FIELD TO PROCESS QUEUES

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PREFACE

The work reported in this thesis deals with queuing systems associated with agricultural processing plants. The major purpose of this study was to analyze the queuing systems at selected agricultural processing and crop terminals and to propose and evaluate ways to minimize waiting costs.

My gratitude goes to Professor Jay G. Porterfield, my thesis advisor, for his encouragement, guidance, and valuable constructive criticism in preparing the manuscript.

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A	acres to be harvested (acres/year) or (acres)
A(t)	probability of at least one arrival during the time interval t
B	location in Kendall notation indicating service time distribution
c	Kendall notation indicating number of service channels
C_d	direct cost of service ($/server-hour)
C_f	fixed cost of service ($/server-hour)
CH	harvesting custom rate ($/acre)
CT	transportation charge ($/pound of product delivered to terminal)
CV	crop value ($/pound of product delivered to terminal)
C_w	cost of waiting ($/customer-hour)
d	number of days harvest season must be extended due to wet weather (days)
$\bar{d}$	mean number of days harvest season must be extended due to wet weather (days)
D	Kendall notation indicating uniform distribution
DET	loss caused by crop delivery delay to terminal ($/pound-hour)
DL	deterioration loss ($/year)
DNC	expected number of days to complete harvest rounded down to nearest integer (days)
Dy	equipment production days per year (days/year)

e	base of Naperian logarathims with numerical value of 2.71828
E_k	Kendall notation indicating Erlang distribution with parameter k
FH	fractional yield reduction of remaining crop due to hail
FIFO	queue discipline indicating first in queue first served
F(z)	generating function
G	Kendall notation indicating general distribution
g(t)	any density function with time as the parameter
h	location in Kendall notation indicating queue discipline
HFC	harvester fixed cost ($/year)
HL	loss due to hail ($/year)
HPR	harvester production rate (acres/hour)
HVC	harvester variable cost while operating, exclusive of labor ($/hour)
i	any integer
k	Erlang distribution parameter
k_f	Erlang service time distribution parameter for customer's first time service
k_i	Erlang service time distribution parameter for facility i service
k_s	Erlang service time distribution parameter for customer's second time service
l	Kendall notation indicating the upper limit on the number of customers permitted in the system at any time
L	average number in queue
LFC	land fixed cost ($/acre)
LH	harvester operator wage rate ($/hour)

LIFO	queue discipline indicating last in queue first served
LK	vehicle operator wage rate ($/hour)
LVC	land variable cost including crop preparation to harvest ($/acre)
LY	loss in yield due to timeliness (pounds/acre)
M	Kendall notation indicating Poisson process
n	number of customers in the system
$\bar{n}$	mean number of customers in the system
N	number of elements in a population sample
ND	normal number of days for harvesting A acres excluding wet weather (days)
NDC	expected number of days to complete harvest (days)
$\bar{n}_n$	mean number of non priority customers in the system, queue plus service
$\bar{n}_p$	mean number of priority customers in the system, queue plus service
NPPS	queue discipline indicating non pre-emptive priority service
$\bar{n}_q$	mean number of customers in queue
$\bar{n}_{qn}$	mean number of non priority customers in queue
$\bar{n}_{qp}$	mean number of priority customers in queue
NT	number of vehicle trips (trip/year)
OP	crop owner's profit ($/year)
P_d	probability that harvest season will be extended d days
P_h	probability of hail on any day during harvest period
PH	average profit by harvester owner over the total production day ($/hour)
P_{ij}	probability of system being in state ij. i = channel 1 or 2; j = number of customers in service and in queue

P_n probability of n customers being in the system, queue plus service

P_r probability of a customer being rejected at a facility

PV average profit by vehicle owner over the total production day ($/hour)

$P_{(w>t)}$ probability that the waiting time exceeds time t

P_0 probability of zero customers in the system

P_{00} probability that harvester will be found idle in the field waiting return of transport vehicle

q number of available queue spaces

r location in Kendall notation indicating maximum number of customers

RT round trip time, field back to field (hours/trip)

s location in Kendall notation indicating number of service channels

SC round trip distance (miles/trip)

s_{ij} state ij. i = channel in use, 1 or 2; j = number of customers in queue and in service

SIRO queue discipline indicating service in random order

s(t) probability density for service completion

t time (units of time)

$(t^2)av$ mean square of the service time duration $(\text{units of time})^2$

TD harvest hours per production day (hours/day)

TF timeliness factor $(\text{day})^{-1}$

TIV product delay prior to delivery (hours)

T(s) average duration of the service operation (hour/customer)

TTT total trip time, field plus round trip time (hours/trip)

TVC	total variable cost (\$/server-hour)
VFC	vehicle fixed cost (\$/year)
Vol	payload per vehicle trip (pounds/trip)
VVC	vehicle variable cost excluding labor (\$/mile)
$\bar{w}$	mean waiting time, queue plus service (time units/customer)
$\bar{w}_q$	mean waiting time in queue (time units/customer)
$\bar{w}_{qn}$	mean waiting time of non priority customers in queue (time units/customer)
$\bar{w}_{qp}$	mean waiting time of priority customers in queue (time units/customer)
w(t)	waiting time distribution with time as parameter
X	location in Kendall notation indicating arrival distribution
Y	crop yield at peak (pounds/acre)
α	fraction of total arrivals having priority
β	μ_n/μ_p
χ^2	chi-square
λ	mean arrival rate (customers/time unit)
μ	mean service rate (customers/time unit)
μ_f	mean service rate for a customer's first time service (customers/time unit)
μ_i	mean service rate of facility i (customers/time unit)
μ_n	mean service rate of non priority customers (customers/time unit)
μ_p	mean service rate of priority customers (customers/time unit)
μ_s	mean service rate for a customer's second time service (customers/time unit)

π	fraction of arrivals going to pseudo channel one in a dual server facility
ρ	utilization factor
τ	any constant time value (units of time)

CHAPTER I

INTRODUCTION

Waiting lines of agricultural products in transit which develop at processing plants and crop terminals are sources of economic loss. The perishable nature of most agricultural products, the idle time of the transport facilities involved, and the resulting inefficient use of the remaining harvesting system facilities and personnel are the major factors rendering such waiting lines undesirable.

Waiting costs vary depending on the type of conveyance, the deterioration rate of the product, and the type of harvesting system and processes involved. Other costs associated with agricultural queues are those incurred due to harvester interruptions. Costs directly related to harvester interruption include the waiting cost of the harvester and associated crew, product quality loss related to timeliness, and price fluctuation of the market. If temporary storage is used only when necessary to prevent harvester interruption, all costs associated with this must be attributed to waiting of the transport facilities.

Statement of Problem

The purpose of this study was to analyze the queuing systems at selected agricultural processing and crop terminals and to propose and evaluate ways to minimize waiting costs.

Objectives

The objectives of this study were to:

1. Describe the queuing systems for selected agricultural processing plants and crop terminals in terms of their operational characteristics.
2. Evaluate the effects of priority in queue discipline and differential pricing.
3. Formulate guide lines for plant design or operation which would result in optimal queue characteristics from the combined viewpoints of the producer and the processor.

Approach

Little can be accomplished in an organized manner to improve queue characteristics until the queue is completely described. To specify a queue, the distribution function for arrivals and service times must be itemized and the type of queue discipline and the number of service channels identified. Once these attributes are known, proposed improvements in facility operating and design criteria may be evaluated, either through simulation techniques or applied mathematical queuing theory. Results of simulation or mathematical analysis of the queue can be used in optimizing overall plant and terminal operations from the producer and/or processor viewpoints.

CHAPTER II

REVIEW OF LITERATURE

Queues are formed when customers (units requiring service) wait for service, or the service facilities are idle waiting for customers. The queuing process is structured around a service system consisting of one or more service facilities and a queue of customers waiting for service (1). Customer arrivals at the service system are generated from a source known as the "population".

Queuing systems are classified according to their input and service system characteristics. The input may be described according to: population size - finite or infinite; arrival distribution - constant, exponential, Erlang, hyperexponential, or of some other distribution; and customer attitude - patient or impatient.

The service system may be identified by queue size permitted - finite or infinite; service facility arrangement - series (tandem), parallel, or mixed; service-time distribution - constant, exponential, Erlang, hyperexponential, etc.; and by queue discipline - first come first served, random, priorities, preemptive priorities, or last come first served.

Classification notation for queuing systems has several accepted forms, however the Kendall notation as adapted by Lee (2) affords a concise abbreviation and will be used throughout this dissertation. The Kendall classification of queuing processes is of the form

X/B/s:(r/h) where X signifies the arrival distribution, B the service time distribution, s the number of service channels, r the maximum number of customers which can be in the system (queue plus service) at any time, and h denotes the queue discipline. Table I presents some of the common symbols used in this type of notation. An example of the use of this notation is M/M/2:(∞/FIFO). The noted system consists of two channels with infinite queue space and a first come first served queue discipline. Arrivals are Poisson and the service channels are exponential (Poisson distributions are reciprocal exponential distributions).

Analysis for orderly improvement of a queuing system requires that the distribution function for arrivals and service times be itemized and the type of queue discipline and the number and arrangement of service channels be specified.

Arrival distributions occurring in practice can usually be described by one of the well-known mathematical distributions such as constant time, exponential, Erlang, or hyperexponential (1). If arrivals occur at intervals of regular length, the cumulative distribution of time intervals between arrivals is given by the uniform distribution function (3).

$$A(t) = 0, \quad t < \tau$$

$$A(t) = 1, \quad t \geq \tau$$

If the interarrival time distribution is exponential, the arrival process is Poisson and has the cumulative frequency distribution function

$$A(t) = 1 - e^{-\lambda t} \qquad (2.00)$$

TABLE I

KENDALL CLASSIFICATION FOR QUEUING SYSTEMS

POSITION	NOTATION	MEANING
X	M	Arrivals are random but occur at a constant average rate of λ customers per unit time (Poisson process).
	D	Constant arrival rate uniformly distributed.
	G	General arrival distribution.
	E_k	Erlangian distribution of parameter k: i.e. the distribution of the sum of k independently and identically distributed negative exponential variables.
B	M	The service time distribution is negative exponential with a constant average value, $1/\mu$ time units per customer service.
	D	Same as above.
	E_k	Same as above.
	G	Same as above.
	Log Normal	Log normal distribution of service time.
s	Integer	The fixed number of service channels.
	c	A variable number of service channels.
r	Integer	Fixed number of customers permitted in the system at any time.
	∞	An infinite number of customers permitted in the system.
	1	The upper limit on the number of customers permitted in the system at any time.
h	FIFO	Customers are served strictly on the order of their arrival.
	LIFO	Last in queue, first into server.
	SIRO	Service in random order.
	NPPS	Nonpreemptive priority service.

The Erlangian frequency distribution describes the case which lies between the exponential and the uniform distributions. The Erlangian frequency distribution is

$$b_k(t) = [(\lambda k)^k/\Gamma(k)]e^{-\lambda kt}t^{k-1}dt \qquad (2.01)$$

where $\int_0^t b_k(t)$ = probability of at least one arrival during the interval t for the k<u>th</u> Erlang

If a Poisson arrival process is filtered so that only every k<u>th</u> arrival enters the system, the resulting frequency distribution of arrivals is given by $b_k(t)$. As k approaches ∞, the uniform distribution is obtained. As k approaches unity, the exponential distribution results.

Actual arrival time distributions have been reported for various processes. Bhata and Garg (1) reported Poisson distributions for arrival of customers at restaurants and failures of machines. Poisson arrivals were reported by Boyce and Phillips (4) for sugarcane transport vehicles arriving at unloading stations from the field and by Simmons (5) for milk trucks arriving at a plant dock in North Carolina.

Bouland (6) identified arrival distributions of wheat trucks at country elevators in the hard red winter wheat area of the central great plains as Poisson for arrival rates less than 35 per hour and as uniform for rates above 35 per hour. Arrival rate varied from a very low rate in the early morning to a maximum during the peak arrival period in middle or late afternoon. Fifty percent or more of the total season's receipts arrived over a 3 to 4 day period. Approximately 22 percent arrived during a single day.

Although other arrival distributions occur in practice, most can be approximated by the Poisson. This results from the inherent assumptions related to Poisson processes. In general, a Poisson arrival distribution occurs when the total number of arrivals during any given time interval is independent of the number of arrivals that have occurred prior to the start of the time interval (1).

A set of service or holding time distributions similiar to the interarrival time distributions is analogously defined. Service time distributions may be constant, exponential, Erlang, or hyperexponential, etc.

Service time distributions for operations common to agricultural processing or crop terminal plants have been reported as Erlang. Boyce and Phillips (4) found that Erlang parameters of 3.15 to 3.61 gave satisfactory results when used in $M/E_k/1:(\infty/FIFO)$ queuing formulas for a scale system. Bouland (6) also reported Erlang service time distributions for various operations at a country elevator. Mean times and Erlang parameters given by Bouland are presented in Table II.

Most agricultural crop terminals and crop processing plants utilize a single scale facility which serves both loaded and empty transport units. This results in a type of queuing system best described as a tandem partially cyclic system. Such systems are tandem in that each customer proceeds from the scale to an unloading server. They are only partially cyclic since, after each vehicle is unloaded, it returns to the scale for service but leaves the cycle after weighing empty. Queuing systems in which either the same scale is not used to reweigh the same vehicles or when vehicles are not required to reweigh, are not partially cyclic.

Bouland (7) describes three types of country grain elevators. Figure 1 shows a facility in which the scale and the unloader are adjacent. Vehicles queue in front of the scale entrance and proceed one at

TABLE II

MEAN OBSERVED TIMES WITH ASSOCIATED ERLANG DISTRIBUTIONS FOR VARIOUS SERVICE OPERATIONS PERFORMED AT COUNTRY ELEVATORS

OPERATION	2 MAN CREW		4 MAN CREW	
	Minutes	k	Minutes	k
Weighing and unloading at separate locations:				
Weighing loaded truck	0.65	6	0.51	10
Weighing empty truck	1.33	4	0.42	4
Total	1.98	—	0.93	—
Unloading truck	2.44	6	——	—
Weighing and unloading at the same location	5.24	10	——	—

Source: 6

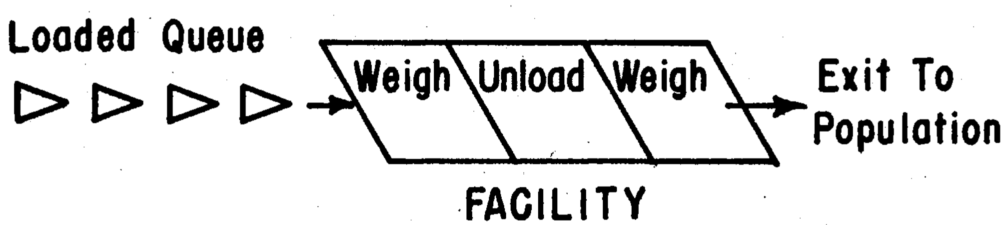

Figure 1. Scale and Unloader Combined

a time into the facility. Only one vehicle can be in the facility at any time. Loaded vehicles are weighed, unloaded, and the empty vehicle reweighed. The empty vehicle then exits, permitting the next loaded vehicle entry.

When the scale and unloader are separate servers, the total queuing system becomes tandem and partially cyclic. Figure 2 is a schematic of such a system. Loaded vehicles queue before the scale as one vehicle at a time is weighed. The loaded vehicles leaving the scale become arrivals at the unloader and join that queue. When unloading is complete, each vehicle returns to the scale for reweighing and subsequently departs to the population. Variations of this system include limited or virtually unlimited queue space at either or both facilities and multiple unloaders in parallel as shown in Figure 3.

Boyce and Phillips (4) describe the queuing systems at sugar cane processing plants as scale-unloader arrangements similiar to that of Figure 2. Similiar systems also occur at sugar beet plants and peanut drying plants. Cotton gins may operate either as tandem partially cyclic systems or as serial queuing processes when empty trailers are not reweighed at the scale.

Queuing system analysis may be accomplished by either mathematical or simulation methods. Most of the mathematical solutions reported in the literature have dealt with simple operational situations in which arrivals are Poisson and the service times follow constant or exponential distributions. Simulation methods are commonly used for more complicated queuing system studies where general service time and interarrival time distributions are not exponential and customer flow is complex. Unlike analytical solutions, the results of simulation studies are usually only applicable to the particular system simulated.

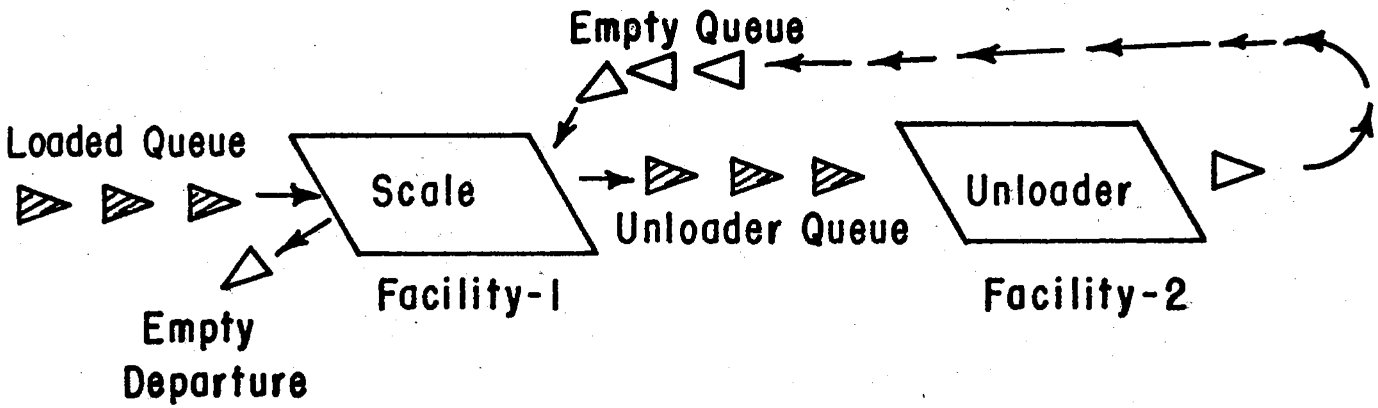

Figure 2. Tandem Partially Cyclic Queuing System

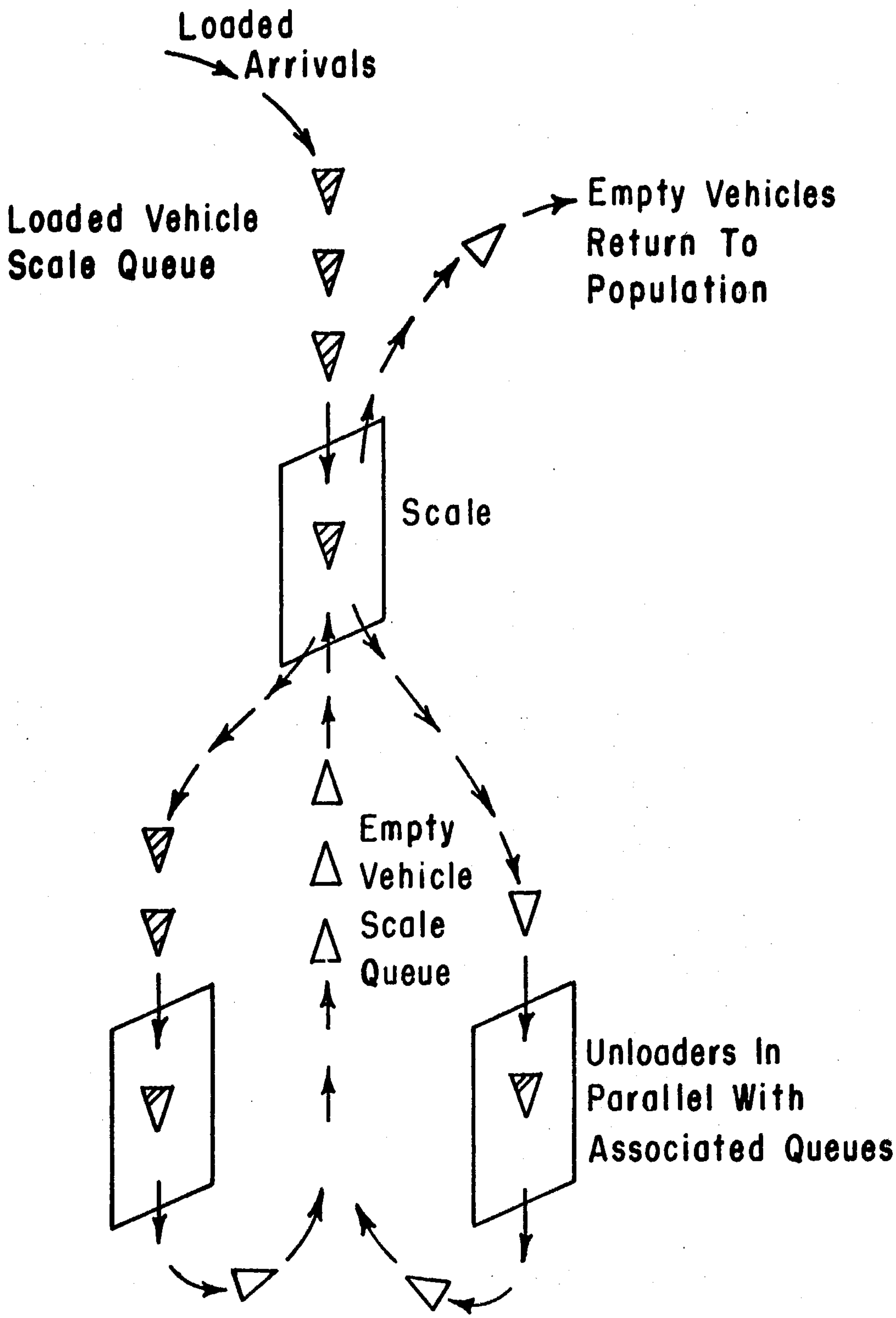

Figure 3. Tandem Partially Cyclic Queuing System With Two Parallel Servers

Analytical solutions for queuing systems related to the tandem partially cyclic system have been reported by several authors. Burke (8) proved that the output from each facility in a queuing system consisting of queues in series with exponential service times and Poisson input is also Poisson. Reich (9) presented the proof that the sojourn times (queue time plus service time) of a customer in a sequence of M/M/1:(∞/FIFO) queues in series are mutually independent if the intermediate servers are single channels. Extending the work of Reich, Burke (10) determined analytically that for a sequence of G/M/1:(∞/FIFO) queues in series, the first server must also be a single channel for the sojourn times to be mutually independent.

Hunt (11) derived the maximum possible utilization of a queuing system consisting of a number of facilities in series with limited queue space and under the assumption of exponential service times and Poisson input.

Hillier and Boling (12) extended the work of Hunt by considering a queuing system consisting of c service channels in series where each channel had an exponential or Erlang holding time and with all but the first queue limited to finite space. Their assumptions included the requirement that all service times have the same mean.

In another publication, Hillier and Boling (13) reported the effect of queue space at each service station for queues in series. Results of analysis of two exponential servers in series with Poisson input and with varying queue space before each server indicated that system capacity was increased by about 20 percent when available queue space was changed from none to four. Above four queue spaces, the benefit of additional space diminished.

Most analytical analyses result in steady state equations for the systems studied. From the equations the steady state expected values of the system queue characteristics are determined. Agricultural production is inherently paced by season and by ambient conditions which result in varying mean arrival rates of agricultural products at processing plants. Arrival patterns, although predictable, are not constant and thus a steady state either does not exist or exists with very short duration at such plants.

The simulation approach to queuing system analysis overcomes the problem of variable input. This method involves duplicating the arrival and service time statistics mechanically, usually by computer, either from historical or assumed data. By duplicating a large number of arrivals and assembling the resulting statistics, system behavior can be predicted. For digital computers, the Monte Carlo technique is usually employed which involves the generation of random variates which are converted to simulation data by cumulative frequency distributions. The frequency distributions are usually generated from historical data related to the system simulated. Various simulation languages for computer use are available such as GASP, SIMSCRIPT, CSL, SIMULA, and GPSS which make programming easier and more efficient (14).

Gue (15) presented a simulation method for finite queuing systems using an analog computer. The queuing system to be simulated is represented by signal flow graphs which facilitates patching the computer. The major limitation on this method is the size requirement for the computer. The number of amplifiers required is proportional to the number of customers and service channels.

The primary objective of most queuing studies is to determine the level of service such that the average cost of waiting plus the average cost of service is at a minimum. The approach is usually to determine the respective cost components and use them in an applicable cost model.

Hillier (16, 17) has outlined the construction of cost models for queuing systems. The typical model is of the form

$$TVC = C_d + C_f + C_w L \qquad (2.02)$$

C_d, the direct cost of service per server is the increment of cost attributable to the addition of the server in question, such as costs of labor and operating expenses. C_f, the indirect cost of service, includes only those costs which actually increase in a cash flow sense due to providing the server under consideration. Capital recovery cost is included in C_f. The mean number in the queue is indicated by L.

Waiting cost, C_w, is the net reduction in long run earnings of the firm due to waiting. Such items as lost productive output, deterioration in customer relations, idle in-process inventories, increased expediting, supervision, and administrative costs should be considered. Lost production due to waiting primarily applies to industries which own the waiting units or when waiting units would otherwise be engaged in productive activity for the industry. Losses due to deteriorating customer relations are difficult to ascertain. Hillier (16, 17) suggests that this element be evaluated from the standpoint of estimated worth of customer relations and the meeting of competition.

Improvement of queuing systems inherently involves seeking to shorten queues and thus reduce the average waiting time of customers. Methods for reducing queue lengths are usually closely related to the type of industry and depend on the identity of the waiting units.

Leeman (18) suggests several possibilities all having to do with pricing as the primary means of shortening human or human related queues. Some of his suggestions include the use by supermarkets of a checkout fee which would be higher for the normally busier periods. Management could adjust the fee by trial and error. The stores could advertise the schedule of checkout fees so that customers could arrange their shopping schedules.

Other suggested uses of price to reduce queues include a "boarding fee" for cabs during the rush hours, entry fees at toll booths for turnpikes, and landing and take-off fees for aircraft during the peak periods of airport activity.

Bouland (6) listed ways that the queuing systems at country elevators could be improved. His suggestions include the following:

1. Encourage farmers to use rapid unloading truck beds.
2. Pay a premium for truck loads of dry grain arriving during the slack periods of the day.
3. Consider balancing the cost of new facilities with bonus money paid to those truckers having to wait.
4. Provide better communication among harvesting crews, truckers, farmers, and elevator operators.

CHAPTER III

QUEUING SYSTEM ANALYSIS

Analysis of the queuing systems commonly in use at agricultural processing plants and terminals may be accomplished through consideration of two basic types; the single server facility having the scale and unloader combined and the tandem system which has the scale and unloader in series.

Scale and Unloader Combined

The combined scale and unloader system services only one vehicle at a time. A schematic of such a system is presented in Figure 1. Loaded vehicles arrive at the system and join the queue in front of the scale entrance. As the server becomes available, the next in line enters, is weighed, unloaded, and reweighed. The vehicle exits freeing the server for the next vehicle in queue. The sequential and distinct phases of service performed in this arrangement suggests analysis as an $M/E_k/1:(\infty/FIFO)$ system.

Theoretically, each of the k phases of service should have the same mean service time and be exponentially distributed. The total system service times are thus distributed as the sum of k, independently and identically distributed times, resulting in the Erlang distribution

$$g(t) = \frac{k\mu}{(k-1)!}(k\mu t)^{(k-1)} e^{-k\mu t}, \quad t>0 \qquad (3.01)$$

For k phases of service, each phase has a mean service time equal to $1/k\mu$.

When a common mean for all k phases of service does not exist, an equivalent k value is obtained through analysis of observed data and the system considered to function as an Erlang facility with parameter k equivalent. Lee (2) states that it is not necessary that a system actually have distinct k phases of service to be treated as an Erlang server but simply that the system act as though it had.

Steady state equations for the $M/E_k/1:(\infty/FIFO)$ system are presented in Table III.

TABLE III

STEADY STATE EQUATIONS FOR THE $M/E_k/1:(\infty/FIFO)$ QUEUING SYSTEM

Entity	Function
$\bar{n}_q$	$\frac{k+1}{2k} \cdot \frac{\lambda^2}{\mu\ (\mu-\lambda)}$
$\bar{n}$	$\frac{k+1}{2k} \cdot \frac{(\lambda/\mu)}{1-(\lambda/\mu)}$
$\bar{w}_q$	$\frac{k+1}{2k} \cdot \frac{\lambda/\mu}{\mu-\lambda}$
$\bar{w}$	$\frac{k+1}{2k} \cdot \frac{1}{\mu-\lambda}$

Scale and Unloader in Tandem (Noncyclic)

One of the basic types of tandem queuing systems in use at agricultural processing installations is the tandem scale and unloader shown in Figure 4. Loaded vehicles join the scale queue and wait to be served on a FIFO basis. When the scale becomes free, the next in queue is weighed and exits to join the unloader queue. When service at the unloader is complete, the vehicle departs the system.

Series M/M/1:(∞/FIFO) Facilities

The tandem system having exponential service time distributions at both the scale and unloader, adequate queue space before each server to be considered infinite, and Poisson arrivals, may be analyzed as two M/M/1:(∞/FIFO) facilities in series. Analysis is direct since each facility may be treated separately (8). The steady state equations for M/M/1:(∞/FIFO) facilities in series are presented in Table IV as given by Jackson (19). Customer waiting time may be determined by the formula

$$\bar{w} = \bar{n}/\lambda \qquad (3.02)$$

When there is limited queue space at the unloader facility, the system equations vary from those of Table IV. Hunt (11) has indicated that the maximum utilization level is reduced to

$$\rho_{max} = \mu_2(\mu_1^{q+1} - \mu_2^{q+1})/(\mu_1^{q+2} - \mu_2^{q+2}) \qquad (3.03)$$

where μ_1, μ_2 = service rate at the scale and unloader respectively. The theoretical maximum arrival rate that this tandem system can sustain without attaining infinite queue length is then

$$\lambda_{max} = \mu_1 \; \rho_{max} \qquad (3.04)$$

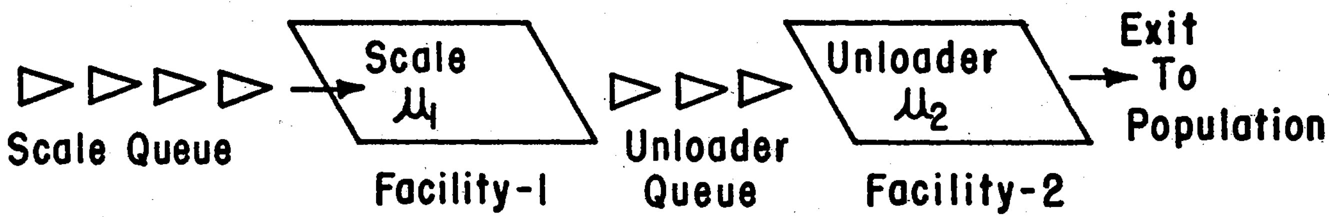

Figure 4. Scale and Unloader in Tandem

TABLE IV

STEADY STATE EQUATIONS FOR TWO M/M/1:(∞/FIFO) QUEUING SYSTEMS IN TANDEM

Entity	Facility 1	Facility 2
$\bar{n}_q$	$\frac{(\lambda/\mu_1)^2}{1-\lambda/\mu_1}$	$\frac{(\lambda/\mu_2)^2}{1-\lambda/\mu_2}$
$\bar{n}$	$\frac{(\lambda/\mu_1)}{1-\lambda/\mu_1}$	$\frac{(\lambda/\mu_2)}{1-\lambda/\mu_2}$
$\bar{w}_q$	$\frac{\lambda}{\mu_1(\mu_1-\lambda)}$	$\frac{\lambda}{\mu_2(\mu_2-\lambda)}$
$\bar{w}$	$\frac{1}{\mu_1-\lambda}$	$\frac{1}{\mu_2-\lambda}$

Since the queue space at most agricultural processing plants is finite in the strict sense, it is desirable to apply an approximation as outlined by Lee (2). When sufficient queue space is provided such that at least 90 percent of the time an arriving customer will find waiting space, the output from an M/M/1:(r/FIFO) queuing system may be treated as being Poisson distributed. The equations of Table IV may then be applied.

The stipulation of a maximum rejection probability at either of the facilities having to be equal to or less than 0.1 for application of the equations of Table IV is of consequence when the traffic intensity ratio is increased.

Let q be the number of available queue spaces at a facility. Then the only time when an arrival would be rejected at the queue would be when q + 1 customers were in the system. The probability density function for an M/M/1 queuing system is

$$P_n = (1 - \lambda/\mu)(\lambda/\mu)^n \qquad (3.05)$$

The probability of rejection is given by 1 - probability of (0, 1, 2, ...q) customers being in the system. Thus the probability of rejection (P_r) is

$$P_r = 1 - \sum_{n=0}^{q} P_n \qquad (3.06)$$

Setting P_r of equation 3.06 equal to 0.1 and substituting the expression for P_n from equation 3.05 yields

$$0.1 = 1 - [(1 - \lambda/\mu) \sum_{n=0}^{q} (\lambda/\mu)^n] \qquad (3.07)$$

A graphical representation of equation 3.07 is presented in Figure 5.

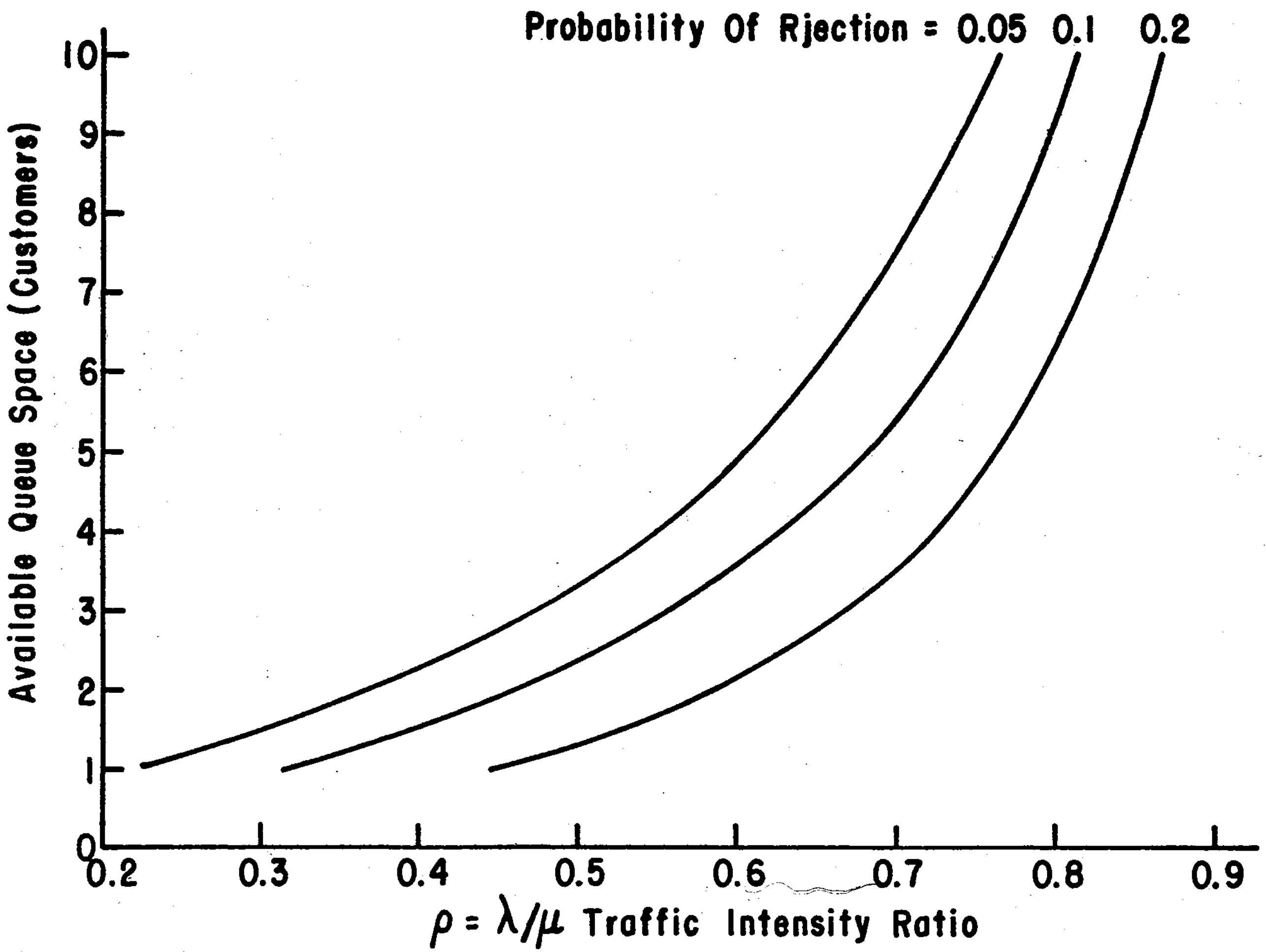

Figure 5. Rejection Probability as a Function of Available Queue Space and Traffic Intensity Ratio for an M/M/1:(r/FIFO) Queuing Facility

$M/E_k/1:(\infty/FIFO)$ and $G/G/1:(\infty/FIFO)$ in Series

A common type of the noncyclic tandem system is that of an $M/E_k/1:(\infty/FIFO)$ facility feeding into a $G/G/1:(\infty/FIFO)$ facility. An example of this type is that of a cotton gin where the empty vehicles are not required to reweigh after unloading.

The steady state operational characteristics of the $M/E_k/1:(\infty/FIFO)$ facility may be described by the equations of Table III. When sufficient queue space exists before the $G/G/1:(\infty/FIFO)$ facility to prevent blocking of the first, the two facilities operate independently. The second facility has an unknown arrival distribution and thus must be analyzed either by mathematical procedures or by simulation. Appendix A presents the results of GPSS/360 (General Purpose Simulation System/ IBM 360) simulation of a noncyclic tandem system with Poisson arrivals, Erlang service time distributions at both facilities, and infinite queue space. An arrival rate of 0.167 customers per minute, and varying service rates of 0.1 to 1.0 customers per minute at the first facility and from 0.022 to 0.040 customers per minute at the second facility were used. The GPSS simulation program for the data of Appendix A is presented in Appendix C-I. Simulation was limited to steady state operation and to two simulation series of 250 customers each. Appendix A contains combined average values of the two simulation runs.

Figures 6 and 7 indicate that the service rates at facility 1 and the Erlang parameters at both facilities have only slight influence on the operational characteristics $\bar{n}_q$ and $\bar{w}_q$ at the second facility. Similar indications are observed regarding the probability of a

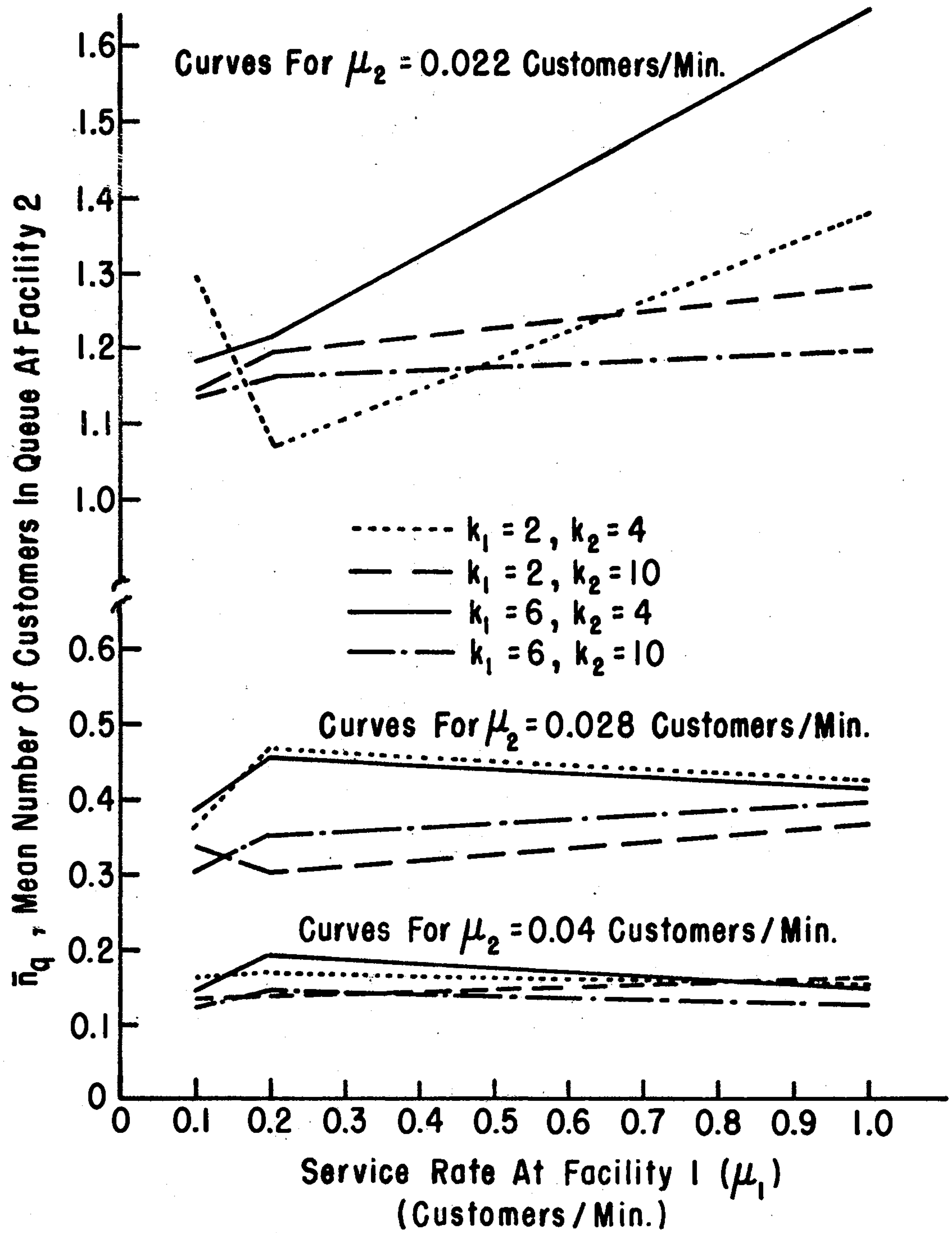

Figure 6. Mean Number in Queue at Facility 2 for Tandem Erlang Servers (λ = 0.167 customers/minute)

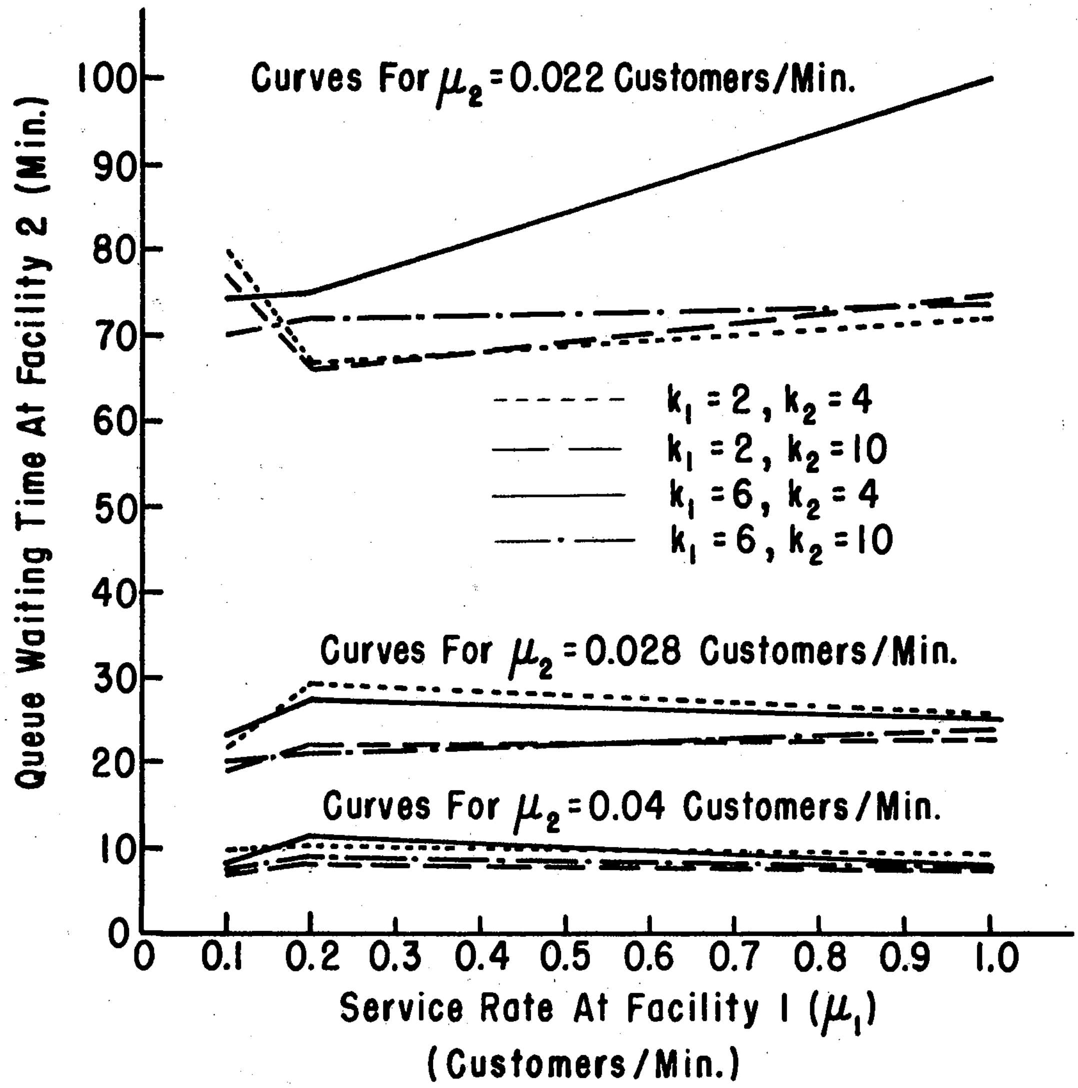

Figure 7. Queue Waiting Time at Facility 2 for Tandem Erlang Servers (λ = 0.167 customers/minute)

customer waiting longer than thirty seconds in queue 1 or longer than 60 minutes in queue 2. Determining the magnitude of the effect of varying arrival rate would require further simulation. Increasing arrival rates generally result in even longer queues and queue times.

Tandem Partially Cyclic Queuing System

The most prevalent type of tandem queuing system found at agricultural processing plants is the tandem partially cyclic system shown schematically in Figure 2. The scale is usually the first server for loaded vehicles arriving at a plant. After weighing, vehicles move to the unloader (facility 2) where they join the unloader queue. When unloading is complete, vehicles return to the scale (facility 1) where they either join the loaded queue or form an additional queue (empty queue). When reweighing is complete, vehicles depart the system.

Queue discipline at the scale may be of several types. When a single queue is maintained at the scale, a FIFO discipline is usually employed. For two opposing queues at the scale, either a priority discipline is used or an arbitrary discipline is maintained. Often a queue discipline is used which alternates between the loaded and empty queues, weighing first a batch of empty vehicles and then a batch of loaded vehicles.

Tandem Partially Cyclic M/M/1:(∞/FIFO) Facilities

Analysis of the tandem partially cyclic group of queuing systems is logically initiated by considering the simplest case represented by two (M/M/1:∞/FIFO) service facilities in tandem. Under steady state operation, customers arrive at facility 1 in Poisson fashion with mean rate λ and join queue 1. Members of queue 1 are served on a FIFO basis by facility 1 which has exponential service times with mean equal to $1/\mu_1$.

Based on the discussion by Burke (8), the output of facility 1 must be Poisson with the same mean as the input. Since twice the average arrival rate is continually joining queue 1, the discharge mean from facility 1 must be 2 λ but with only λ joining queue 2. The effective arrival rate at facility 1 is thus 2 λ while at facility 2 it is λ.

Steady state equations can be written for each service facility separately since they are independent (19). Table V contains the steady state equations for a tandem partially cyclic queuing system with both facilities being M/M/1:(∞/FIFO).

Total system values for $\bar{n}$, $\bar{n}_q$, and $\bar{w}_q$ may be obtained by algebraic addition of equations for the two facilities for each respective entity. The average time a customer spends in the system must include the two separate waits in facility 1.

Tandem Partially Cyclic M/M/1:(∞/FIFO)
<u>Facilities, Dual Service Time at Facility 1</u>

A more common tandem partially cyclic queuing system is one in which facility 1 has two different service times depending on whether the customer is being served for the first time or the second. For first time service a customer is served at a mean rate of μ_f and for second time service with a mean rate of μ_s, all service times being exponentially distributed. Only one of either category (first or second time service) may occupy the first facility at any time. Facility 1 thus operates similar to a hyperexponential system. In true

TABLE V

STEADY STATE EQUATIONS FOR A TANDEM PARTIALLY CYCLIC QUEUING SYSTEM COMPOSED OF M/M/1:(∞/FIFO) FACILITIES

Entity	Facility 1	Facility 2
$\bar{n}$	$2\lambda/(\mu_1-2\lambda)$	$\lambda/(\mu_2-\lambda)$
$\bar{n}_q$	$4\lambda^2/\mu_1(\mu_1-2\lambda)$	$\lambda^2/\mu_2(\mu_2-\lambda)$
$\bar{w}_q$	$2\lambda/\mu_1(\mu_1-2\lambda)$	$\lambda/\mu_2(\mu_2-\lambda)$
$P(w>t)$	$(2\lambda/\mu_1)e^{-t(\mu_1-2\lambda)}$	$(\lambda/\mu_2)e^{-t(\mu_2-\lambda)}$
$w(t)$	$(2\lambda/\mu_1)(\mu_1-2\lambda)e^{-t(\mu_1-2\lambda)}$	$(\lambda/\mu_2)(\mu_2-\lambda)e^{-t(\mu_2-\lambda)}$

hyperexponential facilities, the individual service rates μ_f and μ_s are functions of the fraction of customers served at each rate. Thus when an equal number of customers are served at each rate, the hyperexponential system operates at a single service rate. Facility 1 has equal numbers of customers served at rates μ_f and μ_s yet μ_f and μ_s are distinct and different rates of service.

