The project is devoted to **stochastic control theory** as well as optimization methods in operation research. It might be considered as **interdisciplinary** from the following two perspectives.

First, we are going to introduce and solve stochastic control problems which emerge from various areas such as Finance, Economics, Markov decision processes and Automatic control.

Second, the broad spectrum of methods we are using include tools from stochastic analysis, general theory of stochastic processes, Markov processes, partial differential equations as well as financial and actuarial engineering.

The project consists of three major topics, which are subsequently partitioned into families of more detailed problems. Let us now outline each research problem.

The first problem focuses on risk analysis in decision making. This type of analysis is natural in almost any activity subject to uncertainty. We are going to study problems related to analysis of controls taking into account potential risk (e.g. risk sensitive control), dependence of the market on big transactions (illiquidity of markets), model uncertainty (which comes from the fact our information about real world is limited) as well as different measurements of risk. In particular, we want to characterize optimal solutions for risk-sensitive control problem using impulse strategies that consist of a sequence of random times in which our control strategy is changed.

The second problem comes from mathematics of finance. We study markets with transaction costs, where we can buy asset for a bid price and sell for an ask price. We investigate problems related to these markets which are characterized only be the existing prices of financial instruments (so called model free approach) and markets with shadow price, i.e. the price which gives the same value of the functionals as in the case of market with bid and ask prices. We also want to study problems with general bid and ask prices, as well as the bounds for so called fair prices, which do not allow us to make profit without risk (good deal bounds). In particular, we want to study shadow prices in continuous time and propose a new framework for bid and ask spreads in the model free approach.

The third problem considers dynamic programming method in optimization. It says that optimal control over a time interval should be also optimal in time subintervals. We shall consider various kinds of dependence of the model with respect to the past (certain degrees of Markovianity). We are going to study the following research topics: time-consistency, dynamic measures related to risk and performance, methods of optimal investments based on analysis of future values, analysis of Poisson equations and control problems with partial and asymmetric information. In particular, we want to study the impact of time-consistency assumptions on a structure and solvability for various control problems.

Nowadays, the stochastic control theory starts to influence almost any decision making process. In the project we try to **tighten the link between dynamic programming and other research fields**. We hope that the realization of this project will help to establish additional links between theory and real-world applications. This also includes interdisciplinary cooperation between mathematicians and other scientists.