Notes on Stochastic Optimization Problems Formulation, Warren Powell

compiled by D.Gueorguiev, 2/25/25

# Formulating a Stochastic Optimization Problem

We will consider the ubiquitous inventory problem as an example and will study deterministic and stochastic formulations of the problem.

This requires the introduction of the notion of *policy* (or *control law*) which is a method for making decisions.

## Deterministic inventory problem

We want to solve a simple inventory in which we have to decide how much to order, , at time . We are going to assume that when we order , the items cannot be used until time . Let be the cost of items ordered in period (which can vary from one time period to the next), and assume we are paid a price when we satisfy the demand given by . Let be the sales at time , which is limited by the demand , and the available product which is our inventory plus our orders , so we can write

(1)

(2)

(3)

(4)

We assume that unsatisfied demand is lost. The left-over inventory is:

(5)

We set .

Now we formulate our deterministic optimization problem as

(6)

subject to the constraints (1) – (6)

# References

[1] [Reinforcement Learning and Stochastic Optimization: A Unified Framework for Sequential Decisions, Warren Powel, 2019](https://github.com/dimitarpg13/reinforcement_learning_and_game_theory/blob/main/books/Powell-Reinforcement-Learning-and-Stochastic-Optimization.pdf)