SPSS/SAS ANOVA Manual

- Single Factor Between Subject Design (1B design)
- Single Factor Within Subjects Design (1W design)
- Between Subjects Factorial Design (Factorial Design)
- Mixed Factorial Design (1B + 1W design)
- Two-Within Factorial Design (2W design)
- Contrast
- Power and Sample Size

Version 2.0

（これは個人利用のために作成したマニュアルです。今後修正される可能性があることをあらかじめご了承ください。）

Developed by Ryoh SASAKI

(Final upgrade: April 25, 2006)

Single Factor Between Subjects Design (1B design)

(Week 2&3: #2)

1. Prepare data set

Independent variable …..1

Dependent variable……..1

➔ Type "value labels" at "Data View Sheet" of SPSS

e.g.) 1 = male, 2=female….

Factor A					
.a1		.a2		.a3	
1	xx	5	xx	9	xx
2	xx	6	xx	10	xx
3	xx	7	xx	11	xx
4	xx	8	xx	12	xx

id	.Factor A	.dpdnt
1	1	xx
2	1	xx
3	1	xx
4	2	xx
5	2	xx
6	2	xx
7	3	xx
8	3	xx
9	3	xx

2. Normality test

- Kolmogorov-Smirnov D test (p>.05….Ho:Normality is retained)

  Analyze > Descriptive Statistics > Explore > Dependent (dependent variable) &

  Plots > Normality Plot with Tests (on) > Click OK

  **Boxplots (none) & Stem-and-leaf (off)*

  (Alternative) Analyze > Nonparametric Tests > 1-Sample K-S… > Test Variable List (dpdnt vrbl) &

  At Test Distribution, Normal (on) + Uniform (on) >Click OK

  ➔ <u>K-S value and p value</u>: See "Differences (Positive)" in 1st table (e.g., .066) and "Asymp.Sig (2-tailed)" in 2nd table (e.g., .071).

  ** So if it is 1-tailed, the value should be .071 x 2 = .142.*

- Histogram + Normal curve

  Graph > Histogram > Variable (dpdnt vrbl) > Display normal curve (on) => (Figure 1)

3. Homogeneity of Variance

- Levene's test of homogeneity of variance (p > .05….Ho: Homogeneity is retained)

  (Syntax…..See ANOVA's Homogeneity test)

4. ANOVA

- *Analyze > General Linear Model > Univariate > Dependent variable (dpdnt vrbl) & Fixed factor* *(indpdnt vrbl), & Option > Descriptive Statistics (on) & Homogeneity tests (on) &Estimates of effect size on) & Observed power (on)*

ANOVA Summary Table

Source		SS	df	MS	F	p
A	<="Corrected Model"	SS	df	MS	F	e.g) p <.05
S/A	<= "Error"	SS	df	MS		
Total	<= "Corrected total"	SS				

5. Post Hot Test

Duncan MRS	- Generally restricted to **equal** sample size; -Calculate each pair-wise test (q-test) at set alpha level; - Most powerful.
Tukey HSD	- Can handle **unequal** sample size; - Calculate pair-wise test (q-test); - Family-wise test (Good overall type I error protection)
Schoffe	- Can handle **unbalanced** data; - Too conservative; - Based on F-dist.

- *(Univariate > Host Hoc > Post Hoc Test For (dpdnt vrbl) > Duncan, Tukey, Schoffe (on)*

6. Bar chart

Graph > Bar > Select "Simple" > Define

At "Bar represent" > Other Statistic (dpdnt vrble) & Category Axis (indpndnt vrbl) > Click OK

7. Write your conclusion ("Thus….")

8. Tables

Tables should be attached ((i) Descriptive statistics, (ii) Histogram(overall) + normal curve, (iii) Figure 1: Histogram (by each level of factor)　＊必要に応じて、ANOVA Summary Table, （もし本文に F=　, p =　などの値を書いた場合には、重複するので、ANOVA Summary Table は載せなくていい）

<u>Assumptions for Linear Model (IB, IW, Factorial….)</u>

1) **Independence** – Subjects were randomly assigned to treatment conditions
2) **Normality** – The score in the treatment populations are normally distributed (Check by K-S Test for Normality).
3) **Equal variance** – The variances in the treatment populations are equal and is called common variance, sigma^2 (error) (Check by Levene's Test of Equal of Error Variance)

Q 6 A Single Factor Between Subjects Design (1B design)

(Week 2&3: #2)

	ID	VAS1	Ethnic
1	1	43.67	1
2	2	71.00	3
3	3	99.00	2
4	4	64.33	3
5	5	70.00	2
6	6	48.67	2
7	7	70.33	3
8	8	70.00	3
9	9	38.00	1
10	10	63.33	1
11	11	73.00	1
12	12	44.33	2
13	13	60.66	1
14	14	84.33	3
15	15	26.33	1
16	16	70.67	3
17	17	59.67	1
18	18	43.33	1
19	19	43.67	1
20	20	48.33	2
21	21	37.33	1
22	22	43.00	3
23	23	42.00	2
24	24	37.67	1
25	25	47.67	1
26	26	39.33	2
27	27	41.00	1
28	28	45.00	1

SPSS Syntax

```
UNIANOVA
   VAS1    BY Ethnic
   /METHOD = SSTYPE(3)
   /INTERCEPT = INCLUDE
   /POSTHOC = Ethnic ( TUKEY DUNCAN SCHEFFE )
   /EMMEANS = TABLES(Ethnic)
   /PRINT = DESCRIPTIVE ETASQ OPOWER HOMOGENEITY
   /CRITERIA = ALPHA(.05)
   /DESIGN = Ethnic .
ONEWAY
   VAS1 BY Ethnic
   /MISSING ANALYSIS
   /POSTHOC = TUKEY DUNCAN SCHEFFE ALPHA(.05).
```

A researcher was interested in determining if the difference of ethnic group affected the mean stress after one hour after turning their final examinations. Thirty four EMR 6450 students who responded to a post exam stress survey were selected and divided into three conditions: White, African American and Hispanic. Descriptive statistics are summarized in Table 1. Kolmogorov-Smirnov test for normal distribution was rejected, $p < .01$, and it was also observed in Figure 1. However, since Levene's test for homogeneity of variance was not rejected, F (2, 31) = 1.49, $p > .05$, it what does "it" refer to?does not have to be too much concerned. ANOVA results indicated a statistically difference in the means, F (2, 31) = 5.68, $p < .05$. Tukey HSD post hoc test~~, which can handle unequal sample sizes~~, reveled that the mean stress in White was significantly lower than that in Hispanic, $p < .05$, and other pairs (White and African American, and African American and Hispanic) were not significant, $p > .05$.

Conclusion? –1 Score 9/0

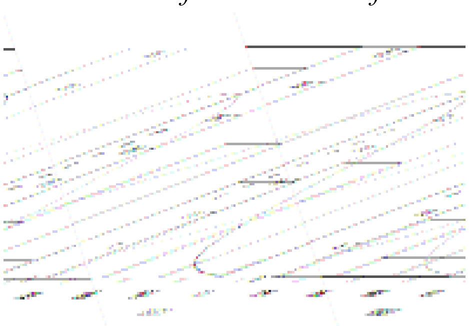
Table 1

Mean stress of the three ethnic groups

Ethnic Group	M	SD
White	44.43	12.56
African American	55.95	21.48
Hispanic	64.22	12.91

Figure 1

Distribution of mean stress of the three ethnic groups



Single Factor Within Subjects Design (1W design)

(Week 4&5: #3)

1. Prepare data set

Independent variable ..1 (but multiple levels)

Dependent variable……..1

➔ Type "value labels" at "Data View Sheet" of SPSS

e.g.) 1 = male, 2=female….

➔ *さらに、all cases を一列に並べた Data も作って、”Alldata”などと Name しておく。Kolmogorov-Smirnov D test のためです。*

	Factor A		
	.a1	.a2	.a3
Subject 1	xx	xx	xx
Subject 2	xx	xx	xx
Subject 3	xx	xx	xx
Subject 4	xx	xx	xx

id	.a1	.a2	.a3
1	xx	xx	xx
2	xx	xx	xx
3	xx	xx	xx
4	xx	xx	xx
5	xx	xx	xx
6	xx	xx	xx
7	xx	xx	xx

\+

Alldata
xx
xx
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xx
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xx
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xx
xx
xx
xx
xx

2. Normality test

- Kolmogorov-Smirnov D test (p>.05….Ho:Normality is retained)

Analyze > Descriptive Statistics > Explore > Dependent (dependent variable) &

Plots > Normality Plot with Tests (on) > Click OK

**Boxplots (none) & Stem-and-leaf (off)*

(Alternative) Analyze > Nonparametric Tests > 1-Sample K-S… > Test Variable List (dpdnt vrbl) &

At Test Distribution, Normal (on) + Uniform (on) >Click OK

➔ <u>K-S value and p value</u>: See "Differences (Positive)" in 1st table (e.g., .066) and "Asymp.Sig (2-tailed)" in 2nd table (e.g., .071).

* So if it is 1-tailed, the value should be .071 x 2 = .142.

- Histogram + Normal curve

Graph > Histogram > Display normal curve (on) => (Figure 1)

3. Sphericity test

- Sphericy tests (Mauchly's W) (p>.05…..Ho: Sphericity is retained)
- Greenhouse-Geisser Epsilon & Huynh-Feldt Epsilon (Nearer 1.0, more lack of sphericity)

(もし P<.05 なら、ANOVA で、「G-G」あるいは「Huynh-Feldt」で計算した effect (Factor A, Error (factor A)) を採用する。もし P > .05 なら、「Sphericity Assumed」で計算した effect を採用する。)

4. ANOVA

- Analyze > General Linear model > Repeated Measures > Within-Subject Factor Name (e.g., time) & Number of Levels (e.g., 3) & click Add;

Click Define > Within-Subject Variables (move one by one) & Click OK;

Click Options > Display Means for (e.g., time) > Compare Main Effect (on) > Confidence interval adjustment (Choose LSD) > Display (Descriptive Statistics (on))> Click Continue;

Click Plots > Horizontal Axis (e.g., time) & Click Add > Click Continue >Click OK ➔ (Figure 2)

ANOVA Summary Table

Source		SS	df	MS	F	p
A	🡐 Test of **Within-Subject** Effects の上段(“Factor A)から採用する。	SS	df	MS	F	e.g) p <.05
S	🡐 Test of **Between-Subjects** Effects の”Error”から採用する。	SS	df	MS	F	
S/A	🡐 Test of **Within-Subject** Effects の下段 (“Error (effect A)”) から採用する。	SS	df	MS		
Total （自分で計算する）		SS	df			

この F だけは自分で計算する。

* To verify the “Total”

Open Excel > Tool > Analysis Tool > One-way ANOVA ➔ You can get the following table. You can verify the values in the boxes. (But F value and p value in the following table do not match them in the above table.

