17.3

a) 68% should fall between

$27.68 - 10.8 = 16.88$

and

$27.68 + 10.8 = 38.48$

actually $\frac{19}{28} = 67.8$

fall within range

17.4 use Toolkit with x vs y

$y = 3.3888 + 0.3725(x)$

$S_{x/y} = 1.232$

$r^2 = 0.81066$

$r = 0.90$

with y vs x

$x = -5.3869 + 2.1763(y)$

$S_{y/x} = 2.977$

$r^2 = 0.81066$

$r = 0.90$

therefore "best" lines, and $S_{x/y}$ and $S_{y/x}$ differ.

r^2 and r stay the same

17.5 Using Toolkit best line becomes

$y = 30.74 - 0.7719x$

at $x = 5$ the predicted value $y(5) = 26.88$

compared to measured $y(5) = 5$

The original standard error of the estimate $= 4.39$

$26.88 - (2)(4.39) = 18.1$

measured value of 5 is greater than 2 times standard error and therefore probably erroneous.

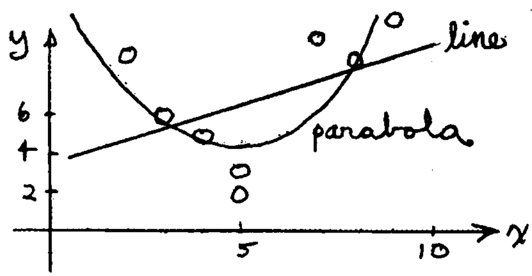
17.6

a) $y = 3.48955 + 0.62985(x)$

Standard error $= 3.221$

correlation coeff $= 0.4589$

b) $y = 16.027 - 4.807\,x + 0.4889\,x^2$



17.7

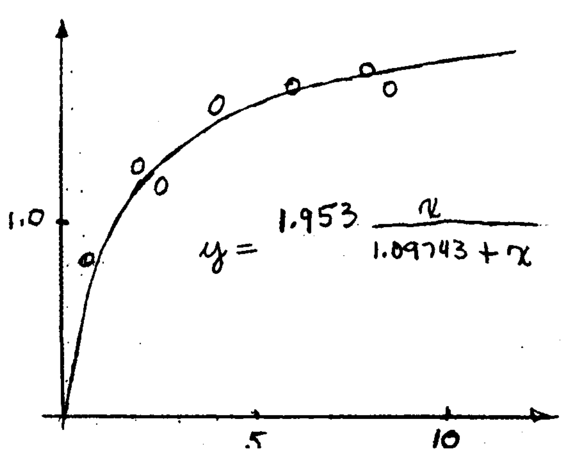
Regress $1/x$ vs $1/y$ using Toolkit gives

