

QRM Chapter 1 Questions

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Chapter 1 Review – Suggested Answers

Exercise 1.1 (Types of financial risk)

- (a) **Market risk.** Risk of losses in on- and off-balance-sheet positions arising from movements in market prices (interest rates, equity prices, FX rates, credit spreads, commodities, volatility, etc.). *Example:* A bank holding a portfolio of long-term fixed-rate bonds suffers losses when interest rates rise and bond prices fall.
- (b) **Credit risk.** Risk of loss due to a counterparty's failure to meet its contractual obligations in full and on time. *Example:* A corporate borrower defaults on a term loan, or a derivatives counterparty fails to pay a large mark-to-market amount.
- (c) **Operational risk.** Risk of loss resulting from inadequate or failed internal processes, people and systems or from external events. This includes internal fraud, external fraud, processing errors, system outages and legal/compliance failures. *Example:* A trader enters a fat-finger order that is not caught by controls, creating a large, unintended position and loss.
- (d) **Model risk.** Risk of losses or wrong decisions arising from the use of incorrect, mis-specified, mis-calibrated or mis-implemented models, or from using a model outside its domain of validity. *Example:* A VaR model that assumes normal returns and ignores liquidity risk leads to a severe underestimation of tail losses in stressed markets.
- (e) **Systemic risk.** Risk that distress or failure of a large or highly interconnected institution, market segment or infrastructure triggers serious dislocation of the broader financial system and real economy. *Example:* The failure of a major dealer bank causing fire sales and funding stress across many other institutions.

Exercise 1.2 (Financial crisis of 2007–9)

- **Build-up.** In the years before 2007, low interest rates, a housing boom and lax underwriting standards led to rapid growth in U.S. residential

mortgages, including subprime loans. Mortgages were securitized into MBS and CDOs, often highly rated, and sold worldwide. Banks and shadow-banking entities increased leverage and relied heavily on short-term wholesale funding.

- **Unwinding of the housing bubble.** Rising delinquencies and falling house prices undermined the value of mortgage-related securities. Confidence in structured products and their ratings declined; funding markets for securitization structures froze.
- **2007–early 2008.** Problems emerged at mortgage lenders and structured investment vehicles, followed by the failure of several institutions (e.g. Bear Stearns' hedge funds and later the firm itself). Interbank money markets became stressed as banks hoarded liquidity.
- **Lehman and systemic phase (autumn 2008).** Lehman Brothers filed for bankruptcy; AIG required a large rescue; money-market funds “broke the buck”; unsecured funding and securitization markets froze. Global equity markets fell sharply and trade financing and credit to the real economy contracted.
- **Policy response.** Central banks provided massive liquidity support; governments guaranteed bank liabilities, injected capital and in some cases nationalised institutions. Fiscal stimulus packages were implemented. Major regulatory-reform agendas (Basel III, new resolution regimes, etc.) were launched.
- **Main causes (very briefly).** Excessive leverage and maturity transformation, misaligned incentives in the originate-to-distribute model, over-reliance on ratings and models, inadequate liquidity and systemic-risk regulation, and weak governance and risk management at many institutions.

Exercise 1.3 (Bank run)

A *bank run* occurs when many depositors¹ simultaneously try to withdraw their funds from a bank because they fear it may become insolvent or illiquid. Since banks transform short-term deposits into longer-term, illiquid assets, they cannot meet large sudden withdrawals without selling assets at depressed prices or failing.

Historical examples include:

- U.S. bank runs during the Great Depression (early 1930s), when thousands of banks failed as depositors rushed to withdraw funds.
- The 2007 run on Northern Rock in the U.K., where depositors lined up outside branches after the bank required emergency liquidity from the central bank.

¹Retail or wholesale

Exercise 1.4 (Regulatory frameworks)

(a) **Three-pillar concept.** Both Basel and Solvency II are structured around three broadly similar pillars:

Pillar 1 Quantitative requirements.

