**AAE 320 Fall 2020 Exam #1 Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**1) (6 pts.)** *Based on material covered in class*, are these True or False? Mark your answer.

1. T\_\_\_ F\_\_\_ The number of dairy herds in Wisconsin has been declining the last 2-3 years at a more rapid rate than in previous years.
2. T\_\_\_ F\_\_\_ In Wisconsin, about 75% of all the farmers have less than $100,000 of agricultural sales annually.
3. T\_\_\_ F\_\_\_ Wisconsin has the second largest processed vegetable industry in the U.S. in terms of the annual value of production.
4. T\_\_\_ F\_\_\_ Based on budgets examined in class for Wisconsin and other states, the full cost of production for a dairy cow exceeds $4,600 per year.
5. T\_\_\_ F\_\_\_ Most value in the U.S. food system is generated after the farmer, so farmers receive only a small part of the money when someone buys food.
6. T\_\_\_ F\_\_\_ Based on materials covered in class, farming is the most capital intensive part of the U.S. food supply chain.

**2) (10 pts.) Short answer**

a) (1 pt) What is Wisconsin’s largest fruit crop in terms of the annual value produced each year?

b) (1 pt) In the context of dairy farming, is a milk cow male or female?

c) (2 pt) In the context of dairy farming, what is the difference between a heifer and a cow?

d) (2 pt) In the context of dairy farming, what is the difference between a bull and a steer?

e) (4 pt) A field of corn can be harvested for corn silage or for grain. Briefly explain how corn silage differs from grain corn in terms of what is harvested and how it is stored.

**3) (10 pts.)** You manage a small organic vegetable farm. This table reports how many sacks of potatoes are dug, cleaned, and ready for sale in one day with different numbers of workers.

|  |  |  |  |
| --- | --- | --- | --- |
| Workers Hired | Sacks/Day | Marginal Product | Value of Marginal Product |
| 1 | 25 | -- | -- |
| 3 | 65 |  |  |
| 5 | 99 |  |  |
| 7 | 121 |  |  |
| 9 | 139 |  |  |

1. (2 pts) Using some numbers from this table, show in the space below how to calculate the Marginal Product for one example, and then fill in the Marginal Product column in the table above.
2. (2 pts) Potatoes sell for $20/Sack. Using numbers from this table, show in the space below how to calculate the Value of Marginal Product for one example, and then fill in the Value of Marginal Product column in the table above.
3. (2 pts) If wages, taxes, materials, etc. cost you $250/day to hire a worker, what is the profit maximizing number of workers to hire? Note, you may need to interpolate between entries. You do not have to get an integer for an answer, round to the nearest tenth.
4. (2 pts) Wisconsin is an important state for potato production. In 2018, what was Wisconsin’s rank among U.S. states in terms of potato production? What percentage of the total US potato production was produced in Wisconsin?

**4) (16 pts.)** You have been planting corn following corn in a field, but want to look at a corn-soybean rotation. For your current system, you would plant corn in 2021 and again in 2022 in the field. For the alternative system, you would switch the field to soybeans in 2021 and then corn in 2022. For corn following soybeans in 2022, your cost will decrease and yield will increase compared to corn following corn, but you have to plant soybeans in the field in 2021.

For your current system, in 2021 your estimated cost is $658 per acre to grow corn following corn, you expect an average yield of 192 bushels per acre and your expected corn price is $3.50 per bushel. For 2022, your estimated cost is $663 per acre to grow corn following corn, you expect an average yield of 195 bushels per acre and your expected corn price is $3.35.

If you switch to a corn-soybean rotation, your estimated cost is $444 per acre to grow soybeans in 2021, you would get 53 bushels per acre and your expected soybean price is $8.50 per bushel. In 2022, your estimated cost is $604 per acre to grow corn following soybeans, you expect a yield of 200 bushels per acre and your expected corn price remains $3.35.

Use the given information to conduct a partial budget analysis of switching to a corn soybean rotation for the field for 2021 and 2022. I have provided two empty partial budget tables to use. The first will be for switch the field to soybeans in 2021 versus planting corn following corn. The second table will be for planting corn following soybeans in 2022 versus planting corn following corn. Calculate the benefits and costs and the net benefit for each year, show your calculations in the tables provided. Round to the nearest cent.

|  |  |  |  |
| --- | --- | --- | --- |
| **Benefits of switching to soybeans in 2021 versus staying with corn following corn** | | **Costs of switching to soybeans in 2021 versus staying with corn following corn** | |
| Additional Revenues  What new revenue will be generated? | | Additional Costs  What new costs will be added? | |
| Costs Reduced  What costs will be eliminated? | | Revenues Reduced  What revenues will be lost? | |
| Total Benefits |  | Total Costs |  |
| Total Benefits – Total Costs = Net Benefit | | |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Benefits of switching to corn following soybeans in 2022 versus staying with corn following corn** | | **Costs of switching to corn following soybeans in 2022 versus staying with corn following corn** | |
| Additional Revenues  What new revenue will be generated? | | Additional Costs  What new costs will be added? | |
| Costs Reduced  What costs will be eliminated? | | Revenues Reduced  What revenues will be lost? | |
| Total Benefits |  | Total Costs |  |
| Total Benefits – Total Costs = Net Benefit | | |  |

1. (2 pts) Based on your results, looking only at 2021, is it more profitable to switch the field to soybeans or to stay with corn following corn?
2. (2 pts) Based on your results, looking only at 2022, is it more profitable to switch to growing corn following soybeans in the field or to stay with growing corn following corn?
3. (2 pts) Based on your results, what is the average net benefit in $ per acre across both years for switching to a corn-soybean rotation in the field versus continuing to grow corn following corn? **Briefly** explain whether you would or would not recommend switching to the corn-soybean rotation for a farmer wanting to maximize the average net benefit over both years.
4. (4 pts) The numbers used for this problem are adapted from Iowa State University crop budgets (<https://www.extension.iastate.edu/agdm/crops/html/a1-20.html>) presented in class. As discussed in recorded presentations and class lectures, give one reason why costs of production are lower and one reason why yields are higher for corn following soybeans compared to corn following corn?

