

Factory Simulation Write Up

74/100

We played the simulation game twice, once in the beginning of the semester and once in the end of the semester. Although the games were slightly different, we felt that we did much better in Sim 2. When we did Sim 1, we did not have any formal training in operations planning. In the middle of the game we got swamped with orders at one point and the person in charge of the factory at that time bought a lot of machines which was expensive and did not help the backup issue much. We learned how to formally play the game in class and by reading The Goal. For the following questions, we will answer them in regards to Sim 2.

Question 1 Demand Forecasting

We were told that demand would be linearly increasing for the first 90-110 days, constant till day 180 and then fall off after that.

We used the demand forecast to plan machinery and inventory levels.

We took the sales per day data that we had and calculated a linear regression. Next we calculated what game day it would be in 24 hours, and then plugged that into the linear regression to get the mean forecasted number of orders on that day. We also looked at the standard deviation of the number of orders per day. Using the newsvendor model we found that we needed a k of 1.19 for 95% service with an understocking cost of \$583 and an overstocking cost of \$5.40 per kit. We then forecasted that we would have the mean number of orders plus 1.19 times the standard deviation on the given day. We conducted a new estimate every 24 "real-life" hours and then took the appropriate steps for the next "real" day.

When we reached the end of the first period, we looked on game day 99 and noticed that demand was still growing. We then estimated that demand would continue to increase to day 105. We believe that it was better to overestimate than to underestimate.

We used the data in the third period to draw down our inventory, because we did not want to be stuck with inventory when the game was over. We could have done this better, because we had a lot of inventory left over. This would have given us an extra ~\$4 million dollars and would have moved us 5 places up to 24th place. Before the last reorder, we should have calculated the demand for each of the remaining days and added them together to find the last reorder quantity.

Question 2 Machinery

We ordered our machines in accordance with our demand forecast. We set a goal of 80% utilization. We remembered that the G/G/N model showed that as the queue in front of a machine increased, the processing time increased exponentially. We therefore wanted to avoid a queue.

We looked each group of machines individually. We looked for what day the group of machines was at 80% utilization and looked at how many orders were processed on that day. We then linearly scaled the number of machines in the group to match our demand forecast for 24 "real" hours in the future. We thought that since the number of machines was relatively high, the increase in capacity would be

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roughly linear. The increase is NOT linear when there are relatively few machines. After the 24 hours, we recalculated the forecast. We did this throughout the growth period of the game.

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We did not sell any machines because there was no salvage value. I assume that could be added to make the game more complex.

machine purchase timing is important

We were happy with how we ordered machines, especially compared to Sim 1.

can you please show calculations for how you decided to buy the number of machines you did?

Question 3 Inventory

We used the EOQ model because the game allowed you to place multiple inventory orders over a period of time. The model requires two things, the order quantity and the reorder point.

you mean "Continuous Review Model"

We quickly realized that the restocking cost for inventory was far higher than the holding cost of inventory. There was no direct inventory holding cost, however we would not receive interest on money tied up in inventory. This interest was .54% a day. We felt that it would be far more advantageous to minimize the number of reorders, so we set the order quantity very high, at 999 batches. We did not want this to be too high we could only order with the cash we had on hand. We had a few technical difficulties setting this number in the simulation which messed us up.

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In order to calculate the reorder point, I calculated the mean demand during lead time (7 days) plus 1.19 times the standard deviation of the demand during lead time. I believe that the biggest mistake we made was in inventory calculations. We ran out of inventory for one day twice. After reviewing my notes, we did not set the reorder point properly. We should have accounted for job growth in calculating the demand during lead time. In order to do this we should have calculated the mean number of jobs for each of the 7 days and added them; instead of calculating the first day and multiplying by 7. We think these two days were we were closed when we were out of stock knocked us out of the 3rd place we were in on game day 99.

How did you handle the final order?

Question 4 Contract Type

Before we got control of our factory, we looked at how our factory was performing. We realized that our factory was performing jobs well enough to qualify for the faster lead time, so we decided to go to contract 2 to capture the extra revenue, at least the current time. We continued to monitor revenue per job throughout the simulation and except for when we ran out of inventory we continued to make more money on contract 2 than we would on contract 1, so we kept it.

