

Lab # 1

End-of-term survey_SLR Ex.

Two freshmen algebra classes at McNair Academic High School in Jersey City, New Jersey were studied. One of which used laptop computers at school and at home, while the other class did not. In each class, students were given a survey at the beginning and end of the semester, measuring his/her technological level. The scores were recorded for the end of semester survey (X) and the final examination (Y) for the laptop group. The data are recorded in the table below:

Student	End of Term Survey (X)	Final Exam (Y)
1	100	98
2	96	97
3	88	88
4	100	100
5	100	100
6	96	78
7	80	68
8	68	47
9	92	90
10	96	94
11	88	84
12	92	93
13	68	57
14	84	84
15	84	81
16	88	83
17	72	84
18	88	93
19	72	57
20	88	83

Enter the data

The screenshot shows the IBM SPSS Statistics Data Editor interface. The title bar reads '*Untitled2 [DataSet2] - IBM SPSS Statistics Data Editor'. The menu bar includes File, Edit, View, Data, Transform, Analyze, Graphs, Utilities, Extensions, Window, and Help. The toolbar contains icons for file operations, data manipulation, and analysis. The main window displays a variable list table with the following columns: Name, Type, Width, Decimals, Label, Values, Missing, Columns, Align, Measure, and Role. Two variables are defined: 'EndOfTerm' (Numeric, Width 8, Decimals 0, None values, None missing, 8 columns, Right align, Scale measure, Input role) and 'FinalExam' (Numeric, Width 8, Decimals 0, None values, None missing, 8 columns, Right align, Scale measure, Input role). The bottom status bar indicates 'Data View' and 'Variable View' tabs, and the system tray shows 'IBM SPSS Statistics Processor is ready' and 'Unicode:ON'.

IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help

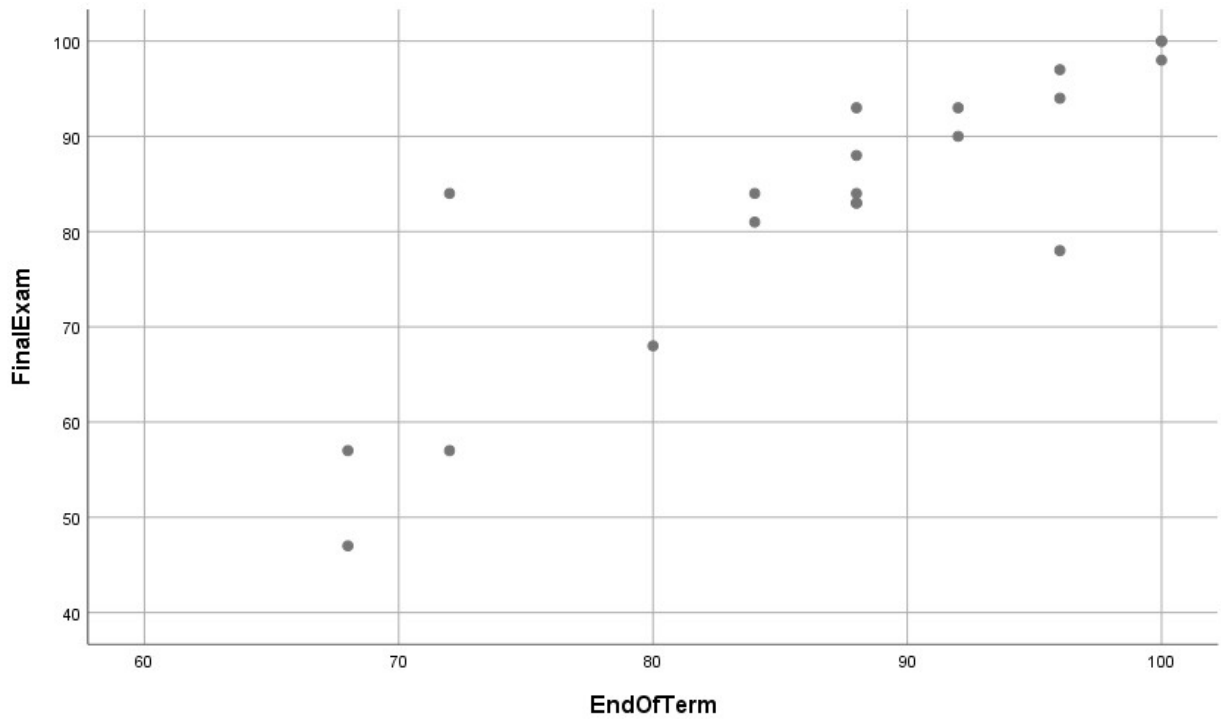
7: Visible: 2 of 2 Variables

	EndOfTerm	FinalExam	var	var	var	var	var	var	var	var	var	var	var	var	var
1	100	98													
2	96	97													
3	88	88													
4	100	100													
5	100	100													
6	96	78													
7	80	68													
8	68	47													
9	92	90													
10	96	94													
11	88	84													
12	92	93													
13	68	57													
14	84	84													
15	88	83													
16	72	84													
17	88	93													
18	72	57													
19	88	83													
20	84	81													

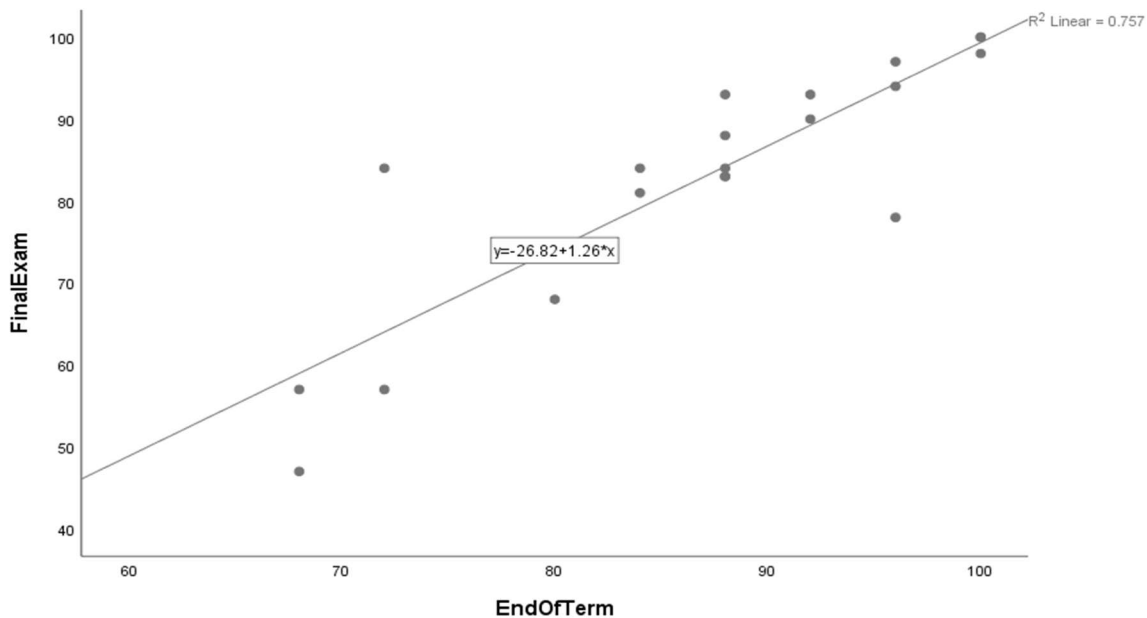
Data View Variable View

IBM SPSS Statistics Processor is ready Unicode:ON

To obtain the **scatter plot** → “graph” → “Legacy Dialog” → “scatter/dot” → “Simple scatter” → “Define” → put “final Exam” on the y axis and “End of Term” on the x axis → OK



To obtain the **least squares line** → hold a right button of the mouse on the scatter plot and select “edit” → “edit in a separate window” → from the top menu of chart editor click on “add fit line at total”, if you do not wish to show grid lines then click on “hide grid lines” .



