

Lesson 9. Reneging and Balking

1 Overview

- Recall the Fantastic Dan example from Lesson 8:

Example. Customers visit the neighborhood hair stylist Fantastic Dan for haircuts. The customer interarrival time is exponentially distributed with mean 20 minutes. Each haircut takes Fantastic Dan anywhere from 15 to 25 minutes, uniformly distributed. This time also includes the initial greetings and the transaction of money at the end of the haircut. Fantastic Dan works 8 hours a day without breaks. Simulate 1 day of Dan's operations.

- What happens when customers change their minds about getting a haircut?
- How can we model these fickle customers in JaamSim?

2 Reneging

- **Reneging** occurs when customers in a queueing system choose to leave the system prior to receiving service
- Suppose that customers at Fantastic Dan's shop will wait at most 30 minutes in the queue
- If they're not served by then, they simply leave the shop
- What fraction of customers renege?

2.1 Modeling reneging customers in JaamSim

- First, make a copy of this lesson's JaamSim file, and name it `09-renege.cfg`
- Next, rename Exit to ExitServed
- Add another EntitySink and call it ExitReneged
- Now, make the following changes to DanQ:

Keyword	Value
RenegeTime	30 min
RenegeCondition	1
RenegeDestination	ExitReneged

- RenegeTime is the time an entity will wait in the queue before deciding whether or not to renege
 - RenegeCondition is a logical condition that determines whether an entity will renege after waiting for RenegeTime time units
 - ◊ A **logical condition** is code that evaluates to 1 (for true) or 0 (for false)
 - RenegeDestination is the object the entity is routed to if it reneges
- How do we determine the fraction of reneging customers?
Hint. Look at the output for ExitReneged, ExitServed, and Entrance

3 Queue capacity and deterministic balking

- **Balking** occurs when potential customers arriving at a queueing system choose not to enter it
- Suppose now that customers do not renege at Fantastic Dan's shop
- Instead, assume that Fantastic Dan's shop only has 3 seats for waiting customers
- Any customers who arrive when the shop is full simply leave
- What fraction of customers balk in 1 day of Dan's operations?

3.1 Modeling balking customers in JaamSim

- Make another copy of this lesson's JaamSim file, and name it 09-dbalk.cfg
- Rename Exit to ExitServed, and add another EntitySink called ExitBalked
- We will use a Branch object, similar to how we modeled the self-serve dispenser at the NCB
- Insert a Branch object between Entrance and DanQ, and name it BalkDecision
- Modify Entrance so that it routes Customers to BalkDecision instead of DanQ
- Configure BalkDecision as follows:

Keyword	Value
NextComponentList	DanQ ExitBalked
Choice	' [DanQ].QueueLength >= 3 ? 2 : 1 '

- Remember that NextComponentList is a list of possible objects where the incoming entity can go next
 - Choice is a number that determines the next component: 1 = first in NextComponentList, 2 = second in NextComponentList, etc.
 - [DanQ].QueueLength, as you might expect, is the number of customers currently in DanQ
 - [DanQ].QueueLength >= 3 ? 2 : 1 translates to this pseudo-code:

```
if [DanQ].QueueLength >= 3 then
    return 2
else
    return 1
```
 - Why does the code for Choice in BalkDecision makes sense?
- How do we determine the fraction of balking customers?

4 Probabilistic balking

- Now let's go back to assuming that Fantastic Dan's shop does not have a queue capacity
- Suppose instead that a customer balks probabilistically: in particular, the probability that a customer balks grows as the length of the queue grows
- For instance, suppose that if x is the current number of customers in the queue, the probability that a customer balks is $\frac{x}{x+1}$

- Let's plot this balking probability as a function of the number of customers in the queue, just to get an idea of what's going on:



- Does having a balking probability like this make sense?

4.1 Modeling probabilistic balking in JaamSim

- This time, let's start from the JaamSim file we just created
- Make a copy of it and name it 09-pbalk.cfg
- Add a UniformDistribution object and name it BalkHelperDist
- Configure BalkHelperDist as follows:

Keyword	Value
UnitType	DimensionlessUnit
MinValue	0
MaxValue	1

- Modify BalkDecision as follows:

Keyword	Value
NextComponentList	DanQ ExitBalked
Choice	'[DanQ].QueueLength / ([DanQ].QueueLength + 1) >= [BalkHelperDist].Value ? 2 : 1'

- Why does the condition $[DanQ].QueueLength / ([DanQ].QueueLength + 1) \geq [BalkHelperDist].Value$ model the probabilistic balking described above?

- What fraction of customers balk?

5 If we have time...

Problem. Fantastic Dan has decided to add two more seats in the waiting area of his shop, raising the total number of seats in the waiting area to 5. Any customers who arrive when the shop is full still leave without receiving service. In addition, with your help, Fantastic Dan has determined that the customer reneging time is not deterministic; instead, it can be modeled as an exponential random variable with mean 22 minutes.

Create a model in JaamSim to reflect these changes in Fantastic Dan's shop. Assume an 8 hour day. Run your simulation once. What fraction of customers barked? What fraction of customers reneged? Compare your numbers to the ones we obtained above in the earlier simulations. Do they make sense?