

Session 5A: Post Class Test Solutions

1. a. Correlation

	<i>EV/Sales</i>	<i>Pre-tax Operating Margin</i>
<i>EV/Sales</i>	1.0000	
<i>Pre-tax Operating Margin</i>	0.7866	1.0000

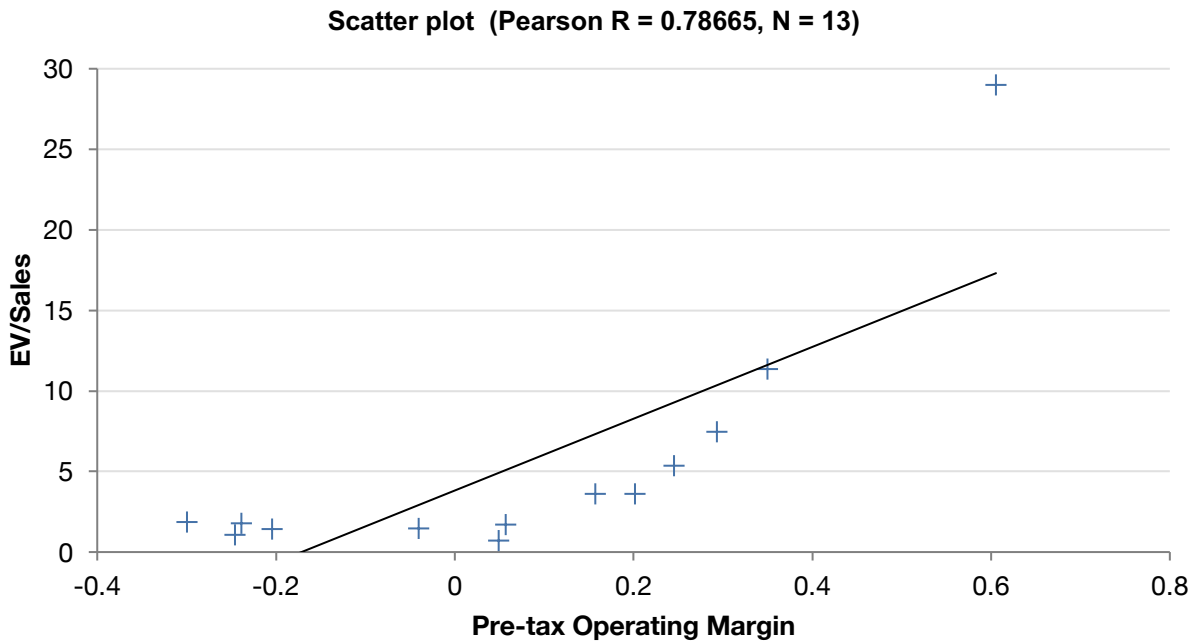
Covariance

	<i>EV/Sales</i>	<i>Pre-tax Operating Margin</i>
<i>EV/Sales</i>	54.9521286	
<i>Pre-tax Operating Margin</i>	1.52622042	0.06849944

EV to Sales and operating margin move together; when one is high, the other is as well.

As an investor, I am interested in buying cheap companies, and am looking for those that trade at low EV to Sales ratios. That, therefore, becomes my dependent variable, with operating margin becoming the variable that I hope to use to explain it.

Scatter Plot



Regression output

Regression Statistics								
Multiple R	0.78664989							
R Square	0.61881805							
Adjusted R S	0.58416515							
Standard Err	4.97546594							
Observations	13							
ANOVA								
	df	SS	MS	F	Significance F			
Regression	1	442.069798	442.069798	17.8576099	0.00142237			
Residual	11	272.307874	24.7552613					
Total	12	714.377672						
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	3.81981681	1.43057608	2.67012489	0.02178915	0.67114008	6.96849355	0.67114008	6.96849355
Pre-tax Oper	22.2807719	5.27252403	4.22582653	0.00142237	10.6760248	33.8855191	10.6760248	33.8855191

