ANSWER KEY - PROBLEM SET 11

12.20)

a.- $S_{xy} = 1.0785$

$S_{xx} = 1.1155$

$\hat{B}_1 = \frac{S_{xy}}{S_{xx}} = \frac{1.0785}{1.1155} = .9668$

$\hat{B}_0 = \bar{y} - \hat{B}_1 \bar{x} = 0.80 - .9668(0.455)$

$= 0.365$

b.) Lichen $N = 0.365 + .9668(NO_3^-$ deposition$)$

$= 0.365 + .9668(.5)$

$= 0.8485$

c.) $\hat{\sigma} = \sqrt{\frac{SSE}{n-2}} = \sqrt{\frac{.4106}{11}} = .1932$

12.25) $nb_0 + (\Sigma x_i) b_1 = \Sigma y_i$

$n\left(\frac{\Sigma y_i - \hat{B}_1 \Sigma x_i}{n}\right) + (\Sigma x_i) b_1 = \Sigma y_i$

$\hat{B}_1 = \frac{\Sigma x_i y_i - \frac{(\Sigma x_i)(\Sigma y_i)}{n}}{\Sigma x_i^2 - \frac{(\Sigma x_i)^2}{n}}$

$\Sigma x_i \left[\frac{\Sigma y_i - \hat{B}_1 \Sigma x_i}{n}\right] + \Sigma x_i^2 \hat{B}_1 = \Sigma x_i y_i$

$\frac{\Sigma x_i \Sigma y_i}{n} + \frac{\hat{B}_1 (\Sigma x_i)^2}{n} + \Sigma x_i^2 \hat{B}_1 = \Sigma x_i y_i$

$\frac{\Sigma x_i \Sigma y_i}{n} + \left[\frac{\Sigma x_i y_i - \frac{(\Sigma x_i)(\Sigma y_i)}{n}}{\Sigma x_i^2 - \frac{(\Sigma x_i)^2}{n}}\right]\left[\Sigma x_i^2 - \frac{(\Sigma x_i)^2}{n}\right]$

$+ \frac{\Sigma x_i \Sigma y_i}{n} + \Sigma x_i y_i - \frac{\Sigma x_i \Sigma y_i}{n} = \Sigma x_i y_i$

28.) a.- See Attached R printout
While the two lines have the same slope, the second one is shifted to the left by the value of $\bar{x}$.

b.- See attached R printout
From the output, we see that B_0^* is equivalent to $\bar{y}$ and that B_1^* is equivalent to B_1.

29.) See R printout
Linear regression would be most effective for data set #3 because it has the highest r^2 and s values.

81.) a.- $S_x^2 = \frac{\sum(x_i - \bar{x})^2}{n-1}$ $S_y^2 = \frac{\sum(y_i - \bar{y})^2}{n-1}$

$$\frac{S_x^2}{S_y^2} = \frac{\frac{\sum(x_i-\bar{x})^2}{n-1}}{\frac{\sum(y_i-\bar{y})^2}{n-1}}$$

