Aggregate Planning

SCM4330/BZAN3310

Flow Analysis

Workers flow:

- number available workers = beginning workers + number hired - number fired

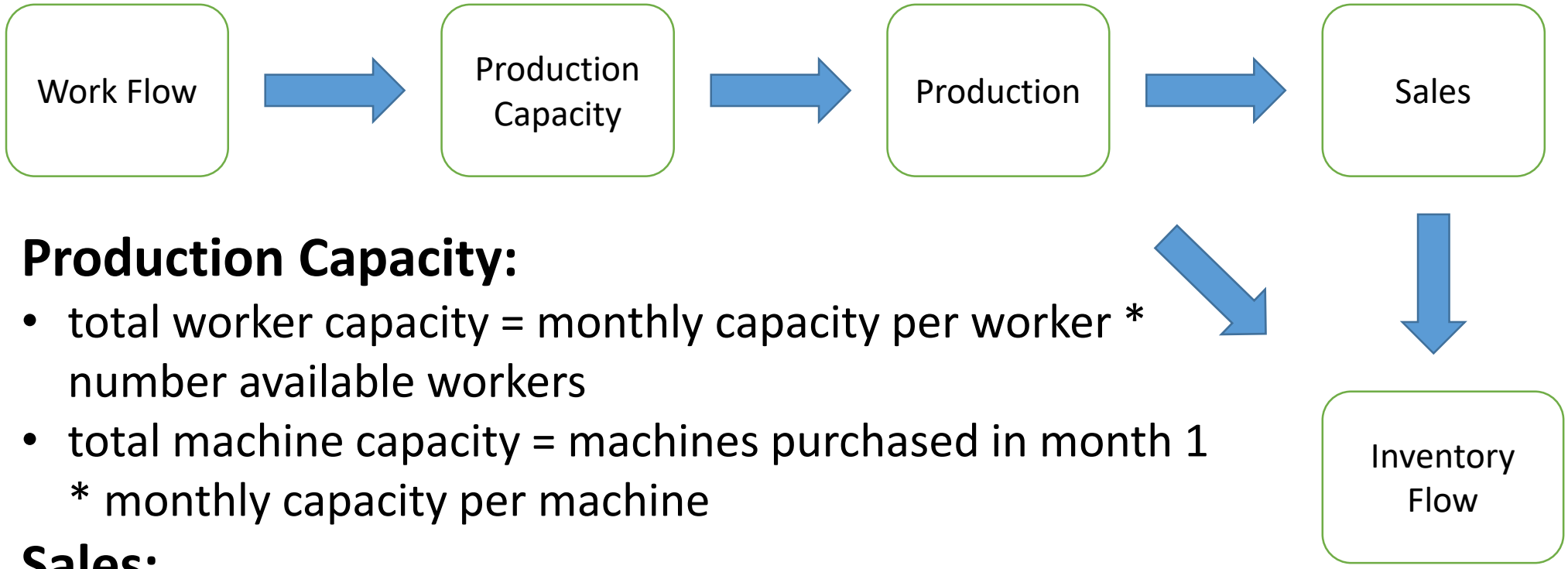
Inventory flow:

- end of month inventory = beginning of month inventory + number produced - sold amount

Cash flow:

