Project Crashing Using QM

In this tutorial, we will cover the concept of project crashing using QM.

An electrical contractor is trying to determine the amount of money it will take to get his project from the normal 15-week completion to a 13-week completion. In other words, he wants to crash this project. The data is shown in the table below.

		Normal	Crash			Crash	Critical
		Time	Time	Cost \$	Cost \$	Cost per	Path
Activity	Predecessors	(weeks)	(weeks)	Normal	Crash	week	Activity?
А		2	1	\$22,000	\$23,000	\$1,000	Yes
В		3	1	\$30,000	\$34,000	\$2,000	No
С	А	2	1	\$26,000	\$27,000	\$1,000	Yes
D	В	4	3	\$48,000	\$49,000	\$1,000	No
Е	С	4	2	\$56,000	\$58,000	\$1,000	Yes
F	С	3	2	\$30,000	\$30,500	\$500	No
G	D, E	5	2	\$80,000	\$86,000	\$2,000	Yes
Н	F, G	2	1	\$16,000	\$19,000	\$3,000	Yes

The crash cost per week is the additional cost it will take to shorten each activity from its normal completion time to its crash time.

1. To solve this problem, open Excel QM, select the **Excel QM** tab \rightarrow **Alphabetical** \rightarrow **Project Management** \rightarrow **Crashing**.

File Home	: Insert Page Layout Formulas Da	ta F	Review N	/iew Exc	el QM								
By Alph chapter Menu:	0 1 2 Gridlines Headings Inst Assignment Breakeven Analysis	ruction nulas	User preference	Color es selection Sett	😭 Default 🎸 Default tings	preferences colors	Load Wind Calulato	ows Print on or 1 page Action	Clear sheet Ex	Unload (cel OM 4	eMail Web Site Su	About H	? Help
A	F	G	Н	1	J	К	L	М	N	0	Р	0	
2	Inventory												
3 4	Linear, Integer & Mixed Integer Programming Markov Chains	-											
5	Material Requirements Planning												
7	Project Management		Predecessor	List (AON)	<u> </u>								
9	Quality Control		Start, End No	odes (AOA)									
10	Statistics (mean, var, sd; Normal Dist)		Crashing Mean, Std De	ev given									
12 13	Transportation												
14	Display OM Models Only												
16	Display QM Models Only Display All Models												
18		_											

Spreadsheet Initialization	
Title:	Sheet name:
Enter the number of activities	8
Name for rows A	
(Use A for A, B, C or a for a, b, c)
	Use Default Settings
	Help Cancel OK

2. A Spreadsheet Initialization window will appear. Enter 8 for the number of activities.

3. Click $\ensuremath{\textbf{OK}}$. A table will display.

	А	В	С	D	E	F	G	Н	I.	J	K	L	М	N
1	Project Managem	ent		Crashing										
2	Entor the da	ita in the cha	dod aroa. Th	on ao to tho		a tha ribbon	aliak on Sal	ver in the Da	ta Analycia (Prou	n and that	a aliak SOLA	/=	
3	If SOLVER	is not on the	Data Tab the	n please see	the Help file	(Solver) for i	nstructions	ver in the Da	ta Analysis C	JIOU	p and the	I CIICK SOLV	/⊑.	
4	4													
5	Data				Normal time	0		Min	imum crash	cost	to meet p	project goal	\$ -	
6	Project goal			M	inimum time	0					Р	roject time	C	
7														
8						Immediate	Predecesso	rs (1 per colu	ımn)			Intermedia	te Computat	tions
		Normal			Total Cost	Immediate								
		Time	Crash Time	Normal	with	Predecesso						Crash		
9	Activity	(weeks)	(weeks)	Cost	Crashing	r(s)	Pred 2	Pred 3	Pred 4	Cı	rash days	cost/day	Crash limit	
10	Α										0	0	C)
11	В										0	0	C)
12	С										0	0	C)
13	D										0	0	C)
14	E										0	0	C)
15	F										0	0	C)
16	G										0	0	C)
17	Н										0	0	C)

4. Enter the data from the table at the start of this tutorial into the table on your spreadsheet, and enter 13 as your project goal, as we want to know how much it will take to shorten the project to 13 weeks. For the predecessor list, be sure to enter each predecessor individually; e.g., for activity G, the immediate predecessor is D and Pred2 is E.

