Solution

The Bonferroni test requires a separate t test for each of three different possible pair of samples. Here are the null hypotheses to be tested:

$$H_0: \mu_1 = \mu_2 \qquad H_0: \mu_1 = \mu_3 \qquad H_0: \mu_2 = \mu_3$$

We begin with $H_0: \mu_1 = \mu_2$. Using the sample data given in Table 12-1 and carrying some extra decimal places for greater accurancy in the calculations, we have $n_1 = 78$ and $\bar{x} = 102.705128$. Also, $n_2 = 22$ and $\bar{x}_2 = 94.136364$. From the technology results shown in Example 1 we also know that MS(error) $= 248.424127$. We now evaluate the test statistic using the unrounded sample means:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\text{MS(error)} \cdot \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

$$= \frac{102.705128 - 94.136364}{\sqrt{248.424127 \cdot \left(\frac{1}{78} + \frac{1}{22}\right)}} = 2.252$$

The number of degrees of freedom is df $= N - k = 121 - 3 = 118$. ($N = 121$ because there are 121 different sample values in all three samples combined, and $k = 3$ because there are three different samples.) With a test statistic of $t = 2.252$ and with df $= 118$, the two-tailed P-value is 0.026172, but we adjust this P-value by multiplying it by 3 (the number of different possible pairs of samples) to get a final P-value of 0.078516, or 0.079 when rounded. Because this P-value is not small (less than 0.05), we fail to reject the null hypothesis. It appears that Samples 1 and 2 do not have significantly different means.

Instead of continuing with separate hypothesis tests for the other two pairings, see the SPSS display showing all of the Bonferroni test results. (The first row of numerical results corresponds to the results found here; see the value of 0.079, which is calculated here.) The display shows that the pairing of low/high yields a P-value of 0.090, so there is not a significant difference between the means from the low and high blood lead levels. Also, the SPSS display shows that the pairing of medium/high yields a P-value of 1.000, so there is not a significant difference between the means from the medium and high blood lead levels.

SPSS BONFERRONI RESULTS

(I) Level	(J) Level	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	8.56876	3.80486	.079	-.6717	17.8092
	3.00	8.51465	3.87487	.090	-.8958	17.9251
2.00	1.00	-8.56876	3.80486	.079	-17.8092	.6717
	3.00	-.05411	4.80851	1.000	-11.7320	11.6238
3.00	1.00	-8.51465	3.87487	.090	-17.9251	.8958
	2.00	.05411	4.80851	1.000	-11.6238	11.7320

Interpretation

Although the analysis of variance test tells us that at least one of the means is different from the others, the Bonferroni test results do not identify any one particular sample mean that is significantly different from the others. In the original article discussing these results, the authors state that "our findings indicate that a chronic absorption of particulate lead . . . may result in subtle but statistically