

Network Models: Project Management

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MSDS 460: Decision Analytics

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Setup

Updated Excel Task Spreadsheet [x project-plan-v003.xlsx](#)

	taskID	predecessor TaskIDs	bestCase Hours	expectedHours	worstCase Hours	project Manager	frontendD eveloper	backendD eveloper	dataSci entist	dataEn gineer
	A	N/A	4	8	12	40				
	B	N/A	12	20	32	40				
	C	A	8	15	24	40				
D	D1	A	4	6	10		50			
	D2	D1	8	12	18		50			
	D3	D1	10	15	24			75		
	D4	D2, D3	20	40	60			75		
	D5	D4	6	12	18				75	
	D6	D4	10	20	30					70
	D7	D6	12	25	40					70
	D8	D5, D7	4	6	10	40				
	E	B, C	10	15	25	40				
	F	D8, E	6	10	15	40				
	G	A, D8	8	16	24				75	
	H	F, G	6	12	20	40				

This table outlines the various tasks, the best-case, expected, and worst-case completion times, as well as the responsible personnel for each task. Each person's hourly cost has been factored in accordingly, with Project Manager, Front-end Developer, Back-end Developer, Data Scientist, and Data Engineer at \$40, \$50, \$75, \$75, and \$70 per hour, respectively. These cost breakdowns allow us to estimate labor cost accurately.

Notable areas of uncertainty include time estimates— while we have accounted for best and worst case scenarios, certain specific tasks like coding (D4), unit testing (D6), and system testing (D7) are contingent on software and role expertise. This means the estimated hours for these tasks could be greater or lesser than expected.

Another notable area of uncertainty is cost estimates— unforeseen and unreported costs related to additional development may arise as the project progresses. The complexity of the

coding task (D4) may create additional cost from additional hours required of employees for sufficient completion of the project.

Model Specification

Decision Variables

- x_{PM} : number of hours Project Manager used between the following routes:
 - AC, BE, CE, D5D8, D7D8, D8F, EF, FH, GH
- x_{FD} : number of hours Front-end Developer used between the following routes:
 - D1D2, AD1
- x_{BD} : number of hours Back-end Developer used between the following routes:
 - D1D3, D2D4, D3D4
- x_{DS} : number of hours Data Scientist used between the following routes:
 - D4D5, AG, D8G
- x_{DE} : number of hours Data Engineer used between the following routes:
 - D4D6, D6D7

Objective Function

- Minimize $Z = 40x_{PM} + 50x_{FD} + 75x_{BD} + 75x_{DS} + 70x_{DE}$

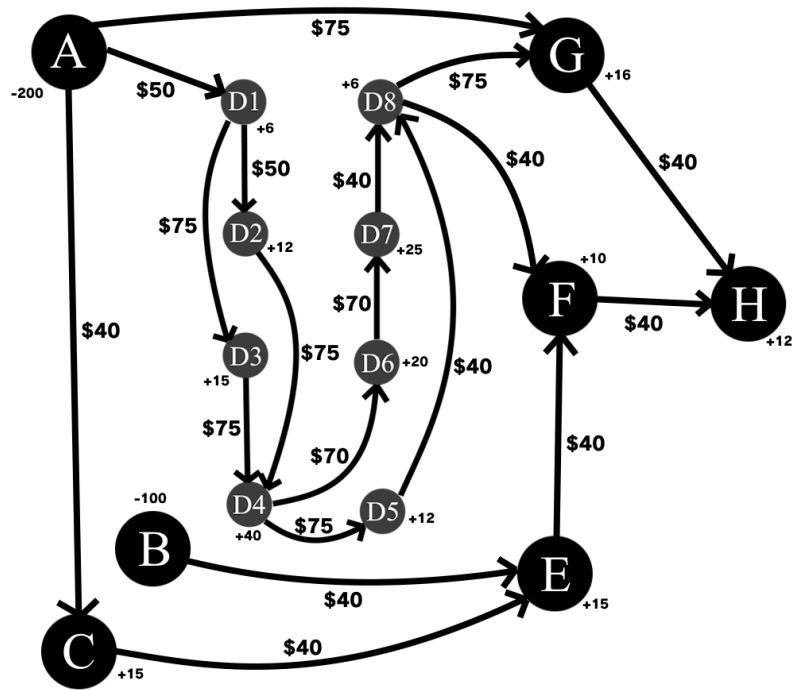
Constraints for Expected Hours

- $8 \leq x_A \leq 200$
- $20 \leq x_B \leq 100$
- $x_{AC} - x_{CE} \geq 15$
- $x_{AD1} - x_{D1D2} - x_{D1D3} \geq 6$
- $x_{D1D2} - x_{D2D4} \geq 12$

- $x_{D1D3} - x_{D3D4} \geq 15$
- $x_{D2D4} + x_{D3D4} - x_{D4D5} - x_{D4D6} \geq 40$
- $x_{D4D5} - x_{D5D8} \geq 12$
- $x_{D4D6} - x_{D6D7} \geq 20$
- $x_{D6D7} - x_{D7D8} \geq 25$
- $x_{D5D8} + x_{D7D8} - x_{D8F} - x_{D8G} \geq 6$
- $x_{BE} + x_{CE} - x_{EF} \geq 15$
- $x_{EF} + x_{D8F} - x_{FH} \geq 10$
- $x_{AG} + x_{D8G} - x_{GH} \geq 16$
- $x_{FH} + x_{GH} \geq 12$
- All $x_{ij} \geq 0$

The total hours required is 232 hours and the total number of hours allocated is 300.

Diagram of Expected Hours



Code Output Table and Solution

Expected

Start Node	Target Node	Hours Spent
A	C	15
A	D1	136
A	G	28
B	E	25
C	E	0
D1	D2	115
D1	D3	15
D2	D4	103
D3	D4	0
D4	D5	18
D4	D6	45
D5	D8	6
D6	D7	25
D7	D8	0
D8	F	0
D8	G	0
E	F	10
F	H	0
G	H	12

Best Case

Start Node	Target Node	Hours Spent
A	C	8
A	D1	74
A	G	14
B	E	16
C	E	0
D1	D2	60
D1	D3	10
D2	D4	52
D3	D4	0
D4	D5	10
D4	D6	22
D5	D8	4
D6	D7	12
D7	D8	0
D8	F	0
D8	G	0
E	F	6
F	H	0
G	H	6

Worst Case

Start Node	Target Node	Hours Spent
A	C	24
A	D1	210
A	G	44
B	E	40
C	E	0
D1	D2	176
D1	D3	24
D2	D4	158
D3	D4	0
D4	D5	28
D4	D6	70
D5	D8	10
D6	D7	40
D7	D8	0
D8	F	0
D8	G	0
E	F	15
F	H	0
G	H	20

Conclusion

Best Case Hours Total	Expected Hours Total	Worst Case Hours Total
\$17,130	\$32,470	\$50,410

My solution costs \$17,130 in the best case hours, \$32,470 in the expected hours, and \$50,410 in the worst case hours. Ignoring costs associated with software licensing and cloud hosting, I would charge \$800,000. \$50,410 is only the pure personnel cost in the worst case scenario. Leasing a physical location and utilities are costs when building a team for a project plan. Company revenue and taxes also need to be taken into consideration, and space for ample negotiation as well. I would expect to deliver the product prototype within a year. Employees going on vacation or sick leave would also delay the project in terms of both completion time and cost. Recruitment is also an issue; none of the roles listed are those in HR-recruiting areas. There is also a major upfront hardware cost in computers and technology. Additional independent contractors being added to the project may or may not decrease the project completion time as integration and the like costs valuable time and money.