# Package ‘RQuantLib’

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**Title** R Interface to the 'QuantLib' Library

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**Description** The 'RQuantLib' package makes parts of 'QuantLib' accessible from R
The 'QuantLib' project aims to provide a comprehensive software framework
for quantitative finance. The goal is to provide a standard open source library
for quantitative analysis, modeling, trading, and risk management of financial
assets.

**Suggests** tinytest, rgl, shiny

**Imports** methods, Rcpp (>= 0.11.0), stats, graphics, zoo

**LinkingTo** Rcpp

**SystemRequirements** QuantLib library (>= 1.25) from
https://quantlib.org, Boost library from https://www.boost.org

**License** GPL (>= 2)

**URL** https://github.com/eddelbuettel/rquantlib,
https://dirk.eddelbuettel.com/code/rquantlib.html

**BugReports** https://github.com/eddelbuettel/rquantlib/issues

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**Author** Dirk Eddelbuettel [aut, cre] (<https://orcid.org/0000-0001-6419-907X>),
Khanh Nguyen [aut] (2009-2010),
Terry Leitch [aut] (since 2016)

**Maintainer** Dirk Eddelbuettel <edd@debian.org>

**Repository** CRAN

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`AffineSwaption` *Affine swaption valuation using several short-rate models*

---

## Description

`AffineSwaption` prices a swaption with specified strike and maturity (in years), after calibrating the selected affine short-rate model to an input swaption volatility matrix. Swaption maturities are in years down the rows, and swap tenors are in years along the columns, in the usual fashion. It is assumed that the swaption is exercisable at the start of the swap if `params$european` flag is set to `TRUE` or on each reset date (Bermudan) of the underlying swap if `params$european` flag is set to `FALSE`.

## Usage

```
AffineSwaption(params, ts, swaptionMaturities, swapTenors,
volMatrix,legparams)
```

## Arguments

params — A list specifying the tradeDate (month/day/year), settlementDate, logical flags payFixed & european (european=FALSE generates Bermudan vlaue), strike, pricing method, and curve construction options (see *Examples* section below). Curve construction options are interpWhat (possible values are discount, forward, and zero) and interpHow (possible values are linear, loglinear , and spline). Both interpWhat and interpHow are ignored when a flat yield curve is requested, but they must be present nevertheless. The pricing method can be one of the following (all short-rate models):

| | |
|---|---|
| G2Analytic | G2 2-factor Gaussian model using analytic formulas. |
| HWAnalytic | Hull-White model using analytic formulas. |
| HWTree | Hull-White model using a tree. |
| BKTree | Black-Karasinski model using a tree. |

ts — A term structure built with DiscountCurve is required. See the help page for DiscountCurve and example below for details.

swaptionMaturities — A vector containing the swaption maturities associated with the rows of the swaption volatility matrix.

swapTenors — A vector containing the underlying swap tenors associated with the columns of the swaption volatility matrix.

volMatrix — The swaption volatility matrix. Must be a 2D matrix stored by rows. See the example below.

legparams — A list specifying the dayCounter the day count convention for the fixed leg (default is Thirty360), and fixFreq, fixed coupon frequecny (defualt is Annual), floatFreq, floating leg reset frequency (default is Semiannual).

## Details

This function is based on QuantLib Version 0.3.10. It introduces support for fixed-income instruments in RQuantLib.

At present only a small number of the many parameters that can be set in QuantLib are exposed by this function. Some of the hard-coded parameters that apply to the current version include: day-count conventions, fixing days (2), index (Euribor), fixed leg frequency (annual), and floating leg frequency (semi-annual). Also, it is assumed that the swaption volatility matrix corresponds to expiration dates and tenors that are measured in years (a 6-month expiration date is not currently supported, for example).

Given the number of parameters that must be specified and the care with which they must be specified (with no defaults), it is not practical to use this function in the usual interactive fashion.

The simplest approach is simply to save the example below to a file, edit as desired, and `source` the result. Alternatively, the input commands can be kept in a script file (under Windows) or an Emacs/ESS session (under Linux), and selected parts of the script can be executed in the usual way.

Fortunately, the C++ exception mechanism seems to work well with the R interface, and `QuantLib` exceptions are propagated back to the R user, usually with a message that indicates what went wrong. (The first part of the message contains technical information about the precise location of the problem in the `QuantLib` code. Scroll to the end to find information that is meaningful to the R user.)

## Value

`AffineSwaption` returns a list containing calibrated model paramters (what parameters are returned depends on the model selected) along with:

| | |
|---|---|
| `NPV` | NPV of swaption in basis points (actual price equals `price` times notional divided by 10,000) |
| `ATMStrike` | At-the-money strike |
| `params` | Input parameter list |

## Author(s)

Terry Leitch

## References

Brigo, D. and Mercurio, F. (2001) *Interest Rate Models: Theory and Practice*, Springer-Verlag, New York.

For information about `QuantLib` see https://www.quantlib.org/.

For information about `RQuantLib` see http://dirk.eddelbuettel.com/code/rquantlib.html.

## See Also

`DiscountCurve`

## Examples

```
if (.Platform$OS.type != "windows" && .Platform$r_arch != "i386") {
## Not run:

# This data was generated to match the original quantlib example for Bermudan Swaption
params <- list(tradeDate=as.Date('2016-2-15'),
               settleDate=as.Date('2016-2-17'),
               startDate=as.Date('2017-2-17'),
               maturity=as.Date('2022-2-17'),
               payFixed=TRUE,
               european=FALSE,
               dt=.25,
               strike=.06,
               method="G2Analytic",
```

```
                interpWhat="discount",
                interpHow="loglinear")

# Market data used to construct the term structure of interest rates
tsQuotes <- list(d1w  =0.0382,
                 d1m  =0.0372,
                 fut1=96.2875,
                 fut2=96.7875,
                 fut3=96.9875,
                 fut4=96.6875,
                 fut5=96.4875,
                 fut6=96.3875,
                 fut7=96.2875,
                 fut8=96.0875,
                 s3y  =0.0398,
                 s5y  =0.0443,
                 s10y =0.05165,
                 s15y =0.055175)


# Swaption volatility matrix with corresponding maturities and tenors
swaptionMaturities <- c(1,2,3,4,5)

swapTenors <- c(1,2,3,4,5)

volMatrix <- matrix(
    c(0.1490, 0.1340, 0.1228, 0.1189, 0.1148,
      0.1290, 0.1201, 0.1146, 0.1108, 0.1040,
      0.1149, 0.1112, 0.1070, 0.1010, 0.0957,
      0.1047, 0.1021, 0.0980, 0.0951, 0.1270,
      0.1000, 0.0950, 0.0900, 0.1230, 0.1160),
    ncol=5, byrow=TRUE)

legparams=list(dayCounter="Thirty360",
               fixFreq="Annual",
               floatFreq="Semiannual")

setEvaluationDate(as.Date("2016-2-16"))
times<-times <- seq(0,14.75,.25)
dcurve <- DiscountCurve(params, tsQuotes, times=times,legparams)

# Price the Bermudan swaption
pricing <- AffineSwaption(params, dcurve,swaptionMaturities, swapTenors, volMatrix,legparams)
summary(pricing)


## End(Not run)
}
```

---

AmericanOption *American Option evaluation using Finite Differences*

---

## Description

This function evaluations an American-style option on a common stock using finite differences. The option value as well as the common first derivatives ("Greeks") are returned.

## Usage

```
## Default S3 method:
AmericanOption(type, underlying, strike,
dividendYield, riskFreeRate, maturity, volatility,
timeSteps=150, gridPoints=149, engine="BaroneAdesiWhaley",
discreteDividends, discreteDividendsTimeUntil)
```

## Arguments

| | |
|---|---|
| `type` | A string with one of the values `call` or `put` |
| `underlying` | Current price of the underlying stock |
| `strike` | Strike price of the option |
| `dividendYield` | Continuous dividend yield (as a fraction) of the stock |
| `riskFreeRate` | Risk-free rate |
| `maturity` | Time to maturity (in fractional years) |
| `volatility` | Volatility of the underlying stock |
| `timeSteps` | Time steps for the "CrankNicolson" finite differences method engine, default value is 150 |
| `gridPoints` | Grid points for the "CrankNicolson" finite differences method, default value is 149 |
| `engine` | String selecting pricing engine, currently supported are "BaroneAdesiWhaley" and "CrankNicolson" |
| `discreteDividends` | Vector of discrete dividends (optional) |
| `discreteDividendsTimeUntil` | Vector of times to discrete dividends (in fractional years, optional) |

## Details

The Finite Differences method is used to value the American Option.

Please see any decent Finance textbook for background reading, and the `QuantLib` documentation for details on the `QuantLib` implementation.

## Value

An object of class `AmericanOption` (which inherits from class `Option`) is returned. It contains a list with the following components:

| | |
|---|---|
| `value` | Value of option |
| `delta` | Sensitivity of the option value for a change in the underlying |

| | |
|---|---|
| gamma | Sensitivity of the option delta for a change in the underlying |
| vega | Sensitivity of the option value for a change in the underlying's volatility |
| theta | Sensitivity of the option value for a change in t, the remaining time to maturity |
| rho | Sensitivity of the option value for a change in the risk-free interest rate |
| dividendRho | Sensitivity of the option value for a change in the dividend yield |

Note that under the new pricing framework used in QuantLib, pricers do not provide analytics for all 'Greeks'. When "CrankNicolson" is selected, then at least delta, gamma and vega are available. With the default pricing engine of "BaroneAdesiWhaley", no greeks are returned.

The "CrankNicolson" engine needs to be used when setting discrete dividends.

## Note

The interface might change in future release as `QuantLib` stabilises its own API.

## Author(s)

Dirk Eddelbuettel <edd@debian.org> for the R interface; the QuantLib Group for `QuantLib`

## References

https://www.quantlib.org/ for details on `QuantLib`.

## See Also

`EuropeanOption`

## Examples

```
# simple call with unnamed parameters
AmericanOption("call", 100, 100, 0.02, 0.03, 0.5, 0.4)
# simple call with some explicit parameters
AmericanOption("put", strike=100, volatility=0.4, 100, 0.02, 0.03, 0.5)
# simple call with unnamed parameters, using Crank-Nicolons
AmericanOption("put", strike=100, volatility=0.4, 100, 0.02, 0.03, 0.5, engine="CrankNicolson")
```

---

`AmericanOptionImpliedVolatility`
*Implied Volatility calculation for American Option*

---

## Description

The `AmericanOptionImpliedVolatility` function solves for the (unobservable) implied volatility, given an option price as well as the other required parameters to value an option.

## Usage

```
## Default S3 method:
AmericanOptionImpliedVolatility(type, value,
underlying, strike,dividendYield, riskFreeRate, maturity, volatility,
        timeSteps=150, gridPoints=151)
```

## Arguments

| | |
|---|---|
| `type` | A string with one of the values `call` or `put` |
| `value` | Value of the option (used only for ImpliedVolatility calculation) |
| `underlying` | Current price of the underlying stock |
| `strike` | Strike price of the option |
| `dividendYield` | Continuous dividend yield (as a fraction) of the stock |
| `riskFreeRate` | Risk-free rate |
| `maturity` | Time to maturity (in fractional years) |
| `volatility` | Initial guess for the volatility of the underlying stock |
| `timeSteps` | Time steps for the Finite Differences method, default value is 150 |
| `gridPoints` | Grid points for the Finite Differences method, default value is 151 |

## Details

The Finite Differences method is used to value the American Option. Implied volatilities are then calculated numerically.

Please see any decent Finance textbook for background reading, and the `QuantLib` documentation for details on the `QuantLib` implementation.

## Value

The `AmericanOptionImpliedVolatility` function returns an numeric variable with volatility implied by the given market prices and given parameters.

## Note

The interface might change in future release as `QuantLib` stabilises its own API.

## Author(s)

Dirk Eddelbuettel <edd@debian.org> for the R interface; the QuantLib Group for `QuantLib`

## References

https://www.quantlib.org/ for details on `QuantLib`.

## See Also

`EuropeanOption`,`AmericanOption`,`BinaryOption`

## Examples

```
AmericanOptionImpliedVolatility(type="call", value=11.10, underlying=100,
strike=100, dividendYield=0.01, riskFreeRate=0.03,
maturity=0.5, volatility=0.4)
```

---

AsianOption *Asian Option evaluation using Closed-Form solution*

---

## Description

The AsianOption function evaluates an Asian-style option on a common stock using an analytic solution for continuous geometric average price. The option value, the common first derivatives ("Greeks") as well as the calling parameters are returned.

## Usage

```
## Default S3 method:
AsianOption(averageType, type, underlying, strike,
                  dividendYield, riskFreeRate, maturity,
                  volatility, first=0, length=11.0/12.0, fixings=26)
```

## Arguments

| | |
|---|---|
| averageType | Specifiy averaging type, either “geometric” or “arithmetic” |
| type | A string with one of the values call or put |
| underlying | Current price of the underlying stock |
| strike | Strike price of the option |
| dividendYield | Continuous dividend yield (as a fraction) of the stock |
| riskFreeRate | Risk-free rate |
| maturity | Time to maturity (in fractional years) |
| volatility | Volatility of the underlying stock |
| first | (Only for arithmetic averaging) Time step to first average, can be zero |
| length | (Only for arithmetic averaging) Total time length for averaging period |
| fixings | (Only for arithmetic averaging) Total number of averaging fixings |

## Details

When "arithmetic" evaluation is used, only the NPV() is returned.

The well-known closed-form solution derived by Black, Scholes and Merton is used for valuation. Implied volatilities are calculated numerically.

Please see any decent Finance textbook for background reading, and the QuantLib documentation for details on the QuantLib implementation.

### Value

The AsianOption function returns an object of class AsianOption (which inherits from class Option). It contains a list with the following components:

| | |
|---|---|
| value | Value of option |
| delta | Sensitivity of the option value for a change in the underlying |
| gamma | Sensitivity of the option delta for a change in the underlying |
| vega | Sensitivity of the option value for a change in the underlying's volatility |
| theta | Sensitivity of the option value for a change in t, the remaining time to maturity |
| rho | Sensitivity of the option value for a change in the risk-free interest rate |
| dividendRho | Sensitivity of the option value for a change in the dividend yield |

### Note

The interface might change in future release as QuantLib stabilises its own API.

