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Determination of Customers' Arrival and Service Patterns for a Restaurant Food Serving Process

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Authors' contributions

This work was carried out in collaboration among all authors. Author LAO established a research gap, carried out data acquisition, spelt out a detailed methodology for the research work and wrote the first draft of the manuscript. Authors RAG, EOO and SOO carried out data analysis and managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Restaurant industry has become one of the most profitable industries in the world where incessant long waiting time may not only lead to customers' dissatisfactions but also facilitate loosing of customers to other competitors. In this paper, in order to determine customers' arrival patterns and service patterns which are critical factors in determining customers' queue length and waiting time for a given restaurant, the food serving process employed at a named International Institute Restaurant (IIR), Ibadan, Nigeria, was used as a case study. Data were collected on customers' number, customers' inter arrival time and service time from Monday to Friday for a week. The data were analyzed statistically using the ARENA Input Analyzer to determine the arrival patterns and service patterns of customers within five working days of the week (Monday, Tuesday, Wednesday, Thursday and Friday). The results of the data analysis revealed that the arrival times of customers who patronized the IIR on Monday and Tuesday followed a Beta distribution. Furthermore, the

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arrival times of customers patronizing the IIR on Wednesday and Thursday followed a Weibull distribution while that of Friday assumed an Erlang distribution. Besides, the results of the data analysis revealed that the service times at IIR on Monday and Tuesday followed a Lognormal distribution. Beta, Lognormal and Weibull distributions were recorded in respect of service times characterizing the IIR on Wednesday, Thursday and Friday, respectively.

Keywords: Restaurant; customer; arrival pattern; service pattern; exponential distribution.

1. INTRODUCTION

A major contributing factor that influences the success of any organization is the increase in customer satisfaction through the improvement of service delivery. Customer satisfaction plays great importance to the success of every business organization whether it is meant for a product or a service [1]. Restaurants, being service organization, pay special attention to service quality and delivery. Restaurant industry has become one of the most profitable industries in the world and it was revealed that one line of business that keeps going and remains sustainable is the restaurant business. International and local restaurant chains are satisfying the demands of customers in variety of range of products and services [2]. In restaurant industry, waiting for service is a common phenomenon for the customers [3]. Restaurant would avoid losing their customers to competitors' door as a result of long waiting time on the line because this would result to customers' dissatisfaction. The frequent problem in most restaurants is the problem of waiting lines. Queue or waiting line causes unnecessary delay and reduces the service effectiveness in restaurant. Waiting lines are a common sight in a restaurant especially during lunch and dinner time. The queue length and waiting time are two significant factors which play an important role in a customer perception about the quality of service in restaurants.

Furthermore, a restaurant prepares and serves food, drink and dessert to customers. Generally, meals are served and eaten on restaurant premises and restaurants vary greatly in appearance and offerings which include a wide variety of cuisines and service models. To receive regular patronage, restaurants have also gone beyond just serving tasty and nutritious dishes to providing additional services such as music, games and other forms of entertainments, all geared towards meeting the demands of the consuming public. Other measures such as cleanliness, mode of service and operations, advertisements, location and accessibility, creativity in using indigenous materials for construction are used as forms of baits to attract consumers [4]. In Western countries, most restaurants serve alcoholic beverages such as beer, wine and light beer. Some restaurants serve all the major meals, such as breakfast, lunch, and dinner (restaurants like: fast food chains, diners, hotel restaurants, and airport restaurants). Other restaurants may only serve a single meal (like pancake) or they may serve two meals (lunch and dinner) or even a kids' meal [5]. Restaurants are classified or distinguished in many different ways. The primary factors are usually the food itself (like vegetarian, seafood, steak); the cuisine (for example, Italian, Chinese, Japanese, Indian, French, Mexican, Thai) or the style of offering (tapas bar, a sushi train, a taster restaurant, a buffet restaurant or a yum cha restaurant).Beyond this, restaurants may differentiate themselves on factors including speed, formality, location, cost, service, or novelty themes (such as automated restaurants).