Appendix B contains the derivation of the steady state queuing equations for a hyperexponential type facility with dual exponential servers. Facility 1 of the tandem partially cyclic queuing system having dual service rates μ_f and μ_s, has bunches of short and long services. Due to this characteristic, the standard deviation from the mean service time is greater than for the case where μ_f equals μ_s. This can be shown by calculating the standard deviation for several ratios of μ_f and μ_s using equation 8.6 of Appendix B. When μ_f is equal to μ_s, the standard deviation is $1/\mu$ where $\mu = \frac{2\mu_f \mu_s}{\mu_f + \mu_s}$. When μ_f equals $2\mu_s$, the standard deviation is $1.11/\mu$ and for $\mu_f = 4\mu_s$, it is $1.31/\mu$. The result is that the service time distribution for the dual server (facility 1) is not exponential and thus the total discharge is not Poisson. This characteristic thus theoretically precludes analysis of the tandem partially cyclic queuing system with dual service rates at facility 1 as two exponential facilities in series. However, since only half of the discharged customers of facility 1 enter facility 2 and since all of those experience the same mean service rate at facility 1, the equations of Appendix B were found to adequately predict the steady state behavior of facility 1. Table VI contains a comparison of the operational queue characteristics obtained by simulating the tandem partially cyclic queuing system with those computed by the theoretical equations of Appendix B.

TABLE VI

THEORETICAL VALUES OF OPERATIONAL CHARACTERISTICS VERSUS SIMULATED VALUES FOR THE TANDEM PARTIALLY CYCLIC QUEUING SYSTEM (FACILITY 1)

Entity	Theoretical Value	Simulated Value	Percent Deviation From Simulated
	(λ = 0.15, μ_f = 2.06, μ_s = 1.65)		
$\bar{n}_q$	0.033	0.034	-4.1
$\bar{w}_q$	0.109	0.116	-6.0
ρ	0.164	0.162	1.2
	(λ = 0.19, μ_f = 0.885, μ_s = 2.58)		
$\bar{n}_q$	0.143	0.152	-5.9
$\bar{w}_q$	0.377	0.396	-4.8
ρ	0.287	0.293	-2.0

Tandem Partially Cyclic $M/E_k/1:(\infty/FIFO)$ System

When Erlang distributed service times were substituted for the exponential distributions in facilities 1 and 2, the equations of Appendix B proved unsatisfactory for predicting the system behavior. Rather than deriving exact mathematical relationships, prediction equations which approximate the operational characteristics were obtained through simulation and curve fitting techniques. The tandem partially cyclic system, shown schematically in Figure 8, was simulated by the GPSS program of Appendix C-II using mean service times, mean arrival rates, and Erlang parameters representative of those actually found at agricultural installations (4, 6).

Dimensionless terms were selected to guide in the combination of system parameters and to reduce the necessary amount of simulation. Selected terms were λ/μ_f, λ/μ_2, μ_s/μ_f, k_f, k_s, and k_2 where μ_f and μ_s apply to facility 1.

Each of the selected terms were varied with the others held constant. Each system parameter was varied over its respective range.

Queue characteristics were obtained for 55 different combinations of the parameters. A nonlinear curve fitting computer program was used to determine the prediction equations relating system parameters to the operational queue characteristics. The equations for the queuing system of Figure 8 are presented in Table VII.

The equations of Table VII are valid for the following ranges of system parameters:

λ, 0.15 to 0.48 customers/minute

μ_f, 0.80 to 2.00 customers/minute

μ_s, 0.63 to 2.50 customers/minute

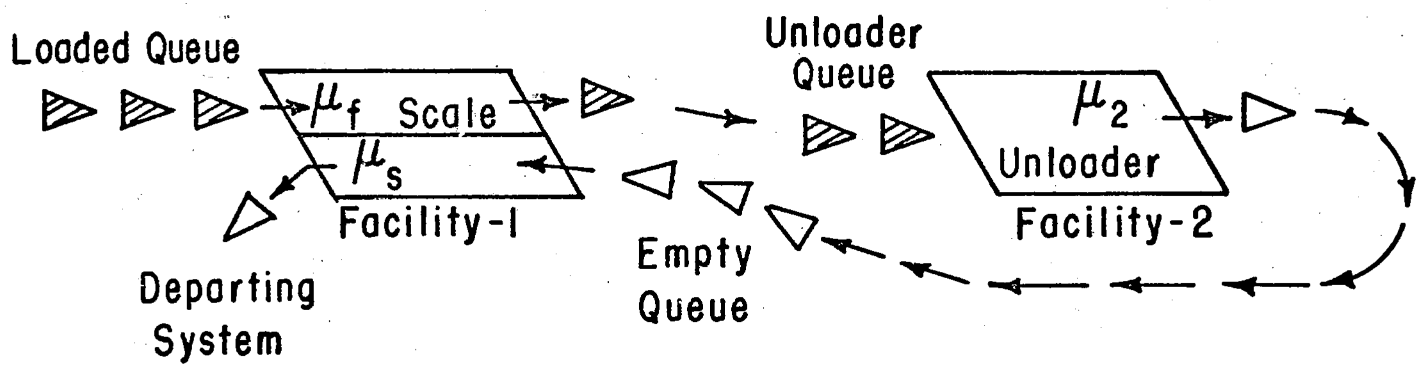

Figure 8. Tandem Partially Cyclic Queuing System With Erlang Servers and Dual Service Rates at Facility 1

TABLE VII

EMPIRICAL STEADY STATE EQUATIONS FOR A TANDEM PARTIALLY CYCLIC QUEUING SYSTEM WITH ERLANG SERVERS AND DUAL SERVICE RATES AT THE FIRST FACILITY

Predicted Entity	Function	Goodness Of Fit Ratio
$\bar{n}_q$ Facility 1	$0.070 k_f^{0.088} k_s^{0.688} k_2^{0.015}\left[\frac{2\rho^2 - (\lambda^2/\mu_f\mu_s)}{(1-\rho)}\right]$	0.873
$\bar{w}_q$ Facility 1	$0.036 k_f^{0.106} k_s^{0.681} k_2^{0.031}\left[\frac{2\rho^2 - (\lambda^2/\mu_f\mu_s)}{\lambda(1-\rho)}\right]$	0.809
ρ Facility 1	$\lambda(\mu_f + \mu_s)/\mu_f\mu_s$	0.810
$\bar{n}_q$ Facility 2	$3.89e^{0.196\left[\frac{(k_2+1)^2\lambda^4}{4k_2^2\mu_2^4[1-(\lambda/\mu_2)]^2}(k_s/k_2)^{2.79}\right]} - 3.26$	0.738
$\bar{w}_q$ Facility 2	$\frac{3.81}{\lambda}e^{0.192\left[\frac{(k_2+1)^2\lambda^4}{4k_2^2\mu_2^4[1-(\lambda/\mu_2)]^2}(k_s/k_2)^{2.79}\right]} + (3.14/\lambda)$	0.765
ρ Facility 2	λ/μ_2	>0.95

*Goodness of fit ratio is a measure of how well the empirical values of operational queue characteristics predicted the simulated values.

μ_2, 0.20 to 0.63 customers/minute

k_f, 6 to 10

k_s, 4 to 6

k_2, 6 to 10

Variation in the number of channels at facility 2 for systems similar to the one of Figure 8 would result in altering the equations of Table VII. Increasing the number of parallel servers in the system would result in decreases in mean queue length at facility 2 and alteration in the arrival distribution of the customers returning to facility 1. The most direct method of analysis would be to use the established methods of computer simulation for each individual case.

Priority Queue Discipline

One of the options which processing plant management may exercise is giving priority to one class of customers over another. For this to occur, at least one service facility must service two or more classes of customers. Such a facility could be the scale which weighs both loaded and empty vehicles.

Morse (20) has investigated the situation of priorities for an M/M/1:(∞/FIFO) facility serving two classes of customers. Each class requires a different length of service. Although this system is not compatible with the tandem partially cyclic system of Figure 8, the analysis may be useful in estimating the worth of priority in such tandem systems.

Equations which describe the results of priority for a dual service M/M/1:(∞/FIFO) facility are presented in Table VIII.

TABLE VIII

STEADY STATE PRIORITY EQUATIONS FOR A DUAL SERVICE M/M/1:(∞/FIFO) FACILITY

Entity	Function
$\bar{n}_p$	$\alpha\rho + \bar{n}_{qp}$
$\bar{n}_n$	$(1 - \alpha)(\rho/\beta) + \bar{n}_{qn}$
$\bar{n}_q$	$\bar{n}_{qp} + \bar{n}_{qn}$
$\bar{n}_{qp}$	$\alpha\rho^2 \left[\frac{\alpha + (1-\alpha)(1/\beta^2)}{1 - \alpha\rho}\right]$
$\bar{n}_{qn}$	$[(1 - \alpha)\rho^2/(1 - \alpha\rho)]\left[\frac{\alpha + (1 - \alpha)(1/\beta^2)}{1 - \alpha\rho - (1 - \alpha)(\rho/\beta)}\right]$
$\bar{w}_{qp}$	$\bar{n}_{qp}/\alpha\lambda$
$\bar{w}_{qn}$	$\bar{n}_{qn}/(1 - \alpha)\lambda$

Comparison of these equations with those of the nonpriority system reveals that induced priorities result in increases in the mean number of nonpriority customers in the total queue. The mean number of priority customers in the total queue is decreased. Likewise, the average waiting time in queue is shortened for the priority class and increased for the nonpriority class. Since waiting space at processing plants is usually more limited within the confines of the plant than without, the logical class of customers to be granted priority are those returning to the facility in question from a point within the plant. In the system of Figure 8, the customers in the empty vehicle queue should get priority if it is to be granted.

The waiting time is affected by the factor

$$\frac{1 - \alpha\rho[\alpha + (1 - \alpha)(1/\beta)]}{1 - \alpha\rho} \tag{3.08}$$

When the ratio is greater than unity, the average waiting time of all customers is greater and there are more customers in queue than if no priority were granted. If it is less than unity, the opposite effect is produced. Direct application to facility 1 of Figure 8 results in $\alpha = \frac{1}{2}$ (as many priority as nonpriority customers arrive). β, which is the ratio μ_p/μ_n, becomes the dominating factor. If priority is granted to the second time customers, then β becomes μ_s/μ_f and only when $\mu_s/\mu_f<1$ is there any reduction in total waiting time.

The relative effect of priority on the overall waiting time and length of queue is directly proportional to the ratio of Equation 3.08. Increases in this ratio result in increases in overall waiting time and queue length.

CHAPTER IV

PRESENTATION AND ANALYSIS OF QUEUING DATA

Queuing data were recorded at selected grain elevators and cotton gins during the harvest periods of 1970 and 1971. Arrival and service time data were collected at these locations to be used in analyzing the individual queuing systems. Arrival patterns of the agricultural products involved and variations in arrival rates were of special interest.

Grain Elevator

Extensive monitoring of the Farmers Cooperative exchange in Weatherford, Oklahoma was made throughout the major portion of the 1970 grain harvesting season. Vehicle arrivals at the elevator and subsequent travel within the plant confines were observed from a single vantage point. The queuing system at the Weatherford elevator is shown schematically in Figure 9. Separate unloaders for barley, oats, and wheat were provided. Two wheat unloading bays were used during peak arrival periods. Queue space throughout the plant was four or more vehicle spaces at each unloader.

Time was recorded when a loaded vehicle joined the scale queue, departed the scale, returned to the scale queue empty, and departed the scale. Unloader codes were associated with the vehicles to identify the unloading bay receiving the load. Wheat unloader #1 and #2 and the barley unloader were identified by code numbers one through three

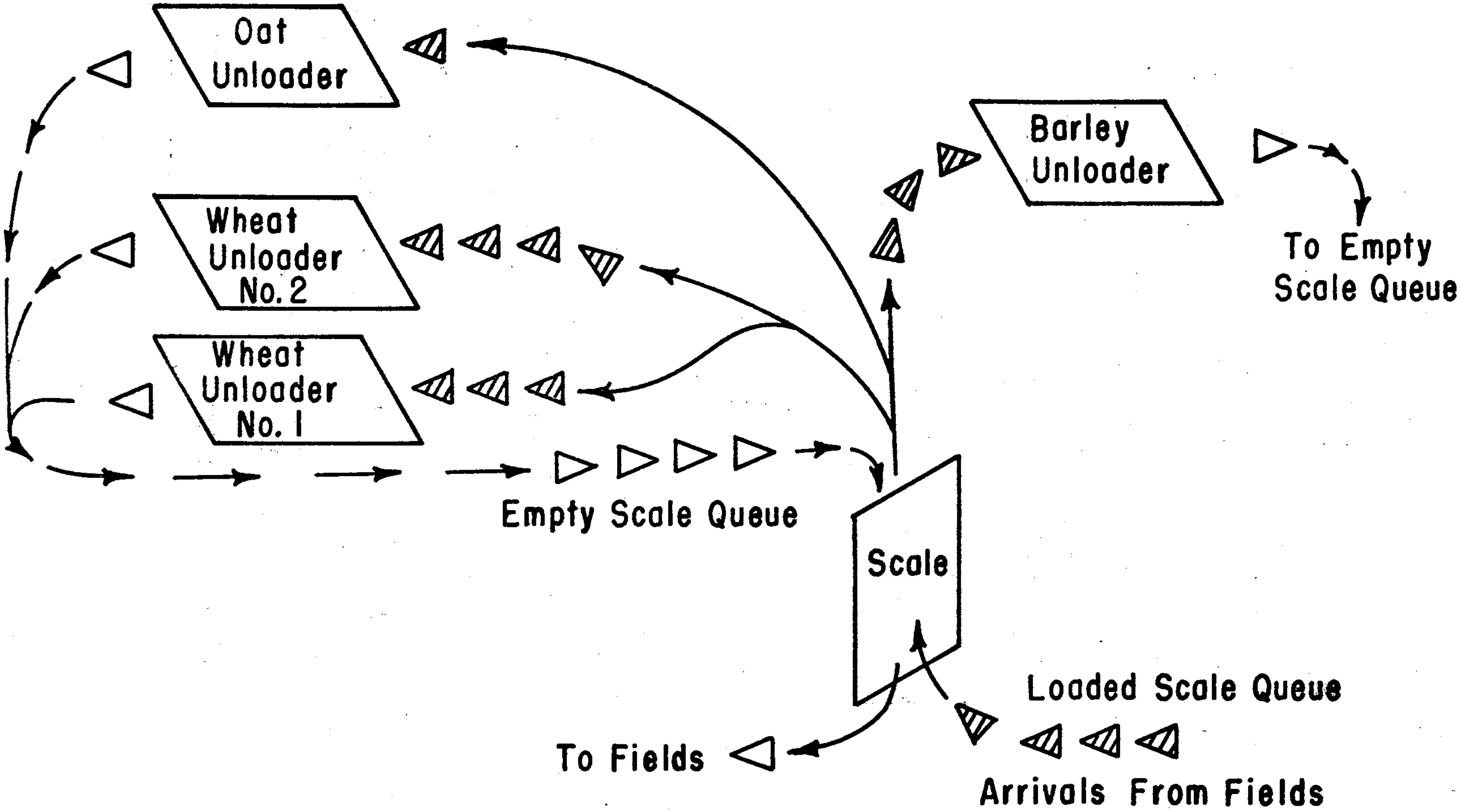

Figure 9. Queuing Systems at the Farmers Cooperative Exchange, Weatherford, Oklahoma

respectively. Unloader code 4 was associated with those vehicles which left without completing the service cycle either due to forgetting to reweigh or intentionally taking the load elsewhere. License plate numbers were used to maintain the individual vehicle identities for each recorded event. The time recordings at Weatherford are included in Appendix D-I.

Some of the time data of Appendix D-I is missing. Occasionally, events occurred so rapidly that a data entry was missed. These represent about two percent of the missing values. On June 9 the main scale broke down resulting in traffic flow to a standby scale. This scale could not be observed from the original observation post and consequently, only the times of loaded arrivals were recorded during the breakdown period. The rest of the data vacancies, other than those associated with code 4, resulted from the decision to record only loaded arrival and system departure times during the latter days of the harvest season.

Analysis of the loaded vehicle arrival data consisted of testing for independence and determining the interarrival time distribution. Interarrival times were computed by taking the difference between successive arrival times. Independence of the data, meaning that the interarrival times were of random length and were not affected by the length of any previous arrival, was determined using the "theory of runs" test (21). Analysis of the data for June 6, 1971 at Weatherford is presented in Appendix D-III. The deviation of the actual total of runs from the expected number of runs is zero which is less than the standard deviation of the total number of runs. The probability of the occurrence in a random sample of a run of length four is 0.8875.

Thus the hypothesis that the data are independent should not be rejected.

The data were analyzed for goodness of fit to a Poisson distribution. The observed and expected frequency values were used to compute the statistic

$$\chi^2 = \Sigma \frac{(\text{observed-expected})^2}{\text{expected}}$$

with the summation taken over all intervals. The expected number of occurrences of arrivals was given by the product of the probability of an occurrence times the number in the random sample. In this case, the random sample was equal to the number of observations under the hypothesis that the population consisted of Poisson distributed variates. Thus the expected frequency of occurrence within a time interval t was given by $A(t) \cdot N$, where $A(t)$ equals $(1 - e^{-\lambda t})$ and N represents the number in the sample. (Reference equation 2.00)

The observed frequency was determined by partitioning the observed data into cumulative time intervals of approximately one-half of a standard deviation and counting the number of interarrival times bounded by each interval.

The chi-square value was compared with the tabulated values of chi-square at the five percent significance level. The degree of freedom was determined by the number of intervals less one. The test for goodness of fit to a Poisson distribution for the arrival data recorded at Weatherford, June 6 is presented in Appendix D-IV.

A summary of statistics associated with the arrival data for each complete day is presented in Table IX. All but one day's (11th) data were independent and all of the individual day's arrival distributions except one (9th) were Poisson.

TABLE IX

SUMMARY OF ARRIVAL TIME STATISTICS
FOR EACH HARVEST DAY

Harvest Day	Number of Observ.	Range	Mean Inter-Arrival Time	Variance	Std. Dev.	Indep. Data	Poisson Dist.
June 6	149	26.1*	4.9*	26.4	5.13	yes	yes
June 7	190	44.3	4.5	36.8	6.06	yes	yes
June 8	351	28.1	2.7	10.5	3.24	yes	yes
June 9	409	28.9	2.4	10.1	3.18	yes	no
June 10	367	21.3	2.6	10.5	3.24	yes	yes
June 11	58	29.0	5.8	51.4	7.17	?	yes
June 12	155	10.2	2.0	5.2	2.28	yes	yes
June 13	252	68.1	3.7	30.6	5.53	yes	yes
June 14	76	29.3	6.5	43.9	6.63	yes	yes

*All times in minutes.

Data from three of the highest receipt days (8, 9, 10) were divided into periods of from 7 A.M. to 1 P.M., 1 P.M. to 3 P.M., 3 P.M. to 5 P.M., 5 P.M. to 7 P.M., 7 P.M. to 9 P.M., and 9 P.M. to midnight. Each period's data was subjected individually to the arrival analysis previously outlined. A summary of the statistics associated with that analysis is presented in Table X. Essentially all periods had independent data and Poisson arrivals.

Service time analysis consisted of determining the individual periods of service time for each facility and evaluating these for the mean, standard deviation, range, and service time distribution. Both loaded and empty vehicle service times at the scale and unloading service times at the wheat and barley unloaders were analyzed for the harvest days June 6, 7, and 8.

Data vacancies due to missed recordings were filled with the average of the ten preceeding respective time periods. Service times were obtained by ranking each event for a particular harvest day in ascending order by time of occurrence and computing the time differences for the respective events of interest.

The average time for servicing a loaded vehicle at the scale on the three days June 6, 7, and 8 was 1.1 minutes. This included sampling of the product while weighing the vehicle. The average time for weighing an empty vehicle was 1.0 minute. This included handing the scale ticket to the driver. All weigh times included positioning time of the vehicle on the scale platform.

Although 1.1 and 1.0 minutes were observed to be the overall average scale time for loaded and empty vehicles respectively, simulation of a queuing system similar to the Weatherford elevator indicated that

TABLE X

SUMMARY OF ARRIVAL TIME STATISTICS
FOR EACH OF SIX PERIODS DURING
JUNE 8, 9, AND 10, 1970

Harvest Day	Time Period	Number of Observ.	Range	Mean Inter-Arrival Time	Variance	Std. Dev.	Indep. Data	Poisson Dist.
June 8	7 A.M. - 1 P.M.	68	28.1*	4.6*	29.0	5.38	yes	yes
	1 P.M. - 3 P.M.	47	8.7	2.5	3.9	1.97	yes	yes
	3 P.M. - 5 P.M.	52	8.3	2.2	4.0	2.00	yes	yes
	5 P.M. - 7 P.M.	49	14.9	2.4	8.1	2.85	yes	yes
	7 P.M. - 9 P.M.	69	6.4	1.7	2.0	1.40	yes	yes
	9 P.M. - Midnight	61	13.1	2.7	8.0	2.82	?	yes
June 9	7 A.M. - 1 P.M.	85	24.8	3.7	17.1	4.14	yes	yes
	1 P.M. - 3 P.M.	65	9.6	1.7	2.8	1.69	yes	yes
	3 P.M. - 5 P.M.	56	28.8	2.1	15.6	3.95	yes	yes
	5 P.M. - 7 P.M.	65	8.9	1.8	3.3	1.81	yes	yes
	7 P.M. - 9 P.M.	66	10.7	1.7	4.4	2.10	yes	yes
	9 P.M. - Midnight	67	21.7	2.7	11.2	3.35	yes	yes
June 10	7 A.M. - 1 P.M.	70	21.3	4.8	23.8	4.88	yes	yes
	1 P.M. - 3 P.M.	64	9.3	1.8	3.8	1.96	yes	yes
	3 P.M. - 5 P.M.	67	9.8	1.8	4.0	2.00	yes	yes
	5 P.M. - 7 P.M.	51	15.8	2.3	8.0	2.82	?	yes
	7 P.M. - 9 P.M.	56	9.9	2.0	3.4	1.84	yes	yes
	9 P.M. - Midnight	none	—	—	—	—	—	—

*All times in minutes.

faster scale service times were in effect during busy periods. Service times as low as 20 seconds were observed during peak periods on June 8. As peak periods occurred, more personnel were used at the scale to pass tickets to the drivers and to take samples thus causing the scale service time data to be dependent on queue length during peak arrival periods. The lower observed scale service times were consistent with those reported by Bouland (7) for a four man scale crew.

Service times at the scale were analyzed for goodness of fit to an Erlang distribution. The results are presented in Table XI. Results of comparing the actual scale service time distribution with various Erlang distributions indicate that statistically, only about one-half of the data were distributed Erlangian. Those days having Erlang distributions are shown in Table XI by the underlined chi-square values beneath the respective k parameter. Generally, scale service times for loaded vehicles had the lowest chi-square values for Erlang distribution parameters of 3 to 5. Scale service times for empty vehicles had the lowest chi-square values for k of 8 to 9.

Unloading time was assumed to include travel time between the scale and unloader and the actual time for dumping the grain. Queuing time at the unloaders was not included. The two unloader bays, identified as unloader #1 and #2 in Figure 9, were simultaneously in use only during peak arrival periods. Only self dumping vehicles hauling wheat were serviced at unloader #1. During peak periods, unloader #2 serviced only the remaining vehicles hauling wheat. Oats and barley went to the oat unloader and barley unloader respectively.

Service time at the unloaders averaged 3.1, 3.0, and 6.0 minutes for unloaders #1, #2, and barley respectively. Service times at the

TABLE XI

SERVICE TIME ANALYSIS FOR SCALE FACILITY,
WEATHERFORD, JUNE 6-8, 1970

Harvest Day	Number of Observ.	Mean Service Time	Range of Service Time	Standard Deviation	Chi-Square Values for Erlang k: k= 2	3	4	5	6	7	8	9
				- Loaded Vehicle Service Time At Scale -								
6	150	1.5	12.8	1.2	7.3*	5.8	9.1	17.2	26.9	39.0	53.8	71.7
7	191	1.3	5.7	0.9	54.2	28.1	18.9	18.4	23.9	34.2	50.6	72.4
8	352	0.9	11.4	0.8	125.7	75.7	61.8	71.8	107.9	183.1	325.3	588.5
Weighted Ave.		1.1										
				- Empty Vehicle Service Time At Scale -								
6	145	1.1	2.4	0.4	126.9	80.7	55.3	39.3	28.5	21.1	15.9	12.5
7	173	1.1	2.8	0.4	131.9	80.0	51.9	34.7	23.7	17.0	13.4	12.3
8	336	0.9	2.7	0.3	339.4	221.5	156.2	114.9	87.3	68.7	56.7	50.3
Weighted Ave.		1.0										

*Underlined values indicate those Erlang distributions which fit the data values for the respective harvest day.

unloaders fit Erlang distributions as indicated by the underlined chi-square values in Table XII. Service time analysis for the unloaders indicated Erlang service time distributions with parameter k of 2 to 8. The values of k were generally within the range presented by Bouland (7) for unloader service times.

Analysis of the total system service time by treating the entire plant as one server, resulted in an overall mean system time of 10.8 minutes. The associated service time distribution was Erlangian with parameter k of 4 to 10.

In most areas of Oklahoma during the spring harvest period, barley and oats as well as wheat are brought to the elevators. Harvesting commences with barley since it tends to ripen earlier than wheat. The barley production rate starts out high relative to wheat and drops off rapidly as harvesting progresses. Oats are harvested in more even quantities throughout the harvesting period. Figure 10 shows the relative amounts and the receipt pattern of each of these grains at Weatherford during the 1970 season as reported by the elevator records.

Loaded vehicles began arriving at Weatherford between 7 A.M. and 8 A.M. daily. These arrivals were loads that had been harvested the previous day and had not been delivered. The arrival rate gradually increased until a peak was reached sometime between 3 P.M. and 4 P.M. Another peak of longer duration occurred later during the interval between 7 P.M. and 9 P.M. After 10 P.M., the rate of arrivals dropped off rapidly.

Figure 11 shows the average arrival pattern for all grains in terms of percent of total daily receipts for various days. Season daily maximum and minimum percentages enclose the mean line. Approximately nine

TABLE XII

SERVICE TIME ANALYSIS FOR UNLOADER FACILITIES,
WEATHERFORD, JUNE 6-8, 1970

Harvest Day	Number of Observ.	Mean Service Time	Range of Service Time	Std. Dev.	Chi-Square Values for Erlang k							
					k = 2	3	4	5	6	7	8	9
					- Unloader #1 -							
8	49	3.1	10.6	1.7	6.6	2.0	0.5	0.7	1.9	4.0	7.0	10.7
					- Unloader # 2 -							
6	73	3.7	12.3	2.5	0.9	2.4	6.3	11.5	17.8	24.8	32.7	41.3
7	119	3.3	10.7	1.8	29.7	14.5	10.8	13.5	21.6	34.6	53.3	78.6
8	222	2.7	6.6	1.2	65.5	30.4	16.8	14.6	20.5	33.9	55.3	86.1
Weighted Ave.		3.0										
					- Unloader #3 -							
6	72	5.6	16.9	3.4	6.6	3.5	4.9	8.6	14.1	21.1	29.4	39.2
7	54	6.2	18.4	3.6	8.4	2.8	1.2	1.7	3.4	6.3	10.1	14.8
8	62	6.3	16.8	3.8	7.4	3.7	4.0	6.4	10.2	15.3	21.5	28.9
Weighted Ave.		6.0										

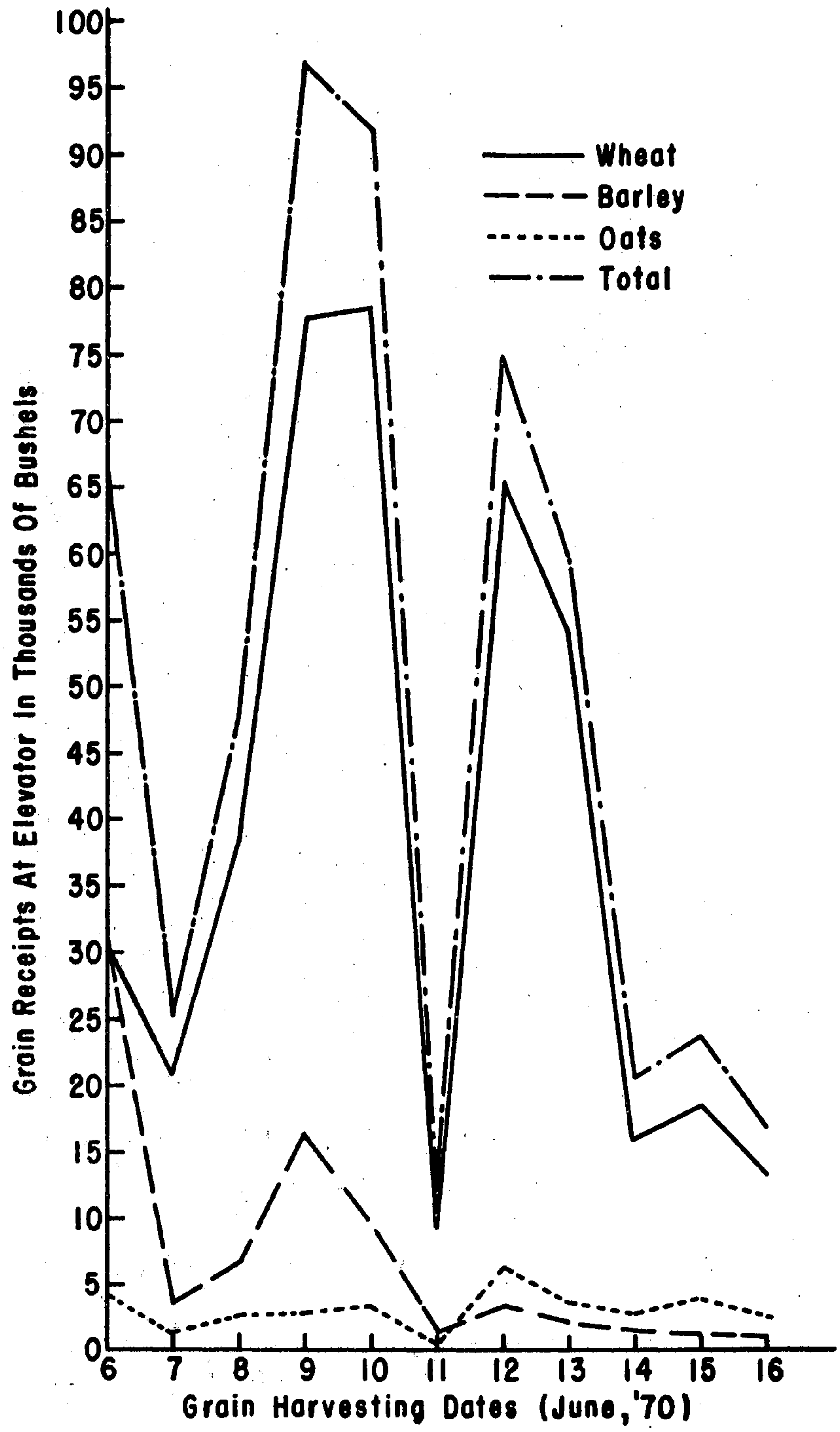

Figure 10. Grain Receipts at Weatherford, June 6-11, 1970

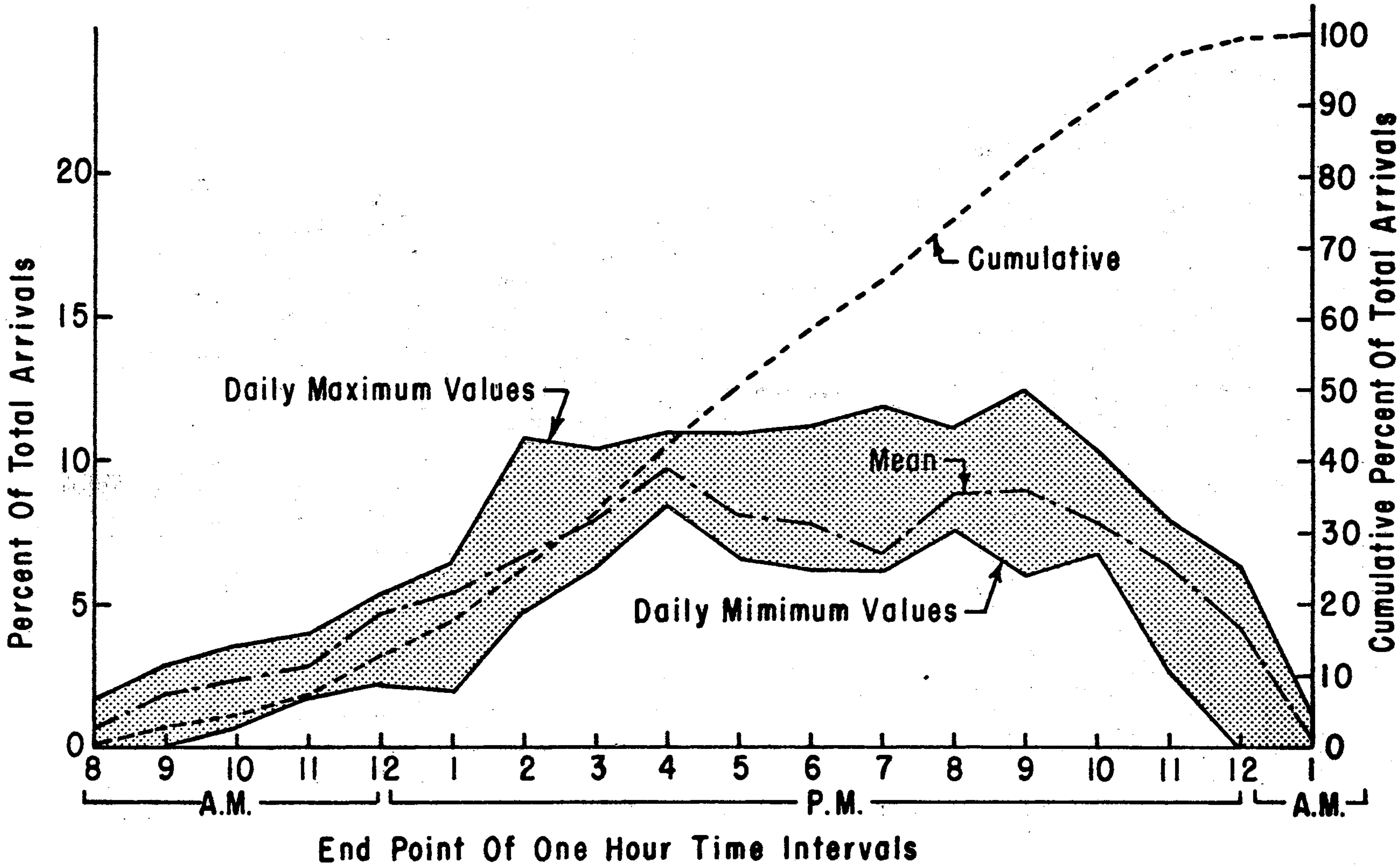

Figure 11. Average Percent of Total Daily Arrivals for Each Hour Interval, Weatherford, 1970

percent of the daily receipts arrived between 3 P.M. and 4 P.M. and about 15 percent of the total arrived between 7 P.M. and 9 P.M. The 50 percent point of total daily arrivals occurred near 5 P.M.

The largest receipt quantity was approximately 97,000 bushels of grain on June 9. This represented about 19 percent of the total season's receipts. The 50 percent point of total grain receipts for the harvest season occurred on the fifth day. (Bouland (6) reported that the 50 percent point usually occurs on the third or fourth day in the three corner area of Kansas, Colorado, and Nebraska.) Rain occurred on June 11 which reduced the receipts on that day and the 12th and essentially extended the harvest period by one day. A reported shortage of custom operators around Weatherford could have been the reason for the relatively even daily receipt volumes observed.

Overall average queue time per vehicle at the scale as a function of time of day for June 6, 7, and 8 is presented in Figure 12. Waiting time for loaded vehicles at the scale averaged between 0.5 and 1.6 minutes during most of the afternoon period. Empty vehicles had to wait less time at the scale. This was due to the management policy of giving priority to empty trucks to prevent traffic jams on the elevator grounds and to satisfy customer demands for speedy service at the scale when empty.

The best time period to bring grain to the elevator from the standpoint of short queue time, was at the beginning or the end of the day. During the day, the periods between 7 A.M. and Noon and between 4 P.M. and 7 P.M. offered the greatest possibility for short queue time.

The identities of 68 vehicles were maintained throughout the monitoring period. For these vehicles, the average total trip time was 212

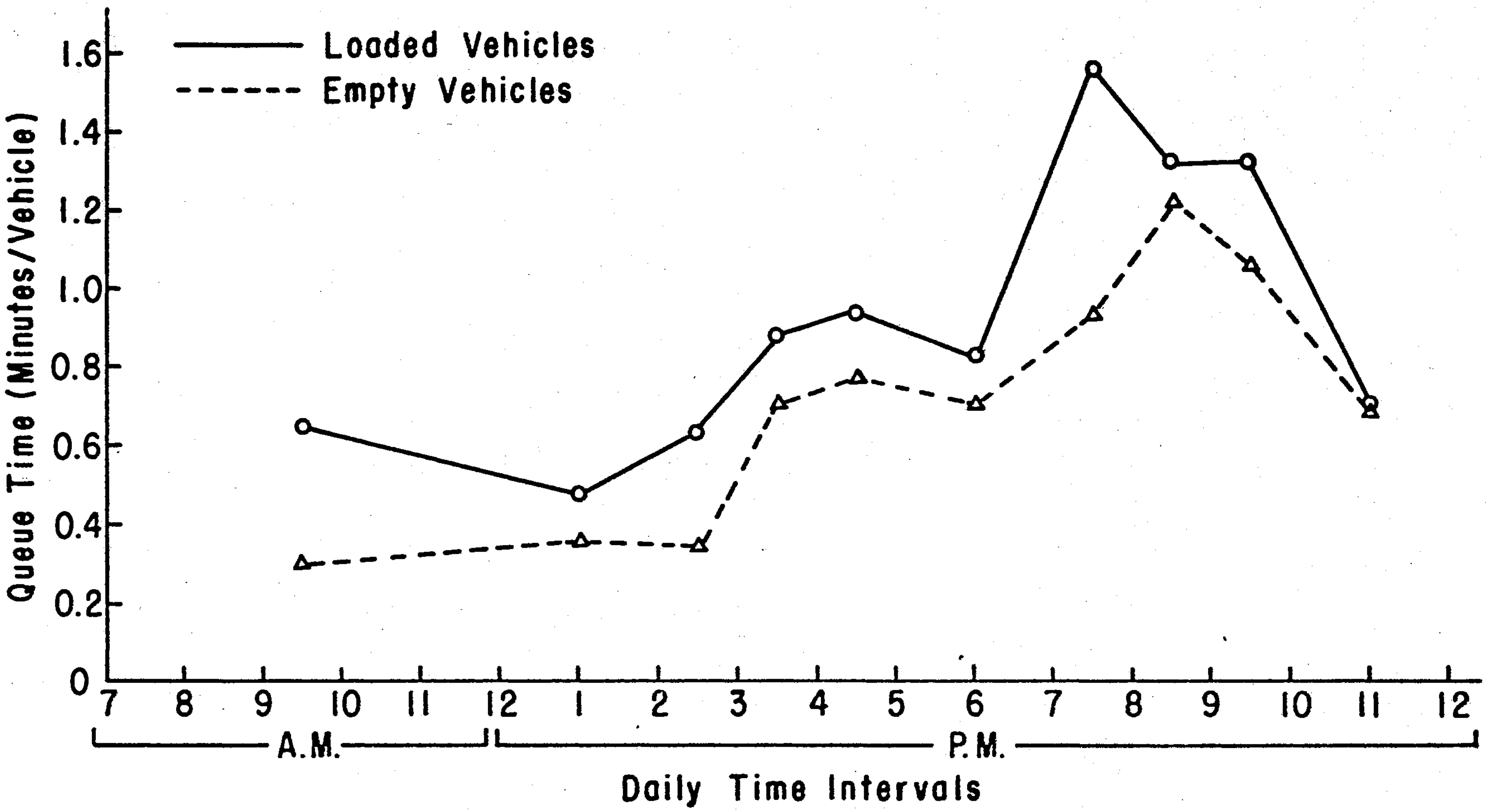

Figure 12. Average Queue Time Per Vehicle at the Scale, June 6, 7, 8, Weatherford, 1970

minutes. On the average, each vehicle spent 94 percent of the daily working time away from the elevator, two percent in the scale facility loaded, three percent unloading, and one percent in the scale facility empty. Queue time was included at each facility.

Cotton Gin

The Osborn, Incorporated cotton gin at Chickasha, Oklahoma was monitored for 51 days during the cotton harvesting season of 1970-71. Movement of vehicles within the gin yard was observed during gin operation from a vantage point above and to the side of the scale. The arrangement of the Osborn plant facilities is shown in Figure 13.

Time was recorded for various stages of vehicle transfer through the system. Status codes used to identify the stages are presented in Table XIII.

Each vehicle was identified by an attached number. Grower identification was maintained for each load by an associated farmer code number arbitrarily assigned. Bale numbers and weights were recorded and associated with vehicle loads according to their respective receipt numbers. The recorded data is presented in Appendix D-II.

The ginning season opened at the Osborn gin with the first load on October 25, 1970. Wide spread harvesting commenced 11 days later. A total of 456 loads of cotton arrived at the gin during the monitored period. Figure 14 shows the arrival distribution over the entire season in terms of the total daily arrivals. The maximum number of arrivals for any one day was 33 on the 40th day of the season.

Figure 15 shows the cumulative percentage of total arrivals for each consecutive day of the season. The 50 percent point of total

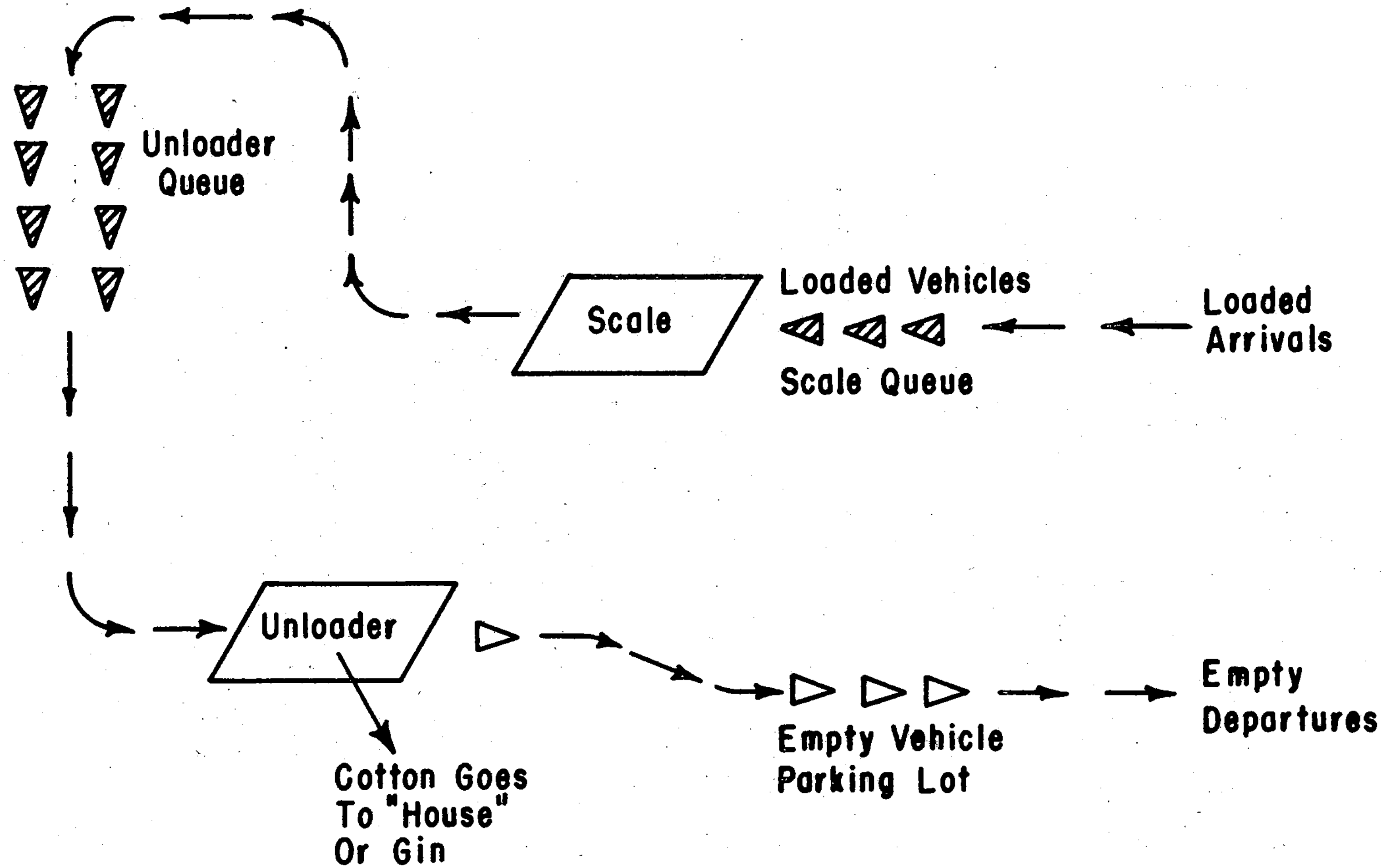

Figure 13. Queuing System at Osborn Incorporated Gin at Chickasha, Oklahoma

TABLE XIII

VEHICLE STATUS CODES

Code	Status
1	Farmer pulled loaded vehicle onto gin yard or parking lot and unhitched at a point other than at the end of the scale queue. Time recorded when unhitching was complete.
2	Farmer pulled loaded vehicle onto gin yard and unhitched at the end of the scale queue. Time recorded when unhitching was complete.
3	Farmer pulled loaded vehicle onto gin yard and waited at end of scale queue. Time recorded when vehicle stopped at end of queue.
4	Yard man pulled loaded trailer from parking lot or gin yard into scale queue. Time recorded when vehicle stopped at end of queue.
5	Loaded vehicle pulled onto scale. Time recorded when rear wheels of vehicle rolled onto scale platform.
6	Loaded vehicle departed scale. Time recorded when rear wheels of vehicle cleared scale platform.
7	Unloading of vehicle commenced. Time recorded when suction operator's actions indicated actual unloading.
8	Unloading of vehicle was complete. Time recorded when suction operator's actions indicated completion of unloading.
9	Empty or partially unloaded vehicle entered scale queue. Time recorded when vehicle stopped at end of queue.
10	Empty or partially unloaded vehicle pulled onto scale. Time recorded when rear wheels of vehicle rolled onto scale platform.
11	Empty or partially unloaded vehicle departed scale. Time recorded when rear wheels of vehicle cleared scale platform.
12	Empty vehicle departed unloading bay, gin yard, or parking lot for farm. Time recorded when intentions became obvious.

TABLE XIII (CONTINUED)

Code	Status
13	Unloading of vehicle into "house"* commenced. Time recorded when suction operator's actions indicated actual unloading.
14	Unloading of vehicle into "house" completed. Time recorded when suction operator's actions indicated completion of unloading.

*House represents a temporary storage for bale remnants and partial loads.

