

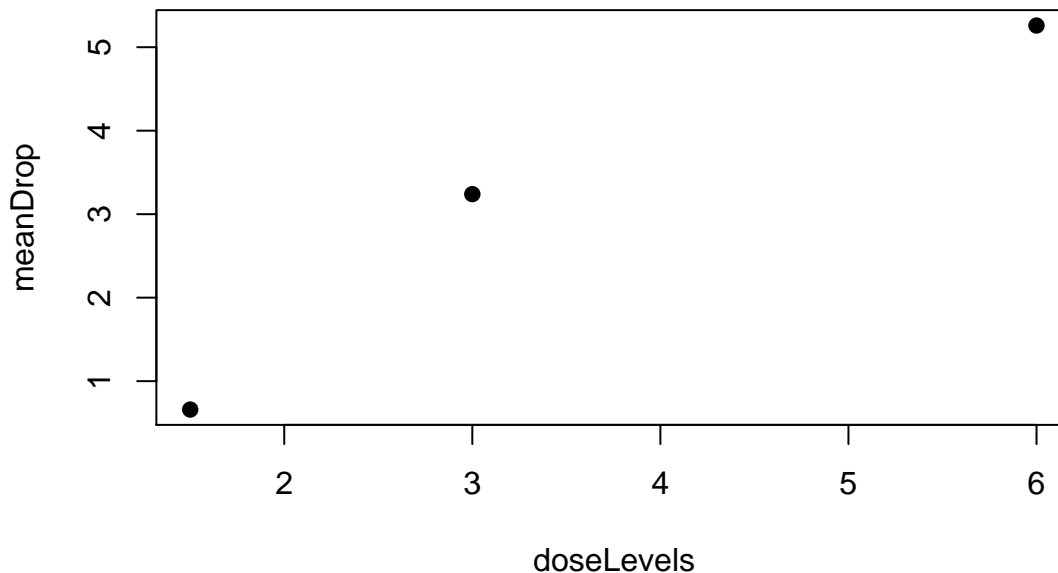
## 1. Exercise 12.4 (page 511).

The problem deals with the physiological effects of alcohol on mice. Fifteen mice are allocated to three different treatment groups that receive 1.5, 3.0, and 6.0 gm of ethanol per kg body weight. The data is the drop in body temperature (Celsius) of the mice after 20 minutes.

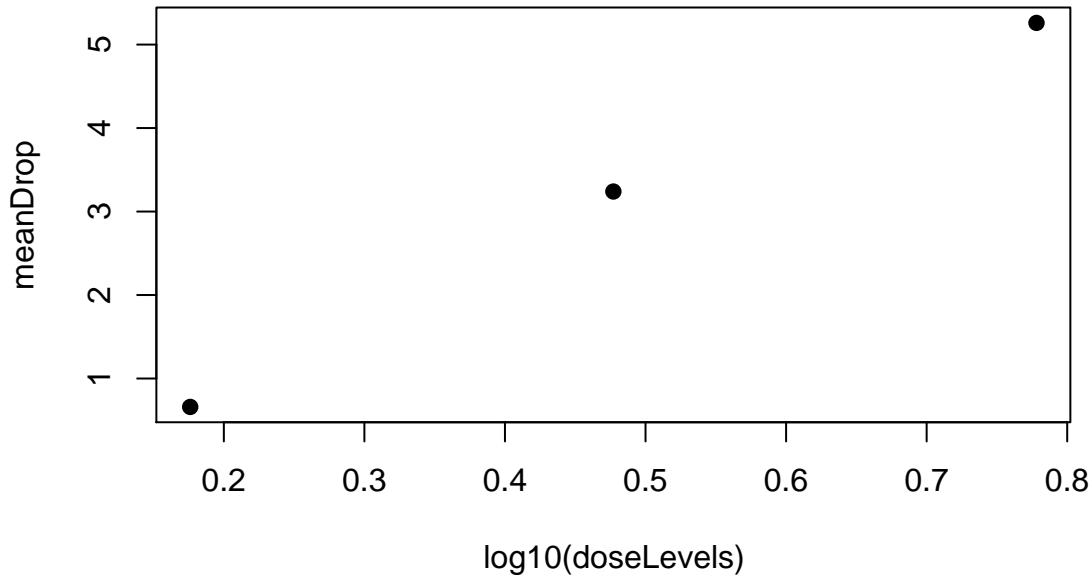
Solution:

(a) Plot group means versus dose and  $\log(\text{dose})$  to determine which is more linear..

```
> ethanol <- read.table("12-4.txt", header = T)
> attach(ethanol)
> doseLevels <- c(1.5, 3, 6)
> meanDrop <- unlist(lapply(split(tempDrop, dose), mean))
> plot(doseLevels, meanDrop, pch = 16)
```



```
> plot(log10(doseLevels), meanDrop, pch = 16)
```



The plot versus log10(dose) is more linear.

