Lecture Notes

Optimisation

Optimisation Application Areas

Optimisation is nothing but utilisation of the resources at hand in the best possible manner. Because of its ubiquitous nature, it is an indispensable tool in businesses and finds application in the following areas:

- Minimising cost
- Maximising profit
- Minimising error
- Design optimisation
- Management optimization

Some of the relevant industry examples where optimization is used are:

- Google AdWords bidding
- Airlines revenue management
- Project estimate based on NPV (Net Present Value)

Optimisation Terminologies

You learnt about the following terms related to optimisation:

- **Objective Function:** It essentially explains the entity that we want to maximise or minimise as per the given business situation.
- **Decision Variables:** These are the quantities that the decision-makers control to optimise the objective function.
- **Constraints:** These are the restrictions that we put on the decision variables to limit the values that they can take.
- **Sensitivity Analysis**: It is a comparison of the different optimal solutions that you would obtain for different constraints.

Optimisation in Excel

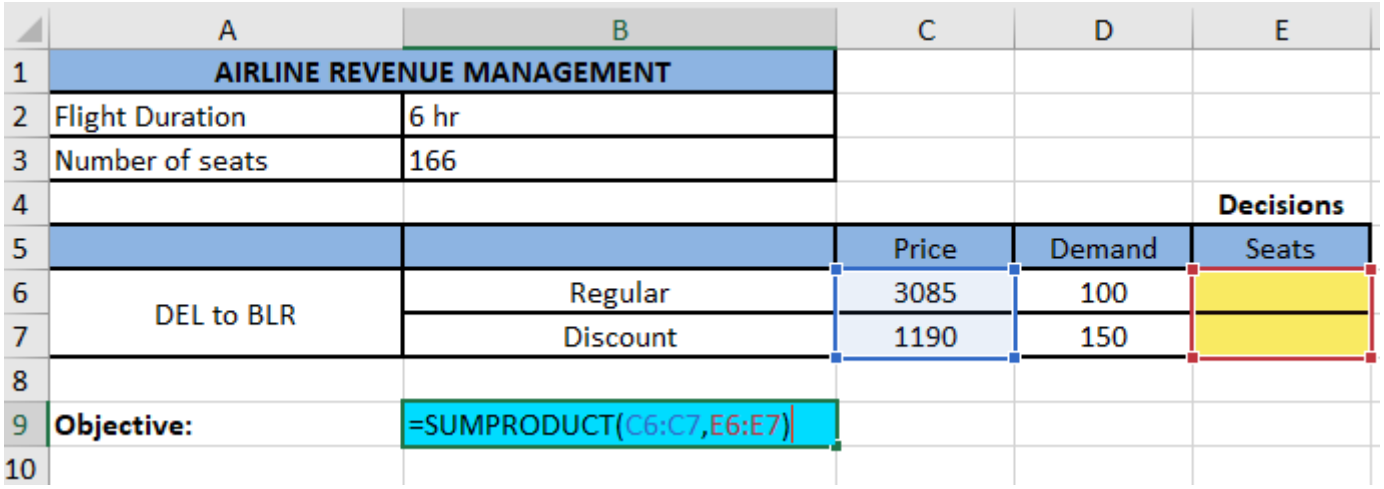
Next, you solved a simple optimization problem using Excel.

The problem at hand was that the airline company XYZ wanted to maximise its revenue for a particular Delhi to Bangalore flight by allocating the regular and discounted seats judiciously. The prices of the tickets are:

- Discounted: 1190 INR
- Regular (Non-Discounted): 3085 INR

Your objective function for this problem thus became **3085x + 1190y**.

You saw that using the **SUMPRODUCT()** function, you could simply implement the function '3085x + 1190y' in Excel.



