

**Factorial Repeated Measures ANOVA by SPSS—Procedures and Outputs**

1. The data is obtained in the website of Tabachnick & Fidell's textbook.

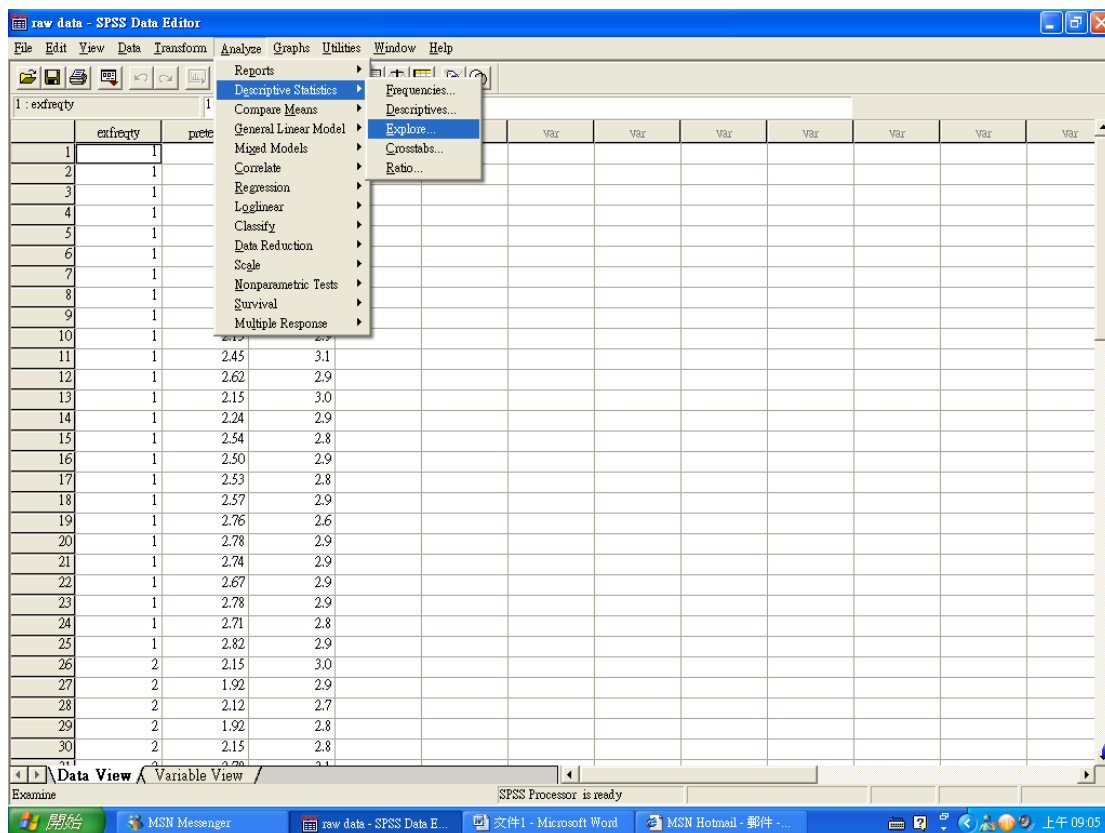
ID #	Exercise type	Pretest	Posttest	ID #	Exercise type	Pretest	Posttest
1	1	1.96	2.70	26	2	2.00	2.95
2	1	2.23	2.63	27	2	1.92	2.86
3	1	2.23	2.70	28	2	1.90	2.68
4	1	1.53	2.68	29	2	1.92	2.82
5	1	1.85	2.64	30	2	2.15	2.82
6	1	2.10	2.70	31	2	2.34	3.05
7	1	1.89	2.92	32	2	2.40	2.96
8	1	2.10	2.70	33	2	2.39	2.83
9	1	2.08	2.85	34	2	2.60	2.87
10	1	2.15	2.79	35	2	2.59	2.92
11	1	2.45	2.98	36	2	2.57	2.92
12	1	2.62	2.91	37	2	2.68	2.90
13	1	2.15	2.88	38	2	2.70	3.03
14	1	2.24	2.79	39	2	2.63	3.09
15	1	2.54	2.70	40	2	2.65	2.78
16	1	2.50	2.81	41	2	2.61	3.04
17	1	2.53	2.70	42	2	2.69	2.92
18	1	2.57	2.82	43	2	2.33	3.13
19	1	2.76	2.48	44	2	2.55	3.15
20	1	2.78	2.78	45	2	2.69	3.14
21	1	2.74	2.76	46	2	2.22	3.13
22	1	2.67	2.77	47	2	2.17	3.08
23	1	2.51	2.75	48	2	2.42	3.11
24	1	2.49	2.72	49	2	2.37	2.97
25	1	2.82	2.76	50	2	2.27	3.04

