Pénzügyi matematika és R

Gáll József
Debreceni Egyetem, Közgazdaságtudományi Kar

Altenburger Szimpózium, 2009

'Előzmények'

Jeszenszky Péter: R előadások, MAT Őszi Iskola, 2009
http://www.inf.unideb.hu/~jeszy/R/index.html

R project

http://cran.at.r-project.org/
CRAN Task Views

- Finance: Empirical Finance,
- Econometrics: Computational Econometrics,
- TimeSeries: Time Series Analysis,
- Multivariate: Multivariate Statistics,
- Distributions: Probability Distributions,
- Optimization: Optimization and Mathematical Programming.

Installálás

```
install.packages("ctv")
library("ctv")
install.views("Finance")
update.views("Finance")
```

CRAN Task Views: Finance

- Finance (fOptions, fAsianOptions, fAssets, fBasics, fBonds, fExtremes, stb),
- Risk management (VaR, CreditMetrics),
- Standard regression models,
- Time series.

CRAN Task Views: Finance, csomagok

actuar, ArDec, backtest, bayesGARCH, BLCOP, CADFtest, car, ccgarch, ChainLadder, copula, CreditMetrics, data.table, dlm, dse, dyn, dynamo, dynlm, evd, evdbayes, evir, extRemes, fame, fArma, fAsianOptions, fAssets, fBasics, fBonds, fCopulae, fEcofin, fExoticOptions, fExtremes, fgac, fGarch, fImport, financial, fMultivar, fNonlinear, fOptions, forecasting, fPortfolio, fracdiff, FracSim, fractal, fRegression, fTrading, fUnitRoots, fUtilities, ghyp, gogarch, fBrokers, ismev, its,lmtest, longmemo, MSBVAR, MSVAR, mvtnorm, opentick, PerformanceAnalytics, portfolio, portfolioSim, POT, QRMlib, quantmod, RBloomberg, Rcmdr, realized, RQuantLib, rwt, sandwich, sde, strucchange, tawny, termstrc, timeDate, timeSeries, timsac, tis, tradeCosts, TSdbi, tsDyn, tseries, tseriesChaos, tsfa, TTR, urca, uroot, VaR, vars, vrtest, wavelets, waveslim, wavethresh, xts, Zelig, zoo

RMetrics

- http://www.rmetrics.org/
- Time Series Econometrics, Hypothesis Testing, GARCH Modelling and Volatility Forecasting, Extreme Value Theory & Copulae, Pricing of Derivatives, Portfolio Analysis, Design and Optimization.
- Diethelm Würtz, Yohan Chalabi, William Chen, Andrew Ellis: Portfolio Optimization with R/Rmetrics, Rmetrics eBooks 2009, Finance Online Publishing, Zurich

Webes források, I

Lei Jin: R Code and examples for David Ruppert 's book:Statistics and Finance: An Introduction, http://www.stat.tamu.edu/~ljin/Finance/stat689-R.htm
Chapter 2: Probability and Statistical Models
Chapter 3: Returns
Chapter 4: Time Series
Chapter 5: Portfolio Theory
Chapter 7: The Capital Asset Pricing Model
Chapter 8: Option Pricing
Chapter 9: Fixed Income Securities
Chapter 10: Resampling
Chapter 12: GARCH Models

Webes források, II

- Jeszenszky, P (Debreceni Egyetem): jegyzetek, példák, linkek, stb, http://www.inf.unideb.hu/~jeszy/R/index.html,
- Solymosi, N.: <-...erre, erre...! (Bevezetés az R-nyelv és környezet használatába), http://cran.r-project.org/doc/contrib/Solymosi-Rjegyzet.pdf,
- Münnich, Á, Nagy, Á és Abari, K (Debreceni Egyetem): Többváltozós statisztika pszichológus hallgatók számára http://psycho.unideb.hu/statisztika/index2.html,

Books on R by R Core Team members, I

- John M. Chambers (2008), Software for Data Analysis: Programming with R. Springer, New York, http://stat.stanford.edu/~jmc4/Rbook/.
- Peter Dalgaard (2008), Introductory Statistics with R, 2nd edition. Springer, http://www.biostat.ku.dk/~pd/ISwR.html.
- Robert Gentleman (2008), R Programming for Bioinformatics. Chapman & Hall/CRC, Boca Raton, FL, http://www.bioconductor.org/pub/RBioinf/.
- Stefano M. Iacus (2008), Simulation and Inference for Stochastic Differential Equations: With R Examples. Springer, New York.
- Deepayan Sarkar (2007), Lattice: Multivariate Data Visualization with R. Springer, New York.

