Package ‘fCertificates’

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R topics documented:

AirbagCertificate ......................................................... 2
BonusCertificate ......................................................... 3
BonusProCertificate .................................................... 5
CappedBonusCertificate .............................................. 7
CappedReverseBonusCertificate ................................. 9
CappedWarrant ......................................................... 10
DiscountCertificate ..................................................... 12
DiscountPlusCertificate ............................................. 13
DoubleBarrierBinaryCall ........................................... 15
EasyExpressCertificate ............................................. 17
GarantieCertificate .................................................... 18
implyVolatility ......................................................... 20
LeveragedBonusCertificate ....................................... 21
OutperformanceCertificate .......................................... 22
Description

This function values a Airbag Certificate using pricing by duplication and the Generalized Black/Scholes formula.

Usage

AirbagCertificate(S, X, B, Time, r, r_d, sigma, participation, ratio = 1)

Arguments

S the asset price, a numeric value.
X the exercise price ("Partizipationslevel"), a numeric value.
B the barrier ("Sicherheitslevel"), a numeric value.
Time time to maturity measured in years
r the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
r_d the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
sigma the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
participation participation rate/factor above strike level. Defaults to 1.
ratio ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset
Details

An Airbag Certificate is a combination of

1. a fixed component X
2. a long call with strike price X
3. X/B short puts with strike price equal to B.

Classification according to the SVSP Swiss Derivative Map 2008: Airbag Certificates (240)

Value

the price (scalar or vector) of the AirbagCertificate

Author(s)

Stefan Wilhelm <wilhelm@financial.com>

References

SVSP Swiss Derivative Map [http://www.svsp-verband.ch/map/](http://www.svsp-verband.ch/map/)

Examples

```r
##
AirbagCertificate(S=100, X=100, B=75, Time=0, r=0.045, r_d=0, sigma=0.2,
    participation=1, ratio=1)

## payoff diagram
S <- seq(0,120)
p <- AirbagCertificate(S, X=100, B=75, Time=1, r=0.045, r_d=0, sigma=0.2,
    participation=1, ratio=1)
p2 <- AirbagCertificate(S, X=100, B=75, Time=0, r=0.045, r_d=0, sigma=0.2,
    participation=1, ratio=1)
plot(S, p, type="l", col="red", xlab="underlying price",
     ylab="payoff", main="Airbag")
lines(S, p2, col="blue")
abline(v=c(75, 100), lty=2, col="gray80")
```

---

**Description**

This function values a Bonus Certificate using pricing by duplication and the Generalized Black/Scholes formula.

**Usage**

```
BonusCertificate(S, X, B, Time, r, r_d, sigma, ratio = 1, barrierHit=FALSE)
```
Arguments

- **S** the asset price, a numeric value.
- **X** the exercise price ("Bonuslevel"), a numeric value.
- **B** the barrier ("Sicherheitslevel"), a numeric value.
- **Time** time to maturity measured in years
- **r** the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
- **r_d** the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
- **sigma** the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
- **ratio** ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset
- **barrierHit** flag whether the barrier has already been reached/hit during the lifetime

Details

A Bonus Certificate is a combination of

1. a long position in the stock (aka Zero-Strike Call)
2. a long down-and-out-put with strike price X and barrier B **(StandardBarrierOption)**

Classification according to the SVSP Swiss Derivative Map 2008: Bonus Certificates (220)
Classification according to the SVSP Swiss Derivative Map 2010: Bonus Certificates (1320)

Value

the price of the BonusCertificate

Author(s)

Stefan Wilhelm <wilhelm@financial.com>

References

SVSP Swiss Derivative Map [http://www.svsp-verband.ch/map/](http://www.svsp-verband.ch/map/)

See Also

*ReverseBonusCertificate, CappedBonusCertificate* for similar structures and *StandardBarrierOption* in the fExoticOptions package for the down-and-out-put

Examples

```r
##
BonusCertificate(S=50, X=60, B=35, Time=2, sigma=0.14, r=0.02, r_d=0, ratio=1)

## payoff diagram
S <- seq(0,120)
p <- BonusCertificate(S, X=60, B=35, Time=2, sigma=0.14, r=0.02, r_d=0, ratio=1)
```
**BonusProCertificate**  

Bonus Pro Certificate valuation using pricing by duplication

### Description

values a Bonus Pro Certificate using pricing by duplication

### Usage

```r
BonusProCertificate(TypeFlag=c("poB1","pdoB2"), S, X, B, Time, time1 = 0, 
                    r, r_d, sigma, ratio = 1, barrierHit = FALSE)
```

### Arguments

- **TypeFlag** see details below
- **S** the asset price, a numeric value.
- **X** the exercise price ("Bonuslevel"), a numeric value.
- **B** the barrier ("Sicherheitslevel"), a numeric value.
- **Time** time to maturity measured in years
- **time1** The start time of barrier monitoring, measured in years. Default value = 0
- **r** the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
- **r_d** the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
- **sigma** the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
- **ratio** ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset
- **barrierHit** flag whether the barrier has already been reached/hit during the lifetime

### Details

A Bonus Pro Certificate is a combination of

1. a long position in the stock (aka Zero-Strike Call)
2. a long partial time down-and-out-put with strike price X and barrier B (**PTSsingleAssetBarrierOption**)
It just differs from Bonus Certificates in that it has a partial-time-end barrier. Partial-time-end barrier options have the monitoring period start at an arbitrary date before expiration and end at expiration. For example the barrier is just monitored during the last 3 months prior to maturity. Ceteris paribus, this means a reduced risk of knock-out.

There are two types of "B" options: "B1" is defined such that only a barrier hit or crossed causes the option to be knocked out, and a "B2" is defined such that a down-and-out-put is knocked out as soon as the underlying price is below the barrier.

TypeFlag = "poB1":
The barrier of the down-and-out-put is only monitored in [time1, Time] with 0 <= time1 <= Time (partial-time monitoring) instead of [0, Time]. Ceteris paribus, this means a reduced risk of knock-out. For time1 = 0 (full-time monitoring), the value of a type "poB1" Bonus Pro equals the value of a standard Bonus certificate. For time1 = Time (no barrier to be monitored), the value of the type "poB1" Bonus Pro duplicates a Protective Put strategy (except for the dividend payments).

TypeFlag = "pdoB2":
The down-and-out-put is knocked out as soon as the underlying price is below the barrier.

Classification according to the SVSP Swiss Derivative Map 2008: Bonus Certificates (220)
Classification according to the SVSP Swiss Derivative Map 2010: Bonus Certificates (1320)

Value
the price (scalar or vector) of the BonusPro Certificate

Author(s)
Stefan Wilhelm <wilhelm@financial.com>

References
SVSP Swiss Derivative Map 2008 http://www.svsp-verband.ch/

See Also
BonusCertificate, PTSingleAssetBarrierOption

Examples
```r
## payoff diagram
S <- seq(50, 130, by=2)
p1 <- numeric(length(S))
p2 <- numeric(length(S))
for (i in seq(along=S)) {
  p1[i] <- bonusprocertificate(TypeFlag="pdoB2", S=S[i], X=100, B=70,
                              Time=0.5, time1 = 0.25,
                              r=0.01, r_d=0, sigma=0.3, ratio = 1)
  p2[i] <- bonusprocertificate(TypeFlag="pdoB2", S=S[i], X=100, B=70,
                              Time=0, time1 = 0,
```

CappedBonusCertificate

Capped Bonus Certificate valuation using pricing by duplication

Description

This function values a Capped Bonus Certificate using pricing by duplication and the Generalized Black/Scholes formula.

