Exercises 1. Vectors

1. Create the vectors:

(a) $(1, 2, 3, \ldots, 19, 20)$

(b) $(20, 19, \ldots, 2, 1)$

(c) $(1, 2, 3, \ldots, 19, 20, 19, 18, \ldots, 2, 1)$

(d) $(4, 6, 3)$ and assign it to the name `tmp`.

For parts (e), (f) and (g) look at the help for the function `rep`.

(e) $(4, 6, 3,\ 4, 6, 3, \ldots, 4, 6, 3)$ where there are 10 occurrences of 4.

(f) $(4, 6, 3,\ 4, 6, 3, \ldots, 4, 6, 3, 4)$ where there are 11 occurrences of 4, 10 occurrences of 6 and 10 occurrences of 3.

(g) $(4, 4, \ldots, 4,\ 6, 6, \ldots, 6,\ 3, 3, \ldots, 3)$ where there are 10 occurrences of 4, 20 occurrences of 6 and 30 occurrences of 3.

2. Create a vector of the values of $e^x \cos(x)$ at $x = 3, 3.1, 3.2, \ldots, 6$. Make a plot of the multiplicands and the product.

3. Create the following vectors:

(a) $(0.1^3 0.2^1, 0.1^6 0.2^4, \ldots, 0.1^{36} 0.2^{34})$ **(b)** $\left(2, \frac{2^2}{2}, \frac{2^3}{3}, \ldots, \frac{2^{25}}{25}\right)$

4. Calculate the following:

(a) $\sum_{i=10}^{100} \left(i^3 + 4i^2\right)$. **(b)** $\sum_{i=1}^{25} \left(\frac{2^i}{i} + \frac{3^i}{i^2}\right)$

5. Use the function `paste` to create the following character vectors of length 30:

(a) `("label 1", "label 2", ....., "label 30")`.
Note that there is a single space between `label` and the number following.

(b) `("fn1", "fn2", ..., "fn30")`.
In this case, there is no space between `fn` and the number following.

6. Execute the following lines which create two vectors of random integers which are chosen with replacement from the integers 0, 1, ..., 999. Both vectors have length 250.

```
set.seed(50)
xVec <- sample(0:999, 250, replace=T)
yVec <- sample(0:999, 250, replace=T)
```

Suppose $\mathbf{x} = (x_1, x_2, \ldots, x_n)$ denotes the vector `xVec` and $\mathbf{y} = (y_1, y_2, \ldots, y_n)$ denotes the vector `yVec`.

(a) Create the vector $(y_2 - x_1, \ldots, y_n - x_{n-1})$. Plot the vector.

(b) Create the vector $\left(\frac{\sin(y_1)}{\cos(x_2)}, \frac{\sin(y_2)}{\cos(x_3)}, \ldots, \frac{\sin(y_{n-1})}{\cos(x_n)}\right)$. Plot the vector.

(c) Create the vector $(x_1 + 2x_2 - x_3, x_2 + 2x_3 - x_4, \ldots, x_{n-2} + 2x_{n-1} - x_n)$.

(d) Calculate $\sum_{i=1}^{n-1} \frac{e^{-x_{i+1}}}{x_i + 10}$.

Make a chart that show the data with the values > 600 clearly presented in a contrasting color.

7. This question uses the vectors `xVec` and `yVec` created in the previous question and the functions `sort`, `order`, `mean`, `sqrt`, `sum` and `abs`.

(a) Pick out the values in `yVec` which are > 600. Make a chart that shows the data points with values > 600 as a subset.

(b) What are the index positions in `yVec` of the values which are > 600?

Make a chart that show the data with the values
> 600 clearly presented in a contrasting color.

(c) What are the values in `xVec` which correspond to the values in `yVec` which are > 600? (By correspond, we mean at the same index positions.)

(d) Create the vector $(|x_1 - \bar{\mathbf{x}}|^{1/2}, |x_2 - \bar{\mathbf{x}}|^{1/2}, \ldots, |x_n - \bar{\mathbf{x}}|^{1/2})$ where $\bar{\mathbf{x}}$ denotes the mean of the vector $\mathbf{x} = (x_1, x_2, \ldots, x_n)$. Make a chart that shows the xVec and the vector you created.

(e) How many values in `yVec` are within 200 of the maximum value of the terms in `yVec`?

(f) How many numbers in `xVec` are divisible by 2? (Note that the modulo operator is denoted `%%`.)

(g) Sort the numbers in the vector `xVec` in the order of increasing values in `yVec`. Make a chart.

(h) Pick out the elements in `yVec` at index positions $1, 4, 7, 10, 13, \ldots$. Make a chart.

8. By using the function `cumprod` or otherwise, calculate

$$1 + \frac{2}{3} + \left(\frac{2}{3}\frac{4}{5}\right) + \left(\frac{2}{3}\frac{4}{5}\frac{6}{7}\right) + \cdots + \left(\frac{2}{3}\frac{4}{5}\cdots\frac{38}{39}\right)$$