To obtain the **basic descriptive statistics** go to “Analyse” → “Descriptive Statistics” → “Descriptives” → “place which variables you want descriptives about (I chose both)” → select “Options” to indicate which descriptives you want and then click OK

Descriptives

Descriptive Statistics							
	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
EndOfTerm	20	32	68	100	87.00	10.372	107.579
FinalExam	20	53	47	100	82.95	15.042	226.261
Valid N (listwise)	20						

To obtain the **ANOVA table** with **coefficient estimates with C.I.’s for parameters** and **r and r²** go to “Analyse” → “Regression” → “Linear” → select your Dependent and Independent/Predictor variables and then click OK

Regression

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.870 ^a	.757	.743	7.619

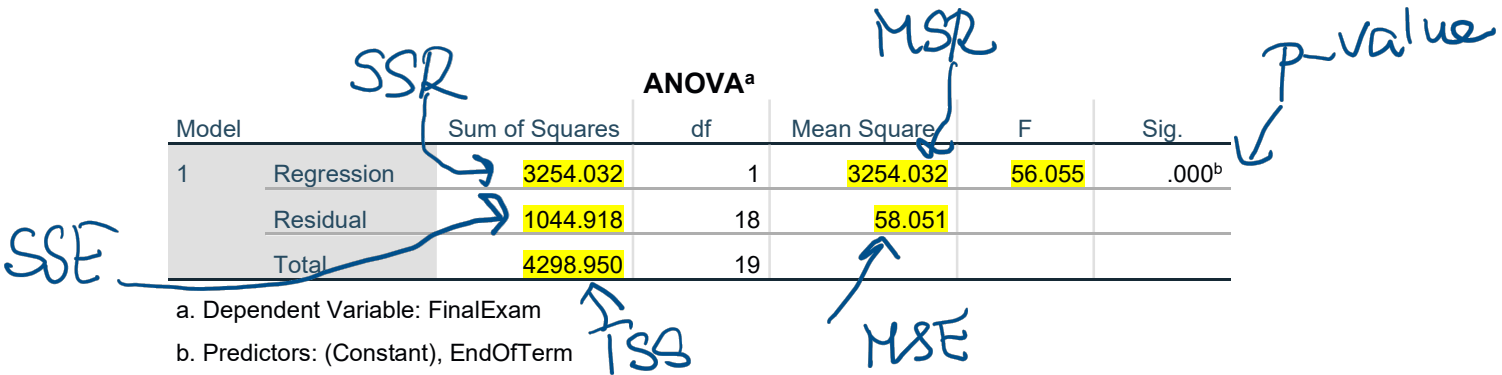
a. Predictors: (Constant), EndOfTerm

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3254.032	1	3254.032	56.055	.000 ^b
	Residual	1044.918	18	58.051		
	Total	4298.950	19			