Usage

CappedBonusCertificate(S, X, B, Cap, Time, r, r_d, sigma, ratio = 1, barrierHit=FALSE)

Arguments

S     the asset price, a numeric value
X     the exercise price ("Bonuslevel"), a numeric value.
B     the barrier ("Sicherheitslevel"), a numeric value.
A Capped Bonus Certificate is a combination of

1. a long position in the stock (aka Zero-Strike Call)
2. a long down-and-out-put with strike price X and barrier B (StandardBarrierOption)
3. a short call with strike price equal to cap

The payoff is similar to the one of BonusCertificate, albeit capped.

Classification according to the SVSP Swiss Derivative Map 2008: Capped Bonus Certificates (380)
Classification according to the SVSP Swiss Derivative Map 2010: Capped Bonus Certificates (1250)

Value

the price (scalar or vector) of the CappedBonusCertificate

Author(s)

Stefan Wilhelm <wilhelm@financial.com>

References

SVSP Swiss Derivative Map [http://www.svsp-verband.ch/map/](http://www.svsp-verband.ch/map/)

See Also

BonusCertificate, CappedReverseBonusCertificate for similar structures

Examples

```r
##
CappedBonusCertificate(S=50, X=60, B=35, Cap=75, Time=2, sigma=0.14,
  r=0.02, r_d=0, ratio=1)

## payoff diagram
S <- seq(0,120)
p <- CappedBonusCertificate(S, X=60, B=35, Cap=75, Time=2, sigma=0.14,
```
CappedReverseBonusCertificate

Capped Reverse Bonus Certificate valuation using pricing by duplication

Description
values a Capped Reverse Bonus certificate using pricing by duplication

Usage
CappedReverseBonusCertificate(S, S0, X, B, Cap, Time, r, r_d, sigma, ratio = 1, barrierHit=FALSE)

Arguments
S         the asset price, a numeric value.
S0        the underlying start price at issue date
X         the exercise price ("Bonuslevel"), a numeric value.
B         the barrier ("Sicherheitslevel"'), a numeric value.
Cap       the cap, a numeric value.
Time      time to maturity measured in years
r         the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
r_d       the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
sigma     the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
ratio     ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset
barrierHit flag whether the barrier has already been reached/hit during the lifetime

Details
A Reverse Capped Bonus Certificate is a combination of
1. a short position in stock with reference price S0 (i.e. a Put with strike S0)
2. an up-and-out-call with strike X and barrier B
3. a short put with strike price equal to Cap
CappedWarrant

Capped Warrant (Discount Call/Discount Put) valuation using pricing by duplication

Description

This function values a Capped Warrant (Discount Call/Discount Put) Certificate using pricing by duplication and the Generalized Black/Scholes formula.

Usage

DiscountCall(S, X, Cap, Time, r, r_d, sigma, ratio = 1)
DiscountPut(S, X, Cap, Time, r, r_d, sigma, ratio = 1)

Arguments

S the asset price, a numeric value.
X the exercise price, a numeric value.
Cap the cap, a numeric value.
CappedWarrant

Time time to maturity measured in years
r the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
r_d the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
sigma the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
ratio ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset

Details

A discount call is a combination of

1. a long call with strike X
2. a short call with strike Cap

Because of the short call component, the discount call is cheaper than a normal call which allows higher returns. On the other hand, the payoff is capped.

A discount put is a combination of

1. a long put with strike Cap
2. a short put with strike X

Because of the short put, the discount put is cheaper than a normal put which allows higher returns. On the other hand, the payoff is capped.

Also known as:

• Capped Warrant
• Spread Warrant

Classification according to the SVSP Swiss Derivative Map 2008: Spread Warrants (115)

Value

the price (scalar or vector) of the Discount Call(Discount Put)

Author(s)

Stefan Wilhelm <wilhelm@financial.com>

References

SVSP Swiss Derivative Map http://www.svsp-verband.ch/map/

See Also

GBSOption, DiscountPut
Examples

```r
##
DiscountCall(S=10, X=10, Cap=12, Time=1, r=0.045, r_d=0, sigma=0.2, ratio = 1)
## payoff diagram
S <- seq(0,20, by=0.1)
p <- DiscountCall(S, X=10, Cap=12, Time=1, r=0.045, r_d=0, sigma=0.2, ratio = 1)
p2 <- DiscountCall(S, X=10, Cap=12, Time=0, r=0.045, r_d=0, sigma=0.2, ratio = 1)
plot(S, p, type="l", col="red", ylim=range(p, p2, na.rm=TRUE),
xlab="underlying price", ylab="payoff", main="Discount Call")
lines(S, p2, col="blue")
abline(v=c(10, 12), lty=2, col="gray80")
```

**DiscountCertificate**

*Discount Certificate valuation using pricing by duplication using pricing by duplication*

**Description**

This function values a Discount Certificate using pricing by duplication and the Generalized Black/Scholes formula.

**Usage**

`DiscountCertificate(S, X, Time, r, r_d, sigma, ratio = 1)`

**Arguments**

- `S` the asset price, a numeric value.
- `X` the exercise price (cap), a numeric value.
- `Time` time to maturity measured in years
- `r` the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
- `r_d` the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
- `sigma` the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
- `ratio` ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset

**Details**

A Discount Certificate is a combination of

1. a long position in the stock (aka Zero-Strike Call)
2. a short call with strike price `X` (= cap)

Also known as:
• Covered Call
• Discountzertifikat Classic

Classification according to the SVSP Swiss Derivative Map 2008: Discount Certificates (310)
Classification according to the SVSP Swiss Derivative Map 2010: Discount Certificates (1200)

**Value**

the price (scalar or vector) of the DiscountCertificate

**Author(s)**

Stefan Wilhelm <wilhelm@financial.com>

**References**

SVSP Swiss Derivative Map [http://www.svsp-verband.ch/map/](http://www.svsp-verband.ch/map/)

**See Also**

*DiscountPlusCertificate* for a similar structure and *GBSOption*

**Examples**

```r
##
DiscountCertificate(S=40, X=42, Time=1, r=0.035, r_d=0, sigma=0.3, ratio=1)

## payoff diagram
S <- seq(0, 100)
p <- DiscountCertificate(S, X=42, Time=1, r=0.035, r_d=0, sigma=0.3, ratio=1)
p2 <- DiscountCertificate(S, X=42, Time=0, r=0.035, r_d=0, sigma=0.3, ratio=1)
plot(S, p, type="l", col="red", , ylim=range(p, p2, na.rm=TRUE),
     xlab="underlying price", ylab="payoff", main="Discount")
lines(S, p2, col="blue")
abline(v=42, lty=2, col="gray80")
```

**Description**

*DiscountPlus Certificate valuation using pricing by duplication*

This function values a DiscountPlus certificate using pricing by duplication and the Generalized Black/Scholes formula.

