THOUGHT FOR THE DAY:

If teachers can teach a student to have a sense of humor about the very serious things in life, they are teaching much more than facts and figures. By teaching students to be able to laugh at themselves, teachers are showing students how to cope in the real world which is one of the most important survival skills we have. (By Deborah Hill in *Humor in the Classroom*)

ECONOMICS JOKE OF THE DAY:

Two college students who had never taken an Econ class decided to start up their own business over the summer to make some money for school. They established a watermelon marketing business where they bought watermelons from farmers and resold them directly to consumers at a roadside stand. They purchased their own truck to haul the watermelons from the farm fields to the stand. They decided to pay the farmers $3.00 for each watermelon and to sell them at the stand for $2.00 each. At the end of the summer, the students added up their revenues and their costs and discovered that they had lost $1,000. Upon discovering this, one student says to the other, "See, I told you we should have bought a bigger truck!"

INSTRUCTIONS:

After you have regained your composure from laughing at the above joke, proceed to answer questions on this exam. Note there are 42 questions, but YOU CAN LEAVE 2 QUESTIONS BLANK WITHOUT PENALTY. Each of the 40 questions that you answer is worth 2.5 points. Relax and good luck.

FINAL COURSE GRADES:

Your final exam score and your final course grade will be posted on our homepage Monday, May 8. If you have any questions or concerns, you can call your instructor at 294-5771, stop in to see him at 174 Heady Hall, or e-mail him at rdeiter@iastate.edu. Thanks for having been a student in my section of Econ 301 this semester. Hopefully, at least some of the economic topics we discussed will aid you in your future endeavors.
Part I. New Material since Exam #3.

1. What famous Professor of Economics tells the best jokes of all time? (Note: this question and answer was submitted by a student in our class in case you were wondering).
   a. Dr. Suess
   b. Dr. Scholls
   c. Dr. Deiter
   d. Dr. Doolittle
   e. Dr. Ruth

2. If the cost of land = $200 per acre and the cost of fertilizer = $100 per ton, which of the following is NOT on the same isocost line for a given producer who is purchasing these two inputs to produce corn?
   a. 50 acres of land, 100 tons of fertilizer
   b. 30 acres of land, 300 tons of fertilizer
   c. 40 acres of land, 200 tons of fertilizer
   d. 25 acres of land, 250 tons of fertilizer
   e. all of the above

3. Assume a farmer wants to produce 200,000 pounds of market hogs using two variable inputs (corn = C and protein supplement = S). To minimize the cost of producing that quantity of hogs, the producer should be producing at that point where the price of a bushel of corn (Pc) divided by the additional output of hogs per additional bushel of corn fed (= marginal product of corn = MPC) is equal to:
   a. 1
   b. MVC
   c. PC/MPc
   d. MRc
   e. MR

4. What short-run production rule did the two college students referred to in the ‘Joke of the Day’ on page 1 fail to consider? Don’t produce in the short run if:
   a. you don’t have large enough fixed equipment
   b. you can’t cover all of your costs
   c. the per unit price you receive for your product is less than your AVC
   d. you can’t pay for your fixed costs (i.e. your truck in this case)
   e. the per unit price you receive for your product is less than your AFC

   \[
   \text{produce if } TR > TVC \\
   \Rightarrow TR > TVC \\
   \Rightarrow P > AVC
   \]
5. Based on the diagram below, what would be the firm's total dollars worth of profit if the firm produced 100 units of output? Assume the dollar values of the corresponding curves at points a, b, c and d are $20, $15, $11 and $8 respectively.

\[ \pi = (AR - ATC)q \]
\[ = (11 - 15)(100) \]
\[ = (-4)(100) \]
\[ = -400 \]

6. Based on the graph in Question #5, the firm would maximize short-run profits by:
   a. producing q = 0 because P < ATC
   b. producing q = 100 because P > AVC
   c. producing q > 100 where P = AVC
   d. producing q < 100 where P = MC
   e. producing q < 100 where MC = AVC

7. Which of the following influences the slope of an isocost line for a long run production process involving land and fertilizer inputs?
   a. the productivity of the land
   b. the quantity of fertilizer applied per acre
   c. the rental rate (or opportunity cost) per acre of land
   d. all of the above
   e. none of the above

8. In perfect competition, an individual firm's short-run demand curve for an input is the firm's:
   a. MC curve above minimum AVC
   b. MR curve
   c. MRP curve below the ARP curve
   d. MFC curve
   e. expansion path curve
9. Suppose a corn farmer is confronted with a constant P (and MR) for output at $3.00 per bushel, constant MC (and AVC) of $1.00 per bushel, and TFC of $180.

a. Suppose this farmer is just breaking even. What & is the farmer producing?

\[ TR = TC \Rightarrow TR - TVC - TFC = 0 \]
\[ (3.00)Q - (1.00)Q - 180 = 0 \]
\[ 2Q = 180 \Rightarrow Q = 90 \]

b. Show graphically, your answer to part 'a' of this question.