- Basel: minimum capital requirements for credit, market and operational risk; later also leverage and liquidity ratios.
- Solvency II: quantitative requirements for insurers, including valuation of assets and liabilities on an economic basis and capital requirements (Solvency Capital Requirement, SCR, and Minimum Capital Requirement, MCR).

Pillar 2 Supervisory review and governance.

- Basel: Internal Capital Adequacy Assessment Process (ICAAP), supervisory review (SREP), assessment of risk management, governance and internal controls.
- Solvency II: Own Risk and Solvency Assessment (ORSA), governance requirements, fit-and-proper rules, risk-management and internal-control standards.

Pillar 3 Market discipline / disclosure.

- Basel: disclosure of risk profile, capital and risk-management practices to enable market discipline.
- Solvency II: extensive public and regulatory reporting (Solvency and Financial Condition Report, etc.) to increase transparency for policyholders and markets.

(b) Comparison of Basel vs. Solvency II.

- **Sector and scope.** Basel applies to banks and investment firms globally; Solvency II applies primarily to insurance and reinsurance undertakings in the EU/EEA.
- **Risk focus.** Basel focuses on credit, market, operational and (under newer rules) liquidity and interest-rate-in-the-banking-book risk. Solvency II focuses on market, credit, insurance underwriting, lapse, catastrophe and operational risks affecting insurers' balance sheets.
- **Capital metrics.** Basel capital ratios are based on regulatory capital divided by risk-weighted assets; Solvency II is based on an economic balance sheet, with SCR calibrated to a high confidence level over one year, plus an MCR floor.

- **Use of internal models.** Both frameworks allow advanced/internal models with supervisory approval, but Solvency II typically embeds a more “full balance sheet” internal-model approach for insurers, whereas Basel often allows internal models only for particular risk types and now increasingly constrains them by standardised “floors”.
- **Macroprudential aspects.** Basel (especially Basel III) explicitly includes macroprudential tools (countercyclical buffers, G-SIB surcharges); Solvency II is more microprudential, with some macroprudential extensions still evolving.

Exercise 1.5 (Procyclicality)

Procyclicality refers to mechanisms that amplify the economic or financial cycle: they make booms stronger and busts deeper. In the context of regulatory capital, it means that measured risks and required capital tend to be low in good times (encouraging more lending and leverage) and high in bad times (forcing deleveraging and credit contraction).

Risk-sensitive capital requirements based on recent historical data and market prices can be procyclical: during expansions, defaults are low and spreads tight, so calculated risk and capital are low; in downturns, rising defaults and widening spreads increase risk weights and capital requirements, encouraging banks to cut lending exactly when the real economy needs credit.

Exercise 1.6 (Basel III)

Key changes introduced (or reinforced) under Basel III include:

- **Higher and better-quality capital.** Greater emphasis on common equity Tier 1 (CET1), tighter eligibility criteria for capital instruments and higher minimum ratios.
- **Capital buffers.** Introduction of the capital conservation buffer, countercyclical buffer and additional surcharges for systemically important banks.
- **Leverage ratio.** A simple, non-risk-based leverage ratio (Tier 1 capital/total exposure) as a backstop to risk-weighted capital requirements.
- **Liquidity standards.** The Liquidity Coverage Ratio (LCR) for short-term (30-day) stress and the Net Stable Funding Ratio (NSFR) for longer-term funding stability.
- **Improved risk coverage.** Stronger capital treatment for trading-book exposures, securitisation and counterparty credit risk (including CVA risk).
- **Output floor and constraints on models.** An output floor limiting the benefits from internal models relative to standardised approaches, to address excessive variability of risk-weighted assets across banks.

These changes address Basel II shortcomings such as insufficient capital and liquidity, over-reliance on internal models, undercapitalised trading and securitisation activities, and a lack of macroprudential focus.

