The program is written in WATFIV for an I.B.M. System 360 computer and can be processed by any FORTRAN compiler. Further information concerning details of the program instructions for its use, and sample runs on the literature cited above, may be obtained from the authors.

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To the Editor:

We have written and documented a computer program package which computes the analysis of variance for a diallel experiment using general least squares techniques which perform the exact analysis of data with unequal subclass numbers or any number of missing observations.

The diallel cross is used by many geneticists and plant breeders. Several different versions of the diallel are presented by Griffing (Griffing, B. 1956, Concept of general and specific combining ability in relation to diallel crossing systems. Aust. J. Biol. Sci. 9: 463-493.) and Cockerham (Cockerham, C. C. 1963. Estimation of genetic variances. Statistical genetics and plant breeding. NAS-NRC Pub. 982:53-94.). They give computing formulas for the analysis of variance of data with equal numbers of observations on each cross (i.e., in each subclass). Littlewood, Carmer, and Hittle (Littlewood, R. D., S. G. Carmer, and C. N. Hittle. 1964. A computer program for estimating combining abilities in relation to diallel crossing systems. Crop Sci. 4:662-663.) discuss a computer program for analysis of the versions presented by Griffing, but their program seems to be intended for data with equal subclass numbers.

The exact analysis of diallel cross data with unequal subclass numbers is so difficult that it is common to use an analysis of unweighted means, or, in the case of missing observations (crosses with no observations), to substitute "estimated" values and then use the standard computing formulas.

Our program computes the analysis of variance for each character observed, along with analyses of crossproducts, if desired. For each source of variation in the analysis of variance the correct number of degrees of freedom, the sum of squares, the mean square, and the expectation of the mean square is calculated. Estimates of the variance and crossproduct components can then be produced along with their standard deviations, and the correlations between the effects for different characters can be estimated.

The model analyzed includes as sources of variation: locations, replications, general combining ability, specific combining ability, maternal, reciprocal, and general combining ability by location interaction. Any of these sources may be omitted from the analysis except for the general and specific combining abilities. Inclusion of various combinations of these effects allows the analysis of the variations discussed by Griffing and Cockerham.

One control card is required by the program. This specifies the size of the experiment and the effects to be included in the model. The format of the data is specified by a user supplied FORTRAN Format statement, and since the data can be read in any order, recoding and other preparation of the data should be minimal. The specification of the options to be used and the interpretation of the output produced are discussed in the documentation.

A copy of the documentation, which includes two worked examples and a listing of the program package is available from us as Genetics Department Research Report Number 1. Two addenda and errata notices are included with the documentation. The program is written in FORTRAN IV and so can be used on most large modern computers (possibly with minor changes required).

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Dear Editor:

Waller and Duncan have recently presented a new statistical procedure for simultaneously testing the differences between $n$ treatments considered in all possible pairs (R. A. Waller and D. B. Duncan. 1969. A Bayes rule for the symmetric multiple comparisons problem. J. Amer. Stat. Assn. 64:1484-1503). The application of the test takes the form of Fisher's least significant difference procedure. However, a dependence on the between-treatment $F$ value exists resulting in the test varying from a sensitive comparisonwise-$a$-like rule at high $F$ values to an experimentwise-$a$-like rule when $F$ is small. As a result of this dependence, disparities observed between other multiple comparison tests disappear. The authors recommend that this procedure be used instead of Duncan's multiple range test because this new test minimizes both the probability of incorrectly declaring means statistically different (Type I error) and the probability of failing to detect significant differences when they exist (Type II error).

I have written a computer program in FORTRAN IV to perform this statistical test. Routines adapted from Waller's Ph.D. thesis compute the new statistic, a minimum-average-risk $t$ value. This statistic is a function of a Type I to Type II error-seriousness ratio, the between-treatment $F$ value, and the degrees of freedom associated with $F$. Printed output is in the form of a table listing all parameters and means with a common letter used to indicate means that do not differ. Program description and source listing are available upon request.

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