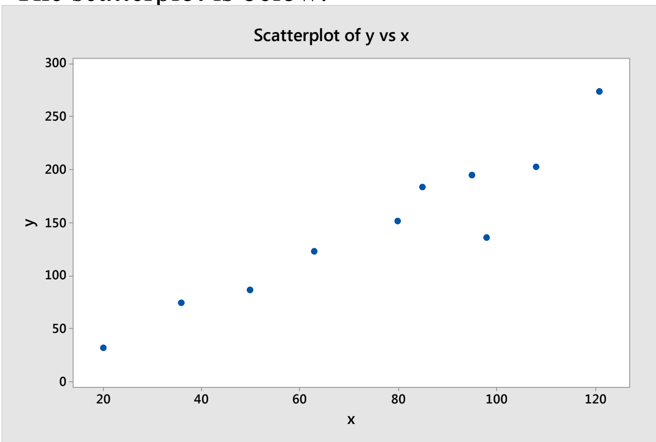
11.6

a. The scatterplot is below.



b. $\hat{y} = -9.7 + 2.06x$

c. The predicted equation does appear to fit the data well.

d. $\hat{y} = -9.7 + 2.06(77) = 148.92$

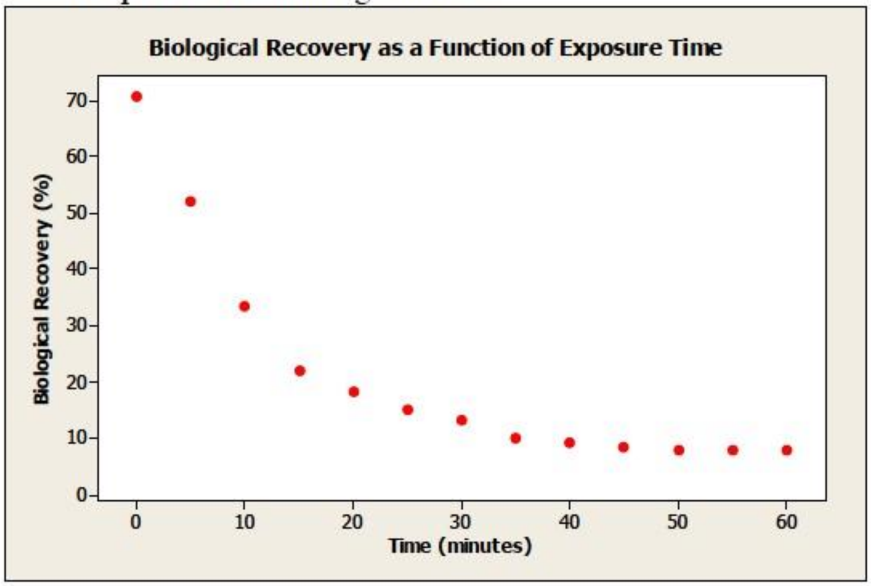
```
> plot(y~x, data=ex11.6)
> lm(y~x, data=ex11.6)
```

