

Plus...
**TEST
BANK**

Sixth Edition

FINANCIAL RISK MANAGER HANDBOOK

FRM[®] PART I / PART II

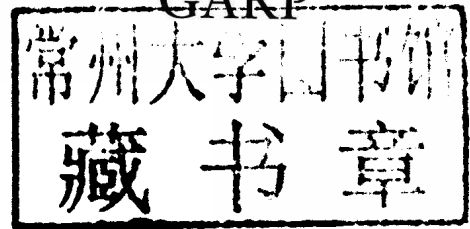
Philippe Jorion

Financial Risk Manager Handbook Plus Test Bank

FRM[®] Part I/Part II

Sixth Edition

PHILIPPE JORION
GARP



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Preface

The *Financial Risk Manager Handbook Plus Test Bank* provides the core body of knowledge for financial risk managers. Risk management has rapidly evolved over the past decade and has become an indispensable function in many institutions.

This *Handbook* was originally written to provide support for candidates taking the FRM examination administered by GARP. As such, it reviews a wide variety of practical topics in a consistent and systematic fashion. It covers quantitative methods, major financial products, as well as market, credit, operational, and integrated risk management. It also discusses investment risk management issues essential for risk professionals.

This edition has been thoroughly updated to reflect recent developments in financial markets and changes in the structure of the FRM program. The book is now structured to correspond to the two levels of the FRM exams. All of the chapters have been updated to account for recent developments in financial markets and regulations. In particular, current issues are integrated in the second part of the book. New chapters have been added, including chapters that deal with advanced univariate and multivariate models, as well as advanced option models. Finally, this *Handbook* incorporates the latest questions from the FRM examinations.

Modern risk management systems cut across the entire organization. This breadth is reflected in the subjects covered in this *Handbook*. The *Handbook* was designed to be self-contained, but only for readers who already have some exposure to financial markets. To reap maximum benefit from this book, readers ideally should have taken the equivalent of an MBA-level class on investments.

Finally, I want to acknowledge the help received in writing this *Handbook*. In particular, I would like to thank the numerous readers who shared comments on previous editions. Any comment or suggestion for improvement will be welcome. This feedback will help us to maintain the high quality of the FRM designation.

Philippe Jorion
October 2010

About the Author

Philippe Jorion is a Professor of Finance at the Paul Merage School of Business at the University of California at Irvine. He has also been a professor at Columbia University, Northwestern University, the University of Chicago, and the University of British Columbia. In addition, he taught the risk management class in the Master of Financial Engineering programs at the University of California at Berkeley and University of California at Los Angeles. He holds an M.B.A. and a Ph.D. from the University of Chicago and a degree in engineering from the University of Brussels.

Dr. Jorion is also a managing director at Pacific Alternative Asset Management Company (PAAMCO), a global fund of hedge funds with approximately \$10 billion under management. PAAMCO is one of the few funds of funds to require position-level transparency from all invested hedge funds. This information is used to provide various measures of portfolio risk as well as to develop tools that help investors to understand the drivers of the funds' alpha and to detect style drift.

Dr. Jorion is the author of more than 100 publications directed to academics and practitioners on the topics of risk management and international finance. He has also written a number of books, including *Big Bets Gone Bad: Derivatives and Bankruptcy in Orange County*, the first account of the largest municipal failure in U.S. history, and *Value at Risk: The New Benchmark for Managing Financial Risk*, which is aimed at finance practitioners and has become an industry standard.

Philippe Jorion is a frequent speaker at academic and professional conferences. He is on the editorial board of a number of finance journals and was editor in chief of the *Journal of Risk*.

About GARP

Founded in 1996, the Global Association of Risk Professionals (GARP) is the leading not-for-profit association for world-class financial risk certification, education, and training, with close to 100,000 members representing 167 countries. With deep expertise and a strong reputation, GARP sets global standards and creates risk management programs valued worldwide. All GARP programs are developed with input from experts around the world to ensure that concepts and content reflect globally accepted practices.

GARP is dedicated to advancing the risk profession. For more information about GARP, please visit www.garp.com.

