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

1) You are deciding on how many steers to put on your 160 ac pasture. You will to start them in mid-May and sell them in mid-to-late October (160 days). You found a publication that has the following equation for the average daily gain in pounds (ADG): ADG = 3.2 – 0.1*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 160 acres is a SR = 20/160 = 0.125). Gain per steer is the ADG times the number of days on the pasture (here 160). You can buy steers for $1,000/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	
						@200cwt	@198/cwt
0	0.00	3.200	512.0	0	---		
8	0.05	3.195	511.2	4,090	511	1022.40	1012.18
16	0.10	3.190	510.4	8,166	510	1019.20	1009.01
24	0.15	3.185	509.6	12,230	508	1016.00	1005.84
32	0.2	3.180	508.8	16,282	506	1012.80	1002.67
40	0.25	3.175	508.0	20,320	505	1009.60	999.50
48	0.3	3.170	507.2	24,346	503	1006.40	996.34
56	0.35	3.165	506.4	28,358	502	1003.20	993.17
64	0.4	3.160	505.6	32,358	500	1000.00	990.00
72	0.45	3.155	504.8	36,346	498	996.80	986.83
80	0.5	3.150	504.0	40,320	497	993.60	983.66

*The ADG is 3.2 – 0.1*SR, where the SR = steers/160 (i.e., the number of steers per acre). Gain per steer is then the ADG x 160 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 ($2.00 or $1.98).*

a) You talk to your buyer in March and he says he can buy them in October and pay you $200/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 = $1000. At 64 steers, the VMP = $1000, which 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 $198/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 40 steers, the VMP = $999.50, which is very close to $1000, so the economically optimal steers is just under 40 steers, or about 39 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			
8	4,090	1000	8,000	9,000	1.956	1.956	2.201
16	8,166	1000	16,000	17,000	1.962	1.959	2.082
24	12,230	1000	24,000	25,000	1.969	1.962	2.044
32	16,282	1000	32,000	33,000	1.975	1.965	2.027
40	20,320	1000	40,000	41,000	1.981 ⟵	1.969	2.018
48	24,346	1000	48,000	49,000	1.987	1.972	2.013
56	28,358	1000	56,000	57,000	1.994	1.975	2.010
64	32,358	1000	64,000	65,000	2.000 ⟵	1.978	2.009
72	36,346	1000	72,000	73,000	2.006	1.981	2.008
80	40,320	1000	80,000	81,000	2.013	1.984	2.009

Fixed cost is given as $1,000, Variable cost is the price of steers ($1000) 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 (9,000 – 1,000)/(4,090 – 0) = 1.956. 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 $200/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 $198/cwt? How do your answers compare to those in problem 1?

   Optimality occurs with output price equals marginal cost, or P = MC. MC is 2.00 at 32,358 pounds of beef produced and 1.981 (almost 1.98) at 20,320 pounds of beef. Thus, optimal Q to produce is about 32,358 pounds of beef, which takes about 64 steers, the same as in problem 1. This is marked with the maroon arrow. MC equals 1.981 at 20,320 pounds of beef, which is just above the market price of $1.98/lb. Thus, optimal Q to produce is just below 20,320 pounds of beef, which takes slightly less than 40 steers to produce, like in problem 1.

b) With a price of $200/cwt, if you produce the economically optimal amount of beef, how much profit (= price x beef – total cost) will you make?

   For this solution we will use the 32,358 pounds of beef produced (with 64 steers). Profit will be revenue minus total cost, or $2.00 x 32,358 – $1,000 – 64 x $1000 = – $284.

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 64 steers on the pasture, you lose only $284 per year, but if you had no cattle on the pasture, you would lose $1,000.