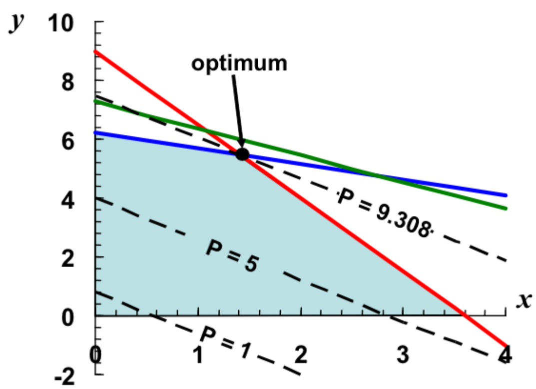
15.3 (a) To solve graphically, the constraints can be reformulated as the following straight lines

$$y = 6.22222 - 0.53333x$$
$$y = 7.2727 - 0.90909x$$
$$y = 9 - 2.5x$$

The objective function can be reformulated as

$$y = 0.8P - 1.4x$$

The constraint lines can be plotted on the *x*-*y* plane to define the feasible space. Then the objective function line can be superimposed for various values of *P* until it reaches the boundary. The result is $P \cong 9.30791$ with $x \cong 1.4$ and $y \cong 5.5$.



(b) The simplex tableau for the problem can be set up and solved as

Basis	P	x	y	S_1	S_2	S_3	Solution	Intercept
P	1	-1.75	-1.25	0	0	0	0	
S_1	0	1.2	2.25	1	0	0	14	11.66667
S_2	0	1	1.1	0	1	0	8	8
S_3	0	2.5	1	0	0	1	9	3.6

Basis	P	x	y	S_1	S_2	S_3	Solution	Intercept
P	1	0	-0.55	0	0	0.7	6.3	
S_1	0	0	1.77	1	0	-0.48	9.68	5.468927
S_2	0	0	0.7	0	1	-0.4	4.4	6.285714
x	0	1	0.4	0	0	0.4	3.6	9

Basis	P	x	y	S_1	S_2	S_3	Solution	Intercept
P	1	0	0	0.310734	0	0.550847	9.30791	
y	0	0	1	0.564972	0	-0.27119	5.468927	
S_2	0	0	0	-0.39548	1	-0.21017	0.571751	
x	0	1	0	-0.22599	0	0.508475	1.412429	

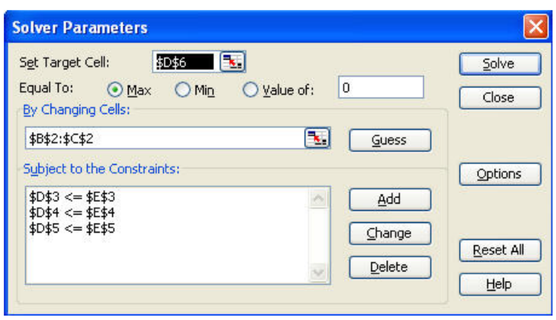
(c) An Excel spreadsheet can be set up to solve the problem as

	A	B	C	D	E
1		x	y	total	constraint
2	amount	0	0		
3	constraint 1	1.2	2.25	0	14
4	constraint 2	1	1.1	0	8
5	constraint 3	2.5	1	0	9
6	profit	1.75	1.25	0	

The formulas in column D are

	A	B	C	D	E
1		x	y	total	constraint
2	amount	0	0		
3	constraint 1	1.2	2.25	=B3*B$2+C3*C$2	14
4	constraint 2	1	1.1	=B4*B$2+C4*C$2	8
5	constraint 3	2.5	1	=B5*B$2+C5*C$2	9
6	profit	1.75	1.25	=B6*B$2+C6*C$2	

The Solver can be called and set up as



The resulting solution is

	A	B	C	D	E
1		x	y	total	constraint
2	amount	1.412429	5.468927		
3	constraint 1	1.2	2.25	14	14
4	constraint 2	1	1.1	7.428249	8
5	constraint 3	2.5	1	9	9
6	profit	1.75	1.25	9.30791	

