Assignment:	Write a simulation of a checkout line. The interval between arrivals and departures and the duration of the simulation are given in the input file. The input file is specified in the section titled **Input File** and sample input file is shown in figure 1. The output file contains a record of the simulation and can be used to compare expected values for the simulation with actual values produced by the simulation. The output file is specified in the section titled **Output File** and a sample output file is given in figure 2. Please note that values produced by the simulation will probably not match values shown in figure 2 due to the random nature of distribution sampling.
	Employ classes *Uniform*, *Exponential*, *ExponentialElapsed*, and *Event* as defined in files given below. Employ file **p05make** to create executable file **p05**.
Prohibition:	Use of the C++ Standard Template Library is prohibited in the implementation of this project.
Program Files:	Project **5** consists of files **p05.cpp**, **Sim05.h**, **Sim05.cpp**, **Uniform05.h**, **Uniform05.cpp**, **Exponential05.h**, **Exponetial05.cpp**, **ExponentialElapsed05.h**, **ExponentialElapsed05.cpp**, **Event05.h**, **Event05.cpp**, **Queue05.h**, and **p05make**. Project file names are exactly as given. Failure to employ the foregoing names will result in a score of *zero* (*0*) for this project
	Project files must be stored in the **root directory of your student account**. Failure to store project files in the root directory of your student account will result in a score of *zero* (*0*) for this project.

File	Description
p05.cpp	File **p05.cpp** contains functions that process command line arguments and manage the checkout line.
Sim05.h	File **Sim05.h** contains the definition of **class** *Sim*. **Class** *Sim* defines private data and member functions specific to the simulation. **Class** *Sim* employs a uniform distribution to determine arrival and departure times.
Sim05.cpp	File **Sim05.cpp** contains the implementation of member functions of **class** *Sim*.

	File	Description
Available in ~tt/cs2613	**Uniform05.h**	File **Uniform05.h** contains the definition of **class** *Uniform*. **Class** *Uniform* defines attributes of the uniform distribution.
Available in ~tt/cs2613	**Uniform05.cpp**	File **Uniform05.cpp** contains the implementation of member functions of **class** *Uniform*.

	File	Description
Available in ~tt/cs2613	**Exponential05.h**	File **Exponential05.h** contains the definition of **class** *Exponential*. **Class** *Exponential* defines the attributes of the exponential distribution. The times between arrivals and departures are drawn from the exponential distribution.
Available in ~tt/cs2613	**Exponential05.cpp**	File **Exponential05.cpp** contains the implementation of member functions of **class** *Exponential*.
Available in ~tt/cs2613	**ExponentialElapsed05.h**	File **ExponentialElapsed05.h** contains the definition of **class** *ExponentialElapsed.* **Class** *ExponentialElapsed* defines the attributes of a sequence of samples drawn from the exponential distribution. A sample from the exponential elapsed distribution is the sum of the intervals of a sequence of samples drawn from the exponential distribution.
Available in ~tt/cs2613	**ExponentialElapsed05.cpp**	File **ExponentialElapsed05.cpp** contains the implementation of member functions of **class** *ExponentialElapsed*.
Available in ~tt/cs2613	**Event05.h**	File **Event05.h** contains the definition of **class** *Event.* **Class** *Event* defines the attributes of sequence of events. An event is either an arrival or a departure. The time of the event is the elapsed time since the simulation start. Class event merges two sequences of elapsed times drawn from the *ExponentialElasped* distribution. One sequence is the sequence of arrivals: the other sequence is the sequence of departures.
Available in ~tt/cs2613	**Event05.cpp**	File **Event05.cpp** contains the implementation of member functions of **class** *Event*.
	Queue05.h	File **Queue05.h** contains the definition of **template class** *Queue*. **Class** *Queue* implements a queue by dynamically allocating individual elements of a queue. Elements of the queue can have any type *T*. Elements are linked from oldest to newest. Elements are dynamically allocated when needed and discarded after they are no longer required.
Available in ~tt/cs2613	**p05make**	File **p05make** contains instructions for creating executable file **p05**. Instructions in file **p05make** are accepted by the UNIX utility *make.*

Command Line:	Project **5** can be invoked with zero, one, or two program parameters. The first program parameter is the input file name. The second parameter is the output file name. Sample command lines together with corresponding actions by program **p05** are shown below. Boldfaced type indicates data entered at the keyboard by the user.

$ **p05**
Enter the input file name: **i05.dat**
Enter the output file name: **o05.dat**

$ **p05 i05.dat**
Enter the output file name: **o05.dat**

$ **p05 i05.dat o05.dat**

Input File:	The input file contains three (3) simulation parameters as shown in Figure 1. All parameters are given in minutes. The first parameter is the mean time between arriving customers. The second parameter is the mean time between departing customers. The third parameter is the duration of the simulation. You may find simulation parameters given in Figure 1 in file **i05.dat** in the class directory (**~tt/cs2613/**

Simulation parameter	Type	Units	Description
Arrival interval	**double**	Minutes	Specifies the average time between arrivals.
Departure interval	**double**	Minutes	Specifies the average time between departures.
Duration	**int**	Minutes	Specifies the length of the simulation.

Figure 1.
Input file format: 0.5000 0.3333 100000

Output File: The format of the output file is shown in Figure 2. Data shown in Figure 2 is produced by Program **p05**. The output file consists of three (3) columns. The first column contains a description of the data shown. The second column lists data produced by program **p05**. The last column lists the units of the data recorded in the second column. The widths of the columns are **40** spaces, **10** spaces, and **20** spaces respectively.

Column	Specification
1 (left)	Text is left justified in a field of **40** spaces.
2 (middle)	Integer data are right justified in a field of **10** spaces.
3 (right)	Text is right justified in a field of **20** spaces.

Figure 2.
Output file
format:

Mean time between arrivals	0.50	minutes
Arrival rate	120.00	customers/hour
Mean time between departures	0.33	minutes
Departure rate	180.02	customers/hour
Expected response time	1.00	minutes
Response time variance	3.00	minutes
Simulation response time	0.96	minutes
Expected line length	2.00	customers
Line length variance	6.00	customers
Simulation mean line length	1.90	customers
Customers served	19741	customers
Simulation maximum response time	8.90	minutes
Simulation maximum line length	17	customers
Simulation lasted for	9999.74	minutes