**5) (9 pts.)** Chicks starting at 8 oz fed the following corn and soybean meal rations gain 40 oz and are ready to sell as broilers in 12 weeks.

|  |  |  |
| --- | --- | --- |
| Ground Corn (lbs) (**Y**) | Soybean Meal (lbs)  (**X**) | Marginal Rate of Technical Substitution |
| 2.0 | 7.9 | --- |
| 3.2 | 5.5 |  |
| 5.2 | 3.9 |  |
| 7.4 | 3.1 |  |

1. (3 pts) Using numbers from this table, show in the space below how to calculate the Marginal Rate of Technical Substitution between ground corn and soybean meal for the second row in the table and then fill in the missing entries in the table above. Round the MRTS to the nearest thousandth (3 places to the right of the decimal).
2. (3 pts) If ground corn costs $0.08/lb and soybean meal costs $0.16/lb, what is the profit maximizing amount of each to feed? Note, you may need to interpolate between entries. Round the optimal amounts to the nearest tenth of a pound (1 place to the right of the decimal).

**6) (20 pts.)** Corn yield as a function of the nitrogen fertilizer rate is Q = 165 + 0.9N – 0.003N2, where yield Q is total bushels of corn per acre and the nitrogen application rate N is in pounds of N per acre. The corn price is $3 per bushel. You have two options for nitrogen fertilizer: 1) urea that is 45% N and sold for $360 per ton and urea-ammonium nitrate (UAN) that is 32% N and sold for $300 per ton.

1. (2 pts) What are the prices in $ per pound of nitrogen for the urea and UAN fertilizers? Which is the lower cost source for nitrogen?
2. (10 pts) Using the price for lowest cost nitrogen source you identified in part a, what is the economically optimal nitrogen rate for corn? Set up and solve this economic problem using calculus and the given information. Check the second order condition. Round to four digits to the right of the decimal while doing algebra and then round your final answer to the nearest tenth of a pound per acre.
3. (2pts) At the nitrogen rate you derived in part b, what is the corn yield in bushels per acre?
4. (2 pts) Besides the cost of nitrogen, other costs are $650/acre. What are net returns ($ per acre)?
5. (4 pts) You should have gotten a negative value in part d. Data show that farmers commonly go through times when they earn below average returns for their work and assets (land). Based on class discussion and materials, briefly list/describe three things a farmer can do to improve profits in times of low margins?

**7) (7 pts.)** *Based on material covered in class*, are these True or False? Mark your answer.

1. T\_\_\_ F\_\_\_ The hypoxic (dead) zone in the Gulf of Mexico caused by Midwestern nutrient pollution is fairly unique and rarely seen elsewhere in the world.
2. T\_\_\_ F\_\_\_ In Wisconsin, private well contamination by nitrates typically only occurs in the few wells near large animal feeding operations.
3. T\_\_\_ F\_\_\_ Wisconsin law regulates how much fertilizer a farmer can apply and when it can be applied.
4. T\_\_\_ F\_\_\_ Wisconsin Nutrient Management Plans are strategies to help famers maximize their returns from nutrients while protecting water quality.
5. (3 pts) Cover crops came up in this course in our discussion around Nitrogen in Agriculture and in Problem Set #1. Write a brief paragraph that a) explains what a cover crop is, b) examples of what types of crops are used as cover crops in the Midwest and c) the types of benefits that cover crops generate.

**8) (22 pts.)** Corn yield is Y = 70 + 3N – 0.05N2 + 2K – 0.3K2 + 0.2NK, where Y is corn yield as bushels per acre, N is pounds of nitrogen fertilizer per acre and K is pounds of potassium per acre. The corn price is $3 per bushel, the price of nitrogen fertilizer is $0.4 per pound, and the price of potassium fertilizer is $0.3 per pound.

1. (15 pts) What is the profit maximizing amount of nitrogen (N) and potassium (K) to use per acre to grow corn (Y)? You do not need to convert prices to set up the profit function. Round to four digits to the right of the decimal while doing algebra and then round your final answer to the nearest tenth of a pound per acre. Be sure to check the second order conditions.
2. (2 pts) At these optimal N and K rates in part a, what is corn yield?
3. (2 pts) Suppose you do not trust your calculus and decided to put a little more on and increase your application rates in part a by 10%. Multiply your answers in part a for N and K by 1.1 to increase them by 10%. What would corn yield be if you used these 10% higher N and K rates? Your answer should be far less than a 1 bu/ac difference from the yield on part b and not a detectable difference for farms; the crop would look fine in either case.
4. (3 pts) Suppose instead you reduced your N and K application rates by 10-20% to save money and reduce losses to surface and groundwater. What are the classic visually apparent symptoms of a corn crop that is deficient in Nitrogen? What about deficient in Potassium?