Maximising Business Profit

Shouldice

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Executive Summary

This report aims to examine what business decisions could potentially lead to higher profits of the Shouldice hospital. The main problem we address in this report is the negative profits Shouldice makes under the current circumstances. This is due to a limited number of extra patients that the hospital can take care of in combination with the current number of beds and the fixed number of elective patients. We advise the management to opt for an alternative inflow of elective patients, which would average at 30 and employ a mobile diagnosis team while lowering the number of beds to maximise the hospital's profit and make use of the capacities more efficiently.

Introduction and Background

Until 2005, Shouldice hospital was paid by medical insurance companies on a process-oriented basis. As of 2005, standard hip surgeries are being purchased by insurance companies as a flat-rate product, and the amount per patient will be fixed, regardless of the medical process and length of stay. Since health care treatments are unpredictable, capacity requirements are challenging to assess. Yet, the hospital may needs to predict patient inflows and adjust its bed capacity likewise not to generate significant losses but to generate profits instead.

Shouldice specialises in hip surgeries, which constitute the only financial income of the hospital with revenue of 4,600 € generated per patient regardless of their length of stay. The cost per surgery is 2,000 €. Shouldice can perform 60 surgeries per day without extra costs inferred and has the capacity of 240 beds for recovery after surgery. However, each day the patient needs to recover costs the hospital money, as the number of beds is limited and operating the beds is expensive - the fixed costs for the hospital is 40.000 € per day, the costs per bed is an additional 500 €. The complete overview of costs can be found in Appendix I.

Shouldice receives patients from two main flows: the elective patients diagnosed in advance need only three days for recovery; and the emergency patients whose immediate unclear diagnosis prolongs the stay of some. The second stream of patients involves patients of three groups based on their length of recovery and thus stay in the hospital, during which they occupy hospital beds. Group I needs three days for recovery, group II needs four days for recovery and group III needs five days for recovery. The number of incoming patients from each of these groups varies. There are between 8 to 12 patients of group I per day, 6 to 14 patients of group II, and 5 to 15 patients of group III; all assumed to be uniformly distributed.

In the course of this report, we use the information we have to build a simulation model that provides us with an idea of how metrics change given different business decisions while taking into account the operational limitations that allow for capacity adjustments only by a factor of 10. Several structural adjustments such as changing the fixed patient inflow, bed capacity, the number of extra operations (over the standard 60 per day), and employing a diagnosis team are tested for in the simulation. Our simulations, in the end, allow us to give concrete recommendations to the hospital board on how to maximise profit.

Base Simulation Model

We use Microsoft Excel to define our simulation model and calculate probabilistic outcomes given different business decisions. The simulation model depicts monthly processes and financial flows of Shouldice. A period of 36 days is simulated, of which five days are defined as lead time to get proper numbers on recovery patients for the 31 remaining days, which illustrate one month of business operations. The simulation model takes care of both surgery and recovery capacities and their financial implications. Assuming that the number of patients of type I, II and III are uniformly distributed, we use a fair random number generator and do 1,000 replications to ensure that our findings hold (and be stable) in the long run. Thus, we know the daily inflow of patients and its implication on surgery and bed capacity, revenue and variable costs probabilistically. While the surgery capacity needed is simply the aggregation of a day's incoming patients, recovery beds needed is the sum of all recovery patients from that day and the day before, minus all patients that finish their recovery by that day. We calculate the maximal business profit (revenue minus the sum of fixed costs and variable costs; the average on 1,000 replications) given a variable number of beds using Microsoft Excel Solver. The base model is visualised in Appendix II.

Findings

We run the simulation (the base simulation model) based on current patient inflows and the current capacity of 240 beds. It appears that under these circumstances, the average monthly profit the hospital would generate is likely to be negative (-66.881.40 € on average). Using Microsoft Excel Solver, we simulate and search for an optimal business model that maximises profit by changing the hospital's capacity under several modelled circumstances. We simulate the conditions 1000 times, using random inputs for incoming patients of different categories - elective patients, type I, II and III patients. It appears that the optimal number of beds is 210, which contributes to a monthly profit of 231,230.80 € on average. More details of this simulation can be found in Appendix III.