**Usage**

```r
DiscountPlusCertificate(S, X, B, Time, r, r_d, sigma, ratio = 1,
barrierActive = TRUE,
barrierHit = FALSE)
```
DiscountPlusCertificate

Arguments

- **S**: the asset price, a numeric value.
- **X**: the exercise price (cap), a numeric value.
- **B**: the barrier level, a numeric value.
- **Time**: time to maturity measured in years
- **r**: the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
- **r_d**: the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
- **sigma**: the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
- **ratio**: ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset
- **barrierActive**: flag telling whether barrier is currently active (TRUE) or inactive (FALSE). Default value is TRUE.
- **barrierHit**: flag whether the barrier has already been reached/hit during the lifetime

Details

A Discount Plus Certificate is a combination of

1. a long position in the stock (aka Zero-Strike Call)
2. a short call with strike price X (= cap)
3. a long (partial-time) down-and-out-put

also known as:

- Barrier Discount Certificates

Classification according to the SVSP Swiss Derivative Map 2008: Barrier Discount Certificates (320)
Classification according to the SVSP Swiss Derivative Map 2010: Barrier Discount Certificates (1210)

Value

the price (scalar or vector) of the DiscountPlusCertificate

Author(s)

Stefan Wilhelm <wilhelm@financial.com>

References

SVSP Swiss Derivative Map [http://www.svsp-verband.ch/map/](http://www.svsp-verband.ch/map/)

See Also

DiscountCertificate for a similar structure and GBSOption
Examples

```
##
DiscountPlusCertificate(S=42, X=42, B=30, Time=1, r=0.035, r_d=0, sigma=0.3, ratio=1)

## payoff diagram
S <- seq(0, 100)
p <- DiscountPlusCertificate(S, X=42, B=30, Time=1, r=0.035, r_d=0, sigma=0.3, ratio=1)
p2 <- DiscountPlusCertificate(S, X=42, B=30, Time=0, r=0.035, r_d=0, sigma=0.3, ratio=1)
plot(S, p, type="l", col="red", ...)
lines(S, p2, col="blue")
abline(v=c(30, 42), lty=2, col="gray80")
```

---

**DoubleBarrierBinaryCall**

*Double Barrier Binary Call valuation using pricing by duplication*

**Description**

Valuation of a Double Barrier Binary Call, aka "Inline Warrant"

**Usage**

```
DoubleBarrierBinaryCall(S, K, L, U, T, r, r_d, sigma, ratio=1, nmax = 20)
```

**Arguments**

- `S` the asset price, a numeric value.
- `K` the fixed cash rebate
- `L` the lower barrier, a numeric value.
- `U` the upper barrier, a numeric value.
- `T` time to maturity measured in years
- `r` the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
- `r_d` the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
- `sigma` the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
- `ratio` ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset
- `nmax` maximum number of iterations. Defaults to 20.
Details

Double Barrier Binary Calls offer a fixed payoff if the underlying stays in the predetermined range [L, U] during the lifetime. If one of the barriers have been hit the certificate is knocked out and will be worthless.

This method implements the Hui (1996) approach, which is a iteration up to a maximum number nmax.

Also known as:

• Inline Warrant
• Range Warrant

Value

the price (scalar or vector) of the Double Barrier Binary Call

Author(s)

Stefan Wilhelm <wilhelm@financial.com>

References


See Also

DoubleBarrierOption

Examples

```r
p <- DoubleBarrierBinaryCall(S=100, K=10, L=80, U=120, T=1, 
r=0.02, r_d=0, sigma=0.2)

# Reproduce Table 4-23 in Haug (2007)
S <- 100
T <- 0.25
L <- c(80, 85, 90, 95)
U <- c(120, 115, 110, 105)
r <- 0.05
b <- 0.03
r_d <- 0.02
K <- 10
sigma <- c(0.1, 0.2, 0.3, 0.5)
p <- matrix(NA, 4, 4)
for (i in 1:4)
{
  for (j in 1:4)
```
EasyExpressCertificate

```r
{ p[i,j] <- DoubleBarrierBinaryCall(S=S, K=K, L=L[i], U=U[i], T=T, r=r, r_d=r_d, sigma=sigma[j]) }
}

X=cbind(L, U, p)
colnames(X)=c("L", "U", "sigma=0.1", "sigma=0.2", "sigma=0.3", "sigma=0.5")
X
```

### Description

values an Easy Express Certificate using pricing by duplication

### Usage

```r
EasyExpressCertificate(S, S0, B, Time, r, r_d, sigma, ratio = 1)
```

### Arguments

- **S**: the asset price, a numeric value.
- **S0**: the fix amount paid at maturity if underlying is above B
- **B**: the barrier ("Sicherheitslevel"), a numeric value.
- **Time**: time to maturity measured in years
- **r**: the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
- **r_d**: the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
- **sigma**: the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
- **ratio**: ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset

### Details

There are more than one duplication of an Easy Express Certificate. One is a combination of

1. A zero bond/cash component that pays $S_0$ at maturity
2. A short cash-or-nothing put (**CashOrNothingOption**) with strike $B$ and cash rebate $S_0-B$
3. A short plain vanilla put with strike price $B$

Also known as:

- Zanonia-Easy-Zertifikat

Classification according to the SVSP Swiss Derivative Map 2008: Express Certificates (360)
Classification according to the SVSP Swiss Derivative Map 2010: Express Certificates (1260)
GarantieCertificate

Value

the price (scalar or vector) of the EasyExpressCertificate

Author(s)

Stefan Wilhelm <wilhelm@financial.com>

References

SVSP Swiss Derivative Map http://www.svsp-verband.ch/map/

See Also

CashOrNothingOption in fExoticOptions package

Examples

```r
##
## EasyExpressCertificate(S=80, S0=100, B=70, Time=1,
##  r=0.045, r_d=0, sigma=0.4, ratio = 1)
##
## payoff diagramm
S <- seq(0, 140)
p <- EasyExpressCertificate(S, S0=100, B=70, Time=1,
  r=0.045, r_d=0, sigma=0.4, ratio = 1)
p2 <- EasyExpressCertificate(S, S0=100, B=70, Time=0,
  r=0.045, r_d=0, sigma=0.4, ratio = 1)
plot(S, p, type="l", col="red", ylim=range(p, p2, na.rm=TRUE),
  xlab="underlying price", ylab="payoff", main="Easy Express")
lines(S, p2, col="blue")
abline(v=70, lty=2, col="gray80")
```

Description

values a Guarantee Certificate using pricing by duplication

Usage

```
GarantieCertificate(S, X, Time, r, r_d, sigma,
  participation, ratio = 1, nominal)
```
Arguments

- **S**: the asset price, a numeric value.
- **X**: the exercise price ("Bonuslevel"), a numeric value.
- **Time**: time to maturity measured in years
- **r**: the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
- **r_d**: the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
- **sigma**: the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
- **participation**: participation rate/factor above strike level. Defaults to 1.
- **ratio**: ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset
- **nominal**: nominal value, e.g. 1000 EUR that is guaranteed; can be the same as S the price of one share

Details

A Guarantee Certificate is a combination of

1. a zero bond with nominal value "nominal"
2. a number of long calls ("participation", default 1) with strike price X

The long calls allow for upside participation while the zero bond ensures the nominal value at maturity (hence a guarantee).