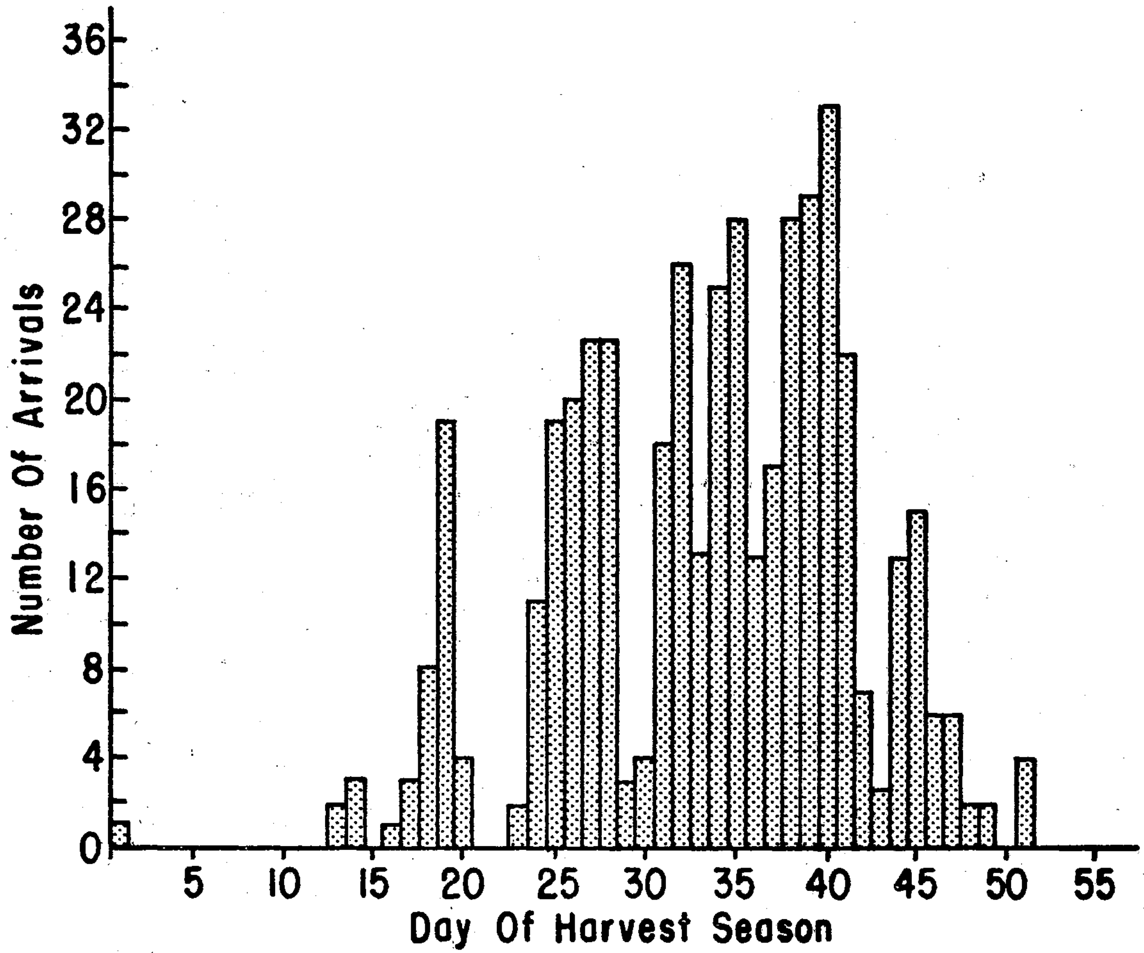

Figure 14. Total Daily Arrivals at Osborn Gin, 1970-71

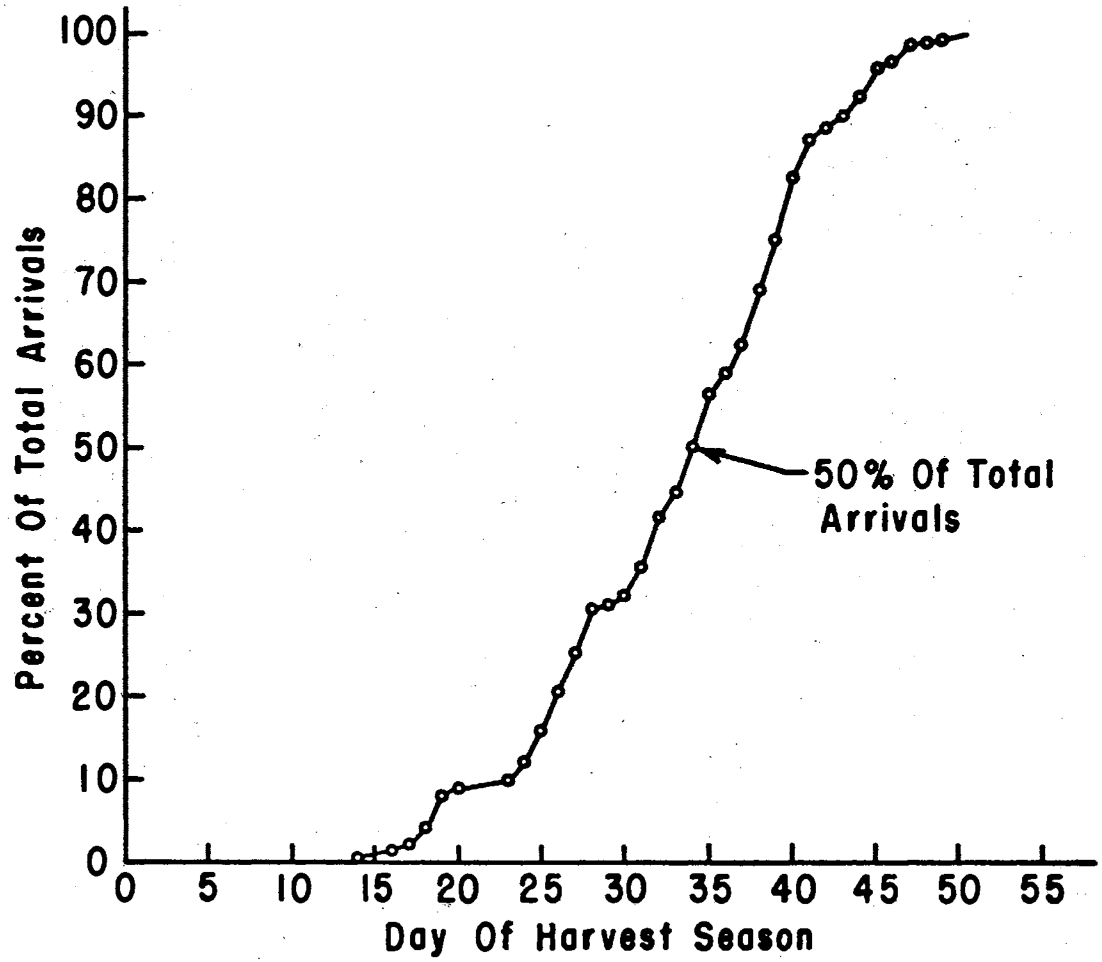

Figure 15. Cumulative Percentage of Arrivals for Consecutive Harvest Days, Osborn Gin, 1970-71

arrivals occurred on the 34th day, about two-thirds of the way through the season.

The total number of arrivals for each hour of the day, summed over all of the season, has been plotted in Figure 16. There were two apparent peak arrival periods. The first occurred during the interval between 9:30 A.M. and Noon and the second around 5 P.M. in the afternoon. The first was about one-half as intense as the second. On the average, 35 percent of the daily arrivals occurred by noon with the 50 percent point occurring between 2 P.M. and 3 P.M. (see Figure 17). The average values of Figure 17 include those days with no arrivals.

Interarrival times ranged from less than a minute to over 500 minutes. For analysis of the arrival time distribution only those times less than 200 minutes were included. This excluded the initial and final portions of the season lowering the total number of observations used to 417 and permitting a closer approximation to steady state operation of the harvesting-ginning system. The mean interarrival time for the total season, excluding the transient portions, was 32.2 minutes. The observed distribution of interarrival times fit the Poisson distribution at the five percent level of significance.

Scale service times ranged from less than one minute to over 1300 minutes. Such long times for vehicles on the scale were caused by parking over night on the scale and by leaving the vehicles on the scale while the driver was engaged in activities other than hauling cotton. Reasonable scale times of ten minutes or less were used in the scale service time analysis, reducing the number of observations to 358. Scale service times averaged 4.7 minutes for loaded vehicles and 2.7 minutes for empty vehicles. When all scale times of ten minutes or less

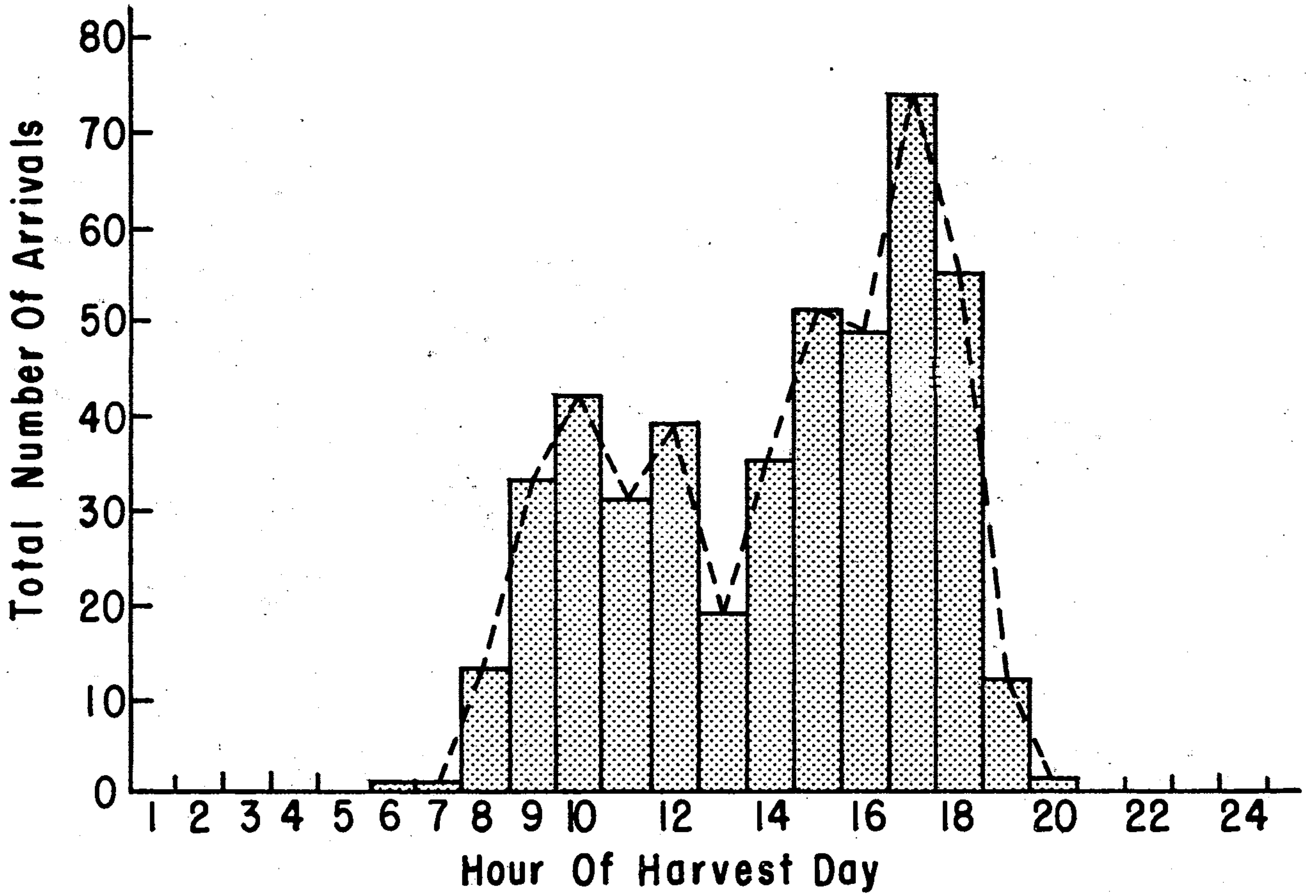

Figure 16. Total Arrivals for Each Hour of the Day (51 days totaled), Osborn Gin, 1970-71

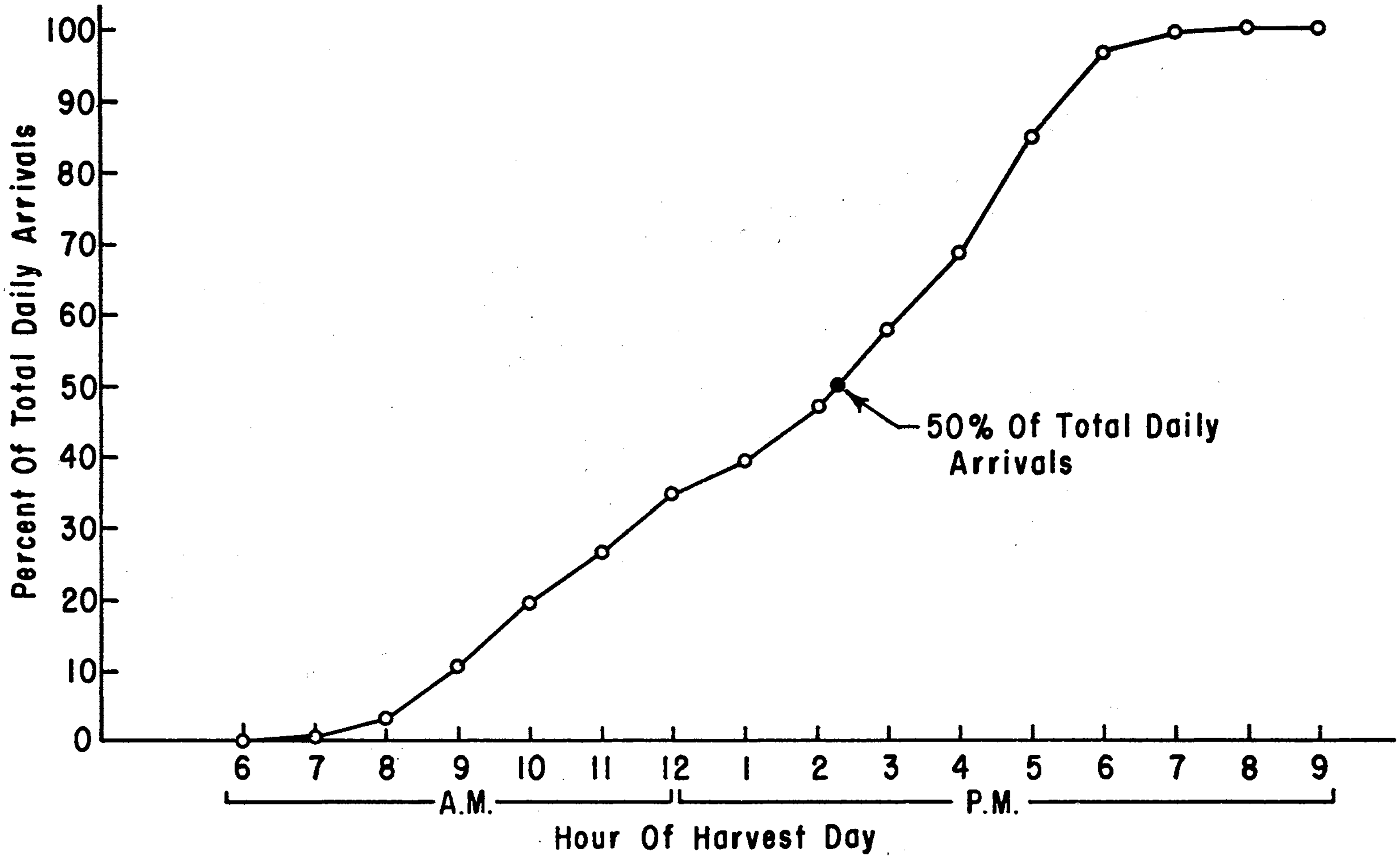

Figure 17. Cumulative Percentage of Total Daily Arrivals for Consecutive Hours, Osborn Gin, 1970-71

were grouped for each category, neither group fit the Erlang distribution. An Erlang distribution of parameter 2 fit the scale service times for all loaded weighings taking five minutes or less.

Recorded unloading times ranged from one minute to over 1,000 minutes. Unloading service times of 60 minutes or less were included in the unloader service time analysis. The overall mean unloading time was 38 minutes. The mean for times less than or equal to 60 minutes was 27 minutes. Unloader service time distributions did not fit the Erlang distribution. The length of unloader service times was proportional to the amount of cotton in the load since the rate of unloading was paced by the gin capacity. The average unloading rate was 125 pounds of seed cotton per minute.

Cumulative probability distributions for each of the three servers are presented in Figure 18. The distributions have been normalized for possible future use in computer simulation programs.

Queues at the scale and unloader were observed to reach maximum values of 3 and 26 vehicles respectively. Only one vehicle waited in queue to weigh empty. It waited for 4.5 minutes. Loaded vehicles waited an overall average of 8.9 minutes to weigh. Fifty percent of the loaded vehicles waited less than 3.6 minutes and 90 percent waited less than 10.0 minutes to weigh.

The overall average unloader queue time per vehicle trip was 602 minutes. The maximum average unloader queue time per vehicle trip was 1187 minutes for a vehicle which made seven trips to the gin.

There were 79 vehicles involved in transporting cotton to the Osborn gin during the 1970-71 harvesting season. These 79 vehicles had a total of 793 hours of waiting time in the unloader queue. This

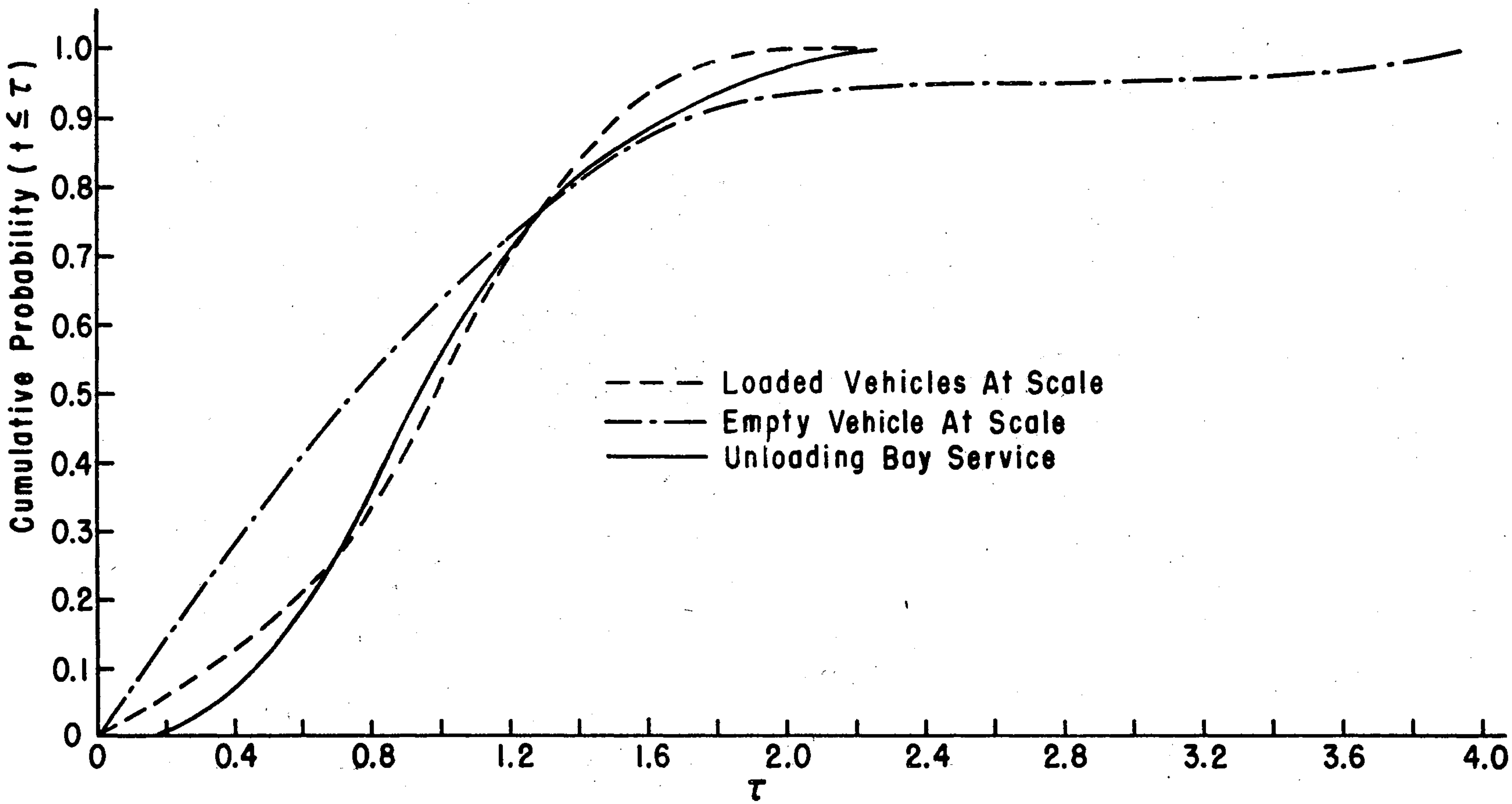

Figure 18. Normalized Cumulative Distributions for Service Times at Osborn Gin, 1970–71

represented 92 percent of the total time that the vehicles were at the gin.

A comparison of the arrival patterns for wheat and cotton at the two monitored locations reflects the inherent differences between the two types of harvesting systems. Cotton usually comes to the gin via pickup towed cotton trailers. Wheat is hauled by trucks capable of faster road speeds better equipped to travel during darkness. The result is that cotton harvested in the late afternoon usually waits for delivery to the gin on the following morning. Wheat, harvested in the late afternoon, can easily be delivered that same evening which makes the time of delivery a management decision variable. Wheat is harvested during more hours of the day than is cotton thus requiring faster round trip times for the transport vehicles.

Arrival peaks at the respective terminals were observed to occur at approximately 3:30 P.M. and 8 P.M. for wheat and at 10 A.M. and 5 P.M. for cotton. In each case the second peak was the largest. The average daily 50 percent point occurred at 5 P.M. for wheat and at 2 P.M. for cotton. The 50 percent point on a seasonal basis occurred at approximately two-thirds the way through the season for both systems.

CHAPTER V

QUEUING SYSTEM IMPROVEMENT

Two methods of improving queues were selected as having direct application to agricultural processing plants. These were priority queue discipline at the scale and alteration of normal arrival patterns through differential pricing. Computer simulation was used to evaluate the effects of each method. The GPSS/360 program of Appendix C-III was written to simulate the operation of an elevator system similar to that shown in Figure 9. Inputs to the system in terms of arrival means, service means, and distributions at servers, were approximately equal to those observed at Weatherford, June 9, 1970.

Vehicle arrivals for normal operation were generated according to a Poisson distribution with interarrival time means as presented in Table XIV. Vehicle capacities and kind of grain was estimated from data collected at Weatherford. For simulation purposes 80, 17, and 3 percent of the generated arrivals were assigned wheat, barley, or oats respectively.

Unloading facilities included an oat, a barley, and two wheat dumping locations. During slow to medium arrival rates, a single wheat unloader was used and each vehicle transferred directly to its respective unloader following the scale. During peak periods, both wheat unloaders were in operation requiring decision criteria as to which wheat unloader a particular load was sent. Since unloader #1 could service only vehicles having self dumping capability, 75 percent (the fraction of vehicles assumed to have self dumping capabilities) of the wheat vehicles on an individual basis were sent to the unloader having the shortest queue. When the queue lengths were equal, either unloader was chosen on an equal random basis. The remaining 25 percent of the wheat vehicles were sent directly to unloader #2 which could dump the vehicles by lift.

TABLE XIV

INTERARRIVAL TIME MEANS USED IN ELEVATOR SIMULATION

Period of Day	Value of Mean (Sec.)
7 A.M. - 9 A.M.	429
9 A.M. - 11 A.M.	408
11 A.M. - 1 P.M.	152
1 P.M. - 3 P.M.	97
3 P.M. - 5 P.M.	91
5 P.M. - 7 P.M.	120
7 P.M. - 9 P.M.	109
9 P.M. - 11 P.M.	117
11 P.M. - 1 A.M.	233

Wheat unloader #1 was opened for service when the number of vehicles in queue at unloader #2 became equal to six. Unloader #1 was shut down when the #2 queue contents was less than two vehicles, the #1 pit was empty, and at least 60 minutes had elapsed since #1 was previously opened.

Vehicle capacities of 250 bushels were assigned for all arrivals during the time when wheat unloader #1 was closed. When #1 was open for service, those vehicles hauling wheat were assigned 350 and 225 bushel loads for those going to unloader #1 and unloader #2 respectively. Vehicles hauling between 350 and 600 bushels were usually self dumping and this more nearly simulated the actual condition.

Service time means and the associated Erlang distributions for the various unloaders and the scale are presented in Table XV.

Service time at each of the unloaders was affected by the pit elevator leg capacity. When the dumping rate into the pits exceeded the leg capacity, the pits filled. The unloading rate then became equal to the leg capacity. This effect was simulated by use of the "split" block in the GPSS/360 program. Pit capacities and elevator leg conveying rates for each unloader are presented in Table XVI.

Results of simulation indicative of how well the simulation program reproduced the actual were the total arrivals for one day's simulation and the total number of bushels of grain received. The actual number of arrivals at Weatherford, June 9, 1970 was 430 vehicles hauling 97,045 bushels of grain and consisting of 80 percent wheat, 17 percent barley, and 3 percent oats. The simulation indicated a total of 460 arrivals accounting for 130,000 bushels of grain consisting of 83 percent wheat, 15 percent barley, and 2 percent oats.

TABLE XV

SERVICE TIME MEANS USED IN ELEVATOR SIMULATION

Facility		Service Time Mean (Sec./Serv.)	Erlang Parameter k
Scale			
Loaded	7 A.M. – 1 P.M.	78	4
	1 P.M. – 1 A.M.	50	4
Empty	7 A.M. – 1 P.M.	71	4
	1 P.M. – 1 A.M.	45	4
Oat Unloader		225	6
Barley Unloader		325	6
Wheat #1		226	6
Wheat #2		202	6

TABLE XVI

ELEVATOR LEG CONVEYING RATES AND PIT CAPACITIES FOR ELEVATOR SIMULATION

Facility (Unloader)	Pit Cap. (Bushels)	Leg Conv. Rate (Bu./Hr.)
Oat	500	800
Barley	500	2000
Wheat #1	1000	5000
Wheat #2	500	5000

Priority at Scale

The effect of priority has previously been discussed in Chapter III for systems such as a scale which weighs two classes of vehicles. The related theory suggests that benefits in terms of total waiting time reduction may be obtained by granting priority to those customers requiring the shortest service times. For complex systems, such as the elevator system of Figure 9, the exact results due to queue discipline variation can best be determined through simulation. Results of two simulation runs, averaged for each queue discipline investigated, are contained in Table XVII.

Reductions in normal (FIFO) values for all empty vehicle queue statistics of Table XVII resulted from granting empty vehicle priority at the scale. The opposite effect was produced for loaded vehicles. Average total scale time was reduced by 20 percent and the average time a vehicle was required to spend at the elevator was reduced by approximately 13 percent. The maximum observed empty scale queue content was reduced from 13 to 3 as a result of priority. This would be significant for those plants having limited queue space within the plant confines. The utilization of the scale facility was not appreciably affected by priority.

Occasionally it is convenient to weigh a series of empty and then a series of loaded vehicles from the standpoint of consistency or perhaps to better utilize scale crew labor and increase production efficiency. Results of simulation in which the empty vehicle queue at the scale was required to contain a given number of vehicles before any were granted priority are also presented in Table XVII. Nonlinear increases in total queue and total system time resulted from increases in the

TABLE XVII

RESULTS OF ELEVATOR SYSTEM SIMULATION
WITH PRIORITY QUEUE DISCIPLINES

SCALE QUEUE DISCIPLINE	MAXIMUM CONTENTS OF SCALE QUEUE		AVERAGE CONTENTS OF SCALE QUEUE		AVERAGE WAITING TIME* IN SCALE QUEUE		AV. TOTAL TIME VEH. SPENT AT ELEVATOR	AV. NO. OF VEH. AT ELEVATOR
	Loaded	Empty	Loaded	Empty	Loaded	Empty		
FIFO	14	13	2.2	2.2	5.2	5.2	23.1	9.8
Priority to Empty Vehicles	19	3	3.3	0.2	7.7	0.6	20.1	8.5
2 Prior**	19	4	3.2	0.7	7.5	1.6	20.9	8.9
4 Prior	21	6	3.7	1.7	8.6	4.0	24.0	10.3
8 Prior	22	10	4.1	3.6	9.7	8.5	32.5	13.9
16 Prior	29	17	5.6	7.5	13.0	17.7	45.2	19.3

*Alltimes in minutes.

**At least two empty vehicles must queue at the scale before all are granted priority and the group admitted consecutively to the scale. Other empty vehicles may join group with priority during the service of the group as long as the group contains at least one vehicle.

number required to queue before service. The relative effect of required queue content on total scale and total system time is presented in Figure 19. When four or more vehicles were required in the empty scale queue, the benefit of priority in terms of reduced system time vanished.

Differential Pricing

Differential pricing is defined relative to agricultural queuing systems as the use of product price in enticing the producer to deliver the product to the plant during periods most convenient to the processor. Complete evaluation of a proposal involving such premium payments can only be accomplished when cost information is available for all operations of both producer and processor. Such requirements indicate that each system must be evaluated separately and unique conclusions drawn for use in management.

Some grain elevators could possibly benefit from arrival pattern alteration by differential pricing. Some grain is harvested toward the end of the day and delivered to the elevator later that night. Occasionally, sufficient moisture exists in the fields to prevent resumption of harvesting until mid morning on the following day. Arrival patterns similar to the one in Figure 20a are the result. Such arrival patterns necessitate business hours at the elevator commencing at about 7 A.M. and continuing until approximately midnight in some areas.

Two possible alternatives are suggested.

1. Stop elevator activities at 9 P.M. requiring that all loads scheduled for delivery after 9 P.M. be brought to the elevator between 7 A.M. and 11 A.M. the following

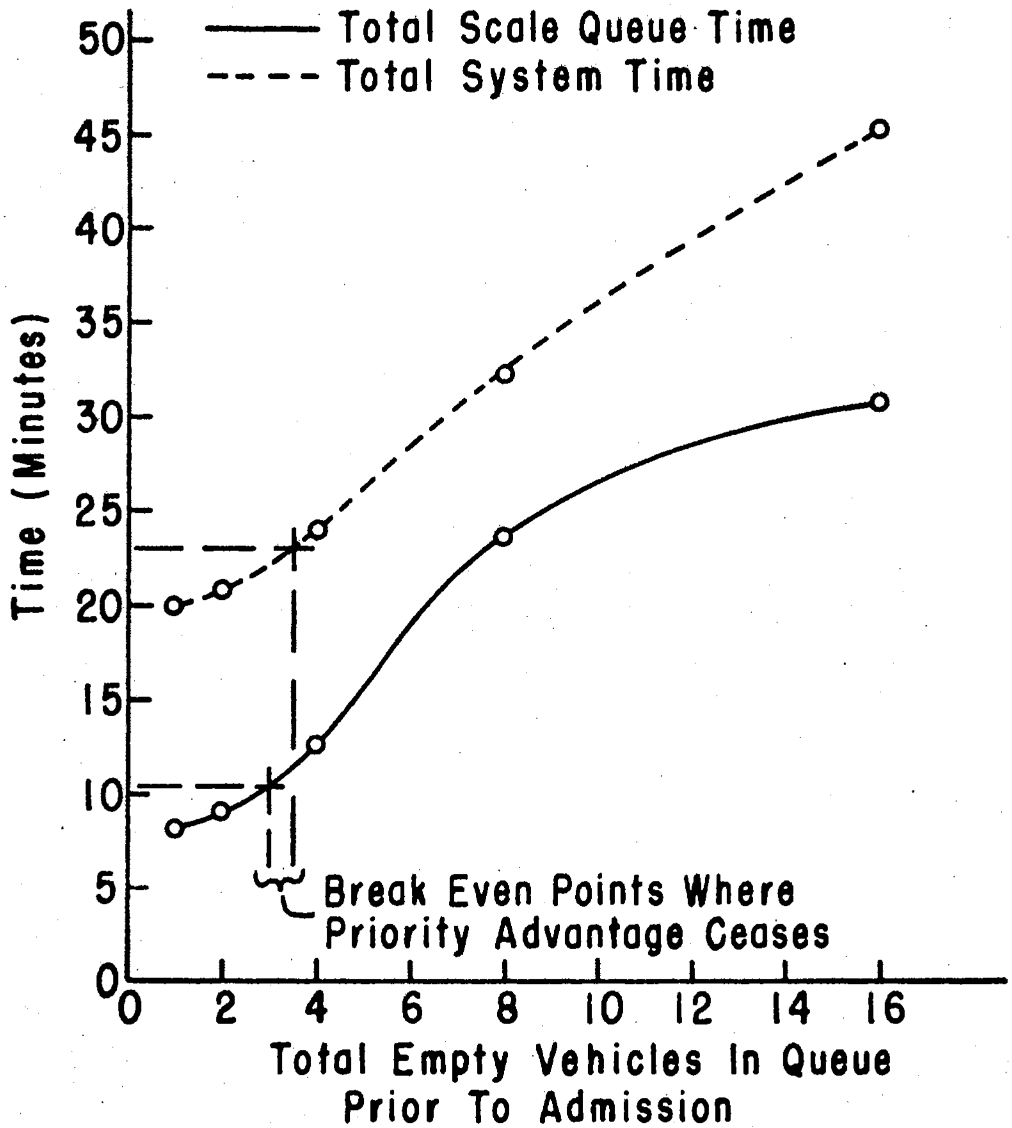

Figure 19. Scale Queue and System Time Due to Several Scale Queue Disciplines (Elevator Simulation)

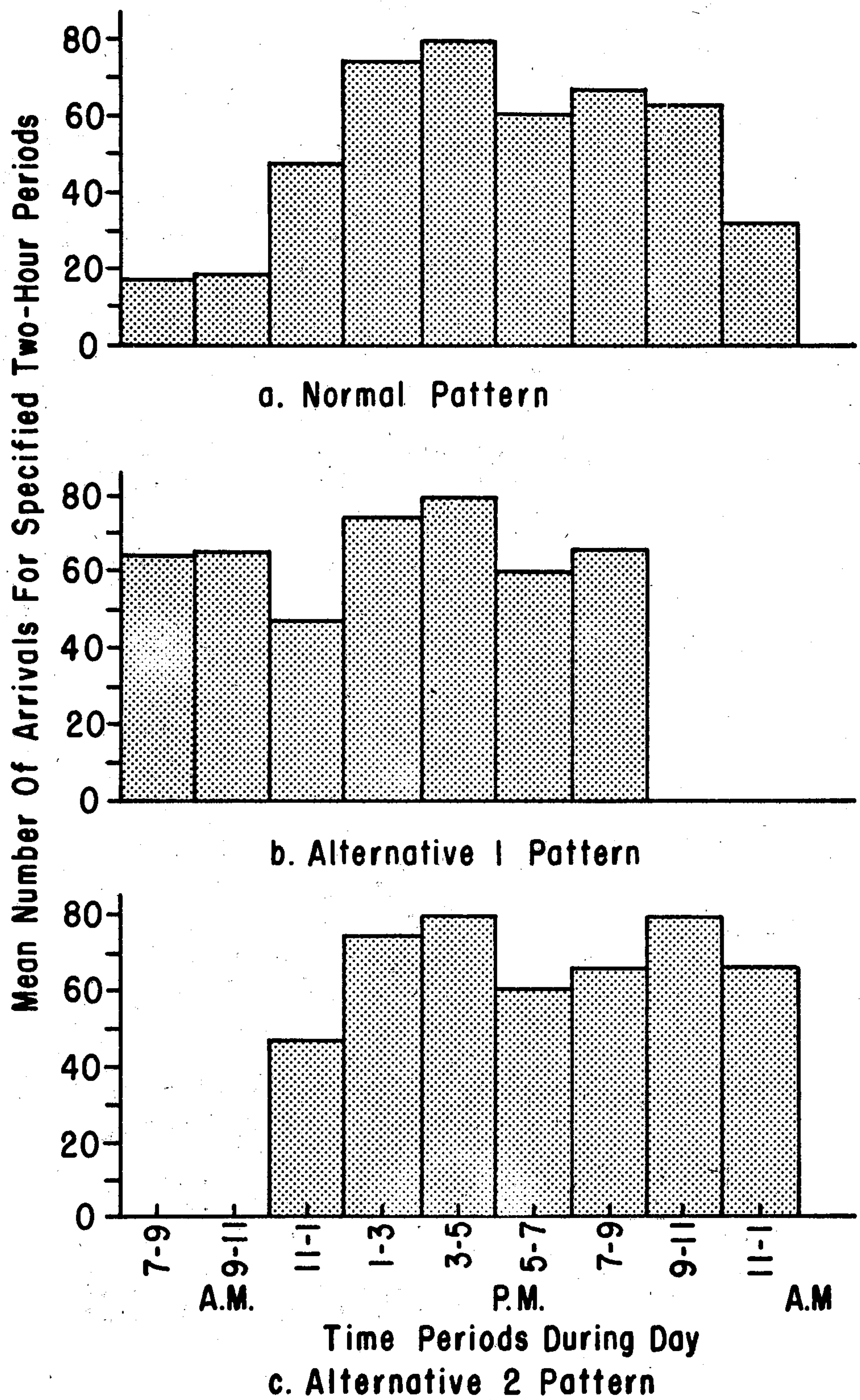

Figure 20. Arrival Patterns for Elevator Simulation

day. An arrival pattern similar to Figure 20b would result.

2. Delay opening the elevator until 11 A.M. requiring that all loads harvested during the period after 9 P.M. be delivered the same day. An arrival pattern similar to Figure 20c would result.

The elevator system of Figure 9 was simulated for each of the three arrival patterns of Figure 20 to estimate the potential advantage of differential pricing. The resulting statistics for vehicle average total system time is presented in Table XVIII. The average time a vehicle spent at the elevator per trip was reduced slightly for alternative one but increased by about 60 percent for alternative two. Those vehicles having to reschedule delivery time also had to spend increased time at the elevator. Approximately 93 vehicles were affected by alternative one and 35 by alternative two.

TABLE XVIII

AVERAGE TOTAL SYSTEM TIME PER VEHICLE TRIP (ELEVATOR SIMULATION)

	Arrivals Prior to 11 A.M.	Arrivals After 9 P.M.	All Arrivals Averaged
Normal Arrival Pattern	8.3*	12.4	23.1
Alternative 1	20.7	——	20.5
Alternative 2	——	21.2	37.1

*All times expressed in minutes.

Since system time was increased by both alternative arrival patterns for those vehicles affected, a premium would be required of the processor to entice the producers to comply with the selected alternative plan. Assuming an average waiting cost of $10 per hour, the 93 affected customers of alternative one would require a total of $129; $75 for those affected by alternative two. This does not include any payment to those who had already scheduled delivery during the proper period and also had increased system time.

The available funds for premium payments would originate from the saving in operating cost to the processor. Since fixed cost would be unaffected by the alternatives and most operating expense excluding labor is a function of grain receipts, the major source of saving would be in reduced labor. Tablx XIX contains the estimated daily labor requirement for each alternative. No advantage is effected by alternative one. The primary difficulty lies in the requirement of a full crew throughout the entire morning. Alternative two yields a labor saving of five man hours. Neither alternative results in sufficient benefit to warrant the use of differential pricing for the elevator considered.

TABLE XIX

ESTIMATED DAILY LABOR REQUIRED FOR ELEVATOR OPERATION FOR EACH ARRIVAL PATTERN (SIMULATED ELEVATOR)

Facility	Normal Arrival Pattern	Alt. 1	Alt. 2
Oat Unloader plus Wheat #2 Unloader	47*	42	39
Wheat #1 Unloader	20	28	26
Barley Unloader	20	28	26
Scale	61	56	52
Total	148	154	143

*Man hours.

CHAPTER VI

WAITING COST

Agricultural harvesting systems consist of crops, harvesters, transport vehicles, and crop terminals. Production efficiency for such systems is determined by the characteristics of each component and its interaction with the others. Since the production rate of the harvester and the processing rate of the terminal are closely associated with the flow of product to the terminal, one of the major considerations affecting system efficiency is the round trip time of a transport unit. Increases in round trip time result in higher probabilities of harvester idleness thus decreasing efficiency and ultimately increasing production costs. If more transport units are added to compensate or if temporary storage is provided in the field, the net result is higher production cost which must be attributed to the increased trip time. Since total trip time consists of time spent in the field, on the road, and at the terminal, analysis of costs attributable to terminal time can be accomplished by considering the total trip time first and categorizing the elemental costs later.

Trip time costs may be divided among the vehicle, harvester, and crop owners on the basis of reduction in profit. Profit equations for each owner are:

Harvest Owner, $$PH = (HPR \cdot CH)(1 - P_{00}) - HFC/(TD \cdot Dy) - HVC(1 - P_{00}) - LH \qquad (6.01)$$

Vehicle Owner, $PV = [(Vol \cdot CT) - (VFC \cdot TTT)/(Dy \cdot TD) - (LK \cdot TTT) - (VVC \cdot SC)]/TTT$ (6.02)

Crop Owner, $OP = A\,[(Y - LY)(CV - CT) - CH - LFC - LVC] - HL - DL$ (6.03)

The loss associated with market delay consists primarily of the risk due to weather and natural losses such as shattering and lodging. Other sources of loss are reduction in market price and spoilage of product during the interim from field to terminal. Timeliness factors have been determined for some crops and are usually presented as a fractional reduction in yield per day of harvest delay. Losses due to natural causes excluding adverse weather are accounted for with timeliness factors. Weather related losses must be based upon the probability of storm occurrence and the expected percent of loss providing the storm does occur.

Since the individual probabilities are disjoint,

$$NDC = (ND)P_0 + (ND + 1)P_1 + (ND + 2)P_2 + \cdots + (ND + d)P_d \quad (6.04)$$

Solution of equation 6.04 results in

$$NDC = ND + \bar{d} \quad (6.05)$$

where $\bar{d}$ = the expected number of days the harvest season is extended due to wet weather. Note that the probabilities of season extension will change with values of ND. The number of consecutive good weather days to complete harvesting is given by

$$ND = A/HPR(1 - P_{00})TD \quad (6.06)$$

NDC then becomes

$$NDC = [A/HPR(1 - P_{00})TD] + \bar{d} \quad (6.07)$$

Use of the value of NDC in the computation of acre-days delay as outlined by Bowers (22) incorporates some of the loss due to rain in the timeliness loss.

LY, the pounds of crop per acre lost due to timeliness is determined by

$$LY = (NDC - 1)(TF)(Y)/2$$

Substituting the value for NDC from equation 6.07 results in

$$LY = (TF)(Y)\left\{[A/HPR(TD)(1 - P_{OO})] + \bar{d} - 1\right\}/2 \qquad (6.08)$$

The expected loss due to hail may be approximated by applying a loss factor given that hail occurs and assuming that a maximum of one hail storm occurs during any harvest season. Assuming that half of the day's harvesting has been accomplished when the storm occurs, the expected loss due to hail is given by

$$HL = (CV)(P_h)(FH)(Y)(\text{Crop remaining on day } 1 + 2 + \ldots \text{ last day})$$

The acres remaining at the halfway point on each harvest day is numerically equal to the total acreage less the acreage harvested on all previous days, less one-half of a production day's harvest. Thus

$$HL = (CV)(P_h)(FH)(Y)[(A - \frac{A}{2NDC}) + (A - \frac{A}{NDC} - \frac{A}{2NDC}) + (A - \frac{2A}{NDC} - \frac{A}{2NDC}) + \ldots + (A - \frac{(DNC)A}{NDC} - \frac{(NDC-DNC)A}{2\ NDC})]$$

Simplification yields

$$HL = (CV)(P_h)(FH)(Y)(A)[DNC + \tfrac{1}{2} - \frac{\sum_{i=1}^{DNC} i}{NDC}] \qquad (6.09)$$

The bracketed value is dimensionless.

Substitution of the loss expressions into equation 6.03 yields the profit equation for the crop owner,

$$OP = A\left\{Y[1 - (TF)(NDC - 1)/2](CV - CT) - CH - LFC - LVC\right\}$$
$$- Y(CV)(P_h)(FH)(A)[DNC + \tfrac{1}{2} - \frac{\sum_{i=1}^{DNC} i}{NDC}]$$
$$- (DET)\sum_{i=1}^{NT}[Vol(i) \bullet TIV(i)] \qquad (6.10)$$

where i indicates the <u>ith</u> trip.

Costs due to increases in trip time may be determined by evaluating the corresponding changes in each of the profit equations 6.01, 6.02, and 6.10.

The primary factor linking the vehicle trip time with the system component profits is P_{00}, the fraction of time the harvester remains idle waiting for a transport vehicle. A direct method of obtaining P_{00} for a particular system is to simulate by GPSS/360. Values for P_{00} and vehicle field time may be obtained for use in the profit equations.

The following wheat harvesting system is evaluated as an example of a typical system:

Harvester

16 foot self propelled

$13,000 initial cost

1000 hours annual use

$5,375 per year fixed cost

$3.55 per hour variable cost excluding labor

100 bushel hopper capacity

12 hoppers per hour dump rate

$2.50 per hour operator wage

$4.00 per acre custom charge rate

5.5 acres per hour production rate @ 75% field efficiency

Transport Vehicle

450 bushel truck with hoist

$11,000 initial cost

1000 hours annual use

$4,279 annual fixed cost

$0.126 per mile variable cost excluding labor

30 miles per hour average road speed enroute to and from terminal

$2.00 per hour operator wage rate

Hauling charge = $0.05 per bushel plus $0.01 per bushel per mile for first five miles, $0.005 per bushel per mile for mileage in excess of five miles

Field

200 acres of wheat

1800 pounds per acre average peak yield

0.003 acres per acre-day delay

0.012 probability of hail on any day

$0.04 per pound crop value

0.9 of crop lost in case of hail

1.5 days extension of season due to wet weather

$15.00 per acre-year land fixed cost

$15.00 per acre-year land variable cost

Terminal

10 miles from field

The example system was simulated for each of five vehicle round trip times (from field back to field). Exponential and Poisson distributions were used with service time and arrival means respectively. The system operated the equivalent of 100 hours resulting in the data presented in Table XX. The GPSS/360 program is presented in Appendix C-IV.

TABLE XX

SELECTED RESULTS OF EXAMPLE HARVESTING SYSTEM SIMULATION

Round Trip Time	Vehicle Field Time	Total Trip Time	Av. No. of Loads Per 10-Hour Day	P_{00}
20*	140.0	160.0	3.4	0.032
40	134.4	174.4	3.2	0.098
60	131.1	191.1	3.0	0.164
90	130.0	220.0	2.7	0.276
120	130.0	250.0	2.4	0.352

*All time in minutes.

Vehicle field time, total trip time, and P_{00} were plotted against round trip time and are presented in Figures 21 and 22. Vehicle field time decreases as the round trip time increases due to increasing frequency of harvester idleness. The lower limit of vehicle field time is equal to the necessary time to fill the vehicle, excluding the harvest time for the first awaiting dump.

The effect of increasing round trip time on component profits is shown by Table XXI. Profits for each of five round trip times are presented.

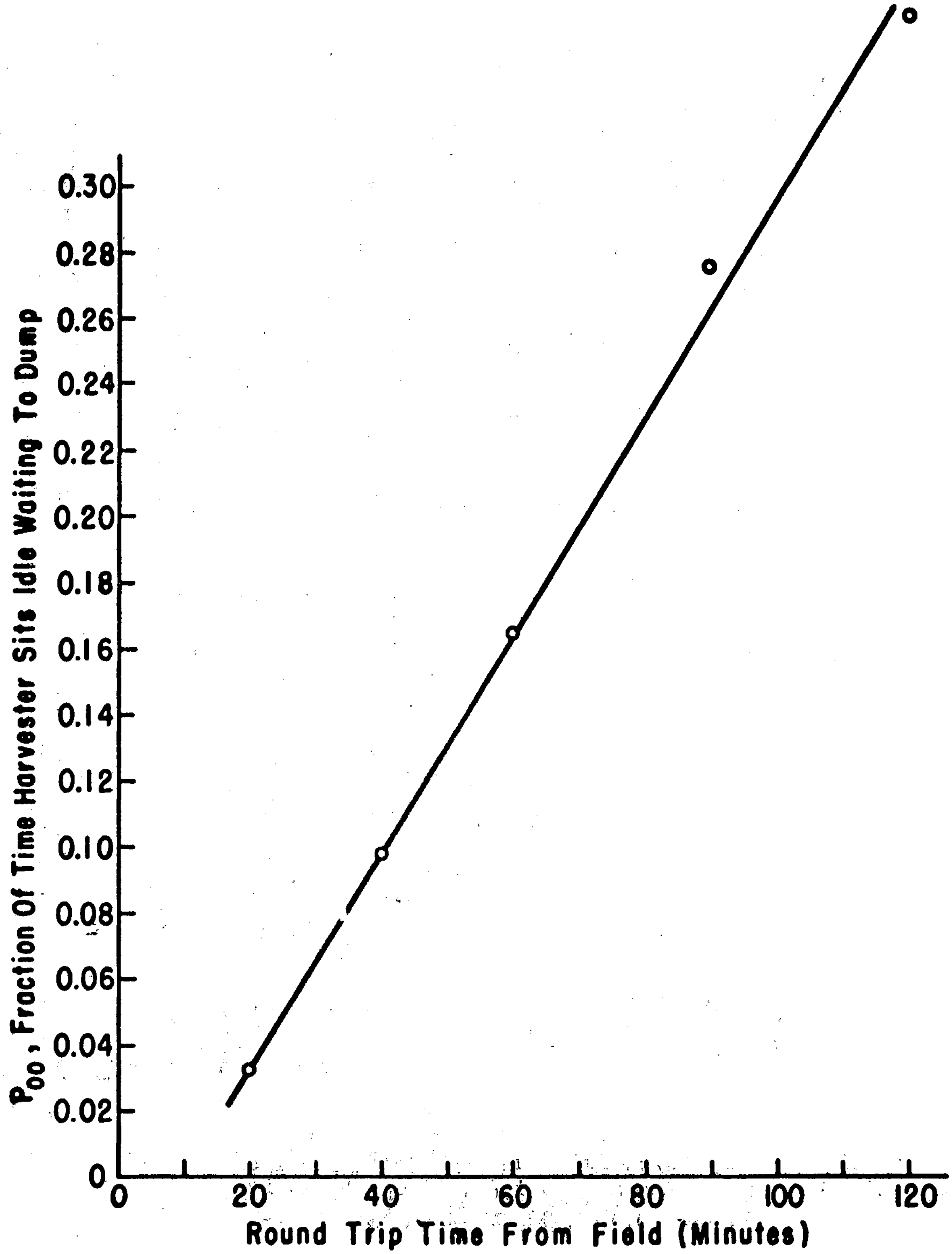

Figure 21. P_{00} Versus Round Trip Time (Simulation of One Harvester and One Vehicle)

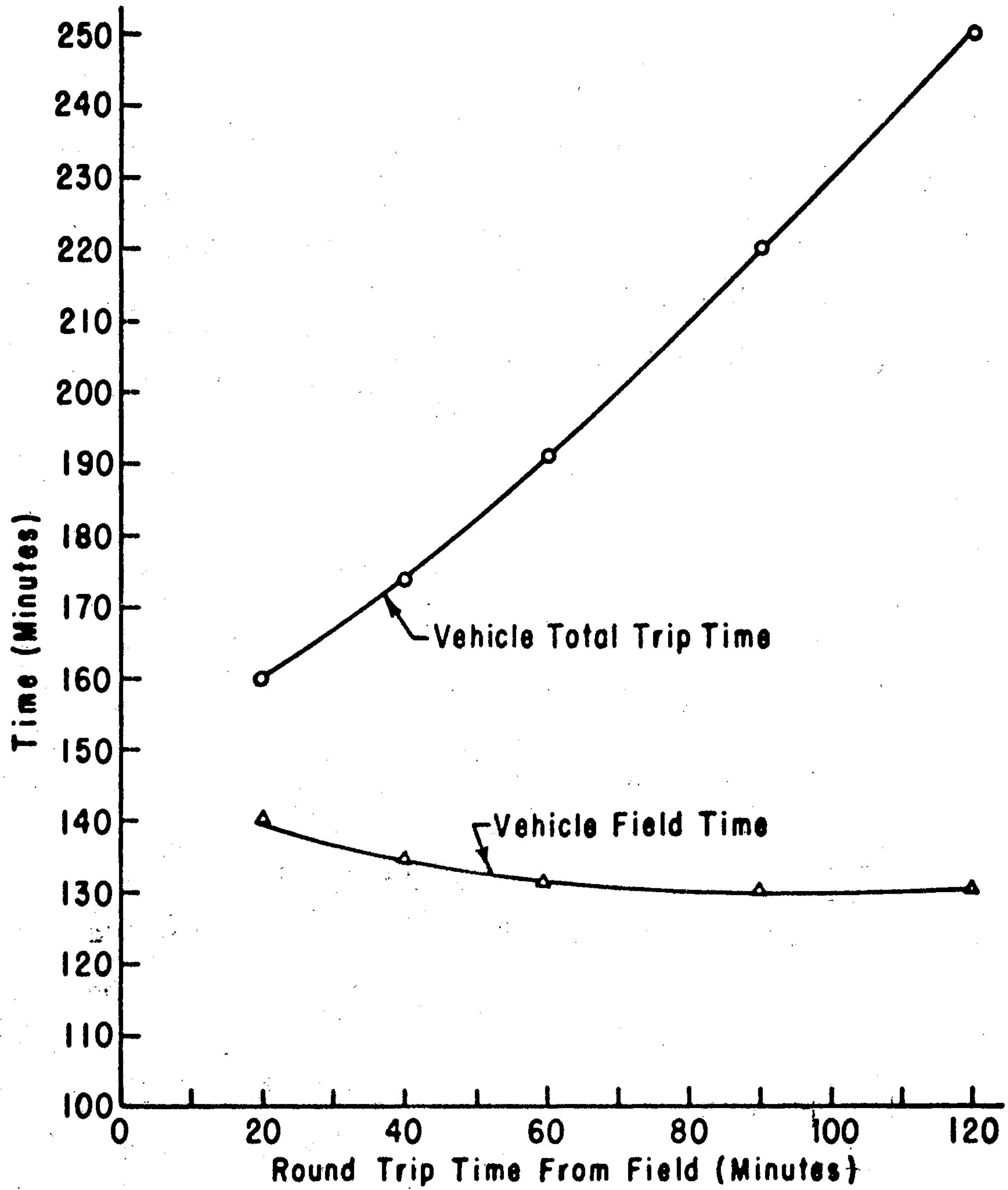

Figure 22. Vehicle Total Trip Time and Field Time as a Function of Round Trip Time (Simulation of One Harvester and One Vehicle)

TABLE XXI

COMPONENT PROFIT FOR VARIOUS ROUND TRIP TIMES

Vehicle Rd. Trip Time (Min.)	Harvester Profit		Vehicle Profit		Crop Owner Profit	
	$/Hour	$/Trip	$/Hour	$/Trip	$/Year	$/Trip
20	9.98	29.35	12.15	35.74	6345.31	423.02
40	8.77	27.40	10.63	33.22	6330.80	422.05
60	7.55	25.17	9.15	30.50	6292.16	419.47
90	5.48	20.30	7.12	26.37	6232.18	415.46
120	4.08	17.00	5.51	22.96	6164.82	410.99

For the system in question, the round trip distance of 20 miles precludes the 20 minute round trip time values. If 40 minutes round trip time is used as the minimum with no queue time at the terminal, succeeding increments of trip time may be considered as terminal queue time per trip. Maximum profit for each system component may be taken at approximately 40 minutes round trip time. Table XXII contains the cost values associated with vehicle time exceeding the minimum required for a round trip.

