Introduction to R: objects, functions, for loops, if-else statements, simulation

Exercises

Machine Learning course

AY 2025-2026

Exercises

1. Find the area of a circle with radius 15 using the formula $A = \pi r^2$.
2. Find the areas of 100 circles having radius $1, 2, \ldots, 100$.
3. Calculate Fahrenheit temperatures corresponding to Celsius temperatures $0, 1, \ldots, 100$. To convert Celsius temperatures to Fahrenheit, use the formula
$$F = 32 + 1.8C.$$
4. Assign the numbers from 1 through 100 to an object called `onehundred`.
   (a) Use the `sum()` function to calculate the sum of the numbers from 1 through 100.
   (b) Calculate the sum of the numbers $1^2, 2^2, \ldots, 100^2$.
   (c) Calculate the sum of the numbers $\sqrt{1}, \sqrt{2}, \ldots, \sqrt{100}$.
5. Given the vector `colors`:

```
[1] "red" "green" "blue"
```

use `rep()` and `:` to create the vector of length 297 whose first 98 elements are "blue", next 99 elements are "green" and final 100 elements are "red".

6. Write an R function called `sumsquares` that calculates the sum of squares
$$1^2 + 2^2 + \cdots + n^2$$
for a given integer n.

7. Write an R function called `classifynumber` that takes a single number as input and:
   - prints `"positive"` if $x > 0$,
   - prints `"negative"` if $x < 0$,
   - prints `"zero"` if $x = 0$.

8. **W**rite an R function called `countevens` that takes a numeric vector as input, loops through its elements, and counts how many of them are even numbers.

9. Simulate a random sample $X_1, \ldots, X_n$ from a Normal distribution $\mathcal{N}(\mu, \sigma^2)$ with $\mu = 10$, $\sigma = 3$, and $n = 500$. Store the result in an object called `x`.

   (a) Plot a histogram of `x` and overlay the Normal density with the true parameters ($\mu = 10, \sigma = 3$). Then overlay the Normal density with the estimated parameters $\hat{\mu}$ and $\hat{\sigma}$ computed from `x`. (Use `hist()`, `curve()`, and `dnorm()`.)

   (b) Repeat the simulation $R = 1000$ times, recording the sample mean in each run. Calculate the mean and the variance of the simulated sample means and compare them with their theoretical values.

   (c) Build the 95% confidence interval for the mean using the performed simulations and compare it with the theoretical confidence interval.