**Introduction**

Current risk-based hydrologic design is based on univariate analysis of rainfall, where durations are artificially prescribed. Multivariate stochastic analyses via copulas are receiving increasing attention for constructing joint distributions. However, there are limitations to extending copulas to trivariate and higher dimensions:

- **Difficulties in preserving all lower-level mutual dependencies**
- **Compatibility problem in multivariate statistics**

In this study, the Plackett family of copulas is examined and found to be a potential trivariate dependence model. It is applied to construct design rainfall hyetographs for several stations in Indiana.

**Comparison between Plackett and Meta-elliptical Copulas**

**Construction of Trivariate Extreme Rainfall Distribution**

**Study Area and Date Source:**
- 53 COOP hourly precipitation stations in Indiana with record length greater than 50 years
- Minimum rainfall hiatus: 6 hours
- Approximately 4800 events per station

**Definition of Extreme Rainfall:**
- Annual maximum cumulative probability (AMP) definition for selecting annual series (Kao and Govindaraju, 2007)

**Selected Variables for Analysis:**
- Depth, P (mm); Duration, D (hour); Peak intensity, I (mm/hour)
- Percent. time to peak, Tp (%)
- Percent. accumulation at each 10% temporal ordinates, A_{10}, A_{20}, ..., A_{90} (%)

**Marginal Distribution:**
- P, D, I: Log Normal
- Tp: A_{10}: Beta

**Feasible Regions for Valid Trivariate Plackett Copulas:**

**Trivariate Dependence Structure:**

**Summary and Conclusions**

- Plackett family of copulas, along with the underlying cross product ratio theory, is found to be a suitable trivariate dependence model in constructing rainfall temporal distribution.
- The feasibility region for Plackett parameters that would result in valid 3-copulas has been identified numerically in this study.
- Not every set of given bivariate dependencies have a corresponding valid 3-copula. The compatibility of given bivariate dependencies needs to be investigated.

**References**


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