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RiskDemo software for demonstrating actuarial and financial risks

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RiskDemo is a free-to-use R software tool designed to illustrate insurance business risks from a probabilistic and statistical perspective. The R commander can be used to illustrate risks through a variety of graphical representations, tables, and risk figures. It includes valuation of bonds and stocks, portfolio optimization, classical ruin theory, demography and epidemic. Risk can be illustrated with a variety of graphs, tables, and figures.

1 Description

RiskDemo works in the R environment, which is open source software specifically designed for statistical modeling and graphics (R Core Team, 2017). R with its source code, binaries and documentation, as well as an extensive collection of additional packages is available on the CRAN network (Comprehensive R Archive Network). RiskDemo is implemented as an add-on to R Commander (Fox & Bouchet-Valat 2017; Fox 2017 ja 2005). RiskDemon resembles R-package TeachingDemos, which can be used to illustrate the basic concepts of statistics and probability (Snow, 2016). The Demographics part of RiskDemon is essentially based on the R-package Demography programmed by Rob Hyndman (2017).
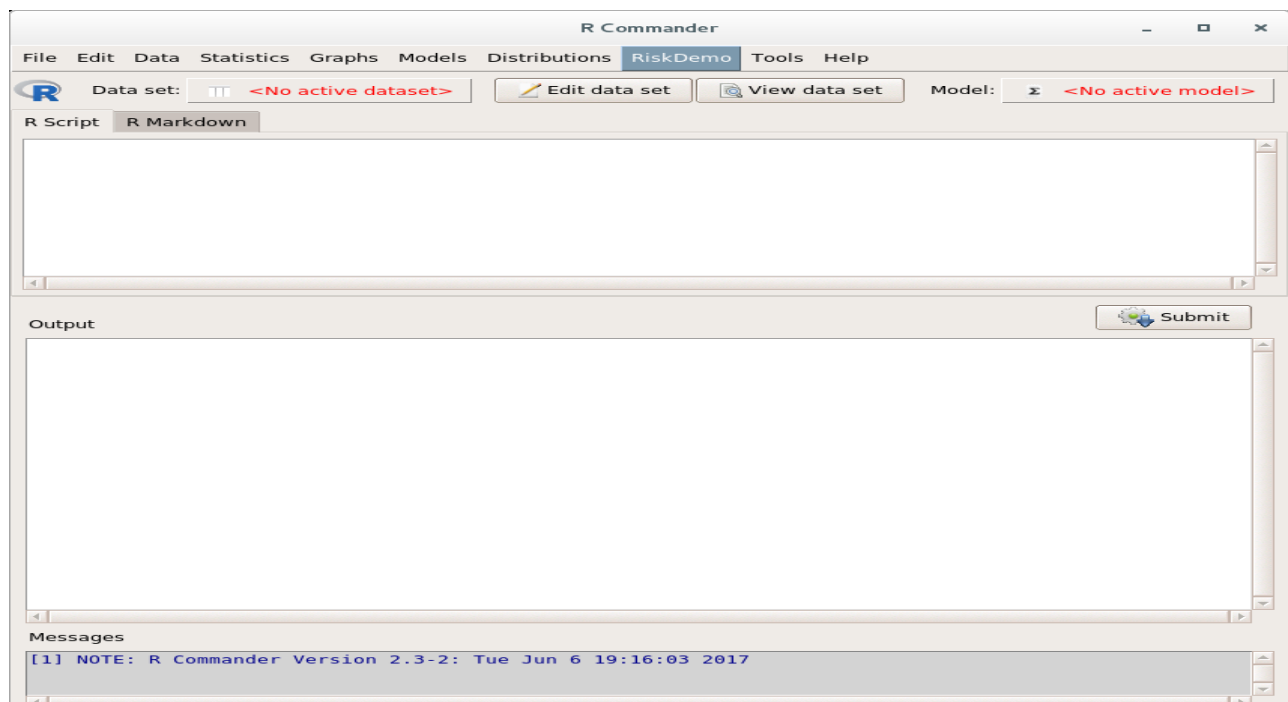

Figure 1. R Commander Window.

