Assignment 5

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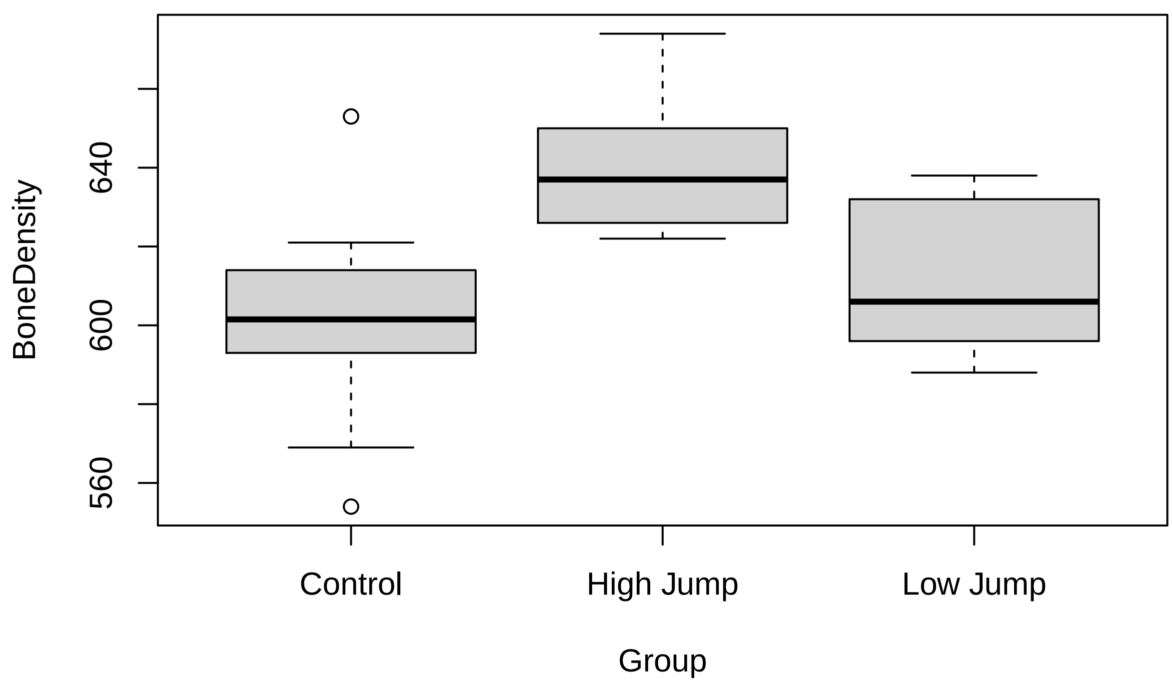
Question 1

```
Group = c(rep("Control",10),rep("Low Jump",10),rep("High Jump",10))
BoneDensity = c(c(611,621,614,593,593,653,600,554,603,569),
                c(635,605,638,594,599,632,631,588,607,596),
                c(650,622,626,626,631,622,643,674,643,650))
boxplot(BoneDensity~Group)
```




```
means = tapply(BoneDensity, Group, mean)
sds = tapply(BoneDensity, Group, sd)
```

Group	Mean	Standard Deviation
Control	601.1	27.364
Low Jump	612.5	19.329
High Jump	638.7	16.594

From the plots we can see that the sample of rats in the high jump group has a mean which is much higher than the low jump and control groups. The means for control and low jump are pretty similar. Also, from the plots we can see that there is an outlier on both the high and low ends of the control group. From the summary table we can see that the standard deviations are decreasing as the jump height increases.

Question 2

Since the largest standard deviation 27.364 is less than twice the smallest standard deviation 16.594 * 2 = 38.658 The assumption of equal variances is reasonable

Question 3

a) The null hypothesis suggests that the mean bone density is the same throughout all 3 population of rats. That is, the mean bone density for the population of rats that do not jump μ_1, the mean bone density for the population of rats that perform low jumps μ_2, the mean bone density for the population of rats that jump high μ_3, all have the same mean bone density. Whereas the alternative hypothesis suggests that at least two of the population mean bone densities will differ between the three populations.

$H_0 : \mu_1 = \mu_2 = \mu_3$
H_A :$\mu_i \neq \mu_j$ for at least one pair (i,j) where $i, j \in 1, 2, 3$ $i \neq j$
μ_1 is the mean bone density of the population of rats that do not jump
μ_2 is the mean bone density of the population of rats that perform low jumps
μ_3 is the mean bone density of the population of rats that perform high jumps

```
#anova(aov(BoneDensity ~ Group)) Used to get the table for b)
```

b)

Source	Degrees of Freedom	Sum of squares	mean of squares	F-Value	P-Value
Group	2	7434	3717	7.98	0.0019
Residuals	27	12579	466	X	X

c) Since the p-value = 0.0019 < 0.05 we reject the null hypothesis.

d) After performing tests, the data suggests there is strong evidence that the three jumping conditions will differ in altering a rats bone density.

Question 4

From the ANOVA table we can see that $SS_E/(N - g) = 466 = MS_E$ and since the estimate for the error standard deviation σ is s = $\sqrt{MS_E}$ the estimate is $\sqrt{466} = 21.587$

Question 5

```
s = sqrt(466)

n=10 # same for all groups
standardError = s/sqrt(n) #same for all groups
ME = pt(0.975,df=n-1)*standardError #same for all groups
CIcontrol = c(means[1]-ME,means[1]+ME)
CIlow = c(means[3]-ME,means[3]+ME)
CIhigh =c(means[2]-ME,means[2]+ME)
```

Group	Mean	Confidence Interval
Control	601.1	(595.485, 606.715)
Low Jump	612.5	(606.885, 618.115)
High Jump	638.7	(633.085, 644.315)