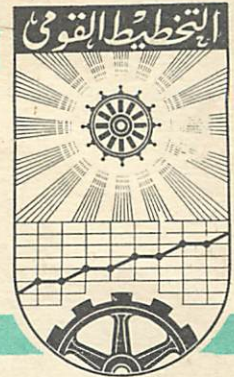


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A MULTI-CHANNEL QUEUING MODEL
A SIMULATION APPROACH

by

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THE PROBLEM:

Consider a manufacturing facility for the production of a product consisting of three components. The system has the following configurations:

- (1) The components are produced in three separate processes, each of which is characterized by stochastic process times.
- (2) The time interval between the arrival of orders at the manufacturing facility is a random variable.

The mechanism of this system is characterized by:

- (1) Orders arrive at the facility at random, according to a certain distribution.
- (2) When an order arrives at the production facility, process times are generated, according to a certain distribution, for each of the three processes.
- (3) When all three components are completed for a particular order, the product is assembled from the three components. The production facility becomes free to receive another order.
- (4) A new order cannot be accepted until all three components of the previous order are completed and all three processes are vacant. Otherwise, new orders are placed in a waiting line until the production facility is vacated.

ASSUMPTIONS:

- (1) The inter-arrival times follow an exponential distribution.
- (2) The production times at the production facilities follow exponential distributions (with different parameters).

PROCEDURE:

(1) Set Initial Conditions:

- Total Idle times for production facilities (when the system is not vacant) equal zero, "STINA(J)"
- Total Idle times for production facilities (when the system is vacant) equal zero, "TDT"
- Total waiting time, till the order enters the system, equals zero, "STW"
- Total time for the system equals zero, "TST"
- Total arrival time, when the order enters the system, = 0 "STA"

(2) Read:

- Number of orders proposed for the simulation run "N"
- Parameter for the inter-arrival time distribution " λ "
- Parameters for the production times distribution " $\mu(J)$ "

(3) Set the arrival time of the first order as zero time

(4) For each of the orders, the following steps are to be considered

(5) Set the following variables to be equal to zero:

- Production times on the three production facilities "TS(J)"
- Idle times of the three production facilities "TINA(J)"
- Max production time on the three facilities, for the components of the order "TSM"
- Waiting time of the order "TW"
- Idle time for production facilities (when the system is vacant) "DT"

(6) Generate production times, for the order's three components, on the three production facilities "TS(J)"

- (7) Final the max. of those three production times " TSM "
- (8) Calculate the total time for the system " TST "
- (9) Check if we are dealing with the last order (i.e. order number N) or not:
 - . If yes, proceed immediately to (21)
 - . If no, carry on ordinarily.
- (10) Find, for each of the production facilities, the following items:
 - Idle time (system is not vacant); by subtracting production time on this facility from the largest production time on the three facilities "TINA(J)"
 - Cumulative Idle time (system is busy, i.e. not vacant)
- (11) Now, the information needed for this order are complete, they are punched
- (12) Proceed to the next order
- (13) Generate the arrival time, according to the inter-arrival distribution and the proposed parameter " TA "
- (14) Calculate total arrival time " STA "
- (15) Calculate the difference between the total arrival time and the total system time " D "
- (16) Examine this difference:
 - . If negative: the order has to queue up till the order before it is through
 - . If positive: the order is admitted to the system as soon as it arrives
- (17) Calculate the idle time during which the system remained vacant, if any
- (18) Calculate the waiting time for the order, if any

(19) Calculate the necessary statistics:

- Total Idle Times " TDT "
- Total Waiting Time " STW "
- Total Time For The System " TST "

(20) Repeat the same steps again, i.e. go to (5)

(21) If we are dealing with order number N:

- Get the cumulative idle times for the three facilities
" STINA(J) "

(22) Punch results concerning order N

(23) Punch results concerning accumulated statistics

The same procedure is translated into FLOW-CHART as shown in the next page

PROGRAMMING FOR THE IBM-1620:

THE FLOW-CHART, as previously analysed, was translated into FORTRAN II coded program. For convinieny and simplicity, in order that the reader should not lose track of the original problem of the job shop, I have decided to generate inter-arrival times and production times using a separate program. Then these values are injected into the main model, which is another program. The latter program is coded according to the flow-chart with slight modifications:

Block (6) : READ TS(J) insted of GENERATE TS(J)

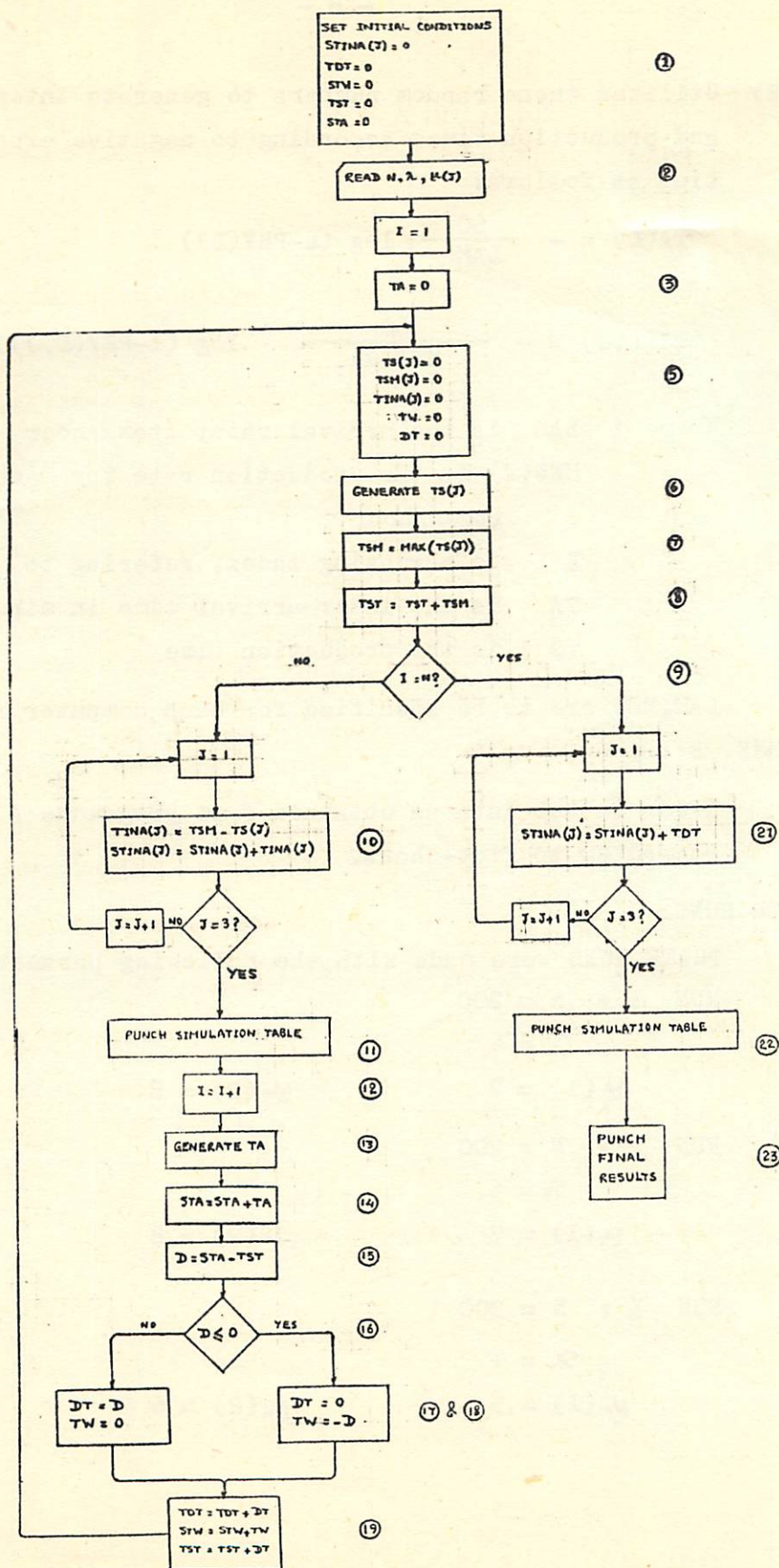
Block (13) : READ TA insted of GENERATE TA

Therefore, the programmes functions are as follows:

PROGRAMME A :

(1) Reads in a group of random numbers(as factions) PHY(I), PSY(I,J)

... ..
... ..
... ..



- (2) Utilizes those random numbers to generate inter-arrival times and production times according to negative exponential distribution as follows:

$$TA(I) = - \frac{60}{LAM} \log (1-PHY(I))$$

$$TS(I,J) = - \frac{60}{MEW(J)} \log (1-PSY(I,J))$$

Where : LAM is the arrival rate; items/hour
 MEW(J) is the production rate for each facility J;
 items/hour
 I is a running index, referring to arriving orders
 TA is the inter-arrival time in minutes
 TS is the production time

LAM, MEW are to be specified for each computer run

PROGRAMME B:

Reads in the data as obtained from programme A and proceeds according to flow-chart.

