Descriptive Statistics II

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Descriptive Statistics

- Univariate methods:
  - quantitative variables: histograms, boxplots, mean/sd (for symmetric vars), median/IQR (for skewed vars)
  - Categorical variables: barplots, table, counts, percentages
- Typical goal in data analysis is understanding the relationship (associations) between pairs of variables
- Today we’ll focus on bivariate descriptive statistics
- Bivariate descriptive statistics can provide initial clues about associations

CHS data

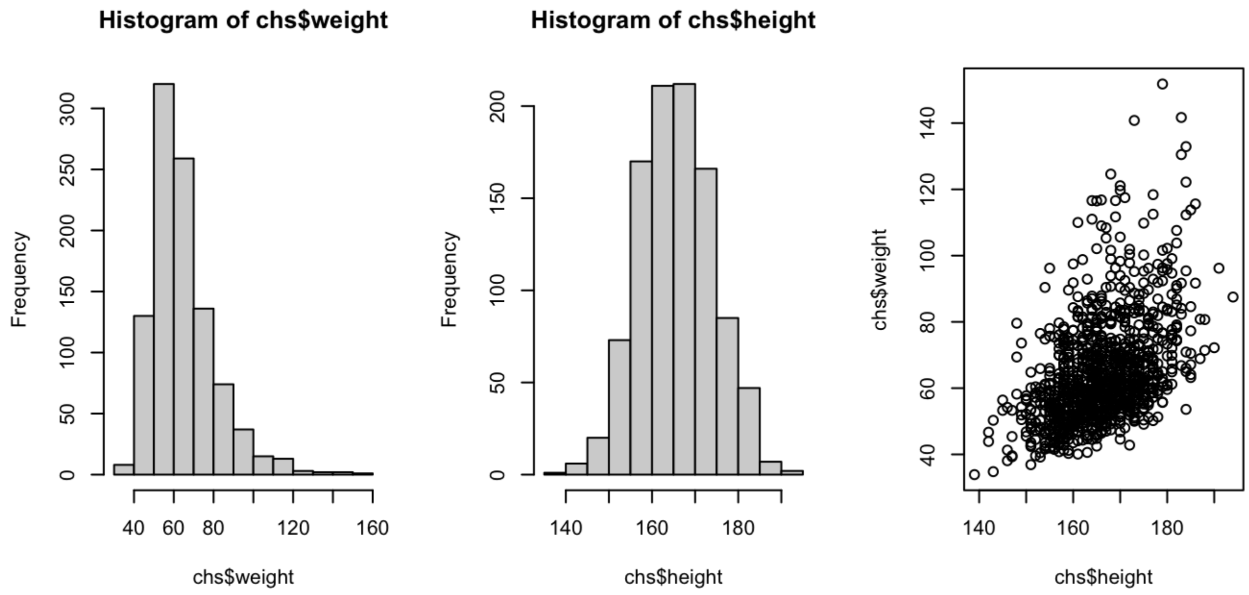
```
setwd("~/LA's best")
chs = read.csv('CHS_cohortE_final_subset.csv')
str(chs)
```

```
## 'data.frame':    1000 obs. of  26 variables:
##  $ id          : int  54577 50863 52081 53817 54683 55339 55766 51056 54919 52992 ...
##  $ townabbr    : chr  "SA" "SD" "SD" "RV" ...
##  $ age         : num  15.1 16.5 15.6 15.2 14.2 15.2 15.8 16 15.2 16.1 ...
##  $ male        : int  1 1 0 1 1 0 1 1 0 0 ...
##  $ race        : chr  "Others" "Mixed" "Caucasian" "Unknown or Missing" ...
##  $ hisp        : chr  "Hispanic" "Hispanic" "Non-Hispanic" "Hispanic" ...
##  $ asthma      : int  0 NA 0 0 1 0 0 1 0 0 ...
##  $ height      : int  168 168 167 160 169 161 185 183 163 165 ...
##  $ weight      : num  52 50.2 55.6 60.9 62.1 ...
##  $ bmi         : num  18.4 17.8 19.9 23.8 21.8 20.6 33.2 39 28.6 28.4 ...
##  $ educ        : int  1 1 3 2 5 5 2 3 1 2 ...
##  $ HomeBuilt   : chr  "1980 or later" "Unknown or Missing" "1960s to 1970s" "Unknown or Missing" ...
##  $ BaseGasstove: int  1 0 1 1 1 0 1 1 1 1 ...
##  $ BasePets    : int  1 0 1 0 1 1 1 1 1 0 ...
##  $ ETS_base    : int  0 0 0 0 0 0 0 1 0 0 ...
##  $ wheeze      : int  0 NA 0 0 0 0 0 0 0 0 ...
##  $ fev1        : int  4090 3790 3240 3890 3730 3530 5420 4480 3290 3390 ...
##  $ fvc         : int  4950 4810 3370 4190 4930 4010 6360 5590 3450 3930 ...
##  $ pm25        : num  8.84 14.28 15 15.76 14.18 ...
##  $ sulfate     : num  0.93 1.38 1.46 1.57 1.32 ...
##  $ nitrate     : num  1.87 2.28 2.48 2.45 2.18 ...
##  $ ec          : num  0.702 0.873 0.884 0.762 0.893 ...
##  $ dust        : num  0.449 1.302 1.246 1.29 1.34 ...
##  $ longitude   : num  -120 -118 -118 -117 -118 ...
##  $ latitude    : num  34.5 34.1 34.1 34 34.1 ...
##  $ obesity     : logi  FALSE FALSE FALSE FALSE FALSE FALSE ...
```