However, the base model does not account for the maximum number of 15 extra recovery beds available to patients on a daily basis. According to the information we have, it is not possible to exceed this number of patients. When taking the operational limitation of a maximum of 15 beds extra while maximising business profits, using Microsoft Excel Solver, we find that employing 240 beds is the most profitable option. In 1,000 replications of month simulations, we had not to reject a single patient (see Appendix IV). That means the hospital could guarantee a service level agreement that at least 99.997 % of the days, all incoming patients could be taken care of without exceeding the max capacities a single time. The remaining 0.003 % is due to chance, and as we have only statistically estimated figures, absolute certainty cannot be reached, only maximised. However, we know that operating 240 beds is not profitable. One strategy to tackle this issue would be to lower the service level and take into account rejecting patients in order to maximise profit (see Figure 1). However, we would need more information on concrete costs of rejecting a patient to build a cost-sensitive model. If the hospital accepts to reject a tiny number of patients with decreasing bed capacity, profits will increase sharply (see Figure 1). Also, the hospital could team up with other hospitals to share patients with and have a more balanced patient inflow.

Beds	**Service Level**	**Profit**
240	> 99.997 % of the days	-66.881.40 €
230	99.997 % of the days	24.777.22 €
220	99.787 % of the days	150,860.54 €

Figure 1: Service levels given amount of beds for 1000 months

However, suppose the inflow of elective patients changed from 30 patients fixed to 30 on average. In that case, the average monthly profit of Shouldice could be increased (and be positive) even under the operational constraints. The number of beds needed to reach the maximum average monthly profit is 230 beds, as we found in the simulations performed (see Appendix IV). With this number of beds and the maximum number of surgeries performed in one day being 62, the average monthly profit obtained in 1000 simulations increased to 81,211 € (see Appendix V). This is because the number of beds, which costs the hospital the most, could be lowered, and the beds could be used more effectively. Instead of fixing the number of elective patients to 30 per day, some days, more than 30 elective patients could be scheduled for surgery. This strategy would compensate for higher numbers with a lower intake of elective patients on a different day, which would depend on the number of emergency patients taken. Emergency patients can not be scheduled. Thus it is harder to optimise their length of stay and plan beds based on them. However, on days with a lower intake of emergency patients, the number of elective patients can be increased since it is the hospital that schedules the elective operations. This allows for more efficient use of hospital beds.

Shouldice has the option to employ a diagnosis team that costs 2,000 € per day. This team allows the hospital to diagnose patients more precisely, with 80 % accuracy. It thus lowers their recovery period, which is especially important for the patient groups II and III, who would typically need 4 and 5 days respectively to recover and occupy the beds that could otherwise be used to take care of other patients. We ran the simulation with this option with the optimal number of extra surgeries, which was 2. Employing a diagnosis team would significantly increase the profit of Shouldice since the length of stay, which is the most costly aspect, would be minimised for 80 % of the emergency patients. While some patients would still stay for 4 and 5 days, the number of them decreases significantly. The average monthly profit we found in our simulation could be around 540,327 €, while lowering the number of beds to 190 (see Appendix VI). The option of employing a diagnosis team is thus a very profitable decision Shouldice could undertake if the depreciation on the investment in the team's equipment is lower than 459,116 € a month (difference of simulated profit with the team to simulated profit without the team; not taking into account interest rates).

Conclusion and Managerial Implications

We recommend the hospital to employ a diagnosis team that is able to determine the diagnosis of patients in advance and thus lowers their recovery time to 3 days for all the incoming patient groups with an accuracy of 80 % if the investment in the team's equipment is moderate. Moreover, we advise not fixing the inflow of elective patients to 30 patients per day, rather than keeping the inflow at 30 patients per day on a monthly average. Additionally, we advise Shouldice to keep the maximum number of surgeries at 62 at most and not go beyond this number of surgeries as it would result in lower profits. Our simulations were performed with a service level of 99.997 % in mind, yet, we could not account for all cases that can happen in real life, although we ran 1000 simulations of each model. This limitation should be kept in mind when making decisions. The hospital could also evaluate the concrete costs of rejecting patients because profits could increase with lowering capacity. Although our simulated models are highly accurate and depict highly probable scenarios, complete certainty could not be reached due to an element of randomness in human health and resulting patient inflows. Also, we highly recommend determining the actual costs of rejecting a patient since this information could help build more profitable models.

