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Project Proposal

I have read the parts of the book "Dowd, K. Measuring Market Risk" related to the code. I have studied source matlab code, which was provided with the book, and played with it a bit in matlab. Also, I have written R functions and and documented them, relating Dowd's code 'Copula functions' for estimation VaR with gaussian copula. For easy test it, I made package, which you can find in https://github.com/evgeniiegorov/VaRgcop

I propose to onvert Kevin Dowd's Matlab code from 'Measuring Market Risk'. Not mechanically, but optimizing and using features of R and more sophisticated numerical algorithms.

Also, I propose to make some extensions of functional. For example, it isn't big step to go from gaussian-copula-VaR for 2 assets portfolio to n assets portfolio. But, in my opinion, it will be a big difference in functionality for those, who use the package.

Coding plan & methods

Literature:

For quantative finance algotrithms field: + Dowd, K. (2005) Measuring Market Risk + A.McNeil, R.Frey, P.Embrechts "Quantitative Risk Management: Concepts,Techniques&Tools"

For numerical methods: + R. W. Hamming, "Numerical Methods for Scientists and Engineers" + S.A. Teukolsky, W.T. Vetterling, B.P. Flannery "Numerical Recipes 3rd Edition: The Art of Scientific Computing"

As code style I will follow: + http://adv-r.had.co.nz/Style.html (also as R table-book) + http://google-styleguide.googlecode.com/svn/trunk/Rguide.xml

Kevin Dowd's Matlab code is divided into sections. Within each section, I will show the functionality that will be implemented. And explain the reasons for which some functions will be not implemented. (if no comments ==> will be implemented in project)

- Backtest
- Binomial backtest –> Value-at-Risk backtesting
  - Blancoihle backtest –> Value-at-Risk backtesting
  - Cristoffersen backtest –> Value-at-Risk backtesting
  - Lopez backtest –> Value-at-Risk backtesting
  - Jarquebere –> distribution normality test –> fBasics
  - KS test –> distribution equality test –> fBasics
  - Kuiper test –> distribution equality test –> CircStats
  - AD test –> distribution equality test –> nortest Thus, I don't see the need of Jarquebre and KS test implementation, package fBasics is widely used. Another story about Kuiper and AD test, it is not convenient to install many packages for a single function. So we need to implement them. Also as all Value-at-Risk backtesting functions.

- Bootstrap
  - bootstrap estimation of VaR and ES, condifence interval
  - plots: bootstrap ES, VaR
- Copula function
  - gaussian, product, gumbel copula VaR for portfolio with two assets !! My extension: modify copulas to n-assets portfolio
- Cornish-Fisher functions
  - compute ES,VaR using Corner-Fisher adjustment –> PerformanceAnalytics This functions are already in PerformanceAnalytics package. :)
- Exploratory data plots
  - hill plot, mef plot, Pickands plot
  - normalqqplot, tqqplot –> stats Hence, we need to implement only hill plot, mef plot anf Pickands plot.
- Frechet/Generalised Pareto/Gumbel functions Assuming extreme losses are Frechet/Generalised Pareto/Gumbel distributed
  - estimate VaR, ES
  - plot: VaR-confidence level, ES-confidence level Here I will naturally combined and parameterized function of VaR,ES estimate and plot, with respect to how are extreme losses distributed.
- Kernel functions
  - Estimate VaR, ES with variety of kernels: box, epanchikov, normal, triangle
- Options functions
  - ES, VaR estimation to american put option by binomial tree, Monte-Carlo simulation
  - ES of BS call, put via Monte-Carlo simulation
  - Price of BS call,put via closed solution
  - VaR of long, short postion in BS call,put closed solution !! My extension: option pricing with stochastic volatility
- Log-t/Lognormal functions Assuming geometric returns are t/normally distributed:
  - estimate ES/VaR
  - percentiles of ES/VaR distribution
  - plot: ES/VaR-confidence level, ES/VaR-holding period, ES/VaR-holding period-confidence level Also here I will naturally combined and parameterized functions with respect to how are geometric returns distributed.
- Principal components functions
  - estimates and plot ES, VaR by principal component analysis
- Miscellaneous functions
  - estimates VaR, ES of a coupon paying bond via monte-carlo
  - estimates VaR, ES of portfolio, assuming loss dataset is transformed using Box-Cox
- t-risk functions
  - estimates VaR/ES assuming P/L is t-distributed, for given confidence level and holding period
  - Estimates percentiles of VaR/ES distribution function
  - plot: VaR/ES-confidence level, VaR/ES-holding period, VaR/ES-confidence level-holding period
- Historical simulation functions –> PerformanceAnalytics
- Normal functions –> PerformanceAnalytics This functions are already in PerformanceAnalytics package. :)