Note: In exercise type (EXFREQTY), "1" represents that exercise 30 minutes everyday. "2" represents that exercise 30 minutes four days a week.

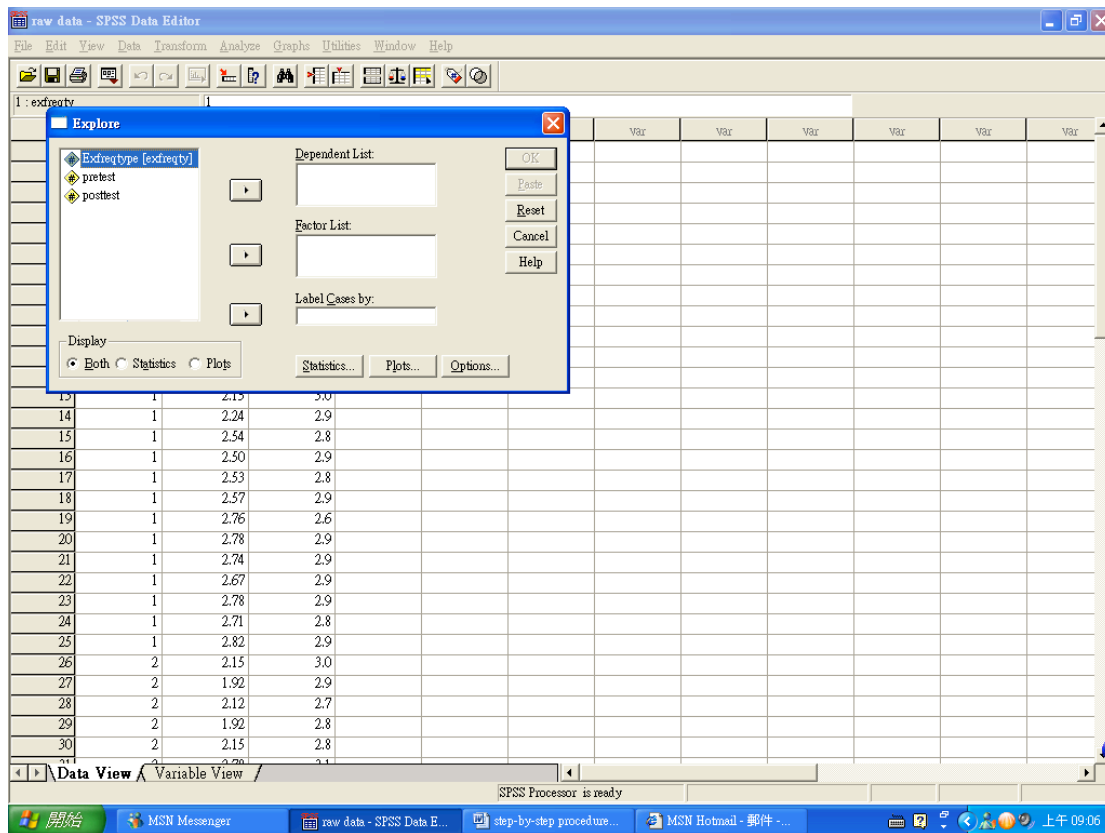
The dependent variable is the how many kilograms participants lose in their weight in a month.

2. Participants who involve in a dieting program to lose their weight are recruited to examine whether there is a statistical significant difference between two kinds of exercise frequency in determination of the weight loss. Fifty participants are recruited and randomly assigned into two groups. In Group 1, participants will exercise 30 minutes everyday. In Group 2, participants will exercise 30 minutes for four days per week. Prior to beginning the exercise, pretest is conducted to see how many kilograms participants lose in their weight by dieting in a month. Then participants engage in aerobic exercise for a month. Posttest is conducted to see how many kilograms participants lose after they involve in exercise.
  
