

A special model of risk based on Radon Transform

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We propose a new method of determining the risk of a financial instrument [1], referring directly to the physical possibility of buying or selling it. In this sense, a financial instrument is all the more risky when there are more opportunities for it to change hands. These opportunities may change due to, for example, a change in assessment of the future profits generated by this instrument. We construct a mathematical model of risk understood in this way and a method of its measurement. In particular, we introduce the concept of a financial frame of reference based on the concept of financial time and a benchmark instrument. From these concepts we derive the definition of an instrument chart. The proposed measure of risk is based on the financial instruments with the lowest risk in a given frame of reference. We call them simple instruments. By selling (or or buying) a financial instrument, we understand its exchange with a simple instrument. Graphically, the moment of possible exchange of financial instruments is interpreted as the point of intersection between their charts. This is the moment when a simple (less risky) instrument is priced the same as the considered instrument. The owner of this instrument is thus faced with a dilemma: to replace it with a less risky one or not. The more such dilemmas, the more risky the instrument is. The measure of the number of these dilemmas is called the reachability of a financial instrument. The financial instrument A is reachable at any given time if there is a simple instrument that has a logarithmic price equal to the logarithmic price of the instrument A. Greater reachability can be associated with greater risk. We will show that simple instruments have the lowest reachability (they are the least risky). More formally, the concept of the reachability of a financial instrument can be represented by the Radon transform [2] defined on the space of simple instruments. Using this concept, we will propose a new measure of the risk of a financial instrument. The Radon transformation has led to a revolution in the field of medical imaging [3]. It is also used in astronomy, optics, and geophysics. Perhaps it will also allow us to look at the risk of financial instruments differently and to better understand the dynamics of financial markets.

References

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