

**General Instructions:** This exam is worth **200 points**. You must provide your own paper. You are allowed one 3x5 note card for the exam. This note card can have anything on it but if it is larger than 3x5 you will get a zero on the exam. You are allowed to use a calculator. **You must show all your work when appropriate to get credit.** This includes showing all applicable formulas you use. No cell phones, music players (ipods), or other technology devices are allowed to be in your possession during the exam. If you are caught with any of these items, you will receive a zero on the exam. **Any exam material left visible and unattended, or visible and on the ground will be thrown out by the professor when discovered.** (Good Luck!)

**Question 1 (100 Points Total):** Suppose you have just started a new company known as DARTH Tader, a company inspired by a recent set of movies that has been released by a major motion picture company. The primary items that your company sells are specialized fries made from potatoes that are sourced internationally. You have come to the conclusion that with all the hype that the movies generate, you will be able to generate great demand for your specialized fries without having to do much marketing. After doing a tremendous amount of marketing research, you believe that you can sell a tub of fries for \$5 per container where a tub of fries weighs approximately 1 pound.

You have decided that you can fill a tub with three different sets of fries and still sell them for the same price of \$5 per tub. The first tub of fries is made from only Argentinian potatoes. You can purchase these potatoes from a supplier for \$1,845 per ton. The second tub of fries you can sell has potatoes that are sourced from both Denmark and England. Given what your market research has shown, you need to sell these potatoes together, because there is no demand for them separately. This is due to the unique texture of each that appear to work well together, but turn consumers off when they are eaten separately. The cost to purchase a hundredweight (CWT) of the potatoes from Denmark are \$30 per CWT, while the cost of potatoes from England are \$2 per pound. The third tub of fries contain potatoes from Romania. You are able to purchase these potatoes for \$180 per CWT.

Since you are new to the business of selling gourmet fries, you have very little knowledge regarding how the fries as raw inputs would be transformed by the cooking process into a tub of fries that you can sell. Having gained insight from a recent movie on how a major burger company estimated and improved efficiency, you decided to conduct experiments with cooking these fries to see how the inputs turn into an output. Based on the data you collected and analyzed using a spreadsheet, you discovered that you could represent the production function for fries as the following:

$$T = f(A, D, E, R) = -3(A(A^2 - 60A - 123)) - 8(D^3E^2)^{1/6} + (R - 26)R);$$

where  $T$  is the number of tubs of fries you sell,  $A$  represents the amount of Argentinian potatoes you fry in tons,  $D$  is the amount of Denmark potatoes you fry measured in CWT,  $E$  represents a pound of potatoes from England that you fry, and  $R$  represents a CWT of potatoes that come from Romania. Each of the four inputs are considered variable. You also have a set of fixed inputs like labor, rent, utilities, etc. that comprise a fixed set of inputs which costs \$44,735.

Please answer the following questions making sure to give proper justification:

- A) At the current given prices, what is the optimal amount of profit you will receive for producing the optimal number of tubs of fries? **(50 Points)**
- B) Suppose your supplier for potatoes from Denmark and England comes to you and tells you she is unable to supply you with any of the potatoes you need and recommends that you should just maximize the revenue by using only potatoes from Argentina and Romania. How much profit would you lose if you followed this individual's advice? Note: you need to calculate a new profit max for this problem and choose values that make economic sense. **(20 Points)**
- C) Suppose you decide that you would like to produce 583,200 baskets using only potatoes from Denmark and England. Graph your cost minimizing solution. Assume the other two variables are zero and that fixed costs are zero. **(20 Points)**
- D) Suppose that you want to produce at the lowest average variable cost (AVC) using only potatoes from Argentina, what is the optimal input and output that would give you the lowest AVC? (Note you can assume for this problem that potatoes from Denmark, England, and Romania are set to zero. Also, you **do not** need to actually compute what the lowest AVC is.) **(10 Points)**

**Question 2 (80 Points Total):** Suppose you are a producer of potatoes that has operations all over the world. The company you run is known as Tuberlicious. You just received a call from a buyer in the US that has a need for potatoes that are grown from Denmark and England. The buyer informs you that he is willing to pay \$30 per CWT of potatoes that are grown in Denmark and \$2 per pound for potatoes grown in England. He has told you that it is very important that you provide him with certification that the potatoes are from their respective region since he will be marketing them as such.

