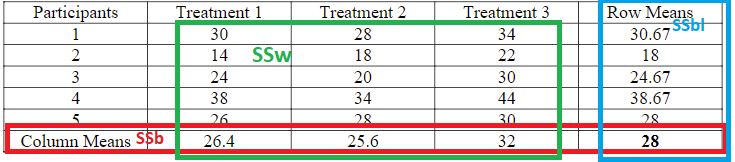
1. 2 general purposes for the use of repeated-measures designs: examine trends across time [when time is the within-subjects factor]; increase power to detect treatment effects by comparing the performance of the same subjects across treatment conditions [when treatment is the within-subjects factor]).

2. advantages: can assess performance across time; tends to be more powerful than between-subjects designs thus requiring fewer participants to attain the same power (increased precision and economy of subjects)  
We block on each participant. variability among the subjects due to individual differences is completely removed from the error term.

3. disadvantages: order effects, carry-over effects, differential attrition.  
Counterbalancing the order of treatments is an effective method of minimizing order effects. (randomly assigning one third of the subjects to each of the following sequences). Counterbalance = all possible orders of treatments are administered: 3 Treatments = 3! = 3 \* 2 \* 1 = 6 possible orders.  
Carryover effects refer to the impact of a previous trial (condition) on a participant’s performance on subsequent trials. Allowing an adequate amount of time to pass between treatments will minimize possible effects.

4. MSw vs MSb. MSb= SSb/(k-1)  
MSw = SSw/(N-k), SSw = SSbl + SSres where SSbl = sum of squares for blocks and SSres = sum of squares residual. SSbl = k∑(MeanPerPerson - GrandMean), where k is the number of repeated measures.



Total: variation of individual scores around the grand mean, SSb(between-subjects variation): variation of the subjects’ means pooled across the repeated measures around the grand mean, between-trial variation: variation of the trial means around the grand mean, error variation: remaining variation of the individual scores around the grand mean that could not be accounted for by between-subject and between-trial variation.

5. Epsilon: The extent to which the covariance matrix deviates from sphericity. To adjust for the positive bias, Greenhouse and Geisser suggest altering the degrees of freedom: df x Epsilon (don’t do this when it’s over 0.7).

6. Sphericity requires that the variances of the differences for all pairs of repeated measures are equal. When sphericity is not met, the F ratio/test in the univariate approach is positively biased (falsely rejecting the null too often). That is, alpha is set at .05, but we are rejecting the null falsely 8-10% of the time. When sphericity is not met, Epsilon can be used to adjust the degrees of freedom for the F test. When sphericity is met, Epsilon = 1.

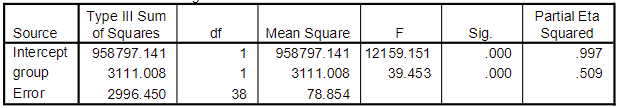
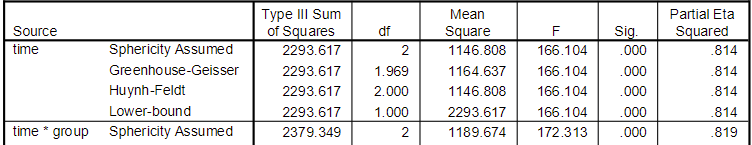
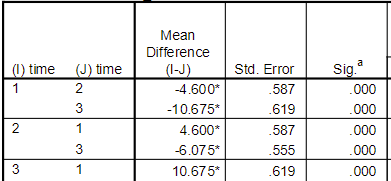
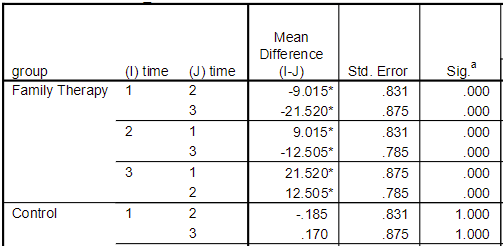
The lowest value that epsilon (ε) can take is called the lower-bound estimate.

7. 1B, 1W repeated design:  
W: is the average weight for all 40 subjects different at the 3 points in time?  
Inter: Is the difference in means between the therapy and control groups the same or different across time? (we expect the two groups to have similar weight at time 1, but different average weight at times 2 and 3 (due to the therapy). )

B: Is there an overall weight difference between the family therapy and control group in the population (averaging across the three time points)

Simple Effects I: Do participants in the family therapy group/control group differ across time?

Simple Effects II: Do family therapy and control groups differ at time 1,2,3?

There was a significant main effect of therapy group, F(1, 38) = 39.45, p< .001, which was a large effect (η = .51).   
  
Participants in the therapy group gained significantly more weight than participants in the control group. The Greenhouse-Geisser adjusted F tests were used when interpreting effects involving the within-subjects factor of time and are reported with adjusted degrees of freedom rounded to the nearest whole number. There was a significant main effect of time, F (2, 75) = 166.10, p< .001, which was a large effect (η = .81).   
 Post hoc tests using the Bonferroni adjustment indicate that participants weighed significantly more at 12 weeks than at   
the beginning of the intervention and weighed significantly more at 24 weeks than at 12 weeks.   
Both main effects are dependent upon the other, as indicated by the significant interaction between therapy group and time, F (2, 75) = 172.31, p < .001, which was a large effect (2pη = .82). Post hoc comparisons using the Bonferroni   
adjustment indicated that average weight increased significantly across time for participants in the family therapy group, but remained fairly constant for participants in the control group.

