Package ‘FER’
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vanilla option pricing models such as Black-Scholes, Bachelier, CEV, and
SABR.

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BachelierImpvol

Description

Calculate Bachelier model implied volatility

Usage

BachelierImpvol(
  price,
  strike = forward,
  spot,
  texp = 1,
  intr = 0,
  divr = 0,
  cp = 1L,
  forward = spot * exp(-divr * texp)/df,
  df = exp(-intr * texp)
)

Arguments

  price  (vector of) option price
  strike (vector of) strike price
  spot   (vector of) spot price
  texp   (vector of) time to expiry
  intr   interest rate (domestic interest rate)
  divr   dividend/convenience yield (foreign interest rate)
  cp     call/put sign. 1 for call, -1 for put.
  forward forward price. If given, forward overrides spot
  df     discount factor. If given, df overrides intr

Value

Bachelier implied volatility
References


See Also

BachelierPrice

Examples

```r
spot <- 100
strike <- 100
texp <- 1.2
sigma <- 20
intr <- 0.05
price <- 20
FER::BachelierImpvol(price, strike, spot, texp, intr=intr)
```

---

**BachelierPrice**

*Calculate Bachelier model option price*

**Description**

Calculate Bachelier model option price

**Usage**

```r
BachelierPrice(
    strike = forward,
    spot,
    texp = 1,
    sigma,
    intr = 0,
    divr = 0,
    cp = 1L,
    forward = spot * exp(-divr * texp)/df,
    df = exp(-intr * texp)
)
```

**Arguments**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>strike</td>
<td>(vector of) strike price</td>
</tr>
<tr>
<td>spot</td>
<td>(vector of) spot price</td>
</tr>
<tr>
<td>texp</td>
<td>(vector of) time to expiry</td>
</tr>
<tr>
<td>sigma</td>
<td>(vector of) volatility</td>
</tr>
</tbody>
</table>
BlackScholesImpvol

### Description

Calculate Black-Scholes implied volatility

### Usage

```r
BlackScholesImpvol(
  price,
  strike = forward,
  spot,
  texp = 1,
  intr = 0,
  divr = 0,
  cp = 1L,
)```

intr

- interest rate (domestic interest rate)

divr

- dividend/convenience yield (foreign interest rate)

cp

- call/put sign. 1 for call, -1 for put.

forward

- forward price. If given, forward overrides spot

df

- discount factor. If given, df overrides intr

### Value

option price

### References


### See Also

BachelierImpvol

### Examples

```r
spot <- 100
strike <- seq(80,125,5)
texp <- 1.2
sigma <- 20
intr <- 0.05
FER::BachelierPrice(strike, spot, texp, sigma, intr=intr)
```
forward = spot * exp(-divr * texp)/df,
   df = exp(-intr * texp)
)

Arguments

price   (vector of) option price
strike  (vector of) strike price
spot    (vector of) spot price
texp    (vector of) time to expiry
intr    interest rate (domestic interest rate)
divr    dividend/convenience yield (foreign interest rate)
cp      call/put sign. 1 for call, -1 for put.
forward forward price. If given, forward overrides spot
df      discount factor. If given, df overrides intr

Value

Black-Scholes implied volatility

References


See Also

BlackScholesPrice

Examples

spot <- 100
strike <- 100
texp <- 1.2
sigma <- 0.2
intr <- 0.05
price <- 20
FER::BlackScholesImpvol(price, strike, spot, texp, intr=intr)
Calculate Black-Scholes option price

Description

Calculate Black-Scholes option price

Usage

```r
BlackScholesPrice(
  strike = forward,
  spot,
  texp = 1,
  sigma,
  intr = 0,
  divr = 0,
  cp = 1L,
  forward = spot * exp(-divr * texp)/df,
  df = exp(-intr * texp)
)
```

Arguments

- **strike** (vector of) strike price
- **spot** (vector of) spot price
- **texp** (vector of) time to expiry
- **sigma** (vector of) volatility
- **intr** interest rate (domestic interest rate)
- **divr** dividend/convenience yield (foreign interest rate)
- **cp** call/put sign. 1 for call, -1 for put.
- **forward** forward price. If given, forward overrides spot
- **df** discount factor. If given, df overrides intr

Value

option price

References


https://en.wikipedia.org/wiki/Black-Scholes_model
CevMassZero

See Also

BlackScholesImpvol

Examples