RcmdrPlugin.RiskDemo: R Commander Plug-in

Version:	3.0
Depends:	R (≥ 3.5.0)
Imports:	stats, Rcmdr, demography, forecast, ftsa, ggplot2, dplyr, scales, zoo, data.table
Suggests:	tkrplot, rgl
Published:	2021-04-06
Author:	Arto Luoma
Maintainer:	Arto Luoma <arto.luoma at wippies.com>
License:	GPL-2
NeedsCompilation:	no
Materials:	ChangeLog
CRAN checks:	RcmdrPlugin.RiskDemo results

Downloads:

Reference manual:	RcmdrPlugin.RiskDemo.pdf
Package source:	RcmdrPlugin.RiskDemo_3.0.tar.gz
Windows binaries:	r-devel: RcmdrPlugin.RiskDemo_3.0.zip, r-release: RcmdrPlugin.RiskDemo_3.0.zip, r-oldrel: RcmdrPlugin.RiskDemo_3.0.zip
macOS binaries:	r-release (arm64): RcmdrPlugin.RiskDemo_3.0.tgz, r-release (x86_64): RcmdrPlugin.RiskDemo_3.0.tgz, r-oldrel: RcmdrPlugin.RiskDemo_3.0.tgz
Old sources:	RcmdrPlugin.RiskDemo archive

Linking: The canonical form

https://CRAN.R-project.org/package=RcmdrPlugin.RiskDemo

Rtopics documented:

RcmdrPlugin.RiskDemo-package, bondCurve, bondFigure, bondPrice, computeRuin computeRuinFinite, countries.mort, covidSmooth, dataCovid, dataCovidFin, drawBars, drawBarsFin, drawFigure, drawIncidence, drawIncidenceFin, drawPositiveRate, drawRuin, drawTests, fin, fin.fcast, fin.lca, loglikCovid, params, plotForecast, plotR, pop.pred, popRegionsFin, portfOptim, returns, solveLund, solveYield, stock.price, stockData.

2. Risk demonstration tools

2.1. Bonds-menu

This tool draws forward and yields curves, for AAA-rated central governement bonds and/or all central government bonds. There are two options. "Determine bond price" ja "Draw yield curves". Theoretical background can be found e.g. in Bodien, Kanen and Marcusin (2014).

