

Linear Regression Problems - Solutions

LR1

Q.1

Complete Model: $SSE_C = 250$ $df_C = 20 - (4+1) = 15$

Reduced Model: $SSE_R = 300$ $df_R = 20 - (2+1) = 17$

$H_0: \beta_3 = \beta_4 = 0$

T.S. $F_{obs} = \frac{\frac{SSR_C - SSR_R}{df_R - df_C}}{\frac{SSE_C}{df_C}} = \frac{\frac{SSE_R - SSE_C}{df_R - df_C}}{\frac{SSE_C}{df_C}} = \frac{\frac{300 - 250}{17 - 15}}{\frac{250}{15}} = \frac{25}{16.67}$

$= 1.5$ RR: $F_{obs} \geq F_{.05, 2, 15} = 3.68$ Do not reject H_0 .

Q.2

Complete Model: $SSE_C = 1500$ $df_C = 34 - (6+1) = 27$

Reduced Model: $SSE_R = 1850$ $df_C = 34 - (3+1) = 30$

$H_0: \beta_4 = \beta_5 = \beta_6 = 0$ T.S. $F_{obs} = \frac{\frac{1850 - 1500}{30 - 27}}{\frac{1500}{27}} = \frac{116.667}{55.556} = 2.10$

RR: $F_{obs} \geq F_{.05, 3, 27} = 2.96$ Do not reject H_0 .

Q.3 $n = 24$ $\hat{Y} = 10.0 + 0.35X_1 + 0.30X_2 + 0.010X_3$ $R^2 = 0.75$

$\hat{Y} = 10.0 + 0.35(10) + 0.30(15) + 0.010(300) = 10 + 3.5 + 4.5 + 3.0 = 21.0$

$H_0: \beta_1 = \beta_2 = \beta_3 = 0$ T.S. $F_{obs} = \frac{R^2/p}{(1-R^2)/(n-p)} = \frac{\frac{.75}{3}}{\frac{.25}{24-4}} = \frac{.2500}{.0125} = 20.0$

RR: $F_{obs} \geq F_{.05, 3, 20} = 3.10$ Reject H_0

Q.4. $E\{Y\} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4$ n=50

\downarrow \downarrow \downarrow \downarrow \downarrow
 Break strength Thickness Length Material 1 Material 2

p=4
p'=5

DF(Reg) = p = 4 DF(Error) = n - p' = 50 - 5 = 45 DF(Total) = n - 1 = 49

Q.5. $R^2 = 1 - \frac{SSE}{TSS}$ Adj- $R^2 = 1 - \frac{n-1}{n-p'} \left(\frac{SSE}{TSS} \right)$

$\frac{n-1}{n-p'} > 1$ (except for intercept only model) FALSE

Q.6. TRUE - Change in SS, does not compensate loss in df_E

Q.7. TRUE $SSR_C \geq SSR_R$ $SSE_R \geq SSE_C$

Q.8. $R^2 = 1 - \frac{SSE}{TSS} \Rightarrow .75 = 1 - \frac{SSE}{TSS} \Rightarrow \frac{SSE}{TSS} = 1 - .75 = .25$

Q.9. p.9.a.

Source	df	SS	MS	F_{obs}	$F_{.05}$
Reg	2	90058	45029	112.93	≈ 3.23
Error	37	14753	398.73		
Total	39	104811			

$t_{\beta_1} = \frac{.014}{.0012} = 11.67$ $t_{\beta_2} = \frac{-58.22}{6.32} = -9.21$ $t_{.025, 37} \approx 2.021$

p.9.b. 58.22 Less lost work hours

p.9.c. $R^2 = \frac{90058}{104811} = .8592$

p.9.d. $\hat{Y} = 31.67 + .014(10000) - 58.22(1) = 31.67 + 140 - 58.22 = 113.45$

p.9.e. No both t-stats $\gg 2.021$

Q.10.

