

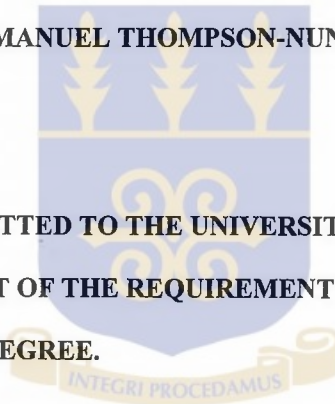
UNIVERSITY OF GHANA

DEPARTMENT OF STATISTICS

**THE APPLICATION OF QUEUING THEORY TO CUSTOMER SERVICE AT
SELECTED BRANCHES OF THE STANDARD CHARTERED BANK GHANA
LIMITED.**

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**THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN
PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF
M. PHIL STATISTICS DEGREE.**



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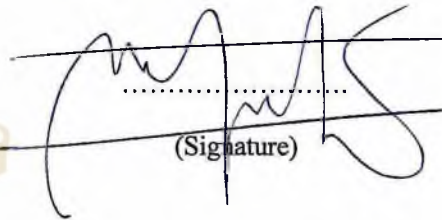
DECLARATION

This thesis was carried out at the Department of Statistics, University of Ghana, Legon under the Supervision of Professor Samuel Isaac Kwesi Odoom.

It is hereby declared that with the exception of other people's work, which has been duly acknowledged, no part of this work has been presented in this or any other University for any other degree.

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ABSTRACT

This thesis investigates the Application of Queuing theory to customer services at selected branches of the Standard Chartered Bank in Accra.

The problem investigated was to determine among other things whether the customer service points of the bank functions well without bottlenecks or undue delays. That is this thesis intends to investigate,

- (a) If the bank current system of operation at the customer service points is satisfactory.
- (b) If not what changes are required to improve the mode of operation at the service points of the bank.

The methodology employed was to collect data from the customers arriving at the service points of the bank. Customers arriving at the service points of the bank are given identification or trial numbers such as 1, 2, 3 etc in the order of their arrival. Their clock time of arrival, beginning of service and at the end of service are observed for each customer at a duration of at least three(3) hours for three days for the selected branches under study.

The data was analyzed by preparing an elaborate worksheet using Microsoft Excel. This would depict the state changes for any arriving customer during the period of observation.

A summarized relative frequency distribution was also depicted for the inter arrival and service times. This would enable the researcher to know the proportion of customers whose inter arrival and service times fall within a certain category for each day of observation. This would help determine in what ways the queues differ from day to day and, possibly from one branch to another.

The results obtained indicate that a customer spends a minimum of thirty (30) minutes at the service points of the bank. Hence the conclusions that follow indicates that very few cash booths are opened to serve customers at the various hours of the day at the service points of the selected branches of the bank investigated.

Consequently, excessive long queues are observed at the service points of the selected branches of the bank. This means that the current demand for service at the selected branches of the bank exceeds the current capacity to provide that service.

Hence, cashiers at the cash booths of the selected branches of the Standard Bank, Ghana Limited spend most of their times serving customers at the service points of the bank.

To improve the mode of operation, an additional teller window should be opened to serve customers at the service points of the bank at various hours of the day. This would reduce the burden on the cashiers and enhance efficient customer service delivery.

DEDICATION

This work is first of all dedicated to the almighty God for given me the wisdom, knowledge, power and understanding to complete the work successfully in spite of all difficulties.

Secondly, I dedicate this to my loving mum Miss Victoria Yarteley Quaye for supporting me both financially and spiritually throughout my educational carrier.

I, also dedicate this work to my uncles and aunties for their elderly advice they accorded to me, most especially to Mr. Benjamin Quaye, Mr. Seth Quaye and Miss Lydia Quaye.

The last but not the least dedication goes to all my cousins and friends for their love, care, prayers and wonderful thought they shared with me.

ACKNOWLEDGEMENT

A project work of this nature could not have been successfully completed without the assistance from different people in diverse ways. In this vein, I am greatly indebted to my main Supervisor, Professor S. I. K. Odoom of the Department of Statistics, University of Ghana, Legon for his meticulous supervision, resourceful suggestions, co-operation, patience and support through out the period of this research.

My sincere gratitude also goes to Dr. F. K. Atsem, Dr. I. G. Akar and Mrs. M. E. Danso-Manu all of the Department of Statistics for their support and encouragement that enabled me complete the study.

Special thanks goes to Mr. Mills-Robertson and Mr. Kofi Gameli all of the Marketing Division Standard Chartered Bank Ghana Limited, High Street Branch for making it possible for me to collect data at the selected branches of the bank for the study.

I owe a debt of gratitude to the selected branch Managers whose cooperation and relevant information has contributed to the success of this study.

Finally, my sincere thanks go to Mr. Emmanuel Thompson-Nunoofio for the neat presentation of Secretarial work and his dedicated service.

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CHAPTER ONE

INTRODUCTION

1.0 Background of Study

Queuing Theory had its beginning in the research work of a Danish engineer named A.K. Erlang. In 1909, Erlang experimented with fluctuating demand in telephone traffic. Eight years later he published a report addressing the delays in automatic dialing equipment. At the end of World War II, Erlang's early work was extended to more general problems and to business applications of waiting lines.

The study of waiting lines or queues, called queuing theory is one of the oldest and most widely used quantitative analysis techniques. Waiting lines are an everyday occurrence, affecting people shopping for groceries, buying gasoline or petrol, making a bank deposit, or waiting on the telephone for the first available airline reservationists to answer. Queues, may also take the form of machines waiting to be repaired, trucks in line to be unloaded, or airplanes lined up on a runway waiting for permission to take off. The three basic components of a queuing process are arrivals, service facilities, and the actual waiting line.

1.1 **Statement of the problem**

The flow of people or items through a system often results in the formation of a queue or waiting lines. The formation of waiting line is, of course, a common phenomenon that occurs whenever the current demand for service exceeds the current capacity to provide that service. Decisions regarding the amount of capacity to provide must be made frequently in banks, industry and elsewhere.

However, because it is often impossible to predict accurately when units will arrive to seek service and/or how much time will be required to provide that service, these decisions often are difficult ones. Providing too much service involves excessive costs.

On the other hand, not providing enough service capacity causes the waiting line or queues to become excessively long at times. Excessive waiting also is expensive in some sense, whether it be a social cost, the cost of lost customers, the cost of idle employees or some other important cost. Therefore, the ultimate goal is to achieve an economic balance between the cost of service and the cost associated with waiting for that service.



Thus this thesis intends to investigate how long customers spend waiting in queue, their service time and the idle time of cashiers at the service points of the Standard Chartered Bank in Accra.

1.2 **Objective of the Study**

The objective of this study is to apply Queuing theory to customer service at the selected branches of Standard Chartered Bank in Accra. The specific objective that this research intends to study is to determine among other things whether the customer service points of the bank functions well, without bottlenecks or undue delays. For example, the following questions would be addressed at the end of the study.

- a) Is the bank current system of operation at the customer service points satisfactory?
- b) If not what changes are required to improve the mode of operation at the service points of the bank.

1.3 **Importance of the Study**

The significance or importance of the research problem is to help the management of the bank to make an efficient decision. That is to say, the banks must decide how many teller windows to keep open to serve customers during various hours of the day at the service points.

1.4 **Methods of Investigation**

The researcher collected data from the customers arriving at the service points of the bank by observing the clock time at arrival, clock time at beginning of service and clock time at the end of service for each customer at duration of at least three hours for three days for the selected branches of the bank. The days, dates and times that the data was collected was subjected to discussions with the selected Branch managers since they would be in the position to tell the times when there are excessive queues. The reason for collecting the data for the three days was to enable the researcher to find out what happens on randomly selected days. This would help the researcher to obtain sufficient data to compute the necessary estimates such as the average customer waiting time, average service time, and idle time of cashiers during the various days of observation. The days and times that the data was collected for the selected branches are as follows:

Tudu Branch	Tuesday March 7, 2000,	9:25am – 12:09pm
	Wednesday March 8, 2000	8:30am – 12:25pm
	Friday March 10, 2000	8:56am – 11:58am
Ring Road Branch	Monday March 13, 2000,	11:15am – 2:15pm
	Wednesday March 15, 2000	8:30am – 2:15pm
	Friday March 17, 2000	8:30am – 12:10pm
Opeibea House Branch	Monday March 20, 2000,	9:00am – 12:00pm
	Wednesday March 22, 2000	8:35am – 12:07pm
	Friday March 24, 2000	8:30am – 12:05pm
Legon Branch	Tuesday March 28, 2000,	8:30am – 12:03pm
	Wednesday March 29, 2000	8:30am – 11:02am
	Friday March 31, 2000.	8:30am – 11:35am

1.5 Methods of Analysis

The data will be analyzed by preparing an elaborate worksheet using Microsoft Excel. This would depict the state changes for any arriving customer during the period of observation. Again, a summarized relative frequency distribution would be depicted for the inter arrival times as well as the service times. This would help the researcher to know the proportion of customers whose inter arrival and service times fall within a certain category for each day of observation. The reasons for doing this was to help the researcher to examine in what ways the queues differ from day to day and, possible, from one branch to another.

CHAPTER TWO

LITERATURE REVIEW

2.0 A Brief Review of Applications of Queuing Theory

As already outlined in the introduction, the flow of people or items through a system often results in the formation of a queue. Whilst we are familiar with human queues, non-human ones occur all around us in the movement of documents, stock, vehicles and raw materials.

Knowledge of where queues occur in a system is of obvious benefit to the manager. It is often necessary to have the formation of queues in mind when designing a system. For instance, an architect must assess how many checkouts to install in a supermarket or how large the Lorry Park of a warehouse should be.

Every queue has three distinguishing characteristics namely arrival patterns, service mechanism and the actual waiting line. We now turn to some applications of birth and death processes in queuing theory.

2.1 Birth and Death Processes

Queues are examples of Birth and Death processes and therefore the properties of Birth and Death processes are applicable.

The Birth and Death process is a mathematical model that is appropriate for modeling changes in the size of a population.

Now, let A_r be the state of the process when the number of customers in the bank is r . It is important to note that the process mentioned above refers to the arrival in and departure of customers from the bank.

We further assume that a transition from state A_r to state A_{r+1} will signify the arrival of a customer into the bank, whereas a transition from state A_r to state A_{r-1} will denote the departure of customers from the bank.

In addition, we consider changes in size of the population where transitions from state A_r take place to the nearest neighbours only.

We suppose further that λ_r and Θ_r be the arrival and service rates respectively when the number of customers at the bank is r . Also, let $P_r(t)$ be the probability that the number of customers at the bank at time t is r . Then in an interval of length Δt , it follows that the assumptions of the birth and death process is applicable. That is we assume that in an interval of length Δt :

A1: Probability that exactly one arrival occurs in the interval $(t, t + \Delta t)$ given that the number of customers at the bank is $r = \lambda_r \Delta t + o(\Delta t)$.

A2: Probability that exactly one departure occurs in the interval $(t, t + \Delta t)$ given that the number of customers at the bank is $r = \Theta_r \Delta t + o(\Delta t)$.

A3: Probability that no arrival occurs in the interval $(t, t + \Delta t)$ given that the number of customers at the bank is $r = 1 - \lambda_r \Delta t + o(\Delta t)$.

A4: Probability that no departure occurs in the interval $(t, t + \Delta t)$ given that the number of customers at the bank is $r = 1 - \Theta_r \Delta t + o(\Delta t)$.

It follows from these assumptions that multiple arrivals, multiple departures, or both an arrival and a departure in a small time interval (Δt) say are prohibited in the sense that each event is negligible.

It follows from Kleinrock L. (1974), Feller W. Vol (II) (1966), Khinchin A.J (1960), Hoel P.G., Port S. C. & Stone C. J.(1994) that:

$$\begin{aligned} P_r(t+\Delta t) &= P_r(t) P_{rr}(\Delta t) + P_{r-1}(t) P_{r-1,r}(\Delta t) + P_{r+1}(t) P_{r+1,r}(\Delta t) + o(\Delta t), r \geq 0 \quad (1) \\ &= P_r(t) \{ [1 - \lambda_r \Delta t + o(\Delta t)] \{1 - \Theta_r \Delta t + o(\Delta t)\} + P_{r-1}(t) [\lambda_r \Delta t + o(\Delta t)] \\ &\quad + P_{r+1}(t) \{ \Theta_{r+1} \Delta t + o(\Delta t) \} + o(\Delta t), r \geq 0 \end{aligned}$$

Re-arranging and taking limits as $\Delta t \rightarrow 0$ gives:

$$\frac{d}{dt} P_r(t) = -(\lambda_r + \Theta_r) P_r(t) + \lambda_{r-1} P_{r-1}(t) + \Theta_{r+1} P_{r+1}(t), r \geq 0 \quad (2)$$

The set of equations obtained in (2) is clearly a set of differential – difference equations and represents the dynamics of our probability system. We will be interested in the equilibrium solutions of equation (2).

Now define $P_r = \lim_{t \rightarrow \infty} P_r(t)$

where P_r is interpreted as the limiting probability that the bank contains r customers at some arbitrary time in the distant future. It is important to understand that whereas P_r (assuming it exists) is no longer a function of t , we are not claiming that the process does not move from state to state in this limiting case; certainly the number of customers at the bank will change with time, but the long run probability of finding the bank with r customers will be properly described by P_r .

Now, for t infinitely large, i.e. as $t \rightarrow \infty$

$d/dt P_r(t) = 0$. Thus (2) now becomes

$$\lambda_{r-1} P_{r-1} - \Theta_r P_r = \lambda_r P_r - \Theta_{r+1} P_{r+1}, r \geq 0 \quad (3)$$

$$\text{Now, let } h_r = \lambda_r P_r - \Theta_{r+1} P_{r+1} \quad (4)$$

Then, it follows from (3) that:

$$h_{r-1} = h_r \quad (5)$$

Clearly, equation (5) implies that:

$$h_r = \text{constant with respect to } r.$$

However, since $\lambda_{-1} = \Theta_0 = 0$, it follows from (4) that $h_{-1} = 0$ and so that constant in (5) must be zero.

Therefore setting $h_r = 0$, we obtain from (4) that:

$$P_{r+1} = \frac{\lambda_r}{\Theta_{r+1}} P_r, r = 0, 1, 2, \dots \quad (6)$$

Thus, it follows from the Principle of Mathematical induction that the general solution of equation (6) is of the form

$$P_r = \frac{\lambda_0 \lambda_1 \dots \lambda_{r-1}}{\Theta_1 \Theta_2 \dots \Theta_r} P_0 \quad (7)$$

It is important to note that the sequence $\{\lambda_r/\Theta_r\}$ remains below unity from some r onwards, i.e. if there exist some r_0 such that for all $r \geq r_0$ we have

$$\lambda_r / \Theta_r < 1 \quad (8)$$

2.2 THE ARRIVAL PATTERN

There are three main arrival patterns. They are:

- (i) Random arrivals
- (ii) Regular arrivals
- (iii) General Independent arrivals.

(i) **Random Arrivals**

The simplest arrival pattern mathematically and the most commonly useful one in applications is when the arrivals are random. The mathematical model employed for random arrivals according to Parzen E. (1962), Bharucha – Reid (1960), Cohen J. (1969), and Markov A. A. (1907) is

$$P_r(t) = \frac{(\lambda t)^r}{r!} \exp - \lambda t, r = 0, 1, 2, \dots \quad (9)$$

This is called the Poisson distribution. It follows from Ross S. (1984), Hogg R.V and Cragg A. T. (1978) that the mean and variance of (9) are both λt .

It is sometimes useful instead to consider the distribution of the interval between successive arrivals. This can be obtained by putting $r = 0$ into (9) and taking its complement. That is

$$1 - P_0(t) = 1 - \exp - \lambda t \quad (10)$$

Since $0! = 1$. If we put $A(t) = 1 - P_0(t)$, then, it follows that $A(t)$ is the distribution function of the exponential distribution.

That is:
$$A(t) = 1 - \exp - \lambda t \quad (11)$$

Consequently, it follows immediately by differentiating with respect to t that the probability density function $a(t)$ of the exponential distribution is given by:

$$a(t) = \frac{d}{dt} A(t) = \lambda \exp - \lambda t, \lambda > 0, t > 0 \quad (12)$$

$$= 0, t \leq 0$$

It is important to note that if $A(t)$ corresponds to the discrete distribution concentrated at α (α constant), then we have case (ii) regular arrivals. If in a particular mathematical analysis we take the inter-arrival to be independent with a general distribution function $A(t)$ we say that the arrivals have the general independent form.

2.3. The Service Mechanism

In the previous section we discussed the arrival of customers at the service points of the bank. We now turn to the servicing operation. There are three aspects of this that need description.

They are:

- (i) The length of time taken to serve an individual customer, the service time.
- (ii) The maximum number of customers that can be served at any time that is service capacity.
- (iii) The service availability.

(i) The Distribution of Service Time

(a) Exponential Service-Time

A great mathematical simplification results if we can reasonably assume the probability density function (p.d.f) of service-time by the exponential curve as stated in (12) that is:

$$f(t) = \lambda \exp - \lambda t, \lambda > 0, t > 0$$

$$= 0, \quad t \leq 0$$

Now, if the random variable t is a service time, then at the point of positive probability:

$$P(t \geq t_0) = 1 - P(t < t_0) = \exp - \lambda t_0 \quad (13).$$

(ii) Service Capacity

The next aspect of service for discussion is the capacity, the maximum number of customers that can be served at a time. The case most commonly discussed in published mathematical work is when the capacity is one and m respectively, where m is an integer. A detailed description of the above can be found in Hillier F.S. and Lieberman G.J. (1967), Kleinrock L. (1974) and Parzen E. (1962).

(iii) **Service Availability**

There are many possibilities here and it does not seem practicable to cover them in any systematic way. In cases when the number of service is one, we have to specify the frequency and duration of the server's absence; these may be independent of the congestion at the service points of the bank. For example, six (6) minutes absence at the end of every hour may be dependent on the congestion, for example, absence 10 percent of the time, periods of absence being begun only when there are no customers for service.

In either type of situation we must, for mathematical purposes, specify the statistical nature of the non-availability of service fairly precisely before calculation can be made; this sometimes causes difficulty in applications in that, say, the time distribution of servers absence is determined largely by personal whim and cannot be represented in a rigid mathematical scheme.

2.4. Queue Disciplines

The final element in the description of a congestion system is the queue discipline which specifies how customers are to be selected for service from the pool of customers who has arrived at the queuing point. The mathematical models developed for essentially the same queuing structure may differ, depending on the discipline that applies.

The most common queue discipline is a physical First In, First Out (FIFO) discipline where customers receive service in the order of their arrival. Banks, retail establishment and public service agencies usually employ this system.

CHAPTER THREE

CHARACTERISTICS OF STANDARD QUEUES

3.0 Types of Queues

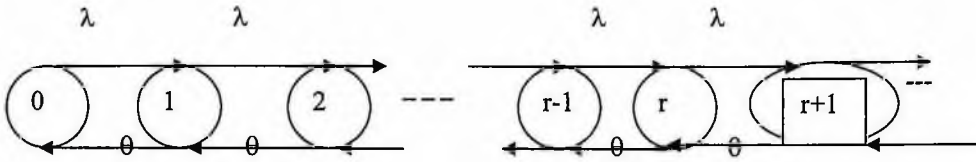
This chapter would examine the type of queues that is applicable to the thesis topic. This would help the researcher to derive theoretical estimates such as the average queue length, the average waiting time of customers etc. It is worth noting that, most of the commercial banks operate multi-server queues, however, the researcher would examine the classical queuing system since that is the basis of any queue.

3.1 M / M / 1 : The classical Queuing System

M / M / 1 is the single-server queuing system with markovian inter-arrival time and service time distributions. It is the simplest non-trivial interesting system and may be described by selecting the arrival and service coefficients as follows:

We choose $\lambda_r = \lambda$, $r = 0, 1, 2, \dots$ and $\theta_r = \theta$, $r = 1, 2, \dots$

That is, we set all arrival coefficients equal to a constant λ and all service coefficients to a constant θ . We further assume that infinite queuing space is provided and that customers are served in a first-come-first-served fashion although this last condition is not necessary for many of our results. For this important example the state transition-rate diagram is as given below.

