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Research Article

Developing Control Operations for Information Risk Management by Formulating a Stochastic Model

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Abstract. Stochastic models are becoming increasingly useful for understanding or making performance evaluation of systems arising in various scientific and engineering disciplines. The present paper is mainly devoted to the explicit formulation, the theoretical investigation, and the practical interpretation of a stochastic model having the necessary advantages for the precise description and the thorough investigation of the behavior and performance of a system evolving in the environment of a random number of competing, global, and catastrophic risks. In addition, such a system incorporates its principal concepts for the strong enforcement of the crucial requirements substantially facilitating the effective use of the formulated stochastic model to the reliable development and successful implementation of vital strategic processes.

Keywords. System; Stochastic model; Risk; Requirements; Information; Strategic process

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1. Introduction

Stochastic models are generally recognized as strong analytical tools for investigating the performance of systems in a wide variety of disciplines such as operational research, informatics, telecommunications, engineering, physics, biology, psychology, economics, and many areas of management [3, 8, 17]. The formulation of stochastic models for the measurement and treatment of risks threatening systems is generally considered by the literature of risk management as an activity with very significant practical interest. Analyzing market conditions, industry needs, and the emerging regulatory requirements makes clear that there is a fast growing global requirement for professionals with skills in formulating stochastic models for fundamental risk management operations [16]. From the fact that the risks threatening systems in nature and society change, requirements as to how these risks are proactively or reactively be treated must change correspondingly. This implies that the development and implementation of approaches and techniques for the discipline of risk management are absolutely necessary. After several decades of efforts for the formulation of stochastic models in the very wide area of fundamental risk management operations, it can quite easily be said that many stochastic models, formulated by making extensive and successful use of strong theoretical results from various sections of probability theory, are very useful for the precise description, the intensive analysis, and the substantial control of significant practical situations strictly related to risk measurement and risk treatment which are generally recognized as fundamental risk management operations. A thorough examination of the contribution of stochastic models to the fast evolution of risk management, as an organizational discipline of exceptional practical importance, reveals a continuing significance attached for the very extensive and effective applicability of some structural concepts of extreme value theory in the development and implementation of risk measurement and risk treatment operations [2]. It is known that many results of extreme value theory have found interesting applications in aerospace, ocean, hydraulic, structural engineering, as well as in research activities of meteorology, pollution, and highway traffic. In addition, very wide use of results of extreme value theory for the formulation of stochastic models in the area of casualty insurance claims is accomplished by experts in actuarial approaches and techniques. In consequence, it does not constitute a novelty that researchers in the discipline of risk management have undertaken activities to investigate the eventual contribution of extreme value theory to risk measurement, risk treatment, and other fundamental risk management operations. The key attraction of extreme value theory is that it provides a set of ready made approaches to a very wide variety of difficult problems related to the implementation of the goals of the risk management process. The literature on extreme value theory is now quite extensive [7]. Moreover, a great portion of this literature is mainly devoted to the theoretical investigation and the explicit analytical evaluation of the distributions corresponding to sample extrema, maxima or minima [9]. It is particularly helpful to mention that the principal constituent parts of the present work is the formulation, the investigation, and the interpretation of such a minimum.

The present paper is mainly devoted to the explicit formulation, theoretical investigation, and practical interpretation of a stochastic model. The explicit formulation of the stochastic model constitutes an extension of the concept of minimum of a random number of positive random variables by making use of the concept of discrete random sum [13] and the concept of random dilation [19]. In general, these three well known concepts are considered as very strong analytical tools of probability theory and mathematical statistics with extremely useful applications in the precise descriptions and effective solutions of particularly difficult real world problems which very frequently arise in econometrics, operations research, risk management, crisis management, cindynics, reliability, engineering, informatics, logistics, systemics, and many other practical disciplines of exceptional interest [17]. The applicability in a wide variety of practical disciplines of the above mentioned concepts constitutes a very good reason for undertaking research activities on the practical importance of the formulated stochastic model. The theoretical investigation of the formulated stochastic model consists of evaluating the corresponding distribution function after the representation of that stochastic model as the minimum of a random number of random dilations. It can quite easily be said that such a theoretical investigation very strongly supports the establishment of the practical interpretation of the formulated stochastic model. In addition, the practical interpretation of the formulated stochastic model consists of making use of that stochastic model in the description and analysis of the evolution of a system in the environment of a random number of competing global and catastrophic risks, or equivalently in a very adverse environment. In particular, the very crucial requirements mainly enforced by the principal concepts of a system must substantially contribute to the creation of the essence of a stochastic model incorporating the necessary advantages for the effective description and analysis of the evolution of that system in an extremely risky environment [21]. It is of particular theoretical and practical interest to make known that a very competent combination of the explicit formulation, the theoretical investigation, and the practical interpretation of the above mentioned stochastic model can very easily be considered as the main intention of the present paper. In consequence, it can be said that the principal steps of the stochastic modeling process are incorporated by the present paper as very strong analytical tools for providing substantial support to the development and implementation of proactive and effective risk treatment operations for a system evolving in the environment of a random number of competing global and catastrophic risks [10]. More precisely the explicit formulation, the theoretical investigation, and the practical interpretation of a stochastic model having the necessary advantages for the precise description and the thorough investigation of the behavior and performance of a system, incorporating its principal concepts for the strong enforcement of the crucial requirements substantially facilitating the effective use of that model, constitute analytical tools with very significant contribution to the reliable development and successful implementation of vital strategic processes arising in a wide variety of practical disciplines [15].

