Assignment # 6: Arena - Spotless Wash - Basic Model

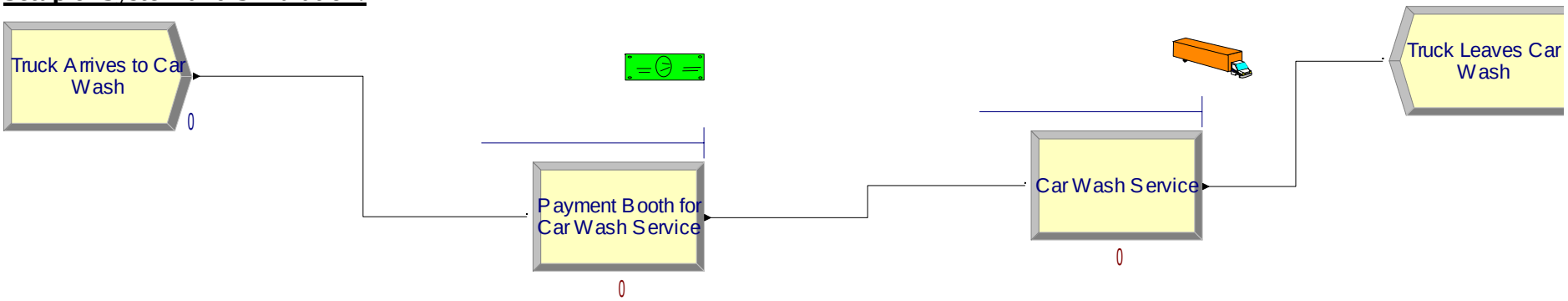
Point: 30

Due Date: Wednesday February 23rd, 2:00pm

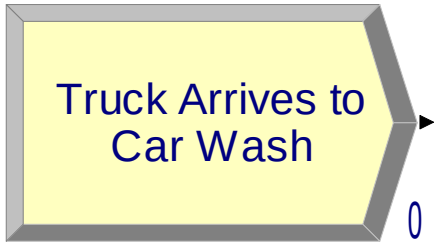
An IE major, which we will refer to him as Oliver Tambo (in honor of South Africa's National Hero Oliver Reginald Tambo), has just graduated from Morgan State University. He has already had several job interviews with prospective employers and is planning to accept an offer from one of them. In the meantime, he is thinking of helping the family business, a car wash especially designed for trucks. He approaches the problem as a system that can be improved by implementing scientific principles that he learned during his study at the IE program in Morgan State University. First he collects data on the arrival time of the trucks for several days. He also makes observations on the time that it takes for trucks to be washed. Trucks enter the system, wait in line until they pay for the service and then move toward the service station. If the service is busy (only one truck at a time can be washed), trucks stay in line and wait for the service station to become available. Trucks leave the system, immediately after they finish the wash. Oliver also realizes that there is only few seconds between the departure of a washed truck from a service area and entrance of the next truck in line to the service area thus for all practical purposes it can be assumed to be zero. Using the tools and techniques he learned at school, he determines that paying for service is exponentially distributed with the mean of 5 minutes, the service time is distributed according to a triangular distribution with parameters of 7, 10, and 15 and inter-arrival times are exponentially distributed with the mean of 13. The car wash has ample parking lot space and all cars who come to the lot will stay to finish their service, whatever time it takes.

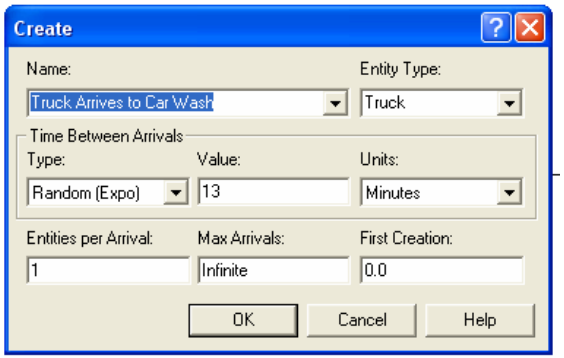
Simulate the system for 480 minutes and collect data. If the simulation stopped because you have too many entities in the system, start reducing the simulation time by increments of 20 (i.e., try 460, 440, etc.) until it completes one complete replication.