Quantitative vs. quantitative variables

Graphical summary: scatter plots

```
par(mfrow = c(1,3))
hist(chs$weight)
hist(chs$height)
plot(chs$height, chs$weight)
```



Many R packages for generating plots. ggplot2 is among the most popular

Quantitative vs. quantitative

Numerical summary: Pearson correlation coefficient

$$r = corr(x, y) = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{sd(x)sd(y)}$$

$$-1 \leq r \leq 1$$

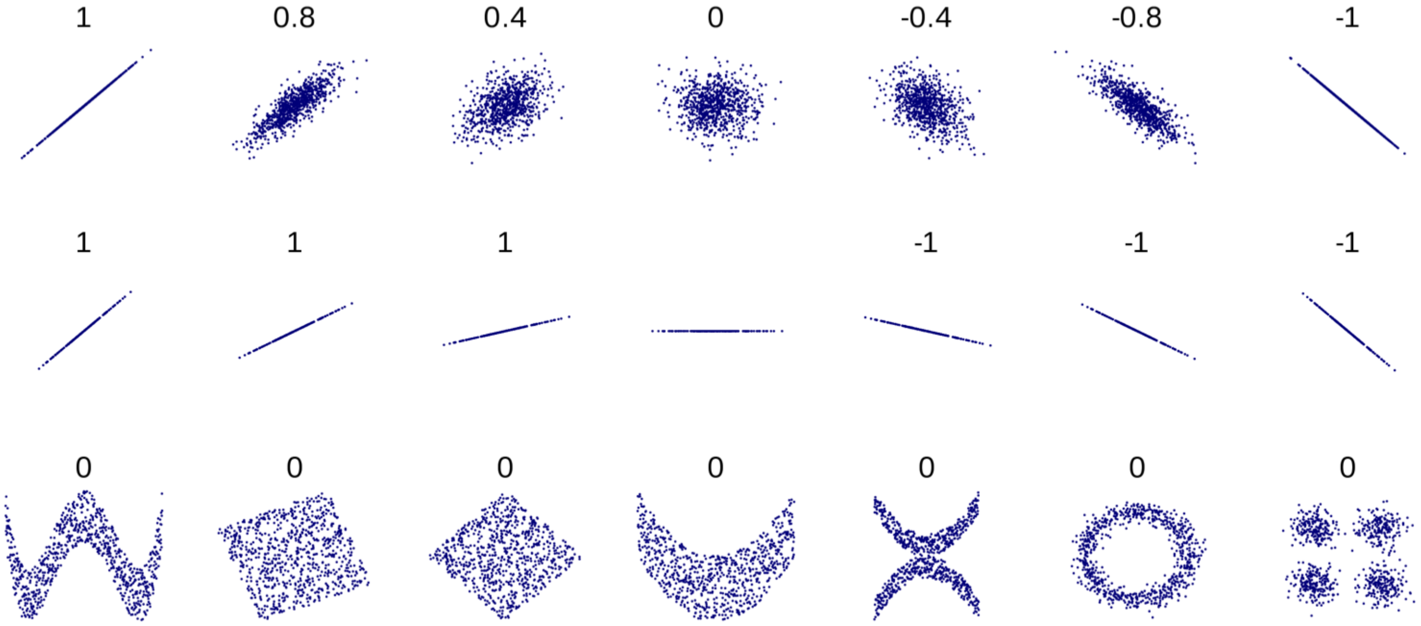
Captures strength of linear relationship between x and y

```
cor(chs$height, chs$weight)
```

```
## [1] 0.450752
```