Predicted versus Actual EV/Sales

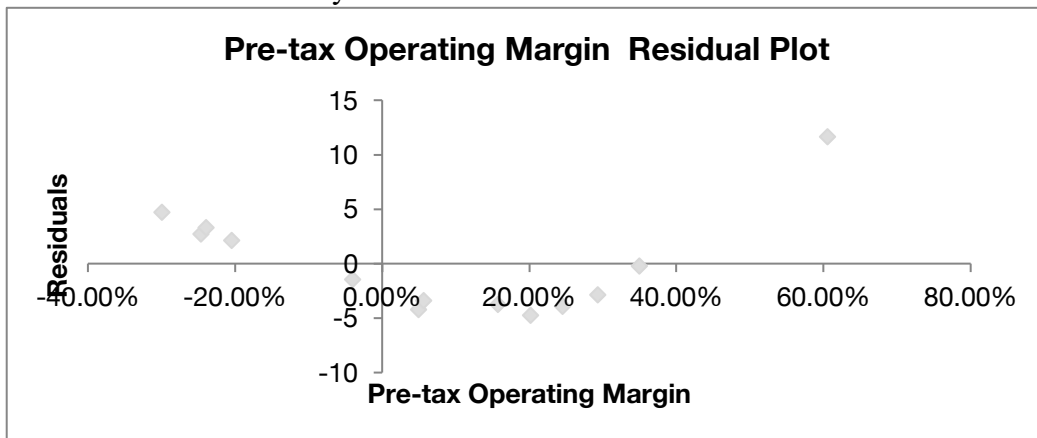
Company Name	EV/Sales	Pre-tax Operating Margin	Predicted EV/Sales	Residual
Coca-Cola Consolidated, Inc. (NasdaqGS:COKE)	0.72	4.90%	4.91	4.19
Jones Soda Co. (OTCPK:JSDA)	1.07	-24.62%	-1.67	-2.74
NewAge, Inc. (NasdaqCM:NBEV)	1.41	-20.43%	-0.73	-2.14
MOJO Organics, Inc. (OTCPK:MOJO)	1.46	-4.02%	2.92	1.46
Primo Water Corporation (TSX:PRMW)	1.69	5.67%	5.08	3.40
Reed's, Inc. (NasdaqCM:REED)	1.78	-23.90%	-1.51	-3.29
The Alkaline Water Company Inc. (NasdaqCM:WTER)	1.84	-29.93%	-2.85	-4.69
National Beverage Corp. (NasdaqGS:FIZZ)	3.60	20.19%	8.32	4.72
PepsiCo, Inc. (NasdaqGS:PEP)	3.60	15.76%	7.33	3.73
Keurig Dr Pepper Inc. (NasdaqGS:KDP)	5.36	24.52%	9.28	3.92
The Coca-Cola Company (NYSE:KO)	7.48	29.33%	10.36	2.88
Monster Beverage Corporation (NasdaqGS:MNST)	11.37	34.98%	11.61	0.24
Greene Concepts, Inc. (OTCPK:INKW)	28.99	60.55%	17.31	-11.68

The companies that have actual EV/Sales that are lowest, relative to their predicted values, are cheap.

Concerns

- Small sample size with outliers
- Scatter plot suggests relationship between EV to Sales and margin is non-linear

- Residuals are not normally distributed



2. The results of the analysis of PBV against ROE are below.

Correlation

Covariance

R	PBV	Return on Equity
PBV	1	
<i>R Std Err</i>		
<i>t</i>		
<i>p-value (2-tailed)</i>		
Return on Equity	0.08724	1
<i>R Std Err</i>	0.01196	
<i>t</i>	0.79784	
<i>p-value (2-tailed)</i>	0.42724	

	PBV	Return on Equity
PBV	13.08687	
Return on Equity	0.06152	0.038

The correlation is a positive number, but it is not statistically significant.

