Package 'SmithWilsonYieldCurve'

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Type Package

Title Smith-Wilson Yield Curve Construction

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Description Constructs a yield curve by the Smith-Wilson method from a table of libor and swap rates. Now updated to take bond coupons and prices in the same table.

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Suggests testthat

Collate 'fWilson.R' 'fFitKernelWeights.R' 'fCreateCashflowMatrix.R' 'fCreateTimeVector.R' 'fCreateKernelMatrix.R' 'fFitSmithWilsonYieldCurve.R' 'fFitYieldCurve.R' 'fFitSmithWilsonYieldCurveToInstruments.R' 'Utilities.R' 'SmithWilsonYieldCurve.R' 'plot.SmithWilsonYieldCurve.R' 'lines.SmithWilsonYieldCurve.R' 'points.SmithWilsonYieldCurve.R'

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`SmithWilsonYieldCurve-package`

Fit yield curves using the Smith-Wilson method

Description

A package to fit yield curves using the Smith-Wilson method

Details

The main function exposed in this package is fFitSmithWilsonYieldCurve, which takes market data in the form of a vector of cashflow times, a matrix of cashflows and a vector of market prices. It returns an object of class "SmithWilsonYieldCurve".

A convenience function fFitSmithWilsonYieldCurveToInstruments takes a dataframe containing market instrument data as type, tenor, frequency and rate. It extracts the required vectors and matrices and then calls fFitSmithWilsonYieldCurve.

Objects of class SmithWilsonYieldCurve are a list, the first element of which is a function P(t), which returns the zero coupon bond price of the fitted curve at time t.

Author(s)

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References

Smith A. and Wilson, T. - "Fitting Yield curves with long Term Constraints" (2001)

Examples

```
dfInstruments <- data.frame(c("SWAP", "SWAP"), c(1,10), c(1,1), c(0.025, 0.05))
colnames( dfInstruments ) <- c( "Type", "Tenor", "Frequency", "Rate" )
Curve <- fFitSmithWilsonYieldCurveToInstruments( dfInstruments, 0.04, 0.1 )
plot( Curve )
```

fCreateCashflowMatrix *Returns the matrix of cashflows for the list of instruments*

Description

Returns the matrix of cashflows for the list of instruments

Usage

```
fCreateCashflowMatrix(dfInstruments)
```

Arguments

dfInstruments	A set of market instruments as a dataframe with columns Type, Tenor, Frequency and Rate with Type in (LIBOR, SWAP, BOND), Tenor the instrument maturity in years and rate the rate per annum

fCreateKernelMatrix *Create the matrix of kernel functions*

Description

Creates a J x J matrix [w(u_i,u_j)] where J is the number of cashflow times in the calibration set

Usage

```
fCreateKernelMatrix(times, fKernel)
```

Arguments

times	a vector of cashflow times
fKernel	a kernel to apply (a function of times x times returning a matrix)

fCreateTimeVector *Extract a vector of cashflow times in years from a list of instruments*

Description

Assumes that LIBOR tenor is in days, with 365 days per year. Assumes that SWAPs are semi-annual Returns a vector of all unique cashflow times in years

Usage

```
fCreateTimeVector(dfInstruments)
```

Arguments

dfInstruments	A dataframe of instuments with at least columns Type and Tenor

fFitKernelWeights *Solve for the vector xi of kernel weights*

Description

Solve for the vector xi of kernel weights

Usage

```
fFitKernelWeights(CashflowMatrix, KernelFunctionMatrix,
  MarketValueVector, BaseZeroVector)
```

Arguments

CashflowMatrix	A matrix of all cashflows, instruments in rows, times in columns
KernelFunctionMatrix	A matrix of kernel function values
MarketValueVector	A vector of market values of the insturments
BaseZeroVector	A vector of "base" values for the zeros

`fFitSmithWilsonYieldCurve`

Construct the Smith-Wilson yield curve

Description

Constructs the SmithWilson ZCB function based on the given market inputs and parameter choices

Usage

```
fFitSmithWilsonYieldCurve(
  TimesVector,
  CashflowMatrix,
  MarketValueVector,
  ufr,
  alpha
)
```

Arguments

`TimesVector`	A vector of all cashflow times
`CashflowMatrix`	A matrix of all cashflows, instruments in rows, times in columns
`MarketValueVector`	A vector of market values of the insturments
`ufr`	The Ultimate Forward Rate (UFR) of the Smith-Wilson kernel
`alpha`	The rate of reversion of forward rates to the UFR in the Smith-Wilson kernel

Value

a list containing:

- "P" a function of time which gives the ZCB price to that term
- "xi" the vector of weights applied to the kernel functions to obtain the ZCB price
- "K" the (compound) kernel vector

`fFitSmithWilsonYieldCurveToInstruments`

Construct the Smith-Wilson yield curve

Description

Constructs the SmithWilson ZCB function based on the given market inputs and parameter choices. Primarily a convenience wrapper around other package functions

Usage

```
fFitSmithWilsonYieldCurveToInstruments(InstrumentSet, ufr, alpha)
```

Arguments

InstrumentSet	A set of market instruments as a dataframe with columns • "Type" One of (LIBOR, SWAP, BOND) • "Tenor" The instrument maturity in years • "Frequency" The payment frequency (ignored for Type=="LIBOR") • "Rate" The coupon rate per annum in percent • "Price"The price per unit nominal for a bond
ufr	The Ultimate Forward Rate (UFR) of the Smith-Wilson kernel
alpha	The rate of reversion of forward rates to the UFR in the Smith-Wilson kernel