FIG 3.1**State-transition-rate diagram for M / M / 1.**

If we put $\lambda_r = \lambda$ and $\theta_r = \theta$ in (7) then:

$$P_r = P_0 \prod_{i=0}^{r-1} \lambda / \theta = P_0 (\lambda / \theta)^r, \quad r = 0, 1, 2, \dots \quad (14).$$

Summing (14) from $r = 0$ to infinity gives:

$$\sum_{r=0}^{\infty} P_r = P_0 \sum_{r=0}^{\infty} (\lambda / \theta)^r$$

$$\text{Or, } 1 / P_0 = \sum_{r=0}^{\infty} (\lambda / \theta)^r \quad (15).$$

Thus, the right hand side of (15) will converge IFF $\lambda / \theta < 1$.

Therefore, the necessary and sufficient condition for ergodicity in the M / M / 1

queue is simply $\lambda < \theta$. Thus, it follows from (15) that:

$$P_0 = 1 - \lambda / \theta, \quad \lambda < \theta.$$

Therefore, equation (14) now reads on substitution as

$$P_r = (1 - \lambda / \theta)(\lambda / \theta)^r, \quad r = 0, 1, 2, \dots$$

$$= (1 - \rho)\rho^r, \quad r = 0, 1, 2, \dots \quad (16).$$

Where $\rho = \lambda / \theta$ is called the server utilization factor or traffic intensity. We therefore require that $0 \leq \rho < 1$ which insures that $P_0 > 0$ for stability conditions.

We note that (16) is indeed the solution for the steady-state probability of finding r customers at the service points of the bank and that P_r depends on λ and θ through their ratio ρ . Clearly, (16) is the geometric distribution, which shares the fundamental memory less property with the exponential distribution. Now let $E(N)$ be the expected number of customers at the service points of the bank. Then by definition:

$$E(N) = \sum_{r=0}^{\infty} r P_r$$

where $P_r = (1 - \rho)\rho^r$, $r = 0, 1, 2, 3 \dots$

$$\text{Therefore, } E(N) = (1 - \rho)\rho \sum_{r=0}^{\infty} r \rho^{r-1}$$

Since $d/d\rho \rho^r = r \rho^{r-1}$, it follows from Stephenson G. (1974) that

$$E(N) = (1 - \rho)\rho \sum_{r=0}^{\infty} d/d\rho \rho^r$$

Assuming uniform convergence we have:

$$E(N) = (1 - \rho)\rho d/d\rho \sum_{r=0}^{\infty} \rho^r$$

$$E(N) = \lambda / \theta - \lambda, \theta > \lambda. \quad (17).$$

According to the published works of Little J. D. C. (1961), Jewell W. S. (1967), Eilon S. (1969) and Stidham S. (1974):



$$E(N) = \lambda T \quad (18).$$

Where λ is the average arrival rate of customers at the service points of the bank and T is the average time spent in the system. Thus, it follows from (18) that,

$$T = E(N) / \lambda = (\theta - \lambda)^{-1} = [\theta (1 - \rho)]^{-1} \quad (19).$$

This dependence of average time on the traffic intensity or on the utilization factor ρ is shown below. The value obtained by T when $\rho = 0$ is exactly the average service time expected by a customer; that is, he / she spends no time in queue and $1 / \theta$ seconds in service on the average.

The behavior given by (17) and (19) is rather dramatic. As ρ approaches or tends to unity, both the number of customers at the service points of the bank and the average time spent at the service points of the bank move in an unbounded fashion.

Both these quantities have a simple pole at $\rho = 1$. This type of behavior with respect to ρ as ρ approach unity is a characteristic of almost every queuing system one can encounter.

FIG 3.2

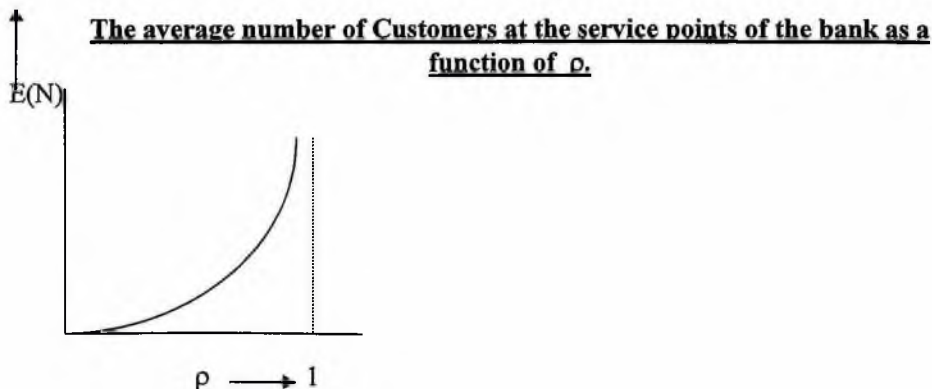
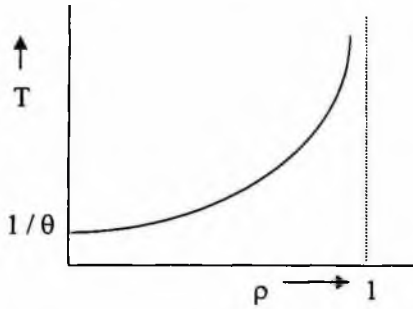


FIG 3.3
Average delay as a function of ρ for M/M/1.



Let $E(q_L)$ be the expected queue length. Then by definition according to Hillier F. S. & Lieberman G. J. (1967), Feller W. Vol II (1966):

$$E(q_L) = \sum_{r=1}^{\infty} (r-1)P_r = \sum_{r=1}^{\infty} r P_r - \sum_{r=1}^{\infty} P_r$$

$$= E(N) - (1 - P_0)$$

$$\text{Since } E(N) = \sum_{r=1}^{\infty} r P_r \text{ and } \sum_{r=0}^{\infty} P_r = 1.$$

Therefore, $E(q_L) = E(N) - \lambda / \theta = \lambda / (\theta - \lambda) - \lambda / \theta$, since $\rho = \lambda / \theta = 1 - P_0$

and $E(N) = \lambda / (\theta - \lambda)$. Thus, it follows that:

$$E(q_L) = \lambda^2 / \theta(\theta - \lambda) \quad (20).$$

And hence the expected waiting time $E(w_q)$ in queue excluding service time for each individual customer is given by:

$$E(w_q) = E(q_L) / \lambda = \lambda / \theta(\theta - \lambda) \quad (21).$$

Which also follows directly from Little's formula that is $\lambda E(w_q) = E(q_L)$.

where the symbols have their usual meanings.

Another, important property of the queuing system is the probability of finding at least r members in the system. That is,

$$\begin{aligned} P[\text{at least } r \text{ customers in system}] &= \sum_{i=r}^{\infty} P_i \\ &= (1-\rho) \sum_{i=r}^{\infty} \rho^i = \rho^r = (\lambda / \theta)^r \quad (22). \end{aligned}$$

Consequently, we see that the probability of exceeding some limit on the number of customers in the system is a geometrically decreasing function of that number and decays very rapidly.

3.2 Discouraged Arrivals

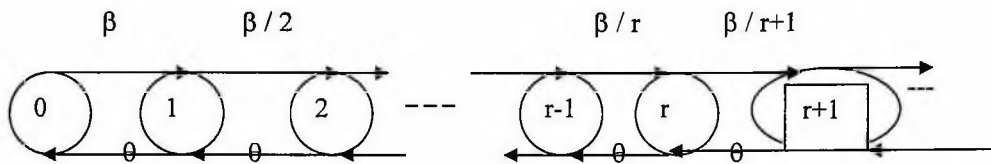
This example considers a case where arrivals tend to get discouraged when more and more people are present in the system. One possible way to model this effect is to choose the arrival rate and service rate coefficients as follows: i.e.

$$\lambda_r = \beta / r + 1 \quad , r = 0, 1, 2, \dots \quad \text{and}$$

$$\theta_r = \theta \quad , r = 1, 2, 3, \dots$$

Here, we are assuming a harmonic discouragement of arrivals with respect to the number present in the system. The state- transition-rate diagram in this case is as shown below.

FIG 3.4



State-transition-rate diagram for discouraged arrivals.

It follows from (7) that:

$$P_r = P_0 \prod_{i=0}^{r-1} \beta / (i+1)\theta = \frac{P_0 (\beta / \theta)^r}{r!} \tag{23}.$$

Summing (23) from $r = 0$ to infinity to get:

$$1 = \sum P_r = P_0 \sum (\beta / \theta)^r / r! = P_0 \exp \beta / \theta.$$

Therefore, $P_0 = \exp -\beta / \theta$ (24).

Consequently, the service utilization factor or the traffic intensity is given by

$$\rho = 1 - P_0 = 1 - \exp -\beta / \theta \tag{25}.$$

We note that the ergodic condition here is merely $\beta / \theta < \infty$. Thus, it follows that

(23) now reads:

$$P_r = \frac{(\beta / \theta)^r \exp -\beta / \theta}{r!} , r = 0, 1, 2, \dots \tag{26}.$$

Therefore, the number of customers in the system of discouraged arrivals have a Poisson distribution with parameter β / θ .

It follows immediately from (26) that the average number of customers at the service points of the bank for discouraged arrivals is given by:

$$E(N) = \beta / \theta. \quad (27).$$

And hence, it follows from Little's results that the average time spent at the service points of the bank becomes:

$$T = E(N) / \lambda = \beta / \lambda \theta.$$

Where $\lambda = \theta \rho = \theta(1 - P_0) = \theta(1 - \exp-\beta / \theta)$.

$$\text{Therefore, } T = \beta / \theta^2 (1 - \exp-\beta / \theta). \quad (28).$$

And so, $E(q_L) = E(N) - (1 - P_0)$

$$= E(N) - (1 - \exp-\beta / \theta).$$

$$= \beta / \theta - (1 - \exp-\beta / \theta) = (\beta - \lambda) / \theta \quad (29).$$

Since $\lambda / \theta = (1 - \exp-\beta / \theta)$.

Also, $E(w_q) = E(q_L) / \lambda$

$$= \frac{\beta / \theta - (1 - \exp-\beta / \theta)}{\theta (1 - \exp-\beta / \theta)}$$

$$= \beta / \theta^2 (1 - \exp-\beta / \theta) - 1 / \theta$$

$$= T - 1 / \theta \quad (30).$$

Since $T = \beta / \theta^2 (1 - \exp-\beta / \theta)$ from (28). Similarly,

$$\begin{aligned} P[\text{at least } r \text{ customers in system}] &= \sum_{i=r}^{\infty} P_i \\ &= 1 - \sum_{i=0}^{r-1} P_i \end{aligned}$$

$$= 1 - \exp -\beta / \theta \sum_{i=0}^{r-1} (\beta / \theta)^i / i! \tag{31}.$$

3.3 M/M/∞: Responsive Servers (Infinite Number of Servers)

Here we consider the case that may be interpreted either as that of a responsive server who accelerates her service rate linearly, when more customers are waiting or may be interpreted as the case where there is always a new clerk or server available for each arriving customer.

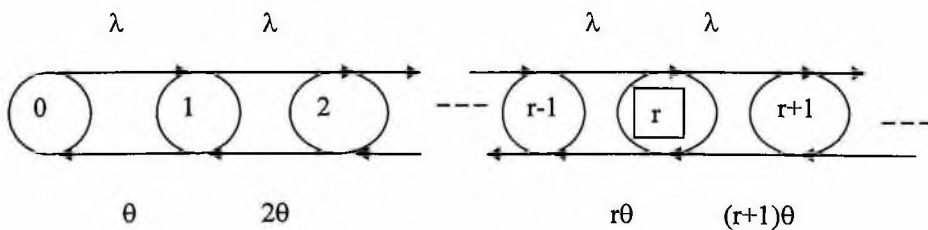
In this case we choose the arrival rate as follows:

$$\lambda_r = \lambda , r = 0, 1, 2, \dots$$

$$\theta_r = r \theta , r = 1, 2, 3, \dots$$

Here the state-transition-diagram is shown below.

FIG 3.5



State-transition-rate diagram for the infinite-Server case.

It turns out that:

$$P_r = P_0 \prod_{i=0}^{r-1} \lambda / (i+1)\theta = \frac{(\lambda / \theta)^r \exp(-\lambda / \theta)}{r!}, \quad r = 0, 1, 2, \dots \quad (32).$$

From (7) and (8). Here too, the ergodic condition is simply $\lambda / \theta < \infty$.

$$\text{Consequently, it follows that: } E(N) = \lambda / \theta. \quad (33).$$

$$\text{And hence, } T = E(N) / \lambda = 1 / \theta. \quad (34).$$

$$\begin{aligned} \text{Also, } E(q_L) &= E(N) - (1 - P_0) \\ &= \lambda / \theta - (1 - \exp(-\lambda / \theta)) \\ &= 0 \end{aligned}$$

Since $\lambda = \theta(1 - \exp(-\lambda / \theta))$. Thus, it follows that, $E(w_q) = E(q_L) / \lambda = 0$.

That is, the expected queue length and the expected waiting time in queue excluding Service time for each individual customer are zero. Hence there is no queue and no waiting time in queue. Similarly,

$$P[\geq r \text{ customers in system}] = 1 - \exp(-\lambda / \theta) \sum_{i=0}^{r-1} \rho^i / i! \quad (35).$$

Here too, the ergodic condition is simply $\lambda / \theta < \infty$. We therefore conclude from (34) that if each arriving customer is granted his own server, then his time in system will be merely his service time which clearly equals $1 / \theta$ on the average.

3.4 M / M / S : The S- Server Case

Here again we consider a system with an unlimited waiting room and with a constant arrival rate λ . The system provides for a maximum of S-Servers. This is within the reach of our birth-death formulation and leads to:

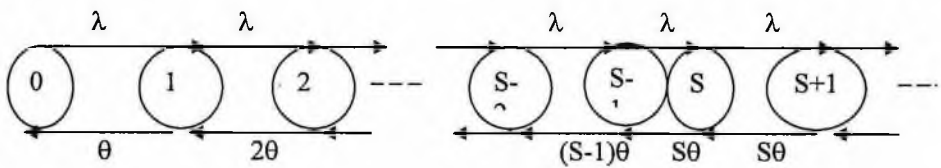
$$\lambda_r = \lambda, r = 0, 1, 2, \dots \text{ and } \theta_r = \min[r\theta, s\theta] = r\theta, 0 \leq r \leq s$$

$$= s\theta \quad s \leq r.$$

It follows from (17) that the condition for ergodicity is $\lambda / s\theta < 1$.

The state- transition-rate diagram is shown below.

FIG 3.6



State-transition-rate diagram for M / M / S.

Solving for P_r from (7) we find that we separate the solution into two parts according to Parzen E. (1962), Khinchin A. J. (1960) and Feller W. Vol II (1966) since the dependence of θ_r upon r is in two parts. Thus, for $r \leq s$,

$$\begin{aligned}
 P_r &= P_0 \prod_{i=0}^{r-1} \lambda / (i + 1)\theta \\
 &= \frac{P_0 (\lambda / \theta)^r}{r!}
 \end{aligned}
 \tag{33}$$

Similarly, for $r \geq s$,

$$\begin{aligned}
 P_r &= P_0 \prod_{i=0}^{r-1} \lambda / (i+1)\theta \prod_{j=s}^r \lambda / s\theta \\
 &= \frac{P_0 (\lambda / \theta)^r}{s! s^{r-s}}
 \end{aligned} \tag{34}$$

It follows from (33) and (34) that:

$$\begin{aligned}
 P_r &= P_0 (s\rho)^r / r! , \quad 0 \leq r \leq s \\
 &= P_0 \rho^r s^s / s! , \quad r \geq s
 \end{aligned} \tag{35}$$

$$\text{Where } \rho = \lambda / s\theta < 1 \tag{36}$$

We note from (36) that ρ is defined as the expected fraction of busy servers. Now solving for P_0 from (7) gives:

$$P_0 = [1 + \sum_{r=1}^{s-1} (s\rho)^r / r! + \sum_{r=s}^{\infty} (s\rho)^r / r! (s^{r-s})]^{-1}$$

and so:

$$P_0 = 1 / \left[\sum_{r=1}^{s-1} (s\rho)^r / r! + (s\rho)^s (1-\rho)^{-1} / s! \right] \tag{37}$$

The probability that an arriving customer is forced to join the queue is given by

$$P[\text{queuing}] = \sum_{r=s}^{\infty} P_r = P_0 \sum_{r=s}^{\infty} (s\rho)^r / s! s^{r-s}$$

$$\text{Consequently, } P[\text{queuing}] = \frac{(s\rho)^s (1-\rho)^{-1} / s!}{\sum_{r=1}^{s-1} (s\rho)^r / r! + (s\rho)^s (1-\rho)^{-1} / s!} \tag{38}$$

(38) above is referred to as Erlang's C formula and is often denoted by $C(m, \lambda / \theta)$ according to Leonard Kleinrock (1974). This gives the probability that no server is available for an arriving customer in a system of S servers.

Recall from (35) that the probability of finding r customers is given by

$$P_r = P_0 (s\rho)^r / r! , 0 \leq r \leq s$$

$$= P_0 \rho^r s^s / s! , r \geq s$$

where $\rho = \lambda / s\theta < 1$.

Now, let $E(q_L)$ be the expected queue length. Then:

$$\begin{aligned} E(q_L) &= \sum_{r=s}^{\infty} (r-s)P_r \\ &= \sum_{i=0}^{\infty} i P_{s+i} \end{aligned}$$

On putting $i = r-s$. Also, for $r \geq s$, $P_r = P_0 \rho^r s^s / s!$. Therefore,

$$P_{s+i} = \frac{P_0 (s\rho)^s}{s!} \sum_{i=0}^{\infty} i \rho^i$$

$$P_{s+i} = \frac{P_0 (s\rho)^s}{s!} \rho \sum_{i=0}^{\infty} i \rho^{i-1}$$

Since $d/d\rho \rho^i = i\rho^{i-1}$, it follows that:

$$E(q_L) = \frac{P_0 (s\rho)^s}{s!} \rho \sum_{i=0}^{\infty} d/d\rho \rho^i$$

Now, assuming uniform convergence, we have from Stephenson G. (1974) that:

$$E(q_L) = \frac{P_0 (s\rho)^s}{s!} \rho d/d\rho \sum_{i=0}^{\infty} \rho^i$$

$$= \frac{P_0 (s\rho)^s}{s!} \rho \frac{d}{d\rho} [1 - \rho]^{-1}, \rho < 1. \text{ That is,}$$

$$E(q_L) = \frac{P_0 (s\rho)^s}{s! (1 - \rho)^2} \rho \quad (39).$$

Thus, it follows that the expected waiting time in queue is given by:

$$E(q_L) = \frac{P_0 (s\rho)^s}{s! (1 - \rho)^2} (1 / s \theta) \quad (40).$$

where the symbols have their usual meanings.

Also the expected number of customers in the system is given by,

$$E(N) = \lambda [E(w_q) + 1 / \theta] = E(q_L) + \lambda / \theta \quad (41).$$

And the average time T spent in the system is given by,

$$T = E(w_q) + 1 / \theta \quad (42).$$

Hence, the various estimates for the case when we have 2 servers that is when $s = 2$ can be deduced from (39), (40), (41) and (42).

CHAPTER FOUR

DATA ANALYSIS

4.0 Analysis.

The data was analyzed by summarizing the inter arrival and service times into a frequency distribution table. This was done by finding a ratio of the number of times an outcome occurs to the total number of customers observed. This would enable the researcher to know the proportion of customers whose inter arrival and service times fall within a certain category. Cumulative frequencies would also be obtained from the relative frequencies and depicted in the summarized frequency table for each day of observation. This would help the researcher to visualize what happens on randomly selected days.

