ISyE 3104 Exam 1 – Part I
Instructor: Damon P. Williams, Ph.D.

Name (Print Neatly): At Solutions

Section (8am or 9am): _____

Quiz Number (Print Neatly): _____

Point values are indicated next to each problem – please take these into consideration as you budget your time during the exam. If you are having difficulty with a question, sometimes it is beneficial to work on another question, and then come back.

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Point Summary

Question	Points	Out of
Multiple Choice		10
True/False		18
Short Answer #1		15
Extra Credit (Do Last!!!)		0
Question Writing E.C.		0
Total		**43**

I. Multiple Choice - Please circle ONE response. (2 points each)

1. We consider a linear programming formulation in aggregate planning because:
   a. It illustrates the basic issues of aggregate planning
   b. It provides the foundation or basis for solving more realistic problems
   c. It can be used to gain accurate results
   d. Both a and b
   e. All of the above

2. In an aggregate planning problem, if an ending inventory is specified it
   a. Does not fit the simplified model discussed, so there is no solution
   b. Can be ignored
   c. Is added to the demand of the last time period
   d. Determines whether a hire/fire or stable workforce strategy is used
   e. Is subtracted from the demand of the first time period

3. Your firm has solved the base EOQ model and found the optimal order quantity (Q^*) is 400 units. Your receiving department has a maximum capacity of 350 units and minimum capacity of 300 units, you should
   a. Order 400 units
   b. Order 300 units
   c. Order 350 units
   d. Order anywhere between 300 and 350 units
   e. Order more than 400 units

4. What is true of Balking?
   a. It is only for service-based industries
   b. It is directly related to smoothing costs
   c. It only affects industries selling both substitutable goods and non-substitutable goods
   d. Both a and b
   e. All of the above

5. An increase in optimal order quantity could be caused by
   a. A decrease in fixed setup costs
   b. An increase in demand rate
   c. Increase in holding costs
   d. Increase in interest rate

II. True/False - Please circle ONE response. (2 points each)

1. T -or- F Optimal order quantity does not depend on cost of a unit

2. T -or- F The holding cost includes all those costs that are proportional to the amount of inventory on hand, whereas the order cost depends on the amount of inventory that is ordered or produced.

3. T -or- F In the deterministic case, a static workforce is best.

4. T -or- F When determining a stable workforce strategy in aggregate planning, cumulative demand is necessary.

5. T -or- F In the EOQ model, when lead time increases, the optimal order quantity increases.

6. T -or- F Planning workforce levels depends on demand and demand forecasting always involve a random component that cannot be predicted

7. T -or- F If set up cost doubles in the EOQ model, Q^* is halved.\

8. T -or- F In the Aggregate Planning, setting time horizon short makes demand forecast more reliable

9. T –or- F The Aggregate unit is a real unit that represents an entire product family

III. Short Answer – Solve the following. Show all of your work. Write neatly and legibly. Place a box around your final answers.

1. Respond to the following: [15]
   a. Define balking and explain its relationship to aggregate planning [5]

When a customer refuses to enter a queue/line for service due to the length and expected wait time.

In a service based context low workforce schedules with too few employees will lead to long wait times and balking.

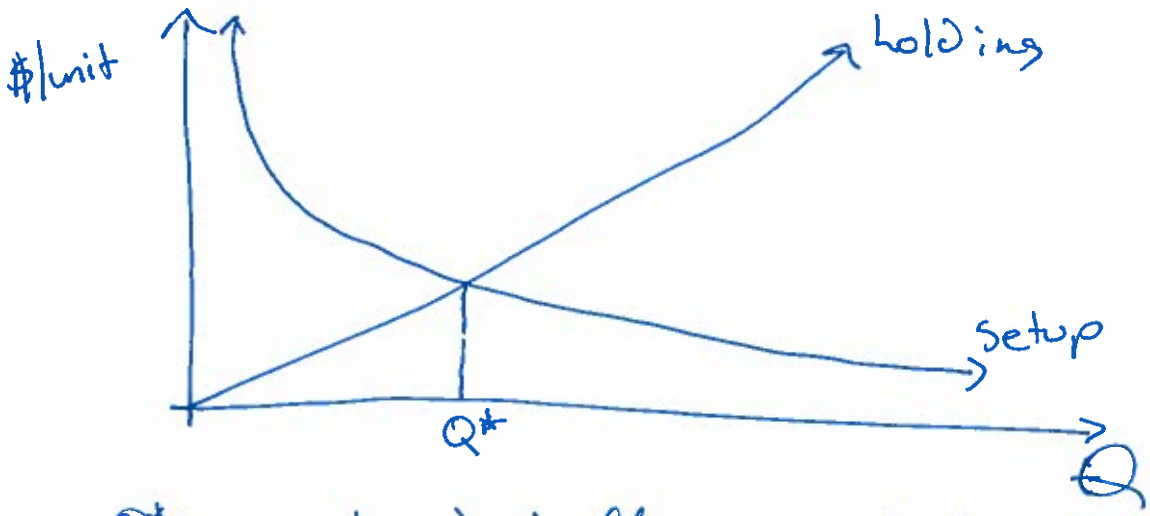
b. What are the three levels of decision making for a firm? Give an example of each. [5]