Quantitative vs. quantitative

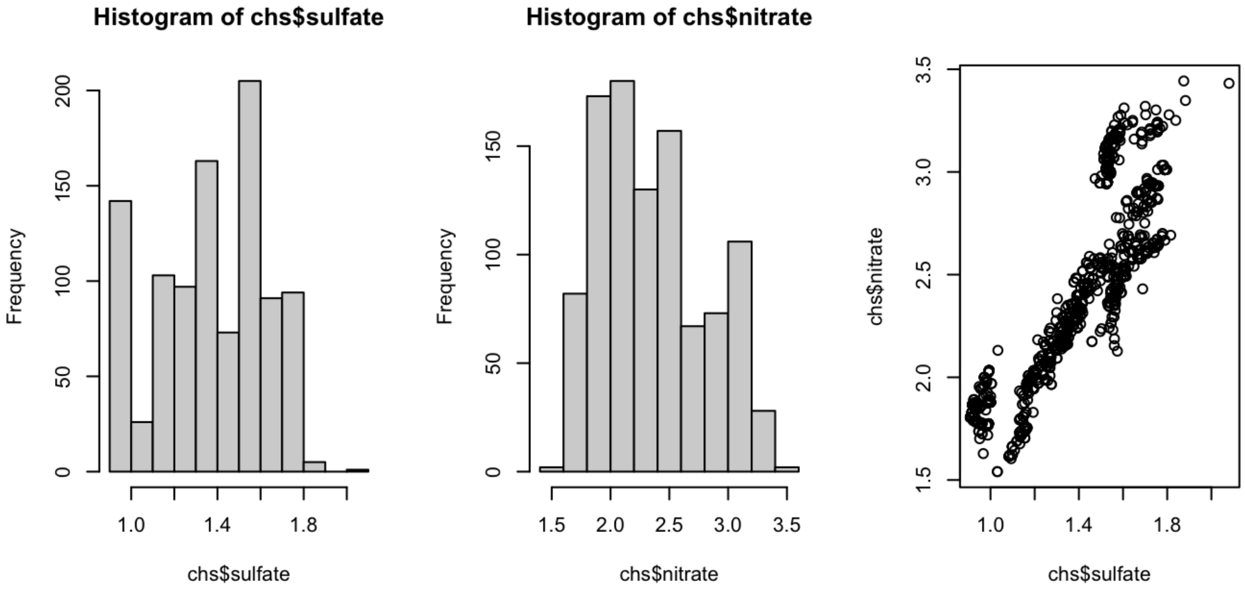
Correlation examples



Source: Wikipedia

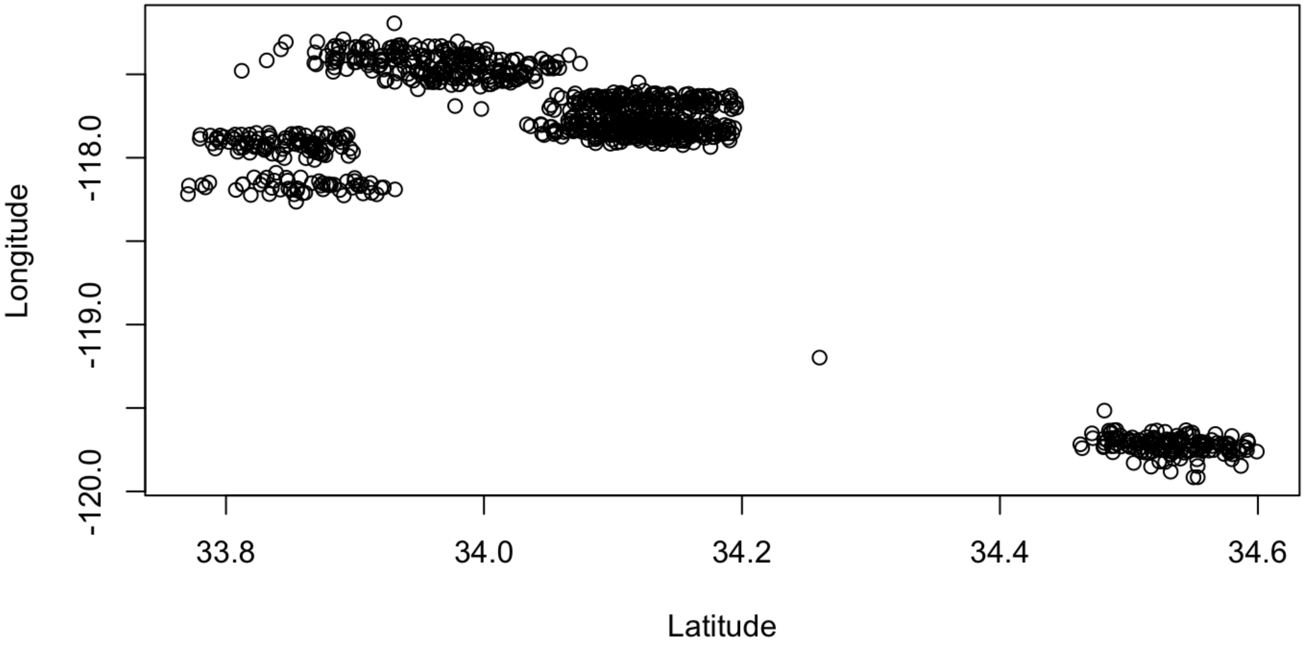
Quantitative vs. quantitative

```
par(mfrow = c(1,3))
hist(chs$sulfate)
hist(chs$nitrate)
plot(chs$sulfate, chs$nitrate)
```



