STAT 423/523 HW1

Guimiao Zhang

Q1 (10pts, 5 each, identify α 1, identify formula 1, identify CI 1, interpret 2)

we are 90% confident that the true (1pt) ave.penetration (in mils)(1pt) for each specimen is b/w ... and ...

a. known true variance, FS (formula sheets) F-1, 1st formula in 1st box:
   $\bar{x} = 35.7,\ n = 35,\ \sigma = 5,\ \alpha = 0.10,\ z_{0.05} = 1.645$

```
x.bar = 35.7; n=35;sigma=5;alpha=1-0.9
z=abs(qnorm(alpha/2))
CI.known=c(x.bar-z*sigma/sqrt(n),x.bar+z*sigma/sqrt(n))
CI.known
```

```
## [1] 34.30984 37.09016
```

b. unknown true variance, F-1 2st formula in 1st box $\bar{x} = 35.7,\ n = 35,\ s = 4.2,\ \alpha = 0.10,\ t_{(0.05,34)} = 1.691$

```
x.bar = 35.7; n=35;s=4.2;alpha=1-0.9
t=abs(qt(alpha/2,n-1))
CI.unknown=c(x.bar-t*s/sqrt(n),x.bar+t*s/sqrt(n))
CI.unknown
```

```
## [1] 34.49956 36.90044
```

Q2 (10pts, 5 each)

a. Ho: the errors are normally distributed.
   Ha: the errors are NOT normally ditributed.
   p=0.3844 (given)
   Reject Ho if p<α.
   (Here the 1st part does not specify a level of significance(α), but we could use the one in part b.)
   Conclusion: fail to reject Ho. There is not sufficient evidence to claim that the errors are NOT normally distributed. Hence, the errors are APPROXIMATELLY normally distributed.
   Remark: the p-value is large, around 0.4. The linear relationship in the plot is moderate. If it is close to zero (<0.05), linearility would be very week, reject Ho. If it close to 1, strong linearility, almost can claim normally distributed error.

b. (t-test 2pt t-critical/p-value 1pt RR 1pt conclusion 1)
   t-test stats=-4.1268 (FS F-1 2nd formula in 2nd box: $\mu = 15,\ \bar{x} = 10.23,\ s = 5.17,\ n = 20, \alpha = 0.05$, the previous result is from R, but if you do it manually, t=-4.1261)
   t-critical=-1.7291 ($t_{(0.05,19)}$, less, "-")
   Ho: $\mu = 15$.
   Ha: $\mu < 15$.
   T=-4.1268
   Reject Ho if t<-1.7291.
   Conclusion: reject Ho. There is significant evidence to claim that $\mu < 15$.

```
x=c(9.41, 20.06, 8.80, 10.10, 14.38, 10.42, 13.30, 4.04, 3.40, 11.95,
    12.77, 6.39, 21.95, 14.82, 12.75, 8.86, 5.56, 6.26, 6.52, 2.81)
t.test(x,mu=15,alternative="less")
```

```
##
```

```
##  One Sample t-test
##
## data:  x
## t = -4.1268, df = 19, p-value = 0.0002868
## alternative hypothesis: true mean is less than 15
## 95 percent confidence interval:
##      -Inf 12.22717
## sample estimates:
## mean of x
##   10.2275
```

Q3

a. 2-sided $\alpha = 0.1, m = n = 45$ FS F-2 case II.
$\bar{x} - \bar{y} = 4.83 - 4.55 = 0.28,\ Z_{0.05} = 1.645\ s_1 = 0.175,\ s_2 = 0.234$

```r
x=4.83; y=4.55; s1=0.175; s2=0.234; z=abs(qnorm(0.05)); d=x-y; n=45
CI=c(d-z*sqrt(s1^2+s2^2)/sqrt(n), d+z*sqrt(s1^2+s2^2)/sqrt(n))
CI
```

```
## [1] 0.2083524 0.3516476
```

```r
test=(d-0)/sqrt(s1^2/n+s2^2/n)
test
```

```
## [1] 6.428115
```

```r
0-z ## 1-sided below to be larger? test < z RR
```

```
## [1] -1.644854
```

We are 90% confident that the difference in the true average dissolved oxygen between locations above and below town is between .. and . . .
b. (1)Ho: $\mu_{above} - \mu_{below} = 0$.
(1)Ha: $\mu_{above} - \mu_{below} < 0$. or do the other way around. But note: 1-sided
(1)$Z - test = \frac{0.25-0}{\sqrt{\frac{0.175^2+0.234^2}{45}}} = 6.428$
(1)Reject Ho if t<-1.645.or find p-value and define it
(1)Conclusion: fail to reject Ho. There is not significant evidence to claim that $\mu_{above} - \mu_{below} < 0$.