# Week 7 Homework

**Due** Mar 1 at 11:59pm **Points** 17 **Questions** 17 **Available** after Feb 21 at 8am
**Time Limit** None

## Attempt History

| | Attempt | Time | Score |
|---|---|---|---|
| **LATEST** | Attempt 1 | 8,748 minutes | 14 out of 17 |

Score for this quiz: **14** out of 17
Submitted Mar 1 at 11:59pm
This attempt took 8,748 minutes.

### Question 1

**1 / 1 pts**

(Lesson 5.15: Two-Channel Manufacturing Example.) Consider the demo from class:

Module05-15 - Model 04-01-ElectronicAssembly-slow.doe

If you run the thing for a while, you'll see that the rework Station gets pretty clogged up every once in a while – probably because the service times are EXPO(45) minutes. Let's suppose that management has noticed this as well and decides to upgrade that station so that the service times are now EXPO(10). Go ahead and make this change and comment on what you see.

- a. There are still very long lines at Rework almost all of the time.
- b. There are occasionally extremely long lines at Rework.

Correct!

- c. There are occasionally short lines, but long lines are very rare.
- d. There is never, ever any line at Rework

(c).

## Question 2

0 / 1 pts

(Lesson 5.15: Two-Channel Manufacturing Example.) To get you in the mood for this problem, let's recall the slightly different demo that incorporates a logic-based equation in the Sealer Process module:

Module05-15 - Model 04-01-ElectronicAssembly-Logic-slow.doe

I'm not going to ask you to run this model, but I'd simply like to know the value of the related logic expression,

( (1 == 1) * 10 ) + ( (1 == 0) * 5 )

- a. 0
- **You Answered** b. 1
- c. 5
- **Correct Answer** d. 10
- e. 15

Since "1 == 1" is true and "1 == 0" is false, we have

( (1 == 1) * 10 ) + ( (1 == 0) * 5 ) = (1*10) + (0*5) = 10,

so that the answer is (d).

## Question 3

1 / 1 pts

(Lesson 5.16: Fake Customers.) Let's use fake customers to calculate an exponential probability. In particular, modify the following demo from class so that you can estimate the probability that an EXPO(2) random variable (this is the Arena notation for an exponential RV with mean 2) is > 2.

Module05-16 - Model 04-05 – NormalProb.doe

Hints on how to do the necessary modification:

- Go to the Assign module and change the normal RV to the exponential.
- Optional: You might also want to change the name of the fake customer's attribute from "Normal Observation" to "Exponential Observation" just to make things clearer.
- Go to the Decide module and make the obvious change to the condition.
- Optional: You might also want to change the counter names in the Record modules to something more obvious.
- Let the run complete and then look at the output! Note that the demo runs for 1 million samples, so the estimate ought to be very good.

Correct!

- a. 0
- b. about 0.135
- c. about 0.368
- d. about 0.632
- e. about 0.865

**Solution:** The answer is (c). In fact, when I ran my simulation, 367460 out of the 1 million fake customers satisfied the inequality.

Of course, you can calculate the answer exactly (without using simulation):

$P(EXPO(2) > 2) = e^{-\lambda x} = e^{-(1/2)2} = 0.3679.$

## Question 4

1 / 1 pts

(Lesson 5.17: The Advanced Process Template.) TRUE or FALSE? You can find individual Seize, Delay, and Release modules in this template.

Correct!

- (●) True
- ( ) False

## Question 5

1 / 1 pts

(Lesson 5.17: The Advanced Process Template.) Grab the file

Module05-ReleaseHospitalRoomLater.doe

from the website. In this model, customers come in to the hospital, use a Process module to Seize and Delay an operating room, and then get Dispose'd. So how are the operating rooms Release'd? Well, any good hospital room needs to be cleaned. So each time a customer is about to be Dispose'd, we use a Separate module to clone a copy of the customer; and this clone uses a Process block to Seize-Delay-Release a cleaning person. After the cleaning is done, we use an additional Release module to free up the operating room. The program runs for 24 simulated hours.

What I would like you to do is to run the same program, except replace both of the Process modules with appropriate Seize and Delay modules from the Advanced Process template (the only Release module you'll need is already there).

After the program runs for its 24 simulated hours, what is the approximate utilization of the cleaning person?

- ( ) a. 5%

Correct!