Appendix

Appendix I - Overview of Costs

Overall Costs: Surgery Costs and Recovery Costs Combined			
Standard Surgery Capacity	60 / day	Cost per Standard Surgery	2,000 €

Extra Surgery	> 60 / day	Cost per extra surgery	3,000 €
Standard Recovery Capacity	240 beds	Overall Standard Recovery Costs	160,000 € / day
Extra Recovery Capacity	max. 15 beds	Recovery Cost per Extra Bed	1,400 €
Recovery Capacity Modification Possibility		minus 5000 € per day for ten beds	

Appendix II - Base Model

We simulate the numbers of incoming patients by using values: 30 for elective patients for each day. We generate random numbers within a range representing the unknown incoming patients of group I, II and III. The amount of incoming patients from group I is simulated by generating a random number between 8 and 12: RANDBETWEEN(8;12), standing for prior statistical findings that the amount of incoming patients from this group varies between 8 to 12 per day. Similarly, the amount of incoming patients from group II is obtained by generating a random number between 6 and 14: RANDBETWEEN(6;14). Group III patient inflow is simulated likewise, using a random number between 5 and 15: RANDBETWEEN(5;15).

Number of beds needed for each day is calculated as a sum of surgeries for both elective and emergency patients (Surgeries total) and beds needed from the previous day, minus the patients who are leaving that day. E.g. Beds needed for one day (for representation) were calculated as J28+I29-D26-E26-F25-G24, where J28 is the sum of surgeries performed that day and I29 is the amount of beds from the previous day. D26 refers to the number of elective patients who are leaving that day (they completed their 3-day recovery on that day), E26 refers to emergency patients from group I (completed their 3-day recovery), F25 are the group II patients (completed their 4-day recovery), and G24 are the group III patients (completed their 5-day recovery on that day).

Excess refers to the total number of surgeries performed that day minus the standard (60 surgeries). Costs are calculated using information provided based on the amount of surgeries and beds for recovery. Costs for surgeries (example for a simulated day 6) is thus calculated using the formula IF(I29<=60;I29*2000;120000+H29*1000) - where I29 refers to the total surgeries that day and H29 is the excess for that day. This allows us to distinguish between surgeries that cost the standard 2,000 eur (are under the limit of 60) and extra surgeries that are more costly. Costs for recovery is also calculated with extra beds costing more in mind, using the formula for a sample simulation day: 160000-(240-$C$2)*500+IF(J29>$C$2;(J29-$C$2)*1400;0), where C2 refers to the cell with the number of total beds in the hospital; and J29 is the Beds needed for that day. Similarly, Revenue is calculated as the number of total surgeries that day times 4600. Lastly, Profit is calculated as Revenue minus costs (for both surgeries and recovery).

