

Using R in Finance

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Debian and R Projects

Invited Panel Presentation at the
58th Midwest Finance Association Meetings
Chicago, IL, March 5, 2009



Outline

Background

About R and CRAN

Finance Task View

Selected Finance Packages

Summary and Outlook

Personal connections

- ▶ Financial Econometrician by training, with twelve+ years as a Quant in (Inv-)Banking, Hedge Funds, Prop Trading
- ▶ Debian developer/contributor since 1995
- ▶ Debian R co-maintainer since 1999, maintainer since 2001
- ▶ R package author or co-author:
 - ▶ RQuantLib: R interface to the QuantLib libraries
 - ▶ digest: hash function 'digests' of serialized R objects
 - ▶ random: R interface to true RNG via random.org
 - ▶ RDieHarder: R interface to DieHarder RNG testers
 - ▶ littler: R scripting front-end
 - ▶ RPostgreSQL: R interface to PostgreSQL RDBMS
 - ▶ Rcpp: C++ classes for extending R with C/C++ functions
 - ▶ RInside: C++ classes for embedding R in C++ programs

Personal connections

- ▶ Other R Open Source activities:
 - ▶ R-SIG-Finance, R-SIG-Debian, R-SIG-HPC list 'owner'
 - ▶ Editor of CRAN Task Views *Empirical Finance* and *High Performance Computing*
 - ▶ Mentor for two R-related projects (cran2deb; RPostgreSQL) at Google Summer of Code
 - ▶ Co-organizer of the first R in Finance conference in April 2009, Chicago (<http://www.RinFinance.com>)
 - ▶ useR! Tutorial lecturer on *High Performance Computing with R* in 2008 and 2009, also at R / Finance
- ▶ Other work-related R projects (spawning the CRAN packages RLim, RBloomberg; others unreleased)
- ▶ Quantian (live cdrom/dvd) author / developer
- ▶ Associate Editor at *Journal of Statistical Software*

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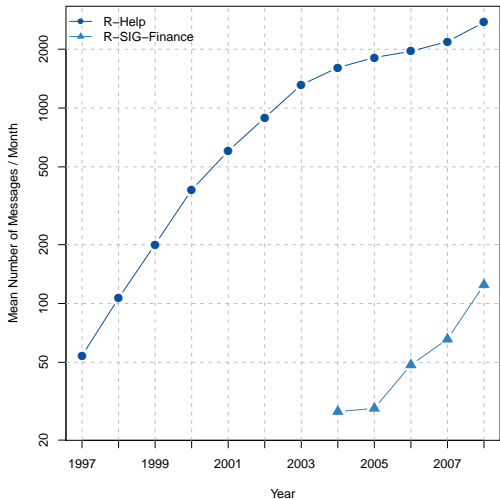
Selected Finance Packages

Summary and Outlook

Where are we right now with R ?

- ▶ R has grown tremendously in recent years, both in terms of capabilities and users.
- ▶ Widespread and increasing use in Finance.
- ▶ S+ has been almost entirely eclipsed by R, much to the chagrin of Insightful.
- ▶ We now also have three companies offering commercial support and extensions.
- ▶ CRAN, the R package archive network, has grown tremendously too: now north of 1600 packages.
- ▶ There is more and more Finance content as shown in the task view.

Illustration: Growth of r-help and r-sig-finance



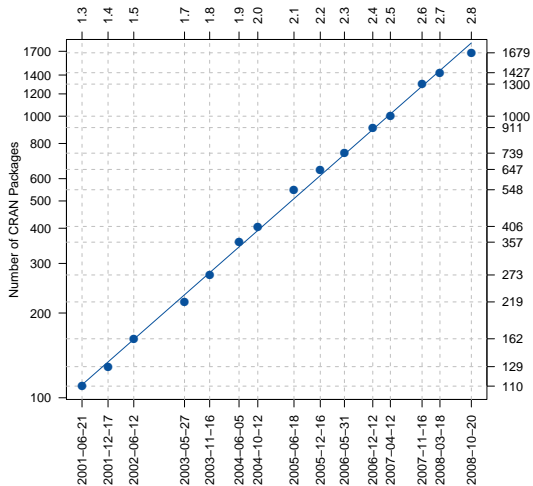
- ▶ Total R usage is difficult to measure.
- ▶ Mailing list activity is sometimes used as a proxy.
- ▶ While r-help growth is slowing, several 'special interest group' lists such as r-sig-finance experience strong growth.

Source: Fox (2008, 2009), our calculations.

