Mathematics Careers at ANZ

Author
Dr Jaime Bulbeck,
Head Quantitative Services Market Risk
ANZ Market Risk

Date
May 2, 2006

Presentation Overview

• A Career Profile
• Mathematics in Risk
• Mathematics in the Investment Bank
• The Ideal Graduate
• Miscellaneous

A Profile

Education
– B.E. (Aero) (Hons) University of Sydney 1987
– PhD. (Mech. Eng.) University of Melbourne 1998
  • Thesis ‘An Investigation of the Invariants of the Velocity Gradient Tensor in Transitioning and Turbulent Fluid Flow’
– Chance and Options Pricing, Mathematics of Options Pricing (3rd/4th year undergrad maths courses, Melbourne, Monash)
  • Mathematics Skill Set ->
    • Calculus, PDEs/ODEs, computational methods, programming (C/Fortran), mathematical modelling

Experience
– Defence Science and Technology Organisation
  • Engineer 1986-1993
    – Advanced Engineering Laboratories, Aeronautical Research Laboratories, Salisbury S.A. and Fishermen’s Bend, VIC
  • Research Scientist 1993-2001
    – Aeronautical and Maritime Research Laboratories
    • Performing Applied Aerodynamic Analysis and Computational Fluid Dynamics in support of the Australian Defence Force’s Air Operations.
High incidence missile flows

\[ M_\infty = 1.6, \alpha = 40° \]

cross-flow separation

bow shocks

leading-edge vortical flow

A Profile

Experience

- ANZ Market Risk
  - Quantitative Analyst 2001-
    - Performing quantitative financial analysis in support of ANZ’s Investment Banking operations

ANZ

- Household Name
- Top 5 Australian Company
- Assets ~AUD$300bn
- Worth ~AUD$40bn
- ~30,000 employees

ANZ

1H06 $1.73bn

Institutional

1H06 $486m

Markets

1H06 $338m

Group Risk

Institutional Risk

Market Risk
Financial Risk Management

Market Risk
Credit Risk
Operational Risk

- Losses on holdings of market-valued instruments due to movements in market rates
  - 'Trading Book' – Investment Banking
  - Foreign Exchange, Interest Rates, Commodities, Credit, Energy, Power etc.
    - Both fundamental and derivative contracts in all markets
- $V(t)$ the value of all our fundamental and derivative contracts at time $t$

Historical Simulation VaR, 500 Hypothetical P&Ls
Portfolio of 27 USD, JPY and XAU FX Options

- $F(x) = P(L(t_i; t) < x)$
- $i = 1, ..., 500$
- What's the Value-at-Risk (tail measure)?
  - Limits management
  - Capital
Financial Risk Management

Market Risk
- Losses on holdings of market-valued instruments due to movements in market rates
- ‘Trading Book’ – Investment Banking
- Foreign Exchange, Interest Rates, Commodities, Credit, Energy, Power etc.

Credit Risk
- Loss due to default of a counterparty to whom money has been lent
- ‘Banking Book’ – Commercial+Retail Banking
- Home loans, credit cards, loan facilities, line-of-credit etc.

Investment Banking

Derivatives – the Sell Side and the Buy Side
Investment Banking primarily ‘Sell-side’ – bank will package up products containing derivatives for clients to buy, whether for risk management or investment purposes.
Asset management ‘Buy-side’ – asset managers will make investments involving derivatives, taking a view on market direction

Derivatives Pricing and Risk Management

No Arbitrage Pricing Theory (Black/Scholes/Merton)
can construct a self-financing portfolio to replicate the derivative using a predictable trading strategy
Valuation is risk-neutral – the sell-side is agnostic to market direction or ‘risk-neutral’. The initial value of the self-financing portfolio is the same regardless of where the market moves
Sell-side will make its money by selling a derivative for more than the value of the replicating portfolio – goal is RISK-FREE PROFITS
Heavy Quant work involved in construction of the underlying rate models and derivative pricing models, construction of the replicating portfolios, measurement of residual risks – difficult and lucrative

Loss Density – Credit Risk analysis of a portfolio of loans

\[ p(l) = \binom{n}{l} p^l q^{n-l} \]

\[ n = 100 \]
\[ p = 0.2 \]
\[ q = 0.8 \]

- What’s the expected loss?
  - Pricing
- What’s the unexpected loss?
  - Capital
Derivatives Pricing and Risk Management

e.g. Black-Scholes underlying SDE (Geometric Brownian Motion) for $X_t$

$$dX_t = \mu X_t dt + \sigma X_t dB_t$$

Let $g(X_T)$ be the price of a derivative at maturity $t=T$. Application of Pricing Theory and use of the Feymann-Kac formula gives the PDE for the value of the derivative

$$\frac{\partial f(x,t)}{\partial t} + \frac{1}{2} \sigma^2 \frac{\partial^2 f(x,t)}{\partial x^2} + r \frac{\partial f(x,t)}{\partial x} = rf(x,t)$$

with $f(x,T)=g(x)$ and $r$ equal to the risk-free interest rate.

If the derivative is a call option, $g(x)=(x-K)^+$ and the solution to this equation is the classic Black-Scholes option pricing formula

$$f(S,0) = SN(d_1) - Ke^{-rT}N(d_1 - \frac{\sigma^2}{2}T),$$

where

$$d_1 = \frac{\ln(S/K) + (r + \frac{1}{2} \sigma^2)T}{\sigma \sqrt{T}}.$$
The Ideal Quant

Education
- PhD in a numerate discipline
  - Maths, Physics, Engineering, Computational Finance
- Financial Education (not essential)
  - Financial Mathematics subjects – Chance and Options Pricing, Mathematics of Options Pricing – basic for Quants
  - Securities Institute – basic
  - Master of Applied Finance – Macquarie University – advanced
  - Master of Quantitative Finance - UTS
  - MBA – very advanced

The Ideal Quant

Skills
- Maths
  - Stochastic Calculus, Martingales, Theory of Options Pricing, Change of Measure, PDEs, Monte-Carlo simulation etc, Probability theory, Numerical Methods
- Programming Skills
  - C/C++, VBA, Databases (SQL) preferred
- Investment Banking – Hot Topics
  - BGM interest rate model (term structure), Structured Credit (synthetic CDOs, CDO options, CDO$^2$), Electricity
- Risk – Hot Topics
  - Copulas, Fat-tailed dependency structures, EVT, multivariate distributions, convergence of credit & market risk, holistic capital allocation

The Ideal Quant

Traits
- Ability to communicate to technical and non-technical personnel
- Analytical ability
- Front Office
  - Ability to work under pressure
  - Ability to think under pressure
  - Ability not to get too stressed under pressure

Some Resources

Jobs Boards (by no means a complete list)
- Australia
  - Bank sites
  - www.seek.com use keywork “Quant”
- International
  - www.wilmott.com
Some Resources

Some Books (by no means a complete list)

- Finance Textbooks
  - John Hull, “Options, Futures and Other Derivatives”
  - Baxter and Rennie, “Financial Calculus”
  - Brigo and Mercurio, “Interest Rate Models – Theory and Practice”

- Good Reads about Wall Street Life
  - Michael Lewis, “Liars Poker”
  - Frank Partnoy, “FIASCO Blood in the Water on Wall Street”

Some Resources

ANZ Contacts
ANZ Careers  http://www.anz.com/aus/careers/default.asp
Graduate program  http://www.anz.com/aus/careers/Graduate.asp