Albeit, probability distributions can be viewed as a tool for dealing with uncertainty which can be used as a distribution to perform specific calculations, and apply the results to make well-grounded decisions. It is a description of a random phenomenon in terms of the probabilities of events [6]. However, if an inappropriate distribution (the one that does not fit to data well) is being selected and applied, the subsequent calculation will be incorrect, and that will certainly result in wrong decisions. Distribution fitting allow the development of valid models of random processes to protect against potential time and money loss which can arise due to invalid model selection, and enable better decisions making. Among the most important probability distributions are (i) Binomial distribution; this distribution models the number of successes in successive trials, where the trials are independent from each other and there is a common success probability, (ii) Poisson distribution; this distribution is used to model arrival processes in fixed time intervals where arrivals are independent. Thus, this distribution can be used to model arrivals of customers at a counter, or arrivals of printer jobs at the printer queue, (iii) Exponential distribution; the

exponential distribution models time between independent events. A typical use of this distribution is the time between arrivals at a counter. If arrivals are modelled by the Poisson distribution then inter-arrivals are modelled by the exponential distribution, (iv) Normal distribution; this distribution is the most common distribution. It often models errors or processing time due to its symmetric character, (v) Weibull distribution; the Weibull distribution is often used to model time to-failure of systems or system components.

Arising from review of literature, it can be inferred that prolonged waiting for service is a common phenomenon for customers, and restaurants could lose their customers to competitor's door due to a long wait on the line. In this paper, in order to understudy the issues of long waiting time and queue length characterizing a restaurant food serving process, Input Analyzer of the ARENA simulation software was employed to determine the statistical distributions of a given set of data consisting of customers' inter-arrival and service times obtained from a named restaurant. By analyzing the aforementioned data, insight would be gained into customers' arrival patterns and service patterns, which are critical factors in determining customers' queue length and waiting time. Thus, baseline information can be inferred from statistical distributions of the analysed data which in no small measure could guide restaurant management in making well-grounded decisions towards quality of service and delivery.

2. LITERATURE REVIEW

2.1 Meaning of Fast Food

According to Ariyo, D. , Raimi, L. and Towobola, W. L. [7,8], the term "fast food" was first recognized by Merriam-Webster dictionary in 1951 and it was referred to as food that can be easily prepared and served very quickly in an outlet to consumers. It can be served directly from oven to table (sit-in) or presented in form of take-out packages or containers (take-away). Common fast food in outlets worldwide apart from drinks include pies, chips, fries, sandwiches, pizzas, noodles, chillis, salads, potatoes, rice, ice-cream, coffee, candies, hamburgers, fish, beef, chicken, turkey, hot dogs and so on. Also, various sizes, types and kinds of outlets exist worldwide for the purpose of retailing fast foods. These range from carts, wagons, stands, kiosks to restaurants, and modern day fast food retail outlets, better known as Quick Service Restaurants (QSRs). Fast food ventures are foods which are located everywhere with round the clock services like in convenient shops, drives, filling stations, schools and cash points. Although, the concept of fast food retailing, also known as quick service restaurants evolved in Nigeria more than thirty five (35) years ago by United African Company of Nigeria (UAC), from the coffee shops of its Kingsway Departmental Stores, which later transformed into Kingsway Rendezvous, the organized fast food industry is fast emerging in the country. The industrial landscape has witnessed the influx of unprecedented numbers of fast food operators since the opening of the first fast food outlet in Nigeria, at Yaba, in 1986 by Mr. Biggs, a subsidiary of UAC Nigeria Plc. At present, there are over one hundred and fifty (150) brand names in the country. Also, the Southwestern Nigeria alone now boast of about 500 outlets, of different sizes, which could be classified as standardized eateries, established by corporate individuals and organizations [9].

2.2 The Concept of the Modern Fast Food

The concept of the modern fast food could be traced to the take-out food services popularized by the then automats restaurants, which flourished greatly in the United State of America (U.S.A) during and after the First World War. Similarly, as automobiles became popular during this period; drive-in restaurants (later known as drive-through) were introduced. The second White castle hamburger restaurant founded in 1921 in Wichita, Kansas was regarded as the first fast food chain in America. Today the U.S.A has the largest fast food industry in the world with locations in over 100 countries. The United Kingdom (U.K.) is also credited with the highest number of fast food per person, followed by Australia and the U.S.A. In 2008, England alone accounted for twenty five percent (25%) of all fast food in the world [10].

The modern fast food industry is highly commercialized and characterized by various pre-formulated procedures and food preparation methods usually set up with the intention of minimizing production cost and delivery time. Greater emphasis is always placed on ensuring certain level of flavour and quality consistency of products and quick services as expected by customers [11]. Various variants of cuisines and dishes are popularized by fast food restaurants across the globe. While pizza is widely known in the U.S., sushi is common in Japan, Kebab; fish and chips are popular fast foods in Europe,

Australia and New Zealand. It is noteworthy that the business of fast food retailing is fast spreading and striving globally with numerous fast food ventures located all over the world [12].

