2.4

(design variables) N =number of tubes, R =radius of each tube (cm)

(objective function) maximize surface area of tubes $N(2\pi R)l$ (cm^2)

(constraints) $R \geq 0.5$, $N(\pi R^2) \leq 2000$, $N \geq 0$ (integer)

$$\left.\begin{array}{l}\text{maximize } S = N(2\pi R)l \\ \text{subject to} \\ R \geq 0.5 \\ N(\pi R^2) \leq 2000 \\ N \geq 0\end{array}\right\} \rightarrow \left\{\begin{array}{l}\text{minimize } f = -2\pi lNR \\ \text{subject to} \\ g_1 = 0.5 - R \leq 0 \\ g_2 = \pi NR^2 - 2000 \leq 0 \\ g_3 = -N \leq 0\end{array}\right\}$$

2.6

(design variables) x_1 = product A in kg, x_2 = product B in kg

(objective function) maximize the profit = $10x_1 + 8\ x_2$

(constraints) $0.4x_1 + 0.5x_2 \leq 100$ (raw material C), $0.6x_1 + 0.5x_2 \leq 80$ (raw material D), $x_1 \leq 70$, $x_2 \leq 110$ (limits on products)

2.11

(design variables) b = width (m), d = depth (m), h = height (m)

(objective function) minimize the total present cost

[2dh(50) + 2bh(60) + bd(90)][1-0.25sppwf(0.12,20)]

+ (2dh +2bh +bd)(12)uspwf(0.12,20)

(constraints) $bdh \geq 150$, $b \geq 0$, $d \geq 0$, $h \geq 0$

2.17

(design variables) b = width (cm), d = depth (cm)

(objective function) minimize the cross-sectional area, f = bd

(constraints) $6M/bd^2 \le \sigma_a$, $3V/2bd \le \tau_a$, $d \le 2b$, $b \ge 0$, $d \ge 0$

$$\left.\begin{array}{l}\text{minimize } A = bd \\ \text{subject to} \\ \dfrac{6\left(1.4\times10^{7}\right)}{bd^{2}} \le 1.65\times10^{4} \\ \dfrac{3\left(2.4\times10^{4}\right)}{2bd} \le 5000 \\ d - 2b \le 0 \\ b \ge 0 \\ d \ge 0\end{array}\right\} \rightarrow \left\{\begin{array}{l}\text{minimize } A = bd \\ \text{subject to} \\ g_1 = \dfrac{6\left(8.0\times10^{6}\right)}{bd^{2}} - 800 \le 0 \\ g_2 = \dfrac{3\left(1.5\times10^{5}\right)}{2bd} - 300 \le 0 \\ g_3 = d - 2b \le 0 \\ g_4 = -b \le 0 \\ g_5 = -d \le 0\end{array}\right\}$$

2.19

1	2	3	4	5	6	7	8	9	10
T	F	T	T	T	F	F	T	T	F
11	12	13	14	15					
F	T	F	F	F					