(b) Find the regression line and residual standard deviation.

```
> fit12.4 <- lm(tempDrop ~ log10(dose))
> summary(fit12.4)
```

Call:

```
lm(formula = tempDrop ~ log10(dose))
```

Residuals:

Min	1Q	Median	3Q	Max
-2.05333	-0.40333	-0.05333	0.64667	1.34667

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	-0.5921	0.5157	-1.148	0.272
log10(dose)	7.6404	0.9609	7.951	2.39e-06 ***

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Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.9147 on 13 degrees of freedom

Multiple R-Squared: 0.8294, Adjusted R-squared: 0.8163

F-statistic: 63.22 on 1 and 13 DF, p-value: 2.391e-06

The regression line is  $Y = -0.592 + 7.64X$ .

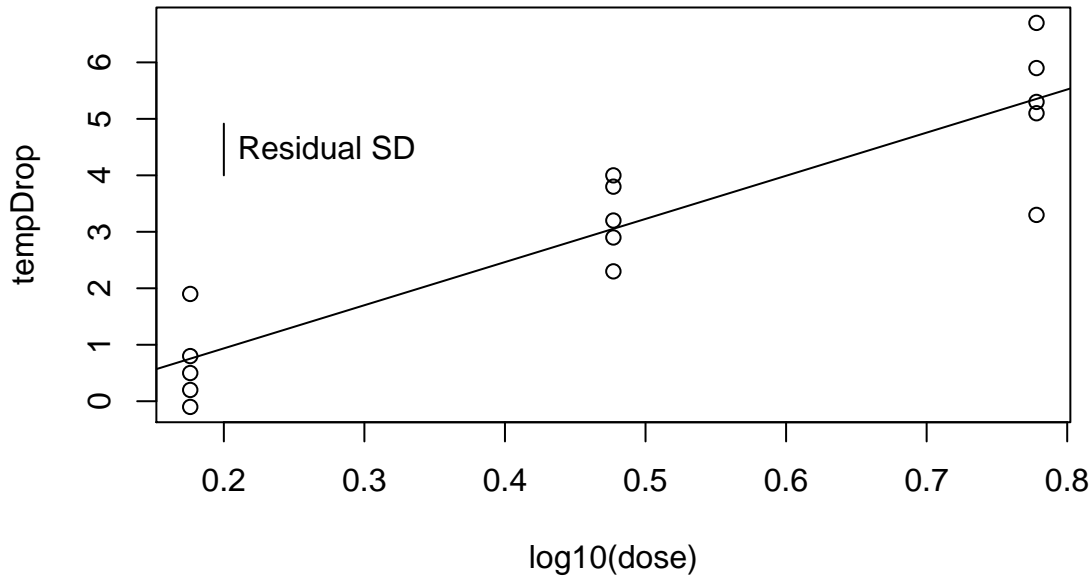
The residual standard deviation is 0.915.

(c) Plot the points and regression line.

(d) Show the magnitude of the residual standard deviation.

```
> plot(log10(dose), tempDrop)
> abline(fit12.4)
```

```
> lines(c(0.2, 0.2), c(4, 4 + rsd))
> text(0.21, 4.5, "Residual SD", adj = 0)
```



2. Exercise 12.8 (page 514).

**Data concerns the adaptation of the rowan (a tree) that grows at a range of altitudes to varying habitats. Data is altitude in meters and dark respiration rate ( $\mu\text{l}$  oxygen per hour per mg dry tissue mass).**

Solution:

(a) Find the regression line.

```
> rowan <- read.table("12-8.txt", header = T)
> attach(rowan)
> fit12.8 <- lm(respRate ~ altitude)
> summary(fit12.8)
```

Call:

```
lm(formula = respRate ~ altitude)
```

Residuals:

Min	1Q	Median	3Q	Max
-0.0671645	-0.0212865	-0.0009336	0.0256477	0.0547724

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	7.196e-02	2.520e-02	2.856	0.017075 *
altitude	3.186e-04	5.254e-05	6.063	0.000121 ***