2.3 Nigerian Fast Food Industry

Food production industry is one of the manufacturing sectors that contribute to the development of a nation [13,14]. According to the Association of Fast Food and Confectioners of Nigeria (AFFCON), the Nigerian fast food industry is healthy and currently worth about one hundred and ninety billion naira with the potential to grow bigger. Due to the socio-cultural background of the various ethnic settlements of the country, the Nigerian formal fast food industry operates amidst its more active informal counterpart, which is characterized by unregistered indigenous operators also providing restaurant services to the populace. But, the fast food industry is quick in changing the existing pattern by distinguishing itself into an organized structure providing healthy, modern and local menus, with class, status and taste attached to it [7,8,15].

Although the list of new restaurants increases daily in Nigeria, as earlier mentioned, only seven fast food owner operators are dominating the industry with less than 50% share of the total industry market as at 2007. There are other numerous indigenous QSRs holding its way in Lagos, Abuja, Ibadan, Port-Harcourt and other urban locations, namely Sweet Sensation, Chicken Lovers, Chicken Licking, Mama Cass, Captain Cook, Chicken Palace, Spices, etc. providing varieties of Africana and continental cuisines to teeming customers. The presence of international brands such as Nandos, Steers and St. Elmos is also felt in the industry. At present, there are about one hundred (100) brand names in the industry. Some big established outlets now offer franchise opportunities and arrangements for willing individual investors and entrepreneurs to own and operate fast food businesses with their brand names. Through these arrangements and others, it is planned that more restaurants will be opened in due course to meet the ever-yearning desires of Nigerians for an ideal fast food industry in the country [7,8]. Furthermore, the fast food industry in Nigeria is modelled after McDonald's and dominated by indigenous entrepreneurs. According to [11], their sizes range from small, medium and big outlets. Mostly, the smaller ones are established by individual investors, while the few bigger ones are owned by corporate organizations.

2.4 Customer Satisfaction

Customer satisfaction is an important aspect of business which determines the business worth as well as its growth because it can lead business to either profit or loss. It is not necessarily every time customer will be satisfied with the product because there is variation in satisfactory level of individual customers [16]. According to [17], customer satisfaction becomes the most important part in every business field because satisfaction of customer will provide the necessary profit to the industry. Basically, customer's satisfaction means customers prediction about ones product after the use of a specific product and how they evaluate such product in single manner and compare with the competitors' products. The customer satisfaction is customer's evaluation of goods and services in term of customer's requirements or whether it dissatisfies customer's needs and wants. [18] defined customer's satisfaction as the customer's evaluation of goods and services in terms of whether it is according to the customer's needs. Customers could be dissatisfied with the product, services or dissatisfied with the performance of the services rendered. Sometime customers are more satisfied if products performance is beyond their expectations. If product and services do not meet the customer's satisfactory level, then they can be dissatisfied with the overall performance. So for the food variable, it involves the price, quality, and value of money. For the service variable, it includes the staff quality, behavior, and attitude and for the restaurants it also involves the decoration and atmospheric condition. Customer satisfaction is the performance of the product or services which are providing at a specific time or on that time when customers are using it [19].

2.5 Queue/Waiting Line

Customers waiting to receive service from server are represented by queue and are also called waiting lines. Unsatisfied customer due to long waiting line can be a potential loss to any service organization because such customer will prefer to go to competitors' door rather than waiting endlessly on the queue. Queue or waiting lines is brought about in a situation where the demand for a service facility is higher than the capacity of such facility. This can either mean that customers are not served immediately upon request but have to wait for the facility, or the service facilities stand idle or wait for the arrival of customers when the total number of customers is higher than the number of service

facilities. Any time there is more customer demand for a service that can be provided then a waiting line occurs. Customers can either be animate or inanimate objects that wait for service to occur. Examples of objects that must wait in lines include a machine waiting for repair, a customer order waiting to be processed, subassemblies in a manufacturing plant (that is, work-in-process inventory), electronic messages on the Internet, and ships or railcars waiting for unloading. Waiting lines occur at a fast-food restaurant during peak meal times each day when there is demand that cannot be quickly handled with the available capacity. In an effort to speed up delivery, some restaurants use an extra window where the first window is used for paying and the second window for picking up the food. Queues have been a major problem causing dissatisfaction in restaurant and service organization at large and it usually result in unnecessary delay which consequently results to service ineffectiveness [20].

3. MATERIALS AND METHODS

In this paper, the research approach being employed includes description of the case study as well as data collection and analysis. In order to determine customers' arrival patterns and service patterns which are critical factors in determining customers' queue length and waiting time for a given restaurant, food serving process employed at a named International Institute Restaurant (IIR), Ibadan, Nigeria, was used as a case study.

