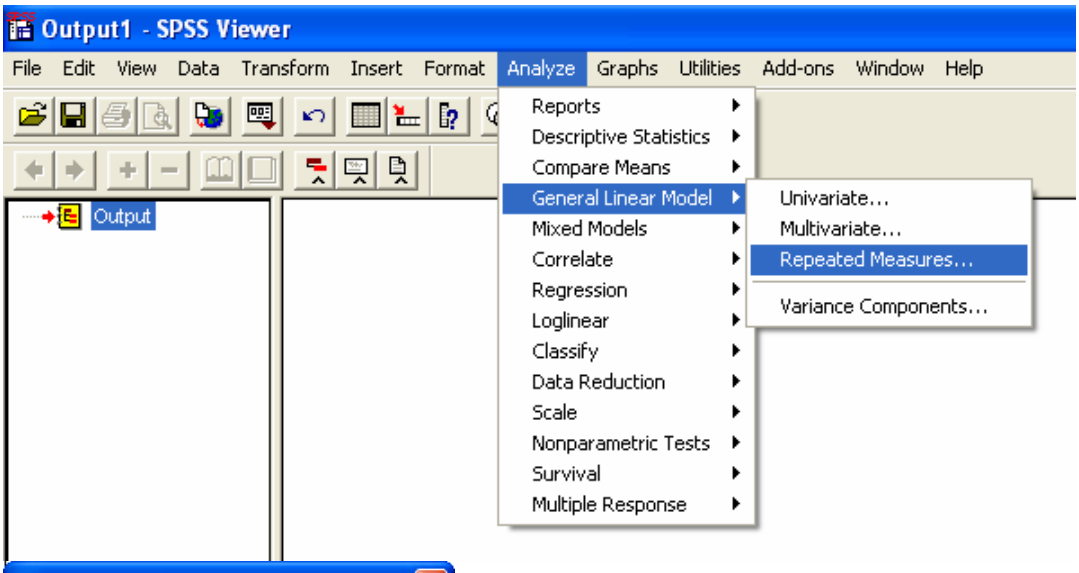
# Two-way Repeated Measures Anova Lab

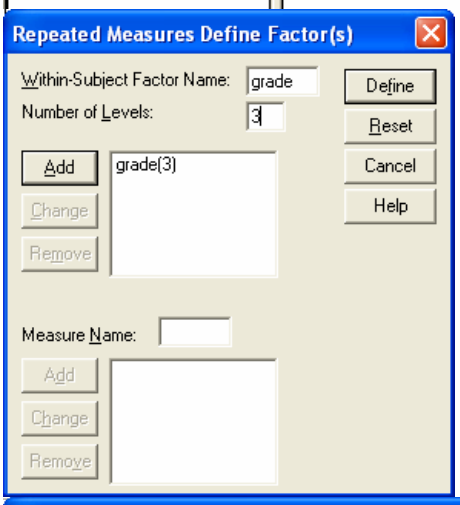
The SPSS data set may be downloaded from:
www.mtsu.edu/~dkfuller/psy629/rmd2way.sav.

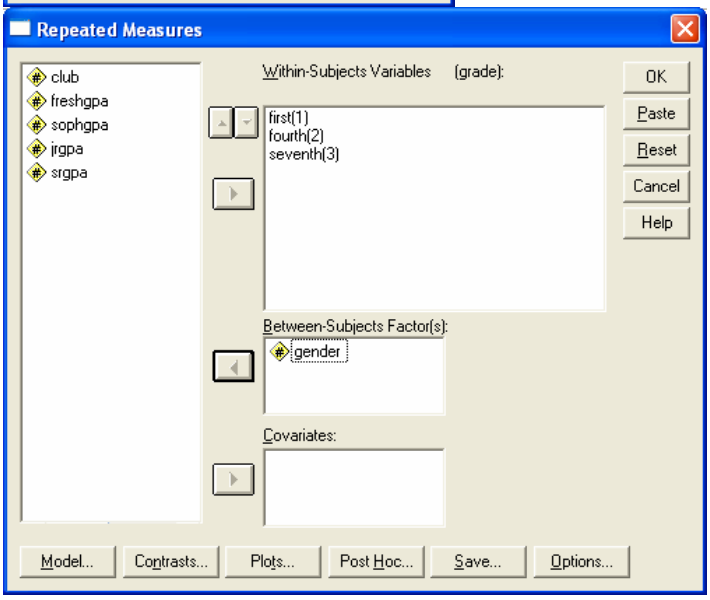
**EXAMPLE 1. The Interaction Test is NOT SIGNIFICANT.**

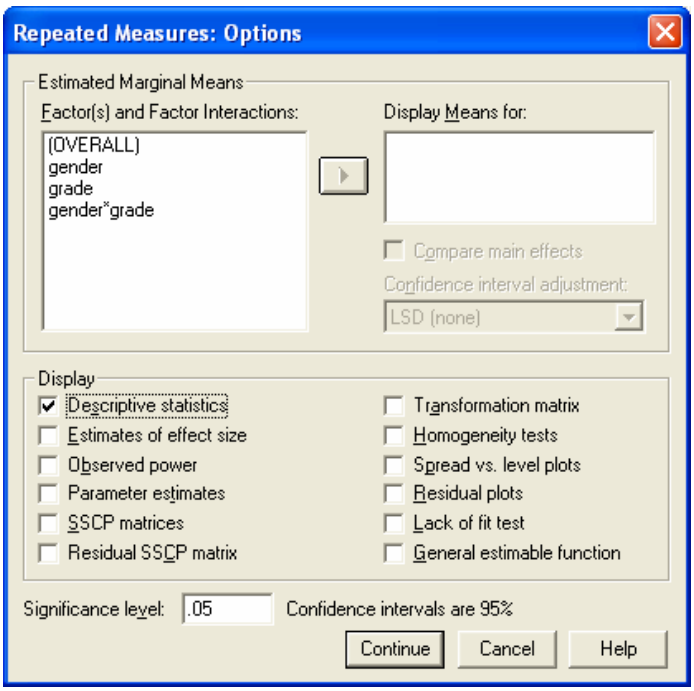
A school psychologist wanted to determine whether interest in science (1 = very negative, 15 = very positive) is related to sex (female, male) and whether the interest in science changed over time (first grade, fourth grade, seventh grade).

| Sex (1= female, 2 = male) | First | Fourth | Seventh |
|---|---|---|---|
| 1 | 4 | 2 | 5 |
| 1 | 3 | 3 | 6 |
| 1 | 2 | 2 | 10 |
| 1 | 7 | 6 | 8 |
| 1 | 3 | 10 | 6 |
| 1 | 4 | 6 | 4 |
| 1 | 2 | 3 | 14 |
| 1 | 5 | 8 | 10 |
| 1 | 4 | 11 | 11 |
| 1 | 6 | 12 | 12 |
| 1 | 6 | 4 | 13 |
| 1 | 5 | 4 | 11 |
| 1 | 4 | 5 | 12 |
| 1 | 3 | 8 | 9 |
| 1 | 6 | 7 | 15 |
| 2 | 5 | 7 | 16 |
| 2 | 4 | 2 | 10 |
| 2 | 6 | 10 | 12 |
| 2 | 5 | 8 | 9 |
| 2 | 12 | 7 | 12 |
| 2 | 1 | 5 | 10 |
| 2 | 7 | 9 | 6 |
| 2 | 6 | 3 | 16 |
| 2 | 5 | 1 | 7 |
| 2 | 5 | 6 | 12 |
| 2 | 3 | 7 | 6 |
| 2 | 5 | 7 | 15 |
| 2 | 3 | 8 | 15 |
| 2 | 7 | 12 | 7 |
| 2 | 3 | 5 | 12 |

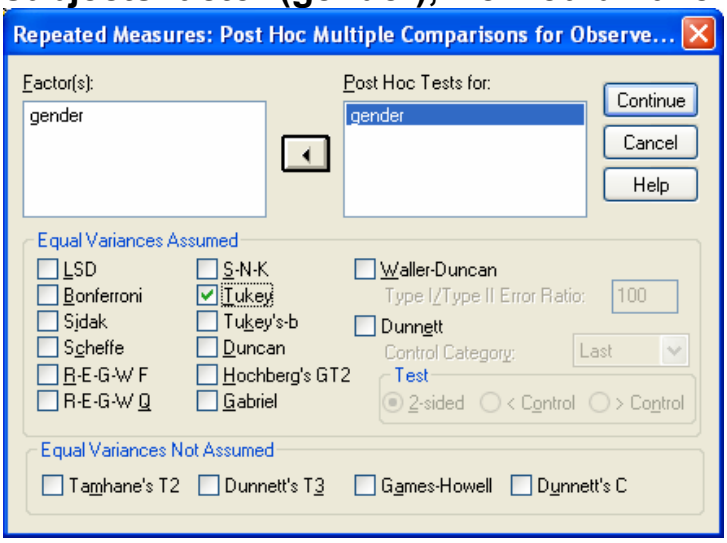

Output1 - SPSS Viewer
File Edit View Data Transform Insert Format Analyze Graphs Utilities Add-ons Window Help
Output
Reports
Descriptive Statistics
Compare Means
General Linear Model
Mixed Models
Correlate
Regression
Loglinear
Classify
Data Reduction
Scale
Nonparametric Tests
Survival
Multiple Response
Univariate...
Multivariate...
Repeated Measures...
Variance Components...


Repeated Measures Define Factor(s)
Within-Subject Factor Name: grade
Number of Levels: 3
Add
grade(3)
Change
Remove
Measure Name:
Add
Change
Remove
Define
Reset
Cancel
Help


Repeated Measures
club
freshgpa
sophgpa
jrgpa
srgpa
Within-Subjects Variables (grade):
first(1)
fourth(2)
seventh(3)
Between-Subjects Factor(s):
gender
Covariates:
OK
Paste
Reset
Cancel
Help
Model...
Contrasts...
Plots...
Post Hoc...
Save...
Options...




