PSTAT 10 Midterm

There are a total of 100 points to be had for the entire exam. Please review the point breakdown of entire exam before proceeding.

- Question 1: 4 points
- Question 2: 4 points
- Question 3: 4 points
- Question 4: 44 points (4 points per blank)
- Question 5: 4 points
- Question 6: 4 points
- Question 7: 10 points
- Question 8: 10 points
- Question 9: 12 points (4 points for each subset)

Consider the following `Iris` dataset. I have converted it into a `tibble` here but I will use both the original dataframe and this tibble going forward.

```r
library(tidyverse)
iris_tib <- as_tibble(iris)
print(iris_tib, n=5)
```

```
## # A tibble: 150 x 5
##   Sepal.Length Sepal.Width Petal.Length Petal.Width Species
##          <dbl>       <dbl>        <dbl>       <dbl> <fct>
## 1          5.1         3.5          1.4         0.2 setosa
## 2          4.9         3            1.4         0.2 setosa
## 3          4.7         3.2          1.3         0.2 setosa
## 4          4.6         3.1          1.5         0.2 setosa
## 5          5           3.6          1.4         0.2 setosa
## # i 145 more rows
```

Question (4 points)

What is one benefit of a tibble compared to a classic dataframe?

A. Tibbles automatically round numeric columns to two decimal places.

B. Tibbles show the column type when printed.

C. Tibbles always display all rows and columns by default.

D. Tibbles convert all character columns to factors by default.

E. Tibbles are immutable and cannot be changed once created.

TRUE: B

Question (4 points)

Which of the following is ***FALSE*** about `iris_tib`?

A. Calling `class(iris_tib)` would show that it is both a tibble and a dataframe.

B. Its dimensions are 150 rows and 5 columns.

C. Calling `is.matrix(iris_tib)` would return TRUE.

D. Each row represents an observation.

E. It has four numeric variables.

TRUE: C

Question (4 points)

You want to understand how `Sepal.Length` is distributed. What code could you use for an appropriate visualization?

A. `boxplot(iris$Sepal.Length, main = "Boxplot of Sepal Length")`

B. `barplot(iris$Sepal.Length, main = "Barplot of Sepal Length")`

C. `plot(iris$Sepal.Length, main = "Plot of Sepal Length")`

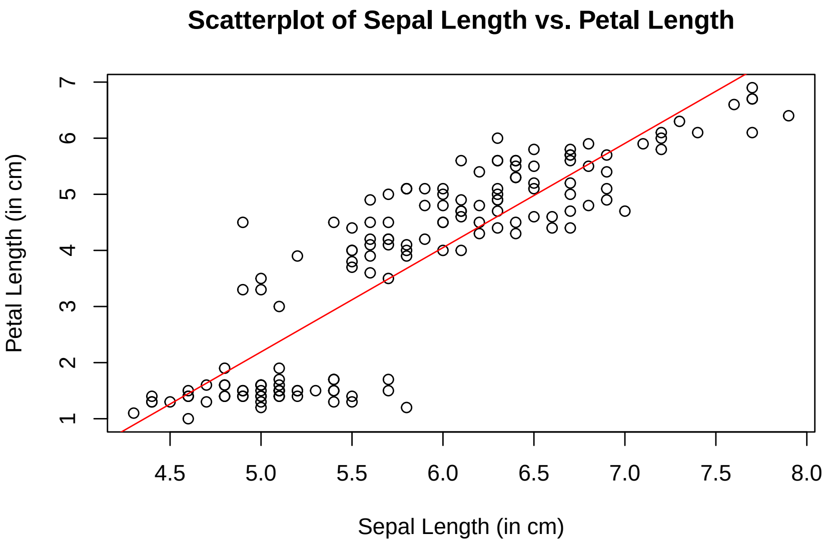
D. `histogram(iris$Sepal.Length, main = "Histogram of Sepal Length")`

E. A and B

TRUE: A

Question (Total for this question: 44 points, 4 points per blank.)

You suspect that `Sepal.Length` and `Petal.Length` are somehow related and decide to create a scatterplot. Fill in the blanks below to produce this scatterplot.



