

Systems Modelling and Simulation (Lab session 8)



After this session you should understand

1. Variable arrival processes
2. Another usage of sets in Arena
3. More variables and expressions
4. Real costing analysis

Chapter 5, Kelton et al, Simulation with Arena, 5th Edition

Model 5-2: Enhancing the call centre model

- New problem description
 - **Main objective is to find the most cost effective way to increase service level or customer satisfaction.**
 - **Actual arrival over a day is a non-stationary Poisson process- Table 5-2 (thus rate varies at various time over the day)**
 - **Staffing level actually varies over the day – Table 5-3**
 - **4% of technical calls require further investigation after completion;**
 - *Further investigation is handled by a team outside our model.*
 - *This takes EXPO(60)*
 - *After this feedback is then sent to the tech. Person who answered the original call*
 - *This person then calls the customer which takes TRIA(2,4,9)*
 - *These calls use one of 26 trunk lines and have priority over incoming calls.*
 - *If call is not completed on same day as original call, its carried to next day.*
 - *We want to count number of rejected calls during each hour.*



New concepts

- Variable arrival rates
- Sets
- Reusing schedules
- Costing



Modifying the model 5-1

- Back to Arena

Model 5-3: More output performance measures

- So far we don't have an overall economic figure to help compare various configurations of the system.
- We'll create an over all cost measure as primary output.
- We'll make five replications representing a work week.
- Will focus on weekly costs.
- Two areas of cost;
 - Staffing and resource costs – **tangible**
 - *\$20/hr – sales staff, additional staff is \$17/hr*
 - *\$18-\$22/hr – tech staff depending on training*
 - *Cost incurred when staff are scheduled (busy or not busy)*
 - Costs due to poor customer service – **less tangible**
- We find peak time based on hourly reject counts: Model 5-2 (between 12:00 and 4pm).
- To model additional resource we use variable “*New Sales*”. Need to make changes to sales schedule.
- For Tech staff, we use variables; *New Tech 1, New Tech 2, New tech 3, and New Tech All*, according to product type.



Model 5-3: More output performance measures, cont.

- Additional generic resources
 - Larry, \$16/hr (product 1 expert)
 - Moe, \$16 (Product 2..)
 - Curly, \$16 (product 3..)
 - Hermann, \$18 (all)
 - Create schedule for each
 - Add resources to all product sets
- Each Trunk line costs \$98/wk
- We need an expression for the total resource cost



Model 5-3: More output performance measures, cont.

- Poor customer service cost
 - **Customer waiting limit**
 - *Tech calls – 3min*
 - *Sales calls – 1min*
 - *Order status calls – 2min*
 - *Corresponding cost per minute*
 - Tech support customers: 36.8 cents
 - Sales customers: 81.8 cents
 - Order status customers: 34.6 cents
 - **Collect accumulated waiting time beyond the limit**
 - **Determine weekly cost of waiting for completed customers**
 - **Determine overall total cost and define as output statistic (Statistic data module)**
- Constraint - Not more than 5% of calls should get a busy signal.



Model scenarios

- Scenario 0: Base scenario
 - **Results**
 - *Total cost = \$22,500.07*
 - *Percent of customers rejected = 12.9%*
- Scenario 1: 3 additional units of each resource
 - **Results**
 - *Total cost = \$23,668.69*
 - *Percent of customers rejected = 1.6049%*