- end of month cash = beginning of month cash + revenue - total costs

Flow Analysis



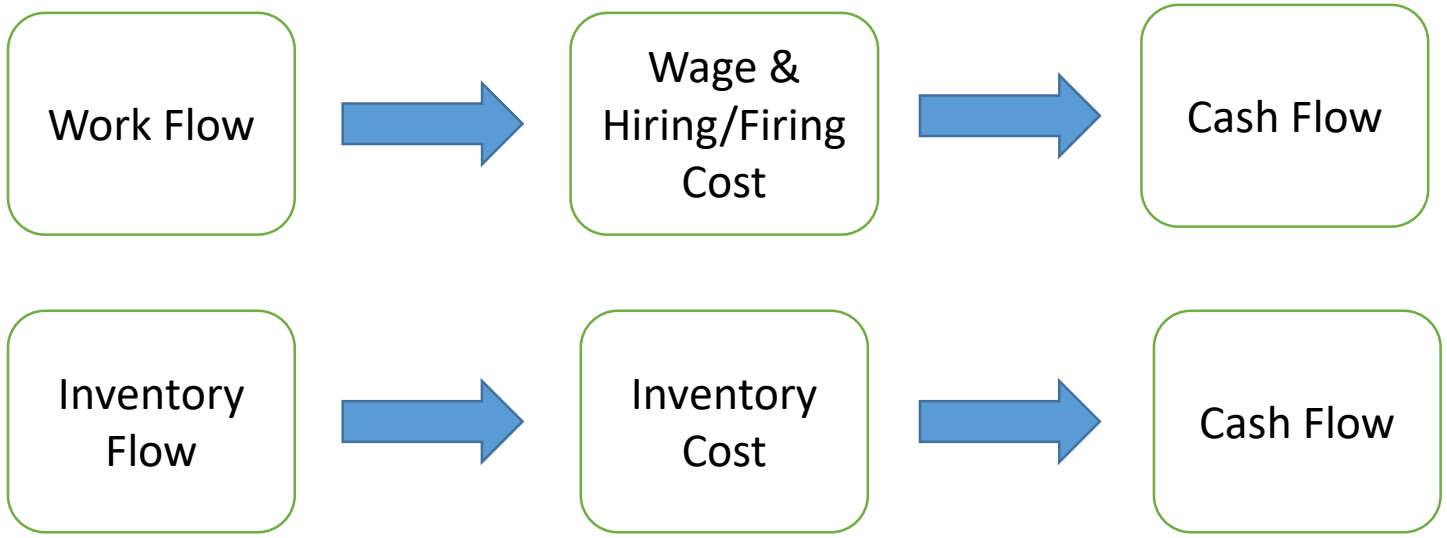
Production Capacity:

- total worker capacity = monthly capacity per worker * number available workers
- total machine capacity = machines purchased in month 1 * monthly capacity per machine

Sales:

- demand after advertising (sold amount) = original demand + advertising money spend / Ad cost to increase demand by 1

