Application exercises: Vectors

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Today, we are building confidence using R. Here are a few exercises.

NOTE: Do not use `for`-loops! We do not need them here. Generally, `for`-loops are hardly ever needed in R.

1 Vectorisation

Write R code that creates the following vectors with as little typing as possible, but without violating the rules of good R coding style (https://style.tidyverse.org/).

1.1 Numeric vector containing a sequence of powers and quotients

$\left(2,\ \frac{2^2}{2},\ \frac{2^3}{3},\ \ldots,\ \frac{2^{25}}{25}\right)$

1.2 Numeric vector containing a sequence of powers and multiplications

$(0.1^3 \cdot 0.2^1,\ 0.1^6 \cdot 0.2^4,\ \ldots,\ 0.1^{36} \cdot 0.2^{34})$

2 Subsetting vectors

Explain the output from the following code chunks. Insert your explanations as comments in the R script that you are going to submit on Canvas.

2.1 Subsetting with a numeric vector

```
x <- c(2, 3, 5, 7, 11)
y <- rep(c(2, 4), each = 2)
x[y]
```

2.2 Subsetting with a logical vector

```
x <- c(1, 1, 2, 3, 5, 8)
y <- c(FALSE, TRUE)
x[y]
```

2.3 Subsetting a character vector

```
x <- seq(16, 30, by = 4)
y <- x %% 7 + 1
LETTERS[y]
```

3 Alphabet with alternating upper and lower case letters

Write R code that generates a vector with the elements

`"a", "A", "b", "B", ..., "z", "Z"`,

in this particular sequence. Avoid typing the letters individually.

4 Vector recycling

Write R code that creates the following sequences with vector recycling. Comment in your code where you use vector recycling.

4.1 Sequence with short sub-sequences

$$(\underbrace{1,2,3,4}, \underbrace{2,3,4,5}, \ldots, \underbrace{16,17,18,19}, \underbrace{17,18,19,20})$$

4.2 Sequence involving exponentiation

$$1^2, 2^1, 3^4, 4^3, \ldots, 17^{18}, 18^{17}, 19^{20}, 20^{19}$$

5 Mysterious numbers

5.1 Mystery sum

Calculate

$$\sum_{n=0}^{1000} \frac{1}{n!}$$

with R, where $n!$ is the factorial of n. Does this value look familiar to you?

5.2 Mystery product

Calculate

$$2\left(\prod_{n=1}^{1000} \frac{4n^2}{4n^2-1}\right)$$

with R. Does this value look familiar to you?

5.3 Mystery continued fraction

Calculate the following continued fraction.

$$2 + \cfrac{2}{1 + \cfrac{1}{\frac{1}{2} + \cfrac{1}{\frac{1}{3} + \cfrac{1}{\frac{1}{4} + \cfrac{1}{\ddots \cfrac{1}{\frac{1}{999} + \cfrac{1}{\frac{1}{1000}}}}}}}}$$

Does this value look familiar to you?

Remember not to use `for`-loops. You may find the `gconvergents()` function in the **contfrac** package useful.