A Generalized Gumbel Distribution and Its Bayesian Estimation

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The Gumbel distribution is mainly used in the analysis of events generating extreme values. It is called type 1 extreme value (EV) distribution. Although there are two other types for EV distributions, the Gumbel distribution is used more frequently than the other types due to its tractability. The analysis of extremes is of importance in the environmental studies.

The standard Gumbel (SG) distribution is well-studied in the literature. Both the skewness and excess kurtosis of the SG distribution are constant. This reduces the change of getting a satisfactory goodness-of-fit between data and SG distribution. To be able to apply the Gumbel distribution to a broader range of situations, numerous generalizations of the Gumbel distribution have been proposed and possible applications are presented in the literature.

The Gumbel distribution is a member of various families of distributions. It is well-known that the SG distribution is included by the family of generalized extreme value (GEV) distributions (Fisher-Tippett distributions). The SG distribution is also related with the log-Weibull and double exponential distributions. In addition to the GEV family of distributions, the Gumbel distribution is also a member of generalized Gompertz-Verhulst (GGV) family of distributions given by Ahuja and Nash (1967). In the literature, much attention has not been paid to the generalized Gumbel (GG) distribution from the GGV family. Ahuja and Nash (1967), and Ahuja (1969) present main characteristics of the GGV family.

In this presentation, we briefly restate the characteristics of the GG distribution derived by Ahuja and Nash (1967). We show that the GG distribution is closely related with the generalized multivariate Gumbel (G-MVGB) distribution introduced by Demirhan and Hamurkaroglu (2011). Then, we derive a general expression for moments of the GG distribution about zero by using the main characteristics of the G-MVGB distribution. We obtain expressions for skewness, kurtosis, mode, and derive hazard and entropy functions of the GG distribution. We present Bayesian parameter estimation and hypothesis testing for the GG distribution, and illustrate use of the GG distribution for environmental data over meteorological data sets.

References:

