



## StatNews #60

### Generalized Additive Models November 2003

Multiple regression analysis is one of the most widely used statistical techniques. It is a powerful tool when its assumptions are met, including that the relationships between the predictors and the response are well described with a defined mathematical function (e.g., straight-line, polynomial, or exponential). In many applications, however, the reliance on a defined mathematical function is limiting. Many phenomena do not have a relationship that can be easily defined.

Generalized additive models (GAM) enable us to relax this assumption by replacing a defined function with a non-parametric smoother to uncover existing relationships. Smoothing is a method that will highlight a trend by separating it from variability due to noise. Several different smoothers are available, but the most commonly used are spline or loess. Smoothers have a parameter that can be used to control the closeness of the fit of the trend to the data.

GAM are additive models because they simultaneously fit the distinct effects of each independent variable. Each effect can be estimated using either a smoother or a defined mathematical function, leading to the description of GAM as semiparametric. GAM are appropriate under the assumption of the absence of interaction effects.

GAM also offers the added flexibility of permitting non-normal error distributions (see [StatNews # 43](#)). This allows modeling response variables with distributions such as binomial and Poisson. Generalized Additive Mixed Models (GAMM) have also been recently developed to incorporate random effects, as described in the new book "Semiparametric Regression," by D. Ruppert, M. Wand, and R. Carroll.

GAM can be implemented in SAS, S-Plus or with an ado file in Stata. The book by T. Hastie and R. Tibshirani "Generalized Additive Models," Chapman & Hall (1995) will provide you with a good general introduction to GAM.

Please contact Francoise Vermeulen in the Office of Statistical Consulting if you need any help implementing GAM or deciding if this technique might be helpful in your research.

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(This newsletter was distributed to faculty and graduate students in the Division of Nutritional Sciences, the College of Human Ecology, and the College of Agriculture and Life Sciences by the Cornell Office of Statistical Consulting. Please forward it to any interested colleagues, students, and research staff. Anyone not receiving this newsletter who would like to be added to the mailing list for future newsletters should contact Karen Grace-Martin at [kg47@cornell.edu](mailto:kg47@cornell.edu). Information about the Cornell Office of Statistical Consulting and copies of previous newsletters can be obtained at <http://www.cscu.cornell.edu>.)

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