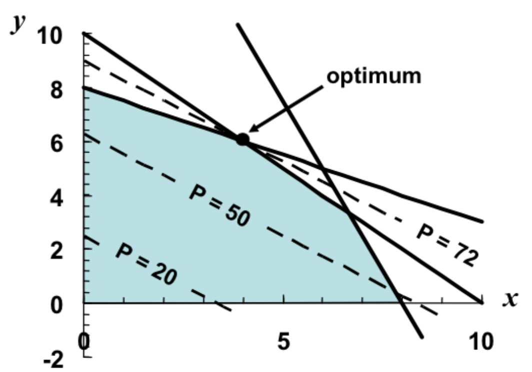
15.4 (a) To solve graphically, the constraints can be reformulated as the following straight lines

$$y = 20 - 2.5x$$
$$y = 10 - 10x$$
$$y = 9 - 2.5x$$

The objective function can be reformulated as

$$y = 0.125P - 0.75x$$

The constraint lines can be plotted on the *x*-*y* plane to define the feasible space. Then the objective function line can be superimposed for various values of *P* until it reaches the boundary. The result is $P \cong 72$ with $x \cong 4$ and $y \cong 6$.



(b) The simplex tableau for the problem can be set up and solved as

Basis	*P*	x	y	S_1	S_2	S_3	Solution	Intercept
P	1	-6	-8	0	0	0	0	
S_1	0	5	2	1	0	0	40	20
S_2	0	6	6	0	1	0	60	10
S_3	0	2	4	0	0	1	32	8

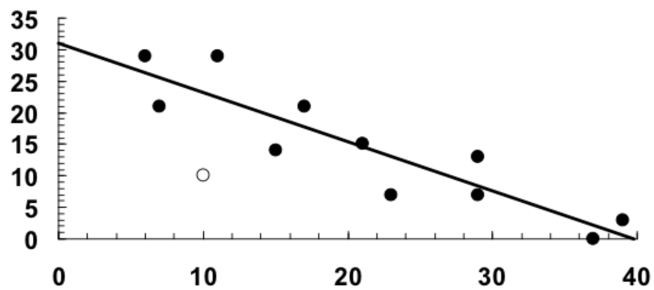
Basis	*P*	x	y	S_1	S_2	S_3	Solution	Intercept
P	1	-2	0	0	0	2	64	
S_1	0	4	0	1	0	-0.5	24	6
S_2	0	3	0	0	1	-1.5	12	4
y	0	0.5	1	0	0	0.25	8	16

Basis	*P*	x	y	S_1	S_2	S_3	Solution	Intercept
P	1	0	0	0	0.666667	1	72	
S_1	0	0	0	1	-1.33333	1.5	8	
x	0	1	0	0	0.333333	-0.5	4	
y	0	0	1	0	-0.16667	0.5	6	

17.4 The results can be summarized as

$$y = 31.0589 - 0.78055x \qquad (s_{y/x} = 4.476306; r = 0.901489)$$

At $x = 10$, the best fit equation gives 23.2543. The line and data can be plotted along with the point (10, 10).



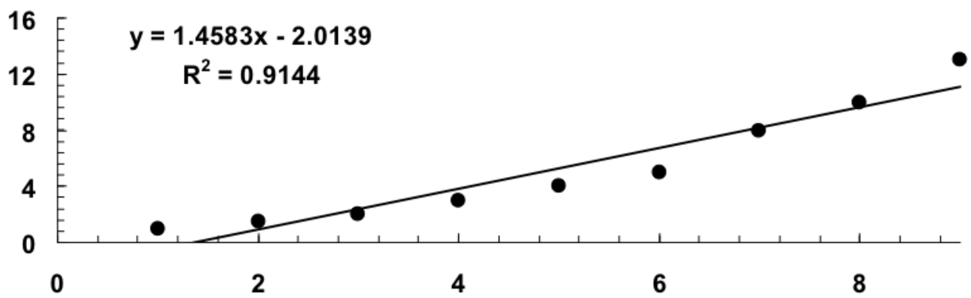
The value of 10 is nearly 3 times the standard error away from the line,

$$23.2543 - 3(4.476306) = 9.824516$$

Thus, we can tentatively conclude that the value is probably erroneous. It should be noted that the field of statistics provides related but more rigorous methods to assess whether such points are "outliers."

