AAE 320 Fall 2014 Exam #1 Name: _____KEY_____

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

a) T___ F_X_ Potassium run-off from farm fields and nitrogen leaching from tractors are causing problems in the Great Lakes.

b) T_X_ F___ Wisconsin may be "America's Dairyland" but it actually ranks second as a state nationally in milk production.

c) T_X_ F___ Commercial agriculture emphasizes that technologies like drones and smartphone apps help farmers better match fertilizer use to crop needs so less is lost to the environment.

d) T___ F_X_ The condition to identify optimal output to maximize profit is to equate the output price to the average marginal product of substitution.

e) T_X_ F___ In Wisconsin, many of those whom the USDA classifies as farmers have less than $10,000 in total annual sales of agricultural products.

2) (10 pts.) You manage a berry farm and hire labor. This table reports how many pints of berries are picked, cleaned, and ready for sale in one hour with different numbers of laborers.

Laborers Hired	Pints/Hour	Marginal Product	Value of Marginal Product
2	80	--	--
4	150	*35*	*52.50*
6	210	*30*	*45.00*
8	250	*20*	*30.00*

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 = (150 – 80)/(4 – 2) = 70/2 = 35

b) Berries sell for $1.50/pint. 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 = Price x Marginal Product = 35 x 1.50 = 52.50

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 $30.00/hour to hire a laborer, what is the profit maximizing number of laborers to hire? (You may need to interpolate between entries.)

VMP = 30 at 8 laborers

3) (15 pts.) Cabbage as a function of sulfur fertilizer is $C = 30 + 1.2S - 0.02S^2$, where yield C is cwt/ac of sauerkraut cabbage and the sulfur rate S is lbs/ac. The price of cabbage is \$70/cwt and the price of sulfur fertilizer is \$2/lbs.

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

$\pi(S)$ = revenue – cost = p x C – r x S = p x f(S) – r x S = p x $(30 + 1.2S - 0.02S^2)$ – r x S
$\pi(S) = 70(30 + 1.2S - 0.02S^2) - 2S$

FOC: $d\pi(S)/dS = 70(1.2 - 0.04S) - 2 = 0$

Solve FOC for S: $70(1.2 - 0.04S) = 2$
$84 - 2.8S = 2$
$84 - 2 = 2.8S$
$82 = 2.8S$ $\quad S = 82/2.8 = 29.3$

SOC: $d^2\pi(S)/dS^2 = 70(-0.04) = -2.8 < 0$, passes SOC for a maximum

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

$C = 30 + 1.2S - 0.02S^2 = 30 + 1.2(29.3) - 0.02(29.3)^2 = 48$

c) Besides the cost of sulfur, other fixed costs are \$2000/ac. What are net returns (\$/ac)?

$\pi(S) = 70(30 + 1.2S - 0.02S^2) - 2S = 70x48 - 2$ x $29.3 - 2000 = 1{,}301.40$

4) (10 pts.) Laying hens fed the following corn and soybean meal rations produce 1 egg per day.

Corn (ounces)	Soybean Meal (ounces)	Marginal Rate of Technical Substitution
7	7.1	---
8	5.0	*0.476*
9	4.0	*1.000*
11	3.5	*4.000*

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.

$MRTS = -\Delta C/\Delta S = -(8 - 7)/(5.0 - 7.1) = 0.476$ or

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

X and Y where $MRTS = -\Delta C/\Delta S$ =price of S / price of C or = $-\Delta Y/\Delta X = r_X/r_Y$

c) If corn cost \$0.10/lb and soybean meal costs \$0.25/lb, what is the profit maximizing level of each to feed? (Note: you may need to interpolate between entries.)
price of S / price of C = 0.25/0.10 = 2.5, which is exactly half way between 1.000 and 4.000, so use average of X and S for these entries: Corn = 10, Soybean Meal = 3.75

5) (20 pts.) Corn production is $Y = 10 + 7S - 0.1S^2 + 5N - 0.05N^2 + 0.02SN$, where Y is corn yield as bushels per acre, S is the seeding rate as 1,000 seeds per acre and N is pounds of nitrogen fertilizer applied per acre. The corn price is \$3/bu, the price of corn seed is \$3 for 1,000 seeds, and the price of nitrogen fertilizer is \$1.00/lb.

What is the profit maximizing amount of seeds (S) and nitrogen (N) to use per acre to grow corn (Y)? (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>.

