**Ag Bus 313 Final**

**Section 1**

**12/14/18**

**Dr. Hurley**

**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!)[[1]](#footnote-1)**

**Question 1 (100 Points Total):** Dr. Hurley enjoys cooking in his spare time. One of the favorite meals he likes to prepare is soup. The reason he enjoys making soup is because it is an opportunity for him to grab all the food in his refrigerator that is about to go bad and use it in an efficient way. He gets great joy when he feels like he is preventing food waste. Dr. Hurley’s soups have become famous in his household to the point that his family has named his soup the Jesus soup. The reason that his soups are called this is because no matter how much you eat, there always seems to be leftovers.

Recently, Dr. Hurley was going through his refrigerator and came across five items that were about to go bad. These included ham, rice, Indian peas, squash, and tomatoes. Since he did not want to throw these items out, he decided to make one of his famous soups. Upon tasting the soup, he found what he believed would be the next great soup that could be marketed for millions of dollars. As you would expect from Dr. Hurley, the first thing he did was use Excel to estimate the production function for making the soup. After modeling the soup making process and trying many different batches, he came up with the following production function:

C = f(H, R, I, S, T) = **–**(H+2R+3I)2 + 2(2HR+3HI+6RI+180(H+R+I))+45S1/3T1/3;

where C represents a 16 ounce cup, which is more like a bowl, H represents 1,000 pounds of ham, R is the quantity of rice in tons, I represents a ton of Indian peas, S signifies 100 pounds of squash, and T represents a hundred pounds of tomatoes. This soup was so good that he expected he could get $20 a cup.

After Dr. Hurley developed his production function for making his soup, he called some of his graduates that he knew sold each of the ingredients to his soup. One of his graduates who was a pork producer quoted him a price of $3,200 per 1,000 pounds of ham. Another graduate of his produced and milled rice. Since he remembered Dr. Hurley’s class fondly (15 years of therapy will do that), he offered to sell a ton of rice for $800. A third graduate of Dr. Hurley specialized in selling Indian peas and tomatoes. She was willing to sell a ton of peas for $3,600 and a hundred pounds of tomatoes for $60. The final person that Dr. Hurley called was a squash producer. This individual quoted Dr. Hurley a price of $50 per 100 pounds. Dr. Hurley considered these five ingredients as variable costs. He also had a bunch of fixed inputs like electricity, water, rent, etc. that cost $55,000.

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

A) At the current given prices, what is the optimal amount of profit Dr. Hurley will receive for producing the optimal number of cups of soup? **(50 Points)**

B) Suppose one of Dr. Hurley’s suppliers tried to convince him to drop the squash and tomatoes in the soup. Suppose also that this supplier wanted Dr. Hurley to maximize his revenue rather than profit. How much profit would Dr. Hurley lose if he followed this individual’s advice? Note: you need to calculate a new profit max for this problem as well as the profit at revenue maximization. **(20 Points)**

C) Suppose another supplier tried to convince Dr. Hurley to produce 5,400 cups of soup using only squash and tomatoes and having an objective of cost minimization. Please calculate the difference in profits between the profit max with two inputs and the profit from the cost min result. **(20 Points)**

D) Graph the cost minimizing solution from Part C assuming fixed costs are zero and Dr. Hurley will be producing 5,400 cups of soup. **(10 Points)**

**Question 2 (80 Points Total):** Suppose you just received a call from Dr. Hurley. He has told you that he has decided that he was going to start a side business of making soups to sell so he could afford the college costs for three of his children who are currently working on their degrees. The reason he called you is because you are a producer of Indian peas and tomatoes. You have been growing these items for the last ten years in hothouses, so Dr. Hurley believes that you can provide him with a quality product that can be consistently delivered to him throughout the year.

Since you have been growing these two items for the last decade, you have a pretty good handle on what it takes to produce each product. Specifically, to grow these two goods, you will need to allocate space in your hothouses. Having looked at your production data for the last couple of years for these crops, you have estimated the production functions for each where you have a fixed input of hothouse space that needs to be allocated to each of these products. Your production function for Indian peas can be represented as: I = f(HI) = 36HI1/3, where I represents a ton of peas, and HI is the number of square feet in your hothouse that you will allocate to growing these peas. The production function for tomatoes can be represented as: T = f(HT) = 60HT1/3, where T represents 100 pounds of tomatoes and HT is equal to the square feet you allocate to the production of tomatoes.

