

Systems Modelling and Simulation (Lab session 7)



After this session you should understand

1. The concept of entity balking, expressions and storages
2. Terminating and steady-state simulations
3. Priority Assignment
4. Control Logic (limiting entity creation)

Chapter 5 Kelton et al, Simulation with Arena 5th Edition, 2010



Model 5-1: A simple call centre system

■ Problem description

- **System provides a central number for**
 - *Technical support*
 - *Sales information*
 - *Order status*
- **Incoming call inter-arrival times: EXPO(0.857) min.**
- **Central number feeds 26 trunk lines**
- **If all 26 in use, caller gets a busy signal, and goes away**
- **An answered caller gets three options to transfer to**
 - *Technical support (76%)*
 - *Sales information (16%)*
 - *Order status inquiry (8%)*
- **Estimated transfer time is UNIF(0.1,0.6)min.**



Problem description cont.

- If caller chooses technical support;
 - **A 2nd recording requests product type customer is using**
 - *Product 1 (25%), Product 2 (34%), Product 3 (41%)*
 - *This process takes UNIF(0.1,0.5)min*
 - *If a qualified tech support person is available for selected product type, call is automatically sent to that person.*
 - *Else customer is placed in a queue*
 - *Time for all Tech support calls (for all product types) is TRIA(3,6,18)min.*
 - *Upon completion of call, customer exits system*
- Sales calls are automatically routed to sales staff;
 - **Sales calls take an estimated time of TRIA(4,15,45)**
 - **Upon completion of call, customer exits system**



Problem description cont.

- Order status calls are automatically handled by the phone system
 - There is no limit to the number the system can handle
 - But an ongoing order status call occupies one of the trunk lines and there are only 26
 - This process takes an estimated time of $TRIA(2,3,4)$
 - 15% of these callers opt to speak to a real person after receiving order status info.
 - These go to the sales staff where they wait with a lower priority than sales calls.
 - This follow-up process takes $TRIA(3,5,10)$
 - They then exit the system after being served



Problem description cont.

■ System information

- **Call centre hours: 8am to 6pm**
- **A few staff stay on till 7pm though system closes to new calls at 6pm.**
- **All calls that enter by 6pm are served.**
- **During the day, 8 tech support persons are available**
 - *2 devoted to product 1 calls*
 - *3 to product 2 calls*
 - *3 to product 3 calls*
- **There are 4 sales persons for sales calls and follow-up order status calls**



Performance measures of interest

- Count number of customer calls not able to get a trunk line and are rejected.
- Total time on line by customer type
- Time waiting for a real person by customer type
- Number of calls waiting for service by customer type
- Personnel utilization



Model 5-1

- New modelling issues
 - **Customer rejection and balking**
 - **Three-way decisions**
 - **Variables and expressions**
 - **Storages**
 - **Terminating and steady-state**



Model 5-1

■ Modelling approach

- Review Arena's hierarchical structure
- Generally, stay at the highest level possible as far as you can.
- We will use modules from the following panels;
 - *Basic process*
 - *Advanced process*
 - *Blocks*



Model 5-1

- Building the model: model sections
 - **Create Arrivals and direct to service**
 - **Arrival cut-off logic**
 - **Technical support calls**
 - **Sales calls**
 - **Order-status calls**
 - **System exit and run setup**
 - **Animation**



Model 5-1

- Back to Arena and start building the model