Days	Elective patients 3 da	3 days	4 days	5 days	Excess	Surgeries Total	Beds needed	Costs (surgeri	Costs (recovery)	Revenue	Profit
1	30	11	12	10	3	63	63	€ 123 000,00	€ 160 000,00	€ 289 800,00	€ 6 800,00
2	30	10	10	12	2	62	125	€ 122 000,00	€ 160 000,00	€ 285 200,00	€ 3 200,00
3	30	11	6	10	-3	57	182	€ 114 000,00	€ 160 000,00	€ 262 200,00	-€ 11 800,00
4	30	8	6	14	-2	58	199	€ 116 000,00	€ 160 000,00	€ 266 800,00	-€ 9 200,00
5	30	10	12	10	2	62	209	€ 122 000,00	€ 160 000,00	€ 285 200,00	€ 3 200,00
6	30	8	8	8	-6	54	202	€ 108 000,00	€ 160 000,00	€ 248 400,00	-€ 19 600,00
7	30	9	6	14	-1	59	205	€ 118 000,00	€ 160 000,00	€ 271 400,00	-€ 6 600,00
8	30	9	10	11	0	60	209	€ 120 000,00	€ 160 000,00	€ 276 000,00	-€ 4 000,00
9	30	9	11	8	-2	58	203	€ 116 000,00	€ 160 000,00	€ 266 800,00	-€ 9 200,00
10	30	10	13	15	8	68	214	€ 128 000,00	€ 160 000,00	€ 312 800,00	€ 24 800,00
11	30	8	9	12	-1	59	220	€ 118 000,00	€ 160 000,00	€ 271 400,00	-€ 6 600,00
12	30	11	11	14	6	66	223	€ 126 000,00	€ 160 000,00	€ 303 600,00	€ 17 600,00
13	30	12	7	15	4	64	225	€ 124 000,00	€ 160 000,00	€ 294 400,00	€ 10 400,00
14	30	9	7	15	1	61	227	€ 121 000,00	€ 160 000,00	€ 280 600,00	-€ 400,00
15	30	8	11	11	0	60	222	€ 120 000,00	€ 160 000,00	€ 276 000,00	-€ 4 000,00
16	30	8	6	5	-11	49	206	€ 98 000,00	€ 160 000,00	€ 225 400,00	-€ 32 600,00
17	30	9	10	14	3	63	209	€ 123 000,00	€ 160 000,00	€ 289 800,00	€ 6 800,00
18	30	9	7	6	-8	52	201	€ 104 000,00	€ 160 000,00	€ 239 200,00	-€ 24 800,00
19	30	8	11	15	4	64	201	€ 124 000,00	€ 160 000,00	€ 294 400,00	€ 10 400,00
20	30	10	14	10	4	64	209	€ 124 000,00	€ 160 000,00	€ 294 400,00	€ 10 400,00
21	30	11	14	9	4	64	219	€ 124 000,00	€ 160 000,00	€ 294 400,00	€ 10 400,00
22	30	9	14	6	-1	59	219	€ 118 000,00	€ 160 000,00	€ 271 400,00	-€ 6 600,00
23	30	12	12	12	6	66	228	€ 126 000,00	€ 160 000,00	€ 303 600,00	€ 17 600,00
24	30	8	6	15	-1	59	217	€ 118 000,00	€ 160 000,00	€ 271 400,00	-€ 6 600,00
25	30	11	14	11	6	66	220	€ 126 000,00	€ 160 000,00	€ 303 600,00	€ 17 600,00
26	30	9	6	12	-3	57	212	€ 114 000,00	€ 160 000,00	€ 262 200,00	-€ 11 800,00
27	30	8	7	13	-2	58	214	€ 116 000,00	€ 160 000,00	€ 266 800,00	-€ 9 200,00
28	30	11	9	9	-1	59	214	€ 118 000,00	€ 160 000,00	€ 271 400,00	-€ 6 600,00
29	30	9	9	14	2	62	208	€ 122 000,00	€ 160 000,00	€ 285 200,00	€ 3 200,00
30	30	11	13	5	-1	59	212	€ 118 000,00	€ 160 000,00	€ 271 400,00	-€ 6 600,00
31	30	8	6	8	-8	52	204	€ 104 000,00	€ 160 000,00	€ 239 200,00	-€ 24 800,00
32	30	8	12	14	4	64	207	€ 124 000,00	€ 160 000,00	€ 294 400,00	€ 10 400,00
33	30	10	8	11	-1	59	207	€ 118 000,00	€ 160 000,00	€ 271 400,00	-€ 6 600,00
34	30	12	14	6	2	62	204	€ 122 000,00	€ 160 000,00	€ 285 200,00	€ 3 200,00
35	30		12	15	-3	57	212	€ 114 000,00	€ 160 000,00	€ 262 200,00	-€ 11 800,00
36	30		12	8	-10	50	202	€ 100 000,00	€ 160 000,00	€ 230 000,00	-€ 30 000,00
										overall	-€ 66 000,00

