GRM - Introduction

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What Is Risk?

- Profit or loss is a 0-1 event
  - either lose or make money
- Risk is likelihood of losing money and potential loss
  - what is the measure of that?
  - different types of risk need different measures
  - why we use volatility? (two in one?)
What is GRM?

• RM is a purely local matter, which varies from culture to culture, region to region, regulation to regulation
  – subjective
  – non-quantitative

• Globalization makes it more universal
  – objective
  – quantitative
Business risks vs financial risks

- ERP (Enterprise Resource Planning)
- Risks from the two sides of the balance-sheet
- Banks -- business risk is also financial risk (own financial assets)
Financial risks

- Market risk, equity, IR, FX, spread, prepayment, commodities, CVA/FVA (credit+liquidity)
- Credit risk
- Liquidity risk
- Operational risk
- (Collateral risk)
Goals of GRM

- Not to eliminate risk completely
  - concept of hedging
- But to put risk under control
  - maintain return goals
  - various tools for various risks
    - VaR for market risk
    - EL and UL for credit risk
    - liquidity discounts for liquidity risk
Extreme GRM

- Concept of hedging
  - Black-Scholes
  - Static hedging
    - use of futures and swaps -- complete elimination of risk
    - use of options -- maintain upside
  - Dynamic hedging
    - same idea but more frequent
    - requires models
Ways to measure/manage these risks

- market risk -- VaR, stress test
- credit risk -- JTD (jump to default), PD/LGD/EAD, EL (UL), CVA (?), CVaR
- liquidity risk -- liquidity disc model, LaR
- operational risk -- data mining
- collateral management
VaR and stress test

- **VaR**
  - historical
  - parametric
  - factor-based

- **Stress Test**
  - historical
Methodologies

- pricing models
  - deltas
- tree/lattice
- Monte Carlo simulations
Basic Models

• Equity
  – Black-Scholes/binomial, CAPM, local vol
• IR
  – Heath-Jarrow-Morton, Hull-White
• FX
  – Garman-Kolhegen (i.e. Black-Scholes)
• Commodities
  – Black, seasonality
Basic Models

- Morgages (prepayment)
  - Andrew-Davidson
- ABS
  - loss timing function
- Credit
  - Jarrow-Turnbull, Duffie-Singleton, transition matrix, ad-hoc approaches
Tools available

- Oldest -- Riskmetrics and Creditmetrics
- Enterprise -- IBM, Oracle, SAP, etc.
- Valuation -- Barra, Algo, etc.
- Consulting -- Big 3, McKinsey, etc.
- Proprietary -- large banks
Basel Accords

• First Accord in 1988
  – orig meant for G10 countries
  – now used over 100 nations
• Accord II in 1998
  – formally published in 2004
• Accord III in 2011 (?)
  – on going
The bank must maintain capital (Tier 1 Tier 2) equal to at least 8% of its RWA

- 0% - cash, any OECD government debt
- 0%, 10%, 20% or 50% - public sector debt
- 20% - development bank debt, OECD bank debt, OECD securities firm debt, non-OECD bank debt (under one year maturity) and non-OECD public sector debt, cash in collection
- 50% - residential mortgages
- 100% - private sector debt, non-OECD bank debt (maturity over a year), real estate, plant and equipment, capital instruments issued at other banks
Tier 1 Capital

• Tier 1 capital is the core measure of a bank's financial strength. It is composed of
  – common stock and
  – disclosed reserves (or retained earnings), but may also include
  – non-redeemable non-cumulative preferred stock.
Tier 1 Capital

• The Basel Committee also observed that banks have used innovative instruments over the years to generate Tier 1 capital; these are subject to stringent conditions and are limited to a maximum of 15% of total Tier 1 capital.
Tier 2 Capital (supplementary capital)

• Tier 2 is limited to 100% of Tier 1 capital
  – Undisclosed reserves
  – Revaluation reserves
  – General provisions/general loan-loss reserves
  – Hybrid debt capital instruments
  – Subordinated term debt
Tier 3 Capital

- Banks will be entitled to use Tier 3 capital solely to support market risks as defined in paragraphs 709 to 718(Lxix).
- Tier 3 capital will be limited to 250% of a bank’s Tier 1 capital that is required to support market risks.
  - This means that a minimum of about 28½% of market risks needs to be supported by Tier 1 capital that is not required to support risks in the remainder of the book;
Capital

- Regulatory (reg) capital
  - Fixed (8%)
  - IRB
- Risk-adjusted return on capital (RAROC)
  - $= \frac{\text{Expected Return}}{\text{Economic Capital}}$
  - $= \frac{\text{Expected Return}}{\text{Value at Risk}}$
Capital

• Economic capital
  – It is the amount of risk capital which a firm requires to cover the risks that it is running or collecting as a going concern, such as market risk, credit risk, and operational risk.
  – Firms and financial services regulators should then aim to hold risk capital of an amount equal at least to economic capital.
Capital Ratios

