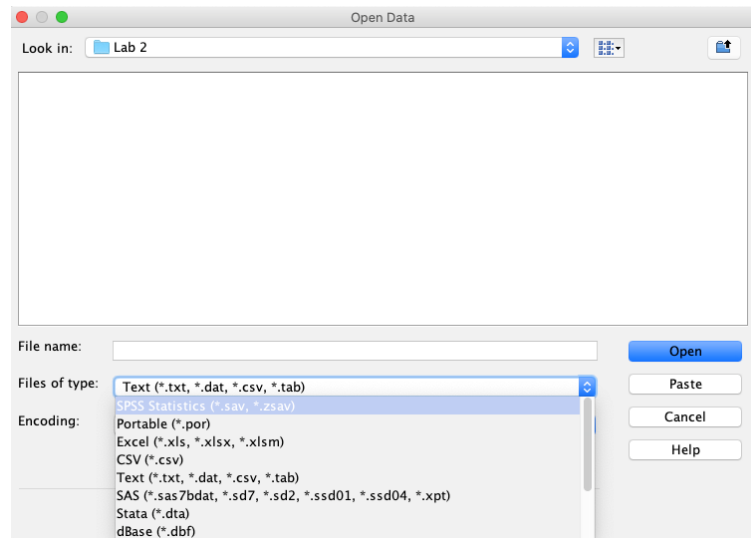
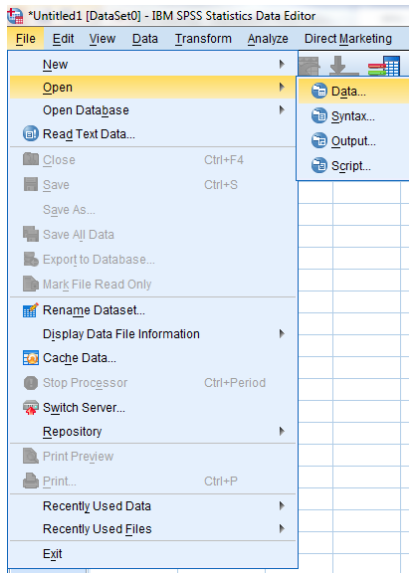


ANOVA and ANCOVA in SPSS

Dataset: Cosmetic Surgery.sav

Open/Import/Read Dataset: File -> Open -> Data. Select **All Files** from Files of type to show the file you're looking for. Select the correct file and click **Open**.



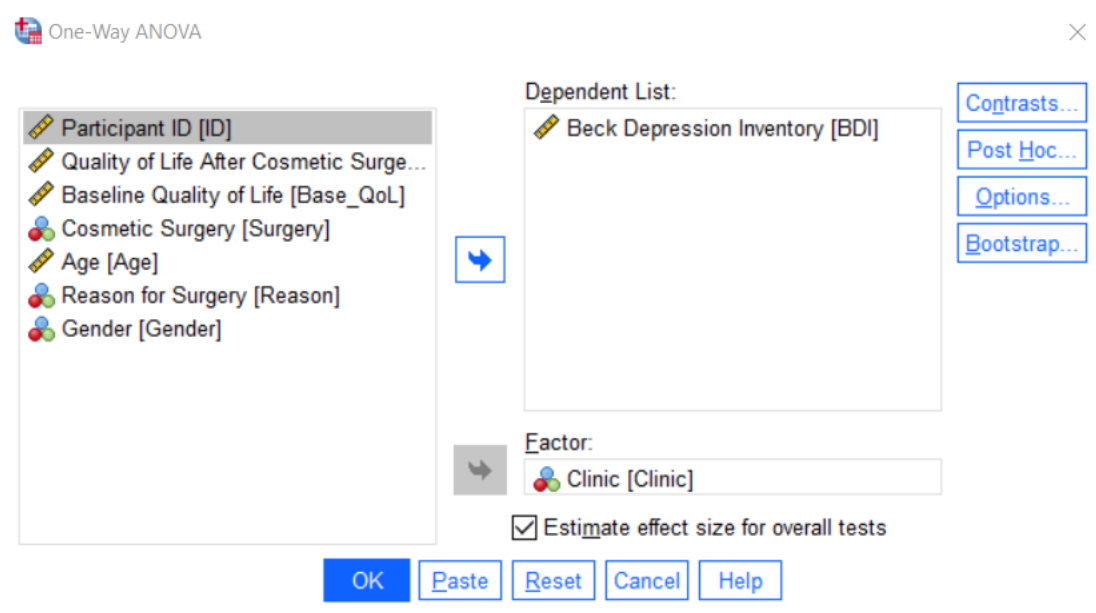
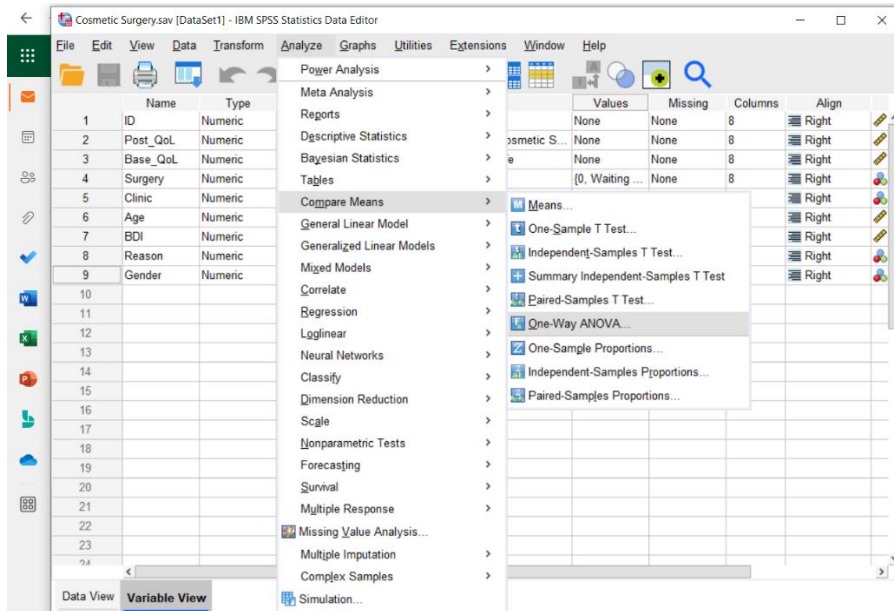
You are interested in determining if depression levels post-surgery are different based on the clinic that patients went to. In other words, is there an association with clinics and depression?

