Rmetrics – FAQ

An Environment for Teaching
Financial Engineering and Computational Finance
with R Rmetrics Built 221.10065

Built 221.10065

Table of Content:

---

1. Introduction

This document contains answers to some of the most frequently asked questions about Rmetrics. For R itself we highly recommend to consult Kurt Hornik's FAQ on R, availalble from the CRANServer. Additionally there are two platform-specific FAQs about R: The R Windows FAQfor all users of Microsoft operating systems, and the R MacOS X FAQfor all users of Apple operating systems. Note that the latter two are complementary to the general R FAQ, i.e., you should read both the general FAQ and your platform-specific one.

1.1 Legalese

General Public License as published by the Free Software Foundation; either version 2, or (at your option) any later version. The document is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details. A copy of the GNU General Public License is available via WWW at: http://www.gnu.org . You can also obtain it by writing to the Free Software Foundation, Inc., 59 Temple Place — Suite 330, Boston, MA 02111-1307, USA.

1.2 Obtaining this Document

The latest version of this document is always available from:
http://www.rmetrics.org , the latest version of the R FAQ is available from:
http://www.ci.tuwien.ac.at .

---

2 The Basics of Rmetrics

Rmetrics is a collection of several hundreds of functions which may be useful for teaching "Financial Engineering" and "Computational Finance". These functions are available for R, “GNU’s S”. This is a freely available language and environment for statistical computing and graphics which provides a wide variety of statistical and graphical techniques.

2.1 What is Rmetrics?

The functions availalbel through Rmetrics have their source in algorithms and functions written by myself, my students, and many other authors. A major aim is to bring financial algorithms and concepts together under a common software platform and to make it public available mainly for teaching financial engineering and computational finance. Rmetrics is not part of CRAN, Rmetrics is an initiative by its own. Rmetrics has some aims similar like Bioconductor. Rmetrics is an open source and open development software project. The basic R port from which Rmetrics originated was already initiated in 1999 as an outcome of lectures held by Diethelm Würtz on topics in econophysics at ETH Zürich. Meanwhile, the family of the Rmetrics packages includes four members dealing with the following subjects: fBasics - Markets, Basic Statistics, Date and Time, fSeries - The Dynamical Process Behind Financial Markets, fExtremes - Beyond the Sample, Dealing with Extreme Values, and fOptions - The Valuation of Options. Two other packages are under current development, fBonds and fPortfolio.

1 fBasics:

What is included in the fBasics Package? The package fBasics covers the management of economic and financial market data. Included are functions to download economic indicators and financial market data from the Internet. Distribution functions relevant in finance are added like the asymmetric stable, the hyperbolic and the inverse normal gaussian distribution function to compute densities, probabilities, quantiles and random deviates. Estimators to fit the distributional parameters are also available. Some additional hypothesis tests for the investigation of correlations, dependencies and other stylized facts of financial time series can also be found in this package.

2 fCalendar:

What is included in the fCalendar Package? The package fCalendar covers the managment of dates, time, and calendars. The package makes available very powerful 'timeDate' and 'timeSeries' S4 classes. A holiday database for all ecclestial and public holidays in the G7 countries and Switzerland is provided together with a database of daylight saving times for financial centers around the world. Special calendar management functions were implemented to create easily business calendars for exchanges. A collection of functions for filtering and outlier detection of high frequency foreign exchange data records collected from Reuters' data feed can also be found together with functions for de-volatilization and de-seasonalization of the data.

3 fSeries:

What is included in the fSeries Package? The package fSeries covers topics from the field of financial time series analysis including ARIMA, GARCH, long memory modelling, and chaotic time series analysis . This library tries to bring together the content of existing R-packages with additional new functionality on a common platform. The collection comes with functions for simulations, parameter estimation, diagnostic analysis and hypothesis testing of financial time series. The tests include methods for testing unit roots, independence, normality of the distribution, trend stationary, and neglected non-linearities. In addition functions for testing for higher serial correlations, for heteroskedasticity, for autocorrelations of disturbances, for linearity, and functional relations are provided. Furthermore, distribution functions for GARCH modelling like the normalized Student-t and the GED together with their skewed versions have been added which require for their computation Heaviside and related functions. The demonstration directory includes also a R-interface for the GarchOx software package.

4 fMultivar:

What is included in the fMultivar Package? The package fMultivar deals mainly with multivariate aspects of time series analysis. Offered are algorithms for regression analysis including neural network modelling with feedforward networks. Furthermore functions for sytem equation modelling are available. Technical analysis and benchmarking is another major issue of this package. The collection offers a set of the most common technical indicators together with functions for charting and benchmark measurements. For the technical analysis of markets several trading functions are implemented and also tools are availalble for a rolling market analysis. A matrix addon with many functions which allow an easy use of matrix manipulations is also part of this package. This addon includes functions to generate several kind of standard matrixes, to extract subsets of a matrix, and some function from linear algebra. This matrix addon is thought to be used to manipulate easily the data of multivariate time series objects.