Exercise 1.7 (Capital adequacy, leverage and liquidity coverage ratios)

- **Capital adequacy ratios.** Risk-based measures comparing regulatory capital to risk-weighted assets (e.g. CET1 ratio). They focus on *solvency* given the risk profile, and rely on risk weights (standardised or model-based).
- **Leverage ratios.** Non-risk-sensitive ratios of Tier 1 capital to a broad measure of total exposures (on- and off-balance sheet). They constrain overall leverage and act as a simple backstop against model error and underestimation of risk.
- **Liquidity coverage ratios (LCR).** Ratios of high-quality liquid assets to net cash outflows over a short stress horizon (typically 30 days). They address *liquidity risk*, not insolvency, and ensure banks can survive short-term funding stress without resorting to fire sales.

Thus, capital adequacy ratios target risk-sensitive solvency, leverage ratios target overall balance-sheet size, and liquidity coverage ratios target short-term funding and market liquidity.

Exercise 1.8 (Major failures)

For each case, we briefly summarise what happened and the main risk-management failures.

- (a) **Barings Bank.** Collapsed in 1995 after a single trader (Nick Leeson) built up huge, largely unhedged positions in Nikkei futures and options, hiding losses in an error account. Failures included lack of segregation between front and back office, poor supervision, inadequate limits and oversight, and concentration of market and operational risk in one individual.
- (b) **Metallgesellschaft (MG).** The U.S. subsidiary MGRM sold long-term fixed-price oil supply contracts and attempted to hedge them with short-dated futures and swaps, rolling these positions forward. When the oil market moved into contango, the hedges generated large margin calls, creating a severe liquidity and funding problem. The case highlights maturity mismatch, basis risk, liquidity risk and governance issues around complex hedging programmes.
- (c) **Sumitomo.** Over roughly a decade, trader Yasuo Hamanaka engaged in large, mostly unauthorized positions in copper, attempting effectively to

corner the market. When positions were unwound, the firm suffered multi-billion losses. Key failures: weak supervision and controls, inadequate position limits and monitoring, and concentration of market risk.

- (d) **Société Générale.** In 2008, the bank revealed large unauthorized positions in equity index futures taken by trader Jérôme Kerviel, leading to losses of several billion euros when the positions were rapidly closed in a falling market. Failures included ineffective monitoring of limit breaches, control overrides, and insufficient challenge of unusual trading patterns.
- (e) **Orange County.** The county treasurer ran a leveraged investment pool funded partly by short-term borrowing and invested heavily in interest-rate-sensitive securities that performed well when rates were low. Rising interest rates caused large mark-to-market losses and margin calls, leading to the county's bankruptcy. Failures: poor understanding of interest-rate and leverage risk, inadequate governance and oversight of public funds.
- (f) **Long-Term Capital Management (LTCM).** A highly leveraged hedge fund pursuing relative-value strategies in fixed income and other markets. Its models assumed stable correlations and liquidity; when crises in emerging markets and Russia caused spreads and correlations to move sharply, LTCM suffered huge losses and was rescued via a private-sector bailout. Failures: excessive leverage, liquidity and funding risk, model risk and concentration risk in crowded trades.
- (g) **American International Group (AIG).** AIG's Financial Products unit wrote very large volumes of credit default swaps on senior tranches of mortgage-related securities, with limited collateral requirements in benign conditions. When spreads widened and collateral calls surged during the crisis, AIG faced a severe liquidity shortfall and required government support. Failures: underestimation of tail credit and correlation risk, insufficient liquidity planning for collateral calls, and weak group-wide risk aggregation.
- (h) **Amaranth Advisors.** A multi-strategy hedge fund that, by 2006, had become heavily concentrated in leveraged natural-gas positions. Unfavourable price moves and volatility led to very large losses in a short period and the fund's collapse. Failures: concentration in one strategy, inadequate limits and stress testing, and insufficient attention to liquidity and position-sizing.

