NCCC170: Research Advances in Agricultural Statistics

Status: Active

Duration 10/01/2016 to 09/30/2021
Admin Advisors: [Bruce Craig]
NIFA Reps:

Statement of Issues and Justification

Statisticians who consult and do research in an Agricultural Experiment Station environment have a unique relationship with their university. Their multi-disciplinary, collaborative role is often more extensive than that of other faculty and often cuts across several departments or units. Collaboration of statisticians and scientists allows land grant institutions to perform their agricultural research missions more effectively and efficiently than would otherwise be possible. Statisticians at each station tend to specialize in specific areas. This multi-state committee provides a mechanism that brings together statisticians from many stations working in related areas. The resulting exchange of ideas and the sharing of knowledge is of benefit to all project members and to the institutions they represent.

As State and Federal appropriations continue to fall short of levels needed for research and as grants become more competitive, it becomes even more imperative that research dollars go as far as possible. This requires Experiment Station statisticians to keep abreast of the latest statistical research as well as to work to develop methodology appropriate to their consulting roles. Advances in the complexity of designed experiments and observational studies along with a broader range of qualitative and quantitative types of data being collected in increasingly larger quantities (i.e., Big Data) require new methodologies for proper design and analysis to ensure the quality of the data and the inferences drawn from them.

Never has the charge to remain current in the statistical profession been more challenging. For statisticians, this requires assessing the utility of the new statistical methods and their associated software, many of which are computationally intensive. Rapid changes in our understanding of best statistical practices also means that agricultural researchers face an unprecedented need for viable mechanisms to stay current as consumers of statistics. Unfortunately, it is not unusual for agricultural researchers who do use state of the art statistical methodology to experience difficulty during the review process because the review infrastructure consisting primarily of subject matter experts and not statisticians has not kept up with advances in statistical practice. Dissemination of information on these advances to agricultural researchers and those who review agricultural research must be made available in a timely manner. Thus, it is critical that Station statisticians work cooperatively to determine the best current approaches to common statistical problems, to help guide future directions of statistical research and software development, and to educate researchers and reviewers.

In this respect, Experiment Station statisticians and their counterparts in government and industry can work together to provide more effective assistance to the agricultural researchers of their respective states. This NCCC committee can play an extremely important role by serving as a focal point for the development and implementation of sound statistical practice, thereby improving the

quality of research in the agricultural sciences through educational outreach. Thus, this committee has an educational support component that ultimately assists agricultural researchers in other disciplines in their efforts to accomplish national research priorities. The members of this NCCC are committed to this goal.

Objectives

1. To identify, foster and coordinate cooperative research efforts in statistics among statisticians serving food and agriculture research programs
2. To provide continuing education and statistical support to the scientific community in the review and editorial process
3. To address the statistical design and analysis issues associated with studies involving technologies that typically produce a large number of spatially and/or temporally correlated observations per sample but few samples (e.g.,-omics, informatics, and -metrics)
4. To address concerns associated with the development and implementation of generalized linear mixed model techniques and software used by statisticians and researchers
5. To address meta-analysis issues associated with multi-location, multi-investigator projects including those in which study treatments and/or designs may differ by location

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Procedures and Activities

Since its inception in 1990, NCCC-170 has addressed a series of statistical topics using the following general approach. At each annual meeting, the members discuss current research projects at their university or research station and the statistical issues associated with them. These topics are compiled and when appropriate, the members use this information to decide on a statistical topic to be addressed by the group. Once that decision has been made, a multi-year cycle begins.

The first and, if necessary, second year of the cycle is devoted to educating the project membership on the chosen topic. This is accomplished primarily through the annual meeting technical programs presented by knowledgeable project members and, on occasion, by non-members (usually located at that year's meeting site). Once this phase has been completed, materials are developed for members to use in their research, education and outreach activities. These may include workshop materials for subject matter audiences, software and usage instructions for data analysis, and statistical material for members own continuing education.

Material development is carried out by a subcommittee of volunteers from the project membership. A draft of their work (e.g., a dry-run of a workshop) is presented at the next annual meeting to obtain feedback from the entire group. During this meeting, a decision is made regarding whether or not a final version needs to be presented at the annual meeting the following year.

Over the past 24 years, project members have dealt with statistical aspects of on-farm trials, mixed models, spatial statistics, bioinformatics, and generalized linear mixed models. They have developed mixed model workshops for both statistical and subject matter audiences and a spatial workshop for subject matter audiences. The mixed model workshops have been successful and continue to be updated and offered upon request.

A generalized linear mixed model workshop was offered for the first time at the American Society

of Agronomy, Soil Science Society of America, and the Crop Science Society annual meeting in 2010. Since that time workshops on linear mixed models, generalized linear mixed models, meta-analysis, spatial data, and “big data” have been presented at the annual meetings of the American Phytopathological Society, the American Society of Animal Sciences, the American Dairy Science Association, the American Society of Horticultural Sciences, Aquaculture America, the Latin American Conference of Statistical Societies (Argentina), the International Horticulture Congress (Australia), and the Tropical Agronomic Center for Research and Teaching (Costa Rica) as well as at meetings of several local chapters of the American Statistical Association (ASA). The workshop was also presented as a full day workshop prior to the Conference on Applied Statistics in Agriculture in 2012. A mixed model workshop was an offering in the ASA’s Council of Chapters Traveling Course program from 2010 through 2012. Several members have presented workshops at their home institutions.

A group of project members wrote a book on applications of generalized linear mixed models to the agricultural sciences that was published by the American Society of Agronomy in 2012. Book sales have been better than may have been expected prior to publication. During the first six months after publication, 312 copies of the book were sold. Sales have slowed over time but copies of the book are currently available on Amazon.com and individual chapters may be purchased directly from the American Society of Agronomy.

In addition to these group outputs, these discussions have also impacted project members' collaborations at their own institutions and have led to numerous refereed and non-refereed publications, participation in competitive grants, and presentations at professional meetings.

The initial years of this project renewal will focus on the continuation of generalized linear mixed model problems with an emphasis on computing issues and the analysis of data sets with high dimensional observations coupled with both small and large sample sizes. Meta-analysis issues for multi-location, multi-investigator studies will be a focus as well.

Expected Outcomes and Impacts

- Education of members leading to cooperative research efforts and improved consulting and teaching by individual members.
- Cooperative research efforts among some members and information exchange on new developments among all members in the areas of generalized linear mixed models and the analysis of high dimensional, large volume data (i.e., Big Data).
- Continued offering of workshops and, where appropriate, alternative means of continuing education and support for subject matter scientists, reviewers, and technical editors on valid design and statistical analysis of studies.

Educational Plan

Members will educate their individual clientele of subject matter scientists and students in one-on-one and group settings as they deem appropriate. Workshops will continue to be offered to regional and national subject matter groups as well as journal editorial boards who may be interested in specific topics.

Organization/Governance

The Chair and Secretary are selected by the members present at the annual meeting. The meeting Local Arrangement Chair for the next year is the member from the state in which the meeting will be held. The meeting Program Chair for the next year is a volunteer from among the members present at the annual meeting.

Literature Cited

This literature section contains selected publications form the Project's 2015 Annual Report as examples of the diversity of disciplines with which Project members interact.

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Land Grant Participating States/Institutions

WI,NE,ID,IL,IN,SC,UT,KS,AR,MI,OH,PR,IA,CA

Non Land Grant Participating States/Institutions

Pioneer Hi-Bred International, Retired-ARS, Southern Plains Area, USDA-ARS Beltsville Agricultural Resarch Center, USDA-ARS/TX