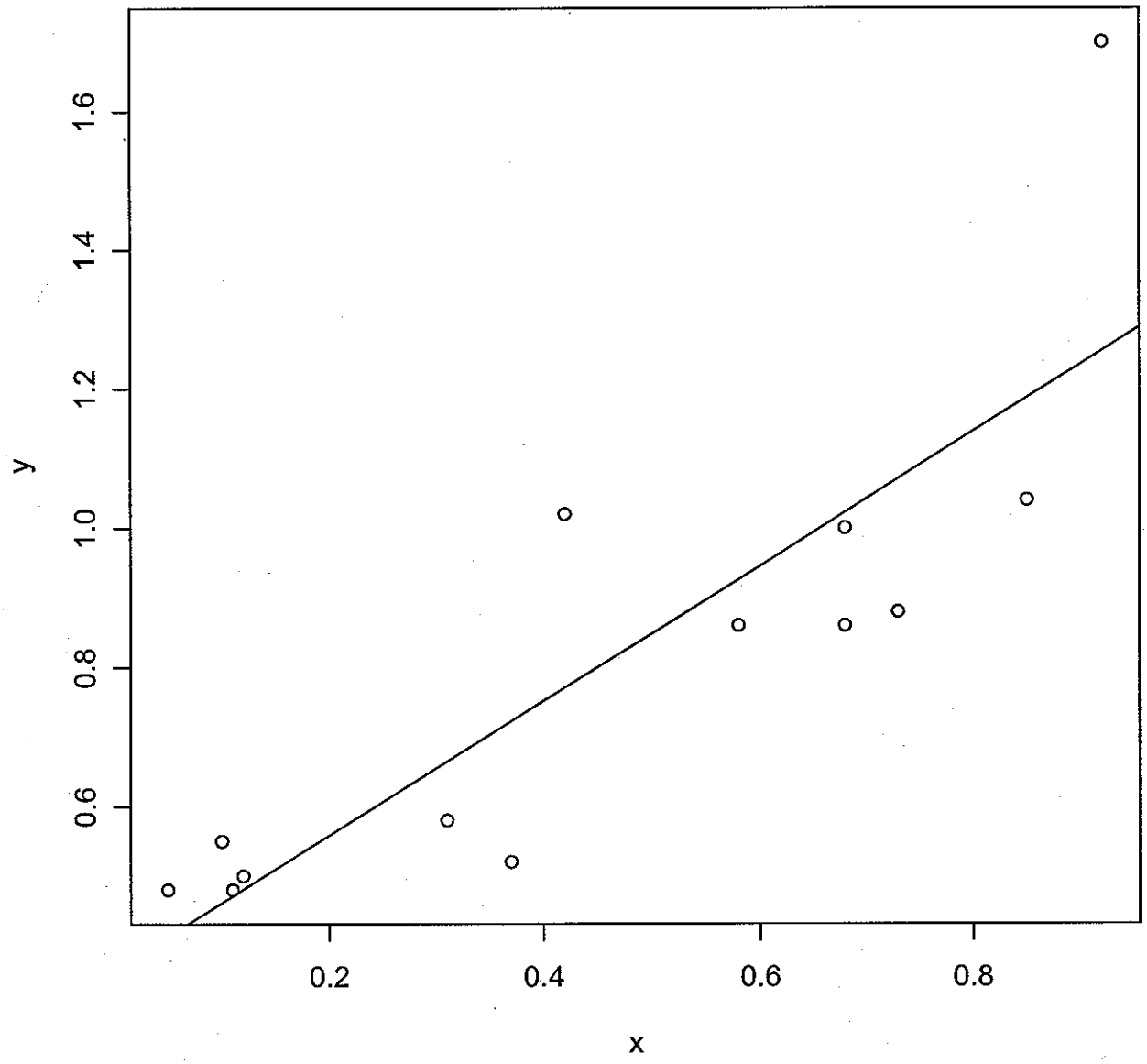
$$\frac{S_x}{S_y} = \frac{\sum(x_i-\bar{x})}{\sum(y_i-\bar{y})} \Longrightarrow \frac{S_y}{S_x} = \frac{\sum(y_i-\bar{y})}{\sum(x_i-\bar{x})}$$

$$y = \hat{B}_0 + \hat{B}_1 x = (\bar{y} - \hat{B}_1\bar{x}) + \hat{B}_1 x = \bar{y} + \hat{B}_1(x-\bar{x})$$