One-way ANOVA (Excel)

Source of variance	SS	df	MS	F	p	F critic
Between	…………………	……………..	……			
Within	S’s SS +S/A’s SS	S’df+S/A’s df				
Total	…………………	……………..				

5. Post Hoc Comparisons

- See the table of “Pairwise Comparisons” (See each p-value (=sig.-value)

6. Write your conclusion (“Thus….”)

7. Tables

Tables should be attached ((i) Descriptive statistics, (ii) Figure 1: Distribution, (iii) Figure 2: Line chart (x: levels of a factor, y: dependent values) ＊必要に応じて、ANOVA Summary Table, （もし本文に F= , p = などの値を書いた場合には、重複するので、ANOVA Summary Table は載せなくていい）

Q & A: Single Factor Within Subjects Design (1W design)

(Week 4&5: #3)

	ID	three	six	nine	var
1	1	10.0	18.0	20.0	
2	2	12.0	20.0	19.0	
3	3	38.0	51.0	52.0	
4	4	14.0	22.0	27.0	
5	5	28.0	37.0	43.0	
6	6	9.0	25.0	26.0	
7	7	21.0	29.0	31.0	
8	8	7.0	23.0	24.0	
9	9	17.0	23.0	20.0	
10					
11					

Data View / Variable View

SPSS Syntax

```
EXAMINE
  VARIABLES=VAS1 VAS2 VAS3
  /PLOT   NPPLOT
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING PAIRWISE
  /NOTOTAL.
EXAMINE
  VARIABLES=VASall
  /PLOT   NPPLOT
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
GRAPH
  /HISTOGRAM(NORMAL)=VASall .
GLM
  VAS1 VAS2 VAS3
  /WSFACTOR = time 3 Polynomial
  /METHOD = SSTYPE(3)
  /PLOT = PROFILE( time )
  /EMMEANS = TABLES(time) COMPARE ADJ(LSD)
  /PRINT = DESCRIPTIVE
  /CRITERIA = ALPHA(.05)
  /WSDESIGN = time .
```

A researcher was interested in determining if the difference of ethnic group affected the mean stress after one hour after turning their final examinations. Thirty four EMR 6450 students who responded to a post exam stress survey were selected and divided into three conditions: White, African American and Hispanic. Descriptive statistics are summarized in Table 1. Kolmogorov-Smirnov test for normal distribution was rejected, $p < .01$, and it was also observed in Figure 1. However, since Levene's test for homogeneity of variance was not rejected, $F(2, 31) = 1.49$, $p > .05$, it what does "it" refer to?does not have to be too much concerned. ANOVA results indicated a statistically difference in the means, $F(2, 31) = 5.68$, $p < .05$. Tukey HSD post hoc test~~, which can handle unequal sample sizes~~, reveled that the mean stress in White was significantly lower than that in Hispanic, $p < .05$, and other pairs (White and African American, and African American and Hispanic) were not significant, $p > .05$.

Conclusion? -1

Score 9/0

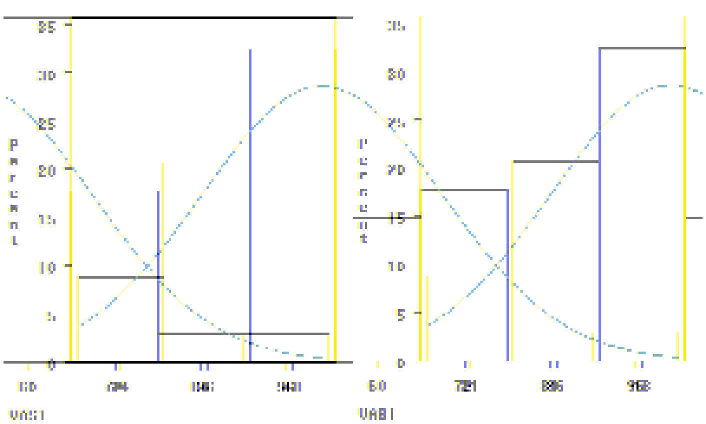
Table 1

Mean stress of the three ethnic groups

Ethnic Group	M	SD
White	44.43	12.56
African American	55.95	21.48
Hispanic	64.22	12.91

Figure 1

Distribution of mean stress of the three ethnic groups



Between Subjects Factorial Design (Factorial design)

(Two-way, Three-way, Four way….)

(Week 6: #4)

1. Prepare data set

Independent variables …Multiple (e.g.,2 x2, 3x3, etc.)

Dependent variable……..1

➔ **Sorting Data**

Data は、Factor A, Factor B, dpdnt value という 3 行で構成されるデータとして打ち込む。

➔ Type "value labels" at "Data View Sheet" of SPSS

e.g.) 1 = male, 2=female…. (for Factor A)

1= teacher, 2=admin., 3=staff…(for Factor B)

		Factor A		
		.a1	.a2	.a3
Factor B	.b1	.x,x,x,	x,x,x,	x,x,x,
	.b2	.x,x,x,	x,x,x,	x,x,x,
	.b3	.x,x,x,	x,x,x,	x,x,x,

⇨

.Factor A	Factor B	.dpdnt
1	1	xxx
1	1	xxx
1	2	xxx
1	2	xxx
1	3	xxx
1	3	xxx
2	1	xxx
2	1	xxx
2	2	xxx
2	2	xxx
2	3	xxx
2	3	xxx
3	1	xxx
3	1	xxx
3	2	xxx
3	2	xxx

3. Normality test

- Kolmogorov-Smirnov D test (p>.05….Ho:Normality is retained)

Analyze > Descriptive Statistics > Explore > Dependent (dependent variable) &

Plots > Normality Plot with Tests (on) > Click OK

**Boxplots (none) & Stem-and-leaf (off)*

(Alternative) Analyze > Nonparametric Tests > 1-Sample K-S… > Test Variable List (dpdnt vrbl) &

At Test Distribution, Normal (on) + Uniform (on) >Click OK

➔ K-S value and p value: See "Differences (Positive)" in 1st table (e.g., .066) and "Asymp.Sig (2-tailed)" in 2nd table (e.g., .071).

* So if it is 1-tailed, the value should be .071 x 2 = .142.

- Histogram + Normal curve

Graph > Histogram > Display normal curve (on) => (Figure 1)

4. Homogeneity of Variance

- Levene's test of homogeneity of variance (p > .05….Ho: Homogeneity is retained)

(Syntax…..See ANOVA's Homogeneity test)

5. ANOVA

Analyze > General Linear Model > Univariate > Dependent variable (dpdnt vrbl (e.g., hr)) & Fixed factor (indpdnt vrbl (e.g., relax, stress)

Click Post Hoc > Post Hoc Tests for (indpdnt vrbls (e.g., stress, relax) & Tukey (on)> Click Continue

*Click Option > Display Means for (all variables (e.g., stress, relax, stress * relax, (Overall) & Descriptive Statistics (on) & Homogeneity tests (on) &Estimates of effect size (on) & Observed power (on) > Click Continue > Click OK*

ANOVA Summary Table

Source	SS	df	MS	F	p
Factor A	SS	df	MS	F	e.g) p <.05
Factor B	SS	df	MS	F	e.g) p <.05
AB Interaction	SS	df	MS	F	e.g) p <.05
Error (S/A)	SS	df	MS		
Total	SS				

＊すべてSPSS のアウトプットから採用することができる！

6. Post hoc Test or Analysis of Simple Effects

No interaction effect is found (**A*B: p >.05**). ➔	Post Hoc Tests
Significant interaction effect is found (**A*B: p <.05**).➔	Analysis of Simple Effects.

(6-1) Analysis of Simple Effects

Data > Select Cases > Select "If condition is…" > Select **a level of A** *factor (e.g., "stress =1") > Click Continue > Click > OK.*

*Analyze > General Linear Model > Univariate > Dependent variable (dpdnt vrbl (e.g., hr)) & Fixed factor (***B** *indpdnt vrbl (e.g., relax))*

*Click Post Hoc > Post Hoc Tests for (***B** *indpdnt vrbls (e.g., relax) & Tukey (on)*

Click Option > Display Means for (all variables (e.g., relax, (Overall) & Descriptive Statistics (on) & Homogeneity tests (on) &Estimates of effect size (on) & Observed power (on)

Data > Select Cases > Select "If condition is…" > Select **a level of B** *factor (e.g., "relax =1") > Click Continue > Click > OK.*

*Analyze > General Linear Model > Univariate > Dependent variable (dpdnt vrbl (e.g., hr)) & Fixed factor (***A** *indpdnt vrbl (e.g., stress))*

*Click Post Hoc > Post Hoc Tests for (***A** *indpdnt vrbls (e.g., stress) & Tukey (on)*

Click Option > Display Means for (all variables (e.g., stress, (Overall) & Descriptive Statistics (on) & Homogeneity tests (on) &Estimates of effect size (on) & Observed power (on)

# of Analysis of Simple Effects = # levels of A * # levels of B (e.g., 3 x 2 = 6)

(6-2) Post hoc Tests (in the case of NO interaction effect)

(Click Post Hoc > Post Hoc Tests for (indpdnt vrbls (e.g., stress, relax) & Tukey (on)> Click Continue)

Duncan MRS	- Generally restricted to **equal** sample size; -Calculate each pair-wise test (q-test) at set alpha level; - Most powerful.
Tukey HSD	- Can handle **unequal** sample size; - Calculate pair-wise test (q-test); - Family-wise test (Good overall type I error protection)
Schoffe	- Can handle **unbalanced** data; - Too conservative; - Based on F-dist.