More precisely, the paper concentrates on the implementation of the following six purposes. The first purpose is the formulation of a stochastic model by using as structural elements a discrete random variable, a sequence of discrete independent and identically distributed random variables, a sequence of positive independent and identically distributed random variables, and a sequence of independent and identically distributed random variables with values greater than one. The fundamental components of the formulated stochastic model are a discrete random sum and a sequence of positive random variables, having the form of the product of a positive random variable and a random variable with values greater than one. The second purpose is the establishment of a sufficient condition for the structural elements of the formulated stochastic model in order to represent that model as the minimum of a random number of independent and identically distributed random dilations and evaluate the corresponding distribution function.

The third purpose is the establishment of applications of the formulated stochastic model in the description of proactive risk treatment operations and investigation of the behavior of a system evolving in the environment of a random number of competing global and catastrophic risks. The implementation of the third purpose reveals that the formulated stochastic model can be considered as an analytical tool suitable for developing significant practical processes such as strategic thinking, strategic planning, and strategic management [11,12]. The fourth purpose is the clarification of the suitability of the formulated stochastic model in the developments and applications of proactive treatment operations for a random number of competing global and catastrophic information risks threatening a system at a given time point. The importance of the fourth purpose follows from the fact that information risks incorporate all the challenges that result from the need of a system to control and protect information. The fifth purpose is the very thorough consideration that the extremely significant requirements very strongly imposed by the fundamental concept of information must constitute the basis of a stochastic model particularly suitable for effectively implementing the investigation of the evolution of a system in the environment of a random number of competing global and catastrophic information risks. In addition, the implementation of the fifth purpose makes quite clear that resourcing requirements for applying and reviewing information strategies should be mainly identified as an essential part of planning for the information security and the information management. The sixth purpose consists of the introduction of significant extensions of very well known stochastic models by the incorporation of the formulated stochastic model as a fundamental component in the mathematical forms of such well known stochastic models. It is quite readily understood that the implementation of the fifth purpose makes sufficiently clear that several very well known stochastic models, incorporating as a fundamental component the formulated stochastic model, are particularly useful in the satisfactory description and thorough investigation of many real world situations arising in a very wide variety of disciplines with particular practical importance.

2. Formulation of a Stochastic Model

The present section concentrates on the formulation of a stochastic model, the establishment of a sufficient condition for representing the formulated stochastic model as the minimum of a random number of positive independent and identically distributed random variables, and the evaluation of the corresponding distribution function. The structural elements of such a model are a discrete random variable, a sequence of discrete independent and identically distributed random variables, a sequence of positive independent and identically distributed random variables, and a sequence of independent and identically distributed random variables with values in the interval $(1,\infty)$. The fundamental components of the formulated stochastic model are a discrete random sum and a sequence of positive random variables having the form of the product of a positive random variable and a random variable with values in the interval $(1,\infty)$.

