical and Categorical Data

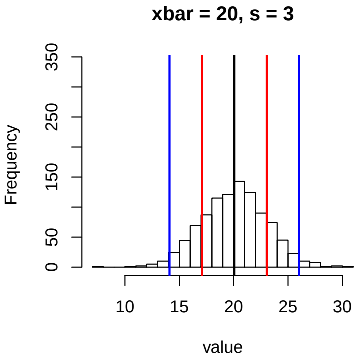
Chapter 1.6+1.7

Goals for Today

- Rule of thumb for standard deviations
- Population vs sample mean/variance/standard deviations
- Percentiles and Quartiles
- Boxplots
- Piecharts, barplots, mosaicplots

Rule of Thumb for Standard Deviations

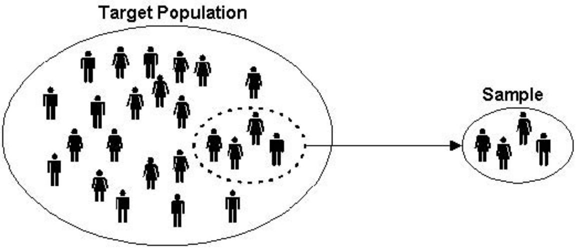
Example



- black line is mean $\overline{x}$
- red lines mark about $\frac{2}{3}$: $[\overline{x} - s, \overline{x} + s] = [17, 23]$.
- blue lines mark about 95%: $[\overline{x} - 2s, \overline{x} + 2s] = [14, 26]$.

Population vs Sample Mean/Variance/Standard Deviation

Recall the notion of taking a representative sample from a study/target population. Say we are interested in the income of the individuals.



Population vs Sample Mean/Variance/Standard Deviation

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Percentiles

Quartiles and IQR

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Example: http://www.npr.org/sections/money/2015/03/19/394057221/how-much-or-little-the-middle-class-makes-in-30-u-s-citie

Robust Statistics (Chapter 1.6.6)

Boxplots

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Example: # US Forces casualties in the war in Afghanistan for each month from 2008-2009:

7, 1, 7, 5, 16, 28, 20, 22, 27, 16, 1, 3, 14, 15, 13, 6, 12, 24, 44, 51, 37, 59, 17, 17

