Question 1 - CMA 1288 5-20 - Learning Curves

Moss Point Manufacturing recently completed and sold an order of 50 units which that had the following costs.

<table>
<thead>
<tr>
<th>Cost</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct materials</td>
<td>$ 1,500</td>
</tr>
<tr>
<td>Direct labor (1,000 hours x $8.50)</td>
<td>$ 8,500</td>
</tr>
<tr>
<td>Variable overhead (1,000 hours x $4.00)*</td>
<td>$ 4,000</td>
</tr>
<tr>
<td>Fixed overhead **</td>
<td>$ 1,400</td>
</tr>
<tr>
<td>**</td>
<td>$15,400</td>
</tr>
</tbody>
</table>

* Applied on the basis of direct labor hours
** Applied at the rate of 10% of variable cost

If Moss Point had experienced a 70% learning curve, the bid for the 150 units would

A. Show a 30% reduction in the total direct labor hours required with no learning curve.
B. Include 6.40 direct labor hours per unit at $8.50 per hour.
C. Be 10% lower than the total bid at an 80% learning curve.
D. Include increased fixed overhead costs.

A. If there were no learning curve the total direct hours would be approximately 4,000 hours, instead of 1,960 hours, a change of more than 200%.

B. Since there are two doublings, the number of hours required for 200 units using a 70% learning curve is:

\[
1,000 \text{ hours} \times (.7 \times 2) \times (.7 \times 2) = 1,960 \text{ hours.}
\]

1,960 hours required for 200 units less 1,000 hours required for the first 50 units = 960 hours required for the last 150 units. 960 hours ÷ 150 units = 6.4 hours required per unit for the last 150 units.

C. If there were an 80% learning curve instead of 70%, the reduction in labor hours would be more than 25% (based on the difference of 1,960 hours at an 80% learning curve and 1,560 hours at a 70% learning curve).

D. Fixed overhead costs per lot (a lot equals 50 units) would decrease since the cost is applied at a rate based on direct labor hours, which is decreasing.

Question 2 - CMA 692 4-5 - Learning Curves

Lake Corporation manufactures specialty components for the electronics industry in a highly labor intensive environment. Arc Electronics has asked Lake to bid on a component that Lake made for Arc last month. The previous order was for 80 units and required 120 hours of direct labor to manufacture. Arc would now like 240 additional components. Lake experiences an 80% learning curve on all of its jobs. The number of direct labor hours needed for Lake to complete the 240 additional components is

A. 187.2.
B. 360.0.
C. 256.0.
D. 307.2.

A.

With an 80% learning curve it means that each time production doubles, the number of hours required for the new production will be 80% less than would be expected given previous production. Therefore, producing a total of 160 units will take 192 hours (120 × 2 × .8). Based on the fact that the first 80 units took 120 hours, we would expect that production of 160 units would take 240 hours. However, it took only 80% of that time, or 192 hours. Given that 160 units take 192 hours, we would expect that 320 units would take 384 hours. However, it will take only 80% of that time because of the learning curve. This means it will take only 307.2 hours to produce 320 units.

Since the question is how many hours will be needed to produce the additional 240 units, we need to

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subtract the time to produce the first 80 units (120 hours) from the time required to produce all 320 units (307.2 hours). This means that it will take 187.2 hours to produce the additional 240 units.

B. This answer does not take into effect the learning curve and the improvements that come with it. See the correct answer for a complete explanation.

C. This answer is incorrect. See the correct answer for a complete explanation.

D. This is the amount of time that it will take to produce 320 units, not the amount of time it will take to produce the additional 240 units. See the correct answer for a complete explanation.

**Question 3 - CMA 688 5-8 - Learning Curves**

LCB, Inc. is preparing a bid to the Department of the Navy to produce engines for rescue boats. The company has manufactured these engines for the Navy for the past 3 years, on an exclusive contract, and has experienced the following costs:

<table>
<thead>
<tr>
<th>Cumulative Units Produced</th>
<th>Cumulative Materials Costs</th>
<th>Cumulative Labor Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>$ 60,000</td>
<td>$120,000</td>
</tr>
<tr>
<td>20</td>
<td>120,000</td>
<td>192,000</td>
</tr>
<tr>
<td>40</td>
<td>240,000</td>
<td>307,200</td>
</tr>
</tbody>
</table>

At LCB, variable overhead is applied on the basis of $1.00 per direct labor dollar. Based on historical costs, LCB knows that the production of 40 engines will be allocated $100,000 of fixed overhead costs. The bid request is for an additional 40 units; all companies submitting bids are allowed to charge a maximum of 25% above full cost for each order.