**If we had needed to conduct pairwise comparisons for the between subjects factor (gender), we would have requested the following:**



# General Linear Model

**Within-Subjects Factors**

Measure: MEASURE_1

| grade | Dependent Variable |
|---|---|
| 1 | first |
| 2 | fourth |
| 3 | seventh |

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| gender | 1 | Female | 15 |
| | 2 | Male | 15 |

**Descriptive Statistics**

| | gender | Mean | Std. Deviation | N |
|---|---|---|---|---|
| first | Female | 4.27 | 1.534 | 15 |
| | Male | 5.13 | 2.503 | 15 |
| | Total | 4.70 | 2.087 | 30 |
| fourth | Female | 6.07 | 3.218 | 15 |
| | Male | 6.47 | 2.949 | 15 |
| | Total | 6.27 | 3.039 | 30 |
| seventh | Female | 9.73 | 3.348 | 15 |
| | Male | 11.00 | 3.525 | 15 |
| | Total | 10.37 | 3.439 | 30 |

**Multivariate Tests[b]**

| Effect | | Value | F | Hypothesis df | Error df | Sig. |
|---|---|---|---|---|---|---|
| grade | Pillai's Trace | .705 | 32.250[a] | 2.000 | 27.000 | .000 |
| | Wilks' Lambda | .295 | 32.250[a] | 2.000 | 27.000 | .000 |
| | Hotelling's Trace | 2.389 | 32.250[a] | 2.000 | 27.000 | .000 |
| | Roy's Largest Root | 2.389 | 32.250[a] | 2.000 | 27.000 | .000 |
| grade * gender | Pillai's Trace | .010 | .134[a] | 2.000 | 27.000 | .875 |
| | Wilks' Lambda | .990 | .134[a] | 2.000 | 27.000 | .875 |
| | Hotelling's Trace | .010 | .134[a] | 2.000 | 27.000 | .875 |
| | Roy's Largest Root | .010 | .134[a] | 2.000 | 27.000 | .875 |

a. Exact statistic

b.
Design: Intercept+gender
Within Subjects Design: grade

**Mauchly's Test of Sphericity[b]**

Measure: MEASURE_1

| Within Subjects Effect | Mauchly's W | Approx. Chi-Square | df | Sig. | Epsilon[a] | | |
|---|---|---|---|---|---|---|---|
| | | | | | Greenhouse-Geisser | Huynh-Feldt | Lower-bound |
| grade | .824 | 5.230 | 2 | .073 | .850 | .932 | .500 |

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

b.
Design: Intercept+gender
Within Subjects Design: grade

**Tests of Within-Subjects Effects**

Measure: MEASURE_1

| Source | | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| grade | Sphericity Assumed | 513.756 | 2 | 256.878 | 32.987 | .000 |
| | Greenhouse-Geisser | 513.756 | 1.701 | 302.117 | 32.987 | .000 |
| | Huynh-Feldt | 513.756 | 1.864 | 275.658 | 32.987 | .000 |
| | Lower-bound | 513.756 | 1.000 | 513.756 | 32.987 | .000 |
| grade * gender | Sphericity Assumed | 2.822 | 2 | 1.411 | .181 | .835 |
| | Greenhouse-Geisser | 2.822 | 1.701 | 1.660 | .181 | .800 |
| | Huynh-Feldt | 2.822 | 1.864 | 1.514 | .181 | .820 |
| | Lower-bound | 2.822 | 1.000 | 2.822 | .181 | .674 |
| Error(grade) | Sphericity Assumed | 436.089 | 56 | 7.787 | | |
| | Greenhouse-Geisser | 436.089 | 47.615 | 9.159 | | |
| | Huynh-Feldt | 436.089 | 52.185 | 8.357 | | |
| | Lower-bound | 436.089 | 28.000 | 15.575 | | |

**Tests of Within-Subjects Contrasts**

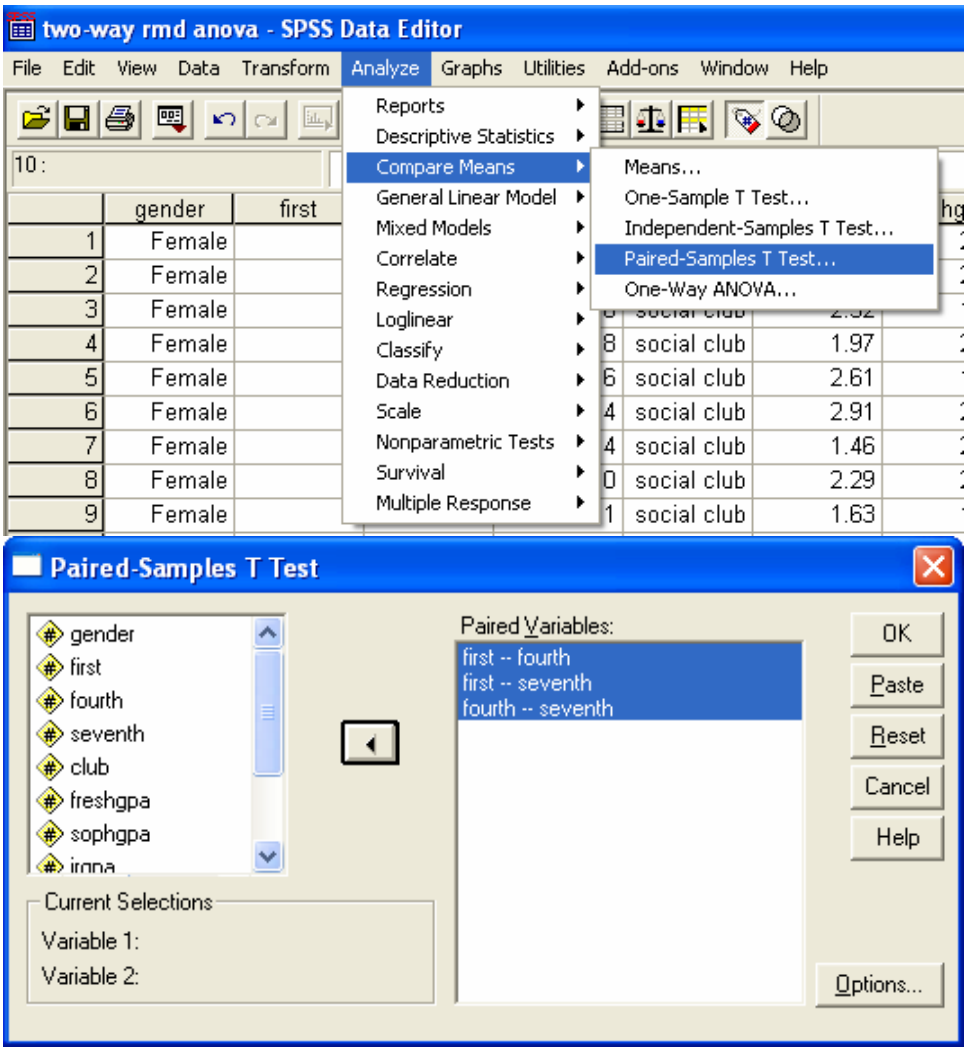
Measure: MEASURE_1

| Source | grade | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| grade | Linear | 481.667 | 1 | 481.667 | 64.612 | .000 |
| | Quadratic | 32.089 | 1 | 32.089 | 3.952 | .057 |
| grade * gender | Linear | .600 | 1 | .600 | .080 | .779 |
| | Quadratic | 2.222 | 1 | 2.222 | .274 | .605 |
| Error(grade) | Linear | 208.733 | 28 | 7.455 | | |
| | Quadratic | 227.356 | 28 | 8.120 | | |

**Tests of Between-Subjects Effects**

Measure: MEASURE_1
Transformed Variable: Average

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Intercept | 4551.111 | 1 | 4551.111 | 451.599 | .000 |
| gender | 16.044 | 1 | 16.044 | 1.592 | .217 |
| Error | 282.178 | 28 | 10.078 | | |


two-way rmd anova - SPSS Data Editor
File Edit View Data Transform Analyze Graphs Utilities Add-ons Window Help
Reports
Descriptive Statistics
Compare Means
General Linear Model
Mixed Models
Correlate
Regression
Loglinear
Classify
Data Reduction
Scale
Nonparametric Tests
Survival
Multiple Response
Means...
One-Sample T Test...
Independent-Samples T Test...
Paired-Samples T Test...
One-Way ANOVA...
10 :
gender
first
1 Female
2 Female
3 Female
4 Female
5 Female
6 Female
7 Female
8 Female
9 Female
social club 1.97
social club 2.61
social club 2.91
social club 1.46
social club 2.29
social club 1.63
Paired-Samples T Test
gender
first
fourth
seventh
club
freshgpa
sophgpa
Paired Variables:
first -- fourth
first -- seventh
fourth -- seventh
OK
Paste
Reset
Cancel
Help
Current Selections
Variable 1:
Variable 2:
Options...

# T-Test

**Paired Samples Statistics**

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Pair 1 | first | 4.70 | 30 | 2.087 | .381 |
| | fourth | 6.27 | 30 | 3.039 | .555 |
| Pair 2 | first | 4.70 | 30 | 2.087 | .381 |
| | seventh | 10.37 | 30 | 3.439 | .628 |
| Pair 3 | fourth | 6.27 | 30 | 3.039 | .555 |
| | seventh | 10.37 | 30 | 3.439 | .628 |

**Paired Samples Correlations**

| | | N | Correlation | Sig. |
|---|---|---|---|---|
| Pair 1 | first & fourth | 30 | .285 | .127 |
| Pair 2 | first & seventh | 30 | .122 | .522 |
| Pair 3 | fourth & seventh | 30 | .004 | .985 |

