Stat 140 - Quiz 2 Sample Solutions

What's Your Name? _____

This is a sample quiz. For the real quiz, I will use a different data set, but will pick roughly 2-3 of the questions that are below and adapt them to the new data set with minimal modification.

Below are the first few rows of a data frame named `NHANES`. NHANES stands for "National Health and Nutrition Examination Surveys", and the data frame contains information about the health of randomly sampled Americans.

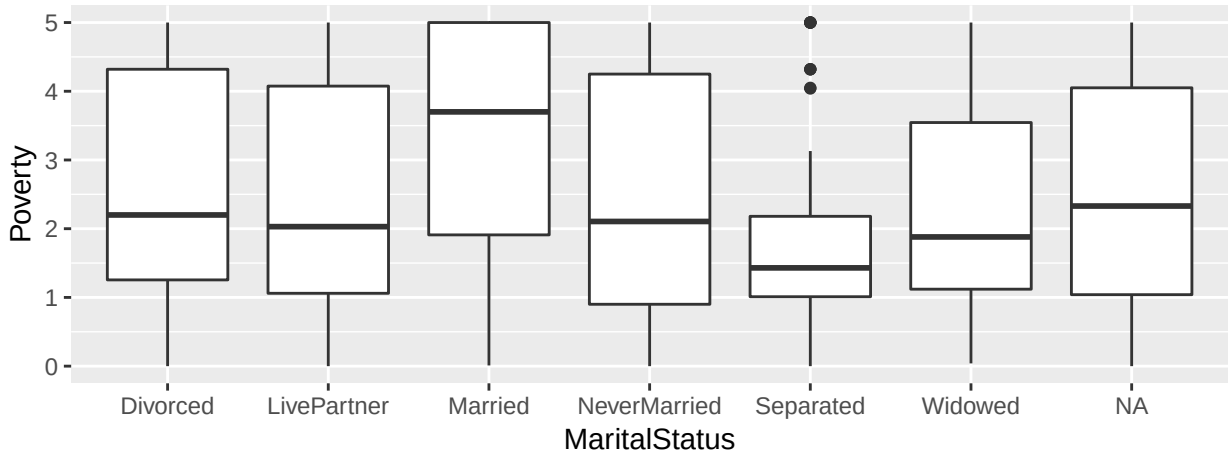
```
##      ID Gender Age MaritalStatus Poverty Weight Height Testosterone
## 1 62163   male  14          <NA>    4.07   49.4  168.9       274.95
## 2 62172 female  43  NeverMarried    2.02   98.6  172.0        47.53
## 3 62174   male  80       Married    4.30   95.8  168.1       642.82
## 4 62174   male  80       Married    4.30   95.8  168.1       642.82
## 5 62176 female  34       Married    5.00   68.7  171.6        21.11
## 6 62178   male  80       Widowed    0.05   85.9  173.5       562.78
##   BPDiaAve
## 1       37
## 2       72
## 3       39
## 4       39
## 5       69
## 6       72
```

1. Poverty and Marital Status

The `Poverty` variable in this data set is described as follows: "A ratio of family income to poverty guidelines. Smaller numbers indicate more poverty."

Here are some side-by-side box plots summarizing the distribution of this poverty index within each level of the `MaritalStatus` variable.

```
ggplot() +
  geom_boxplot(data = NHANES, mapping = aes(x = MaritalStatus, y = Poverty))
```



a. For which marital status is the median of the poverty index lowest (indicating more poverty).

The median of the poverty index is lowest among those who are "Separated". (The median is the value at the horizontal line in the middle of each box.)

b. The median poverty index for individuals in the "NeverMarried" group is about 2. What is the interpretation of this number, in terms of the proportion of individuals in this group who have a poverty index of less than 2?

Half of the people who were never married in this sample have a poverty index of less than 2.

c. For which marital status is the 75th percentile of the poverty index largest?