COMPUTER RUNS:

THREE RUNS were made with the following parameters:

RUN 1 : N = 200

$$\lambda = 4$$

$$\mu(1) = 7$$

$$\mu(2) = 8$$

$$\mu(3) = 9$$

RUN 2 : N = 200

$$\lambda = 6$$

$$\mu(1) = 7$$

$$\mu(2) = 8$$

$$\mu(3) = 9$$

RUN 3 : N = 200 :

$$\lambda = 4$$

$$\mu(1) = 5$$

$$\mu(2) = 6$$

$$\mu(3) = 10$$

ANALYSIS OF OBTAINED RESULTS:

A printout of the obtained results, together with the programmes, is shown in the Appendix. Examining those results, we notice that:

- Changing the arrival rate, while maintaining the same service rates, does not affect:

- Total System Time
- Time Of Vacancy
- Percent of Inactive Time
- Percent of Idleness

But affects:

- Total Waiting Time (Increases as the arrival rate increases)
- Average Waiting Time

- Changing the service rate, while maintaining the same arrival rates, affects:

- Total System Time
- Time of Vacancy
- Percent Of Inactive Time
- Percent Of Idleness
- Total Waiting Time

APPENDIX

*0605

```
DIMENSION PHY(200),PSY(600),PHYL(200),PSYL(200,3)
DIMENSION TA(200),TS(200,3),MEW(3),AM(3)
5 READ 1,N,K,M
1 FORMAT(3I3)
  READ2,(PHY(I),I=1,N)
  READ2,(PSY(I),I=1,K)
2 FORMAT(10X,10(3X,I4))
  DC 10 I=2,N
10 PHY(I)=PHY(I)*.C001
  DC15 I=1,K
15 PSY(I)=PSY(I)*.CC01
  DC 20 I=2,N
20 PHYL(I)=-LCGF(1.-PHY(I))
  L=1
  DC 25 I=1,N
  DC 25J=1,M
  PSYL(I,J)=-LCGF(1.-PSY(L))
25 L=L+1
  READ3,LAM
  READ3,(MEW(J),J=1,3)
3 FORMAT(5X,5I4)
  AL=LAM
  TA(1)=0
  DC30 I=2,N
30 TA(I) =(PHYL(I)/AL)*60.
  DC 35 I=1,N
  DC 35 J=1,M
  AM(J)=MEW(J)
35 TS(I,J)=(PSYL(I,J)/AM(J))*60.
  DC 45 I=1,N
40 PUNCH4,I , TA(I)
45 PUNCH4, I,(TS(I,J),J=1,M)
4 FORMAT (10X,I5,5X,3(5X,F8.3),7X)
GC TC 5
END
```

```

DIMENSION TS(5),TINA(5),STINA(5),PCINT(5)
READ1,N,M
TDT=0
STW=0
TST=0
STA=0
TW=0
DT=0
DC5J=1,M
5 STINA(J)=0
1 FORMAT(5I3)
I=1
READ2,TA
10 DC15J=1,M
TS(J)=0
15 TINA(J)=0
READ2,(TS(J),J=1,M)
2 FORMAT(20X,3(5X,F8.3))
TSM=TS(1)
DC 25J=2,M
IF(TSM-TS(J))20,20,25
20 TSM=TS(J)
25 CONTINUE
TST=TST+TSM
IF(I-N)30,55,55
30 DC35J=1,M
TINA(J)=TSM-TS(J)
35 STINA(J)=STINA(J)+TINA(J)
PUNCH3,I,STA,(TS(J),J=1,M),TSM,(TINA(J),J=1,M),TW,DT
TSM=0
TW=0
DT=0
I=I+1
READ2,TA
STA=STA+TA
C=STA-TST
IF(D)40,40,45
40 DT=0
TW=-D
GCTC50
45 DT=D
TW=0
50 TDT=TDT+DT
STW=STW+TW
TST=TST+DT
GOTO10
55 DC60 J=1,M
60 STINA(J)=STINA(J)+TDT
PUNCH3,I,STA,(TS(J),J=1,M),TSM,(TINA(J),J=1,M),TW,DT
PUNCH6,STA,(STINA(J),J=1,M),STW,TDT
6 FORMAT(10X,F7.2,28X,5F7.2)
3 FORMAT(2X,I3,5X,10F7.2)
DC 70 J=1,M
70 PCINT(J)=(STINA(J)/TST)*100.
AN=N
AVTW=STW/AN
PCIDT=TDT/TST
PUNCH4,TST
PUNCH4,STW
PUNCH4,TDT

```

```

PUNCH4,(PCINT(J),J=1,M)
PUNCH4,AVTH
PUNCH4,PCIDT
4 FCRMAT(20X,3(F8.3,3X))
END

```

CASE NUMBER 1

LAM =4 ITEMS/HOUR
MEW(1) =7 ITEMS/HOUR
MEW(2) =8 ITEMS/HOUR
MEW(3) =9 ITEMS/HOUR

SIMULATION TABLE

ORDER NUMBER	CUMULAT ARRIVAL TIME	PRODUCTION TIMES				IDLE TIMES			WAITING VACANCY	
		TS(1)	TS(2)	TS(3)	TSM	TINA(1)	TINA(2)	TINA(3)	TIME	TIME
1	0.00	.99	1.60	16.48	16.48	15.49	14.88	0.00	0.00	0.00
2	10.98	7.77	20.67	2.25	20.67	12.90	0.00	18.41	5.50	0.00
3	23.94	13.06	1.76	17.19	17.19	4.13	15.42	0.00	13.21	0.00
4	32.31	13.02	6.50	.01	13.02	0.00	6.52	13.01	22.04	0.00
5	35.92	.01	.01	.01	.01	0.00	0.00	0.00	31.46	0.00
6	44.25	.02	.01	.01	.02	0.00	0.00	.01	23.15	0.00
7	55.64	.02	0.00	5.94	5.94	5.92	5.93	0.00	11.78	0.00
8	63.42	0.00	0.00	.01	.01	0.00	0.00	0.00	9.95	0.00
9	63.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.63	0.00
10	63.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.48	0.00
11	71.07	7.85	.01	0.00	7.85	0.00	7.83	7.84	2.32	0.00
12	71.09	.01	0.00	.01	.01	0.00	0.00	0.00	10.15	0.00
13	71.11	.02	.01	.01	.02	0.00	0.00	.01	10.15	0.00
14	71.15	.01	7.06	0.00	7.06	7.04	0.00	7.05	10.13	0.00
15	71.19	.01	.01	.01	.01	0.00	0.00	0.00	17.15	0.00
16	71.22	0.00	0.00	.01	.01	0.00	.01	0.00	17.13	0.00
17	71.25	.01	.01	6.45	6.45	6.43	6.43	0.00	17.12	0.00
18	71.27	.01	.02	.02	.02	0.00	0.00	0.00	23.54	0.00
19	71.31	.01	.01	.01	.01	0.00	0.00	0.00	23.52	0.00
20	71.34	.02	.02	.02	.02	0.00	0.00	0.00	23.51	0.00
21	78.76	8.52	.01	0.00	8.52	0.00	8.50	8.51	16.12	0.00
22	78.78	.01	.01	0.00	.01	0.00	0.00	0.00	24.62	0.00
23	78.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.59	0.00
24	78.84	0.00	7.66	0.00	7.66	7.65	0.00	7.65	24.58	0.00
25	78.87	.01	.01	.01	.01	0.00	0.00	0.00	32.21	0.00
26	78.90	.02	.02	0.00	.02	0.00	0.00	.01	32.19	0.00
27	78.91	.01	.01	6.99	6.99	6.98	6.98	0.00	32.20	0.00
28	78.93	.01	.01	.01	.01	0.00	0.00	0.00	39.18	0.00
29	78.96	.01	.01	.01	.01	0.00	0.00	0.00	39.16	0.00
30	78.99	.01	.01	0.00	.01	0.00	0.00	.01	39.15	0.00
31	86.65	9.24	0.00	.01	9.24	0.00	9.24	9.23	31.51	0.00
32	86.68	.01	.01	.01	.01	0.00	0.00	0.00	40.73	0.00
33	86.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.71	0.00
34	86.75	.01	8.31	.01	8.31	8.29	0.00	8.30	40.67	0.00
35	86.78	.01	0.00	0.00	.01	0.00	0.00	0.00	48.97	0.00
36	86.80	.01	.02	0.00	.02	0.00	0.00	.01	48.96	0.00
37	86.81	.01	.01	7.59	7.59	7.58	7.57	0.00	48.97	0.00
38	86.84	.01	.01	.01	.01	0.00	0.00	0.00	56.53	0.00
39	86.86	.01	0.00	.01	.01	0.00	0.00	0.00	56.52	0.00
40	86.88	.01	.01	.01	.01	0.00	0.00	0.00	56.52	0.00
41	94.79	10.03	.01	0.00	10.03	0.00	10.02	10.03	48.62	0.00
42	94.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	58.64	0.00
43	94.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	58.64	0.00
44	94.85	0.00	9.02	0.00	9.02	9.02	0.00	9.02	58.62	0.00
45	94.87	.01	0.00	0.00	.01	0.00	0.00	0.00	67.63	0.00
46	94.90	0.00	.01	.01	.01	.01	0.00	0.00	67.61	0.00
47	94.93	.01	.01	8.25	8.25	8.24	8.24	0.00	67.60	0.00

