**What Is a Mathematical Optimization Model?**

A “Mathematical Optimization Model” is like a digital twin of your real-world business situation; it mirrors your actual business landscape and encapsulates your unique business processes and problems in a software environment.

Technically speaking, a mathematical optimization model is a mathematical representation of your real-world business problem that is made up of three key features:

**• Decision Variables**: The decisions that you have to make.

**• Constraints**: The business rules that you have to follow.

**• Business Objectives**: The various (and often conflicting) business goals you are aiming to achieve.

Diagram

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To give you an example that is particularly relevant today, a hospital network which has a business problem such as equipment and facility capacity planning during the Covid-19 pandemic could create a model that captures that business problems:

• Decision variables would be like which medical equipment, testing kits, PPE and ventilators to distribute to which hospitals and which ICU wards, beds and operating theatres to allocate to which patients.

• Constraints also would be like conventional, contingency and crisis capacity levels for PPE across the hospital network and regulations regarding which wards and beds need to be reserved for patients with various conditions.

• Business objectives would be like maximizing resource utilization and service-level performance while minimizing operating costs.

This hospital network’s model would probably have millions or more decision variables and constraints, and these inputs could be adjusted at any time to accommodate the changing conditions of the operating environment and shifts in supply and demand dynamics.

There are countless other challenging and critical business problems today, from food production to shipment routing to electric power generation and transmission to classroom seating assignments (while respecting social distancing), that can be captured in mathematical optimization models.

A mathematical optimization model is a dynamic digital representation of your current business situation, encompassing all the complexity and volatility that you are facing today.

**How Can a Mathematical Optimization Model Help You Handle Disruption?**

The act of defining your business problem as a mathematical optimization model can enable you to attain a greater awareness of your business conditions and challenges, but how can that model actually be used to help you deal with disruption? To do this, you need to feed your model up-to-date data and integrate it with a mathematical optimization solver that:

• Automatically processes the data and reads the model.

• Combs through and considers an astronomical number of possible solutions to your business problems.

• Finds the optimal solutions that you can use as the basis to make your business decisions.

With up-to-date data and a solver, a mathematical optimization model becomes much more than merely a representation of your business problem; it becomes an integral part of the solution to that problem.

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Description automatically generatedCombining these three elements (your model, your data and a solver) in a mathematical optimization application gives you the power to:

**• Visualize**: Get a 360-degree, bird’s-eye view over your operations and gain a deep understanding of the dynamics and disruptions present in your business landscape.

Diagram

Description automatically generated**• Analyse**: Explore various scenarios and gauge their potential impact on your business so you can identify risks and opportunities.

**• Decide**: Rapidly generate optimal solutions to your business problems and use those solutions to determine the course of action.

By fusing your model with a mathematical optimization solver and fuelling it with up-to-date data, you get visibility and control over your operational network. No matter how profoundly the business world changes, your mathematical optimization application has the flexibility and robustness to consistently deliver optimal solutions.

**Linear programming:**

In Mathematics, the linear programming method is for optimizing the operations with some constraints. The main point of linear programming is to minimize or maximize the numerical value. It also has the linear functions that are subjected to the constraints in the form of linear equations or in the form of linear inequalities.

Linear programming is considered an important technique which is used to find the optimum resource utilization. The terminology “linear programming” has two words “linear” and “programming”. The word “linear” talks about the relationship between multiple variables with degree one. The word “programming” on the other hand, talks about the process of selecting the best solution from different alternatives.

**An example of linear programming:**

Suppose a smaller decorating shop has:

300 litres of red paint, sells for £2.00 per litre

200 litres of blue paint, sells for £2.00 per litre

200 litres of green paint, sells for £2.00 per litre

and it also sells:

Brown paint (half red, quarter blue, quarter green) for £4.00 a litre.

Navy blue paint (half blue, quarter red, quarter green) for £5.00 a litre.

How can the shop maximise its income?

Now have 5 constraints

Amount of red 0.5x1 + 0.25x2 \_ 300

Amount of blue 0.25x1 + 0.5x2 \_ 200

Amount of green 0.25x1 + 0.25x2 \_ 200

Amount of brown x1 ≥ 0

Amount of navy blue x2 ≥ 0

Income is 1400 + 2x1 + 3x2

Because the function is linear, the function at any point in the allowed region can be expressed in terms of the function value at the corners.

**we only need to look at the corners!**

Graphical user interface

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So optimum is at point B, where red

and blue constraints meet.

2x1 + x2 = 1200

x1 + 2x2 = 800

Maximum income I is:

i.e. I = £2866.66.

**References:**

1. <https://www.forbes.com/>
2. <https://www.vedantu.com/>
3. <https://www-users.york.ac.uk/>