a. Dependent Variable: FinalExam

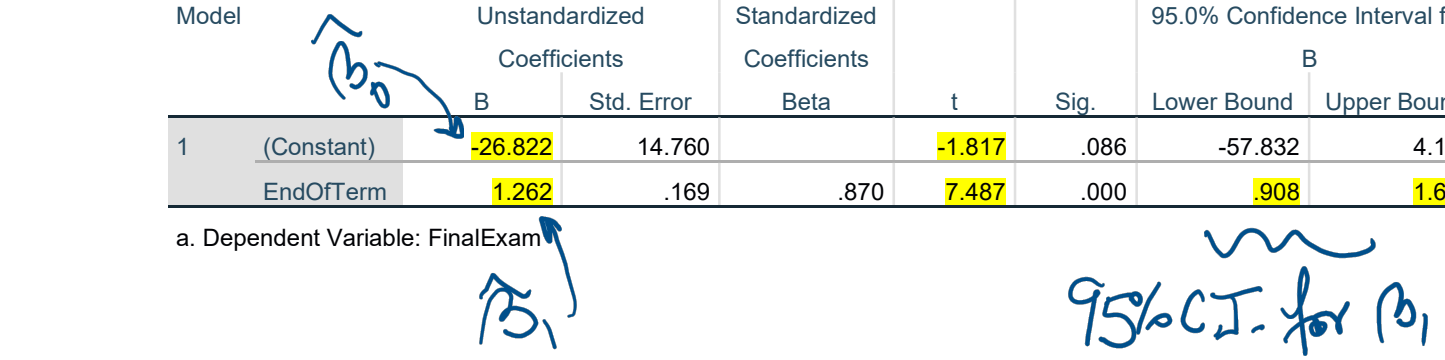
b. Predictors: (Constant), EndOfTerm



Coefficients^a

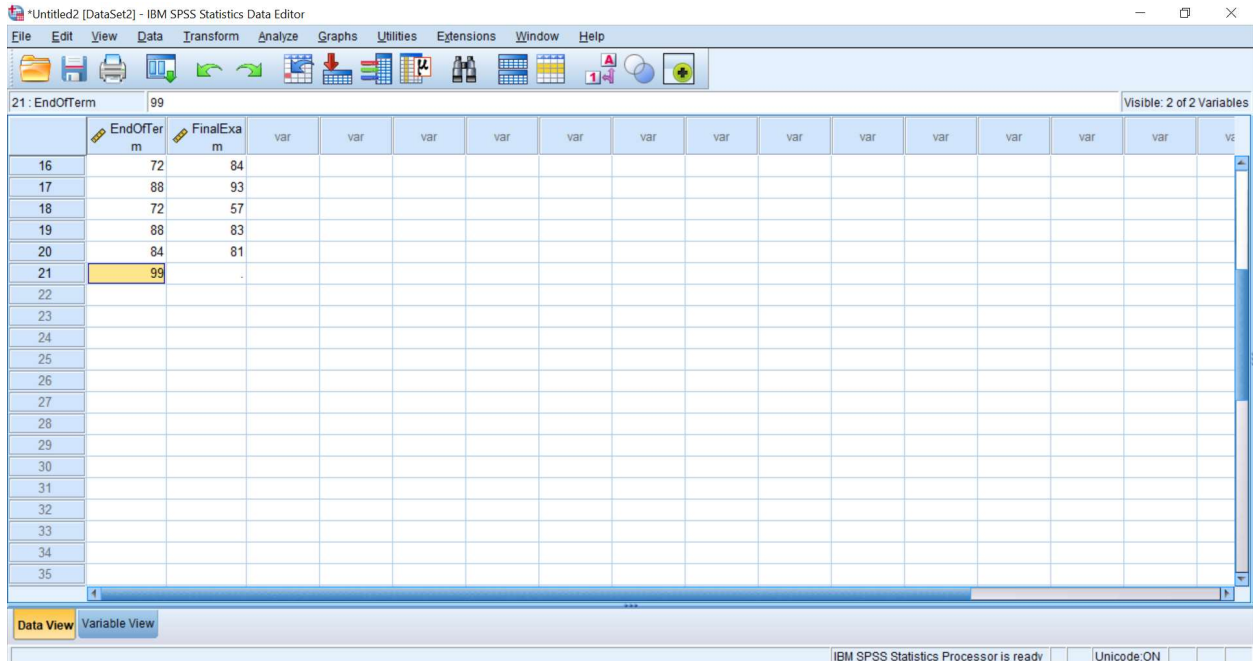
Model		Unstandardized Coefficients		Standardized Coefficients		95.0% Confidence Interval for B		
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	-26.822	14.760		-1.817	.086	-57.832	4.189
	EndOfTerm	1.262	.169	.870	7.487	.000	.908	1.616

a. Dependent Variable: FinalExam



Lab #2.

To obtain the **C.I.'s and P.I.'s for a new value of x_p** → first you need to add a new value for x variable in the original data set (we add x=99)



The screenshot shows the IBM SPSS Statistics Data Editor interface. The data table has two columns: 'EndOfTerm' and 'FinalExam'. Row 21 is highlighted in yellow, indicating the new data point being added.

	EndOfTerm	FinalExam	var	var	var	var	var	var	var	var	var	var	var	var	var
16	72	84													
17	88	93													
18	72	57													
19	88	83													
20	84	81													
21	99	.													
22															
23															
24															
25															
26															
27															
28															
29															
30															
31															
32															
33															
34															
35															

Then go to “Analyse” → “Regression” → “Linear” → click on “save” and select “Mean” and “Individual in “Prediction Interval” (make sure that you select a correct confidence level).

