Homework 9 due at the beginning of class on March 6

This homework counts twice as much as the normal homework, and so is considered both Homework 9 & 10.

Name KEY

(1) We apply nitrogen (N, measured in lbs per acre) to grow and then harvest wheat. We measure wheat production by the bushels of wheat harvested per acre. If the marginal product is calculated as: (change in wheat yield, measured in bushels per acre) / (change in nitrogen use, measured in lbs per acre) then the units of marginal products are:

(a) lbs of N per bushel of wheat
(b) bushels of wheat per lb of nitrogen
(c) lbs of nitrogen per acre per bushel of wheat
(d) acres of wheat per nitrogen of lbs

(2) Suppose you know that at N = 20 and wheat yield is 10 bushels per acre. You also know that at N =20 the marginal product of N is 3. We can then predict that if N = 21, wheat yield is approximately

20+3=23 bushels per acre

(3) We increase days on feed (DOF) to increase the weight of cattle. DOF is the input and live-weight (LW) is the output or product. When a head of cattle has reached its maximum weight the marginal product of DOF is

(a) > 0
(b) = 0
(c) <0

(4) If the marginal product of DOF at DOF = 100 is 5 lbs, and if the price of live-cattle is $2 per lb, then the marginal value product (MVP) of DOF at DOF = 100 is

$10 (5 lbs)($2/lb) = $10 per DOF

(5) Following from question (4), if the cost of one DOF (the cost of the feed the cattle eat in a day, plus other things like water) is $7, at DOF = 100 should we allow the cattle to live another day so that DOF = 101?

(a) yes
(b) no

(6) Chinese communists believed that if you doubled the amount of inputs on an acre of land, production would

(a) Fall
(b) Remain the same
(c) Rise a little
(d) Rise a lot

(7) Complete the table below. *Note the nitrogen application is increasing by 5 lbs per acre, not 10 lbs per acre.*

Produce Wheat?	Change in N (lbs / acre)	Change in Wheat yield (bushels / acre)	Marginal Product
NO	----	----	----
Yes	0 →5	20→22	0.4
Yes	5→10	22→27	1
Yes	10→15	27→30	0.6
Yes	15→20	30→32	0.4
Yes	20→25	32→31	-0.2
Yes	25→30	31→28	-0.6

a. Stage 1 begins at 0→5 lbs of nitrogen per acre and ends at 5→10 lbs.

b. Stage 2 begins at 5→10 lbs of nitrogen per acre and ends at 15→20 lbs.

c. Stage 3 begins at 20→25 lbs of nitrogen per acre and ends at 25→30 lbs.

Now let's consider cattle in a feedlot. The input is "days on feed" in a feedlot and the output is the weight of the animal.

Cattle ID	Live-weight (lbs)	Days on feed (DOF)
12408	650	1
12408	900	100
12408	1000	200

(8) For animal 12408, what is the marginal product of DOF between 1 and 100 DOF?

MP = 2.53 lbs $\frac{900-650}{99} =$

(9) For animal 12408, what is the marginal product of DOF between 100 and 200 DOF?

MP = 1 lbs $\frac{1,000-900}{200-100} = \frac{100}{100} = 1$

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Suppose the marginal product formula for cattle is MP = 4 – 0.011(DOF). Use this for questions 10-13.

(10) What is the marginal product when DOF = 35? Show your work?

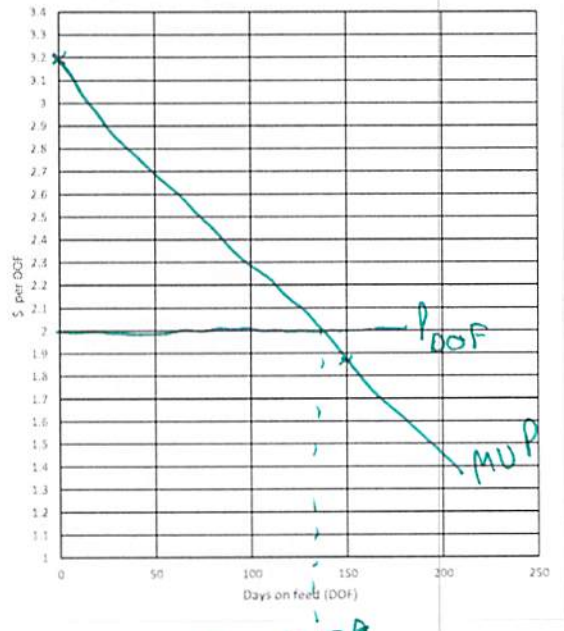
3.615

(11) Using algebra, calculate the value of DOF that maximizes the weight of the moo-cow. Show your work.

