Find the Cheapest Menu!

	Food	Serv. Size	Energy (kcal)	Protein (g)	Calcium (mg)	Price (cents)	Max Serv.
x_1	Oatmeal	28g	110	4	2	3	4
x_2	Chicken	100g	205	32	12	24	3
x_3	Eggs	2 large	160	13	54	13	2
x_4	Whole Milk	237cc	160	8	285	9	8
x_5	Cherry Pie	170g	420	4	22	20	2
x_6	Pork w. beans	260g	260	14	80	19	2
	Min. Daily Amt.		2000	55	800		

Opt. Solution: $x_1 = 4, x_4 = 9/2, x_5 = 2$. Cost:92.5¢. (Chvatal–1980)

Linear Programming (LP) Formulation

$$
\begin{array}{ll}
\text{minimize} & 3x_1 + 24x_2 + 13x_3 + 9x_4 + 20x_5 + 19x_6 \\
\text{subject to} & 0 \le x_1 \le 4 \\
 & 0 \le x_2 \le 3 \\
 & 0 \le x_3 \le 2 \\
 & 0 \le x_4 \le 8 \\
 & 0 \le x_5 \le 2 \\
 & 0 \le x_6 \le 2
\end{array}
$$

$$
\begin{array}{rcl}
110x_1 + 205x_2 + 160x_3 + 160x_4 + 420x_5 + 260x_6 & \ge & 2000 \\
4x_1 + 32x_2 + 13x_3 + 8x_4 + 4x_5 + 14x_6 & \ge & 55 \\
2x_1 + 12x_2 + 54x_3 + 285x_4 + 22x_5 + 80x_6 & \ge & 800
\end{array}
$$

Her problem is known as a *diet problem.*