### Author(s)

Dirk Eddelbuettel <edd@debian.org> for the R interface; the QuantLib Group for QuantLib

### References

https://www.quantlib.org/ for details on QuantLib.

### Examples

```
# simple call with some explicit parameters, and slightly increased vol:
AsianOption("geometric", "put", underlying=80, strike=85, div=-0.03,
            riskFree=0.05, maturity=0.25, vol=0.2)
```

---

## BarrierOption — *Barrier Option evaluation using Closed-Form solution*

---

### Description

This function evaluations an Barrier option on a common stock using a closed-form solution. The option value as well as the common first derivatives ("Greeks") are returned.

### Usage

```
## Default S3 method:
BarrierOption(barrType, type, underlying, strike,
                                    dividendYield, riskFreeRate, maturity,
                                    volatility, barrier, rebate=0.0)
```

### Arguments

| | |
|---|---|
| `barrType` | A string with one of the values `downin`, `downout`, `upin` or `upout` |
| `type` | A string with one of the values `call` or `put` |
| `underlying` | Current price of the underlying stock |
| `strike` | Strike price of the option |
| `dividendYield` | Continuous dividend yield (as a fraction) of the stock |
| `riskFreeRate` | Risk-free rate |
| `maturity` | Time to maturity (in fractional years) |
| `volatility` | Volatility of the underlying stock |
| `barrier` | Option barrier value |
| `rebate` | Optional option rebate, defaults to 0.0 |

### Details

A closed-form solution is used to value the Barrier Option. In the case of Barrier options, the calculations are from Haug's "Option pricing formulas" book (McGraw-Hill).

Please see any decent Finance textbook for background reading, and the `QuantLib` documentation for details on the `QuantLib` implementation.

### Value

An object of class `BarrierOption` (which inherits from class `Option`) is returned. It contains a list with the following components:

| | |
|---|---|
| `value` | Value of option |
| `delta` | Sensitivity of the option value for a change in the underlying |
| `gamma` | Sensitivity of the option delta for a change in the underlying |
| `vega` | Sensitivity of the option value for a change in the underlying's volatility |
| `theta` | Sensitivity of the option value for a change in t, the remaining time to maturity |
| `rho` | Sensitivity of the option value for a change in the risk-free interest rate |
| `dividendRho` | Sensitivity of the option value for a change in the dividend yield |

.

Note that under the new pricing framework used in QuantLib, binary pricers do not provide analytics for 'Greeks'. This is expected to be addressed in future releases of QuantLib.

### Note

The interface might change in future release as `QuantLib` stabilises its own API.

### Author(s)

Dirk Eddelbuettel <edd@debian.org> for the R interface; the QuantLib Group for `QuantLib`

## References

https://www.quantlib.org/ for details on QuantLib.

## See Also

AmericanOption,EuropeanOption

## Examples

```
BarrierOption(barrType="downin", type="call", underlying=100,
strike=100, dividendYield=0.02, riskFreeRate=0.03,
maturity=0.5, volatility=0.4, barrier=90)
```

---

BermudanSwaption *Bermudan swaption valuation using several short-rate models*

---

## Description

BermudanSwaption prices a Bermudan swaption with specified strike and maturity (in years), after calibrating the selected short-rate model to an input swaption volatility matrix. Swaption maturities are in years down the rows, and swap tenors are in years along the columns, in the usual fashion. It is assumed that the Bermudan swaption is exercisable on each reset date of the underlying swaps.

## Usage

```
BermudanSwaption(params, ts, swaptionMaturities, swapTenors,
volMatrix)
```

## Arguments

params A list specifying the tradeDate (month/day/year), settlementDate, startDate, maturity, payFixed flag, strike, pricing method, and curve construction options (see *Examples* section below). Curve construction options are interpWhat (possible values are discount, forward, and zero) and interpHow (possible values are linear, loglinear , and spline). Both interpWhat and interpHow are ignored when a flat yield curve is requested, but they must be present nevertheless. The pricing method can be one of the following (all short-rate models):

| | |
|---|---|
| G2Analytic | G2 2-factor Gaussian model using analytic formulas. |
| HWAnalytic | Hull-White model using analytic formulas. |
| HWTree | Hull-White model using a tree. |
| BKTree | Black-Karasinski model using a tree. |

ts A term structure built with DiscounCurve or market observables needed to construct the spot term structure of interest rates. A list of name/value pairs. See the help page for DiscountCurve for details.

swaptionMaturities
: A vector containing the swaption maturities associated with the rows of the swaption volatility matrix.

swapTenors
: A vector containing the underlying swap tenors associated with the columns of the swaption volatility matrix.

volMatrix
: The swaption volatility matrix. Must be a 2D matrix stored by rows. See the example below.

## Details

This function was update for `QuantLib` Version 1.7.1 or later. It introduces support for fixed-income instruments in `RQuantLib`. It implements the full function and should work in most cases as long as there are suuficient swaption vol data points to fit the affine model. At least 5 unique points are required. The data point search attempts to find 5 or more points with one being the closet match in terms in of expiration and maturity.

See the `SabrSwaption` function for an alternative.

## Value

`BermudanSwaption` , if there are sufficient swaption vols to fit an affine model, returns a list containing calibrated model paramters (what parameters are returned depends on the model selected) along with:

price
: Price of swaption in basis points (actual price equals `price` times notional divided by 10,000)

ATMStrike
: At-the-money strike

params
: Input parameter list

If there are insufficient swaption vols to calibrate it throws a warning and returns `NULL`

## Author(s)

Dominick Samperi

## References

Brigo, D. and Mercurio, F. (2001) *Interest Rate Models: Theory and Practice*, Springer-Verlag, New York.

For information about `QuantLib` see `https://www.quantlib.org/`.

For information about `RQuantLib` see `http://dirk.eddelbuettel.com/code/rquantlib.html`.

## See Also

`DiscountCurve`, `SabrSwaption`

### Examples

```
## Not run:
# This data replicates sample code shipped with QuantLib 0.3.10 results
params <- list(tradeDate=as.Date('2002-2-15'),
               settleDate=as.Date('2002-2-19'),
               startDate=as.Date('2003-2-19'),
               maturity=as.Date('2008-2-19'),
               dt=.25,
               payFixed=TRUE,
               strike=.05,
               method="G2Analytic",
               interpWhat="discount",
               interpHow="loglinear")
setEvaluationDate(as.Date('2002-2-15'))
# Market data used to construct the term structure of interest rates
tsQuotes <- list(d1w  =0.05,
                 # d1m  =0.0372,
                 # fut1=96.2875,
                 # fut2=96.7875,
                 # fut3=96.9875,
                 # fut4=96.6875,
                 # fut5=96.4875,
                 # fut6=96.3875,
                 # fut7=96.2875,
                 # fut8=96.0875,
                 s3y  =0.05,
                 s5y  =0.05,
                 s10y =0.05,
                 s15y =0.05)

times=seq(0,14.75,.25)
swcurve=DiscountCurve(params,tsQuotes,times)
# Use this to compare with the Bermudan swaption example from QuantLib
#tsQuotes <- list(flat=0.04875825)

# Swaption volatility matrix with corresponding maturities and tenors
swaptionMaturities <- c(1,2,3,4,5)

swapTenors <- c(1,2,3,4,5)

volMatrix <- matrix(
    c(0.1490, 0.1340, 0.1228, 0.1189, 0.1148,
      0.1290, 0.1201, 0.1146, 0.1108, 0.1040,
      0.1149, 0.1112, 0.1070, 0.1010, 0.0957,
      0.1047, 0.1021, 0.0980, 0.0951, 0.1270,
      0.1000, 0.0950, 0.0900, 0.1230, 0.1160),
    ncol=5, byrow=TRUE)

volMatrix <- matrix(
    c(rep(.20,25)),
    ncol=5, byrow=TRUE)
# Price the Bermudan swaption
```

```
pricing <- BermudanSwaption(params, ts=.05,
                             swaptionMaturities, swapTenors, volMatrix)
summary(pricing)

## End(Not run)
```

---

BinaryOption *Binary Option evaluation using Closed-Form solution*

---

### Description

This function evaluations an Binary option on a common stock using a closed-form solution. The option value as well as the common first derivatives ("Greeks") are returned.

### Usage

```
## Default S3 method:
BinaryOption(binType, type, excType, underlying,
        strike, dividendYield,
riskFreeRate, maturity, volatility, cashPayoff)
```

### Arguments

| | |
|---|---|
| `binType` | A string with one of the values `cash`, `asset` or `gap` to select CashOrNothing, AssetOrNothing or Gap payoff profiles |
| `type` | A string with one of the values `call` or `put` |
| `excType` | A string with one of the values `european` or `american` to denote the exercise type |
| `underlying` | Current price of the underlying stock |
| `strike` | Strike price of the option |
| `dividendYield` | Continuous dividend yield (as a fraction) of the stock |
| `riskFreeRate` | Risk-free rate |
| `maturity` | Time to maturity (in fractional years) |
| `volatility` | Volatility of the underlying stock |
| `cashPayoff` | Payout amount |

### Details

A closed-form solution is used to value the Binary Option.

Please see any decent Finance textbook for background reading, and the `QuantLib` documentation for details on the `QuantLib` implementation.

## Value

An object of class BinaryOption (which inherits from class Option) is returned. It contains a list with the following components:

| | |
|---|---|
| value | Value of option |
| delta | Sensitivity of the option value for a change in the underlying |
| gamma | Sensitivity of the option delta for a change in the underlying |
| vega | Sensitivity of the option value for a change in the underlying's volatility |
| theta | Sensitivity of the option value for a change in t, the remaining time to maturity |
| rho | Sensitivity of the option value for a change in the risk-free interest rate |
| dividendRho | Sensitivity of the option value for a change in the dividend yield |

## Note

The interface might change in future release as QuantLib stabilises its own API.

## Author(s)

Dirk Eddelbuettel <edd@debian.org> for the R interface; the QuantLib Group for QuantLib

## References

https://www.quantlib.org/ for details on QuantLib.

## See Also

AmericanOption,EuropeanOption

## Examples

```
BinaryOption(binType="asset", type="call", excType="european",
             underlying=100, strike=100, dividendYield=0.02,
             riskFreeRate=0.03, maturity=0.5, volatility=0.4, cashPayoff=10)
```

---

BinaryOptionImpliedVolatility
*Implied Volatility calculation for Binary Option*

---

## Description

The BinaryOptionImpliedVolatility function solves for the (unobservable) implied volatility, given an option price as well as the other required parameters to value an option.

## Usage

```
## Default S3 method:
BinaryOptionImpliedVolatility(type, value, underlying,
strike, dividendYield, riskFreeRate, maturity, volatility,
cashPayoff=1)
```

## Arguments

| | |
|---|---|
| type | A string with one of the values call, put or straddle |
| value | Value of the option (used only for ImpliedVolatility calculation) |
| underlying | Current price of the underlying stock |
| strike | Strike price of the option |
| dividendYield | Continuous dividend yield (as a fraction) of the stock |
| riskFreeRate | Risk-free rate |
| maturity | Time to maturity (in fractional years) |
| volatility | Initial guess for the volatility of the underlying stock |
| cashPayoff | Binary payout if options is exercised, default is 1 |

## Details

The Finite Differences method is used to value the Binary Option. Implied volatilities are then calculated numerically.

Please see any decent Finance textbook for background reading, and the QuantLib documentation for details on the QuantLib implementation.

## Value

The BinaryOptionImpliedVolatility function returns an numeric variable with volatility implied by the given market prices.

## Note

The interface might change in future release as QuantLib stabilises its own API.

## Author(s)

Dirk Eddelbuettel <edd@debian.org> for the R interface; the QuantLib Group for QuantLib

## References

https://www.quantlib.org/ for details on QuantLib.

## See Also

EuropeanOption,AmericanOption,BinaryOption

## Examples

```
BinaryOptionImpliedVolatility("call", value=4.50, strike=100, 100, 0.02, 0.03, 0.5, 0.4, 10)
```

---

Bond *Base class for Bond price evalution*

---

## Description

This class forms the basis from which the more specific classes are derived.

## Usage

```
## S3 method for class 'Bond'
print(x, digits=5, ...)
## S3 method for class 'FixedRateBond'
print(x, digits=5, ...)
## S3 method for class 'Bond'
plot(x, ...)
## S3 method for class 'Bond'
summary(object, digits=5, ...)
```

## Arguments

| | |
|---|---|
| `x` | Any Bond object derived from this base class |
| `object` | Any Bond object derived from this base class |
| `digits` | Number of digits of precision shown |
| `...` | Further arguments |

## Details

Please see any decent Finance textbook for background reading, and the `QuantLib` documentation for details on the `QuantLib` implementation.

## Value

None, but side effects of displaying content.

## Note

The interface might change in future release as `QuantLib` stabilises its own API.

## Author(s)

Khanh Nguyen <knguyen@cs.umb.edu>; Dirk Eddelbuettel <edd@debian.org> for the R interface; the QuantLib Group for `QuantLib`

## References

https://www.quantlib.org/ for details on QuantLib.