[Graph showing TR and TC curves with Q = 90 marked]

c. If the farmer expects to produce Q = 150, what is the breakeven P of the output?

\[ TR - TVC - TFC = 0 \]
\[ (3.00)(150) - (1.00)(150) - 180 = 0 \]
\[ 150P = 330 \Rightarrow P = 2.20 \]

d. Suppose the government imposes a sales tax of $0.20 per bushel on the farmer. What is the new breakeven Q for this farmer? or could view tax as
d. Suppose the government imposes a sales tax of $0.20 per bushel on the farmer. What is the new breakeven Q for this farmer?

\[ Tax \Rightarrow \uparrow AVC \text{ to } 1.20 \]
\[ TR - TVC - TFC = 0 \]
\[ (3.00)Q - (1.20)Q - 180 = 0 \]
\[ 1.8Q = 180 \Rightarrow Q = 100 \]

10. Assume a short run production function of \( q = 400L^{1/2} \), \( P \) = the price of the output = 2, \( w = 20 \) = the cost of one unit of L (labor). What is the mathematical equation for the marginal revenue product of labor (MRP,) as a function of L?

\[ MRP_L = P \cdot MP_L \]
\[ = P \cdot \frac{\partial}{\partial L} q \]
\[ = (2) \cdot \left[ \frac{1}{2} \cdot 400 \cdot L^{-1/2} \right] \]
\[ = \frac{400}{L^{1/2}} = \frac{400}{\sqrt{L}} \]
11. Explain a) what causes the SR supply curve to shift to the right in the LR in a purely competitive industry and b) why this would likely happen.

   a) an up in the number of firms in the industry
   b) the existence of economic profits due to \( P > ATC \)

12. Assume \( MP_L = 100/\sqrt{L} \), \( P \) = the price of output = 4, and \( W \) = the cost of one unit of labor \( (L) = 8 \), what is the profit-maximizing quantity of labor?

\[
\begin{align*}
\text{MRP} &= \text{MFC} \\
\Rightarrow P \cdot MP_L &= W \\
\Rightarrow \frac{400}{\sqrt{L}} &= W \\
\Rightarrow 8 \sqrt{L} &= 400 \\
\Rightarrow \sqrt{L} &= 50 \\
\Rightarrow L &= 2500
\end{align*}
\]

13. Assume a firm’s TR (total revenue) as a function of \( q \) = output is \( 100q - q^2 \). What level of \( q \) would maximize the firm’s profit if \( MC \) = marginal cost is constant at \( $20 \) and \( TFC \) = \( $1000 \)?

\[
\begin{align*}
\pi_{\text{MAX}} &\Rightarrow \text{MR} = \text{MC} \\
\Rightarrow \frac{dTR}{dq} &= \text{MC} \\
\Rightarrow 100 - 2q &= 20 \\
\Rightarrow q &= 40
\end{align*}
\]

14. Show in the graph below, the directional impact on any of the curves and on the profit maximizing quantity of fertilizer to use per acre (N) in producing corn if the price of corn increases.
15. Assume labor is a firm's only short-run variable expense (\(\Rightarrow TVC = W \times L\) where \(w = \) per unit wage rate and \(L = \) units of labor). MFC = marginal factor cost = \(\frac{\partial TVC}{\partial L}\).

\[
\begin{align*}
\text{a.} & \quad \frac{dTVC}{dL} = W + L \frac{\partial W}{\partial L} \\
\text{b.} & \quad \frac{dTVC}{dL} = W + L \frac{\partial W}{\partial L} \\
\text{c.} & \quad \frac{\partial w}{\partial L} \times 1 \\
\text{d.} & \quad L + w \frac{\partial L}{\partial W} \\
\text{e.} & \quad L + w \frac{\partial L}{\partial W}
\end{align*}
\]

16. Assume Merry and Holly operate a home decorating business where \(q = \) the number of houses decorated, \(M = \) hours worked by Merry, \(H = \) hours worked by Holly, \(W_M = 40 = \) the cost to the business of 1M, and \(W_H = 10 = \) the cost to the business of 1H. The cost of all nonlabor expenses are included in \(W_M\). Assume further that all variables are defined for a period of time equal to one month and \(q = 0.4H^{0.4}M^{0.6}\).

\[
\frac{q}{\bar{H}} = (0.4 \times 100)^{0.4}M^{0.6}
\]

Calculate \(q\) as a function of \(M\) if \(H\) is fixed at \(\bar{H} = 100\).

