

# Astrostatistics in the International Arena

Joseph M. Hilbe  
Arizona State University  
&  
Jet Propulsion Laboratory  
hilbe@asu.edu

Astrostatistics in the International Arena

## **Astrostatistics in the International Arena**

**Beginning in the mid 1980s, astronomers began to organize small conferences devoted to what we may now call astrostatistics.**

**One of the first was the “Statistical Methods in Astronomy” conference held in Strasbourg in 1983.**

**“Statistical Challenges in Modern Astronomy” conference, which has been held every 5 years since its inception in 1991.**

**Astrostatistics appears to be first described as such by Babu and Feigelson in their 1996 book, *Astrostatistics*.**

**Authored just prior to the publication of WinBUGS and to the popularity of R. Frequentist methods described.**

**Now – 15 years later – R is fast growing in popularity with some 3000 CRAN packages. A growing number of journal articles use Bayesian methodology and more and more books and CE tutorials address Bayesian topics.**

**Statistics.com ([www.statistics.com](http://www.statistics.com)) began with 3 courses in 2003. Now over 90, many of which are Bayesian in nature. The reason – demand. Likewise R courses among the most popular.**

**Although solid astrostatistical work is still being done using the traditional frequentist approach to statistics, Bayesian methods now predominate in the literature. This trend has only grown in the past five years.**

## **1990s' Astrostatistics programs and collaborations**

**California/Boston/Smithsonian Astrostatistics Collaboration  
(CHASC)**

**International Computational Astrostatistics (InCA) Group**

**Pennsylvania State University Center for Astrostatistics**

**All belong to Large Synoptic Survey Telescope (LSST) Project,  
which will provide huge amounts of data for analysis.**

**Imperial College London**

**University of Calcutta**

**Indo-US Knowledge R&D Networked Joint Centres  
Institutional partners**

**Astrostatistics short courses**

**Video conferences and web based tutorials**

**Involve eminent scientists from India and US in activities**

# **Astrostatistics degree programs – starting, intend**

**Imperial College**

**and**

**University of Calcutta,**

## **Programs in astrostatistics**

**Pennsylvania State University**

**University of Pittsburgh**

**Carnegie Mellon**

**Harvard University**

**University of Florida**

**University of Birmingham**

**Other sites.**

## **In Past...**

**Many astronomers did not fully appreciate the statistical theory underlying their analyses.**

**No special training in statistical estimation.**

**Use only a limited number of statistical procedures.**

**Not become aware of the vast range of statistical capabilities that had become available to professional statisticians**

## **Exceptions**

-----

**Became apparent in the late twentieth and during the first decade of the twenty-first centuries that astronomers in general needed to enhance their statistical knowledge.**

**Those taking up this challenge believed that the best way to address the problem was to conduct conferences and organize collaborative research groups consisting of both astronomers and statisticians.**

**No global association of astrostatisticians**

# **ISI Astrostatistics Network**

**2007, 2008: I was on conference calls with the directors of various NASA and JPL projects and missions:**

**Repeatedly heard that statistical issues were going to be a problem in the analysis of their data.**

**This in turn stimulated me to explore the possibility of forming an association of astrostatisticians that would encourage the global collaboration of statisticians and astronomers with the aim of effecting better statistical research**

**2008: astrostatistics interest group formed within ISI, International Statistical Institute**

**2009: Interest group meeting at ISI in Durban, South Africa – enthusiasm**

**December 2009:**

**the ISI Council approved the existence of astrostatistics as a full standing committee**

**ISI committees consist of no more than twelve to fifteen members.**

**More interest**

**January 2010:**

**Formed ISI Astrostatistics Network, Committee as executive Board**

# **International Astrostatistics Network**

**Network has established solid relationships with both the ISI and *International Astronomical Union*, whose leadership has supported the Network and its goals.**

**Network members were awarded an invited papers session and two special topics sessions at this year's ISI World Statistics Congress in Dublin. Likely unprecedented for new ISI body**

**Discussions have been underway with several publishing houses regarding a *Journal of Astrostatistics*. Care needed...**

**December 2010: Springer Science and Business Media begun a *Springer Series on Astrostatistics*, on which Network members hold the editorial board positions.**

**Springer astrostatistics e-book series is also being developed to publish the Proceedings of major astrostatistical conferences.**

## **IAN goals**

**An association that seeks to augment and support the ongoing efforts of established astrostatistics groups and conferences.**

**It is an association of researchers with a common interest and a resource to help disseminate information regarding astrostatistics related literature, conferences, and research.**

**It can also serve as the professional society for those identifying themselves as astrostatisticians.**

**Astrostatistics as a profession is but in its infancy at this time, but it is hoped that a viable profession will be established within the next twenty years.**

## **Astrostatistics -- challenges**

**The National Virtual Observatory (NVO) is now being constructed which will link archival astronomical databases and catalogues from the many ongoing surveys now being maintained, including LSST.**

**The goal is to make all gathered astronomical data available to astronomers and astrostatisticians for analysis.**

**This will involve many petabytes of information.**

**Current statistical software is not capable of handling such an amount of information.**

**New methods of statistical analysis will need to be developed to deal with these large datasets**

**Possible methods:**

**sequential modeling**

**meta-analysis**

**Problems: anomalous observations become dampened out and may be missed in analysis.**

**Statistical analysis should be made on as much data as possible.**

**Researchers are now developing VOSTat,**

**Statisticians, computation specialists, and astronomers will have to work in concert to deal with these issues.**

# **CONCLUSION**

**I believe that astrostatistics will only develop into a mature discipline, capable of handling the looming data and analytic problems, by becoming a profession.**

**This can be done by developing joint programs in the discipline, sponsored and maintained by the mutual efforts of the departments of statistics and astronomy/astrophysics at leading universities.**

**PhD degrees in astrostatistics, trained in:**  
**statistical analysis**  
**astrophysics**  
**computer and computational logic.**

**RESULT: more likelihood that the foremost questions we have of the early universe, as well a host of other queries, can be answered.**

**We hope that as Network grows, it will be able to secure external funding to help support these efforts.**