

UNIVERSITY OF SWAZILAND
DEPARTMENT OF STATISTICS & DEMOGRAPHY
STA206 -STATISTICAL DATA PROCESSING

Assignment 1

Due 9th April 2020.

Question 1

[20 marks, 14×1+2+2+2]

(a) Use the R function `seq` to create the following sequences

- (i) $v1=1, 2, 3, 4, 5, 6, 7, 8, 9, 10$
- (ii) $v2=3, 6, 9, 12, 15, 18, 21, 24, 27, 30$
- (iii) $v3=1, 4, 7, 10$
- (iv) $v4=1, 2.5, 4, 5.5, 7$

(b) Use `rep` and `seq` to create the vectors

- (i) $0, 0, 0, 0, 1, 1, 1, 1, 2, 2, 2, 2, 3, 3, 3, 3, 4, 4, 4, 4$
- (ii) $1, 2, 3, 4, 1, 2, 3, 4, 1, 2, 3, 4, 1, 2, 3, 4, 1, 2, 3, 4$
- (iii) $1, 2, 3, 4, 2, 3, 4, 5, 3, 4, 5, 6, 4, 5, 6, 7, 5, 6, 7, 8$

(c) Calculate the sum of the 5th element of $v1$ and the 7th element of $v2$.

(d) Using only $v1$, $v2$, $v3$, $v4$ create new vectors containing the following sequences

- (i) $v5=3, 12, 21, 30$
- (ii) $v6=4, 8, 12, 16, 20, 24, 28, 32, 36, 40$

(e) Type in the commands

```
m1 = matrix(v1, nrow = 2, ncol = 5, byrow = TRUE)
m2 = matrix(v1, nrow = 2, ncol = 5)
m3 = t(m1)
```

- (i) What does $m1$ look like?
- (ii) What happens if you increase or decrease the number of rows and columns of the matrix $m1$?
- (iii) What do you get when you type `m1 %*% m2`
- (iv) What do you get when you type `m1 %*% m3`

(f) Plot the following curves

- (i) $\sin(x)$ for $0 < x < 12\pi$
- (ii) $f(x) = 926 \log(9/16 + x) + 581 \log(3/16 - x) + 104 \log(1/16 + x)$ for $0 < x < 3/16$

(g) Using the `matrix()`, `seq()` and `rep()` functions, or `cbind()` or `rbind()`, construct the following matrix

$$A = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 2 & 3 & 4 & 5 \\ 3 & 4 & 5 & 6 \\ 4 & 5 & 6 & 7 \end{pmatrix}.$$

Question 2

[20 marks, 6+4+6+2+2]

- (a) Write an R function that returns the real roots of the quadratic $ax^2 + bx + c$. The function should take a , b and c as arguments and return appropriate messages if the values entered don't specify a quadratic or if there are no real roots. Use the function to determine the roots of $2x^2 - x - 3$.
- (b) The equation $0 = x^7 + 10000x^6 + 1.06x^5 + 10600x^4 + 0.0605x^3 + 605x^2 + 0.0005x + 5$ has exactly one real root.
- (i) Plot the function to try to get a sense of where the root might be?
 - (ii) Write an R function that applies Newton's method to find the root. The function should have 2 arguments : the initial value x_0 and the tolerance value. The function should return the estimated solution, the function value at the estimate and the number of iterations.
 - (iii) What happens when you set $x_0 = 0$?
 - (iv) What happens when you set $x_0 = 1$?

Question 3

[20 marks, 2+2+4+4+3+3]

- (a) Simulate samples of size 10000 from the following distributions
- (i) $X \sim \text{Binomial}(n = 10, p = 6)$
 - (ii) $W \sim \text{Normal}(\mu = 100, \sigma^2 = 9)$
- (b) Use the samples you generated in (a) to estimate the following probabilities. Also calculate the probabilities from their cdf's.
- (i) $\mathbb{P}(X < 5)$
 - (ii) $\mathbb{P}(W > 106)$
- (c) Find x such that
- (i) $\mathbb{P}(X < x) = 0.9$
 - (ii) $\mathbb{P}(W < x) = 0.95$

Test 1 TBA.