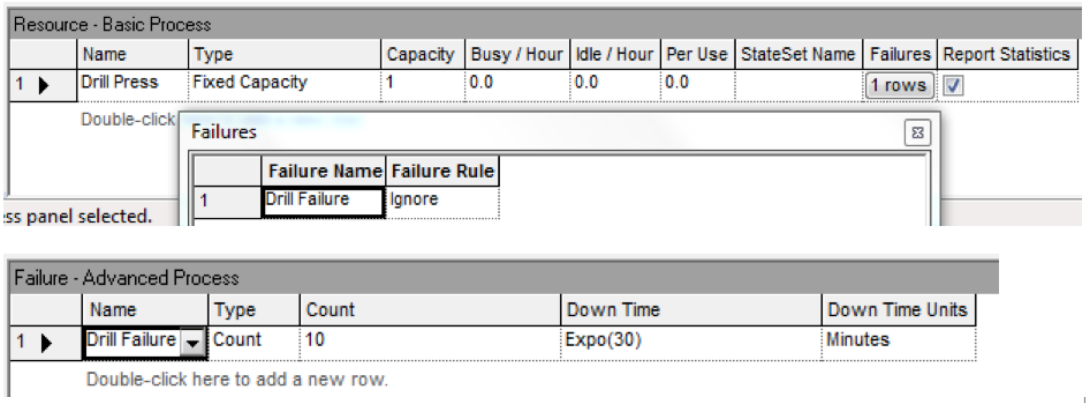
- (●) b. 21%
- ( ) c. 39%
- ( ) d. 54%
- ( ) e. 75%

**Solution:** (b). You should get pretty much the same (and maybe even exactly the same) utilization here as you would if you had run the original program

## Question 6

1 / 1 pts

(Lesson 5.18: Resource Failures + Maintenance.) What do the entries in the following screenshots do?







a. The resource Drill Press will fail after Expo(30) minutes

b. The resource Drill Press will fail after 10 minutes and remain down for Expo(30) minutes.

c. The resource Drill Press will fail after Expo(30) minutes and remain down for 10 minutes.

Correct!

d. The resource Drill Press will fail after 10 customers use it, and will remain down for Expo(30) minutes.

e. The resource Drill Press will fail after Expo(30) customers use it, and will remain down for 10 minutes.

(d).

## Question 7

1 / 1 pts

(Lesson 5.19: The Blocks Template.) Where can you find some sort of Seize?

a. Within a Process module in the Basic Process template

b. A Seize module in the Advanced Process template

c. A Seize block in the Blocks template

Correct!

d. All of the above

(d).

## Question 8

1 / 1 pts

(Lesson 5.19: The Blocks Template.) Where can you set the buffer size of a certain queue?

a. Within a Process module in the Basic Process template

b. In a s Seize module in the Advanced Process template

c. In a Seize block in the Blocks template

Correct!

- d. In a Queue block in the Blocks template
- e. In the Queue spreadsheet in the Basic Process template
- f. All of the above

(d).

## Question 9

1 / 1 pts

(Lesson 5.20: The Joy of Sets.) Consider the file

**Module05-22 - Model 05-01 - CallCenter.doe (%24CANVAS_COURSE_REFERENCE%24/file_ref/g6144775e4030ce228d0ebc6145156040/download?wrap=1)**

from the website. Go to the Set spreadsheet in the Basic Process template and figure out which resource sets the resource Molly belongs to. Give the best answer.

- a. Product 1
- b. Product 2
- c. Product 3

Correct!

- d. Product 1 and Product 3
- e. Product 1, Product 2, and Product 3

(d).

## Question 10

1 / 1 pts

(Lesson 5.20: The Joy of Sets.) TRUE or FALSE? It's possible to request servers in a set randomly, cyclically, or according to some priority characteristic (such as the order in which they are placed in the set).

Correct!

- (•) True
- ( ) False

## Question 11

**0 / 1 pts**

(Lessons 5.21 and 5.22: Call Center Demo.) Again consider the file

Module05-22 - Model 05-01 - CallCenter.doe

We'll do a little bit of analysis on this model. In order to do so,

- Go to Run > Setup > Replication Parameters and change the Replication Length to 550 hours. This will allow the simulation to run long enough to yield meaningful results.
- Then go to Run > Run Control > Batch Run. This will turn off the animation and allow the simulation to run very quickly.

When I ran this simulation for 550 hours with the server schedules as specified in the notes, I obtained a mean tech support customer waiting time of 5.68 minutes. (Hopefully, you'll be able to replicate that just by hitting the Go button.)

Here's what I'd like you to do:

- Go to the Resource spreadsheet.
- Change all of the 11 tech support resources (Charity, Noah,…, Christie) to a Fixed Capacity of 1. In other words, take them all off of their schedules and force the poor souls to work all 11 hours / day.
- Re-run the simulation with everyone working full-time.

What is the approximate mean tech support customer waiting time when we use our full-time crew?

- ( ) a. 8.35 min. (it went up!)
- ( ) b. 5.63 min. (stayed about the same)

Correct Answer

c. 2.59 min. (pretty good improvement)

d. 0.13 min. (incredible improvement!)

You Answered

e. I (the student) solemnly swear that I wasn't able to match your (Dave's) results for the default (scheduled) case, so I couldn't get meaningful results for the full-time case. [This is possible.]

