Lab #4.

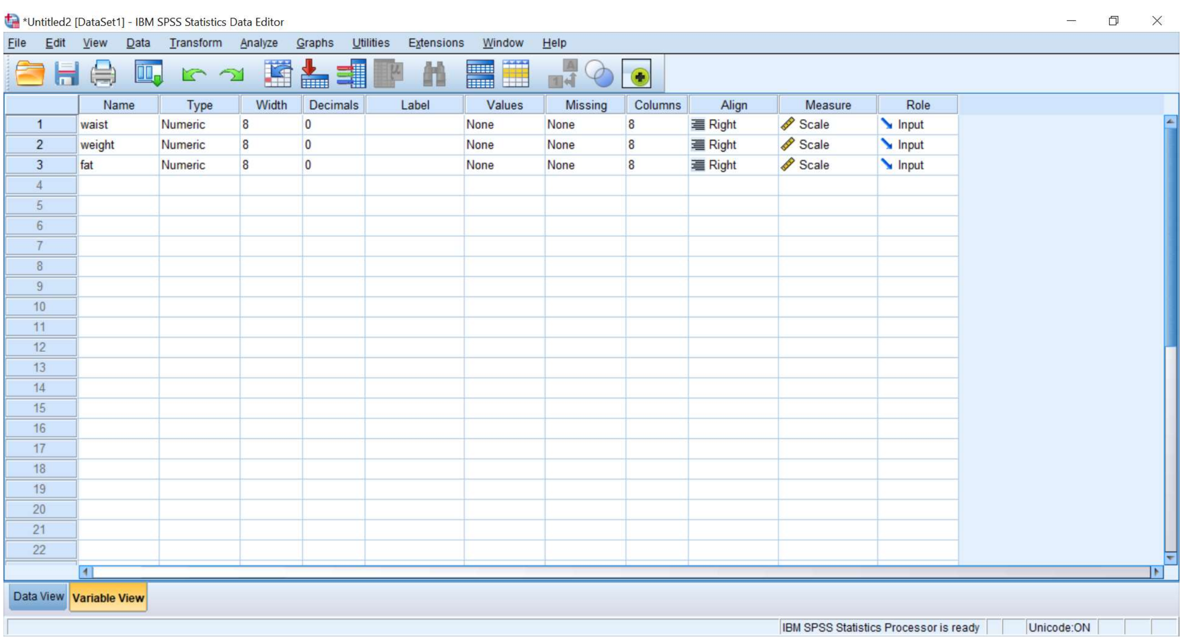
Body fat, waist and weight_MLR Ex.

The following table gives the waist size (in inches), weight (in pounds) and the body fat (in %).

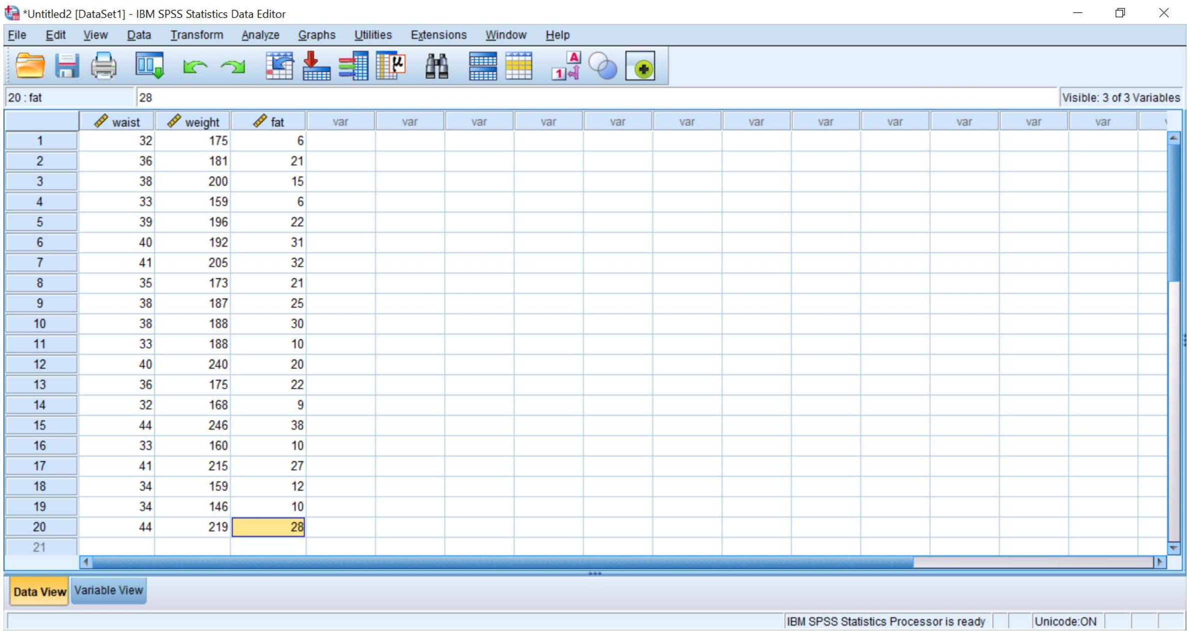
Waist (X_1)	Weight (X_2)	Body Fat (Y)
32	175	6
36	181	21
38	200	15
33	159	6
39	196	22
40	192	31
41	205	32
35	173	21
38	187	25
38	188	30
33	188	10
40	240	20
36	175	22
32	168	9
44	246	38
33	160	10
41	215	27
34	159	12
34	146	10
44	219	28

Consider the model $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \varepsilon$.

