L10: Probability Distributions Lab

Complete the following exercises in R. Work in your small group to solve them. For each question, first write the code on the paper, and once you have completed the whole sheet, you can use R to evaluate yourself and see if the code worked as expected. Your end result should be a knitted RMarkdown file, with Word preferred as the output format.

1. **Distribution Detective** For each situation below, identify which type of distribution or simulation approach seems most appropriate. Choose from ideas such as Bernoulli, Binomial, Uniform Discrete, Uniform Continuous, Poisson, Exponential, Normal, or another reasonable simulation method. Write one sentence explaining why your chosen distribution or approach makes sense.

   (a) Whether one randomly selected student brings a laptop to class.

   (b) The number of students out of 25 who bring a laptop to class.

   (c) A student randomly choosing one of 6 possible tables in the library.

   (d) The number of students who visit office hours during a 30-minute window.

   (e) The amount of time until the next student arrives at office hours.

   (f) The exam scores for a large class where most students score near the average.

2. **Campus Event Attendance** The Student Activities Office is planning an event. Based on previous events, they believe each invited student has a 72% chance of attending. Suppose 40 students are invited.

   (a) Simulate attendance for 500 events. For each event, record how many of the 40 invited students attend.

   (b) Create a table and barplot of the number of students who attend.

   (c) What is the average number of students who attend in your simulation?

   (d) Estimate the probability that at least 32 students attend.

   (e) In 2–3 sentences, explain what your results suggest.

3. **Library Desk Questions** A library worker notices that students come to the front desk with questions at an average rate of 4 questions per hour.

   (a) Simulate the number of student questions for 1,000 different one-hour shifts.

   (b) Create a table and barplot of the simulated number of questions.

   (c) Estimate the probability that the worker receives exactly 4 questions in an hour.

   (d) Estimate the probability that the worker receives more than 7 questions in an hour.

   (e) In 2–3 sentences, explain what this simulation tells us about busy and slow hours at the library desk.

4. **Arrival Time During Office Hours** Suppose a professor holds a 60-minute office hour. Assume that if a student comes, their arrival time is equally likely to occur at any point during the hour.

   (a) Simulate 500 student arrival times between 0 and 60 minutes.

   (b) Create a histogram of the arrival times.

   (c) Estimate the proportion of students who arrive in the first 15 minutes.

   (d) Estimate the proportion of students who arrive between 20 and 40 minutes.

   (e) Explain why this situation is different from counting the number of students who arrive.

5. **Campus Wi-Fi Speeds** Suppose campus Wi-Fi download speeds are approximately normally distributed with a mean of 80 Mbps and a standard deviation of 12 Mbps.

   (a) Simulate 1,000 Wi-Fi speed measurements.

   (b) Create a histogram with a density line.

   (c) Calculate the mean and standard deviation of your simulated values.

   (d) Estimate the proportion of speeds below 60 Mbps.

   (e) Estimate the proportion of speeds between 68 Mbps and 92 Mbps. How does this compare to the expected value we should have from the 68-95-99.7 Rule?

6. Make sure your final turned-in work is a knitted RMarkdown document. Turn in both the `.Rmd` file and the `.docx` file to gain full points.