ECON 2100 – Principles of Microeconomics (KSU, Prof. Mathews)
“Behavior of Firms in Perfectly Competitive Markets”

Relevant readings from the textbook:
• Mankiw, Ch. 14 – “Firms in Competitive Markets”

Suggested problems from the textbook:
• Chapter 14 “Quick Quiz Multiple Choice” (Pages 284-285): 1, 2, 3, and 4
• Chapter 14 “Questions for Review” (Pages 285-286): 2, 3, 4, and 5
• Chapter 14 “Problems and Applications” (Pages 286-287): 1, 2, 3, 5, 6, 7, 8, 9, 10, and 11

Definitions and Concepts:
• Perfectly Competitive Market – a market in which no individual buyer and no individual seller can substantially influence market price by changing his own behavior
• Two primary conditions which must be met for a market to be “perfectly competitive”:
  i. all goods offered for sale are identical
  ii. there are “many” buyers and “many” sellers
  ▪ Primary Implication: in perfectly competitive markets, all buyers and all sellers are “price takers” (i.e., buyers and sellers must “accept the price that market demand and market supply determine”; nobody has any “market power” or “control over price”).
  ▪ A third condition which is assumed when discussing the “Long Run dynamics” of perfectly competitive markets:
    iii. “Free Entry/Exit” – new firms could enter and existing firms could exit the market with relative ease and without incurring substantial costs of doing so
• In general, a firm maximizes profit by applying the “Cost-Benefit Principle”
  ▪ “Cost-Benefit Principle” – a rational decision maker should undertake an action if and only if the Marginal Benefit from taking the action are at least as great as the Marginal Cost of doing so.
  ▪ Additional Benefit for the firm from increasing quantity of output: “Change in Revenue” or “Marginal Revenue”
  ▪ Additional Cost for the firm from increasing quantity of output: “Change in Costs” or “Marginal Costs”
  ▪ Producing the “next unit of output” will make:
    o Profit Larger if and only if “Marginal Revenue is greater than Marginal Costs”
    o Profit Smaller if and only if “Marginal Revenue is less than Marginal Costs”
Revenue for a Price Taking Firm:

In general, we have noted that “Revenue of a Firm” can often be expressed as simply “price times quantity” or:

\[(\text{Per Unit Price})(\text{Quantity Sold})\]

For a “price taking firm,” the “Price Per Unit” does not vary with the “Quantity Sold” => rather, price is a constant value, \(P\)

- It’s as if the firm faces a “perfectly elastic demand” for their product (i.e., demand curve is a “horizontal line”)

- The firm is “so small relative to the entire market” that they can always increase their quantity sold without there being any downward pressure on market price (i.e., they do not have to decrease price at all in order to “attract additional customers”)

- However, since all other sellers are offering an identical good to consumers, if the firm tries to charge a higher price, they will “lose all of their customers”
Implications of “Constant Price” on Total, Marginal, and Average Revenue:

Graphically:

- **Total Revenue** => area of rectangle formed from relevant point on demand curve and back to the origin
- **Marginal Revenue** => simply equal to “height of demand curve,” since there is no “lost revenue as a result of having to decrease price on previous units sold” => constant marginal revenue equal to simply $p$
- **Average Revenue** => area of rectangle divided by quantity => height of the rectangle, which again is simply equal to $p$

Algebraically:

- $(\text{Total Revenue}) = (\text{Per Unit Price})(\text{Quantity Sold})$
- $(\text{Average Revenue}) = (\text{Total Revenue})/(\text{Quantity Sold}) = ([\text{Price}][\text{Quantity}])/(\text{Quantity}) = \text{Price}$
- $(\text{Marginal Revenue}) = (\text{Change in TR})/(\text{Change in Q}) = ([\text{Price}][\text{Change in Q}])/(\text{Change in Q}) = \text{Price}$
Graphical Analysis of SR Profit Max. for a firm in a Perfectly Competitive Market:

- Recall that by application of the “Cost-Benefit Principle,” the profit maximizing level of output must satisfy the condition of “(Marginal Revenue) = (Marginal Costs)”

(i) Relatively High Price => “Positive Profit” equal to the yellow shaded area below