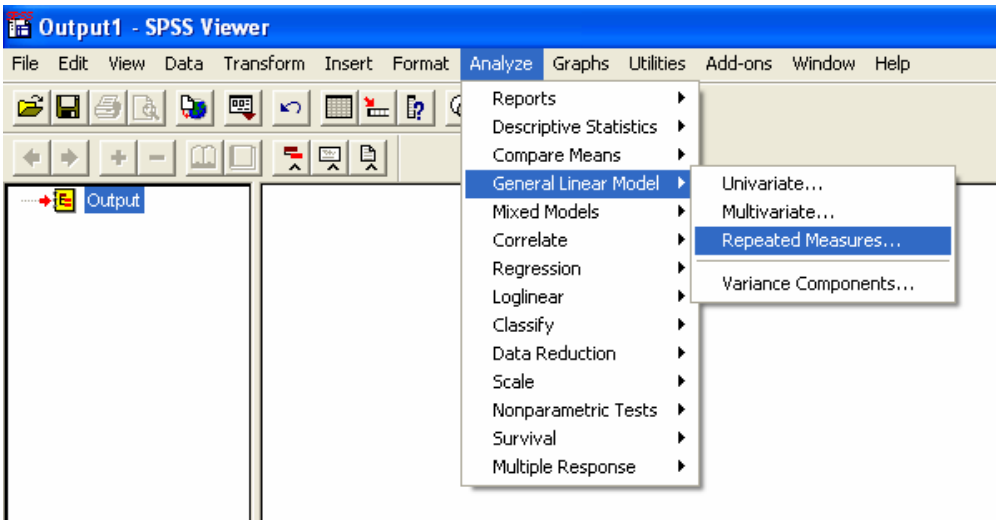
**Paired Samples Test**

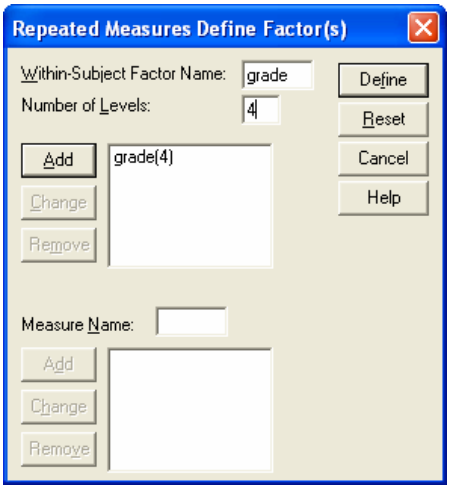
| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference Lower | Upper | | | |
| Pair 1 | first - fourth | -1.567 | 3.159 | .577 | -2.746 | -.387 | -2.717 | 29 | .011 |
| Pair 2 | first - seventh | -5.667 | 3.800 | .694 | -7.085 | -4.248 | -8.169 | 29 | .000 |
| Pair 3 | fourth - seventh | -4.100 | 4.581 | .836 | -5.811 | -2.389 | -4.902 | 29 | .000 |

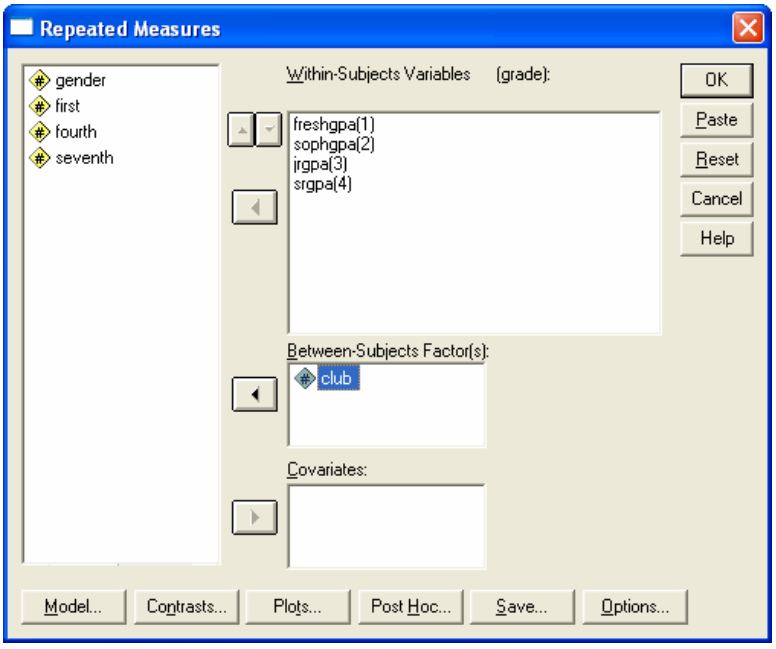
**EXAMPLE 2. The Interaction Test IS significant.**

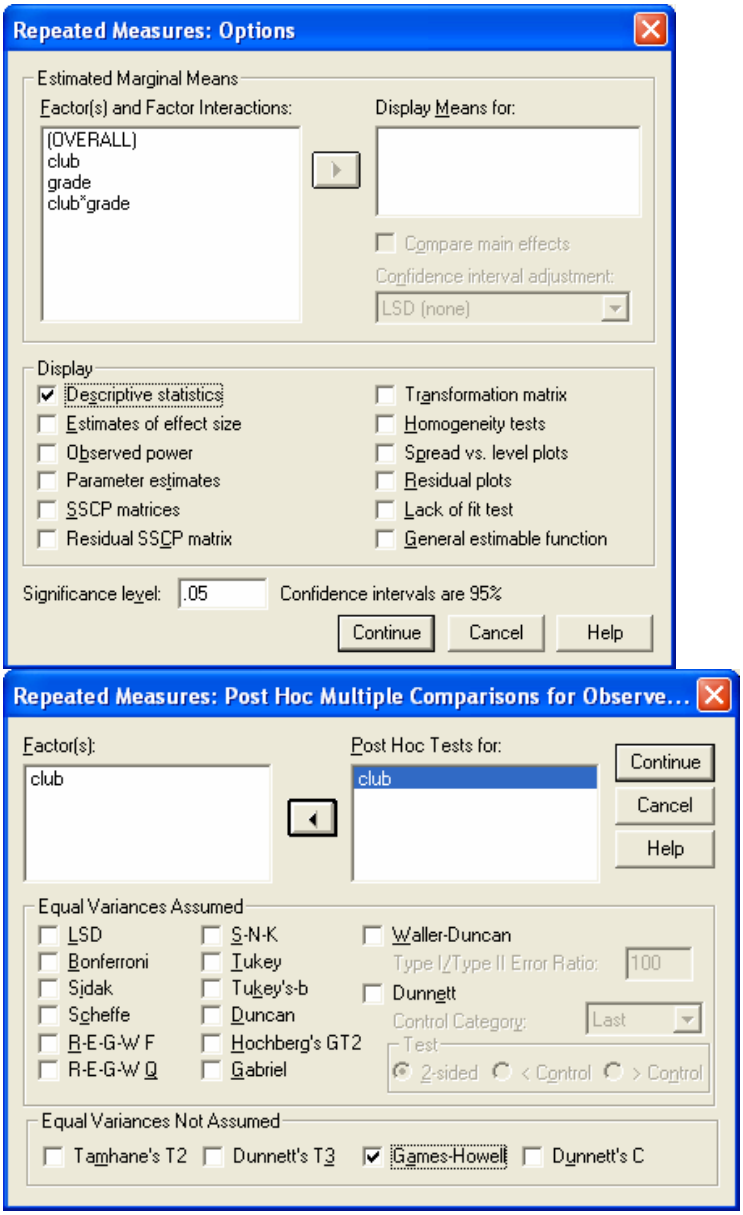
University officials wanted to determine whether college gpa varies across grade (freshman, sophomore, junior, senior) and by participation in campus organizations (1 = social club, 2 = sports club, 3 = academic club).

| Club | Freshman GPA | Sophomore GPA | Junior GPA | Senior GPA |
|---|---|---|---|---|
| 1 | 3.01 | 2.08 | 3.24 | 2.90 |
| 1 | 2.83 | 2.35 | 2.38 | 2.64 |
| 1 | 2.52 | 1.90 | 2.44 | 3.20 |
| 1 | 1.97 | 2.12 | 2.88 | 2.93 |
| 1 | 2.61 | 1.97 | 2.22 | 3.07 |
| 1 | 2.91 | 2.31 | 3.23 | 2.83 |
| 1 | 1.46 | 2.44 | 3.16 | 3.32 |
| 1 | 2.29 | 2.66 | 2.43 | 2.98 |
| 1 | 1.63 | 1.95 | 2.30 | 2.82 |
| 1 | 1.90 | 2.10 | 2.80 | 3.01 |
| 1 | 1.16 | 2.24 | 2.55 | 2.81 |
| 1 | 1.13 | 1.95 | 1.90 | 3.09 |
| 1 | 1.74 | 2.49 | 2.69 | 3.32 |
| 2 | 2.19 | 2.02 | 3.15 | 2.74 |
| 2 | 2.24 | 2.29 | 2.81 | 3.22 |
| 2 | 2.24 | 2.05 | 2.84 | 3.32 |
| 2 | 2.18 | 2.33 | 3.24 | 3.26 |
| 2 | 1.68 | 2.22 | 2.21 | 2.78 |
| 2 | 2.21 | 2.33 | 2.12 | 3.17 |
| 2 | 2.50 | 2.26 | 3.07 | 2.96 |
| 2 | 2.21 | 1.97 | 2.58 | 2.96 |
| 2 | 2.25 | 2.89 | 3.02 | 2.99 |
| 2 | 1.79 | 2.04 | 2.25 | 3.05 |
| 2 | 2.14 | 2.16 | 2.79 | 2.85 |
| 2 | 2.17 | 1.97 | 2.31 | 2.86 |
| 2 | 2.97 | 2.07 | 2.60 | 2.76 |
| 2 | 2.51 | 2.18 | 1.87 | 2.56 |
| 2 | 2.33 | 2.04 | 1.92 | 3.11 |
| 3 | 3.08 | 2.83 | 2.82 | 2.25 |
| 3 | 3.03 | 3.12 | 2.74 | 2.56 |
| 3 | 3.10 | 3.24 | 3.32 | 2.69 |
| 3 | 2.48 | 3.01 | 3.17 | 2.71 |
| 3 | 3.01 | 3.39 | 2.95 | 2.83 |
| 3 | 2.87 | 2.54 | 2.87 | 3.14 |
| 3 | 3.04 | 2.98 | 2.66 | 2.98 |
| 3 | 2.58 | 2.70 | 3.53 | 2.90 |
| 3 | 3.24 | 3.17 | 3.08 | 3.27 |
| 3 | 2.77 | 3.03 | 3.27 | 3.13 |
| 3 | 3.10 | 3.19 | 3.39 | 3.12 |
| 3 | 2.99 | 2.99 | 2.82 | 3.07 |
| 3 | 3.10 | 3.00 | 2.79 | 3.19 |
| 3 | 3.63 | 3.54 | 2.96 | 2.50 |
| 3 | 2.85 | 3.05 | 2.90 | 3.08 |


Output1 - SPSS Viewer
File Edit View Data Transform Insert Format Analyze Graphs Utilities Add-ons Window Help
Output
Reports
Descriptive Statistics
Compare Means
General Linear Model
Mixed Models
Correlate
Regression
Loglinear
Classify
Data Reduction
Scale
Nonparametric Tests
Survival
Multiple Response
Univariate...
Multivariate...
Repeated Measures...
Variance Components...


Repeated Measures Define Factor(s)
Within-Subject Factor Name: grade
Number of Levels: 4
Add
grade(4)
Change
Remove
Measure Name:
Add
Change
Remove
Define
Reset
Cancel
Help


Repeated Measures
gender
first
fourth
seventh
Within-Subjects Variables (grade):
freshgpa(1)
sophgpa(2)
jrgpa(3)
srgpa(4)
Between-Subjects Factor(s):
club
Covariates:
OK
Paste
Reset
Cancel
Help
Model...
Contrasts...
Plots...
Post Hoc...
Save...
Options...


