SFWR TECH 3PR3
Decisions and Looping

Assignment 1

1. Consider a Continuous Stirred Tank Reactor (CSTR) with an organism growing with an initial substrate concentration of S_O (gram per litre). Then the maximum dilution rate (per hour) for 100% yield of biomass can be obtained using

$$D_{\max} = \mu_{\max}\left[1 - \sqrt{\frac{K_S}{K_S + S_O}}\right]$$

Where,

$\mu_{\max}$ = maximum specific growth rate (per hour)

K_S = saturation constant (hour per litre)

Write a C++ program that will calculate the maximum dilution rate in CSTR. Ask the user to enter values for S_O and $\mu_{\max}$ satisfying $25 \le S_O \le 75$ and $0.2 < \mu_{\max} < 0.7$, where S_O is an integer number and divisible by 5. If the input values are invalid, display an appropriate message and terminate the program. Saturation constant, K_S, is a randomly generated integer such that $2 \le K_S \le 7$. Calculate maximum dilution rate and print your result with 3 decimal places. If the dilution rate is in the range, $0.35 < D_{\max} < 0.45$, display a message stating that "*Kinetic parameters are acceptable*" otherwise "*Kinetic* parameters *are not acceptable*". Don't forget to print all input values.

2. Aircraft pilots must know the weight and center of gravity of the aircraft before taking off. For an aircraft, the maximum number of crew members allowed is 2, and the maximum weight of cargo allowed is 5,000 pounds. The total weight of the aircraft must include the weight of the crew, cargo, fuel and the aircraft itself. To calculate the center of gravity, multiply each weight by its distance from the nose of the aircraft, and add these products together. The calculation of a weight multiply by its distance from the nose of the aircraft is called a *moment*. For this aircraft, the empty weight is 9,021 pounds, and its empty center of gravity is 305 inches, so the empty moment is 2,751,405 inch-pounds (weight * inches). Assume the aircraft always starts its journey with a full tank of fuel. The fuel moment for a full tank of fuel is provided as 1,169,167.3 inch-pounds. The center of gravity is calculated by adding all moments, and dividing by the total weight.

For a specific aircraft, the measurements are as follows:

Empty aircraft moment: 2,751,405 inch-pounds
Empty aircraft weight: 9,021 pounds
Fuel moment: 1,169,167.3 inch-pounds
Full tank of fuel weight: 3618 pounds
Distance from the nose to the crew seats: 120 inches
Distance from the nose to the cargo bay: 345 inches

Create a program that will prompt the user for the number of crew members, and each crew member's weight. Validate the input such that the number of crew members is an integer between 1 and 2, and the weight of each crew member is a value between 85 and 400 pounds. If the input is not valid, require the user to re-enter the value until it is valid.

The program will output a report that will list the possible weights of cargo, starting with 0 to 5000 in increments of 500 pounds. Output the number of crew members and their weights, then a table of data that contains the weight of the cargo, and center of gravity for each cargo weight. The pilot would like to be able to scan the report and easily find the cargo weights where the center of gravity is 315 inches or greater. The program should output an asterisk (*) beside the centers of gravity that are 315 or greater. The weight of the cargo should be fixed at 1 decimal place, and the center of gravity value should be fixed at 3 decimal places. Include column headings that list the systems of measurement used.

Note: - Indicate the units for all I/O values required from- or provided to- the user.

Create a Word .doc file that contains the source code and a screen captures of the console window as the program is running, for all C++ programs. Save this file as *YourName_Assignment_1.doc* and upload and submit to the appropriate AVENUE lab assignment drop-box.