Figure *2. Bond Calculator.*
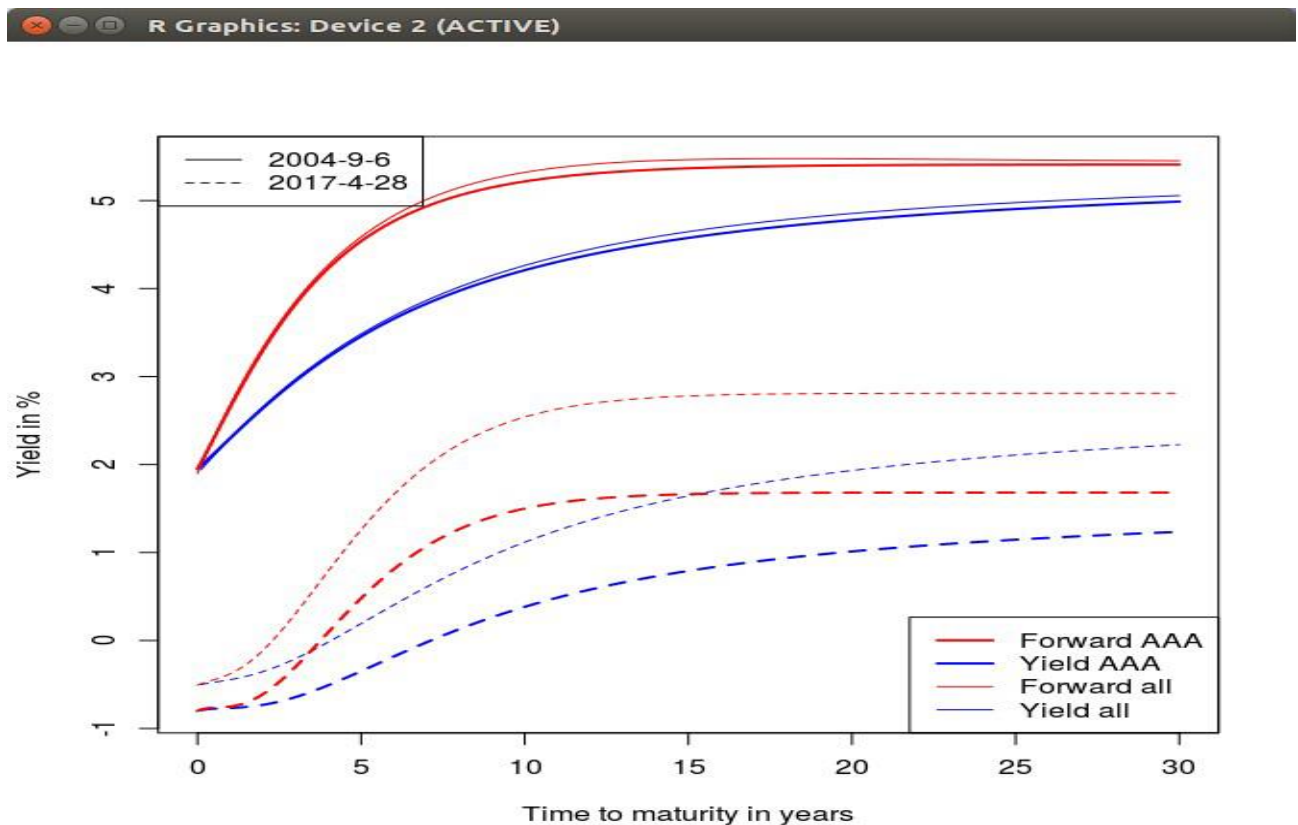

Figure 3. Drawing bond yields.

Figure 4. Bond yield and term structure.

2.2. Demography menu

Demography tools makes it possible to draw demographic graphs and make demographic predictions. In addition, it includes mortality data downloaded from the Human Mortality Database (HMD) for 38 different countries. Main window includes options "Plot demographic data", "Choose demographic data", "Compute lifetable", "Estimate demographic model", "Forecast demographic data", "Forecast population data". Theoretical background can be found e.g. in Alho and Spencer (2005).
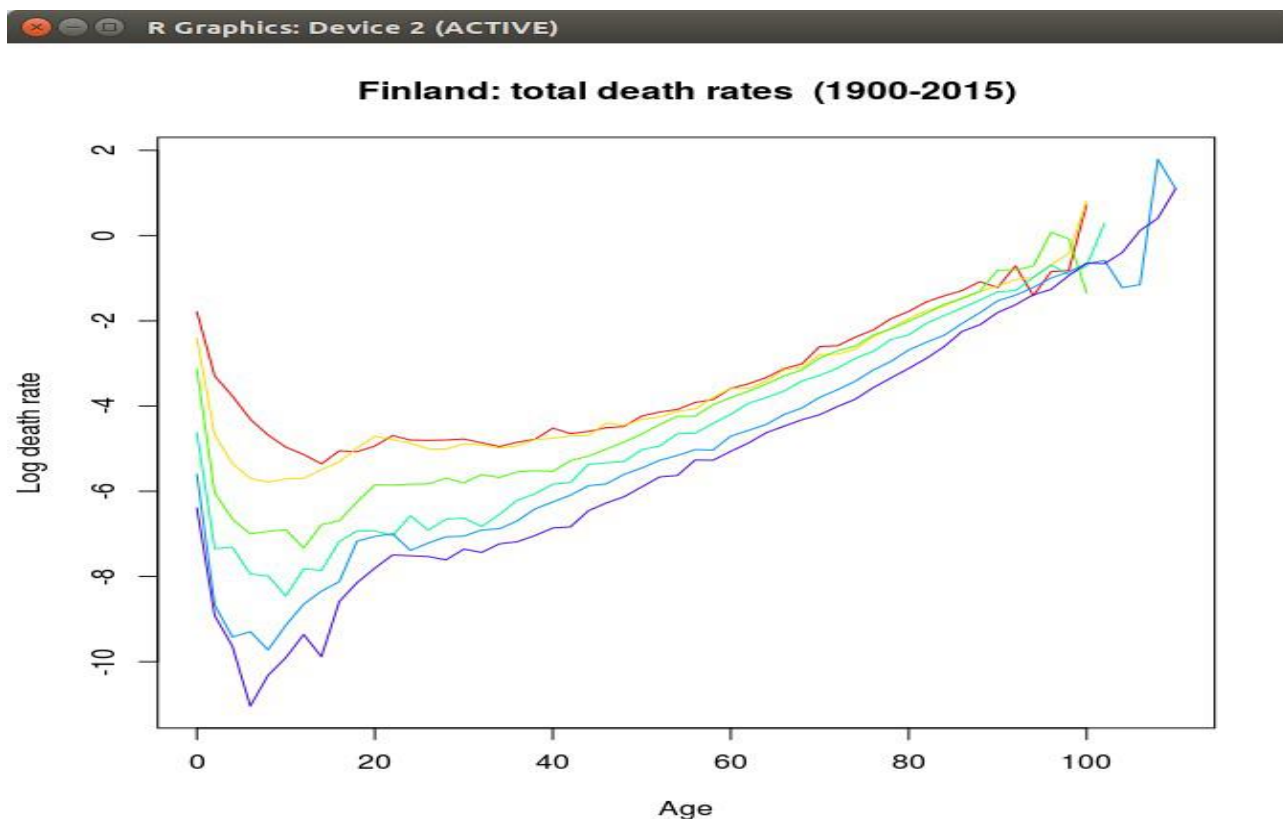

Figure 5. Demographic window.

