GLT approach / Regression

Yes

For the general linear test approach

page 72-73, 121-127, 972-974 of textbook

H_0 : reduced model v.s. H_1 : full model.

GLT approach: Reject H_0 at level α if $F^* > F_{df_R-df_F,df_F,\alpha}$

Ex: problem 6.18 Commercial properties. page 252

A commercial real estate company evaluates vacancy rates, square footage, rental rates, and operating expenses for commercial properties in a large metropolitan area in order to provide clients with quantitative information upon which to make rental decisions. The data below are taken from 81 suburban commercial properties that are the newest, best located, most attractive, and expensive for five specific geographic areas. Shown here are the age (x_1), operating expenses and taxes (x_2), vacancy rates (x_3), total square footage (x_4), and rental rates (Y).

Full model: Y=

Denote SSE_F = SSE1234

```
ch6pr18 <- matrix(scan("CH06PR18.txt"),ncol=5, byrow=T) ;
# y <- ch6pr18[,1];
# x1 <- ch6pr18[,2];
# x2 <- ch6pr18[,3];
# x3 <- ch6pr18[,4];
# x4 <- ch6pr18[,5];
dum <- data.frame(ch6pr18)
names(dum) <- c("Rates","Age","OET","VR","TSF")
# dum <- data.frame("Rates"=y,"Age"=x1,"OET"=x2,"VR"=x3,"TSF"=x4)
attach(dum)
dum
```

```
    Rates Age   OET   VR    TSF
1  13.500   1  5.02 0.14 123000
2  12.000  14  8.19 0.27 104079
3  10.500  16  3.00 0.00  39998
4  15.000   4 10.70 0.05  57112
5  14.000  11  8.97 0.07  60000
6  10.500  15  9.45 0.24 101385
7  14.000   2  8.00 0.19  31300
8  16.500   1  6.62 0.60 248172
9  17.500   1  6.20 0.00 215000
10 16.500   8 11.78 0.03 251015
11 17.000  12 14.62 0.08 291264
12 16.500   2 11.55 0.03 207549
13 16.000   2  9.63 0.00  82000
14 16.500  13 12.99 0.04 359665
15 17.225   2 12.01 0.03 265500
16 17.000   1 12.01 0.00 299000
17 16.000   1  7.99 0.14 189258
18 14.625  12 10.33 0.12 366013
19 14.500  16 10.67 0.00 349930
20 14.500   3  9.45 0.03  85335
```