Quantitative vs. quantitative

```
plot(chs$latitude, chs$longitude, xlab = 'Latitude', ylab = 'Longitude')
```

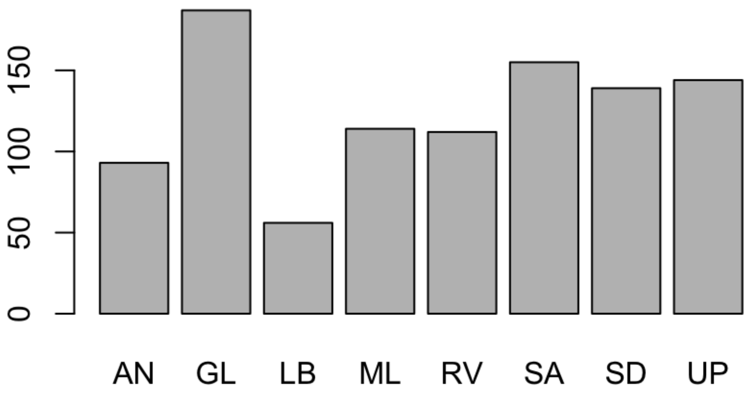


Quantitative vs. categorical

```
table(chs$townabbr)
```

```
##
##  AN  GL  LB  ML  RV  SA  SD  UP
##  93 187  56 114 112 155 139 144
```

