Chap 10

6.

Source	df	SS	MS	F
Treatments	3	509.112	169.707	10.85
Error	36	563.134	15.643	
Total	39	1,072.256		

$F_{.01,3,36} \approx F_{.01,3,30} = 4.51$. The computed test statistic value of 10.85 exceeds 4.51, so reject H_0 in favor of H_a: at least two of the four means differ.

26.

a.

i:	1	2	3	4	5	6	
J_i:	4	5	4	4	5	4	
$x_{i.}$:	56.4	64.0	55.3	52.4	85.7	72.4	$x_{..} = 386.2$
$\bar{x}_{i.}$:	14.10	12.80	13.83	13.10	17.14	18.10	$\Sigma\Sigma x_{ij}^2 = 5850.20$

Thus SST = 113.64, SSTr = 108.19, SSE = 5.45, MSTr = 21.64, MSE = .273, f = 79.3. Since $79.3 \ge F_{.01,5,20} = 4.10$, $H_0: \mu_1 = \cdots = \mu_6$ is rejected.

b. The modified Tukey intervals are as follows; the first number is $\bar{x}_{i.} - \bar{x}_{j.}$ and the second number is $W_{ij} = Q_{.01} \cdot \sqrt{\frac{\text{MSE}}{2}\left(\frac{1}{J_i} + \frac{1}{J_j}\right)}$: Use t instead of Q

Pair	Interval	Pair	Interval	Pair	Interval
1,2	1.30 ± 1.37	2,3	-1.03 ± 1.37	3,5	-3.31 ± 1.37*
1,3	$.27 \pm 1.44$	2,4	$-.30 \pm 1.37$	3,6	-4.27 ± 1.44*
1,4	1.00 ± 1.44	2,5	-4.34 ± 1.29*	4,5	-4.04 ± 1.37*
1,5	-3.04 ± 1.37*	2,6	-5.30 ± 1.37*	4,6	-5.00 ± 1.44*
1,6	-4.00 ± 1.44*	3,4	$.37 \pm 1.44$	5,6	$-.96 \pm 1.37$

Asterisks identify pairs of means that are judged significantly different from one another.

c. The confidence interval is $\Sigma c_i \bar{x}_{i.} \pm t_{\alpha/2,n-I}\sqrt{\text{MSE}\sum \frac{c_i^2}{J_i}}$.

$\Sigma c_i \bar{x}_{i.} = \frac{1}{4}\bar{x}_{1.} + \frac{1}{4}\bar{x}_{2.} + \frac{1}{4}\bar{x}_{3.} + \frac{1}{4}\bar{x}_{4.} - \frac{1}{2}\bar{x}_{5.} - \frac{1}{2}\bar{x}_{6.} = -4.16$, $\sum \frac{c_i^2}{J_i} = .1719$, MSE = .273, $t_{.025,20} = 2.086$.

The resulting 95% confidence interval is

$-4.16 \pm (2.845)\sqrt{(.273)(.1719)} = -4.16 \pm .45 = (-4.61, -3.71)$.

38. $x_{1.} = 15.48$, $x_{2.} = 15.78$, $x_{3.} = 12.78$, $x_{4.} = 14.46$, $x_{5.} = 14.94$ $x_{..} = 73.44$, so CF = 179.78, SST = 3.62, SSTr = 180.71 – 179.78 = .93, SSE = 3.62 – .93 = 2.69.

Source	df	SS	MS	F
Treatments	4	.93	.233	2.16
Error	25	2.69	.108	
Total	29	3.62		

Since $2.16 < F_{.05,4,25} = 2.76$, do not reject H_0 at level .05.

39. $\hat{\theta} = 2.58 - \frac{2.63 + 2.13 + 2.41 + 2.49}{4} = .165$, $t_{.025,25} = 2.060$, MSE = .108, and

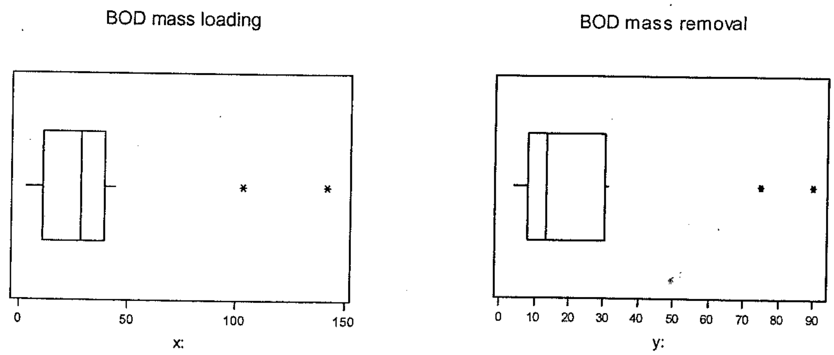
$\Sigma c_i^2 = (1)^2 + (-.25)^2 + (-.25)^2 + (-.25)^2 + (-.25)^2 = 1.25$, so a 95% confidence interval for θ is

$.165 \pm 2.060\sqrt{\frac{(.108)(1.25)}{6}} = .165 \pm .309 = (-.144, .474)$. This interval does include zero, so 0 is a plausible value for θ.

Chap 12

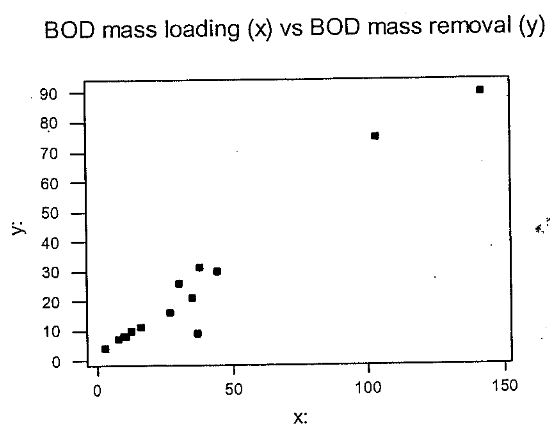
4.

a. Box plots of both variables:



On both the BOD mass loading boxplot and the BOD mass removal boxplot there are 2 outliers. Both variables are positively skewed.

b. Scatter plot of the data:



There is a strong linear relationship between BOD mass loading and BOD mass removal. As the loading increases, so does the removal. The two outliers seen on each of the boxplots are seen to be correlated here. There is one observation that appears not to match the liner pattern. This value is (37, 9). One might have expected a larger value for BOD mass removal.

9.

a. β_1 = expected change in flow rate (y) associated with a one inch increase in pressure drop (x) = .095.

b. We expect flow rate to decrease by $5\beta_1 = .475$.

c. $\mu_{Y\cdot 10} = -.12 + .095(10) = .83$, and $\mu_{Y\cdot 15} = -.12 + .095(15) = 1.305$.

d. $P(Y > .835) = P\left(Z > \dfrac{.835 - .830}{.025}\right) = P(Z > .20) = .4207$

$P(Y > .840) = P\left(Z > \dfrac{.840 - .830}{.025}\right) = P(Z > .40) = .3446$

e. Let Y_1 and Y_2 denote pressure drops for flow rates of 10 and 11, respectively. Then $\mu_{Y\cdot 11} = .925$, so $Y_1 - Y_2$ has expected value .830 - .925 = -.095, and s.d. $\sqrt{(.025)^2 + (.025)^2} = .035355$. Thus

$P(Y_1 > Y_2) = P(Y_1 - Y_2 > 0) = P\left(z > \dfrac{+.095}{.035355}\right) = P(Z > 2.69) = .0036$