The maximum bid price that LCB, Inc. could submit to the Department of the Navy for the 40 units is

A. $885,800.
B. $708,640.
C. $760,800.
D. $608,640.

A.

The company is able to charge 125% of the full cost for the order. The full cost will include $100,000 of fixed costs and $240,000 of materials costs. In addition, there will be labor costs. However, we need to determine what those labor costs will be.

We can calculate that the learning curve is 80%. The first 10 units produced cost $120,000 in labor. If no learning had taken place, the first 20 units would have cost $240,000 in labor. However, the labor cost for the first 20 units was $192,000. By dividing $192,000 by $240,000, we calculate that the learning curve is 80%.

We know that labor costs are $307,200 to produce the first 40 units. However, the company experiences an 80% learning curve, which means that the labor cost to produce the next 40 units will not be $307,200, but $184,320. This is calculated as follows: The first 40 units cost $307,200 to produce. If no learning had taken place, it would cost twice that amount, or $614,400 to produce the first 80 units (the first 40 units plus another 40 units). However, as there is a learning curve of 80%, the total cost for the 80 units will be 80% of that $614,400 expected amount, or $491,520. Since the first set of 40 units cost $307,200, the incremental cost of producing the second set of 40 units was only $491,520 − $307,200, which equals $184,320.

Variable overhead will also be charged at $1 per direct labor dollar, or $184,320. Therefore, the total costs of production are $708,640 ($100,000 + $240,000 + $184,320 + $184,320). Adding 25% to this, we get $885,800.

B. This answer does not include the markup – it is simply the full cost of production. See the correct answer for a
C. This answer does not include the $100,000 of fixed costs. See the correct answer for a complete explanation.

D. This answer does not include the $100,000 of fixed costs or the 25% markup. See the correct answer for a complete explanation.

**Question 4 - CMA 688 5-7 - Learning Curves**

LCB, Inc. is preparing a bid to the Department of the Navy to produce engines for rescue boats. The company has manufactured these engines for the Navy for the past 3 years, on an exclusive contract, and has experienced the following costs:

<table>
<thead>
<tr>
<th>Cumulative Units Produced</th>
<th>Cumulative Materials Costs</th>
<th>Cumulative Labor Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>$60,000</td>
<td>$120,000</td>
</tr>
<tr>
<td>20</td>
<td>120,000</td>
<td>192,000</td>
</tr>
<tr>
<td>40</td>
<td>240,000</td>
<td>307,000</td>
</tr>
</tbody>
</table>

At LCB, variable overhead is applied on the basis of $1.00 per direct labor dollar. Based on historical costs, LCB knows that the production of 40 engines will be allocated $100,000 of fixed overhead costs. The bid request is for an additional 40 units; all companies submitting bids are allowed to charge a maximum of 25% above full cost for each order.

LCB’s rate of learning on the 3-year engine contract is

A. 80.0%.
B. 79.0%
C. 75.5%.
D. 62.6%.

**A. The learning curve is calculated as the percentage of reduction in costs that occurs when production is doubled. In looking at the information provided, we see that the materials costs do not have any efficiencies as production increases. For all levels of production the materials cost is $6,000 per unit. So, our attention is focused on the labor. In order to produce 10 units, the company incurred $120,000 of labor. If that same productivity level were to continue (i.e., if no learning were taking place), in order to produce 20 units, they would incur $240,000 of labor costs. However, they incurred only $192,000 of labor costs, which is 80% of $240,000. And at 20 units at a cost of $192,000, if no learning were taking place, it would have cost $384,000 to produce a total of 40 units, including the first 20. However, it cost only $307,200, which is 80% of $384,000. So, every time production doubles, the company is experiencing a learning curve of 80%.**

B. This answer is incorrect. See the correct answer for a complete explanation.

C. This answer is incorrect. See the correct answer for a complete explanation.

D. This answer is incorrect. See the correct answer for a complete explanation.

**Question 5 - CMA 690 5-22 - Learning Curves**

High Tech Industries, Inc. is in the process of preparing a competitive bid for the sale of a customized product. High Tech is currently manufacturing a comparable specialized component that is labor intensive with a long production run. The method that High Tech should use to project the cost of manufacturing the proposed new customized product is

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A. Learning curve analysis.
B. Monte Carlo simulation.
C. Regression analysis.
D. Expected value analysis.

