**Module E: Learning Curves**

**Practice Problems**

**MULTIPLE CHOICE**

1. Air Road builds family recreational vehicles. They have a new design, and it took 30 hours to assemble the prototype. The team at Air Road is fast learners and has demonstrated a 75% learning curve. What would be the assembly time for the 15th production run item.

|  |  |
| --- | --- |
| a. | 8.28 hours |
| b. | 8.89 hours |
| c. | 9.75 hours |
| d. | 10.00 hours |

ANS: C PTS: 1 DIF: Easy

Elysium Enterprises is planning to build and launch a constellation of nanosatellites. These are satellites that weigh less than 100 pounds. The proposed constellation—Argus—would provide complete camera and video coverage of the entire Earth. The time to build the first Argus satellite took 100 hours. Assume an 85% learning curve for manufacturing. These satellites ride “piggyback” on rockets that launch much larger satellites.

2. How long would it take to build the 5th satellite.

|  |  |
| --- | --- |
| a. | 59.2 hours |
| b. | 68.6 hours |
| c. | 77.2 hours |
| d. | 81.2 hours |

ANS: B PTS: 1 DIF: Easy

3. The first phase of the Argus project requires 20 satellites to be in orbit. How long will it take to build the 20th satellite?

|  |  |
| --- | --- |
| a. | 49.5 hours |
| b. | 52.7 hours |
| c. | 56.1 hours |
| d. | 60.2 hours |

ANS: A PTS: 1 DIF: Easy

4. What was the total time to build the first 5 satellites?

|  |  |
| --- | --- |
| a. | 381.2 hours |
| b. | 403.1 hours |
| c. | 443.2 hours |
| d. | 487.4 hours |

ANS: B PTS: 1 DIF: Hard

5. What was the total time to build the first 20 satellites?

|  |  |
| --- | --- |
| a. | 787.2 hours |
| b. | 834.8 hours |
| c. | 903.4 hours |
| d. | 1240.2 hours |

ANS: D PTS: 1 DIF: Medium

6. The second phase of the Argus project requires 40 satellites to be in orbit. How long will it take to build the 40th satellite with the same 85% learning curve?

|  |  |
| --- | --- |
| a. | 28.9 hours |
| b. | 33.2 hours |
| c. | 42.1 hours |
| d. | 50.4 hours |

ANS: C PTS: 1 DIF: Medium

7. What was the total time to build the first 40 satellites?

|  |  |
| --- | --- |
| a. | 1,875.2 hours |
| b. | 1,929.7 hours |
| c. | 2,001.0 hours |
| d. | 2,142.5 hours |

ANS: D PTS: 1 DIF: Hard

8. To complete the entire constellation requires 80 satellites. How long will it take to build the 80th satellite with the same 85% learning curve.

|  |  |
| --- | --- |
| a. | 26.2 hours |
| b. | 31.5 hours |
| c. | 35.8 hours |
| d. | 39.3 hours |

ANS: C PTS: 1 DIF: Hard

Muntz Motors is a car dealership. Ed Muntz has brought his daughter on board as part of the company. Her first job was to help customers fill out the forms for a car loan and to register the vehicle. The first time she did this job, it took her 40 minutes.

9. If she demonstrates an 80% learning curve, how long would it take her to fill out the 7th set of forms?

|  |  |
| --- | --- |
| a. | 19.7 minutes |
| b. | 21.4 minutes |
| c. | 23.2 minutes |
| d. | 26.1 minutes |

ANS: B PTS: 1 DIF: Easy

10. What would be the total time to fill out these forms if 10 customers were available on the first day?

|  |  |
| --- | --- |
| a. | 198.2 minutes |
| b. | 234,1 minutes |
| c. | 252.6 minutes |
| d. | 288.9 minutes |

ANS: C PTS: 1 DIF: Hard

Maklin Marine produces UUVs (underwater unmanned vehicles) for the U.S. Navy. They have just designed a very large UUV to hunt and destroy mines. Maklin spent 60,000 hours to build the first production unit. Maklin generally employs an 80% learning curve. They estimate that the cost of production runs $100/hour.

