# SDM4 in R: Comparing Groups (Chapter 22)

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*June 12, 2018*

## Introduction and background

This document is intended to help describe how to undertake analyses introduced as examples in the Fourth Edition of *Stats: Data and Models* (2014) by De Veaux, Velleman, and Bock. More information about the book can be found at http://wps.aw.com/aw_deveaux_stats_series. This file as well as the associated R Markdown reproducible analysis source file used to create it can be found at http://nhorton.people.amherst.edu/sdm4.

This work leverages initiatives undertaken by Project MOSAIC (http://www.mosaic-web.org), an NSF-funded effort to improve the teaching of statistics, calculus, science and computing in the undergraduate curriculum. In particular, we utilize the `mosaic` package, which was written to simplify the use of R for introductory statistics courses. A short summary of the R needed to teach introductory statistics can be found in the mosaic package vignettes (http://cran.r-project.org/web/packages/mosaic). A paper describing the mosaic approach was published in the *R Journal*: https://journal.r-project.org/archive/2017/RJ-2017-024.

## Chapter 22: Comparing Groups

### Section 22.1: The standard deviation of a difference

We can replicate the calculations in the example on the bottom of page 587.

```
n1 <- 248
p1 <- 0.57
n2 <- 256
p2 <- 0.70
sediff <- sqrt(p1*(1-p1)/n1 + p2*(1-p2)/n2)
sediff
```

```
## [1] 0.0425
```

### Section 22.3: Confidence interval for a difference

We can replicate the values from the example on page 590.

```
(p2 - p1) + c(-1.96, 1.96)*sediff
```

```
## [1] 0.0466 0.2134
```

### Section 22.4: Testing for a difference in proportions

We can replicate the values from the example on pages 594-595.

```r
n1 <- 293
y1 <- 205
n2 <- 469
y2 <- 235
ppooled <- (y1+y2)/(n1+n2)
ppooled
```

```
## [1] 0.577
```

```r
sepooled <- sqrt(ppooled*(1-ppooled)/n1 + ppooled*(1-ppooled)/n2)
sepooled
```

```
## [1] 0.0368
```

```r
z <- (y1/n1 - y2/n2)/sepooled
z
```

```
## [1] 5.4
```

```r
pval <- 2*pnorm(z, lower.tail = FALSE)
pval
```

```
## [1] 6.7e-08
```

### Section 22.6: Testing for a difference in means

```r
n1 <- 8
n2 <- 7
ybar1 <- 281.88
ybar2 <- 211.43
s1 <- 18.31
s2 <- 46.43
sediff <- sqrt(s1^2/n1 + s2^2/n2)
sediff
```

```
## [1] 18.7
```

```r
t <- (ybar1 - ybar2)/sediff
t
```

```
## [1] 3.77
```

```r
pval <- 2*pt(t, df = 7.62)
pval
```

```
## [1] 1.99
```

```
prices <- read.csv("http://nhorton.people.amherst.edu/sdm4/data/Camera_prices.csv")
prices
```

```
##   Buying.from.a.Friend Buying.from.a.Stranger
## 1                  275                    260
## 2                  300                    250
## 3                  260                    175
## 4                  300                    130
## 5                  255                    200
## 6                  275                    225
## 7                  290                    240
## 8                  300                     NA
```

```
with(prices, t.test(Buying.from.a.Friend, Buying.from.a.Stranger))
```

```
##
##  Welch Two Sample t-test
##
## data:  Buying.from.a.Friend and Buying.from.a.Stranger
## t = 4, df = 8, p-value = 0.006
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##   26.9 114.0
## sample estimates:
## mean of x mean of y
##       282       211
```

Let's turn this dataset in a ggformula friendlier version.

```
ds <- with(prices,
  data.frame(price = c(Buying.from.a.Friend, Buying.from.a.Stranger),
             group = c(rep("Friend", nrow(prices)), rep("Stranger", nrow(prices)))))
ds
```

```
##    price    group
## 1    275   Friend
## 2    300   Friend
## 3    260   Friend
## 4    300   Friend
## 5    255   Friend
## 6    275   Friend
## 7    290   Friend
## 8    300   Friend
## 9    260 Stranger
## 10   250 Stranger
## 11   175 Stranger
## 12   130 Stranger
## 13   200 Stranger
## 14   225 Stranger
## 15   240 Stranger
## 16    NA Stranger
```

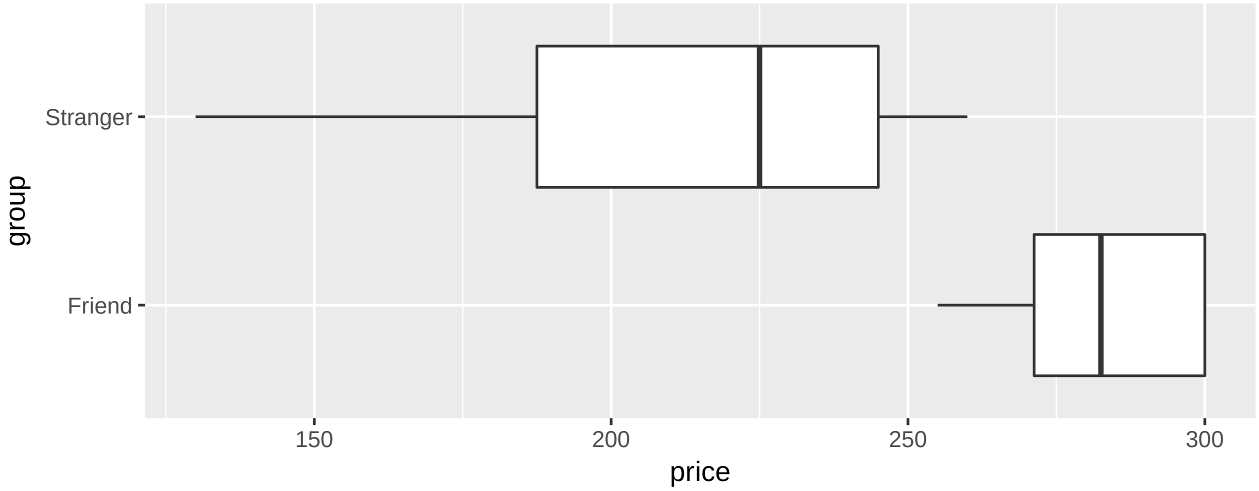
```r
t.test(price ~ group, data = ds)   # Unpooled or unequal variance
```

```
##
##  Welch Two Sample t-test
##
## data:  price by group
## t = 4, df = 8, p-value = 0.006
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##   26.9 114.0
## sample estimates:
##   mean in group Friend mean in group Stranger
##                    282                    211
```

```r
t.test(price ~ group, var.equal = TRUE, data = ds)   # Pooled or equal variance
```

```
##
##  Two Sample t-test
##
## data:  price by group
## t = 4, df = 10, p-value = 0.002
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##   32.1 108.8
## sample estimates:
##   mean in group Friend mean in group Stranger
##                    282                    211
```

```r
gf_boxplot(price ~ group, data = ds) %>%
  gf_refine(coord_flip())
```


Stranger
Friend
group
price