A Gentle Introduction of Mathematical Optimization for R users!

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What's mathematical optimization anyway?

"Optimization" comes from the same root as "optimal", which means best. When you optimize something, you are "making it best".

But "best" can vary. If you're a football player, you might want to maximize your running yards, and also minimize your fumbles. Both maximizing and minimizing are types of optimization problems.

Mathematical Optimization in the "Real World"

Mathematical Optimization is a branch of applied mathematics which is useful in many different fields. Here are a few examples:

- Manufacturing
- Production
- Inventory control
- Transportation
- Scheduling
- Networks
- Finance
- Economics
- Control engineering
- Marketing
- Policy Modeling
- Mechanics

Optimization Model Components

Your basic optimization problem consists of:

1. The objective function, $f(x)$, which is the output you're trying to maximize or minimize. e.g. maximize the gross profit margin; minimize travel distance of a pizza delivery car.
2. Variables, x_1, x_2, x_3 and so on, which are the inputs – things you can control.
3. Constraints, which are equations that place limits on how big or small some variables can get. e.g. The pizza delivery should be on time.

Optimization Example

A football coach is planning practices for his running backs.

- His main goal is to maximize running yards – this will become his objective function .
- He can make his athletes spend practice time in the weight room; running sprints; or practicing ball protection. The amount of time spent on each is a variable.
- However, there are limits to the total amount of time he has. Also, if he completely sacrifices ball protection he may see running yards go up, but also fumbles, so he may place an upper limit on the amount of fumbles he considers acceptable. These are constraints.

Note that the variables influence the objective function and the constraints place limits on the domain of the variables.

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Remark

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Important theorem

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Examples

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Two-column slide

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$$E = mc^2$$

- First item
- Second item

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