Solutions Manual

# Chapter 19: Detailed Scheduling

1.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *Week* | *1* | *2* | *3* | *4* | *5* |
| Planned input | 30 | 30 | 30 | 30 | 20 |
| Actual input | 32 | 34 | 25 | 28 | 25 |
| Deviation | 2 | 4 | -5 | -2 | 5 |
| Cumulative deviation | 2 | 6 | 1 | -1 | 4 |
|  |  |  |  |  |  |
| Planned output | 30 | 30 | 30 | 30 | 25 |
| Actual output | 30 | 28 | 28 | 30 | 22 |
| Deviation | 0 | -2 | -2 | 0 | -3 |
| Cumulative deviation | 0 | -2 | -4 | -4 | -7 |
| Actual backlog | 16 | 22 | 19 | 17 | 20 |
| Beginning backlog | 14 |  |  |  |  |

Cognitive Domain: Comprehension

Difficulty Level: Medium

2.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *Week* | *1* | *2* | *3* | *4* | *5* |
| Planned input | 180 | 180 | 200 | 200 | 190 |
| Actual input | 190 | 180 | 185 | 205 | 198 |
| Deviation | 10 | 0 | -15 | 5 | 8 |
| Cumulative deviation | 10 | 10 | -5 | 0 | 8 |
|  |  |  |  |  |  |
| Planned output | 180 | 180 | 200 | 200 | 190 |
| Actual output | 185 | 175 | 196 | 210 | 190 |
| Deviation | 5 | -5 | -4 | 10 | 0 |
| Cumulative deviation | 5 | 0 | -4 | 6 | 6 |
| Actual backlog | 15 | 20 | 9 | 4 | 12 |
| Beginning backlog | 10 |  |  |  |  |

Cognitive Domain: Comprehension

Difficulty Level: Medium

3.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *Week* | *1* | *2* | *3* | *4* | *5* |
| Planned input | 55 | 60 | 65 | 70 | 70 |
| Actual input | 45 | 55 | 60 | 65 | 70 |
| Deviation | -10 | -5 | -5 | -5 | 0 |
| Cumulative deviation | -10 | -15 | -20 | -25 | -25 |
|  |  |  |  |  |  |
| Planned output | 55 | 60 | 65 | 70 | 70 |
| Actual output | 55 | 55 | 60 | 65 | 70 |
| Deviation | 0 | -5 | -5 | -5 | 0 |
| Cumulative deviation | 0 | -5 | -10 | -15 | -15 |
| Actual backlog | 5 | 5 | 5 | 5 | 5 |
| Beginning backlog | 15 |  |  |  |  |

Cognitive Domain: Comprehension

Difficulty Level: Medium

4. The optimal total cost is $2,600.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | *Route* | | | |
| *Truck* | *1* | *2* | *3* | *4* |
| A |  |  |  | $5 |
| B |  |  | $7 |  |
| C |  | $6 |  |  |
| D | $8 |  |  |  |

Cognitive Domain: Knowledge

Difficulty Level: Easy

5. A total of 5 hours is the optimal assignment.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | *Time Required in Hours* | | | |
| *Patient* | *Nurse-1* | *Nurse-2* | *Nurse-3* | *Nurse-4* |
| Sharma |  |  | Assign |  |
| Singh | Assign |  |  |  |
| Brown |  |  |  | Assign |
| Warner |  | Assign |  |  |

Cognitive Domain: Comprehension

Difficulty Level: Easy

6. Optimal assignment totals 379 units of satisfaction.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | *Patient Satisfaction Ratings* | | | |
| *Patient* | *Nurse-1* | *Nurse-2* | *Nurse-3* | *Nurse-4* |
| Sharma |  | Assign |  |  |
| Singh |  |  | Assign |  |
| Brown | Assign |  |  |  |
| Warner |  |  |  | Assign |

Cognitive Domain: Comprehension

Difficulty Level: Medium

7. The optimal assignment has a total time of 55 minutes.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | *Processing Time in Minutes* | | | | |
| *Component* | *Machine-1* | *Machine-2* | *Machine-3* | *Machine-4* | *Machine-5* |
| A121 |  | Assign |  |  |  |
| B85 |  |  |  | Assign |  |
| C144 | Assign |  |  |  |  |
| C105 |  |  | Assign |  |  |
| A62 |  |  |  |  | Assign |

Cognitive Domain: Comprehension

Difficulty Level: Medium

8a. The optimal assignment requires 33 days of hard-boiled detective work.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | *Average Completion Time in Days* | | | | |
| *Detective Squad* | *Case-1* | *Case-2* | *Case-3* | *Case-4* | *Case-5* |
| A |  |  | Assign |  |  |
| B |  |  |  | Assign |  |
| C |  | Assign |  |  |  |
| D | Assign |  |  |  |  |
| E |  |  |  |  | Assign |

8b. It doesn’t matter; it is not optimal for them to work on this case regardless of the conflict of interest.