17.6 (a) The results can be summarized as

$$y = -2.01389 + 1.458333x \qquad (s_{y/x} = 1.306653; r = 0.956222)$$

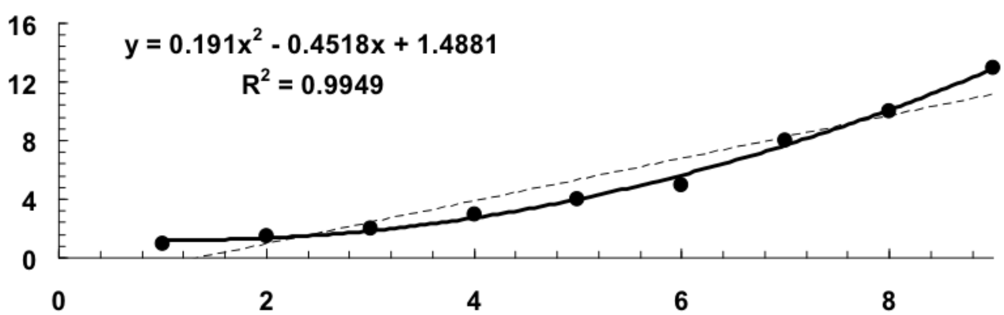


As can be seen, although the correlation coefficient appears to be close to 1, the straight line does not describe the data trend very well.

(b) The results can be summarized as

$$y = 1.488095 - 0.45184x + 0.191017x^2 \qquad (s_{y/x} = 0.344771; r = 0.997441)$$

A plot indicates that the quadratic fit does a much better job of fitting the data.

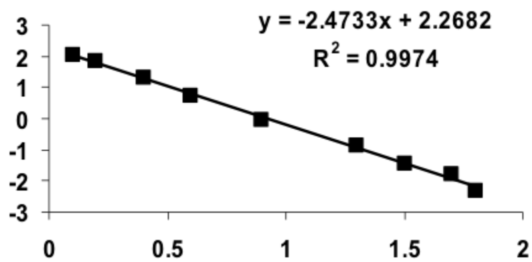


17.11 The function can be linearized by dividing it by x and taking the natural logarithm to yield

$$\ln(y / x) = \ln \alpha_4 + \beta_4 x$$

Therefore, if the model holds, a plot of ln(y/x) versus x should yield a straight line with an intercept of $\ln\alpha_4$ and a slope of β_4.

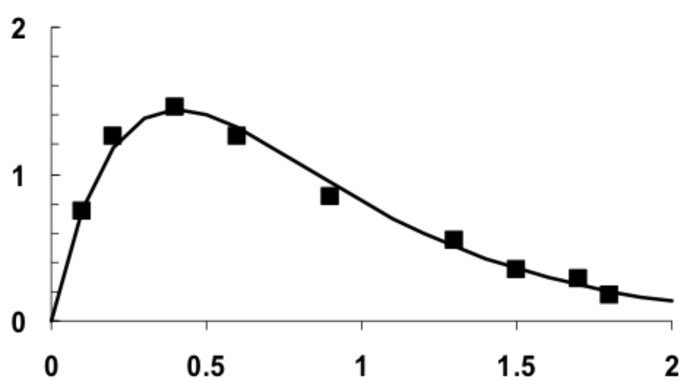
x	y	ln(y/x)
0.1	0.75	2.014903
0.2	1.25	1.832581
0.4	1.45	1.287854
0.6	1.25	0.733969
0.9	0.85	-0.05716
1.3	0.55	-0.8602
1.5	0.35	-1.45529
1.7	0.28	-1.80359
1.8	0.18	-2.30259



Therefore, $\beta_4 = -2.4733$ and $\alpha_4 = e^{2.2682} = 9.661786$, and the fit is

$$y = 9.661786 x e^{-2.4733x}$$

This equation can be plotted together with the data:



17.18 We employ multiple linear regression to fit the following equation to the data

$$y = 14.46087 + 9.025217x_1 - 5.70435x_2 \qquad (r^2 = 0.995523; s_{y/x} = 0.888787)$$

The model and the data can be compared graphically by plotting the model predictions versus the data. A 1:1 line is included to indicate a perfect fit.