COMMISSION B3	**ASTROINFORMATICS AND ASTROSTATISTICS**

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	Eric B. Ford, Alan Heavens, Fionn Murtagh, Saeqa Dil Vrtilek, Yanxia Zhang

TRIENNIAL REPORT 2015-2018

1. Growth of the field

The roles of advanced computation and data analysis have grown precipitously in 21st century astronomy. Many new telescopes and instruments, particularly wide-field multi-epoch surveys and radio interferometers, embody the Three V's of Big Data: the data products have high volume, arrive with high velocity, and display a variety of structure. Pipeline data reduction often requires high performance supercomputers. Statistical analysis is essential to process large datasets effectively and to extract reliable inferences that advance astrophysical understanding. With the diversity of science goals and data types, many sophisticated statistical methods are needed.

The astronomical community thus has greatly increased needs in informatics and statistics, tapping expertise both within the astronomical community and with scholars in methodology from the fields of computer science and statistics. In light of this rapidly changing environment, the IAU formed a Working Group in 2012 that was elevated to Commission B3 in 2015 as part of the Commission restructuring of the IAU. The Commission currently has 207 members.

Various metrics demonstrate that activity in statistical methodology and advanced computation is rapidly growing among astronomical researchers. Over the past decade, refereed papers using Bayesian and machine learning methods grew 4-fold. In 2017, an astonishing 45 gatherings in astrostatistics and astroinformatics took place in 18 countries on 5 continents. These were roughly evenly divided between specialized sessions at large conferences, smaller specialized meetings, and training workshops for young astronomers. During 2015-18, week-long astrostatistics tutorials were offered to 500 students in 6 nations on 3 continents.

2. Meetings organized

Statistics and Exoplanets: IAU Focus Meeting #8 in 2015 At the General Assembly in Honolulu (US), the predecessor Working Group sponsored a Focus Meeting on *Statistics and Exoplanets*. Advanced statistical techniques are needed to extract and characterize the weak signals of orbiting planets from the dominant signal of the host

star. The meeting, followed by a software-oriented work session, drew attendance both from experts and the broader IAU community.

Astroinformatics: IAU Symposium #325 in 2016 The Commission was the primary sponsor of IAU's *Astroinformatics* Symposium held in Sorrento IT. Many nations were represented (facilitated by IAU travel funds), broadening the narrower participation of previous unsponsored astroinformatics workshops. Top-level experts gave talks, superb mid-career researchers emerged into the public arena, and senior IEEE engineers played a significant role. Three members of the Commission B3 Organizing Committee attended.

Continuations of Statistical Challenges in 21st Century Cosmology: IAU Symposium #306 Sponsored by the earlier Working Group, IAU Symposium *Statistical Challenges in 21st Century Cosmology* (Lisbon PT, 2014) was so successful that a follow-up meeting was held in 2016 (Chania GR) and another is planned for 2018 (Valencia ES). There was no mechanism for the IAU to sponsor these meetings.

Bayesian Inference in Astronomy: Proposed Symposium for 2019 The Commission is the primary sponsor of a proposed IAU Symposium *Bayesian Inference in Astronomy* (London UK). Bayesian statistical methods allow prior knowledge, from both theory and observation, to be incorporated into astrophysical modeling of new datasets, with powerful capabilities facilitated by advanced computational methods. Bayesian statistics play a crucial role in cosmology, gravitational wave, exoplanet, and other fields of astronomy.

3. Cross-disciplinary landscape

As an intrinsically cross-disciplinary enterprise, it is gratifying to find that scholarly organizations in the allied fields have recently expressed strong interest in working with astronomical researchers and formed their own organizations parallel to our Commission. These include the International Statistical Institute (essentially the sister society to the IAU) and the independent International Astrostatistical Association, the American Statistical Association, and the IEEE Computer Intelligence Society. Also in U.S. astronomy, the American Astronomical Society and the Large Synoptic Survey Telescope have interest groups emphasizing astroinformatics. During 2016-17, a year-long cross-disciplinary astrostatistics research program took place at the SAMSI institute in the United States. The stand-alone Astrostatistics and Astroinformatics Portal provides a Web-based environment for all these groups with lists of recent papers, jobs, meetings, and other resources. A lively Facebook group in astrostatistics has nearly 4000 members.

4. Future issues

Education of the profession Evidenced by the proliferation of short summer schools, hack days and other informal educational activities, the astronomical community clearly thirsts for specialized training in statistical and computational methodology. Universities have been slow to incorporate these issues into their curriculum for astronomers, although textbooks in astrostatistics are now available. The Organizing Committee has discussed this problem without resolution. Perhaps in consort with sister organizations, a suite of moderated online training guides using flexible software environments with text, interactive software applications and community discussion, can be constructed. We note that several Commissions in Astrobiology, which is similarly multidisciplinary, has collected online resources for education.

Coordination between societies With astrostatistics and astroinformatics interest groups recently formed in different fields, opportunities for multidisciplinary coordina-

tion and collaboration can be developed. This can start with regular electronic meetings of the leaders. The IAU can admit statisticians and computer scientists active in astronomical research as Full and Associate Members.

Web-based outreach   The IAU has unrealized opportunity for communication and outreach with its ownership of Web domains Astroinformatics.net and Astroinformatics.org. Together with the Astrostatistics and Astroinformatics Portal active since 2012, the Commission might improve outreach to the diverse research communities that pursue advanced methodology for astronomy.

Promotion in the developing world   Collaboration with the IAU Office of Astronomy for Development to promote tertiary-level pedagogy and research in astrostatistics. With the proliferation of online datasets, there is considerable potential for high-quality research using advanced methodology in nations without major observing facilities.

Eric D. Feigelson
President of the Commission

Publications of Commission B3 and its predecessor Working Group

References

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