In an attempt to find out how long the customers spend waiting in queue, the average arrival and service rates, the idle time of cashiers etc, the following approach would be adopted according to Render B. & Stair R. M. Jr. (1982):

1. estimated mean arrival rate = number of customers / total time between arrival
2. estimated mean service rate = number of customers / total service time
3. estimated mean customer waiting time = total waiting time / number of customers



4. estimated mean customer time spent in the bank = (total service time + total waiting time) / number of customers.
5. estimated number of customers waiting = total waiting time / elapsed time
6. estimated mean number of customers in the bank = (total service time + total waiting time) / elapsed time.
7. estimated server utilization factor = $\frac{\text{estimated mean arrival rate}}{S * (\text{estimated mean service rate})}$

Where S is the number of servers.

4.1 Data Analysis at the Tudu Branch of the Standard Bank

The Relative frequency distribution for the Time between arrival and Service times on Tuesday March 7, 2000 is as given below.

Tuesday March 7, 2000

Time Between Arrival / min(s)	Relative Frequency	Cummulative Frequency
0	0.38	0.38
1	0.36	0.74
2	0.15	0.89
3	0.05	0.94
4	0.02	0.96
5	0.02	0.98
At least 6	0.02	1.00

Service Time / min(s)	Relative Frequency	Cummulative Frequency
0	0.01	0.01
1	0.15	0.16
2	0.18	0.34
3	0.18	0.52
4	0.12	0.64
5	0.17	0.81
<i>At least 6</i>	0.19	1.00

The Relative frequency distribution for the time between arrival and service time on Wednesday March 8, 2000 is as given below.

Wednesday March 8, 2000

Time Between Arrival / min(s)	Relative Frequency	Cummulative Frequency
0	0.33	0.33
1	0.24	0.57
2	0.13	0.70
3	0.08	0.78
4	0.08	0.86
5	0.07	0.93
<i>At least 6</i>	0.07	1.00

Service Time / min(s)	Relative Frequency	Cummulative Frequency
0	0.03	0.03
1	0.17	0.20
2	0.15	0.35
3	0.16	0.51
4	0.10	0.61
5	0.08	0.69
<i>At least 6</i>	0.31	1.00

The Relative frequency distribution for the Time between arrival and Service time on Friday March 10, 2000 is as given below.

Friday March 10, 2000

Time Between Arrival / min(s)	Relative Frequency	Cummulative Frequency
0	0.40	0.40
1	0.31	0.71
2	0.13	0.84
3	0.10	0.94
4	0.04	0.98
5	0.01	0.99
<i>At least 6</i>	0.01	1.00

Service Time / min(s)	Relative Frequency	Cummulative Frequency
0	0.00	0.00
1	0.10	0.10
2	0.36	0.46
3	0.22	0.68
4	0.14	0.82
5	0.08	0.90
<i>At least 6</i>	0.10	1.00

It follows immediately from Table 1 and section 4.1 that the estimated mean arrival and service rates for the three days period are 0.92 & 0.24, 0.47 & 0.18 and 0.85 & 0.29 customers per minute for Tuesdays, Wednesdays and Fridays respectively.

It can also be deduced from Table 1 and section 4.1 that the average customer time spent at the service points of the bank during the three days period are 16.39, 23.34 and 12.45 minutes respectively.

The number of servers at the above branch was four (4) for the period of observation; therefore the estimated server utilization factor or traffic intensity was 0.95, 0.63 and 0.73 respectively.

The average waiting time excluding service time and the average queue length for the Tudu Branch was 13minutes and 8 customers respectively.

4.2 Data Analysis at the Ring Road Central Branch of the Standard Bank.

The Relative frequency distribution for the Time between arrival and Service times for the stated periods is as given below.

Monday March 13, 2000

Time Between Arrival / min(s)	Relative Frequency	Cummulative Frequency
0	0.28	0.28
1	0.44	0.72
2	0.10	0.82
3	0.08	0.90
4	0.04	0.94
5	0.02	0.96
<i>At least 6</i>	0.04	1.00

Service Time / min(s)	Relative Frequency	Cummulative Frequency
0	0.02	0.02
1	0.20	0.22
2	0.27	0.49
3	0.27	0.76
4	0.05	0.81
5	0.06	0.87
<i>At least 6</i>	0.13	1.00

Wednesday March 15, 2000

Time Between Arrival / min(s)	Relative Frequency	Cummulative Frequency
0	0.27	0.27
1	0.36	0.63
2	0.20	0.83
3	0.08	0.91
4	0.03	0.94
5	0.04	0.98
<i>At least 6</i>	0.02	1.00

Service Time / min(s)	Relative Frequency	Cummulative Frequency
0	0.01	0.01
1	0.23	0.24
2	0.29	0.53
3	0.22	0.75
4	0.10	0.85
5	0.05	0.90
<i>At least 6</i>	0.10	1.00

Friday March 17, 2000

Time Between Arrival / min(s)	Relative Frequency	Cummulative Frequency
0	0.26	0.26
1	0.35	0.61
2	0.21	0.82
3	0.08	0.90
4	0.03	0.93
5	0.04	0.97
<i>At least 6</i>	0.03	1.00

Service Time / min(s)	Relative Frequency	Cumulative Frequency
0	0.01	0.01
1	0.23	0.24
2	0.28	0.52
3	0.22	0.74
4	0.11	0.85
5	0.05	0.90
<i>At least 6</i>	0.10	1.00

It can be inferred from Table 2 and section 4.1 that the estimated average arrival and service rates are 0.73 & 0.26, 0.68 & 0.33 and 0.75 & 0.26 customers per minute for the three days period.

It also follows immediately from Table 2 that the estimated average waiting time at the bank including service time are 14.31, 9.12 and 10.34 minutes on Mondays, Wednesdays and Fridays respectively.

The number of servers during the three days period was three (3), therefore it follows that the estimated server utilization factor are 0.94, 0.69 and 0.96 respectively.

The average waiting time excluding service time and the average queue length for the Ring Road Central Branch was 7 minutes and 5 customers respectively.

4.3 Data Analysis at the Opeibea House Branch of the Standard Bank.

The Relative frequency distribution for the Time between arrival and Service times for the stated periods is as given below

Monday March 20, 2000

Time Between Arrival / min(s)	Relative Frequency	Cummulative Frequency
0	0.43	0.43
1	0.37	0.80
2	0.14	0.94
3	0.01	0.95
4	0.03	0.98
5	0.01	0.99
<i>At least 6</i>	0.01	1.00

Service Time / min(s)	Relative Frequency	Cummulative Frequency
0	0.01	0.01
1	0.21	0.22
2	0.28	0.50
3	0.20	0.70
4	0.13	0.83
5	0.03	0.86
<i>At least 6</i>	0.14	1.00

Wednesday March 22, 2000

Time Between Arrival / min(s)	Relative Frequency	Cummulative Frequency
0	0.43	0.43
1	0.39	0.82
2	0.09	0.91
3	0.05	0.96
4	0.02	0.98
5	0.01	0.99
<i>At least 6</i>	0.01	1.00

Service Time / min(s)	Relative Frequency	Cummulative Frequency
0	0.01	0.01
1	0.21	0.22
2	0.26	0.48
3	0.24	0.72
4	0.08	0.80
5	0.10	0.90
<i>At least 6</i>	0.10	1.00

Friday March 24, 2000

Time Between Arrival / min(s)	Relative Frequency	Cummulative Frequency
0	0.46	0.46
1	0.41	0.87
2	0.08	0.95
3	0.02	0.97
4	0.01	0.98
5	0.01	0.99
<i>At least 6</i>	0.01	1.00

Service Time / min(s)	Relative Frequency	Cumulative Frequency
0	0.02	0.02
1	0.21	0.23
2	0.29	0.52
3	0.23	0.75
4	0.10	0.85
5	0.05	0.90
At least 6	0.10	1.00

It follows immediately from Table (3) that the estimated average arrival and service rates for the three days period are 1.06 & 0.28, 1.07 & 0.33 and 1.22 & 0.33 customer per minute respectively.

It can also be deduced from Table 3 that the estimated average waiting times at the service points of the Opeibea House branch was 9.38, 12.40 and 16.55 minutes respectively.

The number of servers during the period of observation was four (4) and hence it follows that the server utilization factor are 0.95, 0.81 and 0.92 respectively.

The average waiting time excluding the service time and the average queue length for the Opeibea House Branch was 9 minutes and 8 customers respectively.



4.4 Data Analysis at the Legon Branch of the Standard Bank.

The Relative frequency distribution for the Time between arrival and Service times for the stated periods is as given below.

Tuesday March 28, 2000

Time Between Arrival / min(s)	Relative Frequency	Cummulative Frequency
0	0.32	0.32
1	0.62	0.94
2	0.04	0.98
3	0.01	0.99
4	0.01	1.00
5	0.00	1.00
<i>At least 6</i>	0.00	1.00

Service Time / min(s)	Relative Frequency	Cummulative Frequency
0	0.00	0.00
1	0.35	0.35
2	0.39	0.74
3	0.14	0.88
4	0.07	0.95
5	0.01	0.96
<i>At least 6</i>	0.04	1.00

Wednesday March 29, 2000

Time Between Arrival / min(s)	Relative Frequency	Cummulative Frequency
0	0.44	0.44
1	0.55	0.99
2	0.01	1.00
3	0.00	1.00
4	0.00	1.00
5	0.00	1.00
<i>At least 6</i>	0.00	1.00

Service Time / min(s)	Relative Frequency	Cummulative Frequency
0	0.03	0.03
1	0.58	0.61
2	0.26	0.87
3	0.08	0.95
4	0.02	0.97
5	0.01	0.98
At least 6	0.02	1.00

Friday March 31, 2000

Time Between Arrival / min(s)	Relative Frequency	Cummulative Frequency
0	0.41	0.41
1	0.58	0.99
2	0.01	1.00
3	0.00	1.00
4	0.00	1.00
5	0.00	1.00
At least 6	0.00	1.00

Service Time / min(s)	Relative Frequency	Cumulative Frequency
0	0.04	0.04
1	0.56	0.60
2	0.27	0.87
3	0.08	0.95
4	0.02	0.97
5	0.02	0.99
<i>At least 6</i>	0.01	1.00

It follows from Table 4 that the estimated average arrival and service rates are 1.30 & 0.44, 1.74 & 0.64 and 1.67 & 0.62 customers per minute during the three days period respectively.

It can also be deduced from Table 4 that the estimated average waiting times at the service points of the Legon branch are 46.09, 32.33 and 34.38 minutes respectively.

The number of servers during the period was four (4), therefore it follows immediately that the server utilization factor for the period are 0.99, 0.91 and 0.90 respectively.

The average waiting time excluding the service time and the average queue length for the Legon Branch was 36 minutes and 38 customers respectively.

CHAPTER FIVE

FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.0 Tudu Branch

It follows from the summarized data that customers arrives at the service points of the above mentioned branch with an inter arrival time of at most five (5) minutes and a cumulative frequency of 0.98. This means that 98 per cent of the customers arrives with an inter arrival time of at most five (5) minutes.

The associated service time of the customers was also at most five (5) minutes and a cumulative frequency 0.81 on Tuesdays. This indicates that 81 per cent of the customers are served in at most five minutes. It follows from above that 19 per cent of customers are served in at least six (6) minutes. Out of the 19 per cent six (6) per cent of the customers are served in at least ten (10) minutes on Tuesdays. In addition, the average waiting time excluding service time and the average queue length was 12.27 minutes and 9 customers respectively.

On Wednesdays, customers arrives with an inter arrival time of at most five (5) minutes and a cumulative frequency of 0.93. This implies that 93 per cent of customers arrives at the service points with an inter arrival time of at most five (5) minutes.

The service time of customers was also at most five (5) minutes and a cumulative frequency of 0.69. This indicates that 69 per cent of the customers are served in at

most five (5) minutes. Thus, thirty-one (31) per cent of the customers are served in at least six (6) minutes. Out of this fourteen (14) per cent of the customers are served in at least ten (10) minutes. Furthermore, the average waiting time excluding service time and the average queue length for the day in question was 17.27 minutes and 7 customers respectively.

The Fridays was not different from what was observed on Tuesdays and Wednesdays except that the inter arrival and service times of at most five (5) minutes occurs with a cumulative frequencies of 0.99 and 0.90 respectively. This means that ten (10) per cent of the customers are served in at least six (6) minutes. Out of the above four (4) per cent of the customers are served in at least ten (10) minutes. The average waiting time in queue and the average queue length at any point in time was 9.00 minutes and 7 customers respectively.

Thus the average waiting time of customers excluding service time was 13 minutes while 17 minutes of customers time is spent waiting in queue and then receiving service at the Tudu Branch of the bank. It is important to note that the average queue length at the Tudu Branch at any point in time was 8 customers.

Thus on the average the service time of a customer was four (4) minutes. The number of servers at the above branch was four (4). Hence the server utilization factor or the traffic intensity was 0.78. This means that 78 per cent of the cashier's time is spent serving customers on Tuesdays, Wednesdays and Fridays. Therefore, the idle time of a cashier during the three hour period was forty (40) minutes on the average.

Consequently, it follows from the average waiting time, the service time and the



average queue length stated above that the mode of operation at the Tudu Branch was Satisfactory.

5.1 Ring Road Central Branch

It follows from the summarized data that customers arrives at the service points of the above mentioned branch with an inter arrival time of at most five (5) minutes and a cumulative frequency of 0.96. This means that 96 per cent of the customers arrives with an inter arrival time of at most five (5) minutes.

The associated service time of the customers was also at most five (5) minutes and a cumulative frequency of 0.87 on Mondays. This indicates that 87 per cent of the customers are served in at most five minutes. Therefore, thirteen (13) per cent of the customers are served in at least six (6) minutes. Out of the stated figure above seven (7) per cent of the customers are served in at least ten (10) minutes. The average waiting time excluding service time and the average queue length was 10.43 minutes and 6 customers respectively.

On Wednesdays, customers arrives with an inter arrival time of at most five (5) minutes and a cumulative frequency of 0.98. This implies that 98 per cent of customers arrives at the service points with an inter arrival time of at most five (5) minutes.

The service time of customers was also at most five (5) minutes and a cumulative frequency of 0.90. This indicates that 90 per cent of the customers are served in at most five (5) minutes. Thus, ten (10) per cent of the customers are served in at

least six (6) minutes. Out of the ten (10) per cent, four (4) per cent of the customers are served in at least ten (10) minutes. The average waiting time excluding service time and the average queue length was 5.65 minutes and 4 customers respectively.

The Fridays was not different from what was observed on Mondays and Wednesdays except that the inter arrival and service times of at most five (5) minutes occurs with a cumulative frequencies of 0.97 and 0.90 respectively. This means that ten (10) per cent of the customers are served in at least six (6) minutes. It follows from table 2 that five (5) per cent of the customers are served in at least ten (10) minutes. The average waiting time excluding service time and the average queue length at any point in time on Fridays was 6.15 minutes and 5 customers respectively.

The average waiting time of customers excluding service time was 8 minutes while 11 minutes of customers time is spent waiting in queue and then receiving service at the Ring Road Central Branch of the bank.

Thus on the average the service time of a customer was three (3) minutes. The number of servers at the above branch was three (3). Hence the server utilization factor or the traffic intensity was 0.86. This means that 86 per cent of the cashier's time is spent serving customers on Mondays, Wednesdays and Fridays. Therefore, the idle time of a cashier during the three hour period was twenty (20) minutes on the average. The average queue length at the Ring Road Central Branch was 5 customers at any point in time.

Consequently, it follows from the average waiting time, the service time and the average queue length stated above that the mode of operation at the Ring Road Central was satisfactory.

5.2 Opeibea House Branch

It follows from the summarized data that customers arrives at the service points of the above mentioned branch with an inter arrival time of at most five (5) minutes and a cumulative frequency of 0.99. This means that 99 per cent of the customers arrives with an inter arrival time of at most five (5) minutes.

The associated service time of the customers was also at most five (5) minutes and a cumulative frequency 0.86 on Mondays. This indicates that 87 per cent of the customers are served in at most five minutes. Thus, thirteen (13) per cent of the customers are served in at least six (6) minutes. Out of the percentage above, four (4) percent of the customers are served in at least ten (10) minutes. The average waiting excluding service time and the average queue length at any point time was 5.36 minutes and 4 customers respectively.

On Wednesdays, customers arrives with an inter arrival time of at most five (5) minutes and a cumulative frequency of 0.99. This implies that 99 per cent of customers arrives at the service points with an inter arrival time of at most five (5) minutes.

The service time of customers was also at most five (5) minutes and a cumulative frequency of 0.90. This indicates that 90 per cent of the customers of the

customers are served in at most five (5) minutes. Therefore, ten (10) per cent of the customers are served in at least six (6) minutes. It therefore follows from Table 3 that two (2) per cent of the customers are served in at least ten (10) minutes. The average waiting time excluding service time and the average queue length at any point in time was 9.32 minutes and 9 customers respectively.

The Fridays was not different from what was observed on Mondays and Wednesdays except that the inter arrival and service times of at most five (5) minutes occurs with a cumulative frequencies of 0.99 and 0.90 respectively. This implies that ten (10) per cent of the customers are served in at least six (6) minutes. Thus, it follows from Table 3 that three (3) per cent of customers are served in at least ten (10) minutes. The average waiting time excluding the service time and the average queue length was 13.55 minutes and 12 customers respectively.

The average waiting time of customers excluding service time was 9 minutes while 13 minutes of customers time is spent waiting in queue and then receiving service at the Opeibea House Branch of the bank.

Thus on the average the service time of a customer was three (3) minutes. The number of servers at the above branch was three (3). Hence the server utilization factor or the traffic intensity was 0.89. This means that 89 per cent of the cashier's time is spent serving customers on Mondays, Wednesdays and Fridays. Therefore, the idle time of a cashier during the three hour period was twenty (20) minutes on the average. The average queue length of customers at any point in time at the Opeibea House Branch was 8.

Consequently, it follows from the average waiting time, the service time and the average queue length stated above that the mode of operation at the Opeibea House was satisfactory.

5.3 Legon Branch

It follows from the summarized data that customers arrives at the service points of the above mentioned branch with an inter arrival time of at most three (3) minutes and a cumulative frequency of 0.99. This means that 99 per cent of the customers arrives with an inter arrival time of at most three (3) minutes.

The associated service time of the customers was also at most five (5) minutes and a cumulative frequency 0.96 on Tuesdays. This indicates that 96 per cent of the customers are served in at most five minutes. Therefore, four (4) per cent of the customers are served in at least six (6) minutes. Out of the above, two (2) per cent of the customers are served in at least ten (10) minutes. The average waiting time of customers excluding service time and the average queue length was 44.09 minutes and 37 customers respectively.

On Wednesdays, customers arrives with an inter arrival time of at most one (1) minute and a cumulative frequency of 0.99. This implies that 99 per cent of customers arrives at the service points with an inter arrival time of at most one (1) minute.

The service time of customers was at most five (5) minutes and a cumulative frequency of 0.98. This indicates that 98 per cent of the customers of the customers are served in at most five (5) minutes. This means that two (2) per cent of the customers are served in at least six (6) minutes. It follows from Table 4 that one (1) per cent of the customers are served in at least ten (10) minutes. The average waiting time excluding service time and the average queue length at any point was 30.36 minutes and 37 customers respectively.

The Fridays was not different from what was observed on Tuesdays and Wednesdays except that the inter arrival and service times of at most five (5) minutes occurs with a cumulative frequencies of 1.00 and 0.99 respectively. This means that one (1) per cent of the customers are served in at least six (6) minutes.

The average waiting time of customers excluding service time was 36 minutes while 37 minutes of customers time is spent waiting in queue and then receiving service at the Legon Branch of the bank. The average queue length at any point in time was 38 customers.

Thus on the average the service time of a customer was one (1) minute. The number of servers at the above branch was three (3). Hence the server utilization factor or the traffic intensity was 0.93. This means that 93 per cent of the cashier's time is spent serving customers on Tuesdays, Wednesdays and Fridays. Therefore, the idle time of a cashier during the three hour period was thirteen (13) minutes on the average.