Regression

Regression Statistics							
Multiple R	0.087240798						
R Square	0.007610957						
Adjusted R Square	-0.004345538						
Standard Error	3.646945446						
Observations	85						

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	8.466305293	8.466305293	0.636554205	0.427238101
Residual	83	1103.91752	13.30021109		
Total	84	1112.383825			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	1.923830564	0.398333802	4.829694479	6.16718E-06	1.131560653	2.716100475	1.131560653	2.716100475
Return on Equity	1.61898596	2.029202492	0.797843471	0.427238101	-2.417016182	5.654988102	-2.417016182	5.654988102

The regression has minimal explanatory power, with the F statistic, t statistic and p value all indicating that ROE does not do a good job explaining differences in PBV ratios across insurance companies.

Residual Analysis

Breusch-Pagan-Godfrey (BPG) test

<i>Test Statistic</i>	0.0181	<i>p-value</i>	0.89298	<i>H0 (5%)</i>
<i>F</i>	0.01768	<i>p-value</i>	0.89455	

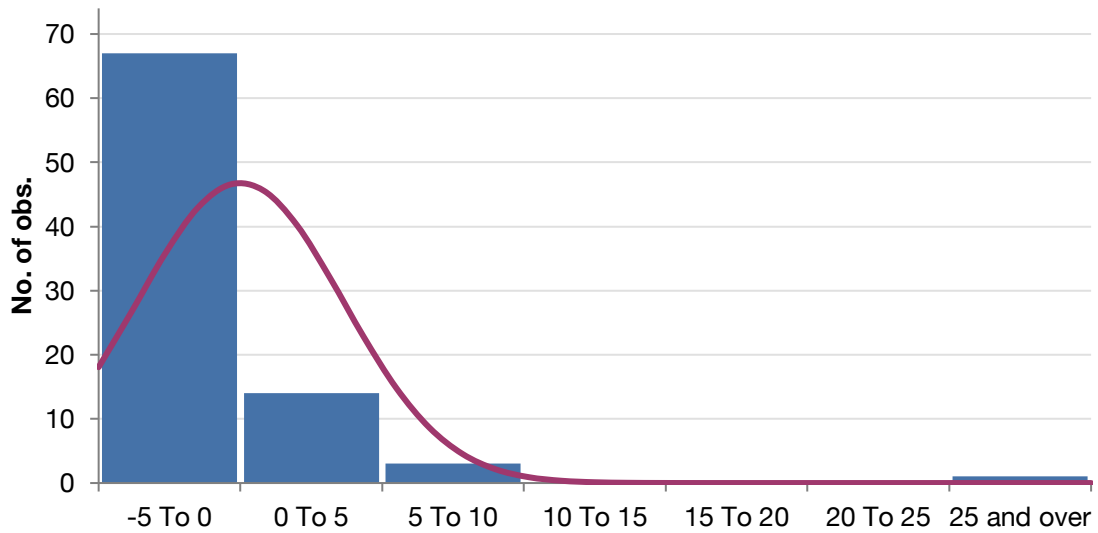
White test (All cross-terms)

<i>Test Statistic</i>	0.18819	<i>p-value</i>	0.9102	<i>H0 (5%)</i>
<i>F</i>	0.09097	<i>p-value</i>	0.91313	