5/10

We are happy with our decision to go with contract 2.

OK but would you have started with contract 2? this would affect capacity decisions....

Question 5 Overall Performance

We believe that the performance of our factory in Sim 2 was strong, especially compared to Sim 1. We think that our only big mistake was setting the reorder point too low so that we ran out of inventory for two separate one-day periods. We could have also ordered less for the last reorder. We believe that these mistakes caused us to drop from 3rd place on game day 99 to 29th place on day 200.

Factory Simulation Write Up

8/10 Looking at the rankings, we actually did worse this time around. I believe that was because the competition was more sophisticated. The relative returns of the groups were much closer this time around than last time. This time we came within 88% of the winner, while last time we only made 28% of what the winner did. The absolute numbers were much higher in Sim 2, but I believe that this was because of the different rules. In Sim 1, we made a 207% return on our investment in 200 days, which would be almost a 400% yearly ROI. In Sim 2, we made a 261% ROI in 200 days, which would be almost 477% yearly. Where do I sign up? ??

Question 6 Insights

We learned many things from reading The Goal and playing the simulation twice:

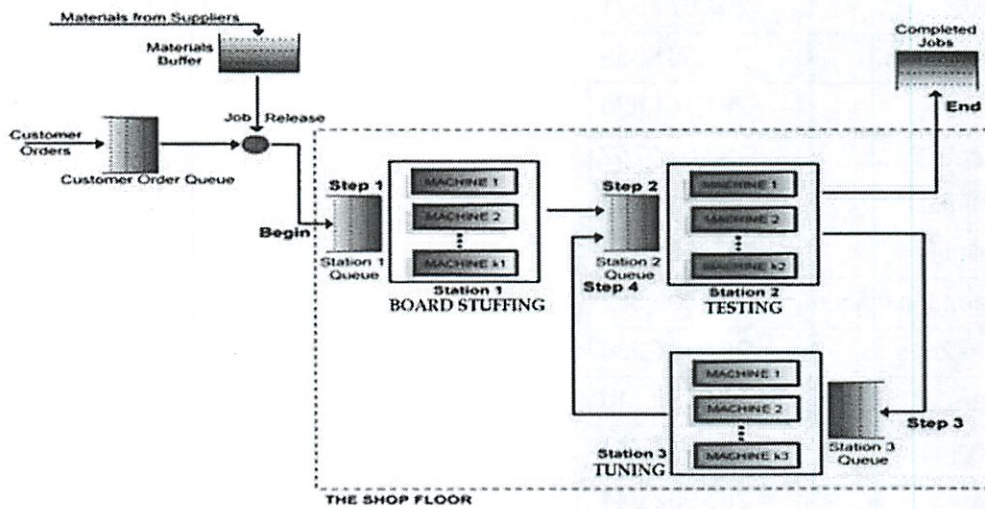
- Do demand forecasting
- Use the QOQ model to predict inventory
- Account for deviations in demand, so you can overstock
- Remember to account for growth when estimating demand during the lead time
- Prevent queuing by understanding the exponential nature of wait times vs capacity utilization
- Minimize in-progress inventory
- Try to balance the station load, if possible
- When you have a bottleneck, solve it
- Always prioritize completing jobs
- Turn off incoming orders to clear your factory if you get behind; avoids you making stuff for free