3.1 Description of the Case Study

The food serving process of IIR was considered in this study. The IIR has a total number of eight (8) servers with distribution of two servers per one customer in each serving point. The food serving process at IIR is designed such that the first server collects meal ticket and commences service for customer while the second server ends service for the same customer. The restaurant opens from 11:30am to 1:30pm between Monday and Friday in order to provide the necessary services needed by the customers and servers are responsible for serving food ordered by the customers. Customers arrive randomly at the restaurant and approach the serving point, joining the queue to request for food; each customer will be attended to when the server is available to receive the order. The flowchart representing the food serving process at IIR is shown in Fig. 1.

Customers represent the entity in the system and each has a unique characteristic with two attributes: first is the arrival time which is the time each customer arrives, gain entrance into the restaurant and begins to wait for service. The second is the time that the customer leaves the queue and start to receive servers' attention. Time attribute was used for determining the arrival time, waiting time and service time for each customer. An important activity taken into consideration is the queue associated with every customer. A queue activity occurred when the flow of customer was suspended for an unspecific period of time. A customer had to wait for the server to be free if all the servers are busy at the time customer arrives and that account for the queue. There were four queues and eight servers with two servers attached to each queue in the restaurant. The logic activity in the restaurant is the decision whether to attend to customer or reject customer in the system and this was determined based on the time the customer arrive at the restaurant because the operation time of the restaurant is between 11:30am and 1:30 pm.

Servers are resources of the restaurant and they were shared by customers. An incoming customer is free to approach any of the four terminals in order to wait for busy server for placing the order. After a customer had been attended to, the customer leaves the queue and the server is free to attend to the next customers on the queue.

3.2 Data Collection

The data being used to determine the customers' arrival patterns and service patterns for the restaurant food serving processes in this paper were collected primarily by direct observation from a named International Institute Restaurant (IIR), Ibadan, Nigeria. The data collected include a number of customers and their arrival time into the restaurant as well as their start and end of service time for five working days (Monday, Tuesday, Wednesday, Thursday and Friday) between the hours of 11:30 am and 1:30pm. All data were collected in minutes and converted to seconds. The analysis of service times was generated through the start of service time and end of service time for each customer and the aggregate value was generated through ARENA. The IIR was used as a case study owing to the fact that the acquisition for the current study was guaranteed.