## Examples

```
## Not run:

## This data is taken from sample code shipped with QuantLib 0.9.7
## from the file Examples/Swap/swapvaluation
params <- list(tradeDate=as.Date('2004-09-20'),
               settleDate=as.Date('2004-09-22'),
               dt=.25,
               interpWhat="discount",
               interpHow="loglinear")
setEvaluationDate(as.Date("2004-09-20"))

## We got numerical issues for the spline interpolation if we add
## any on of these three extra futures, at least with QuantLib 0.9.7
## The curve data comes from QuantLib's Examples/Swap/swapvaluation.cpp
## Removing s2y helps, as kindly pointed out by Luigi Ballabio
tsQuotes <- list(d1w = 0.0382,
                 d1m = 0.0372,
                 fut1=96.2875,
                 fut2=96.7875,
                 fut3=96.9875,
                 fut4=96.6875,
                 fut5=96.4875,
                 fut6=96.3875,
                 fut7=96.2875,
                 fut8=96.0875,
                 # s2y = 0.037125,  ## s2y perturbs
                 s3y = 0.0398,
                 s5y = 0.0443,
                 s10y = 0.05165,
                 s15y = 0.055175)
times <- seq(0,10,.1)

setEvaluationDate(params$tradeDate)
discountCurve <- DiscountCurve(params, tsQuotes, times)

# price a zero coupon bond
bondparams <- list(faceAmount=100, issueDate=as.Date("2004-11-30"),
                   maturityDate=as.Date("2008-11-30"), redemption=100 )
dateparams <-list(settlementDays=1,
                  calendar="UnitedStates/GovernmentBond",
                  businessDayConvention=4)
ZeroCouponBond(bondparams, discountCurve, dateparams)

# price a fixed rate coupon bond

bond <- list(settlementDays=1, issueDate=as.Date("2004-11-30"),
             faceAmount=100, dayCounter='Thirty360',
```

```
            paymentConvention='Unadjusted')
schedule <- list(effectiveDate=as.Date("2004-11-30"),
                 maturityDate=as.Date("2008-11-30"),
                 period='Semiannual',
                 calendar='UnitedStates/GovernmentBond',
                 businessDayConvention='Unadjusted',
                 terminationDateConvention='Unadjusted',
                 dateGeneration='Forward',
                 endOfMonth=1)
calc=list(dayCounter='Actual360', compounding='Compounded',
          freq='Annual', durationType='Modified')
rates <- c(0.02875)
FixedRateBond(bond, rates, schedule, calc, discountCurve=discountCurve)

# price a fixed rate coupon bond from yield

yield <- 0.050517
FixedRateBond(bond, rates, schedule, calc, yield=yield)

# calculate the same bond from the clean price

price <- 92.167
FixedRateBond(bond, rates, schedule, calc, price=price)

# price a floating rate bond
bondparams <- list(faceAmount=100, issueDate=as.Date("2004-11-30"),
                   maturityDate=as.Date("2008-11-30"), redemption=100,
                   effectiveDate=as.Date("2004-12-01"))

dateparams <- list(settlementDays=1, calendar="UnitedStates/GovernmentBond",
                   dayCounter = 1, period=3, businessDayConvention = 1,
                   terminationDateConvention=1, dateGeneration=0, endOfMonth=0,
                   fixingDays = 1)

gearings <- spreads <- caps <- floors <- vector()

iborCurve <- DiscountCurve(params,list(flat=0.05), times)
ibor <- list(type="USDLibor", length=6, inTermOf="Month",
             term=iborCurve)
FloatingRateBond(bondparams, gearings, spreads, caps, floors,
                 ibor, discountCurve, dateparams)

## End(Not run)
```

---

BondUtilities *Bond parameter conversion utilities*

---

## Description

These functions are using internally to convert from the characters at the R level to the enum types used at the C++ level. They are documented here mostly to provide a means to look up some of the possible values—the user is not expected to call these functions directly..

## Usage

```
matchBDC(bdc = c("Following", "ModifiedFollowing", "Preceding",
                 "ModifiedPreceding", "Unadjusted",
                 "HalfMonthModifiedFollowing", "Nearest"))
matchCompounding(cp = c("Simple", "Compounded", "Continuous", "SimpleThenCompounded"))
matchDayCounter(daycounter = c("Actual360", "ActualFixed", "ActualActual", "Business252",
                             "OneDayCounter", "SimpleDayCounter", "Thirty360",
                    "Actual365NoLeap", "ActualActual.ISMA", "ActualActual.Bond",
                             "ActualActual.ISDA", "ActualActual.Historical",
                             "ActualActual.AFB", "ActualActual.Euro"))
matchDateGen(dg = c("Backward", "Forward", "Zero", "ThirdWednesday",
                    "Twentieth", "TwentiethIMM", "OldCDS", "CDS"))
matchFrequency(freq = c("NoFrequency","Once", "Annual", "Semiannual",
                        "EveryFourthMonth", "Quarterly", "Bimonthly",
                        "Monthly", "EveryFourthWeek", "Biweekly",
                        "Weekly", "Daily"))
matchParams(params)
```

## Arguments

| | |
|---|---|
| bdc | A string identifying one of the possible business day convention values. |
| cp | A string identifying one of the possible compounding frequency values. |
| daycounter | A string identifying one of the possible day counter scheme values. |
| dg | A string identifying one of the possible date generation scheme values. |
| freq | A string identifying one of the possible (dividend) frequency values. |
| params | A named vector containing the other parameters as components. |

## Details

The QuantLib documentation should be consulted for details.

Note that `Actual365NoLeap` is soft deprecated as of QuantLib 1.11 and hard deprecated as of QuantLib 1.16. For users on QuantLib 1.16 or later, use of the RQuantLib daycounter enum with a value of severn will result in `Actual365Fixed(Actual365Fixed::NoLeap)` which is functionally equivalent to `Actual365NoLeap`. Previously RQuantLib allowed users to retain `Actual365NoLeap` via defining `RQUANTLIB_USE_ACTUAL365NOLEAP`, but this is no longer required.

Also note that `ActualActual` without explicit convention specification is hard deprecated as of QuantLib 1.23. This is only soft-deprecated in RQuantLib by explicitly passing in the same default convention. Previously RQuantLib allowed users to define `RQUANTLIB_USE_ACTUALACTUAL`, but this is no longer required.

## Value

Each function converts the given character value into a corresponding numeric entry. For `matchParams`, an named vector of strings is converted into a named vector of numerics..

## Note

The interface might change in future release as QuantLib stabilises its own API.

## Author(s)

Khanh Nguyen <knguyen@cs.umb.edu> for the R interface; the QuantLib Group for QuantLib

## References

https://www.quantlib.org/ for details on QuantLib.

---

Calendars *Calendar functions from QuantLib*

---

## Description

The isBusinessDay function evaluates the given dates in the context of the given calendar, and returns a vector of booleans indicating business day status. BusinessDay is also recognised (but may be deprecated one day).

The isHoliday function evaluates the given dates in the context of the given calendar, and returns a vector of booleans indicating holiday day status.

The isWeekend function evaluates the given dates in the context of the given calendar, and returns a vector of booleans indicating weekend status.

The isEndOfMonth function evaluates the given dates in the context of the given calendar, and returns a vector of booleans indicating end of month status.

The getEndOfMonth function evaluates the given dates in the context of the given calendar, and returns a vector that corresponds to the end of month. endOfMonth is a deprecated form for this function.

The getHolidayList function returns the holidays between the given dates, with an option to exclude weekends. holidayList is a deprecated form for this function. Similarly, getBusinessDayList and, for symmetry, businessDayList return the list of business days; this always excludes weekends.

The adjust function evaluates the given dates in the context of the given calendar, and returns a vector that adjusts each input dates to the appropriate near business day with respect to the given convention.

The advance function evaluates the given dates in the context of the given calendar, and returns a vector that advances the given dates of the given number of business days and returns the result. This functions gets called either with both argument n and timeUnit, or with argument period.

The businessDaysBetween function evaluates two given dates in the context of the given calendar, and returns a vector that gives the number of business day between.

The dayCount function returns the number of day between two dates given a day counter, see Enum.

The yearFraction function returns year fraction between two dates given a day counter, see Enum.

The setCalendarContext function sets three values to a singleton instance at the C++ layer.

The `setEvaluationDate` function sets the evaluation date used by the QuantLib pricing engines.

The `advanceDate` function advances the given date by the given number of days in the current calendar instance.

The `addHolidays` and `removeHolidays` add (and remove) holidays to (from) the given calendar. Note that this change is transitory and does not persist the session as all actual calendar information comes from the QuantLib library that this package is linked against.

The `calendars` vector contains all calendar identifiers.

## Usage

```
isBusinessDay(calendar, dates)
businessDay(calendar="TARGET", dates=Sys.Date())  # deprecated form
isHoliday(calendar, dates)
isWeekend(calendar, dates)
isEndOfMonth(calendar, dates)
getEndOfMonth(calendar, dates)
endOfMonth(calendar="TARGET", dates=Sys.Date())
getHolidayList(calendar, from, to, includeWeekends=FALSE)
holidayList(calendar="TARGET", from=Sys.Date(), to = Sys.Date() + 5,
            includeWeekends=FALSE)
getBusinessDayList(calendar, from, to)
businessDayList(calendar="TARGET", from=Sys.Date(), to = Sys.Date() + 5)
adjust(calendar, dates, bdc = 0L)
advance(calendar="TARGET", dates=Sys.Date(), n, timeUnit, period, bdc = 0, emr =0)
businessDaysBetween(calendar, from, to, includeFirst = TRUE, includeLast = FALSE)
dayCount(startDates, endDates, dayCounters)
yearFraction(startDates, endDates, dayCounters)
setCalendarContext(calendar, fixingDays, settleDate)
setEvaluationDate(evalDate)
addHolidays(calendar, dates)
removeHolidays(calendar, dates)
```

## Arguments

| | |
|---|---|
| `calendar` | A string identifying one of the supported QuantLib calendars, see Details for more |
| `dates` | A vector (or scalar) of `Date` types. |
| `from` | A vector (or scalar) of `Date` types. |
| `to` | A vector (or scalar) of `Date` types. |
| `includeWeekends` | boolean that indicates whether the calculation should include the weekends. Default = false |
| `fixingDays` | An integer for the fixing day period, defaults to 2. |
| `settleDate` | A date on which trades settles, defaults to two days after the current day. |
| `n` | an integer number |

| | |
|---|---|
| timeUnit | A value of 0,1,2,3 that corresponds to Days, Weeks, Months, and Year; for more detail, see the QuantLib documentation at https://www.quantlib.org//reference/group__datetime.html |
| period | See Enum |
| bdc | Business day convention. By default, this value is 0 and correspond to Following convention |
| emr | End Of Month rule, default is false |
| includeFirst | boolean that indicates whether the calculation should include the first day. Default = true |
| includeLast | Default = false |
| startDates | A vector of `Date` type. |
| endDates | A vector of `Date` type. |
| dayCounters | A vector of numeric type. See Enum |
| evalDate | A single date used for the pricing valuations. |

## Details

The calendars are coming from QuantLib, and the QuantLib documentation should be consulted for details.

Currently, the following strings are recognised: TARGET (a default calendar), Argentina, Australia, Brazil, Canada and Canada/Settlement, Canada/TSX, China, CzechRepublic, Denmark, Finland, Germany and Germany/FrankfurtStockExchange, Germany/Settlement, Germany/Xetra, Germany/Eurex, HongKong, Hungary, Iceland, India, Indonesia, Italy and Italy/Settlement, Italy/Exchange, Japan, Mexico, NewZealand, Norway, Poland, Russia, SaudiArabia, Singapore, Slovakia, SouthAfrica, SouthKorea, SouthKorea/KRX, Sweden, Switzerland, Taiwan, Turkey, Ukraine, UnitedKingdom and UnitedKingdom/Settlement, UnitedKingdom/Exchange, UnitedKingdom/Metals, UnitedStates and UnitedStates/Settlement, UnitedStates/NYSE, UnitedStates/GovernmentBond, UnitedStates/NERC and WeekendsOnly.

(In case of multiples entries per country, the country default is listed right after the country itself. Using the shorter form is equivalent.)

## Value

A named vector of booleans each of which is true if the corresponding date is a business day (or holiday or weekend) in the given calendar. The element names are the dates (formatted as text in yyyy-mm-dd format).

For `setCalendarContext`, a boolean or NULL in case of error.

## Note

The interface might change in future release as `QuantLib` stabilises its own API.

## Author(s)

Dirk Eddelbuettel <edd@debian.org> for the R interface; the QuantLib Group for `QuantLib`

## References

https://www.quantlib.org/ for details on QuantLib.

## Examples

```
dates <- seq(from=as.Date("2009-04-07"), to=as.Date("2009-04-14"), by=1)
isBusinessDay("UnitedStates", dates)
isBusinessDay("UnitedStates/Settlement", dates)      ## same as previous
isBusinessDay("UnitedStates/NYSE", dates)            ## stocks
isBusinessDay("UnitedStates/GovernmentBond", dates)  ## bonds
isBusinessDay("UnitedStates/NERC", dates)            ## energy

isHoliday("UnitedStates", dates)
isHoliday("UnitedStates/Settlement", dates)      ## same as previous
isHoliday("UnitedStates/NYSE", dates)            ## stocks
isHoliday("UnitedStates/GovernmentBond", dates)  ## bonds
isHoliday("UnitedStates/NERC", dates)            ## energy

isWeekend("UnitedStates", dates)
isWeekend("UnitedStates/Settlement", dates)      ## same as previous
isWeekend("UnitedStates/NYSE", dates)            ## stocks
isWeekend("UnitedStates/GovernmentBond", dates)  ## bonds
isWeekend("UnitedStates/NERC", dates)            ## energy

isEndOfMonth("UnitedStates", dates)
isEndOfMonth("UnitedStates/Settlement", dates)      ## same as previous
isEndOfMonth("UnitedStates/NYSE", dates)            ## stocks
isEndOfMonth("UnitedStates/GovernmentBond", dates)  ## bonds
isEndOfMonth("UnitedStates/NERC", dates)            ## energy

getEndOfMonth("UnitedStates", dates)
getEndOfMonth("UnitedStates/Settlement", dates)      ## same as previous
getEndOfMonth("UnitedStates/NYSE", dates)            ## stocks
getEndOfMonth("UnitedStates/GovernmentBond", dates)  ## bonds
getEndOfMonth("UnitedStates/NERC", dates)            ## energy

from <- as.Date("2009-04-07")
to<-as.Date("2009-04-14")
getHolidayList("UnitedStates", from, to)
to <- as.Date("2009-10-7")
getHolidayList("UnitedStates", from, to)

dates <- seq(from=as.Date("2009-04-07"), to=as.Date("2009-04-14"), by=1)

adjust("UnitedStates", dates)
adjust("UnitedStates/Settlement", dates)      ## same as previous
adjust("UnitedStates/NYSE", dates)            ## stocks
adjust("UnitedStates/GovernmentBond", dates)  ## bonds
adjust("UnitedStates/NERC", dates)            ## energy

advance("UnitedStates", dates, 10, 0)
advance("UnitedStates/Settlement", dates, 10, 1)      ## same as previous
```

```
advance("UnitedStates/NYSE", dates, 10, 2)            ## stocks
advance("UnitedStates/GovernmentBond", dates,  10, 3) ## bonds
advance("UnitedStates/NERC", dates, period = 3)       ## energy

from <- as.Date("2009-04-07")
to<-as.Date("2009-04-14")
businessDaysBetween("UnitedStates", from, to)

startDates <- seq(from=as.Date("2009-04-07"), to=as.Date("2009-04-14"),by=1)
endDates <- seq(from=as.Date("2009-11-07"), to=as.Date("2009-11-14"), by=1)
dayCounters <- c(0,1,2,3,4,5,6,1)
dayCount(startDates, endDates, dayCounters)
yearFraction(startDates, endDates, dayCounters)

head(calendars, 10)
```

---

CallableBond *CallableBond evaluation*

---

## Description

The CallableBond function sets up and evaluates a callable fixed rate bond using Hull-White model and a TreeCallableFixedBondEngine pricing engine. For more detail, see the source codes in quantlib's example folder, Examples/CallableBond/CallableBond.cpp

## Usage

```
## Default S3 method:
CallableBond(bondparams, hullWhite, coupon, dateparams)
```

## Arguments

bondparams a named list whose elements are:

| | |
|---|---|
| issueDate | a Date, the bond's issue date |
| maturityDate | a Date, the bond's maturity date |
| faceAmount | (Optional) a double, face amount of the bond. Default value is 100. |
| redemption | (Optional) a double, percentage of the initial face amount that will be returned at maturity date. Default value is 100. |
| callSch | (Optional) a data frame whose columns are "Price", "Type" and "Date" corresponding to QuantLib's CallabilitySchedule. Defaule is an empty frame, or no callability. |

hullWhite a named list whose elements are parameters needed to set up a HullWhite pricing engine in QuantLib:

| | |
|---|---|
| `term` | a double, to set up a flat rate yield term structure |
| `alpha` | a double, Hull-White model's alpha value |
| `sigma` | a double, Hull-White model's sigma value |
| `gridIntervals`. | a double, time intervals parameter to set up the TreeCallableFixedBondEngine |

Currently, the codes only support a flat rate yield term structure. For more detail, see QuantLib's doc on HullWhite and TreeCallableFixedBondEngine.