17/20
5/15 Game performance / Standings

Littlefield Sim 2 Final

Sunday, May 08, 2011
2:35 PM

Day: 200 Team ID: fieldcheck Cash Balance: 271,283,370



OVERALL STANDING • HISTORY • CASH • UPDATE • QUIT

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OVERALL TEAM STANDING

Rank	Team	Cash Balance (\$)
1	topops	305,123,229
2	cookiemonsters	303,471,922
3	campfour	301,531,219
4	sws	299,062,254
5	bbk	298,152,471
6	e72	297,679,321
7	alicesarah	295,581,355
8	dummy1	294,741,820
9	egrets	293,517,752
10	optimus	291,881,223
11	caligirls	289,585,115
12	asiandomination	288,865,582
13	raindrops	287,107,236
14	team14	284,773,110
15	trajoma	284,747,744
16	kaj	283,982,644
17	saikops	283,567,193
18	montana	282,793,495
19	3dimize	280,625,944
20	frenchies	280,309,615
21	opsoops	279,545,372
22	krb2011	279,331,535
23	kingofom1	278,734,815
24	pdmconsultants	278,646,920
25	egyptianriot	275,173,702
26	mas	275,026,025
27	satrekkers	272,979,271
28	blackops2012	271,322,900
29	fieldcheck	271,283,370

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Day	Parameter	New Value
20	Reorder quantity (kits)	9960
20	Reorder point (kits)	59940
20	Reorder quantity (kits)	59940
20	Reorder quantity (kits)	9960
20	Lots per order	5
20	Contract number	2
21	Reorder point (kits)	9960
21	Reorder quantity (kits)	59940
64	station 3 machine count	12
64	station 2 machine count	21
64	station 2 scheduling rule	pri4
64	station 1 machine count	14
89	station 1 machine count	15
100	Reorder point (kits)	12000
100	station 1 machine count	24
100	station 2 machine count	28
100	station 3 machine count	16
100	Max WIP limit	0
102	Max WIP limit	100
134	Reorder point (kits)	12900
134	Max WIP limit	0
137	Max WIP limit	999
172	Reorder point (kits)	0

update

close

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Littlefield Technologies -
Sources and Uses of Cash

Description	Amount (\$)
Starting Cash	75,000,000
<i>Cash Sources</i>	-
revenue	201,255,199
interest	85,472,171
<i>Cash Uses</i>	-
debt interest	0
machine purchases	38,000,000
inventory	52,444,000
Cash Balance	271,283,370

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Littlefield Technologies -
ORDERS MENU

Name: fieldcheck

Maximum WIP Limit: 999 jobs

Number of kits in 1 job: 60

Lot size: 12 kits, or 5 lots per job

Current contract: 2

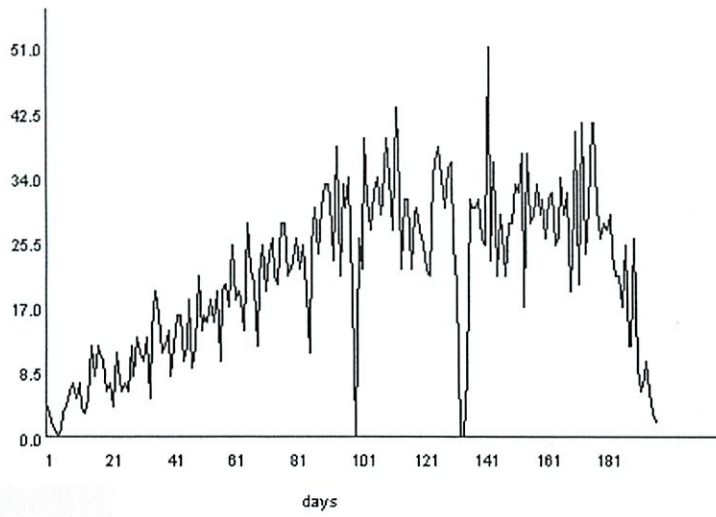
Quoted lead time: 1.3329976851851852 day(s)

Maximum lead time: 1.5 day(s)

