Abstract:

The Biostatistics Laboratory (BSL) provides consulting expertise to NASA Bioastronautics research laboratories in the application of statistical theory and practice to ongoing biomedical research. Personnel in this laboratory often aid in the preparation of parts of research proposals that describe the experimental design, statistical modeling and subsequent analysis of anticipated research data. Once data is gathered, BSL statisticians can also assist with analysis and interpretation of results in order to help the investigators extract the most information consistent with the goal of maintaining statistical integrity. A BSL statistician, in fact, may be a co-investigator in projects requiring sophisticated statistical modeling and/or analysis techniques and will be expected to contribute descriptions of these techniques in forthcoming research papers. In these instances, the participating BSL statistician would be included as a co-author of such papers. Being involved as a consultant to other Bioastronautics research laboratories provides an excellent opportunity for the BSL statistician to expand his/her knowledge base in such diverse medical fields as environmental physiology, osteopathy, neurology, pharmacology, microbiology, cardiology, nutrition and psychology.

In addition to consulting duties described above, BSL personnel are encouraged to enhance their professional careers by carrying out independent research to address the special challenges raised by the idiosyncrasies of data often gathered on small numbers of human subjects under non-standard environments and test regimens. Most Bioastronautics experiments aim to certify proposed countermeasures as effective against adverse effects of space flight on human physiology. Often, these experiments involve repeated observations on disparate subjects with discrete or otherwise non-normally distributed response variables. Proposed dependent measures of countermeasure effectiveness may be innovative, with little or no available published information on their variability or co-variability, especially under proposed test conditions. As a result, simple power calculations based on a comparison of means, such as a t-test do not realistically quantify design efficiency. For effective analysis, statistical models and methodology often have to be developed in a customized manner for each research project. One promising area of research would be to investigate the feasibility of using Bayesian models with Markov Chain Monte Carlo for accommodating the many various random components present in Bioastronautics research data. Another major statistical challenge is to reduce bias caused by severe constraints on human subject participation. Ideally, human subjects are selected with age distribution and other physical characteristics approximately matching the existing NASA astronaut corps, but this is not always possible. For example, subjects volunteering for bed-rest studies are likely to be sedentary and not have life-styles similar to those of astronauts. As a result, extension of bed-rest test results to an astronaut population may be unrealistic. In general, development of customized methodology for modeling and correcting for informative dropout would be welcomed.