We consider the discrete random variable N with values in the set $N = \{1,2,\dots\}$ and probability generating function $P_N(z)$, the sequence $\{S_n, n = 1,2,\dots\}$ of discrete and independent random variables distributed as the random variable S with values in the set N and probability generating function $P_S(z)$ and the discrete sum $R = S_1 + S_2 + \ldots + S_N$. We also consider the sequence $\{X_r, r = 1,2,\ldots\}$ of positive and independent random variables distributed as the random variable X with distribution function $F_X(x)$, the sequence $\{W_r, r = 1,2,\ldots\}$ of independent random variables distributed as the random variable W with values in the interval $(1,\infty)$ and distribution function $F_W(w)$, the sequence $\{Y_r = X_r W_r, r = 1,2,\ldots\}$ of positive random variables distributed as the random variable $Y = XW$. We also consider the stochastic model $T = \min\{Y_1, Y_2, \ldots, Y_R\}$. If N, $\{S_n, n = 1,2,\ldots\}$, $\{X_r, r = 1,2,\ldots\}$, $\{W_r, r = 1,2,\ldots\}$ are independent then it can be readily shown that the above stochastic model is the minimum of a random number R of positive and independent random variables $Y_r = X_r W_r$ distributed as the random variable $Y = XW$, which is a random dilation of the random variable X via the random variable W, and R, $\{Y_r, r = 1,2,\ldots\}$ are independent. Moreover, it can be shown that the distribution function of the formulated minimum T is given by $F_T(t) = 1 - P_N\left(P_S\left(1 - \int_1^\infty F_X\left(\frac{t}{w}\right) dF_W(w)\right)\right)$. The explicit analytical form of the distribution function $F_T(t)$, combined with the mathematical form of the stochastic model T, constitutes a very strong tool for facilitating research activities concentrating on operations supporting strategic thinking for the behavior and the implementation of the main goals of systems in real world situations.

It is of particular practical importance to provide a thorough clarification concerning the advantages of the mathematical form of the formulated stochastic model and reveal the role of the sufficient condition for representing that model as the minimum of a random number of positive independent and identically distributed random variables. First, the consideration of the concept of a discrete random sum, based on a discrete random variable with values in the set N and a sequence of discrete independent and identically distributed random variables with values in the set N, as the primary fundamental component of that model substantially extends the applicability of the model in describing, analyzing, and implementing tactical operations and processes for systems arising in a very wide variety of practical situations. Second, the consideration of the concept of positive random variable, based on the product of a positive random variable with a random variable taking values in the interval $(1,\infty)$, as the secondary fundamental component of that model significantly contributes to the extensive use of the model in the development, assessment, selection, and application of dynamical operations facilitating strategic thinking and decision making for the provision of very significant support to the performance and evolution of various systems related to real world situations. Third, the assumption of independence for the structural elements of the formulated stochastic model makes possible the representation of that model as the minimum of a random number of positive, independent and identically distributed random variables. More precisely, such an assumption makes quite clear the concept of the stochastic model which is the minimum of a random number of independent and identically distributed random dilations. In consequence, this concept can be of particular interest for developing, assessing, and implementing control operations required by the reliable description and the effective investigation of the behavior of various systems. Fourth, the explicit analytical evaluation of the distribution function corresponding to the minimum of a random number of independent and identically distributed random dilations provides analysts, modelers, and other experts with valuable probabilistic information for making and implementing decisions in various practical problems. It is absolutely necessary to state that the presence of unimodality, infinite divisibility, selfdecomposability, stability, and other fundamental properties in the distribution function $F_T(t)$ is generally recognized, from a practical point of view, as very useful. In particular, the four mentioned fundamental properties substantially contribute to the investigation of the probabilistic importance of the best or worst scenario of a tactical operation or a strategic process applied to a system [20]. In conclusion, it can be readily said that the main contribution of the present section consists of providing an extension of the concept of minimum of a random number of positive, independent, and identically distributed random variables by incorporating a discrete random sum and a sequence of independent and identically distributed random dilations. Moreover, it is easily seen that such an extension seems to be suitable for stochastic modeling of information management operations and processes related to the performance and the evolution of systems.

3. Systems Under Competing Risks

The present section concentrates on establishing applications of the formulated stochastic model in the description of proactive risk treatment operations and investigating the behavior of a system evolving in the environment of a random number of competing risks.