The 75th percentile of the poverty index is largest among those who are married. The 75th percentile is the value at the top of the box.

d. The 75the percentile for the "Widowed" group is about 3.5. What is the interpretation of this number, in terms of the proportion of individuals in this group who have a poverty index of less than 4?

About 75% of individuals in the Widowed group have a poverty index of less than 4.

e. For which marital status is the inter-quartile range (IQR) of the poverty index largest?

The interquartile range is largest for the Never Married group. The interquartile range is the difference between the 75th percentile and the 25th percentile. In the plot, that is the height of the box.

f. Based on the plot, what is the IQR for the "Separated" group, approximately? What is the interpretation of this value?

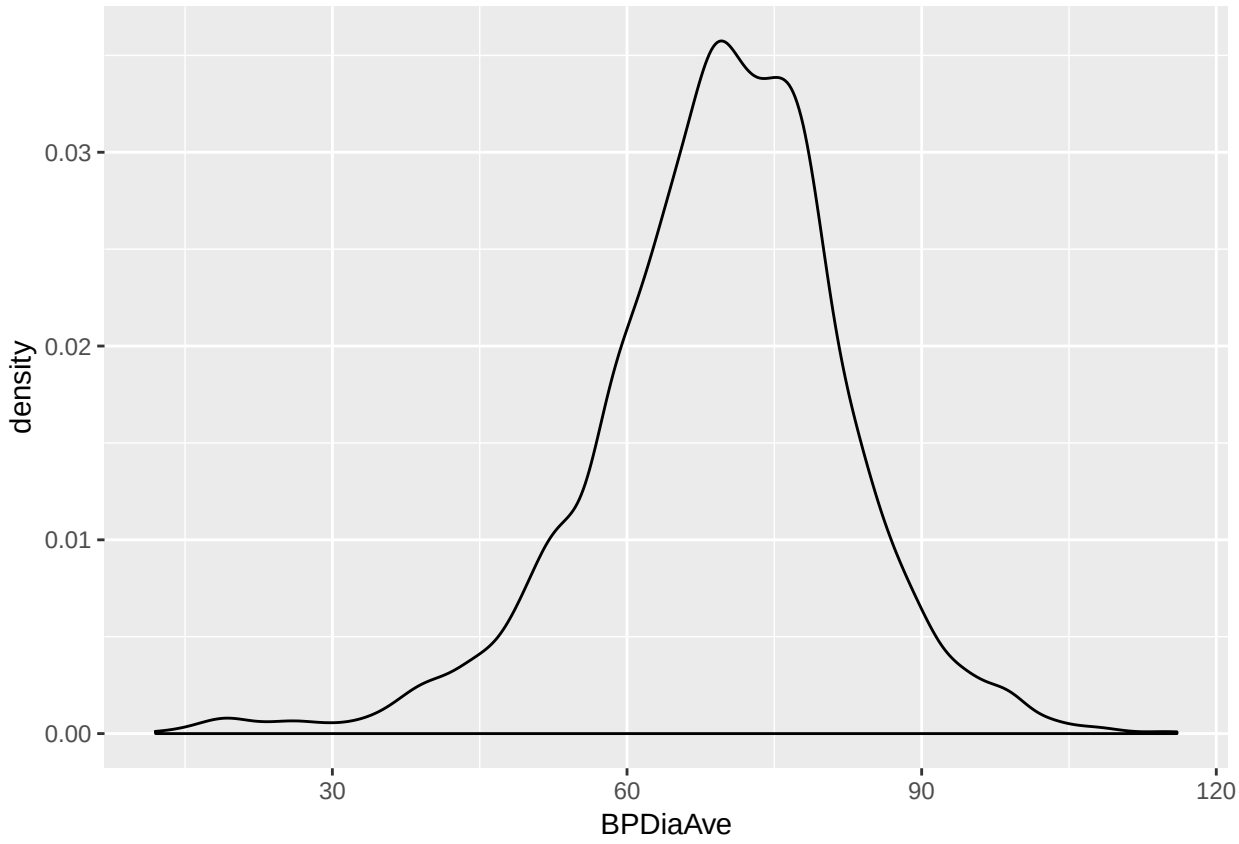
The interquartile range for the "Separated" group is about 1.25. The middle half of the data have a poverty index that falls within an interval of width 1.25.