It follows from the findings that the Legon Branch had the lowest service time as

compared to the other Branches investigated. Also, the average waiting times of a customer at the Legon Branch was greater than any of the branches investigated. The reason being that very few cash booths are open to serve customers at various Hours of the day at the service points of the bank. Thus, the demand for service exceeds the capacity to provide that service and hence excessive long queues are observed at the service points of the bank.

The idle time of a Cashier at the Legon Branch was also the lowest as compared to any of the branches investigated.

Consequently, it follows from the average waiting time and the average queue Length that the mode of operation at the service points of the bank was not satisfactory. To improve the mode of operation at the service points of the bank an additional teller window should be opened to serve customers at various hours of the day. If that is done, and a server is assigned to only withdrawals, then the average waiting time and the average queue length would reduce to an appreciable value.

I would also recommend without reservation that the Legon Branch should be relocated since the building space is small and sometimes the queues extends outside the banking hall. If this is adhered to then, the mode of operation at the Legon Branch would not be different from the other branches investigated.

TABLE 1

WORKSHEET ENTRIES FOR THE TUDU BRANCH OBSERVATION ON TUESDAY MARCH 7, 2000

TRIAL	1	2	3	4	5	6
OR	Time	Clock Time	Clock Time At	Service	Clock Time At	Waiting
Customer	Between	At Arrival	Beginninig of Service	Time	End of Service	Time
No.	Arrival	{last(2) + (1)}	{{(2) or last (5)}		{{(3) + (4)}	{{(3) - (2)}
1		9:25	9:35	2	9:37	10
2	0	9:25	9:37	15	9:52	12
3	1	9:26	9:43	1	9:44	17
4	1	9:27	9:44	1	9:45	17
5	0	9:27	9:44	2	9:46	17
6	2	9:29	9:45	3	9:48	16
7	0	9:29	9:46	3	9:49	17
8	1	9:30	9:48	2	9:50	18
9	0	9:30	9:49	2	9:51	19
10	2	9:32	9:50	3	9:53	18
11	2	9:34	9:51	3	9:54	17
12	0	9:34	9:52	3	9:55	18
13	0	9:34	9:53	7	10:00	19
14	0	9:34	9:54	7	10:01	20
15	0	9:34	9:55	3	9:58	21
16	1	9:35	9:58	1	9:59	23
17	2	9:37	9:59	6	10:05	22
18	1	9:38	10:00	4	10:04	22
19	1	9:39	9:59	11	10:10	20
20	0	9:39	10:00	7	10:07	21
21	1	9:40	10:01	11	10:12	21
22	0	9:40	10:01	1	10:12	21
23	1	9:41	10:05	5	10:10	24
24	1	9:42	10:07	10	10:17	25
25	0	9:42	10:10	0	10:10	28
26	3	9:45	10:10	6	10:16	25
27	3	9:48	10:10	2	10:12	22
28	2	9:50	10:12	6	10:18	22
29	1	9:51	10:16	1	10:17	25
30	1	9:52	10:17	3	10:20	25
31	1	9:53	10:17	3	10:20	24
32	5	9:58	10:18	3	10:21	20
33	0	9:58	10:20	1	10:21	22
34	2	10:00	10:20	2	10:22	20
35	0	10:00	10:20	4	10:24	20
36	3	10:03	10:21	2	10:23	18
37	0	10:03	10:22	16	10:38	19
38	2	10:05	10:23	5	10:28	18
39	0	10:05	10:24	4	10:28	19
40	1	10:06	10:24	1	10:25	18
41	2	10:08	10:25	1	10:26	17

42	2	10:10	10:26	1	10:27	16
43	1	10:11	10:27	2	10:29	16
44	4	10:15	10:28	2	10:30	13
45	1	10:16	10:30	1	10:31	14
46	1	10:17	10:30	1	10:31	13
47	2	10:19	10:30	2	10:32	11
48	1	10:20	10:30	2	10:32	10
49	0	10:20	10:31	3	10:34	11
50	0	10:20	10:32	4	10:36	12
51	0	10:20	10:32	9	10:41	12
52	2	10:22	10:34	10	10:44	12
53	0	10:22	10:36	1	10:37	14
54	1	10:32	10:36	1	10:37	4
55	2	10:34	10:37	5	10:42	3
56	1	10:35	10:37	5	10:42	2
57	1	10:36	10:38	5	10:43	2
58	0	10:36	10:41	3	10:44	5
59	1	10:37	10:42	5	10:47	5
60	2	10:39	10:42	7	10:49	3
61	3	10:42	10:43	3	10:46	2
62	0	10:42	10:44	6	10:50	2
63	1	10:43	10:46	5	10:51	3
64	1	10:44	10:47	4	10:51	3
65	0	10:44	10:49	3	10:52	6
66	0	10:44	10:50	5	10:55	6
67	1	10:45	10:51	4	10:55	6
68	0	10:45	10:52	4	10:56	7
69	0	10:45	10:52	5	10:57	7
70	6	10:51	10:55	5	11:00	4
71	0	10:51	10:56	5	11:01	5
72	0	10:51	10:56	5	11:01	4
73	1	10:52	10:57	2	10:59	5
74	0	10:52	10:59	4	11:03	7
75	0	10:52	11:00	6	11:06	8
76	0	10:52	11:01	6	11:07	9
77	1	10:53	11:01	6	11:07	8
78	0	10:53	11:03	7	11:10	10
79	1	10:54	11:06	1	11:07	12
80	0	10:54	11:07	2	11:09	13
81	1	10:55	11:07	5	11:12	12
82	1	10:56	11:07	5	11:12	11
83	0	10:56	11:09	5	11:14	13
84	0	10:56	11:10	5	11:15	14
85	1	10:57	11:12	27	11:39	15
86	0	10:57	11:14	4	11:18	17
87	0	10:57	11:15	2	11:17	18
88	7	11:04	11:17	3	11:20	13
89	1	11:05	11:17	5	11:22	12
90	0	11:05	11:18	5	11:23	13
91	3	11:08	11:20	4	11:24	12
92	1	11:09	11:22	3	11:25	13
93	0	11:09	11:23	3	11:26	14

94	3	11:12	11:24	3	11:27	12
95	1	11:13	11:25	2	11:27	12
96	1	11:14	11:26	1	11:28	12
97	1	11:15	11:27	2	11:29	12
98	4	11:19	11:27	3	11:30	8
99	2	11:21	11:28	7	11:35	7
100	1	11:22	11:29	6	11:35	7
101	0	11:22	11:30	3	11:33	8
102	0	11:22	11:33	3	11:36	11
103	2	11:24	11:35	2	11:37	11
104	1	11:25	11:36	4	11:40	11
105	0	11:25	11:36	4	11:40	11
106	1	11:26	11:37	3	11:40	11
107	1	11:27	11:39	12	11:51	12
108	0	11:27	11:40	1	11:41	13
109	4	11:33	11:40	1	11:41	7
110	1	11:34	11:41	2	11:43	7
111	1	11:35	11:41	3	11:44	6
112	2	11:37	11:43	1	11:44	6
113	0	11:37	11:44	1	11:45	7
114	2	11:39	11:44	4	11:48	5
115	0	11:39	11:45	1	11:46	6
116	1	11:40	11:46	1	11:47	6
117	1	11:41	11:47	2	11:49	6
118	1	11:42	11:48	2	11:50	6
119	0	11:42	11:49	2	11:51	7
120	0	11:42	11:50	3	11:53	8
121	2	11:44	11:51	2	11:53	7
122	0	11:44	11:51	2	11:53	7
123	0	11:44	11:53	2	11:55	9
124	5	11:49	11:53	3	11:56	4
125	3	11:52	11:53	4	11:57	1
126	1	11:53	11:54	5	11:59	1
127	1	11:54	11:55	5	12:00	1
128	0	11:54	11:56	6	12:02	2
129	0	11:54	11:57	6	12:03	3
130	1	11:55	11:59	5	12:04	4
131	1	11:56	12:00	5	12:05	4
132	3	11:59	12:00	5	12:05	1
133	0	11:59	12:02	4	12:06	3
134	2	12:01	12:03	4	12:07	2
135	1	12:02	12:04	13	12:17	2
136	2	12:04	12:05	4	12:09	1
Total	148			560		1586

TABLE 1

WORKSHEET ENTRIES FOR THE TUDU BRANCH OBSERVATION ON WEDNESDAY MARCH 8, 2000

TRIAL	1	2	3	4	5	6
OR	Time	Clock Time	Clock Time At	Service	Clock Time At	Waiting
Customer	Between	At Arrival	Beginnig of Service	Time	End of Service	Time
No.	Arrival	{last(2) + (1)}	{(2) or last (5)}		{{(3) + (4)}	{{(3) - (2)}
Open		8:30				
1	27	8:57	8:57	8	9:05	0
2	6	9:03	9:05	3	9:08	2
3	2	9:05	9:08	24	9:32	3
4	5	9:10	9:11	1	9:12	1
5	1	9:11	9:13	2	9:15	2
6	1	9:12	9:15	1	9:16	3
7	3	9:15	9:17	1	9:18	2
8	0	9:15	9:19	9	9:28	4
9	5	9:20	9:24	5	9:29	4
10	2	9:22	9:24	31	9:55	2
11	3	9:25	9:29	4	9:33	4
12	5	9:30	9:32	18	9:50	2
13	2	9:32	9:40	4	9:44	8
14	2	9:34	9:35	9	9:44	1
15	1	9:35	9:39	6	9:45	4
16	5	9:40	9:45	10	9:55	5
17	1	9:41	9:47	2	9:49	6
18	1	9:42	9:47	3	9:50	5
19	1	9:43	9:49	2	9:51	6
20	2	9:45	9:50	1	9:51	5
21	1	9:46	9:50	1	9:51	4
22	1	9:48	9:51	4	9:55	3
23	5	9:53	10:02	7	10:09	9
24	1	9:54	9:57	2	9:59	3
25	9	10:03	10:03	2	10:05	0
26	1	10:04	10:05	5	10:10	1
27	1	10:05	10:06	3	10:09	1
28	3	10:08	10:09	3	10:12	1
29	2	10:10	10:12	3	10:15	2
30	0	10:10	10:15	4	10:19	5
31	0	10:10	10:19	3	10:22	9
32	0	10:10	10:30	4	10:34	20
33	0	10:10	10:30	1	10:31	20
34	3	10:13	10:32	12	10:44	19
35	0	10:13	10:34	5	10:39	21
36	2	10:15	10:20	21	10:41	5
37	1	10:16	10:34	4	10:38	18
38	4	10:20	10:35	4	10:39	15
39	0	10:20	10:39	4	10:43	19

40	4	10:24	10:35	39	12:14	11
41	0	10:24	10:39	6	10:45	15
42	1	10:25	10:43	3	10:46	18
43	4	10:29	10:45	3	10:48	16
44	3	10:32	10:46	3	10:49	14
45	1	10:33	10:48	1	10:49	15
46	0	10:33	10:49	0	10:49	16
47	1	10:34	10:49	0	10:49	15
48	0	10:34	10:49	4	10:53	15
49	1	10:35	10:49	3	10:52	14
50	0	10:35	10:52	2	10:54	17
51	5	10:40	10:53	21	11:14	13
52	0	10:40	10:54	31	11:25	14
53	0	10:40	11:03	12	11:15	23
54	1	10:41	11:08	6	11:14	27
55	1	10:42	11:09	7	11:16	27
56	0	10:42	11:10	8	11:18	28
57	4	10:46	11:14	6	11:20	28
58	1	10:47	11:16	7	11:23	29
59	2	10:49	11:18	5	11:23	29
60	0	10:49	11:20	2	11:22	31
61	0	10:49	11:22	3	11:25	33
62	1	10:50	11:23	5	11:28	33
63	0	10:50	11:23	5	11:28	33
64	1	10:51	11:25	5	11:30	34
65	0	10:51	11:25	10	11:35	34
66	0	10:51	11:28	15	11:43	37
67	2	10:53	11:30	9	11:39	37
68	0	10:53	11:35	1	11:36	42
69	4	10:57	11:36	3	11:39	39
70	0	10:57	11:39	1	11:40	42
71	1	10:58	11:40	2	11:42	42
72	2	11:00	11:40	4	11:44	40
73	4	11:04	11:42	8	11:50	38
74	0	11:04	11:43	8	11:51	39
75	7	11:11	11:44	10	11:54	33
76	7	11:18	11:50	2	11:52	32
77	0	11:18	11:51	1	11:52	33
78	1	11:19	11:52	8	12:00	33
79	9	11:28	11:52	3	11:55	24
80	3	11:31	11:54	0	11:54	23
81	4	11:35	11:55	1	11:56	20
82	4	11:39	11:56	9	12:05	17
83	1	11:40	12:00	6	12:06	20
84	0	11:40	12:00	5	12:05	20
85	2	11:42	12:05	3	12:08	23
86	0	11:42	12:06	1	12:07	24
87	2	11:44	12:07	1	12:08	23
88	0	11:44	12:08	2	12:10	24

89	0	11:44	12:08	2	12:10	24
90	3	11:47	12:10	1	12:11	23
91	3	11:50	12:10	1	12:11	20
92	5	11:55	12:11	1	12:12	16
93	1	11:56	12:11	2	12:13	15
94	0	11:56	12:12	1	12:13	16
95	0	11:56	12:13	2	12:15	17
96	8	12:04	12:13	11	12:24	9
97	0	12:04	12:15	2	12:17	11
98	0	12:04	12:17	3	12:20	13
99	1	12:05	12:20	2	12:22	15
100	0	12:05	12:22	3	12:25	17
Total	214			567		1727

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TABLE 1

WORKSHEET ENTRIES FOR THE TUDU BRANCH OBSERVATION ON FRIDAY MARCH 10, 2000

TRIAL	1	2	3	4	5	6
OR	Time	Clock Time	Clock Time At	Service	Clock Time At	Waiting
Customer	Between	At Arrival	Beginning of Service	Time	End of Service	Time
No.	Arrival	{last(2) + (1)}	{{(2) or last (5)}		{{(3) + (4)}	{{(3) - (2)}
1		8:56	9:05	2	9:07	9
2	3	8:59	9:04	1	9:05	5
3	3	9:02	9:05	1	9:06	3
4	0	9:02	9:06	2	9:08	4
5	1	9:03	9:06	4	9:10	3
6	0	9:03	9:14	5	9:19	11
7	1	9:04	9:08	2	9:10	4
8	2	9:06	9:08	3	9:11	2
9	0	9:06	9:10	1	9:11	4
10	0	9:06	9:10	2	9:12	4
11	1	9:07	9:10	4	9:14	3
12	2	9:09	9:11	3	9:14	2
13	1	9:10	9:11	3	9:14	1
14	0	9:10	9:11	5	9:17	2
15	1	9:11	9:14	2	9:16	3
16	1	9:12	9:15	4	9:19	3
17	3	9:15	9:17	2	9:19	2
18	0	9:15	9:19	7	9:26	4
19	4	9:19	9:19	6	9:25	0
20	1	9:20	9:23	2	9:25	3
21	0	9:20	9:25	2	9:27	5
22	2	9:22	9:26	2	9:28	4
23	2	9:24	9:27	2	9:29	3
24	0	9:24	9:28	1	9:29	4
25	3	9:27	9:29	2	9:31	2
26	1	9:28	9:29	4	9:33	1
27	0	9:28	9:30	4	9:34	2
28	3	9:31	9:34	6	9:40	3
29	1	9:32	9:36	5	9:41	4
30	0	9:32	9:33	1	9:34	1
31	2	9:34	9:36	19	9:55	2
32	3	9:37	9:40	12	9:52	3
33	0	9:37	9:41	3	9:44	4
34	1	9:38	9:44	7	9:51	6
35	0	9:38	9:51	4	9:55	13
36	0	9:38	9:52	5	9:57	14
37	4	9:42	9:55	3	9:58	13
38	2	9:44	9:55	5	10:00	11

39	2	9:46	9:57	2	9:59	11
40	1	9:47	9:58	1	9:59	11
41	4	9:51	9:59	4	10:03	8
42	0	9:51	9:59	7	10:06	8
43	1	9:52	10:00	3	10:03	8
44	0	9:52	10:03	3	10:06	11
* 45	3	9:55	10:03	2	10:05	8
46	0	9:55	10:05	1	10:06	10
47	0	9:55	10:06	3	10:09	11
48	2	9:57	10:06	3	10:09	9
49	0	9:57	10:06	2	10:08	9
50	1	9:58	10:08	2	10:10	10
51	2	10:00	10:09	4	10:13	9
52	1	10:01	10:09	12	10:21	8
53	0	10:01	10:10	7	10:17	9
54	0	10:01	10:13	3	10:16	12
55	2	10:03	10:16	3	10:19	13
56	0	10:03	10:17	4	10:21	14
* 57	1	10:04	10:19	5	10:24	15
58	2	10:06	10:21	2	10:23	15
59	1	10:07	10:21	2	10:23	13
60	3	10:10	10:23	2	10:25	13
61	3	10:13	10:23	3	10:26	10
62	0	10:13	10:25	4	10:29	12
63	1	10:14	10:26	5	10:31	12
64	4	10:18	10:29	2	10:31	11
65	0	10:18	10:31	4	10:35	13
66	2	10:20	10:31	1	10:32	11
67	0	10:20	10:31	2	10:33	11
68	1	10:21	10:32	4	10:36	11
69	2	10:23	10:33	4	10:37	10
70	1	10:24	10:35	2	10:37	11
71	0	10:24	10:36	2	10:38	12
72	1	10:25	10:37	2	10:39	12
73	1	10:26	10:37	11	10:48	11
74	1	10:27	10:37	5	10:42	10
75	0	10:27	10:39	4	10:43	12
76	3	10:30	10:42	2	10:44	12
77	0	10:30	10:43	2	10:45	13
78	0	10:30	10:44	2	10:46	14
79	1	10:31	10:45	3	10:48	14
80	0	10:31	10:46	3	10:49	15
81	4	10:35	10:48	1	10:49	13
* 82	0	10:35	10:49	2	10:51	14
83	0	10:35	10:49	2	10:51	14
84	3	10:38	10:51	2	10:53	13
85	0	10:38	10:51	4	10:55	13
86	2	10:40	10:53	2	10:55	13
87	0	10:40	10:53	3	10:56	13

88	0	10:40	10:55	3	10:58	15
89	5	10:45	10:55	3	10:58	10
90	1	10:46	10:56	3	10:59	10
91	0	10:46	10:58	1	10:59	12
92	1	10:47	10:58	5	11:03	11
93	0	10:47	10:59	1	11:00	12
94	0	10:47	10:59	3	11:02	12
95	1	10:48	11:00	2	11:02	12
96	0	10:48	11:02	2	11:04	14
97	1	10:49	11:02	3	11:05	13
98	0	10:49	11:03	2	11:05	14
99	1	10:50	11:04	3	11:07	14
100	0	10:50	11:05	3	11:08	15
101	10	11:00	11:07	2	11:09	7
102	1	11:01	11:07	3	11:10	6
103	1	11:02	11:08	2	11:10	6
104	2	11:04	11:10	1	11:11	6
105	1	11:05	11:10	32	11:42	5
106	0	11:05	11:10	4	11:14	5
107	1	11:06	11:11	3	11:14	5
108	3	11:09	11:12	3	11:15	3
109	0	11:09	11:14	1	11:15	5
110	0	11:09	11:15	1	11:16	6
111	3	11:12	11:15	2	11:17	3
112	1	11:13	11:16	2	11:18	3
113	3	11:16	11:17	1	11:18	1
114	0	11:16	11:18	3	11:21	2
115	1	11:17	11:17	4	11:21	0
116	0	11:17	11:18	2	11:20	1
117	0	11:17	11:20	4	11:24	3
118	2	11:19	11:21	2	11:23	2
119	1	11:20	11:23	3	11:26	3
120	0	11:20	11:24	4	11:28	4
121	1	11:21	11:26	4	11:30	5
122	0	11:21	11:28	3	11:31	7
123	1	11:22	11:30	2	11:32	8
124	1	11:23	11:31	6	11:37	8
125	1	11:24	11:32	2	11:34	8
126	0	11:24	11:34	5	11:39	10
127	0	11:24	11:37	2	11:39	13
128	0	11:24	11:39	6	11:45	15
129	1	11:25	11:39	6	11:45	14
130	1	11:26	11:42	2	11:44	16
131	3	11:29	11:44	2	11:46	15
132	0	11:29	11:45	2	11:47	16
133	4	11:33	11:45	2	11:47	12
134	0	11:33	11:46	2	11:48	13
135	0	11:33	11:47	3	11:50	14
136	5	11:38	11:47	2	11:49	9