48	94.95	.01	.01	.01	.01	0.00	0.00	C.CC	75.83	0.00
49	94.96	.01	.01	.01	.01	0.00	0.00	C.CC	75.83	0.00
50	94.98	.01	0.00	0.00	.01	0.00	.01	C.CC	75.83	0.00
51	103.15	10.91	.01	.01	10.91	0.00	10.90	10.90	67.68	0.00
52	103.18	.02	0.00	.01	.02	0.00	.01	0.00	78.55	0.00
53	103.21	C.CC	0.00	.01	.01	0.00	0.00	C.CC	78.54	0.00
54	103.24	C.CC	9.81	0.00	9.81	9.81	0.00	9.81	78.53	0.00
55	103.28	C.CC	0.00	0.00	0.00	0.00	0.00	C.CC	88.31	0.00
56	103.31	.01	.02	.01	.02	0.00	0.00	C.CC	88.29	0.00
57	103.34	.02	.01	8.98	8.98	8.95	8.96	C.CC	88.29	0.00
58	103.37	.01	.01	0.00	.01	0.00	0.00	C.CC	97.23	0.00
59	103.40	.01	.01	.01	.01	0.00	0.00	C.CC	97.21	0.00
60	103.44	.01	.01	.01	.01	0.00	0.00	C.CC	97.19	0.00
61	111.87	11.88	.02	0.00	11.88	0.00	11.86	11.87	88.78	C.CC
62	111.89	0.00	.01	.01	.01	.01	0.00	C.CC	100.64	C.CC
63	111.91	.01	.01	0.00	.01	0.00	0.00	.01	100.64	C.CC
64	111.92	.01	10.70	.01	10.70	10.69	0.00	10.69	100.65	0.00
65	111.93	0.00	0.00	.01	.01	0.00	0.00	C.CC	111.34	C.CC
66	111.97	C.CC	.01	.01	.01	C.CC	0.00	C.CC	111.32	0.00
67	111.98	.01	.01	9.79	9.79	9.78	9.78	C.CC	111.32	0.00
68	112.00	.01	.01	0.00	.01	0.00	0.00	C.CC	121.10	0.00
69	112.02	.01	.01	.01	.01	0.00	0.00	C.CC	121.09	0.00
70	112.06	.01	.01	.01	.01	0.00	0.00	C.CC	121.07	0.00
71	120.75	12.97	.01	.01	12.97	0.00	12.96	12.96	112.40	0.00
72	120.77	C.CC	0.00	0.00	0.00	0.00	0.00	C.CC	125.35	0.00
73	120.81	.01	.01	.01	.01	0.00	0.00	C.CC	125.32	0.00
74	120.84	.01	11.70	0.00	11.70	11.68	0.00	11.69	125.31	0.00
75	120.86	.01	.01	.01	.01	0.00	0.00	C.CC	136.99	0.00
76	120.88	.02	0.00	0.00	.02	0.00	.01	.01	136.99	0.00
77	120.89	C.CC	0.00	10.72	10.72	10.72	10.72	0.00	136.99	0.00
78	120.93	.01	.01	.01	.01	0.00	0.00	C.CC	147.68	0.00
79	120.96	C.CC	.01	0.00	.01	0.00	0.00	C.CC	147.67	0.00
80	120.98	C.CC	.01	.01	.01	0.00	0.00	C.CC	147.66	0.00
82	129.95	.01	0.00	.01	.01	0.00	.01	0.00	152.94	0.00
83	129.98	.01	.01	.01	.01	0.00	0.00	C.CC	152.93	0.00
81	129.95	14.23	.01	.01	14.23	0.00	14.21	14.21	138.71	0.00
84	130.02	.01	12.86	.01	12.86	12.84	0.00	12.85	152.91	0.00
85	130.05	C.CC	0.00	.01	.01	0.00	.01	C.CC	165.74	0.00
86	130.08	C.CC	.01	.01	.01	.01	0.00	C.CC	165.72	0.00
87	130.10	.02	.01	11.81	11.81	11.78	11.79	C.CC	165.72	0.00
88	130.12	.01	0.00	.01	.01	0.00	.01	C.CC	177.50	0.00
89	130.14	.01	.01	0.00	.01	0.00	0.00	.01	177.51	C.CC
90	130.17	.01	.02	.01	.02	0.00	0.00	C.CC	177.50	0.00
91	139.41	15.70	0.00	0.00	15.70	0.00	15.70	15.69	168.28	0.00
92	139.44	.01	.01	0.00	.01	0.00	0.00	C.CC	183.95	0.00
93	139.48	.01	.01	.01	.01	0.00	0.00	C.CC	183.92	0.00
94	139.51	.02	14.22	.01	14.22	14.20	0.00	14.21	183.91	0.00
95	139.54	C.CC	.01	0.00	.01	0.00	0.00	C.CC	198.11	0.00
96	139.56	.01	.01	.01	.01	0.00	0.00	C.CC	198.09	0.00
97	139.59	.01	.01	13.10	13.10	13.09	13.08	C.CC	198.09	C.CC
98	139.61	C.CC	.01	.01	.01	0.00	0.00	C.CC	211.17	0.00
99	139.64	.01	0.00	.01	.01	0.00	0.00	C.CC	211.16	0.00
100	139.66	.02	.02	.01	.02	0.00	0.00	C.CC	211.15	0.00
101	149.18	17.48	.01	.01	17.48	0.00	17.47	17.47	201.65	C.CC
102	149.20	.01	.01	.01	.01	0.00	0.00	C.CC	219.13	0.00
103	149.20	.01	.01	.01	.01	0.00	0.00	C.CC	219.14	0.00
104	149.22	.02	15.90	0.00	15.90	15.88	0.00	15.89	219.13	0.00
105	149.24	.01	0.00	0.00	.01	0.00	.01	.01	235.02	C.CC
106	149.27	.01	.01	.01	.01	0.00	0.00	C.CC	235.00	C.CC
107	149.29	.01	.01	14.71	14.71	14.70	14.70	C.CC	235.00	0.00

