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**To: Students in Finance 425**

**Subject: Some comments on the next two chapters.**

1. There is an error in Column 5 of Table 6-11. The whole column is wrong, and this means that calculation 6-63 is wrong. The first few values for column 5 should be:

$$\begin{array}{c} (e_t - e_{t-1})^2 \\ (5) \\ 0.0114 \\ 0.0199 \\ 0.1314 \\ 0.0023 \end{array}$$

**The total is 0.6445; I think he just got the wrong column.**

2. The second item is related to problem 6-21, the Web page has a file setup for FPW, it's called 6\_21V.wk1. You will not be able to answer all of the questions using FPW.
3. The Cochrane-Orcutt procedure discussed at the end of Chapter 6 can be implemented in FPW very easily. See attached handout for the worked out problem. I have put the file T6-13V3.wk1 on the FTP site. You download and use it to reproduce the results the handout got. A good exercise since you should begin to check your models with FPW to see if it recommends improvements. You probably want to do that with both problems 21 and 26. And the problems in chapter 7.
4. As to the normal probability plot requested for problem 21. If you are using Excel you can get there fairly quickly. There is a crude option on the regression add-in that will compute a normal probability graph for you. Choose the box and a plot will appear. But instead of relative numbers in percentage it uses absolute numbers. Instead of a 45 degree line you would just look for a straight line. If you want to reproduce the graph on page 252 and 253 exactly you need to put the residuals into a histogram and then cumulate the histogram. You can do this by using the histogram analysis tool. This will reproduce on one graph the combined graphs on pages 252 and 253. You need to create a set of bins that you want the values counted into. The first few would look like this:  
-3.0  
-2.75  
1.25  
Etc.  
+3.0

Then follow the Data analysis histogram tool and choose chart output options. You can try different ones to see the impact.