FINANCIAL RISK MANAGER (FRM®) CERTIFICATION

The benchmark FRM designation is the globally accepted risk management certification for financial risk professionals. The FRM objectively measures competency in the risk management profession based on globally accepted standards. With a compound annual growth rate of 25% over the past seven years, the FRM program has experienced significant growth in every financial center around the world. Now 16,000+ individuals hold the FRM designation in over 90 countries. In addition, organizations with five or more FRM registrants grew from 105 in 2003 to 424 in 2008, further demonstrating the FRM program's global acceptance.

The FRM Continuing Professional Education (CPE) program, offered exclusively for certified FRM holders, provides the perspective and framework needed to further develop competencies in the ever-evolving field of risk management.

For more information about the FRM program, please visit www.garp.com/frmexam.

OTHER GARP CERTIFICATIONS

International Certificate in Banking Risk and Regulation (ICBRR)

The ICBRR allows individuals to expand their knowledge and understanding of the various risks, regulations, and supervisory requirements banks must face in today's economy, with emphasis on the Basel II Accord. This certificate is ideal for employees who are not professional risk managers but who have a strong need to understand risk concepts. The ICBRR program is designed for employees in nonrisk departments such as internal audit, accounting, information technology

(IT), legal, compliance, and sales, acknowledging that everyone in the organization is a risk manager!

Energy Risk Professional Program

The Energy Risk Professional (ERP®) program is designed to measure a candidate's knowledge of the major energy markets and gauge their ability to manage the physical and financial risks inherent in the complex world of energy. This program is valuable for anyone working in or servicing the energy field, requiring an understanding of the physical and financial markets, how they interrelate, and the risks involved.

GARP DIGITAL LIBRARY

As the world's largest digital library dedicated to financial risk management, the GARP Digital Library (GDL) is the hub for risk management education and research material. The library's unique iReadings™ allow users to download individual chapters of books, saving both time and money. There are over 1,000 readings available from 12 different publishers. The GDL collection offers readings to meet the needs of anyone interested in risk management.

For more information, please visit www.garpdigitallibrary.org.

GARP EVENTS AND NETWORKING

GARP hosts major conventions throughout the world, where risk professionals come together to share knowledge, network, and learn from leading experts in the field. Conventions are bookended with interactive workshops that provide practical insights and case studies presented by the industry's leading practitioners.

GARP regional chapters provide an opportunity for financial risk professionals to network and share new trends and discoveries in risk management. Each of our 52 chapters holds several meetings each year, in some locations more often, focusing on issues of importance to the risk management community, either globally or locally.

Introduction

GARP's formal mission is to be the leading professional association for financial risk managers, managed by and for its members and dedicated to the advancement of the risk profession through education, training, and the promotion of best practices globally. As a part of delivering on that mission, GARP has again teamed with Philippe Jorion to produce the sixth edition of the *Financial Risk Manager Handbook Plus Test Bank*.

The *Handbook* follows GARP's FRM Committee's published FRM Study Guide, which sets forth primary topics and subtopics covered in the FRM exam. The topics are selected by the FRM Committee as being representative of the theories and concepts utilized by risk management professionals as they address current issues.

Over the years the Study Guide has taken on an importance far exceeding its initial intent of providing guidance for FRM candidates. The Study Guide is now being used by universities, educators, and executives around the world to develop graduate-level business and finance courses, as a reference list for purchasing new readings for personal and professional libraries, as an objective outline to assess an employee's or job applicant's risk management qualifications, and as guidance on the important trends currently affecting the financial risk management profession.

Given the expanded and dramatically growing recognition of the financial risk management profession globally, the *Handbook* has similarly assumed a natural and advanced role beyond its original purpose. It has now become the primary reference manual for risk professionals, academicians, and executives around the world. Professional risk managers must be well versed in a wide variety of risk-related concepts and theories, and must also keep themselves up-to-date with a rapidly changing marketplace. The *Handbook* is designed to allow them to do just that. It provides a financial risk management practitioner with the latest thinking and approaches to financial risk-related issues. It also provides coverage of advanced topics with questions and tutorials to enhance the reader's learning experience.

This sixth edition of the *Handbook* includes revised coverage of the primary topic areas covered by the FRM examination. Importantly, this edition also includes the latest lessons from the recent credit crisis, as well as new and more recent sample FRM questions.

