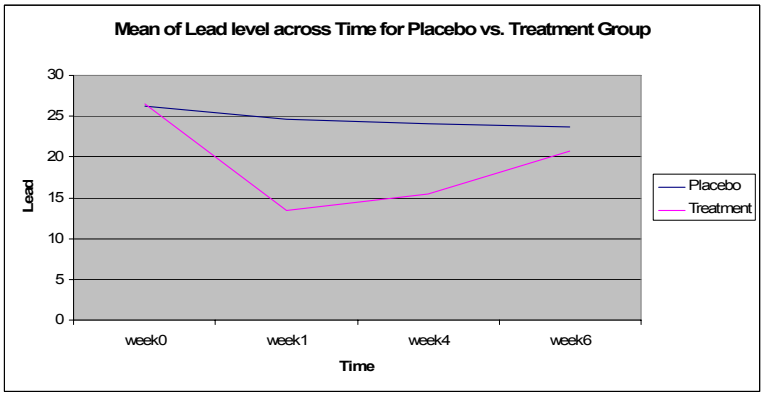
ED255C
Assignment#1
January 18, 2006

Analysis of a Treatment Effect Using ANOVA and ANCOVA

This report investigates a possible treatment effect within a randomized chelation treatment trial involving Lead-Exposed Children. This balanced design study – fifty children were randomly assigned to either a succimer treatment group or a placebo group – repeatedly measured the blood lead levels of children from week 0, week1, week4 and week6.

Figure 1 displays the change in the means of lead levels across time for the treatment and placebo groups. At baseline (week 0), the treatment group (Mean=26.54, SD=5.021) and the placebo group (Mean=26.27, SD=5.024) seem to have very similar distributions. In addition, the mean difference between the two groups was not significant (t*=-0.27, p=0.7902). This supports that the randomization for this study worked well. After treatment, it seems that the mean of the treatment group became substantively lower than that of the placebo group. At Week 1, the mean of the treatment group was 13.52 while the mean of the placebo group was 24.66. At the end of the study, Week 6, the means of both the treatment and placebo groups were 20.76 and 23.65 respectively. This report focuses on the treatment effect at week 6, the end point of the study.

Figure 1 Lead Level by Treatment vs. Placebo group



In order to find out whether there was a treatment effect, an ANOVA was first performed. No serious violations of assumptions for ANOVA were found. The distributions of the dependent variable, the level of lead at Week 6, for the two groups seem to be normal. The two groups have equal size and relatively similar variances. The results of ANOVA in Table 1 show that there was no significant difference between the treatment and control groups (F* (1, 98) = 3.55, p=0.0627). The difference in the mean of the level of lead at Week 6 for the treatment group versus the control group was -2.88. Although the

treatment group seems to have a lower lead level than the placebo group, this difference was not found to be significant.

Since the baseline level of lead can be a good predictor for the lead level at Week6 (the correlation between Week0 and Week6 is 0.56 and the p-value is smaller than 0.001), I also conducted ANCOVA using the baseline level as a covariate. Adjusting for the baseline level of lead, it was found that there was a significant treatment effect (F* (1, 97) = 6.15, p = 0.0148). The ANCOVA result in Table 2 shows that the mean of the lead level at Week6, controlling the baseline lead level for the treatment group, was significantly different from the placebo group. The adjusted mean for the treatment group was 20.64 and the adjusted mean for the placebo group was 23.76 – the mean difference between the two groups was -3.12. Compared to ANOVA, adding the covariate appears to improve the model, which provided a smaller RMSE and a higher R-square. The assumption of parallel regression slopes across the groups for ANCOVA was tested by adding an interaction term between the treatment indicator variable and the baseline lead level in the ANCOVA model. It was found that there was no violation of assumptions regarding the parallel slopes between the two groups because the interaction between the treatment and the covariate was not significant (F(1, 96) = 0.06, p = 0.80 in Table 3) .

Although the ANCOVA concluded that there was a significant treatment effect, it does not seem to indicate any change in the treatment effect over time. In Figure 1, we can see the lead level for the treatment group increased over time even though the means of the treatment group were still lower than the ones for the control group. Therefore, a model which can take into account this rate of change should be considered in order to find whether or not the treatment effect was consistent over time.

Table 1 Result of ANOVA

The GLM Procedure

Dependent Variable: W6

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	207.936400	207.936400	3.55	0.0627
Error	98	5747.802000	58.651041		
Corrected Total	99	5955.738400			

R-Square	Coeff Var	Root MSE	W6 Mean
0.034914	34.49107	7.658397	22.20400

Source	DF	Type III SS	Mean Square	F Value	Pr > F
I	1	207.9364000	207.9364000	3.55	0.0627

Table 2 Result of ANCOVA

The GLM Procedure

Dependent Variable: W6

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Model	2	2122.864391	1061.432196	26.86	<.0001
Error	97	3832.874009	39.514165		
Corrected Total	99	5955.738400			

R-Square	Coeff Var	Root MSE	W6 Mean
0.356440	28.31035	6.286029	22.20400

Source	DF	Type III SS	Mean Square	F Value	Pr > F
W0	1	1914.927991	1914.927991	48.46	<.0001
I	1	243.163395	243.163395	6.15	0.0148

Parameter		Estimate		Standard Error	t Value	Pr > |t|
Intercept		-2.596357333	B	3.47115226	-0.75	0.4563
W0		0.880118965		0.12642750	6.96	<.0001
I	0	3.119871883	B	1.25766237	2.48	0.0148
I	1	0.000000000	B	.	.	.

Table 3 Result of ANCOVA with Interaction

The GLM Procedure

Dependent Variable: W6

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	2125.337144	708.445715	17.76	<.0001
Error	96	3830.401256	39.900013		
Corrected Total	99	5955.738400			

R-Square	Coeff Var	Root MSE	W6 Mean
0.356855	28.44823	6.316646	22.20400

Source	DF	Type III SS	Mean Square	F Value	Pr > F
I	1	19.6407817	19.6407817	0.49	0.4846
INT	1	2.4727521	2.4727521	0.06	0.8039
W0	1	890.4917401	890.4917401	22.32	<.0001