STAT 22000: Homework 10

Zixi Li

Problem 1 Find the p-value

(a) Upper one-sided p-value is 0.00771264

```
pt(2.6,df=26-1,lower.tail = F)
```

```
## [1] 0.00771264
```

(b) Two-sided p-value is 0.0154253

```
2*pt(2.6,df=26-1,lower.tail = F)
```

```
## [1] 0.0154253
```

(c) Lower one-sided p-value is 0.0209623

```
pt(-2.2,df=18-1)
```

```
## [1] 0.0209623
```

(d) Lower one-sided p-value is 0.979038

```
pt(2.2,df=18-1)
```

```
## [1] 0.979038
```

Problem 2 Compare different psychological therapies

(a)

The sample mean $\bar{x}$=3

The standard deviation $s = 7.32042$

```r
weightchange=c(1.7, 11.7, -1.4, 0.7, 6.1, -0.8, -0.1, 1.1,
               2.4, -0.7, -4.0, 12.6, -3.5, 20.9,1.9, 14.9,
               -9.3, 3.9, 3.5, 2.1, 0.1, 17.1, 1.4, 15.4,
               -7.6, -0.3, -0.7,1.6, -3.7)
mean(weightchange)
```

```
## [1] 3
```

```r
sd(weightchange)
```

```
## [1] 7.32042
```

(b)

H_0: $\mu = 0$, H_A: $\mu > 0$, where μ is the population mean weight gain of girls who received the cognitive behavioral therapy.

(c)

$$df = n - 1 = 29 - 1 = 28$$

$$t - statistic = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} = \frac{3 - 0}{7.32/\sqrt{29}} = 2.207$$

(d) The upper one-sided p-value is 0.0178404, which is larger than the significance level 0.01, so we fail to reject H_0, girls' mean weight gain is not significantly higher than 0.

```r
pt(2.207,df=28,lower.tail = F)
```

```
## [1] 0.0178404
```

(e)

Type 1 error: girls who receive the cognitive behavioral therapy have a 0 mean weight gain but we conclude that the mean weight gain is significantly higher than 0.

Type 2 error: girls who receive the cognitive behavioral therapy have mean wight gain higher than 0 but we fail to reject the null hypothesis.

(f)

H_0: $\mu = 0$, H_A: $\mu \neq 0$, where μ is the population mean weight gain of girls who received the cognitive behavioral therapy.

The degree of freedom and t-statistic remain the same. df=28 and t-statistic=2.207

The two-sided p-value $= 0.01784 \times 2 = 0.03568$

(g)

The 95% t-confidence interval is 2.04841, the corresponding mean weight gain is $3 \pm 2.04841 \times 7.32/\sqrt{29} = (0.2155, 5.7845)$, thus the true mean change in weight is positive, but possibly as small as 0.2155

```
qt(0.05/2, df=28, lower.tail = F)
```

```
## [1] 2.04841
```

(h)

We can see the t-statistic, the df, the p-values and the 95% confidence level all agree with our calculation in (c)(d)(f)(g).

```
cognitive = c(1.7, 11.7, -1.4, 0.7, 6.1, -0.8, -0.1, 1.1,
              2.4, -0.7, -4.0, 12.6, -3.5, 20.9,1.9, 14.9,
              -9.3, 3.9, 3.5, 2.1, 0.1, 17.1, 1.4, 15.4,
              -7.6, -0.3, -0.7,1.6, -3.7)
t.test(cognitive, alternative = "greater")
```

```
##
##  One Sample t-test
##
## data:  cognitive
## t = 2.207, df = 28, p-value = 0.0178
## alternative hypothesis: true mean is greater than 0
## 95 percent confidence interval:
##  0.687537      Inf
## sample estimates:
## mean of x
##         3
```

```
t.test(cognitive, alternative = "two.sided")
```

```
##
##  One Sample t-test
##
## data:  cognitive
## t = 2.207, df = 28, p-value = 0.0357
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  0.215461 5.784539
## sample estimates:
## mean of x
##         3
```

Problem 3 True or faulse

(a) is false. Increasing the significance level will increase the probability of making a Type 1 error.

(b) is true.

(c) is false. Failure to reject H_0 means we don't have strong evidence to reject it, we can't be sure that $\mu = 5$.