

MITOCW | MIT15_071S17_Session_9.4.03_300k

In this video, we'll design the optimization problem that the operating room manager would need to solve.

The decision to be made is how many operating rooms to assign each department on each day.

This means that we need to define integer decision variables x_{jk} .

x_{jk} will represent the number of operating rooms department j is allocated on day k .

So here j can take values such as ophthalmology, gynecology, general surgery, and so on.

Whereas k would take values like Monday, Tuesday, Wednesday, and so on.

The objective of this problem will be to maximize the percent of target allocation hours that each department is actually allocated.

So if target allocation hours are t_j for department j , then we want to maximize the sum of $8 \cdot x_{jk}$ divided by t_j over all departments and days of the week.

Let's break this down.

For example, if otolaryngology has a target of 37.3 hours per week-- that means t_j equals to 37.3-- and we allocate them 4 operating rooms, then their percent of target allocation hours is equal to 8 times 4, that is, they got 32 hours, divided by the 37.3 hours they asked for.

So they got 85.8% of what they wanted.

And we try to maximize this percentage value for every department.

So that's why we sum over all departments and all days of the week.

Let's continue on to the constraints.

Remember that Mount Sinai has 10 operating rooms.

Therefore, at most 10 operating rooms can be assigned on any given day.

Also, the number of operating rooms allocated to a department on a given day cannot exceed the number of surgery teams that the department has available that day.

And as we said before, we must meet department daily minimums and maximums as well as weekly minimums and maximums.

Let's turn these constraints into math.

So the first constraint is that at most 10 operating rooms can be assigned on any given day.

Let's consider Monday for example.

That means that x for ophthalmology on Monday plus x for gynecology on Monday plus x for oral surgery on Monday plus x for otolaryngology on Monday plus x for general surgery on Monday must add up to something less than or equal to 10.

We would have a similar constraint for Tuesday, Wednesday, Thursday and Friday.

The next set of constraints is that the number of operating rooms allocated to a department on a given day cannot exceed the number of surgery teams that are available that day.

So for example, for gynecology on Friday there are 3 teams available.

That means that x gynecology Friday must be between 0 and 3.

For oral surgery on Wednesday it must be between 0 and 0 because the oral surgeon is only in on Tuesdays and Thursdays.

The next set of constraints is that we must meet department daily minimums and maximums.

For example, the general surgery department on Tuesday requires between 0 and 6 operating rooms.

We would have a similar constraint for every department and for every day of the week.

We also need to meet department weekly minimums and maximums.

So for example, the ophthalmology department has a minimum of 3 and a maximum of 6 operating rooms that it needs in any given week.