UNIVERSITI SAINS MALAYSIA

Final Examination
Semester I, Academic Session 1994/95

October/November 1994

AGW517 - OPERATIONS MANAGEMENT

Time: [3 hours]

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Instructions

Please make sure that this examination paper consists of SEVEN printed pages before you begin.

Attempt question **No. 1** and any **SIX** questions from the rest.

Q1. A firm producing wheelbarrows has received an order to supply 50 wheelbarrows in week 1, 60 in week 4, 60 in week 6 and 50 in week 8. Among the requirements for each wheelbarrow are two handlebars, a wheel assembly and one tire for the wheel assembly. Order quantities, lead times and inventories on hand at the beginning of period 1 are shown below:

| Part | Order Qty | Lead Times (weeks) | Inventory On Hand |
|---|---|---|---|
| Handlebars | 300 | 2 | 100 |
| Wheel assemblies | 200 | 3 | 120 |
| Tires | 400 | 1 | 50 |

A shipment of 300 handlebars is already scheduled to be received at the beginning of week 2. Complete the material-requirements plan for the handlebars, wheel assemblies and tires on the sheet provided and show what quantities of orders must be released and when must they be released in order to satisfy the MPS.

[16 marks]

...2/-

Q2. Penang Distributors company packages and distributes industrial supplies. A standard shipment can be packaged in any of the 3 types of containers - class I, class II or class III. The profit yielded by each class is shown in the table. Each shipment prepared requires a certain amount of packing material and a certain amount of time.

| Class of container | Resources Needed Per Std. Shipment | | Profit ($) |
|---|---|---|---|
| | Packing Material (kg) | Packing Time (Hours) | |
| I | 2 | 2 | 8 |
| II | 1 | 6 | 6 |
| III | 3 | 4 | 14 |
| Total Amount of Resource available each week | 120 kg | 240 hours | |

Abu bin Kassim, Head of the firm, must decide the optimal number of each class of container to pack each week. He must keep his six full-time packers employed all 240 hours (6 workers x 40 hours) each week.

Formulate this as a linear programming problem and set up an initial tableau for the simplex method.

[14 marks]

Q3. The garbage Trucks of Metropolitan Collection Company (MCC) currently wait an average of 6 minutes each trip before being able to dump their load. MCC is considering hauling to a different collection centre at an extra cost of $8 per trip for each truck. The new centre can process the loads at a constant rate of 30 units/hour. Arrivals at the new centre will be Poisson - distributed, with an average rate of 24 loads per hour. The system is a single - channel, single-phase system with unlimited queue length. If the waiting time for the trucks is valued at $200 per hour, how much of savings per hour would result?

[14 marks]

Q4. A film developing company in Penang must determine how many photo enlarger-cubicles are required to maintain an output of 200 good prints per hour. The set up and exposure time can theoretically be done in 2 minutes per print, but operators are on the average only 90% efficient and in addition 5% of the prints must be scrapped and redone. Also cubicles can be utilized for enlarging only 70% of the time. Calculate the required system capacity in prints per hour and the average output per hour expected from each cubicles. How many enlarger-cubicles are required?

[14 marks]

...3/-

Q5. You are owner of a club named BLUE BEAUTY. You are interested to determine the volume of sale- dollars necessary for the next year to reach the break-even point. For this purpose you have broken down the sales of the club into four categories, the first being liquor and beer. Your estimate of the beer sales is that 30,000 drinks will be served. The selling price for each drink will average $1.50; the cost being $0.75. The second major category is meals, which you expect to be 10,000 units with an average price of $10.00 and a cost of $5.00. The third major category is desserts and wine, the expected sale of which is 10,000 units at an average price of $2.50 per unit and a cost of $1.00 per unit. The last category is lunches and sandwiches, which you expect to total 20,000 units at an average price of $6.25 with a food cost of $3.25. The rent of premises is $1000 per month, cost of other utilities $800 per month, and $2000 per month for entertainment. Determine your break-even point in dollars. What is the expected number of meals each day if you are open 360 days a year?

[14 marks]

Q6. A manufacturer of photo-equipment buys lenses from a supplier at a cost of $100 each. The company requires 150 lenses per year. Carrying costs per unit/year are estimated to be 20% of the unit cost, whereas the ordering cost is $18 per order. The supplier offers a 6% discount for purchases of 50 lenses and 8% discount for purchases of 100 or more lenses. What quantity should be ordered at a time?