We suppose that the discrete random variable N denotes the number of groups of risks threatening a system at the time point zero and the discrete random variable S_n denotes the number of risks contained in the nth group. Hence the random sum $R = S_1 + S_2 + \ldots + S_N$ denotes the number of risks contained in the N groups and threatening the system at the time point zero. We also suppose that the positive random variable X_r denotes the occurrence time of the rth risk. Moreover, we suppose that the random variable W_r denotes the impact of a risk control operation, on the occurrence time X_r, applied to the conditions and the cause of the rth risk. Hence the random dilation $Y_r = X_r W_r$ of the random variable X_r via the random variable W_r denotes the occurrence time of the rth risk after the application of the risk control operation to the conditions and the cause of that risk. In consequence, the stochastic model $T = \min\{Y_1, Y_2, \ldots, Y_R\}$ denotes the smallest occurrence time of the $R = S_1 + S_2 + \ldots + S_N$ risks threatening the system at the time point zero. It is quite easily understood that the formulated stochastic model $T = \min\{Y_1, Y_2, \ldots, Y_R\}$ is particularly suitable for the description and investigation of the behavior and performance of the system evolving in the environment of a random number R of competing risks. It is also easily understood that the practical importance of such a stochastic model substantially increases if the system evolves in the environment of a random number R of competing and catastrophic risks. In this case the formulated stochastic model denotes the life time of the system. Moreover, if the system is a new one at the time point zero then the formulated stochastic model denotes the time life of that system evolving in the environment of a random number R of competing and catastrophic risks. It is of particular practical interest to make a comment on the incorporation of a discrete random sum in the mathematical structure of the formulated stochastic model. It is quite easily seen that such a random sum strongly supports the applicability of that stochastic model in the description and investigation of the behavior and performance of systems arising in a very wide variety of significant disciplines and evolving in the environment of R competing global and catastrophic risks. More precisely, the above comment reveals that the formulated stochastic model constitutes an analytical tool suitable for developing and implementing strategic processes such as strategic thinking, strategic planning, and strategic management [2].

The practical significance of the formulated stochastic model can become clear in the following way. The evolution of a system in the environment of competing global and catastrophic risks creates conditions of strong stress for that system. In this case the decision making process of the system becomes extremely difficult. The use of the formulated stochastic model, being the minimum of a random number of random dilations, provides the system with a very useful advantage. Such an advantage is a time interval having as left point the time point zero and as right point the time point of the first occurrence of one of a random number R of competing global and catastrophic risks, threatening the system, after applying a risk control operation to the conditions and the cause of each of these risks. The explicit analytical form of that time interval is $[0,T)$. It is readily understood that such a time interval, being close at the point 0 and open at the point T, has a substantial characteristic which is the absence of occurrences in that time interval of competing global and catastrophic risks threatening the system. In other words, the system evolves in that random time interval without the stress due to presence of the competing global and catastrophic risks. It is quite obvious that the probabilistic behavior of the free of stress random time interval is completely determined by the distribution function of the formulated stochastic model being the minimum of random number R of independent and identically distributed random dilations. Moreover, the free of stress random time interval constitutes a very significant opportunity for the system to adopt and implement the main principles and goals of very significant strategic processes such as strategic thinking, strategic planning, and strategic management. In addition, the formulated stochastic model provides analysts, modelers, decision makers, and other experts with probabilistic information of particular practical importance for developing, selecting and implementing proactive risk treatment operations, at the time point zero. More precisely, such operations concentrate on the control of the occurrence times of a random number of competing global and catastrophic risks threatening a system. It is readily seen that the development and implementation of a risk strategy, incorporating the proactive and effective treatment of the occurrence times of a random number$R$ of competing global and catastrophic risks, and the mathematical structure of the formulated stochastic model constitute necessary requirements for substantially supporting the behavior and the evolution of a system in an extremely hostile environment. It is very clear that the necessity of these two requirements is mainly based on the very useful theoretical properties and the extremely significant practical applications in a very wide variety of disciplines of the probabilistic concepts of a discrete random sum and a sequence of positive random variables, having the form of the product of a positive random variable and a random variable with values in the interval $(1,\infty)$, which are quite easily recognized as the fundamental components of the stochastic model formulated by the previous section of the present paper.