11. What would be the cost of the 10th unit?

|  |  |
| --- | --- |
| a. | $1,987,000 |
| b. | $2,387,000 |
| c. | $2,862,000 |
| d. | $3,010,000 |

ANS: C PTS: 1 DIF: Medium

12. What would be the cost of the 25th unit?

|  |  |
| --- | --- |
| a. | $1,987,000 |
| b. | $2,130,000 |
| c. | $2,387,000 |
| d. | $2,862,000 |

ANS: B PTS: 1 DIF: Medium

13. What would be the cost of the 40th unit?

|  |  |
| --- | --- |
| a. | $1,830,000 |
| b. | $2,387,000 |
| c. | $2,456,000 |
| d. | $2,862,000 |

ANS: A PTS: 1 DIF: Medium

14. What would be the total cost a production run of 10 units?

|  |  |
| --- | --- |
| a. | $35,630,000 |
| b. | $36,765,000 |
| c. | $37,890,000 |
| d. | $38,987,000 |

ANS: C PTS: 1 DIF: Hard

15. What would be the total cost a production run of 25 units?

|  |  |
| --- | --- |
| a. | $72,987,000 |
| b. | $73,854,000 |
| c. | $75,278,000 |
| d. | $77,062,000 |

ANS: B PTS: 1 DIF: Hard

16. What would be the total cost a production run of 40 units?

|  |  |
| --- | --- |
| a. | $ 96,723,000 |
| b. | $ 99,182,000 |
| c. | $102,450,000 |
| d. | $103,158,000 |

ANS: D PTS: 1 DIF: Hard

17. What would be the cost of the 10th unit if Maklin had a 75% learning curve?

|  |  |
| --- | --- |
| a. | $2,187,000 |
| b. | $2,310,000 |
| c. | $2,407,000 |
| d. | $2,472,000 |

ANS: B PTS: 1 DIF: Medium

18. What would be the cost of the 25th unit if Maklin had a 75% learning curve?

|  |  |
| --- | --- |
| a. | $1,287,000 |
| b. | $1,427,000 |
| c. | $1,578,000 |
| d. | $1,765,000 |

ANS: C PTS: 1 DIF: Medium

19. What would be the cost of the 40th unit if Maklin had a 75% learning curve?

|  |  |
| --- | --- |
| a. | $1,067,000 |
| b. | $1,101,000 |
| c. | $1,296,000 |
| d. | $1,402,000 |

ANS: C PTS: 1 DIF: Medium

Elysium Enterprises is planning to build and launch a second constellation of nanosatellites. These are satellites that weigh less than 100 pounds. The proposed constellation—Skyvanet—would provide Internet services and GPS tracking of the trucking industry. The time to build the first Skyvanet satellite took 75 hours. Assume an 80% learning curve for manufacturing. Like Argus, these satellites ride “piggyback” on rockets that launch much larger satellites.

20. How long would it take to build the 8th satellite?

|  |  |
| --- | --- |
| a. | 36.9 hours |
| b. | 38.4 hours |
| c. | 40.1 hours |
| d. | 41.3 hours |

ANS: B PTS: 1 DIF: Easy

21. How long will it take to build the 15th satellite with the same 80% learning curve?

|  |  |
| --- | --- |
| a. | 31.4 hours |
| b. | 33.2 hours |
| c. | 34.3 hours |
| d. | 36.1 hours |

ANS: A PTS: 1 DIF: Medium

22. How long will it take to build the 30th satellite?

|  |  |
| --- | --- |
| a. | 22.0 hours |
| b. | 25.1 hours |
| c. | 27.3 hours |
| d. | 28.4 hours |

ANS: B PTS: 1 DIF: Medium

23. If the cost of building a Skyvanet satellite runs $750 per hour, what would be the cost of the 15th satellite?

|  |  |
| --- | --- |
| a. | $18,825 |
| b. | $23,550 |
| c. | $26,130 |
| d. | $27,876 |

ANS: B

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PTS: 1 DIF: Medium

24. What would be the cost of the 30th satellite?

|  |  |
| --- | --- |
| a. | $18,825 |
| b. | $21,876 |
| c. | $23,550 |
| d. | $25,689 |