Books on R by R Core Team members, II

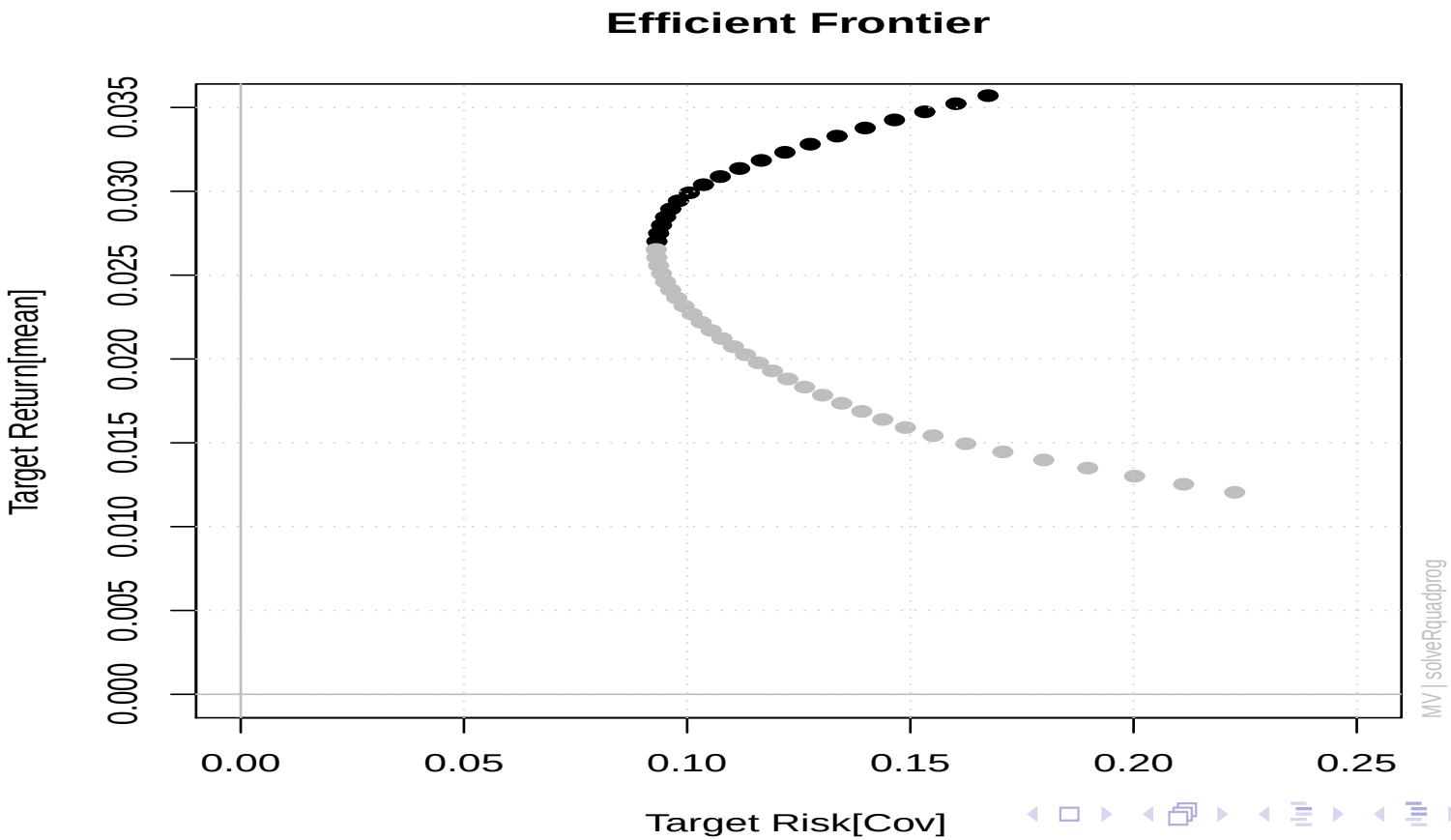
- W. John Braun and Duncan J. Murdoch (2007), A First Course in Statistical Programming with R. Cambridge University Press, Cambridge.
- P. Murrell (2005), R Graphics, Chapman & Hall/CRC, http://www.stat.auckland.ac.nz/~paul/RGraphics/rgraphics.html.
- William N. Venables and Brian D. Ripley (2002), Modern Applied Statistics with S (4th edition). Springer, http://www.stats.ox.ac.uk/pub/MASS4/.
- Jose C. Pinheiro and Douglas M. Bates (2000), Mixed-Effects Models in S and S-Plus. Springer.

fPortfolio

- mean-variance (Markowitz) elmélet,
- mean–VaR/CVaR portfoliók,
- egyéb változatok, feltételek.