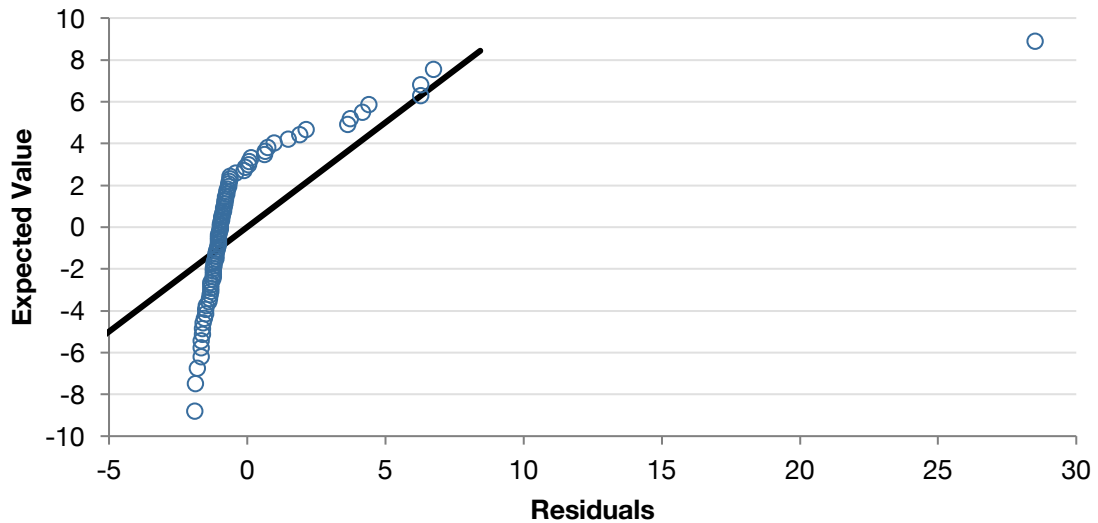
Normality Tests

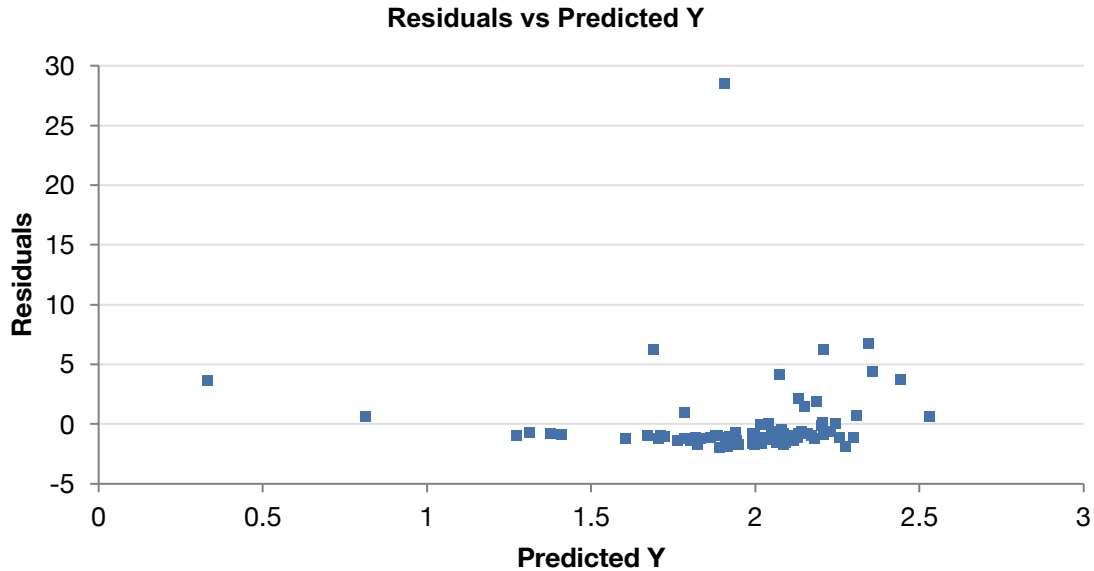
Test	Test Statistic	p-value	H0 (5%)
Shapiro-Wilk W	0.39315	0.	Rejected
Shapiro-Francia	0.37605	0.	Rejected
Anderson-Darling	15.34855	0.	Rejected
Cramer-von Mises	3.09441	0.355	Cannot reject
Kolmogorov-Smirnov (Lilliefors)	0.32065	0.	Rejected
D'Agostino Skewness	9.63576	0	Rejected
D'Agostino Kurtosis	7.17728	0.	Rejected
D'Agostino Omnibus	144.36117	0	Rejected
Jarque-Bera	7,250.3238	0	Rejected

Histogram for "Residuals"



Normal Q-Q Plot - Residuals





The residuals are not normally distributed, and there seems to be heteroskedasticity.