Exercise 1.9 (Market crashes)

- (a) **Wall Street Crash of 1929.** Rapid credit-fuelled stock-price rises, speculation on margin and overvaluation were followed by sharp falls in October 1929 (Black Thursday, Black Monday, Black Tuesday). The crash contributed to the Great Depression and highlighted vulnerabilities from leverage and inadequate regulation. Key regulatory outcomes included

the creation of securities regulation and supervision (e.g. securities laws, securities regulators, restrictions on bank securities activities) and deposit insurance schemes.

- (b) **Black Monday (19 October 1987).** Global equity markets fell dramatically; the Dow Jones Industrial Average dropped over 20% in one day. Contributing factors included overvaluation concerns, program trading and portfolio-insurance strategies that triggered automatic selling as markets fell. Responses included the introduction of market-wide and single-stock circuit breakers, better coordination among exchanges and enhanced risk controls on program trading. Lessons: feedback loops created by mechanistic strategies and leverage can greatly amplify shocks.
- (c) **Flash Crash (6 May 2010).** U.S. equity indices experienced a very sharp intraday drop and rebound within minutes. The episode involved a large automated sell order in futures interacting with thin liquidity and high-frequency trading strategies, leading to extreme short-term price dislocations. Regulatory responses included limit-up/limit-down mechanisms, refined circuit breakers, tighter controls on erroneous orders and greater scrutiny of high-frequency and algorithmic trading. Risk managers learned the importance of intraday liquidity and market-structure risk.

Exercise 1.10 (Natural catastrophes)

- (a) **Kobe Earthquake (1995).** A major earthquake struck the Kobe region of Japan, causing severe damage to housing, infrastructure and industrial facilities, and large numbers of casualties. Economic losses were extremely high, but only a fraction was insured. Consequences included significant reconstruction needs, pressure on insurers and reinsurers, and reforms in building codes, disaster preparedness and catastrophe-risk modelling.
- (b) **Hurricane Katrina (2005).** Hurricane Katrina devastated New Orleans and parts of the U.S. Gulf Coast, with large-scale flooding after levee failures, major disruption to energy infrastructure and long-lasting social and economic impacts. It produced very large insured losses and reinsurance claims, making it one of the costliest natural catastrophes for the insurance industry. The event prompted changes in flood defences, revisions to catastrophe models, re-pricing and restructuring of property and flood insurance, and debates about the role of public schemes in covering extreme risks.
- (c) **Thailand Floods (2011).** Prolonged flooding in Thailand inundated major industrial parks, disrupting global supply chains in sectors such as automotive and electronics. Economic losses and business interruption were substantial, and insurers faced significant contingent business-interruption and property claims. The event highlighted the importance of supply-chain risk management, geographic diversification of production

and insurance, and led to adjustments in pricing and capacity for flood and contingent business-interruption cover.

Exercise 1.11 (Risk and uncertainty)

One succinct definition is:

Risk is the effect of uncertain future events on objectives, typically characterised by a probability distribution of possible outcomes (losses and gains).

A common distinction is that *risk* refers to situations where probabilities can be meaningfully assessed or modelled, whereas *uncertainty* refers to situations where such probabilities are unknown or not reliably quantifiable (“Knightian uncertainty”). In practice, many problems have both elements; risk management often treats some uncertainty as if it were quantifiable risk, while recognising model risk and residual uncertainty.

Exercise 1.12 (The Q in QRM)

Quantitative methods are indispensable in modern risk management for measuring exposures, pricing risk, setting capital and liquidity requirements, and performing stress tests and scenario analyses. However, the crisis experience shows that quantitative models alone are not sufficient: they can be misspecified, misused, or blind to structural breaks and feedback effects.

A reasonable view is that *quantitative methodology should continue to play a central, but not dominant or isolated, role*. It should be:

- embedded in strong governance, with qualitative judgement, expert oversight and challenge;
- complemented by stress testing, reverse stress testing and scenario analysis that explore model uncertainty and extreme events beyond historical data;
- transparent about assumptions, limitations and data quality, with explicit treatment of model risk.

So the aim is not “more or less maths” in isolation, but better integration of quantitative tools with judgement, incentives and a culture of risk awareness.