Since you have been in the potato business for many years, you have a tremendous knowledge regarding what it takes to grow a quality potato. Given the economic climate this year, you have plenty of inputs to utilize producing potatoes from both of these regions except for labor. For these particular regions, you only have 11,296 hours of labor you can use to grow potatoes. These labor hours can be split across the two countries at no significant cost to you as long as you have enough lead time to inform your workers where they will be needed. The workers for you are very high skilled and can command a wage of \$225 per hour. You also have other fixed input costs for the operations in these two regions that sum to \$47,200, which you can consider as fixed costs.

Having looked at your production data for the last couple of years for these regions, you have estimated the production functions for growing potatoes in each of these regions where the input is labor hours. Your production function for potatoes grown in Denmark can be represented as:  $D = f(L_D) = 60L_D^{3/4}$ , where  $D$  represents the number of CWT of potatoes you can produce in Denmark and  $L_D$  is the number of labor hours you allocate to growing potatoes in Denmark. The production function for potatoes grown in England can be represented as:  $E = f(L_E) = 1500L_E^{3/4}$ , where  $E$  represents the number of pounds of potatoes you can produce in England and  $L_E$  is the number of labor hours you allocate to growing potatoes in England. You can assume that the American buyer will purchase all the potatoes you are able to produce at the corresponding prices given above. You can also assume that your goal is to maximize profit given your fixed amount of labor available to you.

Please answer the following questions based on the information given above:

- A) What is the optimal profit at your optimal solution? If you solve this problem using MVP's, you will lose 15 points. **(50 Points)**
- B) Graph the optimal solution. Be sure to use revenue rather than profit when you are graphing the optimal solution. **(20 Points)**
- C) If Tuberlicious allocated 1,296 hours of labor to producing potatoes from Denmark and 10,000 hours of labor to producing potatoes in England, what would be the optimal tradeoff between potatoes from England and potatoes from Denmark? Please briefly explain your answer. **(10 Points)**

**Question 3 (20 Points Total):** Suppose that Darth Tader opened up a restaurant in San Luis Obispo to compete against an established company known as Spuds. Both establishments focus on producing high end potato products for consumers in the area. Each has a goal to maximize profits based on strategies that they choose. Currently the strategies that the two companies are exploring revolve around what type of advertisements and what demographics the companies are trying to target.

Since Spuds has been in the market for a while, it has a pretty good handle on the group of consumers that it prefers to target. It believes that the strategies that it has available to it are related to where it should advertise to its target market. It currently has three options: Web Advertising (WA), Newspaper Advertising (NA), and Television Advertising.

One of the first set of strategies that Darth Tader needs to figure out as it enters the San Luis Obispo market is which group of consumers it should target. After doing some market research, it has discovered that there are four target groups that make sense to advertise to. These include: the College Crowd (ACC), the Tourists (AT), the Locals (AL), and the Seniors (AS).

You can assume that Spuds and Darth Tader know they are competing with each other and they each have the same information. They know each other's strategies and payoffs. They also know that the payoffs they receive are affected by their own strategies and the strategies of the other player. Each will need to make its strategic decision without the other company explicitly

seeing what the other has done, i.e., they move simultaneously. The table provided below gives the daily profit for the corresponding strategies that each company decides to play. Darth Tader's payoffs are represented first, while Spuds' payoffs are listed second.

Based on this information, please answer the following questions.

		<b>Spuds</b>		
		<b>Web Advertising (WA)</b>	<b>Newspaper Advertising (NA)</b>	<b>Television Advertising (TA)</b>
<b>Darth Tader</b>	<b>Advertise to College Crowd (ACC)</b>	484 , 711	465 , 107	849 , 926
	<b>Advertise to Tourist (AT)</b>	238 , 841	129 , 116	425 , 283
	<b>Advertise to Locals (AL)</b>	533 , 815	743 , 213	960 , 287
	<b>Advertise to Seniors (AS)</b>	120 , 604	836 , 716	150 , 638

Please answer the following questions:

A) Are there any dominant or dominated strategies for either company? If so, what is it or are they? **(5 Points)**

B) Does a Nash equilibrium exist? If so, what is it or are they? **(5 Points)**

C) Is there a prisoner's dilemma in the game? Please briefly explain. **(5 Points)**

D) If Spuds could get advanced knowledge of what strategy Darth Tader would do, what strategy would each company choose based on the idea of a Subgame Perfect Nash Equilibrium/Rollback Equilibrium? Please explain. **(5 Points)**