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STC 122 - Assignment 2 submission instructions

Instructions

- Answer the questions that follow and save all your code in a single `R` script. Name the script **Assignment2.R** where **Assignment2** is the filename and **.R** is the file extension.
- Two submissions are required for this Assignment, namely a code submission and an interpretation submission.

Submission 1: Code

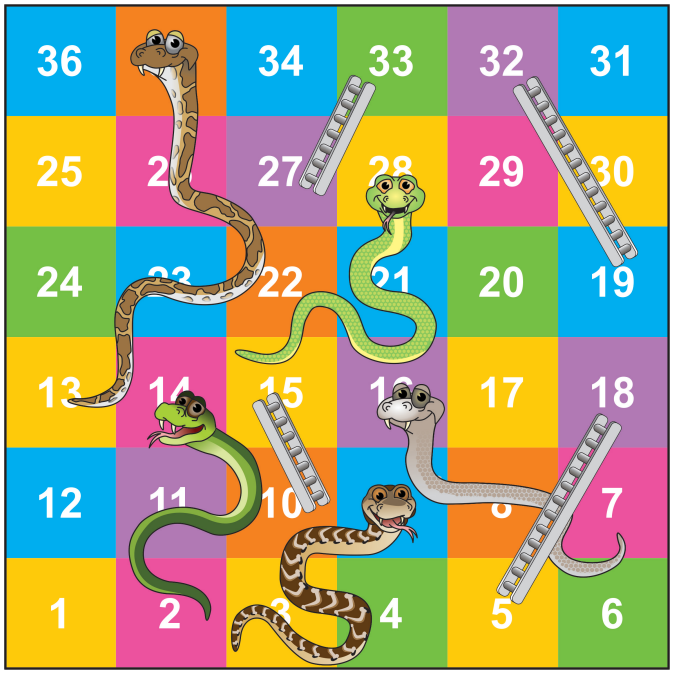
- Submit your `R` script on Gradescope before **Tuesday, 29 August 2023, 23:59**.
- Multiple code submissions are allowed and your autograded results will be available shortly after each submission.
- **Ensure all variables are named correctly, as incorrectly named variables will not be awarded any marks.** (Remember variable names are case sensitive.)
- **Ensure your code does not contain any syntax errors.** If your code produces errors when run, the autograder will not be able to mark it.
- Any code commented out will be considered rough work and will not be marked.
- Once you have completed your submission, ensure the file is submitted on Gradescope with the correct file name, **Assignment2.R** where **Assignment2** is the filename and **.R** is the file extension. **The autograder will only be able to grade your submission if you use the correct filename.**
- Students must add **detailed** explanations of their working as comments in their code. This must be done for every question in the assignment. Students should also add citations for any resources they make use of in their assignment. Refer to the document `commenting_and_citing_in_your_code.pdf` on ClickUP.

Submission 2: Interpretation

- Submission 2 will be an invigilated assessment.
- Full details regarding the date, time and format of this assessment will be communicated as soon as possible on ClickUP.

Guidelines

- This assignment covers Probability.
- The assignment is based on Lab 2, Probability, from the Openintro website. The lab is available on ClickUP.
- To complete this assignment, students need to be familiar with the board game ***Snakes and Ladders***. For those unfamiliar with the game, please watch the following short video before attempting the assignment. Click here to access the video
- The die considered for this assignment is a fair 6-sided die. A die is considered fair if there is an equal probability of the die landing on any one of its sides. For example, a 6-sided die is considered fail if there is precisely a 1/6 probability of landing on any side.
- Usually the board layout for ***Snakes and Ladders*** is from 1 to 100. Consider for this assignment the following board layout for ***Snakes and Ladders*** from 1 to 36:



- With respect to the rules of the game for this assignment, take note of the following adjustements (see above-mentioned video for reference):
  - To begin the game on the board, the first roll of the die does not have to be a 1. In effect, if your first roll is a 5, for example, then you can immediately place your token on 5 (and climb the ladder to 18).
  - Ignore the "rules of the sixes" (rolling a 6 gives another turn).
  - To complete the game, you have to end on 36 **or more**. That is, the final roll of the die does not have to result in your token ending exactly on 36. For example, if your token is on 34, then you complete the game if your next roll of the die gives 2, 3, 4, 5 or 6.

  - Ignore the "bounce back twist".

- Where applicable, answer the questions below by typing the appropriate **code** in the R script template provided on ClickUP. Some questions are theoretical and no coding is needed to answer those questions.
- You need the `openintro` package for this assignment. Ensure that you install this package prior to starting the assignment.

Questions

- Let the random variable X be the value observed for a roll of the die.
- Let the random variable Y be the number of rolls of the die required to complete the game.

Question 1

What is the probability distribution of X?

Question 2

What is $E(X)$, the expected value of X? Save your response into a variable called `Q2`

Question 3

Consider the first turn in the game.

- Let event A be that a ladder is climbed on the first turn.
- Let event B be that the token ends on an odd-numbered block on the first turn.

a) Determine the probability of event A. Save your response into a variable called `Q3a`

b) Given that a ladder is not climbed in the first turn, determine the probability that the token ends on an odd-numbered block. Save your response into a variable called `Q3b`

c) Using R, draw a tree diagram of the possible outcomes and probabilities. Let event A be the first level and event B be the second level in the tree diagram. Where applicable, give the probabilities to three decimal places (for instance, let `digits = 3`).

Attempt the following questions assuming there are no snakes or ladders present on the board.

Question 4

What is the maximum value of Y? What is the minimum value of Y?

Question 5

Simulate a single game of ***Snakes and Ladders***. Use a seed value of 12. How many rolls of the die were needed to complete the game? Save your response into a variable called `Q5`

Question 6

Repeat the above simulation for ***Snakes and Ladders*** 100 different times. Use a seed value of 17. After each iteration, save the number of rolls of the die required to complete the game. Save your vector of 100 responses into a variable called `Q6`

a) What is the mean number of rolls of the die needed to complete the game? Save your response into a variable called `Q6a`

b) What is the standard deviation of the number of rolls of the die needed to complete the game? Save your response into a variable called `Q6b`

c) Using the `plot` function, draw a barplot of the 100 simulated number of rolls of the die needed to complete the game.

Attempt the following questions assuming the snakes and ladders have been added to the board as shown in the given board layout.

Question 7

Simulate a single game of ***Snakes and Ladders***. Use a seed value of 20. How many rolls of the die were needed to complete the game? Save your response into a variable called `Q7`

Question 8

Repeat the above simulation for ***Snakes and Ladders*** 100 different times. Use a seed value of 25. After each iteration, save the number of rolls of the die required to complete the game.

a) What is the mean number of rolls of the die needed to complete the game? Save your response into a variable called `Q8a`

b) What is the standard deviation of the number of rolls of the die needed to complete the game? Save your response into a variable called `Q8b`

c) Using the `plot` function, draw a barplot of the 100 simulated number of rolls of the die needed to complete the game.