

Changes in RHS and Shadow Prices

- How much will GTC pay for an additional 100 hours of assembly time?
- How much will GTC pay for an additional 3 lb of steel?
- How much will GTC pay for an additional 5 lb of steel?
- How much profit will they lose if they only had 20 hours of molding?
- 17 hours of molding?

Parametric Programming

Yomota Automobiles make trucks (x_1) and cars (x_2), using body shop and paint shop labor. Paint shop workers can work at the body shop and vice versa.

$$\begin{aligned}
 \max \quad & 3x_1 + 2x_2 \\
 \text{s.t.} \quad & 1.5x_1 + x_2 \leq 60 + \theta \quad (\text{body shop}) \\
 & x_1 + x_2 \leq 50 - \theta \quad (\text{paint shop}) \\
 & x_1, x_2 \geq 0
 \end{aligned}$$

Final Tableau
when $\theta=0$:

Basic variables	Current values	x_1	x_2	x_3	x_4
z	120	0	0	2	0
x_1	20	1	0	2	-2
x_2	30	0	1	-2	3

Parametric Programming

What happens if Yomota swaps body shop and paint shop workers?

- Changing b_1 by $+\theta$ analogous to setting $x_3 = 0-\theta$
- Changing b_2 by $-\theta$ analogous to setting $x_4 = 0+\theta$

Final Tableau
when

Basic variables	Current values	x_1	x_2	x_3	x_4
z	$120+2\theta$	0	0	2	0
x_1	$20+4\theta$	1	0	2	-2
x_2	$30-5\theta$	0	1	-2	3

Parametric Programming

What if we increase θ to 6 ? (Take 6 paint shop workers to body shop)

Final Tableau
when $\theta \leq 6$:

Basic variables	Current values	x_1	x_2	x_3	x_4
z	$120+2\theta$	0	0	2	0
x_1	$20+4\theta$	1	0	2	-2
x_2	$30-5\theta$	0	1	-2	3



Basic variables	Current values	x_1	x_2	x_3	x_4
z	$+150-3\theta$	0	1	0	3
x_1	$50-\theta$	1	1	0	1
x_3	$-15+2.5\theta$	0	-1/2	1	-3/2

Parametric Programming

What if we decrease θ to -5 ? (Take 5 body shop workers to paint shop)

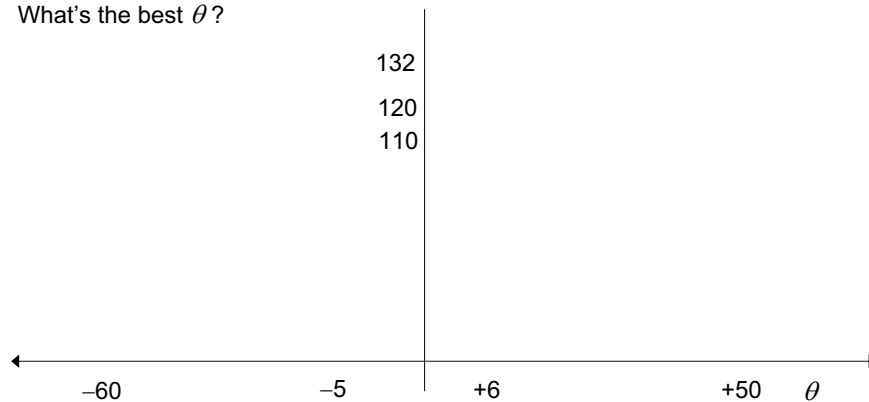
Final Tableau
when $\theta \geq -5$:

Basic variables	Current values	x_1	x_2	x_3	x_4
z	$120+2\theta$	0	0	2	0
x_1	$20+4\theta$	1	0	2	-2
x_2	$30-5\theta$	0	1	-2	3

Basic variables	Current values	x_1	x_2	x_3	x_4
z	$120+2\theta$	0	0	2	0
x_4	$-10-2\theta$	-1/2	0	-1	1
x_2	$60+\theta$	3/2	1	1	0

Parametric Programming

What's the best θ ?



Parametric Programming

Yomota's management want to consider changing the prices of cars

$$\begin{aligned} \max \quad & 3x_1 + (2 + \theta)x_2 \\ \text{s.t.} \quad & 1.5x_1 + x_2 \leq 60 \\ & x_1 + x_2 \leq 50 \\ & x_1, x_2 \geq 0 \end{aligned}$$

Final Tableau
when $\theta=0$:

Basic variables	Current values	x_1	x_2	x_3	x_4
z	120	0	0	2	0
x_1	20	1	0	2	-2
x_2	30	0	1	-2	3

Parametric Programming

For what values of θ is the current basis still feasible? optimal?

Basic variables	Current values	x_1	x_2	x_3	x_4
z	120+30θ	0	0	2-2 θ	3 θ
x_1	20	1	0	2	-2
x_2	30	0	1	-2	3

Parametric Programming

What happens if we increase θ ?

Basic variables	Current values	x_1	x_2	x_3	x_4
z	$120+30\theta$	0	0	$2-2\theta$	3θ
x_1	20	1	0	2	-2
x_2	30	0	1	-2	3

Basic variables	Current values	x_1	x_2	x_3	x_4
z	$100+50\theta$	$-1+\theta$	0	0	$2+\theta$
x_3	10	1/2	0	1	-1
x_2	50	1	1	0	1

Parametric Programming

What happens if we decrease θ ?

Basic variables	Current values	x_1	x_2	x_3	x_4
z	$120+30\theta$	0	0	$2-2\theta$	3θ
x_1	20	1	0	2	-2
x_2	30	0	1	-2	3

Basic variables	Current values	x_1	x_2	x_3	x_4
z	120	0	$-\theta$	2	0
x_1	40	1	2/3	2/3	0
x_4	10	0	1/3	-2/3	1

Parametric Programming

How does θ effect the optimal value?