17. Based on the 'equal slopes' condition, the firm in #16 above would use what quantity of \(M\) if it is to minimize its LR total costs of decorating a given number of houses (assuming both \(M\) and \(H\) are variable in the long run)?

\[
\begin{align*}
\text{a.} & \quad M = H \\
\text{b.} & \quad M = 4H \\
\text{c.} & \quad M = 1/4H \\
\text{d.} & \quad M = 9H \\
\text{e.} & \quad M = 16H \\
\end{align*}
\]

18. Based on your answer to #17, in the long run the business should hire Holly for how many hours in order to decorate 10 houses in a given month?

\[
\begin{align*}
\text{a.} & \quad 25 \rightarrow \text{OK if answered a} \\
\text{b.} & \quad 12.5 \rightarrow \text{OK if answered a} \\
\text{c.} & \quad 50 \\
\text{d.} & \quad 8.33 \rightarrow \text{OK if answered a} \\
\text{e.} & \quad 62.5 \rightarrow \text{OK if answered a} \\
\end{align*}
\]

19. Assume the firm in #16 above has LR TC = 100q. How much cheaper or less expensive will it be for the firm to decorate 8 houses in the long run verses in the short run (i.e. \(H = 100\), \(W_H = 10\), \(W_M = 40\).

\[
\begin{align*}
\text{LR TC} &= 100q \\
\Rightarrow q &= (0.4)(100)^{0.4}M^{0.6} \\
\Rightarrow M^{0.6} &= 2 \\
\Rightarrow M &= 4
\end{align*}
\]
Assume the demand for the firm's decorating service (in #16 above) is given by \( P = 220 - 5q \). How many houses should this firm decorate per month in the LR in order to maximize its profits if LR TC = 100q.

\[
\begin{align*}
\text{MAX } \pi & \Rightarrow \text{ MR } = \text{ MC} \\
\Rightarrow \frac{d\pi}{dq} & = \frac{dTC}{dq} \\
\Rightarrow 220 - 10q & = 100 \\
\Rightarrow 10q & = 120 \\
\Rightarrow q & = 12
\end{align*}
\]
Part II. Old material from previous exams.

21. Place an ‘x’ in the blank in front of each SR production concept listed below which, when graphed, is graphed with physical units of the variable input on the horizontal axis:

- marginal revenue product
- marginal factor cost
- average total cost
- total product
- marginal product
- total variable cost

Grading Note:
- deduct 1/2 pt. for each blank incorrectly marked
- but do NOT deduct more than 2 1/2 pts. total

22. Suppose an industry consists of 100 identical price-taking firms each having MC = 5 + 10q. What is the market supply (Q_s) equation?

a. \[ Q_s = 500 + 1000q \]

b. \[ Q_s = -50 + 10P \]

c. \[ Q_s = 500 + 10P \]

d. \[ Q_s = 50 + 10P \]

e. \[ Q_s = -50 - 10P \]

23. If a short-run production function is such that \( q = 100K^2L + K^2L^3 \) and \( K \) is fixed at \( K = 5 \). Solve for \( q \) or TP as a function of \( L \).

\[ q = (100)(5)^2L^2 - (5)^3L^3 \]

\[ = 2500L^2 - 125L^3 \]

24. For the firm in #23, calculate \( AP_L \) as a function of \( L \) given \( K = 5 \).

\[ AP_L = \frac{TP}{L} = \frac{2500L^2 - 125L^3}{L} = 2500L - 125L^2 \]

25. Assume \( AP_L \) for an ag implement dealership is given by \( AP_L = 1000L - 100L^2 \) where \( L \) = number of workers hired per month. What is the maximum number of tractors in a month that can be repaired per worker (i.e. maximum \( AP_L \))?