(c).

## Question 12

0 / 1 pts

(Lesson 5.23: An Inventory Model.) Consider the demo model from class,

Module05-23 - Model 05-04 - Inventory.doe

What would I do to change the lead time of orders from my supplier to UNIF(0,1) days (which happens to be a little faster than the current lead time)?

a. Go to the Variable spreadsheet in the Basic Process template and change the variable Delivery Lag to UNIF(0,1).

You Answered

b. Go to the Expression spreadsheet in the Advanced Process template and change the expression Delivery Lag to UNIF(0,1).

c. Go to the "Wait for Delivery" Delay module in the main program and change the expression Delivery Lag to UNIF(0,1).

d. Bypass the "Ordering Decision" Decide module.

Correct Answer

e. Either (b) or (c), since both are correct.

(e).

## Question 13

1 / 1 pts

(Lesson 5.24: One Line vs. Two Lines?.) Consider the demo model from class,

Module05-24 - OneLine-vs-TwoLines.doe

I'd like you to modify the demo in order to determine which of the following is better:

(a) Customers join one line in front of **three identical servers** and then go to whichever server is available first.

(b) Customers randomly choose which of **three lines** (in front of single servers) to join.

This won't take too much work.

- Go to the Resource spreadsheet and change the fixed capacity of Drill Press to 3
- Add another resource Drill Press3 with capacity 1
- Make the obvious additions to the bottom half of the Arena model
- Press Go and watch the fireworks for a while.

So what's your answer — (a) or (b)?

Correct!

- (a)
- (b)

(a) easily beats (b) (shorter cycle times and queue).

## Question 14

1 / 1 pts

**Lesson 5.25: A Re-entrant Queue**

BONUS: Consider the demo model from class, in which we observe crazier and crazier behavior as time passes,

**Module05-25 - ReentrantQueue.doe (%24CANVAS_COURSE_REFERENCE%24/file_ref/g4a60652f448036c75de00d12c7cea398/download?wrap=1)**

In particular, the various queues build up and them calm down; but the peaks tend to get bigger and bigger as time passes.

One of the issues is due to the fact that we have strange priorities on the two servers depending on where the customer is in the model. Those priorities are set in the Process modules, just to the right of the Seize-Delay-Release sequence.

Question: What happens when you set the priorities to “Medium” in each of the 5 process modules?

- a. All of the queues still exhibit that crazy behavior.
- b. A couple of the queues (but not all of them) still exhibit crazy behavior.

Correct!

- c. Surprisingly, things pretty much calm down!

The answer is (c). [Apparently, the goofy priorities in the original set-up were messing things up!]

## Question 15

1 / 1 pts

(Lesson 5.26: SMARTS Files and Rockwell Demos.) BONUS: Let’s look at one of the Rockwell SMARTS demo models from class, in which the arrival rate changes over the week (a different arrival rate each day),

Module05-26 - SMARTS - Arrivals Varying Rate via Expression.doe

Salient features of the model:

- day_rate is a vector of length 7 defined in the Variable spreadsheet in the Basic Process template. It keeps track of 7 daily customer arrival rates.
- The first Create module generates customers with *constant* interarrival times 1/(day_rate(day)), which obviously depends on the day of the week.
- The second Create module generates fake customers once every day to update the day of the week (1,2,…,7).
- The constant interarrival times are relatively large compared to the smaller service times given in the first Process module. So there's never really a line… VERY BORING!

Here's what I want you to do:

- Instead of constant interarrival times every day, let's make the interarrivals *random*.
- To this end, augment the Time Between Arrivals Expression in the first Create module to EXPO(1/(day_rate(day))), and tell me what happens.

a. Still no line, ever.

Correct!

b. Occasional small line.

c. Gigantic line forms.

d. I from University of Georgia. What "SMARTS" meaning? Question make brain hurt.

(b).

## Question 16

1 / 1 pts

(Lesson 5.27: A Manufacturing System Demo.) I'd like you to play around with the demo

Module05-27 - Model 07-01 - Basic Mfg Center.doe

What sequence of station visitations do Part Type 1 customers go through?

Correct!

- a. 1-> 2 -> 3 -> 4
- b. 1-> 2 -> 4 -> 2 -> 3
- c. 2 -> 1 ->3
- d. 1-> 2 -> 3 -> 1 -> 4

(a).

## Question 17

1 / 1 pts

(Lesson 5.27: A Manufacturing System Demo (continued).) If you wanted to change Part Type 1's sequence of stations, what would you do?

Correct!

- a. Use the Sequence spreadsheet in the Advanced Process template
- b. Use the Sequence spreadsheet in the Advanced Transfer template
- c. Use the Set spreadsheet in the Basic Process template
- d. Use the Advanced Set spreadsheet in the Advanced Process template

(b).

Quiz Score: **14** out of 17