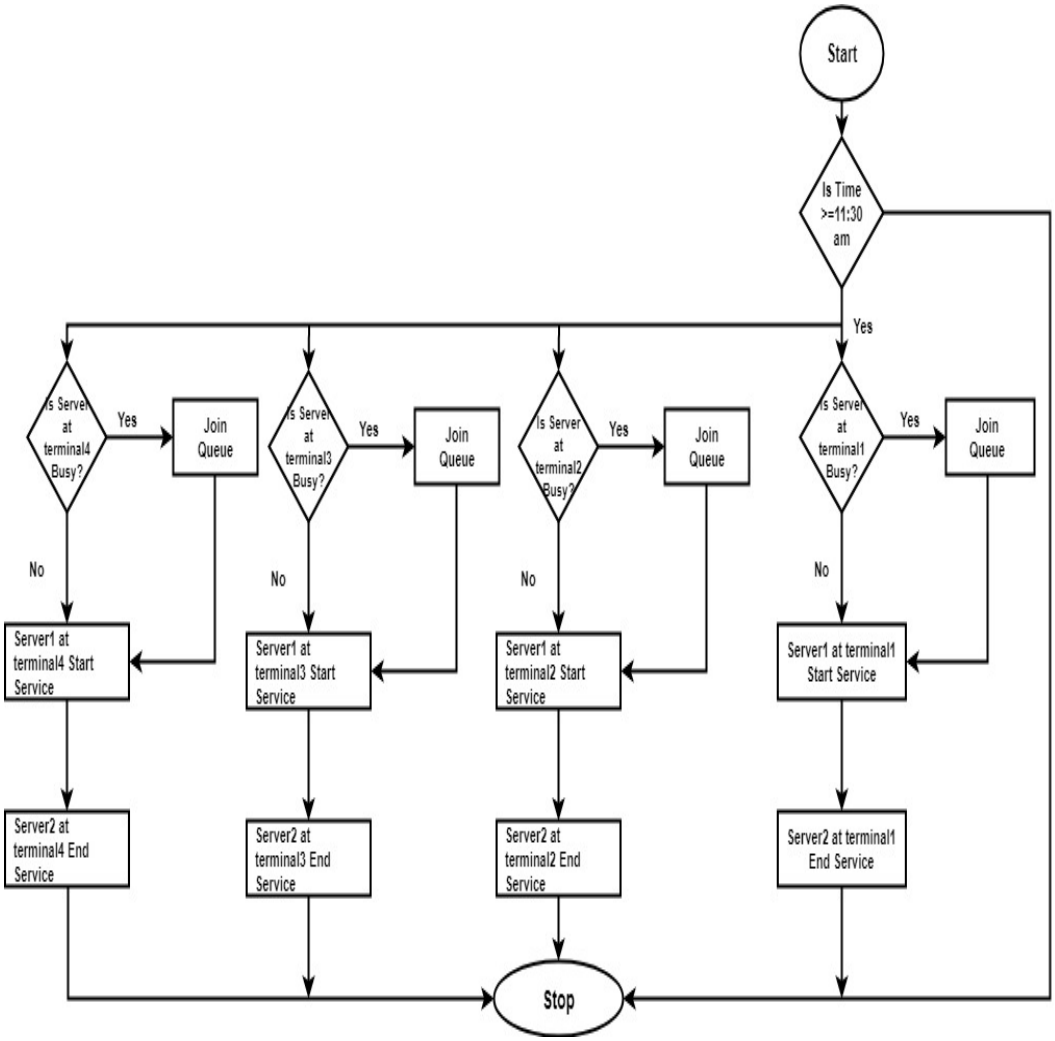

Fig. 1. Flowchart of food serving process at IIR

3.3 Data Analysis for Determination of Customers' Arrival Patterns and Service Patterns

In this paper, data analysis was carried out to determine customers' arrival patterns and service patterns using Input Analyzer. Input Analyzer is employed because it is a powerful and versatile tool in the Arena software environment that can be efficiently utilized to determine the quality of fit of probability distribution functions to input data. It can also be used to fit specific distribution functions to a data file to allow users to compare distribution functions or to display the effects of changes in parameters for the same distribution. Besides, the Input Analyzer can generate sets of random data that can then be analyzed using the software's distribution-fitting features. Here, in order to determine the probability distribution of the acquired data, the Input Analyzer was used to analyze the service times and the inter-arrival times of customers entering the IIR to eat for the five working days (Monday, Tuesday, Wednesday, Thursday and Friday). The Input Analyzer could easily allow users to enter the collected raw data and obtain the probability distribution that such data follows. That is, it can be utilized to identify the probability distribution that best represents a data set.

To run the Input Analyzer, the Input Analyzer command was selected from the Tools menu in Arena. After entering the required information (collected data), data file was generated by clicking a *Generate* button. To analyze the characteristics of data contained in a data file, we attached the data file to window (data fit window) and used the Input Analyzer menus to perform

distribution fitting operations. In the data fit window, information about the data file was displayed beneath a histogram that represents the values in the data file. The information includes the data type, the number of data points, the number of intervals, the histogram range, the sample mean, the sample standard deviation, and the minimum and maximum data values. After this, the next step was to fit a probability distribution function to the data. To do this, the Fit menu item was first selected and a drop-down menu displayed all the available distribution functions. This was followed by selecting the desired probability distribution function. The Input Analyzer thereafter determined the parameters that would fit the distribution function to the data. As soon as the curve-fitting calculations were completed, the resulting probability density function was drawn on top of the histogram. In addition to all of the distributions supported by Arena, the Fit drop-down menu includes a Fit All option. Choosing this option caused all of the applicable distribution functions to be fitted to the data. The distributions were then sorted, from best to worst, based upon the values of the respective square errors. The function resulting in the best fit would then be displayed on the screen, superimposed over the histogram of the data.

4. RESULTS AND DISCUSSION

4.1 Results Obtained From Data Analysis –Arrival Patterns

After data analysis, the results obtained (the inter arrival time statistical distributions of customers entering the restaurant on Monday, Tuesday, Wednesday, Thursday and Friday) from the ARENA Input Analyzer are presented in Table 1. As shown in Table 1, the generated results of the data analysis revealed that the arrival patterns of customers who patronized the IIR on Monday and Tuesday followed a Beta distribution with associated expressions-0.001+170*BETA(0.444, 2.43) and -0.5+77*BETA(0.619,1.91), respectively. Similarly, arrival patterns of customers on Wednesday and Thursday assumed a Weibull distribution with associated expressions -0.001+WEIB(10.04, 0.461) and -0.001+WEIB(15.9, 0.391), respectively. Erlang distribution with associated expression -0.001+ERLA(23.2, 1) was obtained in respect of arrival patterns of customers who patronized the IIR on Friday. The graphical representations of the obtained inter arrival time statistical distributions of customers entering the restaurant on Monday, Tuesday, Wednesday, Thursday and Friday are as depicted in Figs. 2, 3, 4, 5 and 6, respectively.

