AAE 320 Fall 2016 **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_ Wisconsin farmers produce more milk than farmers in any other state.

b) T_X_ F___ The Des Moines Water Works has sued three counties to pay for removing nitrate from river water because they allow farmers to pollute it.

c) T_X_ F___ More cheese is produced in Wisconsin than in any other state.

d) T_X_ F___ As long as it does not cause damage, no laws regulate how much fertilizer a farmer can use.

e) T_X_ F___ This is a financially difficult year for many farmers because their cost of production exceeds the prices they are paid for their crops.

2) (10 pts.) You manage an apple farm. This table reports how many bags of apples are picked, cleaned, and ready for sale in one hour with different numbers of laborers.

Laborers Hired	Bags/Hour	Marginal Product	Value of Marginal Product
1	30	--	--
3	55	*12.5*	*25.00*
5	75	*10.0*	*20.00*
7	90	*7.5*	*15.00*

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 = (55 – 30)/(3 – 1) = 12.5

b) Apples sell for $2/bag. 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 12.5 = $25

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 $15.00/hour to hire a laborer, what is the profit maximizing number of laborers to hire? (You may need to interpolate between entries.)

VMP = $15 when hire 7 laborers

3) (10 pts.) You are a small farmer with 300 acres of corn, with an average yield of 150 bu/acre and an expected corn price of $3/bu. You are exploring different weed control options. Currently you hire a company to apply herbicides, which costs $40/ac for application and herbicides. You are considering switching to using additional tillage before planting and to cultivate the field when the corn is growing (i.e. tilling between the rows to kill the weeds). The cost of the extra tillage is $10 per acre and the cultivation will cost you $5 per acre. However, mechanical weed control is not as effective, so you expect more weeds and 4% yield loss.

a) Use the information given above to conduct a partial budget analysis of this switch in weed control by filling in the table below. Show your calculations in the space provided.

<table>
<tr><td colspan="2">Benefits</td><td colspan="2">Costs</td></tr>
<tr><td colspan="2"><u>Additional Revenues</u>
What new revenue will be generated?

None</td><td colspan="2"><u>Additional Costs</u>
What new costs will be added?

Mechanical weed control
($10/A + $5/A) x 300 acres = $4,500</td></tr>
<tr><td colspan="2"><u>Costs Reduced</u>
What costs will be eliminated?

Herbicides
$40/A x 300 acres = $12,000</td><td colspan="2"><u>Revenues Reduced</u>
What revenues will be lost?

Value of Yield Loss
4% x 150 bu/A x $3/bu x 300 acres = $5,400</td></tr>
<tr><td>Total Benefits</td><td>$12,000</td><td>Total Costs</td><td>$4,500 + $5,400 = $9,900</td></tr>
<tr><td colspan="3">Total Benefits – Total Costs = Net Benefit</td><td>$12,000 – $9,900 = $2,100</td></tr>
</table>

b) Based on your results, considering only the money earned, is switching to mechanical weed control a money making change? Briefly explain.

Yes, the net gain is $2,100 (or $7 per acre).

4) (16 pts.) Pumpkin yield as a function of potassium fertilizer is $Q = 100 + 4K - 0.01K^2$, where yield Q is number of pumpkins harvested per acre and the potassium rate K is lbs/ac. The price for pumpkins is \$2 per pumpkin and the price of potassium fertilizer is \$0.30/lbs.

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

$\pi = 2(100 + 4K - 0.01K^2) - 0.3K$

FOC: $d\pi/dK = 2(4 - 0.02K) - 0.3 = 0$

Solve to get $K = 3.85 / 0.02 = 192.5$ lbs

SOC: $d^2\pi/KN^2 = 2(-0.02) = -0.04 < 0$ passes SOC for maximum

b) At the potassium rate you derived in part a, what is the pumpkin yield (pumpkins/acre)?

$Q = 100 + 4K - 0.01K^2 = 100 + 4(192.5) - 0.01(192.5)^2 = 499.4$ pumpkins/acre

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

$\pi = 2 \times 499.4 - 0.3 \times 192.5 - 500 = \$441.13$/acre

5) (10 pts.) Feeder pigs fed the following corn and soybean meal ration gain 1.5 pounds per day.

Corn (lbs)	Soybean Meal (lbs)	Marginal Rate of Technical Substitution
7.9	5.5	---
8.5	5.0	*1.2 or 0.833*
9.6	4.5	*2.2 or 0.456*
11.1	3.9	*2.5 or 0.400*

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.

$MRTS = -\Delta Y/\Delta X = (8.5 - 7.9)/(5.0 - 5.5) = 1.2$ Corn as Y
$MRTS = -\Delta Y/\Delta X = (5.0 - 5.5)/(8.5 - 7.9) = 0.833$ Soybean meal 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 \$0.06/lb and soybean meal costs \$0.15/lb, what is the profit maximizing level of each to feed? (Note: you may need to interpolate between entries.)

$r_x/r_y = 0.15/0.06 = 2.5$ Corn as Y
MRTS = 2.5 with corn of 11.1 lbs and soybean meal of 3.9 lbs

$r_x/r_y = 0.06/0.15 = 0.4$ Soybean meal as Y
MRTS = 0.4 with corn of 11.1 lbs and soybean meal of 3.9 lbs

6) (20 pts.) Barley production is $B = 1 + 8S - 0.1S^2 + 12K - 0.2K^2 - 0.1SK$, where B is barley yield as bushels per acre, S is the seeding rate as bags of certified seed per acre and K is pounds of potassium applied per acre. The barley price is \$5 per bushel, the price of certified barley seed is \$20 per bag of seed, and the price of potassium fertilizer is \$0.30 per pound.