- Tier 1 capital ratio = Tier 1 capital / Risk-adjusted assets ≥ 6%
- Total capital (Tier 1 and Tier 2) ratio = Total capital (Tier 1 and Tier 2) / Risk-adjusted assets ≥ 10%
- Leverage ratio = Tier 1 capital / Average total consolidated assets ≥ 5%
Capital Ratios

- Common stockholders’ equity ratio = Common stockholders’ equity / Balance sheet assets
Basel II

• Three pillars
  – framework encompassing risk-based capital requirements for credit risk, market risk, and operational risk (Pillar 1);
  – supervisory review of capital adequacy (Pillar 2);
  – and market discipline through enhanced public disclosures (Pillar 3).
Basel II

- June 2006, A Revised Framework
  - risk-based capital for credit risk and for operational risk
- December 7, 2007, OCC, FDIC, OTS issued a final rule
  - advanced internal ratings-based approach for credit risk and the advanced measurement approach for operational risk
Basel II

the advanced approaches rule defines a core bank as a bank that has consolidated total assets of $250 billion or more, has consolidated on-balance sheet foreign exposure of $10 billion or more, or is a subsidiary of a core bank.
Basel III

• Increased overall capital requirement
  – Between 2013 and 2019, the common equity component of capital (core Tier 1) will increase from 2% of a bank’s risk-weighted assets before certain regulatory deductions to 4.5% after such deductions.
  – A new 2.5% capital conservation buffer will be introduced, as well as a zero to 2.5% countercyclical capital buffer.
Basel III

• Increased overall capital requirement
  – The overall capital requirement (Tier 1 and Tier 2) will increase from 8% to 10.5% over the same period.

• Increased capital charges
  – Commencing 31 December 2010, re-securitization exposures and certain liquidity commitments held in the banking book will require more capital.
Basel III

• Increased capital charges
  – In the trading book, commencing 31 December 2010, banks will be subject to new “stressed” value-at-risk models, increased counterparty risk charges, more restricted netting of offsetting positions, increased charges for exposures to other financial institutions and increased charges for securitisation exposures.
Basel III

- New leverage ratio
  - A minimum 3% Tier 1 leverage ratio, measured against a bank’s gross (and not risk-weighted) balance sheet, will be trialled until 2018 and adopted in 2019.
Basel III

• Two new liquidity ratios
  – A “liquidity coverage ratio” requiring high-quality liquid assets to equal or exceed highly-stressed one-month cash outflows will be adopted from 2015.
  – A “net stable funding ratio” requiring “available” stable funding to equal or exceed “required” stable funding over a one-year period will be adopted from 2018.
## Balance Sheet