⇨ *Significant とされた Factor に関してのみ、Post Hoc Tests の結果を見る。*
E.g.) 2Factors なら、最大で2 つの Post Hoc Tests
3Factors なら、最大で３つの Post Hoc Tests
ただし、Level が３に満たない（つまり２）の Factor については、Post Hoc Tests は行われない。なぜなら、単純な F-test（つまり t-test）で足りるから。したがって (I) ANOVA Summary Table で p < .05 かどうかを確かめる。(ii) p < .05 なら違いがあるということなので、Mean difference を確かめて、どちらが高い値でどちらが低い値なのかを確かめるだけ。

7. Histogram by Categories

- *Graph > Bar Charts > Clustered (on) & Data in Chart Are (Summaries for groups of cases) > Click Define*

  Bars Represent >Click Other statistic (move dpdnt vrbl (e.g. hr)), & Category Axis (move A factor) & Define Clusters by (move B factor) > Paste & Run

8. Write your conclusion (“Thus….”)

9. Tables

Tables should be attached ((i) Descriptive statistics, (ii) Figure1: Distribution, (iii) Histogram (x: levels of A factor * levels of B factor *…..), y: dependent values) ＊必要に応じて、ANOVA Summary Table,（もし本文に F= , p = などの値を書いた場合には、重複するので、ANOVA Summary Table は載せなくていい）

Q & A: Between Subjects Factorial Design (Factorial design)

(Two-way, Three-way, Four way….)

(Week 6: #4)

SPSS Syntax

```
EXAMINE
   VARIABLES=number
   /PLOT    NPPLOT
   /STATISTICS DESCRIPTIVES
   /CINTERVAL 95
   /MISSING LISTWISE
   /NOTOTAL.
GRAPH
   /HISTOGRAM(NORMAL)=number .
UNIANOVA
   number    BY diagonosis locus
   /METHOD = SSTYPE(3)
   /INTERCEPT = INCLUDE
   /POSTHOC = diagonosis locus ( TUKEY )
   /EMMEANS = TABLES(diagonosis)
   /EMMEANS = TABLES(locus)
   /EMMEANS = TABLES(diagonosis*locus)
   /EMMEANS = TABLES(OVERALL)
   /PRINT = DESCRIPTIVE ETASQ OPOWER
HOMOGENEITY
   /CRITERIA = ALPHA(.05)
   /DESIGN = diagonosis locus
diagonosis*locus .
UNIANOVA
   number    BY diagonosis
   /METHOD = SSTYPE(3)
   /INTERCEPT = INCLUDE
   /POSTHOC = diagonosis ( TUKEY )
   /EMMEANS = TABLES(diagonosis)
   /EMMEANS = TABLES(OVERALL)
   /PRINT = DESCRIPTIVE ETASQ OPOWER
HOMOGENEITY
   /CRITERIA = ALPHA(.05)
   /DESIGN = diagonosis .
UNIANOVA
   number    BY diagonosis
   /METHOD = SSTYPE(3)
   /INTERCEPT = INCLUDE
   /POSTHOC = diagonosis ( TUKEY )
   /EMMEANS = TABLES(diagonosis)
   /EMMEANS = TABLES(OVERALL)
   /PRINT = DESCRIPTIVE ETASQ OPOWER
HOMOGENEITY
   /CRITERIA = ALPHA(.05)
   /DESIGN = diagonosis .

UNIANOVA
   number    BY diagonosis
   /METHOD = SSTYPE(3)
   /INTERCEPT = INCLUDE
   /POSTHOC = diagonosis ( TUKEY )
   /EMMEANS = TABLES(diagonosis)
   /EMMEANS = TABLES(OVERALL)
   /PRINT = DESCRIPTIVE ETASQ OPOWER
HOMOGENEITY
   /CRITERIA = ALPHA(.05)
   /DESIGN = diagonosis .

UNIANOVA
   number    BY locus
   /METHOD = SSTYPE(3)
   /INTERCEPT = INCLUDE
   /POSTHOC = locus ( TUKEY )
   /EMMEANS = TABLES(locus)
   /EMMEANS = TABLES(OVERALL)
   /PRINT = DESCRIPTIVE ETASQ OPOWER
HOMOGENEITY
   /CRITERIA = ALPHA(.05)
   /DESIGN = locus .
UNIANOVA
   number    BY locus
   /METHOD = SSTYPE(3)
   /INTERCEPT = INCLUDE
   /POSTHOC = locus ( TUKEY )
   /EMMEANS = TABLES(locus)
   /EMMEANS = TABLES(OVERALL)
   /PRINT = DESCRIPTIVE ETASQ OPOWER
HOMOGENEITY
   /CRITERIA = ALPHA(.05)
   /DESIGN = locus .
UNIANOVA
   number    BY locus
   /METHOD = SSTYPE(3)
   /INTERCEPT = INCLUDE
   /POSTHOC = locus ( TUKEY )
   /EMMEANS = TABLES(locus)
   /EMMEANS = TABLES(OVERALL)
   /PRINT = DESCRIPTIVE ETASQ OPOWER
HOMOGENEITY
   /CRITERIA = ALPHA(.05)
   /DESIGN = locus .
```

Score 10/10
A prospective study over a one year period was conducted if locus of control (internalizing, externalizing, and combined) had differential effects on total number of discipline reports reported in seventh grade students in the marking period by either of three disruptive behavior diagnoses, namely, attention deficit hyperactivity disorder (ADHD), oppositional defiant disorder (ODD), and conduct disorder (CD). Forty-five subjects were randomly assigned to nine experimental condition, n =5 per cell, in a two-way between subjects factorial design. All subjects were tested under identical conditions. Technically the experimenter cannot randomly assign subjects to conditions, the subjects come as they are.)

Prior to statistical examination, initial examination of ANOVA assumption indicated that normality was retained (Kolmogorov-Smirnov test $D = .065$, $p = .150$) and no skewness was seen in Figure 1. Also homogeneity of variance was retained (Levene's test for homogeneity of variance is $F = .44$, $p = .8906$).

ANOVA results of the total number of discipline reports indicated a statistically significant main effect of locus of place, $F(2, 36) = 12.35$, $p < .05$ the use of an exact p-value is preferred.but not a statistically significant main effect of disruptive behavior diagnosis, $F(2, 36) = 1.52$, $p = 0.2324$. ANOVA results also indicated a statistically significant interaction effect, $F(4, 24) = 4.95$, $p < .05$. Table 1 presents group means and standard deviations for all nine conditions.

The analysis of the simple effects indicated statistically significant difference with diagnoses at the condition of internalizing locus of control, $F(2, 12) = 4.53$, $p < .05$. The post hoc analysis indicates a statistically significant decrease in total number of discipline reports with CD diagnosis, $p < .05$, relative to ODD diagnoses at the condition of internalizing locus of control. The same post hoc analysis indicated no significant difference either between the total number of the reports with CD diagnosis and that with ADHD diagnosis, $p > .05$, and between that with ADHD and that with ODD, see Figure 2.

The analysis of the simple effects indicated no statistically significant difference with diagnoses at the condition of combined locus of control, $F(2, 12) = 1.85$, $p = .1988$. Thus, no post hoc analysis was conducted.

The analysis of the simple effects indicated statistically significant difference with diagnoses at the condition of externalizing locus of control, $F(2, 12) = 4.66$, $p < .05$. The post hoc analysis indicates a statistically significant decrease in total number of discipline reports with ADHD diagnosis, $p < .05$, relative to CD diagnosis at the condition of internalizing locus of control. The same post hoc analysis indicated no significant difference either between the total number of the reports with ADHD diagnosis and that with ODD diagnosis, $p > .05$, and between that of ODD and that of CD, $p > .05$.

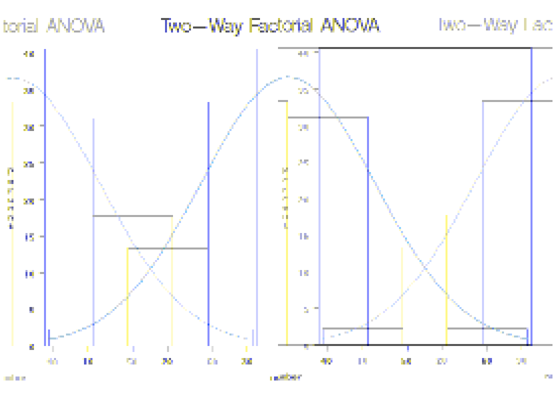
Thus, it appears that there was a significant interaction effect between types of diagnosis and locus of control applied. According to the effects of locus of location and disruptive diagnosis behaviors (see Figure 2), it appears that, when CD diagnosis is employed, there was significant decline in total number of discipline reports with internalizing locus of control relative to combined and external locus of control. Also, it appears that, when internalizing locus of control is applied, there was significant decline in discipline reports with CD diagnosis relative to ODD diagnosis. When externalizing locus of control is applied, there was significant decline in number of the reports with ADHD diagnosis compared to CD diagnosis.

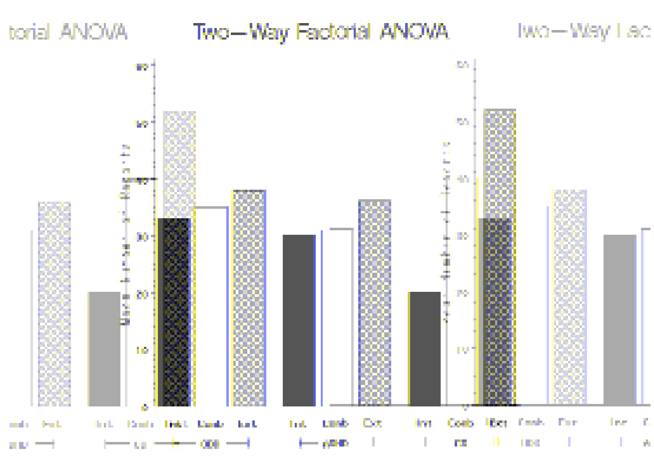
Table 1
Group means and standard deviations

	Oppositional defiant disorder (ODD)		Attention deficit hyperactivity disorder (ADHD)		Conduct disorder (CD)	
	Mean	Std	Mean	Std	Mean	Std
Internalizing	33.00	6.96	30.00	6.96	20.00	7.51
Combined	35.00	8.80	31.00	6.96	40.00	6.20
Externalizing	38.00	9.51	36.00	9.51	52.00	7.97

Figure 1
Distribution of total number of discipline reports with normal distribution superimposed (line)

Figure 2
Effect on different locus point on total number of discipline reports in seven grade students in three different disruptive behavior diagnoses





Mixed Factorial Design (1B+1W design)

(Week 10&11: #5)

1. Prepare data set

Independent variable ..2 (Factor A & Factor B (time))

Dependent variable……..1

➔ Type "value labels" at "Data View Sheet" of SPSS

e.g.) 1 = grade1, 2=grade2, 3=grade3….