(ii) Relatively Low Price => “Negative Profit” equal to the green shaded area below (but since (price) > (AVC) for “some range of (q),” the firm is able to generate revenue which is greater than Variable Costs of production => this loss is not as large as a loss of (Fixed Costs)…)

Quantity at which MR=MC

Quantity with MR=MC (and MC intersecting MR “from below”)
(iii) Very Low Price => if price is “so low” so that \( \text{price} < (\text{AVC}) \) for all levels of output, then there is no quantity of production at which the firm could generate revenue which would cover even Variable Costs of production => producing any positive quantity would lead to a loss “greater than “Fixed Costs” => best thing for the firm to do in the short run is “shutdown” and earn a profit equal to “minus (Fixed Costs).” => the profit of the firm in this case (of “ – (Fixed Costs)”) could be illustrated by a “rectangle with ‘base of quantity’ and ‘height of (ATC-AVC)’” at any arbitrary level of output (such as \( \tilde{q} \) below)
Further explanation of why it might be best for a firm to produce a positive quantity of output in the short run, even if it leads to a negative profit:

- Consider a firm facing a price \( AVC_{\text{min}} < p < ATC_{\text{min}} \)

Even though the firm is earning a negative profit (i.e., realizing a loss), they are still doing better than would be the case if they instead ‘shut down’ and realized a ‘profit of –F.’

The reason is that since \( p > AVC(\bar{q}) \) they are able to generate Revenue at this level of output which “more than covers” the Variable Costs of producing this level of output.

At \( \bar{q} \):
- (Total Costs) = (Green + Blue + Pink)
- (Variable Costs) = (Pink)
- (Fixed Costs) = (TC – VC) = (Green + Blue)
- (Total Revenue) = (Blue + Pink)
- (Total Revenue – Variable Costs) = (Blue) [Positive!]
- (Profit) = (TR) – (TC) = – (Green) [Negative, but not “as negative” as “negative (Green plus Blue)…”]
Graphical Solution to Profit Maximization Problem for a Firm in a Perfectly Competitive Market:

A firm in a perfectly competitive market (in which the prevailing price for output is $P$) maximizes profit by:

(i) ‘shutting down’ and producing $q = 0$ units of output if $p < AVC_{\text{min}}$

(ii) producing the positive quantity of output $\bar{q}$ for which $MC(\bar{q}) = p$ (with $MC$ intersecting $MR$ ‘from below’) if $p > AVC_{\text{min}}$

Thus, the “short run supply curve” of this firm is essentially: the portion of the Marginal Cost Curve which lies above the Average Variable Cost Curve.
In summary, for “all possible positive prices” we have that a profit maximizing firm operating in a perfectly competitive market in the short run will:

- **Minimum Value of Average Variable Costs**
  - ‘Shut Down’ and produce zero units of output
  - Earn a profit of (–F)

- **Minimum Value of Average Total Costs**
  - Produce a positive quantity of output
  - Maximum profit is negative, but greater than (–F)

- **Price of Output**

That is:

- In terms of the “behavior of the firm” (with regards to ‘shutting down’ or producing a positive quantity of output), the minimum value of Average Variable Costs is a critical cut-off:
  - ‘Shut Down’ \( \iff p < AVC_{\text{min}} \)
  - Produce a Positive Quantity \( \iff p > AVC_{\text{min}} \)

- In terms of the “short run profitability of the firm,” the minimum value of Average Total Costs is a critical cut-off:
  - Maximum Profit is Negative \( \iff p < ATC_{\text{min}} \)
  - Maximum Profit Positive \( \iff p > ATC_{\text{min}} \)
Relation between “Profit” and “Producer’s Surplus”:

- (Yellow) = (Revenue from selling first 700 units) minus (Variable Costs of Producing first 700 units) \[\text{since } VC \text{ can be represented as } (\text{quantity})(AVC)\]
- (Blue) = (Revenue from selling units 701 through 1,200) minus (Variable Costs of Producing units 701 through 1,200) \[\text{since } VC \text{ of producing these units can be calculated by “adding up } MC \text{ over these units”}\]

Thus, in total we have that:

(Producer’s Surplus) = (Revenue) – (Variable Costs)

Since (Profit) = (Revenue) – (Var Costs + Fixed Costs), it follows that:

(Profit) = (Producer’s Surplus) – (Fixed Costs)

or equivalently

(Producer’s Surplus) = (Profit) + (Fixed Costs)
**Short Run Market Supply:**

- Over the short run, the “market quantity supplied” at any particular price is simply equal to the “summation of the quantities supplied by each of the individual firms in the market”
- Numerically, if the current market price is $5 and we have 200 firms each supplying 400 units at this price, then market quantity supplied at this price is simply: $400 + 400 + 400 + ... + 400 + 400 = (200)(400) = 80,000$

- Graphically, the “Short Run Market Supply Curve” is simply the “horizontal summation” of all of the “individual short run supply curves of all the firms currently in the market.” Consider a market with “20 firms of ‘Type 1,’ 45 firms of ‘Type 2,’ and 70 firms of ‘Type 3’…” Market Quantity Supplied at a price of $5.00 would be: $(20)(2,500) + (45)(2,200) + (70)(1,800) = 275,000$
**Long Run Market Supply:**
- In the Long Run there is “Free Entry and Exit
  - “Existing Firms” are able to “Completely Exit the Market” (i.e., not just ‘shut down,’ but ‘completely exit’ the industry and avoid incurring any fixed costs)
  - “New Firms” are able to “Enter the Market”
- In a competitive market not only are “entry barriers low (or non-existent),” but further all potential firms have:
  - access to the same production technique or technology (i.e., the same production function)
  - access to the factors of production at the same costs
  - therefore, identical Long Run Cost Curves

**Profit as a Motive for Entry/Exit in the Long Run:**
- If firms “currently in the market” are earning positive profits in the short run, then “entry” will occur and price will be gradually driven down until Profit of Firms in the industry is driven down to zero
- If instead firms “currently in the market” are earning negative profits in the short run, then “exit” will occur and price will be gradually driven up until Profit of Firms in the industry is driven up to zero
- In either case, the outcome of this process is one in which firm in the industry are earning “zero profit”: \((\text{Profit}) = (\text{Quantity})(\text{Price} – \text{ATC}) = 0 \Leftrightarrow (\text{Price}) = (\text{ATC})\)
- Implication:
  - Recall that firms are producing where “\((\text{Price})=(\text{MC})\)”
  - We just argued that in the Long Run price will be driven to a point where “\((\text{Price})=(\text{ATC})\)”
  - For both of the above to be true, it must be that in the Long Run “\((\text{ATC})=(\text{MC})\)”
  - But if this equality holds, it must be that firms are operating at the point where ATC are minimized (i.e., firms are operating at their “Efficient Scale”)

**Long Run Market Supply Curve:**
- Observe that in a market with free entry and exit, there is only one price consistent with zero profit: \( p = ATC_{\text{min}} \implies \) Long Run Market Supply in a perfectly competitive market must be a horizontal line at this price
  - At \( p > ATC_{\text{min}} \) firms would earn positive profits, leading to entry by new firms and an increase in total quantity supplied; at \( p < ATC_{\text{min}} \) firms would earn negative profits, leading to exit by existing firms and a decrease in total quantity supplied
  - Number of firms in the market adjusts so that \( p = ATC_{\text{min}} \) and so there are just enough firms to exactly satisfy quantity demanded by consumers at this price

Two possible reasons why LR Supply could potentially slope upward:
1. **Scarcity of an input used in the production process.** Example: market for agricultural output…
   - “Total Land” is limited \( \implies \) limit to how much farmland we can have
   - As more land is used for farming: price of farmland is driven up, increasing costs for all farmers. Thus, even in the Long Run, costs will in fact be higher when quantity supplied is higher
   - If Long Run Demand increases, Long Run price must increase in order to cover these higher costs
2. **Producers may have different costs.** Example: market for painters…
   - Anyone can enter the market for providing painting services, but not everyone has identical costs. Some people can paint more quickly than others (“fast painters” have lower costs). People differ in regards to profitability of “alternative jobs” (“opportunity cost” of being a painter is higher for someone with a medical degree than for someone with no high school diploma)
   - To increase Long Run quantity supplied, additional producers must be encouraged to enter the market \( \implies \) Price would have to rise to make it profitable for those producers with higher costs to enter
Problem:

1. Consider a firm operating in a perfectly competitive market in the Short Run. Suppose that all inputs are fixed other than “labor.” The table below provides a summary of the Short Run Production Function of this firm (the relation between number of workers hired per month and output per month) and a partial summary of Short Run Costs of this firm.

