

Chapter 6

Mean-Variance Portfolio Theory

1. (Shorting with margin) The money invested is X_0 . The money received at the end of a year is $X_0 - X_1 + X_0$. Hence,

$$R = \frac{2X_0 - X_1}{X_0}$$

2. (Dice product) Let a and b be the outcomes of two dice rolls. Then $Z = ab$. By independence, we know

$$\begin{aligned} E[ab] &= E[a]E[b] \\ \text{and } \text{var}[Z] &= E[a^2]E[b^2] - (E[a]E[b])^2 \\ &= 79.97 \end{aligned}$$

3. (Two correlated assets) For solution method, see solution to problem called Two stocks (below).

(a) α equals $19/23$.

(b) The minimum standard deviation is approximately 13.7%.

(c) The expected return of this portfolio is approximately 11.4%.

4. (Two stocks) Let α, β equal the percent of investment in stock 1 and stock 2, respectively. The problem is

$$\min \alpha^2 \sigma_1^2 + \beta^2 \sigma_2^2 + 2\alpha\beta\sigma_{12}$$

$$\text{subject to } \alpha + \beta = 1.$$

Setting up the Lagrangian, L , we have:

$$L = \alpha^2 \sigma_1^2 + \beta^2 \sigma_2^2 + 2\alpha\beta\sigma_{12} - \lambda(\alpha + \beta - 1)$$

The first order necessary conditions are:

$$0 = \frac{\partial L}{\partial \alpha} = 2\alpha\sigma_1^2 + 2\beta\sigma_{12} - \lambda$$

Luenberger Chapter 6 Exercise

George Ellis



Luenberger Chapter 6 Exercise:

Observers in Control Systems George Ellis, 2002-10-16 Observers are digital algorithms that combine sensor outputs with knowledge of the system to provide results superior to traditional structures which rely wholly on sensors. Observers have been used in selected industries for years but most books explain them with complex mathematics. *Observers in Control Systems* uses intuitive discussion, software experiments, and supporting analysis to explain the advantages and disadvantages of observers. If you are working in controls and want to improve your control systems, observers could be the technology you need, and this book will give you a clear, thorough explanation of how they work and how to use them. Control systems and devices have become the most essential part of nearly all mechanical systems, machines, devices, and manufacturing systems throughout the world. Increasingly, the efficiency of production, the reliability of output, and increased energy savings are a direct result of the quality and deployment of the control system. A modern and essential tool within the engineer's kit is the Observer, which helps improve the performance and reduce the cost of these systems. George Ellis is the author of the highly successful *Control System Design Guide*, Second Edition. Unlike most controls books, which are written by control theorists and academics, Ellis is a leading engineer, designer, author, and lecturer working in industry directly with the users of industrial motion control systems. *Observers in Control Systems* is written for all professional engineers and is designed to be utilized without an in-depth background in control theory. This is a real-world book which will demonstrate how observers work and how they can improve your control system. It also shows how observers operate when conditions are not ideal and teaches the reader how to quickly tune an observer in a working system. Software Available online: A free, updated and enhanced version of the author's popular Visual ModelQ allows the reader to practice the concepts with Visual ModelQ models on a PC. Based on a virtual laboratory, all key topics are demonstrated with more than twenty control system models. The models are written in Visual ModelQ and are available on the Internet to every reader with a PC. Teaches observers and Kalman filters from an intuitive perspective. Explains how to reduce control system susceptibility to noise. Shows how to design an adaptive controller based on estimating parameter variation using observers. Shows how to improve a control system's ability to reject disturbances. Key topics are demonstrated with PC-based models of control systems. The models are written in both MatLab and ModelQ; models are available free of charge. [Linear and Nonlinear Programming](#) David G. Luenberger, Yinyu Ye, 2008-06-20 This third edition of the classic textbook in Optimization has been fully revised and updated. It comprehensively covers modern theoretical insights in this crucial computing area and will be required reading for analysts and operations researchers in a variety of fields. The book connects the purely analytical character of an optimization problem and the behavior of algorithms used to solve it. Now the third edition has been completely updated with recent Optimization Methods. The book also has a new co-author Yinyu Ye of California's Stanford University, who has written lots of extra material, including some on Interior Point Methods. **Elementary Convexity with Optimization** Vivek S. Borkar, K.

S. Mallikarjuna Rao, 2023-06-26 This book develops the concepts of fundamental convex analysis and optimization by using advanced calculus and real analysis. Brief accounts of advanced calculus and real analysis are included within the book. The emphasis is on building a geometric intuition for the subject which is aided further by supporting figures. Two distinguishing features of this book are the use of elementary alternative proofs of many results and an eclectic collection of useful concepts from optimization and convexity often needed by researchers in optimization, game theory, control theory, and mathematical economics. A full chapter on optimization algorithms gives an overview of the field touching upon many current themes. The book is useful to advanced undergraduate and graduate students as well as researchers in the fields mentioned above and in various engineering disciplines. Deterministic Observation Theory and Applications Jean-Paul Gauthier, Ivan