TABLE XXII

QUEUING COST FOR HARVESTING SYSTEM COMPONENTS

Vehicle Queue Time Per Trip	$/Vehicle Trip			$/Hr. Vehicle Waiting Time		
	Harvester	Vehicle	Crop Owner	Harvester	Vehicle	Crop Owner
20	2.23	2.72	2.58	6.69	8.16	7.74
50	7.10	6.85	6.59	8.52	8.22	7.91
80	10.40	10.26	11.06	7.80	7.70	8.30

Queuing costs for each component in the example system were about the same order of magnitude. Total queuing costs were $22.59, $24.65, and $23.80 per hour for queue time per trip of 20, 50, and 80 minutes respectively. This amounts to a cost of approximately $.40 associated with each vehicle-minute of queue time. This amount represents potential funds for terminal queuing system improvement.

Cooperative owned terminals in which the producers own the installation can usually justify more expenditure for waiting time reduction than can those owned by individuals. Improvement expense on the part of the individual owner must be justified through customer satisfaction and evaluated on the basis of the number of customers retained or increased. Cooperatives on the other hand can apply the expense of waiting directly to queuing system improvement and, although the profit of the terminal may decrease, the dividends will have been realized by the stockholder in the form of reduced waiting at the terminal.

Producers in areas where the majority of harvesting is performed by custom operators cannot justify as much expense in reducing queuing cost as can those who own their own harvesting equipment. Custom operators do not contribute to the operating expense of the cooperative terminal and thus any improvement in the queuing system is a free benefit to them. In the example harvesting system approximately a third of the benefit would be realized by the crop owner. Thus the terminal in such an area could only be improved with about one-third the expenditure as compared with a terminal in an area where all the producers owned their own harvesting equipment.

CHAPTER VII

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The objectives of this study were to: (1) Describe the queuing systems for selected agricultural processing plants and crop terminals in terms of their operational characteristics, (2) Evaluate the effects of priority in queue discipline and differential pricing, and (3) Formulate guidelines for plant design or operation which would result in optimal queue characteristics from the viewpoints of the producer and the processor.

Mathematical and simulation techniques were employed to describe the operational characteristics for queuing systems commonly encountered at agricultural processing installations. Combined scale and unloader, tandem noncyclic, and tandem partially cyclic systems were analyzed. Both Erlang and Poisson distributions for service times were considered.

Two locations were selected for study, the Farmers Cooperative Exchange grain elevator at Weatherford, Oklahoma, and the Osborn Incorporated cotton gin at Chickasha, Oklahoma. Arrival and service time distributions were evaluated and characteristic arrival patterns were plotted.

A grain elevator was simulated using arrival and service time distributions and arrival patterns observed at Weatherford. Various priority queue disciplines and two alternative arrival patterns were evaluated.

Waiting cost was determined for a grain harvesting system consisting of one harvester and one transport vehicle. GPSS/360 simulation was applied to determine the probability of the harvester having to wait in the field for return of the transport vehicle. Vehicle waiting time cost was computed for each of the individual system components.

Conclusions

1. Agricultural product arrival patterns at market terminals such as grain elevators and cotton gins exhibit peak intensity periods. Peak wheat arrival periods occurred around 3:30 P.M. and 8 P.M. daily at Weatherford. Cotton arrival intensity at Chickasha peaked at approximately 10 A.M. and 5 P.M.
2. Arrival distribution at the Weatherford elevator was Poisson. Statistically, about half of the days analyzed had Erlang scale service time distributions. Service times for the unloaders were Erlang with k of 2 to 8.
3. Cotton trailer arrivals at the Osborn gin were Poisson. An Erlang distribution with k equal to two fit the scale service times taking less than five minutes. Unloader service times did not fit the Erlang distribution.
4. Transport vehicle waiting costs at the terminal may be attributed to each of three system components, harvester, transport vehicle, and crop. Total waiting cost for a selected system was approximately $25 per vehicle-hour of waiting.

5. Expenditure directed toward waiting time reduction can be justified easier by cooperatives than by individually owned terminals. Cooperatives in areas where the majority of stockholders own their own harvesting equipment can afford to spend more on waiting time reduction than cooperatives in areas predominantly custom harvested.
6. Priority at the scale for empty vehicles results in decreased total system time for all customers providing the priority service time is less than the nonpriority service. Reduction by as much as 13 percent for an elevator system consisting of a scale and four unloading bays was observed. When four or more priority customers were required to queue before granting priority service, the advantage of priority in terms of decreased system time vanished.
7. Differential pricing as a means of improving queuing systems at grain elevators is of questionable value. The saving in labor at such plants is less than the cost of increased waiting time. A major problem concerning induced arrival pattern changes is identification of those customers actually inconvenienced.

Recommendations for Queuing System Design and Improvement

1. Priority should be granted to empty vehicles arriving at the scale when empty weighing time is less than loaded weighing time.

2. Cooperative managers should determine the cost of waiting for their clientele and make improvements which reduce waiting costs by more than the improvement cost. Possible improvements are added labor, more serving channels, or better equipment such as automatic samplers.
3. Management should publish the time when peak arrival periods occur and encourage customers to avoid the rush periods.
4. Management and customers should take advantage of various means to reduce service time. Examples are rapid unloading truck beds for grain harvesting systems, service bay approaches which provide the driver with good visibility and a minimum of maneuvering, and eye level markers locating the proper stopping position for new drivers or trucks with poor visibility.
5. Travel between service facilities should be controlled. Suggestions include: (1) Provide stop and go lights to avoid congestion, (2) Provide good visibility and clearly marked in-plant routes to speed up traffic safely, (3) Avoid crossing routes, (4) Provide parking away from in-plant traffic lanes, and (5) Prohibit drivers leaving vehicles unattended while in traffic flow patterns.

Suggestions for Further Study

1. Normalized time distributions for the various operations encountered in agricultural harvesting should be determined and reported for use in simulation studies.

2. Arrival patterns for all agricultural crops in each respective production area should be determined.
3. Deterioration loss due to delivery delay for most agricultural crops is not known. Such information is especially necessary for perishable crops if reliable estimates of waiting cost are to be made.

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APPENDIXES

APPENDIX A

SIMULATION RESULTS OF A NONCYCLIC TANDEM SYSTEM WITH POISSON ARRIVALS AND ERLANG SERVICE TIME DISTRIBUTIONS AT BOTH FACILITIES

APPENDIX A

POISSON MEAN ARRIVAL RATE (LAMDA) = 0.0167 ARRIVALS/MINUTE

MEAN SERVICE RATE COMPLETIONS PER MINUTE FAC-1	FAC-2	FACILITY UTILIZATION ARRIVAL RATE PER SERVICE RATE THEORETICAL FAC-1	FAC-2	SIMULATED FAC-1	FAC-2	MAXIMUM QUEUE CONTENT Q-1	Q-2	MEAN NUMBER IN QUEUE THEOR. Q-1	SIMULATED Q-1	Q-2	MEAN WAIT IN QUEUE MINUTES THEOR. Q-1	SIMULATED Q-1	Q-2	PROBABILITY OF MEAN QUEUE WAIT >0.5 MIN Q-1	>60 MIN Q-2
SERVICE TIME ERLANG PARAMETERS K1 = 2, K2 = 4															
1.000	0.040	0.016	0.416	0.016	0.399	1	4	0.000	0.0	0.150	0.01	0.01	9.25	0.01	0.03
1.000	0.029	0.016	0.583	0.016	0.579	1	6	0.000	0.0	0.423	0.01	0.01	25.92	0.01	0.15
1.000	0.022	0.016	0.750	0.015	0.724	1	9	0.000	0.0	1.138	0.01	0.01	71.51	0.01	0.42
0.200	0.040	0.083	0.416	0.081	0.419	2	4	0.006	0.006	0.168	0.34	0.42	10.33	0.09	0.04
0.200	0.029	0.083	0.583	0.084	0.573	2	5	0.006	0.005	0.464	0.34	0.36	29.34	0.07	0.16
0.200	0.022	0.083	0.750	0.077	0.722	2	7	0.006	0.005	1.076	0.34	0.32	67.80	0.08	0.43
0.100	0.040	0.166	0.416	0.172	0.423	2	3	0.025	0.032	0.163	1.50	2.00	10.00	0.19	0.03
0.100	0.029	0.166	0.583	0.170	0.561	2	5	0.025	0.023	0.360	1.50	1.49	21.75	0.16	0.12
0.100	0.022	0.166	0.750	0.157	0.739	2	8	0.025	0.018	1.295	1.50	1.14	80.32	0.15	0.46
SERVICE TIME ERLANG PARAMETERS K1 = 2, K2 = 8															
1.000	0.040	0.016	0.416	0.016	0.400	1	4	0.000	0.0	0.151	0.01	0.01	9.27	0.01	0.01
1.000	0.029	0.016	0.583	0.016	0.563	1	5	0.000	0.0	0.368	0.01	0.01	22.42	0.00	0.11
1.000	0.022	0.016	0.750	0.015	0.753	1	7	0.000	0.0	1.285	0.01	0.01	79.24	0.01	0.47
0.200	0.040	0.083	0.416	0.081	0.400	2	3	0.006	0.006	0.136	0.34	0.41	8.38	0.09	0.01
0.200	0.029	0.083	0.583	0.084	0.559	2	4	0.006	0.005	0.308	0.34	0.36	18.92	0.07	0.08
0.200	0.022	0.083	0.750	0.077	0.746	2	7	0.006	0.005	1.193	0.34	0.32	73.08	0.07	0.44
0.100	0.040	0.166	0.416	0.171	0.407	2	3	0.025	0.032	0.134	1.50	2.00	8.24	0.18	0.02
0.100	0.029	0.166	0.583	0.169	0.563	2	5	0.025	0.023	0.339	1.50	1.47	20.79	0.15	0.10
0.100	0.022	0.166	0.750	0.156	0.751	2	8	0.025	0.018	1.145	1.50	1.12	71.87	0.14	0.44
SERVICE TIME ERLANG PARAMETERS K1 = 2, K2 = 10															
1.000	0.040	0.016	0.416	0.016	0.393	1	3	0.000	0.0	0.130	0.01	0.01	7.97	0.01	0.01
1.000	0.029	0.016	0.583	0.016	0.577	1	5	0.000	0.0	0.377	0.01	0.01	23.02	0.01	0.12
1.000	0.022	0.016	0.750	0.016	0.750	1	8	0.000	0.0	1.210	0.01	0.01	74.66	0.01	0.45
0.200	0.040	0.083	0.416	0.081	0.409	2	3	0.006	0.006	0.139	0.34	0.41	8.54	0.09	0.01
0.200	0.029	0.083	0.583	0.085	0.569	2	5	0.006	0.005	0.353	0.34	0.36	21.94	0.07	0.13
0.200	0.022	0.083	0.750	0.077	0.731	2	8	0.006	0.004	1.058	0.34	0.31	66.08	0.08	0.41
0.100	0.040	0.166	0.416	0.173	0.411	2	3	0.025	0.033	0.117	1.50	2.03	7.21	0.19	0.00
0.100	0.029	0.166	0.583	0.170	0.567	2	4	0.025	0.024	0.329	1.50	1.48	20.05	0.16	0.09
0.100	0.022	0.166	0.750	0.156	0.746	2	9	0.025	0.018	1.242	1.50	1.13	77.00	0.15	0.44

APPENDIX A (Continued)

POISSON-MEAN ARRIVAL RATE (LAMDA) = 0.0167 ARRIVALS/MINUTE

MEAN SERVICE RATE COMPLETIONS PER MINUTE		FACILITY UTILIZATION ARRIVAL RATE PER SERVICE RATE				MAXIMUM QUEUE CONTENT		MEAN NUMBER IN QUEUE			MEAN WAIT IN QUEUE MINUTES			PROBABILITY OF MEAN QUEUE WAIT	
		THEORETICAL		SIMULATED				THEOR.	SIMULATED		THEOR.	SIMULATED		>0.5	>60 MIN
FAC-1	FAC-2	FAC-1	FAC-2	FAC-1	FAC-2	Q-1	Q-2	Q-1	Q-1	Q-2	Q-1	Q-1	Q-2	Q-1	Q-2
SERVICE TIME ERLANG PARAMETERS K1 = 4, K2 = 4															
1.000	0.040	0.016	0.416	0.016	0.397	1	4	0.000	0.0	0.166	0.01	0.01	10.30	0.01	0.03
1.000	0.029	0.016	0.583	0.016	0.578	1	5	0.000	0.0	0.512	0.01	0.01	31.87	0.01	0.21
1.000	0.022	0.016	0.750	0.016	0.735	1	9	0.000	0.0	1.317	0.01	0.01	81.48	0.01	0.48
0.200	0.040	0.083	0.416	0.081	0.419	2	4	0.005	0.004	0.184	0.28	0.33	11.56	0.09	0.05
0.200	0.029	0.083	0.583	0.083	0.554	2	4	0.005	0.004	0.343	0.28	0.26	21.34	0.08	0.12
0.200	0.022	0.083	0.750	0.079	0.747	2	8	0.005	0.004	1.259	0.28	0.28	77.92	0.09	0.47
0.100	0.040	0.166	0.416	0.168	0.411	2	4	0.021	0.025	0.137	1.25	1.61	8.44	0.19	0.02
0.100	0.029	0.166	0.583	0.164	0.570	2	4	0.021	0.019	0.353	1.25	1.21	22.04	0.16	0.13
0.100	0.022	0.166	0.750	0.157	0.737	2	9	0.021	0.016	1.267	1.25	1.00	77.92	0.17	0.46
SERVICE TIME ERLANG PARAMETERS K1 = 4, K2 = 8															
1.000	0.040	0.016	0.416	0.016	0.402	1	4	0.000	0.0	0.148	0.01	0.01	9.05	0.01	0.01
1.000	0.029	0.016	0.583	0.016	0.577	1	5	0.000	0.0	0.389	0.01	0.01	24.45	0.01	0.14
1.000	0.022	0.016	0.750	0.016	0.743	1	7	0.000	0.0	1.008	0.01	0.01	62.80	0.01	0.41
0.200	0.040	0.083	0.416	0.081	0.404	2	3	0.005	0.004	0.143	0.28	0.33	8.77	0.09	0.01
0.200	0.029	0.083	0.583	0.083	0.570	2	4	0.005	0.004	0.361	0.28	0.26	22.03	0.08	0.12
0.200	0.022	0.083	0.750	0.079	0.743	2	9	0.005	0.004	1.328	0.28	0.28	81.40	0.09	0.44
0.100	0.040	0.166	0.416	0.169	0.403	2	3	0.021	0.026	0.116	1.25	1.62	7.10	0.19	0.01
0.100	0.029	0.166	0.583	0.165	0.575	2	4	0.021	0.019	0.327	1.25	1.22	19.96	0.16	0.09
0.100	0.022	0.166	0.750	0.158	0.742	2	7	0.021	0.016	1.105	1.25	1.01	68.41	0.17	0.42
SERVICE TIME ERLANG PARAMETERS K1 = 4, K2 = 10															
1.000	0.040	0.016	0.416	0.016	0.392	1	4	0.000	0.0	0.143	0.01	0.01	8.80	0.01	0.01
1.000	0.029	0.016	0.583	0.015	0.572	1	4	0.000	0.0	0.351	0.01	0.01	21.50	0.01	0.10
1.000	0.022	0.016	0.750	0.016	0.738	1	7	0.000	0.0	1.047	0.01	0.01	65.02	0.01	0.40
0.200	0.040	0.083	0.416	0.081	0.405	2	3	0.005	0.004	0.131	0.28	0.33	8.08	0.08	0.01
0.200	0.029	0.083	0.583	0.083	0.575	2	4	0.005	0.004	0.386	0.28	0.26	23.64	0.07	0.14
0.200	0.022	0.083	0.750	0.079	0.747	2	9	0.005	0.004	1.435	0.28	0.28	88.66	0.08	0.44
0.100	0.040	0.166	0.416	0.168	0.397	2	3	0.021	0.025	0.114	1.25	1.59	7.03	0.18	0.01
0.100	0.029	0.166	0.583	0.164	0.566	2	4	0.021	0.019	0.292	1.25	1.20	17.93	0.16	0.08
0.100	0.022	0.166	0.750	0.157	0.757	2	9	0.021	0.015	1.292	1.25	0.99	80.59	0.16	0.44

APPENDIX A (Continued)

POISSON MEAN ARRIVAL RATE (LAMDA) = 0.0167 ARRIVALS/MINUTE

MEAN SERVICE RATE COMPLETIONS PER MINUTE FAC-1	FAC-2	FACILITY UTILIZATION ARRIVAL RATE PER SERVICE RATE THEORETICAL FAC-1	FAC-2	SIMULATED FAC-1	FAC-2	MAXIMUM QUEUE CONTENT Q-1	Q-2	MEAN NUMBER IN QUEUE THEOR. Q-1	SIMULATED Q-1	Q-2	MEAN WAIT IN QUEUE MINUTES THEOR. Q-1	SIMULATED Q-1	Q-2	PROBABILITY OF MEAN QUEUE WAIT >0.5 Q-1	>60 MIN Q-2
SERVICE TIME ERLANG PARAMETERS K1 = 6, K2 = 4															
1.000	0.040	0.016	0.416	0.016	0.389	1	4	0.000	0.0	0.138	0.01	0.01	8.42	0.01	0.01
1.000	0.029	0.016	0.583	0.016	0.555	1	5	0.000	0.0	0.412	0.01	0.01	25.30	0.00	0.17
1.000	0.022	0.016	0.750	0.015	0.752	1	9	0.000	0.0	1.651	0.01	0.01	100.12	0.01	0.49
0.200	0.040	0.083	0.416	0.081	0.410	2	4	0.004	0.004	0.192	0.27	0.31	11.76	0.09	0.04
0.200	0.029	0.083	0.583	0.083	0.586	1	5	0.004	0.003	0.455	0.27	0.25	27.83	0.08	0.17
0.200	0.022	0.083	0.750	0.079	0.754	2	8	0.004	0.003	1.215	0.27	0.25	75.00	0.09	0.45
0.100	0.040	0.166	0.416	0.165	0.402	2	4	0.019	0.023	0.144	1.17	1.45	8.83	0.18	0.02
0.100	0.029	0.166	0.583	0.167	0.572	2	4	0.019	0.019	0.386	1.17	1.21	23.62	0.17	0.14
0.100	0.022	0.166	0.750	0.158	0.735	2	9	0.019	0.015	1.181	1.17	0.97	74.07	0.17	0.43
SERVICE TIME ERLANG PARAMETERS K1 = 6, K2 = 8															
1.000	0.040	0.016	0.416	0.016	0.400	1	4	0.000	0.0	0.145	0.01	0.01	8.90	0.01	0.01
1.000	0.029	0.016	0.583	0.016	0.576	1	5	0.000	0.0	0.395	0.01	0.01	24.45	0.00	0.13
1.000	0.022	0.016	0.750	0.015	0.731	1	7	0.000	0.0	1.127	0.01	0.01	68.95	0.01	0.58
0.200	0.040	0.083	0.416	0.081	0.396	2	3	0.004	0.004	0.142	0.27	0.31	8.71	0.09	0.01
0.200	0.029	0.083	0.583	0.083	0.595	1	4	0.004	0.004	0.403	0.27	0.26	24.55	0.08	0.16
0.200	0.022	0.083	0.750	0.079	0.739	2	9	0.004	0.003	1.201	0.27	0.25	74.81	0.09	0.51
0.100	0.040	0.166	0.416	0.166	0.401	2	3	0.019	0.023	0.115	1.17	1.48	7.02	0.19	0.00
0.100	0.029	0.166	0.583	0.167	0.560	2	5	0.019	0.019	0.346	1.17	1.20	21.41	0.17	0.11
0.100	0.022	0.166	0.750	0.158	0.758	2	8	0.019	0.016	1.246	1.17	0.98	77.23	0.17	0.43
SERVICE TIME ERLANG PARAMETERS K1 = 6, K2 = 10															
1.000	0.040	0.016	0.416	0.016	0.394	1	3	0.000	0.0	0.130	0.01	0.01	7.93	0.01	0.00
1.000	0.029	0.016	0.583	0.015	0.582	1	4	0.000	0.0	0.391	0.01	0.01	23.87	0.00	0.12
1.000	0.022	0.016	0.750	0.015	0.760	1	8	0.000	0.0	1.199	0.01	0.01	74.07	0.01	0.44
0.200	0.040	0.083	0.416	0.081	0.407	2	3	0.004	0.004	0.147	0.27	0.31	9.03	0.09	0.01
0.200	0.029	0.083	0.583	0.083	0.571	1	4	0.004	0.004	0.351	0.27	0.26	21.43	0.06	0.11
0.200	0.022	0.083	0.750	0.079	0.732	2	8	0.004	0.003	1.163	0.27	0.25	72.02	0.09	0.43
0.100	0.040	0.166	0.416	0.166	0.401	2	3	0.019	0.023	0.128	1.17	1.48	7.83	0.19	0.01
0.100	0.029	0.166	0.583	0.167	0.567	2	4	0.019	0.019	0.305	1.17	1.21	18.99	0.17	0.10
0.100	0.022	0.166	0.750	0.158	0.743	2	8	0.019	0.015	1.137	1.17	0.98	70.64	0.17	0.42

APPENDIX B

ANALYSIS OF A QUEUING FACILITY WITH DUAL EXPONENTIAL SERVERS

APPENDIX B

The following is an analytical analysis of a queuing facility (see Figure 23) which receives two classes of customers. Only one customer is served at a time and each of the classes requires different mean service times. The method used for this analysis is presented by Morse (20).

The following is assumed:

1. Arrivals occur in Poisson fashion with mean λ.
2. Arrivals wait in the queue patiently until both channels are empty, the next customer in the queue moves into his designated channel.
3. Arrivals are of two categories, 1 and 2, with π 1's and $(1 - \pi)$ 2's. $(\pi \leq \frac{1}{2})$
4. The service channels have exponentially distributed service times with means μ_1 and μ_2 respectively.

The mean chance that a customer will complete service in a time between t and t + dt is $s(t)dt$.

$$s(t) = \pi\mu_1 e^{-\mu_1 t} + (1 - \pi)\mu_2 e^{-\mu_2 t} \quad (0 < \pi < \tfrac{1}{2}) \tag{8.1}$$

The average duration of the service operation is given by

$$T(s) = \int_0^\infty ts(t)dt$$

$$= \pi\mu_1\int_0^\infty te^{-\mu_1 t} + (1 - \pi)\mu_2\int_0^\infty te^{-\mu_2 t}$$

$$= \pi/\mu_1 + (1 - \pi)/\mu_2 \tag{8.2}$$

$$1/T(s) = \mu = 2\mu_1\mu_2/(\mu_1 + \mu_2) \tag{8.3}$$

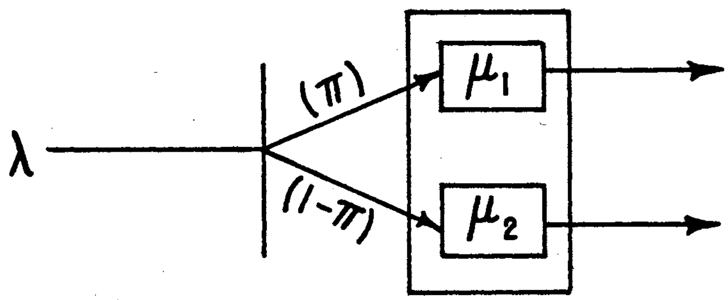

Figure 23. Dual Exponential Server Facility

The mean deviation of the service time above and below the average T(s) is obtained by computing the mean square of the duration.

$$(t^2)_{av} = \int_0^\infty t^2 s(t)dt$$

$$= \pi\mu_1 \int_0^\infty t^2 e^{-\mu_1 t} dt + (1 - \pi)\mu_2 \int_0^\infty t^2 e^{-\mu_2 t} dt$$

Since

$$\underset{t \to \infty}{\text{Limit}} \frac{t^2 e^{-\mu_1 t}}{-\mu_1} = 0,$$

$$(t^2)_{av} = 2\pi/\mu_1^{\ 2} + 2(1 - \pi)/\mu_2^{\ 2} \tag{8.4}$$

The mean square deviation from T(s) is

$$t^2 - T(s)^2 = (\pi/\mu_1^{\ 2})(2 - \pi) + (1 - \pi)(1 + \pi)/\mu_2^{\ 2} - 2\pi(1-\pi)/\mu_1\mu_2 \tag{8.5}$$

The standard deviation from the mean service time is

$$[\pi(2 - \pi)/\mu_1^{\ 2} + (1 - \pi^2)/\mu_2^{\ 2} - 2\pi(1 - \pi)/\mu_1\mu_2]^{\frac{1}{2}} \tag{8.6}$$

Steady state equations for the dual exponential server (diagrammed in Figure 24) are as follows:

s_0; $\mu_1 P_{11} + \mu_2 P_{21} - \lambda P_0 = 0$

s_{11}; $\pi\lambda P_0 + \pi[\mu_1 P_{12} + \mu_2 P_{22}] - [\lambda + \mu_1]P_{11} = 0$

s_{21}; $(1 - \pi)\lambda P_0 + (1 - \pi)[\mu_1 P_{12} + \mu_2 P_{22}] - [\lambda + \mu_2]P_{21} = 0$

.

.

.

s_{1j}; $\lambda P_{1(j-1)} + \pi[\mu_1 P_{1(j+1)} + \mu_2 P_{2(j+1)}] - [\lambda + \mu_1]P_{1j} = 0$

s_{2j}; $\lambda P_{2(j-1)} + (1 - \pi)[\mu_1 P_{1(j+1)} + \mu_2 P_{2(j+1)}] - [\lambda + \mu_2]P_{2j} = 0$

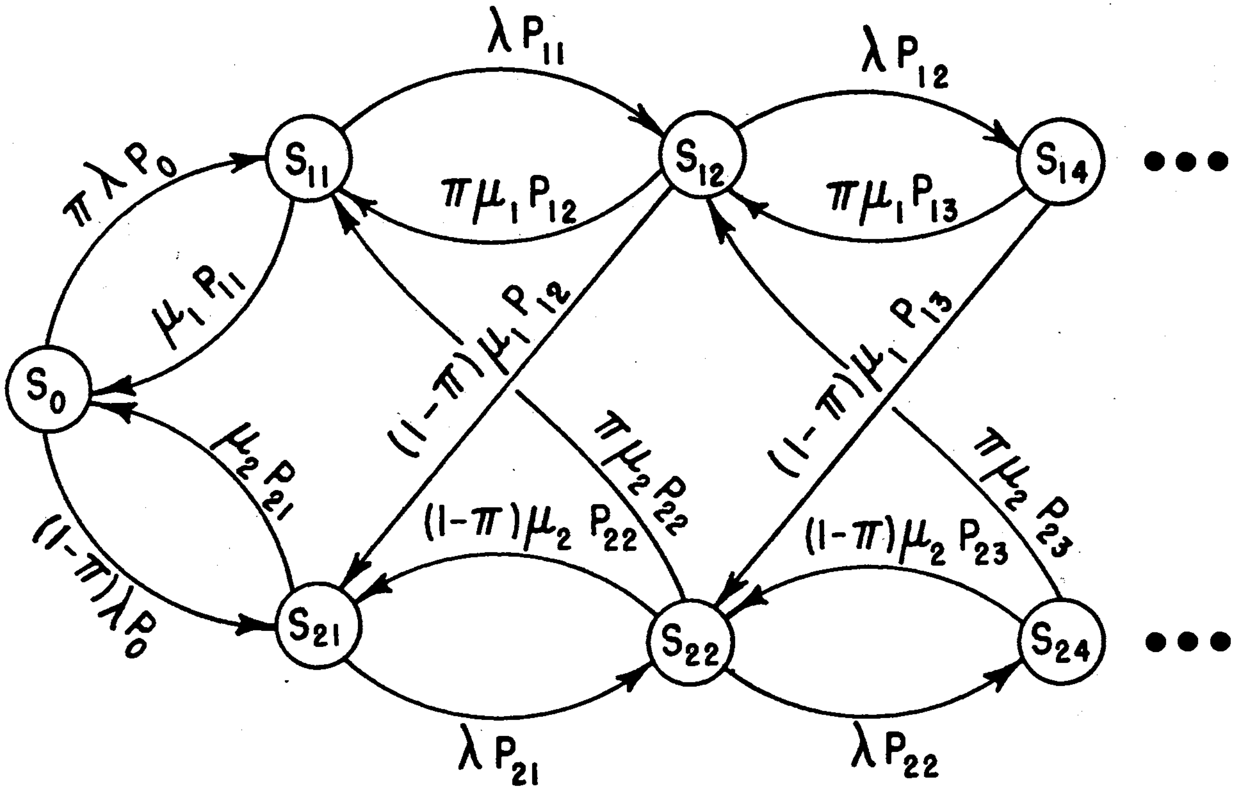

Figure 24. State Diagram for Dual Exponential Server Facility

Define generating function

$$F(z) = \sum_{j=1}^{\infty} z^j P_{sj} \quad (s = 1,2)$$

Multiplying s_{11} by z, s_{12} by z^2. . . s_{1j} by z^j and summing yields:

$$z\pi\lambda P_0 + z\pi[\mu_1 P_{12} + \mu_2 P_{22}] - z[\lambda + \mu_1]P_{11}$$

$$+ z^2\lambda P_{11} + z\pi[\mu_1 P_{13} + \mu_2 P_{23}] - z^2[\lambda + \mu_1]P_{22}$$

$$+ \dots z\lambda P_{1(j-1)} + z^j\pi[\mu_1 P_{1(j+1)} + \mu_2 P_{2(j+1)}]$$

$$- z^j[\lambda + \mu_1]P_{2j} = 0$$

Manipulating to get in terms of the generating function and grouping terms:

$$[\pi\mu_1/z + z\lambda - \lambda - \mu_1]F_1 + F_2\pi\mu_2/z = \pi\mu_1 P_{11} + \pi\mu_2 P_{21} - z\pi\lambda P_0 \quad (8.7)$$

Similarly, multiplying the state equations s_{21} by z, s_{22} by z^2, ... and summing yields:

$$z(1 - \pi)\lambda P_0 + z(1 - \pi)[\mu_1 P_{12} + \mu_2 P_{22}] - z[\lambda + \mu_2]P_{21} + z^2\lambda P_{21}$$

$$+ z^2(1 - \pi)[\mu_1 P_{13} + \mu_2 P_{23}] - z^2[\lambda + \mu_2]P_{22} + \dots$$

$$z^j\lambda P_{2(j-1)} + z^j(1 - \pi)[\mu_1 P_{1(j+1)} + \mu_2 P_{2(j+1)}]$$

$$- z^j[\lambda + \mu_2]P_{2j} = 0$$

Manipulating to get into generating function form and grouping terms:

$$F_1 (1 - \pi)\mu_1/z + F_2[(1 - \pi)\mu_2/z - \lambda - \mu_2 + \lambda z]$$

$$= (1 - \pi)\mu_1 P_{11} + (1 - \pi)\mu_2 P_{21} - (1-\pi)\lambda z P_0 \quad (8.8)$$

Since $\mu_1 P_{11} + \mu_2 P_{21} = \lambda P_0$,

$$[(\pi\mu_1/z) + z\lambda - \lambda - \mu_1]F_1 + [\pi\mu_2/z]F_2 = \pi\lambda P_0(1 - z) \quad (8.9)$$

and

$$[(1-\pi)\mu_1/z]F_1 + [1-\pi)\mu_2/z - \lambda - \mu_2 + \lambda z]F_2$$
$$= (1-\pi)\lambda P_0(1-z) \qquad (8.10)$$

Solving equations 8.9 and 8.10 simultaneously with π equal to $\frac{1}{2}$ results in equations for F_1 and F_2:

$$F_1(z) = P_0(1-z)[\lambda^2(z-1) - \lambda\mu_2]/2Q$$
$$F_2(z) = P_0(1-z)[\lambda^2(z-1) - \lambda/\mu_1]/2Q$$

where

$$Q = \lambda\ [(3/2) - (1/2z) - z](\mu_1 + \mu_2) + \mu_1\mu_2(1 - 1/z)$$
$$+ \lambda^2[1 - 2z + z^2]$$

$$F(z) = F_1 + F_2$$
$$= P_0(1-z)[\lambda^2(z-1) - \lambda(\mu_1 + \mu_2)/2]/Q$$

By definition

$$F(z) = \sum_{j=1}^{\infty} z^j P_{sj} \qquad (s = 1,2)$$

therefore

$$F(1) = \sum_{j=1}^{\infty} P_j = (1 - P_0)$$

Taking the limit of $F(z)$ as z approaches 1 by L'Hospital's rule yield:

$$(1 - P_0) = \lambda(\mu_1 + \mu_2)/2\mu_1\mu_2 \qquad (8.11)$$

and $$P_0 = 1 - \lambda(\mu_1 + \mu_2)/2\mu_1\mu_2 \qquad (8.12)$$

$$\rho = \lambda(\mu_1 + \mu_2)/2\mu_1\mu_2 \qquad (8.13)$$

Solving for $F'(z)$ and taking the limit as z approaches 1 results in:

$$\bar{n} = (\rho^2 + \rho - \lambda^2/\mu_1\mu_2)/(1 - \rho) \qquad (8.14)$$

$$\bar{n}_q = \bar{n} - \rho = (2\rho^2 - \lambda^2/\mu_1\mu_2)/(1 - \rho) \tag{8.15}$$

$$\bar{w}_q = \bar{n}_q/\lambda = (2\rho^2 - \lambda^2/\mu_1\mu_2)/\lambda(1 - \rho) \tag{8.16}$$

APPENDIX C

C-I GPSS/360 SIMULATION PROGRAM FOR NONCYCLIC SYSTEM WITH TANDEM ERLANG SERVERS

C-II GPSS/360 SIMULATION PROGRAM FOR TANDEM PARTIALLY CYCLIC SYSTEM WITH ERLANG SERVERS

C-III GPSS/360 SIMULATION PROGRAM FOR A GRAIN ELEVATOR

C-IV GPSS/360 SIMULATION PROGRAM FOR A HARVESTING SYSTEM WITH ONE HARVESTER AND ONE TRANSPORT VEHICLE

APPENDIX C-I

```
*       SIMULATE
*
*    THIS GPSS/360 PROGRAM SIMULATES OPERATION OF A NON CYCLIC SYSTEM
*       WITH TANDEM ERLANG SERVERS AND POISSON ARRIVAL DISTRIBUTION.
*       UNLIMITED SPACE IS AVAILABLE AT EACH QUEUE.
*
 EASY   STARTMACRO
        QUEUE      #A
        SEIZE      #A
        DEPART     #A
        ADVANCE    #B,#C
        RELEASE    #A
        QUEUE      #D
        SEIZE      #D
        DEPART     #D
        ADVANCE    #E,#F
        RELEASE    #D
        ENDMACRO
 1      QTABLE     1,0,30,60
 2      QTABLE     2,0,600,120
 3      QTABLE     3,0,30,60
 4      QTABLE     4,0,600,120
 5      QTABLE     5,0,30,60
 6      QTABLE     6,0,600,120
 7      QTABLE     7,0,30,60
 8      QTABLE     8,0,600,120
 9      QTABLE     9,0,30,60
 10     QTABLE     10,0,600,120
 11     QTABLE     11,0,30,60
 12     QTABLE     12,0,600,120
 13     QTABLE     13,0,30,60
 14     QTABLE     14,0,600,120
 15     QTABLE     15,0,30,60
 16     QTABLE     16,0,600,120
 17     QTABLE     17,0,30,60
 18     QTABLE     18,0,600,120
*
*  TWENTY FOUR POINT EXPONENTIAL CUM DIST FUNCTION  MEAN=1.0
 3      FUNCTION   RN2,C24
0,0/.1,.104/.2,.222/.3,.355/.4,.509/.5,.69/.6,.915/.7,1.2/.75,1.38/
.8,1.6/.84,1.83/.88,2.12/.9,2.3/.92,2.52/.94,2.81/.95,2.99/.96,3.2/
.97,3.5/.98,3.9/.99,4.6/.995,5.3/.998,6.2/.999,7.0/.9997,8.0
*
*   EIGHTEEN POINT ERLANG  MEAN=1.0  K=4
 2      FUNCTION   RN4,C18
0,0/0.00002247,0.039109/0.0001966,0.069109/0.003288,0.14911/
0.01877,0.24911/0.05332,0.3491/0.10814,0.44911/0.220533,0.59911/
0.30727,0.6991096/0.48403,0.8991097/0.565834,0.99911/0.705229,1.19911/
0.80899,1.399109/0.92791,1.79911/0.98614,2.3991/0.997702,2.99911/
0.99982,3.7991/1.0,6.1991
*
*  SIXTEEN POINT ERLANG  MEAN=1.0    K=8
 4      FUNCTION   RN3,C16
0,0/0.00003618,0.1491099/0.000253,0.1991/0.003281,0.29911/0.01663,0.399
/0.11265,0.59911/0.20212,0.69911/0.311646,0.79911/0.43,0.8991/
0.546,0.9991/0.74085,1.19911/0.8688,1.39911/0.93986,1.59911/
0.989957,1.99911/0.99866,2.3991/1.0,4.1991
        GENERATE   3600,FN3
        SPLIT      1,MAC2
        SPLIT      1,MAC3
        SPLIT      1,MAC4
        SPLIT      1,MAC5
        SPLIT      1,MAC6
        SPLIT      1,MAC7
        SPLIT      1,MAC8
        SPLIT      1,MAC9
 MAC1   ASSIGN     1,K17
 EASY   MACRO      1,60,FN2,2,1500,FN4
        TERMINATE  0
 MAC2   ASSIGN     1,K18
 EASY   MACRO      3,60,FN2,4,2100,FN4
        TERMINATE  0
 MAC3   ASSIGN     1,K19
 EASY   MACRO      5,60,FN2,6,2700,FN4
        TERMINATE  0
 MAC4   ASSIGN     1,K20
 EASY   MACRO      7,300,FN2,8,1500,FN4
        TERMINATE  0
 MAC5   ASSIGN     1,K21
 EASY   MACRO      9,300,FN2,10,2100,FN4
        TERMINATE  0
 MAC6   ASSIGN     1,K22
 EASY   MACRO      11,300,FN2,12,2700,FN4
        TERMINATE  0
 MAC7   ASSIGN     1,K23
 EASY   MACRO      13,600,FN2,14,1500,FN4
        TERMINATE  0
 MAC8   ASSIGN     1,K24
 EASY   MACRO      15,600,FN2,16,2100,FN4
        TERMINATE  0
 MAC9   ASSIGN     1,K25
 EASY   MACRO      17,600,FN2,18,2700,FN4
        TERMINATE  1
        START      400
        RESET
        START      250
        END
```

APPENDIX C-II

```
*       SIMULATE
*
*   THIS GPSS/360 PROGRAM SIMULATES A TANDEM PARTIALLY CYCLIC QUEUING
*       SYSTEM WITH ERLANG SERVERS AND DUAL SERVICE RATES AT THE FIRST
*       FACILITY.  ALL QUEUE DISCIPLINE IS FIFO.
*
*  TWENTY ONE POINT ERLANG  MEAN=1.0  K=6
 7      FUNCTION    RN6,C21
0,0/0.0000013,0.00211/0.0000123,0.0791/0.000334,0.1491/0.004381,0.24911
/0.02023,0.34911/0.03535,0.3991/0.0834,0.49911/0.15515,0.59911/
0.245986,0.6991096/0.34806,0.79911/0.4529,0.89911/0.55346,0.99911/
0.72346,1.19911/0.842304,1.3991/0.9159,1.5991/0.9576,1.7991/
0.9905,2.1991/0.9982,2.5991/0.9998,3.1991/1.0,4.9991
*
*  TWENTY FOUR POINT EXPONENTIAL SUM DIST FUNCTION  MEAN=1.0
 3      FUNCTION    RN2,C24
0,0/.1,.104/.2,.222/.3,.355/.4,.509/.5,.69/.6,.915/.7,1.2/.75,1.38/
.8,1.6/.84,1.83/.88,2.12/.9,2.3/.92,2.52/.94,2.81/.95,2.99/.96,3.2/
.97,3.5/.98,3.9/.99,4.6/.995,5.3/.998,6.2/.999,7.0/.9997,8.0
*
*  TWENTY ONE POINT ERLANG  MEAN=1.0  K=6
 4      FUNCTION    RN3,C21
0,0/0.0000013,0.00211/0.0000123,0.0791/0.000334,0.1491/0.004381,0.24911
/0.02023,0.34911/0.03535,0.3991/0.0834,0.49911/0.15515,0.59911/
0.245986,0.6991096/0.34806,0.79911/0.4529,0.89911/0.55346,0.99911/
0.72346,1.19911/0.842304,1.3991/0.9159,1.5991/0.9576,1.7991/
0.9905,2.1991/0.9982,2.5991/0.9998,3.1991/1.0,4.9991
*
*   EIGHTEEN POINT ERLANG  MEAN=1.0  K=4
 8      FUNCTION    RN5,C18
0,0/0.00002247,0.039109/0.0001966,0.069109/0.003288,0.14911/
0.01877,0.24911/0.05332,0.3491/0.10814,0.44911/0.220533,0.59911/
0.30727,0.6991096/0.48403,0.8991097/0.565834,0.99911/0.705229,1.19911/
0.80899,1.399109/0.92791,1.79911/0.98614,2.3991/0.997702,2.99911/
0.99982,3.7991/1.0,6.1991
*
 9      QTABLE      1,0,5,20
 8      QTABLE      2,0,5,20
 10     TABLE       M1,0,10,20
 11     TABLE       M1,0,10,20
 12     TABLE       M1,0,5,20
        STORAGE     S22,1        LIMITS SCALE TO ONE TRANSACTION
        INITIAL     X1,556
        INITIAL     X2,132
        INITIAL     X3,158
```

```
        INITIAL     X4,167
        GENERATE    X1,FN3
        ASSIGN      2,K2         ASSIGNS IDENTITY 2 TO LOADED VEHICLES
QUE1    QUEUE       1            SCALE QUEUE
        ENTER       22
        TEST E      P2,1,DDD
        TABULATE    11           TRANSIT TIME FROM START TO JUST PRIOR TO
*                                  EMPTY SCALE SERVICE
        TRANSFER    ,EEE
DDD     TABULATE    10           QUEUE TIME FOR LOADED VEHICLES AT SCALE
EEE     DEPART      1
        TEST E      P2,2,FACE
FACF    SEIZE       SCAF         LOADED VEHICLES WEIGH HERE
        ADVANCE     X2,FN4
        RELEASE     SCAF
        LEAVE       22
        ASSIGN      2,K1         ASSIGNS IDENTITY 1 TO EMPTY VEHICLE
QUE2    QUEUE       2            UNLOADER QUEUE
        SEIZE       DUMP         UNLOADER FACILITY
        TABULATE    12           TRANSIT TIME FROM START TO UNLOADING
*                                  COMPLETION
        DEPART      2
        ADVANCE     X4,FN7
        RELEASE     DUMP
        TRANSFER    ,QUE1        TRANSFERS EMPTY VEHICLE BACK TO SCALE QUEUE
FACE    SEIZE       SCAE         EMPTY VEHICLE WEIGHS HERE
        ADVANCE     X3,FN8
        RELEASE     SCAE
        LEAVE       22
        TERMINATE   1
*
*       PLACE SERIES OF START, RESET, AND INITIAL CARDS HERE TO SIMULATE
*         VARIOUS VALUES OF INTER-ARRIVAL TIME, EMPTY AND LOADED SCALE
*         TIMES, AND UNLOADER TIMES.
        END
```

APPENDIX C-III

```
*SIMULATE
*
*
*   THIS GPSS/360 PROGRAM SIMULATES AN ELEVATOR SIMILAR TO THE
*        WEATHERFORD ELEVATOR WITH FOUR UNLOADING BAYS AND ONE SCALE.
*
*
*        NOTE: ALL TIME IS IN TERMS OF SECONDS
*
 1     MATRIX      X,40,8
 2     MATRIX      X,20,2
       INITIAL     X10,76              MEAN SCALE TIME FOR LOADED VEHICLES
       INITIAL     X11,71              MEAN SCALE TIME FOR EMPTY VEHICLES
       INITIAL     X13,45   SEC/BU     OAT PIT LEG CONVEYING RATE X 10
       INITIAL     X14,18   SEC/BU     BARLEY LEG CONVEYING RATE X 10
       INITIAL     X15,72   SEC/BU     WHEAT PIT 1 LEG CONVEYING RATE X 100
       INITIAL     X16,72   SEC/BU     WHEAT PIT 2 LEG CONVEYING RATE X 100
       INITIAL     X17,1000            WHEAT PIT 1 CAPACITY BUSHELS
       INITIAL     X18,500             OAT PIT CAPACITY BUSHELS
       INITIAL     X19,500             BARLEY PIT CAPACITY BUSHELS
       INITIAL     X20,500             WHEAT PIT 2 CAPACITY BUSHELS
       INITIAL     X22,429         INTERARRIVAL TIME  SET INITIALLY
 1     TABLE       M1,0,60,50
*
*
*   SAMPLES OF THE QUANTITY OF EACH PIT ARE TAKEN BY THE SEQUENCE
*        CREATED HERE.
*
*
       GENERATE    1800,,,40,,10,F
       MARK        10
       SAVEVALUE   99+,1
       MSAVEVALUE  1,X99,1,P10
       MSAVEVALUE  1,X99,2,Q11
       MSAVEVALUE  1,X99,3,Q12
       MSAVEVALUE  1,X99,4,Q13
       MSAVEVALUE  1,X99,5,Q14
       MSAVEVALUE  1,X99,6,Q1
       MSAVEVALUE  1,X99,7,Q2
       MSAVEVALUE  1,X99,8,Q20
       TERMINATE   0
*
*
*   THE FOLLOWING TWO CARDS ARE A TIMER WHICH EMITS A TRANSACTION EVERY
*        TWO HOURS.  THESE TRANSACTIONS TRIGGER A NEW INTERARRIVAL MEAN
*        TO BE ENTERED AS X22 AND USED BY THE GENERATE BLOCK.
*
*
       GENERATE    7200,,,10
       TERMINATE   1
*
*
*  TWENTY FOUR POINT EXPONENTIAL CUM DIST FUNCTION  MEAN=1.0
 1     FUNCTION    RN2,C24
0,0/.1,.104/.2,.222/.3,.355/.4,.509/.5,.69/.6,.915/.7,1.2/.75,1.38/
.8,1.6/.84,1.83/.88,2.12/.9,2.3/.92,2.52/.94,2.81/.95,2.99/.96,3.2/
.97,3.5/.98,3.9/.99,4.6/.995,5.3/.998,6.2/.999,7.0/.9997,8.0
*   EIGHTEEN POINT ERLANG  MEAN=1.0  K=4
 2     FUNCTION    RN3,C18
0,0/0.00002247,0.039109/0.0001966,0.069109/0.003288,0.14911/
0.01877,0.24911/0.05332,0.3491/0.10814,0.44911/0.220533,0.59911/
0.30727,0.6991096/0.48403,0.8991097/0.565834,0.99911/0.705229,1.19911/
0.80899,1.399109/0.92791,1.79911/0.98614,2.3991/0.997702,2.99911/
0.99982,3.7991/1.0,6.1991
*
*
*
       GENERATE    X22,FN1,,500,,10,F
       MARK        10
       ASSIGN      2,1
       ASSIGN      3,X10
       ENTER       6
SCAL   ENTER       1
QUEP2  QUEUE       P2
QUE20  QUEUE       20
       SEIZE       20
DEPT   DEPART      P2
       DEPART      20
ADV1   ADVANCE     P3,FN2
       RELEASE     20
       LEAVE       1
       TEST E      P2,K1,LST1
       TRANSFER    .030,NEX1,OATS
NEX1   TRANSFER    .823,BARL,WHET
OATS   ENTER       2
       ASSIGN      4,228,6
       ASSIGN      5,250
       ASSIGN      7,V5
5      FVARIABLE   P5*X13/10
       SPLIT       1,OPIT
```

```
        QUEUE       3
        GATE LS     1,SEZ3
        ASSIGN      4,V5
SEZ3    SEIZE       3
        DEPART      3
        ADVANCE     P4
        RELEASE     3
        LEAVE       2
        TRANSFER    ,ASN2
OPIT    TEST G      Q11,X18,OPITA
        LOGIC S     1
OPITA   QUEUE       11,P5
        SEIZE       11
        DEPART      11,P5
        ADVANCE     P7
        RELEASE     11
        TEST L      Q11,X18,TER1
        LOGIC R     1
TER1    TERMINATE   0
BARL    ENTER       3
        ASSIGN      4,325,6
        ASSIGN      5,250
        ASSIGN      7,V6
6       FVARIABLE   P5*X14/10
        SPLIT       1,BPIT
        QUEUE       4
        GATE LS     2,SEZ4
        ASSIGN      4,V6
SEZ4    SEIZE       4
        DEPART      4
        ADVANCE     P4
        RELEASE     4
        LEAVE       3
        TRANSFER    ,ASN2
BPIT    TEST G      Q12,X19,BPITA
        LOGIC S     2
BPITA   QUEUE       12,P5
        SEIZE       12
        DEPART      12,P5
        ADVANCE     P7
        RELEASE     12
        TEST L      Q12,X19,TER2
        LOGIC R     2
TER2    TERMINATE   0
WHET    GATE LR     7,FRAC
        ASSIGN      5,250
        TEST L      Q8,K6,OPEN
ASN3    ENTER       4
        ASSIGN      4,202,6
        ASSIGN      7,V7
7       FVARIABLE   P5*X16/100
        SPLIT       1,PIT2
        QUEUE       8
        GATE LS     3,SEZ8
        ASSIGN      4,V7
SEZ8    SEIZE       8
        DEPART      8
        ADVANCE     P4
        RELEASE     8
        LEAVE       4
        TRANSFER    ,ASN2
PIT2    TEST G      Q13,X20,PIT2A
        LOGIC S     3
PIT2A   QUEUE       13,P5
        SEIZE       13
        DEPART      13,P5
        ADVANCE     P7
        RELEASE     13
        TEST L      Q13,X20,TER3
        LOGIC R     3
TER3    TERMINATE   0
ASN5    ENTER       5
        ASSIGN      4,226,6
        ASSIGN      7,V8
8       FVARIABLE   P5*X15/100
        SPLIT       1,PIT1
        QUEUE       9
        GATE LS     4,SEZ9
        ASSIGN      4,V8
SEZ9    SEIZE       9
        DEPART      9
        ADVANCE     P4
        RELEASE     9
        LEAVE       5
        TRANSFER    ,ASN2
PIT1    TEST G      Q14,X17,PIT1A
        LOGIC S     4
PIT1A   QUEUE       14,P5
        SEIZE       14
        DEPART      14,P5
```

```
       ADVANCE    P7
       RELEASE    14
       TEST L     Q14,X17,TER4
       LOGIC R    4
TER4   TERMINATE  0
ASN2   ASSIGN     2,K2
       ASSIGN     3,X11
       TRANSFER   ,SCAL
OPEN   MARK       9
       LOGIC S    7
       ASSIGN     8,3
       SAVEVALUE  200+,1
       MSAVEVALUE 2,X200,1,P8
       MSAVEVALUE 2,X200,2,P9
FRAC   TEST E     Q9,0,FRAC1
       TEST L     Q8,K2,FRAC1
       MARK       9
       TEST G     V4,3600,FRAC1
4      VARIABLE   P9-MX2(X200,2)
       LOGIC R    7
       ASSIGN     8,1
       SAVEVALUE  200+,1
       MSAVEVALUE 2,X200,1,P8
       MSAVEVALUE 2,X200,2,P9
       TRANSFER   ,WHET
FRAC1  TRANSFER   .25,NEX3,ASN4
ASN4   ASSIGN     5,225
       TRANSFER   ,ASN3
NEX3   ASSIGN     5,350
       TEST L     Q8,Q9,TST3
       TRANSFER   ,ASN3
TST3   TEST L     Q9,Q8,TST4
       TRANSFER   ,ASN5
TST4   TRANSFER   .5,ASN3,ASN5
LST1   LEAVE      6
       TABULATE   1          TABULATES SYSTEM TIME FOR ALL ARRIVALS
TERM   TERMINATE  0
       START      1,NP
       INITIAL    X22,408
       START      1,NP
       INITIAL    X22,152
       START      1,NP
       INITIAL    X10,50
       INITIAL    X11,45
       INITIAL    X22,97
       START      1,NP
       INITIAL    X22,91
       START      1,NP
       INITIAL    X22,120
       START      1,NP
       INITIAL    X22,109
       START      1,NP
       INITIAL    X22,117
       START      1,NP
       INITIAL    X22,233
       START      1
       END
```