Another way of making clearer the practical significance of the stochastic model $T = \min\{Y_1, Y_2, \ldots, Y_R\}$ is the following. We consider the stochastic model $U = \min\{X_1, X_2, \ldots, X_R\}$. It is easily seen that the stochastic model $U = \min\{X_1, X_2, \ldots, X_R\}$ denotes the smallest occurrence time of the $R = S_1 + S_2 + \ldots + S_N$ risks threatening the system at the time point zero, without applying a risk control operation to the conditions and the cause of any risk and which risk control operation can extend the corresponding risk occurrence time. Since the random variable Y_r is a random dilation of the random variable X_r via the random variable W_r then it easily follows that the random inequality $U < T$ is valid with probability one. In an equivalent way, it can be readily said that the random time interval $[0, U)$ is included in the random time interval $[0, T)$ with probability one. The certain inclusion of the random time interval $[0, U)$ in the time interval $[0, T)$ constitutes the most important reason for selecting the stochastic model $T = \min\{Y_1, Y_2, \ldots, Y_R\}$ instead of the stochastic model $U = \min\{X_1, X_2, \ldots, X_R\}$ as the suitable analytical tool in developing and implementing strategic processes supporting the behavior and the performance of a system evolving in the environment of a random number of groups with each group consisting of a random number of competing global and catastrophic risks. More clearly, from a theoretical point of view the mathematical structure of the stochastic model $T = \min\{Y_1, Y_2, \ldots, Y_R\}$ and the mathematical structure of the stochastic model $U = \min\{X_1, X_2, \ldots, X_R\}$ imply that the stochastic model T is dominant over the stochastic model U. Considering such a stochastic dominance from a practical point of view it can be said that the presence of the concept of random dilation in the stochastic model T and the absence of the concept of random dilation from the stochastic model U make the stochastic model T more effective and suitable in developing and implementing proactive risk treatment operations for the random number R of competing global and catastrophic risks threatening a system at the time point zero. From the fact that the stochastic model T is dominant over the stochastic model U it readily follows that the random time interval $[0, T)$ provides analysts, modelers, decision makers and other experts with more opportunities for the development and implementation of strategies, concerning proactive treatment operations for competing global and catastrophic risks threatening a system at the time point zero, than the random time interval $[0, U)$.

The clarification of the suitability of the formulated stochastic model in developing and implementing proactive information risk treatment operations is considered as an essential requirement by the present paper. Information risk encompasses all the challenges that result from the need of a system to control and protect information. Information risk management follows information as it is created, distributed, stored, copied, transformed, and interacted with throughout its life cycle. Resourcing requirements for implementing and reviewing information risk strategies should be identified as a part of planning for information security and management processes [1]. Although knowledge and its communication are basic phenomena of every human society, it is the rise of information technology and its global impacts that characterize modern society as an information society. From the fact that the concept of information risk constitutes a fundamental structural factor of modern information society it readily follows that the proactive treatment of information risk can substantially support the evolution of a system. Incorporating results of various theoretical and practical disciplines in investigating qualitative and quantitative characteristics of the concept of information risk can strongly facilitate the development and implementation of proactive treatment operations for that risk. More precisely systemics, operations research, stochastic modeling, and cindynics are significant scientific disciplines strongly supporting research activities concentrating on the nature and proactive treatment of information risk [14]. Carefully assessing a system against information risks is the first stage in identifying where a system is most vulnerable and defining a roadmap for implementing governance controls and monitoring to protect the information assets of that system. It is of particular practical importance to mention an advantage of defining information as perception of pattern is that it provides a starting point for quantifying and valuing information, making this type of definition useful for the disciplines of engineering, economics, and information risk management [5, 6]. Moreover, an extremely important thing in information science is to consider information a constitutive force in society and thus recognize the nature of systems. While it cannot be said that every information risk should be controlled using a monetary cost and benefit analysis framework, it can be said that all information risks should be quantified to the greatest extent possible, regardless of the anticipated control regime. It can be said that information risks will be poorly understood until a much better job of quantification of economic losses is implemented. Finally, it can be said that information security countermeasures will continue to be very difficult to justify in voluntary control regimes until their effectiveness can be expressed as a quantifiable reduction of economic losses.