Dirk Eddelbuettel

Using R in Finance

Illustration: Growth of CRAN packages



- ▶ John Fox provided this chart in an invited lecture at the last *useR!* meetings.
- ▶ Details, and more metrics on R and the dynamics of the R Core group, are also in a forthcoming R News (soon: R Journal) article.

Aside: CRANberries

Google Reader (111) <@ron>

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http://www.google.com/reader/view/stream/feed%2Fhttp%3A%2F%2Fdirk.eddelbuettel.com%2Fcranberries%2Findex.rss

Navigation: CRANberries Show: Expanded - List

Show: 2 new items - all items Mark all as read Refresh Feed settings... show details

☆ New package `fpow` with initial version 0.0-1 3:45 PM (28 minutes ago)

Package: `fpow`
 Version: 0.0-1
 Date: 2009-03-01
 Title: Computing the noncentrality parameter of the noncentral F distribution
 Author: Al Buharev
 Maintainer: Al Buharev
 Description: Returns the noncentrality parameter of the noncentral F distribution if probability of type I and type II error, degrees of freedom of the numerator and the denominator are given. It may be useful for computing minimal detectable differences for general ANOVA models. This program is documented in the paper of A. Buharev, S. Kemery, On the computation of the noncentral F and noncentral beta distribution, *Statistics and Computing*, 2008, 18 (3), 333-340. <http://dx.doi.org/10.1007/s11222-008-9065-3> Preprint of this paper is available at <http://reliablecomputing.auth.gr/beta.html>
 License: GPL-2
 Depends: R (>= 2.8.0)
 Packaged: Sun Mar 1 20:11:52 2009; al
[More information about 'fpow' at CRAN](#)

☆ Package `ergm` updated to version 2.2-0 with previous version 2.1 dated 2008-04-28 3:46 PM (38 minutes ago)

Author: Mark S. Handcock, David P. Hurner, Carter T. Butts, Steven H. Goodreau, Pavel H. Krivitsky, Martina Morris
 Title: Fit, Simulate and Diagnose Exponential-Family Models for Networks
 Description: An integrated set of tools to analyze and simulate networks based on exponential-family random graph models (ERGM). 'ergm' is part of the 'statnet' suite of packages for network analysis. For a list of functions type: [help\(package=ergm\)](http://package-ergm/)
 Diff between `ergm` versions 2.1 dated 2008-04-28 and 2.2-0 dated 2009-03-01

```

ergm-2.1/ergm/.atxfile |only
ergm-2.1/ergm/LICENSE.122207 |only
ergm-2.1/ergm/LICENSE.2006 |only
ergm-2.1/ergm/R/ergm.geodist.R |only
ergm-2.1/ergm/R/rd2.pdf |only
ergm-2.1/ergm/ergm-internal.Rd |only
ergm-2.1/ergm/inst/license.statnet.R |only
ergm-2.2-0/ergm/DESCRIPTION | 9
ergm-2.2-0/ergm/R/InitConstraint.R | 24
ergm-2.2-0/ergm/R/InitErgm.R | 649 ++++++
ergm-2.2-0/ergm/R/InitErgmTers.R | 626 ++++++
ergm-2.2-0/ergm/R/InitMFP.R | 14
ergm-2.2-0/ergm/R/parox.ergm.R | 14
  
```

Previous item Next item 2 items

- ▶ The CRANberries feed summarizes both changes to existing packages, as well as new packages.
- ▶ Implemented in 200 lines of R and using the tiny `blosxom` blog engine, it is available as a blog and via an RSS feed.

Source:

<http://dirk.eddelbuettel.com/cranberries/>

Dirk Eddebuettel

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CRAN and CRAN Task View *Finance*

- ▶ Given 1600+ CRAN packages, navigation is difficult.
- ▶ Idea suggested a few years ago to have *topical views*.
- ▶ These *Task Views* are not perfect, but the best currently available approach at navigating CRAN packages.
- ▶ We created the *Empirical Finance* view around 2004 which contains several sections on
 - ▶ standard regression models
 - ▶ time series
 - ▶ finance
 - ▶ risk management
 - ▶ books / data sets
 - ▶ date and data management
- ▶ Rather than repeating the task view, let us illustrate several different packages.