Also known as:

- Capital Protected Certificate
- Structured Note

Classification according to the SVSP Swiss Derivative Map 2008: Uncapped Capital Protection (410)
Classification according to the SVSP Swiss Derivative Map 2010: Uncapped Capital Protection (1100)

Value

the price (scalar or vector) of the GarantieCertificate

Author(s)

Stefan Wilhelm <wilhelm@financial.com>

References

SVSP Swiss Derivative Map [http://www.svsp-verband.ch/map/](http://www.svsp-verband.ch/map/)
Examples

```r
##
GarantieCertificate(S=110, X=90, Time=1, r=0.045, r_d=0,  
sigma=0.4, participation=0.8, ratio = 1, nominal=110)

## payoff diagram
S <- seq(0, 150)
p <- GarantieCertificate(S, X=90, Time=1, r=0.045, r_d=0,  
sigma=0.4, participation=0.8, ratio = 1, nominal=110)
p2 <- GarantieCertificate(S, X=90, Time=0, r=0.045, r_d=0,  
sigma=0.4, participation=0.8, ratio = 1, nominal=110)
plot(S, p, type="l", col="red", ylim=range(p, p2, na.rm=TRUE),  
xlab="underlying price", ylab="payoff",  
main="Uncapped Capital Protection")
lines(S, p2, col="blue")
abline(v=90, lty=2, col="gray80")
```

---

**implyVolatility**

**imply the volatility of the certificate with Newton/Raphson**

Description

The function implies the volatility of the certificate with one-dimensional Newton/Raphson method.

Usage

```r
implyVolatility(price, f, interval = c(0, 1), sigma = NULL, doPlot=FALSE, ...)
```

Arguments

- **price**: current price of the certificate
- **f**: The pricing function of the certificate, e.g. `BonusCertificate`
- **interval**: interval to search for implied volatility
- **sigma**: start value for the volatility
- **doPlot**: flag whether to plot price function for convergence diagnostics. Defaults to `FALSE`
- **...**: additional parameters passed to the pricing function, e.g. `S=100, X=100` etc.

Value

returns the implied volatility if it can be implied. Otherwise NA.

Author(s)

Stefan Wilhelm <wilhelm@financial.com>
**Examples**

```r
p <- DiscountCertificate(S=100, X=110, Time=1, r=0.01, r_d=0, sigma=0.5)
implyVolatility(price=p, DiscountCertificate, S=100, X=110, Time=1, r=0.01, r_d=0)
```

```r
p <- DiscountCertificate(S=100, X=110, Time=1, r=0.01, r_d=0, sigma=0.5)
implyVolatility(price=p, DiscountCertificate, doPlot=TRUE, S=100, X=110, Time=1, r=0.01, r_d=0)
```

---

**LeveragedBonusCertificate**

*Leveraged Bonus Certificate valuation using pricing by duplication*

**Description**

values a Leveraged Bonus Certificate using pricing by duplication

**Usage**

```r
LeveragedBonusCertificate(S, X, B, B2, Time, r, r_d,
sigma, ratio = 1, barrierHit = FALSE)
```

**Arguments**

- `S` the asset price, a numeric value.
- `X` the exercise price ("Bonuslevel"), a numeric value.
- `B` the barrier ("Sicherheitslevel"), a numeric value.
- `B2` knock-out level for the long position (B2 < B)
- `Time` time to maturity measured in years
- `r` the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
- `r_d` the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
- `sigma` the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
- `ratio` ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset
- `barrierHit` flag whether the barrier has already been reached/hit during the lifetime. Default is FALSE

**Details**

A Leveraged Bonus Certificate is a combination of

1. a long leveraged position in the stock (aka Turbo Call)
2. a long down-and-out-put with strike price X and barrier B (Standard Barrier Option)
In contrast to normal Bonus Certificates, a Leveraged Bonus Certificates have a second barrier $B_2$ which marks the knock-out level for the long position (turbo call). They are cheaper than conventional Bonus Certificates because of the inherent barrier risk, but allow for higher performances.

Classification according to the SVSP Swiss Derivative Map 2008: Outperformance Bonus Certificates (235)
Classification according to the SVSP Swiss Derivative Map 2010: Outperformance Bonus Certificates (1330)

Value

the price (scalar or vector) of the Leveraged Bonus Certificate

Author(s)

Stefan Wilhelm <wilhelm@financial.com>

References

SVSP Swiss Derivative Map 2008 http://www.svsp-verband.ch/

See Also

StandardBarrierOption in fExoticOptions package.

Examples

```r
## LeveragedBonusCertificate(S=100, X=120, B=80, B2=70, Time=1, r=0.01, r_d=0, sigma=0.3, ratio=1, barrierHit=FALSE)

## payoff diagram
S <- seq(0, 140)
p <- LeveragedBonusCertificate(S, X=120, B=80, B2=70, Time=1, r=0.01, r_d=0, sigma=0.3, ratio=1, barrierHit=FALSE)
p2 <- LeveragedBonusCertificate(S, X=120, B=80, B2=70, Time=0, r=0.01, r_d=0, sigma=0.3, ratio=1, barrierHit=FALSE)
plot(S, p, type="l", col="red", ylim=range(p, p2, na.rm=TRUE),
     xlab="underlying price", ylab="payoff", main="Leveraged Bonus")
lines(S, p2, col="blue")
abline(v=c(70, 80, 120), lty=2, col="gray80")
```

---

**OutperformanceCertificate**

*Outperformance Certificate valuation using pricing by duplication*

**Description**

values a Outperformance Certificate using pricing by duplication
**Usage**

OutperformanceCertificate(S, X, Time, r, r_d, sigma, participation, ratio = 1)

**Arguments**

- **S**
  - the asset price, a numeric value.

- **X**
  - the exercise price (cap), a numeric value.

- **Time**
  - time to maturity measured in years

- **r**
  - the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.

- **r_d**
  - the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.

- **sigma**
  - the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.

- **participation**
  - participation rate/factor above strike level. Defaults to 1.

- **ratio**
  - ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset

**Details**

A Outperformance Certificate is a combination of

1. a long position in the stock (aka Zero-Strike Call)
2. a long call with strike price X

The long call permits a outperformance above strike level X.

Classification according to the SVSP Swiss Derivative Map 2008: Outperformance Certificates (230)
Classification according to the SVSP Swiss Derivative Map 2010: Outperformance Certificates (1310)

**Value**

the price (scalar or vector) of the OutperformanceCertificate

**Author(s)**

Stefan Wilhelm <wilhelm@financial.com>

**References**

SVSP Swiss Derivative Map [http://www.svsp-verband.ch/map/](http://www.svsp-verband.ch/map/)
OutperformancePlusCertificate

Examples

##
```r
OutperformanceCertificate(S=50, X=60, Time=1,
  r=0.03, r_d=0, sigma=0.4, participation=1.2, ratio = 1)
```

## payoff diagram
```r
S <- seq(0,100)
p <- OutperformanceCertificate(S, X=60, Time=1,
  r=0.03, r_d=0, sigma=0.4, participation=1.2, ratio = 1)
p2 <- OutperformanceCertificate(S, X=60, Time=0,
  r=0.03, r_d=0, sigma=0.4, participation=1.2, ratio = 1)
plot(S, p, type="l", col="red", , ylim=range(p, p2, na.rm=TRUE),
xlab="underlying price", ylab="payoff", main="Outperformance")
lines(S, p2, col="blue")
abline(y=60, lty=2, col="gray80")
```

---

OutperformancePlusCertificate

*Outperformance Plus Certificate valuation using pricing by duplication*

Description

values a Outperformance Plus Certificate using pricing by duplication

Usage

```r
OutperformancePlusCertificate(S, X, B, Time, r,
  r_d, sigma, participation, ratio = 1, barrierHit=FALSE)
```

Arguments

- **S** the asset price, a numeric value.
- **X** the exercise price, a numeric value.
- **B** the barrier ("Sicherheitslevel"), a numeric value.
- **Time** time to maturity measured in years
- **r** the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
- **r_d** the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
- **sigma** the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
- **participation** participation rate/factor above strike level. Defaults to 1.
- **ratio** ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset
- **barrierHit** flag whether the barrier has already been reached/hit during the lifetime. Defaults to FALSE.
Details

A Outperformance Plus Certificate is a combination of

1. a long position in the stock (aka Zero-Strike Call)
2. a number of long calls ("participation") with strike price X
3. a (partial time) down-and-out-put with strike price X and barrier level B

The long call permits a outperformance above strike level X. The down-and-out-put offers partial protection.