Flow Analysis



Costs

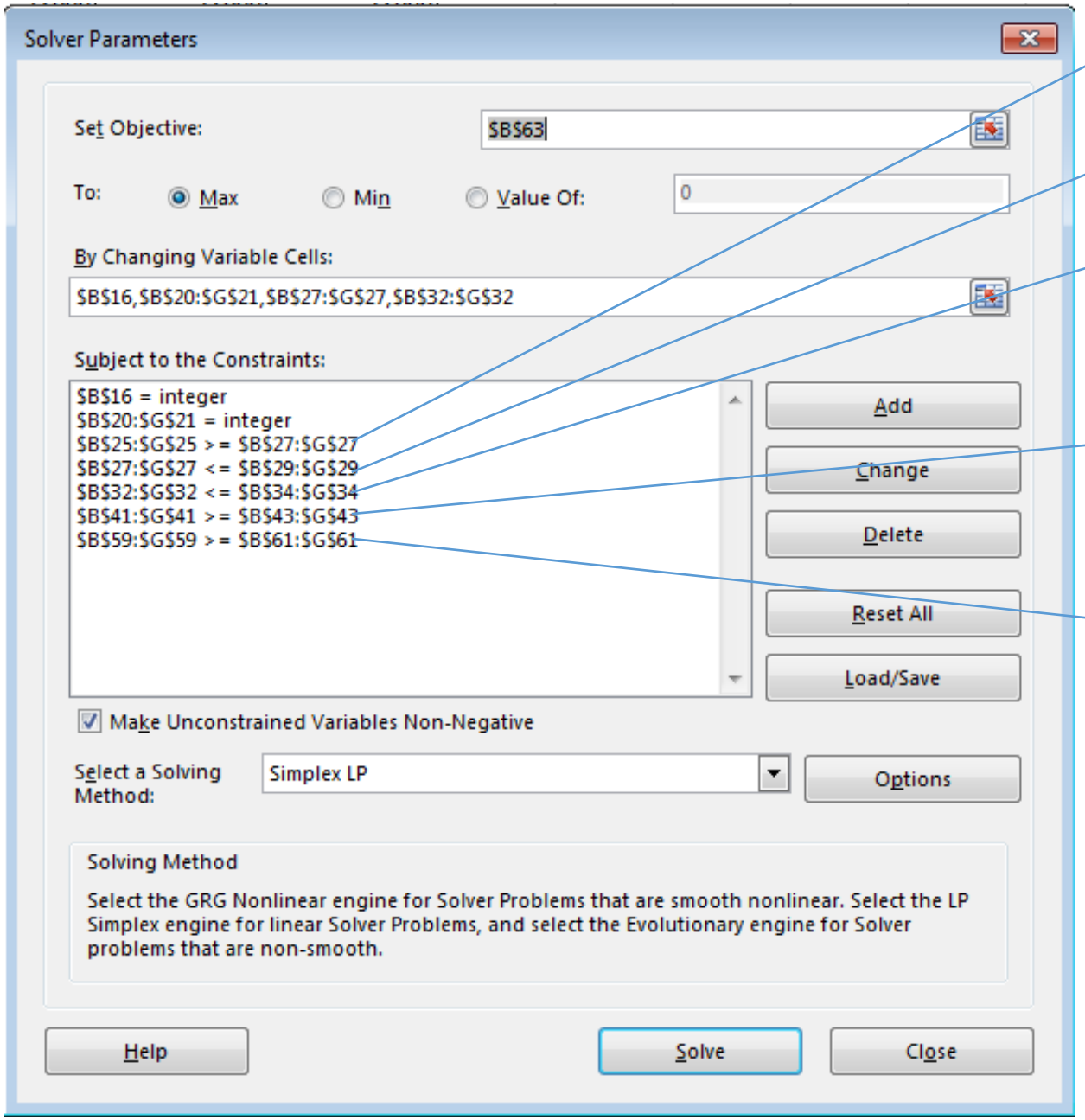
- cost of machines = machines purchased in month 1 * cost of buying a machine
- hiring cost = number hired * hiring cost per worker
- firing cost = number fired * firing cost per worker
- wages = number available workers * monthly worker wage
- advertising cost = advertising money spent
- holding cost = end of month inventory * holding cost per product per month
- raw material cost = number produced * raw material cost per mTune

Profit

- revenue = sold amount * selling price per mTune

Profit

- = SUM(revenue) - SUM(total costs); or
- = end of month cash in month 6 - initial cash



Total worker capacity $\geq$ Number prduced

Total machine capacity $\geq$ Number prduced

Advertsing Spent $\leq$ Maximum advertising

Constraint:

End of Month Inventory ≥ 0

is equivalent to

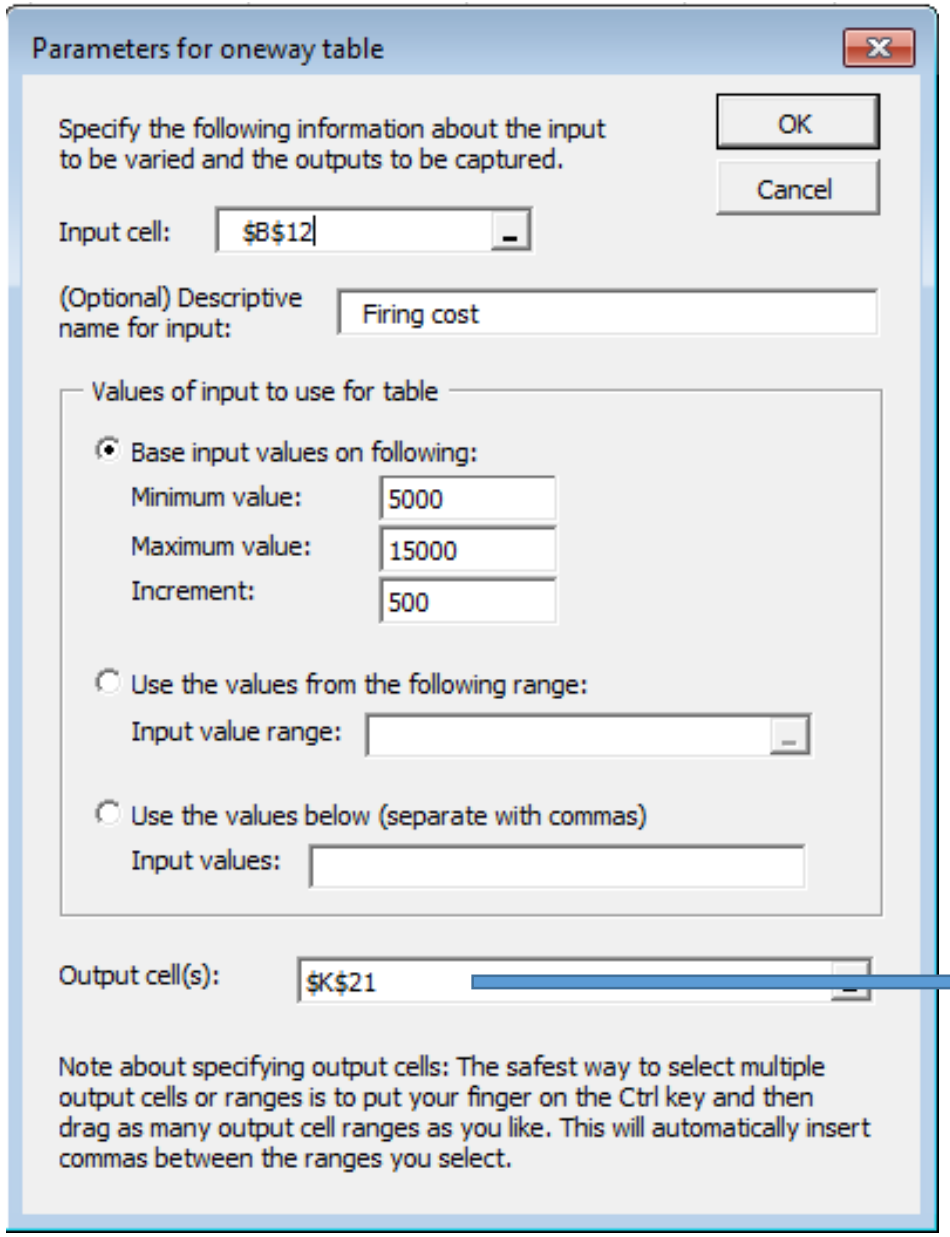
Init Inventory + Production $\geq$ Sales

End of month cash ≥ 0

Solver Table 1

- At what firing cost would the model suggest to not fire any workers?

- Varying firing cost from $5,000 - $15,000 with increment $500, show the **total** number of workers are fired