P.10.a. $MSE_c = \frac{483}{24 - (7+1)} = \frac{483}{16} = 30.1875$

$$C_p = \frac{SSE_1}{MSE_c} + 2P' - n = \frac{874}{30.1875} + 2(3+1) - 24 = 28.95 + 8 - 24 = 12.95$$

P.10.b.1 $df_c = 24 - (7+1) = 16$ $df_r = 24 - (3+1) = 20$

T.S. $F_{obs} = \frac{\frac{874 - 483}{20 - 16}}{\frac{483}{16}} = \frac{97.75}{30.1875} = 3.238$

P.10.b.ii. RR: $F_{obs} \geq F_{.05, 4, 16} = 3.01$ P.10.b.iii. No

Q.11. $F_{.05, 6, 20 - (6+1)} = F_{.05, 6, 13} = 2.92$

$$F_{obs} = \frac{R^2/6}{(1-R^2)/13} = \frac{13}{6} \left(\frac{R^2}{1-R^2} \right) = 2.92 \Rightarrow \frac{R^2}{1-R^2} = 2.92 \left(\frac{6}{13} \right) = 1.348$$

$$\Rightarrow \left(\frac{R^2}{1-R^2} \right)^{-1} = \frac{1}{R^2} - 1 = \frac{1}{1.348} = 0.742$$

$$\Rightarrow \frac{1}{R^2} = 1.742 \Rightarrow R^2 = \frac{1}{1.742} = 0.574$$

Q.12. P.12.a. T.S. $t_{obs} = 2.3394$ RR: $t_{obs} \geq t_{.05, 10-3} = 1.895$

~~P.12.b. $t_{.05, 7} = 2.365$ $2.3394 < 2.365$ (RR) = No~~

~~P.12.c.~~

P.12.b. $t_{.025,7} = 2.365$ 95% CI for β_1 : $-42.3862 \pm 2.365(21.0008)$
 $\equiv -42.3862 \pm 49.6669 \equiv (-92.0531, 7.2807)$

P.12.c. $7.4192 \pm 2.365(0.7288) \equiv 7.4192 \pm 1.7236 \equiv (5.6956, 9.1428)$

P.12.d. $VIF_X = \frac{1}{1 - .9995^2} = \frac{1}{1 - .9990} = \frac{1}{.0001} = 1000$

$VIF_W = \frac{1}{1 - (-.4116)^2} = \frac{1}{1 - .1694} = \frac{1}{.8306} = 1.204$

P.12.e. $X=90$: $\hat{Y} = 1784.1883 - 42.3862(90) + .2722(90)^2 = 174.25$ (round)
 $W=-1.5$: $\hat{Y} = 184.4443 + 7.4192(-1.5) + .2722(-1.5)^2 = 173.93$

Q.13 $n=19$ $p'=2$ P.13.a. $r^2 = \frac{39858}{48342} = 0.8245$

P.13.b. $\hat{Y}_6 = -34.49 + 24.60(6) = 113.11$ $t_{.025,17} = 2.110$

CI for mean: $113.11 \pm 2.110 \sqrt{(499) \left(\frac{1}{20} + \frac{(6-5.7)^2}{65.85} \right)} \equiv 113.11 \pm 2.110 \sqrt{499(.0514)}$
 $\equiv 113.11 \pm 2.110 \sqrt{25.63} \equiv 113.11 \pm 10.68 \equiv (102.43, 123.79)$

P.13.c. $113.11 \pm 2.110 \sqrt{499(1.0514)} \equiv 113.11 \pm 2.110 \sqrt{524.65}$
 $\equiv 113.11 \pm 48.33 \equiv (64.78, 161.44)$

Q.14. $n=25$ $p'=2$ $n-p'=23$

P.14.a. T.S. $t_{obs} = \frac{.06}{.008391} = 7.151$ RR: $|t_{obs}| \geq t_{.025, 23} = 2.069$

P.14.b. T.S. $F_{obs} = \frac{1.585884/1}{0.713406/23} = 51.128$ RR: $F_{obs} \geq F_{.05, 1, 23} = 4.28$

P.14.c. TS: $\chi_{BP}^2 = \frac{SS_{\text{reg}}/2}{(SSE/n)^2} = \frac{.007959/2}{(.713406/25)^2} = 4.887$

RR: $\chi_{BP}^2 \geq \chi_{.05, 1}^2 = 3.84$ Reject H_0

Q.15. $n=30$ $df_1 = 30-10=20$ $df_2 = 30-7=23$ $df_3 = 1-4=26$ $df_4 = 1-5=25$

P.15.a. $F_{obs} = \frac{\frac{86.5-72.4}{23-20}}{\frac{72.4}{20}} = 1.298$ RR: $F_{obs} \geq F_{.05, 3, 20} = 3.10$