Repeated Measures: Options
Estimated Marginal Means
Factor(s) and Factor Interactions:
(OVERALL)
club
grade
club*grade
Display Means for:
Compare main effects
Confidence interval adjustment:
LSD (none)
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%
Continue
Cancel
Help
Repeated Measures: Post Hoc Multiple Comparisons for Observe...
Factor(s):
club
Post Hoc Tests for:
club
Continue
Cancel
Help
Equal Variances Assumed
LSD
Bonferroni
Sidak
Scheffe
R-E-G-W F
R-E-G-W Q
S-N-K
Tukey
Tukey's-b
Duncan
Hochberg's GT2
Gabriel
Waller-Duncan
Type I/Type II Error Ratio: 100
Dunnett
Control Category: Last
Test
2-sided
< Control
> Control
Equal Variances Not Assumed
Tamhane's T2
Dunnett's T3
Games-Howell
Dunnett's C

# General Linear Model

**Within-Subjects Factors**

Measure: MEASURE_1

| grade | Dependent Variable |
|---|---|
| 1 | freshgpa |
| 2 | sophgpa |
| 3 | jrgpa |
| 4 | srgpa |

**Between-Subjects Factors**

| | | Value Label | N |
|---|---|---|---|
| club | 1 | social clubs | 13 |
| | 2 | sports clubs | 15 |
| | 3 | academic clubs | 15 |

**Descriptive Statistics**

| | club | Mean | Std. Deviation | N |
|---|---|---|---|---|
| freshgpa | social clubs | 2.0895 | .65502 | 13 |
| | sports clubs | 2.2415 | .29373 | 15 |
| | academic clubs | 2.9912 | .27179 | 15 |
| | Total | 2.4571 | .57991 | 43 |
| sophgpa | social clubs | 2.1982 | .23975 | 13 |
| | sports clubs | 2.1890 | .23127 | 15 |
| | academic clubs | 3.0518 | .25076 | 15 |
| | Total | 2.4928 | .47606 | 43 |
| jrgpa | social clubs | 2.6321 | .41480 | 13 |
| | sports clubs | 2.5843 | .44926 | 15 |
| | academic clubs | 3.0178 | .26135 | 15 |
| | Total | 2.7500 | .42300 | 43 |
| srgpa | social clubs | 2.9936 | .20435 | 13 |
| | sports clubs | 2.9726 | .21733 | 15 |
| | academic clubs | 2.8950 | .29762 | 15 |
| | Total | 2.9519 | .24300 | 43 |

**Multivariate Tests[c]**

| Effect | | Value | F | Hypothesis df | Error df | Sig. |
|---|---|---|---|---|---|---|
| grade | Pillai's Trace | .679 | 26.855[a] | 3.000 | 38.000 | .000 |
| | Wilks' Lambda | .321 | 26.855[a] | 3.000 | 38.000 | .000 |
| | Hotelling's Trace | 2.120 | 26.855[a] | 3.000 | 38.000 | .000 |
| | Roy's Largest Root | 2.120 | 26.855[a] | 3.000 | 38.000 | .000 |
| grade * club | Pillai's Trace | .673 | 6.590 | 6.000 | 78.000 | .000 |
| | Wilks' Lambda | .344 | 8.938[a] | 6.000 | 76.000 | .000 |
| | Hotelling's Trace | 1.861 | 11.477 | 6.000 | 74.000 | .000 |
| | Roy's Largest Root | 1.835 | 23.854[b] | 3.000 | 39.000 | .000 |

a. Exact statistic

b. The statistic is an upper bound on F that yields a lower bound on the significance level.

c.
Design: Intercept+club
Within Subjects Design: grade

**Mauchly's Test of Sphericity[b]**

Measure: MEASURE_1

| Within Subjects Effect | Mauchly's W | Approx. Chi-Square | df | Sig. | Epsilon[a] | | |
|---|---|---|---|---|---|---|---|
| | | | | | Greenhouse-Geisser | Huynh-Feldt | Lower-bound |
| grade | .745 | 11.410 | 5 | .044 | .842 | .948 | .333 |

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

b.
Design: Intercept+club
Within Subjects Design: grade

**Tests of Within-Subjects Effects**

Measure: MEASURE_1

| Source | | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| grade | Sphericity Assumed | 7.445 | 3 | 2.482 | 23.855 | .000 |
| | Greenhouse-Geisser | 7.445 | 2.525 | 2.948 | 23.855 | .000 |
| | Huynh-Feldt | 7.445 | 2.844 | 2.618 | 23.855 | .000 |
| | Lower-bound | 7.445 | 1.000 | 7.445 | 23.855 | .000 |
| grade * club | Sphericity Assumed | 5.875 | 6 | .979 | 9.411 | .000 |
| | Greenhouse-Geisser | 5.875 | 5.050 | 1.163 | 9.411 | .000 |
| | Huynh-Feldt | 5.875 | 5.688 | 1.033 | 9.411 | .000 |
| | Lower-bound | 5.875 | 2.000 | 2.937 | 9.411 | .000 |
| Error(grade) | Sphericity Assumed | 12.485 | 120 | .104 | | |
| | Greenhouse-Geisser | 12.485 | 101.007 | .124 | | |
| | Huynh-Feldt | 12.485 | 113.765 | .110 | | |
| | Lower-bound | 12.485 | 40.000 | .312 | | |

**Tests of Within-Subjects Contrasts**

Measure: MEASURE_1

| Source | grade | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| grade | Linear | 6.966 | 1 | 6.966 | 49.392 | .000 |
| | Quadratic | .309 | 1 | .309 | 3.580 | .066 |
| | Cubic | .170 | 1 | .170 | 2.012 | .164 |
| grade * club | Linear | 5.016 | 2 | 2.508 | 17.785 | .000 |
| | Quadratic | .765 | 2 | .383 | 4.428 | .018 |
| | Cubic | .093 | 2 | .047 | .550 | .581 |
| Error(grade) | Linear | 5.641 | 40 | .141 | | |
| | Quadratic | 3.456 | 40 | .086 | | |
| | Cubic | 3.387 | 40 | .085 | | |

**Tests of Between-Subjects Effects**

Measure: MEASURE_1
Transformed Variable: Average

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Intercept | 1206.676 | 1 | 1206.676 | 8817.349 | .000 |
| club | 9.805 | 2 | 4.902 | 35.822 | .000 |
| Error | 5.474 | 40 | .137 | | |

## Post Hoc Tests
## club

**Multiple Comparisons**

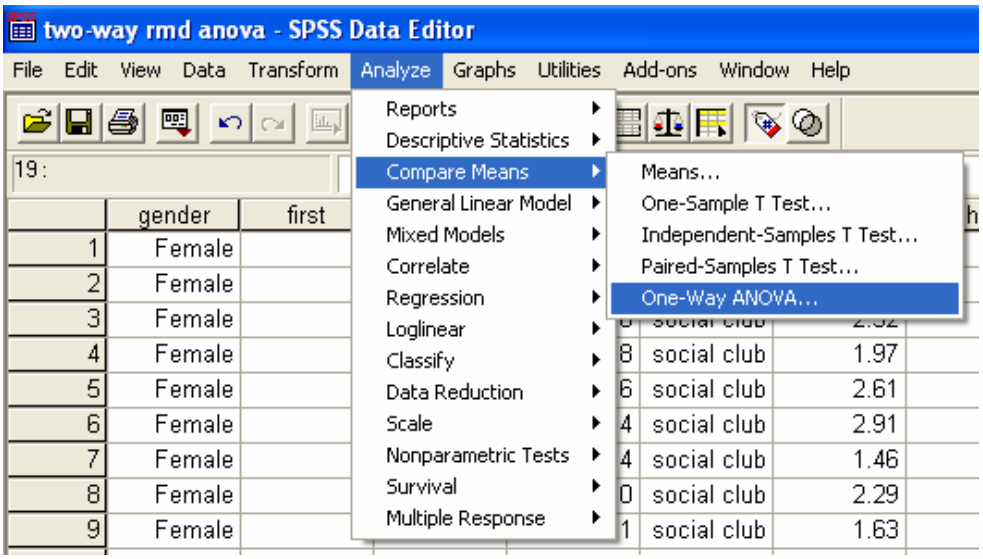
Measure: MEASURE_1
Games-Howell

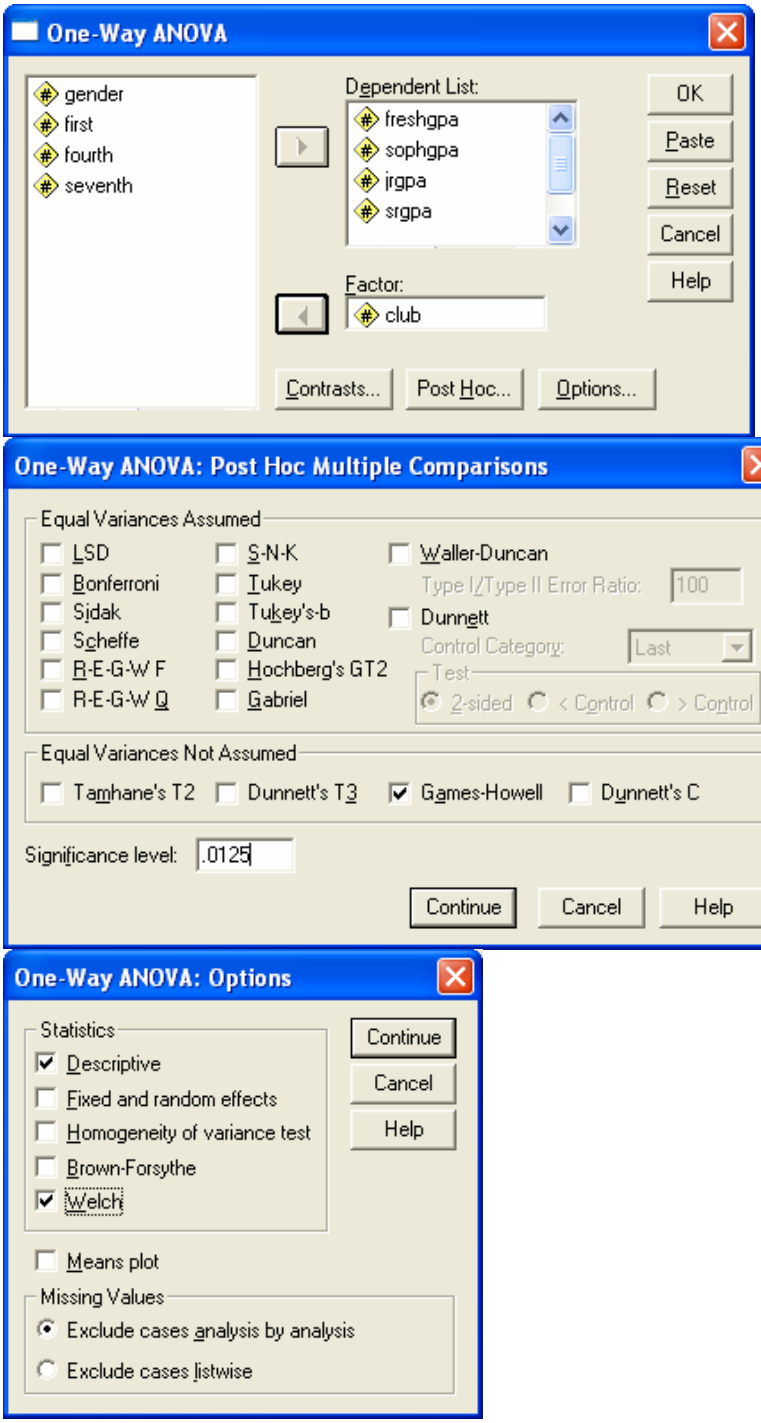
| (I) club | (J) club | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| social clubs | sports clubs | -.0185 | .07981 | .971 | -.2187 | .1816 |
| | academic clubs | -.5106* | .07355 | .000 | -.6977 | -.3235 |
| sports clubs | social clubs | .0185 | .07981 | .971 | -.1816 | .2187 |
| | academic clubs | -.4921* | .05838 | .000 | -.6372 | -.3470 |
| academic clubs | social clubs | .5106* | .07355 | .000 | .3235 | .6977 |
| | sports clubs | .4921* | .05838 | .000 | .3470 | .6372 |