Setup of System and Simulation:

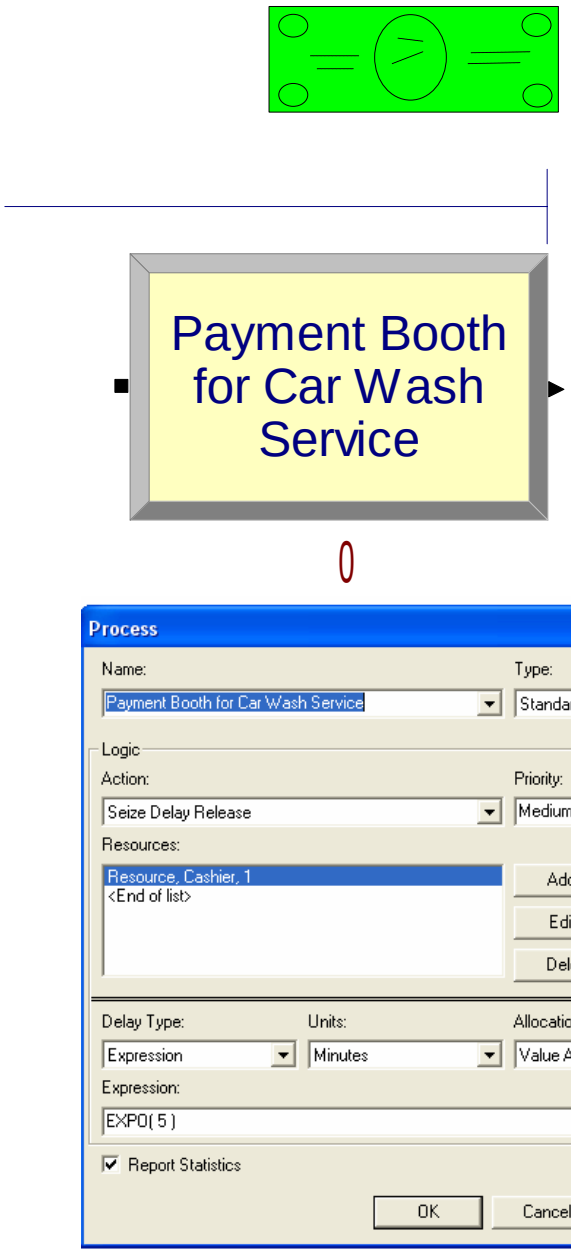


Above is the diagram of the simulation for Oliver Tambo's Family Car Wash. The Arena file can be found on the enclosed disk: TS_IEGR410_CarWashModel1_reva.

