BIOLOGY AND HOMOSEXUALITY

8. Contrasts

The goal of the study is to examine the relationship between sexual orientation and volume of INAH3. Specifically, we wish to answer the following three questions: Do heterosexual males tend to differ from homosexual males in the volume of INAH3? Do heterosexual males tend to differ from heterosexual females in the volume of INAH3? Do heterosexual females tend to differ from homosexual males in the volume of INAH3?

All the above questions involve comparing the volumes for various combinations of sex and sexual orientation. However, the five groups in the study are based on sex, sexual orientation, and cause of death. Why should we include cause of death in the analysis?

Including cause of death is a consequence of the fact that the volumes of INAH3 were obtained only for the homosexuals who died of AIDS. There is no data for homosexuals who died of other causes. Does it appear that volumes are associated with cause of death?

We will answer the above questions by looking at contrasts.

Let us define the mean volumes for the five groups by μ_i, where i=1,2, 3, 4, 5. We define the contrasts in the following way:

NO.	CONTRAST	GROUP				
		1	2	3	4	5
		MALE HET AIDS	MALE HET NON	MALE HOM AIDS	FEM HET AIDS	FEM HET NON
		CONTRAST COEFFICIENTS				
1	$\mu_1-\mu_3$	1	0	-1	0	0
2	$\mu_5-\mu_4$	0	0	0	-1	1
3	$\mu_2-\mu_1$	-1	1	0	0	0
4	$(\mu_2-\mu_5)-(\mu_1-\mu_4)$	-1	1	0	1	-1
5	$(\mu_2-\mu_1)/2 + (\mu_5-\mu_4)/2$	-1/2	1/2	0	-1/2	1/2
6	$\mu_1-\mu_4$	1	0	0	-1	0
7	$\mu_2-\mu_5$	0	1	0	0	-1
8	$(\mu_1-\mu_4)/2 + (\mu_2-\mu_5)/2$	1/2	1/2	0	-1/2	-1/2
9	$(\mu_1+\mu_2)/2-\mu_3$	1/2	1/2	-1	0	0
10	$\mu_3-\mu_4$	0	0	1	-1	0
11	$\mu_3 - (\mu_4+\mu_5)/2$	0	0	1	-1/2	-1/2

Contrast 1 compares the mean volume of heterosexual and homosexual males who died of AIDS. In other words, it measures the association between volume and sexual orientation for males, unconfounded with the cause of death.

Contrasts 2 and 3 measure the NON-AIDS versus AIDS differences for heterosexual females and males, respectively. Contrast 4 asks whether the death cause differences are equal for heterosexual men and women. If there is no evidence that they differ, it is reasonable to proceed to contrast 5, the average of the two cause-of-death differences.

Contrasts 6 and 7 measure the Male-Female differences for AIDS victims and victims of other causes, respectively.

If the contrasts 2 and 3 indicate that volumes are not associated with cause of death, then it is reasonable to ignore the cause of death in any other comparisons.

The contrast 8 is the average of the contrasts 6 and 7 and measures the overall differences between the volumes of heterosexual men and women when cause of death is ignored. The contrast 9 measures the differences between heterosexual males and homosexual males when cause of death is ignored.

The contrasts 10 and 11 address the question whether there is evidence that heterosexual females differed from homosexual males. At first glance, it may appear that this comparison makes no sense - the groups differ both in sex and in sexual orientation. However, both groups have sexual orientation toward males, so the question asks whether - among persons oriented toward males - there was a difference in the volumes between males and females.

The homosexual males in the study all died of AIDS. If one insists on strict control for cause of death, the only comparison available is between the groups 3 and 4. This is done by the contrast 10. However, there is only one subject in the group 4. If the contrasts considered above support an assumption of no cause of death influence, we can measure the difference by combining the groups 4 and 5. This leads to the contrast 11.

Now le us look at the results. SPSS produces the following output:

Variable VOLUME
By Variable CODE

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	4	49611.3712	12402.8428	4.0763	.0079
Unweighted Linear Term	1	15008.0277	15008.0277	4.9325	.0327
Weighted Linear Term	1	20109.5723	20109.5723	6.6092	.0144
Deviations from Linear	3	29501.7989	9833.9330	3.2320	.0335
Within Groups	36	109536.2386	3042.6733		
Total	40	159147.6098			

The analysis of variance F-statistic is F=4.0763, with 4 and 36 degrees of freedom, giving a p-value of 0.0079. That small p-value indicates strong evidence against the null hypothesis of no difference among the mean volumes for the five groups.

