Study of the risk-adjusted pricing methodology model with methods of Geometrical Analysis

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Abstract. The risk-adjusted pricing methodology (RAPM) model generalize the famous Black-Scholes model for pricing of derivative securities. In the RAPM model the presence both transaction costs and the risk from an unprotected portfolio are took in account. Both the transaction costs (modeled after Hoggard, Whalley and Wilmott) and the unprotected portfolio risk depend on the time interval between two transactions. The minimizing of the total risk leads to the RAPM model firstly introduced by Kratka and modified later by Ševčovič and Jandačka. The model was studied recently with numerical methods in case of European and American options.

From analytical point of view this model is represented by a fully nonlinear parabolic differential equation (PDE) with a singular perturbation. Our goal is the study of the RAPM model with methods of Geometrical Analysis. Using the Lie group analysis we obtain the Lie algebra admitted by this equations. It gives us the possibility to describe the optimal system of subalgebras and correspondingly the set of invariant solutions to the RAPM model. On this way we can describe complete set of possible reductions to the given nonlinear PDE. Reductions are given in form of different second order ordinary differential equations (ODE) in some cases they can be reduced as well to the first oder ODE. We discuss the property of these reductions and corresponding invariant solutions.

Keywords transaction costs; invariant reductions; singular perturbation