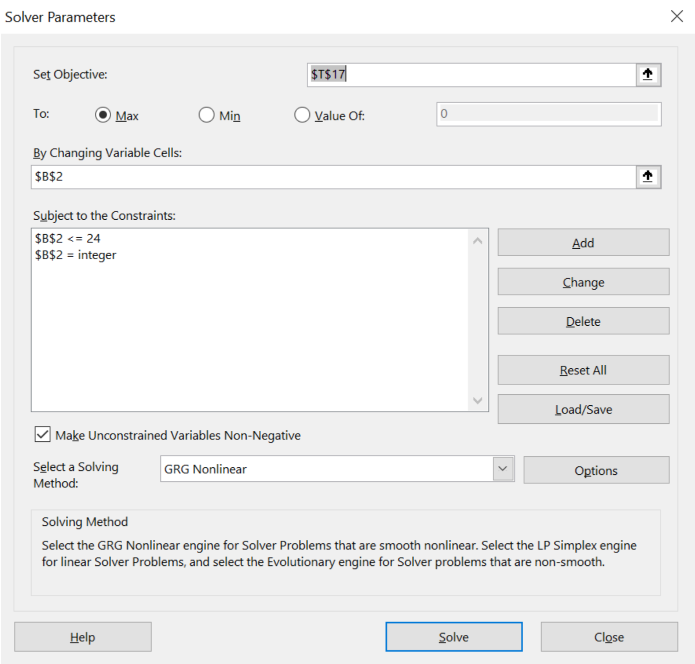
Base simulation model

	Profit Replications		Average Profit from Replications
	-€ 66 000,00		-€ 117 082,00
1	-€ 89 600,00		
2	-€ 113 800,00		
3	€ 48 200,00		
4	-€ 175 800,00		
5	-€ 203 400,00		
6	-€ 51 400,00		
7	-€ 42 200,00		
8	-€ 112 400,00		
9	-€ 155 000,00		
10	-€ 20 600,00		
11	-€ 145 200,00		
12	-€ 42 200,00		
13	-€ 265 000,00		
14	-€ 113 200,00		
15	-€ 178 200,00		

1000 replications on the simulation

Appendix III - Simulation on the Base Model

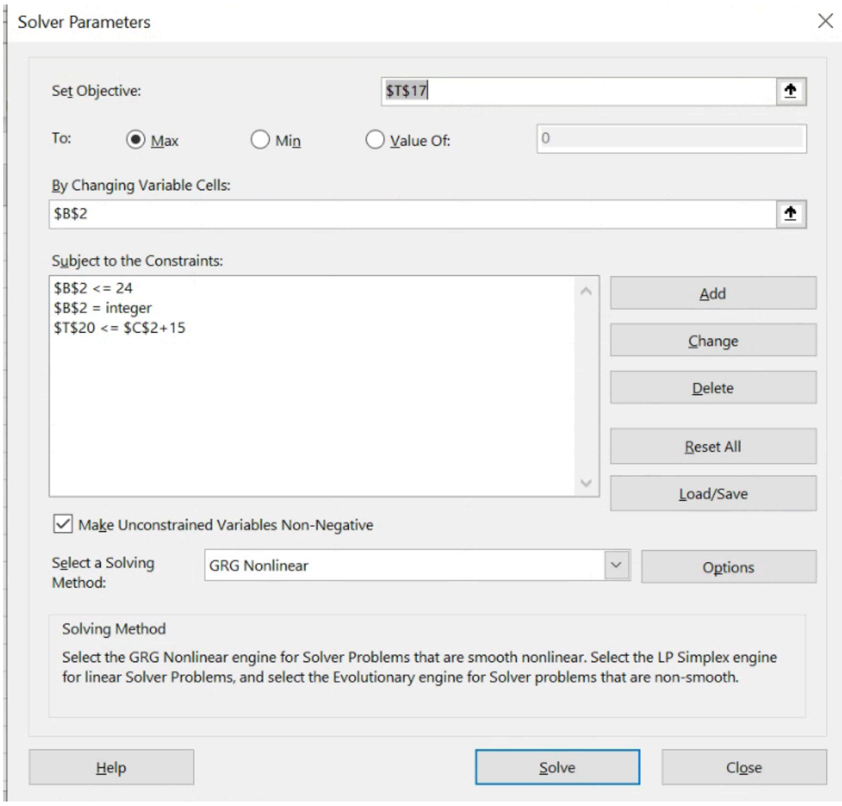
To simulate the current patient inflow without the restriction of exceeding the number of beds by more than 15, we run 1000 simulations to calculate the average profit Shouldice generates in all the simulations. We chose 1000 simulations as this was the number around which the law of big numbers started to apply more visibly, and the average profit seemed to average around the same figures. We used Microsoft Excel Solver to optimise the number of beds for the highest average profit. Average monthly profit is represented by the cell T17 in the Solver, and it is calculated as an average of profits generated in all the 1000 simulations. We maximize for the Average monthly profit by optimizing number of beds in 10s (changing variable cell B2; e.g. B2 would be 22 if number of beds is 220). This is done using several constraints in mind: the number of 10s of beds (B2) should not exceed 24 and it should be in integers to obtain the number of full beds.



Microsoft Excel Solver

Appendix IV - Constraint of Max Extra Beds

We account for the operational limitation by adding this constraint into the solver formula: the maximum number of beds (cell T20) must be smaller or equal to the optimised number of beds (cell C2) + 15, where 15 accounts for the operational constraint. The data used for optimisation - maximising profit - is the number of beds as measured by 10s since we can only make changes in bed capacity in 10s (cell B2).