Note that the size of the blank does not necessarily correspond to the length of the correct content.

```
____1____(____2_____, _____3____,
     __4__ = "Scatterplot of Sepal Length vs. Petal Length",
     __5__ = "Sepal Length (in cm)",
     __6__ = "Petal Length (in cm)")
model <- ___7___(____8_____ ~ _____9____)
_____10____(model, ___11___ = "red")
```

1: ________________________________

2: ________________________________

3: ________________________________

4: ________________________________

5: ________________________________

6: ________________________________

7: ________________________________

8: ________________________________

9: ________________________________

10: ________________________________

11: ________________________________

Question (4 points)

Based on this scatterplot, how would you describe the relationship between `Sepal Length` and `Petal Length`?

____

____

____

Question (4 points)

Assuming a linear relationship between `Sepal Lenght` and `Petal Length`, what base R code could you run to measure the strength of this relationship?

A. `correlation(iris$Sepal.Length, iris$Petal.Length)`

B. `relationship(iris$Sepal.Length, iris$Petal.Length)`

C. `cor(iris$Sepal.Length, iris$Petal.Length)`

D. `linear_model(iris$Sepal.Length ~ iris$Petal.Length) %>% summary()`

E. `relation(iris$Sepal.Length, iris$Petal.Length)`

TRUE: C

Question (10 points)

You decide to measure the total combined area of the Sepal and the Petal for each flower.

First, write a function called `total_area` that takes 4 arguments: `Sepal.Length`, `Sepal.Width`, `Petal.Length`, and `Petal.Width`. It should compute the area of the Sepal and the area of the Petal and return the sum of the two. Assume that the Sepal and Petal are rectangular.

~~~
```{r}
# write your code below








# end
```
~~~

A simple test for this function is

```
total_area(1, 2, 2, 2)
```

```
[1] 6
```

Question (10 points)

Now you want to create a new column in your tibble which contains the total area using the function you wrote above. Use tidyverse functions and the pipe to create this new column.

~~~~
```{r echo=FALSE}
# write your code below









# end
```
~~~~

Question (12 points, 4 for each subset)

You suspect that the relationship between `Sepal.Length` and `Sepal.Width` is different for each Iris species. Write code below to create three subsets, one for each value of the `Species` column, which are **`setosa`**, **`versicolor`**, **`virginica`**. Save these subset dataframes each to their own object. Use base R (not the tidyverse) to subset.

```
setosa_df <-
versicolor <-
virginica <-
```

Question (4 points)

You could have done the same operation using `tidyverse` functions. What `dplyr` function is suitable to subset a data frame, retaining all rows that satisfy your conditions?

A. filter

B. select

C. mutate

D. summary

E. summarize

Part 2

Question

Estimating the Probability of Successfully Picking a Lock **Background**: In the tabletop role-playing game Dungeons & Dragons (D&D), players often find themselves in situations where they need to perform tasks that require a bit of luck and skill. One common task is picking a lock. To determine whether a character successfully picks a lock, players roll dice and add bonuses based on their character's abilities.

Objective: Imagine you are a character trying to pick a lock. You have a high level of skill in this task, represented by a +5 bonus, and you also have some magical assistance in the form of a Guidance spell, which gives you an extra boost.

Task: ***Use simulations to estimate the probability of successfully picking a lock that requires a total score of 15 or higher.*** This involves rolling a 20-sided die (d20), adding a +5 skill bonus, and then rolling an additional 6-sided die (d6) for the magical Guidance spell.

Steps to Simulate:

- Roll a 20-sided die (d20) to represent your initial attempt.
- Add a bonus of 5 to the result of the d20 roll to account for your skill.
- Roll an additional 6-sided die (d6) to represent the extra boost from the Guidance spell and add this to your total score.
- Repeat the above steps 10,000 times.
- Calculate the proportion of times the total score is 15 or higher (successfully picking the lock).

~~~~
```{r echo=FALSE}
# write your code below















# end
```
~~~~

Question

What would happen if you increased the numer of replications from 10,000 to 1,000,000?

A. The estimated probability would become exactly 1.

B. The estimated probability would become exactly 0.

C. The estimated probability would become more accurate.

D. The estimated probability would remain the same, but the computation would be faster.

E. The estimated probability would vary more significantly with each run.

TRUE: C