You may as well select “Unstandardized Predicted values” and “Unstandardized residuals” (that are needed for residual analysis).

Then click “continue” and “OK”.



You obtain following:

95% C.I. for $E(y)$ when $x_p = 99$: (92.53546 , 103.64634)

95% P.I. for y when $x_p = 99$: (81.14709, 115.03471)

$\hat{y} = 98.09090$ when $x_p = 99$

The resulting C.I. for $E(y)$ and P.I. for y will be in an original data set.

*Untitled2 [DataSet2] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help

21 : LMCL_1 92.53546085533016 Visible: 8 of 8 Variables

	EndOfTerm	FinalExam	PRE_1	RES_1	LMCL_1	UMCL_1	LICI_1	UICI_1	var	var	var
13	68	57	58.97691	-1.97691	51.35684	66.59697	41.24854	76.70528			
14	84	84	79.16477	4.83523	75.43118	82.89837	62.72794	95.60161			
15	88	83	84.21174	-1.21174	80.61496	87.80852	67.80544	100.61804			
16	72	84	64.02387	19.97613	57.61944	70.42831	46.78303	81.26472			
17	88	93	84.21174	8.78826	80.61496	87.80852	67.80544	100.61804			
18	72	57	64.02387	-7.02387	57.61944	70.42831	46.78303	81.26472			
19	88	83	84.21174	-1.21174	80.61496	87.80852	67.80544	100.61804			
20	84	81	79.16477	1.83523	75.43118	82.89837	62.72794	95.60161			
21	99		98.09090		92.53546	103.64634	81.14709	115.03471			
22											
23											
24											
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31											
32											