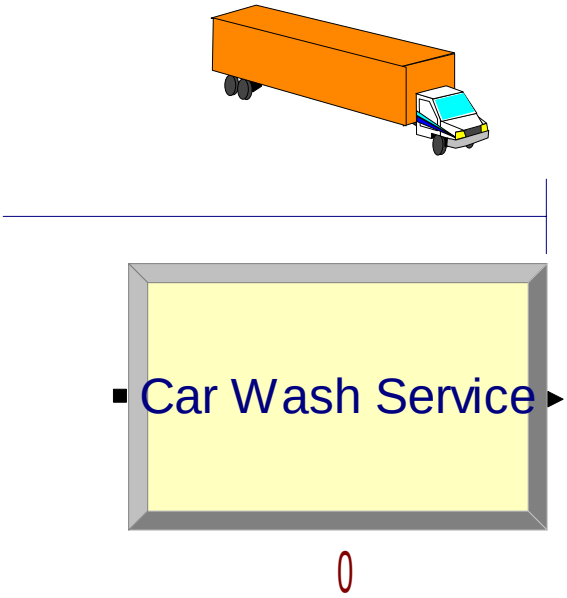


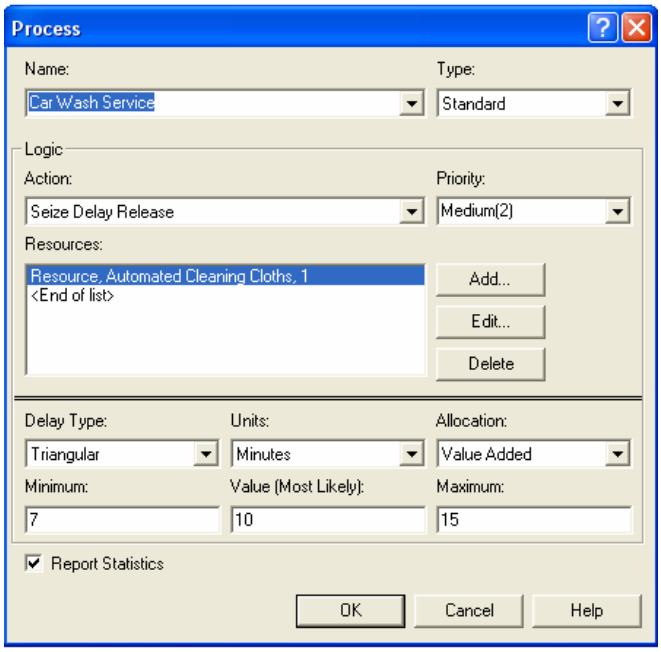


This Module was created using the create type from the basic process template. The create module is the node representing arrival of entities into the model's system boundaries. In this system, the module represents the trucks arriving to the car wash. The interarrival times of the trucks was given as an exponential distribution with a mean of 13 minutes. The exponential distribution is often used to model interevent times in random arrive processes.



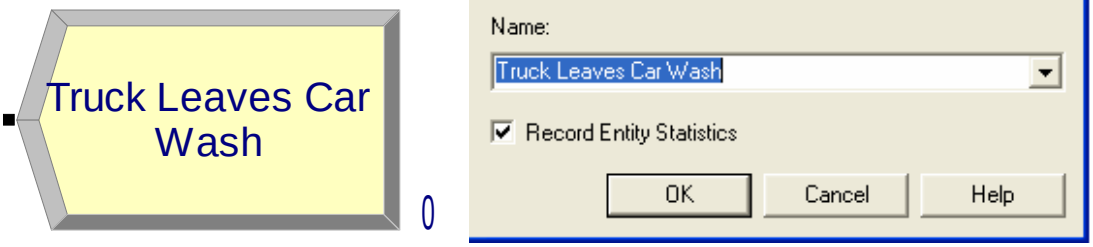
This module was created using the process type from the basic process template. The first process module in the simulation represents the payment booth, the cashier (resource), the line for payment of services, and the delay time trucks spend at the payment booth paying for the service. The delay type has five options: the exponential distribution is not indicated, so an expression must be built for exponential distribution with the mean of 5 minutes. The exponential distribution is available in the expression builder and the mean: 5 minutes replaces the word “mean” in the expression. The green dollar bill icon indicates the idle state of this process. During simulation, the busy state of the process is represented by a green dollar bill icon with a hand over it.





The car wash service module is also a process. The delay type for this process is given: triangular distribution with a min of 7, mode of 10, and a max of 15 minutes. Triangular distribution is used in this case because the exact form of the distribution is not known, but estimates are available based on Tambo's collection of data. The truck icon above the car wash service module represents the idle state of the process. A stop sign during simulation represents the busy state of the process.

In both process, resources had to be defined: Cashier and Automated Cleaning Cloths. The resources each have a fixed capacity of 1 and the assumption is that no failures will occur. Consequently, no pattern for failure has been indicated. The queues for both processes are emptied according to the FIFO (first in, first out) rule.