➔ *さらに、transform で、b1+b2+b3 = Alldata も作って、" Alldata" などと Name しておく。Kolmogorov-Smirnov D test のためです。*

		Factor B (Time)		
		.b1	.b2	.b3
Factor A (Group)	.a1	.x_1,x_2,x_3	.x_1,x_2,x_3	.x_1,x_2,x_3
	.a2	.x_1,x_2,x_3	.x_1,x_2,x_3	.x_1,x_2,x_3
	.a3	.x_1,x_2,x_3	.x_1,x_2,x_3	.x_1,x_2,x_3

⇨

	Factor B(time)		
Factor A (Group)	.b1	.b2	.b3
1	xx	xx	xx
1	xx	xx	xx
1	xx	xx	xx
1	xx	xx	xx
1	xx	xx	xx
1	xx	xx	xx
2	xx	xx	xx
2	xx	xx	xx
2	xx	xx	xx
2	xx	xx	xx
2	xx	xx	xx
2	xx	xx	xx
3	xx	xx	xx
3	xx	xx	xx
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Alldata
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2. Normality test

- Kolmogorov-Smirnov D test (p>.05….Ho:Normality is retained)

Analyze > Descriptive Statistics > Explore > Dependent (dependent variable) &

Plots > Normality Plot with Tests (on) > Click OK

**Boxplots (none) & Stem-and-leaf (off)*

(Alternative) Analyze > Nonparametric Tests > 1-Sample K-S… > Test Variable List (dpdnt vrbl) &

At Test Distribution, Normal (on) + Uniform (on) >Click OK

➔ <u>K-S value and p value</u>: See "Differences (Positive)" in 1st table (e.g., .066) and "Asymp.Sig (2-tailed)" in 2nd table (e.g., .071).

* So if it is 1-tailed, the value should be .071 x 2 = .142.

- Histogram + Normal curve

Graph > Histogram > Display normal curve (on) => (Figure 1)

3. Sphericity test

(- 下の ANOVA の Repeated Measure > Option > Homogeneity tests (on)　で得られる。)

(ア) Sphericy tests (Mauchly's W) (p>.05…..Ho: Sphericity is retained)

(イ) Greenhouse-Geisser Epsilon & Huynh-Feldt Epsilon (Nearer 1.0, more lack of sphericity)

(もし P<.05 なら、ANOVA で、「G-G」あるいは「Huynh-Feldt」で計算した effect (Factor A, Error (factor A)) を採用する。もし P > .05 なら、「Sphericity Assumed」で計算した effect を採用する。)

4. Multisphericity test

(- 下の ANOVA の Repeated Measure > Option > Homogeneity tests (on)　で得られる。)

Box's Test of Equality of Covariance Matrics (Box'M) (p<.05…..Ho: Multisphericity is retained)

5. Homogeneity of Variance

(- 下の ANOVA で得られる。)

- Levene's test of homogeneity of variance (p > .05….Ho: Homogeneity is retained)

  (Syntax…..See ANOVA's Homogeneity test)

6. ANOVA

- Analyze > General Linear model > Repeated Measures > Within-Subject Factor Name (e.g., time) & Number of Levels (e.g., 3) & click Add;

(i) Click Define > Within-Subject Variables (move one by one. E.g.) time1, time2, time3)
> Between-Subject Variables (move the one. E.g.) group) & Click OK;

(ii) Click Options > Display Means for (e.g., time) > Compare Main Effect (on) > Confidence interval adjustment (Choose LSD) >

- Display (Descriptive Statistics (on))

- Estimates of effect size (on)

- Homogeneity tests (on)

(iii) Click Contrast > At "Change Contrast", choose "difference" >Click "Change" >Click Continue;

(iv) Click Post Hoc > Post Hoc Test for (move the one. E.g) group) > Click Tukey >Click Continue

(v) Click Plots > Horizontal Axis (e.g., time)> Separate Lines (e.g., group) & Click Add > Click Continue >Click OK ➔ (Figure 2)

ANOVA Summary Table

Source		SS	df	MS	F	p
Factor A	← Test of **Between-Subject** Effects の中段(“Factor A”)から採用する。	SS	df	MS	F	e.g) p <.05
S/A	← Test of **Between-Subjects** Effects の下段（”Error”）から採用する。	SS	df	MS		
Factor B(time)	*Test of* ***Within-Subject*** *Effects の上・中・下段（“Sphericity Assued”あるいは G-G, H-F) から採*	SS	df	MS	F	e.g) p <.05
AxB Interaction		SS	df	MS	F	e.g) p <.05
Error (BxS/A)		SS	df	MS		
Total （自分で計算する）		SS	df			

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
time	Sphericity Assumed	7537.448	2	3768.724	140.011	.000	.814
	Greenhouse-Geisser	7537.448	1.876	4017.747	140.011	.000	.814
	Huynh-Feldt	7537.448	2.000	3768.724	140.011	.000	.814
	Lower-bound	7537.448	1.000	7537.448	140.011	.000	.814
time * Gender	Sphericity Assumed	554.318	2	277.159	10.297	.000	.243
	Greenhouse-Geisser	554.318	1.876	295.473	10.297	.000	.243
	Huynh-Feldt	554.318	2.000	277.159	10.297	.000	.243
	Lower-bound	554.318	1.000	554.318	10.297	.003	.243
Error(time)	Sphericity Assumed	1722.707	64	26.917			
	Greenhouse-Geisser	1722.707	60.033	28.696			
	Huynh-Feldt	1722.707	64.000	26.917			
	Lower-bound	1722.707	32.000	53.835			

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	time	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
time	Level 2 vs. Level 1	2445.462	1	2445.462	49.894	.000	.609
	Level 3 vs. Previous	9472.076	1	9472.076	215.313	.000	.871
time * Gender	Level 2 vs. Level 1	56.142	1	56.142	1.145	.293	.035
	Level 3 vs. Previous	789.371	1	789.371	17.943	.000	.359
Error(time)	Level 2 vs. Level 1	1568.415	32	49.013			
	Level 3 vs. Previous	1407.749	32	43.992			

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
VAS after 1 hr	8.814	1	32	.006
VAS after 24 hr	6.753	1	32	.014
VAS after 36 hr	5.344	1	32	.027

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

a. Design: Intercept+Gender
Within Subjects Design: time

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	60647.348	1	60647.348	441.855	.000	.932
Gender	2126.314	1	2126.314	15.492	.000	.326
Error	4392.203	32	137.256			

7. Post Hoc Comparisons

Four cases exist.

-Factor A (Btwn factor)	*X or O*
-Factor B (time) (Within factor)	*X or O*
-AxB Interaction	O

(1) If you have **Interaction Affect (AxB Interaction),** conduct "**simple effect analysis**".
Eg) 1B Tukey x 3 times (with 3 barcharts)
+ 1W repeated contrasts x 3 times(with 3 linecharts)

➔ Select cases を使って、a=a1, a=a2, a=a3, b=b1, b=b2, B=b3 といったように、それぞれの Case に分けて 1B ANOVA, 1W ANOVA を行う。

-Factor A (Btwn factor)	O
-Factor B (time) (Within factor)	X
-AxB Interaction	X

(2) If you have significant main effects for **Between-Subjects factor <u>only</u>**, conduct "**Tukey**" , "**Shoffe**", **"Duncan (if assumptions are violated)** post hoc test.
➔ *SPSS, Click Post Hoc > Click Tukey and Shoffe >Click Continue.*
➔ *Use the* ***B's marginals.***

-Factor A (Btwn factor)	X
-Factor B (time) (Within factor)	O
-AxB Interaction	X

(3) If you have significant main effects for **Within-Subjects factor <u>only</u>**, conduct "**Repeated Contrast Measurements**" as post hoc test.
Time 1 x Time 2; Time 2 x Time 3; Time 3 x Time1…..
➔ *SPSS, Click "Difference".*
➔ *Use the* ***A's marginals.***

-Factor A (Btwn factor)	O
-Factor B (time) (Within factor)	O
-AxB Interaction	X

(4) If you have significant main effects for **both Between-Subject factor and Within-Subjects factor (but not interaction effect)**, conduct "**simple effect analysis**".
Eg) 1B Tukey x 3 times (with 3 barcharts)
+ 1W repeated contrasts (with 3 linecharts)

1W ANOVA

Select Data > Select "If" > gender =1 > continue > paste > run

Click > General Linear Model > Repeated Measures > （以下 p4 と同じ）

Click Contrast > Choose "time (none)" >At Change Contrast, choose "Difference" > click change.