5. For chapter 7 skip the discussion of Step-wise Regression on pages 314-322. Generally you will want to use FPW for doing the problems. For problem 7, I will supply the Chow test results so you are responsible only for the use of dummy variables. There is a example file available on the Web site (7\_EXPL.wb3 or 7\_EXPL.xls). Again don't forget that the data is available for these problems, particularly important when you look at problem 10. Also be sure to use FPW to see if you can improve the regression results over what is required in the questions.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	
1	Table 6_1																
2	This is a general layout for a regression analysis using the tools available in most spreadsheets. It uses data from table 6. 1. Of course the																
3	output could then be used in a turning point analysis and a more detailed error analysis. You can also use FPW to obtain the regression results																
4	although in this case the question asks for more detail than is supplied by FPW. But there are techniques that FPW will do that are very difficult																
5	(impossible?) to do in Spreadsheet.																
6		SALES	SOV	RINC	Calculated Y's	Error	0.950	1.960	No Adjust		Standardized	Durbin/Watson		e*et-1	et-1^2		
7	Year	Y	XI	XII	Yc	e	Higher	Bottom	Upper	Lower	Errors	e^2	(e-et-1)^2	Desgr	DeXe	eLsqr	
8	1969.00	2.68	19.90	113.00	2.71	-0.028	3.379	2.037	3.303	2.113	-0.092	0.001					
9	1970.00	3.01	22.60	118.00	3.14	-0.130	3.785	2.494	3.735	2.545	-0.427	0.017	0.010	0.004	0.001		
10	1971.00	3.61	26.00	121.00	3.65	-0.044	4.288	3.021	4.250	3.059	-0.146	0.002	0.007	0.006	0.017		
11	1972.00	2.59	20.50	118.00	2.84	-0.248	3.500	2.175	3.433	2.243	-0.816	0.061	0.041	0.011	0.002		
12	1973.00	4.41	21.50	271.00	4.32	0.090	4.950	3.691	4.915	3.725	0.296	0.008	0.114	-0.022	0.061		
13	1974.00	4.02	23.50	190.00	3.90	0.121	4.518	3.280	4.494	3.304	0.399	0.015	0.001	0.011	0.008		
14	1975.00	3.58	21.50	175.00	3.48	0.100	4.116	2.845	4.075	2.885	0.328	0.010	0.000	0.012	0.015		
15	1976.00	5.04	26.20	263.00	4.93	0.114	5.535	4.316	5.521	4.330	0.377	0.013	0.000	0.011	0.010		
16	1977.00	5.81	28.50	334.00	5.88	-0.067	6.506	5.248	6.472	5.282	-0.221	0.005	0.033	-0.008	0.013		
17	1978.00	5.60	29.50	368.00	6.32	-0.718	6.965	5.671	6.913	5.723	-2.366	0.516	0.424	0.048	0.005		
18	1979.00	5.05	24.50	305.00	5.05	0.001	5.666	4.431	5.644	4.454	0.004	0.000	0.518	-0.001	0.516		
19	1980.00	4.80	29.50	210.00	4.94	-0.136	5.559	4.313	5.531	4.341	-0.448	0.018	0.019	0.000	0.000		
20	1981.00	6.02	26.10	387.00	6.00	0.024	6.639	5.353	6.591	5.401	0.079	0.001	0.026	-0.003	0.018		
21	1982.00	5.41	27.30	270.00	5.14	0.265	5.756	4.533	5.740	4.550	0.873	0.070	0.058	0.006	0.001		
22	1983.00	4.14	22.30	218.00	3.97	0.169	4.594	3.349	4.567	3.376	0.555	0.028	0.009	0.045	0.070		
23	1984.00	5.91	31.00	342.00	6.31	-0.396	6.956	5.657	6.902	5.711	-1.305	0.157	0.319	-0.067	0.028		
24	1985.00	4.91	28.00	173.00	4.40	0.513	5.018	3.776	4.992	3.802	1.690	0.263	0.827	-0.203	0.157		
25	1986.00	6.59	28.50	370.00	6.19	0.398	6.834	5.550	6.787	5.597	1.310	0.158	0.013	0.204	0.263		
26	1987.00	3.61	23.10	170.00	3.67	-0.056	4.292	3.041	4.262	3.071	-0.186	0.003	0.206	-0.022	0.158		
27	1988.00	4.09	27.00	205.00	4.53	-0.443	5.145	3.921	5.128	3.938	-1.459	0.196	0.149	0.025	0.003		
28	1989.00	6.81	32.00	331.00	6.35	0.456	7.010	5.697	6.949	5.759	1.502	0.208	0.809	-0.202	0.196		
29	1990.00	5.95	32.00	283.00	5.93	0.016	6.581	5.287	6.529	5.339	0.053	0.000	0.194	0.007	0.208		
30				Sum		0.000					Sum	1.752	3.779	-0.138	1.752		
31	SUM(x-xb)^2	31.88	290.81	169521.50	Average	0.000	These are Eq 6-11										
32	Count	22	22	22	Variance	0.080					DW	2.157	r				
33	Mean	4.71	25.95	242.50	Std Dev	0.282											
34	Std Dev	1.20	3.64	87.78	Adjusted Std Dev	0.304											
35																	
36																	
37																	
38																	
39																	
40		Correlation Matrix					XII	XI	Constant								
