

STAT2005 Programming Languages for Statistics
Assignment 1
Due: 7 February 2025

1. Using `rep()` and `seq()` as needed to create the following vectors. (The use of `c()` function is prohibited in this question.)

(a) 10 12 14 16 18 20 22 24 26 28 30

(b) 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

2. Search for an R function that solves the roots of polynomial equations.

(a) Find all roots of the following equation and save it as `roots`.

$$5x^5 + 4x^4 + 3x^3 + 2x^2 + x = 0.$$

(b) What is the mode of `roots`?

(c) Use a single line command to sort the values in `roots` by ascending order of its imaginary part.

(Note: the imaginary part of a complex number $a + bi$ is b , where $i = \sqrt{-1}$. You can read the help document of the `order()` function by entering `help(order)`.)

3. A standard deck of playing cards can be created in R as a data frame with the following command.

```
deck <- data.frame(  
  suit = rep(c("D", "C", "H", "S"), 13),  
  # D = ♦ Diamond, C = ♣ Club, H = ♥ Heart, S = ♠ Spade  
  rank = rep(2:14, 4)  
  # 11 = Jack, 12 = Queen, 13 = King, 14 = Ace  
)
```

(a) Describe the structure of the data frame `deck`, what are the information contained in its row and column?

(b) A poker hand is a set of five playing cards. Sample a poker hand using the data frame `deck` and name it as `hand`.

(c) A flush is a hand that contains five cards all of the same suit. Create a logical value named `is.flush` which is TRUE if and only if `hand` is a flush.

Hint: You may use `hand <- deck[c(17, 9, 1, 49, 41),]` as a test case. The `unique()` function could be useful.

(b) Add new columns to `moves` with the following information.

`step`: sum of `die_1` and `die_2`.

`total_step`: cumulative sum of `step`.

`round`: the number times a player passes through the GO land.

`side`: the side number of the current position.

`land`: the land space number of the current position.

A sample is shown below.

```
> head(moves)
```

	die_1	die_2	step	total_step	round	side	land
1	6	1	7	7	0	0	0 7
2	3	2	5	12	0	1	1 2
3	6	1	7	19	0	1	1 9
4	6	2	8	27	0	2	2 7
5	2	6	8	35	0	3	3 5
6	4	6	10	45	1	0	4 5

(c) Create a logical value which equal `TRUE` if and only if the player has landed on both PARK PLACE and BOARDWALK (the two lands in dark blue) throughout its 100 moves.

You should submit a file `asg1.r` via Blackboard, which contains all the R codes you use to finish this assignment. The codes should be commented as clearly as possible. Written work (if any) should also be attached.

STAT2005 Programming Languages for Statistics
Assignment 2
Due: 28 February 2025

1. Consider the built-in data frame `pressure`.

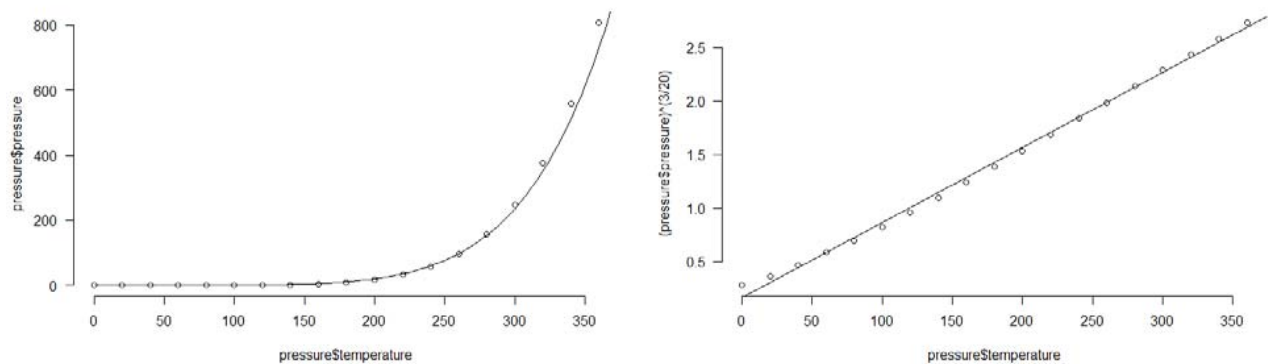
(a) Plot pressure against temperature, and use the following command to pass a curve through these data:

```
curve((0.168 + 0.007*x)^(20/3), from = 0, to = 400, add = TRUE)
```

(b) Now, apply the power transformation $y^{3/20}$ to the pressure data values. Plot these transformed values against temperature. Is a linear or nonlinear relationship evident now? Use the `abline()` function to pass a straight line through the points. (You need an intercept and slope for this – see the part (a) of this question to obtain appropriate values.)

(c) Add a suitable title to the graph.

(d) Re-do the above plots, but use the `mflow()` function to display them in a 1×2 layout on the graphics page. Suppress the surrounding box and arrange the numeric axis labels to be horizontal. A sample output is given below. (see `help(par)`)

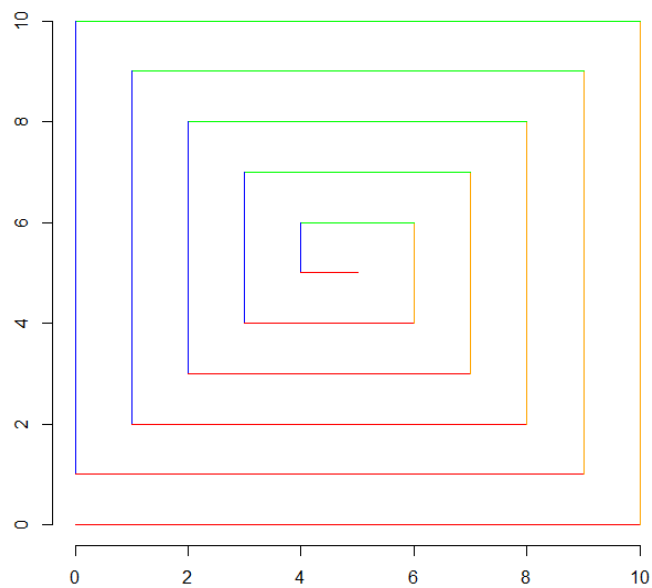


2. Write a function named `alt_matrix()` which accept a positive integer `n` and return a square matrix with alternating 0 and 1 as shown below.

```
> alt_matrix(7)
```

	[,1]	[,2]	[,3]	[,4]	[,5]	[,6]	[,7]
[1,]	0	1	0	1	0	1	0
[2,]	1	0	1	0	1	0	1
[3,]	0	1	0	1	0	1	0
[4,]	1	0	1	0	1	0	1
[5,]	0	1	0	1	0	1	0
[6,]	1	0	1	0	1	0	1
[7,]	0	1	0	1	0	1	0

3. Use R to draw the following graph.



Note: the four colours are "red", "orange", "green", and "blue".

4. A twin prime is a pair of primes (x, y) , such that $y = x + 2$. Construct a vector of all twin primes less than 1000.

You should submit a file `asg2.r` via Blackboard, which contains all the R codes you use to finish this assignment. The codes should be commented as clearly as possible. Written work (if any) should also be attached.