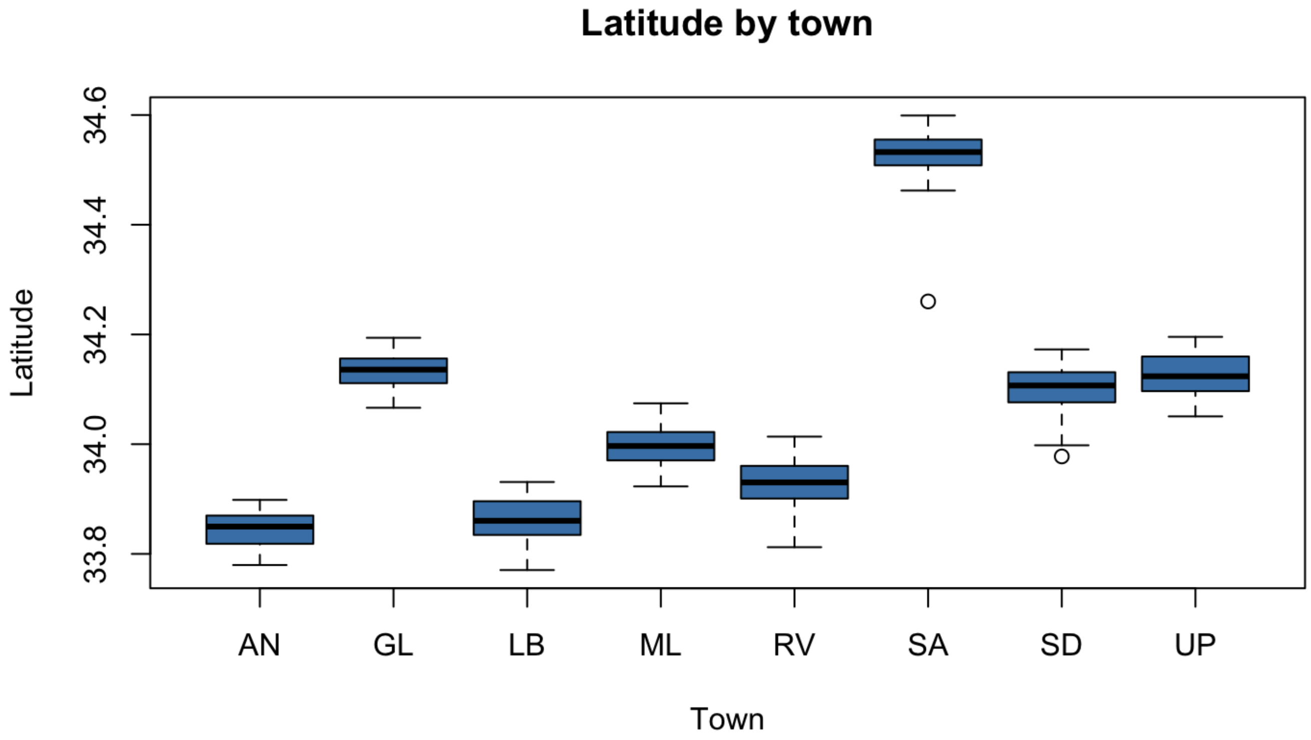
```
barplot(table(chs$townabbr))
```



Quantitative vs. Categorical

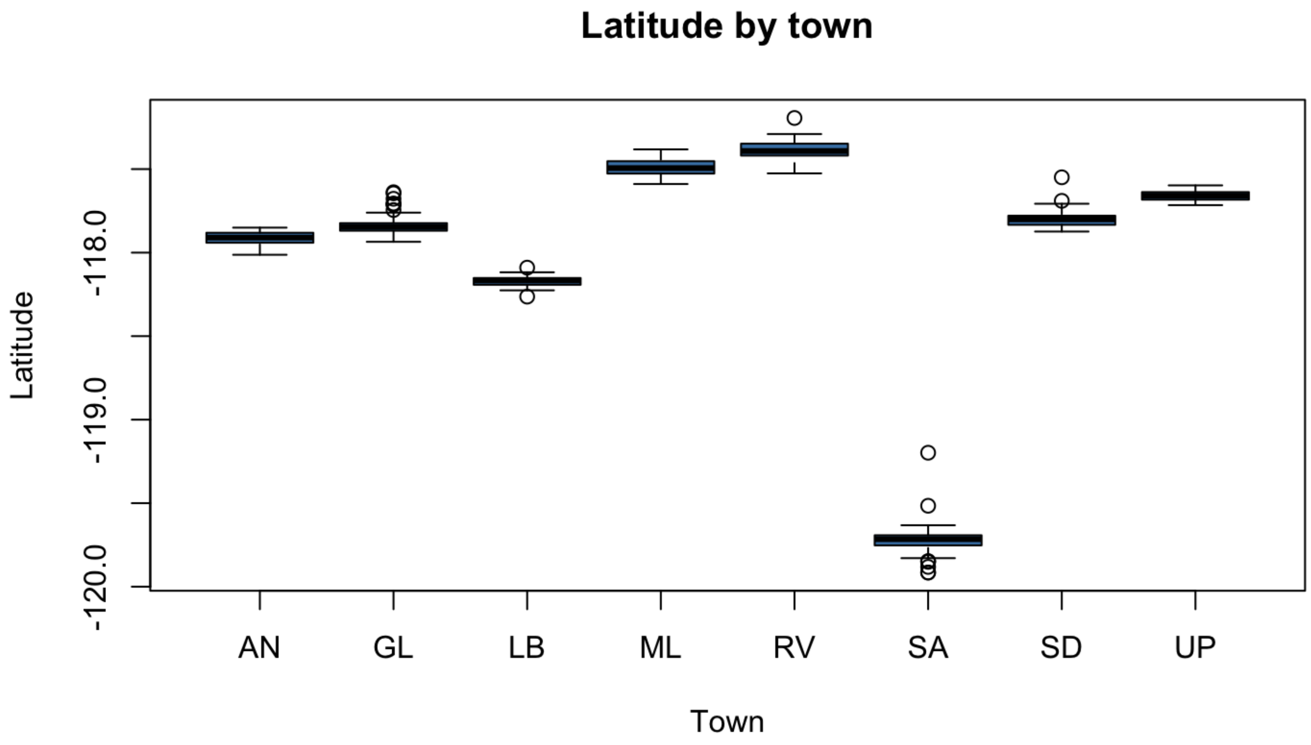
Graphical summary:Side by side Boxplots

```
boxplot(chs$latitude ~ chs$townabbr, main = 'Latitude by town',
        xlab = 'Town', ylab='Latitude', col = 'steelblue')
```



