AAE 320 Problem Set #3 **Name: KEY**

1) You are deciding on how many steers to put on your 200 ac pasture. You will to start them in late April and sell them in mid-to-late October (180 days). You found a publication that has the following equation for the average daily gain in pounds (ADG): ADG = 3.3 – 0.2*SR, where SR is the initial stocking rate (500 lbs of live steers per acre initially put on the pasture, i.e., 20 steers on 200 acres is a SR = 20/200 = 0.1). Gain per steer is the ADG times the number of days on the pasture (here 180). You can buy steers for $1200/steer, with steers at 500 lbs already. Fill in the table below to answer the questions. The price for beef is provided in questions a) and b). It may be easier to put the table into a spreadsheet to perform the calculations and then to copy the results onto this sheet.

Steers (X)	Stocking Rate	ADG (lbs/day)	Gain per Steer (lbs)	Beef Produced (lbs beef)	Marginal Product	Value of Marginal Product	
0	0.00	3.30	594.0	0	---	@211/cwt	@208/cwt
10	0.05	3.29	592.2	5,922	592	1249.54	1231.78
20	0.10	3.28	590.4	11,808	589	1241.95	1224.29
30	0.15	3.270	588.6	17,658	585	1234.35	1216.80
40	0.20	3.260	586.8	23,472	581	1226.75	1209.31
50	0.25	3.250	585.0	29,250	578	1219.16	1201.82
60	0.30	3.240	583.2	34,992	574	1211.56	1194.34
70	0.35	3.230	581.4	40,698	571	1203.97	1186.85
80	0.40	3.220	579.6	46,368	567	1196.37	1179.36
90	0.45	3.210	577.8	52,002	563	1188.77	1171.87
100	0.50	3.200	576.0	57,600	560	1181.18	1164.38

*The ADG is 3.3 – 0.20*SR, where the SR = steers/200 (i.e., the number of steers per acre). Gain per steer is then the ADG x 180 days. Beef produced is then the Gain per steer x the number of steers. The Marginal product is simply* $(Q_1 - Q_0)/(X_1 - X_0)$ *like in problem set #1, then the Value of the marginal product is the marginal product times the price ($2.11 or $2.08).*

a) You talk to your buyer in March and he says he can buy them in October and pay you $211/cwt. At this price, what is the economically optimal number of steers to buy and put on the pasture? Note: you may need to interpolate or round.

Optimality occurs with VMP = input price, or VMP = $1200. At 70 steers, the VMP = $1204 while at 80 steers it is a little over $1196, so in the middle is about $1200, so the economically optimal steers is about 75 steers. This is marked with the maroon arrow.

b) You call your buyer a week later to lock in the price and he says markets have changed, he can now only get you $208/cwt. At this new price, what is the economically optimal number of steers to buy and put on the pasture? Note: you may need to interpolate or round.

At 50 steers, the VMP = $1201.82, which is very close to $1200, so the economically optimal steers is just past 50 steers, or about 51 or 52 steers, which is marked with the light green arrow.

2) This problem continues the previous problem, so use information given in problem 2. You decide to also look at the economic problem from the output/cost side. In addition to the costs described in problem 1, you have $1000 in Fixed Cost for property taxes, fence maintenance, and pasture care that you pay no matter how many steers you buy. Fill in the table below and answer the following questions. Note that the "Lbs Beef Produced" column should be used from the table you made in problem 1. "Variable Cost" is the cost to buy the steers to stock the pasture.

Steers	Lbs Beef Produced (Q)	Fixed Cost	Variable Cost	Total Cost	Marginal Cost	Average Variable Cost	Average Total Cost
0	0	1000		1,000			
10	5,922	1000	12,000	13,000	2.026	2.026	2.195
20	11,808	1000	24,000	25,000	2.039	2.033	2.117
30	17,658	1000	36,000	37,000	2.051	2.039	2.095
40	23,472	1000	48,000	49,000	2.064	2.045	2.088
50	29,250	1000	60,000	61,000	2.077	2.051	2.085
60	34,992	1000	72,000	73,000	2.090	2.058	2.086
70	40,698	1000	84,000	85,000	2.103	2.064	2.089
80	46,368	1000	96,000	97,000	2.116	2.070	2.092
90	52,002	1000	108,000	109,000	2.130	2.077	2.096
100	57,600	1000	120,000	121,000	2.144	2.083	2.101

Fixed cost is given as $1,000, Variable cost is the price of steers ($1200) times the number of steers, and Total Cost is the sum of Fixed and Variable Cost. In this problem, Marginal Cost is approximated using $(TC_1 - TC_0)/(Q_1 - Q_0)$. *The key is to note that the denominator is the change in Q (beef in 2nd column), not X (steers). For the second row, this is (13,000 – 1,000)/(5,922 – 0) = 2.195. Average Variable Cost is variable cost divided by Q (beef) and Average Total Cost is Total Cost divided by Q (beef).*

a) At a price of $211/cwt, what is the economically optimal amount of beef to produce? Again, you may need to interpolate or round. How many steers do you need to put on the pasture to produce this amount of beef? How do your answers change if the price is $208/cwt? How do you answers compare to those in problem 1?

Optimality occurs with output price equals marginal cost, or P = MC. MC is 2.103 at 40,698 pounds of beef produced and 2.116 at 46,368 pounds of beef. The average of 2.103 and 2.116 is 2.1095, or essentially 2.11/lb or $211/cwt, which corresponds to ½(40,698 + 46,368) = 43,533 pounds of beef. Thus, optimal Q to produce is about 43,500 pounds of beef, which takes about 75 steers, the same as in problem 1. This is marked with the maroon arrow. MC equals 2.077 at 29,250 pounds of beef, which is just below the market price of $2.08/lb. Thus, optimal Q to produce is above 29,250 pounds of beef, which takes slightly more than 50 steers to produce, like in problem 1.

b) With a price of $208/cwt, if you produce the economically optimal amount of beef, how much profit (= price x beef – total cost) will you make?

For this soluation we will use the 27,250 pounds of beef produced (with 50 steers). Profit will be revenue minus total cost, or $2.08 x 27,250 – $1,000 – 50 x $1200 = – $160.

c) You should have gotten a negative profit in part b. Why is it economically optimal to buy steers and put them on the pasture, even if you are going to earn a negative profit? (Hint: what's your profit if you put no steers on the pasture?)

It is still optimal to put cattle on the pasture since you then cover part of the fixed cost. With the 50 steers on the pasture, you lose only $160 per year, but if you had no cattle on the pasture, you would lose $1,000.