*Click plot > (confirm what you already set (eg: time *gender))*

** 1W なので、Post Hot Test はしない。ただし自動的に作成される"Pair-wise Analysis"を見る。*

1B ANOVA

Select Data > Select "If" > time = 1> continue > paste >run

Click　>General Linear Model > Univariate >　（以下 p1 と同じ）＋Post Hot Test

** 1B なので、Post Hoc Test も行う。*

t-test *Time1, Time 2, Time 3 それぞれで、Treatment / Non-treatment によって違いがあるかどうかを検証する。*

Click Analyze > Compare means > Paired-Sample T test >

Click simultaneously, A1B1 + A2B1, A1B2+A2B2, A1B3+A2B3 > Move to Paired Variables

8. Write your conclusion ("Thus….")

9. Tables

Tables should be attached ((i) Descriptive statistics, (ii) Figure 2: Lines chart (x: levels of Factor B (time), y: dependent values, three lines according to level of Factor A)　＊必要に応じて、ANOVA Summary Table,（もし本文に F=　, p =　などの値を書いた場合には、重複するので、ANOVA Summary Table は載せなくていい）

Q & A: Mixed Factorial Design (1B+1W design)

(Week 10&11: #5)

	ID	Gender	Age	Activity	VAS1	VAS2	VAS3	Ethnic	Intensity	filter_$	total
1	1	1	23.0	1	43.67	38.67	19.00	1	2	0	101.34
2	2	1	25.0	2	71.00	63.00	41.33	3	4	0	175.33
3	3	1	24.0	1	99.00	81.00	64.00	2	1	0	244.00
4	4	1	22.0	2	64.33	50.67	33.00	3	3	0	148.00
5	5	1	22.0	2	70.00	47.67	41.33	2	4	0	159.00
6	6	1	25.0	2	48.67	45.00	26.33	2	4	0	120.00
7	7	1	24.0	1	70.33	68.00	38.33	3	1	0	176.66
8	8	1	24.0	2	70.00	45.00	26.33	3	5	0	141.33
9	9	1	24.0	1	38.00	44.30	23.33	1	1	0	105.63
10	10	1	33.0	2	63.33	55.33	41.33	1	4	0	159.99
11	11	1	25.0	2	73.00	56.00	44.33	1	4	0	173.33
12	12	1	25.0	1	44.33	27.33	18.00	2	1	0	89.66
13	13	1	31.0	2	60.66	43.67	25.00	1	3	0	129.33
14	14	1	27.0	2	84.33	79.66	71.67	3	3	0	235.66
15	15	1	23.0	2	26.33	25.00	26.67	1	3	0	78.00
16	16	1	27.0	1	70.67	62.00	38.00	3	2	0	170.67
17	17	1	30.0	2	59.67	59.00	30.67	1	4	0	149.34
18	18	2	22.0	2	43.33	38.33	26.33	1	3	1	107.99
19	19	2	24.0	1	43.67	33.00	26.00	1	5	1	102.67
20	20	2	25.0	2	48.33	39.33	40.33	2	4	1	127.99
21	21	2	21.0	2	37.33	37.00	31.33	1	3	1	105.66

```
COMPUTE total = VAS1 + VAS2 + VAS3 .
EXECUTE .

EXAMINE
   VARIABLES=total
   /PLOT    NPPLOT
   /STATISTICS DESCRIPTIVES
   /CINTERVAL 95
   /MISSING LISTWISE
   /NOTOTAL.

GRAPH
   /HISTOGRAM(NORMAL)=total .

GLM
   VAS1 VAS2 VAS3 BY Gender
   /WSFACTOR = time 3 Difference
   /METHOD = SSTYPE(3)
   /POSTHOC = Gender ( TUKEY DUNCAN )
   /PLOT = PROFILE( time*Gender )
   /EMMEANS = TABLES(Gender) COMPARE ADJ(LSD)
   /EMMEANS = TABLES(time) COMPARE ADJ(LSD)
   /EMMEANS = TABLES(Gender*time)
   /PRINT = DESCRIPTIVE ETASQ HOMOGENEITY
   /CRITERIA = ALPHA(.05)
   /WSDESIGN = time
   /DESIGN = Gender .
```

Score 8/10

A mixed factorial design was conducted to determine if there were differences in mean stresses between gender at three time periods following completion. The time periods when stresses were measured were after one hour, after 24 hours, and after 36 hours. Group means and standard deviations were summarized at Table 1.Prior to statistical examination, initial examination of ANOVA assumption indicated that normality was rejected -1 (Kolmogorov-Smirnov test $D = .163$, $p < .05$), see Figure 1. Sphericity was retained (Mauchly's $W = .934$, $p = .347$), and multisphericity was also rejected -1 (*Box'M* = 19.872, $p < .05$). ANOVA results in Table 2 showed that statistically significant main effects for both gender and time periods were indicated. Also interaction effect, a gender by time periods, was indicated statistically significant so that simple effect analysis was conducted.

One-Way Within ANOVA was conduced according to each gender. The post hoc analysis in the ANOVA according to male samples indicated statistically significant difference between after one hour and after 24 hours, between after 24 hours and after 36 hours, and also between after one hour and after 36 hours, all p's < .05. The post hoc analysis in the ANOVA also indicated the same results about female samples, all p's < .05. As suggested in Figure 2, there was a rather large and significant decline on mean stress between three conditions (after one hour, after 24 hours and after 36 hours) for both levels (male and female). One-way Between ANOVA was conducted according to after one hour, after 24 hours, and after 36 hours. The ANOVA result indicated statistically significant difference between male and female for after one hour, $F(1, 32) = 511.490$, $p < .001$. Statistically significant difference was also indicated for after 24 hours, $F(1, 32) = 423.234$, $p < .001$, as well as for after 36 hours, $F(1, 32) = 5.630$, $p < .05$. Thus, it should be concluded that extended time period significantly decrease stress after the test, and stress held by males are higher than that held by females in all time periods of this experiment.

Table 1

Group means and standard deviations

	VAS1 (after one hour)		VAS2 (after 24 hours)		VAS3 (after 36 hours)	
	Mean	Std	Mean	Std	Mean	Std
Male	62.20	17.73	52.43	15.65	35.80	14.63
Female	41.88	6.76	34.69	7.74	26.41	7.23

Table 2

ANOVA Summary Table for mean stress

Source	*df*	*SS*	*MS*	*F*	*p*
Gender	1	6378.941	6378.941	15.492	< .0001
S/A	32	13176.609	411.769		
Time	2	7537.448	3768.724	140.011	< .0001
AxB Interaction	2	554.318	277.159	10.297	< .0001
Error(BxS/A)	64	1722.707	26.917		
Total	101	29370.023			

Figure 1

Distribution of stress

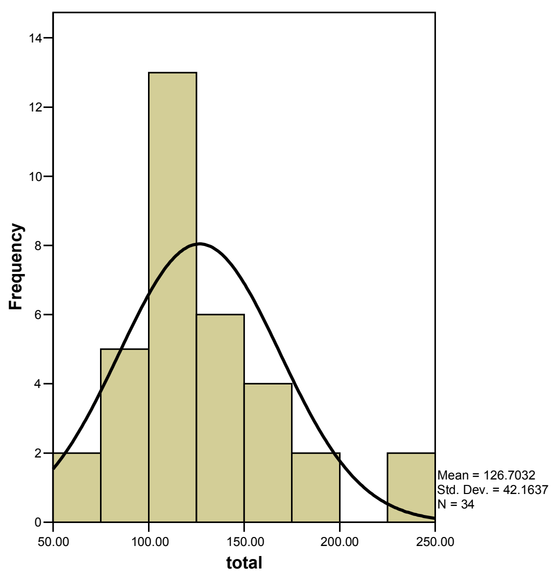
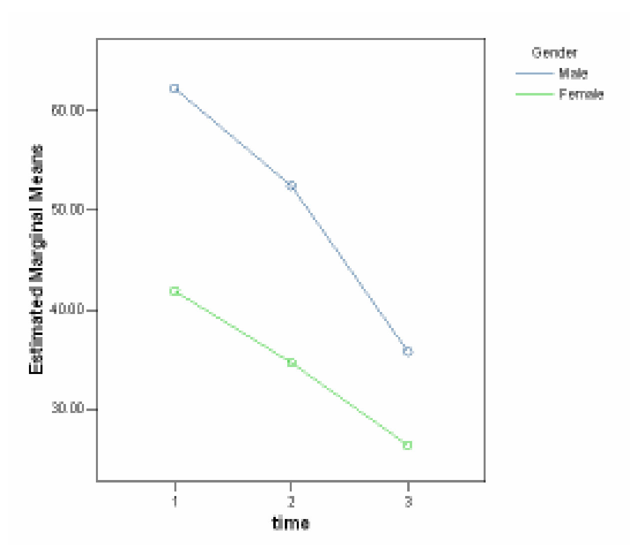


Figure 2

Estimated marginal means of stress for gender by time



time 1 = after one hour; time 2 = after 24 hours; time 3 = after 36 hours

Two-Within Factorial Design (2W design)

(Week 12: #6)

1. Prepare data set

Independent variable ..2 (Factor A (within-factor. Eg. treat ⇔ non-treat) &
Factor B (within-factor. E.g. time))

Dependent variable……..1 (e.g., test score)

➔ Type "Labels" at "Data View Sheet" of SPSS

e.g.) A1B1="treat time1", A1B2="treat time2", …..A2B3="non-treat time3".

➔ *さらに、transform で、b1+b2+b3 = allscore も作って、"Allscore" などと Name しておく。Kolmogorov-Smirnov D test のためです。*

	A1(treat)			A2 (non-treat)		
	B1 (time1)	B2 (time2)	B3 (time3)	B1 (time1)	B2 (time2)	B3 (time3)
S1	.xx	.xx	.xx	.xx	.xx	.xx
S2	.xx	.xx	.xx	.xx	.xx	.xx
S3	.xx	.xx	.xx	.xx	.xx	.xx
S4	.xx	.xx	.xx	.xx	.xx	.xx

ID	A1B1	A1B2	A1B3	A2B1	A2B2	A2B3	Allscore
1	xx	xx	xx	xx	xx	xx	.xxx
2	xx	xx	xx	xx	xx	xx	.xxx
3	xx	xx	xx	xx	xx	xx	.xxx
4	xx	xx	xx	xx	xx	xx	.xxx

3. Normality test

- Kolmogorov-Smirnov D test (p>.05….Ho:Normality is retained)

Analyze > Descriptive Statistics > Explore > Dependent (dependent variable) &
Plots > Normality Plot with Tests (on) > Click OK
**Boxplots (none) & Stem-and-leaf (off)*

- Histogram + Normal curve

Graph > Histogram > Display normal curve (on) => (Figure 1)

3. Sphericity test

(- 下の ANOVA の Repeated Measure > Option > Homogeneity tests (on) で得られる。)

(ア) Sphericy tests (Mauchly's W) (p>.05…..Ho: Sphericity is retained)

(イ) Greenhouse-Geisser Epsilon & Huynh-Feldt Epsilon (Nearer 1.0, more lack of sphericity)

(もし P<.05 なら、ANOVA で、「G-G」あるいは「Huynh-Feldt」で計算した effect (Factor A, Error (factor A)) を採用する。もし P>.05 なら、「Sphericity Assumed」で計算した effect を採用する。)

(4. Multisphericity test)

(- 下の ANOVA の Repeated Measure > Option > Homogeneity tests (on) で得られる。)

Box's Test of Equality of Covariance Matrics (Box'M) (p<.05…..Ho: Multisphericity is retained)

6. ANOVA

- Analyze > General Linear model > Repeated Measures >

(i) *Within-Subject Factor Name (e.g., **treat**) & Number of Levels (e.g., **2**) & click Add;*

