Discriminating Between Probability Distributions for Frequency Analsysis

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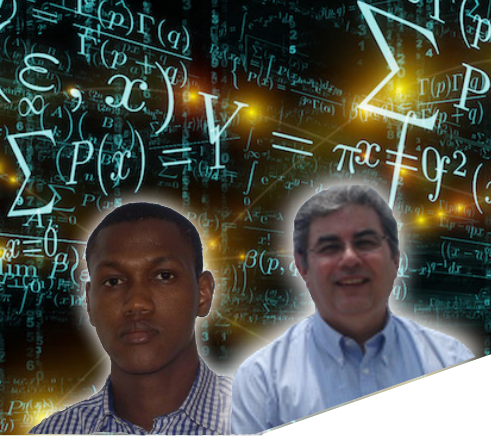

Research Summary

When hydrologists fit several candidate frequency models to a data set, the selection of a final fitting model often reduces to having to choose, or "discriminate", between a specific pair of competitive models (e.g., M1 and M2). In the peaks-over-threshold (POT) approach to the modeling of hydrological extremes, two-parameter probability distributions are typically very useful. One focus of our research is to evaluate and compare some widely used discrimination statistics (DS) in terms of their ability to correctly select between pairs of competitive 2-parameter distributions employed in a hydrological frequency modeling. Another research focus is attempting to classify frequency model pairs according to how difficult it is to discriminate between them.

Statistical research has shown some DS to have better capacity than others for the correct selection between competitive pairs of 2-parameter models. These discrimination statistics include:

1. the classical ratio of maximized likelihood (RML) statistic, which is closely associated with the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC);
2. the widely used Anderson-Darling (AD) goodness-of-fit (GoF) statistic;
3. a relatively new DS denoted by "TN.SW" that our team has introduced and studied, which is derived from the Shapiro-Wilk (SW) statistic used in GoF testing of the normal distribution;
4. another new DS denoted by "TN.PPCC" that is derived from the probability plot correlation coefficient (PPCC) GoF statistic.

To choose between a pair of competing models M1 and M2 to fit a data set, the hydrologist obviously needs to employ the most powerful and least biased procedure possible. The "Probability of correct selection" (PCS) is a standard measure used to compare and choose between the different DS. Two distinct features characterize this PCS: (1) discrimination power (DP), and (2) discrimination absolute bias (DAB). Both of these features are analyzed in our research. We use extensive computer Monte Carlo (MC) techniques to compare the ability of the various DS for correct selection between competing models. While our focus is usually directed towards small to moderate sample sizes that are typically encountered in hydrology, some large-sample studies are also undertaken. Our studies have shown that TN.SW has some advantages that make it worth further consideration in future research.

A hypothetical example:

PCS results for various sample sizes. Discrimination is between a model M1 and two alternative models M2 and M3. Values of *PCS.mean*(a measure of discrimination power, DP) are outside the brackets; values of *PCS.abs.diff* (a measure of discrimination absolute bias, DAB) are within brackets. All reported values are in percentage, rounded to the nearest integer.

		Sample size *n*					
Alternative Distribution (ALT)	**Discrimination Statistic (DS)**	**10**	**20**	**40**	**60**	**80**	**100**
	RML	67(0)	77(0)	88(0)	93(0)	96(0)	97(0)
M2	TN.SW	67(2)	77.5(1)	88(0)	93(0)	96(0)	97(0)
	TN.PPCC	67(2)	77(2)	88(0)	93(0)	95.5(1)	97(0)
	RML	66.5(23)	76.5(15)	88(8)	93(4)	95.5(3)	97.5(1)
M3	TN.SW	67(4)	76.5(3)	87.5(1)	92.5(1)	95.5(1)	97.5(1)
	TN.PPCC	66.5(1)	76.5(1)	87(2)	92.5(3)	95(2)	97(2)

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