Based on observed means.

*. The mean difference is significant at the .05 level.

## NOTE: Since the interaction was significant, DO NOT INTERPRET the pairwise comparisons above.




One-Way ANOVA
gender
first
fourth
seventh
Dependent List:
freshgpa
sophgpa
jrgpa
srgpa
Factor:
club
OK
Paste
Reset
Cancel
Help
Contrasts...
Post Hoc...
Options...
One-Way ANOVA: Post Hoc Multiple Comparisons
Equal Variances Assumed
LSD
Bonferroni
Sidak
Scheffe
R-E-G-W F
R-E-G-W Q
S-N-K
Tukey
Tukey's-b
Duncan
Hochberg's GT2
Gabriel
Waller-Duncan
Type I/Type II Error Ratio: 100
Dunnett
Control Category: Last
Test
2-sided
< Control
> Control
Equal Variances Not Assumed
Tamhane's T2
Dunnett's T3
Games-Howell
Dunnett's C
Significance level: .0125
Continue
Cancel
Help
One-Way ANOVA: Options
Statistics
Descriptive
Fixed and random effects
Homogeneity of variance test
Brown-Forsythe
Welch
Means plot
Missing Values
Exclude cases analysis by analysis
Exclude cases listwise
Continue
Cancel
Help

# Oneway

**Descriptives**

| | | N | Mean | Std. Deviation | Std. Error | 95% Confidence Interval for Mean | | Minimum | Maximum |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound | | |
| freshgpa | social clubs | 13 | 2.0895 | .65502 | .18167 | 1.6936 | 2.4853 | 1.13 | 3.01 |
| | sports clubs | 15 | 2.2415 | .29373 | .07584 | 2.0788 | 2.4042 | 1.68 | 2.97 |
| | academic clubs | 15 | 2.9912 | .27179 | .07018 | 2.8407 | 3.1417 | 2.48 | 3.63 |
| | Total | 43 | 2.4571 | .57991 | .08844 | 2.2786 | 2.6355 | 1.13 | 3.63 |
| sophgpa | social clubs | 13 | 2.1982 | .23975 | .06650 | 2.0533 | 2.3431 | 1.90 | 2.66 |
| | sports clubs | 15 | 2.1890 | .23127 | .05971 | 2.0610 | 2.3171 | 1.97 | 2.89 |
| | academic clubs | 15 | 3.0518 | .25076 | .06475 | 2.9130 | 3.1907 | 2.54 | 3.54 |
| | Total | 43 | 2.4928 | .47606 | .07260 | 2.3463 | 2.6393 | 1.90 | 3.54 |
| jrgpa | social clubs | 13 | 2.6321 | .41480 | .11504 | 2.3815 | 2.8828 | 1.90 | 3.24 |
| | sports clubs | 15 | 2.5843 | .44926 | .11600 | 2.3355 | 2.8331 | 1.87 | 3.24 |
| | academic clubs | 15 | 3.0178 | .26135 | .06748 | 2.8731 | 3.1625 | 2.66 | 3.53 |
| | Total | 43 | 2.7500 | .42300 | .06451 | 2.6198 | 2.8802 | 1.87 | 3.53 |
| srgpa | social clubs | 13 | 2.9936 | .20435 | .05668 | 2.8701 | 3.1171 | 2.64 | 3.32 |
| | sports clubs | 15 | 2.9726 | .21733 | .05611 | 2.8522 | 3.0930 | 2.56 | 3.32 |
| | academic clubs | 15 | 2.8950 | .29762 | .07685 | 2.7302 | 3.0598 | 2.25 | 3.27 |
| | Total | 43 | 2.9519 | .24300 | .03706 | 2.8771 | 3.0267 | 2.25 | 3.32 |

**ANOVA**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| freshgpa | Between Groups | 6.734 | 2 | 3.367 | 18.223 | .000 |
| | Within Groups | 7.391 | 40 | .185 | | |
| | Total | 14.124 | 42 | | | |
| sophgpa | Between Groups | 7.200 | 2 | 3.600 | 62.098 | .000 |
| | Within Groups | 2.319 | 40 | .058 | | |
| | Total | 9.519 | 42 | | | |
| jrgpa | Between Groups | 1.668 | 2 | .834 | 5.707 | .007 |
| | Within Groups | 5.847 | 40 | .146 | | |
| | Total | 7.515 | 42 | | | |
| srgpa | Between Groups | .078 | 2 | .039 | .645 | .530 |
| | Within Groups | 2.402 | 40 | .060 | | |
| | Total | 2.480 | 42 | | | |

**Robust Tests of Equality of Means**

| | | Statistic[a] | df1 | df2 | Sig. |
|---|---|---|---|---|---|
| freshgpa | Welch | 29.818 | 2 | 23.640 | .000 |
| sophgpa | Welch | 58.322 | 2 | 26.345 | .000 |
| jrgpa | Welch | 7.307 | 2 | 24.227 | .003 |
| srgpa | Welch | .537 | 2 | 26.339 | .591 |

a. Asymptotically F distributed.