Also known as:

- Outperformance Bonus Certificate

Classification according to the SVSP Swiss Derivative Map 2008: Outperformance Bonus Certificates (235)
Classification according to the SVSP Swiss Derivative Map 2010: Outperformance Bonus Certificates (1330)

Value

the price (scalar or vector) of the OutperformancePlusCertificate

Author(s)

Stefan Wilhelm <wilhelm@financial.com>

References

SVSP Swiss Derivative Map [http://www.svsp-verband.ch/map/](http://www.svsp-verband.ch/map/)

See Also

similar structures: OutPerformanceCertificate

Examples

```r
##
OutperformancePlusCertificate(S=10, X=12, B=7, Time=1,
   r=0.045, r_d=0, sigma=0.4, participation=1.2, ratio = 1)

## payoff diagram
S <- seq(30, 100, by=0.1)
p <- OutperformancePlusCertificate(S, X=60, B=40, Time=1,
   r=0.045, r_d=0, sigma=0.4, participation=1.2, ratio = 1)
p2 <- OutperformancePlusCertificate(S, X=60, B=40, Time=0,
   r=0.045, r_d=0, sigma=0.4, participation=1.2, ratio = 1)
plot(S, p, type="l", col="red", ylim=range(p, p2, na.rm=TRUE),
   xlab="underlying price", ylab="payoff", main="Outperformance Bonus")
lines(S, p2, col="blue")
abline(v=c(40, 60), lty=2, col="gray")
```
ReturnCertificate

Return Certificate valuation using pricing by duplication

Description

This function values a Return certificate using pricing by duplication and the Generalized Black/Scholes formula.

Usage

ReturnCertificate(S, Bonus, S₀, B, Cap, Time, r, r_d, sigma, ratio = 1,
barrierHit=FALSE)

Arguments

S the asset price, a numeric value.
Bonus the bonus payment/cash rebate in EUR
S₀ underlying start price
B the barrier ("Sicherheitslevel"), a numeric value.
Cap the cap, a numeric value.
Time time to maturity measured in years
r the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
r_d the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
sigma the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
ratio ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset
barrierHit flag whether the barrier has already been reached/hit during the lifetime

Details

A Return Certificate is similar to a Bonus Certificate in the way it offers an extra payment ("bonus") under certain conditions. However, while with Bonus Certificates this bonus is a fixed amount is payed in the range B and X, Return certificates pays a bonus on top of the underlying price.

1. a long position in the stock (aka Zero-Strike Call)
2. a long binary down-and-out-cash-or-nothing-put with strike price X and barrier B and cash rebate Bonus (BinaryBarrierOption)
3. a short call with strike equal to Cap

Value

the price (scalar or vector) of the ReturnCertificate
ReverseBonusCertificate

Author(s)
Stefan Wilhelm <wilhelm@financial.com>

References
see packages fOptions and BinaryBarrierOption in package fExoticOptions

See Also
See also GBSTOption in package fOptions, BinaryBarrierOption in package fExoticOptions, BonusCertificate

Examples
```r
##
# ReturnCertificate (S=100, S0=91.7, Bonus=11, B=45, Cap=91.7, 
# Time=0, r=0.02, r_d = 0, sigma=0.3, ratio = 1)

## payoff diagram
S <- seq(30,120, by=1)
p <- ReturnCertificate (S, S0=91.7, Bonus=11, B=45, Cap=91.7, 
# Time=0.5, r=0.02, r_d = 0, sigma=0.3, ratio = 1)
p2 <- ReturnCertificate (S, S0=91.7, Bonus=11, B=45, Cap=91.7, 
# Time=0, r=0.02, r_d = 0, sigma=0.3, ratio = 1)
plot(S, p, type="l", col="red", , ylim=range(p, p2, na.rm=TRUE), 
# xlab="underlying price", ylab="payoff", main="Return Certificate")
lines(S, p2, col="blue")
abline(v=c(45,91.7), lty=2, col="gray80")
```

ReverseBonusCertificate

Reverse Bonus Certificate valuation using pricing by duplication

Description
values a Reverse Bonus Certificate using pricing by duplication

Usage
```
ReverseBonusCertificate(S, S0, X, B, Time, r, r_d, sigma, ratio=1, 
barrierHit=FALSE)
```

Arguments
```
S    the asset price, a numeric value.
S0   the underlying start price at issue date
X    the exercise price ("Bonuslevel"), a numeric value.
B    the barrier ("Sicherheitslevel"), a numeric value.
```
ReverseBonusCertificate

Time  

time to maturity measured in years

r  

the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.

r_d  

the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.

sigma  

the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.

ratio  

ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset

barrierHit  

flag whether the barrier has already been reached/hit during the lifetime

Details

A Reverse Bonus Certificate is a combination of

1. a short position in the stock with reference price 2*S0 (aka long put with Strike 2*S0)
2. a up-and-out-call with strike X and barrier B (Cash rebate K = 0 for standard barrier options)

Value

the price (scalar or vector) of the ReverseBonusCertificate

Author(s)

Stefan Wilhelm <wilhelm@financial.com>

Examples

```r
##
ReverseBonusCertificate(S=110, S0=120, X=140, B=140, Time=1, r=0.045,
   r_d=0, sigma=0.4, ratio=1)

## payoff diagram
S <- seq(0, 150)
p <- ReverseBonusCertificate(S, S0=120, X=100, B=140, Time=1, r=0.045,
   r_d=0, sigma=0.4, ratio=1)
p2 <- ReverseBonusCertificate(S, S0=120, X=100, B=140, Time=0, r=0.045,
   r_d=0, sigma=0.4, ratio=1)
plot(S, p, type="l", col="red", ylim=range(p, p2, na.rm=TRUE),
   xlab="underlying price", ylab="payoff", main="Reverse Bonus")
lines(S, p2, col="blue")
abline(v=c(100, 140), lty=2, col="gray80")
```
ReverseConvertible

Reverse Convertible Certificate valuation using pricing by duplication

Description

values a Reverse Convertible Certificate using pricing by duplication

Usage

ReverseConvertible(S, Cap, Time, r, r_d, sigma, nominal, coupon)

Arguments

S  the asset price, a numeric value.
Cap the cap, a numeric value.
Time time to maturity measured in years
r  the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
r_d the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
sigma the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
nominal nominal value, e.g. 1000 EUR
coupon annualized coupon rate, e.g. 0.14 means 14% coupon p.a.

Details

Duplication:

• coupon bond with nominal value nominal and coupon coupon
• nominal/Cap short puts with strike price equal to Cap

Also known as:

• Aktienanleihe

Classification according to the SVSP Swiss Derivative Map 2008: Reverse Convertibles (330)
Classification according to the SVSP Swiss Derivative Map 2010: Reverse Convertibles (1220)

Value

the price (scalar or vector) of the Reverse Convertible

Author(s)

Stefan Wilhelm <wilhelm@financial.com>
ReverseConvertiblePlusPro

*Reverse Convertible Plus Pro Certificate valuation using pricing by duplication*

Description

values a Reverse Convertible Plus Pro Certificate using pricing by duplication

Usage

ReverseConvertiblePlusPro(S, Cap, B, Time, r, r_d, sigma, nominal, coupon, barrierHit=FALSE)

Arguments

- **S**: the asset price, a numeric value.
- **Cap**: the cap, a numeric value.
- **B**: the barrier ("Sicherheitslevel"), a numeric value.
- **Time**: time to maturity measured in years
- **r**: the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
- **r_d**: the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.

