

On distribution of runs and patterns in four state trials

Jungtaek Oh*

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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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Malempati M. Rao



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Table of Contents Runs And Patterns In Probability Selected Papers

1. Understanding the eBook Runs And Patterns In Probability Selected Papers
 - The Rise of Digital Reading Runs And Patterns In Probability Selected Papers
 - Advantages of eBooks Over Traditional Books
2. Identifying Runs And Patterns In Probability Selected Papers
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Runs And Patterns In Probability Selected Papers
 - User-Friendly Interface
4. Exploring eBook Recommendations from Runs And Patterns In Probability Selected Papers
 - Personalized Recommendations
 - Runs And Patterns In Probability Selected Papers User Reviews and Ratings
 - Runs And Patterns In Probability Selected Papers and Bestseller Lists
5. Accessing Runs And Patterns In Probability Selected Papers Free and Paid eBooks
 - Runs And Patterns In Probability Selected Papers Public Domain eBooks
 - Runs And Patterns In Probability Selected Papers eBook Subscription Services
 - Runs And Patterns In Probability Selected Papers Budget-Friendly Options
6. Navigating Runs And Patterns In Probability Selected Papers eBook Formats
 - ePub, PDF, MOBI, and More
 - Runs And Patterns In Probability Selected Papers Compatibility with Devices
 - Runs And Patterns In Probability Selected Papers Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Runs And Patterns In Probability Selected Papers
 - Highlighting and Note-Taking Runs And Patterns In Probability Selected Papers
 - Interactive Elements Runs And Patterns In Probability Selected Papers
8. Staying Engaged with Runs And Patterns In Probability Selected Papers

- Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers
9. Balancing eBooks and Physical Books
- Benefits of a Digital Library
 - Creating a Diverse Reading Collection
10. Overcoming Reading Challenges
- Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine
- Setting Reading Goals
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information
- Fact-Checking eBook Content
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
- Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
- Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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