**GROUP ASSIGNMENT**

**Group number: 24**

**Group members:** SHI Hongqu, ZHANG Jingyao, ZHOU Chu**,** LOU Chaoyi

**Final price**: $6.32

**Definitions**: Consumer: people who make purchases.

Customer: all the people, regardless of whether making purchases or not.

**Decision-making process**

* **Interarrival Time**: The interarrival time is calculated as the time difference between the arrivals of the current customer and the previous one.
* **Service Time**: The service time is calculated as the difference between the departure time of the current consumer and the maximum of either the arrival time of the current consumer or the departure time of the previous consumer.
* **Exponential distributions**: Based on Maximum Likelihood Estimation (MLE) method, rate parameters λ and μ can be calculated by formula *λ = n / Σ(X\_i)*. We obtained *λ* = 0.29 for Interarrival Time and *μ* = 0.2 for Service Time.
* **Queue length threshold**: Queue length equals to the number of consumers who have not left before the arrival time of the current customer. Observations indicate that no customers make purchases when the queue length is 5. Therefore, it can be inferred that one purchase condition is that the queue length must be less than 5.
* **Estimated WTP**: Initial data shows that 320 out of 700 customers made purchases. Among the 58 customers with a queue length of 5, it is assumed that half were discouraged by the price and half by queue length. Thus, we estimate the mean WTP to be around $7.0, and it is assumed to follow a uniform distribution *U*(0, 14).
* **Simulate price**:700 random Interarrival Time, Service Time and WTP are simulated. Price is simulated within [2.68, 10.72] range, with step being 0.01. The relationship between price and total revenue is visualized. We set the initial price as $7.5. (see **Appendix A** for complete codes).

**Learnings from updated data**

* **Accurate WTP**: Unexpectedly, the total revenue became lower. When queue length equals 0 (eliminate the influence of queue to focus only on the influence of price) and price equals $7.0 and $7.5 respectively, follow the formula: *(b-Price)/(b-a)=consumer\_count/customer\_count*, we compute a = 3.46, b = 10.36, and the uniform distribution of WTP is *U*(3.46, 10.36).

**Key insights obtained from the analysis**

* **Simulate the price again**: Simulate the process again with updated WTP, with step size equivalent to 0.01 and each simulation consists of 2, 000 customers. Visualize the relationship between Price and Total Revenue, Consumer Count and Average Revenue, as illustrated in **Appendix B**.
* **Pricing**: Due to the randomness of the related variables, the observation with the maximum total revenue may not be what we want. Therefore, we sorted 20 observations with the highest total revenue, chose the medium ($6.32) of the prices as our final decision. This is highly in line with our intuition from observing the diagram in appendix B.
* **Key insights**: When setting the price, it is crucial to consider the trade-off between customers' WTP and the impact of queue length. Customers have their own WTP, but once the queue length exceeds four, they may be discouraged from making a purchase. This insight highlights the importance of balancing pricing strategies with the management of queue length to ensure revenue maximization for Brew-tiful Mornings.