Day 1 Exercises

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Day 1 Outline:

1. Why should we learn R?
2. Installation
3. The Basics
4. R Objects

We have covered some basic concepts in R. Let's do some exercises to familiarize ourselves with the R syntax and objects.

Basic Objects

1. Create a new vector named numbers which stores the numbers from 0 through 100.

```
### YOUR CODE GOES HERE
```

2. Print the 20th element in numbers.

```
### YOUR CODE GOES HERE
```

3. Find the length of numbers.

```
### YOUR CODE GOES HERE
```

4. Find the type of numbers.

```
### YOUR CODE GOES HERE
```

5. Check if numbers is a vector

```
### YOUR CODE GOES HERE
```

6. Create a list l containing the vector numbers, and the letters A, B, C. Show values in l.

```
### YOUR CODE GOES HERE
```

7. Access the 10th element of the first element in the list l. Print out the value. (It should be 9.)

```
### YOUR CODE GOES HERE
```

Matrix Operation

1. Create three vectors x,y,x with integers and each vector has 3 elements. You can choose whatever integers you want. Combine the three vectors to become a 3×3 matrix A where each column represents a vector.

```r
# Here I am just giving you some examples of x, y, z.
x <- c(5, 7, 2)
y <- c(2, 3, 4)
z <- c(3, 4, 5)
### YOUR CODE GOES HERE
```

2. Check whether A is a matrix in R.

```r
### YOUR CODE GOES HERE
```

3. Create a vector with 12 integers from 1 to 12. Convert the vector to a 4x3 matrix B using matrix().

```r
### YOUR CODE GOES HERE
```

4. Obtain the transpose matrix of B and name it tB.

```r
### YOUR CODE GOES HERE
```

5. Get the dimension of tB.

```r
### YOUR CODE GOES HERE
```

6. Multiply A by tB.

```r
### YOUR CODE GOES HERE
```

7. Find the inverse of A.

```r
### YOUR CODE GOES HERE
```

8. Combine A and B vertically.

```r
### YOUR CODE GOES HERE
```

9. Combine A and tB horizontally.

```r
### YOUR CODE GOES HERE
```

Dataframe

1. Create a dataframe that stores all the first names of the students in our R bootcamp, the major fields of study, and their home country

```r
### YOUR CODE GOES HERE
```

2. Get the structure of the dataframe.

```r
### YOUR CODE GOES HERE
```

3. Open df in the data viewer in R.

```r
### YOUR CODE GOES HERE
```

4. What is the dimension of the dataframe? How many observations and variables? What are the column names?

```r
### YOUR CODE GOES HERE
```

Matrix Operation with Real Data

Here we will use the graduate program admission data from UCLA to connect to the linear algebra you covered towards the end of Math Modeling.

```
# load data
df <- read.csv("https://stats.idre.ucla.edu/stat/data/binary.csv")
```

Remember Ted asked you to solve for

$$\hat{\beta} = (X^T X)^{-1} X^T y$$

in Math Modeling.

Here we are going to do some regression manually to see what is going on behind the scene when you obtain the coefficients from R. You'll need to store the dataframe as a matrix. A couple other commands that will come in handy are:

- %*%: matrix multiplication
- t(): transpose a matrix
- solve(): when a square matrix is given as the only argument, inverts it
- diag(): get the diagonal of a matrix

1. What is X and y in this dataframe? To be more specific, which columns should you include for X, and which column is the y?
2. Can you convert df into a matrix?

```
### YOUR CODE GOES HERE
```

3. Define your X. Remember to add a column of 1's for the intercept.

```
### YOUR CODE GOES HERE
```

4. Define your y. It should be a 1-dimensional vector.

```
### YOUR CODE GOES HERE
```

5. Now that you have all the elements, find $\hat{\beta} = (X^T X)^{-1} X^T y$. You can do it step by step to make is easier to interpret. For example, find $(X^T X)^{-1}$ first, then find $(X^T X)^{-1} X^T y$.

```
### YOUR CODE GOES HERE
```