Microsoft Excel Solver

Appendix V - Flexible Elective Patients

We account for the operational constraint of a maximum of 15 extra beds by the same condition in the Solver formula as before. In addition, we test for several excess surgeries options (surgeries over the limit of 60) to, in the end, determine how to distribute elective patients over a one month period.

Extra surgeries performed (Excess)	Capacity for daily average of elective surgeries based on one simulation
60	29,38709677
60+1	29,90322581
60+2	30
60+3	30

Extra surgeries performed per day

The calculation of how many elective patients we take on a certain day is being calculated by the following formula:

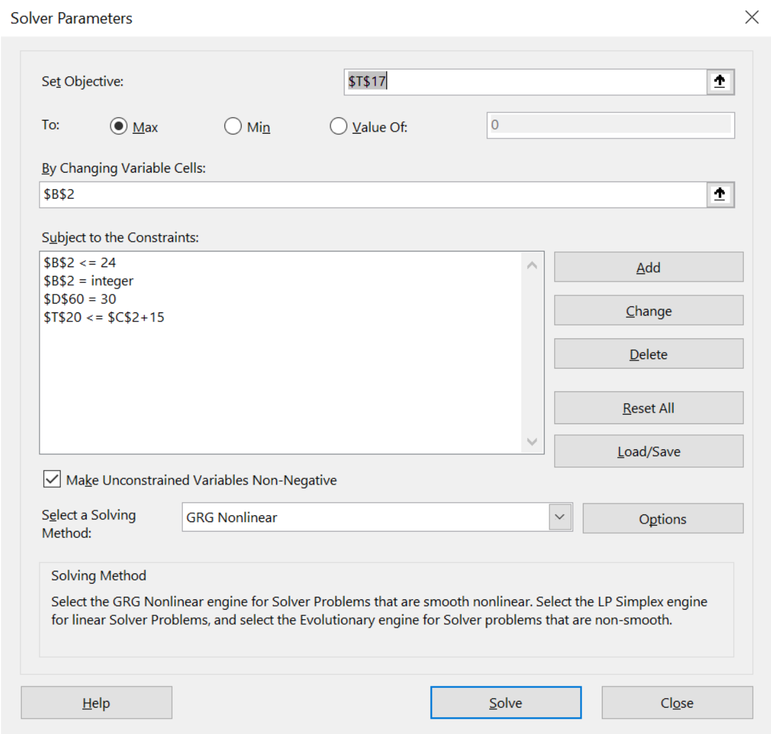
=IF(SUM($D$29:D34)>=930;0;MIN(MIN(($C$2+15-(J34-G30-F31-E32-D32+E35+F35+G35));61-G35-F35-E35);930-SUM($D$29:D34)))

for cell D35. Where cell C2 refers to the overall number of beds in the hospital.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
21														
22														
23	Simulation		Days	Elective patients 3 da	3 days	4 days	5 days	Excess	Surgeries Total	Beds needed	Costs (surgeri	Costs (recovery)	Revenue	Profit
24			1	30	8	13	5	-4	56	56	€ 112 000,00	€ 155 000,00	€ 257 600,00	-€ 9 400,00
25			2	30	11	8	15	4	64	120	€ 124 000,00	€ 155 000,00	€ 294 400,00	€ 15 400,00
26			3	30	8	12	6	-4	56	176	€ 112 000,00	€ 155 000,00	€ 257 600,00	-€ 9 400,00
27			4	30	11	6	14	1	61	199	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
28			5	30	8	14	13	5	65	210	€ 125 000,00	€ 155 000,00	€ 299 000,00	€ 19 000,00
29			6	32	11	8	10	1	61	220	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
30			7	33	12	6	10	1	61	213	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
31			8	28	12	13	8	1	61	224	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
32			9	30	11	10	10	1	61	214	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
33			10	27	12	14	8	1	61	209	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
34			11	29	9	11	12	1	61	214	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
35			12	27	10	14	10	1	61	211	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
36			13	23	9	14	15	1	61	215	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
37			14	35	8	7	11	1	61	214	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
38			15	30	12	11	8	1	61	219	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
39			16	31	10	12	8	1	61	222	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
40			17	27	11	11	12	1	61	216	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
41			18	31	11	13	6	1	61	213	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
42			19	31	9	8	13	1	61	211	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
43			20	33	8	11	9	1	61	214	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
44			21	39	8	9	5	1	61	214	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
45			22	38	8	7	8	1	61	210	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
46			23	36	12	8	5	1	61	216	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
47			24	30	11	11	9	1	61	206	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
48			25	31	10	13	7	1	61	203	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
49			26	34	9	6	12	1	61	204	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
50			27	40	10	6	5	1	61	208	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
51			28	28	8	13	12	1	61	212	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
52			29	30	11	8	12	1	61	208	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
53			30	32	10	12	7	1	61	206	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
54			31	34	9	12	6	1	61	213	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
55			32	37	10	8	6	1	61	215	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
56			33	22	11	13	15	1	61	214	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
57			34	38	9	9	5	1	61	208	€ 121 000,00	€ 155 000,00	€ 280 600,00	€ 4 600,00
58			35	14	10	6	6	-24	36	178	€ 72 000,00	€ 155 000,00	€ 165 600,00	-€ 61 400,00
59			36	0	10	6	8	-36	24	155	€ 48 000,00	€ 155 000,00	€ 110 400,00	-€ 92 600,00
60				30					Max beds need	224		€ 155 000,00	overall	-€ 25 200,00
61														