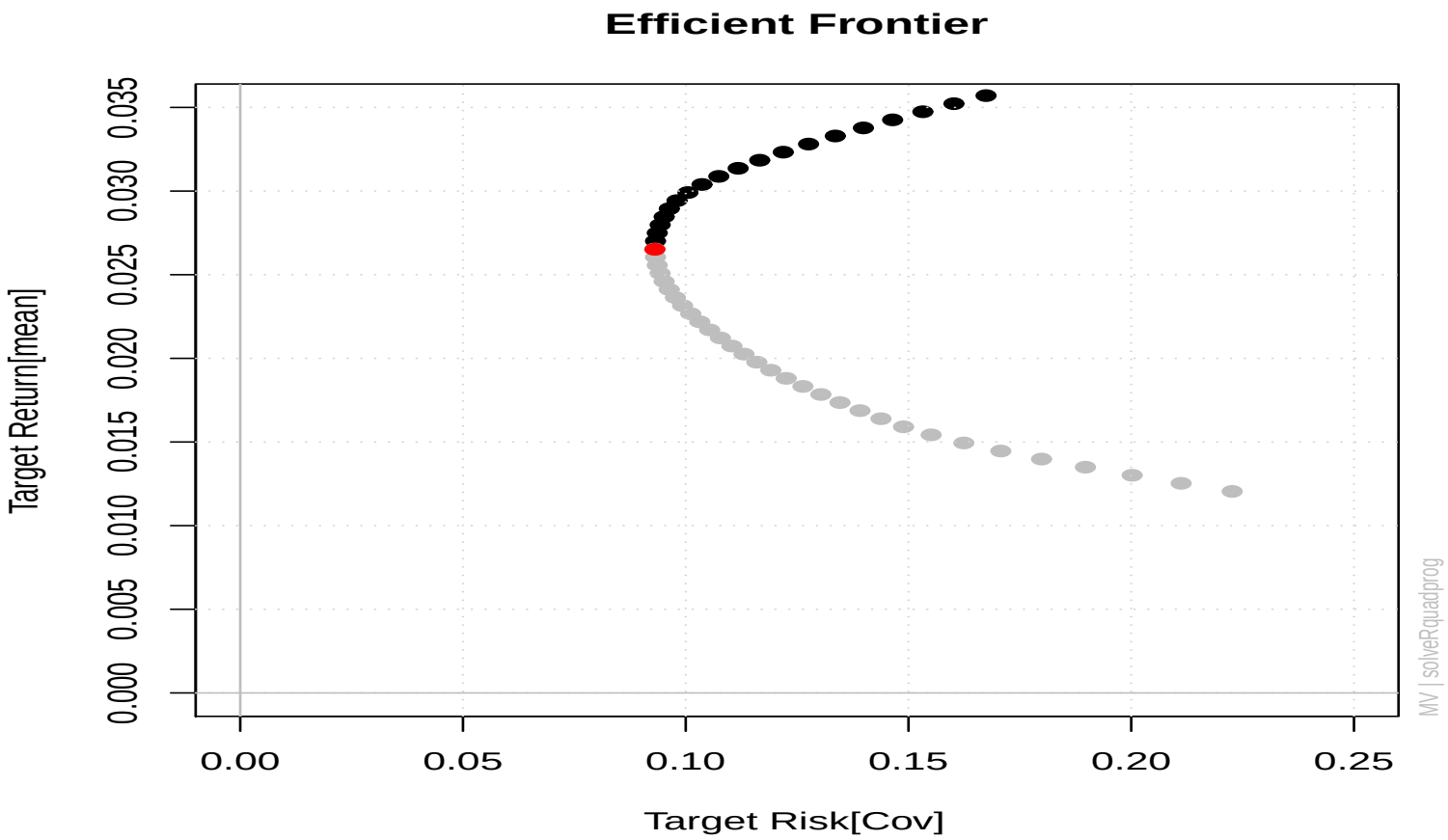
Példa: portfolio frontier 1

Frontier = portfolioFrontier(Data)
frontierPlot(Frontier, ...)