Finland: total death rates (1900-2015)

Figure 6. Mortality between 1900 and 2015 in Finland.

	row.names	1878	1879	1880	1881	1882	1883
1	0	0.201289	0.154785	0.184604	0.206265	0.191259	0.171650
2	1	0.082972	0.052944	0.068387	0.079438	0.073939	0.053752
3	2	0.045015	0.032662	0.042385	0.045003	0.042757	0.036228
4	3	0.028611	0.022491	0.028371	0.033389	0.029953	0.028299
5	4	0.020423	0.016773	0.021245	0.026800	0.023473	0.021520
6	5	0.015087	0.010805	0.016259	0.021063	0.017891	0.017545
7	6	0.012510	0.007491	0.011225	0.016632	0.014518	0.013727
8	7	0.009705	0.007178	0.009738	0.011719	0.012259	0.010582
9	8	0.008268	0.005691	0.008374	0.009062	0.008752	0.008571
10	9	0.005923	0.005296	0.007552	0.008580	0.006410	0.006059
11	10	0.006561	0.004066	0.007742	0.007458	0.006133	0.004510
12	11	0.005391	0.004151	0.005497	0.007978	0.005087	0.004763

Figure 7. Life table.

From the "Estimating demographic model" window you can select which model will be fitted to the demographic (mortality or fertility) data.

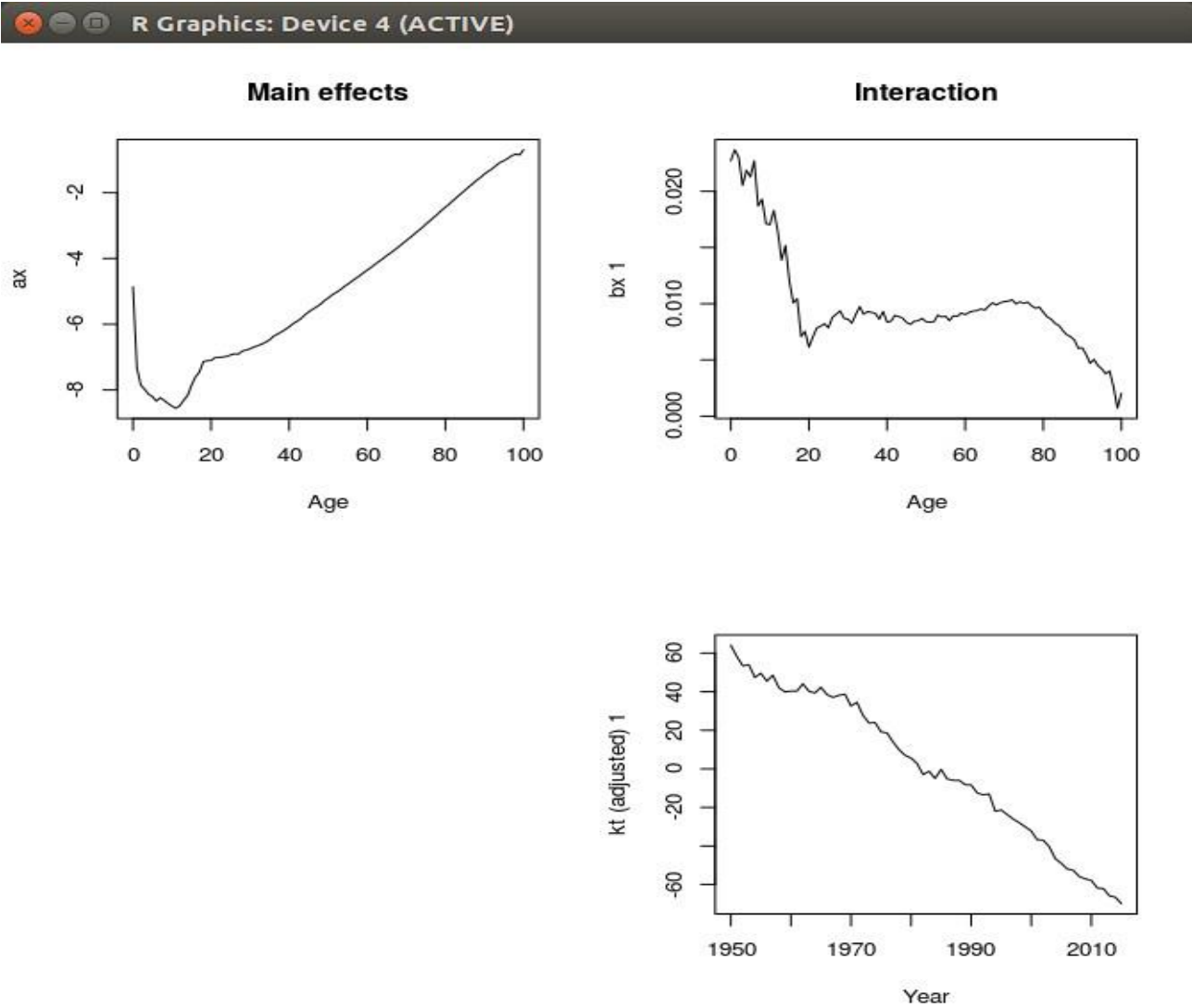
Figure 8. Demographic model window.