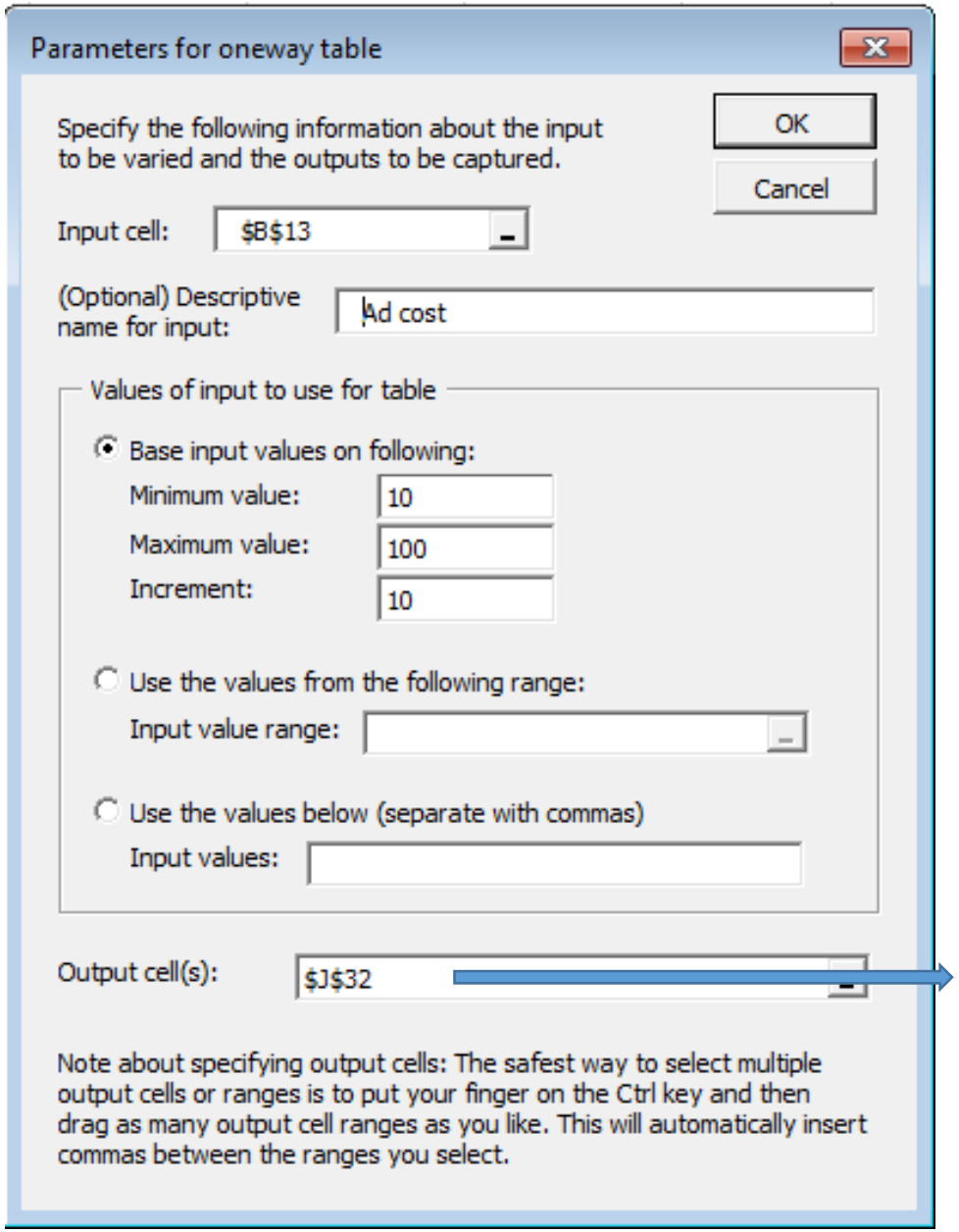
Calculate total number of workers are fired in K21 by formula:

=SUM(B20:G20)

Solver Table 2

- At what Advertising effectiveness (currently at $10 per additional unit) would the model not advertising?

- Varying Ad cost to increase demand by 1 from $10 to $100 with increment $10, show **minimum** advertising spending.



Calculate minimum ad spending by formula:

=MIN(B32:G32)