3. Before running Factorial Repeated Measures ANOVA, model assumptions must be tested. Normality will be tested first.

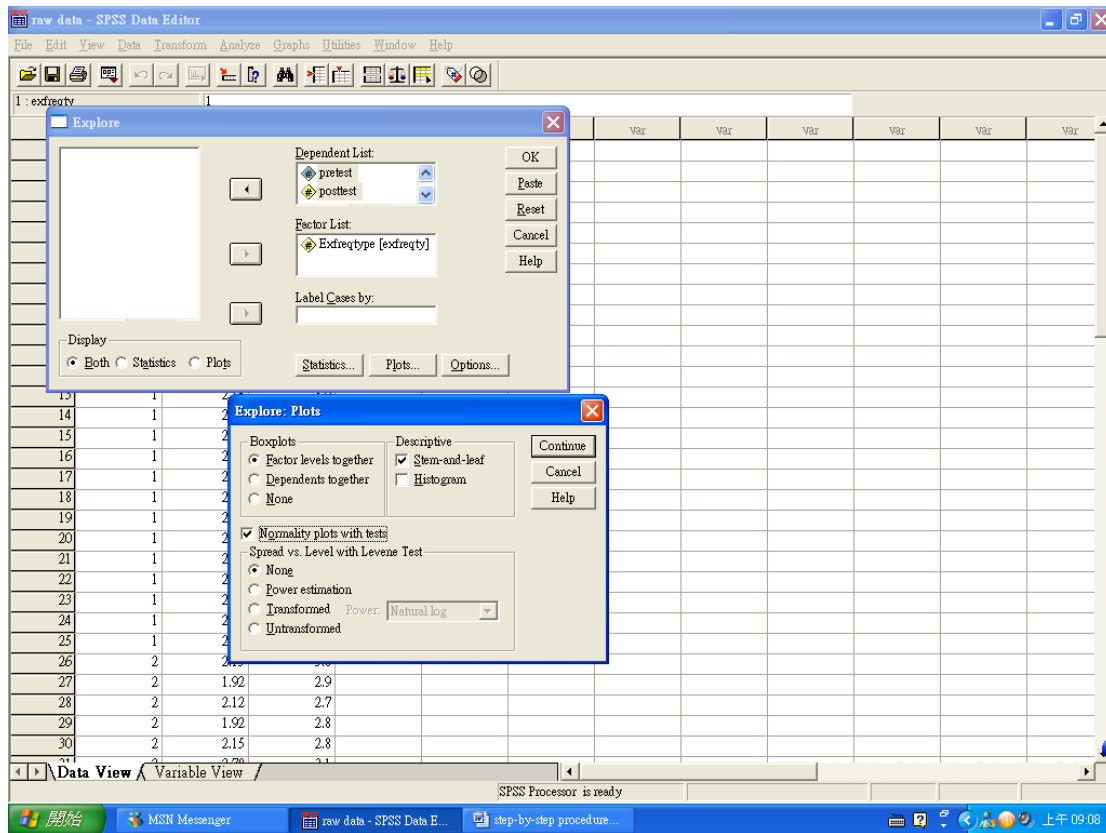
Click “Analyze”, then “Descriptive Statistics,” and then “Explore” to examine the normality.



4. Move the between-subjects variable (EXFREQTY –two kinds of exercise frequency) into “Factor List,” and the within-subject variables (TESTTIME -pretest and posttest) into “Dependent List”.



- Then click on “Plot”, check the “normality plots with tests.” Then click “continue” and “OK.”



6. Reading output of Normality (Refer to page 3 in the output.)

With moderate sample size of 50 people, the Shapiro-Wilk test for normality is examined at significant value of .01. The significant values of both pretest and posttest of these two kinds of exercise frequency are greater than .01. The sample is not significantly deviated from normality. Then we can examine the Homogeneity of Covariance by examine the Box's Test.