Assumptions:  
1. Multivariate normality (inspect the distribution of scores in each cell). The histograms and the descriptive statistics indicated negligible skew and some kurtosis (all values less than 3). The K-S test supports normality whereas the Shapiro-Wilk indicates nonnormality in the control group at time 3. Nonetheless, the absolute value of the kurtosis estimate associated with the control group was less than 2X its corresponding standard error (i.e., 1.009 >2\*1.232). The kurtosis values, while indicating platykurtic distributions, are not extreme enough to warrant concern with non-normality. Thus, you could go ahead and assume normality.

2. Independence of observations (consider the sampling design and study circumstances to identify any possible violations). Independence of Observations (can usually be guaranteed by randomly assigning participants and testing participants individually). Just make sure participants did not interact with others either in a group or a dyad.

3. Sphericity (assume that this is violated and use an adjusted F test, such as the GreenhouseGeisser, or use the multivariate test results for the overall tests in the primary analysis)

4. Between-groups equality of variance (use Levene’s test in SPSS; examine standard deviations for each group) : Between Groups Homogeneity of Variance - population variances for groups/cells are equal assumption of homogeneity of variance : ANOVA is robust to violations of homogeneity of variance when cell sizes are equal, as is in this study.

1. advantages: reduce error variance and allow for increased power in detecting treatment effects; allows for detection of interaction between the covariate and treatment; adjust for initial group differences. (ex: Reduce bias when comparing intact or self-selected groups (e.g., males vs. females);Adjust the posttest means on the dependent variable for any initial differences that may be present.

2. Purpose: ANCOVA: assess the effectiveness of the treatment while improving the power to detect treatment effects and adjusting for initial group differences on the covariate; ATI: used when the treatment and covariate interact. describe how the effectiveness of the treatment varies across the range of the covariate.

3. Covariate: Variables should correlate with the dependent variable; Variables have been shown to correlate with similar types of participants; the covariates should correlate significantly with the dependent variable but low correlations with other covariates; Limit the number of covariates to satisfy the following relationship: , where C is the number of covariates, J is the number of treatment groups, and N is the total sample size.

4. Purpose  
1. Elimination of systematic bias  
 Systematic bias: Groups differ systematically on some variable that is related to the dependent variable. Not sure if differences are due to treatment or group differences when beginning the study.  
 Random assignment takes care of systematic bias, but we are not always able to randomly assign participants to groups.  
 You could match participants on certain variables.  
 ANCOVA can reduce this bias.  
2. Reduction of within group or error variance  
 What happens when we have smaller error variance? MSb/MSw  
To remove the variance due to the covariate:   
 The amount of variance on the dependent variable that is accounted for by the covariate is the squared value of the correlation between the two variables ( rxy^2 ). The within group variance in ANCOVA has removed the portion due to the covariate: MSw – Mswrxy^2 = MSw (1-rxy^2 ).  
The new error term used in ANCOVA:  
MSw\* = MSw (1- rxy^2 )[1+1/( fe - 2)] , where fe is the error degrees of freedom.

5. Assumptions(no measurement error in the covariate can be established with reliability measures; linearity between the covariate and dependent variable in each group can be assessed by examining scatterplots; equal regression slopes in ANCOVA can be assessed by examining the test for the increment in R2 that is obtained by adding the interaction between the independent (treatment) variable and the covariate to a model containing the independent (treatment) variable and covariate only): Null Hypothesis: H0 = u1\* = u2\* = u3\* (the adjusted population means are equal)  
1. no measurement error in the covariate: the covariate is measured with perfect reliability.  
 Reliability analysis will indicate whether predictor variables are measured reliably or not. Some measures of reliability include: Coefficient alpha (measure of internal consistency); Test-retest reliability; Interrater reliability. These are represented using a correlation coefficient which ranges from 0 to 1.0, with values closer to 1 indicating higher reliability. Demographic variables (e.g., age, gender) have reliabilities close to 1.0. Measures of adult abilities (e.g., IQ) typically have reliabilities in the range of .80 to .95. Measures of attitudes and personality traits typically have reliabilities in the range of .70 to .90.  
 If reliability is low, use alternative technique.  
 Low reliability results in biased treatment effects.  
2. linearity: the relationship between the covariate and the outcome is linear for each group in the population.  
 Inspect the scatterplot of the covariate and outcome within each group to determine that the relationship is reasonably linear.  
3. equality of regression slopes: the regression slope has the same value across all groups in the population.  
 Test the increment in R2 that is due to adding the interaction term(s) to a model containing the treatment variable(s) and the covariate. If this increase is statistically significant, conduct an ATI analysis. If this increase is not statistically significant,conduct an ANCOVA analysis.  
  
5. Sums of Squares Within (error)  
SSw\* = (1- r xy(w)^2 )SSw (same for total), rxy is the correlation between the covariate and the dependent variable for all the scores  
SSw = 666.83 (SS of covariate + SS of error)  
Thus, SSb\* = SSt\* - SSw\* =228.72 – 45.86 = 182.86 (within rounding error)  
F\* = (SSb\* /(k -1)) / SSw\* /(N -k -C) = MSb\* / MSw\* , where k is the number of groups, N is the total sample size, and C is the number of covariates