(ii) *Within-Subject Factor Name (e.g., **time**) & Number of Levels (e.g., **3**) & click Add;*

(iii) Click Define > Move each variable to Within-Subject Variables.
E.g., A1B1 (1,1), A1B2 (1,2), A1B3(1,3) ……….B2A2(2,2), B2A3 (2,3)
& Click OK;

*(ii) Click Options > Display Means for (e.g. ,**treat, time, treat*time**)*
- Display (Descriptive Statistics (on))
- Estimates of effect size (on) > Click Contunue

(i) Click Contrast > At "Change Contrast", choose "None" >Click "Change"x2 >Click Continue;

(v) Click Plots > Horizontal Axis (e.g., time)> Separate Lines (e.g., treat) & Click Add > Click Continue >Click OK ➔ (Figure 2)

ANOVA Summary Table

Source		SS	df	MS	F	p
Factor A	*Test of* ***Within-Subject*** *Effects の上・中・下段（"Sphericity Assued"あるいは G-G, H-F) から採用する。*	SS	df	MS	F	e.g) p <.05
Factor B		SS	df	MS	F	e.g) p <.05
AxB Interaction		SS	df	MS	F	e.g) p <.05
S/A	← Test of **Between-Subjects** Effects の下段（"Error"）から採用する。	SS	df	MS		
A x S	*Test of* ***Within-Subject*** *Effects の上・中・下段の Error（"Sphericity Assued"あるいは G-G, H-F）から採用する。*	SS	df	MS		
B x S		SS	df	MS		
A x B x S		SS	df	MS		
Total （自分で計算する）		SS	df			

Tests of Within-Subjects Effects

Measure: MEASURE_1

	Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
A =>	drug	Sphericity Assumed	104.167	1	104.167	32.895	.011	.916
		Greenhouse-Geisser	104.167	1.000	104.167	32.895	.011	.916
		Huynh-Feldt	104.167	1.000	104.167	32.895	.011	.916
		Lower-bound	104.167	1.000	104.167	32.895	.011	.916
AxS=>	Error(drug)	Sphericity Assumed	9.500	3	3.167			
		Greenhouse-Geisser	9.500	3.000	3.167			
		Huynh-Feldt	9.500	3.000	3.167			
		Lower-bound	9.500	3.000	3.167			
B =>	time	Sphericity Assumed	81.083	2	40.542	11.818	.008	.798
		Greenhouse-Geisser	81.083	1.578	51.371	11.818	.016	.798
		Huynh-Feldt	81.083	2.000	40.542	11.818	.008	.798
		Lower-bound	81.083	1.000	81.083	11.818	.041	.798
BxS=>	Error(time)	Sphericity Assumed	20.583	6	3.431			
		Greenhouse-Geisser	20.583	4.735	4.347			
		Huynh-Feldt	20.583	6.000	3.431			
		Lower-bound	20.583	3.000	6.861			
AxB=>	drug * time	Sphericity Assumed	30.583	2	15.292	5.825	.039	.660
		Greenhouse-Geisser	30.583	1.157	26.443	5.825	.082	.660
		Huynh-Feldt	30.583	1.425	21.466	5.825	.065	.660
		Lower-bound	30.583	1.000	30.583	5.825	.095	.660
AxBxS=>	Error(drug*time)	Sphericity Assumed	15.750	6	2.625			
		Greenhouse-Geisser	15.750	3.470	4.539			
		Huynh-Feldt	15.750	4.274	3.685			
		Lower-bound	15.750	3.000	5.250			

7. Post Hoc Comparisons

Four cases exist.

-Factor A (Within factor)	*X or O*
-Factor B (time) (Within factor)	*X or O*
-AxB Interaction	O

(5) If you have **Interaction Affect (AxB Interaction),** conduct "**simple effect analysis**".

Eg) 1W repeated ANOVA (e.g. 3 x 3)

➔ A1 vs. A2 vs. A 3 at B1   B1 vs B2 vs B3 at A1
A1 vs. A2 vs. A 3 at B2   B1 vs B2 vs B3 at A2
A1 vs. A2 vs. A 3 at B3   B1 vs B2 vs B3 at A3

* In case the level is just two, conduct t-test instead of ANOVA.

-Factor A (Within factor)	O
-Factor B (time) (Within factor)	X
-AxB Interaction	X

(6) If you have significant main effects for **Within-Subjects factor A only**, conduct One-way within subject ANOVA (with "contrast").

➔ *Use the **B's marginals.***

A1 vs. A2 vs. A 3 at B's marginals

* In case the level is just two, conduct t-test instead of ANOVA.

-Factor A (Within factor)	X
-Factor B (time) (Within factor)	O
-AxB Interaction	X

(7) If you have significant main effects for **Within-Subjects factor only**, conduct One-way within subject ANOVA.

➔ *Use the **A's marginals.***

B1 vs. B2 vs. B 3 at A's marginals

* In case the level is just two, conduct t-test instead of ANOVA.

-Factor A (Within factor)	O
-Factor B (time) (Within factor)	O
-AxB Interaction	X

(8) If you have significant main effects for **both Within-Subject factor A and Within-Subjects factor B (but not interaction effect)**, conduct "**simple effect analysis**".

Eg) 1W repeated ANOVA (e.g. 3 x 3)

➔ A1 vs. A2 vs. A 3 at B1   B1 vs B2 vs B3 at A1
A1 vs. A2 vs. A 3 at B2   B1 vs B2 vs B3 at A2
A1 vs. A2 vs. A 3 at B3   B1 vs B2 vs B3 at A3

* In case the level is just two, conduct t-test instead of ANOVA.

1W ANOVA *Pair-wise Comparisons が機能しないので、個別の 1W ANOVA を行う。*

Click Analyze > General Linear Model > Repeated Measures > At Within-Subject Factor, name 'time' and type "3" > Click Define > Select ***A1****'s (A1B1, A1B2, A1B3)*

Click Option > Move "time" to Display Means for

Click Contrast > At Change Contrast, choose "Simple" > click change.

ここでSyntax の画面に移る。

まず、以下のように（１）を打ち込む。これは、time(1)と time(2), (3)を比較するということ。

/WSFACTOR = time 3 simple ***(1)***

次に、以下のように（２）を打ち込む。これは、time(2)と time(3), (1)を比較するということ。

/WSFACTOR = time 3 simple ***(2)***

** もし、time が 4 つなら****(1), (2), (3)****となる。常にLevels よりも 1 少ない回数打ち込むことになる。*

** 1W なので、この操作によって作成される****"Test of Within Subjects Contrasts"****を見る。*

➔ *以降、同じように、A2's (A2B1, A2B2, A2B3), A3's (A3B1, A3B2, A3B3)についても 1W ANOVA を行う。*

同じように、Click Analyze > General Linear Model > Repeated Measures > At Within-Subject Factor, name 'time' and type "3" > Click Define > Select ***B1****'s (A1B1, A2B1, A3B1)*

Click Option > Move "time" to Display Means for >

Click Contrast > At Change Contrast, choose "Simple" > click change.

➔ *以降、同じように、B2's (A1B2, A2B2, A3B2), A3's (A1B3, A2B3, A3B3)についても 1W ANOVA を行う。*

t-test *Time1, Time 2, Time 3 それぞれで、Treatment / Non-treatment によって違いがあるかどうかを検証する。*

Click Analyze > Compare means > Paired-Sample T test >

Click simultaneously, A1B1 + A2B1, A1B2+A2B2, A1B3+A2B3 > Move to Paired Variables

8. Write your conclusion ("Thus….")

何でもいいから書く。（書いてあるかないかが、採点の分かれ目。）

9. Tables

Tables should be attached ((i) Descriptive statistics, (ii) Figure 2: Lines chart (x: levels of Factor B (time), y: dependent values, three lines according to level of Factor A) ＊必要に応じて、ANOVA Summary Table,（もし本文に F= , p = などの値を書いた場合には、重複するので、ANOVA Summary Table は載せなくていい）

Q & A: Two-Within Factorial Design (2W design)

(Week 12: #6)

	ID	A1B1	A1B2	A2B1	A2B2	score
1	1	10	16	18	35	79.00
2	2	14	19	19	32	84.00
3	3	17	22	18	37	94.00
4	4	8	20	12	33	73.00
5	5	12	24	14	39	89.00
6	6	15	21	20	32	88.00
7						

```
DATA LIST
/ ID 1-2
A1B1 3-4
A1B2 5-6
A2B1 7-8
A2B2 9-10

VARIABLE LABEL
A1B1 = 'Abstract Indirect'
A1B2 = 'Abstract Direct'
A2B1 = 'Concrete Indirect'
A2B2 = 'Concrete Direct'


compute score=a1b1+a1b2+a2b1+a2b2.
BEGIN DATA
 110161835
 214191932
 317221837
 4 8201233
 512241439
 615212032
END DATA.
```

```
EXAMINE
  VARIABLES=score
  /PLOT  NPPLOT
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.

GLM
  A1B1 A1B2 A2B1 A2B2
  /WSFACTOR = problem 2  incentiv 2
  /METHOD = SSTYPE(3)
  /PLOT = PROFILE( incentiv*problem )
  /EMMEANS = TABLES(problem)
  /EMMEANS = TABLES(incentiv)
  /EMMEANS = TABLES(problem*incentiv)
  /PRINT = DESCRIPTIVE ETASQ
  /CRITERIA = ALPHA(.05)
  /WSDESIGN    =    problem    incentiv
problem*incentiv .
```

A two-way factorial ANOVA for repeated measures was conducted to determine if the different incentive conditions (indirect and direct remuneration) and problem types (abstract and concrete type) affected the number of problems attempted, see Table 1. Initial examination of the dependent variable (score) indicated normality was retained (Kolmogorov-Smirnov $D = 0.178$, $p = 0.200$). Local sphericity was not examined for both factors since they only have two levels.