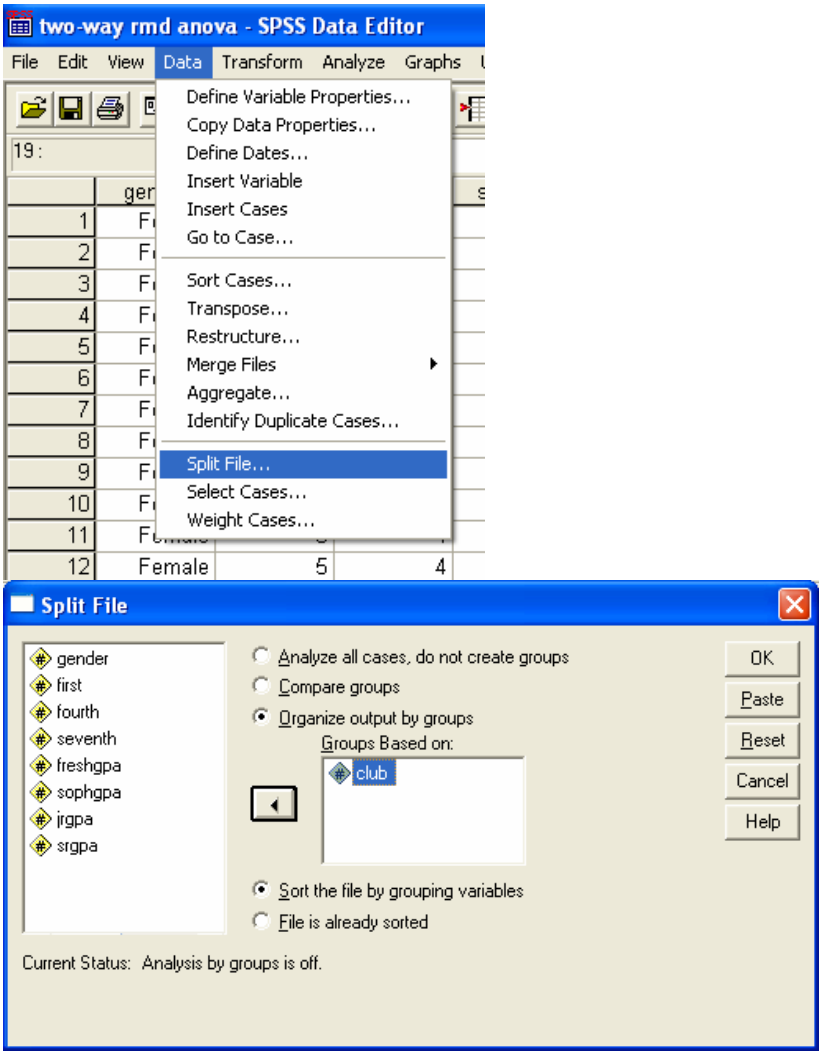
# Post Hoc Tests

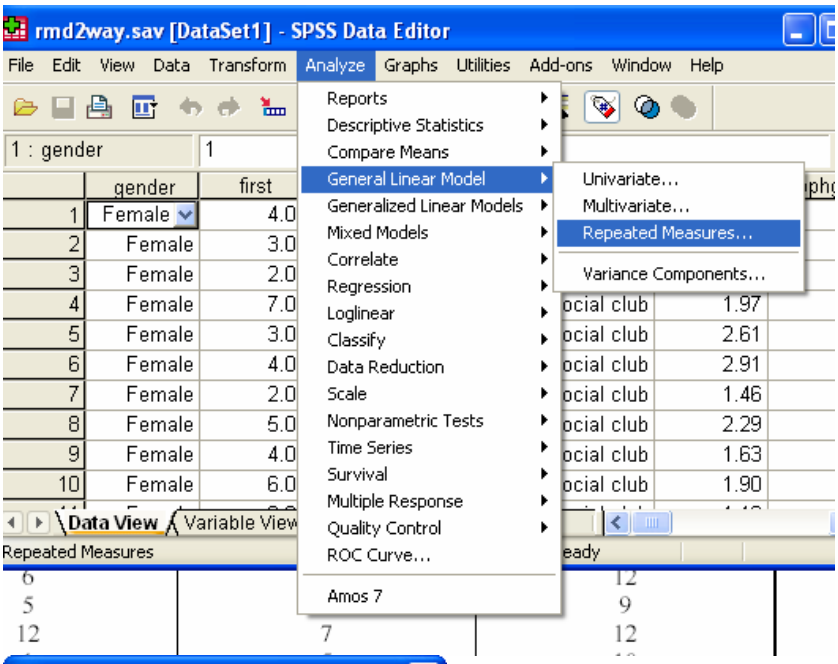
**Multiple Comparisons**

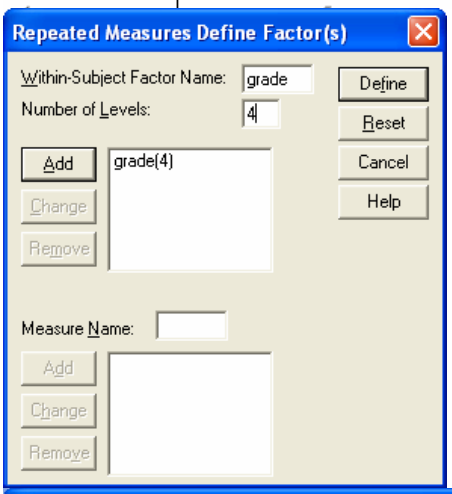
Games-Howell

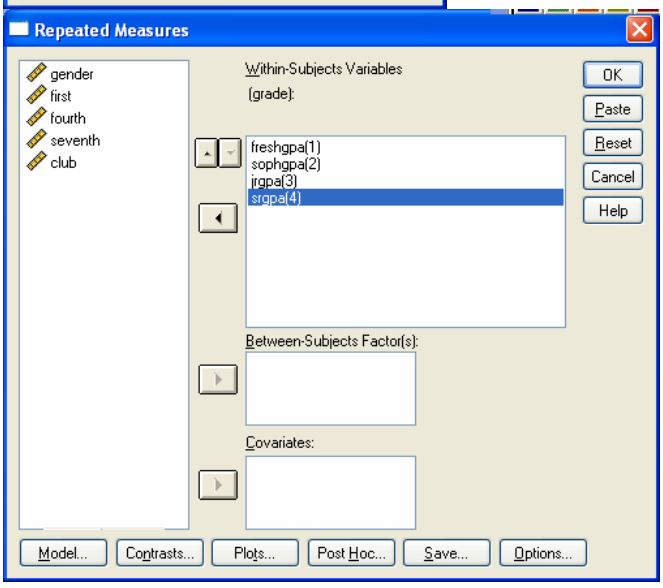
| Dependent Variable | (I) club | (J) club | Mean Difference (I-J) | Std. Error | Sig. | 98.75% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound |
| freshgpa | social clubs | sports clubs | -.15204 | .19686 | .725 | -.7960 | .4920 |
| | | academic clubs | -.90178* | .19475 | .001 | -1.5423 | -.2612 |
| | sports clubs | social clubs | .15204 | .19686 | .725 | -.4920 | .7960 |
| | | academic clubs | -.74974* | .10333 | .000 | -1.0678 | -.4317 |
| | academic clubs | social clubs | .90178* | .19475 | .001 | .2612 | 1.5423 |
| | | sports clubs | .74974* | .10333 | .000 | .4317 | 1.0678 |
| sophgpa | social clubs | sports clubs | .00915 | .08937 | .994 | -.2684 | .2867 |
| | | academic clubs | -.85362* | .09281 | .000 | -1.1412 | -.5660 |
| | sports clubs | social clubs | -.00915 | .08937 | .994 | -.2867 | .2684 |
| | | academic clubs | -.86278* | .08808 | .000 | -1.1339 | -.5916 |
| | academic clubs | social clubs | .85362* | .09281 | .000 | .5660 | 1.1412 |
| | | sports clubs | .86278* | .08808 | .000 | .5916 | 1.1339 |
| jrgpa | social clubs | sports clubs | .04786 | .16337 | .954 | -.4582 | .5539 |
| | | academic clubs | -.38566 | .13338 | .024 | -.8106 | .0393 |
| | sports clubs | social clubs | -.04786 | .16337 | .954 | -.5539 | .4582 |
| | | academic clubs | -.43351* | .13420 | .010 | -.8548 | -.0122 |
| | academic clubs | social clubs | .38566 | .13338 | .024 | -.0393 | .8106 |
| | | sports clubs | .43351* | .13420 | .010 | .0122 | .8548 |
| srgpa | social clubs | sports clubs | .02096 | .07976 | .963 | -.2261 | .2681 |
| | | academic clubs | .09854 | .09549 | .564 | -.1984 | .3954 |
| | sports clubs | social clubs | -.02096 | .07976 | .963 | -.2681 | .2261 |
| | | academic clubs | .07758 | .09515 | .697 | -.2174 | .3726 |
| | academic clubs | social clubs | -.09854 | .09549 | .564 | -.3954 | .1984 |
| | | sports clubs | -.07758 | .09515 | .697 | -.3726 | .2174 |

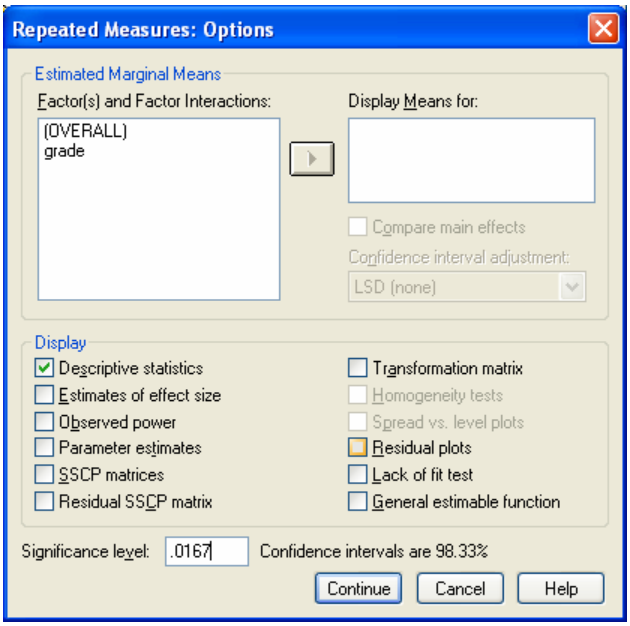
*. The mean difference is significant at the .0125 level.


two-way rmd anova - SPSS Data Editor
File Edit View Data Transform Analyze Graphs
Define Variable Properties...
Copy Data Properties...
Define Dates...
Insert Variable
Insert Cases
Go to Case...
Sort Cases...
Transpose...
Restructure...
Merge Files
Aggregate...
Identify Duplicate Cases...
Split File...
Select Cases...
Weight Cases...
Female 5 4
Split File
gender
first
fourth
seventh
freshgpa
sophgpa
jrgpa
srgpa
Analyze all cases, do not create groups
Compare groups
Organize output by groups
Groups Based on:
club
Sort the file by grouping variables
File is already sorted
OK
Paste
Reset
Cancel
Help
Current Status: Analysis by groups is off.


rmd2way.sav [DataSet1] - SPSS Data Editor
File Edit View Data Transform Analyze Graphs Utilities Add-ons Window Help
Reports
Descriptive Statistics
Compare Means
General Linear Model
Generalized Linear Models
Mixed Models
Correlate
Regression
Loglinear
Classify
Data Reduction
Scale
Nonparametric Tests
Time Series
Survival
Multiple Response
Quality Control
ROC Curve...
Amos 7
Univariate...
Multivariate...
Repeated Measures...
Variance Components...
Data View
Variable View
Repeated Measures


Repeated Measures Define Factor(s)
Within-Subject Factor Name: grade
Number of Levels: 4
Add
grade(4)
Change
Remove
Define
Reset
Cancel
Help
Measure Name:
Add
Change
Remove


Repeated Measures
gender
first
fourth
seventh
club
Within-Subjects Variables (grade):
freshgpa(1)
sophgpa(2)
jrgpa(3)
srgpa(4)
Between-Subjects Factor(s):
Covariates:
OK
Paste
Reset
Cancel
Help
Model...
Contrasts...
Plots...
Post Hoc...
Save...
Options...




# General Linear Model

**Within-Subjects Factors**

Measure: MEASURE_1

| grade | Dependent Variable |
|---|---|
| 1 | freshgpa |
| 2 | sophgpa |
| 3 | jrgpa |
| 4 | srgpa |

# club = social clubs

**Descriptive Statistics[a]**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| freshgpa | 2.0895 | .65502 | 13 |
| sophgpa | 2.1982 | .23975 | 13 |
| jrgpa | 2.6321 | .41480 | 13 |
| srgpa | 2.9936 | .20435 | 13 |

a. club = social clubs

**Multivariate Tests[b,c]**

| Effect | | Value | F | Hypothesis df | Error df | Sig. |
|---|---|---|---|---|---|---|
| grade | Pillai's Trace | .889 | 26.631[a] | 3.000 | 10.000 | .000 |
| | Wilks' Lambda | .111 | 26.631[a] | 3.000 | 10.000 | .000 |
| | Hotelling's Trace | 7.989 | 26.631[a] | 3.000 | 10.000 | .000 |
| | Roy's Largest Root | 7.989 | 26.631[a] | 3.000 | 10.000 | .000 |

a. Exact statistic

b.
Design: Intercept
Within Subjects Design: grade

c. club = social clubs

**Mauchly's Test of Sphericity[b,c]**

Measure: MEASURE_1

| Within Subjects Effect | Mauchly's W | Approx. Chi-Square | df | Sig. | Epsilon[a] | | |
|---|---|---|---|---|---|---|---|
| | | | | | Greenhouse-Geisser | Huynh-Feldt | Lower-bound |
| grade | .358 | 11.000 | 5 | .052 | .615 | .722 | .333 |