137	0	11:38	11:48	6	11:54	10
138	2	11:40	11:49	2	11:51	9
139	0	11:40	11:50	2	11:52	10
140	1	11:41	11:51	5	11:56	10
141	0	11:41	11:52	2	11:54	11
142	1	11:42	11:54	3	11:57	12
143	2	11:44	11:54	3	11:57	10
144	1	11:45	11:56	2	11:58	11
Total	169			497		1238

TABLE 2

WORKSHEET ENTRIES FOR THE RING ROAD CENTRAL BRANCH OBSERVATION ON MONDAY MARCH 13, 2000

TRIAL	1	2	3	4	5	6
OR	Time	Clock Time	Clock Time At	Service	Clock Time At	Waiting
Customer	Between	At Arrival	Beginnig of Service	Time	End of Service	Time
No.	Arrival	{last(2) + (1)}	{(2) or last (5)}		{(3) + (4)}	{(3) - (2)}
1		11:20	11:21	5	11:26	1
2	3	11:23	11:25	1	11:26	2
3	2	11:25	11:26	1	11:27	1
4	1	11:26	11:26	3	11:29	0
5	0	11:26	11:27	3	11:30	1
6	1	11:27	11:29	2	11:31	2
7	1	11:28	11:30	5	11:35	2
8	1	11:29	11:31	3	11:34	2
9	0	11:29	11:32	3	11:35	3
10	3	11:32	11:35	2	11:37	3
11	1	11:33	11:35	2	11:37	2
12	0	11:33	11:35	1	11:36	2
13	1	11:34	11:36	4	11:40	2
14	1	11:35	11:37	1	11:38	2
15	2	11:37	11:38	2	11:40	1
16	1	11:38	11:40	7	11:47	2
17	0	11:38	11:41	2	11:43	3
18	3	11:41	11:43	1	11:44	2
19	6	11:47	11:47	4	11:51	0
20	1	11:48	11:48	33	12:21	0
21	1	11:49	11:51	3	11:54	2
22	0	11:49	11:54	1	11:55	5
23	1	11:50	11:54	1	11:55	4
24	0	11:50	11:55	3	11:57	5
25	9	11:59	11:59	1	12:00	0
26	0	11:59	12:00	3	12:03	1
27	0	11:59	12:02	2	12:04	3
28	1	12:00	12:03	8	12:11	3
29	0	12:00	12:04	3	12:07	4
30	4	12:04	12:07	3	12:10	3
31	5	12:09	12:10	3	12:13	1
32	1	12:10	12:11	13	12:24	1
33	0	12:10	12:13	2	12:15	3
34	1	12:11	12:15	10	12:25	4
35	1	12:12	12:24	3	12:27	12
36	1	12:13	12:22	11	12:33	9
37	1	12:14	12:25	4	12:29	11
38	1	12:15	12:27	1	12:28	12

39	1	12:16	12:28	2	12:40	12
40	4	12:20	12:29	1	12:30	9
41	1	12:21	12:30	7	12:37	9
42	1	12:22	12:37	5	12:42	15
43	1	12:23	12:33	2	12:35	10
44	0	12:23	12:35	1	12:36	12
45	1	12:24	12:36	8	12:44	12
46	0	12:24	12:40	2	12:42	16
47	1	12:25	12:42	3	12:45	17
48	0	12:25	12:42	3	12:45	17
49	1	12:26	12:44	3	12:47	18
50	1	12:27	12:45	3	12:48	18
51	0	12:27	12:45	3	12:48	18
52	1	12:28	12:48	2	12:50	20
53	1	12:29	12:48	1	12:49	19
54	1	12:30	12:49	3	12:52	19
55	1	12:31	12:50	2	12:52	19
56	3	12:34	12:52	1	12:53	18
57	2	12:36	12:47	42	1:29	11
58	2	12:38	12:52	2	12:54	14
59	6	12:44	12:53	2	12:55	9
60	1	12:45	12:54	3	12:57	9
61	3	12:48	12:55	2	12:57	7
62	0	12:48	12:53	20	1:13	5
63	0	12:48	12:57	5	1:02	9
64	2	12:50	12:57	3	1:00	7
65	0	12:50	1:00	2	1:02	10
66	2	12:52	1:02	2	1:04	10
67	0	12:52	1:02	5	1:07	10
68	1	12:53	1:04	4	1:08	11
69	2	12:55	12:59	0	12:59	4
70	2	12:57	1:07	3	1:10	10
71	3	1:00	1:08	3	1:11	8
72	1	1:01	1:13	4	1:17	12
73	1	1:02	1:11	1	1:12	9
74	0	1:02	1:13	2	1:15	11
75	1	1:03	1:15	2	1:17	12
76	0	1:03	1:17	3	1:20	14
77	1	1:04	1:17	5	1:22	13
78	1	1:05	1:20	3	1:23	15
79	1	1:06	1:22	1	1:23	16
80	3	1:09	1:23	12	1:35	14
81	0	1:09	1:23	3	1:26	14
82	1	1:10	1:26	0	1:36	16
83	5	1:15	1:29	2	1:31	14
84	0	1:15	1:36	1	1:37	21
85	1	1:16	1:37	1	1:38	21
86	0	1:16	1:38	1	1:39	22
87	0	1:16	1:39	1	1:40	23

TABLE 2

WORKSHEET ENTRIES FOR THE RING ROAD CENTRAL BRANCH OBSERVATION ON WEDNESDAY MARCH 15, 2000

TRIAL	1	2	3	4	5	6
OR	Time	Clock Time	Clock Time At	Service	Clock Time At	Waiting
Customer	Between	At Arrival	Beginnig of Service	Time	End of Service	Time
No.	Arrival	{last(2) + (1)}	{(2) or last (5)}		{(3) + (4)}	{(3) - (2)}
1		8:30	8:32	1	8:33	2
2	2	8:32	8:32	2	8:34	0
3	0	8:32	8:33	1	8:34	1
4	1	8:33	8:34	14	8:48	1
5	12	8:45	8:45	5	8:50	0
6	1	8:46	8:46	2	8:48	0
7	0	8:46	8:48	3	8:51	2
8	6	8:52	8:52	2	8:54	0
9	2	8:54	8:55	2	8:57	1
10	0	8:54	8:55	3	8:58	1
11	1	8:55	8:57	3	9:00	2
12	1	8:56	8:58	1	8:59	2
13	3	8:59	9:00	1	9:01	1
14	1	9:00	9:01	3	9:04	1
15	2	9:02	9:02	3	9:05	0
16	1	9:03	9:04	15	9:19	1
17	3	9:06	9:06	2	9:08	0
18	2	9:08	9:09	3	9:12	1
19	4	9:12	9:12	3	9:15	0
20	1	9:13	9:15	2	9:17	2
21	2	9:15	9:17	3	9:20	2
22	2	9:17	9:19	3	9:22	2
23	1	9:18	9:20	2	9:22	2
24	5	9:23	9:23	6	9:29	0
25	1	9:24	9:24	4	9:28	0
26	2	9:26	9:28	6	9:34	2
27	1	9:27	9:31	4	9:35	4
28	2	9:29	9:29	2	9:31	0
29	1	9:30	9:34	1	9:35	4
30	1	9:31	9:35	1	9:36	4
31	1	9:32	9:36	1	9:37	4
32	0	9:32	9:36	2	9:38	4
33	1	9:33	9:37	5	9:42	4
34	1	9:34	9:38	3	9:41	4
35	0	9:34	9:41	3	9:44	7
36	0	9:34	9:43	2	9:45	9
37	0	9:34	9:44	2	9:46	10
38	1	9:35	9:45	1	9:46	10
39	0	9:35	9:46	2	9:48	11
40	2	9:37	9:46	1	9:47	9
41	5	9:42	9:47	2	9:49	5
42	0	9:42	9:48	3	9:51	6
43	2	9:44	9:49	3	9:52	5
44	1	9:45	9:51	1	9:52	6

45	3	9:48	9:52	8	10:00	4
46	2	9:50	9:50	2	9:52	0
47	1	9:51	9:52	2	9:54	1
48	0	9:51	9:54	4	9:58	3
49	2	9:53	9:54	1	9:55	1
50	0	9:53	9:55	4	9:59	2
51	3	9:56	9:58	2	10:00	2
52	1	9:57	9:59	1	10:00	2
53	1	9:58	10:00	10	10:10	2
54	1	9:59	10:00	12	10:12	1
55	1	10:00	10:10	3	10:13	10
56	1	10:01	10:12	3	10:15	11
57	0	10:01	10:13	3	10:16	12
58	2	10:03	10:15	1	10:16	12
59	2	10:05	10:16	1	10:17	11
60	1	10:06	10:16	3	10:19	10
61	0	10:06	10:17	3	10:20	11
62	1	10:07	10:18	3	10:21	11
63	1	10:08	10:19	4	10:23	11
64	0	10:08	10:20	4	10:24	12
65	2	10:10	10:21	4	10:25	11
66	1	10:11	10:24	3	10:27	13
67	2	10:13	10:25	3	10:28	12
68	0	10:13	10:26	3	10:29	13
69	1	10:14	10:27	2	10:28	13
70	1	10:15	10:28	0	10:28	13
71	5	10:20	10:28	1	10:29	8
72	5	10:25	10:28	2	10:30	3
73	0	10:25	10:29	2	10:31	4
74	4	10:29	10:30	1	10:31	1
75	1	10:30	10:31	5	10:36	1
76	2	10:32	10:32	7	10:39	0
77	1	10:33	10:33	3	10:36	0
78	3	10:36	10:36	4	10:40	0
79	2	10:38	10:39	4	10:43	1
80	0	10:38	10:40	4	10:44	2
81	1	10:39	10:44	1	10:45	5
82	2	10:41	10:45	2	10:47	4
83	5	10:46	10:47	1	10:48	1
84	1	10:47	10:47	7	10:54	0
85	1	10:48	10:48	1	10:49	0
86	0	10:48	10:49	2	10:51	1
87	0	10:48	10:51	1	10:52	3
88	0	10:48	10:54	2	10:56	6
89	2	10:50	10:56	3	10:59	6
90	0	10:50	10:56	8	11:04	6
91	2	10:52	10:59	1	11:00	7
92	3	10:55	11:00	1	11:01	5
93	0	10:55	11:01	1	11:02	6
94	1	10:56	11:02	5	11:07	6
95	0	10:56	11:02	14	11:16	6
96	3	10:59	11:07	5	11:12	8
97	1	11:00	11:08	1	11:09	8
98	1	11:01	11:09	3	11:12	8
99	2	11:03	11:09	2	11:11	6

100	3	11:06	11:12	2	11:14	6
101	4	11:10	11:12	3	11:15	2
102	1	11:11	11:14	2	11:16	3
103	1	11:12	11:19	1	11:20	7
104	1	11:13	11:20	2	11:22	7
105	1	11:14	11:22	2	11:24	8
106	1	11:15	11:24	2	11:26	9
107	6	11:21	11:24	1	11:25	3
108	1	11:22	11:25	2	11:27	3
109	0	11:22	11:26	2	11:28	4
110	0	11:22	11:27	1	11:28	5
111	0	11:22	11:28	1	11:29	6
112	2	11:24	11:28	5	11:33	4
113	1	11:25	11:29	3	11:32	4
114	2	11:27	11:32	8	11:40	5
115	1	11:28	11:37	4	11:41	9
116	2	11:30	11:40	6	11:46	10
117	2	11:32	11:40	5	11:45	8
118	0	11:32	11:41	8	11:49	9
119	3	11:35	11:45	2	11:47	10
120	2	11:37	11:46	8	11:54	9
121	0	11:37	11:47	2	11:49	10
122	1	11:38	11:49	2	11:51	11
123	0	11:38	11:49	2	11:51	11
124	2	11:40	11:51	1	11:52	11
125	0	11:40	11:51	3	11:54	11
126	4	11:44	11:52	2	11:54	8
127	0	11:44	11:54	4	11:58	10
128	0	11:44	11:55	3	11:58	11
129	1	11:45	11:58	1	11:59	13
130	0	11:45	11:58	3	12:01	13
131	0	11:45	11:58	4	12:02	13
132	3	11:48	11:59	1	12:00	11
133	1	11:49	12:00	2	12:02	11
134	1	11:50	12:01	4	12:05	11
135	0	11:50	11:56	2	11:58	6
136	3	11:53	12:02	4	12:06	9
137	0	11:53	12:05	3	12:08	12
138	2	11:55	12:06	1	12:07	11
139	5	12:00	12:02	2	12:04	2
140	0	12:00	12:07	2	12:09	7
141	1	12:01	12:08	2	12:10	7
142	0	12:01	12:09	2	12:11	8
143	0	12:01	12:10	2	12:12	9
144	1	12:02	12:11	1	12:12	9
TOTAL	212			442		814

TABLE 2

WORKSHEET ENTRIES FOR THE RING ROAD CENTRAL BRANCH OBSERVATION ON FRIDAY MARCH 17, 2000

TRIAL	1	2	3	4	5	6
OR	Time	Clock Time	Clock Time At	Service	Clock Time At	Waiting
Customer	Between	At Arrival	Beginnig of Service	Time	End of Service	Time
No.	Arrival	{last(2) + (1)}	{{(2) or last (5)}		{{(3) + (4)}	{{(3) - (2)}
Open		8:30				
1	20	8:50	8:54	3	8:57	4
2	6	8:56	8:57	2	8:59	1
3	2	8:58	8:59	2	9:01	1
4	0	8:58	8:59	4	9:03	1
5	1	8:59	9:01	1	9:02	2
6	2	9:01	9:02	2	9:04	1
7	0	9:01	9:03	5	9:08	2
8	0	9:01	9:04	1	9:05	3
9	3	9:04	9:05	1	9:06	1
10	0	9:04	9:06	2	9:08	2
11	1	9:05	9:08	8	9:16	3
12	1	9:06	9:08	5	9:13	2
13	6	9:12	9:13	3	9:16	1
14	2	9:14	9:15	4	9:19	1
15	1	9:15	9:15	2	9:17	0
16	0	9:15	9:19	4	9:23	4
17	4	9:19	9:20	3	9:23	1
18	0	9:19	9:23	3	9:26	4
19	1	9:20	9:23	3	9:26	3
20	1	9:21	9:26	4	9:30	5
21	2	9:23	9:24	3	9:27	1
22	4	9:27	9:27	2	9:29	0
23	1	9:28	9:28	3	9:31	0
24	2	9:30	9:30	1	9:31	0
25	3	9:33	9:33	2	9:35	0
26	0	9:33	9:33	2	9:35	0
27	0	9:33	9:35	14	9:49	2
28	2	9:35	9:35	2	9:37	0
29	0	9:35	9:39	73	10:52	4
30	1	9:36	9:37	2	9:39	1
31	1	9:37	9:37	3	9:40	0
32	1	9:38	9:39	3	9:42	1
33	1	9:39	9:40	4	9:44	1
34	4	9:43	9:45	3	9:48	2
35	1	9:44	9:45	12	9:57	1
36	2	9:46	9:48	1	9:49	2
37	0	9:46	9:49	7	9:56	3
38	2	9:48	9:48	3	9:51	0
39	0	9:48	9:49	6	9:55	1
40	0	9:48	9:51	3	9:54	3

41	0	9:48	9:51	2	9:53	3
42	2	9:50	9:53	2	9:55	3
43	0	9:50	9:54	2	9:56	4
44	0	9:50	9:55	1	9:56	5
45	1	9:51	9:55	4	9:59	4
46	1	9:52	9:56	3	9:59	4
47	2	9:54	9:57	3	10:00	3
48	0	9:54	9:59	2	10:01	5
49	1	9:55	9:59	2	10:01	4
50	0	9:55	10:00	3	10:03	5
51	2	9:57	10:01	2	10:03	4
52	0	9:57	10:01	15	10:16	4
53	7	10:04	10:04	1	10:05	0
54	0	10:04	10:04	2	10:06	0
55	0	10:04	10:04	3	10:07	0
56	2	10:06	10:06	2	10:08	0
57	0	10:06	10:06	4	10:10	0
58	1	10:07	10:07	3	10:10	0
59	1	10:08	10:08	2	10:10	0
60	1	10:09	10:10	2	10:12	1
61	1	10:10	10:10	8	10:18	0
62	0	10:10	10:10	3	10:13	0
63	1	10:11	10:12	3	10:15	1
64	1	10:12	10:13	17	10:30	1
65	1	10:13	10:14	2	10:16	1
66	0	10:13	10:23	2	10:25	10
67	2	10:15	10:16	2	10:18	1
68	0	10:15	10:16	1	10:17	1
69	0	10:15	10:17	1	10:18	2
70	1	10:16	10:24	4	10:28	8
71	1	10:17	10:18	5	10:23	1
72	0	10:17	10:18	3	10:21	1
73	1	10:18	10:24	3	10:27	6
74	0	10:18	10:25	1	10:26	7
75	2	10:20	10:25	1	10:26	5
76	0	10:20	10:26	1	10:27	6
77	1	10:21	10:26	2	10:28	5
78	0	10:21	10:27	1	10:28	6
79	1	10:22	10:27	1	10:28	5
80	0	10:22	10:28	1	10:29	6
81	0	10:22	10:28	1	10:29	6
82	1	10:23	10:28	1	10:29	5
83	0	10:23	10:29	1	10:30	6
84	0	10:23	10:29	1	10:30	6
85	3	10:26	10:29	1	10:30	3
86	0	10:26	10:30	1	10:31	4
87	0	10:26	10:30	1	10:31	4
88	0	10:26	10:30	3	10:33	4
89	0	10:26	10:31	2	10:33	5
90	1	10:27	10:31	2	10:33	4
91	1	10:28	10:32	2	10:34	4
92	0	10:28	10:33	2	10:35	5



93	0	10:28	10:33	2	10:35	5
94	2	10:30	10:33	2	10:35	3
95	0	10:30	10:34	2	10:36	4
96	0	10:30	10:35	2	10:37	5
97	1	10:31	10:35	2	10:37	4
98	0	10:31	10:36	3	10:39	5
99	1	10:32	10:37	3	10:40	5
100	1	10:33	10:39	2	10:41	6
101	1	10:34	10:40	1	10:41	6
102	0	10:34	10:40	4	10:44	6
103	0	10:34	10:40	5	10:45	6
104	1	10:35	10:41	4	10:45	6
105	0	10:35	10:41	4	10:45	6
106	0	10:35	10:44	3	10:47	9
107	1	10:36	10:45	4	10:49	9
108	0	10:36	10:45	4	10:49	9
109	1	10:37	10:45	8	10:53	8
110	0	10:37	10:47	9	10:56	10
111	1	10:38	10:49	1	10:50	11
112	0	10:38	10:49	12	11:01	11
113	2	10:40	10:51	14	11:05	11
114	0	10:40	10:56	4	11:00	16
115	1	10:41	10:57	4	11:01	16
116	0	10:41	11:00	1	11:01	19
117	2	10:43	11:01	1	11:02	18
118	1	10:44	11:01	3	11:04	17
119	0	10:44	11:01	3	11:04	17
120	0	10:44	11:02	3	11:05	18
121	2	10:46	11:04	2	11:06	18
122	0	10:46	11:04	3	11:07	18
123	1	10:47	11:05	2	11:07	18
124	0	10:47	11:06	2	11:08	1
125	0	10:47	11:07	3	11:10	20
126	1	10:48	11:07	5	11:12	19
127	1	10:49	11:07	5	11:12	18
128	1	10:50	11:08	6	11:14	18
129	0	10:50	11:10	2	11:12	20
130	1	10:51	11:12	2	11:14	21
131	0	10:51	11:12	3	11:15	21
132	1	10:52	11:12	4	11:16	20
133	0	10:52	11:14	3	11:17	22
134	8	11:00	11:14	4	11:18	14
135	0	11:00	11:15	5	11:20	15
136	0	11:00	11:16	5	11:21	16
137	0	11:00	11:17	5	11:22	17
138	2	11:02	11:21	1	11:22	19
139	0	11:02	11:21	4	11:25	19
140	1	11:03	11:22	3	11:25	19
TOTAL	153			530		861

