STAT 210
Applied Statistics and Data Analysis
Problem List 1 (due on week 2)

Fall 2025

Exercise 1

Using the functions `rep` and `seq`, generate the following sequences

1. 10 10 10 10 10 9 9 9 9 8 8 8 7 7 6 5 4 4 3 3 3 2 2 2 2 1 1 1 1 1
2. 1 1 2 3 3 4 5 5 6 7 7 8 9 9 10
3. 100.0000 100.2222 100.4444 100.6667 100.8889 101.1111 101.3333 101.5556 101.7778 102.0000
4. 1.0 1.0 1.0 1.2 1.4 1.4 1.4 1.6 1.8 1.8 1.8 2.0
5. 1 2 3 4 5 2 3 4 5 6 3 4 5 6 7 4 5 6 7 8 5 6 7 8 9

Exercise 2

Use the Montecarlo method for estimating π.

Exercise 3

Consider the following system of equations:

$$
\begin{aligned}
4x + y + 2z + -3w &= -16 \\
-3x + 3y - z + 4w &= 20 \\
-x + 2y + 5z + w &= -4 \\
5x + 4y + 3z - w &= -10
\end{aligned}
$$

(a) Create a matrix in `R` with the coefficients of the system, and a vector with the constants on the right-hand side of the equations. Call them `mat1` and `vec1`, respectively.

(b) Create a list named `list1` having as components `mat1` and `vec1`. Call these components `item1` and `item2`, respectively. Remove `mat1` and `vec1` from the working directory.

(c) Find the inverse of `item1` and store it in `list1` as `item3`. Verify that you obtained the inverse.

(d) Solve the system of equations and store the solution in `list1` as `item4`. Verify the solution.

(e) Verify that if you multiply the inverse matrix `item3` by `item2` you also get the solution.

(f) Find the eigenvalues of `item1` and `item3` and verify that the eigenvalues of `item3` are the reciprocals of the eigenvalues of `item1`.

Exercise 4

You will need the file Human_data.txt.

(a) Read the file Human_data.txt and store it in an object called `human`.

(b) Using `subset`, create a new data frame with the variables `Head_size, Height_cm, Weight_kg` from `human`. Call this new data frame `human1`.

(c) Use the function `apply` twice to calculate the mean and standard deviation for each of the three variables in `human1`. Call the vectors you obtain `human.mean` and `human.sd`.

(d) Use the function `sweep` twice, first to subtract the mean for each variable to the values in `human1` and then to divide by the standard deviation. Store the result in a data frame named `human_std`.

(e) The previous procedure is known as *standardization.* The resulting columns in the `human.std` should now have mean zero and variance equal to one. Verify this using `apply`.

(f) Another way to standardize the columns of `human1` is to use the function `scale`, which standardizes vectors. Combine this function with `apply` to obtain a standardized version for `human1` and store it in a file named `human1_std`.

(g) Show that `human_std` and `human1_std` are equal.