Enter the data



	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure	Role
1	waist	Numeric	8	0		None	None	8	Right	Scale	Input
2	weight	Numeric	8	0		None	None	8	Right	Scale	Input
3	fat	Numeric	8	0		None	None	8	Right	Scale	Input



	waist	weight	fat
1	32	175	6
2	36	181	21
3	38	200	15
4	33	159	6
5	39	196	22
6	40	192	31
7	41	205	32
8	35	173	21
9	38	187	25
10	38	188	30
11	33	188	10
12	40	240	20
13	36	175	22
14	32	168	9
15	44	246	38
16	33	160	10
17	41	215	27
18	34	159	12
19	34	146	10
20	44	219	28

To obtain the residuals and predicted values, go to “Analyse” → “Regression” → “Linear” → click on “save” and select “Unstandardized Predicted values” and “Unstandardized residuals”. Then click “continue” . After clicking on “OK” you will get ANOVA table with all the parameter estimates.

Regression

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	weight, waist[b]	.	Enter

a. Dependent Variable: fat

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.894[a]	.800	.776	4.526

a. Predictors: (Constant), weight, waist

b. Dependent Variable: fat

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1389.491	2	694.746	33.913	.000[b]
	Residual	348.259	17	20.486		
	Total	1737.750	19			

a. Dependent Variable: fat

b. Predictors: (Constant), weight, waist

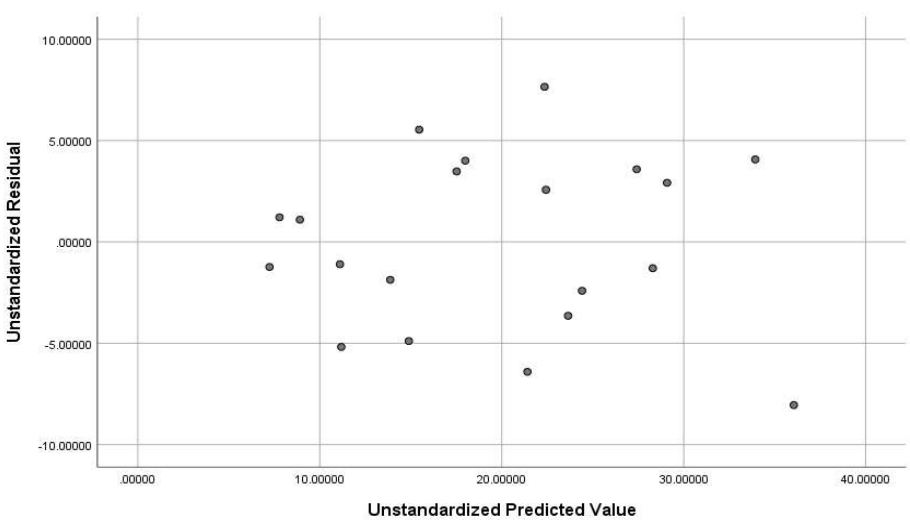
Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-65.074	10.406		-6.254	.000
	waist	2.689	.521	1.074	5.163	.000
	weight	-.079	.075	-.219	-1.053	.307

a. Dependent Variable: fat

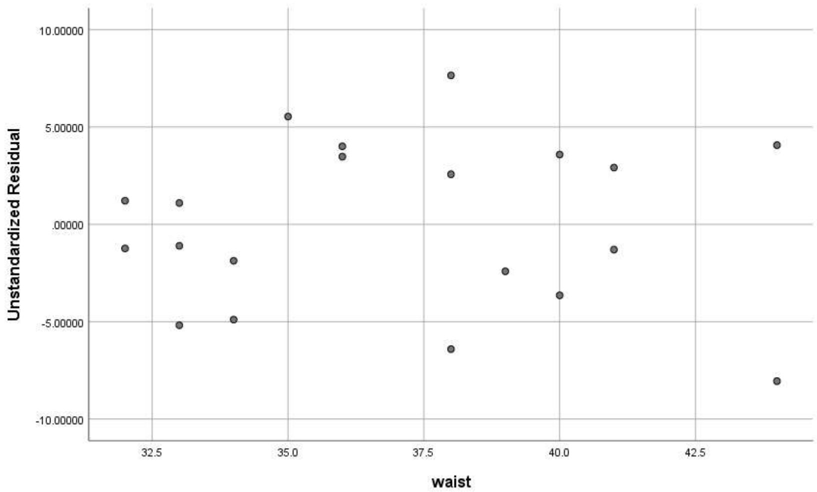
Residual Analysis:

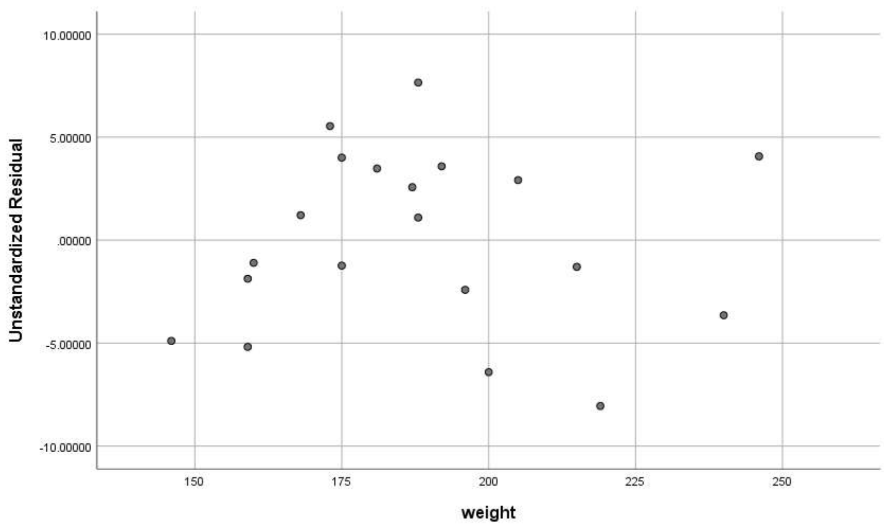
<u>plot of predicted values vs residuals (i.e $\hat{y}_i$ vs e_i)</u> → "graph" → "Legacy Dialog" → "scatter/dot" → "Simple scatter → "Define" →put "Residuals" on the y axis and "Predicted Values" on the x axis → OK (this is to verify the assumption of independence of the errors)



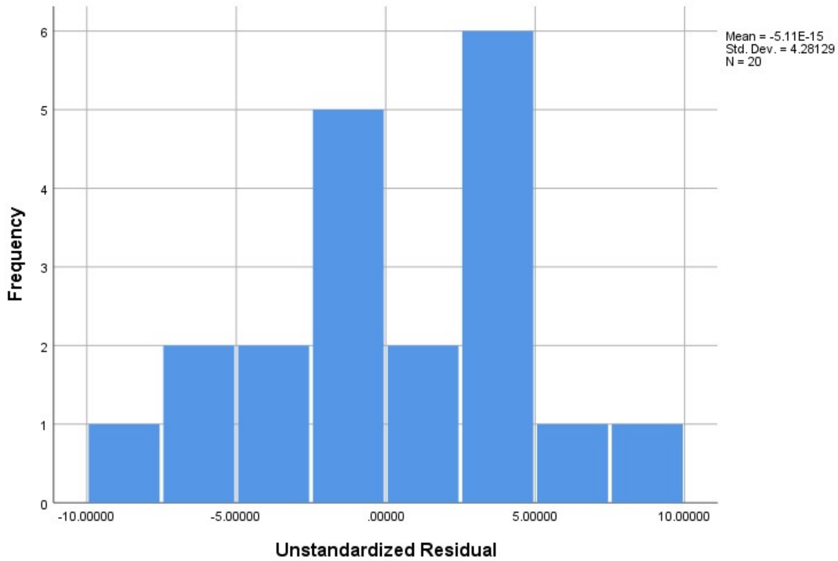
To obtain the **plot of x's vs residuals (i.e x_i vs e_i)** → "graph" → "Legacy Dialog" → "scatter/dot" → "Simple scatter → "Define" →put "Residuals" on the y axis and "waist" on the x axis → OK

And repeat with "weight" (to verify the assumption of constant variance for every x, we need to plot x1 vs residuals and x2 vs residuals)





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



To do F_{drop} or F_{part} test, we need to obtain ANOVA table for the reduced model.

Our Full model is $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \varepsilon$, ANOVA is above with SSR_f = 1389.491 (df = 2)
SSE_f = 348.259 (df = 17)

Reduced model is $y = \beta_0 + \beta_1 x_1 + \varepsilon$, ANOVA table is below

Rerun the ANOVA (same steps as above, except you will have only one independent variable, "waist").

SSRr = 1366.790 (df = 1)
SSEr = 370.960 (df = 18)

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1366.790	1	1366.790	66.320	.000[b]
	Residual	370.960	18	20.609		
	Total	1737.750	19			

a. Dependent Variable: fat

b. Predictors: (Constant), waist

$H_0 : \beta_2 = 0 \qquad \alpha = 0.05$

$H_a : \beta_2 \neq 0$

$$F_{part} = \frac{\left[SSR_f - SSR_r\right] / \left[df_{SSR_f} - df_{SSR_r}\right]}{SSE_f / df_{SSE_f}} = \frac{(1389.491 - 1366.790)/(2-1)}{348.259/17} =$$

$$= \frac{22.701}{20.48582} = \underline{\underline{\mathbf{1.10813}}}$$

<u>R.R:</u> **we reject** H_0 **if** $F_{part} > F_{\alpha(1,17)} = F_{0.05(1,17)} =$ **4.45**