

# Bayesian Emulation for Optimisation: Multi-Step Portfolio Decision Analysis

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## Abstract

We discuss Bayesian analysis in portfolio studies involving multi-step forecasts and decisions in financial time series. Using classes of economically and psychologically relevant multi-step ahead utility functions, we develop solutions to the resulting Bayesian expected utility optimization problem. The solution paths involve mapping the technical structure of (some) optimization problems to those of parallel, synthetic Bayesian inference problems in “emulating” statistical models. This provides access to standard Bayesian simulation and optimization methods that then yield indirect solutions of the decision problems. Study of sequential portfolio studies with multivariate currency, commodity and stock index time series illustrate the approach and show some of the practical utility and benefits of the new Bayesian decision analysis framework and methodology.

**Keywords:** Bayesian forecasting; Bayesian optimization; Dynamic dependency network models; Marginal and joint modes; Multi-step forecasting; Portfolio decisions; Simulation-based optimization; Synthetic statistical model