Boxplots

The summary values:

```
Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
1.00    7.00   16.00   19.25   24.75   59.00
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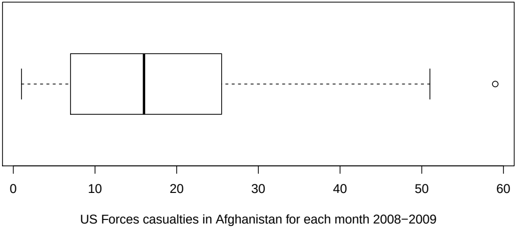

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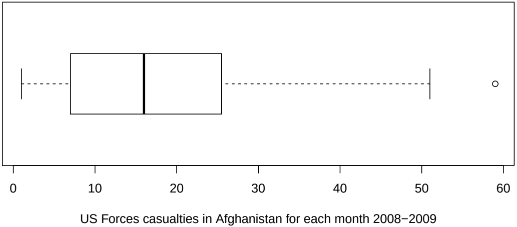

Length of whiskers: they capture data that is no more than $1.5 \times IQR$ of both ends of the box.

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- Identifying strong skew in the distribution.
- Identifying data collection or entry errors.
- Providing insight into interesting properties of the data.

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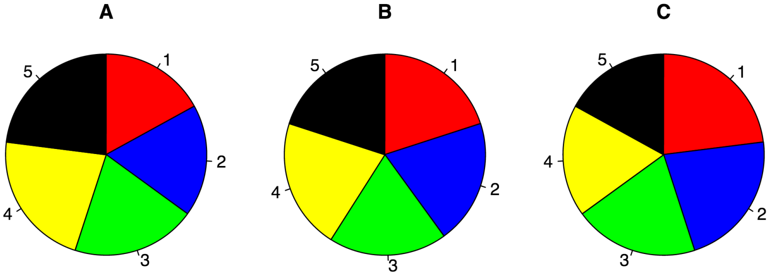

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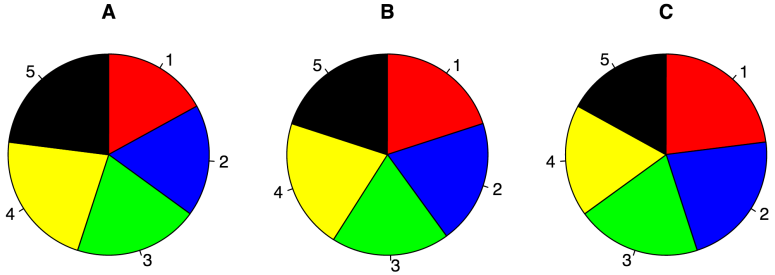
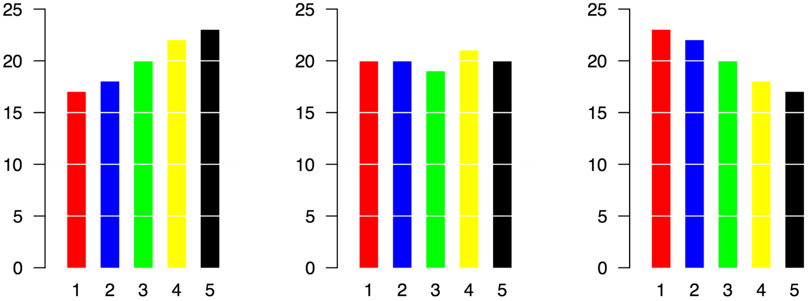


Answer the following questions:

- In the first race, is candidate 5 doing better than candidate 4?
- Who did better between time A and time B, candidate 2 or candidate 4?

Barplots Instead



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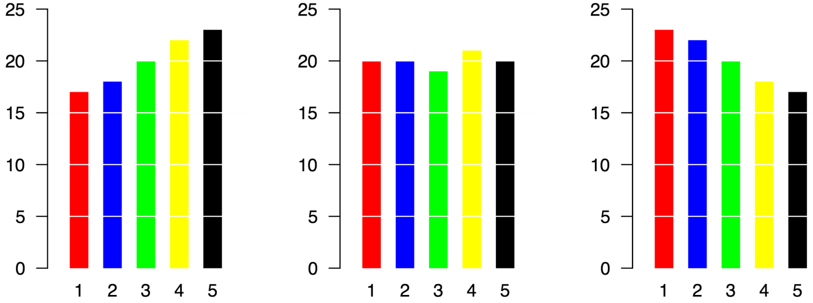
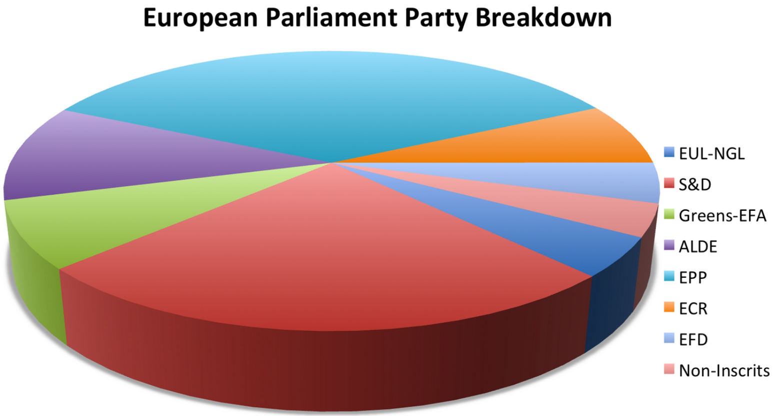


Answers:

- Candidate 5 is doing better than 4
- Between A and B, candidate 2 went from about 17% to 20% while candidate went from about 22% to 21%. So candidate 2 did better

3D Piecharts Can Be Deceiving



EEP (teal) has 266 seats, whereas S&D (red) has 190 seats.

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Questions