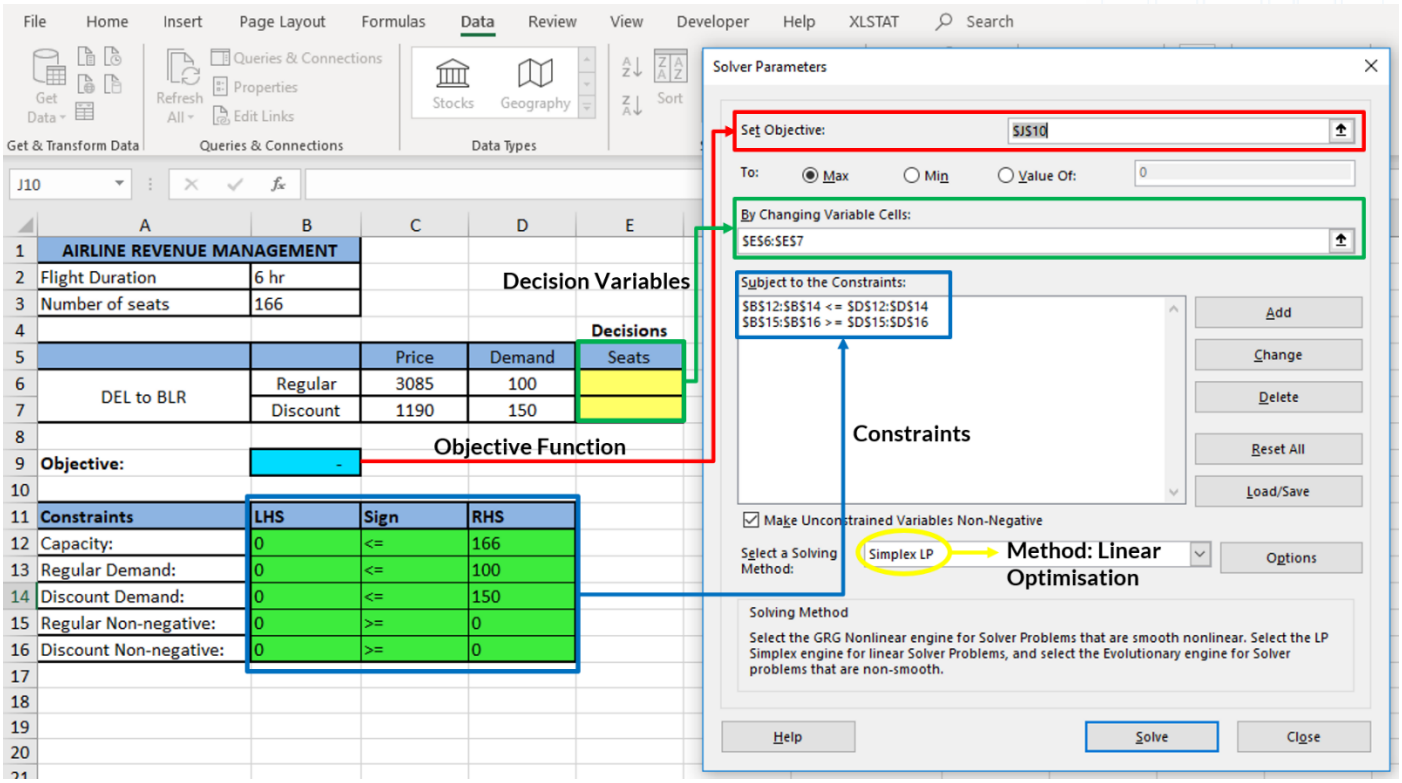
	A	B	C	D	E
1	AIRLINE REVENUE MANAGEMENT				
2	Flight Duration	6 hr			
3	Number of seats	166			
4					Decisions
5			Price	Demand	Seats
6	DEL to BLR	Regular	3085	100	
7		Discount	1190	150	
8					
9	Objective:	=SUMPRODUCT(C6:C7,E6:E7)			
10					

The cells C6 and C7 contain the price of the regular and discounted tickets respectively. The cells E6 and E7 are the ones where we will fill in the seats that we decide to allocate in order to get the optimal revenue. Basically, these cells are the decision variables, i.e., the variables that need to be changed to arrive at the optimal solution.

