R. A. Fisher and Modern Statistics

Stevan Hadživuković
Faculty of Agriculture, Department of Agricultural Economics
Trg Dositeja Obradovića 8
21000 Novi Sad, Serbia & Montenegro
shadzivukovic@eunet.yu

Nikolić-Đorić Emilija
Faculty of Agriculture, Department of Agricultural Economics
Trg Dositeja Obradovića 8
21000 Novi Sad, Serbia & Montenegro

1. Introduction

Ronald Fisher undoubtedly laid the foundation for modern statistical methods and their application. His work contibuted to statistics to become and develop in an independent scientific discipline. His work on statistical inference on the basis of small sample and the design of experiments is considered outstanding. At the begining Fisher's work was a little accepted anywhere except England. In the 1950s American academic statisticians were more impressed by the work of Neyman and Wald. Later on, Bayesian statistics was drawing more attention in the specific field of application. In the latter part of the 20th century Fisher's influence was overshadowed by the introduction of computers in statistics. However, his work had numerous followers and the number of critics were not insignificant. As distinguished from many other theorists, he was strongly attached to the statistical application. Statistical thought has continued to develop by the introduction of innovations in the theory and application. Many scientists, aware of the deficency in Fisher's methods, made an effort to make them better by relying on new scientific achievements. Generally speaking, Fisher's ideas still have a strong impact on statistical theory. Efron (1998) and some other authors speculated about the future of Fisherian statistics in the light of new technological era.

2. Recent development

A great contribution of R. A. Fisher is the development of likelihood as a fundamental concept of making inference about the state of system based on the outcome of a set of experiments of trials. Nowdays ,computationally intensive algorothms make possible wider application of this method and the development of new techniques. Expectation Maximization (EM) iterative algorithm is a statistical technique for maximizing complex likelihood and handling incomplete data problem developed by Dempster et al. (1977). It may be successfully applied in solving Genomic example (Fisher et Balmukand, 1928) It may be applied in estimation mixtures of distributions that occur in many modern areas as pattern recognition and data mining. Also, many problems of classification may be converted to estimation problem.

Fisher's papers on discriminant analysis inspired Anderson to research in the area of Multivariate analysis and to write his famous book (1984).

3. Extreme value theory

Extreme value theory (EVT) (Embrechts et al., 1997, Mladenović, 2002) has been one of the most quickly developing areas of mathematical statistics in the last decades. EVT deals with asymptotic behaviour of extreme order statistics of a random sample, such as the maximum and the minimum. It has found many applications in different are as: engineering, material strength,

oceanography, hydrology, polution studies, meteorology, financial econometrics, especially in risk management and computation of Value at Risk.

Most statisticians aim to characterize typical behaviour and focus on the center of data. EVT aims to characterize rare events and tails of distribution. The theorem of Fisher and Tippett (1928) is the core of this theory. The assertion of this theorem is "limiting forms of the largest and the smallest observation in a sample of given size are few and comparatively simple, although with a normal distribution they are approached exceedingly slowly". Fisher deduced the possible limiting forms from the functional relation which they must satisfy. The theorem suggests that asymptotic distribution of the maximum belongs to one of three distributions regardless of the original data:

$$(1)\ G^1(x) = \exp(-e^{-x}),\ -\infty < x < +\infty,$$

$$(2)\ G^2(x) = \exp(-x^{-\alpha}),\ x > 0,\ \alpha > 0,$$

$$(3)\ G^3(x) = \exp(-(-x)^{-\alpha}),\ x < 0,\ \alpha > 0.$$

Extreme value distribution $G^1(x)$ is Gumbel distribution that has a right tail no thicker than exponential distribution; $G^2(x)$ is Fréchet distribution that exibits the right tail that declines by a power and $G^3(x)$ is Weibul distribution with finite upper limit.

Gnedenko (1943) continued Fisher's research in this area and made EVT more rigorous by giving necessary and sufficient conditions for weak convergence of order statistics. Nowdays modeling extreme events through heavy-tailed distributions attracts more and more attention. The number of statisticians working in extreme value methodology and its application, and the number of publications in this area are growing.

REFERENCES

Anderson, T.W. (1984). An Introduction to Multivariate Statistical Analysis. Wiley, New York.

Dempster, A. P., Laird, N.M., Rubin, D.A. (1977). Maximum likelihood from incomplete data via the EM Algorithm, Journal of the Royal Statistical Society. B, 39, 1-38.

Efron, B. (1998). R. A. Fisher in the 21st century, Statisticaal Science. Vol.13. No. 2, 95-122.

Embrechts, P., Klüppelberg, K., Miklosh, T. (1997). Modelling Extremal Events. Springer: Berlin, Heidelberg.

Fisher, R.A., Balmukand, B. (1928). The estimation of linkage from the offspring of selfed heterozygotes. Journal of Genetics, 20, 79-92.

Fisher, R.A., Tippett, L.H.C. (1928). Limiting forms of the frequency distribution of the largest or smallest member of a sample. Proceedings of the Cambridge Philosophical Society, v. 24, 180-190.

Gnedenko, B.V., (1943). Sur la distribution limite du terme maximum d'une série aléatorire. Ann. Math., 44, 423-453.

Mladenović, P. (2002). Extreme Values of Random Sequences. Faculty of Mathematics, Beograd.

RÉSUMÉ

Cette communication acccentue l'apport et l'influence de R. A Fisher au développement de la théorie statistiqque et son application. Certaines nouveles contributions sur la base de ses idées ont été déployé comme EM (Espérance maximum). L' attention particulière était payé à la théorie de l'extrême valeur (TEV).