Package 'YieldCurve'

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Title Modelling and estimation of the yield curve

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Description Modelling the yield curve with some parametric models. The models implemented are: Nelson-Siegel, Diebold-Li and Svensson. The package also includes the data of the term structure of interest rate of Federal Reserve Bank and European Central Bank.

License GPL (>= 2)

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Details

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DieboldLi

Author(s)

Sergio Salvino Guirreri

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References

Diebold, F.X. and Li, C. (2006), Forecasting the Term Structure of Government Bond Yields, *Journal of Econometrics*, **130**, 337-364.

Diebold, F.X., Ji, L. and Li, C. (2006), A Three-Factor Yield Curve Model: Non-Affine Structure, Systematic Risk Sources, and Generalized Duration, in L.R. Klein (ed.), *Long-Run Growth and Short-Run Stabilization: Essays in Memory of Albert Ando*. Cheltenham, U.K.: Edward Elgar, 240-274.

Nelson, C.R., and A.F. Siegel (1987), Parsimonious Modeling of Yield Curve, *The Journal of Business*, **60**, 473-489.

Svensson, L.E. (1994), Estimating and Interpreting Forward Interest Rates: Sweden 1992-1994, *IMF Working Paper*, **WP/94/114**.

Examples

```
data(FedYieldCurve)
tau <- c(3, 6, 12, 60, 84, 120)
mediumTerm <- c(12,60,84)
NSParameters <- Nelson.Siegel( rate=FedYieldCurve[1:10,],
```

```
maturity=tau, MidTau=mediumTerm )
y <- NSrates(NSParameters[5,1:3],
NSParameters$lambda[5],tau)
plot(tau,FedYieldCurve[5,],main="Fitting Nelson-Siegel yield curve", type="o")
lines(tau,y, col=2)
legend("topleft",legend=c("observed yield curve","fitted yield curve"),
col=c(1,2),lty=1)
```

`ECBYieldCurve` *Yield curve data spot rate, AAA-rated bonds, maturities from 3 months to 30 years*

Description

Government bond, nominal, all triple A issuer companies. The maturity are 3 and 6 months and from 1 year to 30 years with frequency business day, provided by European Central Bank.

Usage

```
data(ECBYieldCurve)
```

Format

A data frame with 655 observations on the following 32 variables.

`X3M` interest rate with maturity 3 months

`X6M` interest rate with maturity 6 months

`X1Y` interest rate with maturity 1 year

`X2Y` interest rate with maturity 2 years

`X3Y` interest rate with maturity 3 years

`X4Y` interest rate with maturity 4 years

`X5Y` interest rate with maturity 5 years

`X6Y` interest rate with maturity 6 years

`X7Y` interest rate with maturity 7 years

`X8Y` interest rate with maturity 8 years

`X9Y` interest rate with maturity 9 years

`X10Y` interest rate with maturity 10 years

`X11Y` interest rate with maturity 11 years

`X12Y` interest rate with maturity 12 years

`X13Y` interest rate with maturity 13 years

`X14Y` interest rate with maturity 14 years

`X15Y` interest rate with maturity 15 years

`X16Y` interest rate with maturity 16 years

X17Y interest rate with maturity 17 years

X18Y interest rate with maturity 18 years

X19Y interest rate with maturity 19 years

X20Y interest rate with maturity 20 years

X21Y interest rate with maturity 21 years

X22Y interest rate with maturity 22 years

X23Y interest rate with maturity 23 years

X24Y interest rate with maturity 24 years

X25Y interest rate with maturity 25 years

X26Y interest rate with maturity 26 years

X27Y interest rate with maturity 27 years

X28Y interest rate with maturity 28 years

X29Y interest rate with maturity 29 years

X30Y interest rate with maturity 30 years

Source

ECB: http://www.ecb.europa.eu/stats/money/yc/html/index.en.html.
Data set is also available for download in Excel format at http://www.guirreri.host22.com/index.php?p=1_2_Documents.

Examples

```
data(ECBYieldCurve)
## maybe str(ECBYieldCurve) ; plot(ECBYieldCurve)
tau <- c(3/12,6/12,1:30)
par(mfrow=c(1,2))
plot(tau,ECBYieldCurve[1,],type="o", ylim=c(0,5),
main="European Union's yield curve",sub="29/12/2006")
grid()
plot(tau,ECBYieldCurve[655,],type="o", ylim=c(0,5),
main="European Union's yield curve",sub="24/07/2009")
grid()
```

FedYieldCurve *Federal Reserve interest rates*

Description

3 months, 6 months, 1 year, 5 year, 7 year and 10 year monthly interest rate of the Federal Reserve from Janury 1982 to June 2009.

Usage

```
data(FedYieldCurve)
```

Format

An object with class attributes `ts`, `mts`.

Source

FED: http://www.federalreserve.gov/.
Data set is available for download in Excel format at http://www.guirreri.host22.com/index.php?p=1_2_Documents.

Examples

```
data(FedYieldCurve)
tau <- c(3, 6, 12, 60, 84, 120 )
plot(tau, FedYieldCurve[1,], type="o")
```

Nelson.Siegel *Estimation of the Nelson-Siegel parameters*

Description

Returns the estimated coefficients of the Nelson-Siegel's model.

Usage

```
Nelson.Siegel(rate, maturity, MidTau)
```

Arguments

`rate`	vector or matrix which contains the interest rates.
`maturity`	vector wich contains the maturity (in months) of the `rate`. The vector's length must be the same of the number of columns of the `rate`.
`MidTau`	vector which indicates medium term maturity to maximize the beta_2 factor.

Details

The Nelson-Siegel's model to describe the yield curve is:

$$y_t(\tau) = \beta_{0t} + \beta_{1t}\frac{1-\exp(-\lambda\tau)}{\lambda\tau} + \beta_{2t}\left(\frac{1-\exp(-\lambda\tau)}{\lambda\tau} - \exp(-\lambda\tau)\right)$$

Value

Returns a data frame with the estimated coefficients: β_{0t}, β_{1t}, β_{2t}, and λ.

Author(s)

Sergio Salvino Guirreri

References

Diebold, F.X. and Li, C. (2006), Forecasting the Term Structure of Government Bond Yields, *Journal of Econometrics*, **130**, 337-364.

Diebold, F.X., Ji, L. and Li, C. (2006), A Three-Factor Yield Curve Model: Non-Affine Structure, Systematic Risk Sources, and Generalized Duration, in L.R. Klein (ed.), *Long-Run Growth and Short-Run Stabilization: Essays in Memory of Albert Ando*. Cheltenham, U.K.: Edward Elgar, 240-274.

Nelson, C.R., and A.F. Siegel (1987), Parsimonious Modeling of Yield Curve, *The Journal of Business*, **60**, 473-489.

See Also

NelsonSiegel, Svensson

Examples

```
data(FedYieldCurve)
tau <- c(3, 6, 12, 60, 84, 120)
mediumTerm <- c(12,60,84)
NSParameters <- Nelson.Siegel( rate=FedYieldCurve[1:10,],
maturity=tau, MidTau=mediumTerm )
y <- NSrates(NSParameters[5,1:3],
NSParameters$lambda[5],tau)
plot(tau,FedYieldCurve[5,],main="Fitting Nelson-Siegel yield curve", type="o")
lines(tau,y, col=2)
legend("topleft",legend=c("observed yield curve","fitted yield curve"),
col=c(1,2),lty=1)
grid()
```

NSrates *Interest rates of the Nelson-Siegel's model.*

Description

Returns the interest rates by Nelson-Siegel's model.

Usage

```
NSrates(betaCoeff, lambdat, maturity)
```

Arguments

betaCoeff	vector or matrix of the beta's coefficients.
lambdat	value of the estimated lambda
maturity	maturity of the yield curve of which want to return the interest rates.

Details

`betaCoeff` is a vector or matrix of the three coefficients of the Nelson-Siegel's model

Value

Return interest rates in matrix object with number of rows equal to `nrow(betaCoeff)` and number of columns equal to `length(maturity)`.

Author(s)

Sergio Salvino Guirreri

References

Diebold, F.X. and Li, C. (2006), Forecasting the Term Structure of Government Bond Yields, *Journal of Econometrics*, **130**, 337-364.

Diebold, F.X., Ji, L. and Li, C. (2006), A Three-Factor Yield Curve Model: Non-Affine Structure, Systematic Risk Sources, and Generalized Duration, in L.R. Klein (ed.), *Long-Run Growth and Short-Run Stabilization: Essays in Memory of Albert Ando*. Cheltenham, U.K.: Edward Elgar, 240-274.

Nelson, C.R., and A.F. Siegel (1987), Parsimonious Modeling of Yield Curve, *The Journal of Business*, **60**, 473-489.

