Plant Science research using Systat

Introduction

Many of the contributions plants make to life on earth are well known, from being producers of food, fuel and oxygen to regulating the weather and maintaining soils. Perhaps not so obvious is their significance in understanding the ongoing process of genetic evolution, their role as living links to ancient earth and their potential to contribute to the medical world. We still have much to learn from plants.

New research methods, powerful instruments and fresh ideas are transforming how biologists study plants, from the molecular mechanisms of cells to the ecological dynamics of the biosphere. Developmental botanists are using DNA technology to unravel the development of the flowers. Taxonomists are reassessing plant classification by applying new methods and data for measuring evolutionary relationships. Plant ecologists are analyzing field data by coupling computers to remote environmental sensing instruments placed in tropical forests. Plant physiologists and biotechnicians are engineering plants to improve agricultural productivity.

Biology is the traditional breeding ground for statistical methods!!! A long time has passed since biology was “anything that is green or wriggles”. Biology is now a wide spectrum of specialisms, many of which are particular views on (or even within) other professional domains. There are still botanists and zoologists, but they are likely to qualify those descriptions with prefixes or suffixes. A "biologist" will usually blur on closer examination into a biochemist, sociobiologist, biometrician, ecologist, geneticist, crop scientist or other subspecies. Chemometrics is perhaps used as much by notional biologists as by chemists, while biometrics is now more associated with business security programs than with life science origins.

If biology is an endlessly fractal term, statistics is little better, with new techniques developed every day in a perpetual process of binary fission. The biological sciences are among the heaviest users of statistical methods, from traditional data centric exploration to pure mathematical modeling tools. Perhaps the best definition of statistics for biology is that offered by an Israeli cereals genome researcher: "anything that crunches at least three numbers for a biologist".

The traditional heart of statistical practice is the triumvirate of summary, visualization and significance testing. To a large extent, any statistics tool in this area can be described as a biologist's tool. Biology, after all, drove and shaped early development of techniques that are now universally applied. It is generally true that the closer a field of biological study is to the traditional zoologic or botanic; the more important will be traditional statistics with a leaning towards spatial statistics tools. The cutting edge of new fields is more likely to require advanced multivariate techniques and such of these methods in addition to basic tools are available in Systat.

Application

Nitrate accumulation in plants is a subject of concern for human and animal health, as edible parts may contain very high concentrations of this ion that has been implicated in the occurrence of methaemoglobinemia and possibly in gastric cancer. So, it is agreed that nitrate accumulation is highly variable and sensitive to both endogenous and exogenous factors. Cardenas-Navarro et al. (1999) monitored plant nitrate and water contents in a study using tomato plants and lettuce cultivars in a growth room and during growth in a glasshouse to check the above. Systat's least square linear regressions were used between plant nitrate as a dependent variable and water content as an independent variable. When categorical variables such as cultivars were also involved, the regressions were studied through ANCOVA (i.e., an ANOVA where one of the independent variables, plant water content in this work, is continuous). In this case, the homogeneity of slopes, i.e., the parallelism of the relationships between nitrate and water contents for the different levels of categorical variables, was checked by testing the interaction between the continuous and the categorical variables. They concluded that, the nitrate-water interdependence may prove valuable for breeders in their attempts to select plants with low nitrate content, for the design of ecophysiological models predicting plant nitrate uptake and accumulation, and for the diagnostic procedures in crop management.

The description above just gave a bird's eye view of Systat's capabilities. But Systat provides a powerful statistical and graphical analysis system in a graphical environment using descriptive menus and simple dialog boxes. Simply pointing and clicking the mouse can accomplish most tasks. Systat's command language provides functionality not available in the dialog box interface in addition to complete coverage of menu-based functionality. Robust algorithms from leading statisticians give meaningful results-even with extreme data. Create missing value estimates using regression-based point estimation or an EM algorithm. Matrix procedure allows you to use matrix algebra to specify statistical analyses and perform data management tasks. Create compelling reports by combining formatted statistical output with publication-quality graphs in SYSTAT 's rich text output window.

References

Raul Cardenas-Navarro, Stephane Adamowicz & Paul Robin. (1999). 'Nitrate accumulation in plants: a role for water', Journal of Experimental Botany, Vol. 50, No. 334, pp. 613-624.