\[ \text{Max } AP_L \Rightarrow \text{value of } AP_L \text{ where } \frac{dAP_L}{dL} = 0 \]

\[ \Rightarrow \frac{dAP_L}{dL} = 1000 - 200L = 0 \]

\[ \Rightarrow 200L = 1000 \Rightarrow L = 5 \]

\[ \Rightarrow AP_L \text{ at } L = 5 = 1000(5) - 100(5)^2 = 5000 - 2500 = 2500 = \text{Max } AP_L \]
26. Which of the following graphs of a set of indifference curves corresponds to two goods, x and y, that are both normal goods and perfect substitutes:

- [Diagram of indifference curves]

a. 

b. 

c. 

d. 

e. 

constant downward slope
27. Assume Ralph enjoys tofu burgers (B) and Evian water (W) and that his utility function is given by \( U = 4B^{1/2}W^{1/2} \). What is the equation of the indifference curve for Ralph that is drawn in this graph?

\[
\Rightarrow 36 = 4B^{1/2}W^{1/2} \\
\Rightarrow B^{1/2} = \frac{36}{4W^{1/2}} \\
\Rightarrow B = \frac{36}{W}
\]

28. Assume Ralph (see #27 above) has a budget constraint, regarding B and W, of \( I = \$20 \) and it is drawn in the graph below. What is the price of a tofu burger?

\[
\Rightarrow \max B = 10 = \frac{I}{P_B} \\
\Rightarrow 10 = \frac{20}{P_B} \\
\Rightarrow 10P_B = 20 \\
\Rightarrow P_B = 2.00
\]
29. Assume a firm's LR production function is given by \( q = 10K^{1/2}L^{1/2} \). What is the mathematical equation of the isoquant for \( q = 1000 \) (assume \( K \) is plotted on the vertical axis)?

\[
\begin{align*}
1000 &= 10K^{1/2}L^{1/2} \\
\Rightarrow K^{1/2} &= \frac{1000}{10L^{1/2}} \\
\Rightarrow K &= \frac{10000}{L} = 10000L^{-1}
\end{align*}
\]

30. Assume that the demand for Pecanlow Seed Corn is downward sloping and linear.
Suppose the marketing department of Pecanlow knows 1) the company will sell 16,000 bags of seed corn at \( P = 60 \) per bag and 2) the company's total revenue (TR) will be \( 900,000 \) at \( P = 50 \) per bag. Given this information, at what price per bag will this company maximize its TR?

<table>
<thead>
<tr>
<th>P</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>16,000</td>
</tr>
<tr>
<td>50</td>
<td>TR = ( \frac{900,000}{50} = 18,000 )</td>
</tr>
</tbody>
</table>

\[
\begin{align*}
P &= a + bQ \\
\Rightarrow b &= \frac{\Delta P}{\Delta Q} = \frac{-10}{-2000} = .005 \\
\Rightarrow P &= a + .005Q \\
a &= P + .005(18,000) = 50 + .005(18,000) = 140
\end{align*}
\]

31. Assume a firm's SR production function is given by \( q = 300L^{1/2} \), \( K = 10 \), \( r = 5 \), and \( w = 90 \). Derive the equation for the firm's SR TC as a function of \( q \).

\[
\begin{align*}
q &= 300L^{1/2} \\
\Rightarrow L^{1/2} &= \frac{q}{300} \\
\Rightarrow L &= \left(\frac{q}{300}\right)^2
\end{align*}
\]

\[
\begin{align*}
\text{SR TC} &= rK + wL \\
&= rK + w\left(\frac{q^2}{300,000}\right) \\
&= 50 + 90\left(\frac{q^2}{300,000}\right) \\
&= 50 + .001q^2
\end{align*}
\]
32. Assume the following is a graph of a firm's TVC equation as a function of output (q).

Based on this:

a. MC is constant
b. AVC is increasing
c. TVC is increasing at a decreasing rate
d. TFC is zero
e. all of the above

33. Assume a firm's SR production function results in \( MP_L = 100/L \) and \( w = 40 \). What is the MC of producing another unit of output at \( L = 25 \)?

\[
MC = \frac{w}{MP_L} = \frac{40}{100/25} = \frac{40}{4} = 10
\]

34. Assume \( q, K, \) and \( L \) are units of output, capital, and labor respectively. If \( q = 10 \) when \( K = 2 \) and \( L = 4 \) and \( q = 16 \) when \( K = 4 \) and \( L = 8 \), what kind of returns to scale are present in the production process? Why?