The screenshot shows the SPSS Viewer interface with the following content:

**POSTTEST**

Median	2.9600	
Variance	.017	
Std. Deviation	.12879	
Minimum	2.68	
Maximum	3.15	
Range	.47	
Interquartile Range	.2200	
Skewness	-.313	.464
Kurtosis	-.702	.902

**Tests of Normality**

	Exfreqtype	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
PRETEST	1	.153	25	.134	.951	25	.262
	2	.168	25	.068	.901	25	.019
POSTTEST	1	.135	25	.200*	.963	25	.487
	2	.126	25	.200*	.955	25	.320

\*. This is a lower bound of the true significance.  
a. Lilliefors Significance Correction

**PRETEST**

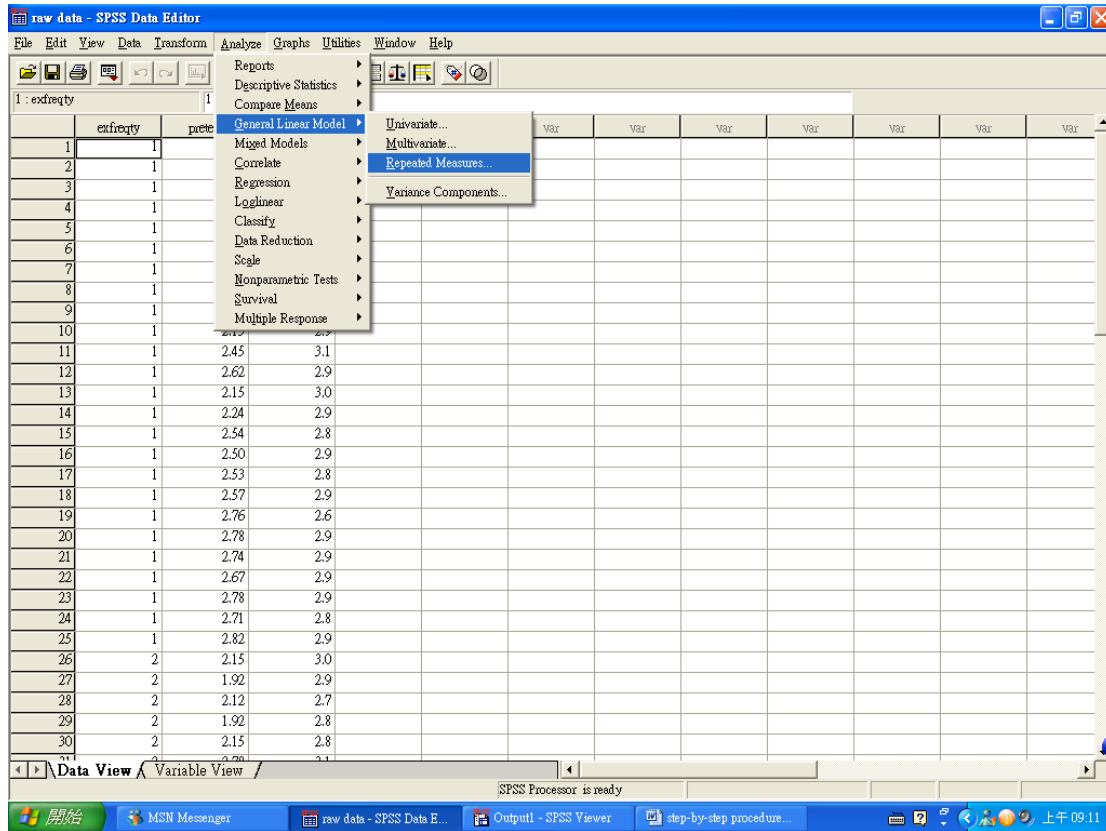
**Stem-and-Leaf Plots**

PRETEST Stem-and-Leaf Plot for  
EXPFREQTY= 1

Frequency	Stem & Leaf
1.00	1 . 5
.00	1 .
3.00	1 . 889

7. Running Factorial Repeated Measures ANOVA by SPSS

Click “Analyze,” then “General Linear Model,” and then “Repeated Measures.”



8. Name the Within-Subject variable by putting the name into the “Within-Subject Factor Name.” Then put the number of levels of Within-subject variable into the “Number of Levels.” In this case, the number of level will be 2, since there is only one pretest and one posttest.

