

# Dynamic Risk-Averse Optimization

**Abstract.** We present the concept of a dynamic risk measure and discuss its important properties. In particular, we focus on time-consistency of risk measures and their local property. Next, we focus on dynamic optimization problems for Markov models. We introduce the concept of a Markov risk measure and we use it to formulate risk-averse control problems for two Markov decision models: a finite horizon model and a discounted infinite horizon model. For both models we derive risk-averse dynamic programming equations and a value iteration method. For the infinite horizon problem we also develop a risk-averse policy iteration method and we prove its convergence. We propose a version of the Newton method to solve a nonsmooth equation arising in the policy iteration method and we prove its global convergence. Finally, we discuss relations to Markov games.

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