5 fExtremes:

What is included in the fExtremes Package? The package fExtremes covers topics from the field what is known as extreme value theory. The package has functions for the exploratory data analysis of extreme values in insurance, economics, and finance applications. Included are plot functions for empirical distributions, quantile plots, graphs exploring the properties of exceedences over

a threshold, plots for mean/sum ratio and for the development of records. Furthermore functions for preprocessing data for extreme value analysis are available offering tools to separate data beyond a threshold value, to compute blockwise data like block maxima, and to de-cluster point process data. One major aspect of this package is to bring together the content of already existing R-packages with additional new functionality for financial engineers on a common platform investigating fluctuations of maxima, extremes via point processes, and the extremal index. A new additional chapter on risk measures, stress testing and copulae is planned to be added in the near future.

6 fCopulae:

This package is under current development.

7 fTickdata:

This package is under current development.

8 fOptions:

What is included in the fOptions Package? The package fOptions covers the valuation of options including topics like the basics of option pricing in the framework of Black and Scholes, including almost 100 functions for exotic options pricing, including the Heston-Nandi option pricing approach mastering stochastic volatility, and Monte Carlo simulations together with generators for low discrepancy sequences. Beside the Black and Scholes option pricing formulas, functions to valuate other plain vanilla options on commodities and futures, and function to approximate American options are also available. Some binomial tree models are implemented. The exotic options part comes with a large number of functions to valuate multiple exercise options, multiple asset options, lookback options, barrier options, binary options, Asian options, and currency translated options. Some functions for the investigation of exponential Brownian motion in the context of Asian option valuation have been recently added.

9 fBonds:

This package is under current development.

10 fPortfolio:

What is included in the fPortfolio Package? The package fPortfolio covers multi-variate distributions, assets modelling, drawdown statistics, value-at-risk modelling, Markowitz portfolios, two assets. The multivariate distribution functions allow to compute multivariate densities and probabilities from skew normal and skew Student-t distribution functions. Furthermore, multivariate random daviates can be generated, and for multivariate data, the parameters of the underlying distribution can be estimated by the maximum log-likelihood estimation. The functions for assets modelling can be used togenerate multivariate artficial data sets of assets, which fit the parameters to a multivariate normal, skew normal, or (skew) Student-t distribution. Included in the library are also functions to compute some benchmark statistics. In addition a function is provided which allows for the selection and clustering of individual assets from portfolios using hierarchical and k-means clustering approaches. Tools are provided to evaluate dtawdown statistics. Availalble are functions for the density,

distribution function, and random number generation for the maximum drawdown distribution. In addition the expectation of drawdowns for Brownian motion can be computed. Value-at-Risk Modelling is another topic which is consider in this library. Value-at-Risk and related risk measures for a portfolio of assets can be evaluated. A group of functions is dedicated to the Markowitz portfolio optimization problem. Functions for the computation of the efficient frontier, for the market line, for the tangency portfolio and for Monte Carlo simulations are part of the library. Analytical formulas for the Markowitz and for the Condition VaR Portfolio approach are implemented.

11 fActuar:

This package is under current development.

12 fAgents:

This package is under current development.

Who are the devellopers behind Rmetrics? The writing of the functions which are now available in Rmetrics started originally as assignments in my lectures on "Econophysics" at the Institute of Theoretical Physics at ETH Zürich. Since in the financial community and also in my lectures MS Windows is the mostly used operating system, special emphasis is given to the Microsofts OS. Thus, to teach financial engineers it became quite natural for me to work under Windows. For a broad distribution and acceptance of Rmetrics I decided to continue the devellopment primarily under Windows 2000/XP. There are no many people behind Rmetrics, currently it's only me. I have my job as a lecturer at the Institute of Theoretical Physics at ETH Zurich, and I'm the senior partner of an ETH spin-off software company, Finance Online. So I have several responsibilities to take, and as a consequence things might go slow ... The growing Rmetrics collection is based on many statistical and financial functions which were contributed by myself, my students, or were ported from many other sources during the last seven years since I started my lectures in "Econophysics" at ETH. I'm aware that the work is by far not complete. Parts of the software are still untested, and may contain some bugs. Contributions are welcome!

2.2 What machines does run Rmetrics on?

Starting with Version 1.7.1 Rmetrics is expected to run under the some platforms as R. R is being developed for the Unix, Windows and Mac families of operating systems. Support for Mac OS Classic ended with the 1.7 series. The current version of R will configure and build under a number of common Unix platforms, for details we refer to the R FAQ. Rmetrics is primarily build and maintained under MS Windows XP.