Adapted base model with the amount of elective patients being calculated on current circumstances

We use Excel Solver using a similar formula as before, adding the constraint of an average of 30 elective patients per month (cell D60 = 30; where D60 is calculated as the average of all the elective patients in that month).



Excel Solver

Appendix VI - Diagnosis Team

Using the same setting for Microsoft Excel Solver as above, with extra surgeries optimized for maximum of 62 surgeries per day, we account for employing the diagnosis team by changing the simulated number of emergency patients in different groups. With 80% correct diagnosis of the team, the patients stay only 3 days instead of more. This means, that there are more group I patients and less group II and III patients. We simulate the situation by changing the calculation of number of patients for groups I, II and III:

Group I - patients who stay 3 days:

ROUND(RANDBETWEEN(8;12)+RANDBETWEEN(6;14)*80%+RANDBETWEEN(5;15)*80%;0)

Group II - patients who stay 4 days:

ROUND(RANDBETWEEN(6;14)*20%;0)

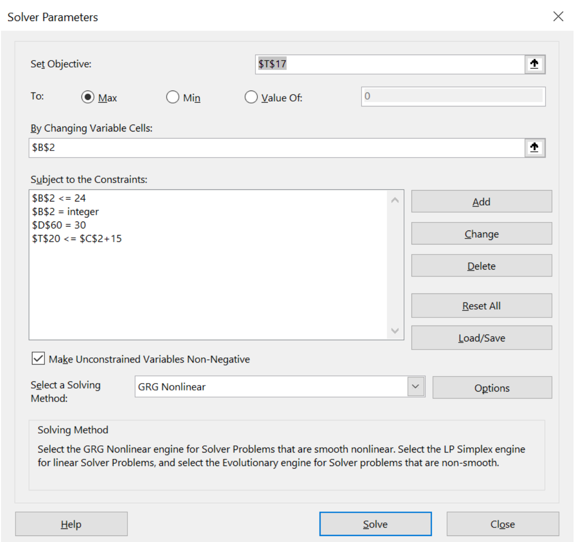
Group III - patients who stay 5 days:

=ROUND(RANDBETWEEN(5;15)*20%;0)

This in turn changes the costs for recovery and average monthly profit. Using Solver with the new estimation of incoming patient distribution, we obtain the highest Average monthly profit by optimizing the number of beds (in 10s) for the diagnosis team scenario.

