Package 'fCertificates'

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Title Basics of Certificates and Structured Products Valuation

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Description

Collection of pricing by duplication methods for popular structured products (``Zertifikate").

License GPL (>= 2)

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R topics documented:

`AirbagCertificate` *Airbag Certificate valuation using pricing by duplication*

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/

Examples

```
##
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")
```

BonusCertificate *Bonus Certificate valuation using pricing by duplication*

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/

See Also

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

Examples

```
##
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)
```

```
p2 <- BonusCertificate(S, X=60 , B=35, Time=0, sigma=0.14, r=0.02, r_d=0, ratio=1)
plot(S, p,  type="l", col="red", xlab="underlying price",
  ylab="payoff", main="Bonus")
lines(S, p2, col="blue")
abline(v=c(35, 60), lty=2, col="gray80")
```

`BonusProCertificate` *Bonus Pro Certificate valuation using pricing by duplication*

Description

values a Bonus Pro Certificate using pricing by duplication

Usage

```
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 (`PTSingleAssetBarrierOption`)

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/

Heynen and Kat (1994). Partial barrier options. *The Journal of Financial Engineering*, **3**, 253–274.

Haug (2007). The complete Guide to Option Pricing Formulas, *Wiley & Sons*, 2nd edition, pp.160

See Also

BonusCertificate, PTSingleAssetBarrierOption

Examples

```
## 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,
```

```
     r=0.01, r_d=0, sigma=0.3, ratio = 1)
}
plot(S, p1, ylim=range(p1, p2, na.rm=TRUE), type="l", lwd=2, col="red",
  xlab="underlying price", ylab="payoff", main="Bonus Pro Certificate")
lines(S, p2, lwd=2, col="blue")
abline(v=c(70, 100), lty=2, col="gray80")

## example: BonusPro vs. Bonus Certificate
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=1, time1 = 0.75,
    r=0.01, r_d=0, sigma=0.3, ratio = 1)
  p2[i] <- BonusProCertificate(TypeFlag="pdoB2", S=S[i], X=100, B=70,
    Time=1, time1 = 0.25,
    r=0.01, r_d=0, sigma=0.3, ratio = 1)
}
p3 <- BonusCertificate(S=S, X=100, B=70, Time=1, r=0.01, r_d=0, sigma=0.3, ratio = 1)

plot(S, S, ylim=range(S, p1, p2, p3), type="l", lwd=2,
  xlab="underlying price", ylab="payoff", main="Bonus Pro Certificate vs. Bonus Certificate")
lines(S, p1, lwd=2, col="red")
lines(S, p2, lwd=2, col="blue")
lines(S, p3, lwd=2, col="darkgreen")
abline(v=c(70,100), lty=2, col="gray")
```

`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.

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 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 of 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/

See Also

BonusCertificate, CappedReverseBonusCertificate for similar structures

Examples

```
##
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,
```

```
  r=0.02, r_d=0, ratio=1)
p2 <- CappedBonusCertificate(S, X=60 , B=35, Cap=75, Time=0, sigma=0.14,
  r=0.02, r_d=0, ratio=1)
plot(S, p,  type="l", col="red", ylim=range(p, p2, na.rm=TRUE),
  xlab="underlying price", ylab="payoff", main="Capped Bonus")
lines(S, p2, col="blue")
abline(v=c(35, 60, 75), lty=2, col="gray80")
```

`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

Value

the price (scalar or vector) of the CappedReverseBonusCertificate

Author(s)

Stefan Wilhelm <wilhelm@financial.com>

See Also

ReverseBonusCertificate, ReverseDiscountCertificate for similar structures

Examples

```
##
CappedReverseBonusCertificate(S=110, S0=100, X=80, B=120, Cap=70, Time=1,
  r=0.045, r_d=0, sigma=0.4, ratio = 1)

## payoff diagram
S <- seq(0,150)
p <- CappedReverseBonusCertificate(S, S0=100, X=80, B=120, Cap=70, Time=1,
  r=0.045, r_d=0, sigma=0.4, ratio = 1)
p2 <- CappedReverseBonusCertificate(S, S0=100, X=80, B=120, Cap=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="Reverse Capped Bonus")
lines(S, p2, col="blue")
abline(v=c(70, 80, 120), lty=2, col="gray80")
```

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.

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

```
##
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/

See Also

DiscountPlusCertificate for a similar structure and GBSOption

Examples

```
##
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")
```

DiscountPlusCertificate

DiscountPlus Certificate valuation using pricing by duplication

---

Description

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

Usage

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

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/

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", , ylim=range(p, p2, na.rm=TRUE),
  xlab="underlying price", ylab="payoff", main="Barrier Discount")
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 certifiate 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

Sutrick, Teall, Tucker, Wei (1997). The Range of Brownian Motion Processes. *The Journal of Financial Engineering*, **6**, 31–46

Hui (1996). One-Touch Barrier Binary Option Values. *Applied Financial Economics*, **6**, 343–346

Haug (2007). The complete Guide to Option Pricing Formulas. *Wiley & Sons*, 2nd edition, 180–181

See Also

DoubleBarrierOption

Examples

```
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)
```

```
 {
   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
```

`EasyExpressCertificate` *Easy Express Certificate valuation using pricing by duplication*

Description

values a Easy Express Certificate using pricing by duplication

Usage

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

Arguments

`S`	the asset price, a numeric value.
`S0`	the fix amount payed 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 S0 at maturity
2. A short cash-or-nothing put (`CashOrNothingOption`) with strike B and cash rebate S0-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)

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

```
##
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")
```

GarantieCertificate *Guarantee Certificate valuation using pricing by duplication*

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/

Examples

```
##
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

```
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

```
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)

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

```
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 (StandardBarrierOption)

In contrast to normal Bonus Certificates, a Leveraged Bonus Certificates have a second barrier B2 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

```
##
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/

Examples

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

## payoff diagram
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(v=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

```
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/

See Also

similar structures: OutperformanceCertificate

Examples

```
##
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="gray80")
```

`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

Author(s)

Stefan Wilhelm <wilhelm@financial.com>

References

see packages fOptions and BinaryBarrierOption in package fExoticOptions

See Also

See also GBSOption in package fOptions, BinaryBarrierOption in package fExoticOptions, BonusCertificate

Examples

```
##
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.

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

```
##
ReverseBonusCertificate(S=110, S0=120, X=100, 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=0.1, 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>

References

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

See Also

similar structures : ReverseConvertiblePlusPro,DiscountCertificate

Examples

```
##
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")
```

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.

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

```
##
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

```
##
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, p2, 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

```
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

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

```
##
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 Certificatevaluation using pricing by duplication

---

Description

values a Reverse Outperformance Certificate using pricing by duplication

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 S0 (i.e. a Put with strike S0)
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,
```

```
  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="Reverse Outperformance")
lines(S, p2, col="blue")
abline(v=90, lty=2, col="gray80")
```

`SprintCertificate` *Sprint Certificate 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

```
##
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)
```

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

`Strangle` *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

```
##
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, ps2, type="l", col="red", xlab="underlying price",
  ylab="payoff", main="Strangle")
lines(S, ps1, 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

```
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

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

```
##
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

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

```
##
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

```
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 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 http://www.svsp-verband.ch/map/

See Also

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)
```

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