$$\frac{1}{y} = 0.5120351 + 0.561923\left(\frac{1}{x}\right)$$

standard error $= 0.0487$

$\frac{1}{0.512035} = 1.953$ and

$0.561923(1.953) = 1.09743$



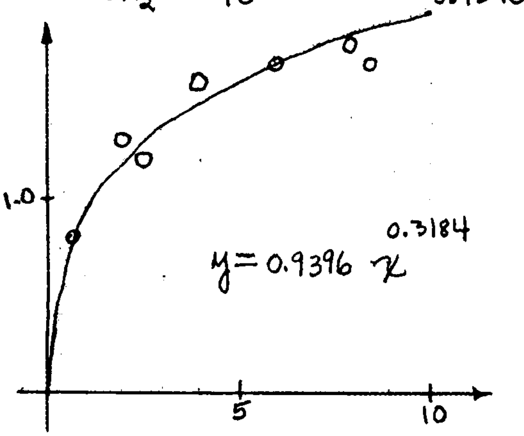
17.8

Regress $\log x$ vs $\log y$ using Toolkit

$\log y = -0.02705 + 0.3184 \log x$

standard Error $= 0.0361$

$a_2 = 10^{-0.02705} = 0.9396$

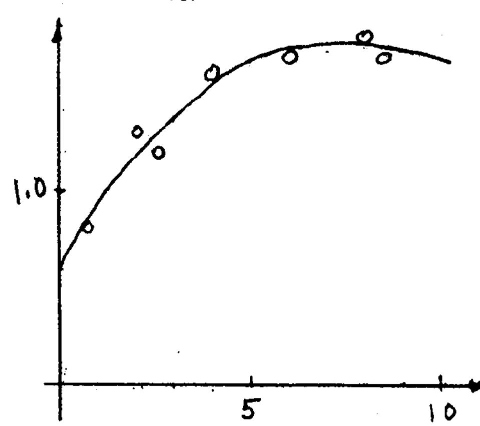


17.9

Use Toolkit with $n = 2$

$y = 0.5967 + 0.3391(x) - 0.02433(x^2)$

standard Error $= 0.08946$



17.10

log x	log y
0.398	0.845
0.544	0.740
0.699	0.591
0.778	0.556
0.875	0.491
1.0	0.447
1.097	0.415
1.176	0.380
1.243	0.362
1.301	0.362