Solver Table 3

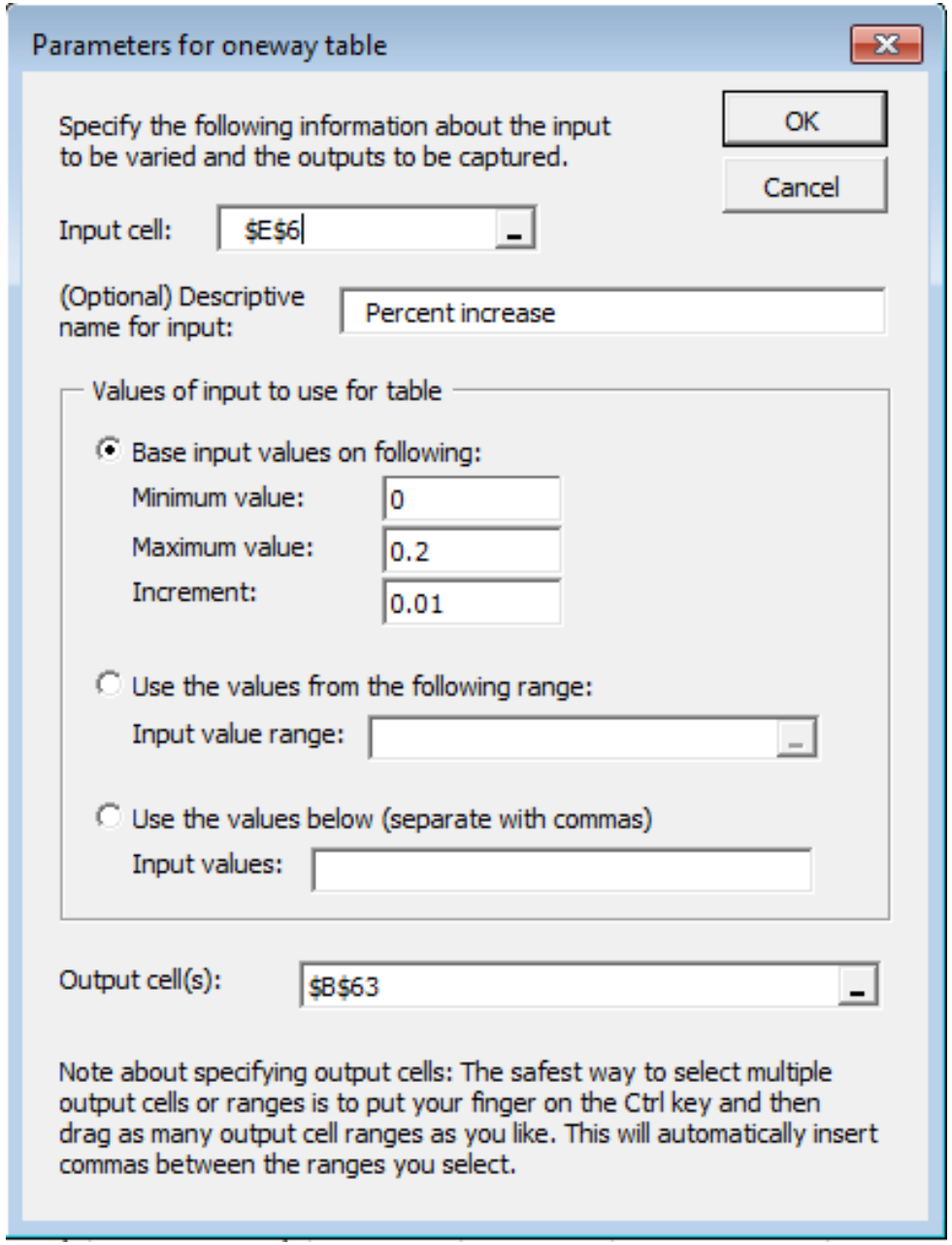
- How much would you be willing to pay for each 1% increase in worker productivity? (potentially by training or reorganizing)

- Varying Monthly Capacity Per Worker Percentage from 1% - 20% with 1% increment, show profit.

	A	B	C	D	E
1	**Manufacturing mTunes**				
2					
3	Initial cash	$100,000			
4	Initial employees (Month 1)	15			
5	Monthly Capacity Per Machine	900			% change
6	Monthly Capacity Per Worker	600	=D6*E6+D6	600	0%
7	Holding cost Per Product Per Month	$2			
8	Cost of buying a machine (Month 1)	$3,000			
9	Raw material cost per mTune	$6			