[14 marks]

Q7. A Malaysian firm is considering 3 locations - Kuala Lumpur, Ipoh and Penang for their new plant. A study of all costs at these places indicate that the production costs of the following items vary from location to location.

| | KL | Ipoh | Penang |
|---|---|---|---|
| Labour (per unit) | $1.10 | $0.80 | $0.75 |
| Plant construction cost ($ million) | 3.90 | 4.00 | 4.60 |
| Materials & Equipment cost/unit | 0.60 | 0.40 | 0.43 |
| Electricity (per year) | 26,000 | 30,000 | 30,000 |
| Water (per year) | 6,000 | 7,000 | 7,000 |
| Transportation (per unit) | 0.10 | 0.10 | 0.02 |
| Other costs (per year) | 28,000 | 63,000 | 33,000 |

...4/-

The firm will finance the new plant from loan bearing 10% interest. If the output volume of the firm is expected to be 105,000 units per year, determine the most suitable location.

[14 marks]

Q8. A schedular in a manufacturing workshop has four jobs that can be done on any of four machines with respective times as shown (minutes). Determine the allocation of jobs to machines that will result in minimum time.

| Jobs | MACHINES | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| A | 5 | 6 | 8 | 7 |
| B | 10 | 12 | 11 | 7 |
| C | 10 | 8 | 13 | 6 |
| D | 8 | 7 | 4 | 3 |

[14 marks]

Q9. a) To make sure that an operation is producing at the expected quality level, inspection of some or all of the items is needed. There are three basic issues relating to such an inspection. Discuss briefly these three issues.

b) A KL manufacturer has set up an automated production of a line of jeans. The popularity of the jeans has provided the company with a high margin of profitability. The percentage defective for jeans produced by this section has been averaging 2.5%. Samples of 20 jeans are taken at random from the line. Establish the control limits for this process at 99.7% confidence.

[14 marks]

oooOOOooo

...5/-

APPENDIX 1

| WEEK No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| REQUIREMENTS | | | | | | | | |

| ORDER QUANTITY = LEAD TIME = | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| PROJECTED REQUIREMENTS | | | | | | | | |
| RECEIPTS | | | | | | | | |
| ON HAND AT THE END OF PERIOD | | | | | | | | |
| PLANNED ORDER RELEASE | | | | | | | | |

| ORDER QUANTITY = LEAD TIME = | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| PROJECTED REQUIREMENTS | | | | | | | | |
| RECEIPTS | | | | | | | | |
| ON HAND AT THE END OF PERIOD | | | | | | | | |
| PLANNED ORDER RELEASE | | | | | | | | |

| ORDER QUANITITY = LEAD TIME = | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| PROJECTED REQUIREMENTS | | | | | | | | |
| RECEIPTS | | | | | | | | |
| ON HAND AT THE END OF PERIOD | | | | | | | | |
| PLANNED ORDER RELEASE | | | | | | | | |

APPENDIX 2

## FORMULEA

$$N_s = L_s = \frac{\lambda}{\mu - \lambda}$$

$$L_q = \frac{\lambda^2}{\mu(\mu-\lambda)} \quad ; \quad L_{q(c)} = \frac{\lambda^2}{2\mu(\mu-\lambda)}$$

$$T_s = W_s = \frac{1}{\mu - \lambda}$$

$$T_q = W_q = \frac{\lambda}{\mu(\mu-\lambda)} \quad ; \quad T_{q(c)} = \frac{\lambda}{2\mu(\mu-\lambda)}$$

$$\rho = \frac{\lambda}{\mu}$$

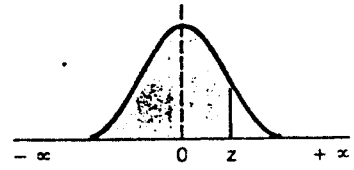
$$P_0 = 1 - \frac{\lambda}{\mu}$$

$$P_{T>t} = e^{-\mu(1-\frac{\lambda}{\mu})t}$$

$$P_n = \left(\frac{\lambda}{\mu}\right)^n \left(1 - \frac{\lambda}{\mu}\right)$$

| Size of Sample ($n$) | Factor for $UCL$ and $LCL$ for $\bar{x}$-Charts ($A_2$) | Factor for $LCL$ for $R$-Charts ($D_3$) | Factor for $UCL$ for $R$-Charts ($D_4$) |
|---|---|---|---|
| 2 | 1.880 | 0 | 3.267 |
| 3 | 1.023 | 0 | 2.575 |
| 4 | 0.729 | 0 | 2.282 |
| 5 | 0.577 | 0 | 2.115 |
| 6 | 0.483 | 0 | 2.004 |
| 7 | 0.419 | 0.076 | 1.924 |
| 8 | 0.373 | 0.136 | 1.864 |
| 9 | 0.337 | 0.184 | 1.816 |
| 10 | 0.308 | 0.223 | 1.777 |

*Source:* 1950 *ASTM Manual on Quality Control of Materials*, copyright © ASTM. Reprinted with permission.




