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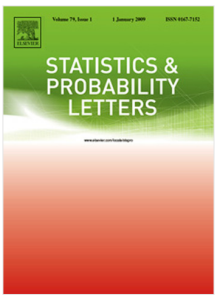

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PII: S0167-7152(17)30365-6
DOI: https://doi.org/10.1016/j.spl.2017.11.011
Reference: STAPRO 8074

To appear in: *Statistics and Probability Letters*

Received date : 18 October 2017
Revised date : 24 November 2017
Accepted date : 24 November 2017

Please cite this article as: Falk M., Khorrami Chokami A., Padoan S.A., Some results on joint record events. *Statistics and Probability Letters* (2017), https://doi.org/10.1016/j.spl.2017.11.011

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Some Results on Joint Record Events

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December 6, 2017

Abstract

Let $X_1, X_2, \ldots$ be independent and identically distributed random variables on the real line with a joint continuous distribution function F. The stochastic behavior of the sequence of subsequent records is well known. Alternatively to that, we investigate the stochastic behavior of arbitrary $X_j, X_k, j < k$, under the condition that they are records, without knowing their orders in the sequence of records. The results are completely different. In particular it turns out that the distribution of X_k, being a record, is not affected by the additional knowledge that X_j is a record as well. On the contrary, the distribution of X_j, being a record, is affected by the additional knowledge that X_k is a record as well. If F has a density, then the gain of this additional information, measured by the corresponding Kullback-Leibler distance, is j/k, independent of F. We derive the limiting joint distribution of two records, which is not a bivariate extreme value distribution. We extend this result to the case of three records. In a special case we also derive the limiting joint distribution of increments among records.

Keywords and phrases: Records, order statistics, Kullback-Leibler distance, domain of attraction, extreme value distribution

Introduction

Let $X_1, X_2, \ldots$ be independent and identically distributed (iid) random variables (rvs). The rv X_m is a record if $X_m > \max(X_1, \ldots, X_{m-1})$. Clearly, X_1 is a record. Records have been investigated extensively over the past decades, see, e.g. Resnick (1987, Section 4.1), Galambos (1987, Sections 6.2 and 6.3), and Arnold, Balakrishnan, and Nagaraja (1998). Consider the indicator function $I_m :=$

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