**Ag Bus 313 Final**

**Section 1**

**3/20/19**

**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!)**

**Question 1 (100 Points Total):** Suppose you run a small start-up company known as Shaken Veggie, which creates artisan milkshakes that are infused with sumptuous roots and vegetables. Recently, the organization that runs the March Madness Tournament had a contest for an opportunity to sell your product as a vendor at each of the games. Given their theme this year, Healthy Half-Time, the organization was impressed by your incredibly tasty vegetable milkshakes and thought they would make an excellent addition to the items that get sold at the tournament.

As a result of your win, the organization will provide you with marketing and operation consultants who can help you with sourcing your ingredients, pricing your product, and scaling your operation to a size that will fit the venues that you will be able to sell. The first consultant that you meet is the marketing consultant. This individual has sat down with you to get a better understanding of your products. You let the individual know that you have four main ingredients to your signature milkshake, which are asparagus, radicchio, carrots, and horseradish. Based on a couple of focus groups that the marketing consultant has conducted, she recommends that you sell your milkshakes in pint size cups that will sell for $10 per cup. After some back-and-forth, the consultant and you come up with an excellent marketing gimmick for your product; Shaken Veggie, Its Shaken Not Stirred. Hence, when you make your shakes in front of the customer, the last thing you do before you give it to them is give the concoction a quick shake in the cup.

The next item that the marketing consultant helps you with is the procurement of your main variable inputs, i.e., asparagus, radicchio, carrots, and horseradish. Having called around to multiple suppliers, you have found that you can purchase a 100 pound box of asparagus for $40 and a 20 pound box of radicchio for $10 from Aspachio, who offers you the best deal on these items. The company, Putting the Carrot Before the Horse, is a specialist in producing root vegetables. You have found that this company will offer you the best deal for carrots and horseradish. Specifically, they are willing to supply you with carrots for $120 per 1000 pounds and horseradish for $60 per 20 pound box. While these are your main variable inputs to production, you also have some fixed inputs. The total fixed cost of these inputs is $1,480. All other costs such as rent and utilities is free to you since you won the contest.

After meeting with the marketing consultant, you next meet with the production consultant. The purpose of this individual is to help you understand how your vegetables turn into milkshakes. This individual works with you for a week to gain a better understanding of how you produce your milkshakes. From the data this individual collected, he was able to develop the following production function:

M = f(A, R, C, H) = 3(256A1/2R1/2)1/2 + 3C(40 **–** C) + 6H(1 + H) **–** H3;

where M represents a pint cup of your award winning milkshake, A represents a 100 pound box of asparagus, R is the quantity of radicchio measured in 20 pound boxes, C represents a 1,000 pounds of carrots, and H represents a 20 pound box of horseradish.

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 expect to make for producing the optimal number of milkshakes assuming that you can sell all that you produce? **(50 Points)**

B) Suppose that the marketer you have been working with says that a new focus group has come back and said that the consumer of your product is very cost conscience. Based on this finding, the marketer recommends that you should sell at you lowest average variable cost and only use horseradish in your milkshakes. What is the minimum average variable cost you could produce at? **(10 Points)**

C) How much profit would you have lost if you produced at the optimal milkshake quantity for minimum average variable cost found in part B instead of maximizing profits utilizing the single input of horseradish? **(10 Points)**

D) Another recommendation the marketer has for you is to just produce 576 milkshakes while only utilizing asparagus and radicchio. What is the minimum total cost you could produce these 576 milkshakes making sure you incorporate your fixed costs? **(15 Points)**

E) Graph the cost minimizing solution from Part D assuming fixed costs are zero and Shaken Veggie will produce 576 milkshakes. **(15 Points)**

**Question 2 (80 Points Total):** Suppose you represent the company Aspachio. You are a new upstart vertical farming company who has just perfected growing different vegetables in your aeroponics system which grows plants within a closed environment that utilizes a nutrient mist spray to grow the plants. You just received a call from a representative at Shaken Veggie inquiring how much you charge for your asparagus and radicchio. Looking at your price list, you see that your manager is willing to sell a 20 pound box of radicchio for $10 and 100 pound box of Asparagus for $40. Based on this pricing, Shaken Veggie says the company is willing to buy all that you are willing to produce at these prices.