$\pi(S,N) = p \times f(S,N) - r_S \times S - r_N \times N = 3(10 + 7S - 0.1S^2 + 5N - 0.05N^2 + 0.02SN) - 3S - 1N$

FOC_S: $d\pi(S,N)/dS = 3(7 - 0.2S + 0.02N) - 3 = 0$
FOC_N: $d\pi(S,N)/dN = 3(5 - 0.1N + 0.02S) - 1 = 0$

Solve FOC_S for S:
$3(7 - 0.2S + 0.02N) = 3$
$21 - 0.6S + 0.06N = 3$
$18 + 0.06N = 0.6S$
$S = 18/0.6 + (0.06/0.6)N = 30 + 0.1N$

First simplify FOC_N, then substitute $S = 30 + 0.1N$ into FOC_N:
$3(5 - 0.1N + 0.02S) = 1$
$15 - 0.3N + 0.06S = 1$
$14 - 0.3N + 0.06(30 + 0.1N) = 0$
$14 - 0.3N + 1.8 + 0.006N = 0$
$15.8 - 0.294N = 0$
$15.8 = 0.294N$
$N = 15.8/0.294 =$ ***53.7 = N***

Substitute this into $S = 30 + 0.1N = 30 + 0.1(53.7) =$ ***35.4 = S***

Check SOC:
SOC_{SS}: $d^2\pi(S,N)/dS^2 = 3(-0.2) = -0.6 < 0$, *passes*
SOC_{NN}: $d^2\pi(S,N)/dN^2 = 3(-0.1) = -0.3 < 0$, *passes*
SOC_{SN}: $d^2\pi(S,N)/dSdN = 3(0.02) = 0.06$
$SOC_{SS} \times SOC_{NN} - (SOC_{NN})^2 = -0.6 \times -0.3 - (0.06)^2 = 0.18 - 0.0036 = 0.1764 > 0$ *passes*
Function passes all three parts of the SOC for a maximum.

6) (10 pts.) Your parents are thinking of quitting farming and ask your advice. Their typical annual farm revenue is $300,000 and all annual costs are $235,000. They tell you the farm's market value is $500,000, but they owe $200,000 for the mortgage. Also, they say they could get jobs and earn $55,000 total for the both of them. You think they could invest the farm equity they have and earn 2% annually in the bond market.

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

Farm Profit is Revenue – Cost = $300,000 – $235,000 = $65,000

Equity = $500,000 – $200,000 = $300,000
Opportunity cost of capital = $300,000 @2% = 6,000

Opportunity cost of time = $55,000 as given

Economic profit	
Farm Profit	$65,000
Oppt. Cost Capital	– $6,000
Oppt. Cost Time	– $55,000
	$4,000

b) Based on these calculations, what is their best option if they want to make as much money as possible and how much better is it in terms of $?

Keep the farm because they are earning an extra $4,000 than their next best options.

c) Suppose you find them a better place to invest their farm equity, so it can earn 4% annually. Now what is their best option and how much better is it in terms of $?

The new investment increases the opportunity cost of the capital equity they have in the farm, $300,000 @4% = $12,000

Redoing the calculations, you find they are now losing **$2,000**

Farm Profit	$65,000
Oppt. Cost Capital	– $12,000
Oppt. Cost Time	– $55,000
	– $2,000

7) (15 pts.) The table below reports the cost of producing turkeys on a farm.

Turkeys (number/week)	Fixed Cost	Variable Cost	Total Cost	Marginal Cost	Average Variable Cost	Average Total Cost
225	100	590	*690*	---	*3.07*	*2.62*
255	100	680	*780*	*3.00*	*3.06*	*2.67*
280	100	770	*870*	*3.60*	*3.11*	*2.75*
300	100	860	*960*	*4.50*	*3.20*	*2.87*

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 = 100 + 590 = 690
MC = ΔTC/ΔQ = (780 – 690)/(255 – 225) = 3.00
AVC = VC/Q = 590 / 225 = 3.07 *ATC = TC/Q = 690 / 225 = 2.62*

b) What optimality condition defines the profit maximizing amount to produce? (Be brief and to the point.)
Q where P = MC

c) If the farmer can sell turkeys for a price of $3.30 each, what is the profit maximizing number of turkeys to produce each week? (Note: you may need to interpolate between entries.)
P = MC exactly half way between $3.00 and $3.60, so average of 255 and 280 = 268

d) At this price, is the farmer making a profit? How do you know?
Yes, because price P exceeds ATC, i.e, $3.30 > 2.71

8) (10 pts.) Short Answer: Answer each of the short questions below.

a) (1 pt each) Classify each of the following as a Mission, a Strategy, or a Goal.
i) To manage the land I own to make it better for the next generation.
Mission
ii) To be selling within 5 years 50 beef cattle each year from a pasture I own in Wisconsin.
Goal
iii) Ally with major canning companies to grow commercial vegetables under contract.
Strategy
iv) To get 5 restaurants to monthly buy the cheese I make on my grass-fed dairy.
Goal (though does not have a timeline)
v) To help feed the world by sustainably growing corn and soybeans for export.
Mission
vi) To work on my parent's dairy farm and eventually buy it from them.
Strategy (way to get afarm)

b) (2 pts.) Why would a profit maximizing farm choose to operate in the short run at a price below Average Total Cost and above Average Variable Cost? (Be brief and to the point.)
Because operating at AVC < P < ATC, cover part of fixed cost. If you quit, cover none of the fixed cost.

c) (2 pts.) When a farmer earns negative *economic* profit, does it mean he/she is also earning negative *accounting* profit? Briefly explain why or why not.
Not necessarily, means instead that they are earning below normal rates of return on their assets and time.