2.3 What is the Current Version of Rmetrics?

The current productive Version is 191.10057. The latest source packages are located in the source directory on the Rmetrics Server, and the latest binary files for the Windows OS are located in the download directory themselves. The DESCRIPTION files hold the most recent version number, please check. The most recent productive built for Rmetrics is available from the CRAN Server.

2.4 How can Rmetrics be obtained and installed?

The source code of the productive packages Version 191.10057 can be downloaded from the CRAN Server, also the binary packages for Windows, Mac OSX and Linux operated computers. Rmetrics is also availalble in form of (compiled) Debian Packages and part of the Knoppix Quantian CD. The current Version of the included packages is 190.10055, beside fBasics which is Version 190.10056. First of all, an R environment must be installed on your sytem. Please follow the instructions as described in R's FAQ. Then the Rmetrics packages can be installed in the usual way as an ordinary R package. Nothing is special.

2.5 What documentation exists for Rmetrics?

Online documentation for most of the functions and variables in Rmetrics exists lik in R, and can be printed on-screen by typing help(name) (or ?name) at the R prompt, where name is the name of the topic help is sought for. This documentation can also be made available as one reference manual for on-line reading in HTML and PDF formats, and as hardcopy via LaTeX. The Rmetrics distribution also comes with the following manuals.

1. General Information: A Flyer, a Fact Sheet, and a Reference Card
2. Rmetrics "Reference Guides" for the following packages: fBasics, fSeries, fExtremes, and fOptions.
3. Rmetrics " Lecture Scripts", which can serve as User Guides. (Unfortunately these Scripts are not always up to date.)

2.6 How to cite Rmetrics?

To cite Rmetrics in publications, use

```
@Manual{,
title = {Rmetrics: An Environment for Teaching Financial
Engineering and Computational Finance with R},
author = {Diethelm Würtz},
organization = {Rmetrics, ITP, ETH Zürich},
address = {Zürich, Switzerland},
year = {2004},
url = {http://www.rmetrics.org} }
```

2.7 What mailing lists exist for Rmetrics?

There is no special mailing list dedicated to Rmetrics. However, for topics concerned with R and in relation to financial applications we recommend the following lists: R-announce A moderated list for major announcements about the development of R and the availability of new code. R-packages A moderated list for announcements on the availability of new or enhanced contributed packages. R-help The "main"' R mailing list, for discussion about problems and solutions using R, about the development of R and the availability of new code, enhancements and patches to the source code and documentation of R, comparison and compatibility with S and S-Plus, and for the posting of nice examples and benchmarks. R-devel This list is for discussions about the future of R, proposals of new functionality, and pre-testing of new versions. It is meant for those who maintain an active position in the development of R. R-sig-finance This is the special interest group for 'R in Finance'.

3 Rmetrics Programming Issues

R and Rmetrics give you many functions and tools at your fingertips to model, to analyze and to visualize financial market data. This is the origin for creating powerful rapid protopype systems for valuating and judging your models.

3.1 Is Rmetrics Open Source Software?

Rmetrics has a commitment to full open source code development and distribution. All contributions included in the Rmetrics packages are expected to exist under an open source license such as GPL2. The reasons for this commitment are the ability to test, to extend and to improve the software in a convenient way, to encourage excellent scientific computing and statistical practice in financial engineering and computational finance, and to provide a workbench of tools that allow to explore and expand the methods used to analyze financial market data and to valuate financial instruments.

3.2 Why uses Rmetrics Builtin-Functions?

All functions used by Rmetrics and becoming part of the Rmetrics packages must be available under a Debian conform license. R packages must be availalble on the CRAN Server in Source and also in Binary form for the Windows and Mac OSX operating systems. Furthermore, they must be part of the (compiled) Debian distribution and the Knoppix Quantian CD. For functions and packages which are not fulfilling these conditions or are in conflict with other functions used in the Rmetrics packages their functionality will be made available in form of Builtin-Functions. These Builtin-Functions are GNU licensed functions which were modified and copied to Rmetrics packages to fullfill the required specifications. This is the only reason why we have added Builtin functionality.

3.3 Can I use R and Rmetrics for commercial purposes?

R and Rmetrics are released under the GNU General Public License (GPL). If you have any questions regarding the legality of using R and/or Rmetrics in any particular situation you should bring it up with your legal counsel. We are in no position to offer legal advice. More information on the opinion of the R Core team about commercial usage can be found in the R FAQ.

3.4 Rmetrics and Finmetrics

Rmetrics and Finmetrics are packages for modeling, analyzing, and visualizing financial market data. Both packages offer a modern and flexible environment for reliable and robust, predictive econometric modeling and for valuation and pricing of financial instruments. What Rmetrics is for R, is Finmetrics for S-Plus.

Diethelm Würtz
Zürich, January 2006