

# Preface

Our everyday life is influenced by many unexpected (difficult to predict) events usually referred as a chance. Probably, we all are as we are due to the accumulation point of a multitude of chance events. Gambling games that have been known to human beings nearly from the beginning of our civilization are based on chance events. These chance events have created the dream that everybody can easily become rich. This pursuit made gambling so popular.

This book is devoted to the dynamics of the mechanical randomizers and we try to solve the problem why mechanical device (roulette) or a rigid body (a coin or a die) operating in the way described by the laws of classical mechanics can behave in such a way and produce a pseudorandom outcome.

During mathematical lessons in primary school we are taught that the outcome of the coin tossing experiment is random and that the probability that the tossed coin lands heads (tails) up is equal to  $1/2$ . Approximately, at the same time during physics lessons we are told that the motion of the rigid body (coin is an example of such a body) is fully deterministic. Typically, students are not given the answer to the question *Why this duality in the interpretation of the simple mechanical experiment is possible?*

Trying to answer this question we describe the dynamics of the gambling games based on the coin toss, the throw of the die, and the roulette run. The dynamics of this type of gambling can be described in terms of the Newtonian mechanics, so one can expect that the outcome can be predicted. We give evidence that from the point of view of dynamical systems this dynamics is predictable. However, due to high (but finite) sensitivity to initial conditions the very precise devices are necessary to predict the outcome, so practically this outcome is pseudorandom. Our studies do not give the general answer to the famous Albert Einstein's question *Does the God play dice?* which is connected with all the events in the whole universe but give evidence to the negative answer to the simpler question *Does the God play dice in the casino?* We give evidence that the pseudorandomness in mechanical systems can be fully understood in terms of nonlinear dynamics as temporal sensitivity to the initial conditions generated by nonsmooth properties of the randomizers.

This book is mainly for mathematicians and physicists interested in nonlinear phenomena. It can also be read by all interested in such chance problems as only basic classical mechanics is necessary to understand most of the text. It is also

addressed to gamblers but our results cannot be directly used to make fortune in the casino. However our results can help to understand that the betting systems that claim to be winning (particularly popular for roulette) are nothing more than charlatanism.

The book is organized as follows. Typical mechanical randomizers like a coin, a die, and a roulette are described in Chap. 2. In Chap. 3 we derive the equations of motion which allow to describe the dynamics of the gambling based on the coin toss, the throw of the die, and the roulette run. Chapter 4 explains why according to the theory of the dynamical systems this gambling is predictable but practically unpredictable. Finally, in Chap. 5 we discuss the origin of randomness in mechanical systems.

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