```r
spot <- 100
strike <- seq(80, 125, 5)
texp <- 1.2
sigma <- 0.2
intr <- 0.05
FER::BlackScholesPrice(strike, spot, texp, sigma, intr=intr)
```

CevMassZero

*Calculate the mass at zero under the CEV model*

Description

Calculate the mass at zero under the CEV model

Usage

```r
CevMassZero(
  spot,
  texp = 1,
  sigma,
  beta = 0.5,
  intr = 0,
  divr = 0,
  forward = spot * exp(-divr * texp)/df,
  df = exp(-intr * texp)
)
```

Arguments

- `spot` (vector of) spot price
- `texp` (vector of) time to expiry
- `sigma` (vector of) volatility
- `beta` beta
- `intr` interest rate
- `divr` dividend rate
- `forward` forward price. If given, forward overrides spot
- `df` discount factor. If given, df overrides intr
Value

mass at zero

Examples

```r
spot <- 100
expiry <- 1.2
beta <- 0.5
sigma <- 2
FER::CevMassZero(spot, expiry, sigma, beta)
```

---

**CevPrice**  
*Calculate the constant elasticity of variance (CEV) model option price*

**Description**

Calculate the constant elasticity of variance (CEV) model option price

**Usage**

```r
CevPrice(
  strike = forward,
  spot,
  texp = 1,
  sigma,
  beta = 0.5,
  intr = 0,
  divr = 0,
  cp = 1L,
  forward = spot * exp(-divr * texp)/df,
  df = exp(-intr * texp)
)
```

**Arguments**

- `strike` (vector of) strike price
- `spot` (vector of) spot price
- `texp` (vector of) time to expiry
- `sigma` (vector of) volatility
- `beta` elasticity parameter
- `intr` interest rate (domestic interest rate)
- `divr` dividend/convenience yield (foreign interest rate)
- `cp` call/put sign. 1 for call, -1 for put.
- `forward` forward price. If given, `forward` overrides `spot`
- `df` discount factor. If given, `df` overrides `intr`
Value

option price

References


Examples

```r
spot <- 100
strike <- seq(80, 125, 5)
texp <- 1.2
beta <- 0.5
sigma <- 2
FER::CevPrice(strike, spot, texp, sigma, beta)
```

---

Nsvh1Choi2019

Calculate the option price under the NSVh model with lambda=1 (Choi et al. 2019)

Description

Calculate the option price under the NSVh model with lambda=1 (Choi et al. 2019)

Usage

```r
Nsvh1Choi2019(
  strike = forward,
  spot,
  texp = 1,
  sigma,
  vov = 0,
  rho = 0,
  intr = 0,
  divr = 0,
  cp = 1L,
  forward = spot * exp(-divr * texp)/df,
  df = exp(-intr * texp)
)
```

Arguments

- strike: (vector of) strike price
- spot: (vector of) spot price
- texp: (vector of) time to expiry
sigma  (vector of) volatility
vov  (vector of) vol-of-vol
rho  (vector of) correlation
intr  interest rate
divr  dividend rate
cp  call/put sign. 1 (default) for call price, -1 for put price, NULL for Bachelier volatility
forward  forward price. If given, forward overrides spot
df  discount factor. If given, df overrides intr

Value
BS volatility or option price based on cp

References

Examples