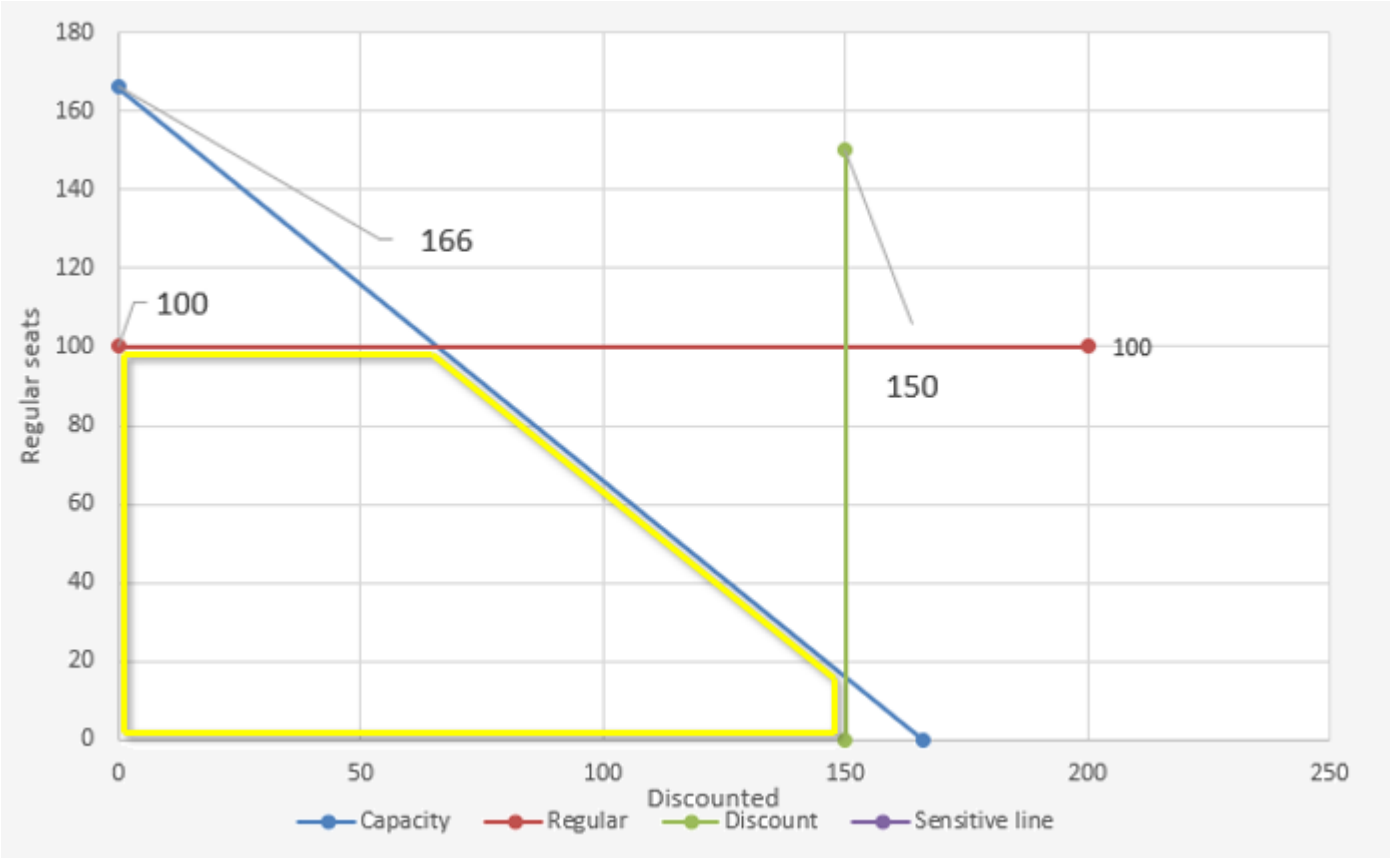
Then you filled in the constraints in Excel in the following format of LHS, sign, and RHS.

