Chapter 10 (please see below for data and questions)

Regression(SPSS output is listed below first then questions/answers)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.994[a]	.988	.987	4.18	.988	904.120	1	11	.000

a. Predictors: (Constant), YEAR

b. Dependent Variable: lean

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	15804.484	1	15804.484	904.120	.000[a]
	Residual	192.286	11	17.481		
	Total	15996.769	12			

a. Predictors: (Constant), YEAR

b. Dependent Variable: lean

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95% Confidence Interval for B Lower Bound	95% Confidence Interval for B Upper Bound
1	(Constant)	-61.121	25.130		-2.432	.033	-116.431	-5.811
	YEAR	9.319	.310	.994	30.069	.000	8.637	10.001

a. Dependent Variable: lean

Residuals Statistics[a]

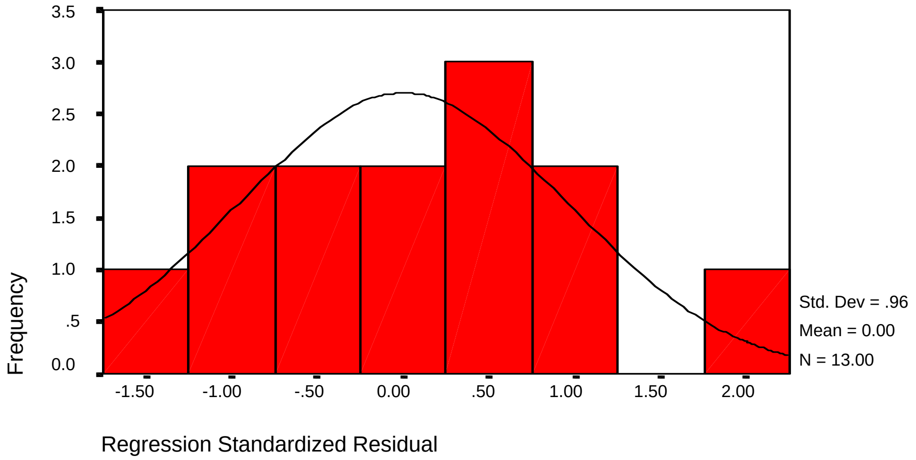
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	637.78	749.60	693.69	36.29	13
Std. Predicted Value	-1.541	1.541	.000	1.000	13
Standard Error of Predicted Value	1.16	2.19	1.60	.37	13
Adjusted Predicted Value	636.18	746.80	693.52	36.16	13
Residual	-5.97	7.40	-4.37E-14	4.00	13
Std. Residual	-1.427	1.769	.000	.957	13
Stud. Residual	-1.562	2.077	.018	1.065	13
Deleted Residual	-7.14	10.20	.17	4.97	13
Stud. Deleted Residual	-1.688	2.540	.039	1.164	13
Mahal. Distance	.000	2.374	.923	.852	13
Cook's Distance	.001	.817	.131	.224	13
Centered Leverage Value	.000	.198	.077	.071	13

a. Dependent Variable: lean

Charts

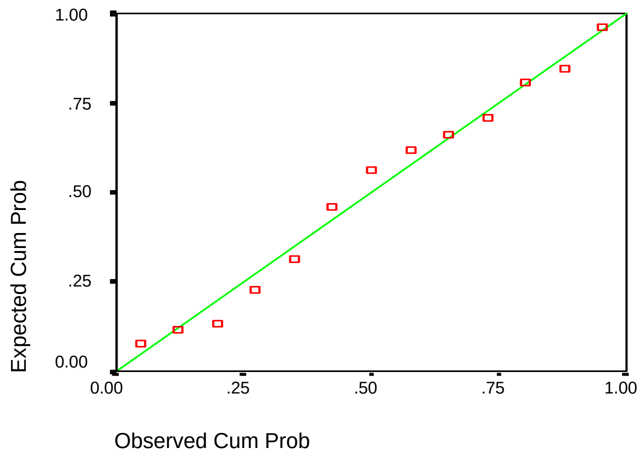
Histogram

Dependent Variable: lean



Normal P-P Plot of Regression Standardized Residua

Dependent Variable: lean



SPSS Output (2 marks)

1. (4 marks)
The following table gives measurements of the Leaning Tower of Pisa's lean for the years 1975 to 1987. The lean represents the difference between where a point on the tower would be if the tower were straight and where it actually is. The data are coded in thenths of a millimeter in excess of 2.9 meters so in 1975, the lean was 2.9642, and it appears on the table as 642.

Year	75	76	77	78	79	80	81	82	83	84	85	86	87
Lean	642	644	656	667	673	688	696	698	713	717	725	742	757

a) Plot the data. Does the trend in lean over time appear to be linear?
b) What is the equation of the least-squares line? What percent of the variation in the lean is explained by this line?
c) Give the 99% confidence interval for the average rate of change of the lean.

Answers

a) The trend appears linear

b) $y_{predicted} = -61.1 + 9.32\ x$

c) R2 = 0.989 thus 98.9% of the variation in lean is explained by this line.

The confidence Interval is 8.64 to 10.0

<u>Question 2 (2 marks)</u>

Refer to the previous question.

a) In 1918 the lean was 2.9071 m. Using the least-squares equation for the years 1975-1987, calculate the predicted value for the lean in 1918.

b) Although the least squares line gives an excellent fit to the data for 1975 to 1987, this pattern did not extend back to 1918. Write a short statement explaining why this conclusion follows from the information available. Use numerical and graphical summaries to support your explanation.

Answers:

a) $y_{predicted} = -61.1 + 9.32\ (18)$

$= 106.21$

b) This is an example of extrapolation – trying to make a prediction outside Of the range of given x values thus it is outside of the bounds collected.

<u>Question 3 (2 marks)</u>

Refer to the previous exercise.

a) The engineers on the Leaning Tower of Pisa were most interested in how much the tower would lean if no corrective action was taken. Use the least-squares equation to predict the tower's lean in the year 2005.

b) To give a margin of error for the lean in 2005, would you use a confidence interval for a mean response or a prediction interval? Explain.

Answers:

c) $y_{predicted} = -61.1 + 9.32\ (97)$

$= 842.822$

b) A prediction interval is appropriate, since we are interested in one future observation, not the mean of all future observation