Examples

```r
##
ReverseConvertible(S=40, Cap=50, Time=1, r=0.045, r_d=0, sigma=0.4,
nominal=1000, coupon=0.14)

## payoff diagram
S <- seq(0, 100)
p <- ReverseConvertible(S, Cap=50, Time=1, r=0.045, r_d=0, sigma=0.4,
nominal=1000, coupon=0.14)
p2 <- ReverseConvertible(S, Cap=50, Time=0, r=0.045, r_d=0, sigma=0.4,
nominal=1000, coupon=0.14)
plot(S, p, type="l", col="red", xlab="underlying price",
    ylab="payoff", main="Reverse Convertible")
lines(S, p2, col="blue")
abline(v=50, lty=2, col="gray80")
```

References

SVSP Swiss Derivative Map [http://www.svsp-verband.ch/map/](http://www.svsp-verband.ch/map/)

See Also

similar structures: ReverseConvertiblePlusPro, DiscountCertificate
ReverseConvertiblePlusPro

sigma the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
nominal nominal value, e.g. 1000 EUR
coupon annualized coupon rate, e.g. 0.14 means 14% coupon p.a.
barrierHit flag whether the barrier has already been reached/hit during the lifetime. Defaults to FALSE.

Details

Also known as:
- Barrier Reverse Convertibles

Classification according to the SVSP Swiss Derivative Map 2008: Barrier Reverse Convertibles (340)
Classification according to the SVSP Swiss Derivative Map 2010: Barrier Reverse Convertibles (1230)

Value

the price (scalar or vector) of the ReverseConvertible

Author(s)

Stefan Wilhelm <wilhelm@financial.com>

References

SVSP Swiss Derivative Map http://www.svsp-verband.ch/map/

See Also

similar structures: ReverseConvertible

Examples

```r
##
ReverseConvertiblePlusPro(S=40, Cap=50, B=35, Time=1, r=0.045, r_d=0,
sigma=0.4, nominal=1000, coupon=0.14)

## payoff diagram
S <- seq(0, 100)
p <- ReverseConvertiblePlusPro(S, Cap=50, B=35, Time=1, r=0.045, r_d=0,
sigma=0.4, nominal=1000, coupon=0.14)
p2 <- ReverseConvertiblePlusPro(S, Cap=50, B=35, Time=0, r=0.045, r_d=0,
sigma=0.4, nominal=1000, coupon=0.14)
plot(S, p, type="l", col="red", xlab="underlying price",
ylab="payoff", main="Barrier Reverse Convertible")
lines(S, p2, col="blue")
abline(v=c(35, 50), lty=2, col="gray80")
```
ReverseDiscountCertificate

Reverse Discount Certificate valuation using pricing by duplication

Description

values a Reverse Discount certificate using pricing by duplication

Usage

ReverseDiscountCertificate(S, S0, X, Time, r, r_d, sigma, ratio = 1)

Arguments

S the asset price, a numeric value.
S0 the underlying start price at issue date
X the exercise price, a numeric value.
Time time to maturity measured in years
r the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
r_d the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
sigma the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
ratio ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset

Details

A Reverse Discount certificate is composed of

1. a short position in stock with reference price S0 (i.e. a Put with strike S0)
2. a short put with strike price X

Value

the price (scalar or vector) of the Reverse Discount Certificate

Author(s)

Stefan Wilhelm <wilhelm@financial.com>

See Also

similar structures: DiscountCertificate, ReverseDiscountPlusCertificate
Examples

```r
##
ReverseDiscountCertificate(S=100, S0=100, X=90, Time=1,
        r=0.045, r_d=0, sigma=0.4, ratio=1)

## payoff diagram
S <- seq(0, 150)
p <- ReverseDiscountCertificate(S, S0=100, X=90, Time=1,
        r=0.045, r_d=0, sigma=0.4, ratio=1)
p2 <- ReverseDiscountCertificate(S, S0=100, X=90, Time=0,
        r=0.045, r_d=0, sigma=0.4, ratio=1)
plot(S, p, type="l", col="red", ylim=range(p, na.rm=TRUE),
    xlab="underlying price", ylab="payoff", main="Reverse Discount")
lines(S, p2, col="blue")
abline(v=90, lty=2, col="gray80")
```

ReverseDiscountPlusCertificate

*Reverse Discount Plus Certificate valuation using pricing by duplication*

Description

values a Reverse Discount Plus Certificate using pricing by duplication

Usage

```r
ReverseDiscountPlusCertificate(S, S0, X, B, Time, r, r_d, sigma,
        ratio = 1, barrierActive = TRUE)
```

Arguments

- **S**: the asset price, a numeric value.
- **S0**: the underlying start price at issue date.
- **X**: the exercise price, a numeric value.
- **B**: the barrier ("Sicherheitslevel"), a numeric value.
- **Time**: time to maturity measured in years.
- **r**: the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
- **r_d**: the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
- **sigma**: the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
- **ratio**: ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset.
- **barrierActive**: flag whether barrier is active or not.
ReverseOutperformanceCertificate

Details

A Reverse Discount Plus Certificate is composed of

1. a short position in stock with reference price S0 (i.e. a Put with strike S0)
2. a short put with strike price X
3. a up-and-out-call

Value

the price (scalar or vector) of the Reverse Discount Plus Certificate

Author(s)

Stefan Wilhelm <wilhelm@financial.com>

See Also

similar structures: ReverseDiscountCertificate

Examples

```r
##
ReverseDiscountPlusCertificate(S=100, S0=100, X=90, B=110, Time=1,
    r=0.045, r_d=0, sigma=0.4, ratio = 1, barrierActive = TRUE)

## payoff diagram
S <- seq(0, 150)
p <- ReverseDiscountPlusCertificate(S, S0=100, X=90, B=110, Time=1,
    r=0.045, r_d=0, sigma=0.4, ratio = 1, barrierActive = TRUE)
p2 <- ReverseDiscountPlusCertificate(S, S0=100, X=90, B=110, Time=0,
    r=0.045, r_d=0, sigma=0.4, ratio = 1, barrierActive = FALSE)
p3 <- ReverseDiscountPlusCertificate(S, S0=100, X=90, B=110, Time=0,
    r=0.045, r_d=0, sigma=0.4, ratio = 1, barrierActive = TRUE)
plot(S, p, type="l", col="red", ylim=range(p, p2, na.rm=TRUE),
    xlab="underlying price", ylab="payoff", main="Reverse Discount Plus Pro")
lines(S, p2, col="blue", lty=2)
lines(S, p3, col="blue")
abline(v=c(90, 110), lty=2, col="gray80")
```

ReverseOutperformanceCertificate

Reverse Outperformance Certificate evaluation using pricing by duplication

Description

values a Reverse Outperformance Certificate using pricing by duplication
ReverseOutperformanceCertificate

Usage

ReverseOutperformanceCertificate(S, S0, X, Time, r, r_d, sigma, participation, ratio = 1)

Arguments

S           the asset price, a numeric value.
S0          the underlying start price at issue date
X           the exercise price, a numeric value.
Time        time to maturity measured in years
r           the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
r_d         the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
sigma       the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
participation participation rate/factor below strike level. Defaults to 1.
ratio       ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset

Details

A Reverse Outperformance Certificate is composed of

1. a short position in stock with reference price $S_0$ (i.e. a Put with strike $S_0$)
2. a number of long puts ("participation") with strike price $X$

Value

the price (scalar or vector) of the Reverse Outperformance Certificate

Author(s)

Stefan Wilhelm <wilhelm@financial.com>

See Also

similar structures: OutperformanceCertificate

Examples

##
ReverseOutperformanceCertificate(S=105, S0=100, X=90, Time=1, 
r=0.045, r_d=0, sigma=0.4, participation=1.2, ratio=1)

## payoff diagram
S <- seq(0, 150)
p <- ReverseOutperformanceCertificate(S, S0=100, X=90, Time=1, 
r=0.045, r_d=0, sigma=0.4, participation=1.2, ratio=1)
p2 <- ReverseOutperformanceCertificate(S, S0=100, X=90, Time=0,
SprintCertificate valuation using pricing by duplication

Description

This function values a Sprint Certificate using pricing by duplication and the Generalized Black/Scholes formula.