The *Handbook* continues to keep pace with the dynamic financial risk profession while simultaneously offering serious risk professionals an excellent and cost-effective tool to keep abreast of the latest issues affecting the global risk management community.

Developing credibility and global acceptance for a professional certification program is a lengthy and complicated process. When GARP first administered its FRM exam in 1997, the concept of a professional risk manager and a global certification relating to that person's skill set was more theory than reality. That has now completely changed, as the number of current FRM holders exceeds 16,000.

The FRM is now the benchmark for a financial risk manager anywhere around the world. Professional risk managers having earned the FRM credential are globally recognized as having achieved a level of professional competency and a demonstrated ability to dynamically measure and manage financial risk in a real-world setting in accordance with global standards.

GARP is proud to continue to make this *Handbook* available to financial risk professionals around the world. Philippe Jorion, a preeminent risk professional, has again compiled an exceptional reference book. Supplemented by an interactive Test Bank, this *Handbook* is a requirement for any risk professional's library.

The Test Bank is a preparatory review for anyone studying for the FRM exam and for risk professionals interested in self-study to review and improve their knowledge of market, credit, and operational risk management. The Test Bank contains hundreds of multiple-choice questions from the 2007, 2008, and 2009 FRM exams, with answers and solutions provided. The Test Bank can be downloaded following the instructions on the FRM® Test Bank Download page at the end of this book.

Global Association of Risk Professionals
October 2010

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PART
One

Foundations of Risk Management

Risk Management

Financial risk management is the process by which financial risks are identified, assessed, measured, and managed in order to create economic value.

Some risks can be measured reasonably well. For those, risk can be quantified using statistical tools to generate a probability distribution of profits and losses. Other risks are not amenable to formal measurement but are nonetheless important. The function of the risk manager is to evaluate financial risks using both quantitative tools and judgment.

As financial markets have expanded over recent decades, the risk management function has become more important. Risk can never be entirely avoided. More generally, the goal is not to minimize risk; it is to take smart risks.

Risk that can be measured can be managed better. Investors assume risk only because they expect to be compensated for it in the form of higher returns. To decide how to balance risk against return, however, requires risk measurement.

Centralized risk management tools such as value at risk (VAR) were developed in the early 1990s. They combine two main ideas. The first is that risk should be measured at the top level of the institution or the portfolio. This idea is not new. It was developed by Harry Markowitz (1952), who emphasized the importance of measuring risk in a total portfolio context.¹ A centralized risk measure properly accounts for hedging and diversification effects. It also reflects the fact that equity is a common capital buffer to absorb all risks. The second idea is that risk should be measured on a forward-looking basis, using the current positions.

This chapter gives an overview of the foundations of risk management. Section 1.1 provides an introduction to the risk measurement process, using an illustration. Next, Section 1.2 discusses how to evaluate the quality of risk management processes. Section 1.3 then turns to the integration of risk measurement with business decisions, which is a portfolio construction problem. These portfolio decisions can be aggregated across investors, leading to asset pricing theories that can be used as yardsticks for performance evaluation and for judging risk management and are covered in Section 1.4. Finally, Section 1.5 discusses how risk management can add economic value.

FRM Exam Part 1 topic. In addition to the topics described in this chapter, FRM candidates should also read the GARP Code of Conduct.

¹ Harry Markowitz, "Portfolio Selection," *Journal of Finance* 7 (1952): 77–91.

1.1 RISK MEASUREMENT

1.1.1 Example

The first step in risk management is the measurement of risk. To illustrate, consider a portfolio with \$100 million invested in U.S. equities. Presumably, the investor undertook the position because of an expectation for profit, or investment growth. This portfolio is also risky, however.

The key issue is whether the expected profit for this portfolio warrants the assumed risk. Thus a trade-off is involved, as in most economic problems. To help answer this question, the risk manager should construct the distribution of potential profits and losses on this investment. This shows how much the portfolio can lose, thus enabling the investor to make investment decisions.

Define ΔP as the profit or loss for the portfolio over a fixed horizon, say the coming month. This must be measured in a *risk currency*, such as the dollar. This is also the product of the initial investment value P and the future rate of return R_P . The latter is a random variable, which should be described using its **probability density function**. Using historical data over a long period, for example, the risk manager produces Figure 1.1.