State the null and alternative hypotheses

H₀: Depression levels are not different based on the clinic that patients went to.

H₁: Depression levels are different based on the clinic that patients went to.

Analyze -> Compare Means -> One-Way ANOVA. Move variable “BDI” to Dependent List. Move Clinic to Factor. Click the “Estimate effect size for overall tests” button.



Click the Post Hoc button and select “Tukey”. Press continue.

One-Way ANOVA: Post Hoc Multiple Comparisons

Equal Variances Assumed

☐ LSD ☐ S-N-K ☐ Waller-Duncan
☒ Bonferroni ☒ Tukey Type I/Type II Error Ratio: 100
☐ Sidak ☐ Tukey's-b ☐ Dunnett
☐ Scheffe ☐ Duncan Control Category: Last
☐ R-E-G-W F ☐ Hochberg's GT2 Test
☐ R-E-G-W Q ☐ Gabriel ☒ 2-sided ☐ < Control ☐ > Control

Equal Variances Not Assumed

☐ Tamhane's T2 ☐ Dunnett's T3 ☐ Games-Howell ☐ Dunnett's C

Null Hypothesis test

☒ Use the same significance level [alpha] as the setting in Options
☐ Specify the significance level [alpha] for the post hoc test
Level: 0.05

Continue Cancel Help

Click the "Options" button and select "Descriptive" and "Homogeneity of variance test". You can also select "Means plot" but for this lab it's optional. Click Continue. Then Click Paste.

One-Way ANOVA: Options

Statistics

☒ Descriptive
☐ Fixed and random effects
☒ Homogeneity of variance test
☐ Brown-Forsythe test
☐ Welch test

☒ Means plot

Missing Values

☒ Exclude cases analysis by analysis
☐ Exclude cases listwise

Confidence Intervals

Level(%): 0.95

Continue Cancel Help

Take a screenshot of your syntax and paste it here:

```
ONEWAY BDI BY Clinic
/STATISTICS DESCRIPTIVES HOMOGENEITY
/PLOT MEANS
/MISSING ANALYSIS
/POSTHOC=Tukey ALPHA(0.05).
```

Run the test (highlight the syntax and click the green triangle button). Take a screenshot of the ANOVA table of your output and paste it below (you DO NOT need to include the whole output, just the ANOVA table):

ANOVA

Beck Depression Inventory

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	19766.071	9	2196.230	13.783	.000
Within Groups	42384.114	266	159.339		
Total	62150.185	275			

What do your results indicate?

