Example 1
- Grocery Store Checkout

Interarrival time distribution - uniform

Time between Arrivals	Probability	Cumulative Probability	Random Digit Assignment
1	0.125	0.125	001-125
2	0.125	0.250	126-250
3	0.125	0.375	251-375
4	0.125	0.500	376-500
5	0.125	0.675	501-625
6	0.125	0.750	626-750
7	0.125	0.875	751-875
8	0.125	1.000	876-000

Grocery Store Checkout

Service time distribution

Service Time	Probability	Cumulative Probability	Random Digit Assignment
1	0.10	0.10	01-10
2	0.20	0.30	11-30
3	0.30	0.60	31-60
4	0.25	0.85	61-85
5	0.10	0.95	86-95
6	0.05	1.000	96-00

Input and Output

- Input: Arrival Time

  Service Begin Time

  Service End Time
- Output: Delay time (waiting in the queue)

Time in System

Idle Time for Server

Simulation Table

Iteration	Inputs					Output
	X_{i1}	X_{i2}	X_{i3}	…	X_{ip}	Y_i
1 2 3 … n						

Generate Inputs

Cust	Random Number	Interarrival Time	Random Number	Service Time
1	-	-	84	4
2	913	8	10	1
3	727		24	
4	015		53	
5	948		17	
6	309		79	
7	922		91	
8	753		67	
9	235		89	
10	302		38	

Simulate for 10 customers

Cust	Random Number	Interarrival Time	Random Number	Service Time
1	-	-	84	4
2	913	8	10	1
3	727	6	24	4
4	015	1	53	3
5	948	8	17	2
6	309	3	79	4
7	922	8	91	5
8	753	7	67	4
9	235	2	89	5
10	302	3	38	3

Simulation Table

Customer	Interarriv-al Time	Arrival Time	Service Time	Service Begins	Delay Time	Service Ends	Time in System	Idle time of Server
1 2 3 4 5	0 8 6 1	0 8 14 15	4 1 4 3	0 8 14 18	0 0 0 3	4 9 18 21	4 1 4 6	0 4 5 0

Output Statistics

- The purpose of simulation is insight — gained by looking at statistics
- The importance of various statistics varies on perspective:
  - Job perspective: wait time is most important
  - Manager perspective: utilization is critical
- Statistics are broken down into two categories
  - Job-averaged statistics
  - Time-averaged statistics

Job-averaged statistics

- Average delay time = $\dfrac{\text{Total Delay Time}}{\text{Number of Customers}}$
- Average service time = $\dfrac{\text{Total Service Time}}{\text{Number of Customers}}$
- Average waiting time = $\dfrac{\text{Total Time in System}}{\text{Number of Customers}}$ (response time, time in system)

Job-averaged statistics

Average delay time for those who delayed

$$= \frac{\text{Total Delay Time}}{\text{Number of Customer Who Delayed}}$$

$$\text{Probability of delay} = \frac{\text{Number of Customers Who Delayed}}{\text{Total Number of Customers}}$$

Average time between arrivals

$$= \frac{\text{Sum of Interarrival Times}}{\text{Number of Customers}}$$

Time-averaged statistics

- Average number of customers in the system
- Average number of customers waiting in the queue
- Average number of customers at the server

Server utilization

- Probability of Idle $= \dfrac{\text{Total Idle Time}}{\text{Length of Simulation}}$

- Utilization of server $= \dfrac{\text{Total Busy Time}}{\text{Length of Simulation}}$