# Midterm Exam

Stochastic Modeling – Fall 2021

---

1. **Objectives**
   The purpose of this assessment is to give you an opportunity to show a clear understanding of the skills you have learned in this class.

2. **What You Will Need**
   Access to R and Rstudio.

3. **What You Will Hand In**
   Submit an R script that you create (*FirstnameLastname*.R) via Blackboard - Midterm.

4. **Due Date**
   November 8th, 2021. You have 1 hour and 20 minutes.

5. **Note on Collaboration**
   This is a Category A assignment. Specifically, you may not receive help from anyone on this assignment. It must be 100% your own work. *It is an honor code offense to give or receive any assistance on these assignments*. Your personal class notes are allowed.

6. **Honor Code**
   The Pledge: "As a member of the William and Mary community, I pledge on my honor not to lie, cheat, or steal, either in my academic or personal life. I understand that such acts violate the Honor Code and undermine the community of trust, of which we are all stewards."

**Requirement: You must type and print the honor pledge at the beginning of your R script. Failure to do so will result in a 20-point deduction.**

**Business Application**

1) A bookstore must decide how many of next year's Batman calendars to order. Each calendar costs the bookstore $8.20 and sells for $12. After January 1, all unsold calendars will be returned to the publisher for a refund of $3.25 per calendar. The demand of calendars follows the frequency distribution shown in the table below.

| *Demand* | *Probability* |
|---|---|
| 100 | 0.30 |
| 150 | 0.20 |
| 200 | 0.30 |
| 250 | 0.15 |
| 300 | 0.05 |

Answer all questions using the glue package in R

   a) What is the expected demand and its standard deviation? (Suggested functions: c() and sum()). (10 Points)
   b) Assuming the bookstore orders 175 calendars, use 10,000 replications to construct a frequency distribution table of the profits. What is the most likely profit value? (Suggested functions: sample(), ifelse(), table()). (20 Points)
   c) Calculate sample statistics. What is the average profit and standard deviation? (Suggested functions: mean(), sd()). (20 Points).

2) Customers that arrive to a popular website are given an engagement score. An algorithm has been developed that predicts the engagement score every minute the customer is on the website. In particular, if the previous engagement score was even, then it is divided by 2 and the result is the new engagement score. However, if it is odd then it is multiplied by 3 and 1 is added to the result to create the new engagement score. Ex: If the initial engagement score is 5 then the predicted engagement for the first minute is 16. For the second minute the prediction is 8. For the third 4, then 2 then 1. Assume that a customer remains engaged if the engagement score is greater than 1 and leaves the website when the engagement score reaches 1.

   a) According to the algorithm, how many minutes would a person with an initial engagement score of 25 be engaged? (Suggested functions: for(), if(), c()). (30 Points).
   b) The company has tracked the initial engagement for several customers and has found that it follows a Poisson distribution with mean of 55. Run a simulation of 1000 customers. What is the average time spent on the website? (Suggested functions: for(), if(), c(), mean(), break to break out of a for loop). (20 Points)