108	149.32	.01	.01	.01	.01	0.00	0.00	0.00	249.69	0.00
109	149.35	.01	.01	0.00	.01	0.00	0.00	0.00	249.67	0.00
110	149.36	.01	0.00	0.00	.01	0.00	0.00	0.00	249.68	0.00
111	159.17	19.73	0.00	0.00	19.73	0.00	19.72	19.72	239.88	0.00
112	159.18	.01	.01	.01	.01	0.00	0.00	0.00	259.61	0.00
113	159.19	.01	.01	.01	.01	0.00	0.00	0.00	259.61	0.00
114	159.21	0.00	18.05	.01	18.05	18.05	0.00	18.04	259.60	0.00
115	159.22	.02	.01	.01	.02	0.00	0.00	0.00	277.65	0.00
116	159.25	.02	0.00	0.00	.02	0.00	.01	.01	277.64	0.00
117	159.29	0.00	0.00	16.83	16.83	16.83	16.83	0.00	277.63	0.00
118	159.31	0.00	.01	.01	.01	0.00	0.00	0.00	294.45	0.00
119	159.32	0.00	.01	.01	.01	.01	0.00	0.00	294.45	0.00
120	159.34	.01	.01	.01	.01	0.00	0.00	0.00	294.44	0.00
121	169.44	22.79	.01	.01	22.79	0.00	22.77	22.78	284.36	0.00
122	169.48	.01	0.00	0.00	.01	0.00	0.00	.01	307.11	0.00
123	169.52	.01	.01	.01	.01	0.00	0.00	0.00	307.08	0.00
124	169.54	.01	21.10	.01	21.10	21.08	0.00	21.08	307.08	0.00
125	169.57	.01	.01	.01	.01	0.00	0.00	0.00	328.16	0.00
126	169.58	.01	.01	.01	.01	0.00	0.00	0.00	328.16	0.00
127	169.58	.01	.01	19.97	19.97	19.95	19.95	0.00	328.18	0.00
128	169.60	.01	0.00	.01	.01	0.00	0.00	0.00	348.13	0.00
129	169.61	.01	.01	.01	.01	0.00	0.00	0.00	348.13	0.00
130	169.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	348.11	0.00
131	180.05	27.59	.01	0.00	27.59	0.00	27.57	27.58	337.72	0.00
132	180.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	365.28	0.00
133	180.11	.01	0.00	.01	.01	0.00	0.00	0.00	365.25	0.00
134	180.13	.01	26.29	0.00	26.29	26.28	0.00	26.29	365.25	0.00
135	180.16	0.00	.01	.01	.01	0.00	0.00	0.00	391.51	0.00
136	180.19	.01	0.00	0.00	.01	0.00	0.00	.01	391.50	0.00
137	180.20	0.00	0.00	26.08	26.08	26.07	26.08	0.00	391.50	0.00
138	180.22	.01	.01	.01	.01	0.00	0.00	0.00	417.56	0.00
139	180.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	417.56	0.00
140	180.26	0.00	0.00	.01	.01	0.00	0.00	0.00	417.55	0.00
141	190.96	39.47	.01	.01	39.47	0.00	39.45	39.46	406.86	0.00
142	190.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	446.30	0.00
143	191.01	.01	.01	.01	.01	0.00	0.00	0.00	446.29	0.00
144	191.05	.01	0.00	0.00	.01	0.00	.01	0.00	446.27	0.00
146	191.09	.01	.01	.01	.01	0.00	0.00	0.00	446.25	0.00
147	191.11	.01	0.00	.06	.06	.04	.06	0.00	446.25	0.00
145	191.08	.01	.01	0.00	.01	0.00	0.00	0.00	446.26	0.00
148	191.15	0.00	0.00	.01	.01	0.00	.01	0.00	446.28	0.00
149	191.19	.01	.01	.01	.01	0.00	0.00	0.00	446.26	0.00
150	191.22	0.00	.01	.01	.01	0.00	0.00	0.00	446.24	0.00
151	202.23	.17	.01	.01	.17	0.00	.15	.15	435.24	0.00
152	202.25	.02	.01	.01	.02	0.00	.01	.01	435.39	0.00
153	202.28	.01	0.00	0.00	.01	0.00	0.00	0.00	435.39	0.00
154	202.30	0.00	.22	.01	.22	.22	0.00	.21	435.38	0.00
155	202.34	.01	.01	.01	.01	0.00	0.00	0.00	435.57	0.00
156	202.36	.01	0.00	0.00	.01	0.00	.01	0.00	435.57	0.00
157	202.39	.01	.01	.27	.27	.25	.25	0.00	435.55	0.00
158	202.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	435.80	0.00
159	202.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	435.78	0.00
160	202.45	.01	.01	.01	.01	0.00	0.00	0.00	435.78	0.00
161	213.78	.43	.01	.01	.43	0.00	.42	.42	424.47	0.00
162	213.82	.01	.01	.01	.01	0.00	0.00	0.00	424.87	0.00
163	213.85	.01	.01	.01	.01	0.00	0.00	0.00	424.86	0.00
164	213.88	.01	.46	0.00	.46	.45	0.00	.45	424.85	0.00
165	213.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	425.25	0.00
166	213.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	425.25	0.00
167	213.97	0.00	0.00	.48	.48	.48	.47	0.00	425.23	0.00

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168	214.01	.01	.01	.01	.01	0.00	0.00	0.00	425.67	0.00
169	214.05	.01	0.00	0.00	.01	0.00	0.00	.01	425.64	0.00
170	214.07	.01	.01	.01	.01	0.00	0.00	0.00	425.63	0.00
171	225.72	.71	.01	.01	.71	0.00	.70	.69	414.00	0.00
172	225.72	0.00	.01	0.00	.01	0.00	0.00	0.00	414.71	0.00
173	225.74	0.00	.01	.01	.01	0.00	0.00	0.00	414.71	0.00
174	225.77	.01	.70	.01	.70	.69	0.00	.69	414.69	0.00
175	225.79	0.00	.01	.01	.01	.01	0.00	0.00	415.37	0.00
176	225.81	.01	0.00	0.00	.01	0.00	.01	.01	415.37	0.00
177	225.83	.01	.01	.70	.70	.69	.68	0.00	415.37	0.00
178	225.85	.01	0.00	0.00	.01	0.00	0.00	.01	416.05	0.00
179	225.87	0.00	0.00	.01	.01	.01	0.00	0.00	416.04	0.00
180	225.88	.02	.01	0.00	.02	0.00	0.00	.01	416.05	0.00
181	237.86	.99	.01	.01	.99	0.00	.98	.98	404.09	0.00
182	237.86	.02	.01	.01	.02	0.00	0.00	0.00	405.08	0.00
183	237.87	.01	.01	.01	.01	0.00	0.00	0.00	405.10	0.00
184	237.88	.01	.95	.01	.95	.94	0.00	.94	405.10	0.00
185	237.90	.02	.01	0.00	.02	0.00	0.00	.01	406.04	0.00
186	237.92	.01	.01	.01	.01	0.00	0.00	0.00	406.04	0.00
187	237.96	0.00	0.00	.92	.92	.92	.92	0.00	406.02	0.00
188	237.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	406.92	0.00
189	238.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	406.91	0.00
190	238.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	406.89	0.00
191	250.35	1.29	.01	.01	1.29	0.00	1.27	1.28	394.58	0.00
192	250.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	395.84	0.00
193	250.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	395.83	0.00
194	250.42	.01	1.21	0.00	1.21	1.20	0.00	1.21	395.81	0.00
195	250.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	396.99	0.00
196	250.49	.01	.01	.01	.01	0.00	0.00	0.00	396.96	0.00
197	250.51	0.00	0.00	1.16	1.16	1.15	1.15	0.00	396.97	0.00
198	250.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	398.11	0.00
199	250.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	398.09	0.00
200	250.60	.01	.01	.01	.01	0.00	0.00	0.00	398.05	0.00

250.60

379.55 439.80 440.05

0.00

1
1

TOTAL SYSTEM TIME= 648.68
TOTAL WAITING TIME=4593.37429
TIME OF VACANCY = 0.00
PERCENT INACT TIME= 58.51
AVER WAITING TIME= 22.968
PERCENT OF IDLE. = 0.00

67.80

67.80

CASE NUMBER 2

LAM =6 ITEMS/HOUR
MEW(1) =7 ITEMS/HOUR
MEW(2) =8 ITEMS/HOUR
MEW(3) =9 ITEMS/HOUR

SIMULATION TABLE

ORDER	CLMPLAT	PRODUCTION TIMES				IDLE TIMES			WAITING VACANCY	
NUMBER	ARRIVAL TIME	TS(1)	TS(2)	TS(3)	TSM	TINA(1)	TINA(2)	TINA(3)	TIME	TIME
1	0.00	.59	1.60	16.48	16.48	15.49	14.88	0.00	0.00	0.00
2	7.32	7.77	20.67	2.25	20.67	12.90	0.00	18.41	5.16	0.00
3	15.96	13.06	1.76	17.19	17.19	4.13	15.42	0.00	21.20	0.00
4	21.54	13.02	6.50	.01	13.02	0.00	6.52	13.01	32.81	0.00
5	23.94	.01	.01	.01	.01	0.00	0.00	0.00	42.44	0.00
6	29.50	.02	.01	.01	.02	0.00	0.00	.01	37.90	0.00
7	37.09	.02	0.00	5.94	5.94	5.92	5.93	0.00	30.33	0.00
8	42.28	0.00	0.00	.01	.01	0.00	0.00	0.00	31.09	0.00
9	42.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.88	0.00
10	42.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.79	0.00
11	47.38	7.85	.01	0.00	7.85	0.00	7.83	7.84	26.01	0.00
12	47.39	.01	0.00	.01	.01	0.00	0.00	0.00	33.85	0.00
13	47.41	.02	.01	.01	.02	0.00	0.00	.01	33.85	0.00
14	47.43	.01	7.06	0.00	7.06	7.04	0.00	7.05	33.85	0.00
15	47.46	.01	.01	.01	.01	0.00	0.00	0.00	40.89	0.00
16	47.48	0.00	0.00	.01	.01	0.00	.01	0.00	40.88	0.00
17	47.50	.01	.01	6.45	6.45	6.43	6.43	0.00	40.87	0.00
18	47.51	.01	.02	.02	.02	0.00	0.00	0.00	47.30	0.00
19	47.54	.01	.01	.01	.01	0.00	0.00	0.00	47.30	0.00
20	47.56	.02	.02	.02	.02	0.00	0.00	0.00	47.30	0.00
21	52.50	8.52	.01	0.00	8.52	0.00	8.50	8.51	42.37	0.00
22	52.52	.01	.01	0.00	.01	0.00	0.00	0.00	50.88	0.00
23	52.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.87	0.00
24	52.56	0.00	7.66	0.00	7.66	7.65	0.00	7.65	50.86	0.00
25	52.58	.01	.01	.01	.01	0.00	0.00	0.00	58.50	0.00
26	52.60	.02	.02	0.00	.02	0.00	0.00	.01	58.49	0.00
27	52.61	.01	.01	6.99	6.99	6.98	6.98	0.00	58.50	0.00
28	52.62	.01	.01	.01	.01	0.00	0.00	0.00	65.45	0.00
29	52.64	.01	.01	.01	.01	0.00	0.00	0.00	65.48	0.00
30	52.66	.01	.01	0.00	.01	0.00	0.00	.01	65.48	0.00
31	57.77	9.24	0.00	.01	9.24	0.00	9.24	9.23	60.35	0.00
32	57.78	.01	.01	.01	.01	0.00	0.00	0.00	69.62	0.00
33	57.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	69.61	0.00
34	57.84	.01	8.31	.01	8.31	8.29	0.00	8.30	69.59	0.00
35	57.85	.01	0.00	0.00	.01	0.00	0.00	0.00	77.89	0.00
36	57.87	.01	.02	0.00	.02	0.00	0.00	.01	77.89	0.00
37	57.87	.01	.01	7.59	7.59	7.58	7.57	0.00	77.90	0.00
38	57.89	.01	.01	.01	.01	0.00	0.00	0.00	85.48	0.00
39	57.91	.01	0.00	.01	.01	0.00	0.00	0.00	85.48	0.00
40	57.92	.01	.01	.01	.01	0.00	0.00	0.00	85.48	0.00
41	63.20	10.03	.01	0.00	10.03	0.00	10.02	10.03	80.22	0.00
42	63.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.24	0.00
43	63.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.24	0.00
44	63.24	0.00	9.02	0.00	9.02	9.02	0.00	9.02	90.23	0.00
45	63.25	.01	0.00	0.00	.01	0.00	0.00	0.00	99.25	0.00
46	63.27	0.00	.01	.01	.01	.01	0.00	0.00	99.24	0.00
47	63.29	.01	.01	8.25	8.25	8.24	8.24	0.00	99.24	0.00