You can assume that Dr. Hurley will purchase all Indian peas that you produce for $3,600 per ton and all of your tomatoes for $60 per 100 pounds. You have estimated that you have 1,736,000 square feet of hothouse space available to produce these two crops. This hothouse space cost you $3 per square foot. Since the hothouses were expensive to build, you would like to recapture $5,416,000 in capital costs. You can assume that these capital costs represent your total fixed costs. Your goal is to maximize profit given the fixed amount of hothouse space you have available for growing Indian peas, and tomatoes.

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) Suppose Dr. Hurley calls you back and says that his soup is a great hit. He tells you that he is now willing to pay $5,400 per ton for the Indian peas and $90 per 100 pounds of tomatoes. What would your new profit be? **(10 Points)**

**Question 3 (20 Points Total):** Suppose Dr. Hurley has decided to open a soup business in San Luis Obispo where he will only be focusing on five types of soups. Each of these soups are made up of a subset of the five key ingredients discussed above. You can assume that Dr. Hurley has only one main competitor in town. This company is known as Souper SLO. Since these two companies are the only two restaurants that primarily serve soup, you can assume that the decision one makes will affect the other’s decisions and payoffs. You can assume that each soup seller knows the payoffs and available strategies of the other, but initially they will need to make their decisions without the other one knowing what the other did, i.e., they are making their strategy decisions simultaneously. Each company’s primary strategy entails some sort of price discount which will be posted the day of the sale.

Dr. Hurley has five strategies available to him. All these strategies entail what the soup special of the day is. One of the soup specials that Dr. Hurley can do is sell his signature Jesus soup for a 10% discount (J). A second strategy available to Dr. Hurley is to do a two-for-one deal on his Split Indian Pea soup (SIP). The third strategy available to Dr. Hurley is to take $1.00 off of his Squash and Tomato soup (ST). Dr. Hurley has a fourth strategy of selling his Indian Pea and Rice soup for $9.99 (IPR). This represents a savings of $2.00 off of his normal pricing for this item. His final strategy consists of giving a 50% discount on a second bowl of his Rice, Squash, and Tomato soup (RST).

Souper SLO has three signature soups that have made it famous. These include Tomato Bisque, Chicken Noodle, and Beef Barley. Souper SLO has great concern regarding the entry of Dr. Hurley into the soup market. To manage this new competition, the company has come up with a set of strategies to counter Dr. Hurley’s sales strategies. The first strategy for Souper SLO is to sell its Tomato Bisque at a 15% discount (TB). The second strategy that Souper SLO can employ is to sell its Chicken Noodle Soup at a 15% discount (CN). The third strategy available to Souper SLO is to sell its Beef Barley for a 20% discount (BB).

The table provided below gives the daily profit for the corresponding strategies that each company decides to play. Dr. Hurley’s payoffs are represented first, while Souper SLO’s payoffs are listed second. You can assume that both are trying to maximize their payoffs given the decisions that are made by both.

Based on this information, please answer the following questions.

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| --- | --- | --- | --- | --- |
|  | | **Souper SLO** | | |
| **Tomato Bisque (TB)** | **Chicken Noodle (CN)** | **Beef Barley (BB)** |
| **Dr. Hurley** | **Jesus (J)** | 235 , 986 | 792 , 49 | 175 , 540 |
| **Split Indian Pea (SIP)** | 675 , 604 | 61 , 311 | 560 , 209 |
| **Squash and Tomato (ST)** | 402 , 972 | 745 , 99 | 897 , 394 |
| **Indian Pea and Rice (IPR)** | 491 , 878 | 639 , 163 | 752 , 655 |
| **Rice, Squash, and Tomato (RST)** | 323 , 729 | 598 , 848 | 550 , 67 |

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) If Souper SLO could get advanced knowledge of what strategy Dr. Hurley will employ, what strategy would each company choose based on the idea of a Subgame Perfect Nash Equilibrium/Rollback Equilibrium? Please explain using a game tree. **(10 Points)**

1. The story presented for this exam should not be construed as an endorsement of any religion. [↑](#footnote-ref-1)