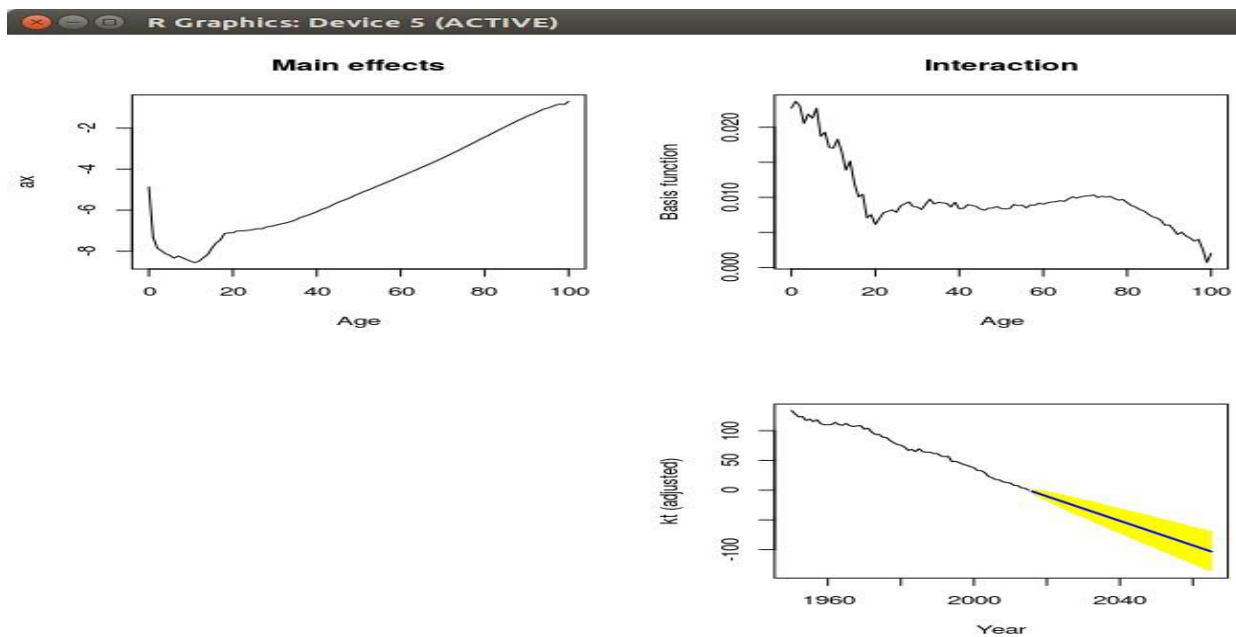*Figure 9. Estimated Lee Carter mortality model.*

Figure 10. Demographic predictions by Lee Carter model.

2.3. Risk Theory Menu

This tool illustrates ruin theory. This tool uses classical ruin theory to compute either ruin probability, safety loading or initial capital, given two of them. The time horizon is infinite. Gamma distribution is used to model claim sizes. Theoretical background can be found e.g. in Kaasin, Goovaertsin, Dhaenen ja Denuitin (2008).

