# FINM3405 Derivatives and Risk Management

## Week 13: Course overview and revision

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# Contents

# Introduction

Last week we finished the final week of material for FINM3405, namely VaR and ES. This week we give a summary and revision of the topics covered in the course. This may or may not be somewhat of a "final exam tips" lecture. I recommend that you prepare some questions about the final exam and try your best to "trick me" into giving away as much as possible about the final exam's content. More seriously, you should ensure that you're relatively certain about on what material to focus your final exam preparation, revision and studies. Please note that it is likely that I will not be on campus again before the exam, since I also work (close to) full-time in the private sector. But of course, and as you've seen, I'm promptly responsive via email, the Discussion Board section of Blackboard, Microsoft Teams, etc.

# Lec 1 Intro

- Basic definitions of:
  - Futures and forwards.
  - Options.
  - Swaps, including interest rate, currency and credit default.
- Differences between futures and forwards.
- Basic payoff diagrams of futures/forwards and options.
- Central, foundational, fundamental building block concepts on which all of financial theory and practice are built:
  - Law of finance and present value (later became risk-neutral pricing).
  - No arbitrage and the law of one price.

# Lec 2-3 Futures & forwards

- Definitions, differences and payoff diagrams of futures and forwards.
- Margin mechanism and leverage effect for futures.
- How to calculate the value of a futures/forward contract.
- The following for the main classes of futures and forwards in terms of the underlying asset, namely commodities, equities, currencies and interest rates (FRA and BAB futures):
  - Main contracts and their specifications.
  - Perfect hedging examples.
  - Basic examples of speculating on the price of the underlying asset.
- Contract pricing via the cost of carry approach.
- Basis risk and optimal hedging.

# Lec 4-8 Options

- Definitions and concepts, including parties (taker, writer), vanilla types (puts & calls, European & American), asymmetric payoffs.
- Moneyness (ITM, ATM, OTM).
- Payoffs vs profits (including the premium).
- Main contracts and markets, contract specifications.
- Pricing bounds and put-call-parity.
- American call premium = European call premium when no dividends.
- Time value and intrinsic value.

# Lec 4-8 Options

Options continued:

- European option premiums/prices via the Black-Scholes model:
  - On non-dividend paying assets.
  - For dividend/income paying assets.
  - For currencies (simply viewed as dividend paying assets).
- Black-Scholes assumption of geometric Brownian motion and consequent log-normal distribution of the underlying asset's price, or normal distribution of the asset's returns.
- Simulating geometric Brownian motion in preparation for the Monte Carlo approach to derivative security pricing.
- Heuristic (non-rigorous) discussion of risk-neutral pricing.
- Heuristic (hand-waving) interpretation of the factors affecting option prices, and quantification of this via the Black-Scholes model Greeks.

# Lec 4-8 Options

Options continued:

- Using delta $\Delta$ and gamma $\Gamma$ to predict small changes in option prices due to small changes in the price of the underlying asset (in preparation for delta and delta-gamma hedging).
- More detailed discussion of theta $\theta$ and associated concept of time decay, and how it relates to moneyness.
- Basic ideas and examples of static delta hedging, static delta-gamma hedging, and dynamic delta hedging.
- Implied volatility and the volatility smile and term structure, and related VIX index enabling volatility to be directly traded.
- Trading strategies and their payoff and profit/loss diagrams.

# Lec 4-8 Options

Options continued:

- Binomial and Monte Carlo numerical option pricing methods:
  - The need for numerical methods:
    - Price more complex derivative securities.
    - More complex pricing methods than the Black-Scholes model, in particular because returns are not normally distributed.
  - 1-period binomial model for European option price and delta.
  - Multi-period binomial model for European option price and delta.
  - More rigorous introduction of risk-neutral pricing via binomial model.
  - Monte Carlo pricing of European options.
    - Simple method that simulates only final asset price.
    - More general method that simulates entire asset price paths in preparation for Monte Carlo pricing of path dependent options.

# Lec 4-8 Options

Options continued:

- Binomial model pricing of vanilla American options.
- Binomial pricing of chooser options.
- Monte Carlo pricing of some path dependent options:
  - Lookback options.
  - Barrier options.
  - Arithmetic average Asian options.

# Lec 9 CDS

- Basic definitions and concepts for credit default swaps.
- More precise description of mechanics, including notions of:
  - Analogy with insurance contracts.
  - Parties: protection buyer and seller.
  - Reference entity, assets and events.
  - Payout, including physical vs cash delivery.
  - Recovery rate and loss given default.
  - CDS coupon or spread or premium.
  - Single name vs multi name, basket, CDS indices.
  - Idea that CDS spreads reflect credit risk perceptions, and relation between breakeven CDS spread and reference entity's risk premium.
  - Survival and default probabilities.

# Lec 9 CDS

CDS continued:

- CDS pricing:
  - Calculating the breakeven CDS spread.
  - Or calculating the upfront cashflow given a fixed CDS spread.
- Speculating and hedging with CDS.
- Idea that CDS opened up credit risk as "just another" asset class that can be directly traded, like VIX indices did for volatility.

# Lec 10 Interest rate swaps

- Floating rate notes (FRN) definition, concepts and pricing in preparation for fixed-for-floating interest rate swap pricing.
- Fixed-for-floating interest rate swap definitions and concepts.
- Calculating the net cashflows on each coupon or interest date.
- The idea that a position in a fixed-for-floating interest rate swap can be replicated via positions in a FRN and a fixed coupon bond.
- Interest rate swap pricing: calculating the fixed rate.
- Hedging and speculating with interest rate swaps.

# Lec 12 VaR and ES

- Basic concepts relating to risk, including:
  - Types: market, default, liquidity, operational.
  - Portfolio expected return and standard deviation (volatility).
- Concepts related to the normal distribution in preparation for calculating value at risk (VaR) and expected shortfall (ES).
- The need for simple, single measures of market risk like VaR and ES.
- VaR and ES definitions, basic concepts, and differences.
- Potential shortcoming of VaR and consequent need for ES.
- Calculating VaR and ES via 2 methods:
  - Parametric approach assuming normally distributed returns.
  - Nonparametric approach directly using historical data.
- Parametric portfolio VaR, worst case VaR, diversification benefits.

# Best wishes in your future endeavours

I hope you learnt a lot from this course. All the best in the final exam and your future careers. Please don't hesitate to contact me anytime with any questions about the course, the course's material and topics, and the final exam.

# Summary