

Applied Statistical Programming - Spring 2022

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Problem Set 3

Due Wednesday, March 2, 10:00 AM (Before Class)

Instructions

1. The following questions should each be answered within an R script. Be sure to provide many comments in the script to facilitate grading. Undocumented code will not be graded.
2. Work on git. Fork the repository found at <https://github.com/johnsontr/AppliedStatisticalProgramming2022> and add your code for Problem Set 3, committing and pushing frequently. Use meaningful commit messages because these will affect your grade.
3. You may work in teams, but each student should develop their own Rmarkdown file. To be clear, there should be no copy and paste. Each keystroke in the assignment should be your own.
4. For students new to programming, this may take a while. Get started.

Let's Make a Deal¹

In the game show “Let's Make a Deal”, the candidate gets to choose one of three closed doors, and receives the prize behind the door they choose. Behind one door is a new car; behind the other two doors are goats. After the contestant selects one of the 3 doors, the host opens one of the other two doors, and reveals a goat. Now, the candidate has the option of either sticking with the door they originally selected, or switching to the only other door that is still closed. What should the candidate do, and why? What are the probabilities of winning the car if they stay versus if they switch? This question is known as the Monty Hall Problem.

Your tasks

For this problem set, you will not solve the Monty Hall Problem, but you will have to code a slightly simplified version of the “Let's Make a Deal” game. More specifically, you will set up a new class, which contains information regarding the door a player chooses, and a method that simulates a modified version of the game. You will have to do this using the S3 class system. Here are the specific instructions:

1. Define a new class: `door`. Objects of this class simply take on one numeric value: 1, 2, or 3 – indicating which door a candidate chooses.
2. Create a method for `door` objects that is called `PlayGame`. This method is supposed to do the following:
 - take the numeric value that is stored in the `door` object,
 - draw a random number between 1 and 3 that presents the door behind which the car is hidden,
 - compare the two numbers, and print a message congratulating a winning candidate that chose the correct door, or expressing sympathies for a losing candidate that chose the wrong door.
3. Write:

¹https://en.wikipedia.org/wiki/Let's_Make_a_Deal

- a construction function that allows the user to create a `door` object,
- and a validation function that checks whether the value stored in `door` is actually an integer

Define functions

```
## Function 1
# The "player" chooses a door with the following function
choose_door <- function(x){
  # The game only has 3 doors, so x cannot be any other number
  criteria <- x %in% c(1,2,3)
  if (!criteria){
    stop("Error: input x must be 1, 2, or 3.")
  }

  # The output will be a list containing the selected door's number, stored as an integer
  numbered_door <- list("selected"=as.integer(x))

  # Assign the output class "door" and return
  class(numbered_door) <- "door"
  return(numbered_door)
}
```

```
## Test choose_door()
test_door <- choose_door(3)
```

```
## Function 2
# The player validates a door with the following function
is_numbered <- function(door){

  criteria <- is.list(door) & is.integer(door$selected) & any(door$selected %in% c(1,2,3))

  if(criteria){
    return(door)
  } else {
    stop("Error: please select a numbered door with choose_door() to proceed")
  }
}
```

```
## Test is_numbered()
is_numbered(test_door)
```

```
## $selected
## [1] 3
##
## attr(,"class")
```

```
## [1] "door"
## Uncomment to test a bad door
# is_numbered(list(2))

## Function 3
PlayGame <- function(door){

  # Use the validator here to ensure input is of appropriate class
  door <- is_numbered(door)

  # The winning door is chosen (from 1:3, randomly choose 1)
  winning_door <- sample(3,1)

  # Determine the outcome with a logical test
  outcome <- winning_door == door$selected

  # Use the logical test to deliver the appropriate message
  if(outcome){
    message(paste0("Congratulations! Door ", winning_door, " was correct! You've won the game!"))
  } else{
    message(paste0("Oh no, you chose Door ", door$selected,
                  " and the winning door was Door ", winning_door,
                  ". Please play again!"))
  }
}
```

Play a round of the game

```
set.seed(444)

almas_door <- choose_door(2)

is_numbered(almas_door)

## $selected
## [1] 2
##
## attr(,"class")
## [1] "door"

PlayGame(almas_door)

## Congratulations! Door 2 was correct! You've won the game!
```