Usage

SprintCertificate(S, X, Cap, Time, r, r_d, sigma, participation, ratio = 1)

Arguments

S
the asset price, a numeric value.
X
the exercise price, a numeric value.
Cap
the cap, a numeric value.
Time
time to maturity measured in years
r
the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
r_d
the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
sigma
the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
participation
participation rate/factor above strike level. Defaults to 1.
ratio
ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset

Details

A Sprint Certificate is a combination of

1. a long position in the stock (aka Zero-Strike Call)
2. 2 long calls with strike price X
3. a short call with strike price Cap

The long calls permit an outperformance (double participation) in the range between strike level X and Cap at maturity. It is somehow a capped outperformance certificate.

Alternative names of this structure are:

1. Kick-start-Certificates
2. Double-Chance-Certificate
3. Capped Outperformance Certificate

Classification according to the SVSP Swiss Derivative Map 2008: Capped Outperformance Certificates (350)
Classification according to the SVSP Swiss Derivative Map 2010: Capped Outperformance Certificates (1240)

Value
the price (scalar or vector) of the SprintCertificate

Author(s)
Stefan Wilhelm <wilhelm@financial.com>

References
SVSP Swiss Derivative Map http://www.svsp-verband.ch/map/

See Also
similar structures: OutperformanceCertificate

Examples

```r
## SprintCertificate(S=32, X=30, Cap=40, Time=1, r=0.045,
##   r_d=0, sigma=0.4, participation=2, ratio = 1)
## payoff diagramm
S <- seq(0, 100)
p <- SprintCertificate(S, X=30, Cap=40, Time=1, r=0.045,
   r_d=0, sigma=0.4, participation=2, ratio = 1)
p2 <- SprintCertificate(S, X=30, Cap=40, Time=0, r=0.045,
   r_d=0, sigma=0.4, participation=2, ratio = 1)
plot(S, p, type="l", col="red", ylim=range(p, p2, na.rm=TRUE),
   xlab="underlying price", ylab="payoff", main="Sprint")
lines(S, p2, col="blue")
abline(v=c(30, 40), lty=2, col="gray80")
```

---

**Straddle**

**Straddle valuation**

**Description**

valuation of a long Straddle strategy (one long call + one long put with same strike price) using pricing by duplication
Usage

Straddle(S, X, Time, r, r_d, sigma, ratio = 1)

Arguments

S           the asset price, a numeric value.
X           the exercise price, a numeric value.
Time        time to maturity measured in years
r           the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
r_d         the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
sigma       the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
ratio       ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset

Details

A strangle is a combination of
1. a long put
2. a long call

with the same strike price X. If the strike prices of the 2 options differ (i.e. X1 < X2), then the strategy is called a long strangle.

Value

the price of the Straddle, either scalar or vector

Author(s)

Stefan Wilhelm <wilhelm@financial.com>

See Also

GBSOption, Strangle

Examples

S <- seq(0, 100)
prices <- Straddle(S, X=50, Time=0, r=0.05, r_d=0, sigma=0.2, ratio = 1)
plot(S, prices, type="l", xlab="underlying price", ylab="payoff")

## Straddle payoff diagram
S <- seq(0, 100)
ps1 <- Straddle(S, X=45, Time=1, r=0.01, r_d=0, sigma=0.3, ratio=1)
ps2 <- Straddle(S, X=45, Time=0, r=0.01, r_d=0, sigma=0.3, ratio=1)
ps3 <- Straddle(S, X=45, Time=1, r=0.01, r_d=0, sigma=0.4, ratio=1)
Strangle valuation

Description

valuation of a long strangle strategy (one long call + one long put with different strike prices) using
pricing by duplication

Usage

Strangle(S, X1, X2, Time, r, r_d, sigma, ratio = 1)

Arguments

S the asset price, a numeric value or vector.
X1 the exercise price of the long put, a numeric value.
X2 the exercise price of the long call, a numeric value.
Time time to maturity measured in years.
r the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
r_d the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
sigma the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
ratio ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset

Details

A strangle is a combination of

1. a long put with strike price X1 and
2. a long call with strike price X2 (X1 < X2).

When X1 = X2 the strategy becomes a straddle.

Value

the price of the Strangle

Author(s)

Stefan Wilhelm <wilhelm@financial.com>
See Also

GBSOption, Straddle

Examples

```r
##
## Strangle(S=50, X1=40, X2=60, Time=1, r=0.01, r_d=0, sigma=0.3, ratio=1)
##
## payoff diagram
S <- 1:100
ps1 <- Strangle(S, X1=45, X2=55, Time=1, r=0.01, r_d=0, sigma=0.3, ratio=1)
ps2 <- Strangle(S, X1=45, X2=55, Time=0, r=0.01, r_d=0, sigma=0.3, ratio=1)
ps3 <- Strangle(S, X1=45, X2=55, Time=1, r=0.01, r_d=0, sigma=0.4, ratio=1)

plot(S, ps1, type="l", col="red", xlab="underlying price", ylab="payoff", main="Strangle")
lines(S, ps2, col="blue")
lines(S, ps3, col="green")
abline(v=c(45, 55), lty=2, col="gray80")
```

### TurboCertificate

**Turbo Certificate valuation**

Description

This function values a TurboCertificate using barrier option formulas. "Call Turbos/Turbo Bulls" are effectively long down-and-out calls and "Put Turbos/Turbo Bears" are effectively up-and-out-puts.

Usage

```r
TurboCertificate(type, S, X, B, Time, r, r_d, sigma, ratio = 1)
```

Arguments

- `type`: type flag, either "c" for long and "p" for short
- `S`: the asset price, a numeric value
- `X`: the exercise price (strike), a numeric value.
- `B`: the barrier (knock-out-level), a numeric value.
- `Time`: time to maturity measured in years
- `r`: the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
- `r_d`: the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
- `sigma`: the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
- `ratio`: ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset
TurboCertificate

Details

This is simply a convenience wrapper function for the standardbarrieroption method which can also scale with a ratio.