48	63.30	.C1	.C1	.01	.01	0.00	0.00	0.00	107.48	0.00
49	63.31	.C1	.C1	.01	.01	0.00	0.00	0.00	107.49	0.00
50	63.32	.01	0.00	0.00	.01	0.00	.01	0.00	107.49	0.00
51	68.77	10.91	.C1	.01	10.91	0.00	10.90	10.90	102.06	0.00
52	68.79	.02	0.00	.01	.02	0.00	.01	0.00	112.95	0.00
53	68.81	C.C0	C.C0	.01	.01	0.00	0.00	C.C0	112.95	0.00
54	68.83	C.C0	9.81	0.00	9.81	9.81	0.00	9.81	112.94	0.00
55	68.86	C.C0	0.00	0.00	0.00	0.00	0.00	0.00	122.74	0.00
56	68.88	.01	.02	.01	.02	0.00	0.00	0.00	122.73	0.00
57	68.89	.02	.01	8.98	8.98	8.95	8.96	0.00	122.73	0.00
58	68.92	.01	.01	0.00	.01	0.00	0.00	0.00	131.68	0.00
59	68.94	.C1	.C1	.01	.01	0.00	0.00	0.00	131.68	0.00
60	68.97	.01	.01	.01	.01	0.00	0.00	C.C0	131.67	0.00
61	74.59	11.88	.02	0.00	11.88	0.00	11.86	11.87	126.06	0.00
62	74.60	C.C0	.C1	.01	.01	.01	0.00	0.00	137.94	0.00
63	74.61	.01	.C1	0.00	.01	0.00	0.00	.01	137.94	0.00
64	74.62	.01	10.70	.01	10.70	10.69	0.00	10.69	137.95	0.00
65	74.63	C.C0	0.00	.01	.01	0.00	0.00	C.C0	148.64	0.00
66	74.65	C.C0	.01	.01	.01	0.00	0.00	0.00	148.64	0.00
67	74.66	.01	.C1	9.79	9.79	9.78	9.78	C.C0	148.64	0.00
68	74.67	.01	.01	0.00	.01	0.00	0.00	0.00	158.42	0.00
69	74.69	.01	.01	.01	.01	0.00	0.00	0.00	158.43	0.00
70	74.71	.01	.01	.01	.01	0.00	0.00	0.00	158.42	0.00
71	80.51	12.97	.C1	.01	12.97	0.00	12.96	12.96	152.64	0.00
72	80.52	C.C0	0.00	0.00	0.00	0.00	0.00	0.00	165.60	0.00
73	80.55	.01	.01	.01	.01	0.00	0.00	0.00	165.59	0.00
74	80.56	.01	11.70	0.00	11.70	11.68	0.00	11.69	165.58	0.00
75	80.58	.01	.C1	.01	.01	0.00	0.00	0.00	177.27	0.00
76	80.59	.02	0.00	0.00	.02	0.00	.01	.01	177.27	0.00
77	80.60	C.C0	0.00	10.72	10.72	10.72	10.72	0.00	177.28	0.00
78	80.63	.01	.01	.01	.01	0.00	0.00	0.00	187.99	0.00
79	80.64	C.C0	.01	0.00	.01	0.00	0.00	0.00	187.98	0.00
80	80.66	C.C0	.C1	.01	.01	0.00	0.00	0.00	187.98	0.00
81	86.64	14.23	.C1	.01	14.23	0.00	14.21	14.21	182.02	0.00
82	86.64	.01	0.00	.01	.01	0.00	.01	0.00	196.25	0.00
83	86.66	.01	.C1	.01	.01	0.00	0.00	0.00	196.25	0.00
84	86.69	.01	12.86	.01	12.86	12.84	0.00	12.85	196.24	0.00
85	86.71	C.C0	0.00	.01	.01	0.00	.01	0.00	209.08	0.00
86	86.73	C.C0	.01	.01	.01	.01	0.00	0.00	209.07	0.00
87	86.74	.02	.01	11.81	11.81	11.78	11.79	0.00	209.07	0.00
88	86.76	.01	0.00	.01	.01	0.00	.01	0.00	220.87	0.00
89	86.77	.01	.C1	0.00	.01	0.00	0.00	.01	220.88	0.00
90	86.79	.01	.02	.01	.02	0.00	0.00	0.00	220.88	0.00
91	92.95	15.70	0.00	0.00	15.70	0.00	15.70	15.69	214.74	0.00
92	92.97	.01	.01	0.00	.01	0.00	0.00	0.00	230.42	0.00
93	93.00	.01	.01	.01	.01	0.00	0.00	0.00	230.41	0.00
94	93.02	.02	14.22	.01	14.22	14.20	0.00	14.21	230.40	0.00
95	93.04	C.C0	.01	0.00	.01	0.00	0.00	0.00	244.61	0.00
96	93.05	.01	.01	.01	.01	0.00	0.00	0.00	244.60	0.00
97	93.07	.01	.01	13.10	13.10	13.09	13.08	0.00	244.61	0.00
98	93.09	0.00	.01	.01	.01	0.00	0.00	0.00	257.70	0.00
99	93.10	.01	0.00	.01	.01	0.00	0.00	0.00	257.70	0.00
100	93.12	.02	.02	.01	.02	0.00	0.00	0.00	257.69	0.00
101	99.47	17.48	.C1	.01	17.48	0.00	17.47	17.47	251.37	0.00
102	99.47	.01	.C1	.01	.01	0.00	0.00	0.00	268.85	0.00
103	99.48	.C1	.C1	.01	.01	0.00	0.00	0.00	268.86	0.00
104	99.49	.02	15.90	0.00	15.90	15.88	0.00	15.89	268.86	0.00
105	99.50	.C1	0.00	0.00	.01	0.00	.01	.01	284.75	0.00
106	99.52	.01	.01	.01	.01	0.00	0.00	0.00	284.75	0.00
107	99.53	.01	.01	14.71	14.71	14.70	14.70	0.00	284.75	0.00