Strategic - President of G.T.

Tactical - Dean of C.O.E. at G.T.

Operating - Chair of ISyE dept. at G.T.

c. Draw a well labeled graph of the average cost per unit for the set up cost and holding cost. Where do the graphs intersect (label it on your graph) and explain what that point of intersection means. [5]



Q* is the tradeoff point between setup cost and holding cost.

Extra Credit – Do Last!!!

a. Johnny's mother had three children. The first child was named April. The second child was named May. What was the third child's name?[1]

Johnny

b. Before Mt. Everest was discovered, what was the highest mountain in the world? [1]

Mt. Everest

c. How much dirt is there in a hole that measures two feet by three feet by four feet? [1]

None.

ISyE 3104 Exam 1 – Part II
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Point Summary

Question	Points	Out of
Short Answer #2		15
Short Answer #3		20
Short Answer #4		26
Short Answer #5		16
Total		**77**

2. Ya Modo LLC sells Dashiki's to their best customer Abi E. Abi E's fixed demand for dashiki's is 5000 units per year. The unit cost of a Dashiki to Ya Modo is $20 and every time an order is placed by Abi E. to Ya Modo, he incurs a fixed cost of $1000. Ya Modo sells the dashiki's to Abi E. at a cost of $100/unit. They experience an annual cost of capital of 15%. [15]

   a. What is Ya Modo's optimal order quantity when he orders dashiki's from his supplier to sell to Abi E.? [5]

$K = \$1000$
$\lambda = 5000$
$c = \$20$
$i = .15$
$h = (.15)(20) = 3$

$$Q^* = \sqrt{\frac{2K\lambda}{h}}$$

$$= \sqrt{\frac{(2)(1000)(5000)}{3}}$$

≈ 1826 dashiki's

   b. How often does Ya Modo order per year? [4]

$$T = Q/\lambda = \frac{1826}{5000} = .3652 \text{ years/order}$$

$\frac{1}{.3652} \approx 2.73$ almost 3 times per year.

   c. Is Ya Modo's business profitable? Why or Why not? [6] Consider each order.

Revenue: $(1826)(100) = \$182,600$

Costs: $G(1826) = K\lambda/Q + \lambda c + hQ/2 = \$105,477$

OR

$c\lambda + \sqrt{2K\lambda h} = \$105,477$

Yes revenue exceeds costs.

3. Kyung is a project manager in a Krispy Kreme doughnut shop. The shop has a production rate of 10 doughnuts per hour, but a demand rate of only 5 doughnuts per hour. Kyung has calculated his costs and determined that his optimal lot size is a production run of 100 donuts. [20]

   a. What additional information do we need to verify that Kyung's optimal lot size is truly a production run of 100 units? [5]

For production rate $Q^* = \sqrt{\frac{2K\lambda}{h(1-\lambda/p)}}$

We need

$K, \lambda, h, \& p.$

We have $\lambda \& p$

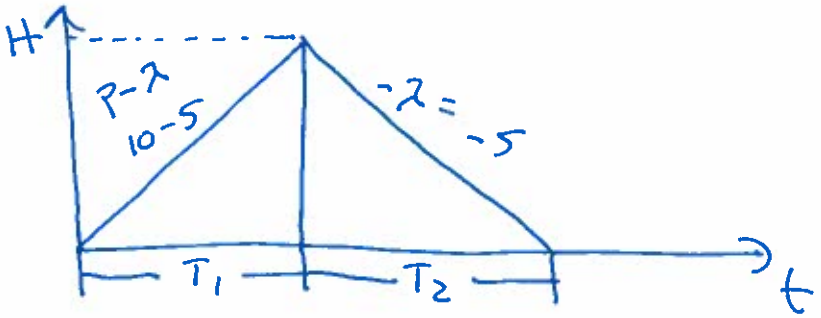
So we need $K \& h$

   b. Of the 100 units produced, in the optimal production run, how many will go into inventory? [5]

