

PART D: Models with Categorical Predictors, Interaction, and/or Polynomial Terms

Q.D. 1. $DF(REG) = 4$ $DF(ERROR) = 50 - 5 = 45$ $DF(TOTAL) = 50 - 1 = 49$

Q.D. 2. P. 2.a.

Source	df	SS	MS	F	F(.05)	$t(obs)$	$t(.025)$
REG	2	90058	45029	112.9	≈ 3.26	X_1	11.67
ERR	37	14753	399	=		X_2	-9.21
TOT	39	104811					≈ 2.03

P. 2.b. $\boxed{58.22 \text{ less}}$ P. 2.c. .859 P. 2.d. 113.42

Q.D. 3. P. 3.a. $S^2 = \frac{483}{24-8} = 30.188$ $C_p \text{ for Model 1} = \frac{874}{30.188} - (24 - 2(4)) = 12.95$

P. 3.b. $F_{obs} = \frac{874 - 483}{4} = 3.238$ $F_{.05, 4, 16} = 3.007$ No

Q.D. 4. P. 4.a. $t_{obs} = 2.3394$ $RR: t_{obs} \geq t_{.05, 7} = 1.895$

P. 4.b. $-42.3862 \pm 2.365(21.0008) = -42.3862 \pm 49.6669 = (-92.0531, 7.2807)$ Yes

P. 4.c. $7.4192 \pm 2.365(0.7288) = 7.4192 \pm 1.7236 = (5.6956, 9.1428)$ No

P. 4.d. $VIF_x = \frac{1}{1 - .9995^2} = 1000.25$ $VIF_w = \frac{1}{1 - (-.4116)^2} = 1.204$

P. 4.e. $\hat{y}_1 = 1784.1883 - 42.3862(90) + .2722(90^2) = 174.25$
 $\hat{y}_2 = 184.4443 + 7.4192(-1.5) + .2722(-1.5)^2 = 173.93$ } *Round. off due to decimal places*

Q.D. 5. P. 5.a. $F_{obs} = 1.298$ $F_{.05} = 3.098$ P. 5.b. $F_{obs} = 144.71$ $F_{.05} = 4.242$

Q.D. 6. $n = 14$ $\hat{y}_{15} = -.0046(15^2) + .1479(15) + .1295 = 1.0880$

T.S. $F_{obs} = \frac{-.6151/2}{(1 - .6151)/(14-3)} = 8.789$ $RR: F_{obs} \geq F_{.05} = 3.982$

Q.D. 7. P. 7.a. $\hat{y} = 3.062$ P. 7.b. $F_{obs} = 2.528$ $F_{.05} = 2.991$

Q.D. 8. P. 8.a. $F_{obs} = 28.25$ $F_{.05} = 3.467$ P. 8.b. $F_{obs} = 3.368$ $F_{.05} = 4.325$

P. 8.c. Model 1: $\hat{y} = 20.15$ Model 2: $\hat{y} = 43.84$

Q.D.9. P.9.a. $H_0: \beta_5 = \beta_6 = \beta_7 = 0$ $H_A: H_0$ is False $TS: F_{obs} = \frac{12020 - 11842}{3} = \frac{178}{3} = 59.33$
 $\frac{24847 - 12020}{441 - 8} = \frac{12827}{433} = 29.62$ ≈ 2.003

P.9.b. $H_0: \beta_2 = \beta_3 = \beta_4 = 0$ $H_A: H_0$ False $RR: F_{obs} \geq F_{.05, 3, 433} \approx 2.625$
 $TS: F_{obs} = \frac{11842 - 11242}{3} = \frac{600}{3} = 200$ $\frac{24847 - 11842}{441 - 5} = \frac{13005}{436} = 29.83$ ≈ 6.71 $RR: F_{obs} \geq F_{.05, 3, 436} \approx 2.625$


Q.D.10. P.10.a. Mod1: 31.08 Mod2: 31.10 Mod3: 30.90


P.10.b. $F_{obs} = 1.52$ $F_{.05} \approx 4.15$ P.10.c. $F_{obs} = 0.017$ $F_{.05} \approx 4.15$

Q.D.11. P.11.a. $F_{obs} = 1.000$ P.11.b. $F_{.05} = 3.028$

Q.D.12. (oil platforms) P.12.a. $F_{obs} = 1.557$ $F_{.05} = 3.587$

P.12.b. Model 1: $\hat{y}_{17} = 81.08$, $e_{17} = -3.4$ Model 2: $\hat{y}_{17} = 73.3$, $e_{17} = 5.2$

Q.D.12. P.12.a. $E\{Y\} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3$  $df_E = 24 - 4 = 20$

P.12.b. P.12.b. $E\{Y\} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_1 X_2 + \beta_5 X_1 X_3$  $df_E = 24 - 6 = 18$

P.12.c. $F_{obs} = \frac{1.853 - 1.261}{\frac{20 - 18}{1.261}} = 4.225$ $F_{.05} = 3.555$ P.12.d. $R^2 = .948$

Q.D.13. $df_{reg} = 3 + (3-1) + (2-1) = 6$ $df_{error} = 30 - 6 - 1 = 23$

Q.D.14. M/0: 50000 F/0: 57000 M/10: 70000 F/10: 70000

Q.D.15. P.15.a.