Finance Task View

CRAN Task View: Empirical Finance <@ron>

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http://cran.r-project.org/web/views/Finance.html

Finance

- The Rmetrics suite of packages comprises [fArma](#), [fAsianOptions](#), [fAssets](#), [fBasics](#), [fBonds](#), [timeDate](#) (formerly: fCalendar), [fCopulae](#), [fEcofin](#), [fExoticOptions](#), [fExtremes](#), [fGarch](#), [fImport](#), [fMultivar](#), [fNonlinear](#), [fOptions](#), [fPortfolio](#), [fRegression](#), [timeSeries](#) (formerly: fSeries), [fTrading](#), [fUnitRoots](#) and [fUtilities](#) packages contain a very large number of relevant functions for different aspect of empirical and computational finance.
- The [RQuantLib](#) package provides several option-pricing functions as well as some fixed-income functionality from the QuantLib project to R.
- The [quantmod](#) package offers a number of functions for quantitative modelling in finance as well as data acquisition, plotting and other utilities.
- The [portfolio](#) package contains classes for equity portfolio management; the [portfolioSim](#) builds a related simulation framework and [tradeCosts](#) estimates the potential impact of trades on the prevalent market prices. The [backtest](#) offers tools to explore portfolio-based hypotheses about financial instruments.
- The [PerformanceAnalytics](#) package contains a large number of functions for portfolio performance calculations and risk management.
- The [TTR](#) contains functions to construct technical trading rules in R.
- The [financial](#) package can compute present values, cash flows and other simple finance calculations.
- The [sde](#) package provides simulation and inference functionality for stochastic differential equations.
- The [termstrc](#) package contains methods for the estimation of zero-coupon yield curves and spread curves based the parametric Nelson and Siegel (1987) method with the Svensson (1994) extension, and the McCulloch (1975) cubic splines approach.
- The [vrtest](#) package contains a number of variance ratio tests for the weak-form of the efficient markets hypothesis.
- The [BL COP](#) package provides implementation of the Black-Litterman portfolio model as well other copula-opinion pooling frameworks.

Risk management

- The [VaR](#) package estimates Value-at-Risk, and several packages provide functionality for Extreme Value Theory models: [evd](#), [evdbayes](#), [evir](#), [extRemes](#), [ismev](#), [POI](#).
- The [CreditMetrics](#) package provides functions for Credit Risk modeling.
- The [QRMLib](#) covers quantitative risk modelling.

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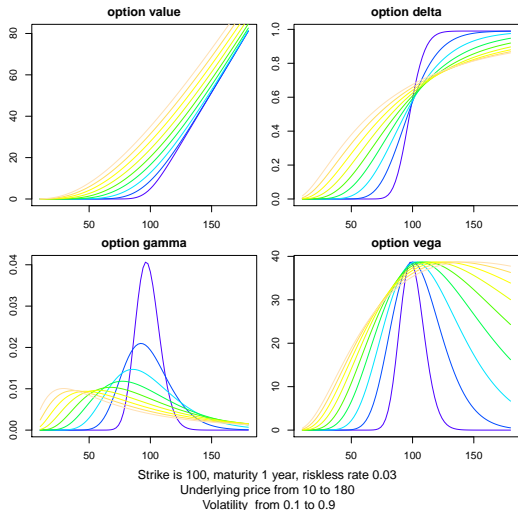
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RQuantLib (QuantLib Group; Eddelbuettel)

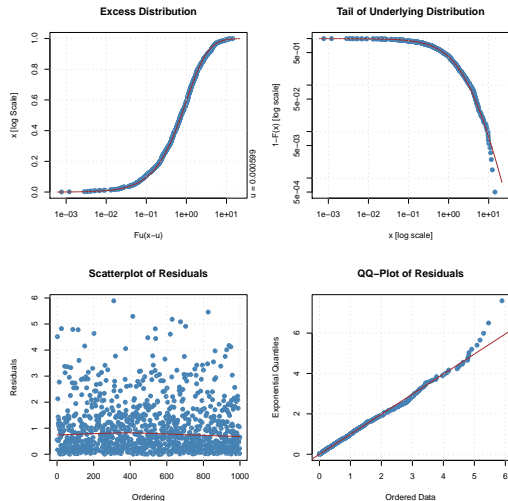


- ▶ `QuantLib` is a very complete and very well written C++ library for quantitative finance.
- ▶ `RQuantLib`, first released in 2002, provides access to a subset of `QuantLib`'s functionality directly from `R`, in particular for (equity) option pricing and some yield curve analysis.



```
> example(EuropeanOptionArrays)
```

Rmetrics (Wuertz et al)

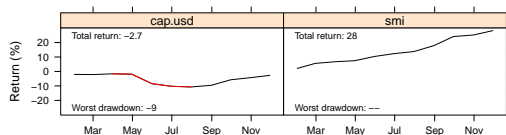


- ▶ Rmetrics, first released in 2004 is a comprehensive set of R packages.
- ▶ It covers time series, GARCH and volatility modeling, Extreme Value Theory and Copulae, derivative pricing, portfolio analysis, optimization and more.