Exercise 1.13 (Trends in financial regulation)

(a) Has risk regulation become too complex? Regulation has undoubtedly become more complex: Basel III (and its “endgame” reforms), Solvency II, detailed liquidity and stress-testing regimes, derivatives clearing rules, etc. run to many hundreds of pages. Complexity can be beneficial when it reflects a genuine need for risk sensitivity and addresses lessons from crises. However, it can also:

- make rules harder to understand and implement, especially for smaller institutions;
- increase compliance costs and reliance on specialists and consultants;
- create scope for regulatory arbitrage and opacity if only experts can fully grasp the rules.

There is an ongoing debate about the right balance between risk sensitivity and simplicity.

(b) Movement away from internal models to simpler standardised approaches? Recent trends do show more scepticism about complex internal models:

- Basel reforms introduce output floors and restrict model use for some portfolios, pushing outcomes closer to standardised approaches.
- Supervisors have increased scrutiny of model risk, sometimes questioning whether model-based RWA variability is justified.
- Parallel simpler measures (like leverage ratios and standardised capital and liquidity metrics) are used as backstops.

This does not mean a complete rejection of internal models, but rather a shift towards a more constrained and complementary role for them.

Exercise 1.14 (Regulation and credit provision)

Proposition: “Increased regulation strangles credit provision.”

Arguments in favour.

- Higher capital and liquidity requirements raise banks’ effective funding costs and may reduce return on equity, which can be passed on via higher lending spreads and tighter credit standards.
- Complex rules and supervisory expectations can discourage lending to riskier borrowers (e.g. SMEs, long-term infrastructure) that receive high risk weights or unfavourable treatment under standardised approaches.
- Compliance and reporting costs may disproportionately burden smaller institutions, potentially reducing competition and credit availability in some segments.

Arguments against.

- Well-capitalised and liquid banks are more resilient and better able to maintain lending during stress; severe crises and banking failures cause far larger and more persistent contractions in credit than incremental regulatory tightening.
- Empirical studies often find that moderate increases in capital requirements have a limited impact on lending volumes over the medium term, especially when phased in.
- Regulation can level the playing field, reduce excessive risk-taking and support sustainable credit growth by curbing boom-bust cycles and implicit subsidies for highly leveraged institutions.

Overall, tight regulation can have some short-run costs for credit growth, but may increase the availability and stability of credit over the long term by reducing the frequency and severity of crises.

Exercise 1.15 (Shadow banking and insurance)

(a) Shadow banking. The *shadow banking* (or non-bank financial intermediation) sector consists of credit intermediation activities performed by entities outside the traditional, regulated banking system, often involving maturity transformation, liquidity transformation or leverage, but with less direct prudential oversight and no direct access to central bank liquidity or deposit insurance.

Examples include:

- money-market and other investment funds providing short-term funding to banks and firms;
- securitisation vehicles and asset-backed commercial paper conduits;
- securities lending and repo markets conducted through non-bank entities;
- some hedge funds and finance companies engaged in lending or liquidity transformation.

Shadow banking can improve credit access and risk sharing, but also create systemic risks through runs on short-term funding, fire sales and interconnectedness with banks.

(b) Shadow insurance industry? A similar concept exists in insurance. One can speak of a *shadow insurance industry* to describe:

- the use of captive reinsurers and special-purpose vehicles to move risks off the balance sheets of primary insurers, sometimes for regulatory capital relief rather than pure risk transfer;

- insurance-linked securities and other capital-market structures that transfer insurance risk to investors outside traditional regulatory perimeters;
- non-traditional, non-insurance activities conducted by insurers (e.g. certain investment and credit activities) that may be lightly regulated from a banking perspective.

These activities can bring genuine risk transfer and diversification, but may also obscure where risks ultimately reside and create forms of maturity transformation and leverage outside the core insurance-regulatory framework. Supervisors therefore increasingly focus on group-wide and system-wide views of both banking and insurance sectors.