11.18 The original data and the log base 10 of recovery are given here:

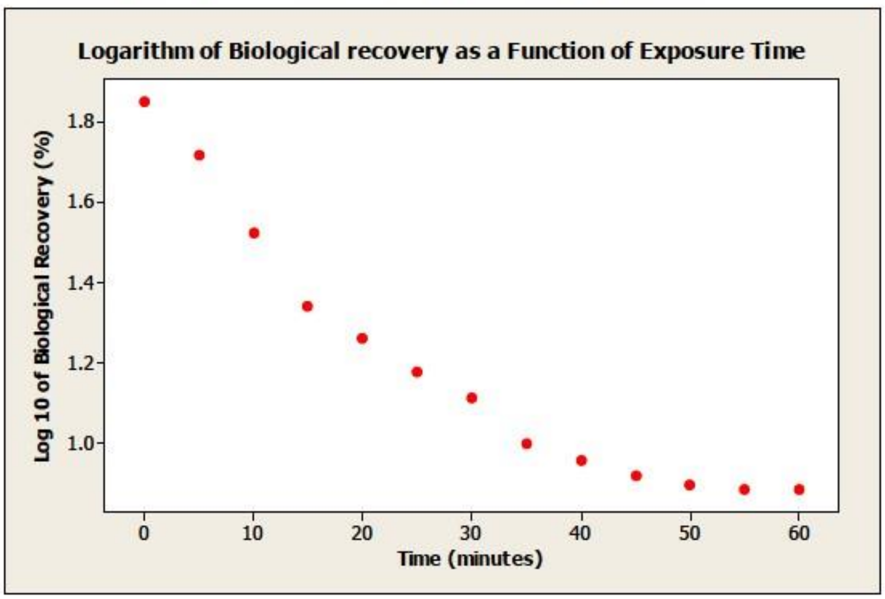
Data Display

Cloud	Time (minutes)	Recovery (%)	log10 Recovery
1	0	70.6	1.84880
2	5	52.0	1.71600
3	10	33.4	1.52375
4	15	22.0	1.34242
5	20	18.3	1.26245
6	25	15.1	1.17898
7	30	13.0	1.11394
8	35	10.0	1.00000
9	40	9.1	0.95904
10	45	8.3	0.91908
11	50	7.9	0.89763
12	55	7.7	0.88649
13	60	7.7	0.88649

a. A scatterplot of the data is given here:



b. A scatterplot of the data using $\log_{10}(y)$ is given here:



11.19 Minitab output is given here:

Regression Analysis: log10 Recovery versus Time (minutes)

```
The regression equation is
log10 Recovery = 1.67 - 0.0159 Time (minutes)


Predictor              Coef    SE Coef       T      P
Constant            1.67243    0.05837   28.65  0.000
Time (minutes)    -0.015914   0.001651   -9.64  0.000


S = 0.111354   R-Sq = 89.4%   R-Sq(adj) = 88.5%


Analysis of Variance

Source          DF      SS      MS      F      P
Regression       1  1.1523  1.1523  92.93  0.000
Residual Error  11  0.1364  0.0124
Total           12  1.2887
```

a. $\hat{y} = 1.67 - 0.0159x$

b. $s_\varepsilon = 0.1114$

c. $SE(\hat{\beta}_0) = 0.05837 \qquad SE(\hat{\beta}_1) = 0.001651$

```
> plot(Recover ~ Time, data=ex11.18)
> plot(log10(Recover) ~ Time, data=ex11.18)
> mdl <- lm(log10(Recover) ~ Time, data=ex11.18)
> summary(mdl)
```

11.23

a. $\hat{\sigma}_\varepsilon^2 = (2.10171)^2 = 4.42$ $(= MS(\text{Residual Error}))$

b. $SE(\hat{\beta}_1) = 0.3462$

c. $-1.8673 \pm 2.101(0.3462) \Rightarrow (-2.595, -1.140)$

d. $H_0 : \beta_1 = 0$ versus $H_a : \beta_1 \neq 0$. From the computer output, $t = -5.39$ and p-value < 0.0001 < 0.05. Thus, we reject H_0 and conclude there is significant evidence that there is a linear relationship between the amount of time needed to run a 10-km race and the time to exhaustion on a treadmill.

```
> summary(lm(TenK ~ Treadmill, data=ex11.22))
```

11.31

a. $\hat{y}_{n+1} \pm t_{0.025,11} s_{\varepsilon} \sqrt{1+\frac{1}{n}+\frac{(30-\bar{x})^2}{S_{xx}}} \Rightarrow$

$$1.195 \pm 2.201(0.1114)\sqrt{1+\frac{1}{13}+\frac{(30-30)^2}{4550}} \Rightarrow 1.195 \pm 0.254 \Rightarrow (0.941, 1.449)$$

b. The prediction interval in part (a) is wider than the confidence interval for the mean in Exercise 11.33.

c. 95% confidence interval for the mean: We are 95% confident that the mean log biological recovery percentage at 30 minutes will be between 1.127 and 1.263. (Or, we are 95% confident that the mean biological recovery percentage at 30 minutes will be between 13.4% and 18.3%.)

95% prediction interval: We are 95% confident that the log biological recovery percentage for a single sample at 30 minutes will be between 0.941 and 1.449. (Or, we are 95% confident that the biological recovery percentage for a single sample at 30 minutes will be between 8.7% and 28.1%.)

```
> predict(mdl, newdata = data.frame(Time=30),interval = c("pred"))
       fit       lwr      upr
1 1.195006 0.9406664 1.449345
> predict(mdl, newdata = data.frame(Time=30),interval = c("conf"))
       fit      lwr      upr
1 1.195006 1.127031 1.262981
```