According to the above short comments on the terms of information, information society, information science, information technology, information risk, information risk management, information risk strategy, economic quantification of information risk severity, systemics, operations research, cindynics, and stochastic modeling it is possible to make quite clear the interpretation of the formulated stochastic model in the development and implementation of proactive risk treatment operations, as a practical requirement of particular importance, for a system evolving in the environment of a random number of competing information risks. From the fact that the impacts of information technology are global it easily follows that many information risks are also global. Moreover, it is very well known that various information risks are global and catastrophic. Examples of global and catastrophic risks are the following. Criminal action, human error, software failure, hardware failure, change in humidity, change in temperature, magnetic disturbance, electric disturbance, earthquake, flood, and fire. It is quite readily understood that if a system is threatened by a random number of global and catastrophic information risks then it is very useful to investigate the evolution of that system in the environment of a random number of competing global and catastrophic information risks. In a more precise and very clear way, the formulation of a stochastic model for effectively implementing the investigation of the evolution of such a system must be mainly based on the very significant requirements which are strongly imposed by the incorporation of the fundamental concept of information and the incorporation of the corresponding structural concept of information risk in the mathematical form of that stochastic model. In consequence, it is quite easily seen that the most significant advantages of making use of the formulated stochastic model in a very thorough understanding of the behavior of a system evolving in the environment of the random number R of competing global and catastrophic information risks are the following. More precisely, it can be very easily said that the structural elements, the fundamental components, the mathematical form, and the interpretation of the formulated stochastic model are quite readily recognized as the most important practical advantages of that stochastic model in the precise description and effective analysis of real world situations related to the consideration of the substantial contribution of strategic thinking for developing and analyzing of proactive treatment operations applied to competing global and catastrophic information risks. In particular, the interpretation of the stochastic model T as the smallest occurrence time of the R competing global and catastrophic information risks threatening a system at the time point zero, with each such risk having experienced a proactive treatment operation extending the corresponding occurrence time, implies the exclusion of the complicated concept of information risk severity from that stochastic model. It is obvious that such exclusion substantially facilitates the applicability of the formulated stochastic model in the development and implementation of proactive treatment operations for competing global and catastrophic information risks threatening a system at the time point zero. In addition, the general recognition that the system evolves in the random time interval $[0,T)$, without the stress due to the presence of the R competing global and catastrophic information risks, strongly supports various processes of strategic thinking concentrating on the effective development and successful implementation of the main principles and the significant goals of a proactive information risk management program.

It is generally recognized by researchers and practitioners that the theoretical and practical importance of a stochastic model is mainly based on the incorporation of that model in the formulation of other stochastic models with useful applications in various disciplines of particular practical interest. The theoretical and practical importance of the stochastic model T can become quite clear by the incorporation of such a stochastic model in the mathematical form of many other stochastic models of significant practical interest. Several very well known examples of stochastic models making use of the stochastic model T are the following. A continuous stochastic compounding model denoting the future value at the random time point T and under constant force of interest of a single random cash flow arising at the time point zero, and a continuous stochastic discounting model denoting the present value at the time point zero and under constant force of interest of a single random cash flow arising at the random time T. A continuous stochastic compounding model denoting the future value at the random time point T and under constant force of interest of a continuous uniform cash flow with random rate of payment and starting at that time point zero, and a continuous stochastic discounting model denoting the present value at the random time point zero and under constant force of interest of a continuous uniform cash flow with random rate of payment and terminating at the random time T. A stochastic multiplicative model incorporating a positive random variable, denoting the performance per unit of time of a system evolving in the environment of a random number R of competing global and catastrophic risks, and the stochastic model T. In consequence, such a stochastic multiplicative model denotes the performance of the system in the random time interval $[0,T)$ being free of stress because of the absence of occurrences, in that random time interval, of competing global and catastrophic risks threatening the system. It is easily seen that the formulation, investigation and implementation of that stochastic multiplicative model provide experts of various kinds with valuable probabilistic information for the performance of the system in the random time interval $[0,T)$ and which valuable probabilistic information is very useful for decision making concerning the repairment or replacement of the system having experienced the occurrence of a competing global and catastrophic risk at the random time point T. Moreover, a stochastic multiplicative model incorporating a discrete random variable, denoting the number of tasks arriving per unit of time at a system evolving in the environment of a random number R of competing global and catastrophic risks, and the stochastic model T. Hence such a stochastic multiplicative model denotes the number of tasks arriving at the system in the random time interval $[0,T]$. The mathematical form of that stochastic multiplicative model seems to be suitable for investigating the behavior of the system during its lifetime T. In other words, such a stochastic model can provide valuable probabilistic information for the factors shaping the behavior of the system until the smallest occurrence time of the competing global and catastrophic risks threatening that system at the time point zero.

In conclusion, it can be readily said that the incorporation of the stochastic model T in the formulation of the above mentioned examples of stochastic models, arising very frequently in the description and solution of significant real world problems, can be quite easily considered as a very good reason for substantially supporting the recognition of the importance in wide variety of theoretical and practical disciplines of that stochastic model.