95% C.I. for $E(y) | x_p = 99$

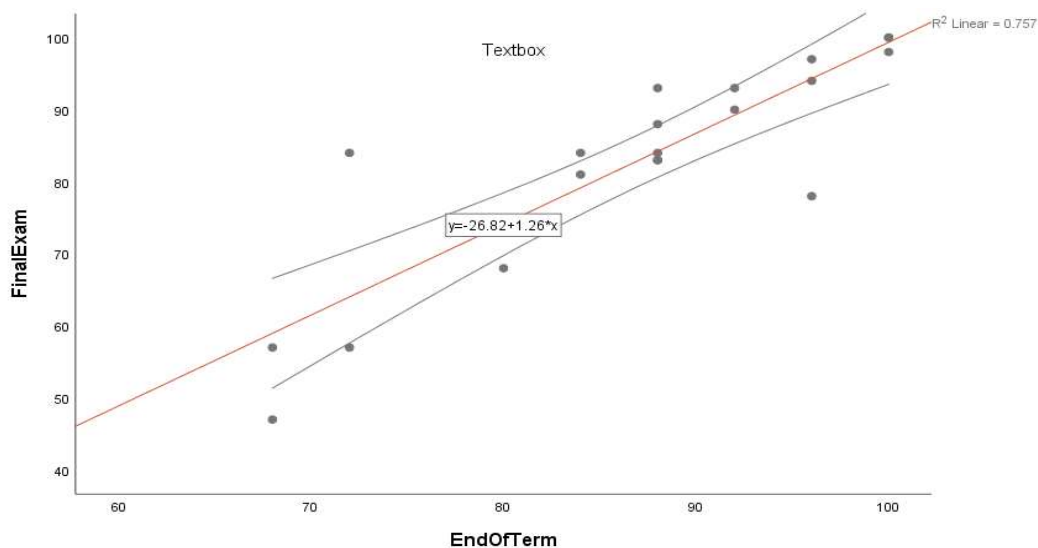
95% P.I. for $y | x_p = 99$

Data View Variable View

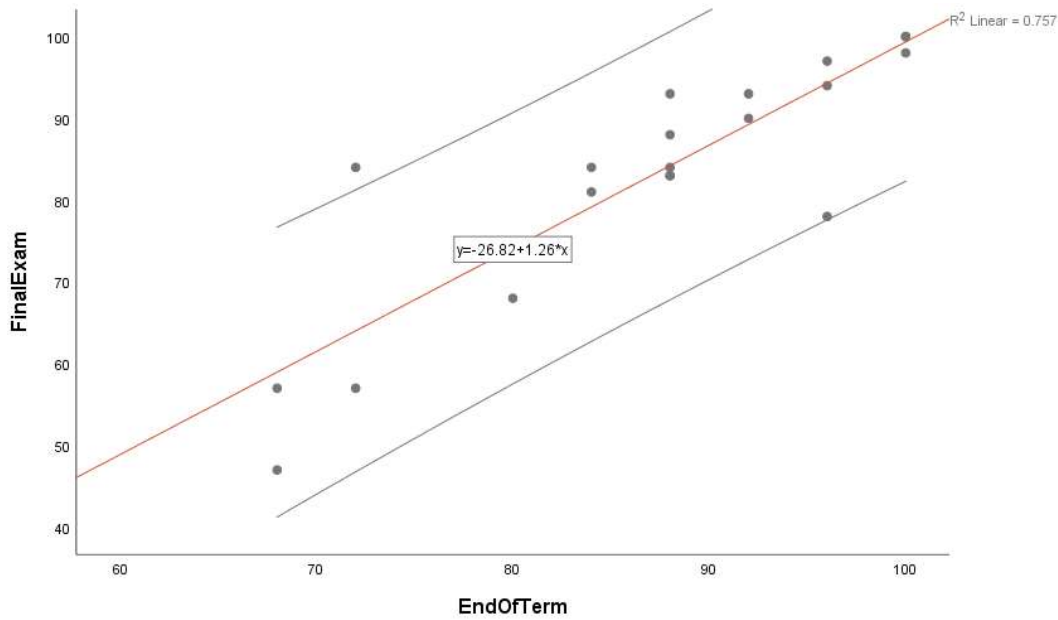
IBM SPSS Statistics Processor is ready Unicode: ON

To obtain the **C.I.'s and P.I.'s bands** → go to your scatter plot and click on “edit” → “edit in a new window” → “fit line at total” in in options you select Intervals for mean and then for individual.

95% C.I. bands for $E(y)$:



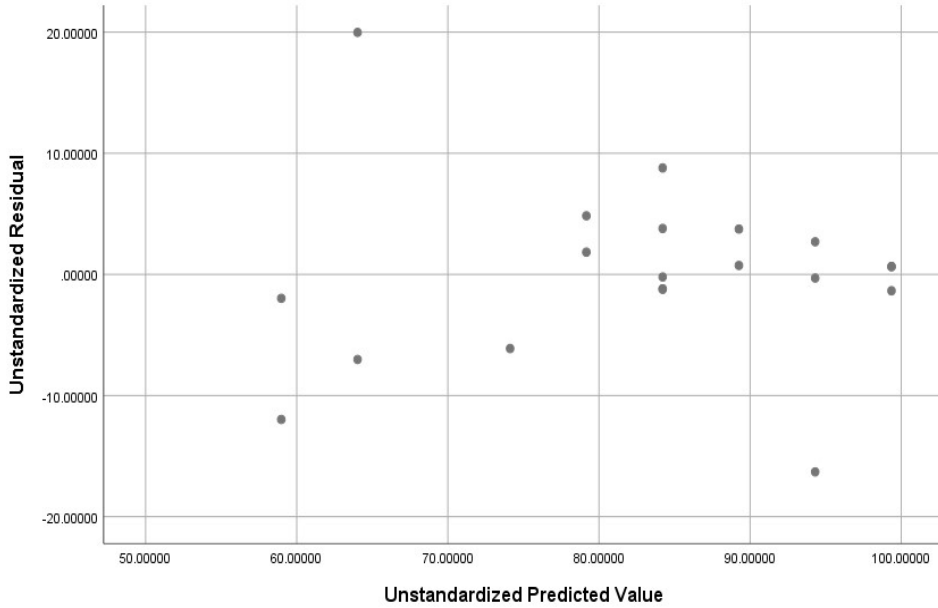
95% P.I. bands for y:



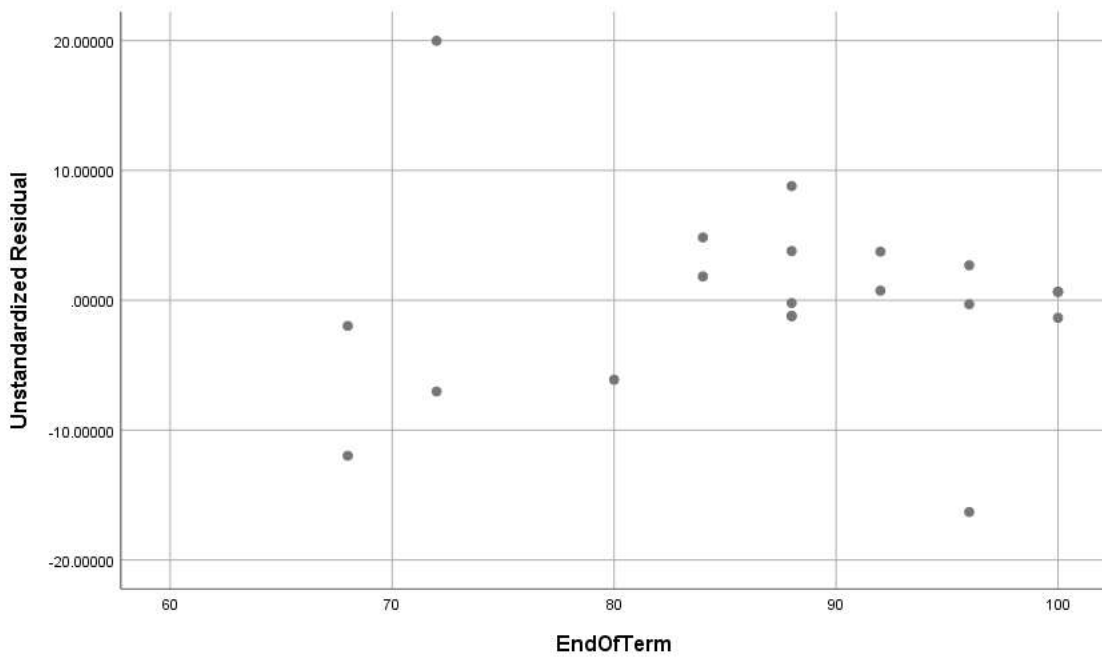
Lab # 3.

Residual Analysis:

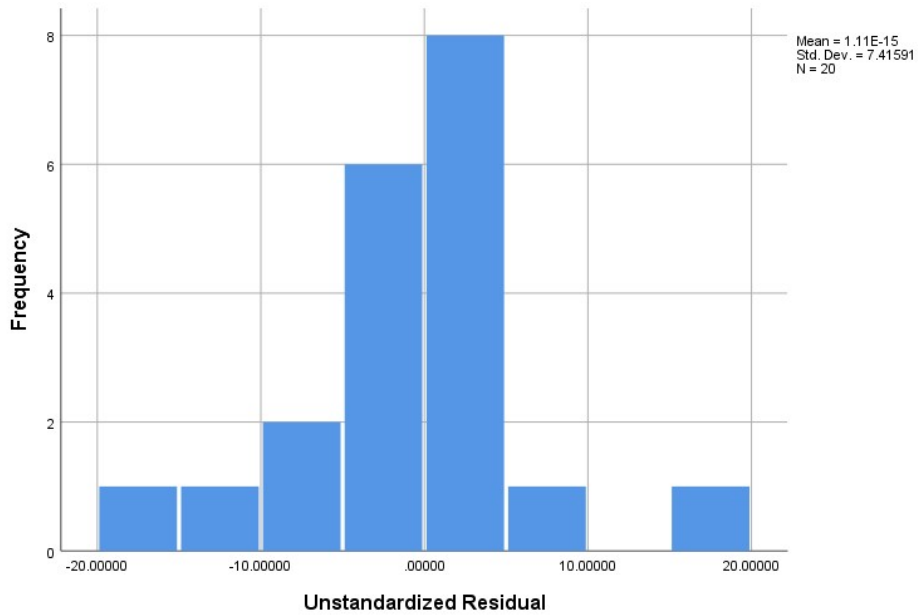
To obtain the plot of predicted values vs residuals (i.e. \hat{y}_i vs e_i) → “graph” → “Legacy Dialog” → “scatter/dot” → “Simple scatter” → “Define” → put “Residuals” on the y axis and “Predicted Values” on the x axis → OK