The graphical representations consist of histogram generated from collected data sets (inter arrival times) and the equivalent probability density function (pdf) of the histograms that best represents inter arrival times of each of the considered working days. A tool that is very useful in finding out whether a set of values fits some theoretical existing probability distribution is a histogram (a graph showing frequency of each value in the considered dataset). The shape of the pdf (blue curve drawn on top of the histogram) showing in Fig. 2 represents the customers' arrival time on Monday which followed a Beta distribution with shape parameters β=0.444 and α=2.43. Similarly, the shape of the pdf showing in Fig. 3 represents the customers' arrival time on Tuesday which assumed a Beta distribution with shape parameters β=0.619 and α=1.91.The shapes of the pdf showing in Fig. 4 and Fig. 5 represent the customers' arrival times on Wednesday and Thursday, respectively. Customers' arrival time on Wednesday followed a Weibull distribution with a scale parameter β=10.4 and a shape parameter α=0.461 while that of Thursday also followed a Weibull distribution with a scale parameter β=15.9 and a shape parameter α=0.391. Furthermore, the shape of the pdf showing in Fig. 6 represents the customers' arrival time on Friday. Customers' arrival time on Friday followed an Erlang distribution having the mean of each of the component exponential distributions (β=23.2) and the number of exponential random variables (k=1) as distribution parameters.

Table 1. Statistical distribution of customers' inter arrival time from Monday to Friday

Day	Distributions	Expression/Time(seconds)
Monday	Beta	-0.001+170*BETA(0.444,2.43)
Tuesday	Beta	-0.5+77*BETA(0.619,1.91)
Wednesday	Weibull	-0.001+WEIB(10.4, 0.461)
Thursday	Weibull	-0.001+WEIB(15.9, 0.391)
Friday	Erlang	-0.001+ERLA(23.2, 1)

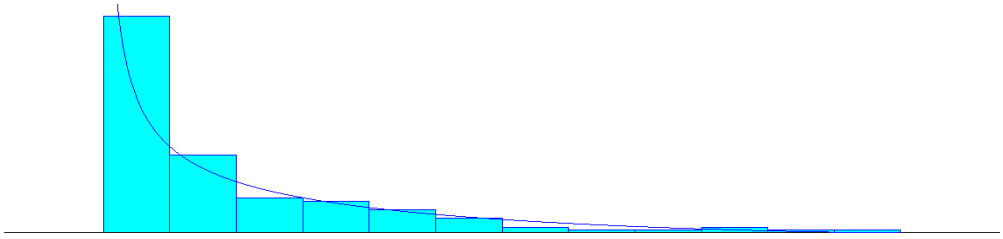

Fig. 2. Histogram and the equivalent pdf that best represents customers' arrival time on Monday

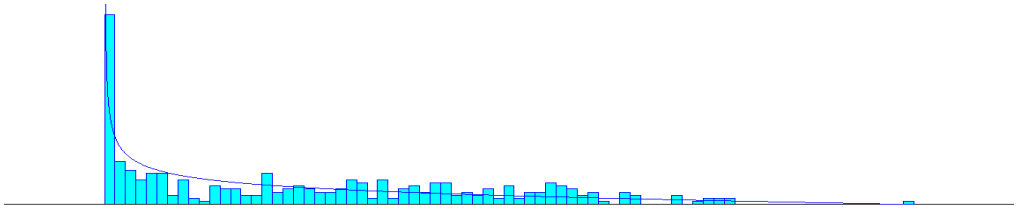

Fig. 3. Histogram and the equivalent pdf that best represents customers' arrival time on Tuesday

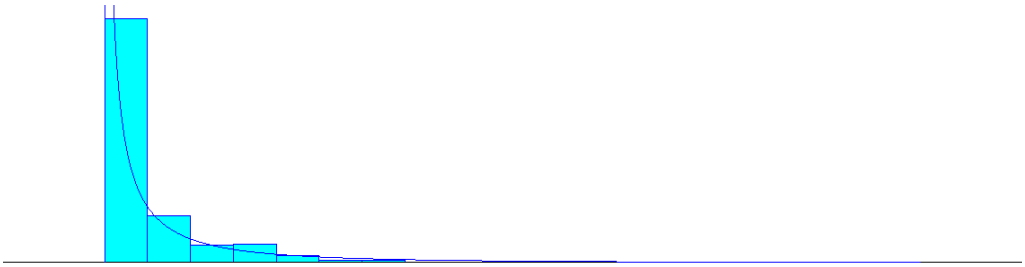

Fig. 4. Histogram and the equivalent pdf that best represents customers' arrival time on Wednesday