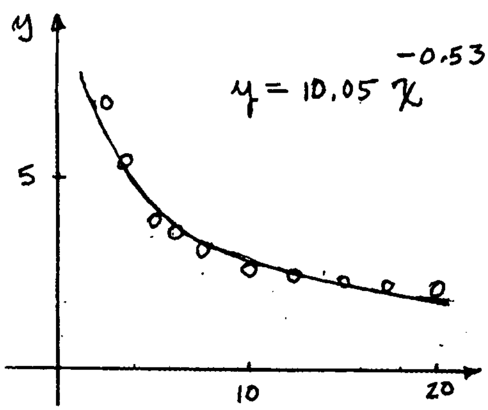
fit straight line

$a_0 = 1.002 \quad a_1 = -0.53$

Standard Error = 0.039

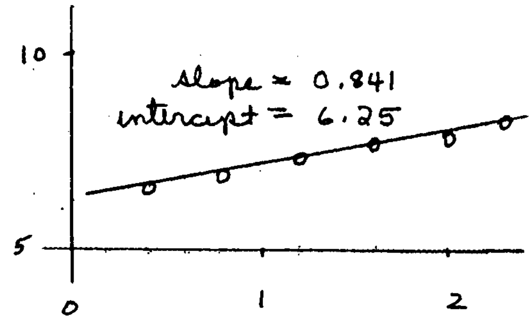
$b_2 = a_1 \quad \log a_2 = a_0$

$a_2 = 10^{1.002} = 10.05$



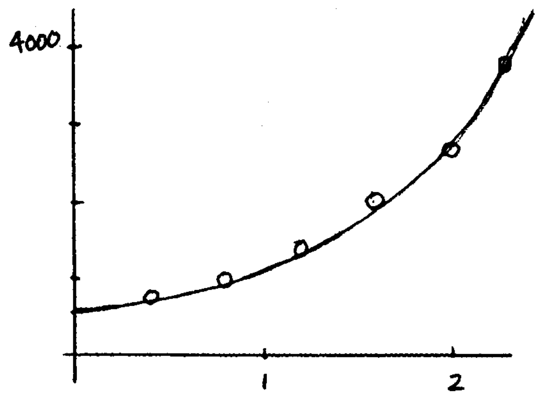
17.11

x	ln y
0.4	6.62
0.8	6.91
1.2	7.24
1.6	7.60
2.0	7.90
2.3	8.23



$e^{6.25} = 518$

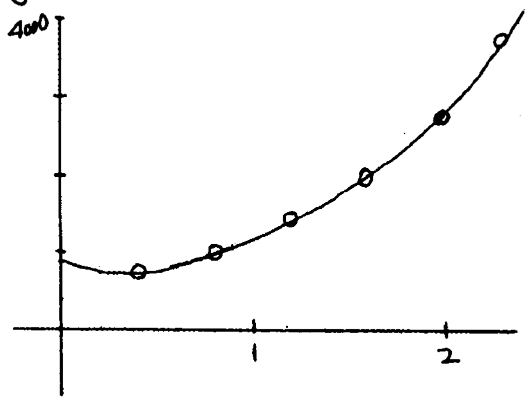
model $y = 518\, e^{0.841x}$



17.12

Standard Error = 112.7

$y = 854.66 - 453.99x + 726.77x^2$



17.13

a) $y = 20.667 + 0.496x$

standard error = 3.728

b) fit $\log x$ vs $\log y$ gives

$\log y = 0.9848 + 0.395 \log x$

with standard Error = 0.036

or $y = 9.656\, x^{0.395}$

c) fit $\frac{1}{x}$ vs $\frac{1}{y}$ gives

$1/y = 0.01914 + 0.213 \frac{1}{x}$

with standard Error = 0.0011

or $y = 52.2 \dfrac{x}{11.1 + x}$

d) $y = 12.17 + 1.35x - 0.01545x^2$

standard error = 2.15

c) is best because standard error is smallest. also model form may be best as well because both data and c) model as $x \to$ large

$y \to$ constant

17.14

$\sum y = 242.7$
$\sum x_1 = 20$
$\sum x_2 = 12$
$\sum x_1^2 = 60$
$\sum x_2^2 = 20$
$\sum x_1 x_2 = 30$
$\sum x_1 y = 661$
$\sum x_2 y = 331.2$

$$\begin{bmatrix} 9 & 20 & 12 \\ 20 & 60 & 30 \\ 12 & 30 & 20 \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ a_2 \end{bmatrix} = \begin{bmatrix} 242.7 \\ 661 \\ 331.2 \end{bmatrix}$$

$a_0 = 14.404$
$a_1 = 9.026$
$a_2 = -5.62$

$S_t = 1060.26$

$S_r = 4.81$

$S_{y/x_1,x_2} = \sqrt{\frac{4.81}{9-3}} = 0.895$

$r^2 = \frac{1060.26 - 4.81}{1060.26} = 0.995$

$r = 0.997$

17.15 $\sum y = 142$
$\sum x_1 = 9$
$\sum x_2 = 27$
$\sum x_1^2 = 15$
$\sum x_2^2 = 117$
$\sum x_1 x_2 = 33$
$\sum x_1 y = 115$
$\sum x_2 y = 453$

$$\begin{bmatrix} 9 & 9 & 27 \\ 9 & 15 & 33 \\ 27 & 33 & 117 \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ a_2 \end{bmatrix} = \begin{bmatrix} 142 \\ 115 \\ 453 \end{bmatrix}$$

$a_0 = 16.67$
$a_1 = -6.3$
$a_2 = 1.8$

$S_t = 281.55$

$S_r = 62.85$

$S_{y/x_1,x_2} = \sqrt{\frac{62.85}{9-3}} = 3.24$

$r^2 = \frac{281.55 - 62.85}{281.55} = 0.777$

$r = 0.881$

17.16 From Toolkit

$y = 685.25 - 218.89x + 643.6x^2$

$\partial f/\partial a_0 = 1 \quad \frac{\partial f}{\partial a_1} = x \quad \frac{\partial f}{\partial a_2} = x^2$

$$[Z_0] = \begin{bmatrix} 1 & 0.075 & 0.005625 \\ 1 & 0.5 & 0.25 \\ 1 & 1.0 & 1.0 \\ 1 & 1.2 & 1.44 \\ 1 & 1.7 & 2.89 \\ 1 & 2. & 4 \\ 1 & 2.3 & 5.29 \end{bmatrix}$$

$$[Z_0]^T[Z_0] = \begin{bmatrix} 7 & 8.77 & 14.87 \\ 8.77 & 14.87 & 27.93 \\ 14.87 & 27.93 & 55.47 \end{bmatrix}$$

TRY Initial guess $a_0 = 675$
$a_1 = -200$
$a_2 = 650$

$$\{D\} = \begin{bmatrix} -63.6 \\ 62.5 \\ 75.0 \\ 29.0 \\ -163.5 \\ -225.0 \\ 96.5 \end{bmatrix}$$

$\Delta A = [Z^T Z]^{-1} Z^T \{D\}$ gives

$$[\Delta A] = \begin{bmatrix} 10.248 \\ -18.88 \\ -6.46 \end{bmatrix}$$