108	99.56	.01	.01	.01	.01	0.00	0.00	0.00	299.45	0.00
109	99.58	.01	.01	0.00	.01	0.00	0.00	0.00	299.45	0.00
110	99.58	.01	0.00	0.00	.01	0.00	0.00	0.00	299.45	0.00
111	106.12	19.73	0.00	0.00	19.73	0.00	19.72	19.73	292.92	0.00
112	106.13	.01	.01	.01	.01	0.00	0.00	0.00	312.65	0.00
113	106.14	.01	.01	.01	.01	0.00	0.00	0.00	312.66	0.00
114	106.15	0.00	18.05	.01	18.05	18.05	0.00	18.04	312.66	0.00
115	106.16	.02	.01	.01	.02	0.00	0.00	0.00	330.71	0.00
116	106.18	.02	0.00	0.00	.02	0.00	.01	.01	330.71	0.00
117	106.20	0.00	0.00	16.83	16.83	16.83	16.83	0.00	330.71	0.00
118	106.22	0.00	.01	.01	.01	0.00	0.00	0.00	347.53	0.00
119	106.22	0.00	.01	.01	.01	.01	0.00	0.00	347.54	0.00
120	106.24	.01	.01	.01	.01	0.00	0.00	0.00	347.54	0.00
121	112.98	22.79	.01	.01	22.79	0.00	22.77	22.78	340.83	0.00
122	113.00	.01	0.00	0.00	.01	0.00	0.00	.01	363.59	0.00
123	113.03	.01	.01	.01	.01	0.00	0.00	0.00	363.58	0.00
124	113.04	.01	21.10	.01	21.10	21.08	0.00	21.08	363.58	0.00
125	113.06	.01	.01	.01	.01	0.00	0.00	0.00	384.66	0.00
126	113.07	.01	.01	.01	.01	0.00	0.00	0.00	384.68	0.00
127	113.07	.01	.01	19.97	19.97	19.95	19.95	0.00	384.69	0.00
128	113.08	.01	0.00	.01	.01	0.00	0.00	0.00	404.65	0.00
129	113.09	.01	.01	.01	.01	0.00	0.00	0.00	404.65	0.00
130	113.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	404.64	0.00
131	120.05	27.59	.01	0.00	27.59	0.00	27.57	27.58	397.72	0.00
132	120.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	425.29	0.00
133	120.09	.01	0.00	.01	.01	0.00	0.00	0.00	425.27	0.00
134	120.10	.01	26.29	0.00	26.29	26.28	0.00	26.29	425.28	0.00
135	120.12	0.00	.01	.01	.01	0.00	0.00	0.00	451.55	0.00
136	120.14	.01	0.00	0.00	.01	0.00	0.00	.01	451.55	0.00
137	120.15	0.00	0.00	26.08	26.08	26.07	26.08	0.00	451.55	0.00
138	120.16	.01	.01	.01	.01	0.00	0.00	0.00	477.62	0.00
139	120.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	477.62	0.00
140	120.19	0.00	0.00	.01	.01	0.00	0.00	0.00	477.62	0.00
141	127.33	39.47	.01	.01	39.47	0.00	39.45	39.46	470.45	0.00
142	127.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	509.95	0.00
143	127.36	.01	.01	.01	.01	0.00	0.00	0.00	509.94	0.00
144	127.38	.01	0.00	0.00	.01	0.00	.01	0.00	509.94	0.00
145	127.40	.01	.01	0.00	.01	0.00	0.00	0.00	509.93	0.00
146	127.41	.01	.01	.01	.01	0.00	0.00	0.00	509.93	0.00
147	127.42	.01	0.00	.06	.06	.04	.06	0.00	509.94	0.00
148	127.45	0.00	0.00	.01	.01	0.00	.01	0.00	509.98	0.00
149	127.47	.01	.01	.01	.01	0.00	0.00	0.00	509.97	0.00
150	127.50	0.00	.01	.01	.01	0.00	0.00	0.00	509.96	0.00
151	134.84	.17	.01	.01	.17	0.00	.15	.15	502.64	0.00
152	134.85	.02	.01	.01	.02	0.00	.01	.01	502.75	0.00
153	134.87	.01	0.00	0.00	.01	0.00	0.00	0.00	502.80	0.00
154	134.89	0.00	.22	.01	.22	.22	0.00	.21	502.80	0.00
155	134.91	.01	.01	.01	.01	0.00	0.00	0.00	503.00	0.00
156	134.92	.01	0.00	0.00	.01	0.00	.01	0.00	503.00	0.00
157	134.94	.01	.01	.27	.27	.25	.25	0.00	503.00	0.00
158	134.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	503.25	0.00
159	134.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	503.24	0.00
160	134.99	.01	.01	.01	.01	0.00	0.00	0.00	503.24	0.00
161	142.54	.43	.01	.01	.43	0.00	.42	.42	495.71	0.00
162	142.56	.01	.01	.01	.01	0.00	0.00	0.00	496.12	0.00
163	142.58	.01	.01	.01	.01	0.00	0.00	0.00	496.12	0.00
164	142.60	.01	.46	0.00	.46	.45	0.00	.45	496.12	0.00
165	142.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	496.57	0.00
166	142.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	496.55	0.00
167	142.66	0.00	0.00	.48	.48	.48	.47	0.00	496.53	0.00

168	142.69	.01	.01	.01	.01	0.00	0.00	0.00	496.99	0.00
169	142.72	.01	0.00	0.00	.01	0.00	0.00	.01	496.97	0.00
170	142.73	.01	.01	.01	.01	0.00	0.00	0.00	496.97	0.00
171	150.50	.71	.01	.01	.71	0.00	.70	.69	489.22	0.00
172	150.50	0.00	.01	0.00	.01	0.00	0.00	0.00	489.93	0.00
173	150.51	0.00	.01	.01	.01	0.00	0.00	0.00	489.93	0.00
174	150.53	.01	.70	.01	.70	.69	0.00	.69	489.92	0.00
175	150.55	0.00	.01	.01	.01	.01	0.00	0.00	490.61	0.00
176	150.56	.01	0.00	0.00	.01	0.00	.01	.01	490.62	0.00
177	150.57	.01	.01	.70	.70	.69	.68	0.00	490.62	0.00
178	150.59	.01	0.00	0.00	.01	0.00	0.00	.01	491.31	0.00
179	150.60	0.00	0.00	.01	.01	.01	0.00	0.00	491.31	0.00
180	150.61	.02	.01	0.00	.02	0.00	0.00	.01	491.32	0.00
181	158.59	.99	.01	.01	.99	0.00	.98	.98	483.36	0.00
182	158.60	.02	.01	.01	.02	0.00	0.00	0.00	484.35	0.00
183	158.60	.01	.01	.01	.01	0.00	0.00	0.00	484.37	0.00
184	158.61	.01	.95	.01	.95	.94	0.00	.94	484.37	0.00
185	158.62	.02	.01	0.00	.02	0.00	0.00	.01	485.32	0.00
186	158.64	.01	.01	.01	.01	0.00	0.00	0.00	485.32	0.00
187	158.66	0.00	0.00	.92	.92	.92	.92	0.00	485.32	0.00
188	158.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	486.23	0.00
189	158.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	486.22	0.00
190	158.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	486.21	0.00
191	166.92	1.29	.01	.01	1.29	0.00	1.27	1.28	478.01	0.00
192	166.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	479.28	0.00
193	166.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	479.27	0.00
194	166.97	.01	1.21	0.00	1.21	1.20	0.00	1.21	479.26	0.00
195	167.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	480.45	0.00
196	167.02	.01	.01	.01	.01	0.00	0.00	0.00	480.44	0.00
197	167.03	0.00	0.00	1.16	1.16	1.15	1.15	0.00	480.45	0.00
198	167.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	481.59	0.00
199	167.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	481.58	0.00
200	167.09	.01	.01	.01	.01	0.00	0.00	0.00	481.56	0.00

167.09

379.55 439.80 440.05

0.00

1
1

TOTAL SYSTEM TIME= 648.68
TOTAL WAITING TIME=5579.083
TIME OF VACANCY = 0.000
PERCENT INACT TIME= 58.512
AVER WAITING TIME= 27.8954
PERCENT OF IDLE. = 0.000