Examples

```
data(FedYieldCurve)
b <- c(11.17514, -3.979371, 0.1302654)
lambda <- c(0.1494588)
tau <- c(3, 6, 12, 60, 84, 120 )
y <- NSrates( b, lambda, tau)
plot(tau,FedYieldCurve[10,],main="Fitting Nelson-Siegel yield curve", type="o")
lines(tau,y, col=2)
legend("topleft",legend=c("observed yield curve","fitted yield curve"),
col=c(1,2),lty=1)
grid()
```

Srates *Interest rates of the Svensson's model.*

Description

Returns the interest rates by Svensson's model.

Usage

```
Srates(betaCoeff, lambdaValues, maturity, whichRate = "Forward")
```

Arguments

betaCoeff	vector or matrix of the beta's coefficients.
lambdaValues	vector or matrix of values of λ_1 and λ_2.
maturity	maturity of the yield curve of which want to return the interest rates.
whichRate	which rate want to return: "Spot" or "Forward" rates.

Details

betaCoeff is a vector or matrix of the four coefficients of the Svensson's model, while lambdaValues is a vector or matrix of two lambda values of Svensson's model.

Value

Return interest rates in matrix object with number of rows equal to nrow(betaCoeff) and number of columns equal to length(maturity).

Author(s)

Sergio Salvino Guirreri

References

Svensson, L.E. (1994), Estimating and Interpreting Forward Interest Rates: Sweden 1992-1994, *IMF Working Paper*, **WP/94/114**.

Nelson, C.R., and A.F. Siegel (1987), Parsimonious Modeling of Yield Curve, *The Journal of Business*, **60**, 473-489.

Examples

```
data(ECBYieldCurve)
tauECB <- c(0.25,0.5,1:30)
Y <- Svensson(ECBYieldCurve[1:10,], tauECB, c(1,4), c(5,8) )
B <- Srates(Y[,1:4], Y[,5:6], tauECB, whichRate="Spot")
plot(tauECB,ECBYieldCurve[10,],main="Fitting Svensson's yield curve", type="o")
lines(tauECB,B[10,], col=2)
legend("topleft",legend=c("observed yield curve","fitted yield curve"),col=c(1,2),lty=1)
grid()
```

Svensson *Estimation of the Svensson parameters*

Description

Returns the estimated coefficients of the Svensson's model.

Usage

```
Svensson(rate, maturity, Tau1 = c(3, 12), Tau2 = c(60, 120))
```

Arguments

`rate`	vector or matrix which contains the interest rates.
`maturity`	vector wich contains the maturity (in months) of the `rate`. The vector's length must be the same of the number of columns of the `rate`.
`Tau1`	vector of short-term maturity
`Tau2`	vector of long-term maturity

Details

The Svensson's model to describe the forward rate is:

$$y_t(\tau) = \beta_0 + \beta_1 \exp\left(-\frac{\tau}{\lambda_1}\right) + \beta_2 \frac{\tau}{\lambda_1} \exp\left(-\frac{\tau}{\lambda_1}\right) + \beta_3 \frac{\tau}{\lambda_2} \exp\left(-\frac{\tau}{\lambda_2}\right)$$

The spot rate can be derived from forward rate and it is given by:

$$y_t(\tau) = \beta_0 + \beta_1 \frac{1 - \exp(-\frac{\tau}{\lambda_1})}{\frac{\tau}{\lambda_1}} + \beta_2 \left[\frac{1 - \exp(-\frac{\tau}{\lambda_1})}{\frac{\tau}{\lambda_1}} - \exp(-\frac{\tau}{\lambda_1})\right] + \beta_3 \left[\frac{1 - \exp(-\frac{\tau}{\lambda_2})}{\frac{\tau}{\lambda_2}} - \exp(-\frac{\tau}{\lambda_2})\right]$$

Value

Returns a data frame with the estimated coefficients: β_0, β_1, β_2,β_3, λ_1 and λ_2.

Author(s)

Sergio Salvino Guirreri

References

Svensson, L.E. (1994), Estimating and Interpreting Forward Interest Rates: Sweden 1992-1994, *IMF Working Paper*, **WP/94/114**.

Nelson, C.R., and A.F. Siegel (1987), Parsimonious Modeling of Yield Curve, *The Journal of Business*, **60**, 473-489.

Examples

```
data(FedYieldCurve)
tau <- c(3,6,12,60,84,120)
A <- Svensson(FedYieldCurve[1:10,], tau, c(3,12), c(60,120) )
```

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