A. Learning curve analysis is interested in the impact of experience on production: for example, the more units that are produced the more quickly each unit is able to be produced. Since this is the situation in this question, learning curve analysis may be used.

B. Monte Carlo simulation may be used to generate expected results from a variety of variables. By setting up various models and running them multiple times, a company can determine an expected value or expected result. This would not be the best method for High Tech to use to project the cost of manufacturing the proposed new customized product.

C. Regression analysis is used to address the behavior in a dependent variable as an independent variable changes. This would not be the best method for High Tech to use to project the cost of manufacturing the proposed new customized product.

D. Expected value analysis is used when there are specific outcomes and the probability of those outcomes occurring is known. This would not be the best method for High Tech to use to project the cost of manufacturing the proposed new customized product.

Question 6 - CMA 1294 4-28 - Learning Curves

Seacraft Inc. received a request for a competitive bid for the sale of one of its unique boating products with a desired modification. Seacraft is now in the process of manufacturing this product but with a slightly different modification for another customer. These unique products are labor intensive and both will have long production runs. Which one of the following methods should Seacraft use to estimate the cost of the new competitive bid?

A. Expected value analysis.
B. Continuous probability simulation.
C. Learning curve analysis.
D. Regression analysis.

A. Expected value analysis is an effective method to use in conditions of risk. It is calculated by multiplying each possible outcome by related probability added up together. In other words it is weighted average of possible outcomes. It is used to select the best of given alternatives. Expected value analysis is not the best method for Seacraft to use to estimate the cost of the new competitive bid.

B. Simulation is a process of changing key variables to determine the possible change in the optimal solution because of changes in the variables. It is used to define how sensitive the project (sales for example) is to a change in those variables. Continuous probability simulation is not the best method for Seacraft to use to estimate the cost of the new competitive bid.

C. Learning curve analysis states that the more experience people have with doing a task, the more efficient they become in doing that task. As production involves intensive labor usage, learning curve analysis is appropriate to use to estimate the cost of the new competitive bid. Seacraft is placing a bid to produce a customized, unique product. The company has had previous experience in producing a similar product for another customer. Because of Seacraft's previous experience, its costs to produce a similar product will be less time consuming and consequently lower than if the company had never produced this type of product before. Seacraft can therefore set its bid lower because of its anticipated lower costs.

D. Regression analysis is a quantitative method that is used to find an equation for the linear relationships between or
among variables. That result can be used to draw conclusions and make forecasts. To use regression analysis, historical data is required for the variable that we are forecasting or for the variables that are causal to this variable. If historical data is not available, regression analysis cannot be used. Even when historical data is available, if there has been a significant change in the conditions surrounding that data, its use is questionable for predicting the future. Regression analysis is not the best method for Seacraft to use to estimate the cost of the new competitive bid.

Question 7 - CIA 1187 III-41 - Learning Curves

A learning curve of 80% assumes that direct labor costs are reduced by 20% for each doubling of output. What is the cost of the sixteenth unit produced as an approximate percentage of the first unit produced?

A. 64%
B. 41%
C. 51%
D. 33%

A. Under the incremental unit-time learning model, this is the incremental labor cost as a percentage of the first unit produced that is required for the 4th unit. See the correct answer for a complete explanation.

B. In a learning curve situation in which the labor costs are reduced by 20% each time that production is doubled, this means that if the first unit requires 100% of the labor cost, under the incremental unit-time learning model, the second unit will require only 80% of the labor cost of the first unit. The 4th unit will require only 80% of the labor cost of the 2nd unit, or 80% of 80%, which is 64%. The 8th unit will require 80% of the labor cost of the 4th unit, or 80% of 80%, which is 51%. The 16th unit will require 80% of the labor cost of the 8th unit, or 80% of 51%, which is 41% of the first unit's direct labor cost.

C. Under the incremental unit-time learning model, this is the incremental labor cost as a percentage of the first unit produced that is required for the 8th unit. See the correct answer for a complete explanation.