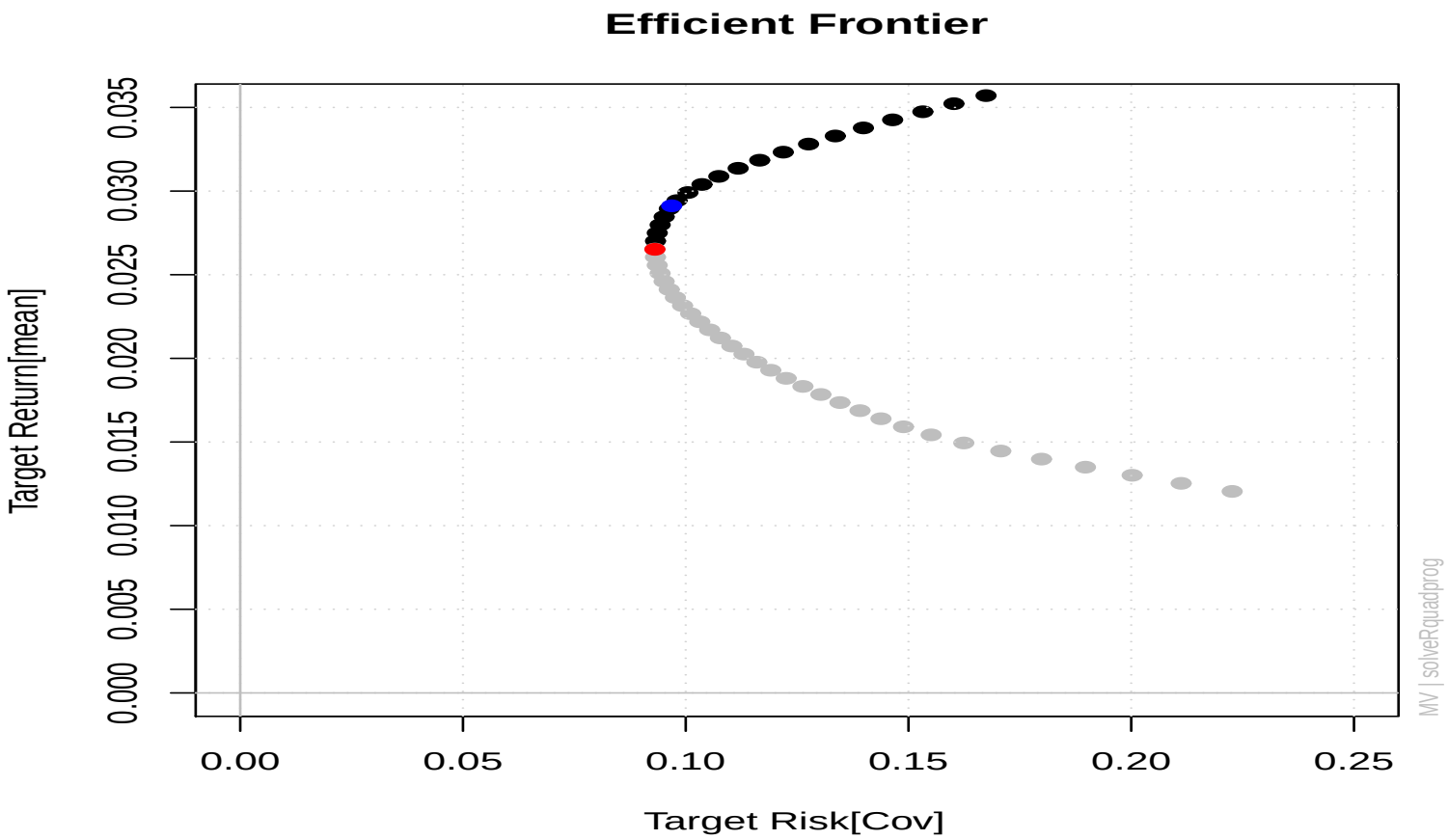
Példa: portfolio frontier 2

minvariancePoints(Frontier, ...)