Revenue per order: 50000.0 dollars

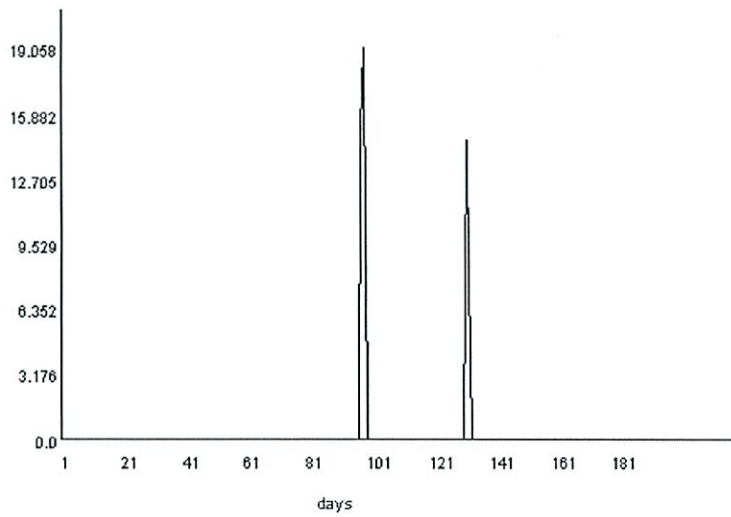
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Plot of number of jobs arriving each day



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Plot of daily average number of jobs waiting for kits



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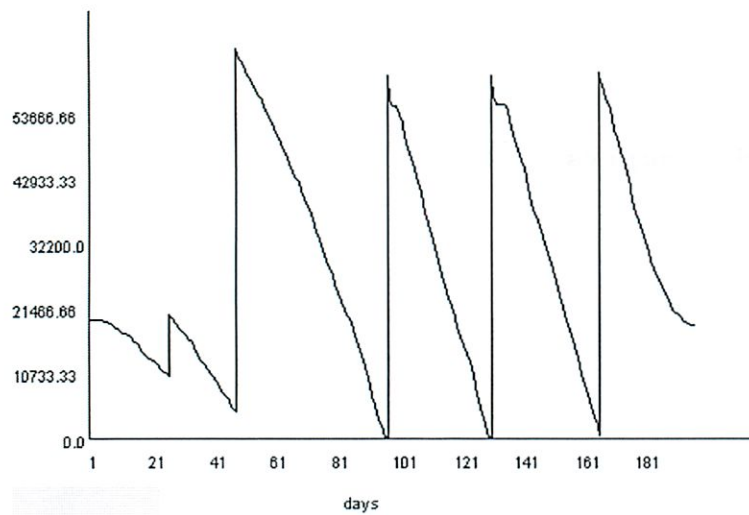
Littlefield Technologies -
MATERIALS MENU

Name: fieldcheck
Unit Cost: \$ 200.0
Order Cost: \$ 500000.0
Lead Time: 7 day(s)
Reorder Point: 0 kits (0 batches of 60)
Order Quantity: 59940 kits (999 batches of 60)

There are no outstanding materials orders

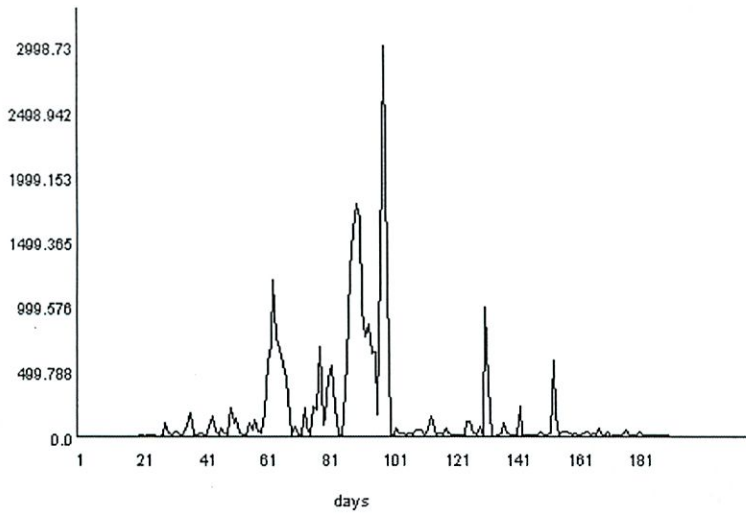
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Plot of inventory level in kits (not an average)



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Plot of daily average number of kits queued for station 1



