GenStat Statistical Software for Design and Analysis of Field Trials

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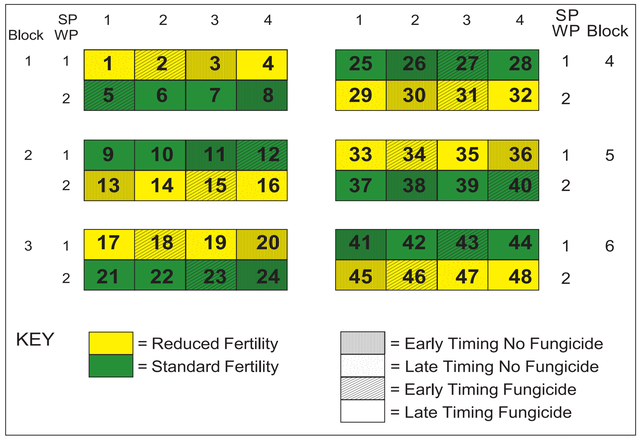

Figure 1

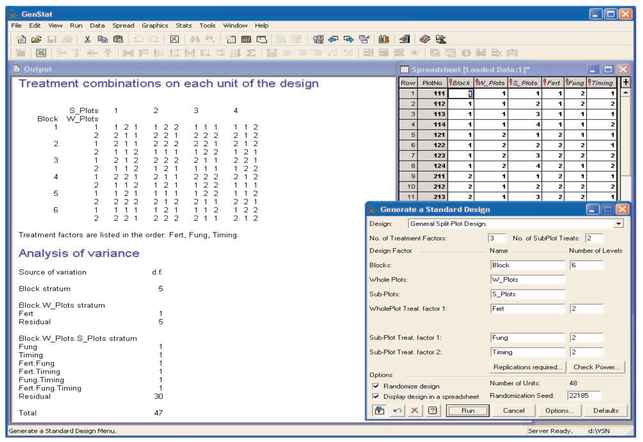

Figure 2

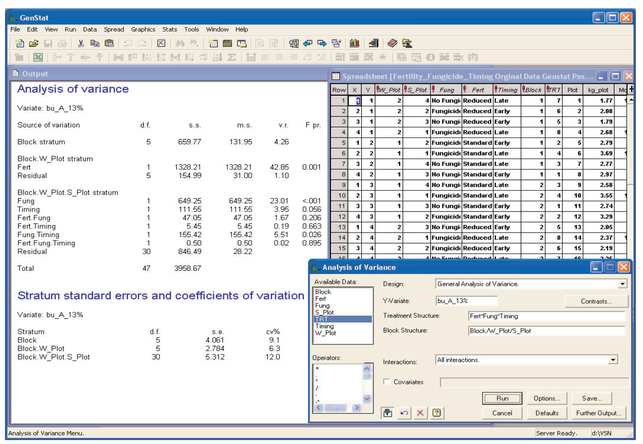

Figure 3

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Abstract

GenStat is a statistical software program originally developed by Rothamsted Agricultural Research Station. Historically, the program was known as a comprehensive statistical package promoting good statistical practices, but was perceived as difficult to use due to its sophisticated programming language. However, in recent years, the programming language was rewritten in a standardized and simplified format. In 1996, a windows interface was added making GenStat's powerful statistical tools accessible to all, even the novice user. Today, GenStat is known as a high power general statistics package that is user friendly, and remains particularly well suited to agricultural applications. It can handle all types of layouts and complexities that are encountered in agricultural experiments. Currently in its 8th edition, GenStat is continuously developed and supported by VSN International, LTD.

The following text is a brief review of GenStat with an example to illustrate the software's facilities for the design and analysis of an agricultural field experiment.

Review

GenStat is a comprehensive statistical system that allows you to summarize, display and analyze data. The Windows implementation of GenStat offers the flexibility of a programming language with the simplicity of a menu-driven package. Users may use menus to automatically generate commands or construct their own commands via the interactive programming language to develop non-standard or cutting edge statistical analysis.

GenStat allows you to illustrate data with graphics such as histograms, box plots, scatter plots, line graphs, trellis plots, contour and 3-dimensional surface plots. Data can be summarized in tabular reports, fitted distributions, and various standard and nonparametric tests. Relationships between variables can be modeled by linear and non-linear regression, generalized linear models, and generalized linear mixed models. GenStat can analyze experiments ranging from one-way analysis of variance to complex design with several sources of variation. The software can handle unbalanced as well as balanced data, fit spatial models to large trials using REML, and can analyze microarray data. GenStat can automatically generate and analyze many designs. This includes one-way, two-way, unbalanced, Split-Plot, Latin Square, Strip Plot, Lattice, Split-Split Plot, General Split plot, Graeco-Latin Square, and alpha designs.

Tutorials, user guides and example data sets are available in pdf format under the Help menu. Data sets from the book's Statistical Methods (Snedecor and Cochran) and Experimental Designs (Cochran and Cox) are available under the help menu. The data sets allow you to see the syntax and play with data sets as you learn the system. An electronic discussion list is available where GenStat enthusiasts share experiences and opinions on a wide range of statistical matters. The software may be purchased as a supported package with which you receive automatic updates and technical support or as an unsupported package.