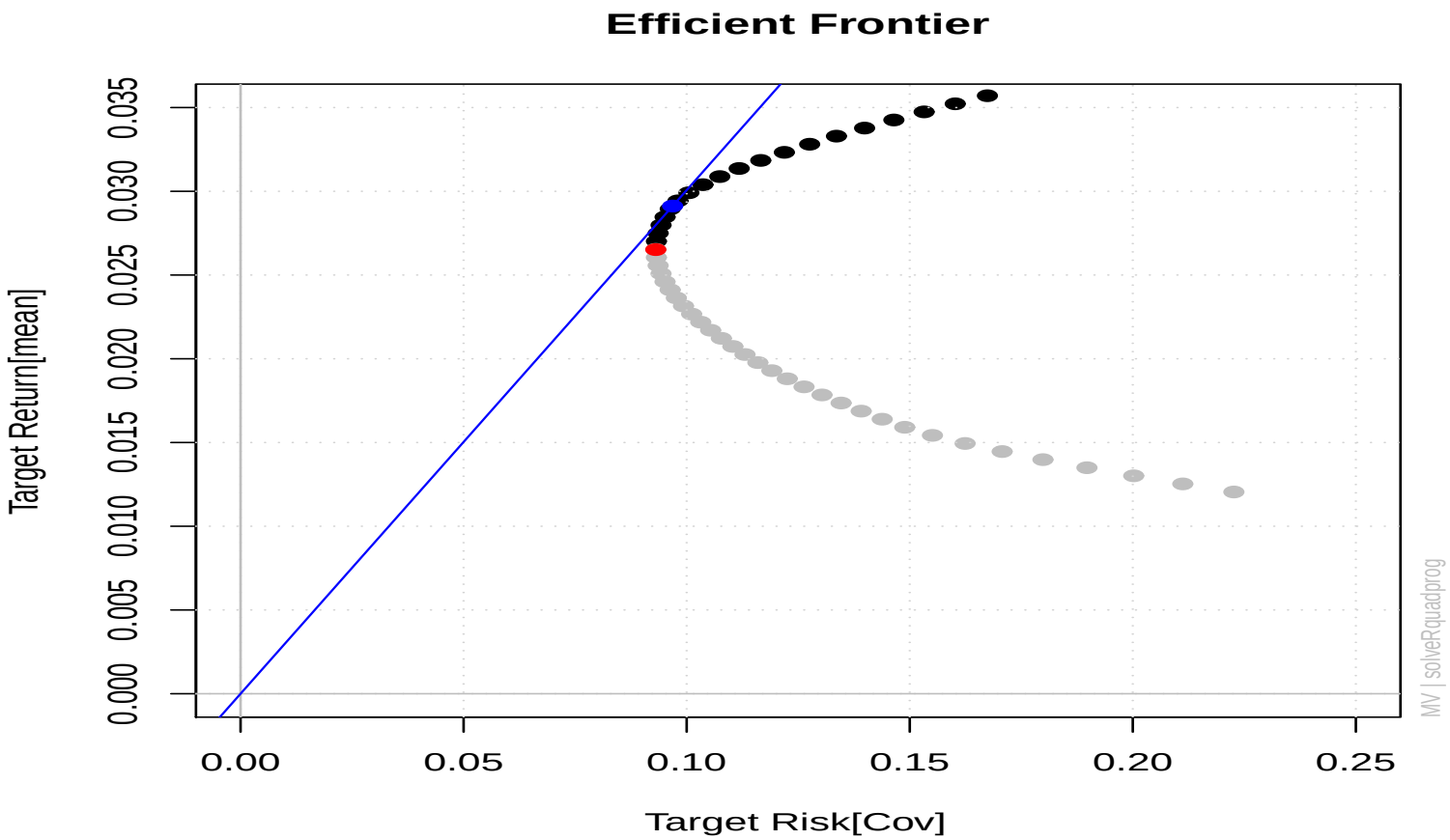
Példa: portfolio frontier 3

tangencyPoints(Frontier, ...)



