# 4211 Homework 2

Matthew DeSantis

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## 1

### (a)

```
(z = (3500-3400)/(300/sqrt(200)))
```

```
## [1] 4.714045
```

```
1-pnorm(z)
```

```
## [1] 1.214234e-06
```

Because the sample size is large, the z and t tests are interchangeable here. The large sample size is also required, because the data is not normal. The t test is only a correct approximation if the data is normal.

### (b)

```
reject = qnorm(0.95)
(power = 1-pnorm(reject, mean = z, sd = 1))
```

```
## [1] 0.9989268
```

The power can be increased by taking a larger sample, or by using a larger alpha. The power is also larger if the two hypothesis are more drastically different (for example, if the mean weight of the babies in our sample was 7000 instead of 3500, we would have much larger power), but this is not typically something we can control.

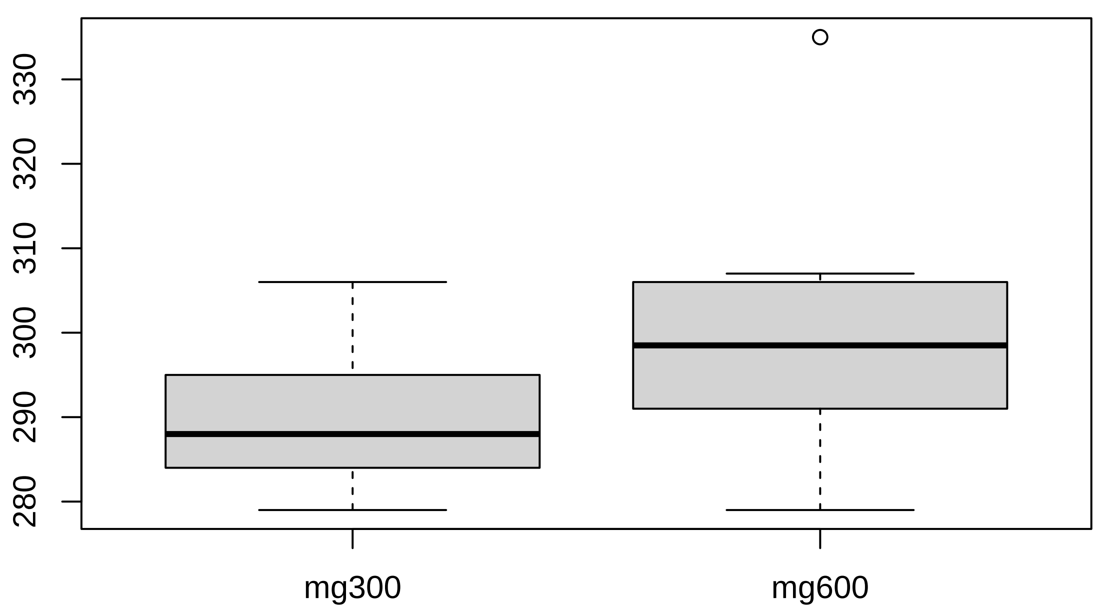
# 2

## (a)

```
data("aztdoses")
x = data.frame(mg300 = aztdoses$azt[aztdoses$dose==300], mg600 = aztdoses$azt[aztdoses$dose==600])
x
```

```
##    mg300 mg600
## 1    284   298
## 2    279   307
## 3    289   297
## 4    292   279
## 5    287   291
## 6    295   335
## 7    285   299
## 8    279   300
## 9    306   306
## 10   298   291
```

```
boxplot(x)
```




As visible from the graph, the data point 335 is an outlier in the 600 mg group.It appears that the 600 mg group have higher p24 levels on average.

### (b)

```r
(z2 = (mean(x$mg600) - mean(x$mg300))/sqrt((var(x$mg600)/10)+(var(x$mg300)/10)))
```

```
## [1] 2.03404
```

```r
1 - pnorm(z2)
```

```
## [1] 0.02097378
```

```r
(test = t.test(x$mg600, x$mg300))
```

```
##
##  Welch Two Sample t-test
##
## data:  x$mg600 and x$mg300
## t = 2.034, df = 14.509, p-value = 0.06065
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.5557409 22.3557409
## sample estimates:
## mean of x mean of y
##     300.3     289.4
```

At the 5% significance level, the difference is not significant.

### (c)

```r
mean(test$conf.int[1:2])
```

```
## [1] 10.9
```

```r
test$conf.int[1:2]
```

```
## [1] -0.5557409 22.3557409
```

### (d)

At the 5% significance level, there is not sufficient evidence to say that patients given 600mg of AZT have different p24 antigen levels than patients given 300mg of AZT.

# 3

## (a)

H0: p<=0.14 H1: p>0.14

## (b)

```
qnorm(0.99)
```

```
## [1] 2.326348
```

The test statistic must be greater than the above value to reject the null hypothesis.

## (c)

```
(z3 = ((104/590)-0.14)/((sqrt(0.14*(1-0.14)))/sqrt(590)))
```

```
## [1] 2.539069
```

```
1 - pnorm(z3)
```

```
## [1] 0.005557393
```

At the 1% significance level, there is sufficient evidence to say that the proportion of drivers wearing their seatbelts is greater than 0.14.

# 4

## (a)

```r
ahat = 476/500
varA = ahat*(1-ahat)
bhat = 463/500
varB = bhat*(1-bhat)
n = 500
(z4 = (ahat-bhat)/sqrt(varA/n + varB/n))
```

```
## [1] 1.720233
```

```r
(1 - pnorm(z4))*2
```

```
## [1] 0.0853901
```

## (b)

```r
prop.test(x = c(476, 463), n = c(500, 500), correct = FALSE)
```

```
##
##  2-sample test for equality of proportions without continuity correction
##
## data:  c(476, 463) out of c(500, 500)
## X-squared = 2.9505, df = 1, p-value = 0.08585
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  -0.00362335  0.05562335
## sample estimates:
## prop 1 prop 2
##  0.952  0.926
```

```r
prop.test(x = c(952, 926), n = c(1000, 1000), correct = FALSE)
```

```
##
##  2-sample test for equality of proportions without continuity correction
##
## data:  c(952, 926) out of c(1000, 1000)
## X-squared = 5.9009, df = 1, p-value = 0.01513
## alternative hypothesis: two.sided
## 95 percent confidence interval:
##  0.005053128 0.046946872
## sample estimates:
## prop 1 prop 2
##  0.952  0.926
```

If the sample size is doubled, our test becomes more powerful and the conclusion changes to reject the null hypothesis.

## 5

### (a)

```
z5 = (0.93 - 0.95)/(0.93*(1-0.93)/sqrt(500))
reject = qnorm(0.05)
(power = pnorm(reject, mean = z5, sd = 1))
```

```
## [1] 0.9999999
```

```
pwr.p.test(h = ES.h(0.93,0.95), n = 500, sig.level = 0.95, alternative = "less")
```

```
##
##      proportion power calculation for binomial distribution (arcsine transformation)
##
##               h = -0.08449984
##               n = 500
##       sig.level = 0.95
##           power = 0.9997956
##     alternative = less
```

### (b)

```
pwr.p.test(h = ES.h(0.95,0.93), power = 0.8, sig.level = 0.95, alternative = "less")
```

```
##
##      proportion power calculation for binomial distribution (arcsine transformation)
##
##               h = 0.08449984
##               n = 90.35884
##       sig.level = 0.95
##           power = 0.8
##     alternative = less
```