Cognitive Domain: Comprehension

Difficulty Level: Medium

9ab.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Rule* | *Sequence* | *Avg Flow Time* | *Avg Tardiness* | *Avg Number of Jobs* |
| FCFS | ABCDE | 37.4 | 19 | 2.88 |
| EDD | CBDAE | 33.6 | 15.2 | 2.58 |
| SPT | DCBAE | 32.6 | 15 | 2.51 |
| LPT | EABCD | 45.4 | 26.4 | 3.49 |
| CR | EBACD | 44.8 | 25.8 | 3.45 |

9c. SPT shows superior performance across all metrics—lower numbers are better.

Cognitive Domain: Comprehension

Difficulty Level: Medium

10a. Ross should use critical ratio if he wants to complete as many assignments as possible on time—two (term project and term paper) out of five will be on time.

10b. The average tardiness is 7.4 days with an EDD sequence.

Cognitive Domain: Comprehension

Difficulty Level: Medium

11. The critical ratio sequence is ABDCE.

Cognitive Domain: Comprehension

Difficulty Level: Medium

12ab. Results in the table calculate flow time as finish time minus ready time, with the assumption that no work begins until Job E appears in the shop at Time 200. Thus, for FCFS, Job A is first, but its flow time is 225 – 180 = 45.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Rule* | *Sequence* | *Avg Flow Time* | *Avg Tardiness* | *Avg Number of Jobs* |
| FCFS | ABCDE | 83.6 | 13.4 | 3.15 |
| EDD | CABED | 78 | 7.8 | 2.92 |
| SPT | CDEAB | 71.2 | 16.2 | 2.63 |
| LPT | BAEDC | 88.8 | 17.4 | 3.37 |
| CR | ABCED | 84 | 12.8 | 3.17 |

12c. The SPT rule minimizes average flow time and inventory; the EDD rule has the lowest average tardiness.

Cognitive Domain: Comprehension

Difficulty Level: Medium

13ab.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Rule* | *Sequence* | *Avg Flow Time* | *Avg Tardiness* | *Avg Number of Jobs* |
| FCFS | PSLGC | 21.4 | 7.6 | 2.68 |
| EDD | PSLCG | 20.6 | 6.8 | 2.58 |
| SPT | LSPCG | 18.6 | 7.4 | 2.33 |
| CR | PGCSL | 27.8 | 14.2 | 3.48 |

Cognitive Domain: Comprehension

Difficulty Level: Medium

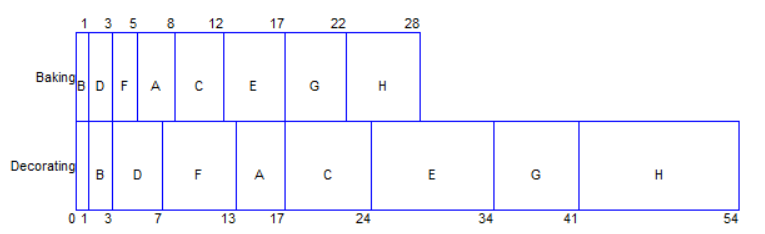
14. The optimal sequence is CADBE.

Cognitive Domain: Comprehension

Difficulty Level: Medium

15a. The optimal sequence is BDFACEGH.

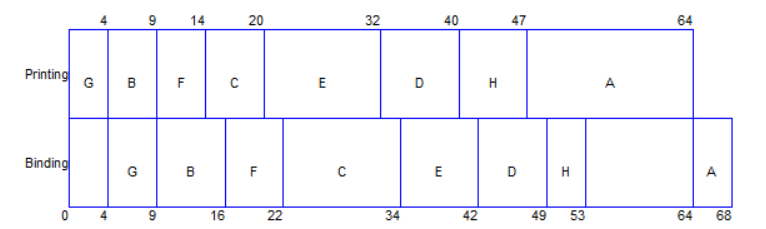
15b. The only idle time in the decorating process is the one hour at the start of the sequence.



Cognitive Domain: Comprehension

Difficulty Level: Medium

16. The optimal sequence is GBFCEDHA. The total idle time in the binding operation work center is 15 hours—4 hours at the outset and 11 hours between Jobs H and A.