This graph is based on the actual distribution of total returns on the S&P 500 index since 1925. The line is a smoothed histogram and does not assume a simplified model such as the normal distribution.

The vertical axis represents the frequency, or probability, of a gain or loss of a size indicated on the horizontal axis. The entire area under the curve covers all of the possible realizations, so should add up to a total probability of 1.

Most of the weight is in the center of the distribution. This shows that it is most likely that the return will be small, whether positive or negative. The tails have less weight, indicating that large returns are less likely. This is a typical characteristic of returns on financial assets. So far, this pattern resembles the bell-shaped curve for a normal distribution.

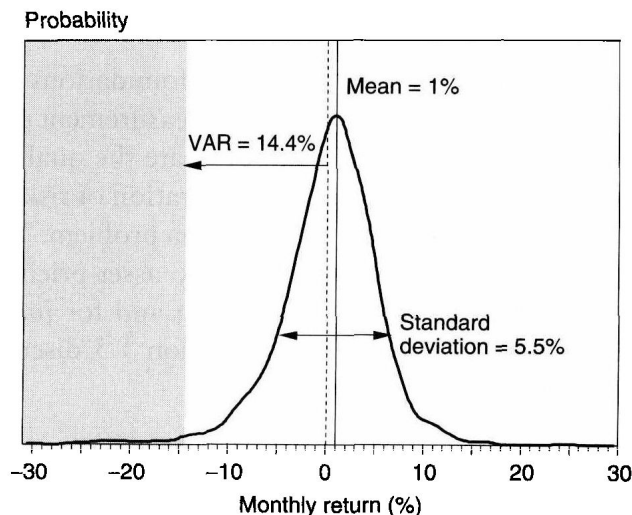


FIGURE 1.1 Distribution of Monthly Returns on U.S. Stocks

On the downside, however, there is a substantial probability of losing 10% or more in a month. This cumulative probability is 3%, meaning that in a repeated sample with 100 months, we should expect to lose 10% or more for a total of three months. This risk is worse than predicted by a normal distribution.

If this risk is too large for the investor, then some money should be allocated to cash. Of course, this comes at the expense of lower expected returns.

The distribution can be characterized in several ways. The entire shape is most informative because it could reveal a greater propensity to large losses than to gains. The distribution could be described by just a few summary statistics, keeping in mind that this is an oversimplification. Other chapters offer formal definitions of these statistics.

- The *mean*, or average return, which is approximately 1% per month. Define this as $\mu(R_P)$, or μ_P in short, or even μ when there is no other asset.
- The *standard deviation*, which is approximately 5.5%. This is often called volatility and is a measure of dispersion around the mean. Define this as σ . This is the square root of the portfolio variance, σ^2 .
- The *value at risk* (VAR), which is the cutoff point such that there is a low probability of a greater loss. This is also the percentile of the distribution. Using a 99% confidence level, for example, we find a VAR of 14.4%.

1.1.2 Absolute versus Relative Risk

So far, we have assumed that risk is measured by the dispersion of dollar returns, or in absolute terms. In some cases, however, risk should be measured relative to some **benchmark**. For example, the performance of an active manager is compared to that of an index such as the S&P 500 index for U.S. equities. Alternatively, an investor may have future liabilities, in which case the benchmark is an index of the present value of liabilities. An investor may also want to measure returns after accounting for the effect of inflation. In all of these cases, the investor is concerned with **relative risk**.

- **Absolute risk** is measured in terms of shortfall relative to the initial value of the investment, or perhaps an investment in cash. Using the standard deviation as the risk measure, absolute risk in dollar terms is

$$\sigma(\Delta P) = \sigma(\Delta P/P) \times P = \sigma(R_P) \times P \quad (1.1)$$

- **Relative risk** is measured relative to a benchmark index B . The deviation is $e = R_P - R_B$, which is also known as the **tracking error**. In dollar terms, this is $e \times P$. The risk is

$$\sigma(e)P = [\sigma(R_P - R_B)] \times P = \omega \times P \quad (1.2)$$

where ω is called **tracking error volatility** (TEV).