What is the profit maximizing amount of seeds (S) and potassium (K) to use per acre to grow barley (B)? (Note: you will not need to convert prices to set up the profit function.) **Be sure to check the second order conditions.**

$\pi = 5(1 + 8S - 0.1S^2 + 12K - 0.2K^2 - 0.1SK) - 20S - 0.3K$

FOC: $d\pi/dS = 5(8 - 0.2S - 0.1K) - 20 = 0$
$d\pi/dK = 5(12 - 0.4K - 0.1S) - 0.3 = 0$

Solve 1st FOC for S:
$5(8 - 0.2S - 0.1K) = 20$
$8 - 0.2S - 0.1K = 4$
$4 - 0.1K = 0.2S$
$S = 20 - 0.5K$

Substitute into other FOC and solve for K
$5(12 - 0.4K - 0.1S) = 0.3$
$12 - 0.4K - 0.1S = 0.06$
$12 - 0.4K - 0.1(20 - 0.5K) = 0.06$
$11.94 - 0.4K - 2 + 0.05K = 0$
$9.94 - 0.35K = 0$
$K = 9.94 / 0.35 = 28.4$ lbs

Use $S = 20 - 0.5K$ to find S
$S = 20 - 0.5K = 20 - 0.5(28.4) = 5.8$ bags of seed

SOC:
$d^2\pi/dS^2 = 5(-0.2) = -1 < 0$ — passes SOC for maximum
$d^2\pi/KN^2 = 5(-0.4) = -2 < 0$ — passes SOC for maximum
$d^2\pi/dSdK = 5(-0.1) = -0.5$

$(d^2\pi/dS^2) \times (d^2\pi/dN^2) - (d^2\pi/dSdN)^2$
$= (-1)(-2) - (-0.5^2) = 1.75 > 0$ — passes SOC for maximum

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

Apples (boxes)	Fixed Cost	Variable Cost	Total Cost	Marginal Cost	Average Variable Cost	Average Total Cost
6,000	10,000	2,250	*12,250*	---	*0.38*	*2.04*
6,800	10,000	3,000	*13,000*	*0.94*	*0.44*	*1.91*
7,400	10,000	3,750	*13,750*	*1.25*	*0.51*	*1.86*
7,800	10,000	4,500	*14,500*	*1.88*	*0.58*	*1.86*

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 = 10,000 + 3,000 = 13,000
AVC = VC/Q = 3,000 / 6,800 = 0.44
ATC = TC/Q = 13,000 / 6,800 = 1.91
MC = ΔTC/ΔQ = (13,000 – 12,250)/(6,800 – 6,000) = 0.94

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

P = MC

c) If the farmer sells apples for a price of $1.25 a box, what is the profit maximizing number of apples to produce? (Note: you may need to interpolate between entries.)

P = 1.25. MC will equal 1.25 at ***Q = 7,400***

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

No, because the price is less than the ATC. Price < ATC means a negative profit.

8) (9 pts.) Short Answer: Answer each of the short questions below.

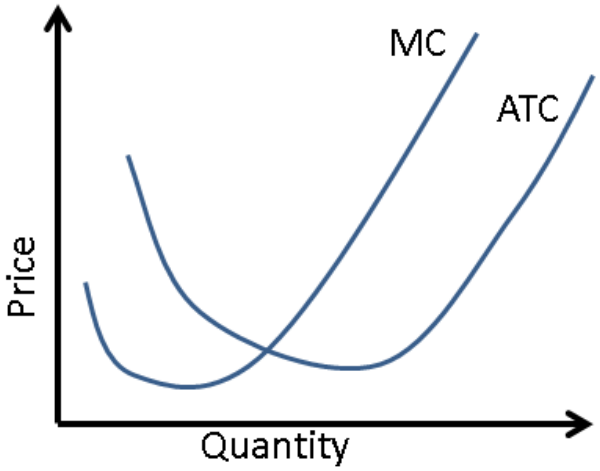
a) (3 pts.) What does selling output at a price below your average total cost but above your average variable cost mean for your profitability – are you losing money? Briefly explain.

It means economic profit is negative, but greater than the fixed costs, so it is economical to remain in production in the short-run. In this situation, the farmer is earning below average rates of return, that is, not earning enough to cover all of his/her opportunity costs, but still generating an accounting profit.

b) (3 pts.) Give one specific agricultural example of how, if you were a farmer, you could estimate the opportunity cost of your time, your financial assets or your working assets?

Opportunity cost of time = salary/wages at a different job you could realistically obtain
Opportunity cost of financial assets = rate of return on certificate of deposit or a low risk bond or mutual fund
Opportunity cost of working assets = rental rate for land, machinery or buildings

c) (3 pts.) What is wrong with this diagram of marginal cost (MC) and average total cost (ATC) for a hypothetical farmer? Re-draw it correctly in the space provided.



The problem with the figure as drawn here is that the MC does not intersect ATC at the minimum of ATC.

It is re-drawn below with the intersection of MC and ATC occurring at the lowest point of the ATC curve.