41	Sales	Price	RINC		0.008749269	0.14367885	-1.139907943										
42	SOV			0.000951154	0.022964396	0.488878701											
43	RINC			0.945051941	0.303641504	#N/A											
44				163.3905482	19	#N/A											
45				30.12861673	1.751765093	#N/A											
46																	
47																	
48																	
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6	Year	SALES Y	SOV XI	RINC XII	Calculated Y's Yc	Error e	0.95 Higher	1.96 Bottom	No Adjust Upper	Lower	Standardized Errors	e^2 esqr	Durbin/Watson (e-et-1)^2 Desgr	e*et-1 DeXe	et-1^2 eLsqr		
7																	
8	1969	2.68	19.9	113	=F56+F561*C8+G61*D8	=B8-E8	=E8+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E8-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E8+\$H\$6*\$F\$49	=E8-\$H\$6*\$F\$49	=F8/\$F\$49	=F8^2	=F8-F9)^2	=F8*F9	=L8		
9	1970	3.01	22.6	118	=F56+F561*C9+G61*D9	=B9-E9	=E9+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E9-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E9+\$H\$6*\$F\$49	=E9-\$H\$6*\$F\$49	=F9/\$F\$49	=F9^2	=F9-F10)^2	=F9*F10	=L9		
10	1971	3.61	26	121	=F56+F561*C10+G61*D10	=B10-E10	=E10+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E10-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E10+\$H\$6*\$F\$49	=E10-\$H\$6*\$F\$49	=F10/\$F\$49	=F10^2	=F10-F11)^2	=F10*F11	=L10		
11	1972	2.59	20.5	118	=F56+F561*C11+G61*D11	=B11-E11	=E11+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E11-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E11+\$H\$6*\$F\$49	=E11-\$H\$6*\$F\$49	=F11/\$F\$49	=F11^2	=F11-F12)^2	=F11*F12	=L11		
12	1973	4.41	21.5	271	=F56+F561*C12+G61*D12	=B12-E12	=E12+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E12-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E12+\$H\$6*\$F\$49	=E12-\$H\$6*\$F\$49	=F12/\$F\$49	=F12^2	=F12-F13)^2	=F12*F13	=L12		
13	1974	4.02	23.5	190	=F56+F561*C13+G61*D13	=B13-E13	=E13+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E13-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E13+\$H\$6*\$F\$49	=E13-\$H\$6*\$F\$49	=F13/\$F\$49	=F13^2	=F13-F14)^2	=F13*F14	=L13		
14	1975	3.58	21.5	175	=F56+F561*C14+G61*D14	=B14-E14	=E14+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E14-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E14+\$H\$6*\$F\$49	=E14-\$H\$6*\$F\$49	=F14/\$F\$49	=F14^2	=F14-F15)^2	=F14*F15	=L14		
15	1976	5.04	26.2	263	=F56+F561*C15+G61*D15	=B15-E15	=E15+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E15-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E15+\$H\$6*\$F\$49	=E15-\$H\$6*\$F\$49	=F15/\$F\$49	=F15^2	=F15-F16)^2	=F15*F16	=L15		
16	1977	5.81	28.5	334	=F56+F561*C16+G61*D16	=B16-E16	=E16+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E16-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E16+\$H\$6*\$F\$49	=E16-\$H\$6*\$F\$49	=F16/\$F\$49	=F16^2	=F16-F17)^2	=F16*F17	=L16		
17	1978	5.6	29.5	368	=F56+F561*C17+G61*D17	=B17-E17	=E17+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E17-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E17+\$H\$6*\$F\$49	=E17-\$H\$6*\$F\$49	=F17/\$F\$49	=F17^2	=F17-F18)^2	=F17*F18	=L17		
18	1979	5.05	24.5	305	=F56+F561*C18+G61*D18	=B18-E18	=E18+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E18-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E18+\$H\$6*\$F\$49	=E18-\$H\$6*\$F\$49	=F18/\$F\$49	=F18^2	=F18-F19)^2	=F18*F19	=L18		
19	1980	4.8	29.5	210	=F56+F561*C19+G61*D19	=B19-E19	=E19+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E19-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E19+\$H\$6*\$F\$49	=E19-\$H\$6*\$F\$49	=F19/\$F\$49	=F19^2	=F19-F20)^2	=F19*F20	=L19		
20	1981	6.02	26.1	387	=F56+F561*C20+G61*D20	=B20-E20	=E20+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E20-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E20+\$H\$6*\$F\$49	=E20-\$H\$6*\$F\$49	=F20/\$F\$49	=F20^2	=F20-F21)^2	=F20*F21	=L20		
21	1982	5.41	27.3	270	=F56+F561*C21+G61*D21	=B21-E21	=E21+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E21-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E21+\$H\$6*\$F\$49	=E21-\$H\$6*\$F\$49	=F21/\$F\$49	=F21^2	=F21-F22)^2	=F21*F22	=L21		