`coupon` a numeric vector of coupon rates

`dateparams` (Optional) a named list, QuantLib's date parameters of the bond.

| | |
|---|---|
| `settlementDays` | (Optional) a double, settlement days. Default value is 1. |
| `calendar` | (Optional) a string, either 'us' or 'uk' corresponding to US Goverment Bond calendar and UK Exchange calendar. Default value is 'us'. |
| `dayCounter` | (Optional) a number or string, day counter convention. See Enum. Default value is 'Thirty360' |
| `period` | (Optional) a number or string, interest compounding interval. See Enum. Default value is 'Semiannual'. |
| `businessDayConvention` | (Optional) a number or string, business day convention. See Enum. Default value is 'Following'. |
| `terminationDateConvention` | (Optional) a number or string termination day convention. See Enum. Default value is'Following'. |

See example below.

## Details

Please see any decent Finance textbook for background reading, and the `QuantLib` documentation for details on the `QuantLib` implementation.

## Value

The `CallableBond` function returns an object of class `CallableBond` (which inherits from class `Bond`). It contains a list with the following components:

| | |
|---|---|
| `NPV` | net present value of the bond |
| `cleanPrice` | price price of the bond |
| `dirtyPrice` | dirty price of the bond |
| `accruedAmount` | accrued amount of the bond |

| | |
|---|---|
| `yield` | yield of the bond |
| `cashFlows` | cash flows of the bond |

## Note

The interface might change in future release as `QuantLib` stabilises its own API.

## Author(s)

Khanh Nguyen <knguyen@cs.umb.edu> for the inplementation; Dirk Eddelbuettel <edd@debian.org> for the R interface; the QuantLib Group for `QuantLib`

## References

https://www.quantlib.org/ for details on `QuantLib`.

## Examples

```
if (interactive()) {  # the example is too computationally expensive for normal checks
    #set-up a HullWhite according to example from QuantLib
    HullWhite <- list(term = 0.055, alpha = 0.03, sigma = 0.01, gridIntervals = 40)

    #callability schedule dataframe
    Price <- rep(as.double(100),24)
    Type <- rep(as.character("C"), 24)
    Date <- seq(as.Date("2006-09-15"), by = '3 months', length = 24)
    callSch <- data.frame(Price, Type, Date)
    callSch$Type <- as.character(callSch$Type)

    bondparams <- list(faceAmount=100, issueDate = as.Date("2004-09-16"),
                       maturityDate=as.Date("2012-09-16"), redemption=100,
                       callSch = callSch)
    dateparams <- list(settlementDays=3, calendar="UnitedStates/GovernmentBond",
                       dayCounter = "ActualActual",
                       period="Quarterly",
                       businessDayConvention = "Unadjusted",
                       terminationDateConvention= "Unadjusted")
    coupon <- c(0.0465)
    setEvaluationDate(as.Date("2004-11-22"))

    CallableBond(bondparams, HullWhite, coupon, dateparams)
    #examples using default values
    CallableBond(bondparams, HullWhite, coupon)
    dateparams <- list(period="Quarterly",
                       businessDayConvention = "Unadjusted",
                       terminationDateConvention= "Unadjusted")
    CallableBond(bondparams, HullWhite, coupon, dateparams)

    bondparams <- list(issueDate = as.Date("2004-09-16"),
                       maturityDate=as.Date("2012-09-16"))
    CallableBond(bondparams, HullWhite, coupon, dateparams)
}
```

ConvertibleBond *Convertible Bond evaluation for Fixed, Floating and Zero Coupon*

## Description

The `ConvertibleFixedCouponBond` function setups and evaluates a ConvertibleFixedCouponBond using QuantLib's BinomialConvertibleEngine and BlackScholesMertonProcess The NPV, clean price, dirty price, accrued interest, yield and cash flows of the bond is returned. For detail, see test-suite/convertiblebond.cpp

The `ConvertibleFloatingCouponBond` function setups and evaluates a ConvertibleFixedCouponBond using QuantLib's BinomialConvertibleEngine and BlackScholesMertonProcess The NPV, clean price, dirty price, accrued interest, yield and cash flows of the bond is returned. For detail, see test-suite/convertiblebond.cpp

The `ConvertibleZeroCouponBond` function setups and evaluates a ConvertibleFixedCouponBond using QuantLib's BinomialConvertibleEngine and BlackScholesMertonProcess The NPV, clean price, dirty price, accrued interest, yield and cash flows of the bond is returned. For detail, see `test-suite/convertiblebond.cpp`.

## Usage

```
## Default S3 method:
ConvertibleFloatingCouponBond(bondparams, iborindex, spread, process, dateparams)
## Default S3 method:
ConvertibleFixedCouponBond(bondparams, coupon, process, dateparams)
## Default S3 method:
ConvertibleZeroCouponBond(bondparams, process, dateparams)
```

## Arguments

`bondparams` bond parameters, a named list whose elements are:

| | |
|---|---|
| `issueDate` | a Date, the bond's issue date |
| `maturityDate` | a Date, the bond's maturity date |
| `creditSpread` | a double, credit spread parameter in the constructor of the bond. |
| `conversitionRatio` | a double, conversition ratio parameter in the constructor of the bond. |
| `exercise` | (Optional) a string, either "eu" for European option, or "am" for American option. Default value is 'am'. |
| `faceAmount` | (Optional) a double, face amount of the bond. Default value is 100. |
| `redemption` | (Optional) a double, percentage of the initial face amount that will be returned at maturity date. Default value is 100. |
| `divSch` | (Optional) a data frame whose columns are |

"Type", "Amount", "Rate", and "Date"
corresponding to QuantLib's DividendSchedule.
Default value is an empty frame, or no dividend.

| | |
|---|---|
| `callSch` | (Optional) a data frame whose columns are "Price", "Type" and "Date" corresponding to QuantLib's CallabilitySchedule. Defaule is an empty frame, or no callability. |

`iborindex` a DiscountCurve object, represents an IborIndex

`spread` a double vector, represents paramter 'spreads' in ConvertibleFloatingBond's constructor.

`coupon` a double vector of coupon rate

`process` arguments to construct a BlackScholes process and set up the binomial pricing engine for this bond.

| | |
|---|---|
| `underlying` | a double, flat underlying term structure |
| `volatility` | a double, flat volatility term structure |
| `dividendYield` | a DiscountCurve object |
| `riskFreeRate` | a DiscountCurve object |

`dateparams` (Optional) a named list, QuantLib's date parameters of the bond.

| | |
|---|---|
| `settlementDays` | (Optional) a double, settlement days. Default value is 1. |
| `calendar` | (Optional) a string, either 'us' or 'uk' corresponding to US Goverment Bond calendar and UK Exchange calendar. Default value is 'us'. |
| `dayCounter` | (Optional) a number or string, day counter convention. See Enum. Default value is 'Thirty360' |
| `period` | (Optional) a number or string, interest compounding interval. See Enum. Default value is 'Semiannual'. |
| `businessDayConvention` | (Optional) a number or string, business day convention. See Enum. Default value is 'Following'. |

See the examples below.

## Details

Please see any decent Finance textbook for background reading, and the `QuantLib` documentation for details on the `QuantLib` implementation.

## Value

The ConvertibleFloatingCouponBond function returns an object of class ConvertibleFloatingCouponBond (which inherits from class Bond). It contains a list with the following components:

| | |
|---|---|
| NPV | net present value of the bond |
| cleanPrice | price price of the bond |
| dirtyPrice | dirty price of the bond |
| accruedAmount | accrued amount of the bond |
| yield | yield of the bond |
| cashFlows | cash flows of the bond |

The ConvertibleFixedCouponBond function returns an object of class ConvertibleFixedCouponBond (which inherits from class Bond). It contains a list with the following components:

| | |
|---|---|
| NPV | net present value of the bond |
| cleanPrice | price price of the bond |
| dirtyPrice | dirty price of the bond |
| accruedAmount | accrued amount of the bond |
| yield | yield of the bond |
| cashFlows | cash flows of the bond |

The ConvertibleZeroCouponBond function returns an object of class ConvertibleZeroCouponBond (which inherits from class Bond). It contains a list with the following components:

| | |
|---|---|
| NPV | net present value of the bond |
| cleanPrice | price price of the bond |
| dirtyPrice | dirty price of the bond |
| accruedAmount | accrued amount of the bond |
| yield | yield of the bond |
| cashFlows | cash flows of the bond |

## Author(s)

Khanh Nguyen <knguyen@cs.umb.edu> for the inplementation; Dirk Eddelbuettel <edd@debian.org> for the R interface; the QuantLib Group for QuantLib

## References

https://www.quantlib.org/ for details on QuantLib.

### Examples

```
# commented-out as it runs longer than CRAN likes
## Not run:
#this follow an example in test-suite/convertiblebond.cpp
params <- list(tradeDate=Sys.Date()-2,
               settleDate=Sys.Date(),
               dt=.25,
               interpWhat="discount",
               interpHow="loglinear")


dividendYield <- DiscountCurve(params, list(flat=0.02))
riskFreeRate <- DiscountCurve(params, list(flat=0.05))

dividendSchedule <- data.frame(Type=character(0), Amount=numeric(0),
                            Rate = numeric(0), Date = as.Date(character(0)))
callabilitySchedule <- data.frame(Price = numeric(0), Type=character(0),
                          Date = as.Date(character(0)))

process <- list(underlying=50, divYield = dividendYield,
                rff = riskFreeRate, volatility=0.15)

today <- Sys.Date()
bondparams <- list(exercise="am", faceAmount=100,
                   divSch = dividendSchedule,
                   callSch = callabilitySchedule,
                   redemption=100,
                   creditSpread=0.005,
                   conversionRatio = 0.0000000001,
                   issueDate=as.Date(today+2),
                   maturityDate=as.Date(today+3650))
dateparams <- list(settlementDays=3,
                   dayCounter="ActualActual",
                   period = "Semiannual", calendar = "UnitedStates/GovernmentBond",
                   businessDayConvention="Following")

lengths <- c(2,4,6,8,10,12,14,16,18,20,22,24,26,28,30)
coupons <- c( 0.0200, 0.0225, 0.0250, 0.0275, 0.0300,
              0.0325, 0.0350, 0.0375, 0.0400, 0.0425,
              0.0450, 0.0475, 0.0500, 0.0525, 0.0550 )
marketQuotes <- rep(100, length(lengths))
curvedateparams <- list(settlementDays=0, period="Annual",
                   dayCounter="ActualActual",
                  businessDayConvention ="Unadjusted")
curveparams <- list(method="ExponentialSplinesFitting",
                    origDate = Sys.Date())
curve <- FittedBondCurve(curveparams, lengths, coupons, marketQuotes, curvedateparams)
iborindex <- list(type="USDLibor", length=6,
                  inTermOf="Month", term=curve)
spreads <- c()
#ConvertibleFloatingCouponBond(bondparams, iborindex, spreads, process, dateparams)
```

```
#example using default values
#ConvertibleFloatingCouponBond(bondparams, iborindex,spreads, process)

dateparams <- list(settlementDays=3,
                   period = "Semiannual",
                   businessDayConvention="Unadjusted")

bondparams <- list(
                   creditSpread=0.005, conversionRatio = 0.0000000001,
                   issueDate=as.Date(today+2),
                   maturityDate=as.Date(today+3650))
#ConvertibleFloatingCouponBond(bondparams, iborindex,
#spreads, process, dateparams)



#this follow an example in test-suite/convertiblebond.cpp
#for ConvertibleFixedCouponBond

#set up arguments to build a pricing engine.
params <- list(tradeDate=Sys.Date()-2,
               settleDate=Sys.Date(),
               dt=.25,
               interpWhat="discount",
               interpHow="loglinear")
times <- seq(0,10,.1)

dividendYield <- DiscountCurve(params, list(flat=0.02), times)
riskFreeRate <- DiscountCurve(params, list(flat=0.05), times)

dividendSchedule <- data.frame(Type=character(0), Amount=numeric(0),
                            Rate = numeric(0), Date = as.Date(character(0)))
callabilitySchedule <- data.frame(Price = numeric(0), Type=character(0),
                          Date = as.Date(character(0)))

process <- list(underlying=50, divYield = dividendYield,
                rff = riskFreeRate, volatility=0.15)

today <- Sys.Date()
bondparams <- list(exercise="am", faceAmount=100, divSch = dividendSchedule,
                   callSch = callabilitySchedule, redemption=100,
                   creditSpread=0.005, conversionRatio = 0.0000000001,
                   issueDate=as.Date(today+2),
                   maturityDate=as.Date(today+3650))
dateparams <- list(settlementDays=3,
                   dayCounter="Actual360",
                   period = "Once", calendar = "UnitedStates/GovernmentBond",
                   businessDayConvention="Following"
                   )
coupon <- c(0.05)
ConvertibleFixedCouponBond(bondparams, coupon, process, dateparams)
```

```
#example with default value
ConvertibleFixedCouponBond(bondparams, coupon, process)

dateparams <- list(settlementDays=3,
                   dayCounter="Actual360")
ConvertibleFixedCouponBond(bondparams, coupon, process, dateparams)

bondparams <- list(creditSpread=0.005, conversionRatio = 0.0000000001,
                   issueDate=as.Date(today+2),
                   maturityDate=as.Date(today+3650))
ConvertibleFixedCouponBond(bondparams, coupon, process, dateparams)



#this follow an example in test-suite/convertiblebond.cpp
params <- list(tradeDate=Sys.Date()-2,
               settleDate=Sys.Date(),
               dt=.25,
               interpWhat="discount",
               interpHow="loglinear")
times <- seq(0,10,.1)


dividendYield <- DiscountCurve(params, list(flat=0.02), times)
riskFreeRate <- DiscountCurve(params, list(flat=0.05), times)

dividendSchedule <- data.frame(Type=character(0), Amount=numeric(0),
                            Rate = numeric(0), Date = as.Date(character(0)))
callabilitySchedule <- data.frame(Price = numeric(0), Type=character(0),
                          Date = as.Date(character(0)))

process <- list(underlying=50, divYield = dividendYield,
                rff = riskFreeRate, volatility=0.15)

today <- Sys.Date()
bondparams <- list(exercise="am", faceAmount=100, divSch = dividendSchedule,
                   callSch = callabilitySchedule, redemption=100,
                   creditSpread=0.005, conversionRatio = 0.0000000001,
                   issueDate=as.Date(today+2),
                   maturityDate=as.Date(today+3650))
dateparams <- list(settlementDays=3,
                   dayCounter="Actual360",
                   period = "Once", calendar = "UnitedStates/GovernmentBond",
                   businessDayConvention="Following"
                   )

ConvertibleZeroCouponBond(bondparams, process, dateparams)

#example with default values
ConvertibleZeroCouponBond(bondparams, process)


bondparams <- list(creditSpread=0.005,
```

```
                    conversionRatio=0.0000000001,
                    issueDate=as.Date(today+2),
                    maturityDate=as.Date(today+3650))

dateparams <- list(settlementDays=3, dayCounter='Actual360')
ConvertibleZeroCouponBond(bondparams, process, dateparams)
ConvertibleZeroCouponBond(bondparams, process)

## End(Not run)
```

