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Author: Mr. Tiziano Francesco D'Addabbo
Politecnico di Bari, Italy, tizianodaddabbo@gmail.com

Dr. Ivan Fino
Italian National Research Council (CNR), Italy, ivan.fino@edu.unito.it

THE BLACK SWANS APPROACH FOR OUTER SPACE ACTIVITIES. A NEW METHOD OF CALCULATING NEGATIVE-POSITIVE RISKS FOR SPACE LAW AND POLICY

Abstract

The scientific community relies on predictions and estimates to guide any human activity. Gaussian-type statistical models are relied upon; although these have proved to be excellent approximation tools, they often underestimate rare events. The black swan theory describes an unforeseen event that has significant effects (positive and/or negative). The main goals of this research are to demonstrate that the Gaussian model is not adequate to describe the risks of the space ecosystem and propose space law and policy strategies based on the fractal type of rare event calculations. Firstly, in the study, emphasis will be placed on calculating NEO impact risks. Specifically, the case of the Čeljabinsk asteroid is analyzed, calculating the associated probabilities using both models (Gaussian and fractal). Comparing current risk estimates shows that the fractal approach is more convenient than the Gaussian one. In the Gaussian model, the rate at which probabilities decreases increases exponentially as the distance from the mean increases. In the fractal model, on the other hand, the same rate at which probabilities decrease does not change as one moves away from the mean values. This type of approach results in an overestimated risk value compared to the standard Gaussian approach; the fractal approach is more beneficial for sporadic events, such as the fall of a meteor (negative black swan) or an extremely important scientific discovery (positive black swan). This results in a better ability to avoid dangerous extreme events by overestimating the risk. A more accurate calculation of the risk obtained through the fractal approach facilitates its understanding by the human masses, facilitating the adoption of insurance. To protect against extreme events, a model is proposed for allocating structural funds to enhance the current monitoring, sighting and neutralization system of dangerous celestial bodies. A similar argument applies to activities that could have positive consequences. This is the case of accidental and unexpected scientific discoveries favored by favorable legislation such as those in the US and Luxembourg in the asteroid mining and planetary terraforming fields.