$1 - \lambda/p = 1 - 5/10 = .5$

$(100)(.5) = 50$

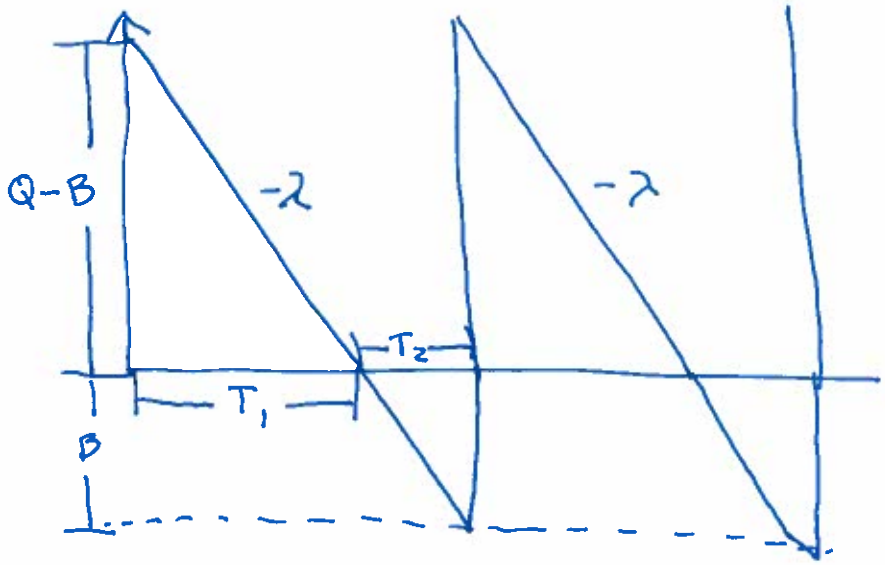
   c. Draw and label a graph of 1 cycle of Kyung's shop. How would you determine the length of 1 cycle? [10]



1 cycle = $T = T_1 + T_2$

$= H/p-\lambda + H/\lambda$

4. Consider an extension "3" to the Base EOQ model where backordering is allowed and everything else about the Base EOQ model is the same. Let B denote the maximum amount of the backorders. [26]
    a. Draw a well labeled graph of the change in inventory over time. [10]



b. Define T as the inter-arrival time between two successive order. How could we define T_1 and T_2 where $T = T_1 + T_2$? [10]

T_1 = time during non-negative on hand inventory.

T_2 = time during which demand is backordered.

T = total cycle time between two successive order arrivals

c. Write equations for T_1 and T_2. [6]

$$T_1 = \frac{Q - B}{\lambda}$$

$$T_2 = \frac{B}{\lambda}$$

5. Siham's Cookies is a company that is trying to plan a stable workforce and production levels for a 5 month period from January to May. Demand forecasts for the next five months is 2000, 1116, 973, 1586, and 1778. At the end of the year Siham's Cookies had 200 employees and 1000 workers. During a 23 day month, with 89 employees, the company produced 1000 cookies. They would like to have 1000 left over cookies at the end of May. The cost of hiring is $600/worker, the cost of firing is $900/worker, and the cost of inventory is $60/unit/month. [16]

   a. Determine k. [6]

$$K = \frac{1000 \text{ cookies}}{23 \text{ days} \mid 89 \text{ workers}}$$

$$= .4885 \text{ cookies/day/worker.}$$

b. Consider the following table. What is the cost of hiring or firing? [10]

Month	# of Working Day	Net Demand
Jan	22	1000
Feb	30	1116
Mar	19	973
Apr	26	1586
May	28	1778

	Production by 1 worker	Cumulative Production	Cumulative Demand	Workers Needed
Jan	10.747	10.747	1000	94
Feb	14.656	25.403	2116	84
Mar	9.292	34.695	3089	88
Apr	12.702	47.397	4675	99
May	13.679	61.076	6353	106

$$C_F = (\$900)(200-106)$$

$$= \$84,600$$