2. Blood Pressure

Here is a density plot representing the blood pressures of the subjects in this study, as well as the 25th percentile (also known as the first quartile), 50th percentile (also known as the median), and 75th percentile (also known as the third quartile).

```
NHANES_orig <- NHANES
NHANES <- filter(NHANES, BPDiaAve > 0)
```

```
ggplot(data = NHANES, mapping = aes(x = BPDiaAve)) + geom_density()
```




```
NHANES %>%
  summarize(
    q25 = quantile(BPDiaAve, probs = 0.25),
    median = median(BPDiaAve),
    q75 = quantile(BPDiaAve, probs = 0.75))
```

```
##   q25 median q75
## 1  62     70  77
```

a. Describe the distribution of blood pressures in this study in terms of its shape, whether it is symmetric or skewed, and whether there are any outliers.

The distribution of blood pressures is unimodal, symmetric, and does not have any outliers.

b. What statistics would you use to summarize the center and spread of the distribution of blood pressures in this study? Why?

Since the distribution is unimodal, symmetric, and does not contain any outliers, I would summarize the center of the distribution with the mean and the spread of the distribution with the standard deviation.

If the distribution had been multimodal or skewed or had any outliers, I would have used the median to summarize the center and the interquartile range to sumamrize the spread.

c. What does the area under the density curve between 30 and 60 represent?

The area under the density curve between 30 and 60 is the proportion of people in this sample who had a blood pressure measurement that was between 30 and 60.

d. What is the approximate area under the density curve to the left of 62? (Don't calculate this based on the plot – answer based on what you know about the interpretation of area under the curve and the definition of a percentile or quantile.)

62 is the 25th percentile of the data, meaning that 25 percent of the people in this sample had a blood pressure measurement less than 62. This means that the area under the density curve to the left of 62 is about 0.25.

e. What is the approximate area under the density curve to the left of 77? (Don't calculate this based on the plot – answer based on what you know about the interpretation of area under the curve and the definition of a percentile or quantile.)