Kupka, 2001-10-08 This 2001 book presents a general theory as well as a constructive methodology to solve observation problems that is reconstructing the full information about a dynamical process on the basis of partial observed data. A general methodology to control processes on the basis of the observations is also developed. Illustrative but also practical applications in the chemical and petroleum industries are shown. This book is intended for use by scientists in the areas of automatic control, mathematics, chemical engineering, and physics. **Information Science** David G. Luenberger, 2012-01-12 From cell

phones to Web portals, advances in information and communications technology have thrust society into an information age that is far reaching, fast moving, increasingly complex, and yet essential to modern life. Now renowned scholar and author David Luenberger has produced *Information Science*, a text that distills and explains the most important concepts and insights at the core of this ongoing revolution. The book represents the material used in a widely acclaimed course offered at Stanford University. Drawing concepts from each of the constituent subfields that collectively comprise information science, Luenberger builds his book around the five E's of information: Entropy, Economics, Encryption, Extraction, and Emission. Each area directly impacts modern information products, services, and technology, everything from word processors to digital cash, database systems to decision making, marketing strategy to spread spectrum communication. To study these principles is to learn how English text, music, and pictures can be compressed; how it is possible to construct a digital signature that cannot simply be copied; how beautiful photographs can be sent from distant planets with a tiny battery; how communication networks expand; and how producers of information products can make a profit under difficult market conditions. The book contains vivid examples, illustrations, exercises, and points of historic interest, all of which bring to life the analytic methods presented. Presents a unified approach to the field of information science. Emphasizes basic principles. Includes a wide range of examples and applications. Helps students develop important new skills. Suggests exercises with solutions in an instructor's manual. Nonlinear Functional Analysis and its Applications E. Zeidler, 2013-12-11 As long as a branch of knowledge offers

an abundance of problems, it is full of vitality. David Hilbert: Over the last 15 years I have given lectures on a variety of problems in nonlinear functional analysis and its applications. In doing this I have recommended to my students a number of

excellent monographs devoted to specialized topics but there was no complete survey type exposition of nonlinear functional analysis making available a quick survey to the wide range of readers including mathematicians natural scientists and engineers who have only an elementary knowledge of linear functional analysis I have tried to close this gap with my five part lecture notes the first three parts of which have been published in the Teubner Texte series by Teubner Verlag Leipzig 1976 1977 and 1978 The present English edition was translated from a completely rewritten manuscript which is significantly longer than the original version in the Teubner Texte series The material is organized in the following way Part I Fixed Point Theorems Part II Monotone Operators Part III Variational Methods and Optimization Parts IV jV Applications to Mathematical Physics The exposition is guided by the following considerations a What are the supporting basic ideas and what intrinsic interrelations exist between them 3 In what relation do the basic ideas stand to the known propositions of classical analysis and linear functional analysis y What typical applications are there VII Preface viii Special emphasis is placed on motivation

Optimal Control for Chemical Engineers Simant Ranjan Upreti, 2016-04-19 This self contained book gives a detailed treatment of optimal control theory that enables readers to formulate and solve optimal control problems With a strong emphasis on problem solving it provides all the necessary mathematical analyses and derivations of important results including multiplier theorems and Pontryagin's principle The text presents various examples and basic concepts of optimal control and describes important numerical methods and computational algorithms for solving a wide range of optimal control problems including periodic processes

Numerical Methods for Linear Control Systems Biswa Datta, 2004-02-24 Numerical Methods for Linear Control Systems Design and Analysis is an interdisciplinary textbook aimed at systematic descriptions and implementations of numerically viable algorithms based on well established efficient and stable modern numerical linear techniques for mathematical problems arising in the design and analysis of linear control systems both for the first and second order models Unique coverage of modern mathematical concepts such as parallel computations second order systems and large scale solutions Background material in linear algebra numerical linear algebra and control theory included in text Step by step explanations of the algorithms and examples

Mathematics for Dynamic Modeling Edward Beltrami, 1998 This new edition of Mathematics for Dynamic Modeling updates a widely used and highly respected textbook The text is appropriate for upper level undergraduate and graduate level courses in modeling dynamical systems differential equations and linear multivariable systems offered in a variety of departments including mathematics engineering computer science and economics The text features many different realistic applications from a wide variety of disciplines The book covers important tools such as linearization feedback concepts the use of Liapunov functions and optimal control This new edition is a valuable tool for understanding and teaching a rapidly growing field Practitioners and researchers may also find this book of interest Contains a new chapter on stability of dynamic models Covers many realistic applications from a wide variety of fields in an accessible manner Provides a broad introduction to the full scope of dynamical systems Incorporates

new developments such as new models for chemical reactions and autocatalysis Integrates MATLAB throughout the text in both examples and illustrations Includes a new introduction to nonlinear differential equations Computer-based Exercises for Signal Processing Using MATLAB 5 James H. McClellan, 1998 For senior or introductory graduate level courses in digital signal processing Developed by a group of six eminent scholars and teachers this book offers a rich collection of exercises and projects which guide students in the use of MATLAB v5 to explore major topical areas in digital signal processing

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