Exercise Programming with R

1. Write a function that computes the coefficient of variation and plot the histogram of a vector.

2. Suppose a researcher obtained the coordinates of *n* points and wish to find the maximum distance between two points from all the different pairs of points possible, produce an R function which helps to find the maximum distance between the coordinates of one particular point, (x_i, y_i), with the coordinates of the other (*n*–1) points. The distance, *d*, between coordinates of points *i* and *j*, can be calculated as follows:

$$d_{ij} = \sqrt{(x_j - x_i)^2 + (y_j - y_i)^2}$$

3. Mann-Kendall test is a statistical test used to determine the existence of monotonic trend in a data set *X*.

   a) Write an R function that computes the test statistic, S_{MK}, of the Mann-Kendall test for a data set *X* of size *n* which is given as follows:

$$S_{MK} = \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} sign(x_j - x_i)$$

   with

$$sign(x_j - x_i) = \begin{cases} 1, & (x_j - x_i) > 0 \\ 0, & (x_j - x_i) = 0 \\ -1, & (x_j - x_i) < 0 \end{cases}$$

   b) If *X* is a series with no tie values, then the standardized test statistic, Z_{MK}, is written as

$$Z_{MK} = \begin{cases} \dfrac{S_{MK} - 1}{\sqrt{Var(S_{MK})}}, & S_{MK} > 0 \\ 0, & S_{MK} = 0 \\ \dfrac{S_{MK} + 1}{\sqrt{Var(S_{MK})}}, & S_{MK} < 0 \end{cases}$$

   where

$$Var(S_{MK}) = \frac{n(n-1)(2n+5)}{18}$$

   Write an R function which calls the function in (a) to get the value of S_{MK} and then compute and return the value of Z_{MK}.