

Lab Challenge 03 – Probability and Counting

Due Date: 11:59 pm, three days after class (four days if over weekend)

Each challenge is graded out of 2 points:

- 0 points – no attempt or no progress to a solution
- 1 point – challenge not fully completed or completed with major errors
- 2 points – challenge fully completed with at most a small error

Deliverables

1. A single pdf document containing your solutions to the challenges you completed.
2. An RStudio file (.R extension) containing a *complete* script used to generate your results.
 - The script must run without errors!

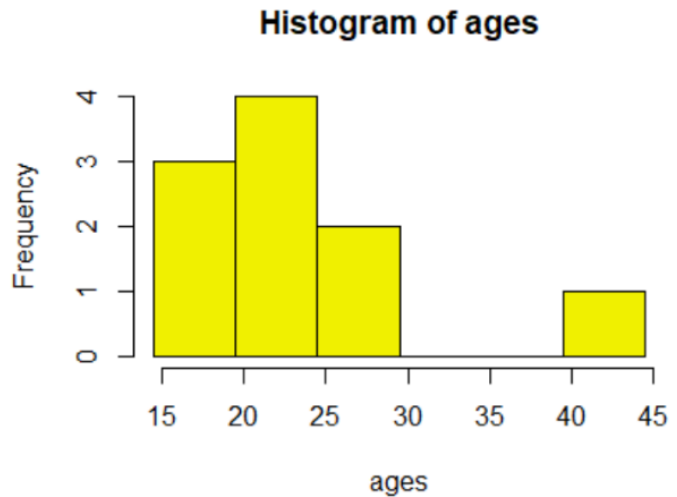
Challenges

1. Use the data in the Excel file “F2021_MATH_1350_Data.xlsx”.
 - a. Suppose you randomly select one student in the course. What is the probability that the student has brown eyes *and* owns a car?
 - b. Suppose you randomly select a student who has brown eyes. What is the probability that this student owns a car?
 - c. Suppose you randomly select *two* students (without replacement). What is the probability that they both wear glasses?
2. Suppose you roll four fair dice. Let \bar{X} = the mean value of the four die. Use R to simulate $4 \times 1000,000$ rolls (so that you end up with 1000,000 simulated values of \bar{X}).
 - a. Plot a probability histogram (freq=FALSE) of \bar{X} . Give it suitable labels and title.
 - b. What is the most likely value of \bar{X} ? (In other words, what is the *mode* of \bar{X} ?)
 - c. Use the experimental data to estimate the probability that $3.0 \leq \bar{X} \leq 4.0$.

3. You are given the following ages, X , for a set of $N = 10$ students:

21, 19, 19, 25, 23, 27, 43, 24, 19, 22.

A histogram for this population is shown here:



- a. What is the probability that a single randomly selected student is 22 or younger?

Now, suppose you take a sample of size $n = 4$, without replacement.

- b. What is the probability that all four students are 22 or younger?
- c. Plot a probability histogram of \bar{X} , the sample mean, using 10^6 simulated samples. Use the default classes and add appropriate labels and title.
- d. What is the probability that the mean age \bar{X} of the four students satisfies $\bar{X} \leq 22$? [Use the simulated \bar{X} values.]
- e. What is the probability that all four students have *different ages*? [Use the simulated \bar{X} values.]