67.800

67.838

CASE NUMBER 3

LAM =4 ITEMS/HOUR
 MEW(1) =5 ITEMS/HOUR
 MEW(2) =6 ITEMS/HOUR
 MEW(3) =10 ITEMS/HOUR

SIMULATION TABLE

ORDER	CUMULAT	PRODUCTION TIMES				IDLE TIMES			WAITING VACANCY	
NUMBER	ARRIVAL TIME	TS(1)	TS(2)	TS(3)	TSM	TINA(1)	TINA(2)	TINA(3)	TIME	TIME
1	0.00	1.38	2.14	14.84	14.84	13.45	12.69	0.00	0.00	0.00
2	10.98	10.88	27.56	2.03	27.56	16.68	0.00	25.53	3.85	0.00
3	23.94	18.28	2.35	15.47	18.28	0.00	15.92	2.80	18.46	0.00
4	32.31	18.24	8.67	.01	18.24	0.00	9.56	18.22	28.37	0.00
5	35.92	.02	.01	.01	.02	0.00	0.00	0.00	43.00	0.00
6	44.25	.03	.02	.01	.03	0.00	.01	.02	34.70	0.00
7	55.64	.03	.01	5.34	5.34	5.31	5.33	0.00	23.34	0.00
8	63.42	.01	.01	0.00	.01	0.00	0.00	0.00	20.91	0.00
9	63.74	0.00	.01	0.00	.01	0.00	0.00	0.00	20.60	0.00
10	63.90	0.00	.01	0.00	.01	0.00	0.00	0.00	20.45	0.00
11	71.07	10.99	.01	0.00	10.99	0.00	10.97	10.99	13.29	0.00
12	71.09	.01	0.00	.01	.01	0.00	0.00	0.00	24.27	0.00
13	71.11	.03	.02	.01	.03	0.00	.01	.02	24.26	0.00
14	71.15	.02	9.41	0.00	9.41	9.39	0.00	9.40	24.26	0.00
15	71.19	.01	.01	0.00	.01	0.00	0.00	0.00	33.63	0.00
16	71.22	0.00	0.00	.01	.01	0.00	0.00	0.00	33.62	0.00
17	71.25	.02	.02	5.80	5.80	5.78	5.78	0.00	33.60	0.00
18	71.27	.02	.02	.01	.02	0.00	0.00	0.00	39.38	0.00
19	71.31	.02	.01	.01	.02	0.00	0.00	.01	39.37	0.00
20	71.34	.03	.02	.01	.03	0.00	0.00	.01	39.36	0.00
21	78.76	11.93	.02	0.00	11.93	0.00	11.90	11.92	31.98	0.00
22	78.78	.01	.01	0.00	.01	0.00	0.00	.01	43.89	0.00
23	78.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43.87	0.00
24	78.84	0.00	10.21	0.00	10.21	10.20	0.00	10.20	43.85	0.00
25	78.87	.01	.01	0.00	.01	0.00	0.00	0.00	54.03	0.00
26	78.90	.02	.02	0.00	.02	0.00	0.00	.02	54.02	0.00
27	78.91	.01	.01	6.29	6.29	6.28	6.28	0.00	54.04	0.00
28	78.93	.01	.01	.01	.01	0.00	0.00	0.00	60.32	0.00
29	78.96	.02	.02	.01	.02	0.00	0.00	.01	60.30	0.00
30	78.99	.02	.02	0.00	.02	0.00	0.00	.01	60.30	0.00
31	86.65	12.94	0.00	.01	12.94	0.00	12.93	12.93	52.66	0.00
32	86.68	.02	.01	0.00	.02	0.00	0.00	.01	65.58	0.00
33	86.71	0.00	.01	0.00	.01	0.00	0.00	0.00	65.57	0.00
34	86.75	.02	11.08	.01	11.08	11.05	0.00	11.07	65.54	0.00
35	86.78	.02	0.00	0.00	.02	0.00	.01	.01	76.60	0.00
36	86.80	.02	.02	0.00	.02	0.00	0.00	.02	76.60	0.00
37	86.81	.01	.02	6.83	6.83	6.81	6.81	0.00	76.62	0.00
38	86.84	.02	.01	0.00	.02	0.00	0.00	.01	83.43	0.00
39	86.86	.01	0.00	.01	.01	0.00	.01	0.00	83.42	0.00
40	86.88	.02	.01	0.00	.02	0.00	0.00	.01	83.43	0.00
41	94.79	14.05	.02	0.00	14.05	0.00	14.03	14.04	75.53	0.00
42	94.81	0.00	.01	0.00	.01	0.00	0.00	0.00	89.57	0.00
43	94.82	.01	.01	0.00	.01	0.00	0.00	.01	89.57	0.00
44	94.85	.01	12.03	0.00	12.03	12.02	0.00	12.03	89.55	0.00
45	94.87	.01	0.00	0.00	.01	0.00	0.00	.01	101.57	0.00
46	94.90	.01	.02	.01	.02	.01	0.00	0.00	101.56	0.00
47	94.93	.01	.01	7.42	7.42	7.41	7.41	0.00	101.55	0.00

48	94.95	.01	.C1	.01	.01	0.00	0.00	C.CC	108.95	C.CC
49	94.96	.01	.C1	.01	.01	0.00	0.00	C.CC	108.96	C.CC
50	94.98	.02	0.00	0.00	.02	0.00	.01	.C1	108.96	C.CC
51	103.15	15.27	.C1	0.00	15.27	0.00	15.26	15.26	100.81	0.00
52	103.18	.02	.C1	.01	.02	0.00	.01	.C1	116.35	C.CC
53	103.21	.01	.C1	.01	.01	0.00	0.00	0.00	116.05	0.00
54	103.24	.01	13.09	0.00	13.09	13.08	0.00	13.09	116.03	C.CC
55	103.28	.01	.01	0.00	.01	0.00	0.00	0.00	129.09	0.00
56	103.31	.02	.C2	.01	.02	0.00	0.00	.01	129.07	0.00
57	103.34	.03	.C2	8.08	8.08	8.05	8.06	0.00	129.07	C.CC
58	103.37	.02	.C1	0.00	.02	0.00	0.00	.01	137.12	0.00
59	103.40	.01	.02	.01	.02	0.00	0.00	.01	137.11	0.00
60	103.44	.02	.02	.01	.02	0.00	0.00	0.00	137.09	0.00
61	111.87	16.63	.C2	0.00	16.63	0.00	16.60	16.62	128.68	0.00
62	111.89	C.CC	.01	.01	.01	.01	0.00	0.00	145.30	0.00
63	111.91	.02	.C1	0.00	.02	0.00	0.00	.02	145.30	0.00
64	111.92	.01	14.27	0.00	14.27	14.25	0.00	14.26	145.32	0.00
65	111.93	C.CC	.C1	.01	.01	0.00	0.00	0.00	159.58	0.00
66	111.97	.01	.C2	.01	.02	0.00	0.00	.01	159.56	C.CC
67	111.98	.02	.C1	8.81	8.81	8.79	8.80	0.00	159.56	0.00
68	112.00	.01	.02	0.00	.02	0.00	0.00	.01	168.36	0.00
69	112.02	.02	.C1	.01	.02	0.00	0.00	.01	168.36	C.CC
70	112.06	.02	.02	.01	.02	0.00	0.00	.01	168.35	0.00
71	120.75	18.16	.01	0.00	18.16	0.00	18.15	18.16	159.68	0.00
72	120.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	177.83	0.00
73	120.81	.01	.C1	.01	.01	0.00	0.00	0.00	177.80	0.00
74	120.84	.02	15.60	0.00	15.60	15.58	0.00	15.60	177.79	0.00
75	120.86	.01	.01	0.00	.01	0.00	0.00	0.00	192.37	0.00
76	120.88	.02	.01	0.00	.02	0.00	.01	.02	192.37	0.00
77	120.89	0.00	0.00	9.65	9.65	9.64	9.65	0.00	192.38	0.00
78	120.93	.02	.01	.01	.02	0.00	0.00	.01	202.00	C.CC
79	120.96	C.CC	.02	0.00	.02	.01	0.00	0.00	202.99	0.00
80	120.98	0.00	.C1	.01	.01	.01	0.00	0.00	202.99	0.00
81	129.95	19.92	.02	.01	19.92	0.00	19.90	19.91	194.04	0.00
82	129.95	.02	.01	.01	.02	0.00	.01	.01	212.97	0.00
83	129.98	.02	.C2	.01	.02	0.00	0.00	0.00	213.96	0.00
84	130.02	.01	17.14	0.00	17.14	17.13	0.00	17.13	212.95	0.00
85	130.05	0.00	0.00	.01	.01	0.00	0.00	0.00	231.07	0.00
86	130.08	.01	.02	.01	.02	.01	0.00	0.00	231.05	C.CC
87	130.10	.03	.02	10.63	10.63	10.59	10.60	0.00	231.05	C.CC
88	130.12	.02	.01	.01	.02	0.00	.01	.01	241.65	C.CC
89	130.14	.02	.02	0.00	.02	0.00	0.00	.01	241.67	C.CC
90	130.17	.02	.02	.01	.02	0.00	0.00	.01	241.66	C.CC
91	139.41	21.99	0.00	0.00	21.99	0.00	21.98	21.98	232.45	0.00
92	139.44	.01	.C1	0.00	.01	0.00	0.00	.01	254.41	0.00
93	139.48	.01	.01	.01	.01	0.00	0.00	0.00	254.38	0.00
94	139.51	.03	18.97	.01	18.97	18.93	0.00	18.95	254.37	0.00
95	139.54	.01	.01	0.00	.01	0.00	0.00	.01	273.31	0.00
96	139.56	.02	.02	.01	.02	0.00	0.00	.01	273.30	0.00
97	139.59	.02	.02	11.79	11.79	11.77	11.77	0.00	273.30	0.00
98	139.61	.01	.02	.01	.02	0.00	0.00	.01	285.07	0.00
99	139.64	.02	0.00	.01	.02	0.00	.01	0.00	285.07	C.CC
100	139.66	.03	.02	.01	.03	0.00	0.00	.01	285.06	C.CC
101	149.18	24.48	.01	.01	24.48	0.00	24.46	24.46	275.57	0.00
102	149.20	.02	.01	.01	.02	0.00	0.00	.01	300.04	C.CC
103	149.20	.01	.01	0.00	.01	0.00	0.00	.01	300.06	C.CC
104	149.22	.02	21.20	0.00	21.20	21.17	0.00	21.19	300.06	C.CC
105	149.24	.02	.01	0.00	.02	0.00	.01	.C1	321.25	C.CC
106	149.27	.02	.01	.01	.02	0.00	0.00	.01	321.24	0.00
107	149.29	.02	.C1	13.24	13.24	13.22	13.22	0.00	321.25	C.CC

