

# Optimal stopping problems: insurance-financial products and American options

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## Abstract

The dissertation is fundamental study from stochastic process theory motivated by risk theory, financial mathematics and random optimization problems. The approach for considered problems is based on martingale techniques, a fluctuation theory of Lévy processes and an optimization theory.

Two main problems are considered. Firstly, American options with a negative discount factor are analysed. The American options are basic and fundamental derivatives, and they are classical examples of more general problems called optimal stopping problems. In this thesis, the negative discount factor is considered. The interest in contracts with negative rate has appeared lately as a consequence of developing collateralized contracts. The negative discount factor appears naturally for e.g. *gold loans* and *stock loans*, where a credit rate is higher than a risk-free interest rate.

The second problem considers insurance-financial product against high drop of an instrument's price from its current supremum. The interest of such contracts has arisen after recent financial crisis, when huge and sudden prices drop cause huge losses for investors. The analysis of the above contracts considers a development of identities of exiting an interval and a half line by of the drawdown and drawup processes, and applying the mentioned identities in solving some optimal problems which are based on reflected processes.

The dissertation is based on results from 5 papers (3 of them published and 2 of them submitted for publication) which are joint work with Zbigniew Palmowski (5 joint papers) and Marzia de Donno (1 joint paper).