**PART I (20 Points) On Marginal Analysis of Activities**

Your company is producing and selling three products, Alpha, Beta and Gamma. The price, quantity sold and unit variable cost (also known as average variable cost) for each product is listed below.

 *Alpha Beta Gamma*

*Price (per unit) $20 $25 $15*

*Quantity Sold (Q) 10 15 5*

*Unit Variable Cost (AVC) $18 $23 $10*

(a) Assuming that the company has a fixed overhead cost of $70 that must be borne if any of the three products is produced, should the firm “stay in business” or “go out of business”? Explain your answer.

**I would “Stay in” or “Go out” (circle one)**

(b) If you answer to (a) was “stay in business”, then how high would the fixed overhead have to be in order for the firm to “go out of business? Likewise, if your answer to (a) was “go out of

business”, then how low would the fixed overhead have to be in order for the firm to “stay in

business”? Show your work.

**Fixed Overhead would need to be = $\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

(c) Assume that products Beta and Gamma are produced using the same facilities so that only one product line can be produced. If you are producing only one of these two, **then the fixed**

**overhead will decrease from $70 to $40**. If that is the case, which one, if either, would you

produce? Explain your answer.

**I would produce Beta or Gamma (circle one)**

(d) In answering (c), you chose to produce Beta or Gamma. To what level would the price of the

excluded produce rise in order for you to change your decision? Explain your answer.

**Price would need to rise to = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**PART II. (50 points) Optimal Product Mix**

Your company produces two products, Model Alpha and Model Beta. These products have profits (or contributions) of $900 and $450 respectively.

Each model is produced in a four process technology. The amount of time used by each model in each process is outlined below. The total amount of time available to produce all models is also listed.

 *Model Alpha Model Beta Total Time Available*

*Process 1 18 24 1440*

*Process 2 8 16 800*

*Process 3 72 6 576*

Process 4 30 15 3750

Using this data, answer the following questions.

(a) You are asked to select the combination of Model Alpha and Model Beta that will maximize

the profitability of your company. Write the linear program that solves this problem.

(b) **Using a ruler and/or graph paper**, sketch the set that shows the combinations of Model

Alpha and Model Beta that can be produced.

(c) **Using ruler and/or graph paper,** make a separate sketch that shows a family of “contour

lines” that show various combinations of Model Alpha and Model Beta that will produce

profit of $90,000 and $135,000 respectively.

(d) Find the combination of Model Alpha and Model Beta that maximizes the firm profit. What is firm’s profit at this profit mix (you may do this graphically, or with the Excel Solver)?

**Alpha = \_\_\_\_\_\_\_\_, Beta = \_\_\_\_\_\_\_, Profit = \_\_\_\_\_\_\_\_\_**

(e) If you could buy extra capacity of Process 1, what is the most that you would be willing to

pay to purchase it? How many units of capacity would you buy? Be sure to show your work

or provide an appropriate explanation.

**Most I would be willing to pay = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**How many units I would buy = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

(f) Suppose that your firm had the ability to produce a new product (Model Gamma). Assume

that this new model used the amount of time for each process listed below. If that is the case,

what would the contribution need to be in order for your firm to produce any units of Model

Gamma?

 Gamma

*Process 1* 18

*Process 2* 48

*Process 3* 18

*Process 4* 6

**Contribution from Gamma would need to be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**PART III. (20 points) A Transportation Problem.**

Your company produces products at three manufacturing facilities. The productive

capacity of the three facilities is given below in Table A. These products are shipped to

two retail outlets which sell them to your customers. The demand by customers at each

outlet is given below in Table B. The cost of shipping product from each manufacturing

facility to each outlet is given below in Table C.

**Table**

Manufacturing Facility Productive Capacity (maximum output)

Factory 1 150

Factory 2 175

Factory 3 175

**Table B.**

Retail Outlet Demand (units needed)

Outlet 1 250

Outlet 2 250

**Table C.**

From Facility To Outlet Transportation Cost (per unit shipped)

Factory 1 Outlet 1 20

Factory 2 Outlet 1 25

Factory 3 Outlet 1 28

Factory 1 Outlet 2 23

Factory 2 Outlet 2 30

Factory 3 Outlet 2 29

Using the data from the above tables, answer the following questions.

(a) Write the above cost minimization problem as a linear program.

(b) If you are ask to minimize shipment cost, how much product should you ship from each *Factory* to each *Outlet*.

From Facility To Outlet Amount Shipped

Factory 1 Outlet 1 \_\_\_\_

Factory 2 Outlet 1 \_\_\_\_

Factory 3 Outlet 1 \_\_\_\_

Factory 1 Outlet 2 \_\_\_\_

Factory 2 Outlet 2 \_\_\_\_

Factory 3 Outlet 2 \_\_\_\_

(c) Minimum total transportation cost = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_