SA421 – Simulation Modeling Spring 2013
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Lesson 18. Advanced Routing

- The first ProModel file for today's lesson contains the model we constructed for the new Fantastic Dan problem in Lesson 17, with some modifications
  - Customers arrive first at an arrival point before joining the queue
  - We keep track of (i) the number of customers in the shop at any time and (ii) the number of customers who spend more than 60 minutes at the shop
  - The customer interarrival times are exponentially distributed with a mean of 15
  - The logic has comments – take a look to see how that works

1 Alternate routing of entities

- Suppose Fantastic Dan's shop only has 3 seats for waiting customers, and any customers who arrive when the shop is full simply leave (they "**balk**")
- In Build → Locations:
  - Change the capacity of the queue to 3
  - Add another location called "Balk" to capture the customers who arrive when the shop is full
- In Build → Processing:
  - Select the "Customer" at "Arrival Point" row in the Processing window
  - Add a routing from the arrival point to the balk location
  - Add a routing from the balk location to the system exit
- Take a look at the Routing window for the processing of customers at the arrival point
  - A **routing block** (Blk) is a set of routes that are processed together
  - The "FIRST" rule selects the first location available listed in a routing block
- Run the simulation. How many customers balked? How many customers exited the system?

2 Routing based on chance

- Balking usually becomes more common as the length of the queue grows
- Suppose the probability that a customer balks is $\frac{n}{n+1}$, where n is the number of customers in the queue
- In Build → Locations, reset the queue capacity to $+\infty$
- In Build → Processing:
  - Select the "Customer" at "Arrival Point" row in the Processing window
  - Select the "Arrival Point" to "Balk" row in the Routing window and click the Rule button

- Check the Start New Block checkbox
- Set the operation of the customer at the arrival point to:

```
# Customer balks with probability n / (n+1)
# where n is the number of customers in the queue
IF U(0.5, 0.5) > CONTENTS(Queue, Customer) / (1 + CONTENTS(queue, customer)) THEN {
    ROUTE 1
} ELSE {
    ROUTE 2
}
```

- Run the simulation. How many customers balked? How many customers exited the system?

3 Percentage routing

- Suppose Fantastic Dan teams up with Bartender Bob to add a bar service to the shop so customers can relax after their haircuts
- Suppose 10% of customers go to Bartender Bob after their haircut
- Start with a fresh copy of the first ProModel file for today's lesson
- In Build → Locations:
  - Create a new location for Bob, with capacity 1
  - Create a queue for Bob, with physical length 0
- In Build → Processing:
  - For customers at Dan, add a routing from Dan to Bob's queue with rule probability 0.1
  - Change the rule for the routing from Dan to the system exit to probability 0.9
  - Add a routing for customers from Bob's queue to Bob, and Bob to the system exit
- Run the simulation. How many customers go to the bar?

4 Steady state

- The second ProModel file for today's lesson contains a model for the original Fantastic Dan problem, with some modifications:
  - Global variables and logic were added to compute the fraction of customers who spend more than 60 minutes at the shop
  - The simulation run time was changed to 1000 hours
- Run the simulation. Open a time plot of the fraction of customers who spend more than 60 minutes at the shop. (Don't forget to select Grouping: None)
- The fraction varies wildly at the beginning (**transient behavior**), and starts to settle down as time progreses (**steady state behavior**)
- If you want to make decisions based on the steady state of a system, you need to make sure you **warm up** the simulation long enough
- For the Fantastic Dan problem, the shop would never reach steady state in 1 working day