To obtain the **plot of x's vs residuals (i.e. x_i vs e_i)** → “graph” → “Legacy Dialog” → “scatter/dot” → “Simple scatter” → “Define” → put “Residuals” on the y axis and “End of term” on the x axis → OK

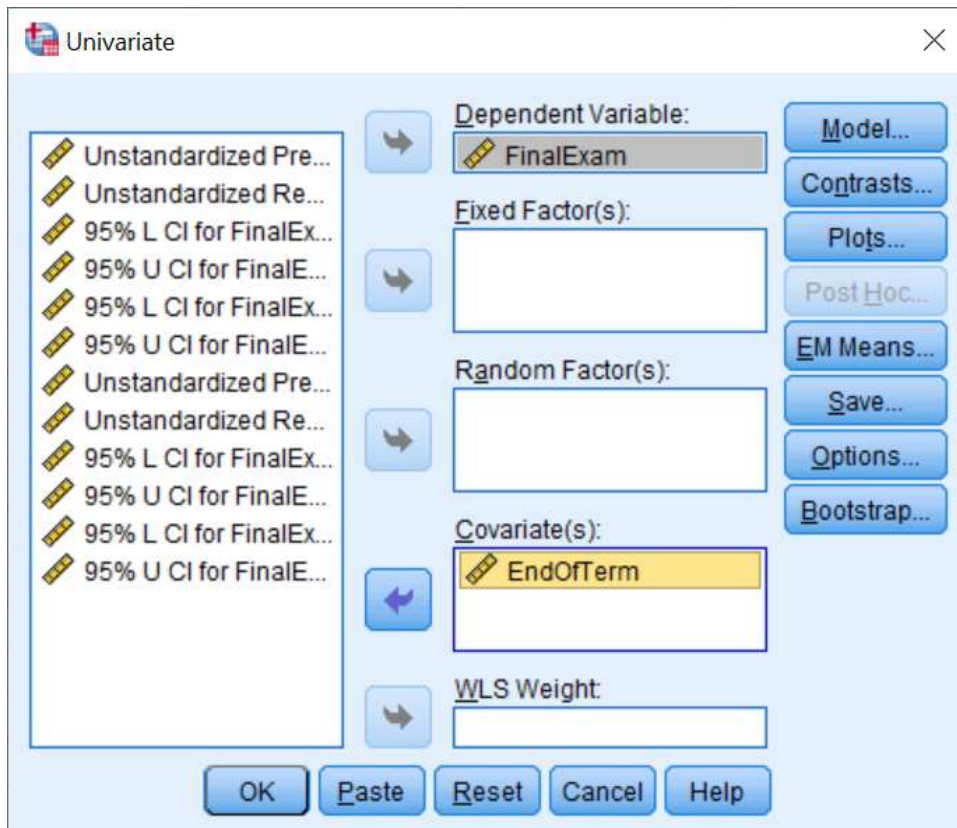


To obtain the **histogram of the errors** → “Graphs” → “Legacy Dialogs” → “Histogram” → select Unstandardized Residuals as a response variable and then click OK



Lack-of-Fit test:

To test lack-of-fit, go to “Analyze” → “General Linear Model” → “Univariate”. Then designate your response variable as the Dependent Variable and your predictor variable as a COVARIATE. Under the Options click the **Lack of fit** test → “continue” and OK.



Lack of Fit Tests

Dependent Variable: FinalExam

Source	Sum of Squares	df	Mean Square	F	Sig.
Lack of Fit	335.285	6	55.881	.945	.499
Pure Error	709.633	12	59.136		

H_0 : model is appropriate

H_a : model is not appropriate

test-statistics: $F_{LF} = \frac{MSLF}{MSPE} = \frac{55.881}{59.136} = \underline{\underline{0.944957}}$

R.R.: we reject H_0 if $F_{LF} > F_{\alpha, (df_{LF}, df_{PE})} = F_{\alpha, (6, 12)}$