Cognitive Domain: Comprehension

Difficulty Level: Medium

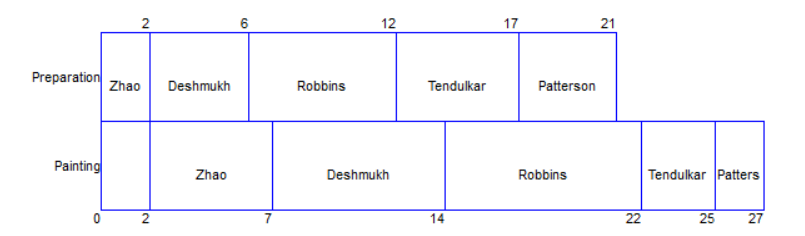
17. The sequence that will minimize makespan is YSWVUTX; Job X is finished at Time 26.

Cognitive Domain: Comprehension

Difficulty Level: Medium

18a. The optimal sequence is Zhao, Deshmukh, Robbins, Tendulkar, Patterson.

18b.



Cognitive Domain: Comprehension

Difficulty Level: Medium

19.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *Day* | *Monday* | *Tuesday* | *Wednesday* | *Thursday* | *Friday* | *Saturday* | *Sunday* |
| *Nurses Required* | *4* | *4* | *5* | *6* | *5* | *4* | *4* |
| Anand | X | X | X | X | X |  |  |
| Vineeth |  |  | X | X | X | X | X |
| Poorvik | X | X | X | X | X |  |  |
| Rakshmi |  |  | X | X | X | X | X |
| Shethal | X | X | X | X |  |  | X |
| Swathi | X | X |  |  | X | X | X |
| Gejo |  |  |  | X |  | X |  |

Cognitive Domain: Analysis

Difficulty Level: Medium

20ab. The total wait staff required is 32, so six folks are scheduled for 5 days and one for 2 days.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *Day* | *Monday* | *Tuesday* | *Wednesday* | *Thursday* | *Friday* | *Saturday* | *Sunday* |
| *Wait Staff Required* | *3* | *4* | *5* | *5* | *6* | *5* | *4* |
| A |  |  | X | X | X | X | X |
| B |  | X | X | X | X | X |  |
| C | X | X |  |  | X | X | X |
| D |  |  | X | X | X | X | X |
| E | X | X | X | X | X |  |  |
| F | X | X | X | X | X |  |  |
| G |  |  |  |  |  | X | X |

Cognitive Domain: Analysis

Difficulty Level: Medium

21.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *Day* | *Monday* | *Tuesday* | *Wednesday* | *Thursday* | *Friday* | *Saturday* | *Sunday* |
| *Volunteers Required* | *5* | *4* | *3* | *4* | *7* | *5* | *3* |
| A | X |  |  | X | X | X |  |
| B | X | X |  |  | X | X |  |
| C |  |  |  | X | X | X | X |
| D | X | X | X |  | X |  |  |
| E |  |  |  | X | X | X | X |
| F | X | X | X |  | X |  |  |
| G | X | X | X | X |  |  |  |
| H |  |  |  |  | X | X | X |

Cognitive Domain: Analysis

Difficulty Level: Medium

22. The optimal assignment results in $50 profit.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | *Jobs* | | | |
| *Workers* | *1* | *2* | *3* | *4* |
| A |  | Assign |  |  |
| B | Assign |  |  |  |
| C |  |  | Assign |  |
| D |  |  |  | Assign |

Cognitive Domain: Analysis

Difficulty Level: Medium

23.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *Week* | *1* | *2* | *3* | *4* | *5* |
| Planned input | 55 | 60 | 65 | 70 | 70 |
| Actual input | 45 | 55 | 60 | 65 | 70 |
| Deviation | -10 | -5 | -5 | -5 | 0 |
| Cumulative deviation | -10 | -15 | -20 | -25 | -25 |
|  |  |  |  |  |  |
| Planned output | 55 | 60 | 65 | 70 | 70 |
| Actual output | 55 | 55 | 60 | 65 | 70 |
| Deviation | 0 | -5 | -5 | -5 | 0 |
| Cumulative deviation | 0 | -5 | -10 | -15 | -15 |
| Actual backlog | 0 | 0 | 0 | 0 | 0 |
| Beginning backlog | 10 |  |  |  |  |

Cognitive Domain: Comprehension

Difficulty Level: Medium

24a.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| *Day* | *Monday* | *Tuesday* | *Wednesday* | *Thursday* | *Friday* | *Saturday* |
| *Volunteers Required* | *2* | *3* | *6* | *4* | *7* | *4* |
| A |  |  | X | X | X | X |
| B |  | X | X | X | X |  |
| C | X | X | X |  | X |  |
| D |  |  | X | X | X | X |
| E | X |  | X |  | X | X |
| F |  | X | X |  | X |  |
| G |  |  |  | X | X | X |