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Littlefield Technologies -

STATION 1 MENU

Name: fieldcheck

Number of Machines: 24

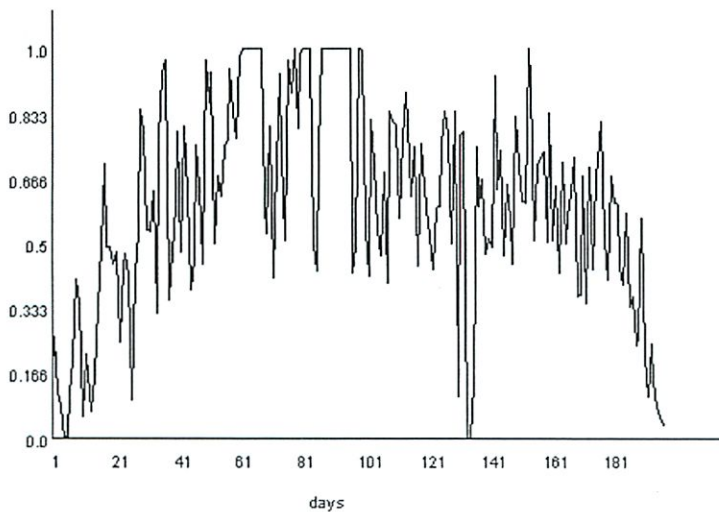
Scheduling Policy: FIFO

Purchase Price: \$ 1000000.0

Retirement Price: \$ 0.0

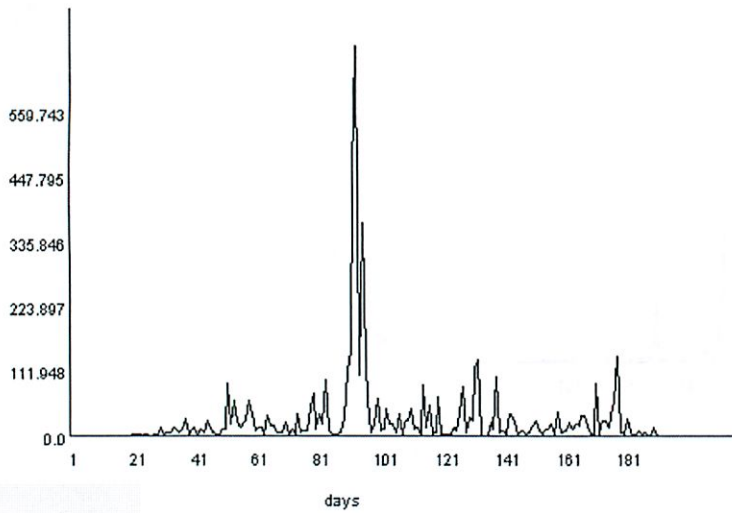
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Plot of utilization of station 1, averaged over each day



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Plot of daily average number of kits queued for station 2



