SYSTAT Application Notes

Analyzing Pathophysiologic Mechanisms Using SYSTAT

Introduction

Rapidly developing statistical methodology and its use in modern pathological research has reached far ranging importance. The rapid developments in computer technology throughout the last two decades allow the programming of tools that facilitate statistical analysis.

Since personal computers have the capacity to process large quantities of data, programs for multivariate and time series statistical analyses, among others, have proliferated contributing to the understanding of the associations among variables and to generate models for projections.

The strength of diagnostic procedures and epidemiological tools available today would be minimal, if statistics were not used to exploit the wealth of acquired data. To make sense of the generated data, the pathologist must have knowledge of statistical techniques or at least work in close association with a statistician. The need for statistical analysis in pathology goes beyond the evaluation of data generated by diagnostic analysis system.

The pathologist must not only evaluate lung inflammation and cell injury in individuals employed in the electronics, dental alloy preparation, nuclear weapons, metal extraction, and aerospace industries, but must also generate an estimate or score of the severity of the injury that occur.

Subtle differences may be meaningful but imperceptible if a statistical analysis is not applied. The scores help visualize a subtle difference that may have not been so easily detectable. The statistical analysis helps determine the trend effect, and to establish a numerical comparison with untreated controls.

Suzy et al. (1999) investigated the antioxidant response of the lungs to the chronic release of reactive oxygen species (ROS), as occurs in the immune-specific granulomatous inflammation of chronic beryllium disease (CBD), and compared it with that in healthy controls and individuals exposed to cigarette smoke.

Thus, coordinate augmentation of the glutathione antioxidant system occurs in granulomatous lung inflammation. Comparisons between the three groups were made through analysis of variance (ANOVA). Research in pathology bridges basic biomedical science and clinical investigations; experimental activities are directed towards understanding the expression and mechanisms involved in disease.

Ultimately, these combined efforts will lead to improvements in disease diagnosis, treatment, and or prevention.

The design and statistical analysis of epidemiological and experimental studies include, parametric and non-parametric analyses, multiple regression including parametric, logistic and survival analyses, simple and multi-factorial analyses of variance with and without repeated measures, covariance structures are fit and assumptions are tested, etc.

To examine the ability of octadecanoyl (C_{18}), hexadecanoyl (C_{16}) and dodecanoyl (C_{12}) fatty acid (FA) conjugates of 5-aminofluorescein (OAF, HAF and DAF, respectively) to insert into the outer membranes (OMs) of Treponema pallidum, Borrelia burgdorferi and Escherichia coli, Cox and Radolf (2001) used paired student t-test to compare groups in each experiment. Their findings support the prediction that the lack of lipopolysaccharide renders I: pallidum and B, burgdorferi OMs markedly more permeable to lipophilic compounds than their Gram-negative bacterial counterparts.

The proliferation of myofibroblasts is a central feature of pulmonary fibrosis. For analysis of [^{3}H] thymidine uptake data, one-way analysis of variance was performed to determine an overall effect of tyrphostin versus control by Rice, et al. (1999). Two-sample t-tests were performed on Brdu data and hydroxyproline data to determine significant differences among control versus treatment groups.

This study provides strong evidence that both EGF-R (epidermal growth factor receptor) and PDGF-R (platelet-derived growth factor receptor) are important to the progression of pulmonary fibrosis and suggests that targeting autophosphorylation of receptor tyrosine kinases could have potential therapeutic value in treating fibroproliferative lung diseases.

Tumor necrosis factor α(TNF-)α is a proinflammatory cytokine with potent experimental antitumor activity. Its clinical use in cancer treatment is severely limited by its considerable toxicity after systemic administration, and it is currently continued to isolated limb and organ perfusion settings.

Applications

Gnant et al. (1999) used ANOVA with repeated measures and Tukey post hoc tests to examine the transfer of the EMAP-II gene into established TNF-resistant human melanomas would render these tumors sensitive to subsequent systemic TNF-a treatment.

Guadagni, et al. (2001) used ROC curve analysis to evaluate the efficacy of CEA and CA 15.3 in monitoring breast cancer. Differences between groups were assessed using the Mann-Whitney nonparametric U test. They showed that the addition of CEA to CA 15.3 measurement reduced the level of significance of the CA 15.3 test.

To investigate whether some cellular and molecular features of tissue retrieved at carotid endarterectomy are associated with the extent of neointima formation at ultrasound follow-up, Pauletto et al. (2000) used the following statistical methods: 2-way contingency tables, 2 tests, Pearson correlation coefficient, multiple regression analysis and logistic regression analysis for analysis.

They concluded that, although the classic risk factors did not play a role, an abundance of SMCs and a scarcity of macrophages characterized the primary lesion of patients in whom neointima developed after surgery.

Sander et al. (2001) evaluated the association between serological detection of Cp IgG and/or IgA antibodies and the progression of the intima-media thickness (IMT) of the common carotid artery using duplex ultrasonography in a prospective study.

Cox proportional-hazard regression analysis demonstrated a significantly increased rate of cerebrovascular and cardiovascular events in patients with Cp seropositivity, particularly in patients with increased C-reactive protein levels.

Conclusions

The applications in diversity of research areas, namely, Aging, Cytogenetics, Mycology, Atherosclerosis, Cytology, Oral Pathobiology, Diabetes, Cancer, Hematopathology, Skeletal Pathobiology, Cell Injury/Death, Microbiology, etc., is growing. Whether you are looking for an all-in-one tool, you'll never have to worry about finding the right statistic for the specific needs of your research.

Systat delivers over 15 years of experience in statistical algorithms written by leading statisticians.

References (in order of appearance)

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