AAE 320 Fall 2015 Exam #1 Name: _____KEY_____

1) (10 pts.) *Based on material covered in class*, are these True or False? Mark your answer.

a) T_X_ F___ Wisconsin farmers produce more cranberries than any other state

b) T_X_ F___ When nitrogen is applied to a crop, the portion not used by the crop can contribute to water pollution.

c) T_X_ F___ The assigned videos discussed groups working with farmers to improve the environment by emphasizing more efficient use of inputs like nitrogen.

d) T_X_ F___ Dairy in Wisconsin generates most of the farm revenue in the state, more than grain, livestock and specialty crops.

e) T___ F_X__ As discussed in class, the break-even price is a more common way for "normal" people to talk about ~~*marginal cost*~~ *average total cost*.

2) (10 pts.) You manage a vegetable farm. This table reports how many carrot bunches are dug, cleaned, and ready for sale in one hour with different numbers of laborers

Laborers Hired	Bunches/Hour	Marginal Product	Value of Marginal Product
4	180	--	--
6	240	*30*	*60*
8	270	*15*	*30*
10	280	*5*	*10*

a) Using numbers given in this table, show below how to calculate the Marginal Product for one example, and then fill in the Marginal Product column in the table above.

MP = ΔQ/ΔX = (240 – 180)/(6 – 4) = 30

b) Carrots sell for $2/bunch. Using numbers from this table, show 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.

VMP = P x MP = 2 x 30 = $60

c) What optimality condition defines the profit maximizing amount of the input to use? (Be brief and to the point.)

VMP = r the input price

d) If wages, taxes, materials, etc. cost you $10.00/hour to hire a laborer, what is the profit maximizing number of laborers to hire? (You may need to interpolate between entries.)

VMP = $10 when hire 10 laborers

3) (16 pts.) Corn yield as a function of nitrogen fertilizer is $Q = 100 + 2N - 0.01N^2$, where yield Q is bu/ac of corn yield and the nitrogen rate N is lbs/ac. The price of corn is \$3/bu and the price of nitrogen fertilizer is \$0.50/lbs.

a) What is the economically optimal nitrogen rate (N) to apply? Set up and solve this economic problem using calculus and this information. **Check the second order condition**.

$\pi = 3(100 + 2N - 0.01N^2) - 0.5N$

$FOC: d\pi/dN = 3(2 - 0.02N) - 0.5 = 0$

$Solve\ to\ get\ N = 5.5 / 0.06 = 91.7\ lbs$

$SOC: d^2\pi/dN^2 = 3(-0.02) = -0.06 < 0$ *passes SOC for maximum*

b) At the nitrogen rate you derived in part a, what is yield (bu/ac)?

$Q = 100 + 2N - 0.01N^2 = 100 + 2(91.7) - 0.01(91.7^2) = 199.3\ bu/ac$

c) Besides the cost of nitrogen, other costs are \$500/ac. What are net returns (\$/ac)?

$\pi = 3 \times 199.3 - 0.5 \times 91.7 - 500 = \$52.05/acre$

4) (10 pts.) Cows fed the following corn and soybean meal rations produce 75 lbs of milk a day.

Corn (lbs)	Soybean Meal (lbs)	Marginal Rate of Technical Substitution
80	55	*Corn is Y --- Soy is Y either is correct*
85	50	*1.0* *1.0*
95	45	*2.0* *0.5*
110	40	*3.0* *0.33*

a) Using numbers from this table, show below how to calculate the Marginal Rate of Technical Substitution between corn and soybean meal for the second row in the table and then fill in the missing entries in the table above.

MRTS = $-\Delta Y/\Delta X$ = (85 – 80)/(50 – 55) = 1.0 Corn as Y
MRTS = $-\Delta Y/\Delta X$ = (50 – 55)/(85 – 80) = 1.0 Soy as Y

b) What optimality condition defines the profit maximizing amount of both inputs to use? (Be brief and to the point.)

MRTS = price ratio r_x/r_y or $-\Delta Y/\Delta X = r_x/r_y$

c) If corn cost \$0.10/lb and soybean meal costs \$0.20/lb, what is the profit maximizing level of each to feed? (Note: you may need to interpolate between entries.)

r_x/r_y = 0.20/0.10 = 2.0 Corn as Y
MRTS = 2.0 with corn of 95 lbs and Soybean meal of 45 lbs

r_x/r_y = 0.10/0.20 = 0.5 Soy as Y
MRTS = 0.5 with corn of 95 lbs and Soybean meal of 45 lbs

5) (20 pts.) Wheat production is $W = 5 + 3S – 0.1S^2 + 4N – 0.05N^2 + 0.01SN$, where W is wheat yield as bushels per acre, S is the seeding rate as pounds of seed per acre and N is pounds of nitrogen applied per acre. The wheat price is \$5/bu, the price of wheat seed is \$3 per pound seeds, and the price of nitrogen fertilizer is \$0.5/lb.