Value

a list containing:

- "P" a function of time which gives the ZCB price to that term
- "xi" the vector of weights applied to the kernel functions to obtain the ZCB price
- "K" the (compound) kernel vector

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fFitYieldCurve *Constructs the ZCB function based on the given market inputs and a specific kernel and base function*

Description

Constructs the ZCB function based on the given market inputs and a specific kernel and base function

Usage

```
fFitYieldCurve(TimesVector, CashflowMatrix,
  MarketValueVector, fKernel, fBase)
```

Arguments

TimesVector	A vector of all cashflow times
CashflowMatrix	A matrix of all cashflows, instruments in rows, times in columns
MarketValueVector	A vector of market values of the insturments
fKernel	a function of two times used as the Kernel "basis" function
fBase	a function giving the base level of the curve

Value

a list comprising elements: a function of time which gives the ZCB price to that time

---

`fGetCashflowsBond` *Gets the cashflow schedule for a bond*

Description

Gets the cashflow schedule for a bond

Usage

```
fGetCashflowsBond(dfInstrument)
```

Arguments

`dfInstrument`	A market instrument as a dataframe with columns Frequency, Tenor and Rate with Type in (LIBOR, SWAP), Tenor the instrument maturity in years and rate the rate per annum

---

`fGetCashflowsLibor` *Gets the cashflow schedule for a LIBOR agreement*

Description

Gets the cashflow schedule for a LIBOR agreement

Usage

```
fGetCashflowsLibor(dfInstrument)
```

Arguments

`dfInstrument`	A set of market instruments as a dataframe with columns Type, Tenor and Rate with Type in (LIBOR, SWAP), Tenor the instrument maturity in years and rate the rate per annum

`fGetCashflowsSwap` *Gets the cashflow schedule for a swap*

Description

Gets the cashflow schedule for a swap

Usage

```
fGetCashflowsSwap(dfInstrument)
```

Arguments

`dfInstrument`	A set of market instruments as a dataframe with columns Type, Tenor and Rate with Type in (LIBOR, SWAP), Tenor the instrument maturity in years and rate the rate per annum

`fGetTimesBond` *Extract the payment dates of a Bond in years*

Description

Extract the payment dates of a Bond in years

Usage

```
fGetTimesBond(dfInstrument)
```

Arguments

`dfInstrument`	A dataframe of an instrument with at least columns Frequency and Tenor

`fGetTimesLibor` *Extract the payment date of a LIBOR agreement in years*

Description

Extract the payment date of a LIBOR agreement in years

Usage

```
fGetTimesLibor(dfInstrument)
```

Arguments

`dfInstrument`	A dataframe of instuments with at least columns Type and Tenor

fGetTimesSwap *Extract the payment dates of a Swap agreement in years*

Description

Extract the payment dates of a Swap agreement in years

Usage

```
fGetTimesSwap(dfInstrument)
```

Arguments

dfInstrument	A dataframe of instuments with at least columns Type and Tenor

fWilson *Wilson function*

Description

Acts as a kernel for regression

Usage

```
fWilson(t, u, ufr, alpha)
```

Arguments

t	a time
u	another time
ufr	the ultimate forward rate
alpha	the spead of reversion to the ultimate forward rate

lines.SmithWilsonYieldCurve

Plot generic for SmithWilsonYieldCurve objects

Description

Plot generic for SmithWilsonYieldCurve objects

Usage

```
## S3 method for class 'SmithWilsonYieldCurve'
lines(x, y, ..., aspect = c("cts", "zero"))
```

Arguments

x	An object of class SmithWilsonYieldCurve or a vector of terms to evaluate the curve at
y	Optionally an object of class SmithWilsonYieldCurve
...	other arguments to pass to the default lines function
aspect	either "cts" for continously compounded spot rates, or "zero" for ZCB prices

Value

No return value, called for side effect of drawing a graph of the curve

plot.SmithWilsonYieldCurve

Plot generic for SmithWilsonYieldCurve objects

Description

Plot generic for SmithWilsonYieldCurve objects

Usage

```
## S3 method for class 'SmithWilsonYieldCurve'
plot(x, y, ..., aspect = c("cts", "zero"))
```

Arguments

x	An object of class SmithWilsonYieldCurve or a vector of terms to evaluate the curve at
y	Optionally an object of class SmithWilsonYieldCurve
...	other arguments to pass to the default plot function
aspect	either "cts" for continously compounded spot rates, or "zero" for ZCB prices

Value

No return value, called for side effect of drawing a graph of the curve

---

`points.SmithWilsonYieldCurve` *Plot generic for SmithWilsonYieldCurve objects*

Description

Plot generic for SmithWilsonYieldCurve objects

Usage

```
## S3 method for class 'SmithWilsonYieldCurve'
points(x, y, ..., aspect = c("cts", "zero"))
```

Arguments

`x`	An object of class SmithWilsonYieldCurve or a vector of terms to evaluate the curve at
`y`	Optionally an object of class SmithWilsonYieldCurve
`...`	other arguments to pass to the default plot function
`aspect`	either "cts" for continously compounded spot rates, or "zero" for ZCB prices

Value

No return value, called for side effect of drawing a graph of the curve

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