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Conditional waiting time distributions of runs and patterns and their applications

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Abstract
In this paper, a simple and general method based on the finite Markov chain imbedding technique is proposed to determine the exact conditional distributions of runs and patterns in a sequence of Bernoulli trials given the total number of successes. The idea is that given the total number of successes, the Bernoulli trials are viewed as random permutations. Then, we extend the result to multistate trials. The conditional distributions studied here lead to runs and patterns-type distribution-free tests whose applications are widespread. Two applications are considered. First, a distribution-free test for randomness is applied to rainfall data at Oxford from 1858 to 1952. The second application is to develop runs and patterns-type distribution-free control charts which can be used as Phase I and/or Phase II control charts. Numerical results for two commonly used runs-type statistics, the longest run and scan statistics, are also given.

Keywords Distribution-free tests · Conditional runs and patterns · Finite Markov chain imbedding · Control charts · Random permutation · Waiting time

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