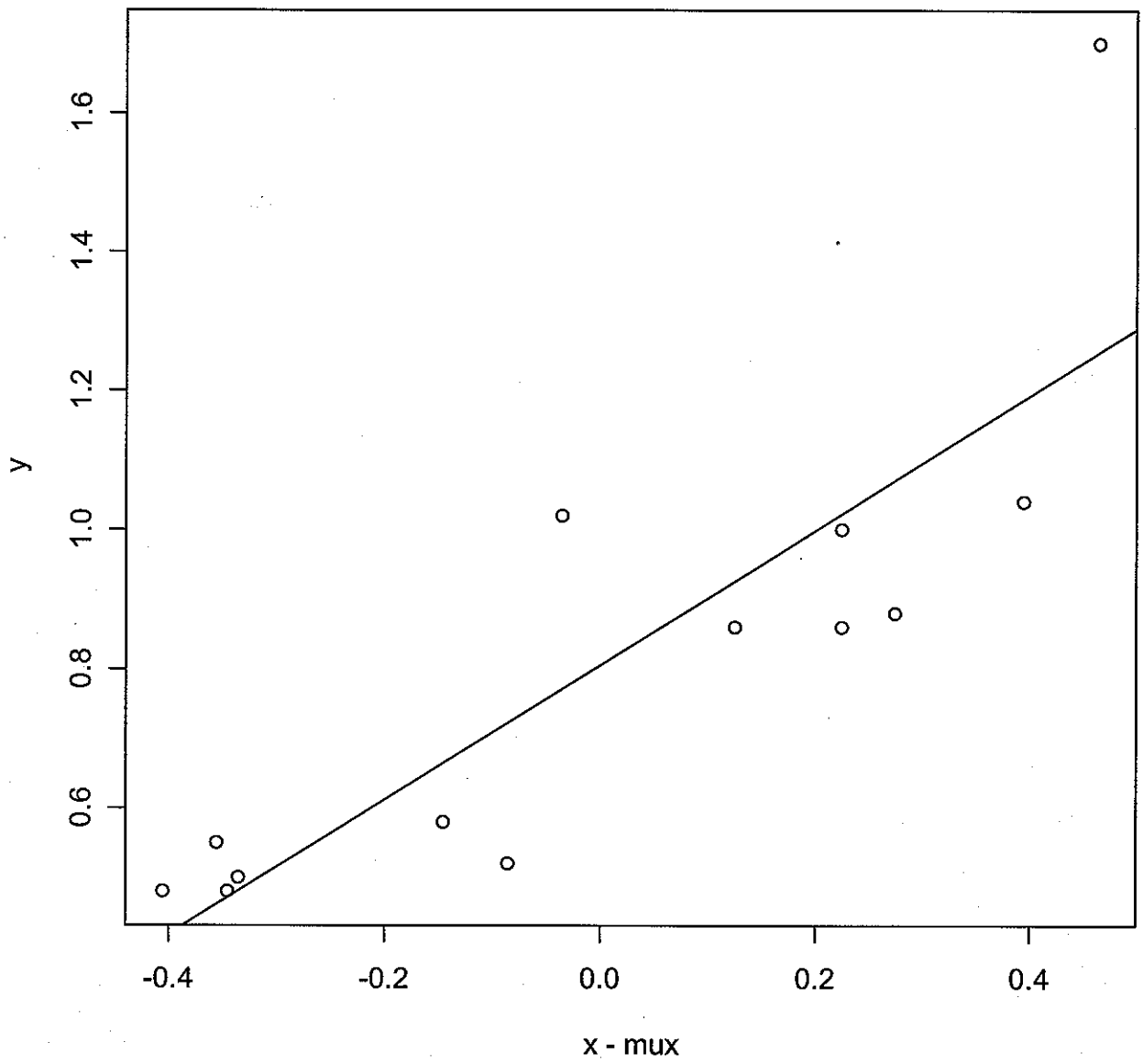
$$\hat{B}_1 = \frac{S_{xy}}{S_{xx}} = \frac{S_{xy}}{\sqrt{S_{xx}}\sqrt{S_{yy}}} \cdot \frac{S_y}{S_x} = r \cdot \frac{S_y}{S_x}$$

$$y = \bar{y} + r\frac{S_y}{S_x}(x-\bar{x}) \quad \checkmark$$

Problem 12.28(a)