ANS: A PTS: 1 DIF: Hard

25. What would be the total cost of building the Skyvanet system of 30 satellites?

|  |  |
| --- | --- |
| a. | $250,765 |
| b. | $263,927 |
| c. | $278,945 |
| d. | $290,654 |

ANS: B PTS: 1 DIF: Hard

26. Bartlett Furniture is reviewing the times to build a new dresser. They are given below.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1st | 2nd | 3rd | 4th | 5th | 6th | 7th | 8th |
| **2 days** | **1.82 days** | **1.71 days** | **1.66 days** | **1.61 days** | **1.59 days** | **1.54 days** | **1.51 days** |

What would be the learning curve for these figures?

|  |  |
| --- | --- |
| a. | 95% |
| b. | 91% |
| c. | 85% |
| d. | 80% |

ANS: B PTS: 1 DIF: Easy

Brandon takes 120 minutes to process a claim on his first try. On the second try, it only takes 108 minutes.

27. How many iterations would he have to go through in order to reduce the process time down to 75 minutes?

|  |  |
| --- | --- |
| a. | 10 |
| b. | 15 |
| c. | 20 |
| d. | 22 |

ANS: D PTS: 1 DIF: Hard

28. How many iterations would Brandon have to go through in order to reduce the process time down to below 55 minutes?

|  |  |
| --- | --- |
| a. | 75 |
| b. | 100 |
| c. | 150 |
| d. | 170 |

ANS: D PTS: 1 DIF: Hard

Asimov Robots is building a humanoid robot for a competition for a robot that could operate in emergency circumstances, such as fires, building collapses, or industrial accidents. The construction time for the first four units were as follows: 9,208 hours; 7,824 hours; 7,028 hours; and 6,652 hours.

29. What would you estimate for the learning curve?

|  |  |
| --- | --- |
| a. | 95% |
| b. | 90% |
| c. | 85% |
| d. | 80% |

ANS: C PTS: 1 DIF: Easy

30. The cost of construction for the 1st robot was $1,381,200. What would be the cost of building the 4th robot?

|  |  |
| --- | --- |
| a. | $888,902 |
| b. | $934,287 |
| c. | $998,608 |
| d. | $1,178,621 |

ANS: C PTS: 1 DIF: Easy

31. What would be the cost of building the 10th robot?

|  |  |
| --- | --- |
| a. | $239,850 |
| b. | $620,664 |
| c. | $762,112 |
| d. | $805,240 |

ANS: D PTS: 1 DIF: Medium

32. What would be the cost of building the first four robots?

|  |  |
| --- | --- |
| a. | $4,219,450 |
| b. | $4,620,114 |
| c. | $5,082,762 |
| d. | $5,524,800 |

ANS: B PTS: 1 DIF: Hard

33. What would be the cost of building the first 10 robots?

|  |  |
| --- | --- |
| a. | $8,828,619 |
| b. | $9,222,465 |
| c. | $9,828,619 |
| d. | $10,234,137 |

ANS: C PTS: 1 DIF: Hard

Agro-Build constructs barns and other farm buildings. They have moved into building industrial-sized silos. Their first project took 96 days and cost $230,400. They hope to expand this unit of the company.

34. What would be the anticipated construction time for the 4th silo project if they operated with an 85% learning curve?

|  |  |
| --- | --- |
| a. | 59.3 days |
| b. | 66.1 days |
| c. | 69.4 days |
| d. | 75.2 days |

ANS: C PTS: 1 DIF: Medium

35. What would be the cost of the 4th silo?

|  |  |
| --- | --- |
| a. | $158,342 |
| b. | $166,560 |
| c. | $172,386 |
| d. | $180,982 |

ANS: B PTS: 1 DIF: Medium

36. What would be the total cost of the first 4 silos?

|  |  |
| --- | --- |
| a. | $770,688 |
| b. | $778,129 |
| c. | $789,109 |
| d. | $806,245 |

ANS: A PTS: 1 DIF: Hard

37. The marketing department believes that Agro-Build can build 14 silos in the foreseeable future. What would the 14th silo cost?

|  |  |
| --- | --- |
| a. | $120,873 |
| b. | $124,186 |
| c. | $129,101 |
| d. | $132,872 |