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>Assets</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Assets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash And Cash Equivalents</td>
<td>308,051,000</td>
<td>281,874,000</td>
<td>219,233,000</td>
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<tr>
<td>Short Term Investments</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Net Receivables</td>
<td>74,455,000</td>
<td>78,140,000</td>
<td>67,900,000</td>
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<tr>
<td>Inventory</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Other Current Assets</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total Current Assets</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Long Term Investments</td>
<td>517,547,000</td>
<td>523,259,000</td>
<td>532,341,000</td>
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<tr>
<td>Property Plant and Equipment</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Goodwill</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Intangible Assets</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Accumulated Amortization</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Other Assets</td>
<td>23,152,000</td>
<td>28,059,000</td>
<td>29,488,000</td>
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<tr>
<td>Deferred Long Term Asset Charges</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total Assets</strong></td>
<td>923,225,000</td>
<td>911,332,000</td>
<td>848,942,000</td>
</tr>
<tr>
<td><strong>Liabilities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Liabilities</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Accounts Payable</td>
<td>662,943,000</td>
<td>659,208,000</td>
<td>624,564,000</td>
</tr>
<tr>
<td>Short/Current Long Term Debt</td>
<td>213,540,000</td>
<td>210,187,000</td>
<td>165,876,000</td>
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<tr>
<td>Other Current Liabilities</td>
<td>46,109,000</td>
<td>38,559,000</td>
<td>39,418,000</td>
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<tr>
<td>Total Current Liabilities</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Long Term Debt</td>
<td>210,909,000</td>
<td>212,776,000</td>
<td>209,219,000</td>
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<tr>
<td>Other Liabilities</td>
<td>38,983,000</td>
<td>41,223,000</td>
<td>49,082,000</td>
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<tr>
<td>Deferred Long Term Liability Charges</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Minority Interest</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Negative Goodwill</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total Liabilities</strong></td>
<td>852,840,000</td>
<td>833,976,000</td>
<td>778,228,000</td>
</tr>
<tr>
<td><strong>Stockholders’ Equity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Misc Stocks Options Warrants</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Redeemable Preferred Stock</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Preferred Stock</td>
<td>3,100,000</td>
<td>6,957,000</td>
<td>6,957,000</td>
</tr>
<tr>
<td>Common Stock</td>
<td>8,000</td>
<td>8,000</td>
<td>8,000</td>
</tr>
<tr>
<td>Retained Earnings</td>
<td>59,834,000</td>
<td>57,163,000</td>
<td>50,252,000</td>
</tr>
<tr>
<td>Treasury Stock</td>
<td>(42,281,000)</td>
<td>(38,295,000)</td>
<td>(32,158,000)</td>
</tr>
<tr>
<td>Capital Surplus</td>
<td>45,553,000</td>
<td>42,103,000</td>
<td>39,770,000</td>
</tr>
<tr>
<td>Other Stockholder Equity</td>
<td>5,165,000</td>
<td>7,420,000</td>
<td>5,883,000</td>
</tr>
<tr>
<td><strong>Total Stockholder Equity</strong></td>
<td>70,379,000</td>
<td>77,356,000</td>
<td>70,714,000</td>
</tr>
<tr>
<td><strong>Net Tangible Assets</strong></td>
<td>70,379,000</td>
<td>77,356,000</td>
<td>70,714,000</td>
</tr>
<tr>
<td>Lehman Brothers Inc.</td>
<td>as of 2002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------</td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Assets</strong></td>
<td><strong>Liabilities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash</td>
<td>2,265</td>
<td>Short-term Debt</td>
<td>123</td>
</tr>
<tr>
<td>Securities</td>
<td>70,881</td>
<td>Other Securities</td>
<td>50,352</td>
</tr>
<tr>
<td>Coll Ag’mt</td>
<td>101,149</td>
<td>Coll ST Financing</td>
<td>121,844</td>
</tr>
<tr>
<td>Receivables</td>
<td>21,191</td>
<td>Payables</td>
<td>12,758</td>
</tr>
<tr>
<td>Real Estate</td>
<td>138</td>
<td>Long-Term Debt</td>
<td>7,990</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Equity</td>
<td>3,152</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>196,219</td>
<td><strong>Total</strong></td>
<td>196,219</td>
</tr>
</tbody>
</table>

million $
Market Risk

- **Value at Risk (VaR)**
  - by JPM in early 90s
  - Riskmetrics
  - a quantitative concept of exposure
  - normal distribution (fat tails)
  - industry standard
  - regulatory requirement
VaR
VaR
VaR
VaR

• Challenges
  – consolidate various assets
    • equities, IR, FX, commodities, derivatives, off-balance items, ...
  – consolidate liquid & illiquid assets
    • valuation
    • pricing models are needed
  – consolidate long and short term assets
    • term structure
Credit Risk

- Understanding credit risks
  - bankruptcy
  - rating migration
  - spread changes
Credit Risk

• Measures of credit risks
  – spread
  – PD/LGD
  – JTD
  – EL/UL
  – CVaR
Jump to default risk

Global CDO market for 2006-07

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Unexpected Loss

EL = PD × LGD

Expected Loss (EL)  VaR  WCL

Unexpected losses (UL = VaR - EL)

Economic capital at 99.9%

Stress loss

0.1% Tail

Portfolio Loss

Frequency

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Unexpected Loss

\[ EC_p(\alpha) = VAR(\alpha) - EL_p \]

\[ ES(\alpha) = E[L_p | L_p > VAR(\alpha)] \]

Distribution of Credit Losses

- **Expected Loss (EL)**
- **Credit VAR**
- **ES**

**EL = EAD \times PD \times LGD**
PD & LGD
PD & LGD

• Models for PD and LGD
  – reduced form
    • Jarrow-Turnbull
    • Duffie-Singleton
  – structural
    • Merton
    • Geske
    • KMV
Italy
Spain
Greece
Credit curves

Model Yield Curve for Euro Market

Yield (bps)

Maturity (yrs)
Credit VaR

- Distance from the mean to the percentile of the forward distribution
  - at the desired confidence level
  - paraphrased from the PRMIA Handbook
  - = unexpected credit loss at the desired confidence level
  - mean $15m, 95% loss is $40m, Credit VaR $25m
Credit VaR

Graph is illustrative, not to scale.

Distribution of the Future Value of a credit portfolio (graph is illustrative, not to scale)

Note that under this way of calculating credit VaR, both expected and unexpected losses are part of the VaR.
Credit Value Adjustment

- Credit exposure
- VA
  - adjust prices to the “right” level
    - most prices are estimated with crude models
    - VA takes time so not run frequently
- CVA (counterparty/credit VA)
Liquidity Quantification

- Systemic risk
  - caused by high correlation
- Collateral management
  - rehypothecation
Liquidity Quantification

• Basel III Liquidity Requirements
  – Liquidity gap and time profile of gaps
    Bessis, Risk Management in Banking, pg 137, 2002
Lehman Default

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