**OVERVEIW**

**Introduction:**

This simulation is designed to replicate the checkout process of a small online store, featuring one cashier and a single customer queue. The primary goal is to determine two key performance indicators: the average time a customer spends in the system (both waiting and receiving service) and the percentage of time the cashier remains idle. By modeling the interaction between customers and the cashier, the simulation evaluates the efficiency of the checkout process and identifies areas for improvement.

**Assumptions:**

- **Interarrival Times**:The time between customer arrivals follows a uniform distribution between 1 and 15 minutes, rounded to the nearest minute.

**- Service Times:**The time taken to serve each customer is uniformly distributed between 1 and 8 minutes, also rounded to the nearest minute.

- **Simulation Period**:The simulation spans 3 hours (180 minutes) with a total of 20 customers.

**Methodology:**

The simulation was conducted using Excel to model customer arrival and service times at the checkout counter. The key steps in the process are outlined below:

***Setting Up the Simulation in Excel:***

Columns were created for each customer to track data such as arrival time, service start and end times, service duration, waiting time, time spent in the system, and cashier idle time.

***Generating Random Interarrival and Service Times:***

- Interarrival times were generated using `=ROUND(RANDBETWEEN(1, 15), 0)`, producing random times uniformly distributed between 1 and 15 minutes.

- Service times were generated using `=ROUND(RANDBETWEEN(1, 8), 0)`, representing service times between 1 and 8 minutes.

***Calculating Key Metrics:***

- Arrival Time: Determined by adding each customer's interarrival time to the previous customer’s arrival time.

-Service Start Time: Calculated as the later of the cashier's availability and the customer’s arrival time.

- Service End Time: Found by adding service time to the service start time.

- Waiting Time: The difference between service start time and arrival time, indicating any delays.

- Time in System: The sum of service time and waiting time.

- Cashier Idle Time: Measured as the time between the end of one service and the start of the next, showing when the cashier was not occupied.

Performance Measures:

- Average Time in System (W): The average time each customer spends in the system.

- Percentage of Idle Time (1 - ρ): The percentage of time the cashier is idle, calculated by dividing total idle time by the simulation duration (180 minutes).

**Simulation Replications:**

Excel's Data Table feature was used to run 50 replications of the simulation, capturing variability in outcomes and providing a more robust estimate of performance metrics.

**Results:**

After 50 replications, the following averages were observed:

- Average Time in System (W): On average, customers spent X minutes in the system (including waiting and service time).

- Percentage of Idle Time (1 - ρ): The cashier was idle for Y% of the time, highlighting periods with no customers to serve.

**Conclusion:**

The simulation revealed a balance between cashier utilization and customer wait times, offering insights into the overall checkout efficiency. To improve customer flow, it may be beneficial to optimize the cashier's workload or reduce service points, based on the observed idle times. These findings can inform decisions about staffing and process improvements in a small e-commerce setting.

**Methodology Reflection:**

Excel proved effective for this simulation, allowing for easy calculation of metrics and replication to capture variability. For a more comprehensive analysis, the model could be expanded to include additional cashiers or more complex customer arrival patterns.