- What was the effect of class (1st, 2nd, 3rd, crew) on your chances of survival?
- Did the "women and children" first lifeboat policy hold?

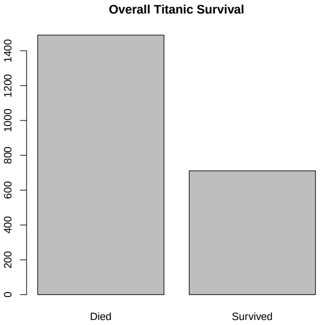
Frequency Table

A table summarizing a single categorial variable is called a frequency table. Overall:

Died	1490
Survived	711
Total	2201

Barplot

Barplots are ways to display categorial variables:



Contingency Table

A table that cross-classifies two categorical variables is a contingency table. Now let's split survival by class: 1st, 2nd, 3rd, and crew.

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Before:

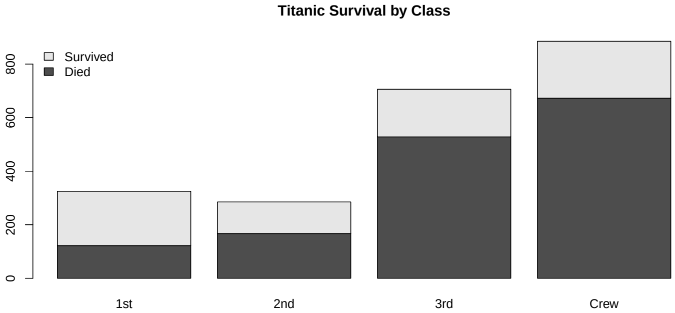
Died	1490
Survived	711
Total	2201

After:

	1st	2nd	3rd	Crew	Total
Died	122	167	528	673	1490
Survived	203	118	178	212	711
Total	325	285	706	885	2201

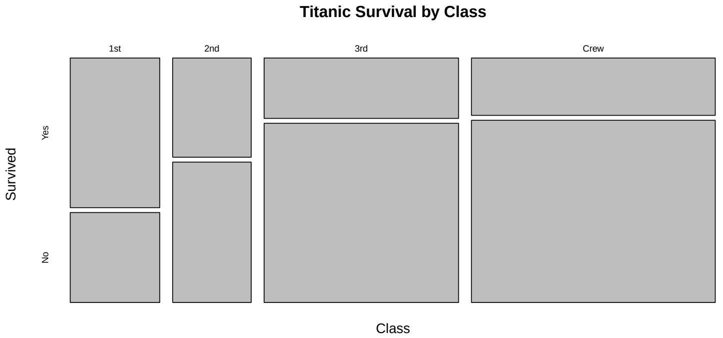
Stacked Barplot

Stacked barplots are one way to display values from a contingency table:



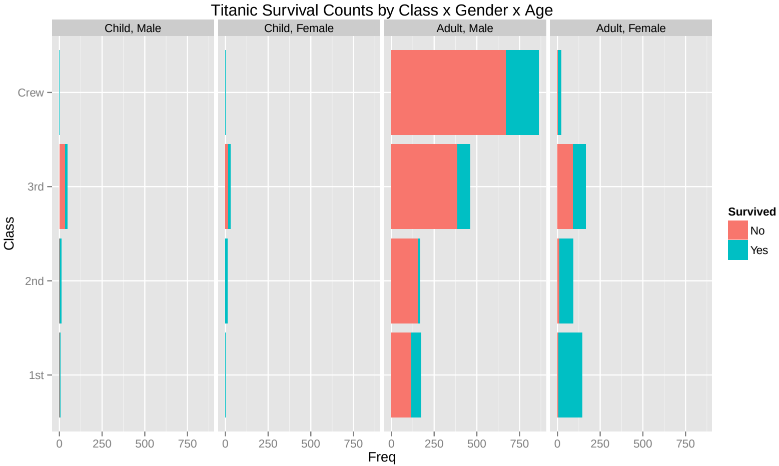
Mosaic Plots

Mosaic plots are similar, but the widths of the bars now reflect proportions:



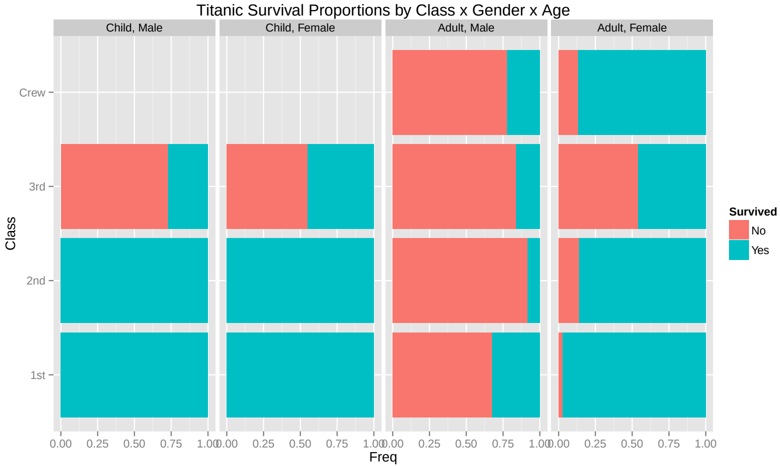
Stacked Barplots

Using the ggplot2 package, we can plot survivals by class, age, and gender all at once.



Standardized/Normalized Stacked Barplots

Instead of raw counts, we can expand each bar to reflect proportions (i.e. standardize/normalize them).


Titanic Survival Proportions by Class x Gender x Age
Child, Male
Child, Female
Adult, Male
Adult, Female
Class
Crew
3rd
2nd
1st
Freq
Survived
No
Yes