The screenshot shows the SPSS Data Editor window with a data table and a dialog box for defining repeated measures factors.

**Data Table:**

	extfreqy	pretest	posttest	Var	Var	Var	Var	Var	Var	Var	Var	Var
1	1	1.96	2.8									
2	1	2.23	2.7									
3	1	2.23	2.8									
4	1	1.53	2.8									
5	1	1.85	2.7									
6	1	2.10	2.8									
7	1	1.89	3.0									
8	1	2.10	2.8									
9	1	2.08	3.0									
10	1	2.15	2.9									
11	1	2.45	3.1									
12	1	2.62	2.9									
13	1	2.15	3.0									
14	1	2.24	2.9									
15	1	2.54	2.8									
16	1	2.50	2.9									
17	1	2.53	2.8									
18	1	2.57	2.9									
19	1	2.76	2.6									
20	1	2.78	2.9									
21	1	2.74	2.9									
22	1	2.67	2.9									
23	1	2.78	2.9									
24	1	2.71	2.8									
25	1	2.82	2.9									
26	2	2.15	3.0									
27	2	1.92	2.9									
28	2	2.12	2.7									
29	2	1.92	2.8									
30	2	2.15	2.8									
31	2	2.50	3.1									

**Repeated Measures Define Factor(s) Dialog Box:**

- Within-Subject Factor Name: testtime
- Number of Levels: 2
- Buttons: Define, Reset, Cancel, Help, Measure >>, Add, Change, Remove

The bottom status bar shows "SPSS Processor is ready" and the Windows taskbar includes "開始", "MSN Messenger", "raw data - SPSS Data E...", "Output1 - SPSS Viewer", "step-by-step procedure...", and the system clock "上午 09:19".







11. Move the Factors and Factor interactions from the left box to the right box of “Display Means for.” Then check “Descriptive Statistics,” and “Homogeneity tests.” Then click “continue.”

The screenshot shows the SPSS Data Editor window with a data table and a dialog box for configuring a Repeated Measures ANOVA. The data table has columns for 'exfreqty', 'pretest', and 'posttest', with rows numbered 1 to 30. The dialog box 'Repeated Measures: Options' is open, showing the following settings:

- Estimated Marginal Means:** Factor(s) and Factor Interactions: (OVERALL), exfreqty, testime, exfreqty\*testime.
- Display Means for:** (Empty box)
- Display:**
  - Descriptive statistics
  - Estimates of effect size
  - Observed power
  - Parameter estimates
  - SSCP matrices
  - Residual SSCP matrix
  - Transformation matrix
  - Homogeneity tests
  - Spread vs. level plots
  - Residual plots
  - Lack of fit test
  - General estimable function
- Significance level:** .05
- Confidence intervals are:** 95%

The task instructions indicate that the factors and interactions should be moved to the 'Display Means for' box, and 'Descriptive Statistics' and 'Homogeneity tests' should be checked. The 'Continue' button is visible at the bottom of the dialog box.

12. Reading output for Homogeneity of Covariance. (Refer to page 10 in the output.)  
 In the results of Box's Test of Equality of Covariance Matrices. The result is tested at the significant value of .01. Therefore, the covariance is homogeneous.

The screenshot shows the SPSS Viewer window for 'Output-no interaction040606'. The left sidebar shows a tree view of the output, with 'Box's Test of Equality of Covariance Matrices' selected. The main window displays the following statistical results:

**Box's Test of Equality of Covariance Matrices<sup>a</sup>**

Box's M	3.573
F	1.137
df1	3
df2	414720.000
Sig.	.332

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept+EXFREQTY  
 Within Subjects Design: FACTOR1

**Multivariate Tests<sup>b</sup>**

Effect		Value	F	Hypothesis df	Error df	Sig.
FACTOR1	Pillai's Trace	.734	132.586 <sup>a</sup>	1.000	48.000	.000
	Wilks' Lambda	.266	132.586 <sup>a</sup>	1.000	48.000	.000
	Hotelling's Trace	2.762	132.586 <sup>a</sup>	1.000	48.000	.000
	Roy's Largest Root	2.762	132.586 <sup>a</sup>	1.000	48.000	.000
FACTOR1 * EXFREQTY	Pillai's Trace	.067	3.433 <sup>a</sup>	1.000	48.000	.070
	Wilks' Lambda	.933	3.433 <sup>a</sup>	1.000	48.000	.070
	Hotelling's Trace	.072	3.433 <sup>a</sup>	1.000	48.000	.070
	Roy's Largest Root	.072	3.433 <sup>a</sup>	1.000	48.000	.070

a. Exact statistic  
 b. Design: Intercept+EXFREQTY  
 Within Subjects Design: FACTOR1