P.15.b. $F_{obs} = \frac{\frac{813.6-122.7}{26-25}}{\frac{122.7}{25}} = 140.77$ RR: $F_{obs} \geq F_{.05, 1, 25} = 4.24$

Q.16. P.16.a. $R^2 = \frac{7073.7}{7311.0} = 0.9675$ $r = \text{sign}(\hat{\beta}_1) \sqrt{.9675} = -.9836$

P.16.b. DW = $\frac{161.4}{237.3} = 0.68 < 1.29 \Rightarrow$ Reject H_0

P.16.c. $t_{.025, 23} = 2.069$ $t_{.025, 22} = 2.074$

OLS CI: $-.863 \pm 2.069(.033) = -.863 \pm .068 = (-.931, -.795)$

EGLS CI: $-.845 \pm 2.074(.055) = -.845 \pm .114 = (-.959, -.731)$

Q.17 $n = 14$ $\hat{y}_{15} = -.0046(15)^2 + .1479(15) + .1295 = 1.313$

$H_0: \beta_1 = \beta_2 = 0$ T.S. $F_{obs} = \frac{R^2/p}{[(1-R^2)/(n-p)]} = \frac{.6151/2}{.3849/11} = 8.79$

RR: $F_{obs} \geq F_{.05, 2, 11} = 3.98$

Q.18. $n = 18, p' = 7$ (Full Model) * Change SBC values

P.18.a. $AIC_{1234} = AIC_{1346} = \overset{18}{\cancel{18}} \ln\left(\frac{48.58}{18}\right) + 2(5) = \overset{27.8711}{\cancel{27.8711}}$

$BIC_{1234} = BIC_{1346} = 18 \ln\left(\frac{48.58}{18}\right) + [\ln(18)](5) = 32.3230$

$AIC_{346} = 18 \ln\left(\frac{48.85}{18}\right) + 2(4) = 25.9709$

$BIC_{346} = 18 \ln\left(\frac{48.85}{18}\right) + [\ln(18)](4) = 29.5323$

Note: $BIC_{123456} = 18 \ln\left(\frac{42.62}{18}\right) + [\ln(18)](7) = 35.7477$

$BIC_{12345} = 18 \ln\left(\frac{42.62}{18}\right) + [\ln(18)](6) = 32.8574$

$BIC_{134} = 18 \ln\left(\frac{52.86}{18}\right) + [\ln(18)](4) = \overset{30.9524}{\cancel{64.4215}}$

$BIC_{234} = 18 \ln\left(\frac{75.31}{18}\right) + [\ln(18)](4) = 37.3238$

P.18.b. AIC_{X_3, X_4, X_6} $BIC: X_3, X_4, X_6$

P.18.c. $.9278 = 1 - \frac{42.62}{TSS} \Rightarrow \frac{42.62}{TSS} = .0722 \Rightarrow TSS = \frac{42.62}{.0722} = 590.30$

Q.19 $n=33$ $p_1'=5$ $p_2'=8$

P.19.a. $\hat{y} = -2.450 + 0.989(1) - 0.467(0) + 0.415(1) + 1.027(4) = 3.062$

P.19.b. T.S. $F_{0.65} = \frac{\frac{28.425 - 27.788}{28 - 25}}{\frac{2.095}{25}} = \frac{.212\bar{3}}{.0838} = 2.534$

RR: $F_{0.65} \geq F_{.05, 3, 25} = 2.991$

Q.20

Predictors	p'	SSE	R^2	C_p	AIC	BIC
RFL	2	3439.9	.39	9.00	552.22	531.55
RFB	2	4191.1	.26	48.31	559.79	566.12
Age	2	5560.2	.01	119.95	609.26	615.59
RFL, RFB	3	3282.5	.42	2.86	519.03	528.52
RFL, RFB, AGE	4	3267.9	.42	4.00	520.25	532.90