```r
spot <- 100
strike <- seq(80,125,5)
texp <- 1.2
sigma <- 20
vov <- 0.2
rho <- -0.5
strike <- seq(0.1, 2, 0.1)
FER::Nsvh1Choi2019(strike, spot, texp, sigma, vov, rho)
```

---

**SabrHagan2002**

Calculate the equivalent BS volatility (Hagan et al. 2002) for the Stochastic-Alpha-Beta-Rho (SABR) model

**Description**

Calculate the equivalent BS volatility (Hagan et al. 2002) for the Stochastic-Alpha-Beta-Rho (SABR) model
Usage

SabrHagan2002(
  strike = forward,
  spot,
  texp = 1,
  sigma,
  vov = 0,
  rho = 0,
  beta = 1,
  intr = 0,
  divr = 0,
  cp = NULL,
  forward = spot * exp(-divr * texp)/df,
  df = exp(-intr * texp)
)

Arguments

strike (vector of) strike price
spot (vector of) spot price
texp (vector of) time to expiry
sigma (vector of) volatility
vov (vector of) vol-of-vol
rho (vector of) correlation
beta (vector of) beta
intr interest rate (domestic interest rate)
divr convenience rate (foreign interest rate)
cp call/put sign. NULL for BS vol (default), 1 for call price, -1 for put price.
forward forward price. If given, forward overrides spot
df discount factor. If given, df overrides intr

Value

BS volatility or option price based on cp

References


Examples

sigma <- 0.25
vov <- 0.3
rho <- -0.8
beta <- 0.3
SpreadBacheller

*Spread option under the Bachelier model*

**Description**

The payout of the spread option is \( \max(S1_T - S2_T - K, 0) \) where \( S1_T \) and \( S2_T \) are the prices at expiry \( T \) of assets 1 and 2 respectively and \( K \) is the strike price.

**Usage**

```r
SpreadBacheller(
  strike = 0,
  spot1,
  spot2,
  texp = 1,
  sigma1,
  sigma2,
  corr,
  intr = 0,
  divr1 = 0,
  divr2 = 0,
  cp = 1L,
  forward1 = spot1 * exp(-divr1 * texp)/df,
  forward2 = spot2 * exp(-divr2 * texp)/df,
  df = exp(-intr * texp)
)
```

**Arguments**

- `strike` (vector of) strike price
- `spot1` (vector of) spot price of asset 1
- `spot2` (vector of) spot price of asset 2
- `texp` (vector of) time to expiry
- `sigma1` (vector of) Bachelier volatility of asset 1
- `sigma2` (vector of) Bachelier volatility of asset 2
- `corr` correlation
- `intr` interest rate
- `divr1` dividend rate of asset 1
- `divr2` dividend rate of asset 2