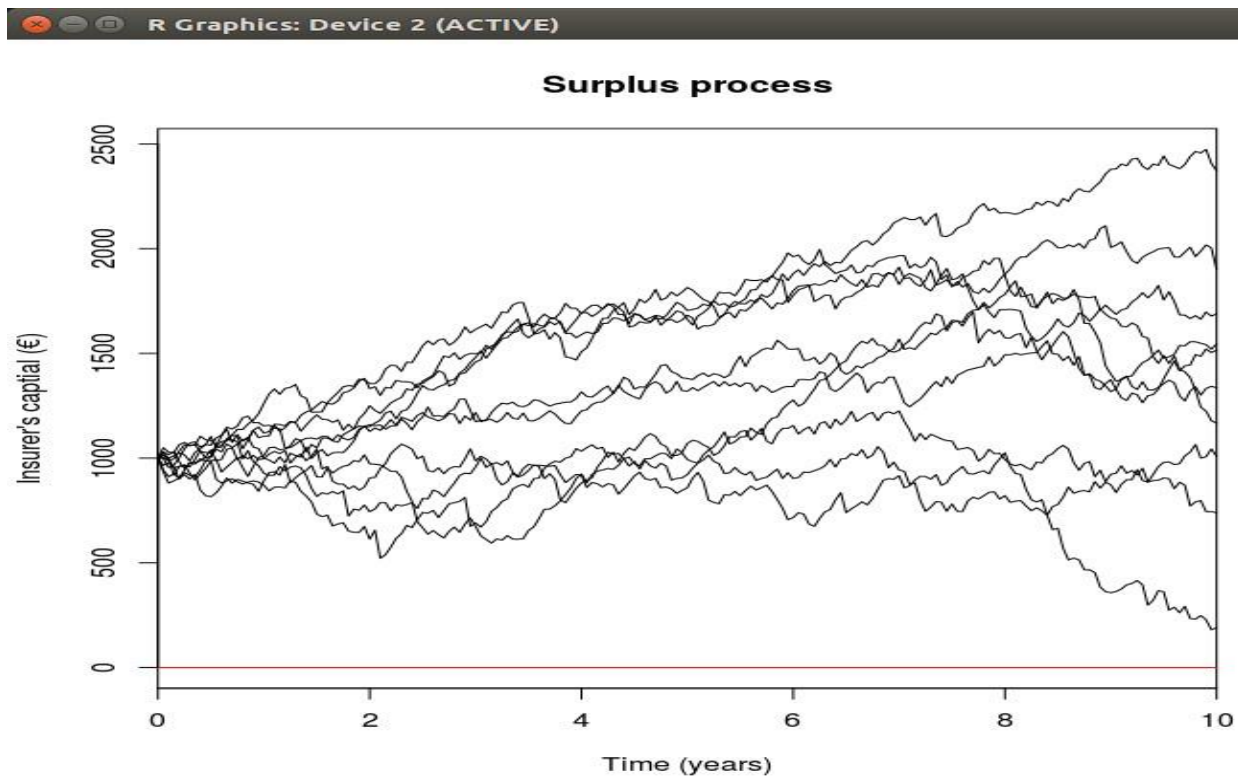*Figure 11. Parameter Window for Risk Models.*

Figure 12. Simulated surplus process.

2.4. Stocks menu

The Stocks tool makes it possible to illustrate the calculations and risks associated with equity investing. The menu contains items "Load stock data", "Optimize portfolio" and "Determine stock price". Theoretical background can be found e.g. in Bodie, Kane and Marcus (2014).
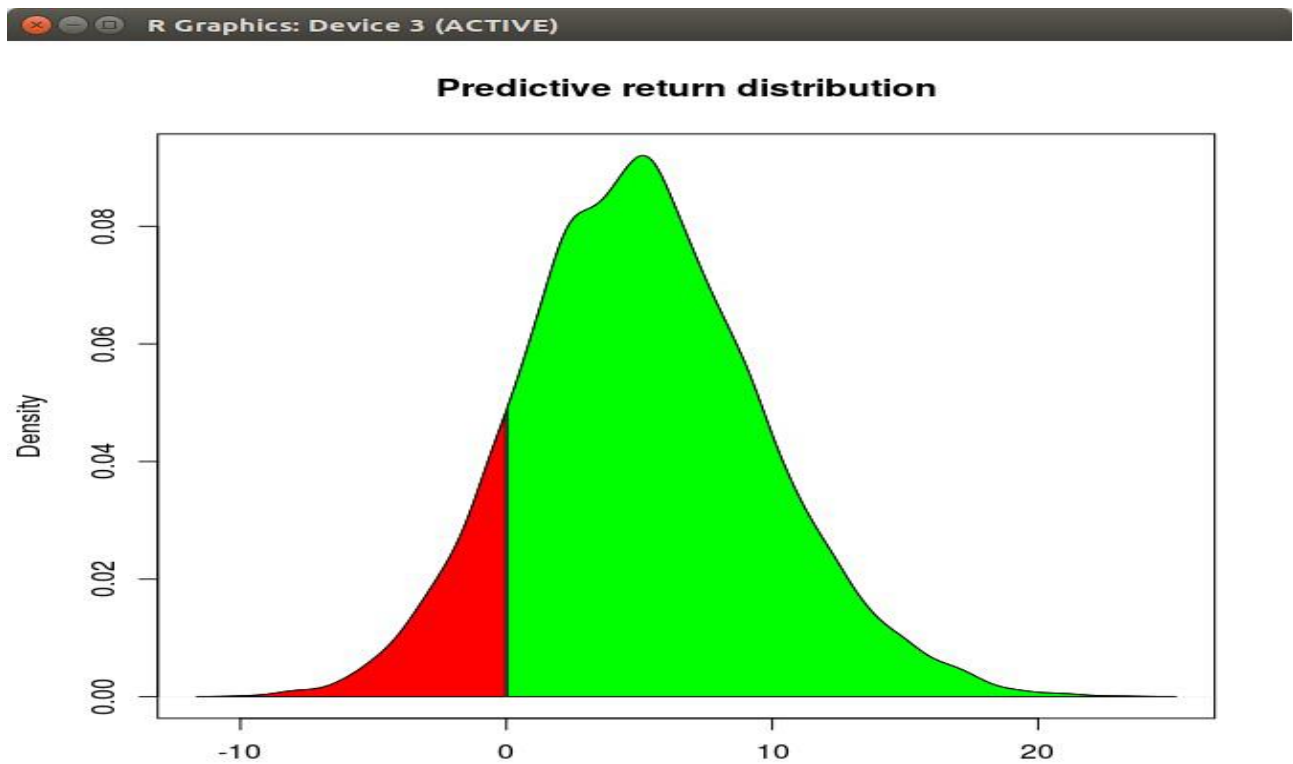