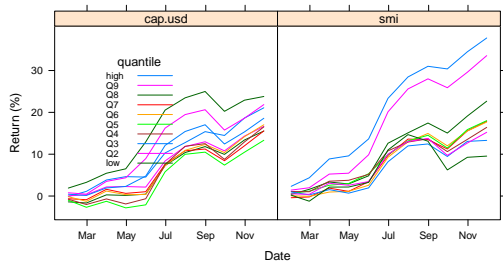
> example(GpdModelling)

portfolio (Enos, Kane et al)

Cumulative Spread Return



Cumulative Quantile Return

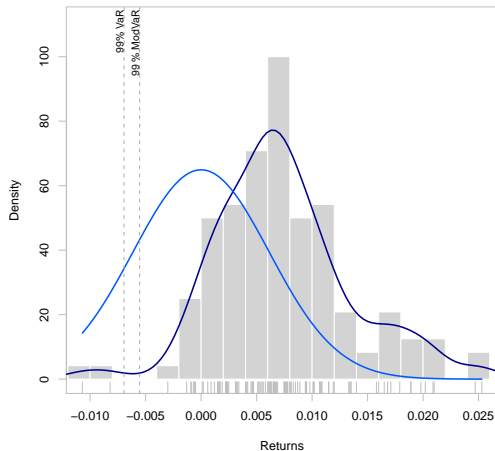


- ▶ The `portfolio` package provides code and data for real-life equity long/short portfolio analysis.
- ▶ The `portfolioSim` package adds simulation support; the `tradeCost` package analyses ex-post trade impact, and the `backtest` package permits to test portfolios.

> `example(backtest)`

PerformanceAnalytics (Carl and Peterson)

Equity.Market.Neutral



- ▶ This package provides a library of econometric functions for performance and risk analysis of financial portfolios.
- ▶ It offers practitioners and researchers some of the latest research in analysis of both normal and non-normal return streams.

```
> example(chart.Histogram)
```

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Summary

- ▶ R is a very vibrant platform for data analysis, visualization and *programming with data*.
- ▶ Hence, R provides an excellent platform for *academic research* and *teaching* — as well as *investment research* and *trading*.
- ▶ Finance has traditionally been one of the two key users of the S language, and this constituency has moved from S+ to R.
- ▶ The number of dedicated Finance packages for R is increasing as well, the R-Forge site is a good place to watch (<http://R-Forge.R-Project.org>).

Outlook

If you don't go with R now, you will someday.
– David Kane on r-sig-finance, 30 Nov 2004

R / Finance in April 2009

R/Finance 2009: Applied Finance with R

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http://www.rinfinance.com/

R/Finance 2009: Applied Finance with R

April 24 & 25, Chicago, IL, USA

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The first annual R/Finance conference for applied finance using **R**, the premier free software system for statistical computation and graphics, will be held this spring in Chicago, IL, USA on Friday April 24 and Saturday April 25.

The two-day conference will cover topics including portfolio management, time series analysis, advanced risk tools, high-performance computing, and econometrics. All will be discussed within the context of using **R** as a primary tool for financial risk management and trading.

Assembled to talk over the two days are some of the industry's most recognizable authorities within the world of R and quantitative finance.

R/Finance 2009 is organized by a leading group of R package authors and community contributors, and hosted by the **International Center for Futures and Derivatives** [ICFD] at the University of Illinois in Chicago.

Conference registration is now open. Special advanced registration pricing is available, as well as discounted pricing for academic and student registrations.

register now

Scheduled Keynotes:

- [Patrick Burns](#) *Burns Statistics, London, UK*
- [Robert Grossman](#) *Director, National Center for Data Mining, UIC, USA*
- [David Kane](#) *Kane Capital, USA*
- [Roger Koehn](#) *University of Illinois, USA*
- [David Ruppert](#) *Cornell University, USA, Statistics and Finance, an Introduction*
- [Diethelm Wuerzt](#) *ETH Zurich CH, Rmetrics*
- [Eric Zivot](#) *University of Washington, USA, Modelling Financial Time Series with S+*

See all confirmed speakers and titles [here](#).

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