D. Under the incremental unit-time learning model, this is the incremental labor cost as a percentage of the first unit produced that is required for the 32nd unit. See the correct answer for a complete explanation.

Question 8 - CIA 1193 III-69 - Learning Curves

Management of a bookkeeping company observed that the average time spent to perform identical tasks using a new software package decreases as the number of tasks performed increases. The following information on the use of the new software was collected.

<table>
<thead>
<tr>
<th>Number of Tasks Performed</th>
<th>Total Time to Perform All Tasks</th>
<th>Average Time To Perform Each Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10 minutes</td>
<td>10 minutes</td>
</tr>
<tr>
<td>2</td>
<td>18 minutes</td>
<td>9 minutes</td>
</tr>
<tr>
<td>4</td>
<td>32.4 minutes</td>
<td>8.1 minutes</td>
</tr>
</tbody>
</table>

If this learning effect continues, what is the average time to perform each of the first eight tasks?

A. 6.56 minutes.
B. 7.29 minutes.
C. 8.1 minutes.
D. 5.90 minutes.

A. This is the amount of time, on average, it will take to perform the first 16 tasks.

B.
The learning curve for each doubling of production is 90%. This is calculated using the following formula for the Cumulative Average-Time Learning Model:

Initial time × 2 × Learning Curve = Time for Doubled Work

Using the numbers given, and letting the learning curve be X:

\[
10 \times 2 \times X = 18 \\
20X = 18 \\
X = .90
\]

And,

\[
18 \times 2 \times X = 32.4 \\
36X = 32.4 \\
X = .90
\]

We can also use the average time per task:

\[
10 \times X = 9 \\
X = .9
\]

And,

\[
9 \times X = 8.1 \\
X = .9
\]

Therefore, the average time to complete 8 units will be 90% of the average time to complete 4 units. It took 8.1 minutes on average to complete each of the first four tasks, so it will take 7.29 minutes on average to complete each of the first 8 tasks (8.1 × .9).

C. This is the amount of time, on average, it took to perform the first four tasks.

D. This is the amount of time, on average, it will take to perform the first 32 tasks.

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**Question 9 - CMA 1288 5-19 - Learning Curves**

Moss Point Manufacturing recently completed and sold an order of 50 units that had costs as follows.

- Direct materials: $1,500
- Direct labor (1,000 hours x $8.50): 8,500
- Variable overhead (1,000 hours x $4.00): 4,000
- Fixed overhead**: 1,400
  - $15,400

*Applied on the basis of direct labor hours.
**Applied at the rate of 10% of variable cost.

The company has now been requested to prepare a bid for 150 units of the same product.

If an 80% learning curve is applicable, Moss Point's total cost on this order would be estimated at

A. $38,000.
B. $26,400.
C. $32,000.
D. $41,800

A. This is the total variable cost for 200 units. However, it is not the total cost, or is it the cost for the last 150 units.
B.

We need to include the first 50 units manufactured in this analysis, since they contributed to the learning curve. So we will analyze the cost for the first 200 units and then subtract from that the cost for the first 50 units in order to calculate the cost for units numbered 51 through 200, which are the units in the second order of 150.

The first doubling takes place at unit no. 100. The second doubling takes place at unit no. 200. Therefore, the time required for the total 200 units was 2,560 hours, calculated as follows: $1,000 \times (0.8 \times 2) \times (0.8 \times 2) = 2,560$ hours for 200 units.

$2,560$ hours for 200 units minus the $1,000$ hours required for the first 50 units = $1,560$ hours required for the last 150 units.

The next step is to calculate the total cost for the whole 200 units and then subtract from that the cost for the first 50 units, which is given in the problem as $15,400.

Using the costs for 50 units provided in the problem, we can calculate the variable costs for 200 units as follows: Direct Materials cost per unit is $1,500 \div 50$ units, or $30$ per unit. Therefore, for 200 units, the total direct materials cost would be $30 \times 200$, or $6,000. Direct labor is $8.50$ per hour for a total of $2,560$ hours, or $21,760$ for 200 units. Variable overhead is applied on the basis of direct labor hours at the rate of $4$ per direct labor hour; so for $2,560$ DL hours, variable overhead would be $10,240.

Thus, the total variable cost for 200 units is $6,000 + 21,760 + 10,240$, for a total of $38,000.

Fixed overhead is applied at the rate of 10% of total variable cost, so fixed overhead applied is 10% of $38,000, or $3,800.