Once you got off the phone, you inform your boss of the order with great enthusiasm. Your boss goes to the production manager and lets him know about the upcoming order. Given the sophisticated nature of the environment that the company is growing the plants in, the production manager has developed production functions for each of the products. The production function for radicchio can be represented as R = 6FR2/3, while the production function for the asparagus can be represented as A = 3FA2/3. For these two production functions, R represents a 20 pound box of radicchio, A represents 100 pound box of asparagus, FR denotes the square-feet of the vertical operation devoted to producing radicchio, and FA is the amount of square-feet devoted to producing asparagus. The key fixed input that you have available to produce is floor space which costs $2 per square-foot. Based on the production of all the company’s other products, the production manager informs your boss that he can only allocate 72,000 square feet to growing both radicchio and asparagus.

Given that the company can grow these products multiple times a year, it allocates $22,000 to recapture capital costs. This capital cost can be considered a fixed cost of production. Assuming that the goal of the company is to maximize profit given the fixed amount of vertical farming floor space available for radicchio and asparagus, please answer the following questions:

A) What is the optimal profit at the 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) What is the tradeoff of asparagus for radicchio when you allocate 8,000 square feet of space to radicchio? Please explain. **(10 Points)**

**Question 3 (20 Points Total):** HT Vendors has been selling at the tournament for the last 25 years. This company normally sells many food favorites that fans at the tournament have come to expect and love. Unfortunately, all the items on the vendor’s menu tend to be very unhealthy. HT Vendors has recently grown greatly concern that the organization running March Madness has adopted a new theme of Healthy Half-Time. The company believes that this new push for healthy foods at the game and the corresponding advertising campaign is going to cut into its sales. The company is especially concerned about the winner of this year’s vendor contest, Shaken Veggie.

Given this new competition coming in, HT Vendors is beginning to think more strategically about its decisions. It has decided to investigate different strategies that it can employ that will allow it to compete with the new entrant. Specifically, it has chosen four strategies to consider in competing with Shaken Veggie. The first strategy entails HT Vendors to sell its beer at a discount (DB). The second strategy the vendor is considering is discounting its hotdogs that it sells (DH). The third strategy would require HT Vendors to discount its popcorn (DP), while the fourth strategy has the company discounting its nachos (DN).

The marketer that is working for Shaken Veggie has cautioned the company that it needs to think strategically about how it will compete with HT Vendors. The individual has recommended that Shaken Veggie consider employing one of four strategies that revolves around discounting one of the four shakes that it can make. The first shake that Shaken Veggie could discount is its asparagus shake (DAS). The second type of shake that the company can discount is its radicchio shake (DRS). The third shake that can be discounted is Shaken Veggie’s signature mixed shake that has asparagus, radicchio, carrots, and horseradish (DMS). The fourth shake that can be discounted is the carrot and horseradish shake (DCHS).

The table provided below gives the daily profit in $100’s for the corresponding strategies that each company decides to play. Shaken Veggie’s payoffs are represented first, while HT Vendor’s payoffs are listed second. You can assume that both are trying to maximize their payoffs given the other’s decision. You can also assume that the decision made by one company will affect the other company and vice versa.

Based on this information, please answer the following questions.

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|  | **HT Vendors** |
| **Discount Beer****(DB)** | **Discount Hotdogs****(DH)** | **Discount Popcorn (DP)** | **Discount Nachos (DN)** |
| **Shaken Veggie** | **Discount Asparagus Shake (DAS)** | 74 , 57 | 24 , 52 | 33 , 49 | 19 , 50 |
| **Discount Radicchio Shake (DRS)** | 51 , 86 | 49 , 50 | 39 , 15 | 54 , 43 |
| **Discount Mixed Shake (DMS)** | 59 , 84 | 11 , 59 | 26 , 27 | 60 , 49 |
| **Discount Carrot and Horseradish Shake (DCHS)** | 33 , 62 | 52 , 17 | 63 , 59 | 91 , 54 |

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 HT Vendors could get advanced knowledge of what strategy Shaken Veggie 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)**