### **REPORT**

### **Simulation Report: Checkout Process in an E-Commerce Store**

#### **Objective**

The goal of this simulation is to model the checkout process at a small gift shop with one cashier and one line of customers. The performance measures we aim to determine are:

1. The **Average Time a Customer Spends in the System** (both waiting and being serviced)
2. The **Proportion of Time the Server is Idle**, denoted as 1−ρ

#### **Assumptions**

* **Interarrival Times:** The time between customer arrivals is uniformly distributed between 1 and 15 minutes, rounded to the nearest minute.
* **Service Times:** The time to serve a customer is uniformly distributed between 1 and 8 minutes, rounded to the nearest minute.
* **Total Time for Simulation:** 3 hours (180 minutes).
* **Number of Customers:** 20 customers.

#### **Methodology**

To simulate the checkout process, we used Microsoft Excel to generate random interarrival and service times for 20 customers. Each replication calculates the key performance metrics for the system.

**Steps Taken:**

1. **Interarrival and Service Times:**
   * We used the RAND() function in Excel to generate random interarrival times between 1 and 15 minutes, and service times between 1 and 8 minutes. These random values were rounded to the nearest whole minute using ROUND().
2. **Arrival Time:**
   * Arrival times for each customer were calculated by adding the interarrival time to the previous customer's arrival time.
3. **Service Start and End Times:**
   * The service start time for each customer was determined by the maximum of either their arrival time or the end time of the previous customer's service.
   * The service end time was calculated as the service start time plus the service time.
4. **Performance Metrics:**
   * **Average Customer Time in the System (W):** Calculated as the average of the total time each customer spent in the system (arrival to end of service).
   * **Proportion of Time the Server is Idle (1-ρ):** Calculated as the total idle time (gaps between customers being served) divided by the total simulation time.
5. **Multiple Replications:**
   * We used the Data Table feature in Excel to generate 50 replications of the simulation. Each replication generated different random interarrival and service times, allowing us to collect data on variability in customer time in the system and server idle time.
6. **Total Simulation Time:**
   * The total simulation time was calculated by subtracting the arrival time of the first customer from the service end time of the last customer.

#### **Results**

After running 50 replications of the simulation, we obtained the following key statistics:

**Average Customer Time in the System (W):** Across the replications, the average time each customer spent in the system was approximately **4.55 minutes**

* **Minutes** (final average value from your simulation data).

**Proportion of Time the Server is Idle (1-ρ):** On average, the server was idle for about **0.416666667**

**Of the total simulation time** (final value from your simulation data).

The results show that a single cashier can handle the customer flow with reasonable efficiency in a simulated 3-hour period, but additional staff may be needed during busier times to reduce waiting times and improve service.