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Littlefield Technologies -

STATION 2 MENU

Name: fieldcheck

Number of Machines: 28

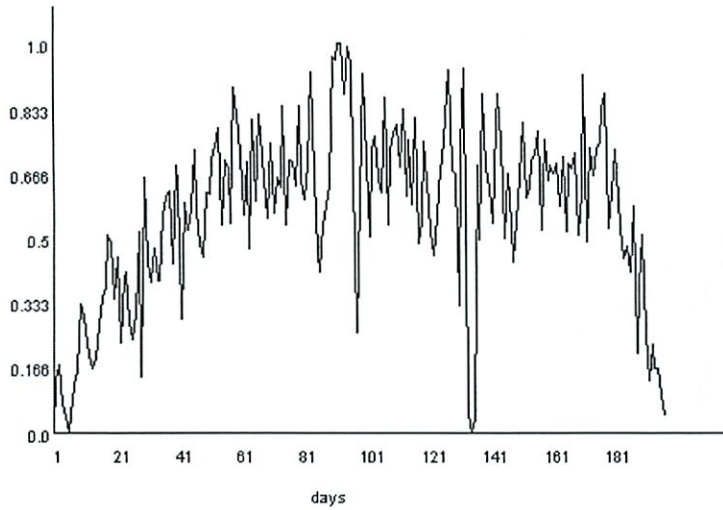
Scheduling Policy: Priority to Step 4

Purchase Price: \$ 1000000.0

Retirement Price: \$ 0.0

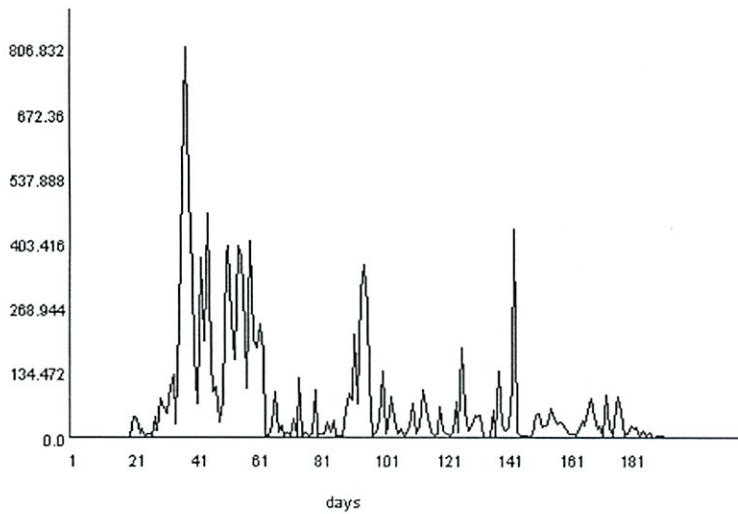
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Plot of utilization of station 2, averaged over each day



Screen clipping taken: 5/8/2011 2:41 PM

Plot of daily average number of kits queued for station 3



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Littlefield Technologies -

STATION 3 MENU

Name: fieldcheck

Number of Machines: 16

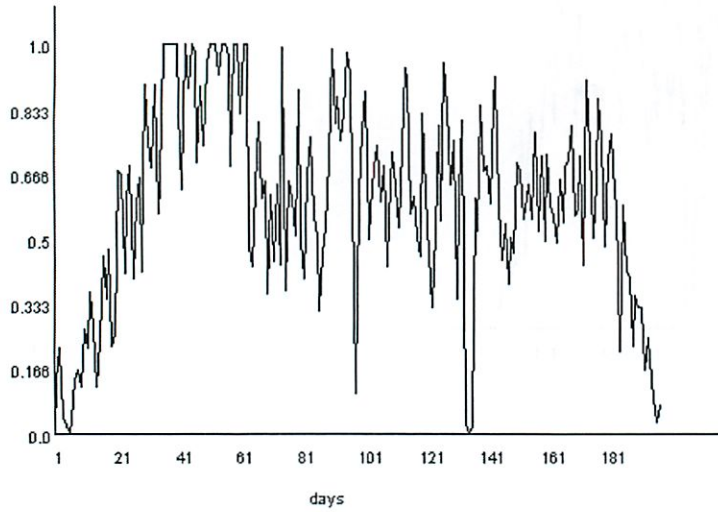
Scheduling Policy: FIFO

Purchase Price: \$ 1000000.0

Retirement Price: \$ 0.0

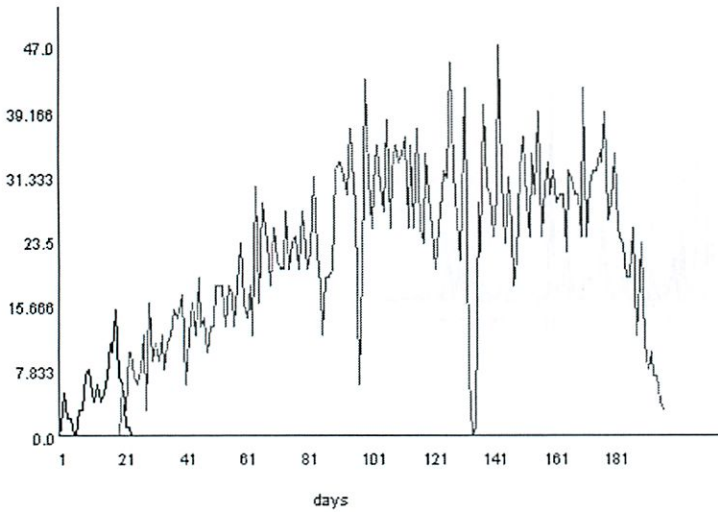
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Plot of utilization of station 3, averaged over each day