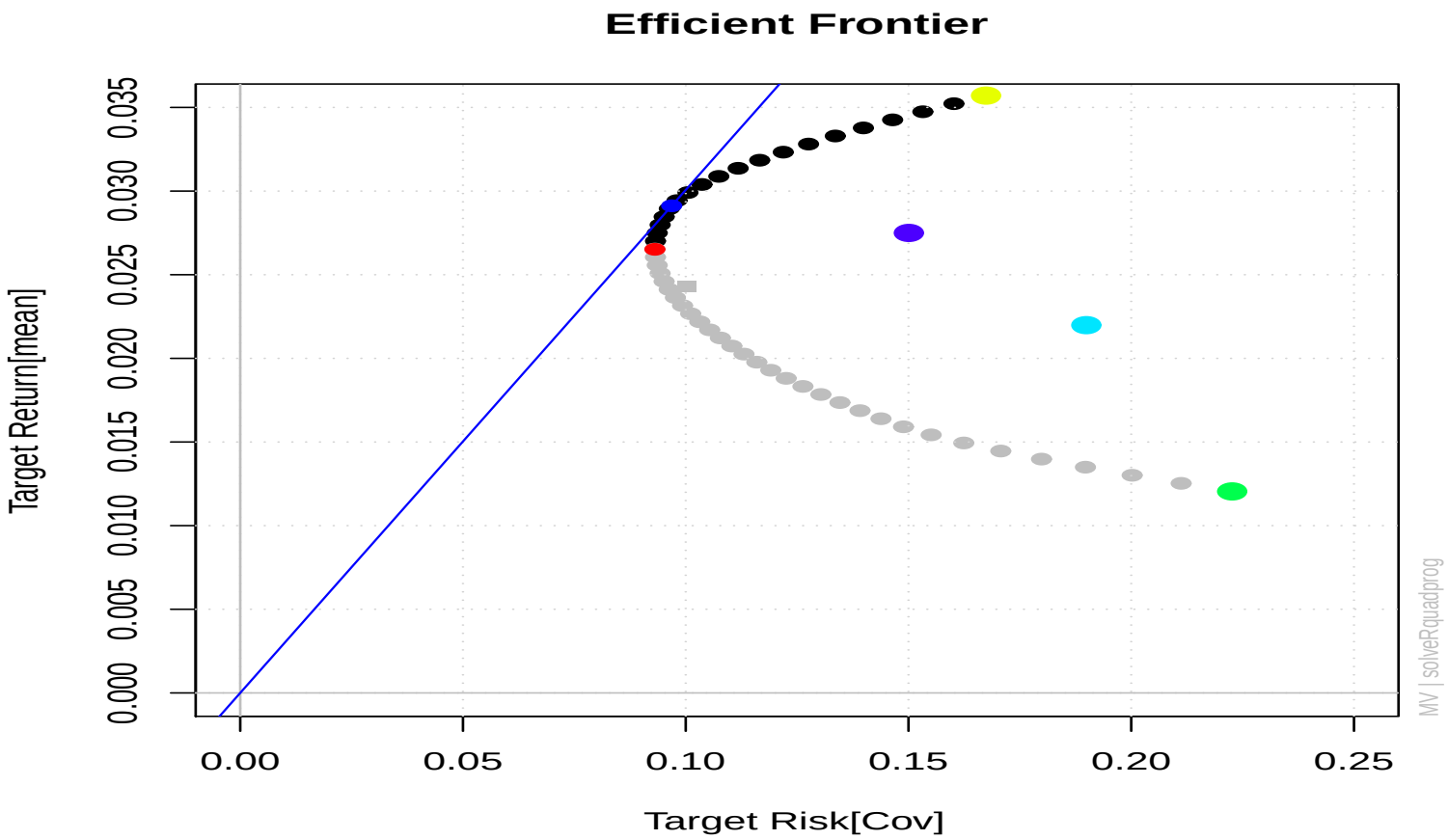
Példa: portfolio frontier 4

tangencyLines(Frontier, ...)