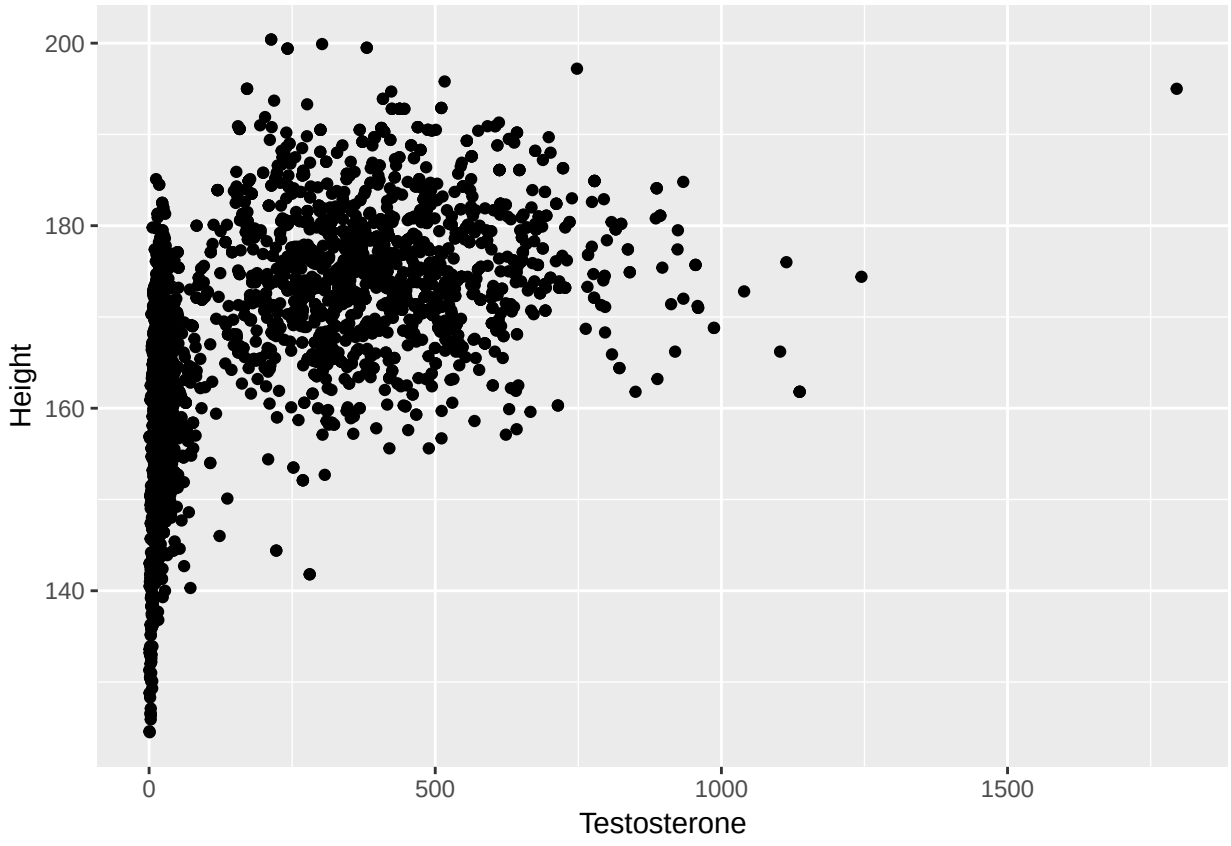
77 is the 75th percentile of the data, meaning that 75 percent of the people in this sample had a blood pressure measurement less than 77. This means that the area under the density curve to the left of 77 is about 0.75.

3. Testosterone and Height

Here's a scatter plot showing a measurement of each subject's testosterone level and their height.

```
NHANES <- filter(NHANES, !is.na(Height), !is.na(Testosterone))
```

```
ggplot(data = NHANES, mapping = aes(x = Testosterone, y = Height)) + geom_point()
```



a. Describe the shape of the relationship between Testosterone and Height. Are there any outliers?

Overall, the relationship between testosterone and height is not linear. There is one outlier with a large testosterone measurement around 1800.

b. Would it be appropriate to summarize the relationship between Testosterone and Height using the correlation between them?

I would not use the correlation to summarize the relationship between testosterone and height since it does not seem like a line would accurately describe the relationship between these variables and there is an outlier.

c. Describe the strength and direction of the relationship between testosterone and height. In case you would like to use it, the correlation cofficient is calculated below. (Even if you don't use the correlation in your answer on this sample quiz, you should know how you would use it.)

```
NHANES %>%
  select(Testosterone, Height) %>%
  cor()
```

```
##              Testosterone    Height
## Testosterone    1.0000000 0.5771714
## Height          0.5771714 1.0000000
```

There is a fairly weak positive association between testosterone levels and height. In broad terms, as testosterone increase height generally tends to increase as well (so there is a positive association). However, this is not a very strong trend, and there is a lot of variability around that trend, which we can see in the plot.

As discussed above, I would **not** use the correlation in describing this relationship. However, for the sake of providing a study guide, I'll say what you would say if the correlation were useful. In this case the correlation is 0.577. If I had seen a linear relationship without outliers in the plot above, I'd say that the positive correlation indicated a positive association between testosterone and height, and the value of about 0.577 (not close to 1) indicated a weak or moderate level of correlation.