22	1983	4.14	22.3	218	=F56+F561*C22+G61*D22	=B22-E22	=E22+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E22-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E22+\$H\$6*\$F\$49	=E22-\$H\$6*\$F\$49	=F22/\$F\$49	=F22^2	=F22-F23)^2	=F22*F23	=L22		
23	1984	5.91	31	342	=F56+F561*C23+G61*D23	=B23-E23	=E23+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E23-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E23+\$H\$6*\$F\$49	=E23-\$H\$6*\$F\$49	=F23/\$F\$49	=F23^2	=F23-F24)^2	=F23*F24	=L23		
24	1985	4.91	28	173	=F56+F561*C24+G61*D24	=B24-E24	=E24+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E24-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E24+\$H\$6*\$F\$49	=E24-\$H\$6*\$F\$49	=F24/\$F\$49	=F24^2	=F24-F25)^2	=F24*F25	=L24		
25	1986	6.59	28.5	370	=F56+F561*C25+G61*D25	=B25-E25	=E25+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E25-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E25+\$H\$6*\$F\$49	=E25-\$H\$6*\$F\$49	=F25/\$F\$49	=F25^2	=F25-F26)^2	=F25*F26	=L25		
26	1987	3.61	23.1	170	=F56+F561*C26+G61*D26	=B26-E26	=E26+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E26-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E26+\$H\$6*\$F\$49	=E26-\$H\$6*\$F\$49	=F26/\$F\$49	=F26^2	=F26-F27)^2	=F26*F27	=L26		
27	1988	4.09	27	205	=F56+F561*C27+G61*D27	=B27-E27	=E27+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E27-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E27+\$H\$6*\$F\$49	=E27-\$H\$6*\$F\$49	=F27/\$F\$49	=F27^2	=F27-F28)^2	=F27*F28	=L27		
28	1989	6.81	32	331	=F56+F561*C28+G61*D28	=B28-E28	=E28+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E28-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E28+\$H\$6*\$F\$49	=E28-\$H\$6*\$F\$49	=F28/\$F\$49	=F28^2	=F28-F29)^2	=F28*F29	=L28		
29	1990	5.95	32	283	=F56+F561*C29+G61*D29	=B29-E29	=E29+\$H\$6*\$F\$49*((1+\$B\$32)+)	=E29-\$H\$6*\$F\$49*((1+\$B\$32)-)	=E29+\$H\$6*\$F\$49	=E29-\$H\$6*\$F\$49	=F29/\$F\$49	=F29^2	=F29-F30)^2	=F29*F30	=L29		
30					Sum	=SUM(F8:F29)					Sum	=SUM(esqr)	=SUM(Desgr)	=SUM(DeXe)	=SUM(eLsqr)		
31	SUM(x-xb)^2	=STDEV((Y)^2*B32	=STDEV(XI)^2*C32	=STDEV(XII)^2*D32	Average	=AVERAGE(F8:F29)	These are Eq 6-11				DW	=M30/L30	r	=N30/O30			
32	Count	=COUNTA(Y)	=COUNTA(XI)	=COUNTA(XII)	Variance	=VARP(F8:F29)											
33	Mean	=AVERAGE(B8:B29)	=AVERAGE(C8:C29)	=AVERAGE(D8:D29)	Std Dev	=F32*0.5											
34	Std Dev	=STDEV(B8:B29)	=STDEV(C8:C29)	=STDEV(D8:D29)	Adjusted Std Dev	=(+F32*D32/R65)^0.5											
35																	
36																	
37																	
38																	
39																	
40																	
41																	
42	Sales	=PEARSON(Y,Y)	Price	RINC	=LINEST(Y,x,1,1)												
43	SOV	=PEARSON(Y,XI)	=PEARSON(C8:C29,C8:C29)	=PEARSON(C8:C29,D8:D29)	=LINEST(Y,x,1,1)												
44	RINC	=PEARSON(Y,XII)	=PEARSON(C8:C29,D8:D29)	=PEARSON(D8:D29,D8:D29)	=LINEST(Y,x,1,1)												
45																	
46																	
47																	
48																	
49																	
50																	
51	All Variables	=+F51															
52	SOV	=+B43^2															
53	RINC	=+B44^2															
54																	
55																	
56	=A53																
57	SOV																
58																	
59																	
60																	
61	Equation 5-4																
62																	
63	Correlation	=CORREL(Y,XI)															
64	Covariance	=CORREL(Y,XI)*B34*C34	=CORREL(Y,XII)														
65																	
66																	
67																	
68																	
69																	
70																	
71																	
72	Variable X2 =	((Total R^2) - [R^2 of X1]) / (1 - [R^2 of X1])															
73																	
74																	
75	** The delta between the All variables and the one variable																
76																	
77	Variable X2 =	((Total R^2) - [R^2 of X1])															
78																	
79																	

