Algorithmic Homework
Mathematical Techniques in Finance

Thoroughly explores the advanced mathematical techniques used in modern finance. Requiring comprehensive knowledge of the underlying principles and utilizing methods from calculus, this Algorithmic Homework resource facilitates mastery of the theory of interest and stimulates rigorous analysis of the techniques used in pricing, financing, investing, trading and managing risks and returns. The Algorithmic Homework resource combines academic thought, proof, theory and the application of formulas.

Measuring interest involved in single payment transactions

- Interest accumulation
- Nominal and effective rates of interest and discount
- The force of interest
- Future value at simple, compound and continuous rates
- Present value at simple, compound and continuous rates
- Equations of value
- Adjusting for inflation

Annuity valuation

- Future value of an ordinary annuity
- Future value of an annuity-due
- Present value of an ordinary annuity and an annuity-due
- Solving for the term, payment and yield of an annuity
- Valuation of deferred annuities
- Present value of a perpetuity as the limit of an annuity
- Valuing annuities with varying interest and periodic payments
- Continuous annuities
- Valuing annuities with inconsistent compounding and payment frequencies
- Valuing annuities that form a geometric progression
- Valuing annuities that form an arithmetic progression
- Applications to reinvestment risk, depreciation and other real world problems

Loans

- Amortization method of loan repayment
- Developing an amortization schedule
- Retrospective and prospective methods of loan outstanding
- Adjusting the repayment and/or term in response to changes in the loan interest rate
- Sinking-fund method of loan repayment
- Applications to valuing loans and other real world problems

Valuation of bonds

- Pricing a bond on a coupon date
- Pricing a bond between coupon dates
- Solving for the yield to maturity implied in a bond purchase
- Holding period return allowing for reinvestment rates
- Amortization of a bond
- Allowing for income and capital gains tax on bonds
- Applications to callable and serial bonds

Probability and random variables

- Introduction to the theory of probability
- Rules of probability and enumeration
- Random variables
- Probability distributions
- Expected value and variance
- Applications to portfolio theory

The rate of return on an investment

- Internal rate of return and net present value
- Payback period
- Profitability index
- Dollar-weighted rate of return
- Time-weighted rate of return
- Applications to investment decisions and fund management with continuous transactions

The term structure of interest rates

- Spot and forward rates
- Yield curves
- The relationship between spot rates and bond yields
- Applications to arbitrage and interest rate swaps
- Duration and immunization
- Duration of a series of cash flows and bond duration
- Convexity of a series of cash flows
- Asset-liability matching and immunization
- Applications to interest rate risk management

Valuing securities and financial instruments

- Pricing using the no arbitrage principle
- Forward and futures contracts
- Modelling returns using the CAPM approach
- Modelling using the binomial and Black-Scholes approaches
- Fixed income investments and bond default risk
- Foreign exchange rates and the interest rate parity theorem

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