Quantitative vs. categorical

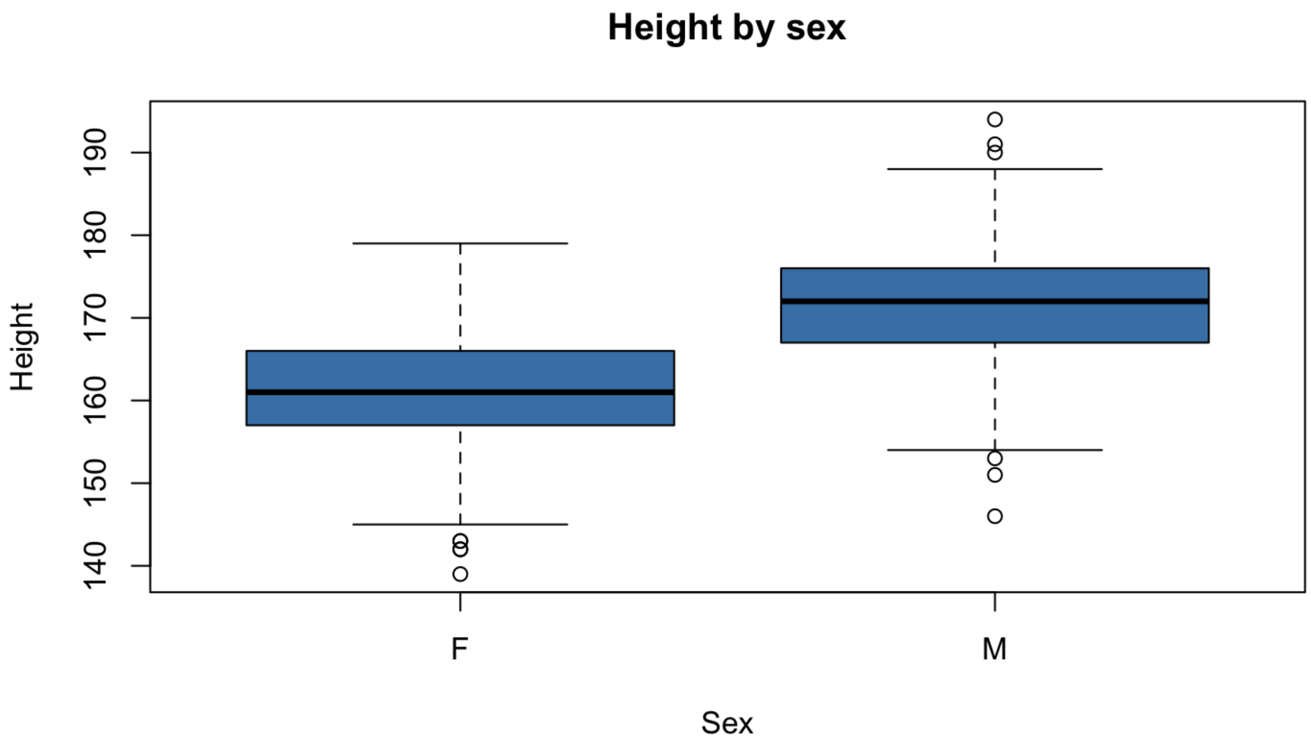
```
boxplot(chs$longitude ~ chs$townabbr, main = 'Latitude by town',
        xlab = 'Town', ylab='Latitude', col = 'steelblue')
```



Quantitative vs. categorical

Numerical summary:

```
chs$sex = factor(chs$male, levels = 0:1, labels = c('F', 'M'))
boxplot(chs$height ~ chs$sex, main = 'Height by sex',
        xlab = 'Sex', ylab='Height', col = 'steelblue')
```