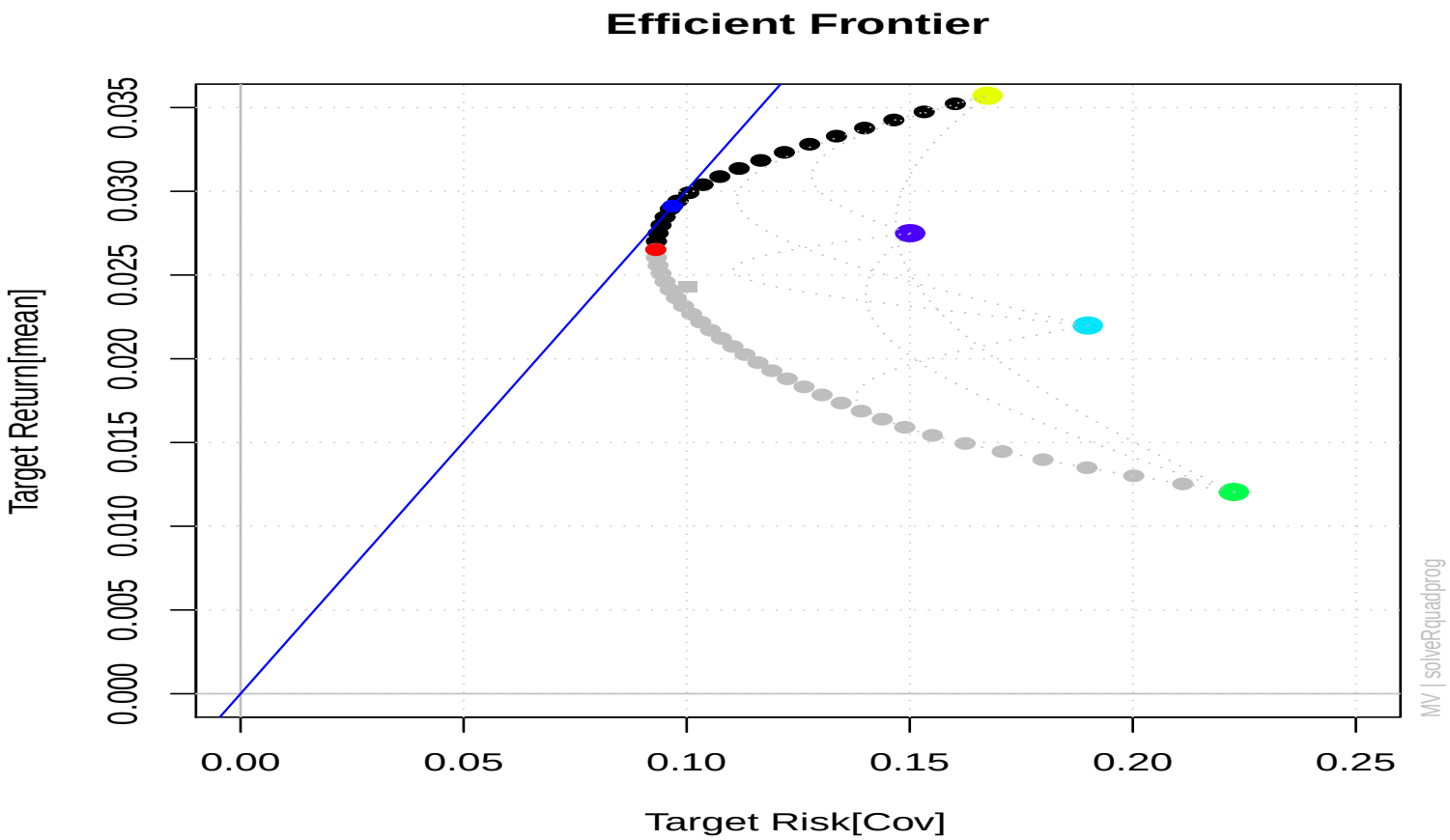
Példa: portfolio frontier 5

singleAssetPoints(Frontier, ...)



Példa: portfolio frontier 6

twoAssetsLines(Frontier, ...)



Megjegyzés: paraméterek

- setWeights(spec), setTargetReturn(spec), setTargetRisk(spec), setRiskFreeRate(spec), setNFrontierPoints(spec), setStatus(spec),
- setSolver(spec), setObjective(spec), setTrace(spec) setType(spec), setOptimize(spec), setEstimator(spec), setTailRisk(spec), setParams(spec), setAlpha(spec)

VaR

- VaR.norm (VaR-ban): Value at Risk, lognormális közelítés,
- VaR.gpd (VaR-ban): Value at Risk, általánosított Pareto eloszlás (likelihood illesztés),
- továbbá ValueAtRisk: fExtremes-ben, szintén VaR és CVaR,
- és egyéb eloszlások, csomagok.

fBonds

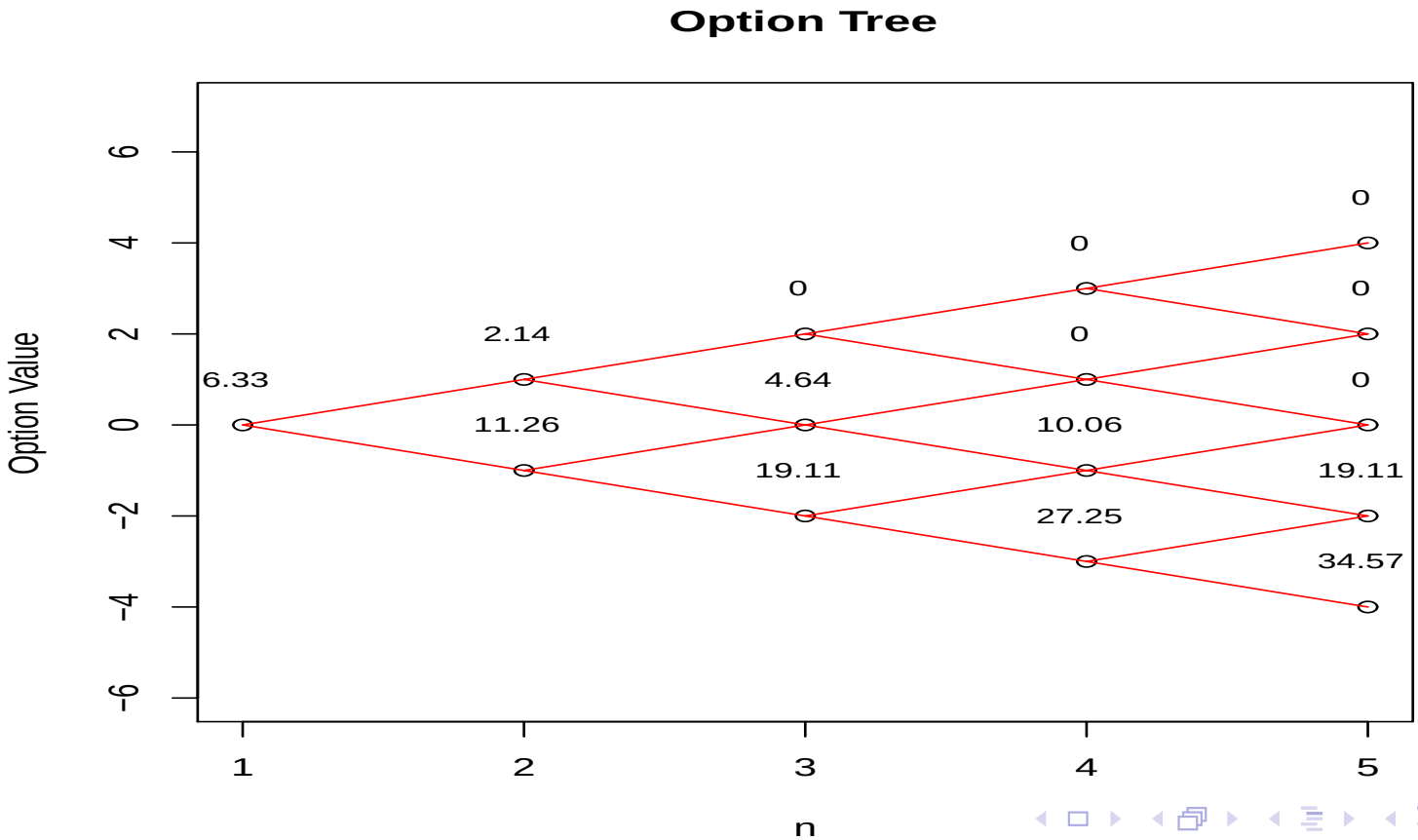
- TermStructure,
- NelsonSiegel,
- Svensson.