Also known as:

- Knock-out Warrant
- Turbo Bull/Turbo Bear
- Turbo Long/Turbo Short
- Up-and-Out-Call/Down-and-Out-Put
- Barrier Option

Classification according to the SVSP Swiss Derivative Map 2008: Knock-out Warrants (120)
Classification according to the SVSP Swiss Derivative Map 2010: Knock-out Warrants (2200)

Value

the price of the TurboCertificate

Author(s)

Stefan Wilhelm <wilhelm@financial.com>

References

SVSP Swiss Derivative Map http://www.svsp-verband.ch/map/

See Also

StandardBarrierOption

Examples

```r
##
TurboCertificate("c", S=40, X=42, B=38, Time=1, r=0.035, r_d=0,
sigma=0.3, ratio=1)
##
## payoff
S <- seq(0, 100)
p <- TurboCertificate("c", S, X=42, B=38, Time=1, r=0.035, r_d=0,
sigma=0.3, ratio=1)
p2 <- TurboCertificate("c", S, X=42, B=38, Time=0, r=0.035, r_d=0,
sigma=0.3, ratio=1)
plot(S, p, type="l", col="red", , ylim=range(p, p2, na.rm=TRUE),
    xlab="underlying price", ylab="payoff", main="Knock-out Warrant")
lines(S, p2, col="blue")
abline(v=c(38, 42), lty=2, col="gray80")
```
TwinWinCertificate

Twin Win Certificate valuation using pricing by duplication

Description

This function values a Twin Win Certificate using pricing by duplication and the Generalized Black/Scholes formula.

Usage

TwinWinCertificate(S, X, B, Time, r, r_d, sigma, participation = 1, ratio = 1)

Arguments

S          the asset price, a numeric value.
X          the exercise price ("Bonuslevel"), a numeric value.
B          the barrier ("Sicherheitslevel"), a numeric value.
Time       time to maturity measured in years
r          the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
r_d        the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
sigma      the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.
participation participation rate/factor between bonus level and strike level. Defaults to 1.
ratio      ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset

Details

A Twin Win Certificate is a combination of

1. a long position in the stock (aka Zero-Strike Call)
2. 2 long down-and-out-puts with strike price X and barrier B (StandardBarrierOption)

The structure is similar to a Bonus Certificate, the only difference is a double participation at maturity in the range between B and X, implying a "Twin Win" situation for slightly falling underlying prices.

Classification according to the SVSP Swiss Derivative Map 2008: Twin-Win Certificates (250)
Classification according to the SVSP Swiss Derivative Map 2010: Twin-Win Certificates (1340)

Value

the price (scalar or vector) of the Twin Win Certificate
Warrant

Author(s)
Stefan Wilhelm <wilhelm@financial.com>

References
SVSP Swiss Derivative Map http://www.svsp-verband.ch/map/

See Also
BonusCertificate for a similar structure

Examples

```r
##
TwinWinCertificate(S=100, X=100, B=80, Time=2, r = 0.03, r_d = 0, 
  sigma=0.15, participation=1.2, ratio = 1)

## payoff diagram
S <- seq(50, 150, by=0.1)
p <- TwinWinCertificate(S, X=100, B=80, Time=0.2, r = 0.03, r_d = 0, 
  sigma=0.15, participation=1.2, ratio = 1)
p2 <- TwinWinCertificate(S, X=100, B=80, Time=0, r = 0.03, r_d = 0, 
  sigma=0.15, participation=1.2, ratio = 1)
plot(S, p, type="l", col="red", ylim=range(p, p2, na.rm=TRUE), 
  xlab="underlying price", ylab="payoff", main="Twin-Win")
lines(S, p2, col="blue")
abline(v=c(80, 100), lty=2, col="gray80")
```

---

### Warrant

**Warrant valuation using pricing by duplication**

#### Description
convenience method for standard Warrant pricing

#### Usage

```r
Warrant(type, S, X, Time, r, r_d, sigma, ratio = 1)
```

#### Arguments

- **type**
  - "call" or "put"
- **S**
  - the asset price, a numeric value.
- **X**
  - the exercise price, a numeric value.
- **Time**
  - time to maturity measured in years
- **r**
  - the annualized rate of interest, a numeric value; e.g. 0.25 means 25% pa.
- **r_d**
  - the annualized dividend yield, a numeric value; e.g. 0.25 means 25% pa.
sigma the annualized volatility of the underlying security, a numeric value; e.g. 0.3 means 30% volatility pa.

ratio ratio, number of underlyings one certificate refers to, a numeric value; e.g. 0.25 means 4 certificates refer to 1 share of the underlying asset

Details
This is simply a convenience wrapper function for the \texttt{GBSOption} method which can also scale with a ratio.

Classification according to the SVSP Swiss Derivative Map 2008: Warrants (110)
Classification according to the SVSP Swiss Derivative Map 2010: Warrants (2100)

Value
the price (scalar or vector) of the Warrant

Author(s)
Stefan Wilhelm <wilhelm@financial.com>

References
SVSP Swiss Derivative Map \url{http://www.svsp-verband.ch/map/}

See Also
\texttt{GBSOption} in fOptions package

Examples
```
# Warrant("c", S=40, X=42, Time=1, r=0.035, r_d=0, sigma=0.3, ratio=0.1)
```
Index

*Topic math

AirbagCertificate, 2
BonusCertificate, 3
BonusProCertificate, 5
CappedBonusCertificate, 7
CappedReverseBonusCertificate, 9
CappedWarrant, 10
DiscountCertificate, 12
DiscountPlusCertificate, 13
DoubleBarrierBinaryCall, 15
EasyExpressCertificate, 17
GarantieCertificate, 18
implyVolatility, 20
LeveragedBonusCertificate, 21
OutperformanceCertificate, 22
OutperformancePlusCertificate, 24
ReturnCertificate, 26
ReverseBonusCertificate, 27
ReverseConvertible, 29
ReverseConvertiblePlusPro, 30
ReverseDiscountCertificate, 32
ReverseDiscountPlusCertificate, 33
ReverseOutperformanceCertificate, 34
SprintCertificate, 36
Straddle, 37
Strangle, 39
TurboCertificate, 40
TwinWinCertificate, 42
Warrant, 43

AirbagCertificate, 2

BinaryBarrierOption, 26, 27
BonusCertificate, 3, 6, 8, 27, 43
BonusProCertificate, 5

CappedBonusCertificate, 4, 7
CappedReverseBonusCertificate, 8, 9
CappedWarrant, 10

CashOrNothingOption, 17, 18
CoveredCall (DiscountCertificate), 12

DiscountCall (CappedWarrant), 10
DiscountCertificate, 12, 14, 30, 32
DiscountPlusCertificate, 13, 13
DiscountPut, 11
DiscountPut (CappedWarrant), 10
DoubleBarrierBinaryCall, 15
DoubleBarrierOption, 16

EasyExpressCertificate, 17

GarantieCertificate, 18
GBSOption, 11, 13, 14, 27, 38, 40, 44
GuaranteeCertificate
(GarantieCertificate), 18

implyVolatility, 20

InlineWarrant
(DoubleBarrierBinaryCall), 15

LeveragedBonusCertificate, 21

OutperformanceCertificate, 22, 25, 35, 37
OutperformancePlusCertificate, 24

PTSingleAssetBarrierOption, 5, 6

ReturnCertificate, 26
ReverseBonusCertificate, 4, 10, 27
ReverseCappedBonusCertificate
(CappedReverseBonusCertificate), 9
ReverseConvertible, 29, 31
ReverseConvertiblePlusPro, 30, 30
ReverseDiscountCertificate, 10, 32, 34
ReverseDiscountPlusCertificate, 32, 33
ReverseOutperformanceCertificate, 34

SprintCertificate, 36
StandardBarrierOption, 4, 21, 22, 41
Straddle, 37, 40
Strangle, 38, 39

TurboCertificate, 40
TwinWinCertificate, 42

Warrant, 43