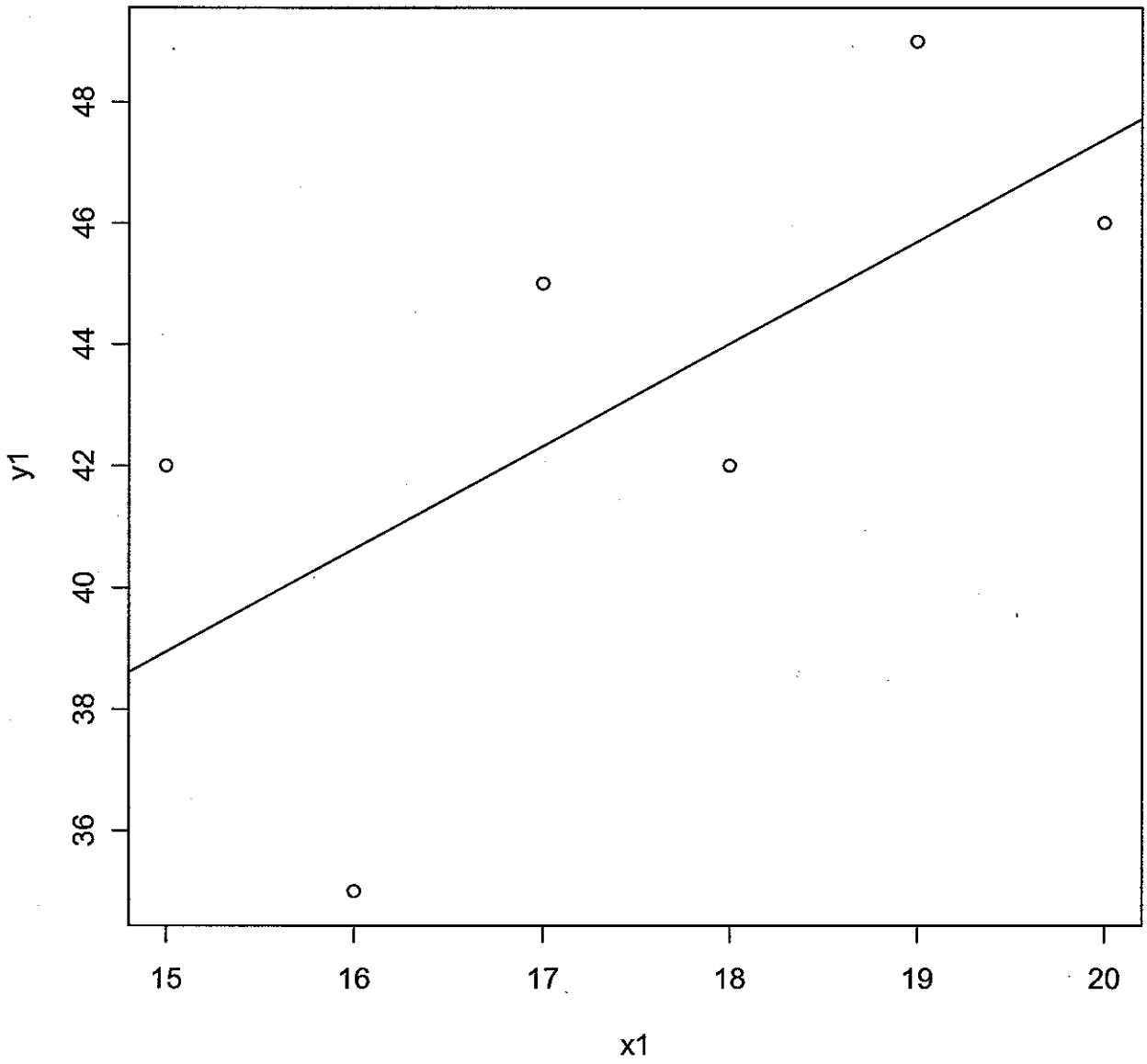
Problem 12.28(a)