<table>
<thead>
<tr>
<th>Number of Workers</th>
<th>Quantity of Output</th>
<th>Marginal Product of Labor</th>
<th>Marginal Costs of Production</th>
<th>Average Variable Costs of Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1,500</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>9,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>10,500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>11,750</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>12,750</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>13,500</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>14,000</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>14,375</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>14,675</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>15,125</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>15,275</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Answer the following questions based upon the information conveyed in this table
A. Based upon the values provided, correctly fill in all empty cells in this table (for “non-integer values,” report your answer to “two digits beyond the decimal”).
B. Based upon your answers to “part (A),” what is the “minimum value of Average Variable Costs of Production”?
C. Suppose that this firm has Fixed Costs of $11,750 and that each unit of output can be sold for $2.50. How much output will the firm produce and how much profit will the firm earn in the short run? Explain.
D. Suppose that this firm has Fixed Costs of $15,000 and that each unit of output can be sold for $1.80. How much output will the firm produce and how much profit will the firm earn in the short run? Explain.
E. Suppose that this firm has Fixed Costs of $5,000 and that each unit of output can be sold for $0.65. How much output will the firm produce and how much profit will the firm earn in the short run? Explain.

Multiple Choice Questions:

1. A firm operating in a perfectly competitive market in the short run
A. will always choose to produce a positive quantity of output.
B. can always earn a positive profit.
C. will choose to “shut down” and produce zero units of output if their maximum profit is ever negative.
D. None of the above answers are correct.
2. It is typically assumed that a “perfectly competitive market” is characterized by “Free Entry/Exit,” an assumption which means that
   A. in the short run all firms in the industry can easily exit and avoid all of their fixed costs of production.
   B. in the long run, new firms can enter and existing firms can exit the industry with relative ease and without incurring any substantial costs of doing so.
   C. since there are “many buyers” and “many sellers” in such markets, nobody would notice if one particular seller chose to exit the industry.
   D. firms currently in the market could easily prevent new firms from entering the market, without having to incur any substantial costs of doing so.

3. For a firm operating in a perfectly competitive market, Marginal Revenue
   A. becomes negative at sufficiently high levels of output.
   B. is less than Average Revenue at every level of output.
   C. does not change as the firm increases quantity of output.
   D. None of the above answers are correct.

4. Jason sells flip-flops near the beach. Last month he earned Total Revenue of $8,000. His Total Costs of Production were $6,000, while his Variable Costs of Production were $5,000. From these figures, it follows that
   a. Jason would want to “exit this industry” in the Long Run.
   b. Jason would have been better off “shutting down” during the past month.
   c. Jason earned a profit of $1,000 last month.
   d. Jason realized a Producer’s Surplus of $3,000 last month.

5. Visually, the “demand curve facing a firm operating in a perfectly competitive market” is
   A. positively sloped, since the “Law of Demand” will be violated in such a market.
   B. downward sloping, since the only way for such a firm to increase quantity sold is by charging a lower price for their output.
   C. a vertical line, since whatever price such a firm sets, quantity demanded will always be exactly equal to the “capacity of the firm.”
   D. a horizontal line, since such a firm can “sell as much as they want at the prevailing market price” but would “lose all customers if they tried to charge a higher price.

6. The “short run supply curve” of a firm in a perfectly competitive market is
   A. a horizontal line at the prevailing market price.
   B. a horizontal line at the minimum value of Average Total Costs of Production.
   C. the portion of the Average Total Cost Curve which lies above the Average Variable Cost curve.
   D. the portion of the Marginal Cost curve which lies above the Average Variable Cost Curve.
7. Producer’s Surplus is equal to  
A. “Profit minus Total Costs of Production.”
B. “Revenue minus Variable Costs of Production.”
C. “Profit plus Fixed Costs of Production.”
D. More than one of the above answers is correct.

8. Brian produces shoes in a perfectly competitive market. During the month of June he: produced 500 shoes, sold each pair of shoes at a price of $25 per pair, had fixed costs of $2,000, and earned a total profit of $(-1,750). In the long run, we should expect that Brian would  
A. “exit” this market.
B. choose to produce more than 500 units per month, so that he could produce at a point with lower Average Total Costs of production.
C. charge more than $25 per pair of shoes, so that he could increase his revenues by getting more money for each pair of shoes sold.
D. charge less than $25 per pair of shoes, so that he could increase his revenues by increasing the quantity of output which he sells.