108	149.32	.02	.01	.01	.02	0.00	0.00	0.00	334.46	0.00
109	149.35	.01	.02	0.00	.02	0.00	0.00	.01	334.45	0.00
110	149.36	.01	0.00	0.00	.01	0.00	0.00	.01	334.46	0.00
111	159.17	27.63	.01	0.00	27.63	0.00	27.61	27.62	324.67	0.00
112	159.18	.02	.01	.01	.02	0.00	0.00	.01	352.29	0.00
113	159.19	.01	.01	0.00	.01	0.00	0.00	.01	352.30	0.00
114	159.21	0.00	24.07	.01	24.07	24.07	0.00	24.06	352.30	0.00
115	159.22	.03	.02	.01	.03	0.00	.01	.02	376.37	0.00
116	159.25	.03	.01	0.00	.03	0.00	.01	.02	376.37	0.00
117	159.29	0.00	.01	15.15	15.15	15.14	15.14	0.00	376.36	0.00
118	159.31	0.00	.01	.01	.01	.01	0.00	0.00	391.50	0.00
119	159.32	.01	.02	.01	.02	.01	0.00	0.00	391.51	0.00
120	159.34	.02	.01	.01	.02	0.00	0.00	.01	391.50	0.00
121	169.44	31.91	.02	.01	31.91	0.00	31.89	31.90	381.42	0.00
122	169.48	.02	0.00	0.00	.02	0.00	.01	.01	413.30	0.00
123	169.52	.02	.01	0.00	.02	0.00	0.00	.01	413.27	0.00
124	169.54	.01	28.13	.01	28.13	28.11	0.00	28.12	413.27	0.00
125	169.57	.02	.02	.01	.02	0.00	0.00	.01	441.39	0.00
126	169.58	.02	.01	0.00	.02	0.00	0.00	.01	441.40	0.00
127	169.58	.01	.01	17.97	17.97	17.95	17.95	0.00	441.42	0.00
128	169.60	.01	0.00	.01	.01	0.00	.01	0.00	459.38	0.00
129	169.61	.02	.01	0.00	.02	0.00	0.00	.01	459.38	0.00
130	169.65	0.00	.01	0.00	.01	0.00	0.00	0.00	459.36	0.00
131	180.05	38.62	.01	0.00	38.62	0.00	38.60	38.62	448.98	0.00
132	180.07	0.00	.01	0.00	.01	0.00	0.00	0.00	487.58	0.00
133	180.11	.02	0.00	.01	.02	0.00	.01	0.00	487.55	0.00
134	180.13	.02	35.06	0.00	35.06	35.04	0.00	35.06	487.55	0.00
135	180.16	.01	.02	.01	.02	0.00	0.00	.01	522.59	0.00
136	180.19	.02	0.00	0.00	.02	0.00	.01	.01	522.58	0.00
137	180.20	0.00	0.00	23.47	23.47	23.47	23.47	0.00	522.59	0.00
138	180.22	.01	.02	.01	.02	0.00	0.00	.01	546.04	0.00
139	180.24	.01	.01	0.00	.01	0.00	0.00	.01	546.04	0.00
140	180.26	.01	.01	0.00	.01	0.00	0.00	0.00	546.03	0.00
141	190.96	55.26	.02	.01	55.26	0.00	55.24	55.25	535.34	0.00
142	190.99	.01	.01	0.00	.01	0.00	0.00	0.00	590.58	0.00
143	191.01	.02	.02	.01	.02	0.00	0.00	.01	590.57	0.00
144	191.05	.02	0.00	0.00	.02	0.00	.02	.01	590.56	0.00
145	191.08	.01	.01	0.00	.01	0.00	0.00	.01	590.55	0.00
146	191.09	.01	.02	.01	.02	0.00	0.00	0.00	590.55	0.00
147	191.11	.02	.01	.06	.06	.03	.05	0.00	590.55	0.00
148	191.15	0.00	0.00	.01	.01	0.00	0.00	0.00	590.58	0.00
149	191.19	.02	.01	0.00	.02	0.00	0.00	.01	590.55	0.00
150	191.22	0.00	.02	.01	.02	.01	0.00	.01	590.54	0.00
151	202.23	.24	.02	.01	.24	0.00	.22	.22	579.55	0.00
152	202.25	.03	.01	0.00	.03	0.00	.02	.02	579.77	0.00
153	202.28	.01	0.00	0.00	.01	0.00	.01	.01	579.77	0.00
154	202.30	0.00	.30	.01	.30	.29	0.00	.29	579.77	0.00
155	202.34	.02	.01	.01	.02	0.00	0.00	0.00	580.04	0.00
156	202.36	.02	.01	0.00	.02	0.00	.01	.01	580.04	0.00
157	202.39	.02	.01	.24	.24	.21	.22	0.00	580.03	0.00
158	202.42	.01	.01	0.00	.01	0.00	0.00	0.00	580.25	0.00
159	202.44	0.00	.01	0.00	.01	0.00	0.00	0.00	580.23	0.00
160	202.45	.01	.01	.01	.01	0.00	0.00	0.00	580.23	0.00
161	213.78	.61	.02	.01	.61	0.00	.59	.59	568.93	0.00
162	213.82	.01	.02	.01	.02	0.00	0.00	0.00	569.50	0.00
163	213.85	.02	.01	.01	.02	0.00	0.00	.01	569.49	0.00
164	213.88	.02	.61	0.00	.61	.59	0.00	.61	569.49	0.00
165	213.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	570.09	0.00
166	213.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	570.05	0.00
167	213.97	0.00	0.00	.43	.43	.43	.42	0.00	570.03	0.00

168	214.01	.01	.01	0.00	.01	0.00	0.00	0.00	0.00	570.43	0.00
169	214.05	.01	0.00	0.00	.01	0.00	.01	.01	.01	570.40	0.00
170	214.07	.02	.01	.01	.02	0.00	0.00	0.00	0.00	570.40	0.00
171	225.72	1.00	.01	.01	1.00	0.00	.98	.98	.98	558.77	0.00
172	225.72	.01	.01	0.00	.01	0.00	0.00	.01	.01	559.77	0.00
173	225.74	.01	.01	0.00	.01	0.00	0.00	0.00	0.00	559.77	0.00
174	225.77	.01	.94	0.00	.94	.92	0.00	.93	.93	559.75	0.00
175	225.79	0.00	.02	.01	.02	.01	0.00	0.00	0.00	560.67	0.00
176	225.81	.02	.01	0.00	.02	0.00	.01	.01	.01	560.67	0.00
177	225.83	.01	.02	.63	.63	.61	.60	0.00	0.00	560.68	0.00
178	225.85	.02	0.00	0.00	.02	0.00	.01	.01	.01	561.29	0.00
179	225.87	0.00	0.00	.01	.01	.01	0.00	0.00	0.00	561.29	0.00
180	225.88	.03	.02	0.00	.03	0.00	.01	.02	.02	561.29	0.00
181	237.86	1.39	.01	.01	1.39	0.00	1.37	1.38	1.38	549.35	0.00
182	237.86	.03	.02	.01	.03	0.00	.01	.02	.02	550.74	0.00
183	237.87	.02	.01	0.00	.02	0.00	0.00	.01	.01	550.76	0.00
184	237.88	.01	1.27	.01	1.27	1.25	0.00	1.26	1.26	550.77	0.00
185	237.90	.03	.02	0.00	.03	0.00	.01	.02	.02	552.03	0.00
186	237.92	.02	.01	.01	.02	0.00	0.00	.01	.01	552.04	0.00
187	237.96	0.00	0.00	.83	.83	.82	.83	0.00	0.00	552.03	0.00
188	237.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	552.83	0.00
189	238.00	0.00	.01	0.00	.01	0.00	0.00	0.00	0.00	552.82	0.00
190	238.03	.01	.01	0.00	.01	0.00	0.00	.01	.01	552.80	0.00
191	250.35	1.80	.01	.01	1.80	0.00	1.79	1.79	1.79	540.50	0.00
192	250.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	542.28	0.00
193	250.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	542.27	0.00
194	250.42	.01	1.62	0.00	1.62	1.61	0.00	1.62	1.62	542.25	0.00
195	250.46	.01	.01	0.00	.01	0.00	0.00	0.00	0.00	543.83	0.00
196	250.49	.02	.02	.01	.02	0.00	0.00	.01	.01	543.81	0.00
197	250.51	.01	.01	1.04	1.04	1.03	1.03	0.00	0.00	543.83	0.00
198	250.53	.01	0.00	0.00	.01	0.00	0.00	0.00	0.00	544.85	0.00
199	250.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	544.83	0.00
200	250.60	.01	.02	.01	.02	0.00	0.00	0.00	0.00	544.80	0.00

250.60

418.61 516.84 607.68

0.00

1
1
TOTAL SYSTEM TIME= 795.430
TOTAL WAITING TIME=6250.5615
TIME OF VACANCY = 0.000
PERCENT INACT TIME= 52.627
AVER WAITING TIME= 31.2528
PERCENT OF IDLE. = 0.000

64.976

76.397