Equation 6-45

Equation 6-62

Equation 6-71

This spreadsheet uses these name for these ranges:

Desgr = \$M\$8:\$M\$29  
DeXe = \$N\$8:\$N\$29  
eLsqr = \$O\$8:\$O\$29  
esqr = \$L\$8:\$L\$29  
MEAN = \$B\$33:\$D\$33  
Print Area = \$A\$1:\$P\$79  
STD DEV = \$B\$34:\$D\$34  
x = \$C\$8:\$D\$29  
XI = \$C\$8:\$C\$29  
XII = \$D\$8:\$D\$29  
Y = \$B\$8:\$B\$29

Equation 6-18

Table 6-1 Data Analysis Using FPW

Forecast Pro Version 4.00 Extended Edition

Database D:\AADOC\PETE\F425\Data\SIX\t6\_1v.wk1 is open and ready for use.

Forecast Model for Sales  
Regression(3 regressors, 0 lagged errors)

Term	Coefficient	Std. Error	t-Statistic	Significance
RINC	0.008749	0.000951	9.198585	1.000000
SOV	0.143679	0.022964	6.256591	0.999995
_CONST	-1.139908	0.488879	-2.331678	0.969124

Within-Sample Statistics

Sample size 22	Number of parameters 3
Mean 4.711	Standard deviation 1.232
R-square 0.9451	Adjusted R-square 0.9393
Durbin-Watson 2.157	Ljung-Box(14)=10.79 P=0.2975
Forecast error 0.3036	BIC 0.3484
MAPE 0.0432	RMSE 0.2822
MAD 0.2061	

Variable specification test battery

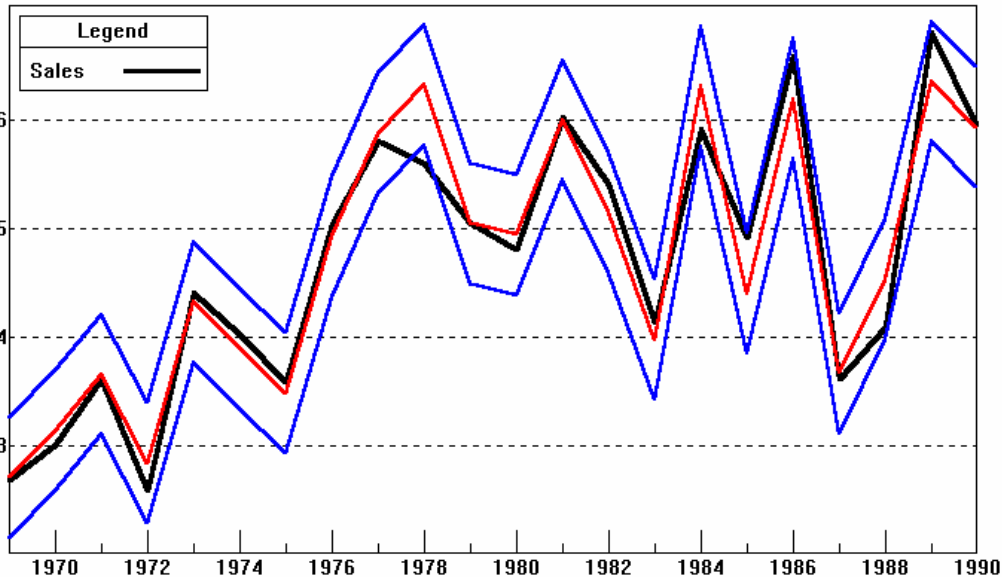
RINC[-1]	ChiSq( 1)=0.12	Percentile=0.2688
SOV[-1]	0.93	0.6641
_TREND	1.37	0.7586

Variable specification tests successful.

Dynamics test battery

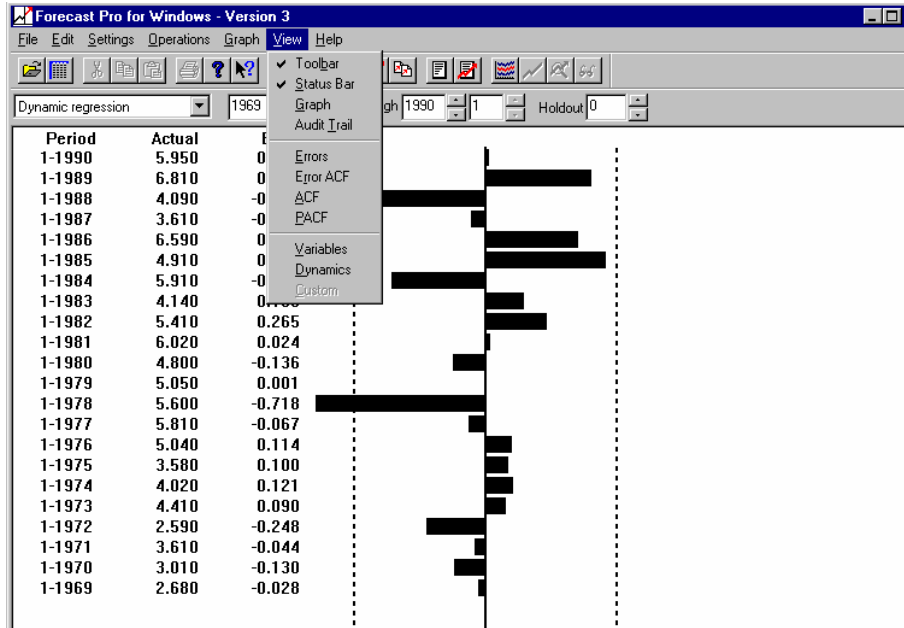
SALES[- 1]	ChiSq( 1)=0.29	Percentile=0.4106
SALES[- 2]	0.73	0.6083
_AUTO[- 1]	ChiSq( 1)=0.11	Percentile=0.2566
_AUTO[- 2]	1.16	0.7181