TSS = 5633.4 $R^2(RFL) = 1 - \frac{3439.9}{5633.4} = .39$

$C_p(RFL, RFB) = \frac{3282.5}{19.1} + 2(3) - 175 = 2.86$

$AIC(AGE) = 175 \ln\left(\frac{5560.2}{175}\right) + 2(2) = 609.26$

$BIC(RFL) = 175 \ln\left(\frac{3439.9}{175}\right) + (\ln 175)(2) = 531.55$

C_p	Best Model	
	AIC	BIC
RFL, RFB	RFL, RFB	RFL, RFB

Q.21. T.S. $F_{obs} = \frac{r^2/1}{(1-r^2)/(136-2)} = \frac{.030}{.970/134} = 4.144$

RA: $F_{obs} \geq F_{.05, 1, 134} \approx 3.90$ Reject H_0

Q.22 Complete Model: (1-way ANOVA): $SSE_C = 115.71$ $df_C = 181$
 Reduced Model: (Simple Linearity): $SSE_R = 119.33$ $df_C = 183$

$SSLF = SSE_R - SSE_C = 3.62$ $df_{LF} = 183 - 181 = 2$

$SSPE = SSE_C = 115.71$ $df_{PE} = 181$

T.S. $F_{obs} = \frac{SSLF/df_{LF}}{SSPE/df_{PE}} = \frac{3.62/2}{115.71/181} = 2.831$

RA: $F_{obs} \geq F_{.05, 2, 181} \approx 3.05$ Do not reject H_0

Q.23 a) TS: $F_{obs} = \frac{3723252 - 3637224}{47-44} = 0.762$
~~1256130~~ $\frac{1656130}{44}$

RA: $F_{obs} \geq F_{.05, 3, 44} \approx 4.06$ Don't reject H_0

P. 23b. $\hat{Y}_1 = 17.07 - 90.48 + 2.42(215) - 0.85(47) = 406.94$

$e_1 = Y_1 - \hat{Y}_1 = 302 - 406.94 = -104.94$

P. 23c. $R^2 = \frac{3637224}{5379382} = .676$

Q.24

P.24.a. T.S. $F_{obs} = \frac{.729/2}{(1-.729)/(24-3)} = 28.25$ $RR: F_{obs} \geq F_{.05, 2, 21} = 3.467$
 Reject H_0

P.24.b. T.S. $F_{obs} = \frac{\frac{43.41-37.41}{22-21}}{\frac{37.41}{21}} = 2.245$ $RR: F_{obs} \geq F_{.05, 1, 21} = 4.325$
 Do not reject H_0 .

P.24.c. $\hat{Y}_1(175) = 4.4353 + .0898(175) = 20.1503$

$\hat{Y}_2(175) = 12.08 + .3285(175) - .0008Y(175)^2 = 43.8425$

Q.25 $n=139$ $p'=2$

P.25.a. T.S: $t_{obs} = \frac{5.32}{0.40} = 13.3$ $RR: |t_{obs}| \geq t_{.025, 137} \approx 1.977$
 Reject H_0

P.25.b. T.S: $F_{obs} = \frac{45933.13/1}{35074.41/137} = 179.41$ $RR: F_{obs} \geq F_{.05, 1, 137} \approx 3.92$
 Reject H_0

P.25.c. T.S. $X^2_{BP} = \frac{SS_{Res}/2}{(SSE/n)^2} = \frac{1070500/2}{(35074.41/139)^2} = 8.406$

$RR: X^2_{BP} \geq X^2_{.05, 1} = 3.84$ Reject H_0 .

Q.26. $n=32$ $TSS=1150$

$$C_p = \frac{SSE}{MSE_F} + 2p' - n$$

$$AIC = n \ln\left(\frac{SSE}{n}\right) + 2p' \quad BIC = n \ln\left(\frac{SSE}{n}\right) + (\ln n)p'$$

P.26.a) $MSE_F = \frac{243}{32-5} = 9$

Model 1: $C_p = \frac{330}{9} + 2(2) - 32 = 8.67$

$p=1$ $AIC = 32 \ln\left(\frac{330}{32}\right) + 2(2) = 78.67$ $BIC = 32 \ln\left(\frac{330}{32}\right) + (\ln(32))(2) = 81.60$

Model 4: $C_p = \frac{255}{9} + 2(3) - 32 = 2.33$

$p=2$ $AIC = 32 \ln\left(\frac{255}{32}\right) + 2(3) = 72.42$ $BIC = 32 \ln\left(\frac{255}{32}\right) + (\ln(32))(3) = 76.81$