Note: \( q \) is a function of input \( I \). When \( I \) input 2.0x

\( \Rightarrow \) proportionate \( \uparrow \) output \( \Leftrightarrow \) \( \uparrow \) input

\( \Rightarrow \) decreasing returns to scale
35. Assume the following is a graph of a firm's TFC. What is the slope of a line from the origin to a specific point on the TFC curve called?

- TFC
- q

a. MC
b. TC
c. AVC
d. AFC
e. MFC (marginal factor cost)

36. In a typical SR production situation where L (labor) is the variable input, a firm would hire at least enough workers up to the point where:
   a. AP_L = 0
   b. MP_L = a maximum
   c. MP_L = 0
   d. AP_L = a maximum
   e. TP = a maximum

37. Suppose H&R Black is a local 'tax preparation' business and its SR TC = 40K + .1q^2K^{-1} where q = number of tax returns prepared per week and K = the number of computers owned by the business. How many computers should the company invest in if it wants to minimize its SR TC of producing q = 100? (HINT: What is true about any function that is at a maximum or a minimum?)

\[ \text{Maximize SR TC} \Rightarrow \frac{\partial SR TC}{\partial K} = 0 \]
\[ = \frac{40 - 1000}{K^2} = 0 \]
\[ \Rightarrow 40 - 1000 = 0 \]
\[ \Rightarrow 40 = 1000 \]
\[ \Rightarrow K^2 = 100 \]
\[ \Rightarrow K = 10 \]
38. Assume that:

- \( X_D = \) student demand (# of students) at ISU for Deiter’s section of Econ 301 for a given semester
- \( X_B = \) student demand (# of students) at ISU for Bunzel’s section of Econ 301 for the same semester
- \( X_T = X_D + X_B = \) total student demand for Econ 301 at ISU for a given semester
- \( P_D = \) price or cost to students of taking Deiter’s section of 301
- \( P_B = \) price or cost to students of taking Bunzel’s section of 301
- \( I = \) average student income measured in $1000

If,

\[
X_D = 100 - 0.05P_D + 11 + 0.02P_B + \text{and}
\]

\[
X_B = 80 - 0.04P_B + 21 + 0.01P_D + \text{and}
\]

\[
I = 10, P_D = 1000, \text{and } P_B = 500,
\]

what will be the total number of students taking Econ 301 (i.e. \( X_T \))?

\[
X_D = 100 - 0.05(1000) + 11 + 0.02(500) = 70
\]

\[
X_B = 80 - 0.04(500) + 21 + 0.01(1000) = 90
\]

\[
X_T = X_D + X_B = 70 + 90 = 160
\]

39. What is the apparent own price elasticity of demand for Deiter’s section of Econ 301 (see #38 above) at \( P_D = 1000 \) if \( I = 10 \) and \( P_B = 500 \)?

\[
e = \frac{\frac{\partial X_D}{\partial P_D} \cdot \frac{P_D}{X_D}}{P_D} = \frac{1000}{70} \\
e = -\frac{30}{70} = \approx -0.71
\]
40. Assume the figure below is a graphical representation of intertemporal choice decisions for Rex where $C_0$ and $C_1$ = quantities of current and future period consumption respectively and the line $aa$ represents Rex's initial budget constraint based on future income $I_1 = $20,000 and an interest rate of $r = 10\%$. Assume further that the price of 1 unit of $C_0$ and $C_1$ = $1$ and that point #1 in the graph corresponds to Rex maximizing his utility by being neither a net borrower nor a net saver.

![Graph showing intertemporal choice decisions](image)

Given this information, what is Rex's current period income ($I_0$)?

\[
\max C_1 = 36,500 = \frac{I_0 (1 + r)}{p} + \frac{I_1}{p} \Rightarrow 36,500 = 1.1I_0 + 20,000
\]

\[
\Rightarrow 1.1I_0 = 16,500 \Rightarrow I_0 = \frac{16,500}{1.1} = \frac{15,000}{1.1}
\]

41. Given the information in #40 above, what is the maximum attainable $C_0$ for Rex?

\[
\max C_0 = \frac{I_1}{p_0 (1 + r)} + \frac{I_0}{p_0} = \frac{20,000}{1.1} + \frac{15,000}{1}
\]

\[
= \frac{18,182}{1.1} + \frac{15,000}{1}
\]

\[
= 33,182
\]

42. Draw in the graph in #40 above, a NEW budget constraint for Rex that would be consistent with a decrease in the interest rate. Label $I_2$.

⇒ Clockwise rotation of $aa$ around pt #1 in above graph.