---

`DiscountCurve` *Returns the discount curve (with zero rates and forwards) given times*

---

## Description

`DiscountCurve` constructs the spot term structure of interest rates based on input market data including the settlement date, deposit rates, futures prices, FRA rates, or swap rates, in various combinations. It returns the corresponding discount factors, zero rates, and forward rates for a vector of times that is specified as input.

## Usage

```
DiscountCurve(params, tsQuotes, times, legparams)
```

## Arguments

`params` A list specifying the `tradeDate` (month/day/year), `settleDate`, forward rate time span `dt`, and two curve construction options: `interpWhat` (with possible values `discount`, `forward`, and `zero`) and `interpHow` (with possible values `linear`, `loglinear`, and `spline`). `spline` here means cubic spline interpolation of the `interpWhat` value.

`tsQuotes` Market quotes used to construct the spot term structure of interest rates. Must be a list of name/value pairs, where the currently recognized names are:

| | |
|---|---|
| `flat` | rate for a flat yield curve |
| `d1w` | 1-week deposit rate |
| `d1m` | 1-month deposit rate |
| `d3m` | 3-month deposit rate |
| `d6m` | 6-month deposit rate |
| `d9m` | 9-month deposit rate |
| `d1y` | 1-year deposit rate |
| `s2y` | 2-year swap rate |
| `s3y` | 3-year swap rate |
| `s4y` | 4-year swap rate |
| `s5y` | 5-year swap rate |
| `s6y` | 6-year swap rate |
| `s7y` | 7-year swap rate |

| | |
|---|---|
| `s8y` | 8-year swap rate |
| `s9y` | 9-year swap rate |
| `s10y` | 10-year swap rate |
| `s12y` | 12-year swap rate |
| `s15y` | 15-year swap rate |
| `s20y` | 20-year swap rate |
| `s25y` | 25-year swap rate |
| `s30y` | 30-year swap rate |
| `s40y` | 40-year swap rate |
| `s50y` | 50-year swap rate |
| `s60y` | 60-year swap rate |
| `s70y` | 70-year swap rate |
| `s80y` | 80-year swap rate |
| `s90y` | 90-year swap rate |
| `s100y` | 100-year swap rate |
| `fut1--fut8` | 3-month futures contracts |
| `fra3x6` | 3x6 FRA |
| `fra6x9` | 6x9 FRA |
| `fra6x12` | 6x12 FRA |

Here rates are expected as fractions (so 5% means .05). If `flat` is specified it must be the first and only item in the list. The eight futures correspond to the first eight IMM dates. The maturity dates of the instruments specified need not be ordered, but they must be distinct.

`times` A vector of times at which to return the discount factors, forward rates, and zero rates. Times must be specified such that the largest time plus `dt` does not exceed the longest maturity of the instruments used for calibration (no extrapolation).

`legparams` A list specifying the `dayCounter` the day count convention for the fixed leg (default is Thirty360), and `fixFreq`, fixed coupon frequecny (defualt is Annual), `floatFreq`, floating leg reset frequency (default is Semiannual).

## Details

This function is based on `QuantLib` Version 0.3.10. It introduces support for fixed-income instruments in `RQuantLib`.

Forward rates and zero rates are computed assuming continuous compounding, so the forward rate $f$ over the period from $t_1$ to $t_2$ is determined by the relation

$$d_1/d_2 = e^{f(t_2-t_1)},$$

where $d_1$ and $d_2$ are discount factors corresponding to the two times. In the case of the zero rate $t_1$ is the current time (the spot date).

Curve construction can be a delicate problem and the algorithms may fail for some input data sets and/or some combinations of the values for `interpWhat` and `interpHow`. Fortunately, the C++ exception mechanism seems to work well with the R interface, and `QuantLib` exceptions are propagated back to the R user, usually with a message that indicates what went wrong. (The first part of the message contains technical information about the precise location of the problem in the `QuantLib` code. Scroll to the end to find information that is meaningful to the R user.)

## Value

`DiscountCurve` returns a list containing:

| | |
|---|---|
| `times` | Vector of input times |
| `discounts` | Corresponding discount factors |
| `forwards` | Corresponding forward rates with time span `dt` |
| `zerorates` | Corresponding zero coupon rates |
| `flatQuotes` | True if a flat quote was used, False otherwise |
| `params` | The input parameter list |

## Author(s)

Dominick Samperi

## References

Brigo, D. and Mercurio, F. (2001) *Interest Rate Models: Theory and Practice*, Springer-Verlag, New York.

For information about `QuantLib` see https://www.quantlib.org/.

For information about `RQuantLib` see http://dirk.eddelbuettel.com/code/rquantlib.html.

## See Also

`BermudanSwaption`

## Examples

```
## Not run:
savepar <- par(mfrow=c(3,3), mar=c(4,4,2,0.5))

## This data is taken from sample code shipped with QuantLib 0.9.7
## from the file Examples/Swap/swapvaluation
params <- list(tradeDate=as.Date('2004-09-20'),
               settleDate=as.Date('2004-09-22'),
               dt=.25,
               interpWhat="discount",
               interpHow="loglinear")
setEvaluationDate(as.Date("2004-09-20"))

## We get numerical issue for the spline interpolation if we add
## any on of these three extra futures -- the original example
## creates different curves based on different deposit, fra, futures
## and swap data
## Removing s2y helps, as kindly pointed out by Luigi Ballabio
tsQuotes <- list(d1w = 0.0382,
                 d1m = 0.0372,
                 d3m = 0.0363,
                 d6m = 0.0353,
                 d9m = 0.0348,
```

```
                    d1y = 0.0345,
                    fut1=96.2875,
                    fut2=96.7875,
                    fut3=96.9875,
                    fut4=96.6875,
                    fut5=96.4875,
                    fut6=96.3875,
                    fut7=96.2875,
                    fut8=96.0875,
#                    s2y = 0.037125,
                    s3y = 0.0398,
                    s5y = 0.0443,
                    s10y = 0.05165,
                    s15y = 0.055175)

times <- seq(0,10,.1)

# Loglinear interpolation of discount factors
curves <- DiscountCurve(params, tsQuotes, times)
plot(curves,setpar=FALSE)

# Linear interpolation of discount factors
params$interpHow="linear"
curves <- DiscountCurve(params, tsQuotes, times)
plot(curves,setpar=FALSE)

# Spline interpolation of discount factors
params$interpHow="spline"
curves <- DiscountCurve(params, tsQuotes, times)
plot(curves,setpar=FALSE)

par(savepar)

## End(Not run)
```

---

Enum *Documentation for parameters*

---

## Description

Reference for parameters when constructing a bond

## Arguments

`DayCounter` an int value

| | |
|---|---|
| 0 | Actual360 |
| 1 | Actual365Fixed |
| 2 | ActualActual (NB: soft deprecated, defaults to ActualActual.ISDA) |

| | |
|---|---|
| 3 | ActualBusiness252 |
| 4 | OneDayCounter |
| 5 | SimpleDayCounter |
| 6 | Thirty360 (NB: soft deprecated, defaults to Thirty360.BondBasis) |
| 7 | Actual365Fixed.NoLeap (NB: Actual365NoLeap if QuantLib version < 1.16) |
| 8 | ActualActual.ISMA |
| 9 | ActualActual.Bond |
| 10 | ActualActual.ISDA |
| 11 | ActualActual.Historical |
| 12 | ActualActual.AFB |
| 13 | ActualActual.Euro |
| 14 | Thirty360.USA |
| 15 | Thirty360.BondBasis |
| 16 | Thirty360.European |
| 17 | Thirty360.EurobondBasis |
| 18 | Thirty360.Italian |
| 19 | Thirty360.German |

`businessDayConvention`
an int value

| | |
|---|---|
| 0 | Following |
| 1 | ModifiedFollowing |
| 2 | Preceding |
| 3 | ModifiedPreceding |
| 4 | Unadjusted |
| 5 | HalfMonthModifiedFollowing |
| 6 | Nearest |
| anything else | Unadjusted |

`compounding` an int value

| | |
|---|---|
| 0 | Simple |
| 1 | Compounded |
| 2 | Continuous |
| 3 | SimpleThenCompounded |

`period` or `frequency`
an int value

| | |
|---|---|
| -1 | NoFrequency |
| 0 | Once |
| 1 | Annual |
| 2 | Semiannual |
| 3 | EveryFourthMonth |
| 4 | Quarterly |
| 6 | BiMonthtly |
| 12 | Monthly |

| | |
|---|---|
| 13 | EveryFourthWeek |
| 26 | BiWeekly |
| 52 | Weekly |
| 365 | Daily |
| anything else | OtherFrequency |

date generation
an int value to specify date generation rule

| | |
|---|---|
| 0 | Backward |
| 1 | Forward |
| 2 | Zero |
| 3 | ThirdWednesday |
| 4 | Twentieth |
| 5 | TwentiethIMM |
| 6 | OldCDS |
| 7 | CDS |
| anything else | TwentiethIMM |

durationType an int value to specify duration type

| | |
|---|---|
| 0 | Simple |
| 1 | Macaulay |
| 2 | Modified |

## Details

Please see any decent Finance textbook for background reading, and the QuantLib documentation for details on the QuantLib implementation, particularly the datetime classes.

## Value

None

## Author(s)

Khanh Nguyen <knguyen@cs.umb.edu>

## References

https://www.quantlib.org/ for details on QuantLib.

EuropeanOption *European Option evaluation using Closed-Form solution*

### Description

The EuropeanOption function evaluations an European-style option on a common stock using the Black-Scholes-Merton solution. The option value, the common first derivatives ("Greeks") as well as the calling parameters are returned.

### Usage

```
## Default S3 method:
EuropeanOption(type, underlying, strike,
dividendYield, riskFreeRate, maturity, volatility,
discreteDividends, discreteDividendsTimeUntil)
```

### Arguments

| | |
|---|---|
| type | A string with one of the values call or put |
| underlying | Current price of the underlying stock |
| strike | Strike price of the option |
| dividendYield | Continuous dividend yield (as a fraction) of the stock |
| riskFreeRate | Risk-free rate |
| maturity | Time to maturity (in fractional years) |
| volatility | Volatility of the underlying stock |
| discreteDividends | Vector of discrete dividends (optional) |
| discreteDividendsTimeUntil | Vector of times to discrete dividends (in fractional years, optional) |

### Details

The well-known closed-form solution derived by Black, Scholes and Merton is used for valuation. Implied volatilities are calculated numerically.

Please see any decent Finance textbook for background reading, and the QuantLib documentation for details on the QuantLib implementation.

### Value

The EuropeanOption function returns an object of class EuropeanOption (which inherits from class Option). It contains a list with the following components:

| | |
|---|---|
| value | Value of option |
| delta | Sensitivity of the option value for a change in the underlying |

| | |
|---|---|
| gamma | Sensitivity of the option delta for a change in the underlying |
| vega | Sensitivity of the option value for a change in the underlying's volatility |
| theta | Sensitivity of the option value for a change in t, the remaining time to maturity |
| rho | Sensitivity of the option value for a change in the risk-free interest rate |
| dividendRho | Sensitivity of the option value for a change in the dividend yield |

## Note

The interface might change in future release as QuantLib stabilises its own API.

## Author(s)

Dirk Eddelbuettel <edd@debian.org> for the R interface; the QuantLib Group for QuantLib

## References

https://www.quantlib.org/ for details on QuantLib.

## See Also

EuropeanOptionImpliedVolatility, EuropeanOptionArrays, AmericanOption,BinaryOption

## Examples

```
## simple call with unnamed parameters
EuropeanOption("call", 100, 100, 0.01, 0.03, 0.5, 0.4)
## simple call with some explicit parameters, and slightly increased vol:
EuropeanOption(type="call", underlying=100, strike=100, dividendYield=0.01,
riskFreeRate=0.03, maturity=0.5, volatility=0.5)
## simple call with slightly shorter maturity: QuantLib 1.7 compiled with
## intra-day time calculation support with create slightly changed values
EuropeanOption(type="call", underlying=100, strike=100, dividendYield=0.01,
riskFreeRate=0.03, maturity=0.499, volatility=0.5)
```

---

EuropeanOptionArrays *European Option evaluation using Closed-Form solution*

---

## Description

The EuropeanOptionArrays function allows any two of the numerical input parameters to be a vector, and a list of matrices is returned for the option value as well as each of the 'greeks'. For each of the returned matrices, each element corresponds to an evaluation under the given set of parameters.