Model 10: $C_p = \frac{245}{9} + 2(4) - 32 = 3.22$

$p=3$ $AIC = 32 \ln\left(\frac{245}{32}\right) + 2(4) = 73.14$ $BIC = 32 \ln\left(\frac{245}{32}\right) + (\ln(32))(4) = 79.00$

Model 14: $C_p = \frac{243}{9} + 2(5) - 32 = 5.00$

$p=4$ $AIC = 32 \ln\left(\frac{243}{32}\right) + 2(5) = 74.87$ $BIC = 32 \ln\left(\frac{243}{32}\right) + (\ln(32))(5) = 82.07$

All criteria Choose Model 4: $C_p \leq p'$ AIC, BIC minimized.
(X_2, X_4)

Q.27 $t_{(.025, 16)} = 2.120$ $t_{.025, 15} = 2.131$

P.27.a. $-.431633 \pm 2.120(.009523) = -.431633 \pm .02019 = (-.45182, -.41144)$

P.27.b. Yes

P.27.c. $-.4488 \pm 2.131(.018576) = -.4488 \pm .0396 = (-.4884, -.4092)$

LR11

Q.28 $n=24$ $TSS=3618$ $p_1'=4$ $p_2'=8$

$$MSE_{full} = \frac{483}{24-8} = 30.1875$$

Model 1: $C_p = \frac{874}{30.1875} + 2(4) - 24 = 12.95$

$SSE=874$

$p_1'=4$

$$AIC = 24 \ln\left(\frac{874}{24}\right) + 2(4) = 94.28$$

$$BIC = 24 \ln\left(\frac{874}{24}\right) + (\ln(24))(4) = 98.99$$

Model 2: $C_p = \frac{483}{30.1875} + 2(8) - 24 = 8.00$

$SSE=483$

$p_1'=8$

$$AIC = 24 \ln\left(\frac{483}{24}\right) + 2(8) = 88.05$$

$$BIC = 24 \ln\left(\frac{483}{24}\right) + (\ln(24))(8) = 97.17$$

All choose Model 2

Q.29 $n=43$ $p_1'=2$

P.29.a. T.S. $t_{obs} = \frac{4.33}{0.95} = 4.526$ R.A: $|t_{obs}| \geq t_{.025,41} \approx 2.024$

P.29.b. T.S. $F_{obs} = \frac{29066/1}{57786/41} = 20.623$ R.A: $F_{obs} \geq F_{.05,1,41} \approx 4.085$

P.29.c. T.S. $\chi_{BP}^2 = \frac{111098168/2}{\left(\frac{57786}{43}\right)^2} = 30.759$

R.A: $\chi_{BP}^2 \geq \chi_{.05,1}^2 = 3.841$

Yes, Reject H_0 .

Q.30. $n=441$ $p'_1=8, p'_2=5, p'_3=2$

P.30.a. $H_0: \beta_5 = \beta_6 = \beta_7 = 0$ $H_A: H_0$ is false

$$T.S. F_{obs} = \frac{\frac{SSR_1 - SSR_2}{(441-5) - (441-8)}}{\frac{TSS - SSR_1}{441-8}} = \frac{\frac{178}{3}}{\frac{12827}{433}} = 2.003$$

$RR: F_{obs} \geq F_{.05, 3, 433} \approx 2.625$

P.30.b. $H_0: \beta_2 = \beta_3 = \beta_4 = 0$ $H_A: H_0$ is false

$$T.S. F_{obs} = \frac{\frac{SSR_2 - SSR_3}{(441-2) - (441-5)}}{\frac{TSS - SSR_2}{441-5}} = \frac{\frac{600}{3}}{\frac{13005}{436}} = 6.705$$