APPENDIX C-IV

```
*        SIMULATE
*
*    THIS GPSS/360 PROGRAM SIMULATES A HARVESTING SYSTEM CONSISTING OF
*         ONE HARVESTER AND ONE TRANSPORT VEHICLE.  ALL SERVICE TIMES ARE
*         EXPONENTIALLY DISTRIBUTED.
*
*    OUTPUT:
*         TABLE 1 -  TOTAL FIELD TIME OF VEHICLE
*         P00 - THE AVERAGE TIME IN QUEUE 1 / TOTAL SIMULATION TIME.
*         TOTAL LOADS - COUNT OF TRANSACTIONS PASSING "TERMINATE 0"
*
         RMULT      33
         INITIAL    X1,2180   SECONDS TO FILL THE HARVESTER HOPPER 100 BJ
         INITIAL    X2,300    SECONDS TO EMPTY HOPPER
         INITIAL    X3,4      NO. OF HOPPERS TRANSPORTED PER VEHICLE TRIP
*                                     (NEAREST WHOLE INTEGER)
         INITIAL    X4,1200   SECONDS VEHICLE IS AWAY FROM FIELD
         STORAGE    S1,1/S2,1
 1       TABLE      MP10,0,600,30
 I       VARIABLE   P1+1
*
*    24-POINT EXPONENTIAL CUM DIST FUNCTION   MEAN=1.0
 1       FUNCTION   RN1,C24
0,0/.1,.104/.2,.222/.3,.355/.4,.509/.5,.69/.6,.915/.7,1.2/.75,1.38/
.8,1.6/.84,1.83/.88,2.12/.9,2.3/.92,2.52/.94,2.81/.95,2.99/.96,3.2/
.97,3.5/.98,3.9/.99,4.6/.995,5.3/.998,6.2/.999,7.0/.9997,8.0
*
         GENERATE   ,,,100,,10,F
         ASSIGN     1,K1
         QUEUE      2
         ENTER      I         FILLS ONLY ONE VEHICLE AT A TIME
         DEPART     2
 COMB    SEIZE      COMB      HARVESTER FACILITY
         ADVANCE    X1,FN1
         RELEASE    COMB
         QUEUE      1         QUEUE TIME HARVESTER SITS IDLE WAITING FOR
*                                     EMPTY VEHICLE
         ENTER      2
         TEST E     P1,K1,DUMP
         MARK       10        PUTS CLOCK TIME OF VEHICLE RETURN INTO P10
 DUMP    SEIZE      DUMP
         DEPART     1
         ADVANCE    X2,FN1    DUMPS HOPPER INTO VEHICLE WHEN VEHICLE IS
*                                     PRESENT
         RELEASE    DUMP
         TEST E     P1,X3,TEST1      CHECKS TO SEE IF VEHICLE IS FULL
         LEAVE      1
         TABULATE   1         TABULATES TOTAL TIME VEHICLE IS AT FIELD
         TRANSFER   ,ROUTE
 TEST1   ASSIGN     1,V1
         LEAVE      2
         TRANSFER   ,COMB
 ROUTE   SEIZE      ROUTE
         ADVANCE    X4        VEHICLE AWAY FROM FIELD
         LEAVE      2         VEHICLE RETURNS TO FIELD
         RELEASE    ROUTE
         TERMINATE  0
         GENERATE   36000,,,10       SYSTEM OPERATES FOR 100 HOURS
         TERMINATE  1
         START      10
         END
```

APPENDIX D

D-I QUEUING DATA FROM FARMERS COOPERATIVE EXCHANGE, WEATHERFORD, OKLAHOMA

D-II QUEUING DATA FROM OSBORN INCORPORATED COTTON GIN, CHICKASHA, OKLAHOMA

D-III INTERARRIVAL TIMES WITH THEORY OF RUNS TEST FOR INDEPENDENCE, WEATHERFORD, JUNE 6, 1970

D-IV TEST OF THE ARRIVAL DISTRIBUTION FOR GOODNESS OF FIT TO THE POISSON DISTRIBUTION, WEATHERFORD, JUNE 6, 1970

APPENDIX D-I

WEATHERFORD QUEUING DATA - JUNE 6,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
10:24:45*	10:29:20	10:33:35	10:34:00		3
10:25:10	10:32:45	10:42:20	10:44:00		3
10:50:05	10:51:55	10:56:20	10:57:50		3
11:00:15	11:02:25	11:06:20	11:07:45	0634	3
11:09:30	11:11:35	11:16:50	11:18:45	3515	3
11:29:35	11:42:25	11:47:00	11:48:45	2137	3
11:47:55	11:50:25	11:54:30	11:55:45		3
12:01:00	12:04:10	12:07:40	12:08:55	2312	3
12:27:10	12:27:15	12:31:55	12:32:50		3
12:51:35	12:55:10	12:57:40	12:59:10	0635	3
13:01:45	13:05:10	13:10:00	13:12:40	0515	3
13:06:40	13:09:50	13:17:20	13:18:05	2206	3
13:24:45	13:26:50	13:32:50	13:34:45	0777	3
13:45:30	13:46:55	13:49:30	13:50:55		3
13:49:40	13:53:20	13:58:20	14:00:05	0886	2
13:56:45	13:59:15	14:02:15	14:03:20		2
13:59:25	14:01:20	14:04:45	14:05:20	2312	2
14:10:15	14:11:50	14:14:20	14:15:00	2218	2
14:17:55	14:20:00	14:26:30	14:28:25	1025	3
14:27:25	14:30:25	14:36:00	14:39:00		3
14:35:40	14:38:00	14:44:00	14:45:30	2411	3
14:37:20	14:40:20	14:48:55	14:49:55	0635	3
14:37:25	14:41:55	14:51:25	14:52:35	2137	3
14:38:45	14:43:05	14:53:58	14:56:05	0496	3
14:42:05	14:44:10	14:59:40	15:01:40		3
14:51:30	14:55:15	15:12:20	15:14:20	0515	3
14:59:30	15:00:30	15:20:30	15:22:05	2205	3
15:04:00	15:05:55	15:31:35	15:32:55	0522	3
15:11:55	15:13:10	15:33:40	15:34:50	2312	3
15:12:20	15:15:15	15:45:00	15:47:15	2303	3
15:17:05	15:18:45	15:35:00	15:36:40	0597	3
15:19:10	15:21:15	15:39:60	15:40:15	0582	3
15:24:50	15:26:30	15:42:10	15:43:00	2348	3
15:33:55	15:35:50	15:45:50	15:47:50		3
15:43:00	15:44:35	15:56:15	15:56:58	2247	2
15:44:00	15:45:30	15:48:59	15:51:55		2
15:45:15	15:46:20	15:58:30	15:59:55	2384	2
15:47:30	15:48:35	15:54:40	15:56:05	2218	2
15:47:35	15:49:40	16:00:15	16:01:25		2
15:49:00	15:50:45	16:03:45	16:05:00	0660	2
15:57:30	15:59:00	16:07:00	16:08:10	2337	2
16:01:45	16:02:50	16:07:35	16:09:00	0460	3
16:13:05	16:14:15	16:22:20	16:23:05	2206	3
16:13:15	16:16:10	16:18:15	16:19:40		2
16:16:50	16:18:30	16:25:00	16:25:50		3

WEATHERFORD QUEUING DATA - JUNE 6,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
16:20:15	16:21:25	16:26:45	16:27:40	0496	3
16:23:15	16:24:40	16:29:50	16:31:00	0886	3
16:31:55	16:32:50	16:36:40	16:37:40		3
16:35:00	16:36:00	16:40:25	16:42:25	0348	3
16:38:55	16:39:45	16:47:40	16:49:25	0350	3
16:39:00	16:41:25	16:43:45	16:45:15	0635	2
16:43:20	16:44:15	16:58:30	16:59:25	0515	3
16:47:15	16:48:30	16:50:40	16:52:55		2
16:48:55	16:52:05	16:55:40	16:57:20	1701	2
17:04:30	17:05:30	17:09:20	17:10:20	2446	3
17:04:50	17:06:40	17:18:50	17:20:50	2521	3
17:07:00	17:08:20	17:22:25	17:23:55	0522	3
17:14:25	17:15:15	17:17:25	17:19:40	2312	2
17:14:55	17:16:10	17:27:30	17:28:15	2249	3
17:15:50	17:17:45	17:19:45	17:21:35		2
17:17:45	17:18:30	17:30:30	17:31:15		3
17:23:50	17:25:45	17:27:50	17:29:15	1334	2
17:25:45	17:26:45	: :	: :	2314	3
17:28:50	17:30:35	17:32:25	17:36:30	2335	2
17:30:55	17:33:30	17:40:25	17:42:15	0256	2
17:31:40	17:34:15	17:40:05	17:40:55	0597	3
17:32:45	17:35:30	17:52:00	17:53:00	2218	3
17:36:20	17:38:05	18:05:55	18:07:10	2410	3
17:42:00	17:43:20	17:47:40	17:48:50	1104	2
17:52:25	17:54:35	18:12:55	18:14:30	2303	3
17:59:25	18:00:55	18:03:25	18:04:25	0634	2
18:07:00	18:08:55	18:21:25	18:22:55	1708	2
18:09:10	18:10:05	18:16:55	18:18:30	0349	3
18:09:15	18:11:25	18:30:40	18:31:55	0036	3
18:10:05	18:13:35	19:31:30	19:32:45	1124	3
18:14:45	18:16:10	18:23:25	18:24:55	2344	2
18:21:50	: :	18:48:20	18:52:55	0886	3
18:33:50	18:36:35	18:39:45	18:40:55	1107	2
18:37:35	18:38:55	18:57:55	: :	2205	3
18:41:25	18:42:40	19:09:50	19:11:20		3
18:42:50	18:44:00	18:46:25	18:49:40		2
18:45:50	18:48:35	19:37:20	19:41:30		2
18:46:40	18:50:35	: :	19:01:30	0635	2
18:49:20	18:52:30	19:15:20	19:17:10	2411	3
18:50:55	18:54:59	19:21:45	19:24:45	2452	3
18:53:35	18:55:40	19:14:20	19:16:18	2506	2
18:54:50	18:57:30	: :	: :	2149	3
18:57:20	18:58:35	19:03:30	19:04:40	0149	2
18:58:05	19:00:35	19:25:55	19:27:50		3
19:10:25	19:12:35	19:27:05	19:29:45		3

*All time entries are in the format of (hours:minutes:seconds).

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 6,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
19:16:20	19:18:40	19:21:20	19:25:40	0072	2
19:21:00	19:22:15	19:36:30	19:39:20		3
19:21:30	19:23:25	19:45:40	19:47:50	2353	3
19:22:00	19:26:45	20:00:00	20:02:30	3515	2
19:25:30	19:28:57	19:31:05	19:37:00	0605	2
19:28:25	19:30:50	20:16:55	20:19:00	0582	2
19:30:15	19:31:45	19:58:40	19:59:40		3
19:30:25	19:33:40	19:38:40	19:42:25		2
19:31:35	19:36:10	19:40:50	19:43:45	0256	2
19:34:05	19:37:50	20:01:30	20:04:50	2521	2
19:35:55	19:38:30	: :	: :	2314	4
19:39:25	19:45:15	19:48:50	19:50:30	1701	3
19:42:10	19:46:05	19:49:55	19:51:15	3018	2
19:43:05	19:46:55	20:03:10	20:05:25	2345	2
19:48:10	19:49:10	20:04:05	20:05:55		2
19:52:05	19:53:00	19:56:10	19:57:15	0014	2
20:02:20	20:03:35	20:07:20	20:08:45	0064	2
20:05:10	20:07:25	20:09:40	20:10:40	2312	2
20:16:50	20:18:00	20:20:20	20:21:40		2
20:18:30	20:19:50	20:21:55	20:22:50		2
20:22:25	20:23:40	20:28:15	20:29:30		3
20:23:50	20:24:55	20:28:40	20:31:00	0104	2
20:26:00	20:27:20	: :	: :	0561	4
20:26:05	20:28:05	20:35:05	20:36:45	2303	2
20:28:45	20:30:05	20:36:40	20:38:00		2
20:31:55	20:32:55	20:41:20	20:42:10		2
20:34:50	20:35:50	20:43:45	20:46:40	1702	2
20:36:35	20:38:45	20:42:35	20:43:20		3
20:43:40	20:45:05	20:48:35	20:49:45		2
20:47:00	20:48:00	20:55:20	20:57:50		3
20:50:55	20:52:00	20:54:30	20:56:50	0634	2
20:52:50	20:53:40	20:58:35	20:59:40		2
20:52:55	20:54:40	21:02:25	21:03:20	0886	2
21:03:55	21:06:02	21:10:45	21:12:25		2
21:06:20	21:08:50	21:12:20	21:13:40	0977	2
21:09:20	21:10:25	21:13:45	21:19:10	2429	3
21:12:55	21:14:45	21:22:10	21:24:03		2
21:15:40	21:18:15	21:21:45	21:22:45		2
21:18:30	21:20:20	21:28:15	21:30:40		3
21:19:40	21:21:25	: :	: :	2452	4
21:22:40	21:27:35	: :	: :	2384	4
21:26:55	21:28:40	21:32:00	21:33:25	0337	2
21:27:15	21:29:50	21:33:50	21:35:30		2
21:33:15	21:34:35	21:36:40	21:37:45	3018	2
21:39:05	21:40:15	21:43:55	21:45:50	2350	2

WEATHERFORD QUEUING DATA - JUNE 6,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
21:53:00	21:54:35	21:58:55	22:00:30	1708	2
21:55:20	21:56:35	22:00:25	22:01:35		2
21:56:40	21:58:25	22:03:30	22:06:25	3615	3
22:01:30	22:03:00	22:10:10	22:13:00	3521	3
22:03:00	22:04:20	22:06:35	22:10:50		2
22:04:15	22:05:15	22:12:35	22:15:05	2206	3
22:04:55	22:07:10	22:10:35	22:11:55	0635	2
22:05:50	22:09:50	22:24:10	22:26:15	0597	2
22:11:05	22:14:05	22:16:55	22:19:10	2149	2
22:12:55	: :	: :	: :	2314	4
22:13:45	22:18:15	22:21:05	22:22:45	0702	2
22:20:30	22:21:40	22:24:20	22:27:50		2
22:22:10	22:25:25	22:28:25	22:30:30		2
22:27:30	22:29:15	22:30:35	22:32:00		2
22:40:10	22:40:50	22:44:15	22:45:20	1702	2

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 7, 1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
09:11:05	09:15:05	09:18:05	09:19:10	1334	2
09:55:30	09:56:50	09:59:50	10:01:15		2
10:01:05	10:03:15	: :	: :	0427	4
10:08:15	10:09:30	10:12:55	10:14:30	2411	2
10:15:05	10:17:10	: :	: :	0561	4
10:24:50	10:26:20	10:28:50	10:29:20	3515	2
10:37:15	10:40:55	10:44:05	10:45:15	0886	2
11:20:40	11:22:25	11:27:00	11:31:10	0349	2
11:21:20	11:24:45	: :	: :		4
11:25:05	11:27:05	11:29:45	11:31:55	0045	2
11:25:10	11:30:20	11:34:30	11:35:45	0084	2
11:41:10	11:42:15	11:45:00	11:46:30		2
11:51:05	11:52:20	11:56:40	11:58:40	2376	2
11:58:35	11:59:25	: :	: :	1124	4
12:00:05	12:01:50	12:04:55	12:08:30	0886	2
12:03:35	12:06:00	12:08:15	12:09:45		2
12:04:20	12:07:00	12:11:25	12:12:25	2249	2
12:36:40	12:38:45	12:41:40	12:42:55	0050	2
12:36:45	12:39:50	12:43:00	12:43:55		2
12:36:50	12:41:10	12:49:20	12:51:10	0863	2
12:46:45	12:47:55	12:52:10	12:53:10	2248	3
12:48:20	12:49:50	13:00:40	13:02:00	0715	2
12:54:25	12:55:40	13:03:20	13:04:40	3515	2
13:05:45	13:06:35	13:11:20	13:12:35	2303	3
13:09:05	13:09:55	13:12:00	13:13:25		2
13:12:15	13:14:20	13:16:35	13:19:00	1165	2
13:13:10	13:17:40	13:21:05	13:22:05	1701	2
13:29:50	13:31:00	: :	: :	1124	4
13:30:45	13:33:25	13:40:50	13:43:10	2350	3
13:45:10	13:46:40	13:50:45	13:53:00	2490	2
13:46:55	13:48:30	13:52:40	13:54:30	3018	2
13:50:25	13:51:55	14:00:55	14:02:55	2380	3
13:59:20	14:00:25	14:03:40	14:06:10	2249	3
14:01:10	14:03:25	14:05:40	14:07:05		2
14:01:30	14:04:35	14:07:30	14:08:35	2312	2
14:01:40	14:05:25	14:08:55	14:10:35	2304	3
14:07:40	14:09:40	14:15:10	14:16:15	2136	3
14:16:45	14:18:00	14:23:05	14:25:30	0104	3
14:20:55	14:23:20	14:32:25	14:34:10	2140	3
14:21:25	14:24:35	: :	: :	0561	4
14:36:10	14:37:05	14:42:60	14:43:10	0715	2
14:37:00	14:38:35	14:45:50	14:46:55	0050	3
14:44:00	14:45:10	14:47:10	14:48:05	2149	2
14:44:15	14:46:05	14:52:00	14:53:40	2411	3
14:55:50	14:57:10	15:00:20	15:01:15	1165	2

WEATHERFORD QUEUING DATA - JUNE 7, 1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
14:56:20	14:58:35	15:02:30	15:04:10	2254	3
15:01:00	15:01:60	15:04:05	15:05:05	2218	2
15:02:05	15:03:10	15:07:00	15:10:00	2222	2
15:06:05	15:07:15	15:15:30	15:16:35	2137	3
15:07:05	15:08:10	15:10:15	15:11:20	0635	2
15:11:50	15:15:20	15:19:20	15:21:00	1701	2
15:24:30	15:26:00	15:31:20	15:32:20	0343	3
15:30:10	15:31:25	15:37:50	15:39:05	1448	2
15:32:20	15:33:50	15:40:10	15:43:10	0582	3
15:32:25	15:35:40	15:44:45	15:48:45	2303	3
15:32:30	15:36:35	15:40:00	15:42:05	2452	2
15:39:30	15:41:10	: :	15:49:30	2348	3
15:42:25	15:44:50	: :	: :	0427	4
15:43:40	15:45:50	15:49:20	15:52:30	0084	2
15:45:25	15:46:55	15:51:15	15:54:35	2220	2
15:45:50	15:48:00	15:52:25	15:55:10	0496	2
15:48:05	15:50:40	15:55:10	15:57:05	3515	2
15:48:30	15:51:30	15:55:35	15:59:30	2255	3
15:52:05	15:53:30	: :	16:01:40	2136	3
15:53:30	15:56:10	16:02:25	16:03:50	0104	3
15:54:00	15:58:15	16:01:00	16:02:25	0634	2
15:55:40	16:00:35	16:10:30	16:14:00	1983	3
16:01:20	16:07:35	16:09:55	16:13:20	1702	2
16:03:15	16:08:30	16:12:40	16:14:50		2
16:04:10	16:09:15	16:13:55	16:15:25	2248	3
16:06:05	16:10:20	16:23:40	16:24:55	2410	3
16:07:30	16:11:10	16:14:25	16:16:00	1165	2
16:10:20	16:11:55	: :	: :	2310	4
16:15:05	16:17:05	: :	: :	2384	4
16:26:15	16:27:20	16:29:15	16:31:45	3018	2
16:32:25	16:33:30	16:36:40	16:37:45	2304	3
16:39:30	16:41:25	16:48:30	16:49:45	2380	3
16:45:50	16:46:45	16:49:05	16:50:30	2218	2
16:46:40	16:47:50	16:50:55	16:52:15	0702	2
16:46:50	16:48:45	16:53:10	16:55:00	2314	2
16:49:00	16:51:25	16:57:10	16:58:20	2312	2
16:53:05	16:54:05	17:17:05	17:19:05	0737	2
16:55:40	16:57:05	17:16:55	17:18:05	0582	3
16:58:20	17:04:00	17:07:15	17:08:30	1701	2
16:59:20	17:04:40	17:10:45	17:11:50	0864	2
17:00:00	17:05:30	17:20:05	17:21:25	0103	2
17:04:15	17:06:25	17:22:15	17:23:45	2254	2
17:15:20	17:16:55	17:26:05	17:27:35	2490	2
17:18:50	17:19:50	17:27:05	17:28:05	0496	2
17:22:05	17:24:55	17:29:45	17:32:40	1284	2

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 7,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
17:23:25	17:26:40	17:31:15	17:33:40	2137	3
17:29:15	: :	17:33:15	17:34:35	3258	2
17:29:35	17:31:20	: :	: :	2310	4
17:37:00	17:42:10	17:45:30	17:49:50	1702	2
17:37:35	17:47:00	17:50:20	17:51:40	0084	2
17:37:55	17:48:20	17:53:15	17:55:10	2222	2
17:52:50	17:53:55	17:57:35	18:00:40	0050	3
17:54:30	17:56:40	18:01:55	18:02:50	2255	3
17:55:10	17:58:35	18:07:59	18:08:25	2303	3
17:56:05	18:00:05	18:04:10	18:05:20	1448	2
17:57:50	18:01:55	18:06:60	18:07:10	2149	2
18:12:55	18:14:15	18:19:45	18:20:55	0104	3
18:21:10	18:22:00	18:37:20	18:38:20	2346	3
18:21:20	18:22:55	18:25:45	18:26:40	1334	2
18:29:25	18:31:10	: :	: :	1124	4
18:32:55	18:34:30	18:38:30	18:39:45	2376	2
18:34:35	18:36:00	18:40:25	18:41:55	2218	2
18:36:15	18:37:05	18:42:30	18:43:40	0635	2
18:40:00	18:41:10	18:44:50	18:46:00	2136	3
18:48:10	18:49:00	18:55:50	18:56:50	0715	2
18:48:40	18:54:45	18:58:50	19:03:10	1701	2
18:55:00	18:55:55	19:00:00	19:01:10	2254	3
18:59:00	18:59:50	19:03:55	19:05:55	0702	2
19:03:20	19:05:00	19:07:15	19:09:45	2359	2
19:05:45	19:07:05	19:08:50	19:10:15	0496	2
19:06:40	19:07:55	19:12:20	19:13:30	0664	2
19:06:50	19:08:40	19:13:45	19:15:40	3258	2
19:13:00	19:14:50	19:19:55	19:21:35	2304	3
19:15:25	19:17:10	19:19:50	19:20:55		2
19:16:30	19:18:25	19:23:10	19:24:10	2348	3
19:16:50	19:19:25	: :	: :	0343	4
19:21:35	19:22:30	19:35:45	19:37:25	2411	3
19:26:45	19:29:50	19:41:35	19:42:55	2353	3
19:27:30	19:30:25	19:34:35	19:36:05	2156	2
19:29:45	19:31:25	19:36:20	19:38:10	2312	2
19:36:45	19:39:15	19:43:00	19:45:15	2137	3
19:38:00	19:40:20	19:51:25	19:52:20	0104	3
19:42:20	19:43:50	19:46:55	19:48:05	2322	2
19:48:55	19:50:20	19:53:50	19:54:45	2220	2
19:56:55	19:58:05	20:02:30	20:03:30	2255	3
20:10:25	20:11:40	20:13:50	20:18:45	3018	2
20:13:25	20:15:40	20:21:50	20:30:05	0663	2
20:14:20	20:17:10	20:25:50	20:26:25	2142	3
20:19:55	20:20:55	20:28:45	20:31:00	2410	3
20:20:00	20:21:45	20:24:35	20:25:45	1334	2

WEATHERFORD QUEUING DATA - JUNE 7,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
20:20:40	20:22:50	20:27:45	20:28:40	0634	2
20:22:20	20:24:45	20:32:50	20:34:10	2380	2
20:25:40	20:27:30	20:37:05	20:39:20	0715	2
20:29:40	20:32:20	20:47:30	20:48:40	2348	3
20:32:10	20:33:15	: :	: :	1124	4
20:35:50	20:37:10	20:40:45	20:45:45	1448	2
20:36:20	20:38:15	20:43:40	20:45:00	0582	2
20:38:25	20:40:25	20:45:25	20:46:30	2218	2
20:40:20	20:41:15	20:46:45	20:47:50	2149	2
20:42:10	20:43:20	20:48:40	20:55:20	1701	2
20:42:30	20:44:00	20:50:40	20:56:10	2358	2
20:47:45	20:50:30	: :	: :	0561	4
20:48:50	20:51:25	20:55:35	21:00:15	2136	3
20:49:50	20:52:30	20:58:05	21:01:20		2
20:49:45	: :	: :	: :		4
20:51:10	: :	21:00:20	21:02:05	3515	2
20:51:25	20:57:15	21:03:55	21:05:05		2
20:51:30	20:58:05	21:10:20	21:12:20	0542	2
20:52:05	20:59:15	21:04:05	21:06:15	0103	3
21:00:30	21:03:35	21:14:55	21:16:20	0664	2
21:00:40	: :	21:16:00	21:16:55	0496	2
21:08:55	21:11:25	21:17:55	21:19:00	2376	3
21:18:05	21:21:00	21:27:55	21:29:45	2303	3
21:19:00	21:21:50	21:25:20	21:28:15	0635	2
21:22:20	21:23:15	21:34:20	21:35:50	2254	3
21:22:50	21:23:50	21:27:45	21:29:00	2222	2
21:24:15	21:24:55	21:29:25	21:30:45	2322	2
21:24:40	21:25:35	21:32:55	21:34:55	5116	2
21:24:50	21:27:10	21:48:05	21:52:25	2411	3
21:32:20	21:33:20	21:40:50	21:41:55	1286	2
21:35:55	21:36:30	21:42:05	21:43:05	3258	2
21:41:05	21:44:25	21:51:50	21:54:40	1702	2
21:41:55	21:45:40	21:51:15	21:53:50	0517	3
21:42:30	21:47:40	21:56:45	21:57:30		2
21:42:35	21:48:40	22:00:40	22:01:35	2452	2
21:42:40	21:49:40	21:58:35	21:59:10	2348	3
21:42:45	21:50:30	22:02:40	22:03:40		2
21:46:40	21:51:10	22:05:45	22:06:55	0864	2
21:52:35	21:53:10	: :	: :		4
22:08:50	22:09:20	22:11:30	22:12:10	2312	2
22:11:50	22:13:45	22:18:00	22:18:55	0542	2
22:12:25	22:12:50	: :	: :		4
22:18:30	22:20:10	22:23:25	22:24:45		3
22:22:30	22:24:00	22:32:00	22:32:50	0050	2
22:24:55	22:25:30	22:30:15	22:31:15	2314	2

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 7,1970

ARRIVAL AT SCALE QUEUE LCADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
22:27:20	22:28:05	22:33:45	22:34:40	0634	2
22:27:40	22:29:05	22:38:10	22:39:40	0662	2
22:36:05	22:37:30	22:42:55	22:45:50	2348	3
22:44:35	22:46:40	22:52:35	22:53:45	2156	2
22:50:00	22:50:35	22:54:20	22:54:55	3018	2
23:02:25	23:02:55	23:07:25	23:08:20	2490	2
23:02:35	23:03:20	23:10:45	23:11:45	1334	2
23:13:40	23:14:35	23:18:55	23:20:00	1708	2
23:26:55	23:27:30	: :	: :	2310	4
23:27:30	23:28:55	23:36:35	23:37:30		2
23:27:35	23:29:55	23:36:45	23:38:10		2

WEATHERFURD QUEUING DATA - JUNE 8,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
07:49:50	07:51:00	07:54:05	07:55:20		2
07:50:00	07:51:45	07:55:00	07:56:10		2
08:02:05	08:03:10	08:07:55	08:09:45	0633	2
08:13:00	08:15:55	08:19:55	: :	2205	3
08:15:00	08:17:40	: :	: :		4
08:22:20	08:25:30	08:29:15	08:31:10	0330	3
08:22:55	08:26:10	08:29:35	08:32:00	0715	2
08:24:25	08:27:30	08:32:05	08:32:55	2335	2
08:28:55	08:29:20	08:50:35	08:51:05	0943	3
08:38:55	08:40:05	: :	: :		4
08:40:25	08:41:45	08:46:15	08:47:20	2410	3
08:40:35	08:42:15	08:44:35	08:45:45		2
09:08:45	09:11:50	: :	: :	2310	4
09:10:40	09:16:25	09:21:40	09:22:40	0910	2
09:17:05	09:20:40	09:24:45	09:27:20	0329	2
09:24:45	09:26:00	09:30:30	09:31:50	2255	3
09:35:50	09:36:50	09:39:25	09:40:25	0977	2
09:57:00	10:11:35	10:18:35	10:19:55	1701	2
09:57:10	10:08:35	10:11:45	10:12:55	1702	2
10:08:00	10:09:35	: :	: :	2245	4
10:08:05	10:10:05	10:13:30	10:14:05		2
10:12:15	10:18:20	10:24:35	10:25:35		3
10:26:15	10:26:50	10:30:00	10:32:20	2156	2
10:29:45	10:31:20	10:35:45	10:37:40	0256	2
10:37:20	10:39:50	10:41:30	10:44:35	2344	2
10:40:55	10:41:50	10:45:45	10:46:45	2249	3
10:41:15	10:42:35	10:47:20	10:48:10	0095	2
10:41:00	10:43:45	10:49:00	10:49:50	3513	2
10:50:20	10:51:00	10:55:15	10:55:45	2206	3
10:56:20	10:57:40	11:00:35	11:04:00	2254	2
10:56:45	10:58:10	10:59:55	11:00:55		2
10:59:60	11:00:15	11:04:40	11:05:40	2446	3
10:59:20	11:01:35	11:05:20	11:06:25	2314	2
10:59:25	11:02:50	11:16:30	11:17:25	2348	3
11:02:05	11:04:50	11:07:00	11:08:20	2234	2
11:06:35	11:07:40	11:09:40	11:10:40	2434	2
11:12:35	11:13:50	11:29:55	11:31:05	2353	3
11:20:00	11:21:15	11:23:30	11:24:05	2208	2
11:24:15	11:25:15	11:35:30	11:36:35	3515	3
11:26:20	11:27:00	11:32:30	11:34:50	0084	2
11:32:00	11:32:45	11:36:00	11:38:00	3514	2
11:34:10	11:35:30	11:37:35	11:38:40	0635	2
11:35:45	11:37:00	11:40:45	11:42:05	2384	2
11:37:55	11:39:15	11:42:15	11:43:45	2220	2
11:40:35	11:41:10	11:44:20	11:45:00	0605	2

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 8,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
11:41:55	11:42:55	11:46:50	11:48:00	2248	3
11:44:25	11:45:35	11:47:45	11:49:00	2218	2
11:48:00	11:50:00	11:54:55	11:56:50	0775	2
11:48:35	11:50:35	11:57:20	11:58:20	2337	2
11:50:50	11:51:35	12:01:10	12:02:00	0542	2
11:51:50	11:52:45	12:03:50	12:04:40	0910	2
11:54:05	11:55:35	12:03:55	12:05:30	0104	3
12:04:15	12:06:35	12:16:30	12:17:25	2348	3
12:04:50	12:07:25	12:19:05	12:20:15	0041	3
12:07:40	12:08:10	12:12:15	12:13:15	0864	2
12:08:45	12:09:45	: :	: :	2299	4
12:09:55	12:11:15	12:30:30	12:31:20	2303	3
12:10:55	12:12:00	12:18:05	12:19:20	1284	2
12:12:15	12:14:15	12:19:20	12:20:45		2
12:21:05	12:21:40	12:24:25	12:26:05	3513	2
12:21:55	12:23:20	12:33:30	12:34:40	2255	3
12:24:15	12:25:15	12:28:50	12:29:30	5116	2
12:44:50	12:45:25	12:47:50	12:49:10		2
12:45:59	12:46:20	12:49:00	12:49:40		2
12:47:40	12:48:25	12:51:00	12:52:00		2
12:51:40	12:52:55	12:59:10	13:02:45	0256	2
12:54:00	12:54:35	12:56:25	12:57:45		2
12:58:50	13:00:35	13:07:55	13:09:25	2254	3
12:59:35	13:01:05	13:03:10	13:03:50	2149	2
13:00:50	13:01:55	13:14:05	13:16:20	2205	3
13:03:10	13:04:25	13:06:45	13:08:35	0685	2
13:04:10	13:04:50	13:08:35	13:10:05	2209	2
13:05:50	13:06:00	13:16:50	13:18:15	0664	2
13:06:15	13:08:00	13:10:40	13:12:20		2
13:09:15	13:11:30	13:21:20	13:22:45	0103	3
13:11:55	13:13:20	13:18:05	13:18:55	0702	2
13:12:05	13:14:20	13:25:15	13:26:40	2411	3
13:12:15	13:14:50	13:27:40	13:28:30	2304	3
13:13:60	13:15:30	13:22:15	13:23:55	0084	2
13:14:30	13:17:00	13:24:00	13:25:35		2
13:18:55	13:19:45	13:39:30	13:40:15		3
13:19:05	13:20:20	13:25:45	13:27:20	2220	2
13:21:25	13:21:50	13:27:40	13:29:00	2344	2
13:23:00	13:24:40	13:31:00	13:31:45	0634	2
13:27:40	13:30:00	13:34:15	13:35:15	0014	2
13:28:35	13:30:45	13:53:00	13:54:00	0464	3
13:33:15	13:34:20	: :	: :	2506	4
13:35:30	13:37:00	: :	: :	0561	4
13:35:40	13:37:40	13:41:50	13:43:00	1286	2
13:39:45	13:45:00	13:50:45	13:52:00	0707	2

WEATHERFORD QUEUING DATA - JUNE 8,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
13:47:10	13:47:55	13:52:30	13:54:55	2384	2
13:52:15	13:53:00	13:55:25	13:56:50	1701	2
13:54:45	13:55:40	13:57:40	13:58:30	3513	2
13:56:45	13:57:20	13:59:05	13:59:45	0867	2
13:59:40	14:00:30	14:02:40	14:03:55	0512	2
14:02:25	14:03:10	14:10:00	14:10:45	2156	2
14:04:20	14:04:50	14:07:35	14:09:20	2209	2
14:05:40	14:06:10	14:11:30	14:12:15	2210	2
14:07:05	14:08:10	14:14:45	14:15:50	0428	3
14:15:50	14:17:05	14:24:40	14:25:45	3515	2
14:17:40	14:18:20	14:23:20	14:24:50	2218	2
14:20:30	14:21:20	14:25:30	14:26:30	0635	2
14:22:00	14:23:20	14:28:50	14:30:00	0104	3
14:23:30	14:24:05	14:29:35	14:30:55	0542	2
14:25:00	14:27:10	14:30:55	14:31:40	2140	2
14:26:10	14:27:50	14:33:45	14:34:45	2236	2
14:30:30	14:32:15	14:35:10	14:36:00	3018	2
14:32:50	14:33:30	14:36:20	14:37:25		2
14:37:10	14:38:00	14:40:25	14:42:20	3514	2
14:37:55	14:38:50	14:43:05	14:44:55	2433	2
14:40:10	14:41:25	14:48:35	14:49:20	1284	2
14:42:45	14:44:00	14:52:10	14:53:05	2255	3
14:50:15	14:50:55	14:55:50	14:57:25	0715	2
14:50:20	14:51:45	14:55:45	14:56:50	2410	3
14:52:15	14:53:35	14:57:40	14:59:00	0014	2
14:52:50	14:54:30	14:59:40	15:00:30	0977	2
14:56:40	14:58:10	15:10:55	15:12:00	2249	3
15:02:45	15:03:55	15:07:25	15:08:40	1448	2
15:03:10	15:04:40	15:09:25	15:10:10		2
15:03:50	15:05:10	15:11:20	15:12:40	2209	2
15:04:05	15:05:45	15:14:00	15:15:00	1286	2
15:06:55	15:07:50	: :	: :	2245	4
15:11:45	15:13:35	15:16:10	15:21:10	2312	2
15:14:15	15:17:05	15:22:05	15:23:55	2376	3
15:14:25	15:18:05	15:19:50	15:21:45		2
15:17:25	15:18:35	15:21:30	15:22:25	0512	2
15:17:55	15:19:20	15:23:55	15:25:15	0084	2
15:18:20	15:20:10	15:29:40	15:30:25	2303	3
15:20:50	15:23:10	15:30:60	15:31:40	0516	2
15:25:00	15:27:30	15:34:45	15:36:00	0910	2
15:25:20	15:27:45	15:40:35	15:42:05	2490	2
15:26:00	15:28:05	15:37:00	15:38:10	2337	2
15:34:05	15:35:00	15:45:45	15:47:05	0662	2
15:36:50	15:37:25	15:41:55	15:43:00		2
15:37:40	15:38:40	15:46:50	15:47:55	2129	2

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 8,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
15:38:20	15:39:30	15:51:30	15:52:35		2
15:39:50	15:40:30	15:54:40	15:55:50	0634	2
15:42:00	15:43:30	15:56:25	15:57:40	0496	2
15:43:50	15:44:35	16:00:20	16:03:10	2411	2
15:44:30	15:45:55	15:56:00	15:57:00	2254	3
15:46:20	15:48:40	15:59:55	16:02:25	2218	1
15:49:20	15:51:40	16:03:50	16:06:45	0542	1
15:52:10	16:01:15	16:05:50	16:08:25	1702	1
15:54:05	15:54:50	16:02:05	16:06:10	2142	2
15:56:25	15:58:05	16:04:20	16:07:25	2209	2
15:57:30	16:03:45	16:07:30	16:09:55		1
15:58:40	15:59:55	16:04:35	16:09:20		3
16:02:30	16:04:40	16:16:25	16:17:40	1143	3
16:03:40	16:05:25	16:07:45	16:11:15	0702	2
16:06:55	16:10:15	16:11:40	16:13:10	2335	2
16:11:20	16:12:30	16:20:50	16:21:30	2304	3
16:13:00	16:14:10	16:23:10	16:24:05	2248	3
16:16:10	16:16:40	16:18:40	16:19:25	0512	2
16:19:00	16:20:20	16:23:45	16:25:05	1145	1
16:23:50	16:25:40	16:27:60	16:30:10	2344	1
16:24:25	16:26:45	: :	: :	2506	4
16:27:35	16:28:30	16:32:40	16:33:50	3515	
16:27:40	16:29:20	16:32:00	16:32:55	2350	1
16:28:45	16:30:45	16:36:40	16:39:55	2156	1
16:29:35	16:31:20	16:34:05	16:35:10	3513	2
16:29:55	16:31:50	16:38:00	16:40:45	2339	2
16:32:20	16:34:20	16:38:30	16:41:15	0635	1
16:36:00	16:36:55	16:43:15	16:44:15	0707	2
16:36:50	16:37:30	16:45:30	16:46:15		2
16:37:20	16:39:00	16:47:10	16:48:15	2255	3
16:45:40	16:46:45	16:50:05	16:51:45	2314	2
16:53:50	16:54:55	: :	: :	2506	4
16:54:05	16:55:25	16:57:45	16:58:25	3018	2
16:54:15	16:55:45	16:58:55	16:59:35		2
16:57:10	16:57:45	17:00:40	17:01:40	2434	2
17:02:40	17:03:15	17:06:00	17:06:45	2222	2
17:08:10	17:09:15	17:12:60	17:13:55	2303	3
17:09:30	17:10:25	17:14:25	17:16:15	0864	2
17:11:30	17:13:05	17:18:05	17:19:40	1983	2
17:12:35	17:14:40	17:17:35	17:18:50	3514	2
17:13:40	17:15:10	17:19:45	17:20:50	1144	2
17:14:35	17:16:55	17:23:20	17:24:10	1448	2
17:16:30	17:17:45	17:21:15	17:22:15	0428	3
17:24:35	17:25:15	17:27:55	17:30:35	2234	2
17:25:40	17:26:15	17:29:40	17:31:15	2249	2

WEATHERFORD QUEUING DATA - JUNE 8,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
17:26:40	17:28:30	17:32:25	17:33:40	0464	2
17:28:15	17:29:10	17:35:35	17:36:30	2312	2
17:28:40	17:29:45	17:37:05	17:38:55	0512	2
17:33:40	17:34:25	17:38:35	17:39:45	2484	2
17:36:50	17:38:10	17:44:45	17:45:40	0737	
17:39:25	17:40:25	17:42:30	17:43:30		2
17:42:25	17:42:50	17:45:00	17:46:20	0605	2
17:44:45	17:47:10	17:49:35	17:52:00	0977	2
17:45:20	17:48:30	17:51:45	17:52:55	2243	2
17:45:25	17:49:00	17:56:55	17:57:55	0715	2
17:48:55	17:50:30	17:54:55	17:56:00		1
17:49:00	17:51:05	17:57:25	17:59:50	0516	1
17:51:40	17:53:35	17:58:45	18:00:25	0685	2
17:54:30	17:54:45	17:59:55	18:00:50	2335	2
17:55:20	17:57:10	18:05:10	18:06:10	2256	3
17:55:25	17:58:40	18:02:30	18:03:25	2410	2
17:57:30	17:59:00	18:01:25	18:02:30		1
17:57:35	18:01:40	18:07:15	18:07:50	2304	3
18:12:35	18:14:35	18:28:45	18:30:10	1982	3
18:12:50	18:16:30	18:23:45	18:25:15	2299	3
18:14:10	18:17:20	18:19:40	18:21:00	2248	2
18:14:35	18:18:20	18:27:40	18:29:15	0428	3
18:18:35	18:19:10	18:21:30	18:22:30	1165	2
18:18:45	18:19:55	18:24:05	18:26:15	0328	2
18:20:05	18:21:35	18:25:40	18:26:50	2218	2
18:23:00	18:23:35	18:27:15	18:28:15		2
18:23:15	18:24:20	18:31:50	18:32:45	0095	2
18:34:40	18:35:40	18:39:10	18:40:20	2433	2
18:39:30	18:41:40	18:49:25	18:51:25	2247	3
18:40:30	18:42:15	18:43:35	18:44:25		2
18:43:40	18:45:15	18:48:60	18:50:35	0634	2
18:45:05	18:46:00	18:52:40	18:54:50	0084	2
18:46:30	18:47:35	18:54:00	18:58:25	0103	3
18:46:35	18:48:05	18:53:10	18:56:25	2337	1
18:47:35	18:49:20	18:55:05	19:01:00	2156	1
18:51:25	18:52:10	18:54:45	18:57:20	2446	2
18:51:55	18:53:35	19:11:40	19:12:40	1983	3
18:52:20	18:55:25	18:58:25	19:01:55	0327	2
18:53:40	18:59:30	19:18:35	19:20:15	0737	3
18:58:10	19:00:05	19:04:45	19:05:40	0542	2
19:00:55	19:03:30	19:10:60	19:11:10	2254	3
19:03:10	19:04:30	19:07:20	19:08:20	2521	1
19:05:25	19:06:25	19:08:45	19:09:35	2142	2
19:06:40	19:07:10	19:10:10	19:11:55	2220	2
19:12:20	19:13:15	19:15:20	19:16:45	0512	2

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 8,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
19:13:30	19:14:00	19:17:30	19:18:25	2209	2
19:14:10	19:15:55	19:19:05	19:21:00	3514	2
19:16:55	19:17:40	19:26:10	19:27:45	0910	2
19:18:05	19:18:55	19:21:15	19:22:35		2
19:20:15	19:21:45	19:26:40	19:28:50	2411	1
19:22:20	19:23:15	19:27:55	19:29:25	0635	1
19:23:10	19:23:55	19:28:45	19:32:05	5116	2
19:24:00	19:24:30	19:30:20	19:33:15	1165	2
19:24:15	19:24:50	19:31:20	19:33:40	2135	2
19:24:30	19:25:30	19:29:35	19:32:45	3018	1
19:25:55	19:26:45	19:32:25	19:34:50	1145	1
19:26:30	19:30:10	19:37:40	19:44:10	0464	1
19:26:35	19:30:40	19:32:40	19:35:30		2
19:26:40	19:31:15	19:35:30	19:37:50	0104	3
19:41:45	19:42:05	19:45:00	19:46:40	0972	2
19:30:30	19:38:55	19:40:55	19:44:50	2350	2
19:31:50	19:39:50	19:44:10	19:45:40		1
19:36:40	19:41:30	19:48:25	19:50:00	2303	3
19:36:55	19:43:05	: :	: :	2245	4
19:38:25	19:47:10	19:49:45	19:50:40		2
19:40:05	19:47:30	19:50:40	19:52:05		2
19:43:20	19:48:05	19:50:35	19:51:40		1
19:45:10	19:48:30	19:53:30	19:54:35	0715	2
19:45:20	19:49:10	: :	: :		4
19:51:50	19:53:00	19:57:35	19:58:40	1448	2
19:52:25	19:53:30	19:55:40	19:57:05	2344	1
19:55:05	19:56:00	20:00:55	20:01:50	0014	1
19:59:00	20:00:00	20:02:50	20:04:50	2348	2
20:02:15	20:03:05	20:07:05	20:08:05	0328	2
20:02:40	20:04:00	20:07:40	20:08:55	0864	1
20:05:50	20:06:50	20:09:45	20:12:40	2446	2
20:07:50	20:09:45	20:13:50	20:15:20	3515	1
20:09:40	20:10:45	20:14:00	20:16:00	0582	2
20:09:55	20:11:50	20:20:15	20:21:50	2255	3
20:10:40	20:14:05	20:20:25	20:24:50	1982	3
20:15:20	20:16:45	20:19:00	20:23:15	2434	2
20:16:60	20:17:30	20:20:20	20:22:25	2220	2
20:18:10	20:18:40	20:21:35	20:24:15	0512	2
20:21:40	20:24:40	20:26:05	20:28:35	2335	2
20:22:15	20:26:35	: :	: :	2310	4
20:23:00	20:27:05	20:31:45	20:33:25	0707	1
20:23:20	20:27:45	20:29:50	20:30:45	3515	2
20:25:15	20:29:55	20:33:45	20:36:15	2304	3
20:25:20	20:31:20	20:34:15	20:37:10		1
20:28:10	20:31:50	20:36:00	20:38:40	0542	2