### Usage

```
EuropeanOptionArrays(type, underlying, strike, dividendYield,
                     riskFreeRate, maturity, volatility)
oldEuropeanOptionArrays(type, underlying, strike, dividendYield,
                        riskFreeRate, maturity, volatility)
plotOptionSurface(EOres, ylabel="", xlabel="", zlabel="", fov=60)
```

### Arguments

| | |
|---|---|
| `type` | A string with one of the values `call` or `put` |
| `underlying` | (Scalar or list) current price(s) of the underlying stock |
| `strike` | (Scalar or list) strike price(s) of the option |
| `dividendYield` | (Scalar or list) continuous dividend yield(s) (as a fraction) of the stock |
| `riskFreeRate` | (Scalar or list) risk-free rate(s) |
| `maturity` | (Scalar or list) time(s) to maturity (in fractional years) |
| `volatility` | (Scalar or list) volatilit(ylies) of the underlying stock |
| `EOres` | result matrix produced by `EuropeanOptionArrays` |
| `ylabel` | label for y-axsis |
| `xlabel` | label for x-axsis |
| `zlabel` | label for z-axsis |
| `fov` | viewpoint for 3d rendering |

### Details

The well-known closed-form solution derived by Black, Scholes and Merton is used for valuation.

Please see any decent Finance textbook for background reading, and the `QuantLib` documentation for details on the `QuantLib` implementation.

### Value

The `EuropeanOptionArrays` function allows any two of the numerical input parameters to be a vector or sequence. A list of two-dimensional matrices is returned. Each cell corresponds to an evaluation under the given set of parameters.

For these functions, the following components are returned:

| | |
|---|---|
| `value` | (matrix) value of option |
| `delta` | (matrix) change in value for a change in the underlying |
| `gamma` | (matrix) change in value for a change in delta |
| `vega` | (matrix) change in value for a change in the underlying's volatility |
| `theta` | (matrix) change in value for a change in delta |
| `rho` | (matrix) change in value for a change in time to maturity |
| `dividendRho` | (matrix) change in value for a change in delta |
| `parameters` | List with parameters with which object was created |

The `oldEuropeanOptionArrays` function is an older implementation which vectorises this at the R level instead but allows more general multidimensional arrays.

### Note

The interface might change in future release as QuantLib stabilises its own API.

### Author(s)

Dirk Eddelbuettel <edd@debian.org> for the R interface; the QuantLib Group for QuantLib

### References

https://www.quantlib.org/ for details on QuantLib.

### See Also

AmericanOption,BinaryOption

### Examples

```
## Not run:
# define two vectos for the underlying and the volatility
und.seq <- seq(10,180,by=2)
vol.seq <- seq(0.1,0.9,by=0.1)
# evaluate them along with three scalar parameters
EOarr <- EuropeanOptionArrays("call", underlying=und.seq,
                              strike=100, dividendYield=0.01,
                              riskFreeRate=0.03,
                              maturity=1, volatility=vol.seq)
# and look at four of the result arrays: value, delta, gamma, vega
old.par <- par(no.readonly = TRUE)
par(mfrow=c(2,2),oma=c(5,0,0,0),mar=c(2,2,2,1))
plot(EOarr$parameters.underlying, EOarr$value[,1], type='n',
     main="option value", xlab="", ylab="")
topocol <- topo.colors(length(vol.seq))
for (i in 1:length(vol.seq))
  lines(EOarr$parameters.underlying, EOarr$value[,i], col=topocol[i])
plot(EOarr$parameters.underlying, EOarr$delta[,1],type='n',
     main="option delta", xlab="", ylab="")
for (i in 1:length(vol.seq))
  lines(EOarr$parameters.underlying, EOarr$delta[,i], col=topocol[i])
plot(EOarr$parameters.underlying, EOarr$gamma[,1],type='n',
     main="option gamma", xlab="", ylab="")
for (i in 1:length(vol.seq))
  lines(EOarr$parameters.underlying, EOarr$gamma[,i], col=topocol[i])
plot(EOarr$parameters.underlying, EOarr$vega[,1],type='n',
     main="option vega", xlab="", ylab="")
for (i in 1:length(vol.seq))
  lines(EOarr$parameters.underlying, EOarr$vega[,i], col=topocol[i])
mtext(text=paste("Strike is 100, maturity 1 year, riskless rate 0.03",
        "\nUnderlying price from", und.seq[1],"to", und.seq[length(und.seq)],
        "\nVolatility  from",vol.seq[1], "to",vol.seq[length(vol.seq)]),
      side=1,font=1,outer=TRUE,line=3)
par(old.par)
```

```
## End(Not run)
```

---

EuropeanOptionImpliedVolatility

*Implied Volatility calculation for European Option*

---

### Description

The `EuropeanOptionImpliedVolatility` function solves for the (unobservable) implied volatility, given an option price as well as the other required parameters to value an option.

### Usage

```
## Default S3 method:
EuropeanOptionImpliedVolatility(type, value,
underlying, strike, dividendYield, riskFreeRate, maturity, volatility)
```

### Arguments

| | |
|---|---|
| `type` | A string with one of the values `call` or `put` |
| `value` | Value of the option (used only for ImpliedVolatility calculation) |
| `underlying` | Current price of the underlying stock |
| `strike` | Strike price of the option |
| `dividendYield` | Continuous dividend yield (as a fraction) of the stock |
| `riskFreeRate` | Risk-free rate |
| `maturity` | Time to maturity (in fractional years) |
| `volatility` | Initial guess for the volatility of the underlying stock |

### Details

The well-known closed-form solution derived by Black, Scholes and Merton is used for valuation. Implied volatilities are then calculated numerically.

Please see any decent Finance textbook for background reading, and the `QuantLib` documentation for details on the `QuantLib` implementation.

### Value

The `EuropeanOptionImpliedVolatility` function returns an numeric variable with volatility implied by the given market prices and given parameters.

### Note

The interface might change in future release as `QuantLib` stabilises its own API.

### Author(s)

Dirk Eddelbuettel <edd@debian.org> for the R interface; the QuantLib Group for QuantLib

### References

https://www.quantlib.org/ for details on QuantLib.

### See Also

EuropeanOption,AmericanOption,BinaryOption

### Examples

```
EuropeanOptionImpliedVolatility(type="call", value=11.10, underlying=100,
strike=100, dividendYield=0.01, riskFreeRate=0.03,
maturity=0.5, volatility=0.4)
```

---

## FittedBondCurve *Returns the discount curve (with zero rates and forwards) given set of bonds*

---

### Description

FittedBondCurve fits a term structure to a set of bonds using three different fitting methodologies. For more detail, see QuantLib/Example/FittedBondCurve.

### Usage

```
FittedBondCurve(curveparams, lengths, coupons, marketQuotes, dateparams)
```

### Arguments

curveparams curve parameters

| | |
|---|---|
| method | a string, fitting methods: "ExponentialSplinesFitting", "SimplePolynomialFitting", "NelsonSiegelFitting" |
| origDate | a Date, starting date of the curve |

| | |
|---|---|
| lengths | an numeric vector, length of the bonds in year |
| coupons | a numeric vector, coupon rate of the bonds |
| marketQuotes | a numeric vector, market price of the bonds |

dateparams (Optional) a named list, QuantLib's date parameters of the bond.

| | |
|---|---|
| settlementDays | (Optional) a double, settlement days. Default value is 1. |
| dayCounter | (Optional) a number or string, day counter convention. See Enum. Default value is 'Thirty360' |
| period | (Optional) a number or string, interest compounding interval. See Enum. Default value is 'Semiannual'. |
| businessDayConvention | (Optional) a number or string, business day convention. See Enum. Default value is 'Following'. |

See example below.

## Details

Please see any decent Finance textbook for background reading, and the QuantLib documentation for details on the QuantLib implementation.

## Value

table, a three columns "date - zeroRate - discount" data frame

## Author(s)

Khanh Nguyen <knguyen@cs.umb.edu> for the inplementation; Dirk Eddelbuettel <edd@debian.org> for the R interface; the QuantLib Group for QuantLib

## References

https://www.quantlib.org/ for details on QuantLib.

## Examples

```
# commented-out as it runs longer than CRAN likes
## Not run:
lengths <- c(2,4,6,8,10,12,14,16,18,20,22,24,26,28,30)
coupons <- c( 0.0200, 0.0225, 0.0250, 0.0275, 0.0300,
              0.0325, 0.0350, 0.0375, 0.0400, 0.0425,
              0.0450, 0.0475, 0.0500, 0.0525, 0.0550 )
marketQuotes <- rep(100, length(lengths))
dateparams <- list(settlementDays=0, period="Annual",
                   dayCounter="ActualActual",
                  businessDayConvention ="Unadjusted")
curveparams <- list(method="ExponentialSplinesFitting",
                    origDate = Sys.Date())
curve <- FittedBondCurve(curveparams, lengths, coupons, marketQuotes, dateparams)
z <- zoo::zoo(curve$table$zeroRates, order.by=curve$table$date)
```

```
plot(z)

## End(Not run)
```

FixedRateBond *Fixed-Rate bond pricing*

## Description

The FixedRateBond function evaluates a fixed rate bond using discount curve, the yield or the clean price. More specificly, when a discount curve is provided the calculation is done by DiscountingBondEngine from QuantLib. The NPV, clean price, dirty price, accrued interest, yield, duration, actual settlement date and cash flows of the bond is returned. When a yield is provided instead, no engine is provided to the bond class and prices are computed from yield. In the latter case, NPV is set to NA. Same situation when the clean price is given instead of discount curve or yield. For more detail, see the source codes in QuantLib's file test-suite/bond.cpp.

The FixedRateBondPriceByYield function calculates the theoretical price of a fixed rate bond from its yield.

The FixedRateBondYield function calculates the theoretical yield of a fixed rate bond from its price.

## Usage

```
## Default S3 method:
FixedRateBond(bond, rates, schedule,
                                   calc=list(dayCounter='ActualActual.ISMA',
                                             compounding='Compounded',
                                             freq='Annual',
                                             durationType='Modified'),
                                   discountCurve = NULL, yield = NA, price = NA)

## Default S3 method:
FixedRateBondPriceByYield( settlementDays=1, yield, faceAmount=100,
                                    effectiveDate, maturityDate,
                                   period, calendar="UnitedStates/GovernmentBond",
                                    rates, dayCounter=2,
                             businessDayConvention=0, compound = 0, redemption=100,
                                    issueDate)

## Default S3 method:
FixedRateBondYield( settlementDays=1, price, faceAmount=100,
                                    effectiveDate, maturityDate,
                                   period, calendar="UnitedStates/GovernmentBond",
                                    rates, dayCounter=2,
                                    businessDayConvention=0,
                                    compound = 0, redemption=100,
                                    issueDate)
```

**Arguments**

bond (Optional) bond parameters, a named list whose elements are:

| | |
|---|---|
| settlementDays | (Optional) a double, settlement days. Default value is 1. |
| faceAmount | (Optional) a double, face amount of the bond. Default value is 100. |
| dayCounter | (Optional) a number or string, day counter convention. Defaults to 'Thirty360' |
| issueDate | (Optional) a Date, the bond's issue date Defaults to QuantLib default. |
| paymentConvention | (Optional) a number or string, the bond payment convention. Defaults to QuantLib default. |
| redemption | (Optional) a double, the redemption amount. Defaults to QuantLib default (100). |
| paymentCalendar | (Optional) a string, the name of the calendar. Defaults to QuantLib default. |
| exCouponPeriod | (Optional) a number, the number of days when the coupon goes ex relative to the coupon date. Defaults to QuantLib default. |
| exCouponCalendar | (Optional) a string, the name of the ex-coupon calendar. Defaults to QuantLib default. |
| exCouponConvention | (Optional) a number or string, the coupon payment convention. Defaults to QuantLib default. |
| exCouponEndOfMonth | (Optional) 1 or 0, use End of Month rule for ex-coupon dates. Defaults to 0 (false). |

rates a numeric vector, bond's coupon rates

schedule (Optional) a named list, QuantLib's parameters of the bond's schedule.

| | |
|---|---|
| effectiveDate | a Date, when the schedule becomes effective. |
| maturityDate | a Date, when the schedule matures. |
| period | (Optional) a number or string, the frequency of the schedule. Default value is 'Semiannual'. |
| calendar | (Optional) a string, the calendar name. Defaults to 'TARGET' |
| businessDayConvention | (Optional) a number or string, the day convention to use. Defaults to 'Following'. |
| terminationDateConvention | (Optional) a number or string, the day convention to use for the terminal date. Defaults to 'Following'. |
| dateGeneration | (Optional) a number or string, the date generation rule. |

| | |
|---|---|
| | Defaults to 'Backward'. |
| endOfMonth | (Optional) 1 or 0, use End of Month rule for schedule dates. Defaults to 0 (false). |

See example below.

calc (Optional) a named list, QuantLib's parameters for calculations.

| | |
|---|---|
| dayCounter | (Optional) a number or string, day counter convention. Defaults to 'ActualActual.ISMA' |
| compounding | a string, what kind of compounding to use. Defaults to 'Compounded' |
| freq | (Optional) a number or string, the frequency to use. Default value is 'Annual'. |
| durationType | (Optional) a number or string, the type of duration to calculate. Defaults to 'Simple' |
| accuracy | (Optional) a number, the accuracy required. Defaults to 1.0e-8. |
| maxEvaluations | (Optional) a number, max number of iterations. Defaults to 100. |

discountCurve Can be one of the following:

| | |
|---|---|
| a DiscountCurve | a object of DiscountCurve class For more detail, see example or the discountCurve function |
| A 2 items list | specifies a flat curve in two values "todayDate" and "rate" |
| A 3 items list | specifies three values to construct a DiscountCurve object, "params" , "tsQuotes", "times". For more detail, see example or the discountCurve function |

yield yield of the bond

price clean price of the bond

settlementDays an integer, 1 for T+1, 2 for T+2, etc...

effectiveDate bond's effective date

maturityDate bond's maturity date

period frequency of events,0=NoFrequency, 1=Once, 2=Annual, 3=Semiannual, 4=EveryFourthMonth, 5=Quarterly, 6=Bimonthly ,7=Monthly ,8=EveryFourthWeek,9=Biweekly, 10=Weekly, 11=Daily. For more information, see QuantLib's Frequency class

calendar Business Calendar. Either us or uk

faceAmount face amount of the bond

businessDayConvention
convention used to adjust a date in case it is not a valid business day. See quantlib for more detail. 0 = Following, 1 = ModifiedFollowing, 2 = Preceding, 3 = ModifiedPreceding, other = Unadjusted

| | |
|---|---|
| `dayCounter` | day count convention. 0 = Actual360(), 1 = Actual365Fixed(), 2 = ActualActual(), 3 = Business252(), 4 = OneDayCounter(), 5 = SimpleDayCounter(), all other = Thirty360(). For more information, see QuantLib's DayCounter class |
| `compound` | compounding type. 0=Simple, 1=Compounded, 2=Continuous, all other=SimpleThenCompounded. See QuantLib's Compound class |
| `redemption` | redemption when the bond expires |
| `issueDate` | date the bond is issued |

## Details

A discount curve is built to calculate the bond value.

