NSF Award in Mathematical and Physical Sciences

Principal investigator: Thomas Severini, statistics, Weinberg College of Arts and Sciences

- Project: Likelihood Inference in Models with a High-Dimensional Nuisance Parameter
- Start Date: September 15, 2009
- Total Award Amount: $178,974

How the results of this project will benefit society:
Statistical methods are used in a wide range of fields. In particular, likelihood-based methods have been used in applications ranging from the reliability of computer software to the analysis of genetic data. Much of current statistical theory is restricted to relatively simple models, in which the available data is large relative to the number of unknown parameters in the model. However, in complex models, it may be necessary to estimate a large number of parameters based on relatively little data. This research will develop statistical theory and methodology for this type of model and these results will lead to improved statistical methods that will be useful in many areas of application. The research will also further our understanding of the properties of statistical models and, hence, will be useful in the training of researchers in statistics and related fields.

The problem the project is trying to solve:
Likelihood methods, such as maximum likelihood estimation and likelihood ratio tests, play an important role in statistical theory and methodology. There is a large body of work showing that, under relatively weak conditions, likelihood-based methods of inference are optimal in large samples. Such results are based on asymptotic theory in which the dimension of the parameter remains fixed as the sample size increases indefinitely. However, the conclusions based on such a large-sample theory may not be valid for models in which the dimension of the parameter is large relative to the sample size. Thus, for many models used in practice, standard methods of likelihood-based inference may not perform well.

How the project will work:
The goal of this research is to study and develop likelihood-based methods of inference in models in which the dimension of the nuisance parameter is large relative to the sample size. The research will focus on three broad areas: the development of higher-order asymptotic approximations to the distribution of the likelihood-based statistics in models with stratum nuisance parameters, the development of a small-dispersion asymptotic theory for models with stratum nuisance parameters, and the development of methods of inference in models with an unknown function. The research will consider the theoretical properties of likelihood-based methods of inference as well as the development of new statistical methodology based on those results.

This project is funded under the American Recovery and Reinvestment Act of 2009, NSF Award number: 0906466.