The last module is Truck Leave Car Wash or the Dispose module. The Dispose module represents entities leave the model boundaries. In this simulation, that is the trucks leaving the system, immediately after they finish the wash.

Results of Simulation for System:

The results for the simulation can be found in the file: TS_IEGR410_category by replication. Plots of the results can be found in the folder:TS_IEGR410_html

Interpretations of Results:

The simulation ran for 480 minutes, or 8 hours. The average wait time for the trucks to be washed was 0.1374 hours or 8.244 minutes. The range of wait times was from 0 to 32.266 minutes. At the payment booth, the average wait time was 6.948 minutes. The range was from 1.3332 minutes to 14.454 minutes.

For the duration of the simulation, 33 trucks paid and received service. Thirty nine trucks entered the payment booth and had not received service. So at the end of the simulation, five trucks were waiting to pay and then be serviced, while one truck was currently paying for service.

The max number of trucks in the queue for the payment booth and car wash service were 5 and 3, respectively. For the two processes, the efficiency of the cashier and automated cleaning cloth resources were 41.7% and 76.67%.

Category by Replication

10:58:55AM

February 23, 2005

Replications: 1

Tambo

Replication 1

Start Time: 0.00 Stop Time: 8.00 Time Units: Hours

Process

Time per Entity

VA Time Per Entity	Average	Half Width	Minimum	Maximum
Car Wash Service	0.1859	(Insufficient)	0.1249	0.2446
Payment Booth for Car Wash Service	0.0936	(Insufficient)	0.00029100	0.5512

Wait Time Per Entity	Average	Half Width	Minimum	Maximum
Car Wash Service	0.1374	(Insufficient)	0	0.5371
Payment Booth for Car Wash Service	0.02222494	(Insufficient)	0	0.2409

Total Time Per Entity	Average	Half Width	Minimum	Maximum
Car Wash Service	0.3232	(Insufficient)	0.1249	0.7649
Payment Booth for Car Wash Service	0.1158	(Insufficient)	0.00029100	0.6398

Accumulated Time

Accum VA Time	Value
Car Wash Service	6.1334
Payment Booth for Car Wash Service	3.0887

Accum Wait Time	Value
Car Wash Service	4.5337
Payment Booth for Car Wash Service	0.7334

Other

Number In	Value
Car Wash Service	33
Payment Booth for Car Wash Service	39

Number Out	Value
Car Wash Service	33
Payment Booth for Car Wash Service	33

Queue

Time

Waiting Time	Average	Half Width	Minimum	Maximum

Category by Replication

February 23, 2005

Car Wash Service.Queue	0.1374	(Insufficient)	0	0.5371
Payment Booth for Car Wash Service.Queue	0.03766741	(Insufficient)	0	0.5473

Other

Number Waiting	Average	Half Width	Minimum	Maximum
Car Wash Service.Queue	0.5667	(Insufficient)	0	3.0000
Payment Booth for Car Wash Service.Queue	0.2792	(Insufficient)	0	5.0000

Resource

Usage

Instantaneous Utilization	Average	Half Width	Minimum	Maximum
Automated Cleaning Cloths	0.7667	(Insufficient)	0	1.0000
Cashier	0.4170	(Insufficient)	0	1.0000

Number Busy	Average	Half Width	Minimum	Maximum
Automated Cleaning Cloths	0.7667	(Insufficient)	0	1.0000
Cashier	0.4170	(Insufficient)	0	1.0000

Number Scheduled	Average	Half Width	Minimum	Maximum
Automated Cleaning Cloths	1.0000	(Insufficient)	1.0000	1.0000
Cashier	1.0000	(Insufficient)	1.0000	1.0000

Scheduled Utilization	Value
Automated Cleaning Cloths	0.7667
Cashier	0.4170

Total Number Seized	Value
Automated Cleaning Cloths	33.0000
Cashier	34.0000