Please see any decent Finance textbook for background reading, and the `QuantLib` documentation for details on the `QuantLib` implementation.

## Value

The `FixedRateBond` function returns an object of class `FixedRateBond` (which inherits from class `Bond`). It contains a list with the following components:

| | |
|---|---|
| `NPV` | net present value of the bond |
| `cleanPrice` | clean price of the bond |
| `dirtyPrice` | dirty price of the bond |
| `accruedAmount` | accrued amount of the bond |
| `yield` | yield of the bond |
| `duration` | the duration of the bond |
| `settlementDate` | the actual settlement date used for the bond |
| `cashFlows` | cash flows of the bond |

The `FixedRateBondPriceByYield` function returns an object of class `FixedRateBondPriceByYield` (which inherits from class `Bond`). It contains a list with the following components:

| | |
|---|---|
| `price` | price of the bond |

The `FixedRateBondYield` function returns an object of class `FixedRateBondYield` (which inherits from class `Bond`). It contains a list with the following components:

| | |
|---|---|
| `yield` | yield of the bond |

## Note

The interface might change in future release as `QuantLib` stabilises its own API.

## Author(s)

Khanh Nguyen <`knguyen@cs.umb.edu`> for the inplementation; Dirk Eddelbuettel <`edd@debian.org`> for the R interface; the QuantLib Group for `QuantLib`

## References

https://www.quantlib.org/ for details on QuantLib.

## Examples

```
#Simple call with a flat curve
bond <- list(settlementDays=1,
             issueDate=as.Date("2004-11-30"),
             faceAmount=100,
             dayCounter='Thirty360',
             paymentConvention='Unadjusted')
schedule <- list(effectiveDate=as.Date("2004-11-30"),
                 maturityDate=as.Date("2008-11-30"),
                 period='Semiannual',
                 calendar='UnitedStates/GovernmentBond',
                 businessDayConvention='Unadjusted',
                 terminationDateConvention='Unadjusted',
                 dateGeneration='Forward',
                 endOfMonth=1)
calc=list(dayCounter='Actual360',
          compounding='Compounded',
          freq='Annual',
          durationType='Modified')
coupon.rate <- c(0.02875)

params <- list(tradeDate=as.Date('2002-2-15'),
               settleDate=as.Date('2002-2-19'),
               dt=.25,
               interpWhat="discount",
               interpHow="loglinear")
setEvaluationDate(as.Date("2004-11-22"))

discountCurve.flat <- DiscountCurve(params, list(flat=0.05))
FixedRateBond(bond,
              coupon.rate,
              schedule,
              calc,
              discountCurve=discountCurve.flat)


#Same bond with a discount curve constructed from market quotes
tsQuotes <- list(d1w  =0.0382,
                 d1m  =0.0372,
                 fut1=96.2875,
                 fut2=96.7875,
                 fut3=96.9875,
                 fut4=96.6875,
                 fut5=96.4875,
                 fut6=96.3875,
                 fut7=96.2875,
                 fut8=96.0875,
                 s3y  =0.0398,
```

```
                 s5y  =0.0443,
                 s10y =0.05165,
                 s15y =0.055175)
tsQuotes <- list("flat" = 0.02) ## While discount curve code is buggy

discountCurve <- DiscountCurve(params, tsQuotes)
FixedRateBond(bond,
              coupon.rate,
              schedule,
              calc,
              discountCurve=discountCurve)

#Same bond calculated from yield rather than from the discount curve
yield <- 0.02
FixedRateBond(bond,
              coupon.rate,
              schedule,
              calc,
              yield=yield)


#same example with clean price
price <- 103.31
FixedRateBond(bond,
              coupon.rate,
              schedule,
              calc,
              price = price)

#example with default calc parameter
FixedRateBond(bond,
              coupon.rate,
              schedule,
              discountCurve=discountCurve)

#example with default calc and schedule parameters
schedule <- list(effectiveDate=as.Date("2004-11-30"),
                 maturityDate=as.Date("2008-11-30"))
FixedRateBond(bond,
              coupon.rate,
              schedule,
              discountCurve=discountCurve)

#example with default calc, schedule and bond parameters
FixedRateBond(,
              coupon.rate,
              schedule,
              discountCurve=discountCurve)

FixedRateBondPriceByYield(,0.0307, 100000, as.Date("2004-11-30"),
                          as.Date("2008-11-30"), 3, , c(0.02875),
                          , , , ,as.Date("2004-11-30"))
```

```
FixedRateBondYield(,90, 100000, as.Date("2004-11-30"), as.Date("2008-11-30"),
                   3, , c(0.02875), , , , ,as.Date("2004-11-30"))
```

FloatingRateBond *Floating rate bond pricing*

## Description

The FloatingRateBond function evaluates a floating rate bond using discount curve. More specificly, the calculation is done by DiscountingBondEngine from QuantLib. The NPV, clean price, dirty price, accrued interest, yield and cash flows of the bond is returned. For more detail, see the source codes in quantlib's test-suite. test-suite/bond.cpp

## Usage

```
## Default S3 method:
FloatingRateBond(bond, gearings, spreads,
                                       caps, floors, index,
                                       curve, dateparams )
```

## Arguments

bond — bond parameters, a named list whose elements are:

| | |
|---|---|
| issueDate | a Date, the bond's issue date |
| maturityDate | a Date, the bond's maturity date |
| faceAmount | (Optional) a double, face amount of the bond. Default value is 100. |
| redemption | (Optional) a double, percentage of the initial face amount that will be returned at maturity date. Default value is 100. |
| effectiveDate | (Optinal) a Date, the bond's effective date. Default value is issueDate |

gearings — (Optional) a numeric vector, bond's gearings. See quantlib's doc on FloatingRateBond for more detail. Default value is an empty vector c().

spreads — (Optional) a numeric vector, bond's spreads. See quantlib's doc on FloatingRateBond for more detail.Default value is an empty vector c()

caps — (Optional) a numeric vector, bond's caps. See quantlib's doc on FloatingRateBond for more detail. Default value is an empty vector c()

floors — (Optional) a numeric vector, bond's floors. See quantlib's doc on FloatingRateBond for more detail. Default value is an empty vector c()

curve — Can be one of the following:

| | |
|---|---|
| a DiscountCurve | a object of DiscountCurve class<br>For more detail, see example or<br>the discountCurve function |
| A 2 items list | specifies a flat curve in two<br>values "todayDate" and "rate" |
| A 3 items list | specifies three values to construct a<br>DiscountCurve object, "params" ,<br>"tsQuotes", "times".<br>For more detail, see example or<br>the discountCurve function |

index a named list whose elements are parameters of an IborIndex term structure.

| | |
|---|---|
| type | a string, currently support only "USDLibor" |
| length | an integer, length of the index |
| inTermOf | a string, period unit, currently support only 'Month' |
| term | a DiscountCurve object, the term structure of the index |

dateparams (Optional) a named list, QuantLib's date parameters of the bond.

| | |
|---|---|
| settlementDays | (Optional) a double, settlement days.<br>Default value is 1. |
| calendar | (Optional) a string, either 'us' or 'uk'<br>corresponding to US Goverment Bond<br>calendar and UK Exchange calendar.<br>Default value is 'us'. |
| dayCounter | (Optional) a number or string,<br>day counter convention.<br>See Enum. Default value is 'Thirty360' |
| period | (Optional) a number or string,<br>interest compounding interval. See Enum.<br>Default value is 'Semiannual'. |
| businessDayConvention | (Optional) a number or string,<br>business day convention.<br>See Enum. Default value is 'Following'. |
| terminationDateConvention | (Optional) a number or string,<br>termination day convention.<br>See Enum. Default value is 'Following'. |
| endOfMonth | (Optional) a numeric with value 1 or 0.<br>End of Month rule. Default value is 0. |
| dateGeneration | (Optional) a numeric, date generation method.<br>See Enum. Default value is 'Backward' |

See example below.

### Details

A discount curve is built to calculate the bond value.

Please see any decent Finance textbook for background reading, and the QuantLib documentation for details on the QuantLib implementation.

### Value

The FloatingRateBond function returns an object of class FloatingRateBond (which inherits from class Bond). It contains a list with the following components:

| | |
|---|---|
| NPV | net present value of the bond |
| cleanPrice | clean price of the bond |
| dirtyPrice | dirty price of the bond |
| accruedAmount | accrued amount of the bond |
| yield | yield of the bond |
| cashFlows | cash flows of the bond |

### Note

The interface might change in future release as QuantLib stabilises its own API.

### Author(s)

Khanh Nguyen <knguyen@cs.umbno.edu> for the inplementation; Dirk Eddelbuettel <edd@debian.org> for the R interface; the QuantLib Group for QuantLib

### References

https://www.quantlib.org/ for details on QuantLib.

### Examples

```
bond <- list(faceAmount=100, issueDate=as.Date("2004-11-30"),
             maturityDate=as.Date("2008-11-30"), redemption=100,
             effectiveDate=as.Date("2004-11-30"))
dateparams <- list(settlementDays=1, calendar="UnitedStates/GovernmentBond",
                   dayCounter = 'ActualActual', period=2,
                   businessDayConvention = 1, terminationDateConvention=1,
                   dateGeneration=0, endOfMonth=0, fixingDays = 1)

gearings <- spreads <- caps <- floors <- vector()

params <- list(tradeDate=as.Date('2002-2-15'),
               settleDate=as.Date('2002-2-19'),
               dt=.25,
               interpWhat="discount",
               interpHow="loglinear")
setEvaluationDate(as.Date("2004-11-22"))
```

```
tsQuotes <- list(d1w  =0.0382,
                 d1m  =0.0372,
                 fut1=96.2875,
                 fut2=96.7875,
                 fut3=96.9875,
                 fut4=96.6875,
                 fut5=96.4875,
                 fut6=96.3875,
                 fut7=96.2875,
                 fut8=96.0875,
                 s3y  =0.0398,
                 s5y  =0.0443,
                 s10y =0.05165,
                 s15y =0.055175)
tsQuotes <- list("flat" = 0.02) ## While discount curve code is buggy

## when both discount and libor curves are flat.

discountCurve.flat <- DiscountCurve(params, list(flat=0.05))
termstructure <- DiscountCurve(params, list(flat=0.03))
iborIndex.params <- list(type="USDLibor", length=6,
                  inTermOf="Month", term=termstructure)
FloatingRateBond(bond, gearings, spreads, caps, floors,
                 iborIndex.params, discountCurve.flat, dateparams)


## discount curve is constructed from market quotes
## and a flat libor curve
discountCurve <- DiscountCurve(params, tsQuotes)
termstructure <- DiscountCurve(params, list(flat=0.03))
iborIndex.params <- list(type="USDLibor", length=6,
                  inTermOf="Month", term = termstructure)
FloatingRateBond(bond, gearings, spreads, caps, floors,
                 iborIndex.params, discountCurve, dateparams)

#example using default values
FloatingRateBond(bond=bond, index=iborIndex.params, curve=discountCurve)
```

---

getQuantLibCapabilities *Return configuration options of the QuantLib library*

---

## Description

This function returns a named vector of boolean variables describing several configuration options determined at compilation time of the QuantLib library.

## Usage

```
getQuantLibCapabilities()
```

### Details

Not all of these features are used (yet) by RQuantLib.

### Value

A named vector of logical variables

### Author(s)

Dirk Eddelbuettel

### References

https://www.quantlib.org for details on `QuantLib`.

### Examples

```
getQuantLibCapabilities()
```

---

## getQuantLibVersion *Return the QuantLib version number*

---

### Description

This function returns the QuantLib version string as encoded in the header file `config.hpp` and determined at compilation time of the QuantLib library.

### Usage

```
getQuantLibVersion()
```

### Value

A character variable

### Author(s)

Dirk Eddelbuettel

### References

https://www.quantlib.org for details on `QuantLib`.

### Examples

```
getQuantLibVersion()
```

ImpliedVolatility *Base class for option-price implied volatility evalution*

## Description

This class forms the basis from which the more specific classes are derived.

## Usage

```
## S3 method for class 'ImpliedVolatility'
print(x, digits=3, ...)
## S3 method for class 'ImpliedVolatility'
summary(object, digits=3, ...)
```

## Arguments

| | |
|---|---|
| x | Any option-price implied volatility object derived from this base class |
| object | Any option-price implied volatility object derived from this base class |
| digits | Number of digits of precision shown |
| ... | Further arguments |

## Details

Please see any decent Finance textbook for background reading, and the QuantLib documentation for details on the QuantLib implementation.

## Value

None, but side effects of displaying content.

## Note

The interface might change in future release as QuantLib stabilises its own API.

## Author(s)

Dirk Eddelbuettel <edd@debian.org> for the R interface; the QuantLib Group for QuantLib

## References

https://www.quantlib.org/ for details on QuantLib.

## See Also

AmericanOptionImpliedVolatility, EuropeanOptionImpliedVolatility, AmericanOption, EuropeanOption, BinaryOption

## Examples

```
impVol<-EuropeanOptionImpliedVolatility("call", value=11.10, strike=100,
                                        volatility=0.4, 100, 0.01, 0.03, 0.5)
print(impVol)
summary(impVol)
```

---

Option *Base class for option price evalution*

---

## Description

This class forms the basis from which the more specific classes are derived.

