Displaying & Describing Categorical Data

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Titanic Data

```
load("../Data/titanic.Rda")
head(titanic, n = 3)
```

```
  pclass survived                           name    sex   age sibsp parch
1  First      Yes  Allen, Miss. Elisabeth Walton female 29.00     0     0
2  First      Yes Allison, Master. Hudson Trevor   male  0.92     1     2
3  First       No   Allison, Miss. Helen Loraine female  2.00     1     2
  ticket  fare   cabin embarked boat body                       home.dest
1  24160 211.3      B5        S    2   NA                    St Louis, MO
2 113781 151.6 C22 C26        S   11   NA Montreal, PQ / Chesterville, ON
3 113781 151.6 C22 C26        S        NA Montreal, PQ / Chesterville, ON
```

- **Who?** People on the Titanic
- **What?** Survival status, class
- **When?** April 14, 1912
- **Where?** North Atlantic
- **How?** Vanderbilt University
- **Why?** Historical interest

Frequency Table

A frequency table is a table whose first column displays each distinct outcome and second column displays that outcome's frequency.

```
table(titanic$pclass)
```

```

 First Second  Third
   323    277    709
```

Relative Frequency Table

A relative frequency table (also referred to as a proportional table) is a table whose first column displays each distinct outcome and second column displays that outcome's relative frequency.

```
prop.table(table(titanic$pclass)) * 100
```

```
 First Second  Third 
 24.68  21.16  54.16 
```

Contingency Tables

A contingency table is a table that displays two categorical variables and their relationships.

```
        No Yes Total
 First 123 200   323
Second 158 119   277
 Third 528 181   709
 Total 809 500  1309
```

Marginal Distribution

The distribution of either variable alone is the marginal distribution. In the table above we have the marginal distribution of class on the right column and the marginal distribution of survival on the bottom row.

Table of Percents

```
prop.table(table(titanic$pclass, titanic$survived)) * 100
```

```
             No    Yes
  First   9.396 15.279
  Second 12.070  9.091
  Third  40.336 13.827
```

Conditional Distributions

You need to be careful how you define the percentages. Do the sum of all cells equal 100, or the sum of each column, or the sum of each row.

```
prop.table(table(titanic$pclass, titanic$survived), 1) * 100
```

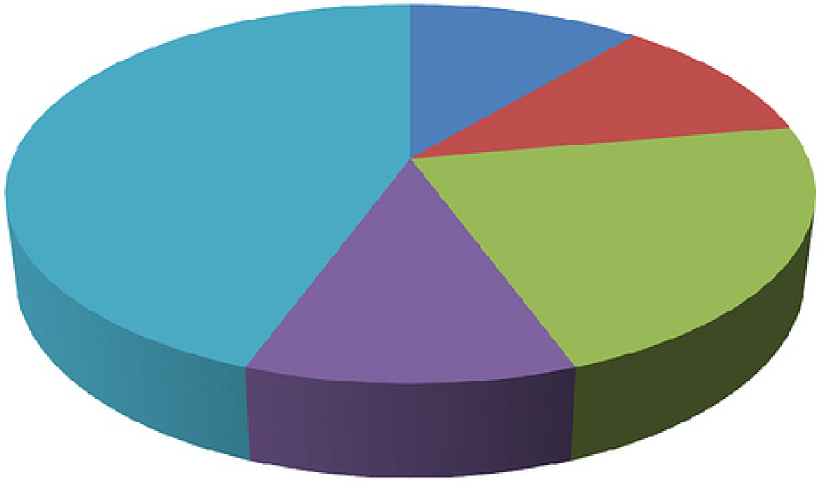
```
           No   Yes
  First  38.08 61.92
  Second 57.04 42.96
  Third  74.47 25.53
```

Pie Charts

> “There is no data that can be displayed in a pie chart, that cannot be displayed BETTER in some other type of chart.”