WEATHERFORD QUEUING DATA - JUNE 8,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
20:31:15	20:32:25	20:35:35	20:38:00	2484	1
20:32:25	20:34:25	20:40:50	20:45:05	0256	2
20:32:45	20:34:50	20:37:05	20:42:00	2218	2
20:34:40	20:35:30	20:37:15	20:42:45	0605	1
20:35:10	20:40:10	20:44:40	20:48:00	2486	3
20:37:25	20:40:45	20:43:55	20:45:50	2410	1
20:39:45	20:41:15	20:44:35	20:46:20		2
20:40:50	20:44:00	20:48:05	20:49:20	0078	2
20:44:05	20:46:55	20:50:50	20:52:00	0541	2
20:47:00	20:48:30	20:50:20	20:51:30	2140	1
20:48:50	20:50:00	20:53:10	20:54:50	2349	2
20:49:55	20:50:50	20:53:45	20:55:45	2427	1
20:51:20	20:52:50	20:58:30	21:03:00	0327	2
20:51:35	20:53:20	20:55:45	20:58:10		1
20:52:45	20:53:55	21:01:60	21:03:50	0084	1
20:56:10	20:59:10	21:01:50	21:05:40	2156	2
20:56:15	20:59:45	21:02:40	21:06:25	1983	1
20:56:20	21:00:30	21:06:10	21:10:55		3
20:57:05	21:01:05	21:04:25	21:08:00		3
20:57:50	21:01:50	21:04:15	21:07:15		1
21:01:30	21:04:20	21:07:20	21:11:30	2314	2
21:02:35	21:04:50	21:09:10	21:12:05		2
21:03:05	21:08:25	21:09:50	21:12:30	2334	2
21:04:55	21:08:55	21:12:25	21:13:10	0095	1
21:05:45	21:09:25	21:12:50	21:13:55	0864	2
21:09:30	21:10:05	21:14:55	21:15:45	2433	2
21:13:50	21:14:25	21:15:55	21:16:35	0335	2
21:21:15	21:22:20	21:25:30	21:26:25	2446	2
21:28:00	21:28:45	21:31:00	21:34:15	0512	2
21:29:35	21:30:20	21:33:30	21:35:45	2426	1
21:29:45	21:31:10	21:33:00	21:34:55		2
21:30:00	21:32:35	21:39:55	21:42:30	2254	3
21:30:40	21:33:25	21:36:55	21:40:50	1982	3
21:33:40	21:36:25	21:40:20	21:43:20	0329	2
21:35:10	21:37:25	21:39:50	21:41:35	2312	1
21:35:45	21:38:25	21:43:40	21:45:05	2247	2
21:35:50	21:38:55	21:47:10	21:49:15	2303	3
21:37:45	21:39:50	21:45:55	21:47:30	2243	2
21:40:05	21:43:50	21:46:45	21:48:15	2337	1
21:45:45	21:46:35	21:48:40	21:50:45	0428	1
21:47:25	21:49:50	21:51:55	21:54:00	2220	2
21:50:15	21:51:30	21:54:25	21:55:15	2348	1
21:50:40	21:52:05	21:54:40	21:55:45	0972	2
21:52:15	21:53:05	21:56:45	21:57:35	0975	2
21:53:35	21:54:35	21:58:45	21:59:50	2384	2

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 8,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
21:59:00	22:00:25	22:04:25	22:05:40		2
22:06:45	22:07:45	22:10:25	22:16:25	1701	1
22:09:50	22:11:20	: :	: :		4
22:10:35	22:13:05	22:23:30	22:26:50		3
22:11:05	22:13:55	22:17:25	22:21:10		2
22:11:10	22:14:25	22:17:10	22:20:20		1
22:11:20	22:14:50	22:19:15	22:21:50	1557	2
22:16:10	22:17:30	22:20:25	22:22:25		2
22:16:60	22:18:55	: :	: :	2256	4
22:18:30	22:19:20	22:22:50	22:25:45	5116	1
22:22:35	22:23:25	22:26:30	22:29:15		2
22:22:40	22:24:00	22:29:50	22:30:50		2
22:22:45	22:24:45	: :	22:30:10	1144	1
22:22:50	22:27:45	22:29:15	22:31:40	2149	1
22:23:54	22:28:20	22:31:05	22:32:30		
22:27:55	22:34:05	: :	: :	2256	4
22:33:05	22:34:35	22:37:05	22:38:05	2446	2
22:35:00	22:35:55	22:38:55	22:40:50	0328	1
22:36:35	22:37:05	22:39:25	22:41:35	3515	2
22:38:00	22:39:05	22:47:45	22:49:00	2518	2
22:38:45	22:39:45	22:45:20	22:47:00	0715	2
22:42:50	22:43:45	22:51:05	22:51:55	0084	2
22:56:00	22:56:30	22:58:35	23:00:20		2
22:58:25	22:59:10	23:01:25	23:02:25		2
22:59:50	23:01:05	23:03:30	23:04:45		2
23:04:25	23:05:30	23:07:45	23:09:05	0977	2
23:16:45	23:17:05	23:18:55	23:20:20		2
23:16:50	23:17:45	23:21:20	23:22:45		2
23:17:55	23:18:40	23:23:15	23:24:00	2484	2
23:19:40	23:21:35	23:24:40	23:25:40	1702	2
23:24:50	23:26:35	23:28:40	23:30:30		2
23:28:25	23:29:20	23:33:20	23:34:20	0864	2
23:31:30	23:32:20	23:37:15	23:38:10	0329	2
23:34:10	23:35:10	23:38:00	23:39:40	1165	2
23:42:40	23:44:40	23:48:55	23:50:10	2418	2
23:43:05	23:45:15	23:50:50	23:53:10	2218	2
23:43:55	23:46:00	23:53:10	23:54:20	0327	2

WEATHERFORD QUEUING DATA - JUNE 9,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
07:32:00	07:35:00	: :	: :	2303	4
07:33:00	07:36:50	07:42:50	07:44:20		2
07:43:35	07:47:35	: :	: :		4
07:45:55	07:48:45	07:50:55	07:52:25	2140	2
08:09:20	08:10:40	08:13:05	08:14:50	2136	2
08:03:30	08:11:30	08:16:20	08:17:35	2411	2
08:16:25	08:18:20	08:21:30	08:22:50	0541	2
08:20:50	08:21:50	08:25:00	08:26:20	2521	2
08:26:30	08:27:10	08:29:40	08:30:55	2142	2
08:32:55	08:34:10	: :	: . :	2310	4
08:38:05	08:40:05	08:41:55	08:43:00		2
08:38:55	08:41:10	08:44:15	08:45:10	0975	2
08:43:05	08:43:50	08:46:55	08:47:55	0103	2
08:49:30	08:50:10	08:52:30	08:54:15	2156	2
09:02:00	09:02:50	09:05:40	09:06:45	2209	2
09:02:55	09:04:10	09:08:40	09:10:55	2206	3
09:08:40	09:09:55	09:12:35	09:16:00	1701	
09:08:45	09:12:00	09:14:40	09:17:10	1708	
09:08:50	09:13:35	09:16:10	09:18:20	1702	
09:09:00	09:14:20	09:19:55	09:22:45	2455	
09:11:45	09:14:55	09:24:05	09:26:55	0104	
09:12:50	09:19:35	09:26:25	09:30:25	2426	
09:13:15	09:20:10	09:28:45	09:31:15	2427	
09:15:25	09:21:00	09:31:00	09:32:00	2477	
09:22:50	09:26:05	09:38:00	09:39:20	0130	3
09:24:50	09:28:20	09:33:35	09:34:55	2506	
09:27:25	09:29:10	09:35:00	09:36:05	2478	
09:33:25	09:33:55	09:36:45	09:37:45	0078	
09:40:00	09:42:10	09:45:15	09:46:25	2024	2
09:46:15	09:47:35	09:50:10	09:50:50	2434	2
10:11:05	10:12:50	10:23:00	10:24:20	0707	3
10:12:50	10:13:55	10:22:10	10:23:15	0775	2
10:26:20	10:27:05	10:32:40	10:34:00	0084	2
10:32:55	10:35:05	10:38:30	10:39:20	2236	2
10:36:30	10:36:50	10:40:00	10:42:20	2209	2
10:36:40	10:37:50	10:40:50	10:41:40	0037	2
10:38:40	10:40:30	10:44:30	10:45:50	1048	3
10:39:40	10:40:55	10:42:35	10:44:40	2335	2
10:42:10	10:43:40	10:48:05	10:49:00	2255	3
10:49:00	10:49:55	10:53:30	10:54:20	0864	2
10:57:00	10:59:25	: :	: :		4
10:58:05	10:59:25	11:06:05	11:07:00	0256	2
11:03:25	11:04:55	11:07:35	11:08:30	2220	2
11:11:15	11:13:35	11:25:30	11:27:45	0095	3
11:12:20	11:14:15	11:17:45	11:20:20	2518	2

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 9,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
11:17:10	11:19:15	11:28:45	11:31:30	2299	3
11:20:40	11:21:45	11:24:50	11:26:00	2477	2
11:21:10	11:22:40	11:26:30	11:28:45	2242	2
11:21:40	11:23:50	11:28:35	11:30:20	3515	2
11:31:05	11:32:10	11:34:30	11:35:10	2140	2
11:31:20	11:33:30	11:40:35	11:41:45	1497	2
11:37:15	11:38:15	11:43:00	11:43:40	0084	2
11:44:00	11:44:50	11:46:40	11:47:45	0605	2
11:45:40	11:46:55	11:49:15	11:50:40	0257	2
11:46:55	11:48:30	11:50:45	11:54:05	2210	2
11:47:15	11:49:15	11:51:00	11:54:55	1557	2
11:49:45	11:51:40	11:53:55	11:55:45	0635	2
11:51:05	11:52:35	11:55:50	11:56:55	2344	2
11:51:10	11:53:20	11:57:40	11:58:15	2222	2
11:55:40	11:57:30	11:59:50	12:01:30	2209	2
11:55:50	: :	12:02:35	12:04:15	2069	2
11:59:55	12:00:30	12:03:45	12:05:10	2335	2
12:01:10	12:02:25	12:07:30	12:09:50		2
12:01:45	12:03:20	12:06:55	12:08:25	2311	3
12:03:55	12:06:30	: :	: :	2254	4
12:07:45	12:10:45	12:14:05	12:15:10	2426	2
12:12:25	12:13:30	12:18:10	12:20:05	0542	2
12:21:30	12:22:45	12:27:10	12:28:10	0573	3
12:22:20	12:23:55	12:31:00	12:34:00	2303	3
12:29:30	12:30:10	12:32:35	12:34:45	2345	2
12:29:45	12:30:55	12:34:30	12:36:30	2478	2
12:29:50	12:31:25	12:35:40	12:37:00	2218	2
12:32:00	12:33:15	12:46:35	12:48:45	0910	
12:33:35	12:35:25	12:37:45	12:40:00	2312	2
12:34:15	12:37:50	12:40:35	12:41:55	0775	2
12:34:40	12:38:30	12:44:05	12:45:30	0715	2
12:35:15	12:38:55	12:46:45	12:49:25	2156	2
12:37:25	12:42:45	12:49:15	12:50:45	2260	3
12:40:10	12:43:25	12:48:00	12:50:10	3018	2
12:41:10	12:44:15	12:50:55	12:52:25	0864	2
12:43:30	12:44:45	12:53:05	12:54:15	2477	2
12:44:40	12:46:25	12:56:00	12:57:05	0329	2
12:46:40	12:47:10	12:58:45	12:59:35	0972	2
12:46:40	12:47:40	13:01:10	13:01:55	0512	2
12:47:35	12:52:00	13:00:10	13:01:00	0039	2
12:48:45	12:53:10	13:03:35	13:04:25	2518	2
13:01:50	13:02:45	13:05:30	13:07:35		2
13:03:25	13:05:10	13:08:00	13:11:55	3513	2
13:04:10	13:05:45	13:10:10	13:12:45	2209	2
13:04:35	13:06:40	: :	: :	2255	4

WEATHERFORD QUEUING DATA - JUNE 9,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
13:05:40	13:08:10	13:13:55	13:14:45	2337	2
13:07:40	13:10:15	13:17:25	13:18:40	2493	2
13:08:50	13:13:15	13:18:45	13:19:30	2335	2
13:09:55	13:10:45	13:15:30	13:16:45	0460	2
13:19:35	13:20:35	13:23:10	13:24:25	2506	2
13:20:45	13:21:45	13:25:30	13:26:35	2304	2
13:23:20	13:25:15	13:28:05	13:29:15	2455	2
13:26:25	13:27:25	13:29:15	13:30:05	0867	2
13:27:00	13:28:10	13:33:05	13:34:05	3514	2
13:29:45	13:30:45	13:35:15	13:36:15	2359	2
13:30:55	13:32:35	13:37:50	13:39:00	0257	2
13:35:50	13:37:35	13:39:40	13:40:55	2350	2
13:42:00	13:42:50	13:45:55	13:47:00	2426	2
13:42:15	13:43:25	13:48:05	13:50:25	2384	2
13:42:55	13:44:40	13:50:50	13:52:20	0328	2
13:44:55	13:45:25	13:54:10	13:54:45	0104	2
13:47:15	13:49:00	13:54:45	13:56:40	1046	3
13:49:05	13:51:05	13:57:45	13:59:55	2142	2
13:52:00	13:53:55	14:00:55	14:02:15	1497	3
13:55:10	13:57:25	14:02:35	14:04:30		2
13:56:15	13:58:15	14:04:50	14:08:15	2348	2
13:58:05	13:58:45	14:06:30	14:09:00	2220	2
14:01:10	14:03:30	14:09:40	14:13:50	0707	3
14:01:20	14:05:55	14:09:30	14:12:35	0084	2
14:02:20	14:06:35	14:09:20	14:11:45	3515	1
14:05:00	14:06:55	14:11:00	14:17:05	2477	1
14:05:55	14:07:25	14:11:30	14:17:45	2446	2
14:06:30	14:09:50	14:13:15	14:21:10	0702	1
14:07:00	14:10:55	14:12:40	14:18:50	2350	2
14:07:45	14:15:20	14:19:35	14:22:25	0886	1
14:10:45	14:16:30	14:30:58	14:35:30	2691	3
14:12:55	14:19:50	14:33:30	14:36:20	2303	3
14:15:50	14:20:25	14:23:20	14:26:30	2518	2
14:22:10	14:23:20	14:26:30	14:28:20	2521	2
14:22:20	14:23:50	14:28:40	14:30:00		2
14:22:25	14:24:20	14:29:20	14:31:00	5116	1
14:24:00	14:25:00	14:30:20	14:32:15	0635	1
14:24:10	14:25:30	14:30:10	14:31:40	2069	
14:25:00	14:27:30	14:33:40	14:39:20	2433	
14:25:15	14:29:10	14:34:30	14:38:40	2045	1
14:27:00	14:32:50	14:35:20	14:39:50	2218	2
14:25:50	14:33:15	14:36:25	14:42:40	0415	1
14:25:55	14:26:50	14:31:15	14:34:30	2335	2
14:28:25	14:33:50	14:37:00	14:43:05	2156	
14:29:00	14:36:45	14:42:20	14:47:15	0715	

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 9,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
14:30:50	14:37:55	14:45:35	14:48:20	2420	3
14:34:15	14:40:20	: :	14:43:40	2149	1
14:35:10	14:41:00	: :	14:47:45	2336	2
14:35:55	14:41:25	14:46:25	14:51:35	0014	1
14:35:40	14:41:50	14:46:10	14:48:55		2
14:37:40	14:44:15	14:48:40	14:52:55	2410	
14:38:10	14:45:45	14:48:15	14:52:20		1
14:42:00	14:45:10	14:51:00	14:55:50	2024	3
14:44:40	14:49:40	14:52:40	14:56:25		1
14:45:30	14:50:15	14:56:30	14:58:55	2369	1
14:45:50	14:50:35	14:53:00	14:56:55		2
14:47:50	14:53:30	14:56:45	14:59:35	2478	2
14:50:40	14:54:00	14:59:10	15:00:05	0597	2
14:52:25	14:54:55	14:59:30	15:03:45	2359	3
14:53:50	14:57:35	14:59:55	15:04:25	0974	1
14:54:05	14:58:00	15:00:55	15:05:05	0143	2
14:55:10	15:01:10	15:04:50	15:05:50	0493	1
15:00:50	15:02:00	15:05:55	15:11:00	0573	3
15:01:55	15:02:50	15:12:40	15:14:00		3
15:04:35	15:06:45	: :	: :	2254	4
15:06:00	15:07:15	15:09:05	15:11:35		2
15:06:35	15:07:50	15:11:35	15:12:55		1
15:07:15	15:08:20	15:10:15	15:12:15	2124	2
15:07:30	15:08:50	15:13:55	15:14:40	0864	2
15:08:20	15:09:55	15:15:20	15:19:35	0095	1
15:13:20	15:15:45	15:18:40	15:20:05	2304	3
15:14:00	15:16:55	15:22:40	15:26:20	1048	3
15:14:50	15:17:25	15:20:00	15:22:45	2243	2
15:15:10	15:18:00	15:20:40	15:23:15	3513	1
15:18:15	15:18:50	15:22:05	15:24:05	2209	2
15:16:25	15:20:50	15:22:50	15:24:45	2376	1
15:19:05	15:21:25	15:26:10	15:27:45	0329	2
15:20:30	15:21:50	15:24:45	15:27:05	1145	1
15:20:50	15:25:15	15:29:00	15:33:50	2384	2
15:30:15	15:31:15	15:34:25	15:36:35	2427	1
15:28:40	15:32:00	15:40:05	15:41:20	2245	2
15:30:20	15:33:00	15:38:20	15:40:20	2220	3
15:32:55	15:33:25	15:36:55	15:39:25	2348	1
15:34:15	15:35:30	15:46:55	15:49:30	0130	3
15:36:20	15:37:30	15:43:30	15:45:00	2210	2
15:36:25	15:37:55	15:44:35	15:47:35	2335	2
15:37:55	15:38:30	15:42:35	15:44:00	0103	1
15:39:50	15:42:20	15:44:30	15:47:00	0635	1
15:40:45	15:43:10	15:46:35	15:48:25	3514	
15:41:20	15:45:35	15:48:55	15:52:30	0975	

WEATHERFORD QUEUING DATA - JUNE 9,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
15:41:55	15:45:55	: :	15:57:45		1
15:42:00	15:46:25	15:50:40	: :	2477	1
15:42:50	15:51:00	: :	: :	1448	
15:44:10	15:51:40	: :	: :	0460	3
15:49:05	: :	: :	: :	2506	
15:51:30	: :	: :	: :		
15:52:10	: :	: :	: :		
15:53:60	: :	: :	: :		
16:22:55	: :	: :	: :		
16:24:45	: :	: :	: :		
16:24:55	: :	: :	: :		
16:25:00	: :	: :	: :		
16:25:50	: :	: :	: :		
16:25:55	: :	: :	: :		
16:28:10	: :	: :	: :		
16:28:25	: :	: :	: :		
16:30:45	: :	: :	: :		
16:31:40	: :	: :	: :		
16:36:15	: :	: :	: :		
16:36:55	: :	: :	: :		
16:39:15	: :	: :	: :		
16:42:05	: :	: :	: :		
16:44:35	: :	: :	: :		
16:45:60	: :	: :	: :		
16:49:20	: :	: :	: :		
16:50:50	: :	: :	: :		
16:54:25	: :	: :	: :		
16:55:05	: :	: :	: :		
16:56:05	: :	: :	: :		
17:02:15	: :	: :	: :		
17:02:25	: :	: :	: :		
17:03:30	: :	: :	: :		
17:04:20	: :	: :	: :		
17:04:40	: :	: :	: :		
17:04:50	: :	: :	: :		
17:07:35	: :	: :	: :		
17:09:25	: :	: :	: :		
17:13:55	: :	: :	: :		
17:18:00	: :	: :	: :		
17:24:00	: :	: :	: :		
17:27:55	: :	: :	: :		
17:28:35	: :	: :	: :		
17:29:35	: :	: :	: :		
17:30:45	: :	: :	: :		
17:31:35	: :	: :	: :		

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 9,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
17:33:15	: :	: :	: :		
17:35:05	: :	: :	: :		
17:36:05	: :	: :	: :		
17:36:25	: :	: :	: :		
17:39:15	: :	: :	: :		
17:39:20	: :	: :	: :		
17:40:10	: :	: :	: :		
17:40:50	: :	: :	: :		
17:45:45	: :	: :	: :		
17:46:55	: :	: :	: :		
17:47:50	: :	: :	: :		
17:48:00	: :	: :	: :		
17:49:30	: :	: :	: :		
17:50:00	: :	: :	: :		
17:51:00	: :	: :	: :		
17:53:00	: :	: :	: :		
17:53:45	: :	: :	: :		
17:54:50	: :	: :	: :		
17:56:00	: :	: :	: :		
17:58:15	: :	: :	: :		
17:59:10	: :	: :	: :		
17:59:30	: :	: :	: :		
18:01:50	: :	: :	: :		
18:05:45	: :	: :	: :		
18:07:45	: :	: :	: :		
18:09:10	: :	: :	: :		
18:11:10	: :	: :	: :		
18:13:10	: :	: :	: :		
18:13:30	: :	: :	: :		
18:14:35	: :	: :	: :		
18:16:35	: :	: :	: :		
18:19:45	: :	: :	: :		
18:20:50	: :	: :	: :		
18:22:50	: :	: :	: :		
18:26:05	: :	: :	: :		
18:28:45	: :	: :	: :		
18:28:35	: :	: :	: :		
18:28:45	: :	: :	: :		
18:33:05	: :	: :	: :		
18:42:00	: :	: :	: :		
18:43:45	: :	: :	: :		
18:45:10	: :	: :	: :		
18:45:15	: :	: :	: :		
18:46:05	: :	: :	: :		
18:54:10	: :	: :	: :		

WEATHERFORD QUEUING DATA - JUNE 9,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
18:54:15	: :	: :	: :		
18:58:05	: :	: :	: :		
18:58:45	: :	: :	: :		
18:59:10	: :	: :	: :		
18:59:40	: :	: :	: :		
19:00:35	19:04:25	: :	19:08:10		3
19:03:40	19:04:55	: :	19:12:30	0095	
19:07:00	19:09:35	: :	19:13:40	0635	
19:07:05	19:11:10	: :	19:19:00		
19:07:10	19:11:40	: :	19:14:50		
19:08:00	19:12:55	: :	19:19:40		
19:10:00	19:15:25	: :	19:20:30	2242	
19:10:05	19:15:55	: :	19:21:00		
19:14:00	19:17:10	: :	19:27:20		
19:13:00	19:17:35	: :	19:21:35		
19:16:00	19:18:00	: :	19:25:40		
19:17:35	19:23:15	: :	19:30:45		
19:18:35	19:24:20	19:28:00	19:32:55		
19:18:50	19:24:55	: :	19:34:20		
19:18:55	19:28:10	: :	19:38:25	0084	
19:19:15	19:28:50	: :	19:42:40	2222	
19:23:10	19:29:35	: :	19:37:45	0354	
19:31:25	19:33:25	: :	19:39:05	2142	
19:31:30	19:35:10	: :	19:43:35		
19:31:45	19:36:30	19:44:20	19:49:10		
19:32:55	19:39:40	19:41:40	19:47:50		
19:33:55	19:40:25	19:48:30	19:54:20		
19:34:15	19:40:55	19:43:50	19:48:25		
19:35:05	19:41:50	19:52:00	19:55:40		
19:35:10	19:44:10	19:47:40	19:53:45		
19:35:20	19:44:55	19:49:45	19:55:05		
19:35:25	19:45:45	19:54:50	19:59:10		
19:38:05	19:44:15	20:17:40	20:20:35		
19:38:10	19:50:30	20:03:55	20:06:25		
19:38:40	19:51:00	19:54:00	19:58:15		
19:38:00	19:51:25	: :	19:57:45		
19:40:30	19:51:45	19:55:40	19:59:40		
19:45:10	19:52:20	19:56:50	20:00:25		
19:45:50	19:52:45	19:59:00	20:00:55		
19:49:20	19:56:10	20:01:20	20:04:55		
19:50:55	19:56:30	20:00:10	20:04:20		
19:49:10	19:57:10	20:05:45	20:07:20		
19:56:45	20:01:25	20:03:20	20:05:35		
19:57:35	20:02:00	20:08:45	20:10:20		
19:58:10	20:02:45	20:20:15	20:25:20		

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 9,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
19:59:20	20:03:50	20:33:00	20:34:45		
20:06:55	20:08:00	20:10:50	20:12:00		
20:07:05	20:08:30	20:10:45	20:11:20		
20:07:25	20:08:50	20:12:50	20:14:00		
20:07:45	20:09:30	20:13:35	20:14:45		
20:12:15	20:13:20	20:18:55	20:24:35		
20:15:55	20:16:30	20:18:40	20:21:30		
20:17:15	20:18:00	20:25:55	20:27:00		
20:17:45	20:19:35	20:40:00	20:44:10		
20:17:55	20:23:15	21:02:25	21:06:35		
20:28:40	20:29:05	20:31:25	20:32:30		
20:32:15	20:33:30	21:00:25	21:03:05		
20:36:00	20:36:50	20:40:40	20:42:20		
20:36:10	20:37:35	20:41:00	20:43:15		
20:39:00	20:40:15	20:54:58	20:56:45	3	
20:39:20	20:41:10	21:06:40	21:09:40		
20:41:45	20:44:40	20:46:30	20:50:15		
20:43:00	20:45:15	20:47:20	20:51:05		
20:45:35	20:46:35	20:49:35	20:51:55		
20:47:10	20:48:40	20:58:40	21:01:40		
20:49:10	20:49:30	20:54:50	20:57:45		
20:50:00	20:52:30	21:01:55	21:05:50		
20:51:30	20:53:05	20:55:10	20:58:15		
20:51:55	20:54:00	21:18:40	21:21:45		
20:52:30	20:54:35	20:58:30	21:00:40		
20:53:25	20:55:50	21:00:00	21:02:25		
20:53:30	20:59:10	21:01:50	21:05:05		
21:00:00	21:03:55	21:07:10	21:10:25		
21:05:35	21:08:20	21:12:00	21:15:55		
21:06:10	21:08:45	21:11:00	21:15:05		
21:11:10	21:11:35	21:13:15	21:16:50		
21:11:35	21:12:30	21:20:35	21:22:40		
21:12:15	21:13:20	21:25:40	21:28:55		3
21:13:00	21:14:00	21:33:00	21:35:40		3
21:16:15	21:19:00	: :	21:46:00		
21:17:55	21:19:35	21:22:15	21:23:20		
21:19:00	21:20:15	21:23:05	21:24:15		
21:19:05	21:20:45	21:23:45	21:24:50		
21:24:00	21:25:45	21:28:15	21:29:50		
21:24:45	21:26:45	21:31:00	21:31:55		
21:26:00	21:27:40	21:33:05	21:34:55		
21:34:40	21:36:20	21:38:40	21:43:50		
21:37:10	21:38:10	21:40:45	21:44:40		
21:37:30	21:40:40	: :	21:48:40		
21:40:00	21:41:55	21:44:40	21:47:05		

WEATHERFORD QUEUING DATA - JUNE 9,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLDADER CODE
21:40:10	21:42:20	21:44:50	21:47:55		
21:40:30	21:42:30	21:46:40	21:48:40		
21:40:35	21:43:05	21:48:55	21:50:20		
21:43:15	21:45:10	: :	21:56:05		
21:47:55	21:51:10	: :	22:00:00		
21:45:10	21:53:35	: :	: :		
21:35:00	21:54:30	: :	22:00:40		
21:50:55	21:56:50	: :	22:08:45		
21:48:45	21:57:25	: :	22:03:45		
21:51:15	21:57:55	: :	22:05:30		
21:53:30	21:58:45	: :	22:11:50		
21:59:30	22:01:55	: :	22:15:50		
22:01:50	22:02:45	: :	22:18:10		
22:05:30	22:07:00	: :	22:15:00		
22:08:25	22:09:35	: :	22:16:50		
22:08:30	22:10:40	: :	22:19:45		
22:13:50	22:20:45	: :	22:26:40		
22:15:40	22:21:50	: :	22:34:25		
22:17:25	22:22:40	: :	22:27:25		
22:18:00	22:23:10	: :	22:34:50		
22:20:50	22:23:55	: :	22:28:25		
22:23:55	22:24:30	: :	22:35:30		
22:24:30	22:28:50	: :	: :		4
22:25:40	22:30:25	: :	22:42:30		
22:26:15	22:31:10	: :	22:36:30		
22:27:35	22:31:45	: :	22:47:40		
22:29:10	22:33:00	: :	: :		
22:33:50	22:38:00	: :	22:50:00		
22:39:45	22:41:00	: :	22:48:40		
22:42:00	22:43:20	: :	22:50:45		
22:45:30	22:46:30	: :	22:55:40		
22:45:35	22:51:25	: :	22:57:40		
22:48:10	22:53:00	: :	23:04:45		
22:58:20	22:58:50	: :	23:02:45		
23:01:40	23:03:35	: :	23:07:35		
23:23:25	23:24:30	23:34:30	23:36:55	2156	2
23:24:15	23:25:15	23:31:55	23:33:10		2
23:26:35	23:28:10	23:37:30	23:44:25		2
23:27:50	23:29:00	23:44:10	23:46:40		
23:29:40	23:30:25	23:46:15	23:48:20		
23:35:10	23:39:00	23:45:55	23:47:40		
23:35:35	23:37:45	23:40:50	23:45:40		
23:35:40	23:39:55	23:48:20	23:49:15		
23:38:40	23:40:55	23:49:00	23:49:55		
23:39:35	23:41:30	23:50:15	23:51:10		
23:39:45	23:43:00	23:58:10	24:00:00		
23:50:45	23:52:50	24:00:25	24:01:40		
23:57:35	23:58:15	24:05:05	24:06:35		
24:00:35	24:02:10	24:10:45	24:15:20		
24:02:10	24:04:15	24:14:30	24:16:00		

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 10,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
07:26:25	07:28:10	07:31:45	07:32:50	2303	
07:31:35	07:34:40	07:44:40	07:46:30	0688	
07:42:55	07:43:55	07:48:55	07:50:40	0541	
07:50:40	07:53:10	07:55:50	07:57:20	1144	
08:05:40	08:06:10	08:09:05	08:11:25	0512	
08:16:00	08:18:10	08:20:40	08:22:10		3
08:21:50	08:24:45	08:27:10	08:30:40	2220	
08:22:00	08:25:30	08:29:45	08:31:40	1165	
08:22:05	08:29:25	: :	: :		
08:37:50	08:38:50	08:47:15	08:48:40	0664	
08:41:55	08:42:55	08:48:15	08:49:50	0415	
08:44:10	08:44:45	08:50:40	08:52:50	2348	
08:50:05	08:52:00	09:06:10	09:07:50	3314	3
08:57:15	09:00:05	09:06:45	09:08:55		
09:10:05	09:10:40	09:13:20	09:15:10	0975	
09:11:55	09:14:10	09:20:55	09:22:35	0526	
09:15:45	09:16:25	09:24:20	09:25:35	2521	
09:26:25	09:28:45	09:39:40	09:41:45	7818	
09:34:15	09:35:35	09:41:50	09:43:00	2477	
09:35:30	09:36:40	09:44:50	09:46:50	2478	
09:42:35	09:44:00	09:46:45	09:47:55	1701	
09:42:40	09:45:25	09:49:50	: :	1702	4
09:59:50	10:02:20	: :	: :		4
10:18:25	10:19:45	10:23:50	10:24:55	2477	
10:18:40	10:20:30	10:31:00	10:32:15	2494	
10:21:55	10:22:50	10:32:15	10:33:05	0910	
10:43:20	10:45:00	10:48:30	10:49:25	0255	
10:46:00	10:46:50	10:51:30	10:52:10	2233	
10:58:10	10:59:30	11:03:35	11:04:50	0069	
10:59:58	11:01:05	11:07:20	11:09:25	2478	
11:08:40	11:11:45	11:20:20	11:22:30	0688	
11:11:05	11:12:40	11:21:50	11:23:10	2163	
11:17:10	11:18:20	11:24:40	11:25:45	2477	
11:18:35	11:19:50	11:27:00	11:27:50	0050	
11:19:20	11:21:35	11:27:35	11:28:40	2518	
11:25:50	11:26:45	11:30:40	11:31:50	0095	
11:28:30	11:30:10	11:35:40	11:39:45	2692	
11:29:30	11:30:55	11:33:25	11:34:30	2434	
11:35:30	11:36:30	11:39:35	11:40:25	2156	
11:36:15	11:37:35	11:42:00	11:43:45	0634	
11:38:40	11:41:20	11:46:00	11:47:05	2299	
11:41:25	11:42:35	11:47:50	11:48:30	2206	
11:44:10	11:45:25	11:51:25	11:53:10	2478	
11:47:50	11:49:25	11:51:20	11:52:30	0343	
11:48:15	11:50:10	11:59:45	12:02:50		

WEATHERFORD QUEUING DATA - JUNE 10,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
11:48:20	11:50:45	11:53:25	11:54:30	0273	1
11:50:60	11:51:50	11:56:50	11:58:60	2427	1
12:01:45	12:03:25	12:06:45	12:09:20	2233	
12:05:55	12:07:55	12:19:00	12:21:35	0910	
12:12:50	12:14:05	12:17:10	12:18:10	2477	
12:18:45	12:20:05	12:27:35	12:29:35	0664	
12:18:55	12:20:35	12:22:40	12:23:40	0635	
12:20:35	12:22:30	12:30:20	12:31:25	0329	
12:23:15	12:24:55	12:28:15	12:30:35	2025	
12:30:30	12:32:15	12:36:10	12:38:00	2478	
12:31:20	12:33:30	12:38:55	12:41:45	0070	1
12:32:50	12:34:35	12:39:50	12:43:10	0128	
12:34:55	12:35:45	12:41:10	12:43:45	2470	1
12:35:05	12:36:45	12:44:55	12:46:00	2177	
12:37:15	12:38:55	12:43:05	12:44:40		1
12:37:30	12:40:00	12:45:05	12:46:40	2426	
12:39:20	12:40:40	12:48:45	12:49:45	2303	
12:45:10	12:47:20	12:50:20	12:52:30	2410	1
12:49:45	12:51:00	12:53:45	12:54:40	2245	2
12:47:25	12:47:45	12:56:25	12:58:40	0715	
12:49:55	12:51:35	12:57:30	12:59:15	0328	1
12:52:00	12:53:35	12:59:50	13:01:40	2345	3
12:53:58	12:55:40	13:00:25	13:02:20		
12:54:50	12:56:40	13:04:35	13:07:05	0095	3
12:57:35	13:00:00	13:02:10	13:03:00	2312	1
12:58:55	13:00:55	13:06:40	13:08:15	5116	1
13:01:15	13:03:45	13:07:40	13:09:00	2255	
13:02:35	13:04:55	13:10:15	13:11:55	0273	
13:03:40	13:05:40	13:09:45	13:11:00	2344	1
13:03:55	13:06:15	13:14:30	13:15:55	2045	1
13:09:10	13:10:10	13:12:35	13:13:35	1086	
13:11:40	13:15:05	13:28:55	13:30:35	2690	
13:15:20	13:16:50	13:24:40	13:26:25	5274	1
13:16:25	13:17:30	13:29:25	13:31:25	0273	1
13:17:35	13:20:15	13:33:55	13:36:20	2692	
13:17:40	13:21:35	13:34:00	13:37:20	0084	1
13:19:55	13:22:55	13:38:10	13:43:25	2518	1
13:20:10	13:23:55	13:35:40	13:38:15	2233	
13:20:45	13:32:00	13:37:35	13:42:40	2348	
13:21:15	13:32:45	13:39:25	13:44:30	2506	
13:21:45	13:33:30	13:42:00	13:45:20	2149	1
13:22:50	13:34:45	: :	: :		4
13:23:50	13:39:00	13:42:15	13:49:35	0327	
13:24:25	13:39:35	13:44:00	13:50:25	2304	3
13:25:30	13:40:00	13:49:55	13:52:35	1165	3

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 10,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
13:27:05	13:40:45	13:44:10	13:51:00	2206	
13:31:05	13:41:40	13:49:05	13:51:55	0663	1
13:40:30	13:46:05	13:54:05	13:55:00	0460	
13:41:35	13:47:00	13:55:40	13:56:55	0707	
13:42:35	13:47:25	: :	13:55:45	2411	1
13:43:15	13:48:15	13:57:45	13:59:40	0069	1
13:45:20	13:48:45	13:58:35	14:00:15	2384	
13:47:25	13:53:25	14:02:05	14:03:10	2243	
13:48:40	13:53:50	14:02:50	14:03:50		1
13:56:45	13:57:35	14:06:10	14:07:20	2490	
13:57:55	13:58:25	14:08:15	14:10:10	0329	1
14:02:55	14:04:30	14:09:30	14:12:40	9999	
14:03:25	14:05:10	14:10:50	14:13:20	2427	1
14:03:58	14:05:45	14:12:15	14:13:55	0128	
14:04:55	14:06:25	14:21:20	14:22:10	2269	
14:05:55	14:09:00	14:14:30	14:19:00	2478	
14:07:35	14:11:00	14:17:25	14:19:50	1	
14:07:55	14:11:25	14:14:40	14:18:15	0412	1
14:08:05	14:11:50	14:22:30	14:24:45	0104	1
14:10:25	14:16:00	14:31:55	14:33:05	2691	
14:14:45	14:16:25	14:28:50	14:29:35	2156	1
14:15:60	14:17:25	14:36:45	14:37:55	2690	
14:15:15	14:20:50	14:38:50	14:40:25	2233	
14:16:58	14:23:15	14:33:05	14:34:10	7818	1
14:17:30	14:24:00	14:38:40	14:39:55	0864	
14:20:10	14:26:30	14:41:00	14:43:55	0406	1
14:20:40	14:31:45	14:40:45	14:41:35	0656	
14:28:25	14:34:45	14:45:05	14:48:35	2521	1
14:32:50	14:35:35	14:43:05	14:44:30	2254	
14:33:50	14:38:25	14:49:35	14:52:25	2337	1
14:34:10	14:38:55	14:44:55	14:47:55		
14:34:45	14:42:10	: :	14:49:15	2470	
14:35:50	14:43:05	14:50:20	14:53:10	0910	
14:36:30	14:45:15	14:49:05	14:52:07	1230	
14:36:58	14:45:40	14:53:40	14:55:30	2312	
14:39:45	14:46:00	14:55:20	14:56:40	2419	
14:39:50	14:46:40	14:54:10	14:56:05	0328	1
14:39:58	14:49:55	14:59:30	15:01:25	0273	
14:41:05	14:50:20	15:04:30	15:06:45	0696	
14:44:25	14:50:40	14:58:10	15:00:05	1145	
14:46:20	14:54:00	14:59:00	15:00:45	2303	
14:48:25	14:54:50	15:07:50	15:09:00	0070	
14:52:17	14:57:15	15:08:50	15:09:50	1708	1
14:54:25	14:58:35	15:19:30	15:22:40	0664	
14:58:00	14:59:15	15:08:55	15:10:25	0327	

WEATHERFORD QUEUING DATA - JUNE 10,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
14:58:20	15:02:30	15:06:20	15:07:30		
15:00:50	15:03:20	15:09:20	15:12:35		3
15:03:40	15:04:15	15:12:50	15:13:55	2518	
15:09:30	15:11:35	15:18:30	15:19:45	0906	
15:13:10	15:14:55	15:18:58	15:20:15	0573	3
15:13:25	15:15:30	15:23:45	15:28:40	1143	
15:14:25	15:16:00	15:21:55	15:23:10	0343	1
15:14:35	15:17:20	: :	: :	0537	4
15:16:50	15:18:55	15:23:35	15:27:45	0977	1
15:18:35	15:21:00	15:28:20	15:29:30	0095	
15:19:10	15:21:25	15:30:50	15:32:05	0695	
15:19:45	15:23:50	15:32:05	15:32:50	0128	
15:20:05	15:26:55	15:41:58	15:44:45	8305	3
15:20:15	15:30:00	15:37:20	15:38:35	0715	
15:21:10	15:30:25	15:33:50	15:36:00	1086	
15:22:30	15:30:45	15:40:05	15:42:55	2233	
15:26:55	15:31:25	15:37:05	15:38:00	2299	1
15:30:15	15:34:00	15:55:10	15:57:45	0687	3
15:32:15	15:34:40	15:39:58	15:42:25		1
15:32:35	15:35:05	15:45:20	15:47:25	2405	1
15:37:50	15:39:45	15:54:50	15:56:45	5274	
15:38:05	15:40:20	15:43:45	15:46:40	0541	
15:40:15	15:41:20	: :	: :	2359	4
15:44:40	15:45:45	: :	: :		4
15:45:20	15:48:35	16:01:50	16:03:35		
15:47:40	15:49:40	: :	15:54:45	2304	
15:48:35	15:50:40	15:57:00	15:58:30		
15:49:10	15:51:10	16:01:45	16:02:40	0084	
15:49:20	15:52:15	15:58:25	16:01:40	2478	
15:48:30	15:53:00	16:06:10	16:10:00	2466	
15:49:45	15:53:45	16:06:15	16:10:35	0975	
15:50:05	15:59:05	16:09:20	16:11:20	2242	
15:51:25	15:59:40	16:09:50	16:14:25	1231	
15:53:30	16:06:40	16:13:00	16:15:40	0542	
15:53:45	16:07:10	16:12:40	16:15:00	2255	
15:54:05	16:07:55	16:16:20	16:17:40	2410	
15:55:00	16:09:10	: :	: :	2480	4
15:58:00	16:12:15	16:17:45	16:19:05	2691	
15:59:45	16:12:50	16:19:20	16:21:05	2206	
16:01:30	16:13:10	16:20:35	16:21:40	2455	
16:06:05	16:13:45	16:24:50	16:26:20	0273	
16:06:25	16:16:15	16:22:25	16:25:05	0328	
16:12:00	16:16:45	16:23:05	16:25:50	2426	
16:13:00	16:19:55	16:30:00	16:32:10	3514	1
16:08:10	16:20:30	16:29:50	16:31:25	0707	

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 10,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
16:20:05	16:22:30	16:33:35	16:35:35	0635	
16:20:20	16:23:10	: :	: :	2477	4
16:21:15	16:24:00	16:33:40	16:36:40	5116	
16:21:50	16:27:00	16:38:35	16:39:45	0696	1
16:22:00	16:27:25	16:36:00	16:37:20		
16:23:00	16:27:50	16:39:30	16:40:35	2452	
16:23:50	16:28:55	16:44:10	16:44:50	0460	3
16:27:30	16:29:35	: :	: :	2506	4
16:24:50	16:33:00	: :	: :	0702	4
16:27:05	16:33:40	16:44:35	16:45:40	2524	
16:28:35	16:34:20	16:50:10	16:51:45	2427	
16:29:05	16:35:00	16:42:40	16:43:55	0428	
16:37:10	16:38:10	16:49:20	16:50:45	2405	
16:37:30	16:42:15	17:01:10	17:03:15	0663	
16:37:55	16:43:05	16:51:40	16:52:35	2069	
16:47:50	16:48:50	16:56:55	16:58:20	2690	
16:48:40	16:49:50	17:06:25	17:08:30	7818	
16:49:35	16:53:20	16:59:20	17:00:25	1145	
16:50:25	16:54:20	16:59:40	17:01:00	2177	3
16:50:40	16:54:50	17:00:45	17:01:40	2312	
16:52:15	16:55:25	17:03:50	17:04:55	0596	
16:53:35	16:58:45	17:05:25	17:06:10	0512	
16:54:45	17:02:00	17:08:25	17:09:20	0695	
16:58:45	17:02:20	17:09:30	17:10:45	0095	
17:00:30	17:03:50	17:10:35	17:11:35	2411	
17:01:05	17:06:35	17:12:50	17:16:15	2233	
17:02:15	17:07:30	17:12:00	17:15:40	2303	
17:07:35	17:09:55	17:14:10	17:17:00	0329	1
17:12:05	17:13:10	17:16:50	17:18:15	0103	
17:12:10	17:14:15	17:16:40	17:17:45	2156	1
17:14:05	17:14:55	17:18:20	17:20:00	0596	1
17:17:25	17:18:55	17:22:25	17:23:40	0715	
17:26:40	17:27:35	17:29:58	17:33:00	2434	
17:26:50	17:29:40	17:35:10	17:36:30	2348	
17:27:25	17:30:20	17:41:30	17:42:40	2269	
17:27:45	17:30:45	17:34:50	17:35:40	2337	1
17:28:40	17:31:05	17:36:25	17:40:45	0415	1
17:28:55	17:31:40	17:38:10	17:41:25	2254	
17:29:00	17:32:00	17:39:55	17:41:55	0273	1
17:34:50	17:37:20	: :	: :		4
17:32:25	17:39:20	17:44:20	17:45:40	0664	
17:35:40	17:39:55	17:46:25	17:48:00	2692	
17:42:05	17:43:20	17:45:00	17:47:05	1086	
17:37:05	17:44:05	17:50:40	17:54:10	0910	
17:57:55	17:59:00	18:02:55	18:05:20	2245	

WEATHERFORD QUEUING DATA - JUNE 10,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
17:59:45	18:00:30	18:03:35	18:06:10	1143	1
17:59:55	18:01:35	18:06:10	18:07:50	2304	3
18:00:00	18:02:10	18:04:35	18:06:50	2205	
18:01:20	18:03:30	18:06:25	18:10:45	5274	1
18:03:15	18:04:20	18:08:20	18:11:25	0327	
18:05:55	18:09:00	18:11:30	18:14:50	2426	1
18:06:50	18:09:40	18:12:50	18:15:50	2521	
18:08:40	18:12:05	18:14:50	18:16:20		
18:10:45	18:13:30	18:19:45	18:22:15	0014	3
18:13:10	18:14:05	18:16:50	18:17:50	1145	1
18:16:50	18:18:20	18:21:10	18:23:10	2233	
18:18:50	18:20:25	18:25:45	18:27:30	1701	1
18:20:05	18:20:55	18:23:50	18:26:35	2386	
18:20:10	18:21:25	18:26:50	18:31:20	0084	
18:23:20	18:24:50	18:31:55	18:33:55	2690	
18:24:40	18:25:45	18:29:20	18:33:10	0663	
18:24:55	18:28:30	18:33:35	18:37:45	0542	1
18:26:05	18:29:05	18:33:50	18:38:20	0050	
18:26:35	18:30:00	: :	: :	0702	4
18:27:30	18:30:30	18:35:55	18:39:15	2255	1
18:28:10	18:35:00	18:38:25	18:40:10		
18:29:50	18:35:55	18:41:45	18:43:30	0707	
18:33:25	18:36:40	18:43:40	18:45:00	0977	
18:41:25	: :	18:45:10	18:46:00	5116	
18:48:00	18:49:05	18:54:55	18:56:10	2377	3
18:53:10	18:53:50	18:56:20	18:58:20	0428	
18:55:10	18:57:10	19:00:10	19:01:50	2222	
18:57:30	18:59:05	19:03:30	19:04:20	0329	
18:58:25	18:59:40	19:06:30	19:07:20	0541	
18:58:40	19:00:55	: :	: :	0537	4
18:58:50	19:02:35	19:09:55	19:10:45	1104	
19:09:00	19:09:35	19:12:10	19:13:05	2233	
19:10:10	19:11:55	19:15:59	19:16:55	0573	3
19:12:15	19:14:20	19:19:20	19:20:25	2303	
19:16:60	19:17:30	19:19:55	19:21:00	2344	
19:14:45	19:18:15	19:21:20	19:23:55		
19:18:15	19:18:45	19:22:20	19:25:00	0128	
19:18:20	19:19:15	19:23:10	19:25:45	0273	
19:18:25	19:19:40	19:25:50	19:28:30	2433	
19:18:30	19:21:45	19:28:15	19:32:40	9999	
19:18:35	19:22:15	19:32:10	19:33:15	2691	
19:20:45	19:22:55	19:29:40	19:31:45	2427	1
19:23:35	19:26:40	19:33:10	19:35:20	2239	
19:21:45	19:27:10	19:35:20	19:38:10	0343	
19:26:05	19:27:35	19:36:30	19:38:50		

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 10,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
19:29:30	19:30:45	19:37:00	19:39:45		
19:30:50	19:34:05	19:43:45	19:44:50	7818	
19:31:60	19:36:00	19:39:45	19:43:30	2478	
19:33:50	19:36:35	19:41:45	19:44:00		
19:34:05	19:37:05	19:45:00	19:46:35	0715	
19:36:10	19:40:35	19:50:00	19:52:20	2243	
19:38:15	19:41:10	19:49:55	19:51:25	1143	1
19:39:15	19:42:05	: :	: :	2348	4
19:39:25	19:42:40	19:54:30	19:56:15	2384	
19:45:50	19:47:15	19:52:59	19:55:20	2410	
19:46:15	19:48:00	19:55:35	19:58:00	2360	
19:51:30	19:53:05	20:01:00	20:06:00		
19:52:20	19:53:40	19:58:40	20:05:20	1145	1
19:53:05	19:54:20	20:02:25	20:06:55	0864	
19:55:20	19:56:50	20:04:15	20:10:15	0975	
19:57:05	20:02:25	20:07:45	20:11:00	2312	
19:58:05	20:03:40	20:08:10	20:11:35	2304	
19:58:25	20:04:20	20:09:40	20:12:25	2233	
20:02:50	20:07:40	: :	: :	2506	4
20:03:55	20:08:20	20:11:40	20:13:50	0541	
20:05:10	20:08:55	20:11:35	20:13:05	2156	
20:08:45	20:09:30	20:14:20	20:16:10	0512	
20:11:45	20:14:45	20:18:20	20:21:35	2690	
20:14:40	20:15:25	20:20:20	20:22:35	0910	1
20:15:35	20:17:35	20:24:25	20:25:45	2426	
20:15:45	20:18:50	20:22:00	20:23:10	2225	
20:18:20	20:19:20	20:22:50	20:25:10	0273	
20:22:10	20:23:45	20:25:30	20:26:40	2254	1
20:23:50	20:24:25	20:27:50	20:31:00		1
20:28:00	20:29:05	20:31:50	20:32:35		
20:25:05	20:29:45	20:34:00	20:35:30	0103	1
20:27:00	20:30:10	20:34:10	20:36:00	0050	
20:32:10	20:33:30	20:39:40	20:40:10	2177	3
20:32:20	20:34:30	20:46:50	20:48:40	0793	
20:42:20	20:43:00	20:45:30	20:49:30	2405	
20:43:25	20:44:10	20:48:25	20:50:25	2452	
20:45:00	20:47:15	20:51:40	20:52:40	0635	
20:50:05	20:54:00	20:57:30	20:58:25	2245	1
20:50:35	20:54:30	20:59:45	21:01:00	0095	
20:50:40	20:55:00	21:00:10	21:01:55	0707	
20:53:00	20:55:35	21:02:20	21:07:00	2242	
20:57:45	20:59:40	21:02:00	21:06:05	0412	
20:59:30	21:02:35	21:06:45	21:08:25	2691	
21:02:25	21:03:20	21:06:20	21:07:40	0128	
21:02:45	21:04:25	21:08:55	21:12:50	2478	