Cognitive Domain: Comprehension

Difficulty Level: Medium

24b.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| *Day* | *Monday* | *Tuesday* | *Wednesday* | *Thursday* | *Friday* | *Saturday* |
| *Volunteers Required* | *2* | *3* | *6* | *4* | *7* | *4* |
| A | X | X |  |  | X |  |
| B |  |  | X | X | X | X |
| C |  | X | X | X | X |  |
| D |  |  | X | X | X | X |
| E |  |  | X | X | X |  |
| F |  |  | X |  | X | X |
| G |  |  | X |  | X | X |
| H | X | X |  |  |  |  |

Cognitive Domain: Comprehension

Difficulty Level: Medium

25. The optimal sequence is KRPNMOL.

Cognitive Domain: Knowledge

Difficulty Level: Easy

26.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| *Day* | *Monday* | *Tuesday* | *Wednesday* | *Thursday* | *Friday* | *Saturday* | *Sunday* |
| *Volunteers Required* | *3* | *4* | *4* | *2* | *5* | *6* | *6* |
| A |  | X | X |  | X | X | X |
| B |  | X | X |  | X | X | X |
| C | X | X |  |  | X | X | X |
| D |  |  | X | X | X | X | X |
| E | X | X | X |  |  | X | X |
| F | X |  |  | X | X | X | X |

Cognitive Domain: Comprehension

Difficulty Level: Medium

27.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| *Day* | *Monday* | *Tuesday* | *Wednesday* | *Thursday* | *Friday* | *Saturday* |
| *Employees Required* | *3* | *3* | *5* | *4* | *6* | *4* |
| A |  | X | X | X | X |  |
| B |  |  | X | X | X | X |
| C |  | X | X | X | X |  |
| D | X | X |  |  | X | X |
| E | X |  |  | X | X | X |
| F | X |  | X |  |  | X |
| G |  |  | X |  | X |  |

Cognitive Domain: Comprehension

Difficulty Level: Medium

28.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *Week* | *1* | *2* | *3* | *4* | *5* |
| Planned input | 30 | 30 | 30 | 30 | 25 |
| Actual input | 28 | 32 | 25 | 26 | 31 |
| Deviation | -2 | 2 | -5 | -4 | 6 |
| Cumulative deviation | -2 | 0 | -5 | -9 | -3 |
|  |  |  |  |  |  |
| Planned output | 30 | 30 | 30 | 30 | 27 |
| Actual output | 30 | 28 | 29 | 30 | 28 |
| Deviation | 0 | -2 | -1 | 0 | 1 |
| Cumulative deviation | 0 | -2 | -3 | -3 | -2 |
| Actual backlog | 11 | 15 | 11 | 7 | 10 |
| Beginning backlog | 13 |  |  |  |  |

Cognitive Domain: Knowledge

Difficulty Level: Easy

29.

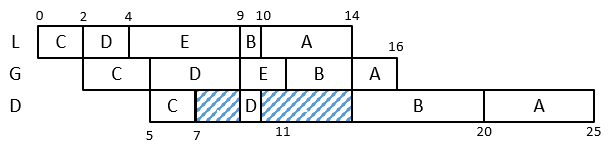
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Rule* | *Sequence* | *Avg Flow Time* | *Avg Tardiness* | *Avg Number of Jobs* |
| FCFS | ABCDEF | 9 | 1.58 | 3.09 |
| EDD | EBACFD | 8.08 | 0 | 2.77 |
| SPT | BEACDF | 7.83 | 0 | 2.69 |
| LPT | FDCAEB | 12.58 | 5.83 | 4.31 |
| CR | EAFCBD | 9.67 | 1.42 | 3.31 |

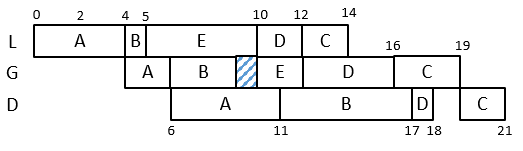
Cognitive Domain: Comprehension

Difficulty Level: Medium

30a. SPT rule sequence: CDEBA; LPT rule sequence: ABEDC

30b. The SPT sequence is the Gantt chart on top, the LPT sequence is the lower Gantt chart.





30c. The LPT rule is preferable since it results in a lower makespan.

Cognitive Domain: Comprehension

Difficulty Level: Medium