-- John Tukey

Example of a Bad Pie Chart

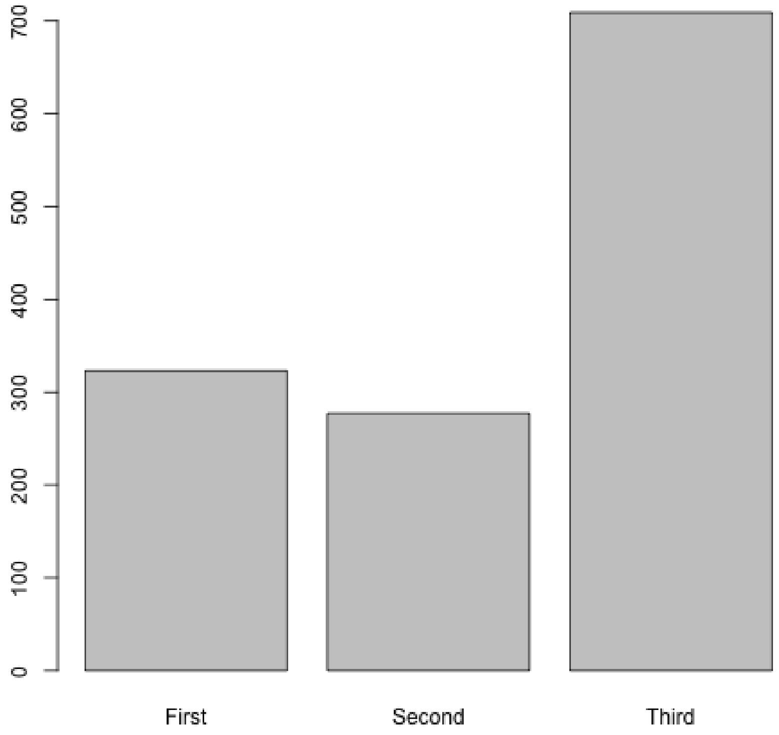


Three of the categories have the same proportions (11%), the other two are 44% and 22%!

Bar Charts

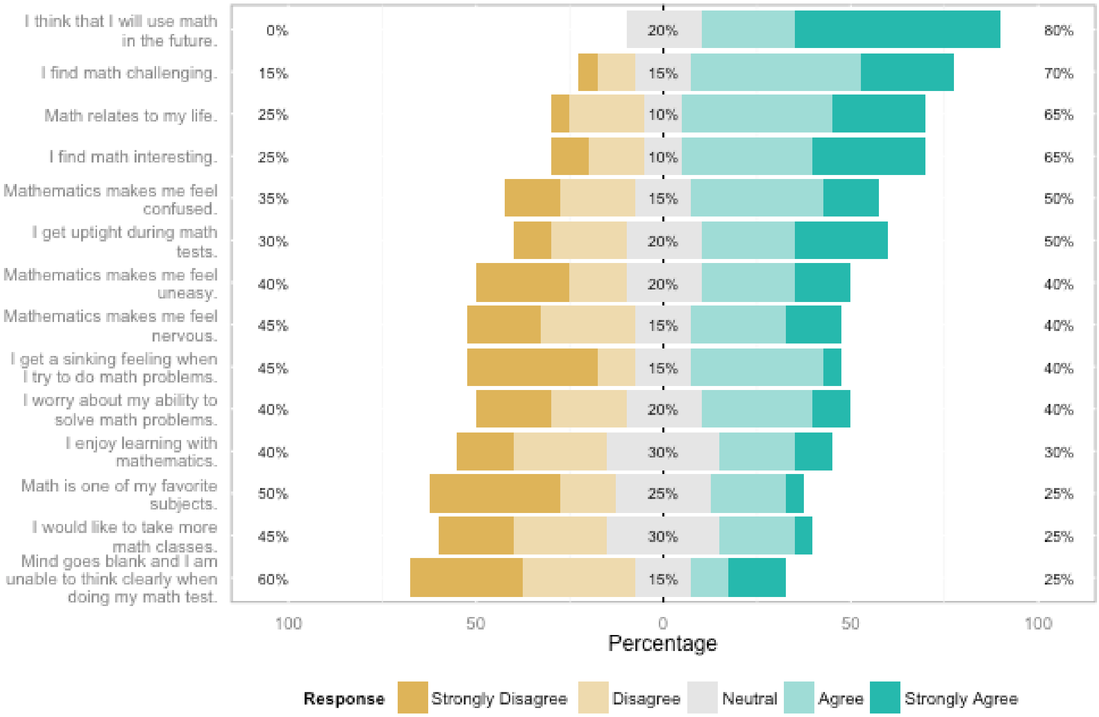
- A bar chart displays the frequency or relative frequency of each category.
- All bars must have the same width.
- The y-axis should begin at zero.

```
plot(titanic$pclass)
```