$RR: F_{obs} \geq F_{.05, 3, 436} \approx 2.003$

Q.31 $n=34, p'=3$

P.31.a. $T.S: F_{obs} = \frac{202.3}{30.9} = 6.547$ $RR: F_{obs} \geq F_{.05, 2, 31} \approx 3.316$

$$R^2 = \frac{404.6}{1362.7} = .2969$$

P.31.b. $DW = \frac{1794.5}{958.1} = 1.87$ Do not reject H_0

P.31.c. $t_{.025, 31} \approx t_{.025, 30} = 2.042$

OLS: $1.05 \pm 2.042(0.29) = 1.05 \pm 0.59 = (0.46, 1.64)$

EGLS: $1.04 \pm 2.042(0.29) = 1.04 \pm 0.59 = (0.45, 1.63)$

LR13

Q. 32. $n=35$ $p_1' = p_3' = 2$ $p_2' = 3$

P. 32.a.

$X=30$

$$\hat{Y}_1 = 9.77 + 0.7103(30) = 31.079$$

$$\hat{Y}_2 = 10.42 + 0.6465(30) + 0.00087(30)^2 = 31.098$$

$$\hat{Y}_3 = 6.2445(30) + 0.00715(30)^2 = 30.900$$

P. 32.b.

$$SSE_F = 54.797 \quad df_F = 35-3=32$$

$$SSE_R = 57.400 \quad df_R = 35-2=33$$

$$T.S. F_{obs} = \frac{\frac{57.400 - 54.797}{33-32}}{\frac{54.797}{32}} = \frac{2.603}{1.712} = 1.520$$

$$RR: F_{obs} \geq F_{.05, 1, 32} \approx 4.171$$

P. 32.b.

$$SSE_F = 54.797 \quad df_F = 32$$

$$SSE_R = 54.826 \quad df_R = 33$$

$$T.S. F_{obs} = \frac{\frac{54.826 - 54.797}{33-32}}{\frac{54.797}{32}} = 0.017$$

$$RR: F_{obs} \geq F_{.05, 1, 32} \approx 4.171$$

Q.33. $n=277$ $p=5$ $R^2=.44$

P.33.a. $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$

T.S. $F_{obs} = \frac{R^2/p}{(1-R^2)/(n-p)} = \frac{.44/4}{.56/272} = 53.43$

RR: $F_{obs} \geq F_{.05, 4, 272} \approx 2.402$

P.33.b. $H_0: \beta_2 = 0$

T.S. $t_{obs} = \frac{.263}{.052} = 5.058$ RR: $|t_{obs}| \geq t_{.025, 272} \approx 1.969$

Q.34 $n=30$ $p_1=4$ $p_2=7$

P.34.a. TS: $F_{obs} = \frac{\frac{0.54 - 0.48}{3}}{\frac{1 - 0.54}{30 - 7}} = 1.00$

P.34.b.

RR: $F_{obs} \geq F_{.05, 3, 23} = 3.028$

Q.35

	Model 1 (Complete) $p=5$		Model 2 (Reduced)		
	df	SS	df	SS	$g=2$
Regression	5	7397	2	7163	
Residual	11	551	14	785	
Total	16	7948	16	7948	

a) T.S.: $F_{obs} = \frac{\frac{7397 - 7163}{5-2}}{\frac{551}{11}} = \frac{78}{50.091} = 1.557$

RR: $F_{obs} \geq F_{.05, 3, 11} = 3.587$ Fail to reject H_0 .

P.36.d. $R_a^2 = 1 - \frac{1.853}{35.676} = 1 - .0519 = .9481$

Q.37. $s^2 = \frac{1361}{24-5} = 71.632$

a) $C_p(X_2, X_3) = \frac{1531}{71.632} - (24 - 2(3)) = 21.373 - 18 = 3.373$

$AIC(X_1, X_2, X_3, X_4) = 24 \ln\left(\frac{1361}{24}\right) + 2(5) = 96.91 + 10 = 106.91$

$BIC(X_1, X_2, X_3) = 24 \ln\left(\frac{1395}{24}\right) + (\ln(24))(4) = 97.50 + 12.71 = 110.21$

P.37.b. $C_p: X_1, X_2, X_3$ ($3.48 \leq 4$) $AIC: X_1, X_2, X_3$ $BIC: X_3$

P.37.c. $\hat{Y}_1 = 16.59 + 1.06(46) + 2.38(1.6) + 2.96(6.3) = 16.59 + 48.76 + 3.81 + 18.65$
 $= 87.81$ $Y_1 = 92 \Rightarrow e_1 = 92 - 87.81 = 4.19$

P.37.d. $DW = \frac{3206}{1395} = 2.30$ Accept H_0 .