TABLE 3

WORKSHEET ENTRIES FOR THE OPEIBEA HOUSE BRANCH OBSERVATION ON MONDAY MARCH 20, 2000

TRIAL	1	2	3	4	5	6
OR	Time	Clock Time	Clock Time At	Service	Clock Time At	Waiting
Customer	Between	At Arrival	Beginnig of Service	Time	End of Service	Time
No.	Arrival	{last(2) + (1)}	{{(2) or last (5)}		{{(3) + (4)}	{{(3) - (2)}
1		9:25	9:25	1	9:26	0
2	0	9:25	9:26	1	9:27	1
3	0	9:25	9:27	1	9:28	2
4	1	9:26	9:28	1	9:29	2
5	2	9:28	9:28	7	9:35	0
6	1	9:29	9:29	7	9:36	0
7	0	9:29	9:30	1	9:31	1
8	1	9:30	9:30	1	9:31	0
9	1	9:31	9:32	1	9:33	1
10	1	9:32	9:32	2	9:34	0
11	0	9:32	9:33	8	9:41	1
12	0	9:32	9:36	3	9:39	4
13	1	9:33	9:34	2	9:36	1
14	0	9:33	9:36	3	9:39	3
15	1	9:34	9:36	5	9:41	2
16	0	9:34	9:39	2	9:41	5
17	1	9:35	9:42	3	9:45	7
18	1	9:36	9:42	7	9:49	6
19	0	9:36	9:43	4	9:47	7
20	0	9:36	9:44	3	9:47	8
21	1	9:37	9:45	2	9:47	8
22	0	9:37	9:47	1	9:48	10
23	1	9:38	9:47	4	9:51	9
24	0	9:38	9:47	4	9:51	9
25	1	9:39	9:48	3	9:51	9
26	1	9:40	9:49	1	9:50	9
27	0	9:40	9:50	2	9:52	10
28	1	9:41	9:51	0	9:51	10
29	0	9:41	9:51	2	9:53	10
30	0	9:41	9:51	2	9:53	10
31	1	9:42	9:52	2	9:54	10
32	0	9:42	9:52	2	9:54	10
33	0	9:42	9:53	2	9:55	11
34	0	9:42	9:53	3	9:56	11
35	1	9:43	9:54	2	9:56	11
36	1	9:44	9:54	3	9:57	10
37	1	9:45	9:55	3	9:58	10
38	0	9:45	9:56	3	9:59	11
39	1	9:46	9:56	4	9:59	10
40	0	9:46	9:57	2	9:59	11
41	1	9:47	9:59	1	10:00	12

42	1	9:48	9:59	2	10:01	11
43	0	9:48	9:59	3	10:02	11
44	0	9:48	9:59	8	10:07	11
45	0	9:48	10:00	4	10:04	12
46	5	9:53	10:01	3	10:04	8
47	0	9:53	10:02	3	10:05	9
48	0	9:53	10:04	2	10:06	11
49	2	9:55	10:04	3	10:07	9
50	1	9:56	10:05	4	10:09	9
51	0	9:56	10:06	6	10:12	10
52	0	9:56	10:07	1	10:08	11
53	1	9:57	10:08	6	10:14	11
54	1	9:58	10:09	2	10:11	11
55	1	9:59	10:09	2	10:11	10
56	0	9:59	10:11	4	10:15	12
57	0	9:59	10:12	4	10:16	13
58	1	10:00	10:13	4	10:17	13
59	0	10:00	10:14	3	10:17	14
60	2	10:02	10:15	4	10:19	13
61	3	10:05	10:16	4	10:20	11
62	2	10:07	10:17	3	10:20	10
63	0	10:07	10:17	4	10:21	10
64	1	10:08	10:17	4	10:21	9
65	1	10:09	10:19	3	10:22	10
66	1	10:10	10:20	3	10:23	10
67	1	10:11	10:21	3	10:24	10
68	0	10:11	10:22	2	10:24	11
69	1	10:12	10:22	1	10:23	10
70	0	10:12	10:23	2	10:25	11
71	6	10:18	10:18	5	10:23	0
72	0	10:18	10:19	6	10:25	1
73	2	10:20	10:21	3	10:24	1
74	0	10:20	10:21	4	10:25	1
75	2	10:22	10:23	2	10:25	1
76	0	10:22	10:23	2	10:25	1
77	0	10:22	10:24	14	10:38	2
78	1	10:23	10:50	44	11:34	27
79	1	10:24	10:25	4	10:29	1
80	0	10:24	10:28	1	10:29	4
81	0	10:24	10:29	3	10:32	5
82	0	10:24	10:30	2	10:32	6
83	4	10:28	10:32	1	10:33	4
84	0	10:28	10:32	1	10:33	4
85	5	10:33	10:33	1	10:34	0
86	0	10:33	10:33	7	10:40	0
87	0	10:33	10:34	2	10:36	1
88	2	10:35	10:35	2	10:37	0
89	1	10:36	10:36	2	10:38	0
90	0	10:36	10:38	3	10:41	2
91	1	10:37	10:38	2	10:40	1
92	0	10:37	10:40	6	10:46	3
93	2	10:39	10:40	5	10:45	1

94	2	10:41	10:41	2	10:43	0
95	1	10:42	10:43	1	10:44	1
96	2	10:44	10:45	2	10:47	1
97	0	10:44	10:46	3	10:49	2
98	0	10:44	10:47	1	10:48	3
99	1	10:45	10:49	1	10:50	4
100	1	10:46	10:49	1	10:50	3
101	0	10:46	10:50	2	10:52	4
102	2	10:48	10:50	2	10:52	2
103	2	10:50	10:50	4	10:54	0
104	0	10:50	10:52	2	10:54	2
105	1	10:51	10:52	1	10:53	1
106	2	10:53	10:54	8	11:02	1
107	0	10:53	10:54	2	10:56	1
108	1	10:54	10:54	2	10:56	0
109	0	10:54	10:56	3	10:59	2
110	2	10:56	10:56	3	10:59	0
111	0	10:56	10:59	1	11:00	3
112	1	10:57	10:59	2	11:01	2
113	1	10:58	11:00	3	11:03	2
114	0	10:58	11:01	2	11:03	3
115	0	10:58	11:02	1	11:03	4
116	1	10:59	11:03	2	11:05	4
117	4	11:03	11:03	6	11:09	0
118	3	11:06	11:06	4	11:10	0
119	2	11:08	11:09	3	11:12	1
120	1	11:09	11:10	1	11:11	1
121	0	11:09	11:11	5	11:16	2
122	1	11:10	11:11	2	11:13	1
123	0	11:10	11:12	2	11:14	2
124	1	11:11	11:13	1	11:14	2
125	1	11:12	11:14	3	11:17	2
126	2	11:14	11:14	6	11:20	0
127	2	11:16	11:16	2	11:18	0
128	1	11:17	11:17	2	11:19	0
129	0	11:17	11:20	23	11:43	3
130	7	11:24	11:24	9	11:33	0
131	2	11:26	11:29	1	11:30	3
132	1	11:27	11:30	11	11:41	3
133	2	11:29	11:33	11	11:34	4
134	1	11:30	11:34	1	11:35	4
135	0	11:30	11:35	4	11:39	5
136	0	11:30	11:39	1	11:40	9
137	0	11:30	11:40	1	11:41	10
138	4	11:34	11:41	19	12:00	7
139	1	11:35	11:41	3	11:44	6
140	1	11:36	11:38	5	11:43	2
TOTAL	131			507		751

TABLE 3

WORKSHEET ENTRIES FOR THE OPEIBEA BRANCH OBSERVATION ON WEDNESDAY MARCH 22, 2000

TRIAL	1	2	3	4	5	6
OR	Time	Clock Time	Clock Time At	Service	Clock Time At	Waiting
Customer	Between	At Arrival	Beginnig of Service	Time	End of Service	Time
No.	Arrival	{last(2) + (1)}	{(2) or last (5)}		{(3) + (4)}	{(3) - (2)}
1		8:35	8:50	3	8:53	15
2	0	8:35	8:52	1	8:53	17
3	4	8:39	8:53	1	8:54	14
4	1	8:40	8:53	2	8:55	13
5	0	8:40	8:54	1	8:55	14
6	0	8:40	8:54	2	8:56	14
7	2	8:42	8:55	2	8:57	13
8	1	8:43	8:56	5	9:01	13
9	1	8:44	8:56	6	9:02	12
10	1	8:45	8:57	5	9:02	12
11	0	8:45	9:01	3	9:04	16
12	0	8:45	9:02	5	9:07	17
13	1	8:46	9:03	3	9:06	17
14	1	8:47	8:52	6	8:58	5
15	1	8:48	8:58	2	9:00	10
16	1	8:49	9:00	3	9:03	11
17	0	8:49	9:06	1	9:07	17
18	0	8:49	9:07	1	9:08	18
19	0	8:49	9:07	1	9:08	18
20	1	8:50	9:07	2	9:09	17
21	4	8:54	9:08	3	9:11	14
22	1	8:55	9:08	3	9:11	13
23	1	8:56	9:00	5	9:05	4
24	1	8:57	9:09	3	9:12	12
25	1	8:58	9:11	2	9:13	13
26	1	8:59	9:11	3	9:14	12
27	1	9:00	9:12	5	9:17	12
28	3	9:03	9:13	3	9:16	10
29	0	9:03	9:14	3	9:17	11
30	3	9:06	9:16	4	9:20	10
31	0	9:06	9:17	3	9:20	11
32	1	9:07	9:18	2	9:20	11
33	0	9:07	9:19	2	9:21	12
34	1	9:08	9:20	1	9:21	12
35	1	9:09	9:20	2	9:22	11
36	1	9:10	9:21	1	9:22	11
37	0	9:10	9:21	1	9:22	11
38	1	9:11	9:22	1	9:23	11

39	0	9:11	9:22	2	9:24	11
40	0	9:11	9:22	2	9:24	11
41	1	9:12	9:22	3	9:25	10
42	0	9:12	9:22	6	9:28	10
43	4	9:16	9:24	1	9:25	8
44	0	9:16	9:24	1	9:25	8
45	0	9:16	9:25	1	9:26	9
46	0	9:16	9:25	1	9:26	9
47	0	9:16	9:25	2	9:27	9
48	1	9:17	9:26	2	9:28	9
49	0	9:17	9:26	4	9:30	9
50	3	9:20	9:27	3	9:30	7
51	0	9:20	9:28	5	9:33	8
52	1	9:21	9:30	3	9:33	9
53	0	9:21	9:32	2	9:34	11
54	0	9:21	9:33	1	9:34	12
55	1	9:22	9:33	2	9:35	11
56	0	9:22	9:34	2	9:36	12
57	1	9:23	9:34	3	9:37	11
58	0	9:23	9:35	3	9:38	12
59	2	9:25	9:36	5	9:41	11
60	1	9:26	9:37	1	9:38	11
61	0	9:26	9:37	3	9:40	11
62	1	9:27	9:38	6	9:44	11
63	0	9:27	9:40	2	9:42	13
64	5	9:32	9:40	4	9:44	8
65	1	9:33	9:41	7	9:48	8
66	0	9:33	9:42	3	9:45	9
67	1	9:34	9:44	2	9:46	10
68	1	9:35	9:44	2	9:46	9
69	1	9:36	9:45	3	9:48	9
70	0	9:36	9:46	4	9:50	10
71	0	9:36	9:46	3	9:49	10
72	0	9:36	9:48	3	9:51	12
73	1	9:37	9:48	7	9:55	11
74	0	9:37	9:49	5	9:54	12
75	3	9:40	9:51	3	9:54	11
76	0	9:40	9:54	5	9:59	14
77	2	9:42	9:54	5	9:59	12
78	0	9:42	9:55	1	9:56	13
79	0	9:42	9:56	6	10:02	14
80	1	9:43	9:59	1	10:00	16
81	0	9:43	10:00	1	10:01	17
82	1	9:44	10:01	2	10:03	17
83	0	9:44	10:03	2	10:05	19
84	0	9:44	10:03	2	10:05	19
85	1	9:45	10:03	7	10:10	18
86	0	9:45	10:05	1	10:06	20
87	2	9:47	10:05	1	10:06	18

88	1	9:48	10:06	1	10:07	18
89	1	9:49	10:06	1	10:07	17
90	1	9:50	10:07	1	10:08	17
91	2	9:52	10:07	2	10:09	15
92	2	9:54	10:07	3	10:10	13
93	1	9:55	10:08	7	10:15	13
94	2	9:57	10:09	6	10:15	12
95	1	9:58	10:10	3	10:13	12
96	0	9:58	10:12	3	10:15	14
97	1	9:59	10:13	14	10:27	14
98	0	9:59	10:15	1	10:16	16
99	1	10:00	10:15	2	10:17	15
100	6	10:06	10:16	1	10:17	10
101	0	10:06	10:17	3	10:20	11
102	1	10:07	10:17	5	10:22	10
103	0	10:07	10:18	3	10:21	11
104	2	10:09	10:22	3	10:25	13
105	1	10:10	10:24	2	10:26	14
106	0	10:10	10:24	2	10:26	14
107	1	10:11	10:26	1	10:27	15
108	0	10:11	10:26	2	10:28	15
109	0	10:11	10:26	2	10:28	15
110	2	10:13	10:27	2	10:29	14
111	1	10:14	10:28	2	10:30	14
112	1	10:15	10:28	4	10:32	13
113	6	10:21	10:28	5	10:33	7
114	1	10:22	10:29	6	10:35	7
115	0	10:22	10:30	2	10:32	8
116	0	10:22	10:32	1	10:33	10
117	1	10:23	10:32	1	10:33	9
118	4	10:27	10:33	3	10:36	6
119	0	10:27	10:33	4	10:37	6
120	1	10:28	10:35	3	10:38	7
121	0	10:28	10:35	3	10:38	7
122	0	10:28	10:36	2	10:38	8
123	2	10:30	10:37	3	10:40	7
124	0	10:30	10:38	4	10:42	8
125	0	10:30	10:38	4	10:42	8
126	1	10:31	10:38	5	10:43	7
127	0	10:31	10:42	2	10:44	11
128	0	10:31	10:42	3	10:45	11
129	0	10:31	10:43	2	10:45	12
130	1	10:32	10:44	3	10:47	12
131	1	10:33	10:45	2	10:47	12
132	2	10:35	10:45	3	10:48	10
133	0	10:35	10:47	2	10:49	12
134	1	10:36	10:47	3	10:50	11
135	1	10:37	10:48	1	10:49	11
136	0	10:37	10:48	1	10:49	11

137	0	10:37	10:49	1	10:50	12
138	1	10:38	10:49	2	10:51	11
139	0	10:38	10:49	2	10:51	11
140	3	10:41	10:50	2	10:52	11
141	4	10:45	10:50	3	10:53	5
142	0	10:45	10:51	3	10:54	6
143	0	10:45	10:53	2	10:55	8
144	1	10:46	10:53	3	10:56	7
145	0	10:46	10:54	2	10:56	8
146	1	10:47	10:55	1	10:56	8
147	3	10:50	10:56	0	10:56	6
148	2	10:52	10:56	2	10:58	4
149	1	10:53	10:56	2	10:58	3
150	0	10:53	10:56	3	10:59	3
151	1	10:54	10:58	2	11:00	4
152	0	10:54	10:58	5	11:03	4
153	1	10:55	10:59	4	11:03	4
154	0	10:55	11:00	2	11:02	5
155	2	10:57	11:00	5	11:05	3
156	0	10:57	11:03	2	11:05	6
157	0	10:57	11:03	3	11:06	6
158	0	10:57	11:06	1	11:07	9
159	1	10:58	11:06	1	11:07	8
160	6	11:04	11:06	2	11:08	2
161	0	11:04	11:07	2	11:09	3
162	1	11:05	11:07	2	11:09	2
163	0	11:05	11:07	4	11:11	2
164	1	11:06	11:09	1	11:10	3
165	2	11:08	11:09	2	11:11	1
166	0	11:08	11:09	6	11:15	1
167	1	11:09	11:10	2	11:12	1
168	2	11:11	11:11	5	11:16	0
169	0	11:11	11:11	6	11:17	0
170	1	11:12	11:12	3	11:15	0
171	0	11:12	11:15	3	11:18	3
172	3	11:15	11:16	4	11:20	1
173	0	11:15	11:18	1	11:19	3
174	0	11:15	11:20	2	11:22	5
175	2	11:17	11:20	1	11:21	3
176	1	11:18	11:20	5	11:25	2
177	1	11:19	11:22	2	11:24	3
178	0	11:19	11:24	5	11:29	5
179	0	11:19	11:25	4	11:29	6
180	3	11:22	11:28	1	11:29	6
181	0	11:22	11:29	1	11:30	7
182	1	11:23	11:29	4	11:33	6
183	1	11:24	11:30	2	11:32	6
184	1	11:25	11:27	25	11:53	2
185	0	11:25	11:32	1	11:33	7

186	1	11:26	11:32	2	11:34	6
187	1	11:27	11:33	3	11:36	6
188	1	11:28	11:33	6	11:39	5
189	3	11:31	11:34	4	11:38	3
190	1	11:32	11:35	1	11:36	3
191	0	11:32	11:36	1	11:37	4
192	0	11:32	11:37	5	11:42	5
193	2	11:34	11:38	6	11:44	4
194	0	11:34	11:39	3	11:42	5
195	2	11:36	11:42	1	11:43	6
196	0	11:36	11:42	3	11:45	6
197	4	11:40	11:44	3	11:47	4
198	2	11:42	11:44	4	11:48	2
199	0	11:42	11:45	5	11:50	3
200	1	11:43	11:45	5	11:50	2
201	3	11:46	11:46	5	11:51	0
202	1	11:47	11:48	12	12:00	1
203	1	11:48	11:50	3	11:53	2
204	1	11:49	11:49	4	11:53	0
205	1	11:50	11:54	6	12:00	4
206	0	11:50	11:54	3	11:57	4
207	0	11:50	11:57	10	12:07	7
208	0	11:50	12:00	4	12:04	10
209	1	11:51	12:00	3	12:03	9
210	0	11:51	12:00	3	12:03	9
TOTAL	196			646		1958