| | .00 | .01 | .02 | .03 | .04 | .05 | .06 | .07 | .08 | .09 |
|---|---|---|---|---|---|---|---|---|---|---|
| .0 | .5000 | .5040 | .5080 | .5120 | .5160 | .5199 | .5239 | .5279 | .5319 | .5359 |
| .1 | .5398 | .5438 | .5478 | .5517 | .5557 | .5596 | .5636 | .5675 | .5714 | .5753 |
| .2 | .5793 | .5832 | .5871 | .5910 | .5948 | .5987 | .6026 | .6064 | .6103 | .6141 |
| .3 | .6179 | .6217 | .6255 | .6293 | .6331 | .6368 | .6406 | .6443 | .6480 | .6517 |
| .4 | .6554 | .6591 | .6628 | .6664 | .6700 | .6736 | .6772 | .6808 | .6844 | .6879 |
| .5 | .6915 | .6950 | .6985 | .7019 | .7054 | .7088 | .7123 | .7157 | .7190 | .7224 |
| .6 | .7257 | .7291 | .7324 | .7357 | .7389 | .7422 | .7454 | .7486 | .7517 | .7549 |
| .7 | .7580 | .7611 | .7642 | .7673 | .7704 | .7734 | .7764 | .7794 | .7823 | .7852 |
| .8 | .7881 | .7910 | .7939 | .7967 | .7995 | .8023 | .8051 | .8078 | .8106 | .8133 |
| .9 | .8159 | .8186 | .8212 | .8238 | .8264 | .8289 | .8315 | .8340 | .8365 | .8389 |
| 1.0 | .8413 | .8438 | .8461 | .8485 | .8508 | .8531 | .8554 | .8577 | .8599 | .8621 |
| 1.1 | .8643 | .8665 | .8686 | .8708 | .8729 | .8749 | .8770 | .8790 | .8810 | .8830 |
| 1.2 | .8849 | .8869 | .8888 | .8907 | .8925 | .8944 | .8962 | .8980 | .8997 | .9015 |
| 1.3 | .9032 | .9049 | .9066 | .9082 | .9099 | .9115 | .9131 | .9147 | .9162 | .9177 |
| 1.4 | .9192 | .9207 | .9222 | .9236 | .9251 | .9265 | .9279 | .9292 | .9306 | .9319 |
| 1.5 | .9332 | .9345 | .9357 | .9370 | .9382 | .9394 | .9406 | .9418 | .9429 | .9441 |
| 1.6 | .9452 | .9463 | .9474 | .9484 | .9495 | .9505 | .9515 | .9525 | .9535 | .9545 |
| 1.7 | .9554 | .9564 | .9573 | .9582 | .9591 | .9599 | .9608 | .9616 | .9625 | .9633 |
| 1.8 | .9641 | .9649 | .9656 | .9664 | .9671 | .9678 | .9686 | .9693 | .9699 | .9706 |
| 1.9 | .9713 | .9719 | .9726 | .9732 | .9738 | .9744 | .9750 | .9756 | .9761 | .9767 |
| 2.0 | .9772 | .9778 | .9783 | .9788 | .9793 | .9798 | .9803 | .9808 | .9812 | .9817 |
| 2.1 | .9821 | .9826 | .9830 | .9834 | .9838 | .9842 | .9846 | .9850 | .9854 | .9857 |
| 2.2 | .9861 | .9864 | .9868 | .9871 | .9875 | .9878 | .9881 | .9884 | .9887 | .9890 |
| 2.3 | .9893 | .9896 | .9898 | .9901 | .9904 | .9906 | .9909 | .9911 | .9913 | .9916 |
| 2.4 | .9918 | .9920 | .9922 | .9925 | .9927 | .9929 | .9931 | .9932 | .9934 | .9936 |
| 2.5 | .9938 | .9940 | .9941 | .9943 | .9945 | .9946 | .9948 | .9949 | .9951 | .9952 |
| 2.6 | .9953 | .9955 | .9956 | .9957 | .9959 | .9960 | .9961 | .9962 | .9963 | .9964 |
| 2.7 | .9965 | .9966 | .9967 | .9968 | .9969 | .9970 | .9971 | .9972 | .9973 | .9974 |
| 2.8 | .9974 | .9975 | .9976 | .9977 | .9977 | .9978 | .9979 | .9979 | .9980 | .9981 |
| 2.9 | .9981 | .9982 | .9982 | .9983 | .9984 | .9984 | .9985 | .9985 | .9986 | .9986 |
| 3.0 | .9987 | .9987 | .9987 | .9988 | .9988 | .9989 | .9989 | .9989 | .9990 | .9990 |
| 3.1 | .9990 | .9991 | .9991 | .9991 | .9992 | .9992 | .9992 | .9992 | .9993 | .9993 |
| 3.2 | .9993 | .9993 | .9994 | .9994 | .9994 | .9994 | .9994 | .9995 | .9995 | .9995 |
| 3.3 | .9995 | .9995 | .9995 | .9996 | .9996 | .9996 | .9996 | .9996 | .9996 | .9997 |
| 3.4 | .9997 | .9997 | .9997 | .9997 | .9997 | .9997 | .9997 | .9997 | .9997 | .9998 |