Source	df	SS	MS	F	$F_{.05}$	<u>P.15.b.</u> smaller
Regression	3	.0478	.0159	58.9	≈ 2.774	
Residual	55	.0146	.00027			
Total	58	.0624				

P.15.c. .766 P.15.d. $t_5 = -1.463$, $t_6 = 7.87$, $t_{5 \times 6} = 1.535$ $t_{.025} \approx 2.005$

Q.D. 16. P.16.a. $F_{obs} = 5.799$ $F_{.05} = 3.411$ P.16.b. $F_{obs} = 6.340$ $F_{.05} = 3.708$

Q.D. 17.

Source	df	SS	MS	F	F(.05)
Regression	2	13.72	6.86	8.68	3.555
Residual	18	14.23	0.79		
Total	20	27.95			

P.17.b. $P < .05$

P.17.c. $S = \sqrt{.79} = .89$

P.17.d. $t_1 = 2.499$, $t_2 = 2.282$ $t_{.05} = 1.734$

Q.D. 18. P.18.a. $H_0: \beta_{12} = \beta_{13} = \beta_{23} = \beta_{11} = \beta_{22} = \beta_{33} = 0$ TS: $F_{obs} = 1.548$
 $H_a: H_0$ is False RR: $F_{obs} \geq F_{.05} = 3.866$

P.18.b. Model 1: .899 Model 2: .943 Model 3: .956

Q.D. 19. P.19.a. $F_{obs} = 143.3$ $F_{.05} \approx 2.747$ P.19.b. .870

P.19.c. $SSR(X_1) = 22528.0$ $SSR(X_2|X_1) = 17391.6$ $SSR(X_1, X_2|X_1, X_2) = 5182.6$
 $SSR(X_2) = 39919.6$ $SSR(X_1|X_2) = 170.9$

P.19.d. $R^2_{YX_2, X_1} = \frac{SSR(X_2|X_1)}{TSS - SSR(X_1)} = \frac{17391.6}{29483.4} = .590$

Q.D. 20. P.20.a. $H_0: \beta_4 = \beta_5 = \beta_6 = \beta_7 = 0$ P.20.b. $F_{obs} = 1.155$ $F_{.05} = 2.709$

P.20.c. $1 - \frac{30808}{TSS} = .9965 \Rightarrow .0035 = \frac{30808}{TSS} \Rightarrow TSS = 8802286$

Q.D. 21. P.21.a. .988 P.21.b. $\frac{2.788 - 2.497}{2.788} = .104$

P.21.c. $F_{obs} = 15.07$ $F_{.05} = 2.928$

Q.D. 22. P.22.a. $R_1^2 = .550$ $R_2^2 = .727$ $R_3^2 = .782$

P.22.b.

	Non-us	us
5	2.98	5.55
6	4.93	9.30
6-5	1.95	3.75

P.22.c. $F_{obs} = 78.74$ $F_{.05} \approx 2.745$

Q.D. 23. $p^* = 1+3+3+3 = 10$ $n-p^* = 25 \Rightarrow n = 35$

Q.D. 24. P. 24.a. $F_{obs} = 6.689$ $F_{.05} \approx 2.88$

P. 24.b. $H_0: \beta_2 = \beta_3 = 0$ $F_{obs} = 0.741$ $F_{.05} \approx 3.274$

Q.D. 25. P. 25.a. $n = 20$ P. 25.b. $F = .5093$, $P = .7616$

P. 25.c. $TSS = 1,01326$ i) .282 ii) .485 iii) .913

Q.D. 26. P. 26.a. Model 1: #params = 8 Model 2: 19

P. 26.b. $F_{obs} = 64.26$ $F_{.05} \approx 2.010$ P. 26.c. $F_{obs} = 5.463$ $F_{.05, 11, 499} < 1.752$

Q.D. 27. P. 27.a. $F_{obs} = 967.6$ $F_{.05} = 3.344$ P. 27.b. .990

P. 27.c. 10.8436 11.2756 11.7076 (11.7076)

10.8916 11.1596 11.6596

10.8986 11.1718 11.6130

Q.D. 28. P. 28.a. $F/23: 158.226$ $F/25: 166.2100$ $M/23: 162.011$ $M/25: 170.187$

P. 28.b. $F_{obs} = 407.28$ $F_{.05} \approx 3.841$ P. 28.c. $F_{obs} = 0.599$ $F_{.05} \approx 3.841$

Q.D. 29. P. 29.a. $F_{obs} = 0.762$ $F_{.05} = 2.82$ P. 29.b. $\hat{y} = 480.79$, $e = -179$
(481)

P. 29.c. .676