TABLE 3

WORKSHEET ENTRIES FOR THE OPEIBEA HOUSE BRANCH OBSERVATION ON FRIDAY MARCH 24, 2000

TRIAL	1	2	3	4	5	6
OR	Time	Clock Time	Clock Time At	Service	Clock Time At	Waiting
Customer	Between	At Arrival	Beginning of Service	Time	End of Service	Time
No.	Arrival	{last(2) + (1)}	{(2) or last (5)}		{(3) + (4)}	{(3) - (2)}
OPEN		8:30				
1	0	8:30	8:34	1	8:35	4
2	0	8:30	8:35	2	8:37	5
3	0	8:30	8:35	2	8:37	5
4	0	8:30	8:37	1	8:38	7
5	0	8:30	8:37	5	8:42	7
6	0	8:30	8:38	2	8:40	8
7	0	8:30	8:39	10	8:49	9
8	0	8:30	8:40	2	8:42	10
9	0	8:30	8:41	4	8:45	11
10	0	8:30	8:42	3	8:45	12
11	5	8:35	8:42	5	8:47	7
12	0	8:35	8:45	2	8:47	10
13	1	8:36	8:46	3	8:49	10
14	0	8:36	8:47	5	8:52	11
15	0	8:36	8:47	1	8:48	11
16	1	8:37	8:48	4	8:52	11
17	1	8:38	8:49	2	8:51	11
18	1	8:39	8:49	3	8:52	10
19	0	8:39	8:52	1	8:53	13
20	1	8:40	8:52	3	8:55	12
21	0	8:40	8:52	3	8:55	12
22	1	8:41	8:53	1	8:54	12
23	0	8:41	8:53	2	8:55	12
24	1	8:42	8:54	1	8:55	12
25	1	8:43	8:55	1	8:56	12
26	0	8:43	8:55	2	8:57	12
27	0	8:43	8:55	2	8:57	12
28	0	8:43	8:57	1	8:58	14
29	1	8:44	8:57	1	8:58	13
30	0	8:44	8:57	2	8:59	13
31	8	8:52	8:57	2	8:59	5
32	0	8:52	8:58	2	9:00	6
33	0	8:52	8:58	3	9:01	6
34	1	8:53	8:59	2	9:01	6
35	1	8:54	9:00	0	9:00	6
36	2	8:56	9:02	6	9:08	6
37	1	8:57	9:00	2	9:02	3

38	3	9:00	9:01	4	9:05	1
39	0	9:00	9:01	15	9:16	1
40	1	9:01	9:05	6	9:11	4
41	0	9:01	9:06	2	9:08	5
42	1	9:02	9:08	3	9:11	6
43	3	9:05	9:11	1	9:12	6
44	0	9:05	9:12	2	9:14	7
45	7	9:12	9:13	3	9:16	1
46	2	9:14	9:14	2	9:16	0
47	0	9:14	9:14	3	9:17	0
48	2	9:16	9:16	2	9:18	0
49	1	9:17	9:18	2	9:20	1
50	0	9:17	9:20	1	9:21	3
51	1	9:18	9:21	2	9:23	3
52	0	9:18	9:23	1	9:24	5
53	1	9:19	9:24	1	9:25	5
54	1	9:20	9:20	3	9:23	0
55	1	9:21	9:23	3	9:26	2
56	0	9:21	9:25	2	9:27	4
57	1	9:22	9:26	2	9:28	4
58	0	9:22	9:27	1	9:28	5
59	1	9:23	9:28	2	9:30	5
60	0	9:23	9:28	2	9:30	5
61	1	9:24	9:30	1	9:31	6
62	0	9:24	9:30	1	9:31	6
63	0	9:24	9:31	2	9:33	7
64	2	9:26	9:31	2	9:33	5
65	1	9:27	9:32	3	9:35	5
66	1	9:28	9:33	4	9:37	5
67	0	9:28	9:35	2	9:37	7
68	1	9:29	9:36	3	9:39	7
69	0	9:29	9:37	2	9:39	8
70	0	9:29	9:37	3	9:40	8
71	1	9:30	9:39	1	9:40	9
72	2	9:32	9:39	1	9:40	7
73	1	9:33	9:39	1	9:40	6
74	1	9:34	9:40	0	9:40	6
75	1	9:35	9:40	2	9:42	5
76	2	9:37	9:40	3	9:43	3
77	0	9:37	9:40	3	9:43	3
78	2	9:39	9:40	7	9:47	1
79	1	9:40	9:42	6	9:48	2
80	0	9:40	9:43	4	9:47	3
81	0	9:40	9:45	3	9:48	5
82	5	9:45	9:48	1	9:49	3
83	0	9:45	9:48	2	9:50	3
84	0	9:45	9:49	4	9:53	4
85	1	9:46	9:49	10	9:59	3
86	0	9:46	9:53	0	9:53	7

87	1	9:47	9:53	2	9:55	6
88	0	9:47	9:53	6	9:59	6
89	0	9:47	9:55	14	10:09	8
90	1	9:48	9:59	2	10:01	11
91	0	9:48	9:59	4	10:03	11
92	0	9:48	10:00	3	10:03	12
93	1	9:49	10:01	1	10:02	12
94	0	9:49	10:02	3	10:05	13
95	1	9:50	10:03	3	10:06	13
96	1	9:51	10:03	3	10:06	12
97	1	9:52	10:05	1	10:06	13
98	2	9:54	10:06	3	10:09	12
99	0	9:54	10:06	1	10:07	12
100	2	9:56	9:56	4	10:00	0
101	0	9:56	10:08	3	10:11	12
102	2	9:58	10:09	3	10:12	11
103	2	10:00	10:09	1	10:10	9
104	0	10:00	10:10	4	10:14	10
105	0	10:00	10:11	4	10:15	11
106	1	10:01	10:14	3	10:17	13
107	1	10:02	10:15	3	10:18	13
108	1	10:03	10:17	4	10:21	14
109	0	10:03	10:18	4	10:22	15
110	4	10:07	10:19	4	10:23	12
111	3	10:10	10:21	7	10:28	11
112	2	10:12	10:21	22	10:43	9
113	0	10:12	10:22	2	10:24	10
114	2	10:14	10:24	3	10:27	10
115	1	10:15	10:27	2	10:29	12
116	2	10:17	10:28	8	10:36	11
117	0	10:17	10:29	1	10:30	12
118	1	10:18	10:30	1	10:31	12
119	0	10:18	10:30	2	10:32	12
120	0	10:18	10:32	3	10:35	14
121	1	10:19	10:34	1	10:35	15
122	0	10:19	10:34	2	10:36	15
123	0	10:19	10:35	1	10:26	16
124	1	10:20	10:35	1	10:36	15
125	0	10:20	10:36	0	10:36	16
126	1	10:21	10:36	1	10:37	15
127	0	10:21	10:36	2	10:38	15
128	1	10:22	10:37	1	10:38	15
129	0	10:22	10:37	3	10:40	15
130	1	10:23	10:38	2	10:40	15
131	0	10:23	10:38	3	10:41	15
132	1	10:24	10:40	3	10:43	16
133	1	10:25	10:41	8	10:49	16
134	0	10:25	10:41	11	10:52	16
135	1	10:26	10:43	1	10:44	17

136	0	10:26	10:43	1	10:44	17
137	1	10:27	10:44	2	10:46	17
138	0	10:27	10:44	3	10:47	17
139	1	10:28	10:46	5	10:51	18
140	0	10:28	10:47	5	10:52	19
141	2	10:30	10:49	1	10:50	19
142	0	10:30	10:50	4	10:54	20
143	5	10:35	10:52	1	10:53	17
144	1	10:36	10:53	2	10:55	17
145	0	10:36	10:53	3	10:56	17
146	1	10:37	10:54	2	10:56	17
147	0	10:37	10:54	2	10:56	17
148	0	10:37	10:56	2	10:58	19
149	3	10:40	10:56	2	10:58	16
150	0	10:40	10:56	2	10:58	16
151	2	10:42	10:56	2	10:58	14
152	1	10:43	10:58	1	10:59	15
153	1	10:44	10:58	2	11:00	14
154	0	10:44	10:58	5	11:03	14
155	1	10:45	10:58	5	11:03	13
156	0	10:45	11:00	3	11:03	15
157	0	10:45	11:03	3	11:06	18
158	1	10:46	11:03	3	11:06	17
159	0	10:46	11:04	2	11:06	18
160	1	10:47	11:04	3	11:07	17
161	0	10:47	11:06	2	11:08	19
162	0	10:47	11:06	3	11:09	19
163	1	10:48	11:07	2	11:09	19
164	1	10:49	11:08	2	11:10	19
165	1	10:50	11:08	3	11:11	18
166	0	10:50	11:09	5	11:14	19
167	0	10:50	11:09	5	11:14	19
168	1	10:51	11:10	6	11:16	19
169	1	10:52	11:11	8	11:19	19
170	1	10:53	11:14	2	11:16	21
171	0	10:53	11:15	1	11:16	22
172	1	10:54	11:16	2	11:18	22
173	1	10:55	11:16	3	11:19	21
174	1	10:56	11:18	4	11:22	22
175	0	10:56	11:19	5	11:24	23
176	4	11:00	11:19	6	11:25	19
177	0	11:00	11:22	6	11:28	22
178	1	11:01	11:24	2	11:26	23
179	0	11:01	11:25	1	11:26	24
180	0	11:01	11:26	1	11:27	25
181	1	11:02	11:26	3	11:29	24
182	1	11:03	11:26	3	11:29	23
183	1	11:04	11:29	2	11:31	25
184	1	11:05	11:29	2	11:31	24

185	1	11:06	11:29	2	11:31	23
186	0	11:06	11:31	1	11:32	25
187	1	11:07	11:31	4	11:35	24
188	1	11:08	11:31	4	11:35	23
189	1	11:09	11:32	5	11:37	23
190	1	11:10	11:33	2	11:35	23
191	1	11:11	11:35	1	11:36	24
192	1	11:12	11:35	2	11:37	23
193	1	11:13	11:36	1	11:37	23
194	1	11:14	11:37	0	11:37	23
195	1	11:15	11:37	3	11:40	22
196	0	11:15	11:00	3	11:40	22
197	0	11:15	11:37	4	11:41	22
198	1	11:16	11:37	6	11:43	21
199	1	11:17	11:40	1	11:41	23
200	1	11:18	11:41	1	11:42	23
201	0	11:18	11:41	3	11:44	23
202	1	11:19	11:42	4	11:46	23
203	0	11:19	11:43	3	11:46	24
204	0	11:19	11:43	3	11:46	24
205	1	11:20	11:45	2	11:47	25
206	0	11:20	11:46	3	11:49	26
207	0	11:20	11:46	4	11:50	26
208	0	11:20	11:47	3	11:50	27
209	0	11:20	11:49	1	11:50	29
210	1	11:21	11:50	2	11:52	29
211	4	11:25	11:50	4	11:54	25
212	0	11:25	11:52	2	11:54	27
213	0	11:25	11:52	3	11:55	27
214	2	11:27	11:52	6	11:58	25
215	0	11:27	11:54	8	12:02	24
216	3	11:30	11:54	9	12:03	28
217	0	11:30	11:58	1	11:59	28
218	1	11:31	11:59	2	12:01	28
219	0	11:31	11:59	3	12:02	28
220	0	11:31	12:01	4	12:05	30
TOTAL	181			659		2980

TABLE 4

WORKSHEET ENTRIES FOR THE LEGON BRANCH OBSERVATION ON TUESDAY MARCH 28, 2000

* TRIAL	1	2	3	4	5	6
OR	Time	Clock Time	Clock Time At	Service	Clock Time At	Waiting
Customer	Between	At Arrival	Beginnig of Service	Time	End of Service	Time
No.	Arrival	{last(2) + (1)}	{(2) or last (5)}		{(3) + (4)}	{(3) - (2)}
1		8:50	9:07	13	9:20	17
2	0	8:50	9:07	2	9:09	17
3	0	8:50	9:09	2	9:11	19
4	4	8:54	9:11	2	9:13	17
5	1	8:55	9:13	2	9:15	18
6	3	8:58	9:15	7	9:22	17
7	1	8:59	9:20	2	9:22	21
8	0	8:59	9:22	2	9:24	23
9	3	9:02	9:24	3	9:27	22
10	0	9:02	9:25	2	9:27	23
11	0	9:02	9:27	2	9:29	25
12	1	9:03	9:27	2	9:29	24
13	1	9:04	9:29	1	9:30	25
14	1	9:05	9:29	4	9:33	24
15	0	9:05	9:30	2	9:32	25
16	0	9:05	9:32	1	9:33	27
17	4	9:09	9:33	2	9:35	24
18	0	9:09	9:33	2	9:35	24
19	1	9:10	9:35	1	9:36	25
20	0	9:10	9:35	1	9:36	25
21	1	9:11	9:36	2	9:38	25
22	1	9:12	9:36	3	9:39	24
23	1	9:13	9:38	2	9:40	25
24	1	9:14	9:39	2	9:41	25
25	1	9:15	9:40	3	9:43	25
26	0	9:15	9:41	1	9:42	26
27	0	9:15	9:42	7	9:49	27
28	1	9:16	9:43	4	9:47	27
29	1	9:17	9:45	1	9:46	28
30	0	9:17	9:47	1	9:48	30
31	2	9:19	9:48	4	9:52	29
32	0	9:19	9:49	2	9:51	30
33	1	9:20	9:51	1	9:52	31
34	0	9:20	9:52	1	9:53	32
35	1	9:21	9:52	1	9:53	31
36	1	9:22	9:53	1	9:54	31
37	2	9:24	9:53	2	9:55	29
38	0	9:24	9:54	1	9:55	30

39	2	9:26	9:55	2	9:57	29
40	0	9:26	9:55	5	10:00	29
41	1	9:27	9:57	2	9:59	30
42	2	9:29	9:58	3	10:01	29
43	0	9:29	9:59	4	10:03	30
44	1	9:30	10:01	2	10:03	31
45	0	9:30	10:03	2	10:05	33
46	0	9:30	10:03	4	10:07	33
47	1	9:31	10:05	4	10:09	34
48	0	9:31	10:07	3	10:10	36
49	1	9:32	10:09	2	10:11	37
50	0	9:32	10:10	1	10:11	38
51	1	9:33	10:11	1	10:12	38
52	1	9:34	10:11	1	10:12	37
53	0	9:34	10:12	1	10:13	38
54	0	9:34	10:12	5	10:17	38
55	1	9:35	10:13	4	10:17	38
56	0	9:35	10:14	1	10:15	39
57	1	9:36	10:17	2	10:19	41
58	0	9:36	10:17	4	10:21	41
59	0	9:36	10:19	2	10:21	43
60	1	9:37	10:21	2	10:23	44
61	0	9:37	10:21	2	10:23	44
62	1	9:38	10:23	1	10:24	45
63	0	9:38	10:23	1	10:24	45
64	1	9:39	10:24	1	10:25	45
65	0	9:39	10:24	1	10:25	45
66	1	9:40	10:25	8	10:33	45
67	0	9:40	10:25	1	10:26	45
68	1	9:41	10:25	2	10:27	44
69	0	9:41	10:26	3	10:29	45
70	1	9:42	10:27	3	10:30	45
71	1	9:43	10:30	2	10:32	47
72	0	9:43	10:32	3	10:35	49
73	1	9:44	10:33	2	10:35	49
74	1	9:45	10:35	1	10:36	50
75	1	9:46	10:35	2	10:37	49
76	1	9:47	10:36	2	10:38	49
77	1	9:48	10:37	2	10:39	49
78	1	9:49	10:38	2	10:40	49
79	1	9:50	10:39	1	10:40	49
80	1	9:51	10:40	1	10:41	49
81	1	9:52	10:40	3	10:43	48
82	1	9:53	10:41	1	10:42	48
83	1	9:54	10:42	2	10:44	48
84	1	9:55	10:43	2	10:45	48
85	0	9:55	10:44	2	10:46	49
86	1	9:56	10:45	2	10:47	49
87	1	9:57	10:46	2	10:48	49

88	1	9:58	10:47	1	10:48	49
89	1	9:59	10:48	3	10:51	49
90	1	10:00	10:48	2	10:50	48
91	1	10:01	10:50	1	10:51	49
92	1	10:02	10:51	1	10:52	49
93	1	10:03	10:51	1	10:52	48
94	1	10:04	10:52	2	10:54	48
95	1	10:05	10:52	2	10:54	47
96	1	10:06	10:54	1	10:55	48
97	0	10:06	10:54	3	10:57	48
98	1	10:07	10:55	2	10:57	48
99	1	10:08	10:57	1	10:58	49
100	1	10:09	10:57	1	10:58	48
101	1	10:10	10:58	2	11:00	48
102	1	10:11	10:58	1	10:59	47
103	1	10:12	10:59	1	11:00	47
104	0	10:12	11:00	1	11:01	48
105	0	10:12	11:00	3	11:03	48
106	1	10:13	11:01	1	11:02	48
107	0	10:13	11:02	3	11:03	49
108	2	10:15	11:03	1	11:04	48
109	0	10:15	11:03	2	11:05	48
110	0	10:15	11:04	2	11:06	49
111	1	10:16	11:05	3	11:08	49
112	1	10:17	11:06	2	11:08	49
113	1	10:18	11:08	3	11:11	50
114	1	10:19	11:08	7	11:15	49
115	0	10:19	11:11	1	11:12	52
116	1	10:20	11:12	2	11:14	52
117	0	10:20	11:14	1	11:15	54
118	1	10:21	11:15	2	11:17	54
119	0	10:21	11:15	2	11:17	54
120	1	10:22	11:17	1	11:18	55
121	1	10:23	11:17	1	11:18	54
122	1	10:24	11:18	1	11:19	54
123	1	10:25	11:18	2	11:20	53
124	1	10:26	11:19	2	11:21	53
125	1	10:27	11:20	2	11:22	53
126	0	10:27	11:21	2	11:23	54
127	0	10:27	11:22	1	11:23	55
128	1	10:28	11:23	1	11:24	55
129	1	10:29	11:23	2	11:25	54
130	1	10:30	11:24	1	11:25	54
131	0	10:30	11:25	1	11:26	55
132	0	10:30	11:25	1	11:26	55
133	1	10:31	11:26	1	11:27	55
134	1	10:32	11:26	2	11:28	54
135	1	10:33	11:27	3	11:30	54
136	1	10:34	11:28	3	11:31	54

137	1	10:35	11:30	3	11:33	55
138	1	10:36	11:31	2	11:33	55
139	1	10:37	11:33	1	11:34	56
140	0	10:37	11:33	2	11:35	56
141	1	10:38	11:34	4	11:38	56
142	1	10:39	11:35	12	11:47	56
143	1	10:40	11:38	1	11:39	58
144	1	10:41	11:38	12	11:50	57
145	1	10:42	11:39	3	11:42	57
146	1	10:43	11:42	1	11:43	59
147	1	10:44	11:43	2	11:45	59
148	0	10:44	11:45	2	11:47	61
149	1	10:45	11:47	1	11:48	62
150	0	10:45	11:47	3	11:50	62
151	1	10:46	11:48	1	11:49	62
152	1	10:47	11:49	1	11:50	62
153	1	10:48	11:50	2	11:52	62
154	1	10:49	11:50	2	11:52	61
155	1	10:50	11:52	6	11:58	62
156	0	10:50	11:52	2	11:54	62
157	1	10:51	11:53	3	11:56	62
158	1	10:52	11:54	3	11:57	62
159	1	10:53	11:56	2	11:58	63
160	1	10:54	11:57	1	11:58	63
161	0	10:54	11:58	1	11:59	64
162	1	10:55	11:58	4	12:02	63
163	0	10:55	11:59	4	12:03	64
TOTAL	125			375		7122

TABLE 4

WORKSHEET ENTRIES FOR THE LEGON BRANCH OBSERVATION ON WEDNESDAY MARCH 29, 2000

TRIAL	1	2	3	4	5	6
OR	Time	Clock Time	Clock Time At	Service	Clock Time At	Waiting
Customer	Between	At Arrival	Beginning of Service	Time	End of Service	Time
No.	Arrival	{last(2) + (1)}	{(2) or last (5)}		{(3) + (4)}	{(3) - (2)}
^p Open		8:30				
1	0	8:30	8:30	4	8:34	0
2	0	8:30	8:34	1	8:35	4
3	0	8:30	8:34	3	8:37	4
4	0	8:30	8:35	1	8:36	5
5	0	8:30	8:36	1	8:37	6
6	0	8:30	8:37	1	8:38	7
7	0	8:30	8:37	2	8:39	7
8	0	8:30	8:38	2	8:40	8
9	0	8:30	8:39	3	8:42	9
10	0	8:30	8:40	1	8:41	10
11	0	8:30	8:41	1	8:42	11
12	0	8:30	8:42	1	8:43	12
^s 13	0	8:30	8:42	1	8:43	12
14	0	8:30	8:43	1	8:44	13
15	0	8:30	8:43	1	8:44	13
16	0	8:30	8:44	1	8:45	14
17	0	8:30	8:44	1	8:45	14
18	0	8:30	8:45	1	8:46	15
19	0	8:30	8:45	2	8:47	15
20	0	8:30	8:46	2	8:48	16
21	0	8:30	8:47	2	8:49	17
22	0	8:30	8:48	2	8:50	18
23	0	8:30	8:49	1	8:50	19
24	0	8:30	8:50	1	8:51	20
25	0	8:30	8:50	1	8:51	20
[*] 26	0	8:30	8:51	0	8:51	21
27	0	8:30	8:51	2	8:53	21
28	0	8:30	8:51	2	8:53	21
29	0	8:30	8:53	1	8:54	23
30	0	8:30	8:53	1	8:54	23
31	1	8:31	8:54	1	8:55	23
32	0	8:31	8:54	2	8:56	23
33	0	8:31	8:55	3	8:58	24
34	0	8:31	8:56	2	8:58	25
35	0	8:31	8:58	1	8:59	27
36	1	8:32	8:58	1	8:59	26
37	1	8:33	8:59	2	9:01	26
38	0	8:33	8:59	2	9:01	26
[*] 39	1	8:34	9:01	1	9:02	27
40	1	8:35	9:01	3	9:04	26

