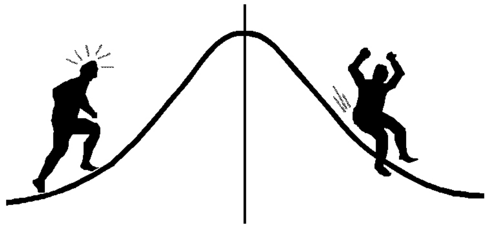

BIOMETRICS INFORMATION

(You're 95% likely to need this information)

PAMPHLET NO. # 22 DATE: October 12, 1989

SUBJECT: ANOVA: Using a hand calculator to test a one-way ANOVA

Hand calculators can be used to do one-way ANOVA calculations. The calculator must have a key that calculates means and standard deviations. Suppose that there are i = 1, 2, ..., a treatments in the ANOVA, and each treatment has a sample size, n, and an observed mean $\overline{Y}_i$ with a standard deviation S_i. The method (for balanced ANOVA's) is as follows:

STEP 1: Enter all values, Y_{ij}, for **one** treatment to obtain $\overline{Y}_i$ and S_i (or S_i^2). Record using many decimal places. If possible accumulate S_i^2 in a memory (Step 3).

STEP 2: Repeat for each treatment.

STEP 3: Calculate the Sums of Squares Error (SSE) by: $SSE = (n\text{-}1)\,\Sigma S_i^2$
or the Mean Sums of Squares Error (MSE) by: $MSE = \left[\Sigma S_i^2\right] / a$.

STEP 4: Enter all the means, $\overline{Y}_i$, to obtain S_m, the standard deviation of the means. Use lots of decimal places when inputting the means to avoid round-off error.

STEP 5: Calculate the Sums of Squares Between (SSB) by: $SSB = n(a\text{-}1)\,S_m^2$
or the Mean Sums of Squares Between (MSB) by: $MSB = nS_m^2$

STEP 6: Calculate the F-value as:

$$F = \frac{SSB/(a-1)}{SSE/(a(n-1))} = \frac{MSB}{MSE} = \frac{anS_m^2}{\Sigma S_i^2}\text{ , with df} = [(a\text{-}1), (a(n\text{-}1))]$$

Example:

Treatment	Data	Mean, $\overline{Y}_i$	Standard Deviation, S_i	S_i^2
1	5 3 5 6 1	4.0000	2.0000	4.0000
2	1 2 2 0 3	1.6000	1.140175	1.3000
3	5 4 7 5 2	4.6000	1.816590	3.3000
	Grand Mean:	3.4000	Sum:	8.6000
	Std. Dev. S_m:	1.587451		

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In this case, a = 3, n = 5, $\sum S_i^2 = 8.6000$, and $S_m^2 = 2.52000$. Hence:

$$MSE = \frac{\sum S_i^2}{a} = \frac{8.6000}{3} = 2.86666$$

and

$$MSB = nS_m^2 = 5(1.587451)^2 = 12.6000$$

and

$$F = \frac{12.6000}{2.866666} = 4.395 \text{ with df} = 2, 12$$

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PROBLEMS FROM BI #21

The residual df for a simple regression on a dataset with 50 observations is 48. With three independent variables the df become 50 - 4 = 46. The df for a dataset with 3 numbers is 3 - 4 = -1. Since df must have positive values, this means that a multiple regression with 3 variables can not be fit to a dataset with only 3 observations.

The residual df for a dataset with 70 observations divided into 6 groups would be df = 70 - 6 = 64. The df for the F-test is 5, 64.

The df for the usual contingency table χ^2-value is (3-1)(6-1) = 10.

The df for a t-test of a mean with a sample size of 80 is 78.

NEW PROBLEM

Calculate the SSB, MSE, and the F-test for the following data:

Treatment	Data	Mean, $\overline{Y}_i$	Standard Deviation, S_i	S_i^2
1	5 3 1 0 1			
2	7 6 5 8 4			
3	11 9 7 6 7			
4	10 6 9 9 6			
	Grand Mean:			
	Std. Dev. S_m:			