1. Input initial value 600 in D6
2. Use E6 as percentage change
3. Set formula in B6 as = D6*E6+D6

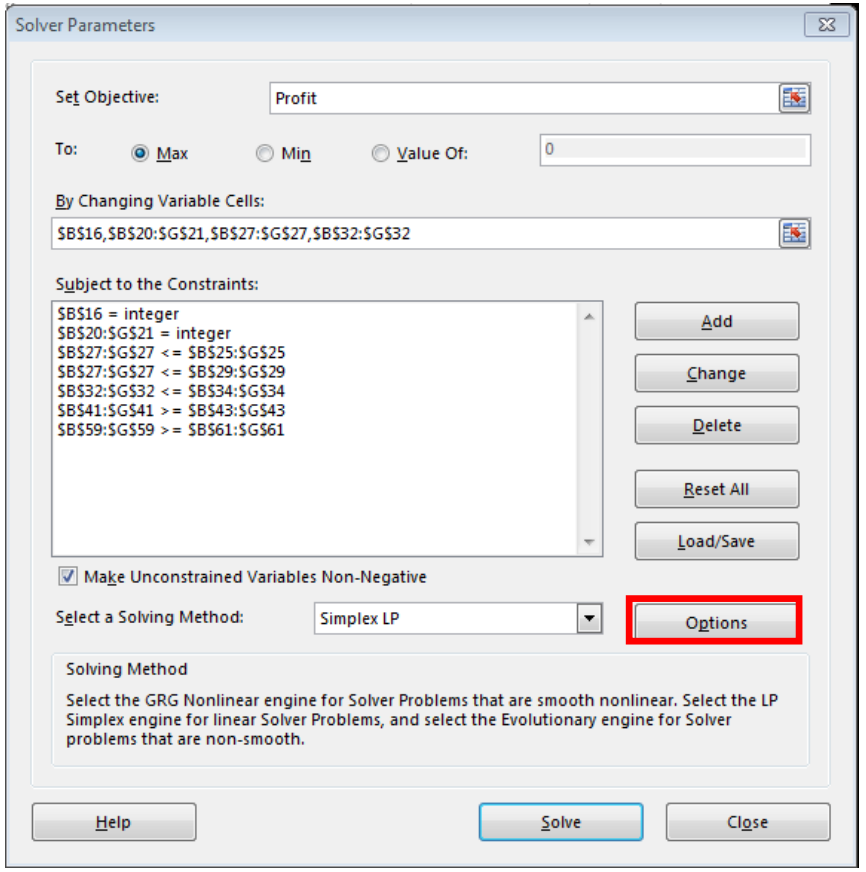
Now changing value in E6 can very “monthly capacity per worker” by certain percentage

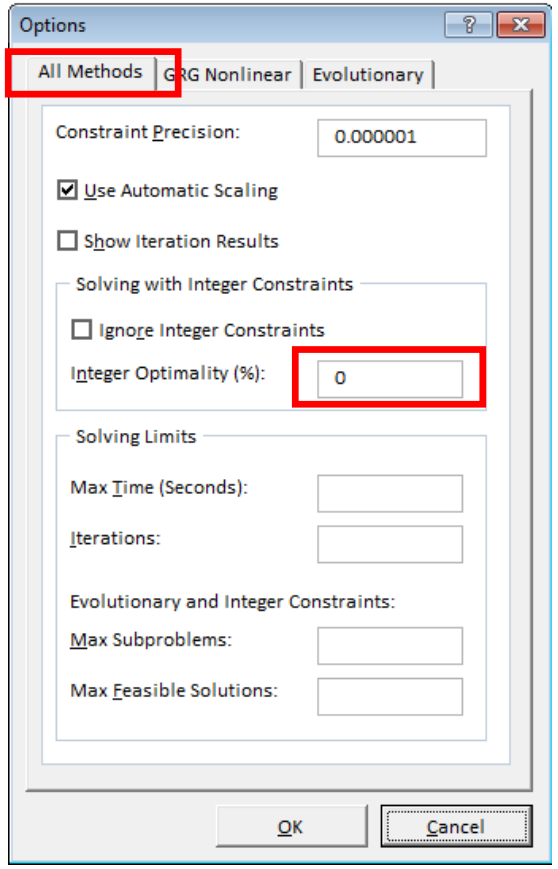


- The results are shown as below.
- Ideally, the profit should not decrease if we increase workers capacity. However, this is not the case here after we take the differences between profits.
- Thus, we need to adjust Excel solver's default setting

	A	B	C	D	E	F
1	**Oneway analysis for Solver model in Model worksheet**					
2						
3	Percent increase (cell E6) values along side, output cell(s) along top					
4		Profit				
5	0%	$3,785,300				
6	1%	$3,790,056	$4,756	=B6-B5		
7	2%	$3,796,888	$6,832	=B7-B6		
8	3%	$3,804,428	$7,540			
9	4%	$3,803,960	-$468			
10	5%	$3,809,050	$5,090			
11	6%	$3,808,360	-$690			
12	7%	$3,815,224	$6,864			
13	8%	$3,828,044	$12,820			
14	9%	$3,822,388	-$5,656			
15	10%	$3,830,580	$8,192			
16	11%	$3,830,746	$166			
17	12%	$3,831,308	$562			
18	13%	$3,840,104	$8,796			
19	14%	$3,843,584	$3,480			
20	15%	$3,853,700	$10,116			
21	16%	$3,845,948	-$7,752			
22	17%	$3,855,312	$9,364			
23	18%	$3,850,072	-$5,240			
24	19%	$3,858,678	$8,606			
25	20%	$3,865,080	$6,402			

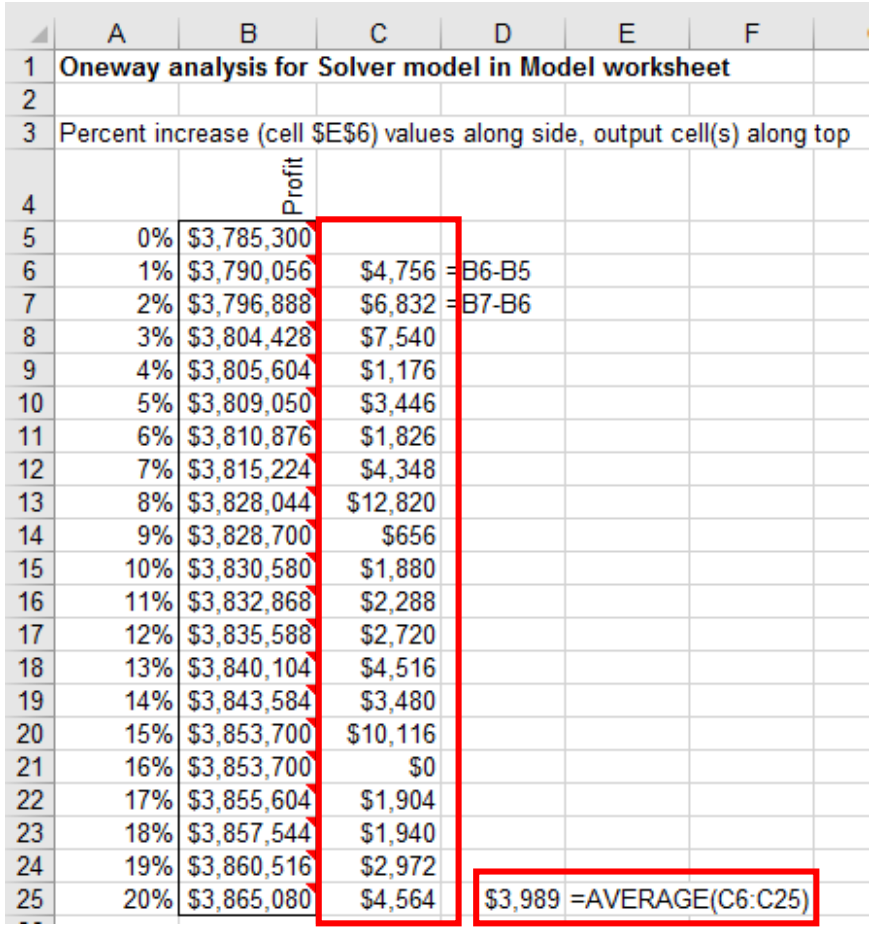
Solver Setting





1. Click Options in Excel solver
2. In Options window, typing 0 in Integer Optimality (%) box
3. Re-run Solver Table

Solver Table 3



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8	3%	$3,804,428	$7,540			
9	4%	$3,805,604	$1,176			
10	5%	$3,809,050	$3,446			
11	6%	$3,810,876	$1,826			
12	7%	$3,815,224	$4,348			
13	8%	$3,828,044	$12,820			
14	9%	$3,828,700	$656			
15	10%	$3,830,580	$1,880			
16	11%	$3,832,868	$2,288			
17	12%	$3,835,588	$2,720			
18	13%	$3,840,104	$4,516			
19	14%	$3,843,584	$3,480			
20	15%	$3,853,700	$10,116			
21	16%	$3,853,700	$0			
22	17%	$3,855,604	$1,904			
23	18%	$3,857,544	$1,940			
24	19%	$3,860,516	$2,972			
25	20%	$3,865,080	$4,564	$3,989	=AVERAGE(C6:C25)	

- As expected, the profit increases as workers capacity increase.
- D25 shows that we would be willing to pay about $3989 or less for a 1% increase in productivity.