WEATHERFORD QUEUING DATA - JUNE 10,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
21:03:58	21:05:00	21:08:20	21:12:00	5274	
21:05:40	21:09:35	21:15:05	21:16:05	2269	
21:07:05	21:10:10	21:17:35	21:19:10	2233	
21:07:35	21:10:40	21:12:45	21:13:25	2149	
21:11:20	21:14:25	21:16:45	21:17:30		1
21:11:45	21:14:55	21:18:15	21:19:50	2434	1
21:17:10	21:18:20	21:22:05	21:22:45	2417	1
21:19:35	21:20:20	21:24:30	21:26:00	0084	
21:23:15	21:25:00	21:29:15	21:33:15	0864	
21:26:30	21:27:10	21:31:00	21:34:25	1708	
21:26:40	21:27:50	21:32:05	21:35:10	2691	
21:28:30	21:29:50	21:33:40	21:35:45		
21:28:60	21:31:40	21:34:10	21:37:55	2220	
21:31:45	21:36:35	21:40:00	21:41:10	5116	1
21:34:15	21:37:00	21:40:10	21:41:55	0343	
21:34:30	21:38:25	21:41:50	21:42:30	0273	1
21:35:00	21:39:00	21:43:05	21:44:15		
21:36:35	21:40:10	21:52:05	21:54:05	0663	
21:43:15	21:44:55	21:48:35	21:50:20	2411	
21:47:15	21:48:25	: :	21:52:15		
21:47:35	21:49:05	21:53:40	21:55:45	0327	
21:28:15	21:30:50	21:50:55	21:51:35		
21:51:55	21:52:50	21:56:05	21:56:55	2384	
21:52:50	21:55:00	22:01:20	22:02:50	2303	3
21:56:05	21:57:40	22:01:15	22:02:10	2332	1
21:56:55	21:58:20	22:00:50	22:01:25	0685	
22:01:30	22:03:45	22:07:45	22:10:10	2518	
22:02:00	22:04:25	22:07:30	22:09:10	0977	
22:04:55	22:05:30	22:09:40	22:11:00	1145	
22:05:00	22:05:55	22:10:10	22:13:35	2690	
22:06:60	22:07:30	22:12:10	22:14:50	2233	
22:07:10	22:08:20	22:15:50	22:17:25	7818	1
22:09:05	22:11:50	22:17:05	22:19:15		
22:11:45	22:12:25	22:17:15	22:20:15	0329	
22:13:25	22:15:25	22:20:40	22:23:35	2386	
22:13:40	22:15:50	22:18:55	22:21:00	2156	
22:15:30	22:18:00	22:23:05	22:24:20	2377	
22:15:40	22:21:35	22:25:10	22:26:00	2478	
22:20:15	22:22:15	22:26:20	22:27:45	2149	
22:27:15	22:29:10	22:35:35	22:36:30	0664	
22:27:30	22:29:55	22:32:40	22:33:30		
22:39:20	22:39:55	22:42:00	22:43:00	9999	
22:45:15	22:46:20	22:49:00	22:50:50		
22:52:05	22:55:00	22:58:05	22:59:25		
22:52:50	22:55:35	22:58:59	23:00:25	0707	1

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 10, 1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
22:53:25	22:56:00	22:59:55	23:03:10	2233	
22:53:30	22:56:30	23:00:40	23:04:05	0050	
22:56:10	22:57:00	23:03:35	23:04:55	0715	
22:59:10	23:01:30	23:05:45	23:07:40	2691	
22:59:40	23:02:20	23:05:35	23:06:45	2521	1
23:19:55	23:22:30	23:26:55	23:28:40	2213	3
23:21:30	23:25:55	23:29:60	23:30:20		
23:28:30	23:29:10	23:33:20	23:34:55	2243	

WEATHERFORD QUEUING DATA - JUNE 11, 1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
07:50:00	07:51:30	08:00:45	08:03:20		2
07:59:55	08:01:50	08:07:15	08:10:35	0453	1
08:00:20	08:04:10	08:19:45	08:20:40	2433	2
08:03:05	08:05:30	: :	: :	1143	4
08:04:30	08:07:25	08:13:40	08:15:10	2420	
08:06:05	08:08:10	08:16:50	08:18:35	0496	
08:08:05	08:09:30	08:16:15	08:17:50	2248	3
08:14:20	08:15:50	08:23:45	08:24:45	2348	
08:35:25	08:36:35	08:42:55	08:44:45	2137	
08:46:45	08:48:50	08:54:55	08:56:55	0664	
08:57:50	09:02:40	09:07:15	09:11:40		
09:06:10	09:10:20	09:14:10	09:15:15	1708	
09:06:25	09:16:05	09:18:50	09:20:15	1702	
09:06:45	09:16:50	09:20:45	09:21:50	1701	
09:07:00	09:17:25	09:23:40	09:24:35	2236	
09:11:35	09:17:58	09:31:50	09:32:55		
09:12:35	09:18:25	09:27:25	09:28:20	2521	
09:18:30	09:19:15	09:29:20	09:30:00	2278	
09:27:50	09:29:05	09:34:05	09:35:40	0975	
09:33:20	09:34:50	09:39:40	09:40:45	0573	
10:02:20	10:03:00	10:06:30	10:07:35		
10:03:00	10:31:30	10:34:00	10:34:45		
10:31:40	10:34:00	10:39:50	10:40:50		
10:33:35	10:34:20	10:43:20	10:45:10		
10:39:50	10:40:45	10:44:40	10:46:15	0605	
10:40:58	10:43:30	10:47:00	10:51:35		
10:46:45	10:47:30	10:52:40	10:54:10		
10:47:05	10:48:15	10:50:55	10:53:10	2410	
10:47:10	10:48:55	10:54:35	10:55:40	0761	
10:47:25	10:49:55	10:56:40	10:57:30		
11:02:55	11:03:50	11:06:40	11:07:35	0273	
11:19:35	11:22:45	11:29:20	11:30:40	0454	
11:44:35	11:46:20	11:48:35	11:49:55	2206	
11:44:50	11:47:30	11:50:58	11:52:15	0128	
11:47:05	11:48:20	11:54:15	11:55:20	0715	
11:48:05	11:49:05	11:55:45	11:56:55	2233	
11:49:15	11:51:15	11:58:40	12:00:30	2137	
11:57:50	11:59:30	12:03:50	12:04:50	2348	
12:02:20	12:03:10	12:07:25	12:10:05		
12:06:55	12:08:20	12:10:35	12:12:30	2242	
12:07:40	12:09:20	12:12:25	12:13:25		
12:09:55	12:11:25	12:14:20	12:15:05	0553	
12:25:40	12:26:30	12:32:10	12:34:05		
12:35:50	12:36:40	12:42:10	12:43:00		
12:43:45	12:44:00	12:46:50	12:47:30		

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 11,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
12:46:55	12:48:05	12:50:40	12:51:35	1145	
12:46:58	12:48:50	12:52:50	12:53:58	5274	
12:49:45	12:50:30	12:57:40	12:58:55	0104	
12:52:58	12:54:35	13:00:25	13:01:05	0761	
12:59:00	13:00:05	13:06:25	13:09:25	2405	
13:00:50	13:01:30	13:07:05	13:09:58		
13:01:25	13:01:55	13:09:35	13:10:45		
13:01:50	13:03:05	13:14:40	13:16:00		
13:04:50	13:07:00	: :	: :		4
13:05:50	: :	13:14:40	13:17:55		
13:06:35	: :	: :	: :		
13:07:20	13:08:10	: :	: :		
13:09:45	13:11:20	: :	: :		
13:26:15	13:27:20	: :	: :	0906	

WEATHERFURD QUEUING DATA - JUNE 12,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
2:49:35	: :	: :	: :		
2:50:53	: :	: :	: :		
2:55:23	: :	: :	: :		
2:55:30	: :	: :	: :		
2:55:35	: :	: :	: :		
2:57:23	: :	: :	: :		
2:59:41	: :	: :	: :		
3: 1: 0	: :	: :	: :		
3: 4:30	: :	: :	: :		
3:13: 5	: :	: :	: :		
3:14:23	: :	: :	: :		
3:16:41	: :	: :	: :		
3:16:47	: :	: :	: :		
3:18:23	: :	: :	: :		
3:19:11	: :	: :	: :		
3:21:47	: :	: :	: :		
3:23:41	: :	: :	: :		
3:27:30	: :	: :	: :		
3:28: 0	: :	: :	: :		
3:29:47	: :	: :	: :		
3:35:17	: :	: :	: :		
3:35:35	: :	: :	: :		
3:36: 5	: :	: :	: :		
3:36:11	: :	: :	: :		
3:36:30	: :	: :	: :		
3:39:11	: :	: :	: :		
3:39:23	: :	: :	: :		
3:42:41	: :	: :	: :		
3:43:11	: :	: :	: :		
3:43:41	: :	: :	: :		
3:44:41	: :	: :	: :		
3:47: 0	: :	: :	: :		
3:47:35	: :	: :	: :		
3:47:47	: :	: :	: :		
3:53:47	: :	: :	: :		
3:54:17	: :	: :	: :		
3:55:35	: :	: :	: :		
3:57:23	: :	: :	: :		
3:59:35	: :	: :	: :		
4: 0:35	: :	: :	: :		
4: 2:47	: :	: :	: :		
4: 2:53	: :	: :	: :		
4: 5:23	: :	: :	: :		
4:14: 0	: :	: :	: :		
4:21:35	: :	: :	: :		

WEATHERFORD QUEUING DATA - JUNE 12,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
4:21:41	: :	: :	: :		
4:21:47	: :	: :	: :		
4:22:30	: :	: :	: :		
4:22:35	: :	: :	: :		
4:24:47	: :	: :	: :		
4:25:41	: :	: :	: :		
4:27: 5	: :	: :	: :		
4:27:11	: :	: :	: :		
4:28: 0	: :	: :	: :		
4:29: 0	: :	: :	: :		
4:29:41	: :	: :	: :		
4:34:47	: :	: :	: :		
4:35:11	: :	: :	: :		
4:35:41	: :	: :	: :		
4:35:47	: :	: :	: :		
4:41:47	: :	: :	: :		
4:42:41	: :	: :	: :		
4:48:41	: :	: :	: :		
4:48:53	: :	: :	: :		
4:49: 0	: :	: :	: :		
4:49:35	: :	: :	: :		
4:49:41	: :	: :	: :		
4:52:53	: :	: :	: :		
4:54: 5	: :	: :	: :		
4:59:53	: :	: :	: :		
5: 0: 0	: :	: :	: :		
5: 2: 0	: :	: :	: :		
5: 4:47	: :	: :	: :		
5: 5:41	: :	: :	: :		
5:10:23	: :	: :	: :		
5:12:30	: :	: :	: :		
5:13:35	: :	: :	: :		
5:14: 0	: :	: :	: :		
5:14:47	: :	: :	: :		
5:16:23	: :	: :	: :		
5:16:30	: :	: :	: :		
5:23:23	: :	: :	: :		
5:23:41	: :	: :	: :		
5:24:30	: :	: :	: :		
5:25: 0	: :	: :	: :		
5:26:35	: :	: :	: :		
5:26:47	: :	: :	: :		
5:26:53	: :	: :	: :		
5:28:47	: :	: :	: :		
5:32: 5	: :	: :	: :		

WEATHERFORD QUEUING DATA - JUNE 12,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
5:40:17	: :	: :	: :		
5:44: 5	: :	: :	: :		
5:45:30	: :	: :	: :		
5:47: 0	: :	: :	: :		
5:47: 5	: :	: :	: :		
5:48:23	: :	: :	: :		
5:50:35	: :	: :	: :		
5:50:47	: :	: :	: :		
5:51:30	: :	: :	: :		
5:51:41	: :	: :	: :		
5:55:47	: :	: :	: :		
5:58: 5	: :	: :	: :		
6: 0: 5	: :	: :	: :		
6: 1:53	: :	: :	: :		
6: 2: 0	: :	: :	: :		
6: 5:35	: :	: :	: :		
6: 5:47	: :	: :	: :		
6: 6:35	: :	: :	: :		
6: 6:47	: :	: :	: :		
6: 8:41	: :	: :	: :		
6: 9: 5	: :	: :	: :		
6:16:53	: :	: :	: :		
6:17: 5	: :	: :	: :		
6:24:11	: :	: :	: :		
6:25: 0	: :	: :	: :		
6:27: 5	: :	: :	: :		
6:31:35	: :	: :	: :		
6:34:17	: :	: :	: :		
6:34:53	: :	: :	: :		
6:43:41	: :	: :	: :		
6:44: 5	: :	: :	: :		
6:48:30	: :	: :	: :		
6:48:35	: :	: :	: :		
6:49:47	: :	: :	: :		
6:51:17	: :	: :	: :		
6:53: 5	: :	: :	: :		
6:53:11	: :	: :	: :		
6:53:35	: :	: :	: :		
6:57:47	: :	: :	: :		
7: 0:23	: :	: :	: :		
7: 1:53	: :	: :	: :		
7: 2:30	: :	: :	: :		
7: 8:35	: :	: :	: :		
7:12: 5	: :	: :	: :		
7:12:11	: :	: :	: :		

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 12,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
7:13:47	: :	: :	: :		
7:16:23	: :	: :	: :		
7:20:17	: :	: :	: :		
7:20:30	: :	: :	: :		
7:22:30	: :	: :	: :		
7:22:35	: :	: :	: :		
7:32: 5	: :	: :	: :		
7:33: 5	: :	: :	: :		
7:33:23	: :	: :	: :		
7:34: 5	: :	: :	: :		
7:35: 5	: :	: :	: :		
7:37:11	: :	: :	: :		
7:37:30	: :	: :	: :		
7:38:30	: :	: :	: :		
7:44:30	: :	: :	: :		
7:49:53	: :	: :	: :		
7:50: 0	: :	: :	: :		
7:51:23	: :	: :	: :		
7:55:11	: :	: :	: :		
7:56:41	: :	: :	: :		
8: 7: 0	: :	: :	: :		

WEATHERFORD QUEUING DATA - JUNE 13,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
08:04:00	: :	: :	: :		
08:17:15	: :	: :	: :		
08:21:25	: :	: :	08:28:10	1104	
08:48:05	: :	: :	08:52:40	2137	
08:45:00	: :	: :	08:53:40		
09:00:55	: :	: :	: :		
09:10:40	: :	: :	: :	2242	
09:24:05	: :	: :	09:28:58		
09:25:20	: :	: :	09:30:35	1166	
09:30:45	: :	: :	09:39:15		
09:38:55	: :	: :	09:44:30		
10:47:05	: :	: :	: :		
10:58:55	: :	: :	11:05:30		
11:07:00	: :	: :	11:15:10		
11:13:10	: :	: :	11:18:05	2521	
11:32:50	: :	: :	: :	2278	
11:39:50	: :	: :	11:46:35	2311	
11:46:50	: :	: :	11:53:35		
11:57:35	: :	: :	12:06:55	2218	
12:06:30	: :	: :	12:14:10	1782	
12:13:55	: :	: :	: :		
12:18:45	: :	: :	12:26:30	2405	
12:31:10	: :	: :	12:36:50	0715	
12:38:30	: :	: :	12:49:58	0329	
12:58:05	: :	: :	: :	0328	
13:21:15	: :	: :	13:27:50	0072	
13:26:30	: :	: :	13:36:15	0103	
13:26:58	: :	: :	13:37:40		
13:30:45	: :	: :	13:40:00	2447	
13:31:00	: :	: :	13:43:00		
13:39:20	: :	: :	13:50:10	2384	
13:40:20	: :	: :	13:51:00	2434	
13:46:50	: :	: :	13:54:30	2303	
13:51:05	: :	: :	13:58:25		
13:54:50	: :	: :	14:03:50	0635	
13:59:40	: :	: :	14:04:45	0771	
14:01:55	: :	: :	14:09:50	0702	
14:05:30	: :	: :	14:11:55	0607	
14:07:00	: :	: :	14:12:55	2054	
14:08:55	: :	: :	14:16:45	0103	
14:11:25	: :	: :	14:19:00		
14:11:30	: :	: :	14:22:40	2249	
14:14:50	: :	: :	14:25:40	2424	
14:14:55	: :	: :	14:30:58	2129	
14:16:25	: :	: :	14:26:25	1549	

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 13, 1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
14:17:55	: :	: :	14:30:10		
14:23:10	: :	: :	14:32:05	2156	
14:24:25	: :	: :	14:35:25	2218	
14:26:40	: :	: :	14:35:55	2304	
14:27:35	: :	: :	14:36:35		
14:27:50	: :	: :	14:41:10	0696	
14:27:55	: :	: :	14:40:25		
14:31:15	: :	: :	14:41:40	0315	
14:31:20	: :	: :	: :	0073	
14:33:40	: :	: :	14:44:40	2045	
14:34:00	: :	: :	14:49:55	0842	
14:34:25	: :	: :	14:46:05	1230	
14:38:30	: :	: :	14:49:10	0553	
14:44:05	: :	: :	14:55:35		
14:50:55	: :	: :	14:58:35	0343	
14:51:10	: :	: :	14:57:45	2337	
14:51:25	: :	: :	: :		
15:04:30	: :	: :	15:09:05		
15:07:00	: :	: :	15:07:50		
15:08:00	: :	: :	15:22:20		
15:09:10	: :	: :	15:18:45		
15:18:30	: :	: :	15:23:30		
15:21:35	: :	: :	15:34:45	0715	
15:23:30	: :	: :	15:31:30	0889	
15:27:45	: :	: :	15:35:45	0559	
15:28:30	: :	: :	15:40:05	0329	
15:30:00	: :	: :	15:41:50	2149	
15:31:10	: :	: :	15:41:10		
15:36:00	: :	: :	15:46:15		
15:36:35	: :	: :	15:45:40		
15:36:40	: :	: :	15:47:10		
15:39:45	: :	: :	15:47:50		
15:40:00	: :	: :	15:51:05		
15:40:05	: :	: :	: :		
15:40:55	: :	: :	15:50:15		
15:44:50	: :	: :	15:56:05	1231	
15:48:40	: :	: :	15:57:00	2408	
15:48:45	: :	: :	18:57:50	2142	
15:50:05	: :	: :	15:59:25	2299	
15:51:10	: :	: :	15:58:30		
15:53:05	: :	: :	16:00:10	0072	
15:56:40	: :	: :	16:06:45		
15:58:58	: :	: :	16:09:58		
16:02:20	: :	: :	16:07:40	2405	
16:04:55	: :	: :	16:10:50		

WEATHERFORD QUEUING DATA - JUNE 13, 1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
16:05:10	: :	: :	16:14:25	2303	
16:05:20	: :	: :	16:13:35	2129	
16:08:20	: :	: :	16:15:05		
16:10:30	: :	: :	16:15:40		
16:10:45	: :	: :	16:20:45		
16:10:40	: :	: :	16:20:00		
16:14:15	: :	: :	16:21:35		
16:15:30	: :	: :	16:25:30		
16:16:25	: :	: :	16:34:20		
16:16:30	: :	: :	16:35:10		
16:16:55	: :	: :	16:26:10		
16:20:10	: :	: :	16:39:10		
16:27:00	: :	: :	16:36:05		
16:28:00	: :	: :	16:40:40		
16:30:20	: :	: :	16:42:15		
16:33:10	: :	: :	16:42:55	0104	
16:38:30	: :	: :	16:44:20		
16:44:40	: :	: :	16:49:05		
16:48:25	: :	: :	16:55:45	2410	
16:48:45	: :	: :	16:56:25	2304	
16:52:10	: :	: :	16:57:10	1333	
16:52:35	: :	: :	16:58:40		
16:53:50	: :	: :	16:57:50	0073	
16:57:35	: :	: :	17:04:55	2156	
16:57:45	: :	: :	17:05:50	2312	
17:07:25	: :	: :	17:15:25		
17:09:50	: :	: :	17:16:10	0696	
17:10:55	: :	: :	17:21:50	0014	
17:12:30	: :	: :	17:19:10	2369	
17:12:50	: :	: :	17:23:45	2452	
17:14:15	: :	: :	17:22:35	2405	
17:14:55	: :	: :	17:23:05	2255	
17:15:35	: :	: :	17:26:20	0766	
17:17:15	: :	: :	17:29:30	2243	
17:17:20	: :	: :	17:25:30	2457	
17:21:20	: :	: :	17:27:10	2434	
17:28:20	: :	: :	17:35:30	0343	
17:28:40	: :	: :	17:40:50	2245	
17:29:10	: :	: :	17:36:45		
17:29:25	: :	: :	17:36:05	0553	
17:29:55	: :	: :	17:44:10	1025	
17:33:00	: :	: :	17:42:15	2521	
17:33:55	: :	: :	17:41:35	2494	
17:34:20	: :	: :	17:45:35	0694	
17:35:30	: :	: :	17:44:55	0605	

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 13,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
17:36:55	: :	: :	17:48:35	0634	
17:41:25	: :	: :	17:49:35		
17:44:20	: :	: :	17:52:00		
17:45:05	: :	: :	17:51:00	2344	
17:49:20	: :	: :	17:55:55	0715	
17:52:05	: :	: :	17:59:00	2305	
17:55:10	: :	: :	18:00:00	2245	
17:59:00	: :	: :	18:07:20	0702	
18:04:05	: :	: :	18:08:05		
18:05:15	: :	: :	: :		
18:05:50	: :	: :	18:19:45	0493	
18:07:35	: :	: :	: :	2156	
18:08:00	: :	: :	18:14:40	2466	
18:08:50	: :	: :	18:20:55		
18:09:20	: :	: :	18:20:25	2270	
18:12:20	: :	: :	18:22:55	2469	
18:12:35	: :	: :	18:24:55		
18:14:50	: :	: :	18:26:35		
18:21:05	: :	: :	18:29:25	2269	
18:22:40	: :	: :	18:30:35	2521	
18:24:50	: :	: :	18:33:05		
18:26:05	: :	: :	18:35:45	2376	
18:28:35	: :	: :	18:34:50	0106	
18:29:45	: :	: :	18:37:45	2446	
18:30:25	: :	: :	18:38:30	0103	
18:32:40	: :	: :	18:40:05	0412	
18:36:55	: :	: :	18:42:50	1230	
18:41:00	: :	: :	18:50:05		
18:42:20	: :	: :	18:52:25	0906	
18:45:45	: :	: :	18:53:10	1701	
18:52:05	: :	: :	18:56:30		
18:52:10	: :	: :	18:59:25	0635	
18:59:30	: :	: :	19:04:00	2405	
19:04:20	: :	: :	19:10:35	0050	
19:10:05	: :	: :	19:20:05	1839	
19:17:05	: :	: :	19:22:45	1782	
19:17:35	: :	: :	19:24:50	2337	
19:18:45	: :	: :	19:29:45		
19:26:15	: :	: :	19:33:10	2303	
19:27:45	: :	: :	19:34:10	2433	
19:30:20	: :	: :	19:39:15	2299	
19:30:25	: :	: :	19:40:00	1850	
19:35:35	: :	: :	19:41:20		
19:35:40	: :	: :	19:40:35	2405	
19:36:15	: :	: :	19:46:30	2330	

WEATHERFORD QUEUING DATA - JUNE 13,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
19:37:35	: :	: :	19:47:25	2222	
19:39:35	: :	: :	19:58:35	2144	
19:40:40	: :	: :	19:47:30	0696	
19:41:45	: :	: :	19:48:50		
19:44:05	: :	: :	19:53:35	0207	
19:47:25	: :	: :	19:55:10		
19:47:50	: :	: :	19:56:10	0343	
19:51:55	: :	: :	20:00:05		
19:56:55	: :	: :	20:02:15	0599	
20:07:30	: :	: :	: :	2255	
20:08:05	: :	: :	: :	2149	
20:09:30	: :	: :	20:16:55	0842	
20:09:40	: :	: :	20:20:40		
20:19:45	: :	: :	20:26:40	2304	
20:23:40	: :	: :	20:30:10		
20:24:20	: :	: :	20:33:30	0702	
20:26:30	: :	: :	20:32:30	0694	
20:31:35	: :	: :	20:38:28	0050	
20:36:35	: :	: :	20:42:45		
20:36:40	: :	: :	20:40:25		
20:41:00	: :	: :	20:45:30		
20:32:00	: :	: :	20:47:10		
20:42:55	: :	: :	20:50:10		
20:46:20	: :	: :	20:50:50	2312	
20:48:20	: :	: :	20:56:30	2405	
20:51:25	: :	: :	20:59:55		
20:53:25	: :	: :	: :		
20:56:10	: :	: :	21:01:10		
21:02:40	: :	: :	21:07:20		
21:06:35	: :	: :	21:11:45		
21:11:20	: :	: :	21:18:25		
21:16:35	: :	: :	21:22:55		
21:19:15	: :	: :	21:24:50		
21:19:35	: :	: :	21:26:00	2156	
21:20:05	: :	: :	21:27:30		
21:23:30	: :	: :	21:28:15		
21:30:15	: :	: :	21:34:10		
21:41:05	: :	: :	21:45:10		
21:33:55	: :	: :	21:40:50		
21:30:40	: :	: :	21:39:50		
21:42:05	: :	: :	21:48:15		
21:42:25	: :	: :	21:47:15	2303	
21:49:55	: :	: :	21:54:20		
21:50:50	: :	: :	21:58:45		
21:54:40	: :	: :	21:59:30		

APPENDIX D-I (Continued

WEATHERFORD QUEUING DATA - JUNE 13,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FRUM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
21:58:30	: :	: :	22:05:45		
22:06:10	: :	: :	22:10:30		
22:06:35	: :	: :	22:18:00		
22:08:25	: :	: :	22:16:10		
22:09:45	: :	: :	22:17:20	0715	
22:10:45	: :	: :	22:16:50		
22:11:20	: :	: :	: :		
22:11:30	: :	: :	22:23:30		
22:13:25	: :	: :	22:21:00		
22:15:35	: :	: :	22:22:20		
22:16:20	: :	: :	22:24:15		
22:21:60	: :	: :	22:24:55		
22:21:10	: :	: :	22:30:10		
22:25:55	: :	: :	22:31:50		
22:30:50	: :	: :	22:38:10		
22:36:05	: :	: :	22:40:00		
22:45:00	: :	: :	22:48:30		
22:45:05	: :	: :	22:49:55		
22:55:00	: :	: :	22:59:00		
22:57:10	: :	: :	23:03:00		
22:59:05	: :	: :	23:04:00		
23:01:25	: :	: :	23:04:35		
23:04:05	: :	: :	23:08:45		
23:13:05	: :	: :	23:18:30		
23:13:45	: :	: :	23:19:10		
23:14:30	: :	: :	23:19:40		
23:18:00	: :	: :	23:27:15	2156	
23:23:45	: :	: :	: :		

WEATHERFORD QUEUING DATA - JUNE 14,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
13:00:00	: :	: :	13:05:4D		
13:04:00	: :	: :	13:07:15		
13:07:40	: :	: :	13:12:15	2312	
13:08:55	: :	: :	13:16:55	0104	
13:20:30	: :	: :	13:29:40		
13:27:05	: :	: :	13:31:25	2254	
13:37:10	: :	: :	13:43:00	2369	
13:47:00	: :	: :	: :		
14:13:45	: :	: :	14:24:00		
14:18:30	: :	: :	14:25:55	3320	
14:18:35	: :	: :	14:27:00		
14:18:45	: :	: :	14:29:50		
14:29:00	: :	: :	14:35:00		
14:33:10	: :	: :	14:40:00		
14:44:10	: :	: :	14:50:00		
14:51:30	: :	: :	14:55:10		
14:55:20	: :	: :	15:01:10		
15:01:20	: :	: :	15:10:30		
15:15:00	: :	: :	15:19:20		
15:35:45	: :	: :	15:40:00		
15:36:25	: :	: :	15:43:30		
15:44:50	: :	: :	15:50:00	0343	
15:51:50	: :	: :	15:58:00	2369	
15:52:10	: :	: :	16:00:00	0104	
15:59:40	: :	: :	16:09:45	2339	
16:03:30	: :	: :	16:13:50	7207	
16:04:30	: :	: :	16:12:00	2248	
16:05:00	: :	: :	16:17:30	0415	
16:05:30	: :	: :	16:17:50		
16:06:00	: :	: :	16:19:15		
16:09:05	: :	: :	16:20:10	0975	
16:31:15	: :	: :	16:39:05		
16:33:40	: :	: :	16:41:10	2446	
16:38:45	: :	: :	16:47:50	2299	
16:52:00	: :	: :	16:58:50		
16:52:55	: :	: :	17:01:50	0078	
16:59:30	: :	: :	17:05:45		
17:07:30	: :	: :	17:17:55	2119	
17:08:25	: :	: :	17:20:20		
17:10:00	: :	: :	17:25:30		
17:15:30	: :	: :	17:28:40		
17:24:00	: :	: :	17:31:10		
17:31:20	: :	: :	17:35:05		
17:31:40	: :	: :	17:37:20		
17:44:00	: :	: :	17:49:30		

APPENDIX D-I (Continued)

WEATHERFORD QUEUING DATA - JUNE 14,1970

ARRIVAL AT SCALE QUEUE LOADED	DEPARTURE FROM SCALE LOADED	ARRIVAL AT SCALE QUEUE EMPTY	DEPARTURE FROM SCALE EMPTY	VEHICLE ID	UNLOADER CODE
17:44:35	: :	: :	17:53:55		
17:46:25	: :	: :	17:55:00		
17:48:00	: :	: :	17:56:00		
17:49:55	: :	: :	: :		
17:51:45	: :	: :	: :		
17:52:00	: :	: :	18:02:50		
18:10:05	: :	: :	18:15:05		
18:39:30	: :	: :	18:45:35		
18:40:35	: :	: :	18:46:40		
18:46:00	: :	: :	18:51:10		
18:51:50	: :	: :	18:56:40		
18:53:10	: :	: :	18:58:00		
19:01:00	: :	: :	19:09:30		
19:18:30	: :	: :	19:25:15		
19:23:25	: :	: :	19:23:25		
19:27:55	: :	: :	19:34:30		
19:28:00	: :	: :	19:35:25		
19:28:50	: :	: :	19:38:40		
19:31:45	: :	: :	19:39:45		
19:32:30	: :	: :	19:41:00		
19:34:45	: :	: :	19:44:30		
19:47:30	: :	: :	19:51:50		
19:52:15	: :	: :	19:56:50		
19:58:05	: :	: :	20:02:00		
20:20:10	: :	: :	20:24:40		
20:34:20	: :	: :	20:39:10		
20:35:25	: :	: :	20:42:15		
20:41:35	: :	: :	20:47:50		
20:43:20	: :	: :	20:49:25		
20:53:05	: :	: :	21:02:58		
21:11:00	: :	: :	: :		
21:14:00	: :	: :	: :		

APPENDIX D-II

DAY OF ARRIVAL	VEHICLE NUMBER	STATUS CODE NUMBER* 1	2	3	4	5	6	7	8	9	10	11	12	13	14	RECEIPT NUMBER
18	1												996.4			0
19	1					1020.0	1023.8	1130.3	1163.8				1164.8			35
24	1					983.2	985.1	1008.7	1037.4							0
24	1							1080.8	1085.9				2257.2			53
37	1					795.0	797.8	879.7	901.1				984.3			283
39	1			957.8		966.7	968.8	2035.2	2058.9				2079.0			339
40	1					971.3	973.3	2264.0	2289.5				2308.2			368
44	1			812.7		817.0	834.3	857.5	876.7				877.6			419
19	2												765.6			0
20	2	761.0						805.5	842.9				843.9			42
25	2			1012.2		1013.9	1016.3	1267.8	1296.4							0
26	2							730.9	733.8				916.2			71
37	2					842.0	843.8	941.1	951.0				952.0			285
23	3												762.0			0
26	3			513.3		521.1	545.2	652.8	684.5		686.9	688.7	7700.2			76
32	3					584.4	619.1	664.7	710.3							0
33	3							1013.6	1016.7				2066.0			170
35	3					1069.3	1082.3	1726.1	2004.7				2291.3			258
36	3					1055.0	1058.5	2018.0	2056.3		2244.8	2260.1				0
39	3							808.4	817.8				954.8			271
40	3					454.3	481.4	896.8	940.8				1073.8			347
44	3					556.3	560.4	626.2	661.4				2301.7			413
48	3					604.8	633.9	665.9	702.8				703.8			452
51	3					796.3	808.0	955.1	1003.0				1004.0			458
26	4												1031.5			0
26	4			1086.2		1087.9	1094.3	2019.2	2064.9				2266.8			95
28	4					429.5	506.1	632.1	661.1				922.5			119
28	4			1076.3		1076.7	1118.5	2430.3	2449.2				4902.0			141
32	4					484.5	493.7	712.2	741.9				834.0			167
32	4					1063.0	1071.7	2096.6	2120.4							0
34	4							589.8	591.7							0
35	4							538.0	540.5				1005.2			191
36	4					1036.3	1042.0	1993.1	2016.3							0
37	4							767.5	771.7		772.2	773.2		774.0	776.8	0
37	4										778.2	781.0	2429.3			270
39	4			904.6		907.2	909.6	1148.0	1182.5				2330.9			335
40	4					1007.8	1015.2	2204.3	2235.3		2390.5	2393.3		2401.6	2405.3	0
41	4												965.3			373
27	5												789.8			0
27	5			896.6		897.8	912.4	1057.1	1100.9				2181.8			107
30	5					612.3	620.7	624.4	671.3				693.1			146
31	5					681.6	690.8	773.8	798.7				2070.2			155
32	5					901.5	912.2	1318.3	1353.9							0
33	5							918.8	923.3				1023.5			162
35	5					583.4	600.3	970.2	995.3				3728.4			235
39	5					944.0	951.3	1247.8	1292.3				2125.4			337
40	5					1022.9	1026.8	2445.7	2454.8		2455.8	2457.1		2458.4	2462.0	0
41	5										1023.8	1024.0	4886.3			375
46	5					495.8	633.2	647.4	690.8				3525.8			440
48	5					1110.0	2010.0	2013.0	2098.0				2099.0			453

*All entries beneath status code numbers are in terms of minutes of elapsed time for the respective day of arrival. Time commences at midnight of the previous day.

APPENDIX D-II (Continued)

DAY OF ARRIVAL	VEHICLE NUMBER	STATUS CODE NUMBER 1	2	3	4	5	6	7	8	9	10	11	12	13	14	RECEIPT NUMBER
19	6												875.7			0
19	6					1063.4	1067.8	1193.8	1209.4		1210.8	1212.3				0
20	6							966.0	979.9				8218.3			36
37	6					913.7	918.0	952.1	974.0				2401.0			286
39	6					633.8	638.4	908.6	919.7				2401.8			324
44	6					838.3	848.8	1991.9	2022.5				2023.5			420
24	7												950.1			0
26	7					599.8	601.6	759.0	792.8		10556.9	10562.5		10565.0	10570.1	0
37	7												781.5			79
39	7					545.8	549.8	2142.9	2163.0				3403.8			321
46	7					649.6	678.3	901.1	909.3							0
48	7							554.5	567.9				568.8			441
25	8												550.3			0
26	8					558.3	564.3	734.7	757.3		758.4	758.9		761.4	769.5	0
26	8										771.0	771.7	13903.5			78
36	8			854.5		856.7	858.7	911.7	953.0				3536.8			300
42	8					789.7	795.8	3648.7	3670.9				3671.9			405
17	9												617.4			0
19	9					687.8	692.0	694.9	723.1							0
19	9							798.2	802.3				7827.9			25
25	9					927.4	931.1	934.3	963.6				2146.8			64
38	9					533.7	537.7	602.4	623.5				1996.7			291
40	9					945.8	950.4	2236.7	2262.2				6360.8			367
44	9			1021.0		1025.5	1028.6	1972.7	1990.8				1991.8			424
25	10												558.0			0
25	10					995.8	999.2	1034.0	1073.2				1994.8			67
26	10					960.7	965.3	1135.6	1166.0							0
27	10							875.5	879.1				2020.0			90
28	10					1058.9	1076.4	2392.9	2429.6				11025.0			140
35	10					1037.3	1041.6	1442.1	1468.3				2300.0			254
36	10					960.0	964.9	967.7	998.0				2035.4			266
41	10					847.2	850.8	1965.5	1985.3				2080.5			388
44	10			481.8		489.3	497.5	519.8	542.9				543.9			412
19	11					572.9	576.7	642.8	677.1				678.1			24
19	11					1105.8	1106.2	1211.3	1241.1				1242.1			39
25	11			637.9		639.7	643.6	657.8	687.9				872.9			59
26	11					692.8	702.3	847.3	874.2				1902.8			82
34	11					920.0	921.5	1341.8	1360.7				2153.8			220
37	11					977.8	979.4	2000.8	2019.5				2373.2			288
39	11			900.6		905.2	906.8	2060.1	2095.7				2137.9			334
40	11			985.2		995.3	998.2	2371.8	2392.7				2399.7			372
46	11			731.0		732.0	735.1	910.6	929.4				930.3			443
19	12												613.8			0
19	12					884.3	895.9	946.8	979.2				2206.8			30
24	12					940.3	942.3	944.3	971.2				1904.7			51
25	12					948.8	950.7	965.0	994.6				22589.1			65
47	12					572.1	576.6	589.1	597.4				598.3			446
25	13												857.4			0
26	13			540.5		545.8	550.6	691.0	724.0				864.8			77
27	13			674.1		675.9	680.5	885.7	923.9				1006.8			102

APPENDIX D-II (Continued)

DAY OF ARRIVAL	VEHICLE NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	RECEIPT NUMBER
								STATUS CODE NUMBER								
28	13					727.9	731.3	988.8	1024.5				9589.7			127
34	13					1183.9	1192.9	2254.1	2285.0				3502.7			231
36	13			844.8		852.8	857.1	889.8	917.7				1025.3			264
38	13					1054.7	1059.5	2009.3	2033.8				2058.8			316
39	13					918.9	923.0	1183.7	1246.0				2017.8			336
41	13			850.3		852.1	856.3	1986.5	2019.3				2088.8			389
45	13					945.9	953.4	955.1	980.1				981.1			434
27	14												684.8			0
28	14					569.7	575.1	690.9	720.0							0
28	14							974.2	981.5				6340.2			121
35	14					660.0	668.2	1086.7	1101.3		1101.7	1104.4		1106.8	1115.7	0
38	14												937.5			238
39	14					813.3	816.9	1003.7	1034.0				2428.5			330
44	14					806.3	816.5	825.9	851.0				852.0			418
24	15												489.6			0
25	15					999.7	1002.5	1075.5	1103.7				1909.2			68
31	15			880.5		884.8	888.3	1065.9	1095.0							0
33	15							500.5	501.4				3560.7			161
35	15					854.0	867.6	1339.8	1365.1				3368.4			246
38	15					527.9	532.1	580.5	601.3				1917.7			290
39	15					988.7	992.2	2164.8	2190.2		3856.7	3858.8		3859.1	3866.0	0
44	15												611.0			341
45	15			536.3		540.7	543.7	615.3	625.4				823.0			427
26	16												552.9			0
33	16					895.3	904.2	1062.0	1091.9							0
35	16							905.3	907.2				5165.3			200
38	16			977.9		979.8	981.8	1234.7	1280.7							0
39	16							494.8	500.4				501.4			310
45	16					981.8	988.0	2075.4	2086.2				2087.1			435
16	17												730.0			0
18	17					1048.8	1050.2	2049.3	2081.2				8188.5			20
24	17					1056.6	1058.9	1086.8	1104.3							0
26	17							725.3	730.5				868.0			55
35	17					941.0	942.7	1527.0	1554.4				3441.0			249
38	17					925.3	927.7	2062.6	2081.7				3354.7			304
41	17					711.8	714.2	1287.6	1306.0				1910.2			386
45	17					815.2	818.0	856.8	876.8				877.8			431
14	18												963.6			0
14	18					996.8	1018.7	1043.0	1060.2		1061.5	1062.8				0
16	18							505.0	510.6		543.1	545.3	5049.8			8
19	18			1063.8		1068.2	1076.7	1168.2	1193.0				10687.1			37
28	18					838.2	842.1	1235.3	1258.8				6689.5			132
34	18					977.3	986.9	1368.4	1400.2				2328.5			224
38	18					936.6	939.5	3536.8	3558.4				3791.3			306
41	18					917.0	920.0	2164.3	2191.2				4794.5			394
18	19												492.9			0
19	19					864.3	870.0	907.1	938.5		939.8	944.3	6489.8			29
24	19					480.0	485.8	503.4	536.2				2467.1			45
27	19			500.7		505.6	510.5	678.3	697.8				1020.0			97
32	19					993.1	1017.2	1425.8	1451.3		3376.6	3377.6		3378.7	3382.5	0

APPENDIX D-II (Continued)

DAY OF ARRIVAL	VEHICLE NUMBER	STATUS CODE NUMBER 1	2	3	4	5	6	7	8	9	10	11	12	13	14	RECEIPT NUMBER
34	19												886.7			185
34	19					1073.9	1082.1	2193.5	2221.8				2311.3			230
37	19			705.7		711.0	713.3	821.8	849.0				2005.5			281
38	19					859.3	862.7	956.1	984.3				2084.5			301
39	19					1007.0	1010.8	2271.3	2296.0		3496.8	3498.3	3498.5			343
44	19					599.6	602.8	664.0	688.1				2065.5			414
45	19			987.6		988.2	990.8	2018.5	2046.9				2047.9			436
19	20												972.7			0
19	20					987.8	993.7	1074.1	1087.8				9642.2			34
26	20					857.5	860.3	1005.1	1035.8							0
27	20							879.8	884.8				2189.1			86
31	20					847.7	856.2	965.2	1035.4				1036.4			158
35	20					991.2	995.2	1469.0	1495.4				2058.7			251
36	20					1062.3	1065.3	2456.4	2469.5		2470.4	2472.0		2474.0	2480.2	D
38	20												792.5			272
38	20			1029.5		1033.2	1036.5	1984.8	2008.5				2043.0			314
40	20					562.9	567.4	986.2	1000.0		1966.8	1968.1		1970.1	1974.0	D
41	20												548.6			350
45	20					525.3	537.2	780.3	807.5				808.5			425
17	21												982.2			D
19	21					718.3	722.8	767.0	794.4							0
19	21							1164.4	1167.5		1157.8	1170.2	6489.9			26
24	21					996.5	1000.8	1040.4	1071.9				1072.9			54
25	21					1016.8	1021.7	1104.6	1135.3				3430.5			72
27	21			1012.3		1014.8	1017.2	2044.5	2070.3							0
32	21							830.4	839.9				1020.8			116
35	21			745.4		746.3	766.7	1221.9	1245.1				3601.3			243
38	21					537.8	540.0	624.8	646.3				865.1			292
39	21			633.9		638.6	640.3	920.7	937.8				1019.3			325
41	21			562.0		566.7	569.2	1224.3	1248.9				4930.5			383
45	21			536.2		537.6	540.4	587.8	612.1							0
46	21							607.7	615.5				616.5			426
16	22												889.1			0
17	22					803.5	945.2	948.9	988.5				14993.8			10
28	22			497.8		507.3	509.8	670.0	689.5				2010.8			120
30	22					573.3	579.5	585.5	622.5				2166.0			145
31	22					860.0	876.8	1037.0	1063.9				3425.5			159
34	22					652.9	659.3	706.8	731.8				2144.5			209
39	22					593.0	597.2	852.0	865.8				2389.8			322
40	22					1098.5	1113.8	2394.3	2405.4		2406.5	2409.9		2413.2	2417.7	0
41	22												978.7			379
18	23												686.3			0
19	23					532.4	538.3	564.3	605.8				606.8			23
27	23					596.0	601.5	753.1	806.3				981.3			100
28	23					847.0	859.6	1143.6	1171.2				3557.3			133
32	23					801.8	806.9	1179.1	1219.3				3414.5			177
35	23			594.3		600.8	606.6	1008.1	1045.5				3578.6			236
40	23					1045.2	1053.1	2482.0	2516.8				3428.5			377
47	23					1030.0	1033.0	2032.1	2057.3				2058.3			450
26	24												712.4			0

APPENDIX D-II (Continued)

DAY OF ARRIVAL	VEHICLE NUMBER	STATUS CODE NUMBER 1	2	3	4	5	6	7	8	9	10	11	12	13	14	RECEIPT NUMBER
27	24			569.3		572.3	589.4	719.3	750.3							0
28	24							663.6	669.0				950.0			99
33	24					526.6	554.1	855.8	885.3				1949.1			194
35	24					573.8	579.2	935.3	968.8				6267.0			234
40	24		477.9			570.0	574.6	1000.8	1032.8							0
41	24							1165.0	1170.5							0
42	24							580.3	582.0				583.0			351
28	25					936.1	943.6	2282.3	2307.8				3462.4			137
32	25					508.8	517.4	789.3	828.9				1030.3			168
34	25			496.7		497.8	503.4	670.8	705.8				2024.3			206
39	25			498.7		500.9	503.6	818.4	848.6				1931.6			320
41	25					503.5	509.2	1126.3	1164.1				2295.9			380
43	25					540.0	1928.0	1983.2	1993.3				1994.3			409
19	26												963.7			0
24	26		688.5			707.0	710.6	733.1	761.2				762.2			48
19	27												902.0			0
20	27	543.9						848.0	878.1				879.1			41
25	27		545.3			582.7	583.4	589.3	615.3				616.3			56
17	29												927.9			0
18	29					1020.0	1026.4	1051.5	1089.8				11064.9			19
26	29					940.9	944.6	1093.6	1134.4				3560.7			89
30	29					646.9	650.6	682.1	720.8				721.8			147
31	29			689.4		877.2	882.4	934.2	963.2				2067.2			160
32	29					846.8	850.8	1160.3	1175.3				12002.5			179
40	29			982.7		990.3	995.0	2357.3	2370.7		2377.3	2377.8		2379.0	2384.8	0
41	29												946.9			371
42	29					597.4	600.3	992.6	1008.8				1009.8			404
26	30												607.7			0
27	30					918.8	923.8	1103.4	1120.1				1903.3			108
28	30					740.8	745.1	1074.0	1102.7				5180.4			129
31	30			1046.0		1046.7	1051.4	2025.1	2055.4				2089.4			165
32	30					931.6	936.8	1355.7	1380.0				3601.8			183
34	30			873.5		880.3	884.2	2162.3	2192.2				2200.3			218
35	30					870.5	875.3	1366.3	1404.9				1899.3			247
36	30					1017.8	1026.4	1036.1	1060.0							0
37	30							618.1	623.3				2103.0			268
38	30					786.5	788.5	806.3	828.8				995.1			297
39	30			788.1		790.0	793.3	981.0	1002.2				1941.8			328
40	30					853.0	856.8	2006.1	2032.4				2138.8			361
41	30					1039.0	1042.9	2341.6	2365.5							0
46	30							869.8	874.6				875.6			400
27	31												916.0			0
28	31					654.8	667.7	769.2	817.1				4962.7			123
31	31					1037.5	1046.4	1983.0	2023.4				2074.2			164
32	31					1040.2	1042.4	1420.0	1424.4							0
33	31							572.5	593.7				909.8			188
34	31					528.9	555.5	631.8	669.8				752.0			208
34	31					939.0	945.8	2223.2	2253.3				2322.0			221
35	31			1044.5		1050.2	1055.8	1663.3	1695.0				2063.3			256
36	31					896.5	909.0	918.7	966.6				2035.0			265

APPENDIX D-II (Continued)

DAY OF ARRIVAL	VEHICLE NUMBER	STATUS CODE NUMBER 1	2	3	4	5	6	7	8	9	10	11	12	13	14	RECEIPT NUMBER
38	31					875.1	878.9	985.3	1009.1				1940.0			302
39	31					870.0	874.7	1088.3	1112.2				2053.8			332
40	31					927.3	930.5	2107.8	2133.3				3490.0			365
44	31					1019.1	1025.3	3755.8	3780.6				3781.6			423
13	32					420.0	497.8	506.9	533.8		535.8	538.4	746.3			4
14	32					544.4	567.6	569.3	686.2				4813.8			6
18	32					390.0	595.8	599.6	642.8							0
18	32							886.7	892.2				900.0			13
19	32					423.4	472.0	499.3	561.0				562.0			21
20	32					898.2	940.3	941.7	958.0							0
26	32					620.1	638.7	794.9	809.2				917.6			80
26	32					1014.2	1028.1	1215.9	1255.7				2026.3			93
27	32					740.3	744.8	924.5	977.5				2110.0			103
28	32					914.0	918.9	1260.5	2280.5				3515.0			136
31	32			586.3		588.6	602.3	735.7	771.8				886.8			153
32	32					700.5	711.4	1042.5	1135.6		1995.8	1997.3		1998.9	2002.7	0
33	32												563.7			175
36	32					305.6	500.8	585.3	616.2		617.8	619.7		620.3	625.3	0
38	32												643.8			260
38	32			878.1		885.3	888.3	1010.5	1078.3				2353.8			303
40	32					620.0	625.8	1038.0	1068.3				2268.0			352
43	32	600.0				1986.8	1990.2	1995.1	2029.9				2435.8			410
45	32					886.0	899.9	902.2	924.8							0
48	32							545.9	549.0				550.0			432
49	32					610.0	655.0	659.0	720.0							0
51	32							941.0	946.6				990.1			454
18	33												1019.5			0
19	33					761.1	773.1	803.4	827.5							0
19	33							940.1	945.3				9289.3			27
25	33					1048.4	1049.5	1241.6	1266.7							0
26	33							840.0	846.7				9431.8			73
33	33					995.1	1003.2	1193.8	1224.4				2165.8			201
35	33			697.5		699.4	705.2	1165.4	1189.6				3553.0			241
39	33					687.8	691.7	2119.2	2141.0				2208.5			326
41	33					561.9	566.4	1199.1	1223.8				1918.7			382
45	33	1035.0						2283.5	2308.5				2309.5			439
35	34												998.3			0
37	34					530.7	535.7	628.8	646.8				3412.5			274
40	34		473.1			490.5	498.0	942.7	962.8				1001.8			348
47	34					1035.0	1997.5	2008.8	2029.8				2030.8			451
26	35												713.3			0
27	35					1081.8	1084.8	1164.8	1177.3				12096.0			118
35	35					1115.8	1117.8	2062.5	2099.0				6731.0			259
40	35					834.7	839.4	1259.2	1285.5							0
41	35							695.2	701.3				702.3			358
1	36	1080.0				2280.0	2312.8	2329.2	3594.5				5035.5			1
18	36					991.9	1002.7	1023.8	1049.9				1912.5			18
19	36					960.8	964.8	982.8	1009.8				2003.6			31
24	36					810.5	817.5	824.3	851.8				2458.3			50
26	36			858.2		862.5	863.1	1037.3	1063.0				2270.9			87