Days	Elective patients 3 da	3 days	4 days	5 days	Excess	Surgeries Total	Beds needed	Costs (surgerie	Costs (recovery)	Revenue	Profit
1	30	22	2	2	-4	56	56	€ 112 000,00	€ 135 000,00	€ 257 600,00	€ 10 600,00
2	30	25	2	3	0	60	116	€ 120 000,00	€ 135 000,00	€ 276 000,00	€ 21 000,00
3	30	23	2	1	-4	56	172	€ 112 000,00	€ 135 000,00	€ 257 600,00	€ 10 600,00
4	30	24	1	2	-3	57	177	€ 114 000,00	€ 135 000,00	€ 262 200,00	€ 13 200,00
5	30	31	3	3	7	67	187	€ 127 000,00	€ 135 000,00	€ 308 200,00	€ 46 200,00
6	34	25	2	1	2	62	192	€ 122 000,00	€ 139 800,00	€ 285 200,00	€ 23 400,00
7	31	27	2	2	2	62	195	€ 122 000,00	€ 144 000,00	€ 285 200,00	€ 19 200,00
8	32	25	2	3	2	62	194	€ 122 000,00	€ 142 600,00	€ 285 200,00	€ 20 600,00
9	30	27	2	3	2	62	192	€ 122 000,00	€ 139 800,00	€ 285 200,00	€ 23 400,00
10	35	23	2	2	2	62	191	€ 122 000,00	€ 138 400,00	€ 285 200,00	€ 24 800,00
11	39	19	1	3	2	62	193	€ 122 000,00	€ 141 200,00	€ 285 200,00	€ 22 000,00
12	32	25	3	2	2	62	194	€ 122 000,00	€ 142 600,00	€ 285 200,00	€ 20 600,00
13	30	28	2	2	2	62	193	€ 122 000,00	€ 141 200,00	€ 285 200,00	€ 22 000,00
14	34	24	2	2	2	62	192	€ 122 000,00	€ 139 800,00	€ 285 200,00	€ 23 400,00
15	33	24	2	3	2	62	194	€ 122 000,00	€ 142 600,00	€ 285 200,00	€ 20 600,00
16	33	25	2	2	2	62	192	€ 122 000,00	€ 139 800,00	€ 285 200,00	€ 23 400,00
17	37	22	2	1	2	62	192	€ 122 000,00	€ 139 800,00	€ 285 200,00	€ 23 400,00
18	35	25	1	1	2	62	193	€ 122 000,00	€ 141 200,00	€ 285 200,00	€ 22 000,00
19	34	26	1	1	2	62	193	€ 122 000,00	€ 141 200,00	€ 285 200,00	€ 22 000,00
20	31	27	2	2	2	62	191	€ 122 000,00	€ 138 400,00	€ 285 200,00	€ 24 800,00
21	34	24	2	2	2	62	189	€ 122 000,00	€ 137 000,00	€ 285 200,00	€ 26 200,00
22	34	25	2	1	2	62	189	€ 122 000,00	€ 137 000,00	€ 285 200,00	€ 26 200,00
23	31	27	3	1	2	62	191	€ 122 000,00	€ 138 400,00	€ 285 200,00	€ 24 800,00
24	33	26	2	1	2	62	192	€ 122 000,00	€ 139 800,00	€ 285 200,00	€ 23 400,00
25	35	24	2	1	2	62	191	€ 122 000,00	€ 138 400,00	€ 285 200,00	€ 24 800,00
26	33	25	1	3	2	62	191	€ 122 000,00	€ 138 400,00	€ 285 200,00	€ 24 800,00
27	29	29	2	2	2	62	190	€ 122 000,00	€ 137 000,00	€ 285 200,00	€ 26 200,00
28	37	22	1	2	2	62	190	€ 122 000,00	€ 137 000,00	€ 285 200,00	€ 26 200,00
29	34	22	3	3	2	62	191	€ 122 000,00	€ 138 400,00	€ 285 200,00	€ 24 800,00
30	34	23	2	3	2	62	193	€ 122 000,00	€ 141 200,00	€ 285 200,00	€ 22 000,00
31	36	21	2	3	2	62	191	€ 122 000,00	€ 138 400,00	€ 285 200,00	€ 24 800,00
32	28	29	2	3	2	62	194	€ 122 000,00	€ 142 600,00	€ 285 200,00	€ 20 600,00
33	31	27	2	2	2	62	194	€ 122 000,00	€ 142 600,00	€ 285 200,00	€ 20 600,00
34	1	20	2	2	-35	25	157	€ 50 000,00	€ 137 000,00	€ 115 000,00	-€ 72 000,00
35	0	30	1	1	-28	32	127	€ 64 000,00	€ 137 000,00	€ 147 200,00	-€ 53 800,00
36	0	27	2	2	-29	31	95	€ 62 000,00	€ 137 000,00	€ 142 600,00	-€ 56 400,00
	30					Max beds need	195		€ 142 000,00	overall	€ 445 400,00

Adapted base model to the diagnosis team; added fixed costs of the team and moved 80 % of the patients to 3 days recovery period



Excel Solver