

On distribution of runs and patterns in four state trials

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Abstract

From a mathematical and statistical point of view, a segment of a DNA strand can be viewed as a sequence of four-state (A, C, G, T) trials. We consider distributions of runs and patterns related to run lengths of multi-state sequences, especially for four states (A, B, C, D). Let X_1, X_2, \dots be a sequence of four state i.i.d. trials taking values in the set $S = \{A, B, C, D\}$ of four symbols with probability $P(A) = P_a$, $P(B) = P_b$, $P(C) = P_c$ and $P(D) = P_d$, respectively. In this paper, we obtain exact formulae for the probability distribution function for runs of B's the discrete distribution of order k , longest run statistics, shortest run statistics, waiting time distribution and the distribution of run lengths.

Keywords: runs and patterns, multi-state trials, discrete distribution of order k , waiting time distribution, distribution of run length, longest run, shortest run, DNA sequence.

1 Introduction

Runs and run related statistics have been intensively studied in the literature due to the wide range of applications in various areas including statistics (e.g. hypothesis testing), engineering (e.g. system reliability, health services monitoring and quality control), molecular biology and bioinformatics (e.g. population genetics and DNA sequence homology), physics, psychology, radar astronomy, computer science (e.g. encoding/decoding and transmission of digital information) and finance (e.g. financial engineering, risk analysis and prediction). During the past few decades up to recently, the significant progress on runs and related statistics has been nicely surveyed in Balakrishnan, N. and Koutras, M. V. (2003) as well as in Fu, J. C. and Lou, W. W. (2003) and references therein. Furthermore, there are various more recent contributions on the topic such as Arapis, A. N., Makri, F. S. and Psillakis, Z. M. (2018), Eryilmaz, S. (2018), Kong, Y. (2019), Makri, F. S., Psillakis, Z. M. and Arapis, A. N. (2019), and Aki, S. (2019).

There are two main types of problems concerning runs and related statistics:

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Runs And Patterns In Probability Selected Papers

Jianjun Gao



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