### 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.

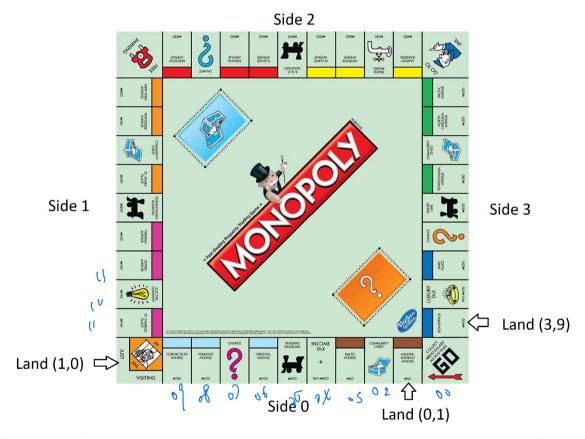
```
deck <- data.frame(
    suit = rep(c("D","C","H","S"), 13),
# D = ♦ Diamond, C = ♣ Club, H = ♥ Heart, S = ♠ Spade
    rank = rep(2:14, 4)
# 11 = Jack, 12 = Queen, 13 = King, 14 = Ace
)</pre>
```

- (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.

Hint: The all () function could be useful.

- (e) A straight flush is a hand that is both a straight and a flush. Create a logical value named is.straightflush which is TRUE if and only if hand is a straight flush. Modify the logical values is.flush and is.straight in (c) and (d) such that they becomes FALSE if hand is a straight flush. Use a test case similar to that in (c) to verify your answer.
- 4. The Monopoly game board consists of forty spaces as shown below.



The four sides of the gaming board are labelled as side 0, 1, 2, 3 clockwise beginning from the bottom as shown in the picture. Each land space is labelled with two digits, the first is the side number from 0 to 3, the second is the land space number from 0 to 9 along one side. For instance, the beginning GO land space is labelled as (0,0).

(a) We would like to simulate the movement of a single player in the game. For simplicity, we ignore all teleport events such as sending to jail from Land (3,0). To begin, a player will start at Land (0,0). In each round, a player will roll two dice of six faces, and the player will move clockwisely with step size equal to the sum of the two dice. Create a data frame named moves with 100 observations and two variables die\_1, and die\_2 which are the results of rolling the two dice.

(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	lar	nd
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	(	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.

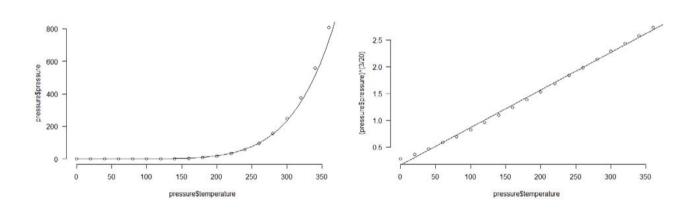
# STAT2005 Programming Languages for Statistics Assignment 2

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 mfrow () function to display them in a  $1 \times 2$  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))

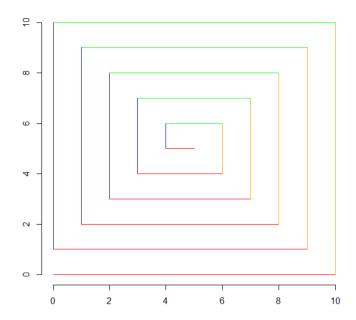


2. Write a function named  $alt_matrix()$  which accept a positive integer n and return a square matrix with alternating 0 and 1 as shown below.

> alt matrix(7)

	_						
	[,1]	[,2]	[,3]	[,4]	[ <b>,</b> 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 <b>,</b> ]	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.