# 4. Statistical Analysis

To create a realistic simulation model of the restaurant system, we collected real life sample data in Excel and analyzed it using Arena’s Input Analyzer tool. This tool helps us choose the most appropriate probability distributions by checking how well each one fits the data. We used two main tests:  
- The Kolmogorov-Smirnov (K-S) test, which checks if the data matches the shape of the distribution.  
- The Chi-Square test, which compares how the observed data and the expected distribution frequencies match.  
  
Below are the results and explanations for each process in our simulation.

## 4.1 Order Taking Time (Waiter)

A screen shot of a graph

AI-generated content may be incorrect.This is the time it takes a waiter to take a customer’s order.  
  
- Best Fit Distribution: NORM(3.91, 1.09)  
- Mean: 3.91 minutes  
- Standard Deviation: 1.09 minutes  
- Square Error: 0.0116  
- K-S Test p-value: > 0.15 → Good fit  
- Chi-Square Test: Not reliable (degrees of freedom = 0)  
  
Explanation:  
The data is symmetric and bell-shaped, which is typical for a normal distribution. Although the Chi-Square test could not give reliable results due to low degrees of freedom, the low square error and the good K-S test result confirm that this is a good choice. So, we used the Normal distribution.

Figure: Output for order taking time in input analyzer

## 4.2 Meal Preparation Time (Chef)

A screenshot of a graph

AI-generated content may be incorrect.This is the time chefs take to prepare a customer's meal.  
  
- Best Fit Distribution: TRIA(5.5, 7, 15.8)  
- Minimum Time: 5.5 minutes  
- Most Likely Time (Mode): 7 minutes  
- Maximum Time: 15.8 minutes  
- Square Error: 0.0051  
- K-S Test p-value: > 0.15  
- Chi-Square Test p-value: 0.541  
  
Explanation:  
The data has a single peak and looks like a triangle shape, so Arena suggested a Triangular distribution. This is a good fit when there is a clear minimum, maximum, and most likely value. Both test results support this choice, and the square error is very low.

Figure: Output for chief meal prep time in input analyzer

## 4.3 Customer Eating Time

This is the time customers spend eating their food before leaving.  
  
- Best Fit Distribution: 11 + 20 \* BETA(α, β) \*(shape parameters α and β were not estimated properly)\*  
- Mean: 19.5 minutes  
- Standard Deviation: 4.51 minutes  
- Square Error: 0.0067  
- K-S Test p-value: > 0.15  
- Chi-Square Test p-value: 0.368  
  
Explanation:  
Arena suggested a Beta distribution, which is flexible and useful for data that has limits (like a fixed minimum and maximum eating time). Even though Arena didn’t estimate the exact shape parameters (it showed them as 0), the statistical tests and histogram show that Beta is a good match. We may adjust the shape parameters manually based on expert judgment or a better fitting tool.

A screen shot of a graph

AI-generated content may be incorrect.

Figure: Output for customer eating time in input analyzer