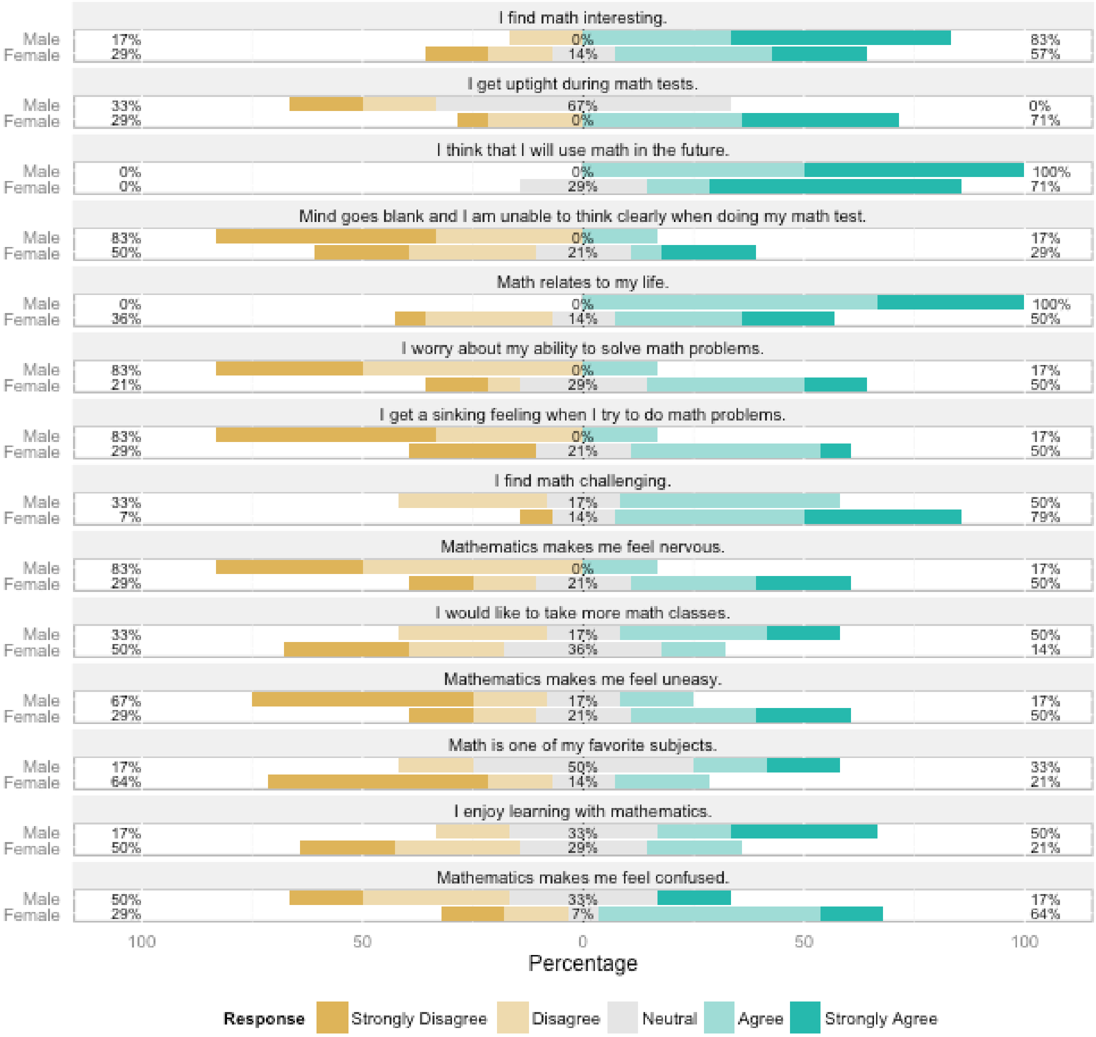


Likert Items

```
require(likert)
l <- likert(mass[, 2:ncol(mass)])
plot(l, wrap = 30)
```



Grouped Likert Results



Simpson's Paradox

Berkeley gender bias case

GENDER	APPLICANTS	ADMITTED
Men	8442	44%
Women	4321	35%

In the above table it appears there is a bias against women. However, including department it appears the bias against women disappears, and in fact there are several advantages for women.

DEPARTMENT	MEN	MEN	WOMEN	WOMEN
	Applicants	Admitted	Applicants	Admitted
A	825	62%	108	82%
B	560	63%	25	68%
C	325	37%	593	34%
D	417	33%	375	35%
E	191	28%	393	24%
F	272	6%	341	7%