41	1	8:36	9:02	1	9:03	26
42	1	8:37	9:03	1	9:04	26
43	1	8:38	9:04	1	9:05	26
44	0	8:38	9:04	2	9:06	26
45	1	8:39	9:05	1	9:06	26
46	1	8:40	9:06	3	9:09	26
47	0	8:40	9:06	3	9:09	26
48	0	8:40	9:09	1	9:10	29
49	1	8:41	9:09	2	9:11	28
50	1	8:42	9:10	4	9:14	28
51	1	8:43	9:11	1	9:12	28
52	1	8:44	9:12	3	9:15	28
53	1	8:45	9:14	4	9:18	29
54	1	8:46	9:15	2	9:17	29
55	1	8:47	9:17	1	9:18	30
56	0	8:47	9:18	2	9:20	31
57	1	8:48	9:18	2	9:20	30
58	0	8:48	9:20	1	9:21	32
59	1	8:49	9:20	2	9:22	31
60	1	8:50	9:21	3	9:24	31
61	0	8:50	9:22	2	9:24	32
62	0	8:50	9:24	1	9:25	34
63	0	8:50	9:24	1	9:25	34
64	1	8:51	9:25	1	9:26	34
65	1	8:52	9:25	3	9:28	34
66	1	8:53	9:26	2	9:28	33
67	1	8:54	9:28	1	9:29	33
68	1	8:55	9:28	6	9:34	34
69	1	8:56	9:29	1	9:30	33
70	1	8:57	9:30	1	9:31	33
71	1	8:58	9:31	2	9:33	33
72	1	8:59	9:33	1	9:34	33
73	1	9:00	9:34	2	9:36	34
74	0	9:00	9:34	3	9:37	34
75	0	9:00	9:36	1	9:37	34
76	1	9:01	9:37	1	9:38	36
77	0	9:01	9:37	1	9:38	36
78	1	9:02	9:38	1	9:39	36
79	1	9:03	9:38	2	9:40	35
80	1	9:04	9:39	1	9:40	35
81	1	9:05	9:40	1	9:41	35
82	1	9:06	9:40	1	9:41	34
83	1	9:07	9:41	0	9:41	34
84	0	9:07	9:41	1	9:42	34
85	1	9:08	9:41	3	9:44	33
86	1	9:09	9:42	2	9:44	33
87	1	9:10	9:44	1	9:45	34
88	1	9:11	9:44	2	9:46	33
89	1	9:12	9:45	1	9:46	33
90	1	9:13	9:46	1	9:46	33
91	1	9:14	9:46	1	9:47	32
92	1	9:15	9:47	1	9:47	32

93	1	9:16	9:47	1	9:48	31
94	1	9:17	9:48	0	9:48	31
95	1	9:18	9:48	1	9:48	30
96	1	9:19	9:48	1	9:49	29
97	1	9:20	9:49	0	9:49	29
98	1	9:21	9:49	1	9:49	28
99	1	9:22	9:49	2	9:50	27
100	1	9:23	9:50	1	9:51	27
101	1	9:24	9:51	0	9:51	27
102	1	9:25	9:51	1	9:51	26
103	1	9:26	9:51	1	9:52	25
104	0	9:26	9:52	1	9:52	26
105	0	9:26	9:52	1	9:53	26
106	0	9:26	9:53	0	9:53	27
107	0	9:26	9:53	1	9:53	53
108	0	9:26	9:53	1	9:54	27
109	1	9:27	9:54	1	9:54	27
110	0	9:27	9:54	1	9:55	27
111	1	9:28	9:55	1	9:55	27
112	0	9:28	9:55	1	9:56	27
113	1	9:29	9:56	2	9:56	27
114	1	9:30	9:56	1	9:58	26
115	0	9:30	9:57	2	9:57	26
116	0	9:30	9:58	7	9:59	27
117	0	9:30	9:59	1	10:05	28
118	1	9:31	10:00	1	10:00	29
119	0	9:31	10:01	1	10:01	29
120	0	9:31	10:02	2	10:02	30
121	0	9:31	10:04	2	10:04	31
122	1	9:32	10:05	2	10:06	33
123	1	9:33	10:06	2	10:07	33
124	1	9:34	10:07	1	10:08	33
125	0	9:34	10:08	1	10:08	33
126	0	9:34	10:08	1	10:09	34
127	0	9:34	10:09	1	10:09	34
128	1	9:35	10:09	2	10:10	35
129	0	9:35	10:10	1	10:11	34
130	0	9:35	10:11	1	10:11	35
131	0	9:35	10:11	2	10:12	36
132	1	9:36	10:12	2	10:13	36
133	1	9:37	10:13	1	10:14	36
134	1	9:38	10:14	2	10:14	36
135	1	9:39	10:14	2	10:16	36
136	1	9:40	10:16	2	10:16	35
137	1	9:41	10:16	11	10:18	36
138	1	9:42	10:18	1	10:27	35
139	0	9:42	10:19	2	10:19	36
140	0	9:42	10:21	1	10:21	37
141	1	9:43	10:22	3	10:22	39
142	0	9:43	10:25	2	10:25	39
143	1	9:44	10:27	1	10:27	42
144	0	9:44	10:27	2	10:28	43

145	0	9:44	10:28	1	10:29	43
146	1	9:45	10:29	1	10:29	44
147	1	9:46	10:29	1	10:30	44
148	1	9:47	10:30	1	10:30	43
149	1	9:48	10:30	1	10:31	43
150	2	9:50	10:31	1	10:31	42
151	0	9:50	10:31	1	10:32	41
152	0	9:50	10:32	1	10:32	41
153	1	9:51	10:32	2	10:33	42
154	1	9:52	10:33	1	10:34	41
155	1	9:53	10:34	0	10:34	41
156	1	9:54	10:34	3	10:34	41
157	1	9:55	10:34	1	10:37	40
158	1	9:56	10:35	1	10:35	39
159	1	9:57	10:36	1	10:36	39
160	1	9:58	10:37	1	10:37	39
161	1	9:59	10:37	2	10:38	39
162	1	10:00	10:38	1	10:39	38
163	0	10:00	10:39	1	10:39	38
164	0	10:00	10:39	1	10:40	39
165	1	10:01	10:40	1	10:40	39
166	1	10:02	10:40	1	10:41	39
167	0	10:02	10:41	1	10:41	38
168	2	10:04	10:41	1	10:42	39
169	0	10:04	10:42	1	10:42	37
170	0	10:04	10:42	1	10:43	38
171	1	10:05	10:43	1	10:43	38
172	0	10:05	10:43	1	10:44	38
173	1	10:06	10:44	1	10:44	38
174	1	10:07	10:44	3	10:45	38
175	1	10:08	10:45	1	10:47	37
176	1	10:09	10:46	3	10:46	37
177	0	10:09	10:47	1	10:49	37
178	0	10:09	10:48	1	10:48	37
179	1	10:10	10:49	1	10:49	38
180	0	10:10	10:49	2	10:50	39
181	1	10:11	10:50	1	10:51	39
182	0	10:11	10:51	1	10:51	39
183	1	10:12	10:51	2	10:52	39
184	1	10:13	10:52	2	10:53	40
185	1	10:14	10:53	2	10:54	39
186	1	10:15	10:54	2	10:55	39
187	1	10:16	10:55	2	10:56	39
188	1	10:17	10:56	3	10:57	39
189	1	10:18	10:57	5	10:59	39
190	1	10:19	10:59	1	11:02	39
TOTAL	109			298		5768

TABLE 4

WORKSHEET ENTRIES FOR THE LEGON BRANCH OBSERVATION ON FRIDAY MARCH 31, 2000

TRIAL	1	2	3	4	5	6
OR	Time	Clock Time	Clock Time At	Service	Clock Time At	Waiting
Customer	Between	At Arrival	Beginnig of Service	Time	End of Service	Time
No.	Arrival	{last(2) + (1)}	{{(2) or last (5)}		{{(3) + (4)}	{{(3) - (2)}
Open		8:30				
1	0	8:30	8:30	4	8:34	0
2	0	8:30	8:34	1	8:35	4
3	0	8:30	8:34	3	8:37	4
4	0	8:30	8:35	1	8:36	5
5	0	8:30	8:36	1	8:37	6
6	0	8:30	8:37	1	8:38	7
7	0	8:30	8:37	2	8:39	7
8	0	8:30	8:38	2	8:40	8
9	0	8:30	8:39	3	8:42	9
10	0	8:30	8:40	1	8:41	10
11	0	8:30	8:41	1	8:42	11
12	0	8:30	8:42	1	8:43	12
13	0	8:30	8:42	1	8:43	12
14	0	8:30	8:43	1	8:44	13
15	0	8:30	8:43	1	8:44	13
16	0	8:30	8:44	1	8:45	14
17	0	8:30	8:44	1	8:45	14
18	0	8:30	8:45	1	8:46	15
19	0	8:30	8:45	2	8:47	15
20	0	8:30	8:46	2	8:48	16
21	0	8:30	8:47	2	8:49	17
22	0	8:30	8:48	2	8:50	18
23	0	8:30	8:49	1	8:50	19
24	0	8:30	8:50	1	8:51	20
25	0	8:30	8:50	1	8:51	20
26	0	8:30	8:51	0	8:51	21
27	0	8:30	8:51	2	8:53	21
28	0	8:30	8:51	2	8:53	21
29	0	8:30	8:53	1	8:54	23
30	0	8:30	8:53	1	8:54	23
31	1	8:31	8:54	1	8:55	23
32	0	8:31	8:54	2	8:56	23
33	0	8:31	8:55	3	8:58	24
34	0	8:31	8:56	2	8:58	25
35	0	8:31	8:58	1	8:59	27
36	1	8:32	8:58	1	8:59	26
37	1	8:33	8:59	2	9:01	26

38	0	8:33	8:59	2	9:01	26
39	1	8:34	9:01	1	9:02	27
40	1	8:35	9:01	3	9:04	26
41	1	8:36	9:02	1	9:03	26
42	1	8:37	9:03	1	9:04	26
43	1	8:38	9:04	1	9:05	26
44	0	8:38	9:04	2	9:06	26
45	1	8:39	9:05	1	9:06	26
46	1	8:40	9:06	3	9:09	26
47	0	8:40	9:06	3	9:09	26
48	0	8:40	9:09	1	9:10	29
49	1	8:41	9:09	2	9:11	28
50	1	8:42	9:10	4	9:14	28
51	1	8:43	9:11	1	9:12	28
52	1	8:44	9:12	3	9:15	28
53	1	8:45	9:14	4	9:18	29
54	1	8:46	9:15	2	9:17	29
55	1	8:47	9:17	1	9:18	30
56	0	8:47	9:18	2	9:20	31
57	1	8:48	9:18	2	9:20	30
58	0	8:48	9:20	1	9:21	32
59	1	8:49	9:20	2	9:22	31
60	1	8:50	9:21	3	9:24	31
61	0	8:50	9:22	2	9:24	32
62	0	8:50	9:24	1	9:25	34
63	0	8:50	9:24	1	9:25	34
64	1	8:51	9:25	1	9:26	34
65	1	8:52	9:25	3	9:28	33
66	1	8:53	9:26	2	9:28	33
67	1	8:54	9:28	1	9:29	34
68	1	8:55	9:28	6	9:34	33
69	1	8:56	9:29	1	9:30	33
70	1	8:57	9:30	1	9:31	33
71	1	8:58	9:31	2	9:33	33
72	1	8:59	9:33	1	9:34	34
73	1	9:00	9:34	2	9:36	34
74	0	9:00	9:34	3	9:37	34
75	0	9:00	9:36	1	9:37	36
76	1	9:01	9:37	1	9:38	36
77	0	9:01	9:37	1	9:38	36
78	1	9:02	9:38	1	9:39	36
79	1	9:03	9:38	2	9:40	35
80	1	9:04	9:39	1	9:40	35
81	1	9:05	9:40	1	9:41	35
82	1	9:06	9:40	1	9:41	34
83	1	9:07	9:41	0	9:41	34
84	0	9:07	9:41	1	9:42	34
85	1	9:08	9:41	3	9:44	33
86	1	9:09	9:42	2	9:44	33

87	1	9:10	9:44	1	9:45	34
88	1	9:11	9:44	2	9:46	33
89	1	9:12	9:45	1	9:46	33
90	1	9:13	9:46	1	9:47	33
91	1	9:14	9:46	1	9:47	32
92	1	9:15	9:47	1	9:48	32
93	1	9:16	9:47	1	9:48	31
94	1	9:17	9:48	0	9:48	31
95	1	9:18	9:48	1	9:49	30
96	1	9:19	9:48	1	9:49	29
97	1	9:20	9:49	0	9:49	29
98	1	9:21	9:49	1	9:50	28
99	1	9:22	9:49	2	9:51	27
100	1	9:23	9:50	1	9:51	27
101	1	9:24	9:51	0	9:51	27
102	1	9:25	9:51	1	9:52	26
103	1	9:26	9:51	1	9:52	25
104	0	9:26	9:52	1	9:53	26
105	0	9:26	9:52	1	9:53	26
106	0	9:26	9:53	0	9:53	27
107	0	9:26	9:53	1	9:54	53
108	0	9:26	9:53	1	9:54	27
109	1	9:27	9:54	1	9:55	27
110	0	9:27	9:54	1	9:55	27
111	1	9:28	9:55	1	9:56	27
112	0	9:28	9:55	1	9:56	27
113	1	9:29	9:56	2	9:58	27
114	1	9:30	9:56	1	9:57	26
115	0	9:30	9:57	2	9:59	27
116	0	9:30	9:58	7	10:05	28
117	0	9:30	9:59	1	10:00	29
118	1	9:31	10:00	1	10:01	29
119	0	9:31	10:01	1	10:02	30
120	0	9:31	10:02	2	10:04	31
121	0	9:31	10:04	2	10:06	33
122	1	9:32	10:05	2	10:07	33
123	1	9:33	10:06	2	10:08	33
124	1	9:34	10:07	1	10:08	33
125	0	9:34	10:08	1	10:09	34
126	0	9:34	10:08	1	10:09	34
127	0	9:34	10:09	1	10:10	35
128	1	9:35	10:09	2	10:11	34
129	0	9:35	10:10	1	10:11	35
130	0	9:35	10:11	1	10:12	36
131	0	9:35	10:11	2	10:13	36
132	1	9:36	10:12	2	10:14	36
133	1	9:37	10:13	1	10:14	36
134	1	9:38	10:14	2	10:16	36
135	1	9:39	10:14	2	10:16	35

136	1	9:40	10:16	2	10:18	36
137	1	9:41	10:16	11	10:27	35
138	1	9:42	10:18	1	10:19	36
139	0	9:42	10:19	2	10:21	37
140	0	9:42	10:21	1	10:22	39
141	1	9:43	10:22	3	10:25	39
142	0	9:43	10:25	2	10:27	42
143	1	9:44	10:27	1	10:28	43
144	0	9:44	10:27	2	10:29	43
145	0	9:44	10:28	1	10:29	44
146	1	9:45	10:29	1	10:30	44
147	1	9:46	10:29	1	10:30	43
148	1	9:47	10:30	1	10:31	43
149	1	9:48	10:30	1	10:31	42
150	2	9:50	10:31	1	10:32	41
151	0	9:50	10:31	1	10:32	41
152	0	9:50	10:32	1	10:33	42
153	1	9:51	10:32	2	10:34	41
154	1	9:52	10:33	1	10:34	41
155	1	9:53	10:34	0	10:34	41
156	1	9:54	10:34	3	10:37	40
157	1	9:55	10:34	1	10:35	39
158	1	9:56	10:35	1	10:36	39
159	1	9:57	10:36	1	10:37	39
160	1	9:58	10:37	1	10:38	39
161	1	9:59	10:37	2	10:39	38
162	1	10:00	10:38	1	10:39	38
163	0	10:00	10:39	1	10:40	39
164	0	10:00	10:39	1	10:40	39
165	1	10:01	10:40	1	10:41	39
166	1	10:02	10:40	1	10:41	38
167	0	10:02	10:41	1	10:42	39
168	2	10:04	10:41	1	10:42	37
169	0	10:04	10:42	1	10:43	38
170	0	10:04	10:42	1	10:43	38
171	1	10:05	10:43	1	10:44	38
172	0	10:05	10:43	1	10:44	38
173	1	10:06	10:44	1	10:45	38
174	1	10:07	10:44	3	10:47	37
175	1	10:08	10:45	1	10:46	37
176	1	10:09	10:46	3	10:49	37
177	0	10:09	10:47	1	10:48	38
178	0	10:09	10:48	1	10:49	39
179	1	10:10	10:49	1	10:50	39
180	0	10:10	10:49	2	10:51	39
181	1	10:11	10:50	1	10:51	39
182	0	10:11	10:51	1	10:52	40
183	1	10:12	10:51	2	10:53	39
184	1	10:13	10:52	2	10:54	39

185	1	10:14	10:53	2	10:55	39
186	1	10:15	10:54	2	10:56	39
187	1	10:16	10:55	2	10:57	39
188	1	10:17	10:56	3	10:59	39
189	1	10:18	10:57	5	11:02	39
190	1	10:19	10:59	1	11:00	40
191	1	10:20	11:00	1	11:01	40
192	0	10:20	11:01	1	11:02	41
193	0	10:20	11:02	1	11:03	42
194	1	10:21	11:02	1	11:03	41
195	1	10:22	11:03	2	11:05	41
196	1	10:23	11:03	1	11:04	40
197	1	10:24	11:04	1	11:05	40
198	1	10:25	11:05	1	11:06	40
199	1	10:26	11:05	2	11:07	39
200	1	10:27	11:06	1	11:07	39
201	1	10:28	11:07	1	11:08	39
202	1	10:29	11:07	3	11:10	38
203	1	10:30	11:08	2	11:10	38
204	0	10:30	11:10	3	11:13	40
205	0	10:30	11:10	3	11:13	40
206	0	10:30	11:13	1	11:14	43
207	1	10:31	11:13	5	11:18	42
208	1	10:32	11:14	5	11:19	42
209	1	10:33	11:18	4	11:22	45
210	0	10:33	11:19	2	11:21	46
211	1	10:34	11:21	1	11:22	47
212	1	10:35	11:22	0	11:22	47
213	1	10:36	11:22	1	11:23	46
214	1	10:37	11:22	1	11:23	45
215	1	10:38	11:23	2	11:25	45
216	1	10:39	11:23	2	11:25	44
217	1	10:40	11:25	0	11:25	45
218	0	10:40	11:25	1	11:26	45
219	1	10:41	11:25	2	11:27	44
220	1	10:42	11:26	2	11:28	44
221	1	10:43	11:27	2	11:29	44
222	1	10:44	11:28	5	11:33	44
223	1	10:45	11:29	2	11:31	44
224	0	10:45	11:31	2	11:33	46
225	0	10:45	11:33	2	11:35	48
TOTAL	135			364		7280

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