Opciók

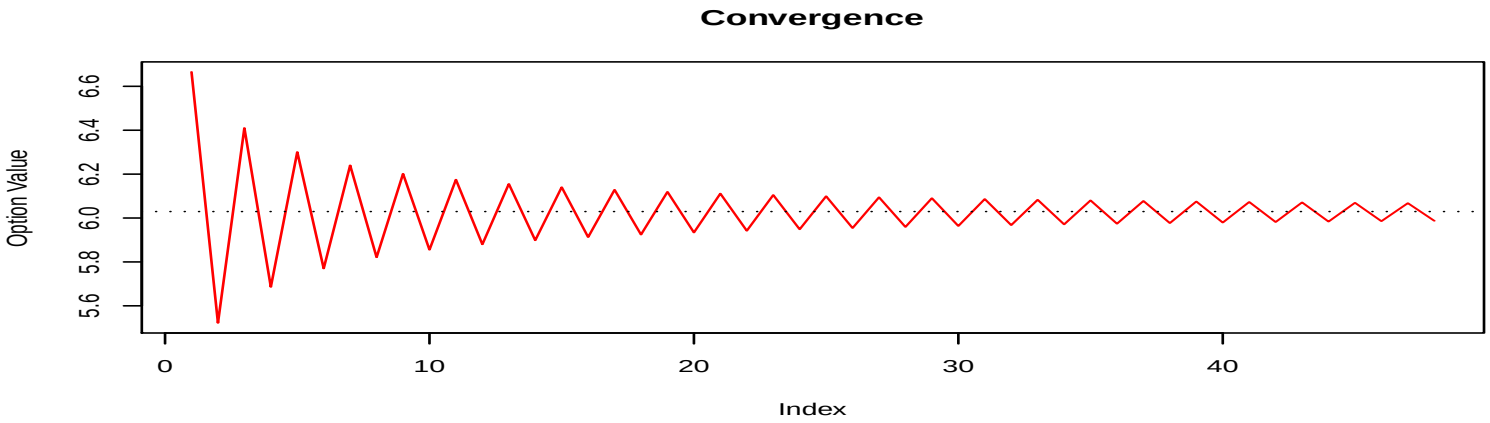
- fOptions: bináris fák, Black-Scholes, Görögök.
- fAsianOptions, fExoticOptions: útfüggő opciók (barrier, binary, lookback, multiple asset, currency/translated,
- fAsianOptions: segédfv-ek.

Példa: Binomiális (CRR) modell, library(fOptions)

CRRTree=BinomialTreeOption(TypeFlag = "pa",...)
BinomialTreePlot(CRRTree, ...)



Példa: CRR konvergencia (Eu put)



Egy kamatlábpélda:

- diszkrét idejű véletlen mezős forward kamatlábmodell,
- együttes ML becslések R-ben,
- nem i.i.d. (fae) megfigyelések, nincs explicit alak a becslésre,
- R: optim fv, klasszikus numerikus ML becslés.

optim

- NelderMead, quasi-Newton and conjugate-gradient algorithms,
- "BFGS" módszer: quasi-Newton (Broyden, Fletcher, Goldfarb and Shanno, '70).
- "CG" módszer: conjugate gradients (Fletcher and Reeves, '64),
- "L-BFGS-B": Byrd et. al., '95), box constraints,
- "SANN": variant of simulated annealing given in Belisle (1992), non-differentiable functions,