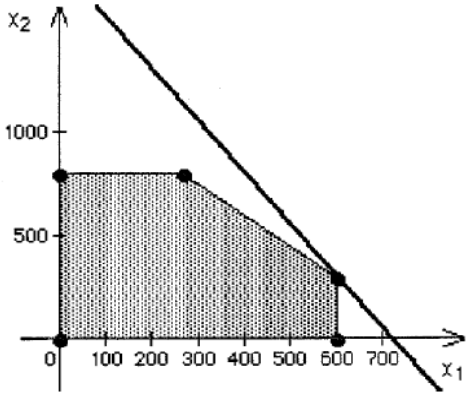
## 題號 3.1-9

**3.1-9.**

(a) Let $x_1$ be the number of units on special risk insurance and $x_2$ be the number of units on mortgages.

$$\begin{aligned} \text{maximize} \quad & z = 5x_1 + 2x_2 \\ \text{subject to} \quad & 3x_1 + 2x_2 \leq 2400 \\ & x_2 \leq 800 \\ & 2x_1 \leq 1200 \\ & x_1 \geq 0, x_2 \geq 0 \end{aligned}$$

(b) Optimal Solution: $(x_1^*, x_2^*) = (600, 300)$ and $Z^* = 3600$



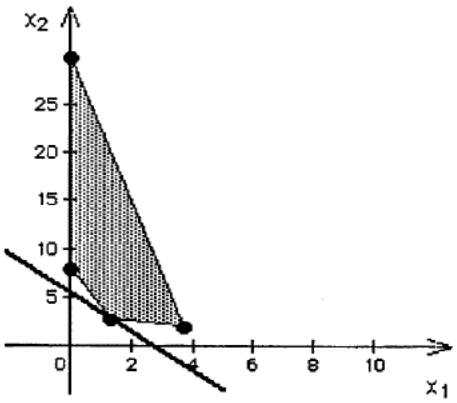

(c) The relevant two equations are $3x_1 + 2x_2 = 2400$ and $2x_1 = 1200$, so $x_1 = 600$ and $x_2 = \frac{1}{2}(2400 - 3x_1) = 300$, $z = 5x_1 + 2x_2 = 3600$.

## 題號 3.4-8 (a) (b)

**3.4-8.**

(a) $$\begin{aligned} \text{minimize} \quad & C = 8S + 4P \\ \text{subject to} \quad & 5S + 15P \geq 50 \\ & 20S + 5P \geq 40 \\ & 15S + 2P \leq 60 \\ & S, P \geq 0 \end{aligned}$$

(b) Optimal Solution: $(S, P) = (x_1^*, x_2^*) = (1.3, 2.9)$ and $C^* = 21.82$



## 題號 3.4-10(a)

**3.4-10.**

(a) Let $f_1$ = number of full-time consultants working the morning shift (8 a.m.-4 p.m.),
$f_2$ = number of full-time consultants working the afternoon shift (Noon-8 p.m.),
$f_3$ = number of full-time consultants working the evening shift (4 p.m.-midnight),
$p_1$ = number of part-time consultants working the first shift (8 a.m.-noon),
$p_2$ = number of part-time consultants working the second shift (Noon-4 p.m.),
$p_3$ = number of part-time consultants working the third shift (4 p.m.-8 p.m.),
$p_4$ = number of part-time consultants working the fourth shift (8 p.m.-midnight).

$$\text{minimize} \quad C = (40 \times 8)(f_1 + f_2 + f_3) + (30 \times 4)(p_1 + p_2 + p_3 + p_4)$$

$$\begin{aligned}
\text{subject to} \quad & f_1 + p_1 \geq 4 \\
& f_1 + f_2 + p_2 \geq 8 \\
& f_2 + f_3 + p_3 \geq 10 \\
& f_3 + p_4 \geq 6 \\
& f_1 \geq 2p_1 \\
& f_1 + f_2 \geq 2p_2 \\
& f_2 + f_3 \geq 2p_3 \\
& f_3 \geq 2p_4 \\
& f_1, f_2, f_3, p_1, p_2, p_3, p_4 \geq 0
\end{aligned}$$

## 題號 3.4-14(a)

**3.4-14.**

(a) Let $x_{ij}$ be the number of tons of cargo type $i = 1, 2, 3, 4$ stowed in compartment $j =$ F (front), C (center), B (back).