ANS: B PTS: 1 DIF: Medium

38. What would be the total cost for building the 14 silos?

|  |  |
| --- | --- |
| a. | $1,875,239 |
| b. | $1,982,333 |
| c. | $2,149,862 |
| d. | $2,408,842 |

ANS: C PTS: 1 DIF: Hard

Security Systems modifies limousines to make them better protected for the safety of their owners. They are now building a hybrid limousine with all security items. The labor time for building the first four limousines is given below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Limousine 1** | **Limousine 2** | **Limousine 3** | **Limousine 4** |
| **986 hours** | **789 hours** | **714 hours** | **661 hours** |

39. Based on these figures, what would you estimate is the value of the learning curve?

|  |  |
| --- | --- |
| a. | 95% |
| b. | 90% |
| c. | 85% |
| d. | 80% |

ANS: D PTS: 1 DIF: Easy

40. What would be the labor input for the 11th vehicle?

|  |  |
| --- | --- |
| a. | 529 hours |
| b. | 488 hours |
| c. | 456 hours |
| d. | 423 hours |

ANS: C PTS: 1 DIF: Medium

41. If Security Systems assigns a cost of $90/hour, what would be the cost of the 11th vehicle?

|  |  |
| --- | --- |
| a. | $54,201 |
| b. | $48,910 |
| c. | $40,998 |
| d. | $35,762 |

ANS: C PTS: 1 DIF: Hard

42. What would be the total cost of building the 11 limousines?

|  |  |
| --- | --- |
| a. | $592,982 |
| b. | $601,391 |
| c. | $620,762 |
| d. | $678,824 |

ANS: B PTS: 1 DIF: Medium

Aurora Electronics builds navigation gear for private aircraft. The 10th production version of a new Heads-Up Display took 1,212 hours to build.

43. If they operate on a 80% learning curve, how long did it take to build the first unit?

|  |  |
| --- | --- |
| a. | 1,029 hours |
| b. | 1,198 hours |
| c. | 2,345 hours |
| d. | 2,541 hours |

ANS: D PTS: 1 DIF: Medium

44. If Aurora assigns a cost of $220/hour, what would have been the cost of building the 1st unit?

|  |  |
| --- | --- |
| a. | $266,640 |
| b. | $402,887 |
| c. | $559,020 |
| d. | $702,932 |

ANS: C PTS: 1 DIF: Medium

45. If Aurora assigns a cost of $220/hour, what would have been the cost of building the 10th unit?

|  |  |
| --- | --- |
| a. | $247,982 |
| b. | $266,640 |
| c. | $273,865 |
| d. | $281,423 |

ANS: B PTS: 1 DIF: Easy

46. If Aurora assigns a cost of $220/hour, what would have been the cost of building the 40th unit?

|  |  |
| --- | --- |
| a. | $156,293 |
| b. | $165.826 |
| c. | $170,501 |
| d. | $185,293 |

ANS: C PTS: 1 DIF: Medium

47. What would be the total cost of building 10 units?

|  |  |
| --- | --- |
| a. | $3,003,782 |
| b. | $3,530,211 |
| c. | $3,987,002 |
| d. | $4,287,864 |

ANS: B PTS: 1 DIF: Hard

48. What would be the total cost of building 40 units?

|  |  |
| --- | --- |
| a. | $7,982,624 |
| b. | $8,839,220 |
| c. | $9,208,624 |
| d. | $9,611,231 |

ANS: D PTS: 1 DIF: Hard

49. At the beginning of a tour, a road crew for a rock band sets up a stage in 8.5 hours. At the 4th show, it takes them 6 hours and 9 minutes. What was the learning curve?

|  |  |
| --- | --- |
| a. | 90% |
| b. | 85% |
| c. | 80% |
| d. | 75% |

ANS: B PTS: 1 DIF: Easy

50. What would be the setup time for the 20th show?

|  |  |
| --- | --- |
| a. | 3 hours, 20 minutes |
| b. | 4 hours |
| c. | 4 hours, 12 minutes |
| d. | 5 hours |

ANS: C PTS: 1 DIF: Medium