

Homework Assignment 01

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Section 1

a. Create two vectors named `v1` and `v2`, where `v1` is the sequence of integers from 2 to 6, and `v2` is the sequence of integers from 5 to 9.

```
# Create vector for the sequence of integers from 2 to 6
v1 <- 2:6
v1
```

```
## [1] 2 3 4 5 6
```

```
# Create vector for the sequence of integers from 5 to 9
v2 <- 5:9
v2
```

```
## [1] 5 6 7 8 9
```

b. What is `v2` minus `v1`?

```
# Perform difference of vectors
v2 - v1
```

```
## [1] 3 3 3 3 3
```

c. What is the inner product of `v1` and `v2`?

```
# Calculate the inner product of the two vectors
v1 %*% v2
```

```
##      [,1]
## [1,] 150
```

d. Replace the elements in `v1+v2` that are greater than 10 with the number 0. Show that vector.

```
# Perform addition of vectors
v3 <- v1 + v2

# Replace values greater than 10
v3[v3 > 10] <- 0
v3
```

```
## [1] 7 9 0 0 0
```

Section 2

a. Create a 5 by 5 matrix with the numbers 1 to 25 as its elements, and call it m1.

```
# Create a matrix for the sequence of integers from 1 to 25
m1 <- matrix(1:25, 5, 5)
m1
```

```
##      [,1] [,2] [,3] [,4] [,5]
## [1,]    1    6   11   16   21
## [2,]    2    7   12   17   22
## [3,]    3    8   13   18   23
## [4,]    4    9   14   19   24
## [5,]    5   10   15   20   25
```

b. What is m1 times v1?

```
# Perform matrix-vector multiplication
m1 %*% v1
```

```
##      [,1]
## [1,]  270
## [2,]  290
## [3,]  310
## [4,]  330
## [5,]  350
```

c. What is v1 times m1?

```
# Perform vector-matrix multiplication
v1 %*% m1
```

```
##      [,1] [,2] [,3] [,4] [,5]
## [1,]   70  170  270  370  470
```

d. What is m1 times the transpose of m1?

```
# Perform matrix-matrix multiplication
m1 %*% t(m1)
```

```
##      [,1] [,2] [,3] [,4] [,5]
## [1,]  855  910  965 1020 1075
## [2,]  910  970 1030 1090 1150
## [3,]  965 1030 1095 1160 1225
## [4,] 1020 1090 1160 1230 1300
## [5,] 1075 1150 1225 1300 1375
```

Section 3

a. Create a date frame with at least five rows and three columns. The first variable (column) should be dates, the second variable should be strings (characters), and the third variable should be numbers. Name each variable something appropriate and short.

```
# Create individual columns data
dates <- as.Date(c(rep("2024-09-09", 3), rep("2024-09-16", 3), rep("2024-09-23", 3)))
fruits <- rep(c("bananas", "apples", "pears"), 3)
stock <- sample(15:30, 9, replace = TRUE)

# Create a dataframe with the individual columns data
df <- data.frame(Date = dates, Fruit = fruits, Stock = stock)
df
```

Date	Fruit	Stock
2024-09-09	bananas	24
2024-09-09	apples	24
2024-09-09	pears	26
2024-09-16	bananas	19
2024-09-16	apples	23
2024-09-16	pears	29
2024-09-23	bananas	17
2024-09-23	apples	28
2024-09-23	pears	23

b. Use `str()` to show that your data frame is appropriately structured.

```
# Show dataframe structure
str(df)
```

```
## 'data.frame':  9 obs. of  3 variables:
## $ Date : Date, format: "2024-09-09" "2024-09-09" ...
## $ Fruit: chr  "bananas" "apples" "pears" "bananas" ...
## $ Stock: int  24 24 26 19 23 29 17 28 23
```

c. Save it as a csv file, and then reload the data from the csv file.

```
# Set directory variables
main_path <- paste0(getwd(), "/..")
file_path <- paste0(main_path, "/data/homework_assignment_01/df.csv")

# Create the directory if it doesn't exist
dir.create(dirname(file_path), recursive = TRUE, showWarnings = FALSE)

# Save df as a csv file
write.csv(df, file_path, row.names = FALSE)

# Reload df from recently created csv file
reloaded_df <- read.table(file_path, header=TRUE, sep="," , stringsAsFactors=FALSE)
reloaded_df
```

Date	Fruit	Stock
2024-09-09	bananas	24
2024-09-09	apples	24
2024-09-09	pears	26
2024-09-16	bananas	19
2024-09-16	apples	23
2024-09-16	pears	29
2024-09-23	bananas	17
2024-09-23	apples	28
2024-09-23	pears	23

d. Create a new data frame that is just a subset of your data: the first, third, and last rows, and the first two variables.

```
# Subset dataframe
df2 <- df[c(1,3,nrow(df)), 1:2]
df2
```

	Date	Fruit
1	2024-09-09	bananas
3	2024-09-09	pears
9	2024-09-23	pears

e. Replace all the even numbers in the original data frame with 0.

```
# Replace even numbers in the Stock column
is_even <- df["Stock"] %% 2 == 0
df["Stock"][is_even] <- 0
df
```

Date	Fruit	Stock
2024-09-09	bananas	0
2024-09-09	apples	0
2024-09-09	pears	0
2024-09-16	bananas	19
2024-09-16	apples	23
2024-09-16	pears	29
2024-09-23	bananas	17
2024-09-23	apples	0
2024-09-23	pears	23

f. Create a list with v1, v2, m1, and your data frame. Give all the items in that list a name. Now pick out the third item's second item.

```
# Create a named list to store our data
data_list <- list(
  "v1" = v1,
  "v2" = v2,
  "m1" = m1,
  "df" = df
)

# Access second item in m1 (third item in the list)
data_list[[3]][2]
```

```
## [1] 2
```

Section 4

a. Using latex equation notation in your .Rmd file, write out the quadratic formula, so that in your html file it looks pretty and like the version we all learned in high school. (Eg, see the box in the top right of this wikipedia page: http://en.wikipedia.org/wiki/Quadratic_equation.)

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$