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

b.
Design: Intercept
Within Subjects Design: grade

c. club = social clubs

**Tests of Within-Subjects Effects[a]**

Measure: MEASURE_1

| Source | | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| grade | Sphericity Assumed | 6.745 | 3 | 2.248 | 13.972 | .000 |
| | Greenhouse-Geisser | 6.745 | 1.846 | 3.654 | 13.972 | .000 |
| | Huynh-Feldt | 6.745 | 2.166 | 3.114 | 13.972 | .000 |
| | Lower-bound | 6.745 | 1.000 | 6.745 | 13.972 | .003 |
| Error(grade) | Sphericity Assumed | 5.793 | 36 | .161 | | |
| | Greenhouse-Geisser | 5.793 | 22.149 | .262 | | |
| | Huynh-Feldt | 5.793 | 25.992 | .223 | | |
| | Lower-bound | 5.793 | 12.000 | .483 | | |

a. club = social clubs

**Tests of Within-Subjects Contrasts[a]**

Measure: MEASURE_1

| Source | grade | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| grade | Linear | 6.434 | 1 | 6.434 | 27.496 | .000 |
| | Quadratic | .207 | 1 | .207 | 1.714 | .215 |
| | Cubic | .103 | 1 | .103 | .805 | .387 |
| Error(grade) | Linear | 2.808 | 12 | .234 | | |
| | Quadratic | 1.452 | 12 | .121 | | |
| | Cubic | 1.532 | 12 | .128 | | |

a. club = social clubs

**Tests of Between-Subjects Effects[a]**

Measure: MEASURE_1
Transformed Variable: Average

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Intercept | 319.393 | 1 | 319.393 | 1467.636 | .000 |
| Error | 2.611 | 12 | .218 | | |

a. club = social clubs

# club = sports clubs

**Descriptive Statistics[a]**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| freshgpa | 2.2415 | .29373 | 15 |
| sophgpa | 2.1890 | .23127 | 15 |
| jrgpa | 2.5843 | .44926 | 15 |
| srgpa | 2.9726 | .21733 | 15 |

a. club = sports clubs

**Multivariate Tests[b,c]**

| Effect | | Value | F | Hypothesis df | Error df | Sig. |
|---|---|---|---|---|---|---|
| grade | Pillai's Trace | .894 | 33.585[a] | 3.000 | 12.000 | .000 |
| | Wilks' Lambda | .106 | 33.585[a] | 3.000 | 12.000 | .000 |
| | Hotelling's Trace | 8.396 | 33.585[a] | 3.000 | 12.000 | .000 |
| | Roy's Largest Root | 8.396 | 33.585[a] | 3.000 | 12.000 | .000 |

a. Exact statistic

b. Design: Intercept
Within Subjects Design: grade

c. club = sports clubs

**Mauchly's Test of Sphericity[b,c]**

Measure: MEASURE_1

| | | | | | Epsilon[a] | | |
|---|---|---|---|---|---|---|---|
| Within Subjects Effect | Mauchly's W | Approx. Chi-Square | df | Sig. | Greenhouse-Geisser | Huynh-Feldt | Lower-bound |
| grade | .716 | 4.250 | 5 | .515 | .833 | 1.000 | .333 |

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

b. Design: Intercept
Within Subjects Design: grade

c. club = sports clubs

**Tests of Within-Subjects Effects[a]**

Measure: MEASURE_1

| Source | | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| grade | Sphericity Assumed | 5.909 | 3 | 1.970 | 22.921 | .000 |
| | Greenhouse-Geisser | 5.909 | 2.498 | 2.365 | 22.921 | .000 |
| | Huynh-Feldt | 5.909 | 3.000 | 1.970 | 22.921 | .000 |
| | Lower-bound | 5.909 | 1.000 | 5.909 | 22.921 | .000 |
| Error(grade) | Sphericity Assumed | 3.609 | 42 | .086 | | |
| | Greenhouse-Geisser | 3.609 | 34.978 | .103 | | |
| | Huynh-Feldt | 3.609 | 42.000 | .086 | | |
| | Lower-bound | 3.609 | 14.000 | .258 | | |

a. club = sports clubs

**Tests of Within-Subjects Contrasts[a]**

Measure: MEASURE_1

| Source | grade | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| grade | Linear | 5.026 | 1 | 5.026 | 61.317 | .000 |
| | Quadratic | .729 | 1 | .729 | 8.766 | .010 |
| | Cubic | .155 | 1 | .155 | 1.671 | .217 |
| Error(grade) | Linear | 1.147 | 14 | .082 | | |
| | Quadratic | 1.164 | 14 | .083 | | |
| | Cubic | 1.298 | 14 | .093 | | |

a. club = sports clubs

**Tests of Between-Subjects Effects[a]**

Measure: MEASURE_1
Transformed Variable: Average

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Intercept | 374.057 | 1 | 374.057 | 2854.700 | .000 |
| Error | 1.834 | 14 | .131 | | |

a. club = sports clubs

# club = academic clubs

**Descriptive Statistics[a]**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| freshgpa | 2.9912 | .27179 | 15 |
| sophgpa | 3.0518 | .25076 | 15 |
| jrgpa | 3.0178 | .26135 | 15 |
| srgpa | 2.8950 | .29762 | 15 |

a. club = academic clubs

**Multivariate Tests[b,c]**

| Effect | | Value | F | Hypothesis df | Error df | Sig. |
|---|---|---|---|---|---|---|
| grade | Pillai's Trace | .163 | .778[a] | 3.000 | 12.000 | .529 |
| | Wilks' Lambda | .837 | .778[a] | 3.000 | 12.000 | .529 |
| | Hotelling's Trace | .194 | .778[a] | 3.000 | 12.000 | .529 |
| | Roy's Largest Root | .194 | .778[a] | 3.000 | 12.000 | .529 |

a. Exact statistic

b.
Design: Intercept
Within Subjects Design: grade

c. club = academic clubs

**Mauchly's Test of Sphericity[b,c]**

Measure: MEASURE_1

| Within Subjects Effect | Mauchly's W | Approx. Chi-Square | df | Sig. | Epsilon[a] | | |
|---|---|---|---|---|---|---|---|
| | | | | | Greenhouse-Geisser | Huynh-Feldt | Lower-bound |
| grade | .466 | 9.710 | 5 | .085 | .732 | .874 | .333 |

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

b.
Design: Intercept
Within Subjects Design: grade

c. club = academic clubs

**Tests of Within-Subjects Effects[a]**

Measure: MEASURE_1

| Source | | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| grade | Sphericity Assumed | .204 | 3 | .068 | .927 | .436 |
| | Greenhouse-Geisser | .204 | 2.196 | .093 | .927 | .414 |
| | Huynh-Feldt | .204 | 2.621 | .078 | .927 | .427 |
| | Lower-bound | .204 | 1.000 | .204 | .927 | .352 |
| Error(grade) | Sphericity Assumed | 3.083 | 42 | .073 | | |
| | Greenhouse-Geisser | 3.083 | 30.739 | .100 | | |
| | Huynh-Feldt | 3.083 | 36.689 | .084 | | |
| | Lower-bound | 3.083 | 14.000 | .220 | | |

a. club = academic clubs

**Tests of Within-Subjects Contrasts[a]**

Measure: MEASURE_1

| Source | grade | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| grade | Linear | .078 | 1 | .078 | .649 | .434 |
| | Quadratic | .126 | 1 | .126 | 2.101 | .169 |
| | Cubic | 2.59E-005 | 1 | 2.59E-005 | .001 | .980 |
| Error(grade) | Linear | 1.686 | 14 | .120 | | |
| | Quadratic | .840 | 14 | .060 | | |
| | Cubic | .557 | 14 | .040 | | |

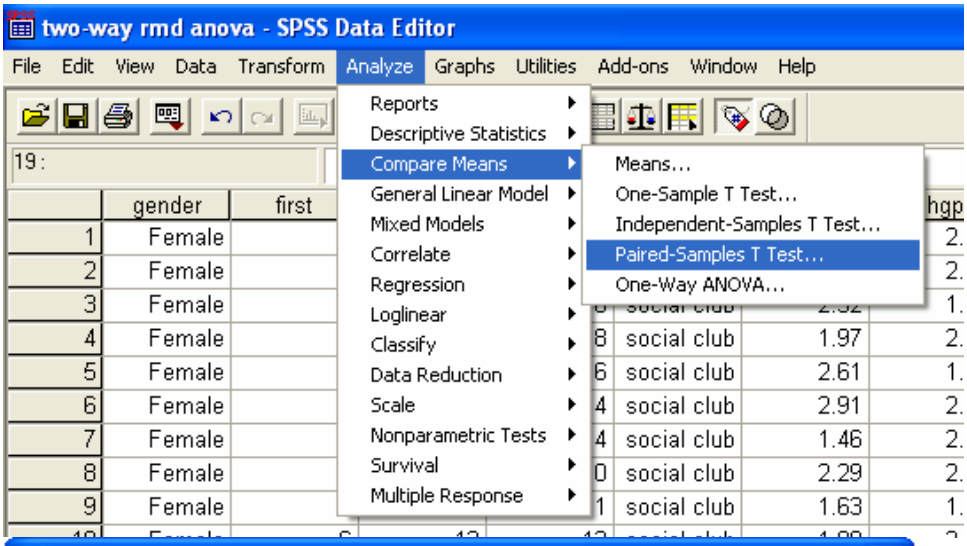
a. club = academic clubs

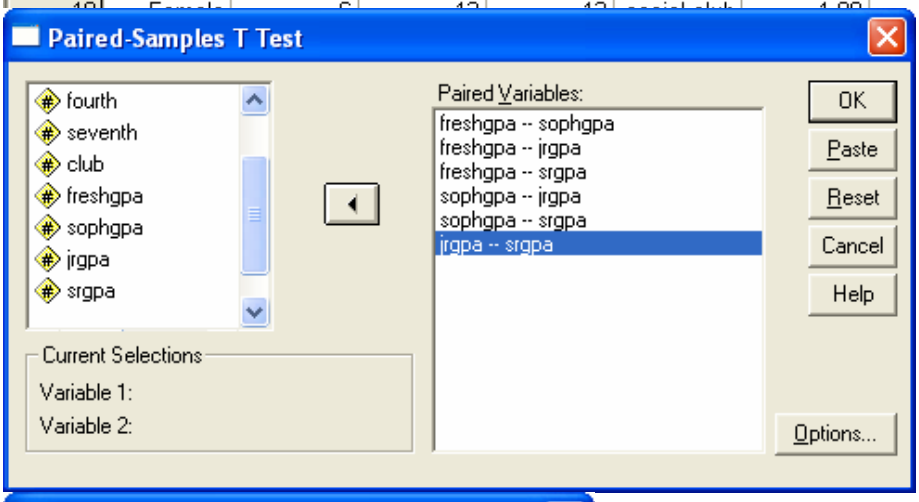
**Tests of Between-Subjects Effects[a]**