Figure 13. Optimization window.

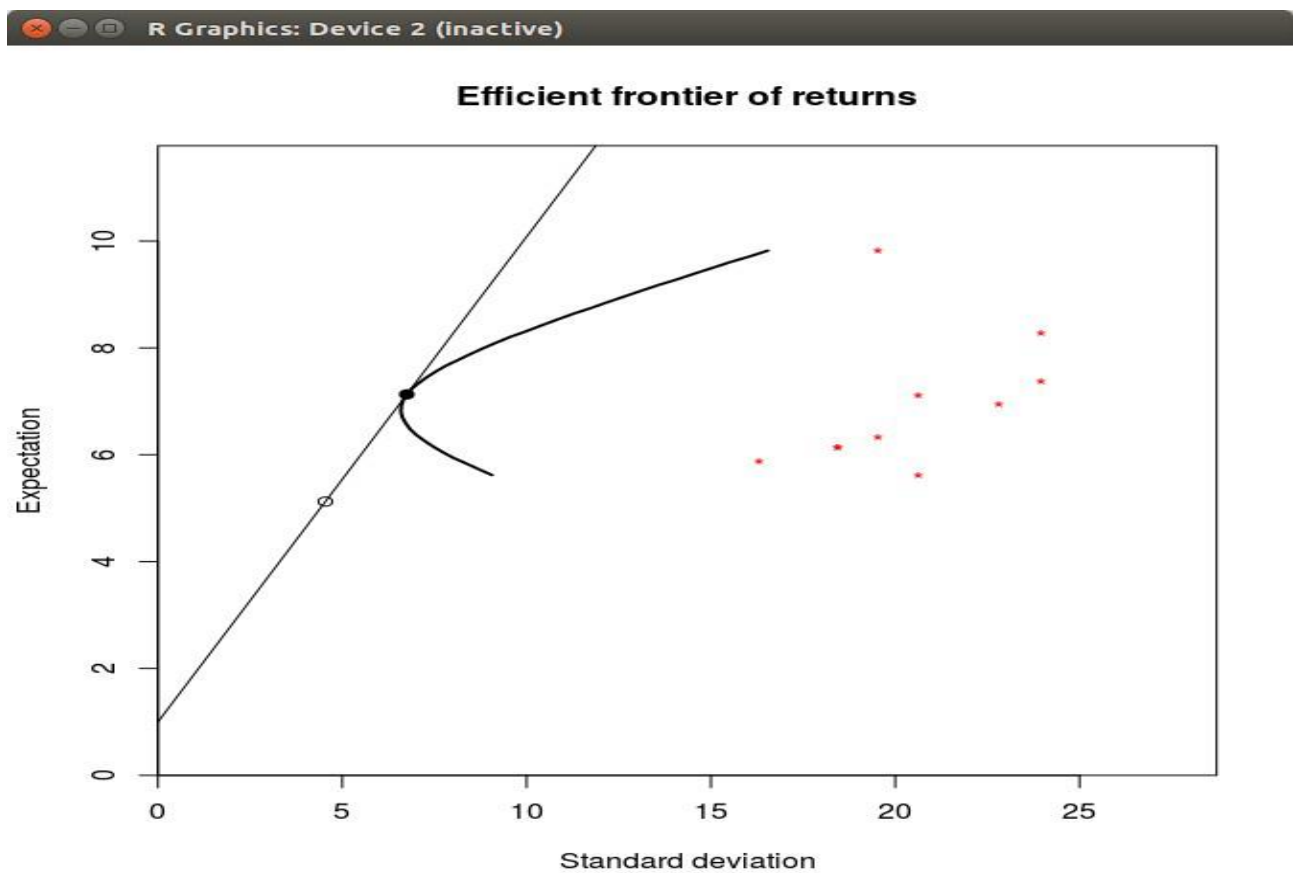*Figure 14. Predictive return distribution.*

Figure 15. Efficient frontier window.