21	16.500	6	12.65	0.13	235932
22	16.500	3	12.08	0.00	130000
23	15.000	3	10.52	0.05	40500
24	15.000	3	9.47	0.00	40500
25	13.000	14	11.62	0.00	45959
26	12.500	1	5.00	0.33	120000
27	14.000	15	9.89	0.05	81243
28	13.750	16	11.13	0.06	153947
29	14.000	2	7.96	0.22	97321
30	15.000	16	10.73	0.09	276099
31	13.750	2	7.95	0.00	90000
32	15.625	3	9.10	0.00	184000
33	15.625	3	12.05	0.03	184718
34	13.000	16	8.43	0.04	96000
35	14.000	16	10.60	0.04	106350
36	15.250	13	10.55	0.10	135512
37	16.250	1	5.50	0.21	180000
38	13.000	14	8.53	0.03	315000
39	14.500	3	9.04	0.04	42500
40	11.500	15	8.20	0.00	30005
41	14.250	1	6.13	0.00	60000
42	15.500	15	8.32	0.00	73521
43	12.000	1	4.00	0.00	50000
44	14.250	15	10.10	0.00	50724
45	14.000	3	5.25	0.16	31750
46	16.500	3	11.62	0.00	168000
47	14.500	4	5.31	0.00	70000
48	15.500	1	5.75	0.00	27000
49	16.750	4	12.46	0.03	129614
50	16.750	4	12.75	0.00	129614
51	16.750	2	12.75	0.00	130000
52	16.750	2	11.38	0.00	209000
53	17.000	1	5.99	0.57	220000
54	16.000	2	11.37	0.27	60000
55	14.500	3	10.38	0.00	110000
56	15.000	15	10.77	0.05	101206
57	15.000	17	11.30	0.00	288847
58	16.000	1	7.06	0.14	105000
59	15.500	14	12.10	0.05	276425
60	15.250	2	10.04	0.06	33000
61	16.500	1	4.99	0.73	210000
62	19.250	0	7.33	0.22	240000
63	17.750	18	12.11	0.00	281552

```
64 18.750  16 12.86 0.00 421000
65 19.250  13 12.70 0.04 484290
66 14.000  20 11.58 0.00 234493
67 14.000  18 11.58 0.03 230675
68 18.000  16 12.97 0.08 296966
69 13.750   1  4.82 0.00  32000
70 15.000   2  9.75 0.03  38533
71 15.500  16 10.36 0.02 109912
72 15.900   1  8.13 0.23 236000
73 15.250  15 13.23 0.05 243338
74 15.500   4 10.57 0.04 122183
75 14.750  20 11.22 0.00 128268
76 15.000   3 10.34 0.00  72000
77 14.500   3 10.67 0.00  43404
78 13.500  18  8.60 0.08  59443
79 15.000  15 11.97 0.14 254700
80 15.250  11 11.27 0.03 434746
81 14.500  14 12.68 0.03 201930
```

```r
fm1234 <- lm(Rates~Age+OET+VR+TSF, dum)
SSE1234<-sum((Rates-fitted(fm1234))^2)
SSE1234
```

```
[1] 98.23059
```

```r
anova(fm1234)
```

```
Analysis of Variance Table

Response: Rates
          Df Sum Sq Mean Sq F value    Pr(>F)    
Age        1 14.819  14.819 11.4649  0.001125 ** 
OET        1 72.802  72.802 56.3262 9.699e-11 ***
VR         1  8.381   8.381  6.4846  0.012904 *  
TSF        1 42.325  42.325 32.7464 1.976e-07 ***
Residuals 76 98.231   1.293                      
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
fm12 <- lm(Rates~Age+OET, dum)   # reduced model has only two predictors X1, X2
SSE12<-sum((Rates-fitted(fm12))^2)
SSE12
```

```
[1] 148.937
```

```r
anova(fm12)
```

```
Analysis of Variance Table

Response: Rates
          Df  Sum Sq Mean Sq F value    Pr(>F)
Age        1  14.819  14.819  7.7606  0.006701 **
OET        1  72.802  72.802 38.1272 2.787e-08 ***
Residuals 78 148.937   1.909
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
F34 <- ((SSE12-SSE1234)/2)/(SSE1234/76)   # F stat for testing H0: beta3=0 and beta4=0
F34
```

```
[1] 19.6155
```

```r
qf(.95,2,76)                              # level of the test = 0.05
```

```
[1] 3.116982
```

```r
fm3 <- lm(Rates~VR, dum)       # reduced model has only one predictor X3
SSE3<-sum((Rates-fitted(fm3))^2)
SSE3
```

```
[1] 235.5106
```

```r
anova(fm3)
```

```
Analysis of Variance Table

Response: Rates
          Df  Sum Sq Mean Sq F value Pr(>F)
VR         1   1.047  1.0470  0.3512 0.5551
Residuals 79 235.511  2.9811
```

```r
F124 <- ((SSE3-SSE1234)/3)/(SSE1234/76)  # F stat for testing H0: beta1=beta2=beta4=0
F124
```

```
[1] 35.40403
```

```r
qf(.95,3,76)
```

```
[1] 2.724944
```

```r
# Ex 3
fm124 <- lm(Rates~Age+OET+TSF, dum)       # reduced model has three predictors X1 2 4
SSE124<-sum((Rates-fitted(fm124))^2)
SSE124
```

```
[1] 98.65034
```

```r
anova(fm124)
```

```
Analysis of Variance Table

Response: Rates
          Df Sum Sq Mean Sq F value    Pr(>F)
Age        1 14.819  14.819  11.566  0.001067 **
OET        1 72.802  72.802  56.825 7.841e-11 ***
TSF        1 50.287  50.287  39.251 1.973e-08 ***
Residuals 77 98.650   1.281
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
F3 <- ((SSE124-SSE1234)/1)/(SSE1234/76)  # F stat fpr testing H0: beta3=0
F3
```

```
[1] 0.3247534
```

```r
qf(.95,1,76)
```

```
[1] 3.96676
```

What is $H_0: $ for Ex s ?