Screen clipping taken: 5/8/2011 2:42 PM

Plot of number of completed jobs each day



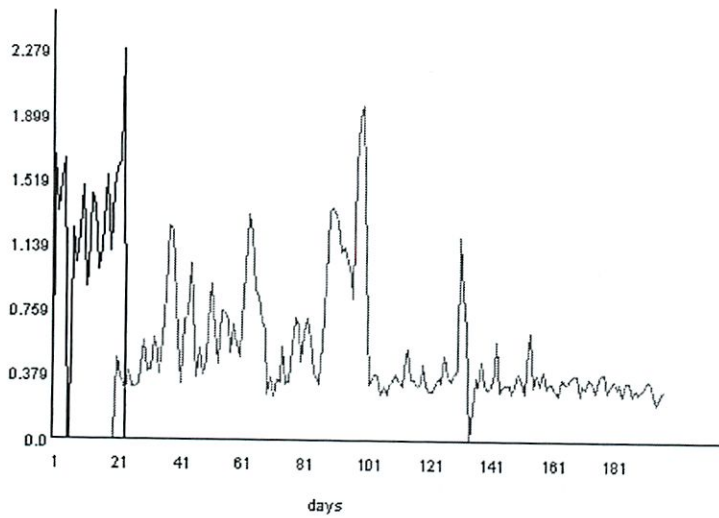
drag mouse over region of interest to zoom in plot

Legend

quoted lead time = 2.0 day(s), maximum lead time = 3.0 day(s), maximum revenue = 35000.0
quoted lead time = 1.3329976851851852 day(s), maximum lead time = 1.5 day(s), maximum revenue = 50000.0

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Plot of daily average job lead time



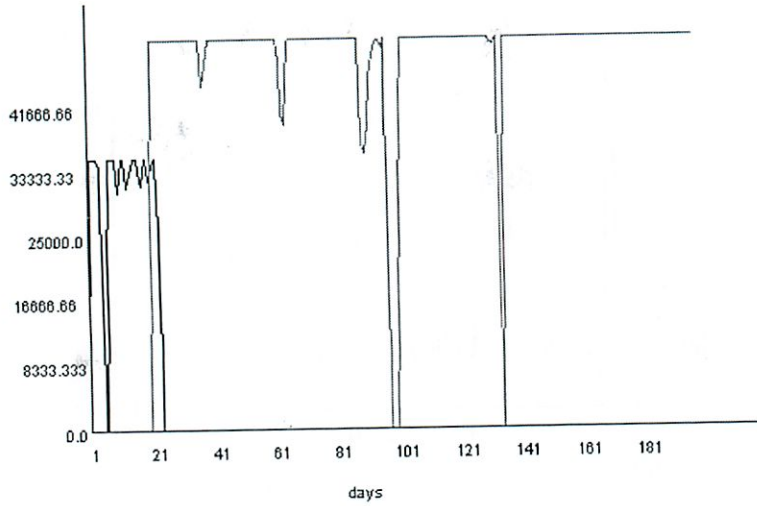
drag mouse over region of interest to zoom in plot

Legend

quoted lead time = 2.0 day(s), maximum lead time = 3.0 day(s), maximum revenue = 35000.0
quoted lead time = 1.3329976851851852 day(s), maximum lead time = 1.5 day(s), maximum revenue = 50000.0

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Plot of daily average revenue per job



drag mouse over region of interest to zoom in plot

Legend

quoted lead time = 2.0 day(s), maximum lead time = 3.0 day(s), maximum revenue = 35000.0
quoted lead time = 1.3329976851851852 day(s), maximum lead time = 1.5 day(s), maximum revenue = 50000.0

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