3. The results of the EP ratio against interest rates and unexpected inflation are below:

Correlation

R	Earnings Yield	T.Bond Rate	Unexpected Inflation
Earnings Yield	1		
<i>R Std Err</i>			
<i>t</i>			
<i>p-value (2-tailed)</i>			
T.Bond Rate	0.63253	1	
<i>R Std Err</i>	0.01017		
<i>t</i>	6.27285		
<i>p-value (2-tailed)</i>	4.53895E-8		
Unexpected Inflation	0.37748	0.05497	1
<i>R Std Err</i>	0.01453	0.0169	
<i>t</i>	3.13114	0.42284	

Earnings yield is positively correlated with both the T.Bond rate and unexpected inflation. In other words, the EP ratio is higher (or PE ratio is lower) when interest rates are high and inflation is higher than expected. Both pass the statistical significant test (t statistics are 6.27 and 3.13), but the T.Bond rate is more strongly correlated with Earnings Yield.

Regression

SUMMARY OUTPUT								
<i>Regression Statistics</i>								
Multiple R	0.71965384							
R Square	0.51790165							
Adjusted R S	0.50127757							
Standard Err	0.01724931							
Observations	61							
<i>ANOVA</i>								
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>			
Regression	2	0.01853886	0.00926943	31.1537013	6.4704E-10			
Residual	58	0.01725725	0.00029754					
Total	60	0.03579611						
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	0.03551289	0.00495921	7.16099208	1.5724E-09	0.02558595	0.04543983	0.02558595	0.04543983
T.Bond Rate	0.51434788	0.07653463	6.72045966	8.6275E-09	0.36114717	0.66754858	0.36114717	0.66754858
Unexpected	0.33342095	0.08856432	3.7647322	0.00039126	0.1561402	0.51070169	0.1561402	0.51070169

The F value suggests that the multiple regression has strong explanatory power, and the t statistics and p values on the two variables (T.Bond rate and Unexpected inflation) backs up the proposition that both variables are adding significant explanatory power. The R-squared, not surprisingly, is solid 0.51, and since the sample size is decent (60 years), the adjusted R-squared is very similar.

Stocks are priced higher, when interest rates are low and when inflation comes in below expectations, and lower, when the interest rates are high and inflation is higher than expected.

4.

- The F value indicates that the multiple regression has strong explanatory power, and the t statistics (p values) suggest that each variable adds to that explanatory power significantly. You may be surprised that, given these findings, the R-squared is only 16.7%, but that seeming contradiction can be explained by the large sample size (>30,000 firms). With a sample that large, a low R-squared and statistical significance can go together.
- The low R-squared indicates that even though the regression has statistical power, the predictions based upon the regression will come with large standard error, yielding a wide range for the predicted value. That said, here are some of the questions I would have:
 - a. The sample size is big, but it is still a sample. What is the population and what happened to the firms that did not make it into the sample? (Are there specific characteristics on which these firms differ from those that were sampled?)
 - b. What is the process by which the independent variables were picked? (Are they based upon an economic or common-sense model, or just picked based upon their statistical power? Were other independent variables tried and rejected, before you settled on these)

- c. This is a linear regression. Did you check, with a scatter plot, for the linearity assumption?
- d. How correlated are the independent variables, with each other?
- e. Do the residuals pass the normality and homoskedasticity tests?

5.

- There is clearly multicollinearity in the data. Effective tax rates are positively correlated with both return on capital and debt ratios and return on capital is negatively correlated with debt ratios. I could look for other measures of tax rates that are less correlated or remove it entirely, but from an overall predictive value basis, I feel that it is better to leave the variables in the regression, not read too much into the individual coefficients, but use the overall regression to make predictions.
- The residuals also have a mild positive skew, violating the normality assumption. It does indicate that using this regression to make forecasts will yield more over estimation than under estimation errors, but not by enough to redo or tweak the regression.