Ag Bus 313
Midterm 1
10/16/19
Section 1
Dr. Hurley

General Instructions: This exam is worth **100 points**. You must provide your own paper. You are allowed one 3x5 note card written on one side 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 tablets are allowed to be in your possession during the exam. If you are caught with any of these devices, 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.***

1. If your average physical product (APP) is equal to 60 using 100 inputs, what do you expect to happen to your current APP when your marginal physical product (MPP) is 180 when you move to 120 inputs? What is your new APP given this new MPP? Please show how you found your answer. **(10 points)**

2. Please explain how you decide what level of outputs you produce given a fixed level of an input. Show this on a graph. **(5 points)**

3. Suppose your goal this year is to produce 19,600 bushels of organic corn. Suppose your production technology has the following relationship for producing bushels of corn Q = f(L,T) = LT where Q is the number of bushels of corn you produce, L is the number of labor hours you utilize, and T is the number of tractor hours you utilize. You know that the cost per hour of labor is $30 and the cost per hour of tractor time is $750. Assume that you are a cost minimizing producer. **(15 points)**

   a) Suppose after reviewing your business plan, your banker tells you she is only willing to give you $21,000. Theoretically, tell me how you would figure out what your maximum production is when you have only $21,000 to work with and you are a cost minimizer.

   b) What is the maximum amount you can produce? (Note: when given a particular expenditure E and you are trying to maximize output, the optimal amount of input formulas are $L = \frac{E}{2p_L}$ and $T = \frac{E}{2p_T}$, where p_L is the cost of labor and p_T is the cost of tractor time.)

   a) Please sketch a graph of this solution. Include the isoquant and iso-cost line

4. Solve x_2 as a function of x_1: **(5 Points)**

   a) $x_1^{-3/4} x_2^{1/2} + 6561 = 27x_2^{1/8} + 6561$

5. Using the three equations, get Y_2 as a function of Y_1 (Please do not represent your answer in decimals.): **(10 Points)**

   a) $Y_1 = 5x_1^{1/3}$
      $Y_2 = 25x_2^{1/3}$
      $x_1 + x_2 = 8{,}000$

6. Find the inverse of the following functions: **(5 Points)**

   a) $y = f(x) = 225x^2 - 450x + 225$

7. Solve for Y_1: **(10 Points)**

$$\frac{4Y_1^{2/3}}{(5280 - 5Y_1^2)^{1/3}} = \frac{8}{5}$$

8. Please find the derivative of the following functions: **(4 Points)**

   a) $y = f(x) = 45x^4 + 360x^{1/2} + (x+2)(3x+4)$

   b) $y = f(x) = (60x^{-1/2} + 20x^{-3/2} - 3030)^{-1/2}$ (Use either Generalized Power Rule or the Chain Rule)

9. Find the first order and second order (this includes the cross partial derivatives) partial derivatives of the following functions with respect to **<u>x_1</u>** only: **(6 Points)**[1]

   a) $y = f(x_1,x_2) = 10x_1^5 + 32x_2^3 + 100x_1^4x_2^{1/2} + 20(x_1x_2)^{3/2} + 47$

10. Use the first order conditions to find the critical points of the function. Use the second order conditions to show whether the critical points are maximum, minimum, or saddle points (point of inflection). Are the critical points relative or absolute extrema? Please explain. **(15 Points)**

    a) $y = f(x) = (x + 3)^2(x - 3)^2$

11. Minimize $f(x_1,x_2) = 25x_1 + 4000x_2$ subject to the constraint $8000 = g(x_1,x_2) = 5x_1^{1/2}x_2^{1/4}$. Solve this problem using the Lagrange Method **<u>or</u>** solve this problem by changing it into an unconstrained minimization problem. **(15 Points)**

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[1] The derivatives for the function $f(x_1,x_2)$ are $\frac{\partial y}{\partial x_1}, \frac{\partial^2 y}{\partial x_1^2}$ *and* $\frac{\partial^2 y}{\partial x_1 \partial x_2}$

Last revised: 10/10/19