The total cost for 200 units is thus $38,000 + 3,800$, or $41,800.

Subtracting the cost for the first 50 units from the total cost for the first 200 units, we get $41,800 − 15,400$, or $26,400$ as the cost for units 51 through 200.

C. This is the total cost of the labor and variable overhead for 200 units. However, it is not the total cost, nor is it the cost for the last 150 units.

D. This is the total cost for 200 units. However, the problem asks for the total cost for the last 150 units.

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**Question 10 - CMA 688 5-9 - Learning Curves**

LCB, Inc. is preparing a bid to the Department of the Navy to produce engines for rescue boats. The company has manufactured these engines for the Navy for the past 3 years, on an exclusive contract, and has experienced the following costs:

<table>
<thead>
<tr>
<th>Units Produced</th>
<th>Cumulative Materials Costs</th>
<th>Cumulative Labor Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>$60,000</td>
<td>$120,000</td>
</tr>
<tr>
<td>20</td>
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<td>192,000</td>
</tr>
<tr>
<td>40</td>
<td>240,000</td>
<td>307,200</td>
</tr>
</tbody>
</table>

At LCB, variable overhead is applied on the basis of $1.00 per direct labor dollar. Based on historical costs, LCB knows that the production of 40 engines will be allocated $100,000 of fixed overhead costs. The bid request is for an additional 40 units; all companies submitting bids are allowed to charge a maximum of 25% above full cost for each order. In order to ensure that the company would not lose money on the project, LCB’s minimum bid for the 40 units would be

A. $608,640
In order to determine the minimum bid, we need to calculate the costs that will be incurred only if the additional 40 engines will be produced. This will include materials of $240,000 (equal to the cost of materials for the 40 units already produced) plus the costs of the labor and variable overhead. We will not include fixed overhead that is allocated to the engines because this overhead would be incurred even if the engines are not produced.

To determine the cost of the labor for the next 40 units, we first need to find the learning curve percentage that applies. The first 10 units cost $120,000 in labor. If no learning had taken place, then units 11 through 20 would have also cost $120,000, and the total cumulative labor cost for the first 20 units would have been $240,000. However, the cumulative labor cost for the first 20 units was $192,000. Under the Cumulative Average-Time Learning Model, the formula to find the learning curve would be $120,000 \times (2 \times X) = $192,000, where $X$ = the learning curve. Solving for $X$, we get $240,000X = $192,000, and $X = .80$. We can do the same thing for units 21 through 40: $192,000 \times (2 \times X) = $307,200. $384,000X = $307,200, and $X = .80$. So we know the learning curve is 80%.

Therefore, we can calculate the cost of the labor to produce the next 40 engines as follows: $307,300 \times (2 \times .80) = X$, where $X$ = the cumulative cost of labor for all 80 units produced. Solving for $X$, we get $X = $491,520. From this, we can calculate the labor cost to produce units 41 through 80. It will be $491,520 minus $307,200 (the cost to produce the first 40 engines), or $184,320. Variable overhead will also be charged at $1 per direct labor dollar, so that will also be $184,320. The variable costs of production are therefore $608,640 ($240,000 + $184,320 + $184,320).

B. This answer is incorrect. See the correct answer for a complete explanation.

C. This answer is incorrect. See the correct answer for a complete explanation.

D. This answer includes the fixed costs as an incremental cost that would be incurred only if the production of the additional 40 engines took place. See the correct answer for a complete explanation.

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**Question 11 - CMA 1291 4-22 - Learning Curves**

Huron Company plans to bid on a special project that calls for a total of 24,000 units. The units will be produced in lots, with the first lot consisting of 750 units. Based on prior experience, the direct labor time needed per unit of product will be progressively smaller by a constant percentage rate as experience is gained in the manufacturing process. The quantitative method that would best estimate Huron’s total cost for the project is

A. Differential calculus.
B. Learning curve techniques.
C. Linear programming.
D. Discounted cash flow techniques.

A. Differential calculus is used to discover the minimum and maximum points of functions.

B. Learning curves exist in a situation in which the time necessary to complete an item becomes smaller as more items are produced. Since this is what is happening in this situation, learning curve techniques would be appropriate.

C. Linear programming is used to determine how to maximize profit in a situation in which there are constraints.

D. Discounted cash flow techniques are used in capital budgeting.

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