How to write if else statement in Linear programming?

Asked 7 years, 1 month ago Modified 3 years, 9 months ago Viewed 36k times

10

How to write the following if-else condition in Linear Programming? If $a > b$ then $c = d$ else $c = e$

d, e are variables. How can we write a linear program without multiplying d and e with binary variables? But we can use binary variables.

$a, b, c, d, e > 0$

linear-programming mixed-integer-programming

Share Cite Follow

edited Mar 25, 2020 at 5:57
Lê Thành Đạt
4,256 3 11 29

asked Nov 1, 2017 at 21:23
Vinay
225 1 3 8

3 In general this can not be done in a pure continuous LP. You need binary variables to overcome the non-convexity in this construct. Some very special cases may not need binary variables. – Erwin Kalvelagen Nov 2, 2017 at 0:13

We can use binary variables but I don't want to multiply those binary variables with d or e because they too are variables in my problem. If we multiply binary variables with d or e the problem will lose linearity. – Vinay Nov 2, 2017 at 0:40

1 Answer

Sorted by: Highest score (default)

This can not be formulated as a linear programming problem. We need extra binary variables and end up with a MIP.

25

First we do:

$$a > b \iff \delta = 1$$

This can be formulated as:

$$\begin{aligned} a &\geq b + 0.001 - M(1-\delta) \\ a &\leq b + M\delta \\ \delta &\in \{0, 1\} \end{aligned}$$

(in practice I would drop the 0.001 term).

Next we do:

$$\begin{aligned} \delta = 1 &\implies c = d \\ \delta = 0 &\implies c = e \end{aligned}$$

This can be written as:

$$\begin{aligned} d - M(1-\delta) \leq c \leq d + M(1-\delta) \\ e - M\delta \leq c \leq e + M\delta \end{aligned}$$

Many modern MIP solvers have indicator constraints. This can make things easier as one can write implications directly without big-M constraints.

Share Cite Follow

edited Nov 2, 2017 at 8:41

answered Nov 2, 2017 at 8:22

Erwin Kalvelagen
4,327 ● 2 ■ 13 ▲ 16

1 @Erwin....how can we formulate, If a = b then c = d else c = e ? – Vinay Mar 24, 2020 at 18:19

In a similar way. Use something like $\delta = 0 \implies a = b, c = d$ and $\delta = 0 \implies a \neq b, c = e$. – Erwin Kalvelagen Mar 27, 2020 at 23:54

I was expecting something more like this – Vinay Mar 28, 2020 at 3:17