Dynamics tests successful.

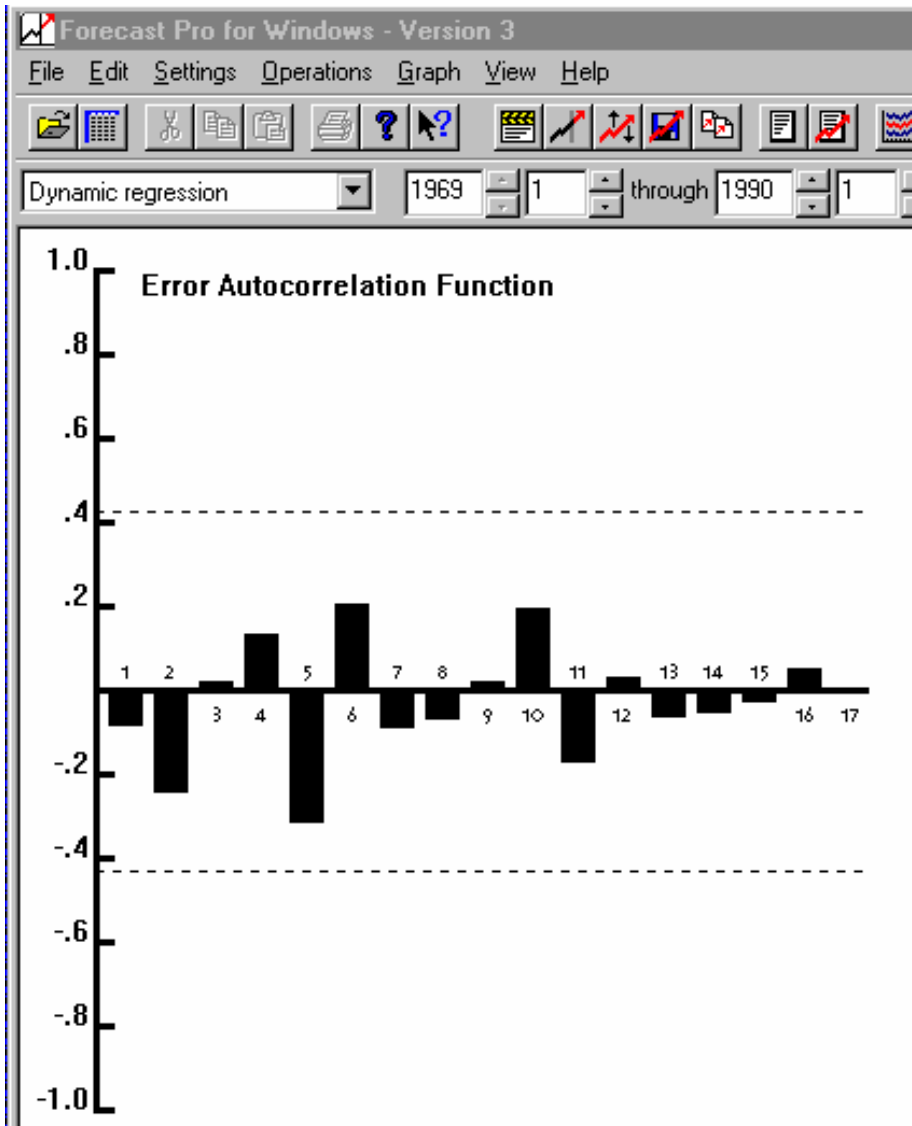


Graph of the data allows you peek at individual points.