$$\begin{aligned}
\text{maximize} \quad & P = 320(x_{1F} + x_{1C} + x_{1B}) + 400(x_{2F} + x_{2C} + x_{2B}) \\
& \quad + 360(x_{3F} + x_{3C} + x_{3B}) + 290(x_{4F} + x_{4C} + x_{4B})
\end{aligned}$$

$$\begin{aligned}
\text{subject to} \quad & x_{1F} + x_{2F} + x_{3F} + x_{4F} \leq 12 \\
& x_{1C} + x_{2C} + x_{3C} + x_{4C} \leq 18 \\
& x_{1B} + x_{2B} + x_{3B} + x_{4B} \leq 10 \\
& x_{1F} + x_{1C} + x_{1B} \leq 20 \\
& x_{2F} + x_{2C} + x_{2B} \leq 16 \\
& x_{3F} + x_{3C} + x_{3B} \leq 25 \\
& x_{4F} + x_{4C} + x_{4B} \leq 13 \\
& 500x_{1F} + 700x_{2F} + 600x_{3F} + 400x_{4F} \leq 7,000 \\
& 500x_{1C} + 700x_{2C} + 600x_{3C} + 400x_{4C} \leq 9,000 \\
& 500x_{1B} + 700x_{2B} + 600x_{3B} + 400x_{4B} \leq 5,000 \\
& \tfrac{1}{12}(x_{1F} + x_{2F} + x_{3F} + x_{4F}) - \tfrac{1}{18}(x_{1C} + x_{2C} + x_{3C} + x_{4C}) = 0 \\
& \tfrac{1}{12}(x_{1F} + x_{2F} + x_{3F} + x_{4F}) - \tfrac{1}{10}(x_{1B} + x_{2B} + x_{3B} + x_{4B}) = 0 \\
\text{and} \quad & x_{1F}, x_{2F}, x_{3F}, x_{4F}, x_{1C}, x_{2C}, x_{3C}, x_{4C}, x_{1B}, x_{2B}, x_{3B}, x_{4B} \geq 0
\end{aligned}$$

## 題號 3.4-15 (a)

**3.4-15.**

(a) Let $x_{ij}$ be the number of hours operator $i$ is assigned to work on day $j$ for $i = KC, DH, HB, SC, KS, NK$ and $j = M, Tu, W, Th, F$.

minimize $Z = 25(x_{KC,M} + x_{KC,W} + x_{KC,F}) + 26(x_{DH,Tu} + x_{DH,Th}) + 24(x_{HB,M} + x_{HB,Tu} + x_{HB,W} + x_{HB,F}) + 23(x_{SC,M} + x_{SC,Tu} + x_{SC,W} + x_{SC,F}) + 28(x_{KS,M} + x_{KS,W} + x_{KS,Th}) + 30(x_{NK,Th} + x_{NK,F})$

subject to

$x_{KC,M} \le 6, x_{KC,W} \le 6, x_{KC,F} \le 6$
$x_{DH,Tu} \le 6, x_{DH,Th} \le 6$
$x_{HB,M} \le 4, x_{HB,Tu} \le 8, x_{HB,W} \le 4, x_{HB,F} \le 4$
$x_{SC,M} \le 5, x_{SC,Tu} \le 5, x_{SC,W} \le 5, x_{SC,F} \le 5$
$x_{KS,M} \le 3, x_{KS,W} \le 3, x_{KS,Th} \le 8$
$x_{NK,Th} \le 6, x_{NK,F} \le 2$

$x_{KC,M} + x_{KC,W} + x_{KC,F} \ge 8$
$x_{DH,Tu} + x_{DH,Th} \ge 8$
$x_{HB,M} + x_{HB,Tu} + x_{HB,W} + x_{HB,F} \ge 8$
$x_{SC,M} + x_{SC,Tu} + x_{SC,W} + x_{SC,F} \ge 8$
$x_{KS,M} + x_{KS,W} + x_{KS,Th} \ge 7$
$x_{NK,Th} + x_{NK,F} \ge 7$

$x_{KC,M} + x_{HB,M} + x_{SC,M} + x_{KS,M} = 14$
$x_{DH,Tu} + x_{HB,Tu} + x_{SC,Tu} = 14$
$x_{KC,W} + x_{HB,W} + x_{SC,W} + x_{KS,W} = 14$
$x_{DH,Th} + x_{HB,Th} + x_{NK,Th} = 14$
$x_{KC,F} + x_{HB,F} + x_{SC,F} + x_{NK,F} = 14$

$x_{ij} \ge 0$ for all $i, j$.

**題號 3.5-3 (a)**

**3.5-3.**

(a) maximize $P = 50A + 40B + 30C$

subject to $0.02A + 0.03B + 0.05C \leq 40$

$0.05A + 0.02B + 0.04C \leq 40$

and $A, B, C \geq 0$

**題號 3.5-4 (a) (b)**

**3.5-4.**

(a) minimize $C = 60x_1 + 50x_2$

subject to $5x_1 + 3x_2 \geq 60$

$2x_1 + 2x_2 \geq 30$

$7x_1 + 9x_2 \geq 126$

and $x_1, x_2 \geq 0$

(b) Optimal Solution: $(x_1^*, x_2^*) = (6.75, 8.75)$ and $C^* = 842.50$