University of Calgary **Fall 2022**
Department of Civil Engineering Prepared by: T. Jin
ENCI 697 Project Planning and Control

Assignment 4 – Monte Carlo Simulation

Implement **Inverse Transform Algorithm (ITA)** to develop a model that conducts **Monte Carlo Simulation** for any given schedule that is presented in the format of the attached table. The ITA logic has to be coded from the cumulative density function (CDF) equations and it is not allowed to use any libraries to implement the Inverse Transform Algorithm. The model will prompt the user for the number of desired samples (please use **200,000** as the default value) and takes, as input, a **CSV file** in the format of the attached file and will provide, as output

i. For the total duration of the project:
    a) Determine the mean and standard deviation
    b) Plot the Probability Density Function (PDF)
    c) Prompt the user for a number and determine the probability that the total project duration *exceeds* this random input.
ii. For each activity:
    a) Determine the probability that it belongs to the critical path
    b) For the **Total Float** of that activity, return:
        1. Mean and standard deviation
        2. A plot of its PDF
iii. For each path in the network (tabulated):
    a) Determine the probability that it is the critical path
    b) Determine the probability that it is the only critical path

Bonus Marks (5): You can assume a normal distribution instead of the Gumbel distribution. You will be given up to 5 marks in bonus marks if a Gumbel distribution is correctly implemented.

Submission Requirements:

Submit to **Assignment 4 Dropbox folder** on D2L a well-commented source code. Please use: first name_family format of both members for naming of the files (e.g. Farnaz_Sadeghpour_and_Tian_Jin).
Notes:

- There is no need to submit the original csv file. A csv file with different content but same format will be utilized to test and verify your code.
- Your program should be commented well enough for the instructor to understand it; e.g. function defined, variables. Please use in-text comments. You are encouraged to use built-in in text comment such as Live script, Jupyter notebook, or Pycharm. Please refer to the following link for best practices for in-text comments and implement these in your code:

  https://stackoverflow.blog/2021/07/05/best-practices-for-writing-code-comments/

- Please include a Header Block for your submission that includes the information printed in the example below. You can decide on the format:

```
/*============================================================================
 |   Assignment:  ASSIGNMENT NUMBER AND TITLE
 |
 |       Author:  STUDENT'S NAME HERE
 |     Due Date:  Assignment Due Date Here
 |     Language:  NAME OF LANGUAGE IN WHICH THE PROGRAM IS WRITTEN AND THE
 |                NAME OF THE COMPILER USED TO COMPILE IT WHEN IT WAS TESTED
 |   To Compile:  EXPLAIN HOW TO COMPILE THIS PROGRAM
 +----------------------------------------------------------------------------
 |  Description:  DESCRIBE THE PROBLEM THAT THIS PROGRAM WAS WRITTEN TO SOLVE.
 |
 |        Input:  DESCRIBE THE INPUT THAT THE PROGRAM REQUIRES.
 |
 |       Output:  DESCRIBE THE OUTPUT THAT THE PROGRAM PRODUCES.
 |
 |    Algorithm:  OUTLINE THE LIST OF MAIN ALGORITHMS USED TO SOLVE THE PROBLEM.
 |
 |Not Addressed:  DESCRIBE HERE ANY REQUIREMENTS OF THE ASSIGNMENT THAT THE PROGRAM
                  IS NOT ABLE TO ADDRESS.
 |
 |   Known Bugs:  IF THE PROGRAM DOES NOT FUNCTION CORRECTLY IN SOME SITUATIONS,
                  DESCRIBE THE SITUATIONS AND PROBLEMS HERE.
 |
 *============================================================================*/
```

Grading Notes:

If ITA is not implemented → 50% of the grade