Quantitative vs. categorical

Numerical summary: mean/sd or median/IQR **by** levels of the categorical variable

```
aggregate(chs$height, by = list(chs$sex), FUN=mean)
```

```
##   Group.1        x
## 1       F 161.2863
## 2       M 171.4741
```

```
aggregate(chs$height, by = list(chs$sex), FUN=sd)
```

```
##   Group.1        x
## 1       F 6.657984
## 2       M 7.192727
```

Many nice alternatives using R packages like dplyr for general data manipulation

Categorical vs. categorical

```
# '< 12th Grade', 'Grade12','Some post high-school', '4 years of college', 'Some post-graduate'
table(chs$educ)
```

```
## 
##   1   2   3   4   5 
## 171 153 323 151 138
```

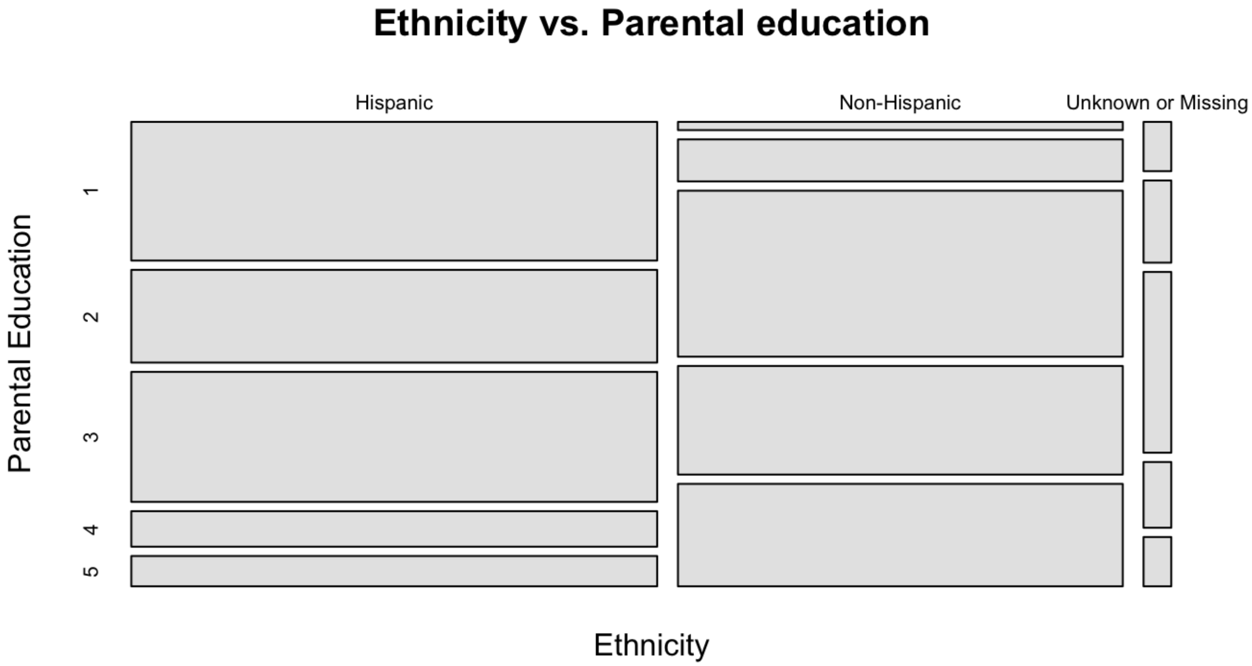
```
table(chs$hisp)
```

```
## 
##           Hispanic       Non-Hispanic Unknown or Missing 
##                522                422                 56
```