APPENDIX D-II (Continued)

DAY OF ARRIVAL	VEHICLE NUMBER	STATUS CODE NUMBER 1	2	3	4	5	6	7	8	9	10	11	12	13	14	RECEIPT NUMBER
37	36					609.6	611.3	779.7	796.6		3667.3	3667.9		3669.6	3673.3	0
39	36												927.3			278
40	36					534.2	543.8	964.0	984.9				2221.0			349
44	36					723.3	726.8	1007.0	1024.3				1025.3			417
19	37												691.8			0
24	37					520.3	526.8	540.0	570.8							0
24	37							1073.8	1080.0				3851.8			46
27	37					1000.8	1002.8	1980.0	2008.3							0
28	37							982.3	987.8				19272.3			114
41	37					925.4	929.0	2193.0	2222.4				2223.4			395
27	38												966.7			0
28	38			729.1		731.9	738.9	1025.8	1070.0				6650.5			128
33	38					826.9	843.0	1137.0	1168.3				2484.2			199
37	38					799.1	804.2	902.6	936.8				2138.3			284
39	38					896.0	905.0	1113.8	1146.2				2349.5			333
41	38					810.3	813.8	1925.7	1959.3				8148.3			387
47	38					877.9	1002.5	1978.0	1985.0				1986.0			448
41	39			902.5		906.3	911.2	2125.6	2163.1				2164.1			393
18	40												829.5			0
18	40					959.2	963.8	981.9	1011.5				1012.5			17
19	40					839.9	846.3	848.0	905.0		906.3	907.7	998.2			28
24	40					740.8	748.1	805.7	821.9				983.4			49
25	40					1003.7	1009.3	1136.8	1182.8				2270.7			69
26	40					969.8	975.5	1167.6	1214.0				2287.6			91
27	40			955.0		961.3	963.9	1224.5	1277.8				2095.3			110
31	40			688.8		691.1	695.4	834.8	878.9							0
31	40							1145.8	1151.2				1938.2			156
32	40					874.9	882.0	1252.8	1292.0				4998.5			180
38	40					688.0	693.6	746.7	775.1							0
38	40							1378.7	1385.8				2351.3			296
40	40					884.8	888.5	2034.0	2068.0							0
42	40							521.0	523.3				594.8			362
43	40	960.0				2000.9	2008.9	2031.8	2064.2				2065.2			411
45	40	1030.0						2132.8	2169.8				2170.8			438
19	41												766.0			0
24	41					617.3	699.0	701.3	730.3				1035.0			47
25	41					747.3	765.9							772.0	782.5	0
25	41												1027.0			51
27	41					500.6	505.4	628.3	677.4				1915.8			96
34	41	1036.2						1987.3	2020.5				2076.0			228
35	41					921.8	938.9	1406.8	1440.9				1899.0			248
37	41			534.0		536.4	539.6	647.8	669.1				5018.3			275
40	41					1034.8	1039.0	2456.3	2480.3				2481.3			376
26	42												470.2			0
39	42					1139.4	1144.8	2298.0	2335.7				3580.4			346
19	43												1027.3			0
23	43					985.2	1018.1	1020.0	1047.3				2134.3			43
25	43			637.9		645.8	646.1	690.9	719.8				931.2			60
26	43					672.3	673.8	810.8	839.0				2341.7			81
37	43					663.0	667.9	772.6	779.1				2005.9			279

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DAY OF ARRIVAL	VEHICLE NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	RECEIPT NUMBER
38	43					955.0	957.8	1123.4	1151.2				2459.4			307
40	43					756.0	764.8	1230.8	1258.2		2410.5	2411.8	2412.8			357
44	43			599.7		602.9	606.2	689.1	704.8				2065.6			415
45	43			987.7		991.0	994.8	2056.3	2070.4				2071.4			437
24	44												815.7			0
25	44					867.9	873.1	875.5	904.0				2042.3			62
27	44					895.4	897.4	1178.3	1219.7				1897.3			106
34	44					966.5	967.7	1361.3	1367.0				2210.8			222
37	44					705.5	710.7	799.0	820.3				3524.2			280
39	44			1007.1		1011.0	1013.2	2244.6	2270.3				2366.2			344
41	44			950.7		953.3	955.2	2300.4	2326.6		6402.2	6402.7				0
45	44							643.0	644.3				645.3			398
17	45												977.7			0
18	45					813.8	863.3	893.5	928.4				1866.3			14
19	45			962.8		965.5	969.4	1011.1	1071.4				9546.1			32
31	45					570.4	576.8	631.5	682.3				960.0			151
32	45					1049.4	1055.2	2035.8	2076.9				2288.2			189
34	45					685.2	698.3	733.4	777.3				5313.6			210
39	45					616.1	629.1	867.1	907.0				985.6			323
40	45			981.8		984.2	990.1	2318.2	2355.5				2400.1			370
42	45					810.4	841.2	1011.6	1047.3				1048.3			406
45	45					663.3	669.2	670.9	714.1				805.9			428
47	45			621.6		623.1	629.0	633.3	666.9							0
48	45							550.9	553.3				554.3			447
28	47												765.2			0
28	47					1019.4	1023.3	2350.5	2392.0				5211.4			139
32	47					1032.4	1036.9	1942.8	1974.4				3544.9			187
35	47					692.9	699.1	1135.7	1163.7				2302.2			240
37	47					495.7	499.7	520.0	552.3				2476.3			273
39	47					862.4	865.8	1061.8	1086.8							0
40	47							544.0	547.4							0
40	47							1035.6	1037.0				2308.3			331
42	47			840.3		841.7	849.8	1052.1	1081.3				1082.3			407
24	48												987.5			0
25	48					879.2	882.3	905.4	932.3				954.5			63
26	48					911.5	912.8	1064.8	1092.5				1914.1			88
28	48			903.1		904.0	906.5	1218.3	1234.4				3341.3			135
34	48					858.4	863.4	887.0	1216.5				2075.1			215
35	48					1058.8	1062.1	1698.7	1724.3		3730.9	3731.4		3731.8	3735.4	0
38	48												943.3			257
40	48					980.2	983.0	2290.8	2316.8				2317.8			369
26	49												475.2			0
27	49					824.3	827.2	979.9	1007.4				1020.8			104
32	49					564.8	576.3	840.8	882.0				3818.6			169
37	49					773.6	775.8	850.2	879.0				3576.6			282
40	49					690.9	694.9	1202.1	1229.5							0
41	49							500.5	509.5				624.3			356
45	49					676.3	681.8	808.8	824.4				931.8			429
23	50												947.8			0
26	50			460.4		464.7	520.7	591.9	649.5		651.3	652.6	976.5			75

APPENDIX D-II (Continued)

DAY OF ARRIVAL	VEHICLE NUMBER	STATUS CODE NUMBER 1	2	3	4	5	6	7	8	9	10	11	12	13	14	RECEIPT NUMBER
31	50					1063.7	1069.8	2057.6	2102.8				2112.6			166
33	50					663.8	671.2	1018.4	1060.2				1933.6			198
35	50					476.8	496.5	858.3	904.0				3494.6			233
39	50			469.2		490.9	500.3	755.7	806.0				1939.0			319
40	50					1018.2	1021.5	2407.9	2444.7				2445.7			374
47	50			1001.5		1003.1	1025.0	2060.0	2103.6				2103.6			449
28	51												536.2			0
29	51					555.0	564.2	1017.6	1043.2		1044.3	1046.3	4842.3			142
32	51					1019.9	1025.7	1975.7	2010.0				2093.9			186
34	51			869.8		873.3	877.3	1263.8	1294.9				1944.5			217
36	51					597.7	602.2	664.4	687.6							0
37	51							624.3	627.9				1915.4			261
40	51			836.3		839.8	844.4	1950.5	1980.8				2158.8			359
44	51					962.3	965.2	972.4	1006.1				2395.5			421
51	51					660.0	685.0	829.9	864.8				865.8			456
27	52												550.3			0
27	52					1012.1	1014.6	2010.1	2043.7				12025.4			115
35	52					733.3	746.1	1191.2	1220.1				.			0
36	52							660.2	663.3				2160.8			242
38	52			537.9		541.1	545.2	647.4	670.8				980.9			293
41	52					902.5	906.0	2098.3	2124.7				4744.3			392
49	52					780.0	840.0	3746.0	3779.0				3780.0			455
25	53												648.8			0
25	53					1011.7	1013.4	1207.7	1240.7				2044.8			70
27	53					1032.2	1033.9	1312.6	1335.3				7760.7			117
32	53			881.2		885.4	889.0	1292.5	1315.0							0
33	53							495.8	499.6				525.3			181
34	53					709.1	718.8	818.3	833.3				970.4			212
35	53			1001.3		1002.5	1005.0	1496.8	1526.5				3495.0			253
38	53					1021.0	1024.8	2082.6	2106.4				2412.6			312
40	53					916.7	918.4	2085.0	2106.0				2107.0			364
25	54												884.1			0
26	54					708.5	710.7	876.5	901.1				12305.9			83
35	54					770.8	775.3	1246.5	1269.7		3717.3	3717.9		3719.8	3721.8	0
40	54												850.1			244
41	54					542.2	543.5	1171.3	1197.3		6391.3	6391.8				0
45	54							632.4	634.9				635.9			381
18	55												395.0			0
18	55					879.9	885.2	931.1	966.3				969.3			16
20	55					487.9	878.7	884.8	937.3				5085.9			40
23	55					1045.6	1051.4	1053.2	1100.3				2231.9			44
24	55					943.2	951.7	973.7	996.1				2205.4			52
25	55					1054.8	1075.2	1184.4	1206.1				2081.2			74
26	55					775.7	781.0	902.7	957.6				978.5			84
27	55					564.7	571.5	699.5	713.5				747.4			98
27	55					836.4	844.3	1009.9	1055.5				3529.8			105
30	55					678.3	692.5	722.5	762.7				962.1			148
31	55					629.6	639.5	801.3	833.3				1953.5			154
33	55					595.9	625.3	925.4	969.8				1945.5			196
34	55			880.8		884.5	890.1	1301.6	1340.0				2084.6			219

APPENDIX D-II (Continued)

DAY OF ARRIVAL	VEHICLE NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	RECEIPT NUMBER
						STATUS CODE NUMBER										
38	55					929.6	934.3	1079.4	1121.9				1888.0			305
39	55					956.9	966.3	1945.0	1982.7				2090.5			338
40	55					937.4	944.5	2142.3	2203.2				3600.4			366
42	55					987.3	1005.1	1086.5	1117.7				1118.7			408
23	56												843.5			0
31	56					940.0	953.7	1097.1	1143.5				2102.7			162
33	56			1009.6		1012.5	1017.9	1093.3	1135.3				2218.8			203
35	56					1043.6	1049.6	1631.6	1661.3				3700.7			255
38	56					550.5	557.6	672.3	705.3				995.5			294
40	56					642.3	645.4	1162.4	1200.1				2096.9			355
41	56					945.3	950.3	2262.5	2298.2				2299.2			397
44	56					981.5	988.1	1027.1	1062.0				2333.7			422
46	56					926.1	933.1	934.6	968.8							0
47	56							515.0	516.5				517.5			444
32	57												891.5			0
33	57					1042.4	1047.8	1225.8	1256.2				11083.6			204
42	57					585.5	589.5	966.3	992.2				993.2			403
38	58					972.1	976.3	1152.5	1192.6				1868.8			308
44	58					607.1	611.2	2420.9	2440.2				3529.8			416
51	58			660.1		685.3	690.0	902.1	931.3				932.3			457
28	61					888.1	903.8	1173.1	1215.5				4912.3			134
32	61					820.3	831.3	1220.9	1250.9				1978.0			178
33	61			1001.7		1003.8	1012.2	1934.1	1981.3				2168.4			202
34	61					1016.2	1033.8	1405.4	1976.8				2059.5			225
35	61					996.3	1002.2	1595.0	1625.7				3382.8			252
14	64												601.2			0
14	64					957.6	963.8	975.9	1039.5				1124.3			7
35	64					625.8	642.2	1047.8	1084.8							0
36	64							580.8	584.1				895.5			237
39	64					446.2	490.2	700.8	750.1				870.8			318
40	64			624.0		626.4	630.5	1070.3	1100.0				2418.2			353
41	64					998.7	1008.3	2328.3	2340.0		2488.8	2490.2		2492.7	2499.3	0
42	64												1060.3			399
13	65					992.2	1924.3	1942.3	2002.2				2071.2			5
32	65					1103.2	1116.0	2223.8	2259.8							0
34	65							1296.8	1300.0				1967.4			192
38	65					838.4	840.5	842.3	885.5				891.8			298
38	65					1029.4	1033.0	1941.7	1982.5							0
39	65							751.6	754.2				819.8			313
40	65		475.9			633.3	641.8	1101.8	1148.3				2219.7			354
41	65			926.5		929.3	936.2	2248.5	2261.2		2394.2	2395.3		2399.1	2403.3	0
42	65												964.3			396
28	66					636.9	647.3	721.5	766.5							0
31	66							685.0	688.2				705.1			122
32	66					635.8	640.9	935.6	979.3				1060.5			173
34	66					1035.2	1039.8	2021.8	2054.0							0
35	66							996.7	1006.2				2235.3			226
37	66					980.2	988.2	1031.0	1069.3				2026.0			289
38	66			979.0		982.2	989.2	1283.7	1376.5				2074.2			311
39	66			963.2		969.2	978.2	1988.3	2022.4				2093.0			340

APPENDIX D–II (Continued)

DAY OF ARRIVAL	VEHICLE NUMBER	STATUS CODE NUMBER 1	2	3	4	5	6	7	8	9	10	11	12	13	14	RECEIPT NUMBER
41	66					646.5	649.8	1250.7	1285.6				2287.3			384
45	66					791.2	801.1	825.8	854.7							0
45	66							894.5	900.3				901.3			430
46	66					1025.0	1929.1	1957.6	1993.1							0
47	66							526.1	631.6				930.4			445
27	67					971.0	976.0	1336.7	1383.0				5208.0			112
33	67					641.7	646.8	972.6	1011.5				2087.6			197
38	67					976.7	979.5	1193.8	1232.8				2036.7			309
40	67					848.8	852.5	1981.8	2004.0				2013.8			360
42	67					538.9	544.8	926.7	964.7							0
42	67							1048.7	1050.8							0
44	67							853.8	856.6				857.6			402
28	68					668.1	672.8	821.3	867.4				3393.3			124
31	68					962.2	977.1	1933.3	1976.0				2250.8			163
34	68					522.0	528.8	592.8	630.7				881.6			207
39	68			1012.4		1013.4	1016.8	2209.0	2243.7				2297.6			345
41	68			851.7		856.6	861.4	2024.3	2061.5				5187.2			390
16	70					1045.6	1922.3	1930.6	1960.9		1969.6	1999.2	2252.7			9
17	70					1036.1	1041.8	1057.7	1082.3				2471.2			12
17	71					1015.6	1026.3	1028.4	1055.4				3859.0			11
25	71					976.7	981.6	1005.0	1032.8				2267.8			66
26	71					1084.3	1087.6	1957.5	2007.5				2122.5			94
28	71					817.9	822.1	869.3	878.4				971.1			131
31	71					710.1	714.7	880.8	932.7				2207.0			157
32	71			1052.4		1055.5	1059.5	2078.7	2095.2				3422.1			190
34	71			1035.4		1040.2	1042.8	2060.7	2092.2				2114.6			227
38	71			1029.8		1036.7	1039.4	2035.6	2061.6				2247.0			315
40	71					890.4	894.7	2069.3	2083.1				2143.7			363
41	71					1063.5	1068.1	2223.2	2247.0				2248.0			401
38	73					850.2	856.4	887.3	909.2				910.2			299
18	74			860.8		863.8	866.8	869.5	882.7				883.4			15
19	74			963.3		969.7	973.5	1089.2	1128.4				9468.1			33
26	74					819.3	822.8	959.3	1004.3				1996.8			85
28	74			671.0		673.1	676.8	879.5	923.8				3547.2			125
32	74					619.4	623.0	883.0	920.6				3730.8			171
36	74					989.3	994.9	999.4	1034.1				3451.8			267
39	74					794.3	798.6	1036.0	1060.9				1919.4			329
40	74					1062.1	1065.9	2518.0	2549.6				3485.0			378
19	75			1067.3		1076.9	1079.4	1242.7	1256.3							0
25	75							998.7	1004.0	1005.3	1009.8	1011.3	2388.0			38
27	75					672.7	677.3	833.3	873.5				1990.8			101
28	75					962.1	967.4	2309.1	2349.4				5205.7			138
32	75					754.2	760.3	1136.2	1159.7				2097.9			176
34	75					844.7	849.8	860.3	885.7							0
35	75							616.0	619.8				6379.8			214
39	75			989.7		992.4	995.8	2191.6	2207.7				2341.5			342
41	75					691.9	698.3	1110.8	1124.8				1904.4			385
27	76					953.2	960.5	1122.7	1162.1				2347.3			109
31	76					584.5	588.3	690.8	733.8				1028.9			152
33	76					1103.6	1116.3	1982.7	2028.3				2029.3			205

APPENDIX D—II (Continued)

DAY OF ARRIVAL	VEHICLE NUMBER	STATUS CODE NUMBER 1	2	3	4	5	6	7	8	9	10	11	12	13	14	RECEIPT NUMBER
35	76					978.0	985.8	1555.9	1592.7				3382.7			250
27	77			956.8		964.2	965.9	1279.7	1311.8				6385.3			111
32	77					652.9	658.8	1001.1	1041.1				2447.9			174
34	77					771.8	781.3	834.5	858.7							0
34	77							1401.5	1402.8				1403.8			213
38	77					663.8	669.0	709.7	745.6				862.9			295
39	77					788.0	789.9	939.4	978.7							0
40	77							587.2	592.2				748.5			327
41	77					889.2	894.8	2063.0	2095.5				5173.9			391
46	77			676.3		678.8	684.8	802.6	842.3				843.3			442
34	78												964.0			0
37	78					554.2	557.7	590.2	721.8				849.8			276
38	79					1106.0	1110.8	2114.6	2139.2		2140.5	2141.3	2142.3			317
45	80					926.7	930.1	931.8	953.6				5024.6			433
26	89					975.8	984.8	1271.8	1435.7		1436.6	1437.0	2429.2			92
29	89			589.8		594.5	609.7	1084.8	1131.6				2053.5			144
32	89			932.9		937.2	941.5	1382.5	1418.3				1955.0			184
34	89					867.2	872.9	1220.2	1261.0				1918.3			216
35	89					785.4	800.1	1272.8	1313.7							0
36	89							619.4	621.3				636.3			245
37	89					589.3	595.7	723.1	767.1				1002.2			277
27	90			973.0		976.5	983.8	1938.6	1976.6				2132.3			113
29	90					589.5	594.1	1043.5	1083.2				2095.1			143
33	90					571.5	581.8	886.4	916.7				1955.5			195
35	90					464.1	473.4	690.5	720.0				807.0			232
36	90					844.3	852.3	853.5	888.3				924.7			263
37	90					939.0	953.8	976.4	1014.7				2121.3			287
28	91					681.3	686.0	930.8	972.8				2059.7			126
31	91			522.3		526.0	543.4	593.1	629.2				3438.6			150
34	91			688.5		699.0	702.0	781.0	806.4				881.3			211
35	91			667.2		668.5	672.9	1102.6	1133.0				1972.0			239
36	91			1025.9		1026.8	1030.5	1060.4	1959.1				2056.4			269
26	92					759.7	762.7	1104.9	1142.2				2050.3			130
31	92					522.2	525.5	555.7	591.0				699.5			149
33	92					497.3	509.5	821.5	854.3				1854.8			193
34	92			1037.5		1043.3	1046.7	2099.2	2129.5				2134.9			229
36	92					816.8	821.3	823.3	851.8				868.8			262
25	97					637.5	638.3	645.6	656.3				813.2			58
32	97	628.3						922.2	933.8				13560.0			172
51	97			806.0		808.3	810.5	811.0	827.3				828.3			459
25	98					600.1	613.0	618.8	625.8		627.1	629.9	662.4			57
19	99			468.0		472.4	473.4	484.9	496.8		497.8	504.8	517.6			22

APPENDIX D-II (Continued)

DAY OF SEASON	VEHICLE NUMBER	FARMER CODE NUMBER	RECEIPT NUMBER	NET WEIGHT	BALE NUMBERS AND BALE WEIGHTS
19	1	43	35	5060	2840-525 2841-625
24	1	85	53	5010	2860-545 2861-525
37	1	71	283	4020	2945-465 2946-445
39	1	43	339	4370	2972-545 2973-550
40	1	43	368	4560	2983-495 2984-525
44	1	3	419	3500	847-525 848-545
20	2	43	42	4550	2844-500 2845-430
25	2	85	71	4780	2878-555 2879-480
37	2	20	285	1940	2947-435
26	3	36	76	4560	103-450 104-550 105-545
32	3	36	170	6640	315-515 316-545 317-550 318-570
35	3	36	258	7900	534-460 535-515 536-505 537-480
36	3	42	271	7300	568-490 569-455 570-515 571-500
40	3	42	347	7240	712-490 713-535 714-510 715-465
44	3	93	413	5100	839-545 840-495 841-555
48	3	36	452	6110	911-475 912-525 913-495
51	3	36	458	6810	928-455 929-435 930-465 931-470
26	4	17	95	7230	137-540 138-520 139-510
28	4	49	119	4160	186-525 187-575
28	4	50	141	3370	236-470 237-330
32	4	45	167	4960	308-515 309-570
32	4	4	191	5000	368-555 369-560
36	4	5	270	5700	565-540 566-570
39	4	54	335	6670	683-520 684-545 685-580
40	4	58	373	5140	762-578 763-570
27	5	17	107	7570	163-490 164-480 165-415
30	5	74	146	8340	251-485 252-455 253-470
31	5	1	155	3690	277-510 278-550
32	5	60	182	7270	344-580 345-590 346-575
35	5	45	235	4160	483-495 484-520
39	5	42	337	7200	688-495 689-475 690-480 691-455
40	5	42	375	1670	767-530
46	5	36	440	6360	882-535 883-515 884-450 885-510
48	5	36	453	7100	914-515 915-510 916-510
19	6	14	36	2420	68-560
37	6	20	286	4550	2948-480 2949-455
39	6	38	324	2200	668-565
44	6	94	420	5840	649-515 850-495 851-465
26	7	43	79	5240	2890-540 2891-545
39	7	88	321	3440	2964-575
46	7	70	441	4410	891-560
26	8	85	78	4390	2885-460
38	8	43	300	4000	2956-400 2957-440
42	8	90	405	4010	2993-520 2994-510
19	9	85	25	4950	2831-520 2832-525
25	9	43	64	4550	2874-535 2875-530
38	9	43	291	3920	2954-495
40	9	53	367	4150	754-558 755-545
44	9	94	424	3330	861-580 865-375
25	10	73	67	6130	87-475 88-480 89-435
26	10	73	90	4920	121-525 122-560
28	10	73	140	5400	234-575 235-600
35	10	49	254	4660	525-535 526-500
36	10	49	266	5510	555-510 556-485 557-405
41	10	49	388	3820	790-445 791-430
44	10	74	412	3670	832-610
19	11	43	24	5460	2828-485 2829-460 2830-480
19	11	85	39	3800	2842-510 2843-510
25	11	43	59	4810	2866-520 2867-520
26	11	75	82	3930	2887-450 2886-490 2888-440
34	11	8	220	3300	2914-565
37	11	43	288	3390	2952-495 2953-545
39	11	43	334	4090	2970-550 2971-510
40	11	49	372	3760	760-460 761-434
46	11	23	443	3300	2810-575
19	12	85	30	4960	2835-475 2836-475 2839-510
24	12	43	51	4150	2858-450 2859-440
25	12	43	65	4380	2876-490 2877-560
47	12	102	446	800	
26	13	73	77	4970	106-550 107-620
27	13	73	102	5390	152-490 153-560 154-560
28	13	73	127	5390	206-580 207-540 208-515
34	13	70	231	6500	470-465 471-470 472-440
36	13	49	264	5030	551-540 552-565
38	13	49	316	4480	650-540 651-505
39	13	49	336	4210	686-530 687-480
41	13	10	389	5950	792-470 793-475 794-500
45	13	2	434	4620	874-470 875-455 876-485
28	14	73	121	5480	190-555 191-530
35	14	48	238	2470	437-565
39	14	54	330	6240	638-495 674-500 675-460
44	14	23	418	4410	2997-550 2998-545
25	15	64	68	3920	90-500 91-500
31	15	31	161	4350	290-565 291-570
35	15	55	246	4120	510-545 511-515
38	15	43	290	4000	2950-465 2951-500
39	15	53	341	5110	699-575 700-575
45	15	96	427	1600	864-425
33	16	36	200	4880	394-445 395-530 396-580
38	16	54	310	6870	636-475 637-560
45	16	97	435	1450	677-500
18	17	43	20	4620	2826-485 2827-475
24	17	85	55	3200	2864-515 2865-560
35	17	37	249	4900	2919-580
38	17	43	304	3240	2960-465 2961-465
41	17	23	386	3450	2987-470 2988-415
45	17	23	431	3750	2804-470 2805-590
14	18	62	8	3220	19-565
19	18	14	37	3900	70-570 71-580
28	18	75	132	3870	2909-500 2910-495

APPENDIX D-II (Continued)

DAY OF SEASON	VEHICLE NUMBER	FARMER CODE NUMBER	RECEIPT NUMBER	NET WEIGHT	BALE NUMBERS AND BALE WEIGHTS		
34	18	31	224	5480	454-530	455-480	456-515
38	18	88	306	3740	2958-550	2959-460	
41	18	43	394	4270	2989-505	2990-520	
19	19	14	29	4640	58-560	59-585	
24	19	14	45	5320	76-465	77-465	78-360
27	19	64	97	3120	142-575		
32	19	48	185	4640	352-565	353-545	
34	19	70	230	5600	468-495	469-470	
37	19	55	281	4870	586-530	587-560	
38	19	38	301	4390	617-515	618-575	
39	19	82	343	4120	702-560	703-590	
44	19	82	414	3980	842-555	843-565	
45	19	99	436	3340	878-450		
19	20	82	34	1980	67-580		
26	20	73	86	5150	116-555	117-560	
31	20	49	158	3790	285-495	286-470	
35	20	49	251	5010	521-490	522-470	
36	20	51	272	2550	572-605		
38	20	49	314	4170	646-490	647-490	
40	20	9	350	2960	720-570		
45	20	23	425	5520	2800-485	2801-465	
19	21	14	26	4920	52-500	53-540	
24	21	18	54	4850	81-540	82-605	
25	21	64	72	4540	95-515	96-445	
27	21	24	116	4270	184-530	185-550	
35	21	55	243	4170	502-535	503-480	
38	21	48	292	4190	598-475	599-495	
39	21	38	325	2890	669-615		
41	21	82	383	4300	781-570	782-530	
45	21	99	426	3990	862-565	863-465	
17	22	87	10	6430	22-520	23-500	24-470
28	22	57	120	3180	188-490	189-450	
30	22	80	145	6590	248-465	249-455	250-590
31	22	72	159	4230	287-550	288-510	
34	22	80	209	4890	423-455	424-500	
39	22	89	322	3600	664-435		
40	22	58	379	2520	775-550		
19	23	56	23	6430	49-500	50-480	51-590
27	23	3	100	6940	146-525	147-525	148-550
28	23	3	133	3730	218-425	219-400	
32	23	3	177	6280	332-495	333-540	334-540
35	23	3	236	6660	485-530	486-525	487-530
40	23	3	377	6740	770-605	771-530	772-520
47	23	100	450	3960	906-480	907-300	
27	24	57	99	5960	144-565	145-565	
33	24	80	194	5760	377-585	378-540	
35	24	41	234	6210	480-510	481-445	482-450
40	24	10	351	7030	721-510	722-550	
28	25	40	137	4240	226-470	227-470	
32	25	80	168	6620	310-490	311-565	

DAY OF SEASON	VEHICLE NUMBER	FARMER CODE NUMBER	RECEIPT NUMBER	NET WEIGHT	BALE NUMBERS AND BALE WEIGHTS			
34	25	80	206	7100	414-525	415-475	416-465	
39	25	89	320	5660	662-575	663-585		
41	25	10	380	6700	776-490	777-480	778-490	
43	25	92	409	2430	831-520			
24	26	85	48	4650	2856-535	2857-530		
20	27	43	41	4620	2846-480	2847-535		
25	27	43	56	4220	2862-450	2863-485		
18	29	56	19	5880	41-510	42-490	43-480	
26	29	28	89	6140	118-515	119-530	120-460	
30	29	16	147	6250	254-480	255-470	256-435	
31	29	16	160	2980	289-460	292-395		
32	29	66	179	2790	338-535			
40	29	81	371	2760	759-565			
42	29	69	404	1510	823-320			
27	30	70	108	2670	167-585			
28	30	49	129	4010	212-510	213-450		
31	30	49	165	4430	303-545	304-550		
32	30	49	183	4400	347-555	348-505		
34	30	70	218	5580	445-450	446-495	447-460	
35	30	49	247	7080	512-485	513-515	514-500	
36	30	49	268	5890	561-535	562-520		
38	30	49	297	4830	610-555	611-530		
39	30	49	328	4680	670-540	671-505		
40	30	49	361	5080	742-555	743-545		
41	30	49	400	5620	813-535	814-495		
28	31	50	123	5840	195-495	196-490	216-575	
31	31	72	164	6540	300-550	301-490	302-600	
32	31	49	188	3950	360-450	361-450		
34	31	36	208	5430	420-545	421-545	422-585	
34	31	70	221	5480	452-470	453-515	509-475	
35	31	49	256	6110	529-490	530-450	531-460	
36	31	49	265	5350	553-575	554-580		
38	31	49	302	4740	619-535	620-530		
39	31	49	332	4460	678-530	679-455		
40	31	49	365	5040	748-545	749-550		
44	31	70	423	4590	859-530	860-545		
13	32	62	4	4200	4-480	5-510		
14	32	62	6	7190	10-510	11-490	12-500	13-575
18	32	12	13	7360	29-500	30-505	31-525	
19	32	74	21	8360	44-490	45-500	46-530	47-505
26	32	74	80	2730	108-500			
26	32	59	93	7100	130-500	131-535	132-455	
27	32	17	103	9110	155-530	156-500	157-455	158-440
28	32	50	136	7760	223-510	224-505	225-460	239-480
31	32	34	153	5540	271-500	272-450	273-425	
32	32	29	175	2620	329-570			
36	32	52	260	6730	541-540	542-510	543-530	
38	32	54	303	6930	621-510	622-530	623-490	
40	32	54	352	6580	724-525	725-510	726-510	
43	32	46	410	6740	833-515	834-515	835-520	

APPENDIX D-II (Continued)

DAY OF SEASON	VEHICLE NUMBER	FARMER CODE NUMBER	RECEIPT NUMBER	NET WEIGHT	BALE NUMBERS AND BALE WEIGHTS			
45	32	46	432	5700	872-525			
49	32	36	454	4390	917-540	918-505	919-555	920-465
19	33	85	27	4560	2833-525	2834-555		
25	33	75	73	3350	2882-580	2883-540		
33	33	31	201	5340	398-540	399-490	413-395	
35	33	22	241	4290	497-590	498-535		
39	33	88	326	3770	2966-505	2967-585		
41	33	82	382	4140	779-585	780-545		
45	33	98	439	5050	2808-585	2809-580		
37	34	49	274	3700	576-530	577-520		
40	34	49	348	4290	716-465	717-470		
47	34	70	451	3830	908-505	909-495	910-575	
27	35	84	118	2010	2908-475			
35	35	5	259	6600	538-560	539-565	540-555	
40	35	58	358	5950	738-580	739-535		
1	36	27	1	3530	1-530			
18	36	85	18	4130	2935-525	2936-500		
19	36	43	31	4430	2837-490	2838-460		
24	36	43	50	4200	2854-480	2855-480		
26	36	84	87	3900	2898-490	2899-515		
37	36	65	278	4320	2939-480			
40	36	49	349	4280	718-475	719-455		
44	36	95	417	3200	2995-540	2996-540		
24	37	85	46	5200	2850-490	2851-500		
27	37	73	114	5200	180-560	181-500		
41	37	76	395	5460	806-535	807-510		
28	38	50	128	6640	209-515	210-550	211-565	
33	38	45	'99	5960	391-525	392-505	393-445	
37	38	45	284	6160	588-515	461-475		
39	38	46	333	6000	680-515	681-555	682-575	
41	38	46	387	5900	787-560	788-520	789-555	
47	38	46	448	808	873-450			
41	39	68	393	4880	803-465	804-485	805-475	
18	40	13	17	4610	39-560	40-580		
19	40	82	28	8680	54-520	55-545	56-545	57-570
24	40	12	49	2810	79-515			
25	40	19	69	8040	92-475	93-470	94-480	
26	40	59	91	7660	123-500	124-500	125-500	126-485
27	40	17	110	8900	170-490	171-470	172-445	173-480
31	40	45	156	7000	279-525	280-550	281-515	276-475
32	40	45	180	6490	339-530	340-565	341-545	
38	40	45	296	7840	607-460	608-480	609-495	
40	40	46	362	7140	744-520	745-555	746-530	
43	40	46	411	6000	836-485	837-485	838-525	
45	40	46	438	6760	879-500	880-555	881-620	
24	41	43	47	4870	2852-520	2853-505		
25	41	35	61	1030				
27	41	64	96	4870	140-550	141-555		
34	41	37	228	6300	2916-510	2917-515	2918-525	
35	41	49	248	5820	515-520	516-505	517-530	

DAY OF SEASON	VEHICLE NUMBER	FARMER CODE NUMBER	RECEIPT NUMBER	NET WEIGHT	BALE NUMBERS AND BALE WEIGHTS				
37	41	49	275	4480	578-535	579-555			
40	41	49	376	4600	768-520	769-515			
39	42	42	346	6420	709-470	710-435	711-475		
23	43	43	43	4180	2849-470				
25	43	85	60	4350	2868-525	2869-555			
26	43	75	81	4150	2892-490	2893-480			
37	43	65	279	1280	2940-545				
38	43	38	307	4460	628-560	629-580			
40	43	82	357	3610	736-565	737-555			
44	43	82	415	2490	844-540				
45	43	99	437	1610	886-350				
25	44	75	62	4450	2870-555	2871-525			
27	44	84	106	4800	2904-535	2905-510			
34	44	8	222	1000	2915-570				
37	44	55	280	4500	584-530	585-545			
39	44	82	344	4780	704-575	705-600			
41	44	43	398	4910	2991-520	2992-560			
18	45	12	14	5810	32-490	33-440			
19	45	82	32	8810	60-560	61-570	62-545	63-575	
31	45	45	151	7030	265-495	266-475	267-465		
32	45	45	189	7300	362-510	363-460	364-445	365-465	
34	45	45	210	8490	425-450	426-440	427-475		
39	45	45	323	7510	665-485	666-495	667-480		
40	45	46	370	6460	756-550	757-550	758-505		
42	45	46	406	6160	824-550	825-500	826-430		
45	45	46	428	6660	866-535	867-525	868-540		
47	45	46	447	6320	899-590	900-535	901-575		
28	47	73	139	6400	231-480	232-520	233-550		
32	47	31	187	5600	357-545	358-550	359-575		
35	47	41	240	4810	494-560	495-530			
37	47	5	273	6000	573-540	574-585	575-535		
39	47	54	331	5300	676-530	677-545			
42	47	10	407	5870	827-485	723-500			
25	48	85	63	4350	2872-510	2873-480			
26	48	75	88	4200	2894-540	2895-510			
28	48	75	135	2760	2911-465				
34	48	8	215	4010	2912-595	2913-485			
35	48	22	257	5150	532-540	533-585			
40	48	43	369	4280	2981-580	2982-556			
27	49	75	104	4430	2902-525	2903-505			
32	49	24	169	5770	312-500	313-485	314-530		
37	49	71	282	5710	2942-465	2943-475	2944-475		
40	49	43	356	5230	2974-610	2975-570			
45	49	20	429	2970	2802-455	2803-415			
26	50	36	75	7990	99-505	100-485	101-480	102-440	
31	50	36	166	6440	305-505	306-510	307-510		
33	50	36	198	6510	367-525	388-495	389-455	390-470	
35	50	36	233	7750	475-540	476-530	477-465	478-495	479-505
39	50	42	319	8320	658-485	659-460	660-465	661-475	
40	50	42	374	5800	764-465	765-435	766-500		

APPENDIX D-II (Continued)

DAY OF SEASON	VEHICLE NUMBER	FARMER CODE NUMBER	RECEIPT NUMBER	NET WEIGHT	BALE NUMBERS AND BALE WEIGHTS				
47	50	36	449	7330	902-515	903-490	904-495	905-500	
29	51	39	142	4200	240-480	241-405			
32	51	80	186	7040	354-505	355-455	356-525		
34	51	3	217	6010	442-510	443-450	444-450		
36	51	49	261	5360	544-560	501-510			
40	51	43	359	5780	2976-445	2977-480	2978-475		
44	51	95	421	5650	2999-550	3000-550			
51	51	2	456	6100	921-485	922-530	923-550		
27	52	24	115	4920	182-560	183-490			
35	52	49	242	5670	499-480	500-570			
38	52	48	293	4500	600-505	601-550			
41	52	68	392	4470	801-475	802-480			
49	52	2	455	5330	924-515	925-475			
25	53	75	70	4830	2880-530	2881-520			
27	53	22	117	3190	2906-565	2907-520			
32	53	31	181	4980	342-555	343-565			
34	53	49	212	2940	432-575				
35	53	37	253	4870	2921-500	2922-580	2923-550		
38	53	43	312	4030	2962-445	2963-565			
40	53	23	364	4240	2979-530	2980-500			
26	54	84	83	3680	2896-510	2897-440			
35	54	22	244	4550	504-575	505-545			
41	54	43	381	4900	2985-545	2986-545			
18	55	12	16	5890	35-520	36-450	37-460	38-490	
20	55	74	40	4020	69-555				
23	55	74	44	8320	73-470	74-460	75-555		
24	55	50	52	3040	80-545				
25	55	19	74	3800	97-490	98-450			
26	55	59	84	8560	109-485	110-535	111-480	112-545	
27	55	59	98	2290	143-555				
27	55	17	105	8100	159-460	160-440	161-470	162-500	
30	55	74	148	6970	257-430	258-460	259-525		
31	55	1	154	4940	274-560	275-555			
33	55	60	196	8830	381-540	382-490	383-460	384-465	397-390
34	55	52	219	7690	448-545	449-535	450-465	451-475	
38	55	54	305	8320	624-495	625-490	626-485	627-490	
39	55	54	338	8250	692-480	693-495	694-580	695-555	
40	55	58	366	7540	750-540	751-540	752-558	753-568	
42	55	91	408	6130	828-470	829-525	830-485		
31	56	45	162	7220	293-480	294-490	295-480	296-440	
33	56	45	203	7600	404-455	405-490	406-495		
35	56	45	255	4700	527-435	528-565			
38	56	45	294	6930	602-500	603-500			
40	56	46	355	6940	733-560	734-545	735-550		
41	56	46	397	6320	809-535	810-545	811-500		
44	56	46	422	6540	856-560	857-515	858-515		
46	56	46	444	6870	892-540	893-545	894-520		
33	57	78	204	6030	407-505	408-500			
42	57	46	403	5000	821-515	822-540			
38	58	68	308	6470	630-490	631-565	632-555		

DAY OF SEASON	VEHICLE NUMBER	FARMER CODE NUMBER	RECEIPT NUMBER	NET WEIGHT	BALE NUMBERS AND BALE WEIGHTS				
44	58	2	416	5140	845-470	846-570			
51	58	2	457	5210	926-485	927-450	933-550		
28	61	4	134	6600	220-565	221-570	222-560		
32	61	4	178	5640	335-480	336-450	337-490		
33	61	4	202	7880	400-555	401-510	402-525	403-560	
34	61	4	225	6670	457-550	458-565	459-580		
35	61	4	252	5300	523-550	524-525			
14	64	62	7	10150	14-510	15-500	16-565	17-500	18-525
35	64	52	237	7120	488-565	489-570	490-530		
39	64	54	318	8780	654-540	655-565	656-540	657-575	
40	64	54	353	5930	727-490	728-455	597-465		
41	64	61	399	2210	812-565				
13	65	62	5	9290	6-500	7-500	8-540	9-500	
32	65	52	192	6630	370-470	371-490	372-580		
38	65	54	298	7860	612-480	613-480	614-425	615-530	
38	65	54	313	8410	642-570	643-530	644-515	645-520	
40	65	54	354	8090	729-490	730-470	731-475	732-485	
41	65	61	396	2250	808-600				
28	66	45	122	7070	192-545	193-535	194-540		
32	66	45	173	6270	323-515	324-535	325-540		
34	66	45	226	7500	460-540	428-460			
37	66	45	289	7200	592-460	593-435	594-565		
38	66	45	311	8260	639-465	640-465	641-495		
39	66	46	340	6200	696-565	697-565	698-560		
41	66	46	384	6310	783-545	784-500	785-540		
45	66	46	430	5330	869-520	870-540	871-525		
46	66	46	445	7440	895-550	896-555	897-510		
27	67	3	112	6460	174-520	175-510	176-520		
33	67	3	197	6600	385-530	386-540	387-585		
38	67	3	309	7030	633-560	634-550	635-560		
40	67	47	360	3960	740-440	741-345			
42	67	11	402	6920	818-580	819-530	820-575		
28	68	3	124	6800	197-535	198-520	199-540		
31	68	3	163	6100	297-470	298-500	299-525		
34	68	3	207	6060	417-475	418-515	419-505		
39	68	47	345	6300	706-500	707-500	708-430		
41	68	3	390	6660	795-600	796-580	797-570		
16	70	63	9	4610	20-575	21-620			
17	70	32	12	3440	27-455	28-455			
17	71	7	11	3960	25-560	26-490			
25	71	15	66	3980	85-575	86-600			
26	71	28	94	7760	133-485	134-480	135-460	136-475	
28	71	28	131	1450	217-470				
31	71	16	157	6670	282-475	283-470	284-465		
32	71	103	190	3600	366-595				
34	71	44	227	6800	462-470	463-495	464-540		
38	71	26	315	5290	648-485	649-480			
40	71	81	363	2740	747-545				
41	71	76	401	4880	815-480	816-425	567-520		
38	73	16	299	4520	616-565				

APPENDIX D-II (Continued)

DAY OF SEASON	VEHICLE NUMBER	FARMER CODE NUMBER	RECEIPT NUMBER	NET WEIGHT	BALE NUMBERS AND BALE WEIGHTS			
18	74	86	15	2540	34-500			
19	74	77	33	6360	64-550	65-560	66-595	
26	74	28	85	6860	113-535	114-540	115-535	
28	74	28	125	6890	200-480	201-455	202-460	
32	74	66	171	6460	319-440	320-460	321-515	
36	74	44	267	6720	558-470	559-465	560-480	
39	74	26	329	4460	672-355	673-425		
40	74	83	378	5460	773-480	774-515		
19	75	15	38	3042	72-540			
27	75	28	101	6280	149-440	150-495	151-505	
28	75	16	138	6460	228-475	229-520	230-445	
32	75	66	176	5010	330-435	331-470		
34	75	44	214	6200	435-530	436-565		
39	75	21	342	3120	701-605			
41	75	83	385	2810	786-485	817-380		
27	76	4	109	5800	166-410	168-570	169-475	
31	76	4	152	6500	268-555	269-540	270-530	
33	76	4	205	7900	409-530	410-500	411-545	412-555
35	76	4	250	6100	518-600	519-515	520-505	
27	77	22	111	4710	2900-480	2901-480		
32	77	31	174	6390	326-550	327-535	528-555	
34	77	31	213	4670	433-565	434-510		
38	77	22	295	7770	604-535	605-465	606-515	
39	77	43	327	5470	2968-510	2969-565		
41	77	30	391	5630	798-485	799-455	800-385	
46	77	22	442	8900	887-490	888-445	889-485	
37	78	25	276	6160	2924-530	2925-480	2938-410	
38	79	79	317	5100	652-530	653-525		
45	80	98	433	4000	2806-490	2807-475		
26	89	5	92	6200	127-530	128-515	129-505	
29	89	5	144	7010	244-530	245-505	246-510	247-495
32	89	5	184	6600	349-505	350-475	351-475	373-580
34	89	5	216	7700	438-540	439-475	440-520	441-460
35	89	5	245	7330	506-530	507-550	508-530	
37	89	5	277	8250	580-565	581-535	582-480	583-560
27	90	5	113	6010	177-480	178-465	179-525	
29	90	5	143	5680	242-495	243-555		
33	90	5	195	5740	379-570	380-560		
35	90	5	232	5850	473-520	474-475	496-450	
36	90	5	263	6070	549-560	550-550		
37	90	5	287	6760	589-565	590-550	591-520	
28	91	5	126	6050	203-475	204-545	205-500	
31	91	5	150	6070	263-560	264-555		
34	91	5	211	6440	429-540	430-570	431-505	
35	91	5	239	6100	491-540	492-525	493-460	
36	91	5	269	5520	563-565	564-560		
28	92	5	130	5520	214-480	215-500	238-505	
31	92	5	149	5380	260-485	261-535	262-550	
33	92	5	193	5880	374-525	375-505	376-460	
34	92	5	229	5850	465-500	466-525	467-455	
36	92	5	262	5570	546-555	547-550	548-555	
25	97	67	58	1800	83-440			
32	97	67	172	1900	322-465			
51	97	101	459	2000	932-525			
25	98	6	57	1090				
19	99	33	22	1920	48-465			

APPENDIX D-III

Sequential Interarrival Times (Minutes)

0.4	2.7	2.1	3.0	6.1	7.1	4.7	10.3	1.9	2.3
24.9	10.8	5.7	8.7	1.9	12.0	0.5	2.8	0.1	1.3
10.2	7.7	9.1	3.1	3.1	3.8	0.5	11.7	11.0	4.8
9.3	9.5	9.1	3.9	2.1	3.8	3.5	1.7	2.4	1.5
20.1	8.3	1.0	0.1	0.8	1.4	2.9	3.9	3.0	1.3
18.3	1.7	1.3	4.3	1.1	3.0	1.8	1.4	3.6	0.7
13.1	0.1	2.3	3.9	3.6	0.8	0.2	2.2	2.8	0.9
26.2	1.3	0.1	1.7	5.7	2.7	1.2	0.1	2.8	5.3
24.4	3.3	1.4	15.6	10.4	1.6	2.5	2.7	1.2	1.8
10.2	9.4	8.5	0.3	7.0	2.7	1.8	3.2	3.0	0.8
4.9	8.0	4.3	2.2	7.6	1.3	3.5	2.9	4.3	6.8
18.1	4.5	11.3	7.4	2.2	2.5	2.8	1.8	0.3	1.7
20.8	7.9	0.2	0.5	0.1	0.8	0.9	7.1	6.0	5.3
4.2	0.4	3.6	0.9	0.8	12.3	5.1	3.3	5.8	12.7
7.1	4.8	3.4	1.9	4.7	5.9	3.9	3.9	13.9	

Statistical Attributes

Number of Observations = 149
Range = 26.083
Mean Interarrival Time = 4.936
Variance = 26.359
Standard Deviation = 5.134

APPENDIX D-III (Continued)

Independence Analysis

Length Of Run	Number Of Runs Upward	Number Of Runs Down	Total Number Of Runs	Expected Number Of Runs	Probability Of One Or More
1	37	34	71	62.17	1.00
2	9	12	21	27.08	1.00
3	3	5	8	7.73	1.00
≥ 4	2	0	2	2.02	0.88
TOTAL	51	51	102	99.0	

Variance of the Total Number of Runs 26.167
Standard Deviation of the Total Number of Runs = 5.115

APPENDIX D-IV

TEST OF THE ARRIVAL DISTRIBUTION FOR GOODNESS OF FIT TO THE POISSON DISTRIBUTION, WEATHERFORD, JUNE 6, 1970

End Point Of Interval (Minutes)	Observed Frequency	Probability Cumulative	Expected Frequency
2.57	59	0.406	60.43
5.13	43	0.647	35.92
7.70	16	0.790	21.35
10.27	13	0.875	12.69
12.84	8	0.926	7.54
15.40	2	0.956	4.49
17.97	1	0.974	2.67
20.54	3	0.984	1.59
23.10	1	0.991	0.94
25.67	2	0.994	0.56
28.24	1	0.997	0.33
>	0	0.003	0.49

No. In Group	Observed Frequency	Expected Frequency	Chi Value
1.	59.00	60.43	0.034
1.	43.00	35.92	1.395
1.	16.00	21.35	1.342
1.	13.00	12.69	0.007
1.	8.00	7.55	0.027
7.	10.00	11.06	0.102
		CHI-SQUARED =	2.908

VITA

Richard W. Whitney

Candidate for the Degree of

Doctor of Philosophy

Thesis: FIELD TO PROCESS QUEUES

Major Field: Agricultural Engineering

Biographical:

Personal Data: Born in Miami County, Kansas, November 1, 1938, the son of Wilbur and Helen Whitney.

Education: Graduated from Kansas State University in 1961 with Bachelor of Science Degree in Agricultural Engineering; received Master of Science in Agricultural Engineering from Oklahoma State University in 1967; completed the requirements for the Doctor of Philosophy degree at Oklahoma State University in May, 1972.

Professional Experience: During undergraduate program worked one semester for the United States Department of Agriculture. After graduation, employed as Temporary Instructor in the Agricultural Engineering Department at Kansas State University, 1961-1962; Instructor at Oklahoma State University in the Agricultural Engineering Department, 1962-1969.

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