	А	В	С	D	Е	F	G	Н	I	J K	L	М	Ν
1	Project Managem	ent		Crashing									
2 3 4	 Enter the data in the shaded area. Then go to the DATA Tab on the ribbon, click on Solver in the Data Analysis Group and then click SOLVE. If SOLVER is not on the Data Tab then please see the Help file (Solver) for instructions. 												
5	Data				Normal time	15		Min	imum crash	cost to meet	project goal	\$-	
6	Project goal	13		M	inimum time	7					Project time	0	
7													
8						Immediate	Predecesso	rs (1 per colu	ımn)		Intermedia	te Computat	ons
		Normal			Total Cost	Immediate							
		Time	Crash Time	Normal	with	Predecesso					Crash		
9	Activity	(weeks)	(weeks)	Cost	Crashing	r(s)	Pred 2	Pred 3	Pred 4	Crash days	cost/day	Crash limit	
10	A	2	1	\$22,000	\$23,000					0	1000	1	
11	В	3	1	\$30,000	\$34,000					C	2000	2	
12	С	2	1	\$26,000	\$27,000	А				C	1000	1	
13	D	4	3	\$48,000	\$49,000	В				C	1000	1	
14	E	4	2	\$56,000	\$58,000	С				C	1000	2	
15	F	3	2	\$30,000	\$30,500	С				0	500	1	
16	G	5	2	\$80,000	\$86,000	D	E			0	2000	3	
17	Н	2	1	\$ 16,000	\$ 19,000	F	G			0	3000	1	
381													

5. Then click on the **Data** tab \rightarrow **Solver**



6. A **Solve Parameters** window will display.

Solve	er Parameters	x
		_
	Set Objective: \$M\$5	<u></u>
	To: O Max O Min O Value Of: 0	
	By Changing Variable Cells:	
	\$M\$6,\$B\$33:\$Z\$33,\$B\$34:\$Z\$34	S
	Subject to the Constraints:	
	\$B\$36:\$Z\$36 >= \$B\$33:\$Z\$33 \$B\$34:\$Z\$34 <= \$B\$35:\$Z\$35 bt=29:c\$24 <= c529:c524 c5	
	\$0\$30:\$0\$40 >= \$C\$30:\$C\$40 \$B\$38:\$B\$46 >= \$D\$38:\$D\$46 \$M\$6 <= \$B\$6	
	\$8\$38:\$8\$46 >= \$J\$38:\$J\$46 \$8\$38:\$8\$46 >= \$J\$38:\$I\$46 @elete	
	\$8\$30:\$8\$46 >= \$F\$38:\$F\$46 \$8\$33:\$8\$46 >= \$E\$38:\$E\$46 \$8\$33:\$8\$46 >= \$E\$38:\$E\$46	
	+ Load/Save	
	Make Unconstrained Variables Non-Negative	
	Select a Solving Method: Simplex LP	
	Solving Method	ווה
	Select the GRG Nonlinear engine for Solver Problems that are smooth nonlinear. Select the LP Simplex engine for linear Solver Problems, and select the Evolutionary engine for Solver problems that are non-smooth.	
	Help Solve Close	

7. Click **Solve**. A Solver Results window will display.

Solver Results	×
Solver found a solution. All Constraints and optin	mality Reports
	Answer Sensitivity Limits
O <u>R</u> estore Original Values	
Return to Solver Parameters Dialog	O <u>u</u> tline Reports
<u>OK</u> <u>C</u> ancel	<u>S</u> ave Scenario
Solver found a solution. All Constraints and optim satisfied.	ality conditions are
When the GRG engine is used, Solver has found a solution. When Simplex LP is used, this means So optimal solution.	t least a local optimal lver has found a global

8. Click **OK**.

From the results below, we can see that the cost will be \$3,000 to shorten the project by two weeks by crashing activities A and G. We can see with additional money, the shortest possible completion time will be 7 weeks.