2.5. Corona pandemic Menu

Kalman smoothing of the SIER model is used to predict new COVID-19 cases. Data set consists of several statistics about the COVID-19 pandemic in 45 countries. Tool plots a time series of either the positive rate of COVID-19 tests or the number of tests per case.Theoretical background can be found e.g. in Hethcote, H.W. (1989).

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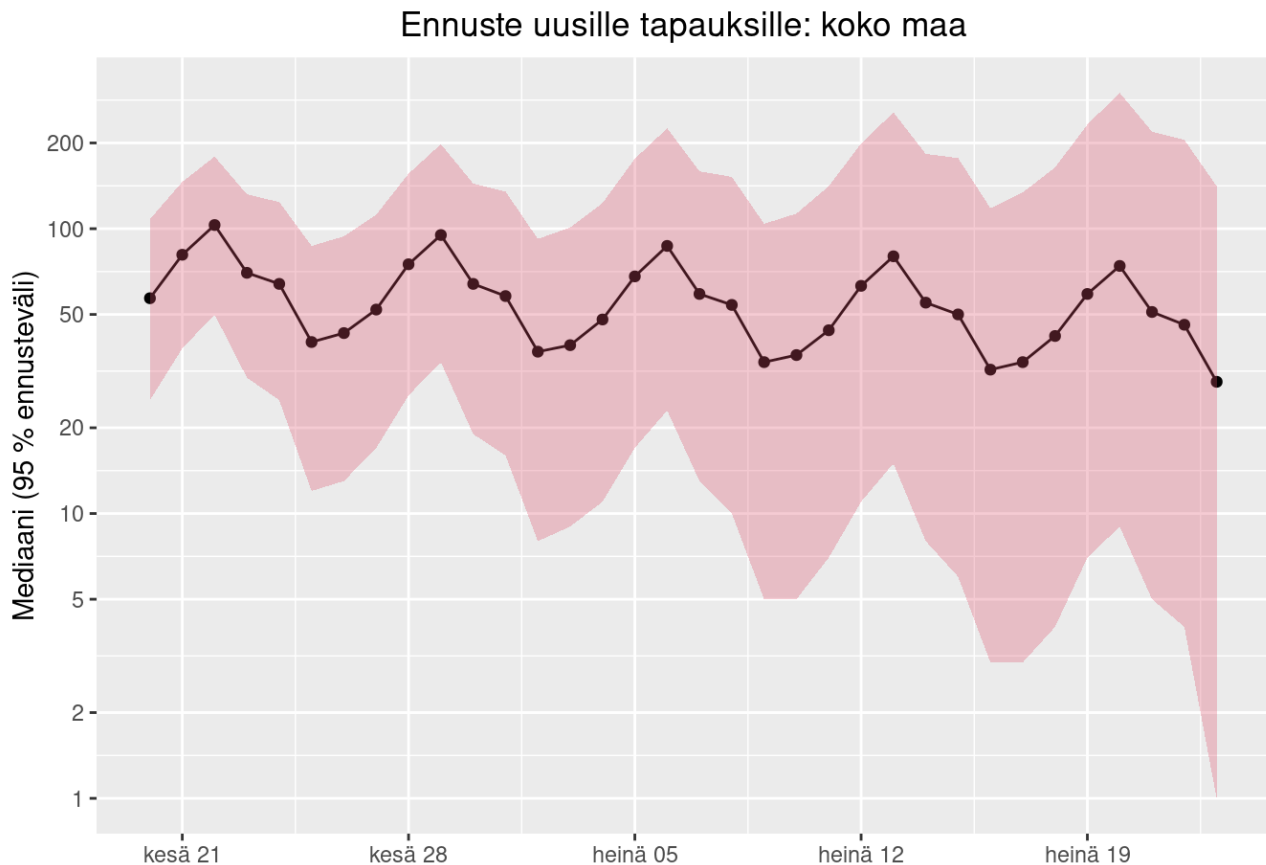
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Covid Data

http://www.arto-luoma.fi/covid.html

RiskDemo

https://CRAN.R-project.org/package=RcmdrPlugin.RiskDemo