When you go to a grocery store, generally, you find several different lines (one for each checker), and one or more lines are designated as express lanes. On the other hand, when you go to a bank, you usually find only one line, and several tellers are available to serve the next person in line. Your goal in this assignment will be to write a simulation program that can determine which of these cases is most efficient under different circumstances. Your program should be based on the following assumptions:

1) Customer arrival is a uniform distribution at a given arrival rate (as in the airline simulation in your textbook). The arrival rate should be an input to your program.

2) The number of servers (tellers or checkers) ranges from 1 to 5 (an input to your program).

3) The number of lines is either 1, or 1 per server (input to your program).

4) If there is more than 1 line, then one of them can be designated as an express line (whether there is an express lane is determined by an input to your program).

5) Customer transaction times can vary from 2 minutes to 10 minutes. As in the example, choose the transaction time randomly from this range. If there is an express lane, customers may not enter the express lane unless their transaction time is 3 minutes or less.

6) If there are multiple lines, customers choose the shortest line that is available. If an express lane is available and the customer is eligible (due to short transaction time) the customer chooses the express lane.

Additional requirements include:

Your program should be able to create a log that includes information about every customer processed, such as customer id, arrival time, line number (or teller number), and departure time.

Your program should take as input the number of “minutes” it should run for. When the simulation is complete, it should print the total number of customers served by each server (designating if one is an “express line”), the average waiting time per customer, the average number of customers served per server, and the total number of “idle minutes” -- over all servers, add up the minutes that the server is not serving a client.

You are welcome, in fact encouraged, to modify the Lab 5 code for this assignment. Please indicate which code is from the book, which from the lab (and who your partner was), and which is your own new code.
In addition to your program, you must hand in sample runs with a writeup that answers each of the following questions:

1) In a 5-server scenario, is it more efficient to have one line or 5 lines (with no express line)?

2) Is it more efficient to have 5 undesignated lines, or 4 lines + an express line?

3) Is it more efficient to have 2 undesignated lines, or 1 line + an express line?

4) In case of assumption 6, if the express lane is only chosen when its line is shorter than all other lines, does this make average processing time longer, shorter, or no difference?