Table 6\_1



This is a look at the errors. Notice that only one is a real outlier.



Here is a look at the autocorrelations in the error terms

Forecast Pro Version 4.00 Extended Edition

Database T6-11\_13b.wk1 is open and ready for use.

Forecast Model for PCFS  
Regression(2 regressors, 0 lagged errors)

Term	Coefficient	Std. Error	t-Statistic	Significance
PCINC	1.485004	0.046454	31.967133	1.000000
_CONST	-0.495872	0.460271	-1.077347	0.705185

Marked regressors are insignificant.

Within-Sample Statistics

Sample size 21                      Number of parameters 2  
 Mean 14.14                          Standard deviation 1.604  
 R-square 0.9817                      Adjusted R-square 0.9808  
 Durbin-Watson 0.6864              \*\* Ljung-Box(14)=52.74 P=1  
 Forecast error 0.2223              BIC 0.2445  
 MAPE 0.01284                      RMSE 0.2115  
 MAD 0.1776

Variable specification test battery

Term	ChiSq( 1)	Percentile
PCINC[-1]	1.26	0.7391
_TREND	1.64	0.7997

Variable specification tests successful.

Dynamics test battery

Term	ChiSq( 1)	Percentile
PCFS[- 1]	1.54	0.7858
PCFS[- 2]	2.19	0.8607
_AUTO[- 1]	7.05	0.9921 **
_AUTO[- 2]	2.07	0.8495

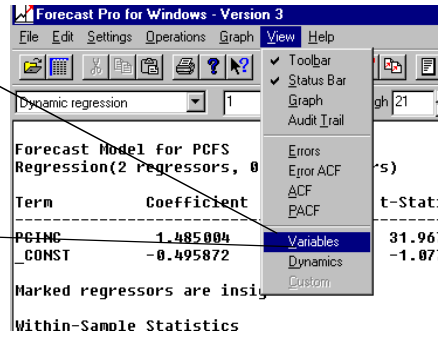
Try adding \_AUTO[-1] to model.

This output is from FPW and uses the data from Table 6-11. Notice that the output matches (within rounding errors) the output presented in Chapter 6.

Also notice that FPW makes applying this technique very simple. It does all of the calculations and even suggests appropriate modifications to the model.

This result can be seen on page 260 (6-53)

This result can be seen on page 271 (He has a calculation error.)



Here is FPW's suggestion about how to improve the model.

Forecast Model for PCFS  
Regression(2 regressors, 1 lagged errors)

Term	Coefficient	Std. Error	t-Statistic	Significance
PCINC	1.522063	0.087858	17.324193	1.000000
_CONST	-0.921957	0.902886	-1.021122	0.678491 <-
_AUTO[- 1]	0.602274	0.176133	3.419435	0.996733

Marked regressors are insignificant.

This result can be seen on page 274-275

Within-Sample Statistics

Sample size 20	Number of parameters 3
Mean 14.25	Standard deviation 1.558
R-square 0.9894	Adjusted R-square 0.9881
Durbin-Watson 1.859	* Ljung-Box(12)=24.06 P=0.9799
Forecast error 0.1699	BIC 0.1962
MAPE 0.008659	RMSE 0.1567
MAD 0.1223	

$-0.922 * (1 - 0.6023) = -0.36669$

Notice that DW is now acceptable as is Ljung-Box

Forecast Report  
Mon Oct 20 13:20:16 1997  
Dynamic Regression model for PCFS  
Analysis of Historic Fit Set

Date	Historic	Fitted
1970	11.888	11.888
1971	12.060	12.003
1972	12.559	12.301
1973	12.907	13.109
1974	12.602	12.616
1975	12.450	12.707
1976	12.911	12.898
1977	13.459	13.276
1978	13.948	13.958
1979	14.099	14.071
1980	13.774	13.913
1981	13.796	13.886
1982	13.605	13.787
1983	14.076	14.028
1984	14.864	14.867
1985	15.518	15.205
1986	15.898	15.837
1987	16.173	15.911
1988	16.525	16.573
1989	16.772	16.963
1990	16.966	17.053

Compare this value with the results of (6-77) on page 275