

## IMQF Assessment Exam in Mathematics

This exam is for those that are interested in financial aid. There is **NO minimal passing score**.

### Required literature:

- **The Professional Risk Managers' Handbook, Volume II. Mathematical Foundations of Risk Management. THIS SOURCE IS REFERENCED BELOW AS PRM. Covered in part**
- **Quantitative Methods for Investment Analysis. CFA Institute. THIS SOURCE IS REFERENCED BELOW AS CFA. Covered in part**

You may want to go over (if you have not done this before) the book by Urošević and Božović *Operaciona istraživanja i kvantitativne metode investicija* (for sure the first 5 chapters but ideally at least the first 9 chapters). This book is available at the bookstore of the Faculty of Economics (ground floor).

It is really useful in preparation for the program to try to learn about the software *Mathematica*. While this is not going to be tested for the exam, I suggest you try to learn how to implement all math concepts that you study using that software. The trial version (legal one) valid for 30 days can be obtained from [www.wolfram.com](http://www.wolfram.com).

I am preparing videos where I explain basic math concepts in Mathematica. These videos should be available at some point on a DVD in our office, free of charge. In the meantime please go over all the introductory Mathematica videos on the Wolfram site. The more you learn about that program the easier will be in of my courses at IMQF.

## REQUIRED READING

### TOPICS FROM PRM (PART II)

#### A. FOUNDATIONS

##### A.1 Symbols and rules

- Expressions, functions, graphs, equations, greek letters
- Elementary algebra
- The order of operations

##### A.2 Sequences and series

- Sequences and series. Limits

##### A.3 Exponents and logarithms

- Exponents
- Logarithms
- The exponential function and natural log

##### A.4 Equations and inequalities

- Linear equations in one unknown
- Inequalities
- System of linear equations with more than one unknown
- Quadratic equations

#### A.5 Functions and graphs

- Functions
- Graphs
- The graphs of some functions

#### A.6 Compounding

- Discrete versus continuous compounding
- Annuities, perpetuities

### **B DESCRIPTIVE STATISTICS**

#### B.1 Introduction

#### B.2 Data

- Continuous and discrete data
- Grouped data
- Graphical presentation of data

#### B.3. Moments of a distribution

#### B.4. Measures of location of central tendency

- Arithmetic mean
- Geometric mean
- Median
- Mode

#### B.5. Measures of dispersion

- Variance
- Standard deviation
- Calculating historical volatilities from return data
- Skewness
- Kurtosis

#### B.6. Bivariate data

- Covariance
- Covariance matrix
- Correlation coefficient
- Correlation matrix
- Calculating volatility of a portfolio

### **C. CALCULUS**

### C.1. Differential calculus

- Functions
- First derivatives
- Notation
- Simple rules
- Differential

### C.3. Higher order derivatives

- Second order derivatives
- Third and higher order derivatives
- Taylor approximation

### C.5. Differentiating a function of more than one variable

- Partial differentiation
- Total differentiation

### C.6. Integral calculus

- Indefinite and definite integrals
- Rules of integrations
- Guessing the right answer

### C.7. Optimization

- Minimum and maximum of a function of one variable
- More than one variable
- Constrained optimization. Lagrange multipliers
- Applications

## **D. LINEAR AND MATRIX ALGEBRA**

### D.1 Matrix algebra

- Matrices
- Vectors and transposes
- Manipulation of matrices
- Matrix multiplication
- Inverting a matrix

### D.3. Quadratic forms

- The variance of portfolio returns as a quadratic form
- Definition of positive definiteness

### D.5. Eigenvalues and eigenvectors

- Matrices and transformations
- Definition of eigenvector and eigenvalue
- Determinants
- The characteristic equation

## **E. PROBABILITY THEORY IN FINANCE**

### E.1 Definitions and rules

### E. 2 Probability distributions

- Random variables
- Probability density functions and histograms
- Cumulative distribution function
- The algebra of random variables
- Expected value of a discrete random variable
- Variance of a discrete random variable
- Algebra of continuous random variables

### E.3. Joint distributions

- Bivariate random variables
- Covariance
- Correlation
- The expected value and variance of a linear combination fo random variables

### E.4. Specific probability distributions

- Binomial distribution
- Normal distribution

### **TOPICS FROM CFA**

- Chapter 1 (Time value of money). Pp.1-40
- Chapter 2 Net present value and internal rate of return. Pp. 57-63.