Based on a one-way ANOVA, there is a significant difference in the measure of depression based on the clinic that patients used ($F(9, 266) = 13.78, p < .001$). Post hoc analyses using Tukey adjustments indicate that clinic 1 had a significantly higher mean of depression than clinic 7 (MD = 14.33, $p = .002$), clinic 8 (MD = 12.89, $p = .018$), and clinic 9 (MD = 12.44, $p = .025$). ...

Following this pattern, complete the write up for the rest of the pairwise comparisons below.

Clinic 2 had a significantly higher mean of depression than clinic 7 (MD = 20.46, $p = .000$), clinic 8 (MD = 19.02, $p = .000$), and clinic 9 (MD = 18.57, $p = .000$).

Clinic 3 had a significantly higher mean of depression than clinic 7 (MD = 15.02, $p = .000$), clinic 8 (MD = 13.58, $p = .005$), and clinic 9 (MD = 13.13, $p = .007$).

Clinic 4 had a significantly higher mean of depression than clinic 7 (MD = 23.91, $p = .000$), clinic 8 (MD = 22.47, $p = .000$), clinic 9 (MD = 22.01, $p = .000$) and clinic 10 (MD = 12.41, $p = .006$).

Clinic 5 had a significantly higher mean of depression than clinic 7 (MD = 19.10, $p = .000$), clinic 8 (MD = 17.66, $p = .000$), and clinic 9 (MD = 17.21, $p = .000$).

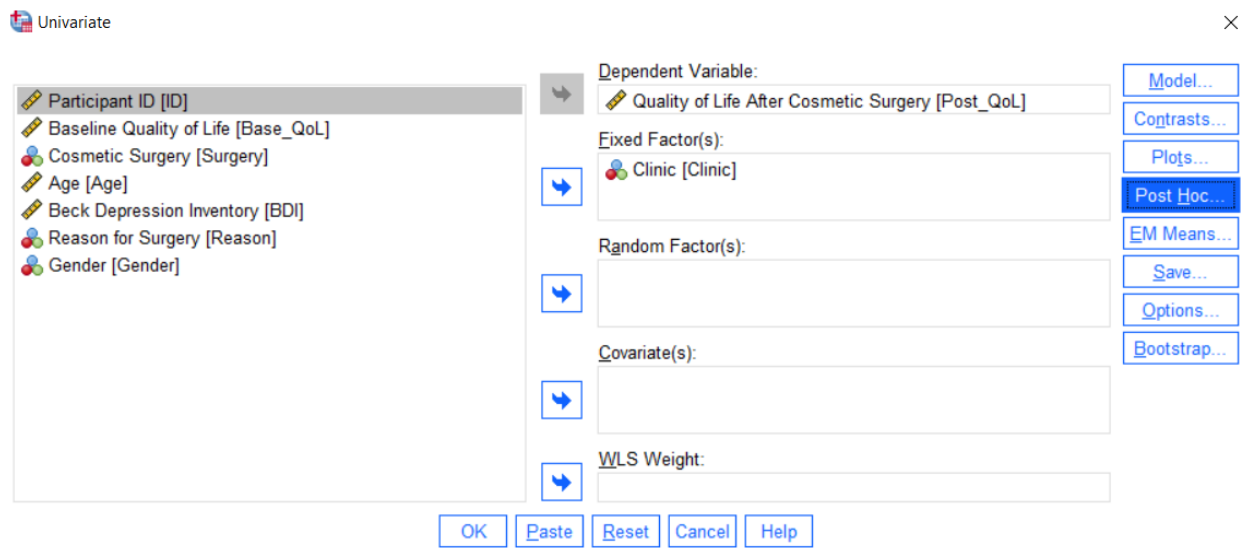
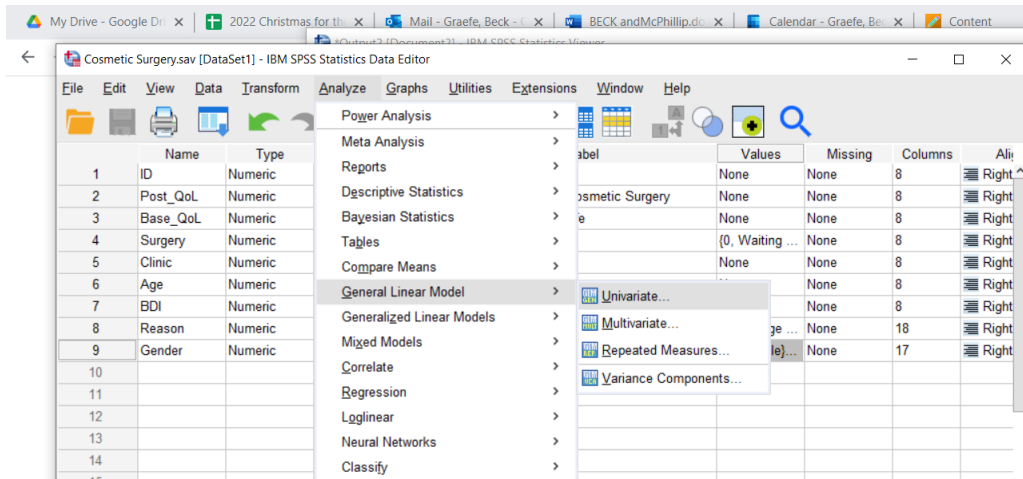
Clinic 6 had a significantly higher mean of depression than clinic 7 (MD = 18.45, $p = .000$), clinic 8 (MD = 17.01, $p = .000$), and clinic 9 (MD = 16.56, $p = .000$).