Constraints	LHS	Sign	RHS
Capacity:	0	<=	166
Regular Demand:	0	<=	100
Discount Demand:	0	<=	150
Regular Non-negative:	0	>=	0
Discount Non-negative:	0	>=	0

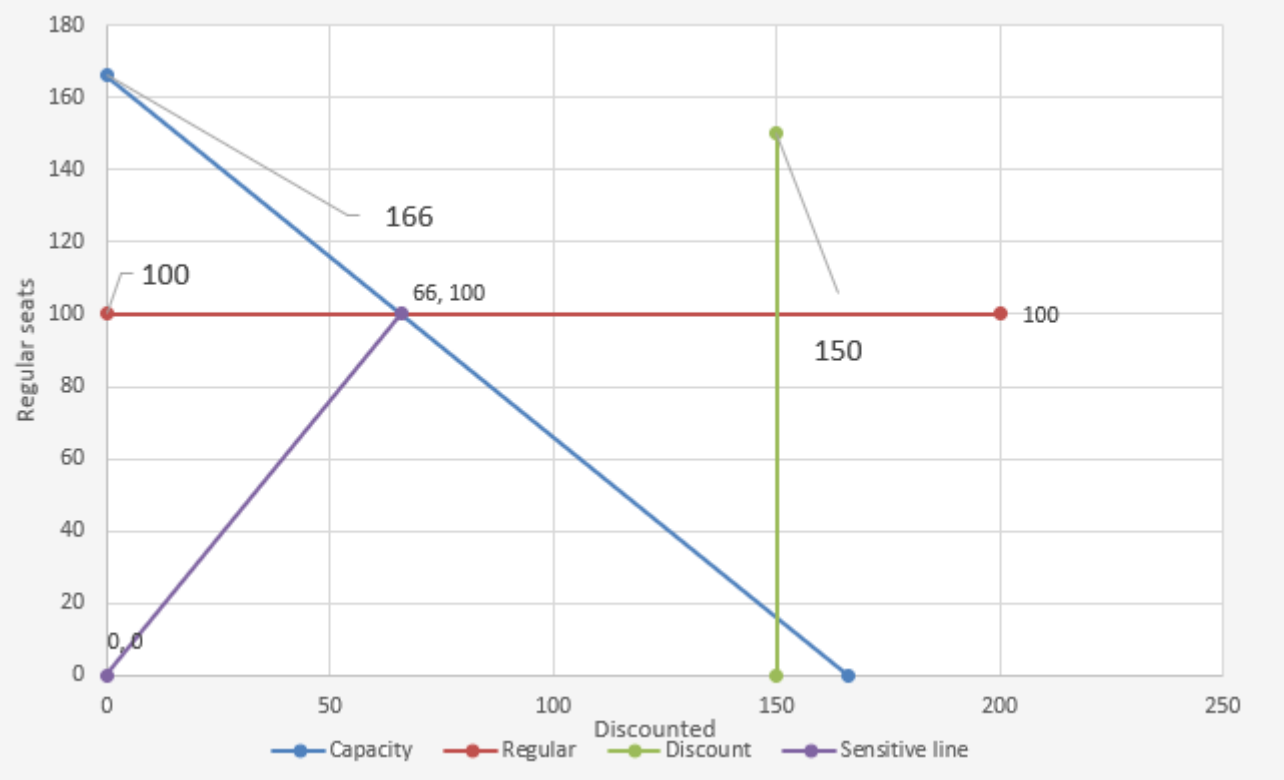
Finally, once you had all the data in the Excel in a proper format, you input all this information in the Solver as shown below.



Finally, you saw how you can visualise the constraints and results of the graph.



The yellow polygon highlights the feasible solution region in the graph. And in the graph below, the purple line showcases the optimal solution.



Airline Revenue Optimisation – Sensitivity Analysis

You started off by performing a sensitivity analysis on the airline optimisation problem when marketing came into the picture. You understood that even though you would get the optimal revenue by selling all the tickets at a regular price, you wouldn't do it to lose out on a customer segment.

Next, you performed another sensitivity analysis - this time for different capacities. There you saw that the 166-seater gave you the maximum marginal revenue and the 218 seater gave you the maximum market share (since its capacity is the highest) along with a decent marginal revenue. You then understood that based on the business situation - increasing profitability or increasing the market share, you would make the appropriate decision.

Finally, you saw another example of connecting flight where the flight from Delhi to Bangalore had a stop at Mumbai and understood that the main skill to have while solving any optimisation problem is the ability to define the objective function, identify the decision variables, and formulate the constraints.

You should be able to:

- Understand the terminologies related to optimisation
- Understand the objective function, identify the decision variables, and formulate the constraints for any optimisation problem at hand
- Solve the optimisation problem in Excel using the Solver Add-in