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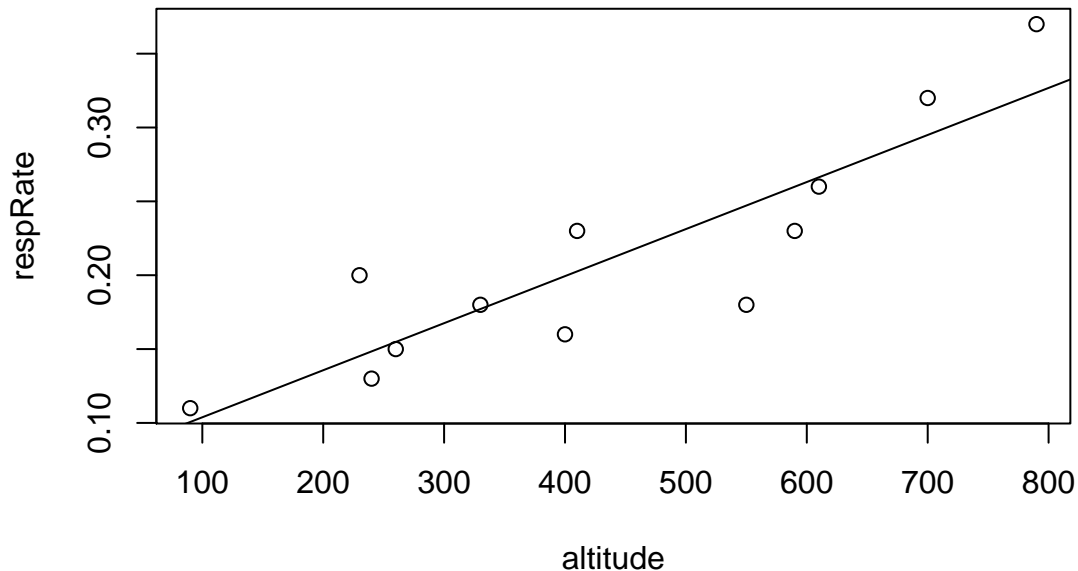
Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.0374 on 10 degrees of freedom

Multiple R-Squared: 0.7862, Adjusted R-squared: 0.7648  
 F-statistic: 36.76 on 1 and 10 DF, p-value: 0.0001215

(b) **Plot the data and regression line.**

```
> plot(altitude, respRate)
> abline(fit12.8)
```



(c) **Interpret the value of the regression line.**

Dark respiration of the rowan increases by 0.00032 ( $\mu\text{l}$  oxygen per hour per mg dry tissue mass per meter altitude).

(d) **Compute the residual standard deviation.** The residual standard deviation is 0.0374.

3. Exercise 12.11 (page 521).

**Refer to the drunk mouse data. Make a prediction of the drop in body temperature for a mouse given 2gm/kg body weight of alcohol.**

Solution:

The predicted drop is 14.7  $\mu\text{l}$  oxygen per hour per mg dry tissue mass.

4. Exercise 12.20 (page 526).

**Refer to the respiration data of the rowan in Exercise 12.8. Test the null hypothesis of no relationship to altitude, assuming the linear model is okay.**

Solution: From above, the test statistic is 6.06. There is very strong evidence that there is an increase in dark respiration in rowan as altitude increases.

5. Exercise 12.21 (page 539).

**Data is leaf area and dry weight from soybean seedlings after 16 days of growth.**

Solution:

(a) **Find the correlation coefficient.**

```
> soybean <- read.table("12-21.txt", header = T)
> attach(soybean)
> cor(LeafArea, DryWeight)

[1] 0.8147143
```

(b) Calculate  $s_Y$  and  $s_{Y|X}$ . Verify the relationship between  $s_Y$ ,  $s_{Y|X}$  and  $r$ .

```
> sy <- sd(DryWeight)
> fit12.21 <- lm(DryWeight ~ LeafArea)
> n <- nrow(soybean)
> syx <- sqrt(sum(residuals(fit12.21)^2)/(n - 2))
> r <- cor(LeafArea, DryWeight)
```

$s_Y = 0.174$  and  $s_{Y|X} = 0.105$ .

$s_{Y|X}/s_Y = 0.605647 \approx 0.579863 = \sqrt{1 - r^2}$ .

(c) Find the regression line

```
> sum12.21 <- summary(fit12.21)
> sum12.21
```

Call:

```
lm(formula = DryWeight ~ LeafArea)
```

Residuals:

Min	1Q	Median	3Q	Max
-0.14292	-0.07479	-0.02299	0.09830	0.16356

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	0.8812789	0.2789182	3.16	0.009085 **
LeafArea	0.0029122	0.0006249	4.66	0.000694 ***

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Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1054 on 11 degrees of freedom

Multiple R-Squared: 0.6638, Adjusted R-squared: 0.6332

F-statistic: 21.71 on 1 and 11 DF, p-value: 0.0006938

The regression line is  $Y = 0.881 + 0.00291X$ .

(d) Make a scatterplot and draw the regression line.

```
> plot(LeafArea, DryWeight)
> abline(fit12.21)
> lines(c(500, 500), c(2, 2 + syx))
> text(500, 1.9, "s y/x")
> lines(c(525, 525), c(2, 2 + sy))
> text(525, 1.9, "s y")
```