## Usage

```
## S3 method for class 'Option'
print(x, digits=4, ...)
## S3 method for class 'Option'
plot(x, ...)
## S3 method for class 'Option'
summary(object, digits=4, ...)
```

## Arguments

| | |
|---|---|
| x | Any option object derived from this base class |
| object | Any option object derived from this base class |
| digits | Number of digits of precision shown |
| ... | Further arguments |

## Details

Please see any decent Finance textbook for background reading, and the QuantLib documentation for details on the QuantLib implementation.

## Value

None, but side effects of displaying content.

## Note

The interface might change in future release as QuantLib stabilises its own API.

## Author(s)

Dirk Eddelbuettel <edd@debian.org> for the R interface; the QuantLib Group for QuantLib

## References

https://www.quantlib.org/ for details on QuantLib.

## See Also

AmericanOption,EuropeanOption, BinaryOption

## Examples

```
EO<-EuropeanOption("call", strike=100, volatility=0.4, 100, 0.01, 0.03, 0.5)
print(EO)
summary(EO)
```

---

SabrSwaption *SABR swaption using vol cube data with bermudan alternative using markovfunctional*

---

## Description

SabrSwaption prices a swaption with specified expiration or time range if Bermudan, strike, and maturity, using quantlibs SABR model for europeans and quantlib's markovfunctional for Bermudans. Currently the input is a zero offset log-normal vol surface. An example of a dataset can be found in the dataset rqlib inlcuded with Rquantlib. It is assumed that the swaption is exercisable at the start of a forward start swap if params$european flag is set to TRUE or starting immediately on each reset date (Bermudan) of an existing underlying swap or spot start swap if params$european flag is set to FALSE.

## Usage

```
SabrSwaption(params, ts, volCubeDF,
legparams = list(dayCounter = "Thirty360", fixFreq = "Annual", floatFreq = "Semiannual"),
tsUp01 = NA, tsDn01 = NA, vega = FALSE)
```

## Arguments

| | |
|---|---|
| params | A list specifying the tradeDate (month/day/year), settlementDate, logical flags payFixed & european (european=FALSE generates Bermudan vlaue), strike, pricing method, and curve construction options (see *Examples* section below). Curve construction options are interpWhat (possible values are discount, forward, and zero) and interpHow (possible values are linear, loglinear , and spline). Both interpWhat and interpHow are ignored when a flat yield curve is requested, but they must be present nevertheless. |
| ts | A term structure built with DiscountCurve is required. See the help page for DiscountCurve and example below for details. |
| volCubeDF | The swaption volatility cube in dataframe format with columns Expiry, Tenor, Spread, and LogNormalVol stored by rows. See the example below. |

| | |
|---|---|
| legparams | A list specifying the dayCounter the day count convention for the fixed leg (default is Thirty360), and fixFreq, fixed coupon frequecny (defualt is Annual), floatFreq, floating leg reset frequency (default is Semiannual). |
| tsUp01 | Discount for a user specied up move in rates. |
| tsDn01 | Discount for a user specied down move in rates. |
| vega | Discount for a user specied up move. |

## Details

This function is based on QuantLib Version 1.64. It introduces support for fixed-income instruments in RQuantLib.

## Value

SabrSwaption returns a list containing the value of the payer and receiver swaptions at the strike specified in params.

| | |
|---|---|
| NPV | NPV of swaption in basis points (actual price equals price times notional divided by 10,000) |
| strike | swaption strike |
| params | Input parameter list |
| atmRate | fair rate for swap at swap start date for european or fair swap rate for swap at expiration for bermudan |
| vol | vol for swaption at swap start date and rate strike for european or vol for swaption for given expiration and strike for bermudan |
| rcvDv01 | reveiver value for a change in rates defined by dv01Up |
| payDv01 | payer value for a change in rates defined by dv01Up |
| rcvCnvx | reveiver second order value change for a change in rates defined by dv01Up & dv01Dn |
| payCnvx | payer second order value for a change in rates defined by dv01Up & dv01Dn |
| strike | swaption strike |

## Author(s)

Terry Leitch

## References

Brigo, D. and Mercurio, F. (2006) *Interest Rate Models: Theory and Practice, 2nd Edition*, Springer-Verlag, New York.

For information about QuantLib see https://www.quantlib.org/.

For information about RQuantLib see http://dirk.eddelbuettel.com/code/rquantlib.html.

## See Also

AffineSwaption

## Examples

```
params <- list(tradeDate=as.Date('2016-2-15'),
               settleDate=as.Date('2016-2-17'),
               startDate=as.Date('2017-2-17'),
               maturity=as.Date('2022-2-17'),
               european=TRUE,
               dt=.25,
               expiryDate=as.Date('2017-2-17'),
               strike=.02,
               interpWhat="discount",
               interpHow="loglinear")

# Set leg paramters for generating discount curve
dclegparams=list(dayCounter="Thirty360",
                 fixFreq="Annual",
                 floatFreq="Semiannual")

setEvaluationDate(as.Date("2016-2-15"))
times<-times <- seq(0,14.75,.25)

data(tsQuotes)
dcurve <- DiscountCurve(params, tsQuotes, times=times,dclegparams)

# Price the Bermudan swaption
swaplegparams=list(fixFreq="Semiannual",floatFreq="Quarterly")

data(vcube)
pricing <- SabrSwaption(params, dcurve,vcube,swaplegparams)
pricing
```

---

Schedule *Schedule generation*

---

## Description

The Schedule function generates a schedule of dates conformant to a given convention in a given calendar.

## Usage

```
## Default S3 method:
Schedule(params)
```

## Arguments

| | |
|---|---|
| params | a named list, QuantLib's parameters of the schedule. |

| | |
|---|---|
| `effectiveDate` | a Date, when the schedule becomes effective. |
| `maturityDate` | a Date, when the schedule matures. |
| `period` | (Optional) a number or string, the frequency of the schedule. Default value is 'Semiannual'. |
| `calendar` | (Optional) a string, the calendar name. Defaults to 'TARGET' |
| `businessDayConvention` | (Optional) a number or string, the day convention to use. Defaults to 'Following'. |
| `terminationDateConvention` | (Optional) a number or string, the day convention to use for the terminal date. Defaults to 'Following'. |
| `dateGeneration` | (Optional) a number or string, the date generation rule. Defaults to 'Backward'. |
| `endOfMonth` | (Optional) 1 or 0, use End of Month rule for schedule dates. Defaults to 0 (false). |

See example below.

## Details

Please see any decent Finance textbook for background reading, and the `QuantLib` documentation for details on the `QuantLib` implementation.

## Value

The `Schedule` function returns an object of class `Schedule`. It contains the list of dates in the schedule.

## Author(s)

Michele Salvadore <michele.salvadore@gmail.com> for the inplementation; Dirk Eddelbuettel <edd@debian.org> for the R interface; the QuantLib Group for `QuantLib`

## References

https://www.quantlib.org/ for details on `QuantLib`.

## See Also

`FixedRateBond`

## Examples

```
params <- list(effectiveDate=as.Date("2004-11-30"),
               maturityDate=as.Date("2008-11-30"),
               period='Semiannual',
               calendar='UnitedStates/GovernmentBond',
               businessDayConvention='Unadjusted',
```

```
                 terminationDateConvention='Unadjusted',
                 dateGeneration='Forward',
                 endOfMonth=1)
Schedule(params)
```

---

tsQuotes *Vol Cube Example Data Short time series examples*

---

## Description

Vol Cube Example Data

Short time series examples

## Format

A series of tenors and rates approppriate for calling DiscountCurve

## Source

TBA

---

vcube *Vol Cube Example Data*

---

## Description

Data for valuing swaption examples including rates and a lognormal vol cube

## Usage

```
data(vcube)
```

## Format

two data frames: `vcube`, a data frame with four columns: `Expiry`, `Tenor`, `LogNormalVol`, and `Spread`

## Source

TBA

ZeroCouponBond *Zero-Coupon bond pricing*

### Description

The ZeroCouponBond function evaluates a zero-coupon plainly using discount curve. More specificly, the calculation is done by DiscountingBondEngine from QuantLib. The NPV, clean price, dirty price, accrued interest, yield and cash flows of the bond is returned. For more detail, see the source code in the QuantLib file test-suite/bond.cpp.

The ZeroPriceYield function evaluates a zero-coupon clean price based on its yield.

The ZeroYield function evaluations a zero-coupon yield based. See also http://www.mathworks.com/access/helpdesk/help/to

### Usage

```
## Default S3 method:
ZeroCouponBond(bond, discountCurve, dateparams)

## Default S3 method:
ZeroPriceByYield(yield, faceAmount,
                             issueDate, maturityDate,
                             dayCounter=2, frequency=2,
                             compound=0, businessDayConvention=4)

## Default S3 method:
ZeroYield(price, faceAmount,
                             issueDate, maturityDate,
                             dayCounter=2, frequency=2,
                             compound=0, businessDayConvention=4)
```

### Arguments

bond bond parameters, a named list whose elements are:

| | |
|---|---|
| issueDate | a Date, the bond's issue date |
| maturityDate | a Date, the bond's maturity date |
| faceAmount | (Optional) a double, face amount of the bond. Default value is 100. |
| redemption | (Optional) a double, percentage of the initial face amount that will be returned at maturity date. Default value is 100. |

discountCurve Can be one of the following:

| | |
|---|---|
| a DiscountCurve | a object of DiscountCurve class For more detail, see example or |

| | |
|---|---|
| | the discountCurve function |
| `A 2 items list` | specifies a flat curve in two values "todayDate" and "rate" |
| `A 3 items list` | specifies three values to construct a DiscountCurve object, "params" , "tsQuotes", "times". For more detail, see example or the discountCurve function |

`dateparams` (Optional) a named list, QuantLib's date parameters of the bond.

| | |
|---|---|
| `settlementDays` | (Optional) a double, settlement days. Default value is 1. |
| `calendar` | (Optional) a string, either 'us' or 'uk' corresponding to US Goverment Bond calendar and UK Exchange calendar. Default value is 'us'. |
| `businessDayConvention` | (Optional) a number or string, business day convention. See Enum. Default value is 'Following'. |

See example below.

`yield` yield of the bond

`price` price of the bond

`faceAmount` face amount of the bond

`issueDate` date the bond is issued

`maturityDate` maturity date, an R's date type

`dayCounter` day count convention. 0 = Actual360(), 1 = Actual365Fixed(), 2 = ActualActual(), 3 = Business252(), 4 = OneDayCounter(), 5 = SimpleDayCounter(), all other = Thirty360(). For more information, see QuantLib's DayCounter class

`frequency` frequency of events,0=NoFrequency, 1=Once, 2=Annual, 3=Semiannual, 4=EveryFourthMonth, 5=Quarterly, 6=Bimonthly ,7=Monthly ,8=EveryFourthWeely,9=Biweekly, 10=Weekly, 11=Daily. For more information, see QuantLib's Frequency class

`compound` compounding type. 0=Simple, 1=Compounded, 2=Continuous, all other=SimpleThenCompounded. See QuantLib's Compound class

`businessDayConvention`
convention used to adjust a date in case it is not a valid business day. See quantlib for more detail. 0 = Following, 1 = ModifiedFollowing, 2 = Preceding, 3 = ModifiedPreceding, other = Unadjusted

## Details

A discount curve is built to calculate the bond value.

Please see any decent Finance textbook for background reading, and the `QuantLib` documentation for details on the `QuantLib` implementation.

## Value

The ZeroCouponBond function returns an object of class ZeroCouponBond (which inherits from class Bond). It contains a list with the following components:

| | |
|---|---|
| NPV | net present value of the bond |
| cleanPrice | clean price of the bond |
| dirtyPrice | dirty price of the bond |
| accruedAmount | accrued amount of the bond |
| yield | yield of the bond |
| cashFlows | cash flows of the bond |

The ZeroPriceByYield function returns an object of class ZeroPriceByYield (which inherits from class Bond). It contains a list with the following components:

| | |
|---|---|
| price | price of the bond |

The ZeroYield function returns an object of class ZeroYield (which inherits from class Bond). It contains a list with the following components:

| | |
|---|---|
| yield | yield of the bond |

## Note

The interface might change in future release as QuantLib stabilises its own API.

## Author(s)

Khanh Nguyen <knguyen@cs.umb.edu> for the inplementation; Dirk Eddelbuettel <edd@debian.org> for the R interface; the QuantLib Group for QuantLib

## References

https://www.quantlib.org/ for details on QuantLib.

## Examples

```
# Simple call with all parameter and a flat curve
bond <- list(faceAmount=100,issueDate=as.Date("2004-11-30"),
             maturityDate=as.Date("2008-11-30"), redemption=100 )

dateparams <-list(settlementDays=1, calendar="UnitedStates/GovernmentBond",
                  businessDayConvention='Unadjusted')

discountCurve.param <- list(tradeDate=as.Date('2002-2-15'),
                           settleDate=as.Date('2002-2-15'),
                           dt=0.25,
                           interpWhat='discount', interpHow='loglinear')
discountCurve.flat <- DiscountCurve(discountCurve.param, list(flat=0.05))

ZeroCouponBond(bond, discountCurve.flat, dateparams)
```

```
# The same bond with a discount curve constructed from market quotes
tsQuotes <- list(d1w  =0.0382,
                 d1m  =0.0372,
                 fut1=96.2875,
                 fut2=96.7875,
                 fut3=96.9875,
                 fut4=96.6875,
                 fut5=96.4875,
                 fut6=96.3875,
                 fut7=96.2875,
                 fut8=96.0875,
                 s3y  =0.0398,
                 s5y  =0.0443,
                 s10y =0.05165,
                 s15y =0.055175)
tsQuotes <- list("flat" = 0.02) ## While discount curve code is buggy

discountCurve <- DiscountCurve(discountCurve.param, tsQuotes)
ZeroCouponBond(bond, discountCurve, dateparams)


#examples with default arguments
ZeroCouponBond(bond, discountCurve)

bond <- list(issueDate=as.Date("2004-11-30"),
             maturityDate=as.Date("2008-11-30"))
dateparams <-list(settlementDays=1)
ZeroCouponBond(bond, discountCurve, dateparams)


ZeroPriceByYield(0.1478, 100, as.Date("1993-6-24"), as.Date("1993-11-1"))

ZeroYield(90, 100, as.Date("1993-6-24"), as.Date("1993-11-1"))
```

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