9. In a perfectly competitive market in the Long Run  
A. most firms will be earning a “negative profit” and be realizing a Producer’s Surplus equal to zero.
B. the market supply curve will typically be downward sloping.
C. the typical firm will be operating at its “efficient scale of production.”
D. More than one of the above answers is correct.

10. Consider a perfectly competitive market in the Short Run in which at the prevailing market price of $8.95 per unit of output we observe: 100 firms each producing 2,000 units of output; 40 firms each producing 5,000 units of output; 50 firms each producing 8,000 units of output; and 20 firms each producing 10,000 units of output. It follows that the Short Run market quantity supplied at a price of $8.95 is  
A. 1,000,000 units of output (the sum of the amount produced by each individual firm in the market).
B. 20,000 units of output (the combined output of the two firms which produce the most output in the market).
C. approximately 4,761.9 units of output (the average amount of output produced across all firms in the market).
D. 2,000 units of output (the amount produced by the firm with the lowest quantity of output).

11. Consider a firm in a perfectly competitive market with: output price of $5.45 per unit; \( AVC_{\text{min}} = $4.85 \); and \( ATC_{\text{min}} = $6.15 \). In the short run, this firm should  
A. shut down, since their maximum profit is negative.
B. produce a positive quantity, even though their maximum profit is negative.
C. produce a positive quantity, since they can earn a positive profit.
D. produce a negative quantity, so that they can avoid their fixed costs.
For questions 12 through 15, consider a firm in a perfectly competitive market with costs of production as illustrated below:

12. If this firm were to produce zero units of output in the short run, then
   A. it would earn zero profit.
   B. it would earn a profit of $(– 2,400).
   C. it would earn a profit of $(– 4,200).
   D. it would earn a profit of $(– 6,000).

13. If the per unit price of output in this market was $12.00, then this firm would
   A. produce 2,250 units of output.
   B. incur Variable Costs of Production equal to $20,250.
   C. earn a profit of $6,750.
   D. More than one of the above answers is correct.

14. If the per unit price of output in this market was $7.75, then this firm would
   A. produce fewer than 1,400 units of output.
   B. produce more than 1,400 but fewer than 2,000 units of output.
   C. produce exactly 2,000 units of output.
   D. produce more than 2,000 units of output.

15. This firm will produce a positive quantity of output in the short run but earn a
    negative profit if and only if the per unit price of output is
    A. less than $3.15.
    B. greater than $3.15 but less than $4.35.
    C. greater than $4.35 but less than $8.50.
    D. greater than $8.50.
Answer to Problem:

1A. The cells which contain values that were given have been shaded in “yellow” in the table below.

<table>
<thead>
<tr>
<th>Number of Workers</th>
<th>Quantity of Output</th>
<th>Marginal Product of Labor</th>
<th>Marginal Costs of Production</th>
<th>Average Variable Costs of Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1,500</td>
<td>1,500</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3,500</td>
<td>2,000</td>
<td>.75</td>
<td>.86</td>
</tr>
<tr>
<td>3</td>
<td>6,500</td>
<td>3,000</td>
<td>.5</td>
<td>.69</td>
</tr>
<tr>
<td>4</td>
<td>9,000</td>
<td>2,500</td>
<td>.6</td>
<td>.67</td>
</tr>
<tr>
<td>5</td>
<td>10,500</td>
<td>1,500</td>
<td>1</td>
<td>.71</td>
</tr>
<tr>
<td>6</td>
<td>11,750</td>
<td>1,250</td>
<td>1.2</td>
<td>.77</td>
</tr>
<tr>
<td>7</td>
<td>12,750</td>
<td>1,000</td>
<td>1.5</td>
<td>.82</td>
</tr>
<tr>
<td>8</td>
<td>13,500</td>
<td>750</td>
<td>2</td>
<td>.89</td>
</tr>
<tr>
<td>9</td>
<td>14,000</td>
<td>500</td>
<td>3</td>
<td>.96</td>
</tr>
<tr>
<td>10</td>
<td>14,375</td>
<td>375</td>
<td>4</td>
<td>1.04</td>
</tr>
<tr>
<td>11</td>
<td>14,675</td>
<td>300</td>
<td>5</td>
<td>1.12</td>
</tr>
<tr>
<td>12</td>
<td>14,925</td>
<td>250</td>
<td>6</td>
<td>1.21</td>
</tr>
<tr>
<td>13</td>
<td>15,125</td>
<td>200</td>
<td>7.5</td>
<td>1.29</td>
</tr>
<tr>
<td>14</td>
<td>15,275</td>
<td>150</td>
<td>10</td>
<td>1.37</td>
</tr>
</tbody>
</table>