Simpson's Paradox

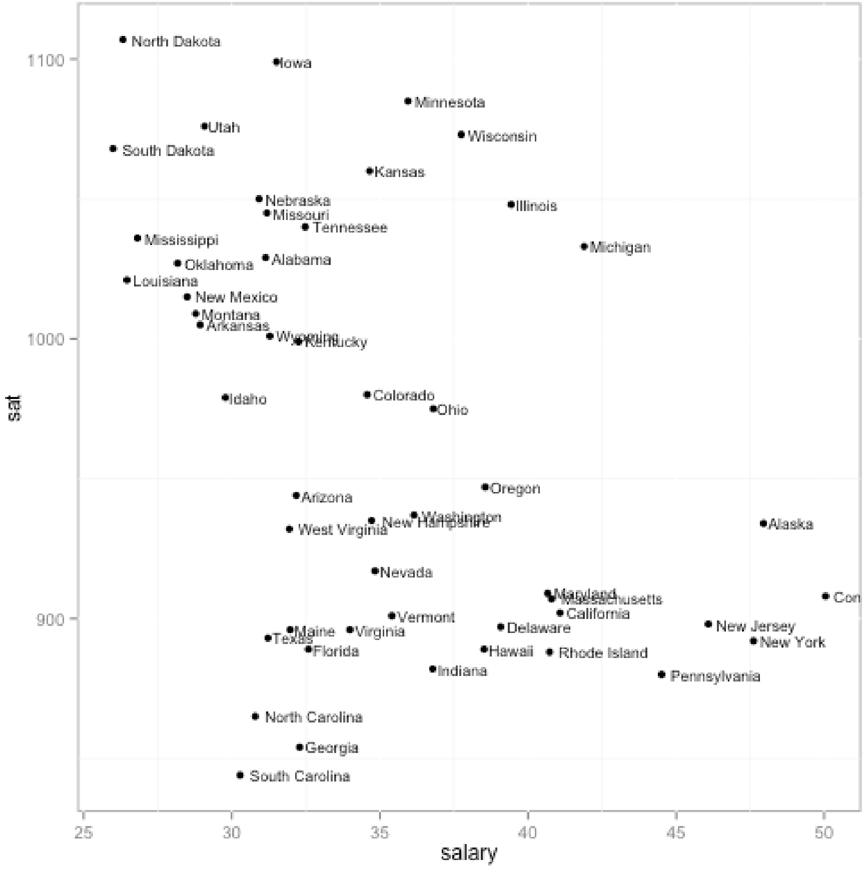
Teacher salary's and SAT Scores

SAT data including:

- `state` - the state whose SAT score is used.
- `salary` - estimated average annual salary of teachers in public schools in 1994-95 school year (in thousands of dollars).
- `frac` - the faction of eligible students taking the SAT in 1994-95.

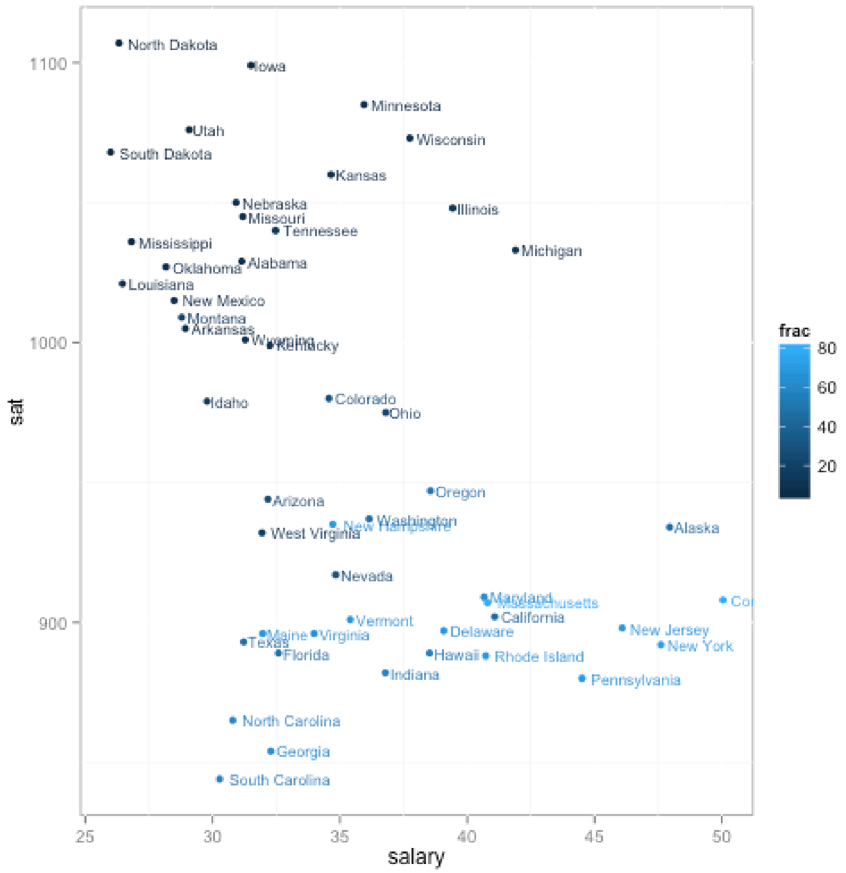
Guber, D.L. (1999), Getting what you pay for: the debate over equity in public school expenditures, Journal of Statistics Education 7(2).