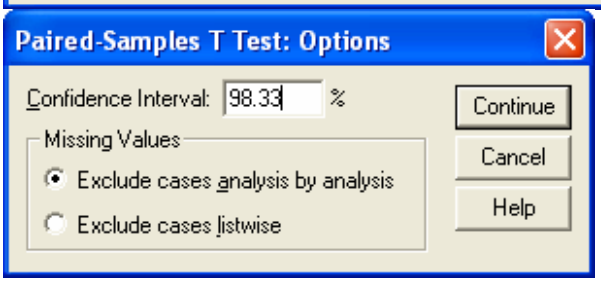
Measure: MEASURE_1
Transformed Variable: Average

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Intercept | 536.035 | 1 | 536.035 | 7298.916 | .000 |
| Error | 1.028 | 14 | .073 | | |

a. club = academic clubs


two-way rmd anova - SPSS Data Editor
File Edit View Data Transform Analyze Graphs Utilities Add-ons Window Help
Reports
Descriptive Statistics
Compare Means
General Linear Model
Mixed Models
Correlate
Regression
Loglinear
Classify
Data Reduction
Scale
Nonparametric Tests
Survival
Multiple Response
Means...
One-Sample T Test...
Independent-Samples T Test...
Paired-Samples T Test...
One-Way ANOVA...
19 :
gender
first
1 Female
2 Female
3 Female
4 Female
5 Female
6 Female
7 Female
8 Female
9 Female
social club 1.97
social club 2.61
social club 2.91
social club 1.46
social club 2.29
social club 1.63


Paired-Samples T Test
fourth
seventh
club
freshgpa
sophgpa
jrgpa
srgpa
Paired Variables:
freshgpa -- sophgpa
freshgpa -- jrgpa
freshgpa -- srgpa
sophgpa -- jrgpa
sophgpa -- srgpa
jrgpa -- srgpa
OK
Paste
Reset
Cancel
Help
Options...
Current Selections
Variable 1:
Variable 2:


Paired-Samples T Test: Options
Confidence Interval: 98.33 %
Missing Values
Exclude cases analysis by analysis
Exclude cases listwise
Continue
Cancel
Help

# T-Test
# club = social clubs

**Paired Samples Statistics[a]**

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Pair 1 | freshgpa | 2.0895 | 13 | .65502 | .18167 |
| | sophgpa | 2.1982 | 13 | .23975 | .06650 |
| Pair 2 | freshgpa | 2.0895 | 13 | .65502 | .18167 |
| | jrgpa | 2.6321 | 13 | .41480 | .11504 |
| Pair 3 | freshgpa | 2.0895 | 13 | .65502 | .18167 |
| | srgpa | 2.9936 | 13 | .20435 | .05668 |
| Pair 4 | sophgpa | 2.1982 | 13 | .23975 | .06650 |
| | jrgpa | 2.6321 | 13 | .41480 | .11504 |
| Pair 5 | sophgpa | 2.1982 | 13 | .23975 | .06650 |
| | srgpa | 2.9936 | 13 | .20435 | .05668 |
| Pair 6 | jrgpa | 2.6321 | 13 | .41480 | .11504 |
| | srgpa | 2.9936 | 13 | .20435 | .05668 |

a. club = social clubs

**Paired Samples Correlations[a]**

| | | N | Correlation | Sig. |
|---|---|---|---|---|
| Pair 1 | freshgpa & sophgpa | 13 | .016 | .958 |
| Pair 2 | freshgpa & jrgpa | 13 | .320 | .286 |
| Pair 3 | freshgpa & srgpa | 13 | -.325 | .279 |
| Pair 4 | sophgpa & jrgpa | 13 | .321 | .285 |
| Pair 5 | sophgpa & srgpa | 13 | .069 | .824 |
| Pair 6 | jrgpa & srgpa | 13 | .043 | .888 |

a. club = social clubs

**Paired Samples Test[a]**

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 98.33% Confidence Interval of the Difference Lower | Upper | | | |
| Pair 1 | freshgpa - sophgpa | -.10875 | .69384 | .19244 | -.64341 | .42591 | -.565 | 12 | .582 |
| Pair 2 | freshgpa - jrgpa | -.54269 | .65354 | .18126 | -1.04630 | -.03907 | -2.994 | 12 | .011 |
| Pair 3 | freshgpa - srgpa | -.90411 | .74679 | .20712 | -1.47958 | -.32864 | -4.365 | 12 | .001 |
| Pair 4 | sophgpa - jrgpa | -.43394 | .40704 | .11289 | -.74760 | -.12028 | -3.844 | 12 | .002 |
| Pair 5 | sophgpa - srgpa | -.79536 | .30418 | .08436 | -1.02976 | -.56097 | -9.428 | 12 | .000 |
| Pair 6 | jrgpa - srgpa | -.36143 | .45438 | .12602 | -.71157 | -.01128 | -2.868 | 12 | .014 |

a. club = social clubs

# club = sports clubs

**Paired Samples Statistics[a]**

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Pair 1 | freshgpa | 2.2415 | 15 | .29373 | .07584 |
| | sophgpa | 2.1890 | 15 | .23127 | .05971 |
| Pair 2 | freshgpa | 2.2415 | 15 | .29373 | .07584 |
| | jrgpa | 2.5843 | 15 | .44926 | .11600 |
| Pair 3 | freshgpa | 2.2415 | 15 | .29373 | .07584 |
| | srgpa | 2.9726 | 15 | .21733 | .05611 |
| Pair 4 | sophgpa | 2.1890 | 15 | .23127 | .05971 |
| | jrgpa | 2.5843 | 15 | .44926 | .11600 |
| Pair 5 | sophgpa | 2.1890 | 15 | .23127 | .05971 |
| | srgpa | 2.9726 | 15 | .21733 | .05611 |
| Pair 6 | jrgpa | 2.5843 | 15 | .44926 | .11600 |
| | srgpa | 2.9726 | 15 | .21733 | .05611 |

a. club = sports clubs

**Paired Samples Correlations[a]**

| | | N | Correlation | Sig. |
|---|---|---|---|---|
| Pair 1 | freshgpa & sophgpa | 15 | -.004 | .989 |
| Pair 2 | freshgpa & jrgpa | 15 | .104 | .713 |
| Pair 3 | freshgpa & srgpa | 15 | -.194 | .489 |
| Pair 4 | sophgpa & jrgpa | 15 | .309 | .263 |
| Pair 5 | sophgpa & srgpa | 15 | .165 | .558 |
| Pair 6 | jrgpa & srgpa | 15 | .269 | .333 |

a. club = sports clubs

**Paired Samples Test[a]**

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 98.33% Confidence Interval of the Difference Lower | Upper | | | |
| Pair 1 | freshgpa - sophgpa | .05244 | .37457 | .09671 | -.21030 | .31519 | .542 | 14 | .596 |
| Pair 2 | freshgpa - jrgpa | -.34279 | .51060 | .13184 | -.70095 | .01537 | -2.600 | 14 | .021 |
| Pair 3 | freshgpa - srgpa | -.73111 | .39780 | .10271 | -1.01015 | -.45207 | -7.118 | 14 | .000 |
| Pair 4 | sophgpa - jrgpa | -.39523 | .43719 | .11288 | -.70190 | -.08857 | -3.501 | 14 | .004 |
| Pair 5 | sophgpa - srgpa | -.78355 | .29012 | .07491 | -.98706 | -.58005 | -10.460 | 14 | .000 |
| Pair 6 | jrgpa - srgpa | -.38832 | .44343 | .11449 | -.69936 | -.07727 | -3.392 | 14 | .004 |

a. club = sports clubs

# club = academic clubs

**Paired Samples Statistics[a]**

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Pair 1 | freshgpa | 2.9912 | 15 | .27179 | .07018 |
| | sophgpa | 3.0518 | 15 | .25076 | .06475 |
| Pair 2 | freshgpa | 2.9912 | 15 | .27179 | .07018 |
| | jrgpa | 3.0178 | 15 | .26135 | .06748 |
| Pair 3 | freshgpa | 2.9912 | 15 | .27179 | .07018 |
| | srgpa | 2.8950 | 15 | .29762 | .07685 |
| Pair 4 | sophgpa | 3.0518 | 15 | .25076 | .06475 |
| | jrgpa | 3.0178 | 15 | .26135 | .06748 |
| Pair 5 | sophgpa | 3.0518 | 15 | .25076 | .06475 |
| | srgpa | 2.8950 | 15 | .29762 | .07685 |
| Pair 6 | jrgpa | 3.0178 | 15 | .26135 | .06748 |
| | srgpa | 2.8950 | 15 | .29762 | .07685 |

a. club = academic clubs

**Paired Samples Correlations[a]**

| | | N | Correlation | Sig. |
|---|---|---|---|---|
| Pair 1 | freshgpa & sophgpa | 15 | .624 | .013 |
| Pair 2 | freshgpa & jrgpa | 15 | -.340 | .215 |
| Pair 3 | freshgpa & srgpa | 15 | -.182 | .517 |
| Pair 4 | sophgpa & jrgpa | 15 | .021 | .942 |
| Pair 5 | sophgpa & srgpa | 15 | -.204 | .467 |
| Pair 6 | jrgpa & srgpa | 15 | .131 | .641 |

a. club = academic clubs

**Paired Samples Test[a]**

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 98.33% Confidence Interval of the Difference Lower | Upper | | | |
| Pair 1 | freshgpa - sophgpa | -.06059 | .22729 | .05869 | -.22003 | .09884 | -1.033 | 14 | .319 |
| Pair 2 | freshgpa - jrgpa | -.02657 | .43642 | .11268 | -.33270 | .27956 | -.236 | 14 | .817 |
| Pair 3 | freshgpa - srgpa | .09621 | .43802 | .11310 | -.21104 | .40346 | .851 | 14 | .409 |
| Pair 4 | sophgpa - jrgpa | .03403 | .35846 | .09255 | -.21742 | .28547 | .368 | 14 | .719 |
| Pair 5 | sophgpa - srgpa | .15680 | .42645 | .11011 | -.14233 | .45594 | 1.424 | 14 | .176 |
| Pair 6 | jrgpa - srgpa | .12278 | .36937 | .09537 | -.13632 | .38187 | 1.287 | 14 | .219 |

a. club = academic clubs