**Mauchly's Test of Sphericity<sup>b</sup>**

Measure: MFASURE 1

13. Refer to page 11 in the output.

After the model assumptions are evaluated and met, examine whether there is interaction effect first. In the results of “Tests of Within-Subjects Contrasts,” the result of “TESTTIME\*EXFREQTY” is not significant,  $F(1, 48) = 3.43, p = .07$ . There is no interaction effect. Then we will examine the main effect. The result of main effect of TESTTIME is significant,  $F(1, 48) = 132.59, p < .001$ .

**Output-no interaction040606 - SPSS Viewer**

File Edit View Insert Format Analyze Graphs Utilities Window Help

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Error(FAC TOR1)	2.237	48	4.661E-02		
	Greenhouse-Geisser	2.237	48.000	4.661E-02	
	Huynh-Feldt	2.237	48.000	4.661E-02	
	Lower-bound	2.237	48.000	4.661E-02	

**Tests of Within-Subjects Contrasts**

Measure: MEASURE\_1

Source	FACTOR1	Type III Sum of Squares	df	Mean Square	F	Sig.
FACTOR1	Linear	6.180	1	6.180	132.596	.000
FACTOR1 * EXFREQTY	Linear	.160	1	.160	3.433	.070
Error(FACTOR1)	Linear	2.237	48	4.661E-02		

**Levene's Test of Equality of Error Variances<sup>a</sup>**

	F	df1	df2	Sig.
PRETEST	2.449	1	48	.124
POSTTEST	2.360	1	48	.131

Tests: the null hypothesis: that the error variance of the dependent variable is equal across groups.

a. Design: Intercept+EXFREQTY  
Within Subjects Design: FACTOR1

**Tests of Between-Subjects Effects**

Measure: MEASURE\_1  
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	683.090	1	683.090	11743.727	.000
EXFREQTY	.428	1	.428	7.353	.009
Error	2.792	48	5.817E-02		

2 items selected (0 hidden/collapsed)

SPSS Processor is ready

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14. Refer to page 11 in the output.

Then we are going to examine another main effect of EXFREQTY. In the box of “Test of Between-Subjects Effect.” There is significant main effect in EXFREQTY,  $F(1, 48) = 7.35$ ,  $p = .009$ .

The screenshot shows the SPSS Output Viewer window with the following content:

**Levene's Test of Equality of Error Variances\***

	F	df1	df2	Sig.
PRETEST	2.449	1	48	.124
POSTTEST	2.360	1	48	.131

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a.  
Design: Intercept+EXFREQTY  
Within Subjects Design: FACTOR1

**Tests of Between-Subjects Effects**

Measure: MEASURE\_1  
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	683.090	1	683.090	11743.727	.000
EXFREQTY	.428	1	.428	7.353	.009
Error	2.792	48	5.817E-02		