```r
texp <- 10
strike <- seq(0.1, 2, 0.1)
FER::SabrHagan2002(strike, 1, texp, sigma, vov, rho, beta)
FER::SabrHagan2002(strike, 1, texp, sigma, vov, rho, beta, cp=1)
```
SpreadBjerksund2014

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cp</td>
<td>call/put sign. 1 for call, -1 for put.</td>
</tr>
<tr>
<td>forward1</td>
<td>forward price of asset 1. If given, overrides spot1</td>
</tr>
<tr>
<td>forward2</td>
<td>forward price of asset 2. If given, overrides spot2</td>
</tr>
<tr>
<td>df</td>
<td>discount factor. If given, df overrides intr</td>
</tr>
</tbody>
</table>

**Value**

option price

**Examples**

FER::SpreadBachelier((-2:2)*10, 100, 120, 1.3, 20, 36, -0.5)

---

**SpreadBjerksund2014**  
*Spread option pricing method by Bjerksund & Stensland (2014)*

**Description**

The payout of the spread option is \( \max(S1_T - S2_T - K, 0) \) where \( S1_T \) and \( S2_T \) are the prices at expiry \( T \) of assets 1 and 2 respectively and \( K \) is the strike price.

**Usage**

SpreadBjerksund2014(
  strike = 0,
  spot1,
  spot2,
  texp = 1,
  sigma1,
  sigma2,
  corr,
  intr = 0,
  divr1 = 0,
  divr2 = 0,
  cp = 1L,
  forward1 = spot1 * exp(-divr1 * texp)/df,
  forward2 = spot2 * exp(-divr2 * texp)/df,
  df = exp(-intr * texp)
)
Arguments

- strike (vector of) strike price
- spot1 (vector of) spot price of asset 1
- spot2 (vector of) spot price of asset 2
- texp (vector of) time to expiry
- sigma1 (vector of) volatility of asset 1
- sigma2 (vector of) volatility of asset 2
- corr correlation
- intr interest rate
- divr1 dividend rate of asset 1
- divr2 dividend rate of asset 2
- cp call/put sign. 1 for call, -1 for put.
- forward1 forward price of asset 1. If given, overrides spot1
- forward2 forward price of asset 2. If given, overrides spot2
- df discount factor. If given, df overrides intr

Value

option price

References


Examples

FER::SpreadBjerksund2014((-2:2)*10, 100, 120, 1.3, 0.2, 0.3, -0.5)

SpreadKirk

Kirk’s approximation for spread option

Description

The payout of the spread option is \( \max(S1_T - S2_T - K, 0) \) where \( S1_T \) and \( S2_T \) are the prices at expiry \( T \) of assets 1 and 2 respectively and \( K \) is the strike price.
SpreadKirk

Usage

SpreadKirk(
    strike = 0,
    spot1,
    spot2,
    texp = 1,
    sigma1,
    sigma2,
    corr,
    intr = 0,
    divr1 = 0,
    divr2 = 0,
    cp = 1L,
    forward1 = spot1 * exp(-divr1 * texp)/df,
    forward2 = spot2 * exp(-divr2 * texp)/df,
    df = exp(-intr * texp)
)

Arguments

strike (vector of) strike price
spot1 (vector of) spot price of asset 1
spot2 (vector of) spot price of asset 2
texp (vector of) time to expiry
sigma1 (vector of) volatility of asset 1
sigma2 (vector of) volatility of asset 2
corr correlation
intr interest rate
divr1 dividend rate of asset 1
divr2 dividend rate of asset 2
cp call/put sign. 1 for call, -1 for put.
forward1 forward price of asset 1. If given, overrides spot1
forward2 forward price of asset 2. If given, overrides spot2
df discount factor. If given, df overrides intr

Value

option price

References

SwitchMargrabe

See Also

SwitchMargrabe

Examples

FER::SpreadKirk((-2:2)*10, 100, 120, 1.3, 0.2, 0.3, -0.5)

---

Margrabe's formula for exchange option price

Description

The payout of the exchange option is \( \max(S1_T - S2_T, 0) \) where \( S1_T \) and \( S2_T \) are the prices at expiry \( T \) of assets 1 and 2 respectively.

Usage

SwitchMargrabe(
    spot1,  # (vector of) spot price of asset 1
    spot2,  # (vector of) spot price of asset 2
    texp = 1,  # (vector of) time to expiry
    sigma1,  # (vector of) volatility of asset 1
    sigma2,  # (vector of) volatility of asset 2
    corr,  # correlation
    intr = 0,  # interest rate
    divr1 = 0,  # dividend rate of asset 1
    divr2 = 0,  # dividend rate of asset 2
    cp = 1L,
    forward1 = spot1 * exp(-divr1 * texp)/df,
    forward2 = spot2 * exp(-divr2 * texp)/df,
    df = exp(-intr * texp)
)

Arguments

spot1  # (vector of) spot price of asset 1
spot2  # (vector of) spot price of asset 2
texp  # (vector of) time to expiry
sigma1  # (vector of) volatility of asset 1
sigma2  # (vector of) volatility of asset 2
corr  # correlation
intr  # interest rate
divr1  # dividend rate of asset 1
SwitchMargrabe

divr2  dividend rate of asset 2
cp     call/put sign. 1 for call, -1 for put.
forward1 forward price of asset 1. If given, overrides spot1
forward2 forward price of asset 2. If given, overrides spot2
df     discount factor. If given, df overrides intr

Value

option price

References


See Also

SpreadKirk

Examples

FER::SwitchMargrabe(100, 120, 1.3, 0.2, 0.3, -0.5)
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