Q.38. $n = 52$ $TSS = 9237$ $R^2 = .262$

a)

ANOVA Source	df	SS	MS	F	F(.05)
Reg	1	2420.0	2420.0	17.75	4.034
Residual	50	6816.7	136.3		
Total	51	9236.7			

b) $n_a (\bar{Y}_a - \hat{Y}_a)^2 = 1(222.00 - 220.78)^2 = 1.22^2 = 1.49$

$SSLF = 524.38$ $df_{LF} = 9 - 2 = 7$ $SSPE = 6293.23$ $df_{PE} = 52 - 9 = 43$

P. 35b) Case 17: $X_1 = 44$ $X_2 = 13$ $Y = 78.5$

Mod 1: $\hat{Y}_{17} = -20.399 - 0.357(44) + 6.155(13) + 0.047(44^2) - 0.077(13^2) - 0.070(44)(13) = -20.399 - 15.708 + 80.015 + 90.992 - 13.013 - 40.040 = 81.847$

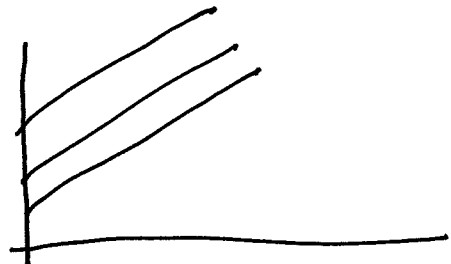
$e_{17} = 78.5 - 81.847 = -3.347$

Mod 2: $\hat{Y}_{17} = -26.064 + 0.957(44) + 4.401(13) = -26.064 + 42.108 + 57.213 = 73.257$

$e_{17} = 78.5 - 73.257 = 5.243$

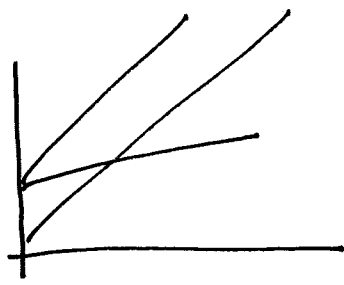
Q. 36 $n = 24$ $TSS = 35.686$

P. 36.a. $E\{Y\} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3$ $SSE = 1.853$ $df_e = 24 - 4 = 20$



P. 36.b. $E\{Y\} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_1 X_2 + \beta_5 X_1 X_3$

$SSE = 1.261$ $df_e = 24 - 6 = 18$



P. 36.c. $H_0: \beta_4 = \beta_5 = 0$ $H_A: \beta_4$ and/or $\beta_5 \neq 0$

T.S. $F_{obs} = \frac{\frac{1.853 - 1.261}{20 - 18}}{\frac{1.261}{18}} = \frac{0.296}{.0701} = 4.225$ $F_{.05, 2, 18} = 3.555$
Reject H_0 .

P. 38.6 continued

$$T.S. F_{LF} = \frac{MSLF}{MSPE} = \frac{524.38/7}{6293.23/43} = \frac{74.91}{146.35} = 0.51$$

RR: $F_{LF} \geq F_{.05, 7, 43} = 2.23$ Fail to Reject H_0

Q. 39

P. 39.a. $t_{obs} = \frac{-.6626}{.3915} = -1.692$ $t_{.05, 43} \approx 1.681$

\Rightarrow Reject H_0 (Barely) Reject H_0 if $|t_{obs}| \geq 1.681$

P. 39.b. $\chi^2_{BP} = \frac{SS_{Reg}^*/2}{(SSE/n)^2} = \frac{1362.60/2}{(489.2068/45)^2} = \frac{681.30}{118.18} = 5.765$

RR: $\chi^2_{BP} \geq \chi^2_{.05, 1} = 3.841$

Q. 40. T.S. $F_{obs} = \frac{R^2/p}{(1-R^2)/(n-p)} = \frac{n-p}{p} \left(\frac{R^2}{1-R^2} \right) = \left(\frac{25-4}{3} \right) \left(\frac{R^2}{1-R^2} \right) = 7 \left(\frac{R^2}{1-R^2} \right)$

RR: $F_{obs} \geq F_{.05, 3, 21} = 3.072$

\Rightarrow Reject H_0 if $7 \left(\frac{R^2}{1-R^2} \right) \geq 3.072 \Rightarrow \frac{R^2}{1-R^2} \geq \frac{3.072}{7} = 0.439$

Q. 41. True If X_1, X_2 are highly correlated.