Categorical vs. categorical

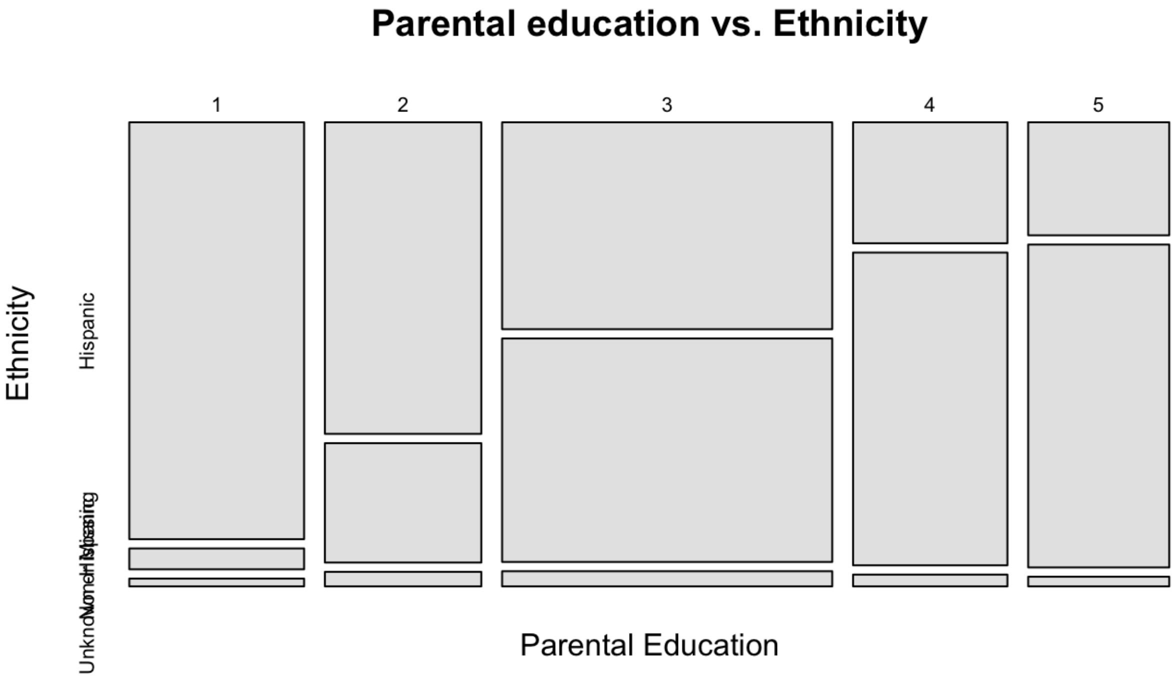
Graphical summary: Mosaic plots

```
mosaicplot(chs$hisp ~ chs$educ, na.action = na.omit, ylab ='Parental Education',
           xlab = 'Ethnicity', col='gray90', main = 'Ethnicity vs. Parental education')
```



Categorical vs. categorical

```
mosaicplot(chs$educ ~ chs$hisp, na.action = na.omit, xlab ='Parental Education',
           ylab = 'Ethnicity', col='gray90', main = 'Parental education vs. Ethnicity')
```



Categorical vs. Categorical

Numerical summary: cross tabulation / contingency table

```
table(chs$educ, chs$hisp)
```

```
## 
##     Hispanic Non-Hispanic Unknown or Missing
##   1      160            8                  3
##   2      107           41                  5
##   3      150          162                 11
##   4       41          106                  4
##   5       35          100                  3
```

- the base R `table`is not great for generating richly-featured crosstabs
- Many packages: ctabs, xtable, ftable, function `CrossTable` in gmodels, and many more

Categorical vs. Categorical

Cross tabulation

```
library(catspec)
ctab(factor(chs$educ), factor(chs$hisp), type = 'n', addmargins = TRUE)
```

```
##      Hispanic Non-Hispanic Unknown or Missing Sum
##
## 1          160            8                  3 171
## 2          107           41                  5 153
## 3          150          162                 11 323
## 4           41          106                  4 151
## 5           35          100                  3 138
## Sum        493          417                 26 936
```

Categorical vs. categorical

Frequency table

```
library(catspec)
ctab(factor(chs$educ), factor(chs$hisp), type = 'row', addmargins = TRUE)
```

```
##        Hispanic Non-Hispanic Unknown or Missing    Sum
##
## 1         93.57         4.68               1.75 100.00
## 2         69.93        26.80               3.27 100.00
## 3         46.44        50.15               3.41 100.00
## 4         27.15        70.20               2.65 100.00
## 5         25.36        72.46               2.17 100.00
## Sum      262.46       224.29              13.25 500.00
```

Categorical vs. categorical

```
ctab(factor(chs$educ), factor(chs$hisp), type = 'column', addmargins = TRUE)
```

```
##      Hispanic Non-Hispanic Unknown or Missing    Sum
##
## 1       32.45         1.92              11.54  45.91
## 2       21.70         9.83              19.23  50.77
## 3       30.43        38.85              42.31 111.58
## 4        8.32        25.42              15.38  49.12
## 5        7.10        23.98              11.54  42.62
## Sum    100.00       100.00             100.00 300.00
```