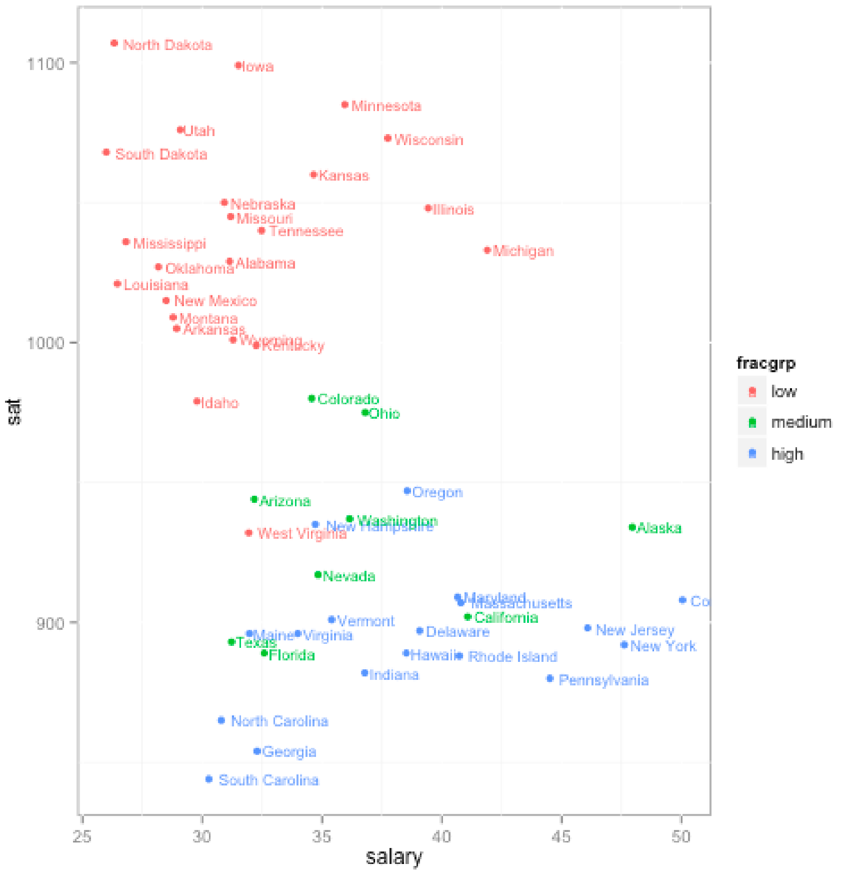
See also `?SAT` for more information.



Simpson's Paradox

Let's now include the fraction of eligible students who took the SAT.


sat
salary
frac
North Dakota
Iowa
Minnesota
Utah
Wisconsin
South Dakota
Kansas
Nebraska
Missouri
Illinois
Tennessee
Mississippi
Michigan
Oklahoma
Alabama
Louisiana
New Mexico
Montana
Arkansas
Wyoming
Kentucky
Idaho
Colorado
Ohio
Oregon
Arizona
Washington
New Hampshire
Alaska
West Virginia
Nevada
Maryland
Massachusetts
Co
California
Vermont
New Jersey
Maine
Virginia
Delaware
Texas
New York
Florida
Hawaii
Rhode Island
Indiana
Pennsylvania
North Carolina
Georgia
South Carolina


sat
salary
fracgrp
low
medium
high
North Dakota
Iowa
Minnesota
Utah
Wisconsin
South Dakota
Kansas
Nebraska
Missouri
Illinois
Tennessee
Mississippi
Michigan
Oklahoma
Alabama
Louisiana
New Mexico
Montana
Arkansas
Wyoming
Kentucky
Idaho
Colorado
Ohio
Oregon
Arizona
Washington
New Hampshire
Alaska
West Virginia
Nevada
Maryland
Massachusetts
Co
California
Vermont
New Jersey
Maine
Virginia
Delaware
Texas
New York
Florida
Hawaii
Rhode Island
Indiana
Pennsylvania
North Carolina
Georgia
South Carolina