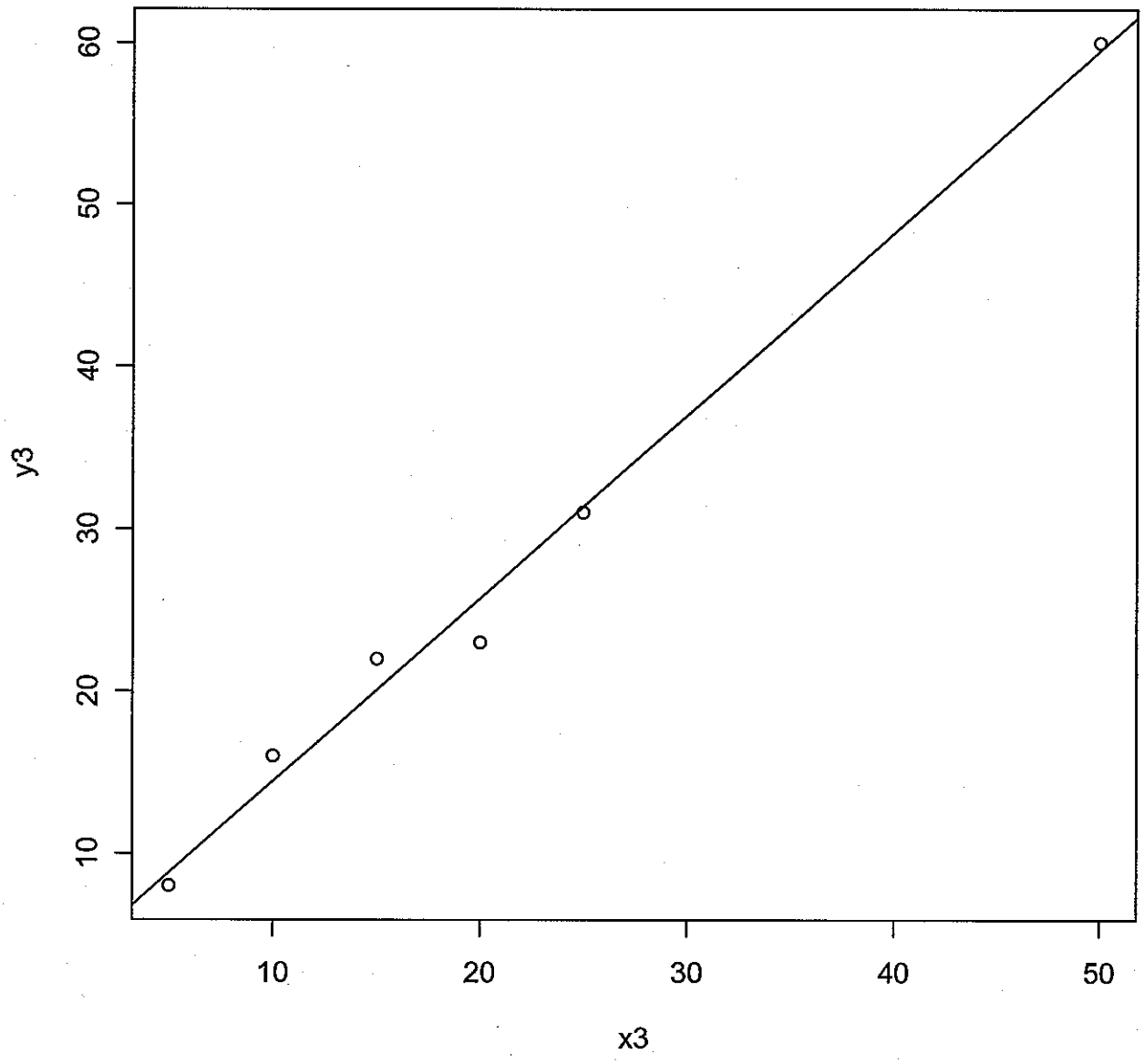
Problem 12.28(b)

```
> z = x-mux
> abline(lm(y~z))
> a = lm(y~z)
> summary(a)

Call:
lm(formula = y ~ z)

Residuals:
    Min      1Q  Median      3Q     Max
-0.20283 -0.14691 -0.02255  0.06655  0.44541

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.80538    0.05358  15.031 1.12e-08 ***
z            0.96683    0.18292   5.286 0.000258 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1932 on 11 degrees of freedom
Multiple R-Squared: 0.7175,     Adjusted R-squared: 0.6918
F-statistic: 27.94 on 1 and 11 DF,  p-value: 0.0002581

> b = lm(y~x)
> summary(b)

Call:
lm(formula = y ~ x)

Residuals:
    Min      1Q  Median      3Q     Max
-0.20283 -0.14691 -0.02255  0.06655  0.44541

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.36510    0.09904   3.686 0.003586 **
x            0.96683    0.18292   5.286 0.000258 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1932 on 11 degrees of freedom
Multiple R-Squared: 0.7175,     Adjusted R-squared: 0.6918
F-statistic: 27.94 on 1 and 11 DF,  p-value: 0.0002581
```

Problem 12.29



Problem 1229



Problem 12.29

Data Set 1

```
Call:
lm(formula = y1 ~ x1)

Residuals:
    1     2     3     4     5     6
3.048 -5.638  2.676 -2.010  3.305 -1.381

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  13.6667    16.9572   0.806    0.465
x1            1.6857     0.9644   1.748    0.155

Residual standard error: 4.034 on 4 degrees of freedom
Multiple R-Squared: 0.433,      Adjusted R-squared: 0.2913
F-statistic: 3.055 on 1 and 4 DF,  p-value: 0.1554
```

Data Set 2

```
Call:
lm(formula = y2 ~ x2)

Residuals:
     1      2      3      4      5      6
-2.58033  2.70820  3.99672 -5.71475  1.57377  0.01639

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  7.8689     2.8760   2.736   0.0521 .
x2           2.1423     0.1132  18.930 4.59e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 4.034 on 4 degrees of freedom
Multiple R-Squared: 0.989,      Adjusted R-squared: 0.9862
F-statistic: 358.4 on 1 and 4 DF,  p-value: 4.587e-05
```

Data Set 3

```
Call:
lm(formula = y3 ~ x3)

Residuals:
    1     2     3     4     5     6
-0.8295  1.5377  1.9049 -2.7279 -0.3607  0.4754
```