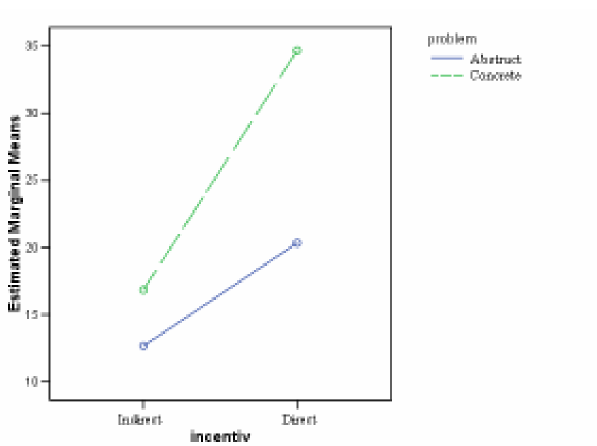
Analysis of variance results indicated statistically significant main effects for both the incentive condition, $F(1,5) = 63.029$, $p < .001$ and problem types, $F(1,5) = 114.721$, $p < .001$, and a significant incentive condition by problem type interaction, $F(1,5) = 66.210$, $p < .01$. Analyses of the simple effects, in this case, *t*-tests, revealed that concrete problem type increased the number of problem attempted more than abstract type did both in indirect remuneration condition (p (two-tailed) < .01) and in direct remuneration condition (p (two-tailed) < .001), see Figure 1. Also the analyses of the simple effects, again *t*-tests, revealed that direct incentive condition increased the number of problem attempted more than indirect did both in abstract problem type (p (two-tailed) < .05) and in concrete condition (p (two-tailed) < .05) , see Figure 1.

There are strong evidences from this study that suggest the use of direct enumeration for concrete type of problems would maximize the number of problems attained than sole use of the direct condition or simply choosing concrete problems. The least effective mixture is indirect enumeration applying for indirect problems. It is expected that the more concrete problems are provided to the people and more direct remuneration is offered, they would become more seriously respond to attain those problems. However, the sample used in this study was very small and it is recommended that the study be replicated with a larger sample.

Table 1
Means and standard deviations for score

	Abstract Mean	Abstract Standard deviation	Concrete Mean	Concrete Standard deviation
Indirect	12.67	3.327	16.83	3.125
Direct	20.33	2.733	34.67	2.875

Figure 1.
Effect of incentive conditions on the number of problems attempted for each problem type



Q & A: Two-Between One-Within Factorial Design (2B-1W design)

(Week 12: Extra credit)

	ID	A1B1	A1B2	A2B1	A2B2	score
1	1	10	16	18	35	79.00
2	2	14	19	19	32	84.00
3	3	17	22	18	37	94.00
4	4	8	20	12	33	73.00
5	5	12	24	14	39	89.00
6	6	15	21	20	32	88.00
7						

```
DATA LIST
/ ID 1-2
A1B1 3-4
A1B2 5-6
A2B1 7-8
A2B2 9-10

VARIABLE LABEL
A1B1 = 'Abstract Indirect'
A1B2 = 'Abstract Direct'
A2B1 = 'Concrete Indirect'
A2B2 = 'Concrete Direct'


compute score=a1b1+a1b2+a2b1+a2b2.
BEGIN DATA
 110161835
 214191932
 317221837
 4 8201233
 512241439
 615212032
END DATA.
```

```
EXAMINE
  VARIABLES=score
  /PLOT  NPPLOT
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.

GLM
  A1B1 A1B2 A2B1 A2B2
  /WSFACTOR = problem 2  incentiv 2
  /METHOD = SSTYPE(3)
  /PLOT = PROFILE( incentiv*problem )
  /EMMEANS = TABLES(problem)
  /EMMEANS = TABLES(incentiv)
  /EMMEANS = TABLES(problem*incentiv)
  /PRINT = DESCRIPTIVE ETASQ
  /CRITERIA = ALPHA(.05)
  /WSDESIGN      =      problem      incentiv
problem*incentiv .
```

Score 8/10

A study was conducted if driving experience (inexperienced and experienced), road types (highway, street and dirt) and driving conditions (day time and night time) had differential effects on the number of steering correction. Driving simulator along a one mile section of roadway for 48 subjects randomly assigned to one treatment condition out of 12 experimental condition, n = 4 per cell, in a between subjects factorial design.

Prior to statistical examination, initial examination of ANOVA assumption indicated that normality was violated (Shapiro-Wilk W = .935, p = .010) and positive skewness was seen in Figure 1. However, homogeneity of variance was retained (Levene's test for homogeneity of variance is F= .203, p = .996) so that the use of linear model may be still be valid.

ANOVA results of the number of steering correction indicated a statistically significant main effect of road types, $F(2, 36) = 19.043$, see Figure 2. ANOVA results indicated statistically significant main effects of driving experience $F(1, 36) = 48.777$, $p < .001$, and driving conditions, $F(1, 36) = 34.417$, $p < .001$, but also indicated statistically significant interaction effect between driving experience and driving conditions, $F(1, 36) = 8.120$, $p = .007$. All other interaction effects were indicated not significant. However, the interaction effect among all three variables should be something concerned because $F(2, 36) = 2.375$ and $p = .78$, though it is not statistically significant. Table 1 presents group means and standard deviations for all conditions.

The analysis of the simple effects indicated statistically significant difference with experiences at the condition of day time, $F(1, 22) = 5.964$, $p = .023$., see Figure 3. Since there were only two levels of the experience, post hoc test was not conducted. The analysis of the simple effects indicated statistically significant difference with experiences at the condition of night time, $F(1, 22) = 19.601$, $p < .001$., see Figure 3. Since there were only two levels of the experience, post hoc test was not conducted. Thus, the number of steering correction of experienced persons was less than inexperienced persons either day time or night time.

The analysis of the simple effects indicated statistically significant difference with driving times at the inexperienced condition, $F(1, 22) = 13.890$, $p = .001$., see Figure 3. Since there were only two levels of the driving time, post hoc test was not conducted. The analysis of the simple effects indicated statistically not significant difference with driving times at the experienced condition, $F(1, 22) = 3.906$, p =.61, I get a different finding -1. p = .061see Figure 3. Thus, the number of steering correction of day time was less than night time for inexperienced persons but not significantly different for experienced persons.

It is concluded that road conditions make difference in steering correction numbers for either inexperienced or experienced and also for either day or night. But experienced persons are not affected by time differences. It suggests that people would get accustomed to driving in different lighting levels if they get experienced, but we see the limitations of human being to control the physical effects on driving caused by different road conditions.

What about the main effet for road condition? -1

Table 1

Group means and standard deviations

		Driving Conditions					
		Day		Night		Total	
Driving Experience	**Road Condition**	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Inexperience	Highway	10.00	5.89	20.00	4.97	15.00	7.35
	Street	18.00	4.76	27.00	5.72	22.50	6.85
	Dirt	20.00	6.01	40.00	5.89	30.00	12.04
	Total	16.00	6.78	29.00	10.00	22.50	10.67
Experienced	Highway	7.50	3.87	10.00	4.55	8.75	4.13
	Street	7.00	4.16	15.50	5.07	11.25	6.25
	Dirt	15.00	5.10	17.50	5.45	16.25	5.06
	Total	9.83	5.52	14.33	5.63	12.08	5.92
Total	Highway	8.75	4.80	15.00	6.93	11.87	6.60
	Street	12.50	7.19	21.25	7.92	16.87	8.59
	Dirt	17.50	5.83	28.75	13.12	23.13	11.40
	Total	12.92	6.82	21.67	10.91	17.29	10.03

Figure 1

Distribution of number of steering correction with normal distribution superimposed (line)

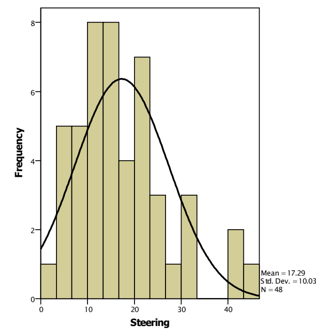


Figure 2

Effect of road types on steering corrections

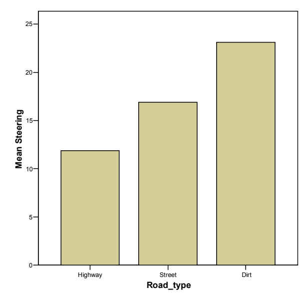
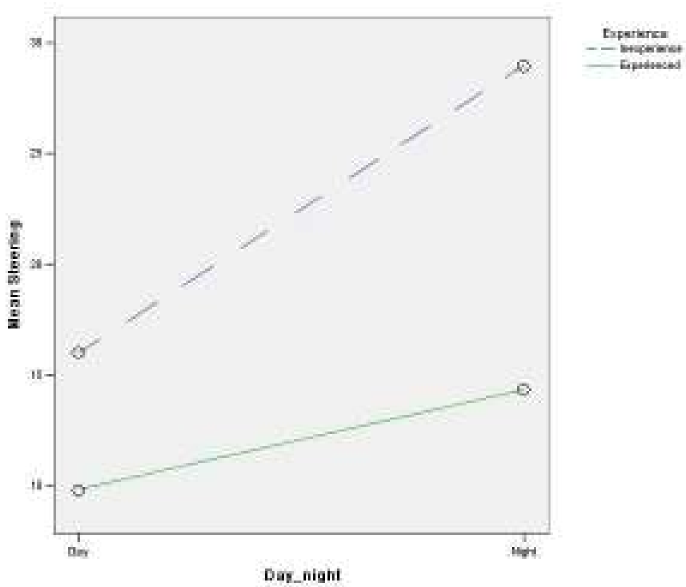


Figure 3

Effect of driving experience on steering corrections in two different driving conditions



Contrast

(Week 13: #7)

1. Prepare data set

Independent variable ..2 (Factor A & Factor B (time))

Dependent variable……..1 (score)

➔ Type "value labels" at "Data View Sheet" of SPSS

e.g.) 1 = time1, 2=time2, 3=time3….

		Factor B (Time)		
		.b1	.b2	.b3
Factor A (Group)	.a1	.x_1,x_2,x_3	.x_1,x_2,x_3	.x_1,x_2,x_3
	.a2	.x_1,x_2,x_3	.x_1,x_2,x_3	.x_1,x_2,x_3
	.a3	.x_1,x_2,x_3	.x_1,x_2,x_3	.x_1,x_2,x_3

id	Factor A (Group)	*Factor b (time)*	score
1	1	1	.x
1	1	2	.x
1	1	3	.x
2	1	1	.x
2	1	2	.x
2	1	3	.x
3	1	1	.x
3	1	2	.x
3	1	3	.x
4	2	1	.x
4	2	2	.x
4	2	3	.x
5	2	1	.x
5	2	2	.x
5	2	3	.x
:	:	:	.x

2. Prepare a "Coding Table"

Write a Coding table like the following.