Fig. 5. Histogram and the equivalent pdf that best represents customers' arrival time on Thursday

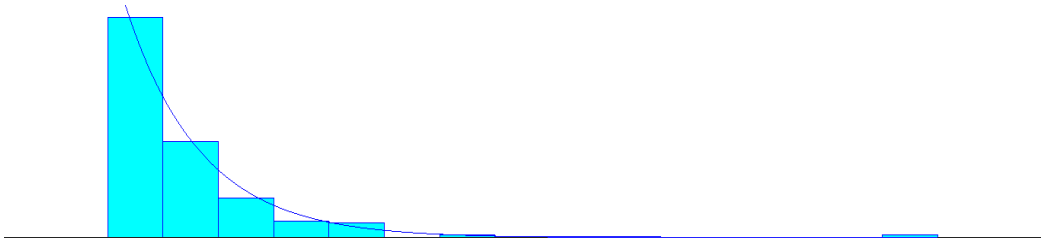

Fig. 6. Histogram and the equivalent pdf that best represents customers' arrival time on Friday

4.2 Results Obtained From Data Analysis – Service Patterns

After data analysis, the results obtained (the service time statistical distributions in respect of customers served at IIR on Monday, Tuesday, Wednesday, Thursday and Friday) from the ARENA Input Analyzer are presented in Table 2. As shown in Table 2, the results of the data analysis revealed that the service times at IIR on Monday and Tuesday followed a Lognormal distribution with associated expressions 6+LOGN(13.6,18.7) and 4.4+LOGN(8.8,3.78), respectively. Similarly, Beta, Lognormal, and Weibull distributions with associated expressions 7+119*BETA(0.69,14.3), 11.5+LOGN(4.36,2.46) and 6+WEIB(13.6,0.965) were obtained in respect of service times characterizing the IIR on Wednesday, Thursday and Friday, respectively. The equivalent graphical representations of the service time statistical distributions of customers served on Monday, Tuesday, Wednesday, Thursday and Friday are as depicted in Figs. 7, 8, 9, 10 and 11, respectively.

The shapes of the pdf showing in Fig. 7 and Fig. 8 represent the customers' service times on Monday and Tuesday, respectively. Customers' service time on Monday followed a Lognormal distribution with parameters LogMean μ=13.6 and LogStd σ=18.7while that of Tuesday also followed a Weibull distribution with parameters LogMean μ=8.8and LogStd σ=3.78.Similarly, the shape of the pdf showing in Fig. 9 represents the customers' service time on Wednesday which assumed a Beta distribution with shape parameters β=0.679and α=14.3. Furthermore, the shape of the pdf showing in Fig. 10 represents the customers' service time on Thursday which followed Lognormal distribution with parameters LogMean μ=4.36and LogStd σ=2.46. The shape of the pdf showing in Fig. 11 represents the customers' service time on Friday. Customers' service time on Friday followed a Weibull distribution with a scale parameter β=13.6 and a shape parameter α=0.965.

Table 2. Statistical distribution of customers service time from Monday to Friday

Day	Distributions	Expression/Time(seconds)
Monday	Lognormal	6 + LOGN(13.6, 18.7)
Tuesday	Lognormal	4.5 + LOGN(8.8, 3.78)
Wednesday	Beta	7 + 119*BETA(0.679,14.3)
Thursday	Lognormal	11.5+LOGN(4.36, 2.46)
Friday	Weibull	6 + WEIB (13.6, 0.965)

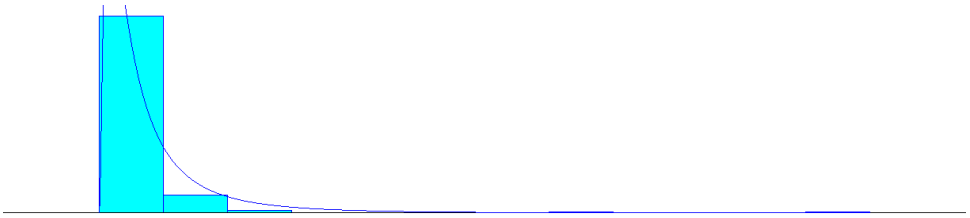

Fig. 7. Histogram and the equivalent pdf that best represents customers' service time on Monday