Example

In 2005, a field experiment (Figure 1) was designed to evaluate the effects of fertility, fungicide, and timing on the yield of spring wheat. The design menu (Figure 2) generated a 3 factor factorial, split plot arrangement, with 1 factor for whole plots (fertility) and 2 factors for subplots (fungicide and timing). For this factorial trial, the analysis of variance was completed by opening the ANOVA menu (Figure 3) and typing in the appropriate block and treatment structure. The treatment structure contains 3 crossed terms, Fertility*Fungicide*Timing. For the block structure, the whole plots are nested within blocks with subplots nested in the whole plots Block/W_Plot/S_Plot (Figure 3). This example illustrates how GenStat excels in its ability to easily and correctly handle multiple sources of variation - which is key to agricultural experimentation.

Other useful options include contrasts, residual plots (Figure 4) and mean plots (Figure 5). A helpful feature in GenStat is the automatic warning of plots which have high residual errors. In this trial, the preliminary analysis indicated that plots 28, 40, and 44 had large residuals, which GenStat graphically illustrates as a contour or surface plot (Figure 6). The warning leads to further investigation and the discovery that these plots were longer than the rest. Yields were recalculated based on the correct plot length and the result was an improved data set.

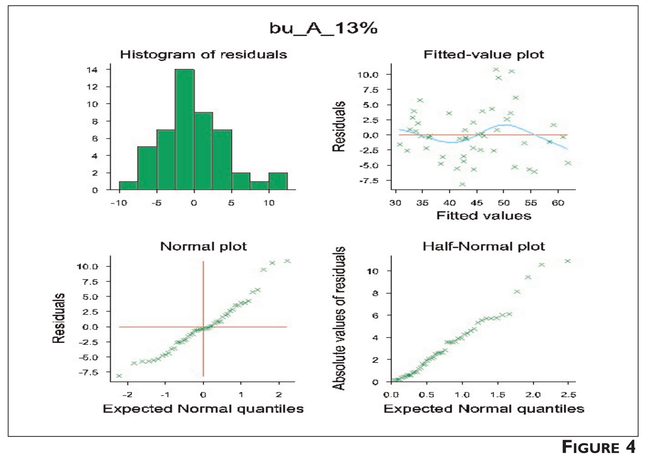

Figure 4

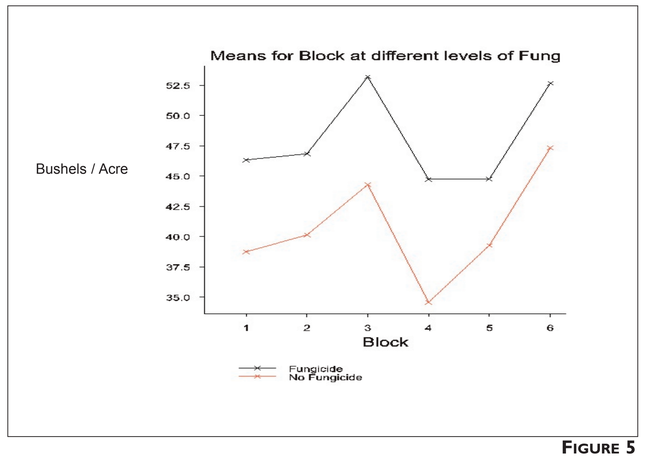

Figure 5

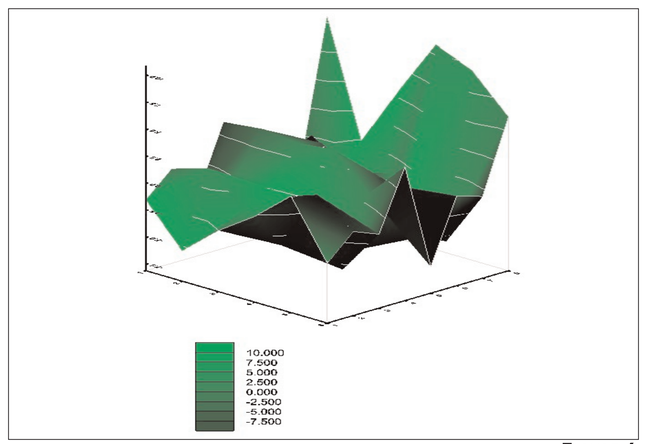

Figure 6

References

Buysse, W. , R. Stern, Ric Coe, B. McDerMott, S. Muchiri, M. Okello, P. Kurji, E. Obudho and P. Mong'are, 2005. GenStat 8th Edition for everyday use. ICRAF Nairobi, Kenya. 114 pp.

Payne, R., D. Murray., S. Harding, D. Baird and D.Soutar. GenStat for Windows 8th Edition Introduction VSN International Ltd., Hemel Hempstead, UK. 343 pp.

Kagular, S., P. Kurgy, D. Salifu, 2001. A strategy for statistical software for faculty. 12 pp.

O'Neil, M. 2005. Third Year Biometry Manual. University of Sidney. Australia. 247 pp.