Recall the following general definitions: “Marginal Product of Labor” provides a measure of how quantity of output increases as additional labor is used; “Marginal Costs of Production” provide a measure of how total costs change as additional output is produced; and “Average Variable Costs of Production” are equal to Variable Costs of Production divided by quantity of output produced.

Each of the empty cells in the columns for “Quantity of Output” and “Marginal Product of Labor” up to the “Row for 11 Workers” can be determined by directly noting the relation between “Quantity of Output” and “Marginal Product of Labor.”

Recalling the basic definition of “Marginal Costs of Production,” it follows that each unit of labor must cost $1,500 (since the first unit of labor hired has a Marginal Cost of $1, while increasing the Quantity of Output produced by 1,500 units – recall, in this context MC=(per unit wage rate of labor)/(MPL)...).

Knowing that the per unit wage rate of labor is $1,500 Marginal Costs can now be calculated for every row up to the “Row for 11 Workers” according to the formula MC=$(1,500)/(MPL)$.

Note that since MC=(PerUnitWageRate)/(MPL), it follows that MPL=(PerUnitWageRate)/(MC). Focusing on the “Row for 12 Workers,” we are given that the MC of hiring this worker is $6. Since we now know that each unit of labor costs $1,500, it follows that the marginal product of the 12th worker is $(1,500)/(6)=250$. Thus, when 12 workers are hired, 14,925 units will be produced. At this point it is straightforward to determine the remaining values of MC and MPL for 13 and 14 workers.

Finally, in each row “Average Variable Costs of Production” are simply equal to (Variable Costs) divided by “Quantity of Output Produced.” For example, when 8 workers are hired: Variable Costs are $(8)(1,500)=$(12,000) and 13,500 units of output are produced => $AVC=(12,000)/(13,500)=.8888...
1B. The minimum value of AVC occurs when 4 workers are hired. At this number of workers: Variable Costs are \((4)(1,500)\) = \($6,000\) and 9,000 units of output are produced. Thus, \(AVC = (6,000)(9,000) = .6666\ldots\)

1C. If each unit of output can be sold for $2.50, then Marginal Revenue is equal to $2.50 in each row. The firm maximizes profit by hiring 8 units of labor and producing 13,500 units of output. From here, it follows that Total Revenue is \((2.50)(13,500) = (33,750)\) and Variable Costs are \((1,500)(8) = (12,000)\). Thus, with Fixed Costs of $11,750, it follows that the firm is able to earn a profit of \((33,750)-(23,750) = (10,000)\).

1D. If each unit of output can be sold for $1.80, then Marginal Revenue is equal to $1.80 in each row. The firm maximizes profit by hiring 7 units of labor and producing 12,750 units of output. From here, it follows that Total Revenue is \((1.80)(12,750) = (22,950)\) and Variable Costs are \((1,500)(7) = (10,500)\). Thus, with Fixed Costs of $15,000, it follows that the firm is able to earn a profit of \((22,950)-(25,500) = (–2,550)\). Finally note that, since Revenue is greater than Variable Costs, the firm is clearly better producing a positive level of output than "shutting down."

1E. Since the minimum value of AVC is (0.67), in this case price is less than Average Variable Costs at every level of labor which could be hired (or equivalently, at every level of output that could be produced). Thus, the firm is best off "shutting down" in the short run. With fixed costs of production equal to $5,000, this leads to a profit of $\((–5,000)\).

Answers to Multiple Choice Questions:

1. D
2. B
3. C
4. D
5. D
6. D
7. D
8. A
9. C
10. A
11. B
12. D
13. D
14. B
15. C