Clinic 10 had a significantly higher mean of depression than clinic 7 (MD = 11.5, $p = .010$).

~~~~~

ANCOVA: Using the same dataset , you want to check to see if quality of life after surgery is impacted by the specific clinic that a patient goes to. You will start by running a regular ANOVA. Below is an alternative method to run the ANOVA.

Analyze -> General Linear Model -> Univariate. Move “Post\_QoL” to the Dependent Variable line and “Clinic” to the Fixed Factor(s) line. Click on the Post Hoc button, move Clinic over to the Post Hoc Tests for box, and select Tukey. Click Continue. Click options and select “Descriptive”, “Homogeneity tests”, and “Estimate effect size”. Click continue. Click paste.



Univariate: Post Hoc Multiple Comparisons for Observed Means

Factor(s):  
Clinic

Post Hoc Tests for:  
Clinic

Equal Variances Assumed

☐ LSD ☐ S-N-K ☐ Waller-Duncan  
☐ Bonferroni ☒ Tukey Type I/Type II Error Ratio: 100  
☐ Sidak ☐ Tukey's-b ☐ Dunnett  
☐ Scheffe ☐ Duncan Control Category: Last  
☐ R-E-G-W-F ☐ Hochberg's GT2 Test  
☐ R-E-G-W-Q ☐ Gabriel ☒ 2-sided ☐ < Control ☐ > Control

Equal Variances Not Assumed

☐ Tamhane's T2 ☐ Dunnett's T3 ☐ Games-Howell ☐ Dunnett's C

Continue Cancel Help

Univariate: Options

Display

☒ Descriptive statistics ☒ Homogeneity tests  
☒ Estimates of effect size ☐ Spread-vs.-level plots  
☐ Observed power ☐ Residual plots  
☐ Parameter estimates ☐ Lack-of-fit test  
☐ Contrast coefficient matrix ☐ General estimable function(s)

Heteroskedasticity Tests

☐ Modified Breusch-Pagan test ☐ F test  
Model... Model...  
☐ Breusch-Pagan test ☐ White's test  
Model... Model...

☐ Parameter estimates with robust standard errors

☒ HC0  
☐ HC1  
☐ HC2  
☒ HC3  
☐ HC4

Significance level: .05 Confidence intervals are 95.0%

Continue Cancel Help

Screenshot your Syntax and results below:

```
UNIANOVA Post_QoL BY Clinic
/METHOD=SSTYPE(3)
/INTERCEPT=INCLUDE
/POSTHOC=Clinic(TUKEY)
/PRINT=ETASQ HOMOGENEITY DESCRIPTIVE
/CRITERIA=ALPHA(.05)
/DESIGN=Clinic.
```

### Tests of Between-Subjects Effects

Dependent Variable: Quality of Life After Cosmetic Surgery

| Source          | Type III Sum of Squares | df  | Mean Square | F         | Sig. | Partial Eta Squared |
|-----------------|-------------------------|-----|-------------|-----------|------|---------------------|
| Corrected Model | 9839.439 <sup>a</sup>   | 9   | 1093.271    | 20.866    | .000 | .414                |
| Intercept       | 979169.080              | 1   | 979169.080  | 18688.223 | .000 | .986                |
| Clinic          | 9839.439                | 9   | 1093.271    | 20.866    | .000 | .414                |
| Error           | 13937.065               | 266 | 52.395      |           |      |                     |
| Total           | 1004494.530             | 276 |             |           |      |                     |
| Corrected Total | 23776.504               | 275 |             |           |      |                     |

a. R Squared = .414 (Adjusted R Squared = .394)

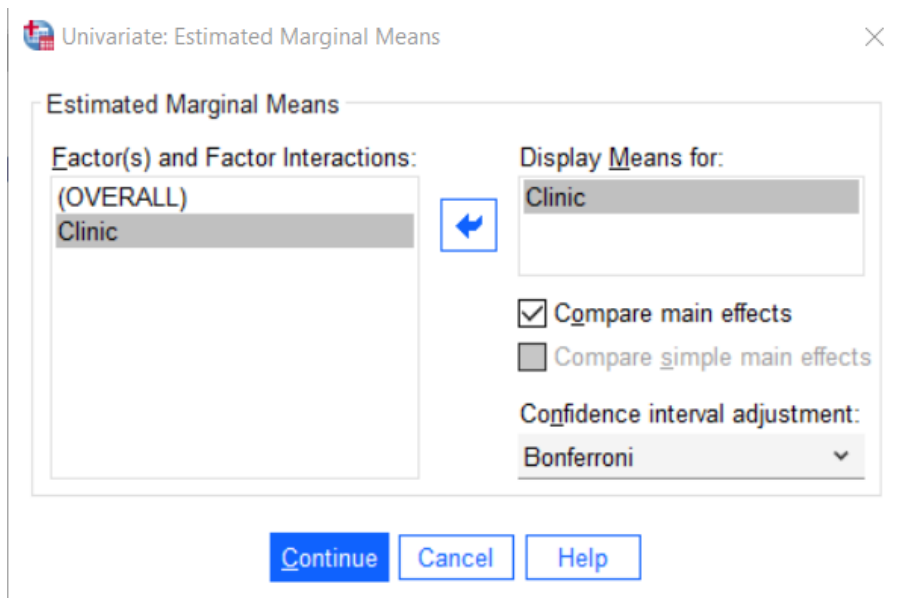
**What do your results mean? You do not need to write up the full results for the post hoc tests. Only write up the F test results.**

The quality of life after surgery is impacted by the specific clinic that a patient goes to shown by the p value of 0.000 indicating enough statistical significance.

**Do you think its possible that there may be other factors contributing to differences in quality of life?**  
**Yes.**

**Let's see if there is any effect of the pre-operative quality of life on the post-op quality of life.**

Follow the same procedure as you did before but this time, also move "Base\_QoL" to the Covariate(s) box. Click on the EM Means box, move "Clinic" over to the Display means for box, and select "Compare main effects". Under "Confidence interval adjustment", select Bonferroni. Click Continue. Click paste.



**Screenshot your syntax below:**

```
UNIANOVA Post_QoL BY Clinic WITH Base_QoL
/METHOD=SSTYPE(3)
/INTERCEPT=INCLUDE
/EMMEANS=TABLES(Clinic) WITH(Base_QoL=MEAN) COMPARE ADJ(BONFERRONI)
/PRINT=ETASQ HOMOGENEITY DESCRIPTIVE
/CRITERIA=ALPHA(.05)
/DESIGN=Base_QoL Clinic.
```

**Screenshot your Tests of Between-Subjects Effects table below.**

### Tests of Between-Subjects Effects

Dependent Variable: Quality of Life After Cosmetic Surgery

| Source          | Type III Sum of Squares | df  | Mean Square | F      | Sig. | Partial Eta Squared |
|-----------------|-------------------------|-----|-------------|--------|------|---------------------|
| Corrected Model | 12522.132 <sup>a</sup>  | 10  | 1252.213    | 29.485 | .000 | .527                |
| Intercept       | 3900.927                | 1   | 3900.927    | 91.853 | .000 | .257                |
| Base_QoL        | 2682.693                | 1   | 2682.693    | 63.168 | .000 | .192                |
| Clinic          | 2230.694                | 9   | 247.855     | 5.836  | .000 | .165                |
| Error           | 11254.372               | 265 | 42.469      |        |      |                     |
| Total           | 1004494.530             | 276 |             |        |      |                     |
| Corrected Total | 23776.504               | 275 |             |        |      |                     |

a. R Squared = .527 (Adjusted R Squared = .509)

**Write up your results below (finish the started write-up):**

Based on an ANCOVA analysis, after controlling for baseline quality of life, clinic has a significant effect on the quality of life after surgery.