4. Conclusions and Future Work

The present section is mainly based on a creative adoption and an effective realization of a holistic and systematic approach to the previous two sections for making clear that the explicit formulation, the theoretical investigation, and the practical interpretation of a stochastic model constitute the three main results of the present paper. It is quite apparent that the very thorough understanding of the existing structural interdependence between these three results can directly provide substantial contribution to the decisive advancement of their corresponding impact on the precise description and the effective treatment of situations with specific practical interest.

Considering from a quite objective point of view the vital essence corresponding to the explicit formulation of such a model it is easily seen that the incorporation of a discrete random sum and a random dilation, being two concepts with very extensive theoretical and practical applicability in a wide variety of significant disciplines, to an interesting extension of the fundamental concept of minimum of a random number of positive random variables provides analysts, modelers, decision makers, and other experts with a strong probabilistic tool for the development and the implementation in various practical disciplines of some particular useful strategic processes [18].

The direct and vital requirement of the explicit formulation of the stochastic model, or equivalently the introduction of an extension of the concept of minimum of a random number of positive random variables, is the evaluation of the distribution function corresponding to that model. Moreover, the essential requirement for that evaluation is the independence of the structural elements of the formulated stochastic model. In addition, such an evaluation strongly facilitates the practical applicability of the formulated stochastic model in effectively developing and successfully implementing of strategic processes for a system evolving in a quite unpredictable and extremely hostile environment [4].

It constitutes a quite reasonable and very interesting consideration that the provision of a very good clarification for the great importance of the interpretation in various practical situations of the formulated stochastic model can readily obtain a general recognition as a necessary and useful course of action. It is quite clear that the general mathematical form of the formulated stochastic model represents the main factor strongly supporting the interpretation of that model as an analytical tool, involving particular suitability, for the thorough consideration of the evolution of a system in the environment of a random number of competing risks. Moreover, it is obvious that the incorporation of the concept of discrete random sum in the mathematical form of the formulated stochastic model makes quite clear its exceptional suitability for the thorough consideration of the evolution of a system in the environment of a random number of risks being competing and global. Risks of this kind very frequently threaten various systems arising in the activities of nature and society. In addition, it is also obvious that the incorporation of the concept of random dilation in the mathematical form of the formulated stochastic model makes sufficiently clear its remarkable suitability for the thorough consideration of the evolution of a system in the environment of a random number of competing global risks and after the application of a risk control operation to the conditions and the cause of everyone of these risks. In the extremely important case of risks being competing global and catastrophic, it is easily seen that the formulated stochastic model denotes the life time of such a system. In general, risks being competing global and catastrophic are readily recognized as a frequent threat for various systems arising in the activities of nature and society. The practical interpretation of the formulated stochastic model in the basic and dominant research area of development and implementation of effective control operations for various frequently arising and leading risks, being competing global and catastrophic, straightly becomes of particular importance in the special case of distinct and prevailing category of information risks. It can be said that such an importance is mainly based on the very specific and essential properties of information risks, the structural stochastic elements, the independence of these stochastic elements, the fundamental stochastic components, the mathematical form, and the distribution function of that stochastic model.

Conclusively, the contribution of the present paper consists of the following two parts. The first part of the main contribution of this paper incorporates the explicit formulation, the theoretical investigation, and the interpretation in practical situations of a stochastic model having the mathematical form of the minimum of a random number of positive random variables, a discrete random sum and a random dilation as fundamental components and the necessary analytical advantages for making quite the precise description and the thorough investigation of the behavior and performance of a system which evolves in the environment of a random number of competing global and catastrophic risks. In addition, the second part of the main contribution of this paper incorporates the very informative clarification distinctly indicating that a system of this kind makes a particular effective and direct use of its principal concepts for their strong enforcement of the crucial requirements providing substantial facilitation to the valuable and necessary employment of the formulated stochastic model for the reliable development and successful implementation of strategic thinking, strategic planning, strategic management and other extremely useful strategic processes.

It seems to be of some particular theoretical and practical importance the undertaking of future research activities for providing further extensions of the results of the present paper. More precisely, the explicit formulation, the theoretical investigation, and the interpretation in practical situations of stochastic models incorporating as fundamental component the concept of minimum of a random number of random dilations, introduced by the second section of the present paper, are readily recognized as new research activities which can contribute to the extension of the theoretical and practical results of this paper. In particular, the applicability of such stochastic models in understanding or making performance evaluation of systems evolving in a very hostile environment is readily considered as extremely important.

Competing Interests

The author declares that he has no competing interests.

Authors' Contributions

The author wrote, read and approved the final manuscript.

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