Management of coding & timeline

I'm plannig to work full time to this project. My goal is not to work fixed hours in week, but to reach all goals of the project. Hence, I'm certainly willing to try my best. Thus, I will have no other commitments during this summer.

For transparency and for the benefit of the community, I'll be blogging my development, include description of financial algorithms, code (and and why it is so) and tests.

I plan to commit each week. About all deviations I will communicate immediately with mentors of the project. My planned schedule (atom of time is week, atom of week result is section) is:

27 April - 25 May

- 1 Backtest, Bootstrap
- 2,3 Copula function
- 4 Exploratory data plots

26 May - 26 June

- 1 Frechet/Generalised Pareto/Gumbel functions
- 2 Kernel functions
- 3,4 Options functions

27 June - 2 Jule (Mid-term)

- 1 documentation&testing what wasn't, provide examples

3 Jule - 17 August

- 1 Log-t/Lognormal functions
- 2 Principal components functions
- 3 Miscellaneous functions
- 4 t-risk functions
- 5 documentation&testing what wasn't, provide examples

17 August - 20 August

- all recheck, final :)

Test task

I solved the problem of calculating the value-at-risk using a Gaussian copula for a portfolio of two assets, which P/L has normal distribution. The task is divided into steps: * Evaluation of the Gaussian copula on the it domain: unit cube * Calculation of the distribution function return assets * Finding value-under-risk as a quantile, for a given confidence level

Then I write documentation with roxygen2 and build the package. You can find package, source code and example of using here: https://github.com/evgeniiegorov/VaRgcop

Also in example I provide visualization of gaussian copula and it dependence of level of correlation (with library 'manipulate')

Academic Experience

I graduated with a B.S. degree in Economics from Moscow State University, Russia, in 2009. My B.S. thesis was about option pricing with implementation in R. Now I am student of Moscow State University, finishing second year of master degree in quantitate finance.

Also I participate in Centre of Mathematical Finance MSU as instructor. I taught a group of students of Applied Econometrics, mostly on examples of how to measure the risk of a financial portfolio based on coherent measures, step-by-step to more sophisticated cases. However, the main objective of the course was to introduce students to the language R and to refresh mathematical statistics skills for more advanced courses. For more information about the centre and about my activities on slides http://www.slideshare.net/CMFMSU/20140913-cmf-fall-2014-presentation

Work/Internship Experience

Also, I have industrial experience in credit risk estimating with R in top-10 Russian bank
You can find review about my work in my LinkedIn https://www.linkedin.com/in/egorovevgenii

Mentors

- Mentor names: Peter Carl, Brian Peterson
- Mentor emails: peter@braverock.com, brian@braverock.com
- Mentor id in melage: peter_carl

I emailed Peter Carl and he gave me some useful tips. I realize the importance of staying in touch with a mentor when working remotely and promise do it.

Why Rstats

It sounds a bit strange, but R has played a big role in my life, and my friends. Without it, and without a huge number of different packages, we were not able to create Centre for Mathematical Finance, as we would like. I will be very happy to contribute to the development of the package, so I'm sure that it can really help many people in their projects.