**Estimated Marginal Means**

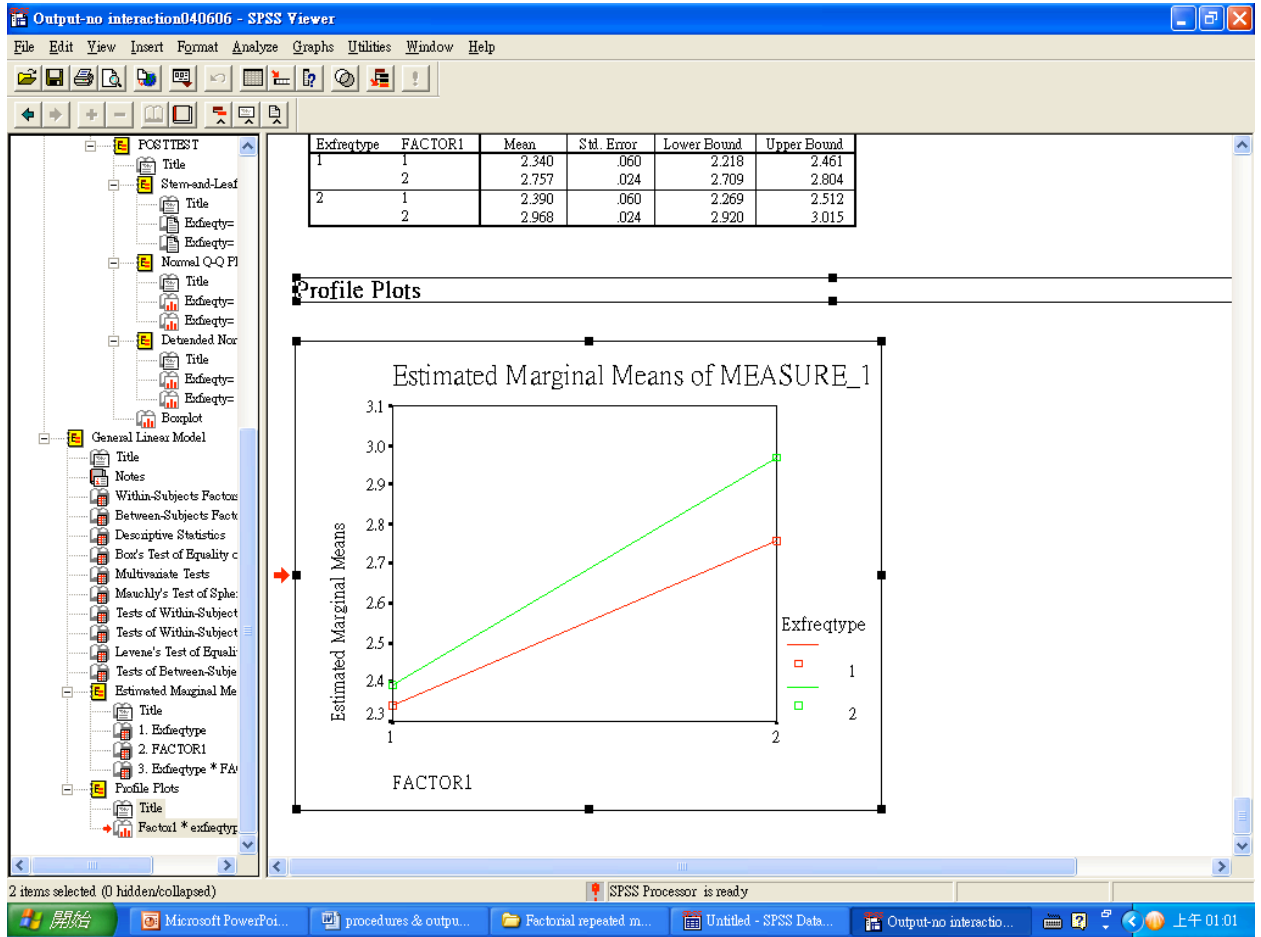
1. Exfreqtype

Measure: MEASURE\_1

Exfreqtype	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	2.548	.034	2.480	2.617
2	2.679	.034	2.610	2.748



16. We can also examine the plot of the results to help us easily see the pattern of the results.



## Results

A two-way ANOVA with repeated measure on one factor was conducted to determine whether there was a statistical significance between two different types of exercise frequency for helping losing weight. The independent variable included a between-subjects variable, the exercise frequency, and within-subject variable, repeated measures of pretest and posttest. The dependent variable was the amount of kilograms of weights loss in a month. An alpha level of .05 was utilized for this analysis. Results for model assumptions of normality, homogeneity of covariance, and linearity were satisfactory.

There was not a statistically significant interaction in the amount of weight loss between the exercise frequency type and test time,  $F(1, 48) = 3.43, p = .07$ . The result of main effect of pretest and posttest was significant,  $F(1, 48) = 132.59, p < .001, \eta^2 = .73$ . A large effect size was evident. There was also a significant main effect in the exercise frequency type,  $F(1, 48) = 7.35, p = .009, \eta^2 = .13$ , which was indicative of a moderate to large effect size.