Observe that the above ANOVA table provides more information about the variation between groups than the ANOVA table provided in the previous section. More precisely,

a linear pattern in the group means is investigated. The table indicates moderate evidence of a linear pattern in the group means.

Now let us look at the analysis of the contrasts. All the contrasts obtained below are based on the assumption that the pooled estimate of standard deviation from all five groups was used.

Pooled Variance Estimate

	Value	S. Error	T Value	D.F.	T Prob.
Contrast 1	53.0175	25.8312	2.052	36.0	.047
Contrast 2	51.6000	60.4252	.854	36.0	.399
Contrast 3	25.4667	28.4847	.894	36.0	.377
Contrast 4	-26.1333	66.8026	-.391	36.0	.698
Contrast 5	38.5333	33.4013	1.154	36.0	.256
Contrast 6	91.3333	59.5801	1.533	36.0	.134
Contrast 7	65.2000	30.2126	2.158	36.0	.038
Contrast 8	78.2667	33.4013	2.343	36.0	.025
Contrast 9	65.7509	19.0522	3.451	36.0	.001
Contrast 10	38.3158	56.5934	.677	36.0	.503
Contrast 11	12.5158	32.7558	.382	36.0	.705

The p-value of 0.047 for the contrast 1 provides moderate evidence of the difference between the volumes of homosexual and heterosexual males who died of AIDS or its complications. The difference between the two groups is estimated based on the samples of size 6 and 19.

The high p-values of the contrasts 2 and 3 indicate that there is no evidence of any effect of cause of death on volumes for heterosexual females and males. The p-value of 0.698 for the contrast 4 shows that the cause of death had no impact on the differences in volumes between heterosexual males and females. Contrast 5 is the average of the two cause-of-death differences. The p-value of 0.256 indicates that there is no evidence that volumes are associated with cause of death.

The p-value of 0.134 for the contrast 6 shows no evidence of the differences between heterosexual males and females that died of AIDS or its complications. However, notice that the contrast is based on two groups of size 6 and 1.

The contrast 7 with its p-value of 0.038 indicates a difference in the volumes for the males and females who died of other causes. The p-value for the contrast 8 that measures

the overall sex difference is 0.025. It shows that the effect of sex on volumes is significant.

In summary, it appears that volumes are associated with sex but not with cause of death. Therefore, it is reasonable to pool over causes of death. Pooling over causes of death the groups 1 and 2 and comparing their average to the average for the combined groups 4 and 5 produces the contrast 8. The p-value of 0.025 shows convincing evidence of the differences in volumes between heterosexual males and heterosexual females.

Pooling over causes of death the groups 1 and 2 and comparing their average to the group 3 produces the contrast 9. Thus the contrast measures the sexual orientation difference. The small p-value of 0.001 indicates convincing evidence of the differences in volumes between heterosexual and homosexual males.

Observe that the pooling process provides stronger evidence (p-value=0.001) of the differences in volumes between heterosexual and homosexual males than does the contrast 1 (p-value=0.047).

The final question was whether there is evidence that heterosexual females differed from homosexual males. The difference is measured by the contrasts 10 and 11. The two-sided p-values of 0.503 and 0.705 respectively indicate that there is no evidence for this difference.

If we pool over the cause of death the groups 1 and 2, and 4 and 5, we will obtain three groups: heterosexual males, homosexual males, and heterosexual females. The ANOVA table produced by SPSS in this case has the form:

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	44960.5045	22480.2522	7.4811	.0018
Unweighted Linear Term	1	18013.3636	18013.3636	5.9946	.0191
Weighted Linear Term	1	32634.4676	32634.4676	10.8603	.0021
Deviation from Linear	1	12326.0369	12326.0369	4.1019	.0499
Within Groups	38	114187.1053	3004.9238		
Total	40	159147.6098			

Notice that after pooling, ANOVA provides even stronger evidence of the differences among the three groups. The analysis of variance F-statistic is F=7.4811, with 2 and 38 degrees of freedom, giving a p-value of 0.0018 much smaller than the p-value of 0.0079 obtained before the pooling. That small p-value indicates strong evidence of differences among the group means.

The summary statistics for each group are provided below:

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean
Grp 1	16	119.2500	56.4405	14.1101	89.1750 TO 149.3250
Grp 2	19	50.3158	51.6710	11.8541	25.4112 TO 75.2204
Grp 3	6	55.0000	60.5739	24.7292	-8.5675 TO 118.5675
Total	41	77.9024	63.0769	9.8510	57.9929 TO 97.8120