

## **Chapter 1**

- 1) Consider an on-line registration system (e.g., course registration at a university, or membership registration in a conference).
  - 1.a) List the main components of the system and its transactions.
  - 1.b) How would you define the state and events of each component of the registration system?
  - 1.c) Which performance measures might be of interest to registrants?
  - 1.d) Which performance measures might be of interest to the system administrator?
  - 1.e) What data would you collect?

### ***Answers:***

- 1.a) Main components: the arrival stream of registrants, the queue of registrants, and registration processing. Transactions are registrants.
  - 1.b) Arrival stream: state is residual time to next arrival; events are registrant arrivals. Queue: state is number of registrants in queue; events are registrants joining the queue, moving on in the queue, and leaving the queue. Registration: state is residual processing time of current registrant; events are processing inauguration and completion of registrants.
  - 1.c) Registrants are interested in their time through the registration system.
  - 1.d) The system administrator is interested in system utilization and the throughput that is the number of completed registrations per unit time.
  - 1.e) Registrant arrival and service times and actual customer waiting times for comparisons with any improved values.
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- 2) The First New Brunswick Savings (FNBS) bank has a branch office with a number of tellers serving customers in the lobby, a teller serving the drive-in line and a number of service managers serving customers with special requests. The lobby, drive-in and service managers, have each a separate single queue. Customers may join either of the queues (the lobby queue, the drive-in queue, or the service managers' queue). FNBS is interested in performance evaluation of their customer service operations.
    - 2.a) What are the random components in the system and their parameters?
    - 2.b) What are the measures you would recommend FNBS to consider?

**2.c)** What would you collect data on and why?

**Answers:**

**2.a)** Random components: arrival stream, mix of service types and service times. Parameters are the parameters of arrival distribution, service distribution and mix distribution.

**2.b)** Customer waiting times and teller utilizations.

**2.c)** Customer inter-arrival times, mix probabilities, and customer service times by service type, and actual customer waiting times for comparisons with any improved values.

**3)** Consider the production/inventory system of Section 1.7. Suppose the system produces and stores multiple products.

**3.a)** List the main components of the system and its transactions as depicted in Figure 1.1.

**3.b)** What are the transactions and events of the system, in view of Figure 1.1?

**3.c)** Which performance measures might be of interest to customers, and which to owners?

**3.d)** What would you collect data on and why?

**Answers:**

**3.a)** Main components: batch processing, failure arrivals and repairs, warehouse, and demand arrivals.

**3.b)** Transactions: finished product batches, failures, and customer demands. Event: batch processing beginning and end, batch processing blocking and unblocking, failure arrival and repair, demand arrival and departure, and warehouse reordering and unblocking of processing.

**3.c)** Customers are interested in what portion of their order is satisfied. Owners are interested in reducing inventories and in the mean time satisfying the customer orders as much as possible.

**3.d)** Customer inter arrival times, demand quantities, batch processing times, time to a failure, repair times, and percentage of customers with fully satisfied demands as well as quantity of unfilled demand given that a customer's demand is not filled completely, for comparison purposes (if and when needed).