Name (Last, First):

Student ID:

Assignment 1

METCS544A3A4_F2024

Instructions:

1. For answering programming questions, please use Adobe Acrobat edit the pdf file in two steps **[See Appendix: Example Question and Answer]**:
    a. Copy and paste your R code as text in the box provided (so that your teaching team can run your code);
    b. Screenshot your R console outputs, save as a .PNG image file, and paste/insert in the box provided.
    c. Show all work - credit will not be given for code without showing the code in action by including the screenshot of R console outputs.
2. For non-programming questions, please type or handwrite your final answers clearly in the boxes. Show all work - credit will not be given for numerical solutions that appear without explanation in the space above the boxes.
3. **[Total 78 pts = 66 pts + 12 Extra Credit pts]**

Grading Rubric

Each question is worth 3 points and will be graded as follows:

3 points: Correct answer with work shown

2 points: Incorrect answer but attempt shows some understanding (work shown)

1 point: Incorrect answer but an attempt was made (work shown), or **correct answer without explanation (work not shown)**

0 points: Left blank or made little to no effort/work not shown

Reflective Journal [3 pts]

(Copy and paster the link to your live Google doc in the box below)

Part I. Arithmetic Review (24 pts) [Enter your final answer in the box. Show your work in the space in between, to gain full credit]

1. Solve the following problem. Remember your order of operations!

$$\frac{3*(120-10)}{5}$$

Answer:

2. Solve the following problem. Remember your order of operations! Please round your final answer to the 2 decimal places.

$$\frac{(105-110)}{\sqrt{\frac{3^2}{12}+\frac{2^2}{10}}}$$

Answer:

3. Please solve for x:

$$5 = \frac{x+60}{2}$$

Answer:

4. Please solve for x. Please round your final answer to the 2 decimal places.

$$\frac{2x-8}{6} = 10$$

Answer:

5. The following number is written in scientific notation. Please write it in standard decimal notation.

6.52E-3

Answer:

6. The following is written in scientific notation. Please write it in standard decimal notation.

7.38E2

Answer:

7. You collected data on 72 college students and found that eight were left-handed. What proportion of the students you surveyed are left-landed? Please write your final answer as a decimal rounded to 2 decimal places.

Answer:

8. A study found that 33 out of 105 teenagers had admitted to texting and driving. What proportion of the teenagers you surveyed text and drive? Please write your final answer as a decimal rounded to 2 decimal places.

Answer:

Part II Statistical Programming (51 pts) [* Extra Credits]

1. **Sequences.** Generate the following sequences using `rep()`, `seq()` and arithmetic:

   (a) $1, 3, 5, 7, \ldots, 21$.

   (b) $1, 10, 100, \ldots, 10^9$.

   (c) $0, 1, 2, 3, 0, \ldots, 3, 0, 1, 2, 3$ [with each entry appearing 6 times]

   (d) $0, 0, 0, 1, 1, 1, 2, \ldots, 4, 4, 4$.

   (e)* $50, 47, 44, \ldots, 14, 11$.

   (f)* $1, 2, 5, 10, 20, 50, 100, \ldots, 5 \times 10^4$.

   Can any of your answers be simplified using recycling?

2. **Arithmetic.** Create a vector containing each of the following sequences:

   (a) $\cos\left(\frac{\pi n}{3}\right)$, for $n = 0, \ldots, 10$.

   (b) $1, 9, 98, 997, \ldots, 999994$.

   (c) $e^n - 3n$, for $n = 0, \ldots, 10$.

   (d)* $3n \mod 7$, for $n = 0, \ldots, 10$.

   Let

   $$S_n = \sum_{i=1}^{n} \frac{(-1)^{i+1}}{2i-1} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \cdots + \frac{(-1)^{n+1}}{2n-1}.$$

   You will recall that $\lim_n S_n = \pi/4$.

   (e) Evaluate $4S_{10}$, $4S_{100}$ and $4S_{1000}$. *[Hint: use the `sum()` function.]*

   (f) Create a vector with entries $S_i - \frac{\pi}{4}$, for $i = 1, \ldots, 1000$. *[Hint: try creating the vector with entries S_i first; the function `cumsum()` may be useful.]*

3. **Subsetting**

   Create a vector `x` of normal random variables as follows:

```
> set.seed(123)
> x <- rnorm(100)
```

   The `set.seed()` fixes the random number generator so that we all obtain the same `x`; changing the argument `123` to something else will give different results. This is useful for replication.

   Give commands to select a vector containing:

   (a) the 25th, 50th and 75th elements;

   (b) the first 25 elements;

   (c) all elements except those from the 31st to the 40th.

   Recall the logical operators `|`, `&` and `!`. Give commands to select:

   (d) all values larger than 1.5 (how many are there?);

   (e) what about the entries that are either > 1.5 or < -1?

Answer: Copy and paste your R code in the box below (not an image but the text).

Screenshot of your R console outputs and paste the image in the box below

Appendix: Example Question and Answer for R programming questions:

Calculate the sum $\sum_{j=0}^{n} r^j$, where r has been assigned the value 1.08, and compare with $(1-r^{n+1})/(1-r)$, for $n = 10, 20, 30, 40$.

Answer: Copy and paste your R code in the box below (not an image but the text).

```
r <- 1.08
n <- c(10, 20, 30, 40)
sum1 <- c()
for(i in n){
  x <- 0:i
  sum1 <- c(sum1, sum(r^x))
}
sum1   # This gives the calculated sums for n = 10, 20, 30, 40.

sum2 <- (1 - r^(n + 1)) / (1 - r)
sum2

sum2 - sum1   # The formula works.
```

Screenshot of your R console outputs and paste the image in the box below

```
> r <- 1.08
> n <- c(10, 20, 30, 40)
> sum1 <- c()
> for(i in n){
+   x <- 0:i
+   sum1 <- c(sum1, sum(r^x))
+ }
> sum1   # This gives the calculated sums for n = 10, 20, 30, 40.
[1]  16.64549  50.42292 123.34587 280.78104
> sum2 <- (1 - r^(n + 1)) / (1 - r)
> sum2
[1]  16.64549  50.42292 123.34587 280.78104
> sum2 - sum1   # The formula works.
[1] 0 0 0 0
```

THE END