Example 1: Elkin’s Batil-Patung Pansitan wants their business to be studied using modeling and simulation. Assuming that the arrival of customers is one at a time with arrival rates specified on table 1 with customer number 1 arriving at time 0 minute and assuming that the service time per customer of the cook, who is also Elkin, are also provided on table 1, simulate from time 0 to 20 minutes. Another assumption is that Elkin is vacant and idle at the beginning of simulation. Elkin would want to know the total customer served (P), average waiting time in queue, maximum time waiting in queue (WQ\*), time average number of customers waiting in queue, maximum number of customers that were ever waiting in queue (Q\*), average & maximum total time in system of customers served (TS\*), and utilization of cook.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Customer Number | Arrival Time | Interarrival Time | Service Time | Departure Time | Symbol legend |
| 1 |  | 1.73 | 2.90 |  | N- number of entities that passed thru the queue so far  ΣWQ- summation of queue times observed so far  ΣTS- summation of total time in system observed so far  ∫Q- area under the Q(t) curve so far  ∫B- area under the B(t) curve so far  Q(*t*)- number of entities in the queue at any time instant *t*  B(*t*)- 1 if busy, 0 if idle |
| 2 |  | 1.35 | 1.76 |  |
| 3 |  | 0.71 | 3.39 |  |
| 4 |  | 0.62 | 4.52 |  |
| 5 |  | 14.28 | 4.46 |  |
| 6 |  | 0.70 | 4.36 |  |
| 7 |  | 15.52 | 2.07 |  |
| 8 |  | 3.15 | 3.39 |  |
| 9 |  | 1.76 | 2.37 |  |
| 10 |  | 1 | 5.38 |  |

Table 1Arrival rates and service rates of pansitan customers

| Just-Finished Event | | | Variables | | Attributes: Arrival Times | | Statistical Accumulators | | | | | | | | | Event Calendar |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Entity No. | Time *t* | Event type | Q(*t*) | B(*t)* | (In Queue) | In Service | P | N | ΣWQ | WQ\* | ΣTS | TS\* | ∫Q | Q\* | ∫B | [Entity No., Time, Type] |
| - | 0.00 | Init | 0 | 0 | ( ) | - | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0.00 | [1,0.00,Arr], [-,20.00, End] |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Table 2. Simulation matrix for Pansitan

Example 2: Jay-r’s Rural Bank wants their business to be studied using modeling and simulation. Assuming that the arrival of customers is one at a time with arrival rates specified on table 3 with customer number 1 arriving at time 0 minute and assuming that the service time per customer of the teller, who is Jay-r for the mean time since his employee is absent, are also provided on table 3, simulate from time 0 to 25 minutes. Another assumption is that Jay-r is vacant and idle at the beginning of simulation. Jay-r would want to know the total customer served (P), average waiting time in queue, maximum time waiting in queue (WQ\*), time average number of customers waiting in queue, maximum number of customers that were ever waiting in queue (Q\*), average & maximum total time in system of customers served (TS\*), and utilization of cook.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Customer Number | Arrival Time | Interarrival Time | Service Time | Departure Time | Given formula: |
| 1 |  | 1.07 | 2.98 |  | ΣWQ += *t* – arrival time of entity in service  ΣTS += *t* – arrival time of departing entity  ∫Q += Q(*t*) of previous event \* (*t* – previous event *t*)  ∫B += B(*t*) of previous event \* (*t* – previous event *t*)  Arrival time = previous arrival time + previous interarrival time  Departure time = *t* + Service Time |
| 2 |  | 1.8 | 3.78 |  |
| 3 |  | 4.97 | 4.01 |  |
| 4 |  | 0.2 | 3.15 |  |
| 5 |  | 0.86 | 4.1 |  |
| 6 |  | 5.59 | 3.88 |  |
| 7 |  | 2.53 | 5.13 |  |
| 8 |  | 0.62 | 2.43 |  |
| 9 |  | 0.42 | 3.14 |  |
| 10 |  | 0.15 | 2.19 |  |

Table 3. Arrival rates and service rates of bank customers

| Just-Finished Event | | | Variables | | Attributes: Arrival Times | | Statistical Accumulators | | | | | | | | | Event Calendar |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Entity No. | Time *t* | Event type | Q(*t*) | B(*t)* | (In Queue) | In Service | P | N | ΣWQ | WQ\* | ΣTS | TS\* | ∫Q | Q\* | ∫B | [Entity No., Time, Type] |
| - | 0.00 | Init | 0 | 0 | ( ) | - | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0.00 | [1,0.00,Arr], [-,20.00, End] |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Table 4. Simulation matrix for Bank

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ΣWQ += *t –* arrival time of entity in service; no change when server is empty | ΣTS += *t –* arrival time of departing entity | ∫Q += Q(*t*) of previous event \* (*t* – previous event *t*) | ∫B += B(*t*) of previous event \* (*t* – previous event *t*) | Departure time = *t* + Service Time |