E.g) (1) lecture vs. self study at baseline (a1 vs a3 at b1)

Factor B (time)

		.b1 (base)	.b2 (end)	.b3 (reten.)	(total)
Factor A (Group)	.a1 (lecture)	1	0	0	1
	.a2 (group)	0	0	0	0
	.a3 (self)	-1	0	0	-1
	(total)	0	0	0	0

Syntax

```
/LMATRIX = 'lecture vs. self study at base'
                    group    1
                             0
                            -1
                    a*b   1 0 0
                          0 0 0
                         -1 0 0
                    id*a  .2  .2  .2  .2  .2
                          0   0   0   0   0
                         -.2 -.2 -.2 -.2 -.2 ;
```

4. ANOVA

- *Analyze > General Linear Model > Univariate > Dependent variable (dpdnt vrbl: (eg:score)) & Fixed factor (indpdnt vrbls (eg: group, time)) & Random fixed factor (eg: id)*
  > Click Model > Push Custom
  *> Move Group; time; group*time; group*id ➔ right box >Continue >Paste*

- At the syntax, type the following part.

```
UNIANOVA
  score  BY group time id
  /RANDOM = id
  /METHOD = SSTYPE(3)
  /INTERCEPT = INCLUDE
  /CRITERIA = ALPHA(.05)
  /LMATRIX ='lecture vs ss at base'  group 1
                                           0
                                          -1
                              time*group  1 0 0
                                          0 0 0
                                          -1 0 0
                              id*group  .2  .2  .2  .2  .2
                                         0   0   0   0   0
                                        -.2 -.2 -.2 -.2 -.2
  /print=test(LMATRIX)
  /DESIGN = group time group*time group*id .
```

5. Post Hot Test

- You will get the following output.

Custom Hypothesis Tests

Test Results

Dependent Variable: score

Source	Sum of Squares	df	Mean Square	F	Sig.
Contrast	.000	1	.000	.000	1.000
Error	272.667	24	11.361		

7. Write your conclusion ("Thus….")

8. Tables

Q 6 A Contrast

(Week 13: #7)

	id	group	time	score
1	1	1	1	50
2	2	1	1	57
3	3	1	1	55
4	4	1	1	52
5	5	1	1	56
6	1	1	2	48
7	2	1	2	58
8	3	1	2	59
9	4	1	2	61
10	5	1	2	66
11	1	1	3	52
12	2	1	3	63
13	3	1	3	65
14	4	1	3	63
15	5	1	3	65
16	6	2	1	58
17	7	2	1	58
18	8	2	1	50
19	9	2	1	53
20	10	2	1	50

SPSS Syntax

```
UNIANOVA
  score  BY group time id
  /RANDOM = id
  /METHOD = SSTYPE(3)
  /INTERCEPT = INCLUDE
  /CRITERIA = ALPHA(.05)
  /LMATRIX ='lecture vs ss at base'  group 1
                                           0
                                          -1
                           time*group   1 0 0
                                        0 0 0
                                       -1 0 0
                         id*group  .2 .2 .2 .2 .2
                                    0  0  0  0  0
                                  -.2 -.2 -.2 -.2 -.2
  /print=test(LMATRIX)
  /DESIGN = group time group*time group*id .
```

The first scientific hypothesis is there is no difference on the test scores between lecture and self study conditions before they are provided at baseline period. The null hypothesis is there no difference and alternative hypothesis is there is a difference. The 1-Between 1-Within groups simple effect contrast indicated that there is statistical difference on the scores of lecture and study, $F = .00$, $p = 1.000$.

Annex Coding Tables

1. Simple effect contrast

(1) lecture vs. self study at baseline (a1 vs a3 at b1)

		Factor B			
		.b1 (base)	.b2 (end)	.b3 (reten.)	(total)
Fac-	.a1 (lecture)	1	0	0	1
tor	.a2 (group)	0	0	0	0
A	.a3 (self)	-1	0	0	-1
	(total)	0	0	0	0

Syntax: Contrast "lecture - self at base " a 1 0 -1 a*b 1 0 0 0 0 0 -1 0 0
id*a .2 .2 .2 .2 .2 0 0 0 0 0 -.2 -.2 -.2 -.2 -.2 ;

Since one group consists of 5 people.

Power and Sample Size

(Week 14: #8)

Q & A Power and Sample size

(Week 14: #8)

Data below represent test scores on a 50 item vocabulary test for 24 participants (n = 12 high ability and n = 12 average ability) randomly assigned to one of three study conditions in a foreign language course.

Conduct an alaysis of the data. If any main effect or the interaction is not statistically significant ('NS'), conduct a power study to determine what sample size would be necessary to detect the observed effect size(s) as statistically significant. In such a study practical and if not how would you propose to alter the design?

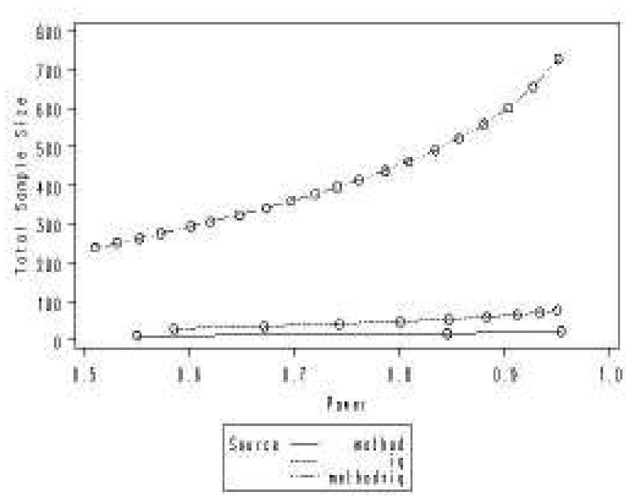
		Method		
		Oral	Translation	Combined
IQ	High (>115)	37,30,26,31	27,24,22,19	20,31,24,21
	Avg (<=114)	32,19,37,28	20,23,14,15	17,18,23,18

SAS Syntax

```
data b2;
title 'two-way factorial anova';
 input method iq score @@;
 title 'two between';
 datalines;
 1 1 37 1 1 30 1 1 26 1 1 31
 2 1 27 2 1 24 2 1 22 2 1 19
 3 1 20 3 1 31 3 1 24 3 1 21
 1 2 32 1 2 19 1 2 37 1 2 28
 2 2 20 2 2 23 2 2 14 2 2 15
 3 2 17 3 2 18 3 2 23 3 2 18
;
run;
proc glm data=b2;
 class method iq;
 model score=method iq method*iq;
run;
```

```
proc means data=b2 mean nway noprint;
 class method iq;
 var score;
 output out=b2a mean=mscore;
 run;

proc print data=b2a;
 run;
proc glmpower data=b2a;
 class method iq;
 model mscore=method iq method*iq;
 power
   stddev    = 4.83
   alpha     = 0.05
   ntotal    = .
   power     = .8 .9;
 plot x = power min=.5 max=.95;
 title1 'looling for sample size';
 run;
```

```
two between         17:49 Saturday, April 22, 2006  13
                                The GLM Procedure

                    Number of Observations Read         24
                    Number of Observations Used         24
                                  two between        17:49 Saturday, April 22, 2006  14
                                The GLM Procedure
Dependent Variable: score
                                               Sum of
       Source                     DF          Squares     Mean Square    F Value    Pr > F
       Model                       5      544.0000000     108.8000000       4.66    0.0066
       Error                      18      420.0000000      23.3333333
       Corrected Total            23      964.0000000

                       R-Square     Coeff Var      Root MSE    score Mean
                       0.564315      20.12691      4.830459      24.00000

       Source                     DF        Type I SS     Mean Square    F Value    Pr > F
       method                      2      436.0000000     218.0000000       9.34    0.0016
       iq                          1       96.0000000      96.0000000       4.11    0.0576
       method*iq                   2       12.0000000       6.0000000       0.26    0.7761

       Source                     DF      Type III SS     Mean Square    F Value    Pr > F
       method                      2      436.0000000     218.0000000       9.34    0.0016
       iq                          1       96.0000000      96.0000000       4.11    0.0576
       method*iq                   2       12.0000000       6.0000000       0.26    0.7761
                                  two between        17:49 Saturday, April 22, 2006  15
                        Obs    method    iq    _TYPE_    _FREQ_    mscore
                         1        1       1       3         4        31
                         2        1       2       3         4        29
                         3        2       1       3         4        23
                         4        2       2       3         4        18
                         5        3       1       3         4        24
                         6        3       2       3         4        19
                             looling for sample size   17:49 Saturday, April 22, 2006  16
                             The GLMPOWER Procedure
                            Fixed Scenario Elements

                    Dependent Variable                  mscore
                    Alpha                                 0.05
                    Error Standard Deviation              4.83

                                Computed N Total

                                   Nominal     Test     Error     Actual         N
                Index     Source     Power       DF        DF      Power     Total

                    1     method       0.8        2        12      0.845        18
                    2     method       0.9        2        18      0.953        24
                    3     iq           0.8        1        42      0.800        48
                    4     iq           0.9        1        60      0.911        66
                    5     method*iq    0.8        2       450      0.803       456
                    6     method*iq    0.9        2       588      0.900       594
```



A two-between ANOVA was conducted to determine if the different methods (aural-oral, translation, and combined) and ability (high ability and low ability) effected the number of test scores of foreign language course.

The ANOVA result indicated a statistically significant main effect for methods, $F(2, 18) = 9.34$, $p = .0016$. The ANOVA result indicated not significant main effect for ability, $F(1, 18) = 4.11$, $p = .058$, and also not significant interaction effect, $F = 0.26$, $p = .776$.

The result of power analysis indicated that 60 samples would be needed if statistical significance is set as .05 and the power is set as .90 for ability, see Figure 1. Also the sample size should be 558 would be needed if statistical significance is set as .05 and the power is set as .90 for interaction effect.

It should be concluded that the suggested sample size for ability is practical but not practical for interaction effect. More systematic sampling methods, such as blocking, stratified sampling and cluster sampling are recommended rather than simple random sampling in order to minimize a sample size.

Score 10/10

Figure 1

Power and sample size