	Α	В	С	D	E	F	G	Н	I	J K	L	Μ	Ν	
1	Project Managem	ent		Crashing										
2 3 4	 Enter the data in the shaded area. Then go to the DATA Tab on the ribbon, click on Solver in the Data Analysis Group and then click SOLVE. If SOLVER is not on the Data Tab then please see the Help file (Solver) for instructions. 													
5	Data				Normal time	15		Mir	imum crash	cost to meet	project goal	\$ 3,000.00		
6	Project goal	13		M	inimum time	7				F	Project time	13		
7														
8						Immediate	Predecesso	rs (1 per coli	umn)		Intermedia	e Computati	ons	
		Normal Time	Crash Time	Normal	Total Cost with	Immediate Predecesso					Crash			
9	Activity	(weeks)	(weeks)	Cost	Crashing	r(s)	Pred 2	Pred 3	Pred 4	Crash days	cost/day	Crash limit		
10	A	2	1	\$22,000	\$23,000					1	1000	1		
11	В	3	1	\$30,000	\$34,000					0	2000	2		
12	C	2	1	\$26,000	\$27,000	A				0	1000	1		
13	D	4	3	\$48,000	\$49,000	B				0	1000	1		
14	E	4	2	\$56,000	\$58,000	C				0	1000	2		
15	F	3	2	\$30,000	\$30,500	C				0	500	1		
16	G	5	2	\$80,000	\$86,000	D	E			1	2000	3		
17	Н	2	1	\$ 16,000	\$ 19,000	F	G			0	3000	1		

<u>Click here</u> to download the completed spreadsheet table so you can compare it to yours.

If we shorten the goal to 7 weeks by simply entering 7 as our project goal and repeating steps 5-8. We will see that we crash almost every activity and it will cost us a total of an extra \$18,000 to get it shortened from 15 weeks to 7 weeks.

	А	В	С	D	Е	F	G	Н	I	J K	L	Μ	Ν
1	Project Managem	ent		Crashing									
2	Enter the da	ta in the sha	ded area. Th	en go to the	DATA Tab or	the ribbon,	click on Sol	ver in the Da	ita Analysis (Group and the	n click SOLV	<mark>/E.</mark>	
4	If SOLVER i	is not on the	Data Tab the	n please see	the Help file	(Solver) for i	nstructions.						
5	Data				Normal time	15		Min	imum crash	cost to meet	project goal	\$ 18,000.00	
6	Project goal	7		M	inimum time	7				F	Project time	7	
7													
8	3					Immediate	Predecesso	rs (1 per colu	ımn)		ns		
		Normal			Total Cost	Immediate							
		Time	Crash Time	Normal	with	Predecesso					Crash		
9	Activity	(weeks)	(weeks)	Cost	Crashing	r(s)	Pred 2	Pred 3	Pred 4	Crash days	cost/day	Crash limit	
10	A	2	1	\$22,000	\$23,000					1	1000	1	
11	В	3	1	\$30,000	\$34,000					2	2000	2	
12	С	2	1	\$26,000	\$27,000	А				1	1000	1	
13	D	4	3	\$48,000	\$49,000	В				1	1000	1	
14	E	4	2	\$56,000	\$58,000	С				2	1000	2	
15	F	3	2	\$30,000	\$30,500	С				0	500	1	
16	G	5	2	\$80,000	\$86,000	D	E			3	2000	3	
17	Н	2	1	\$ 16,000	\$ 19,000	F	G			1	3000	1	

<u>Click here</u> to download the completed spreadsheet table so you can compare it to yours.

This concludes the tutorial on project crashing using QM.