$0 = 4 - 0.011(DOF)$

$DOF = \frac{4}{0.011} = 364$

(12) Suppose that the output price is \$0.80 / lb and the price of one DOF is \$2. In the graph below, plot the marginal value product curve (labeling it MVP) and the P_{DOF} curve (labeling it P_{DOF}). On the graph, indicate the approximate number of DOF that maximizes profits on the x-axis as DOF*.



DOF	MVP
0	3.2
150	1.88

(13) Suppose that the output price is \$1.20 / lb and the price of one DOF is \$2.1. Using the marginal product formula given previously, and using algebra, calculate the profit-maximizing number of DOF. Show your work.

$\{4 - 0.011(DOF)\}(1.2) = 2.1$

$\frac{(4)(1.2) - 2.1}{(0.011)(1.2)} = DOF^* = 205$

(14) An acre is about 1 football field(s).

(15) A bushel is about 9.3 gallons.

Suppose we are studying the relationship between the lbs of nitrogen applied per acre and the wheat yield, where yield is measured in bushels per acre. Suppose that the formula for the marginal product of nitrogen is MP = 0.4 – 0.004(N) where MP is the marginal product and N is lbs of nitrogen per acre. For all questions, assume that the price of wheat is \$4.00 per bushel and the price of nitrogen is \$0.50 per lb of N.

$\frac{(bu/acre)}{(lbs/acre)}$

(16) What are the units for marginal product?

a. bushels
b. bushels per acre
c. acres
d. dollars per lb N
e. dollars per acre
f. bushels per lb N

(17) What are the units for marginal value product?

a. bushels
b. bushels per acre
c. acres
d. dollars per lb N
e. dollars per acre
f. acres

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(18) What is the marginal product at N = 20? Be sure to include the units.

MP = 0.32 bushels per 1lb N

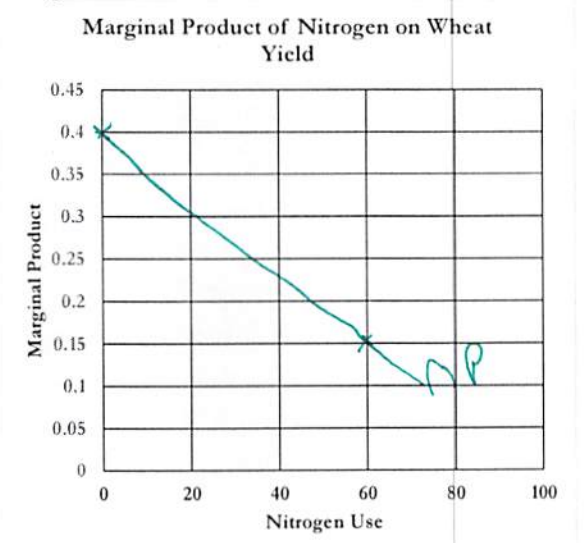
(19) Using the marginal product formula and price data, what is the marginal value product (MVP) when N = 20? Be sure to indicate the units.

MVP = $1.28 per 1lb N

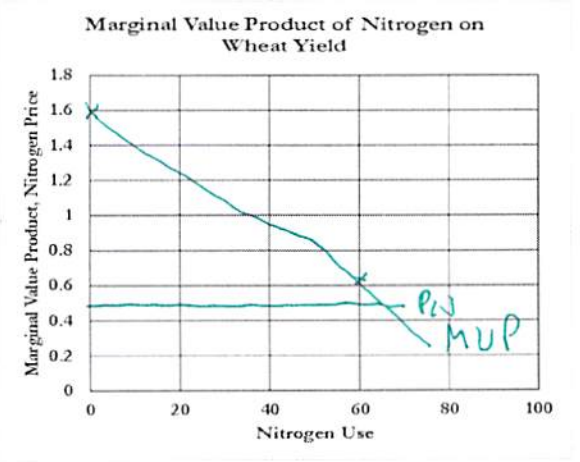
(20) Given the MVP in (~~11~~ 19), if the price of nitrogen is $0.5 per lb, should you apply more than 20 lbs?

a. Yes
b. no

(21) In the figure below, graph the marginal product of nitrogen.



(22) In the figure below, graph the marginal value product of nitrogen (labeling it MVP), as well as the nitrogen price (labeling it P_N). Indicate approximately the profit-maximizing point of nitrogen use on the x-axis by labeling it N*.



(23) Using algebra and showing your work, calculate the precise amount of nitrogen that maximizes wheat production profits.

$\{0.4 - 0.004(N)\}(4) = 0.5$

$\frac{(0.4)(4) - 0.5}{(0.004)(4)} = 68.75 \frac{\text{lb N}}{\text{acre}}$

N	MP	MVP
0	0.4	1.6
60	0.16	0.64