What is the profit maximizing amount of seeds (S) and nitrogen (N) to use per acre to grow wheat (W)? (Note: you will <u>not</u> need to convert prices to set up the profit function.) **<u>Be sure to check the second order conditions</u>.**

$\pi = 5(5 + 3S – 0.1S^2 + 4N – 0.05N^2 + 0.01SN) – 3S – 0.5N$

FOC: $d\pi/dS = 5(3 – 0.2S + 0.01N) – 3 = 0$
$d\pi/dN = 5(4 – 0.1N + 0.01S) – 0.5 = 0$

Solve 1st FOC for S: $5(3 – 0.2S + 0.01N) = 3$
$15 – S + 0.05N = 3$
$S = 12 + 0.05N$

Substitute into other FOC $5(4 – 0.1N + 0.01S) = 0.5$
$20 – 0.5N + 0.05S = 0.5$
$19.5 – 0.5N + 0.05(12 + 0.05N) = 0$
$19.5 – 0.5N + 0.6 + 0.0025N = 0$
$20.6 = 0.4975N$
$N = 40.4$ lbs

Use $S = 12 + 0.05N$ to find S
$S = 12 + 0.05N = 12 + 0.05(40.4) = 14.0$

SOC: $d^2\pi/dS^2 = 5(–0.2) = –1 < 0$ *passes SOC for maximum*
$d^2\pi/dN^2 = 5(–0.1) = –0.5 < 0$ *passes SOC for maximum*
$d^2\pi/dSdN = 5(0.011) = 0.05$

$(d^2\pi/dS^2) \times (d^2\pi/dN^2) – (d^2\pi/dSdN)^2$
$= (–1)(-0.5) – (0.0025) = 0.4975 >$ *passes SOC for maximum*

6) (10 pts.) Your sister is evaluating her farm performance and asks for your help. Her typical annual farm revenue is $1,300,000 and all annual costs are $1,000,000. The farm has 1,000 acres and could rent for $250 per acre. She says she could get a manger job earning $75,000.

a) Given these numbers, what is her economic profit for owning and operating the farm?

Revenue	*+1,300,000*	
Farm Costs	*–1,000,000*	
Opportunity Cost of Land	*–250,000*	*= 1,000 acres x 250/acre*
Opportunity Cost of Time	*–75,000*	
Economic Profit	*–25,000*	

b) Based on these calculations, what is her best option (to stay farming or to rent the land to someone else and take a manager job) if she wants to make as much money as possible?

Rent out the land and take the manager job

c) Suppose you help her better manage her inputs and she can reduce her annual costs to $900,000. Now what is her best option and how much better is it in terms of $?

Revenue	*+1,300,000*
Farm Costs	*–900,000*
Opportunity Cost of Land	*–250,000*
Opportunity Cost of Time	*–75,000*
Economic Profit	*+75,000*

Her best option is to stay on the farm, as she's earning an economic profit of $75,000

7) (16 pts.) The table below reports the cost of producing chickens on a farm.

Chickens (number/week)	Fixed Cost	Variable Cost	Total Cost	Marginal Cost	Average Variable Cost	Average Total Cost
250	200	230	*430*	---	*0.92*	*1.72*
290	200	310	*510*	*2.0*	*1.07*	*1.76*
310	200	390	*590*	*4.0*	*1.26*	*1.90*
325	200	470	*670*	*5.33*	*1.45*	*2.06*

a) Using numbers from this table, show below how to calculate Total Cost, Marginal Cost, Average Variable Cost, and Average Total Cost for the second row and then fill in the missing values in the table.

TC = FC + VC = 20 + 230 = 430
AVC = VC/Q = 230 / 250 = 0.92
ATC = TC/Q = 430 / 250 = 1.72
MC = ΔTC/ΔQ = (510 – 430)/(2910 – 250) = 2.0

b) What optimality condition defines the profit maximizing amount to produce? (Be brief and to the point.)

P = MC

c) If the farmer sells chickens for a price of $3 each, what is the profit maximizing number of chickens to produce each week? (Note: you may need to interpolate between entries.)

P = 3. MC will equal 3 halfway between MC of 2 and 4, so use Q half way between Q of 290 and 310, or ***Q = 300***

d) At this price, is the farmer making a profit? How do you know?

This price $3 exceeds all ATC in the table, and at Q = 300, so if P > ATC, so we know profit is greater than zero

8) (8 pts.) Short Answer: Answer each of the short questions below.

a) (2 pts.) Why is "To own 200 acres of good farm land in Columbia County within 5 years" a good example of a goal, while "To own some farm land someday" is not? Be brief.

The first one is specific, measurable and has a deadline. The 2nd one is vague and has no clear deadline.

b) (2 pts.) What does selling output at a price below your average total cost mean in terms of profitability – are you losing money? Explain, but be brief.

P < ATC means economic profit is negative. Often means you still make money in the sense that your accounting profit is positive, but are better opportunities elsewhere for your time and other assets, you are earning below average rates of return.

c) (2 pts.) What does earning a negative *economic* profit mean in terms of financial returns to the farmer's time and to the land and other assets? Explain, but be brief.

There are better opportunities elsewhere for your time and other assets. You are earning below average rates of return – less than the land could rent for, less % return on equity than if you had invested elsewhere, less income than if you had taken a different job.

d) (2 pts.) Did you find the smartphone apps interesting? Why or Why not? Did you download any of them onto your mobile device? Be brief.