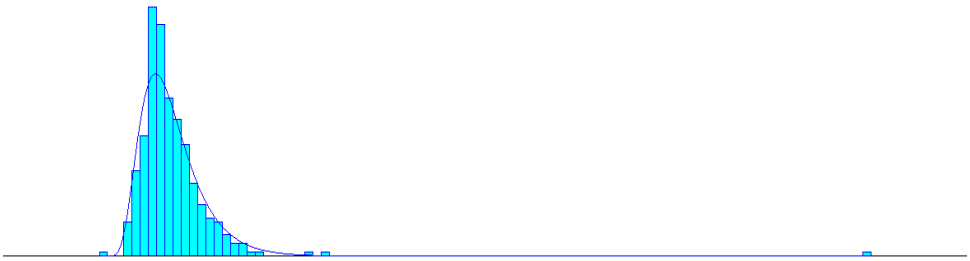

Fig. 8. Histogram and the equivalent pdf that best represents customers' service time on Tuesday

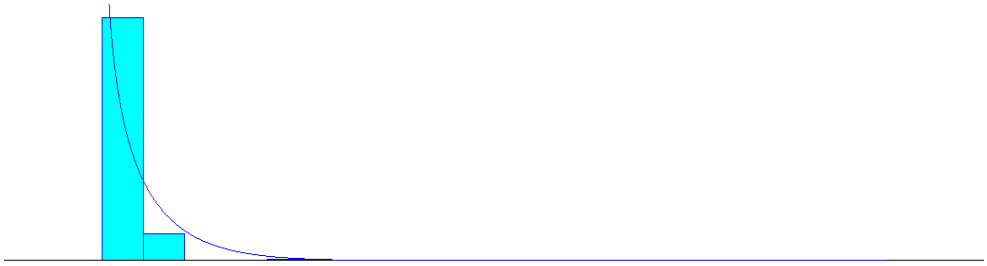

Fig. 9. Histogram and the equivalent pdf that best represents customers' service time on Wednesday

Fig. 10. Histogram and the equivalent pdf that best represents customers' service time on Thursday

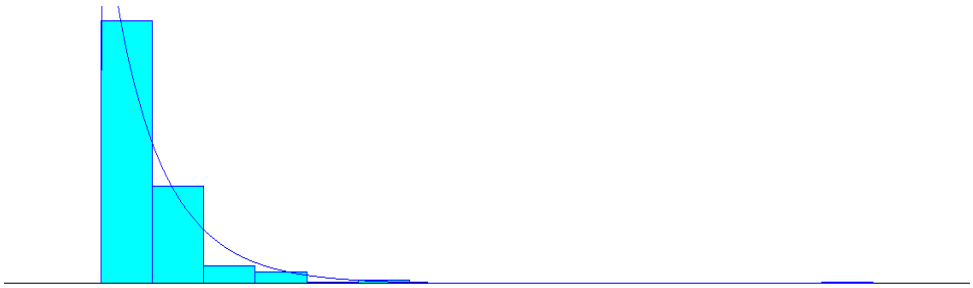

Fig. 11. Histogram and the equivalent pdf that best represents customers' service time on Friday

It is pertinent to note in this paper that all the histograms and probability distribution functions (Figs. 2–11) were captured from the ARENA Input Analyzer. Thus, Figs. 2–11 were presented as automatically captured from the ARENA software, and this accounted for our inability to label x-axis and y-axis of each of the graphs in line with the conventional practice. Also, all distribution parameters for each curve were captured from the ARENA Input Analyzer by choosing the Window menu option and clicking on *Curve Fit Summary*.

5. CONCLUSION

Food restaurant business is very competitive and requires that the service be well managed in order to avoid incessant long waiting time which may not only lead to customers' dissatisfactions but also facilitate loosing of customers to other competitors. In this paper, we have acquired a preliminary data involving inter-arrival and service times from a named restaurant which is characterized by multiple servers that collectively serve each customer on queue. We analyzed the data in order to determine customers' arrival patterns and service patterns which are critical factors in determining customers' queue length and waiting time. We have shown that the customers' arrival patterns and service patterns during five working days (Monday, Tuesday, Wednesday, Thursday and Friday) in a week could assume different statistical/probability distributions ranging from Beta, Lognormal,

Weibull and Erlang distributions. It is obvious that the probability distributions obtained from data analysis carried out in this study could be utilized to make well-grounded managerial decisions. Precisely, the results could assist restaurant management in gaining more insights into customers' arrival patterns and service patterns as baseline information for a high quality of service delivery in the considered restaurant or other related systems.

Future research will be geared towards development of an executable model which could be utilized to study and manage problems of over-crowding during restaurant peak hours using the customers' arrival patterns and service patterns being obtained for the restaurant under study as input parameters for model development.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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