

Package ‘VarSwapPrice’

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Type Package

Title Pricing a variance swap on an equity index

Version 1.0

Date 2012-03-14

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Description Computes a portfolio of European options that replicates the cost of capturing the realised variance of an equity index.

License GPL-3

LazyLoad yes

Repository CRAN

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R topics documented:

VarSwapPrice-package	1
black_scholes	2
VarSwap	3

Index	6
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VarSwapPrice-package *Pricing the variance swap of an equity index*

Description

Using mild assumptions, Demeterfi, Derman, Kamal and Zou (1999) show that there exists an exotic stock option that generates a payoff equal to the variance of the stock’s returns. This payoff can then be replicated through a portfolio of European options available in the marketplace. The fair value of the variance swap is the cost of the replicating portfolio. The code presented herein computes the replicating portfolio using the analytical formulas of Demeterfi, Derman, Kamal and Zou (1999) for a theoretical fair value with volatility skews.

Details

```

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```

This a standard one-function thing. Therefore, it is enough to follow the instructions and call for the function the standard R-way.

Author(s)

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References

Kresimir Demeterfi, Emanuel Derman, Michael Kamal and Joseph Zou, "More Than You Ever Wanted To Know About Volatility Swaps", Goldman Sachs Quantitative Strategies Research Notes, March 1999.

Examples

```

rm(list=ls())

S0      <- c(100)      #spot price
puts    <- matrix( seq(100,45,-5) )      #available put strike prices
vol_put <- matrix( seq(0.2,0.3,0.01) )    #implied vols for puts
calls   <- matrix( seq(100,140,5) )      #available call strike prices
vol_call <- matrix( seq(0.2,0.13,-0.01) ) #implied vols for calls

r <- c( 0.05 )      #risk free rate
T <- c( 90/365 )    #maturity of 3 months
SQ <- c( 100 )      #strike price which is nearest to forward price

equity_varswap <- VarSwap(S0, puts, calls, vol_put, vol_call, r, T, SQ)

```

black_scholes

Black-Scholes pricing for call and put options

Description

This function computes the analytical prices of call and put options using the formulas obtained by Black and Scholes (1973).

Usage

```
black_scholes(S, X, r, t, vol)
```

Arguments

S	spot price
X	strike price
r	risk-free interest rate
t	time to maturity
vol	volatility

Value

CallPrice	price of a call option
PutPrice	price of a put option

Author(s)

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References

Fischer Black and Myron Scholes (1973), "The Pricing of Options and Corporate Liabilities", Journal of Political Economy, 81(3), 637-654.

Examples

```
S <- c( 100 )
X <- c( 70 )
r <- c( 0.05 )
t <- c( 50 )
vol <- c( 0.2 )
prices <- black_scholes(S, X, r, t, vol)
```

VarSwap

Pricing a variance swap of an equity index

Description

This routine prices a swap contract on the realized variance of the daily returns for an equity index. The code computes the portfolio of European-style put and call options used for calculating the cost of capturing realized variance in the presence of implied volatility skew with a discrete set of options strikes. The pricing method used in the code is proposed by Demeterfi, Derman, Kamal and Zou (1999).

Usage

VarSwap(S, puts, calls, vol_put, vol_call, r, T, SQ)

Arguments

S	spot price
puts	vector of available put strike price
calls	vector of available call strike price
vol_put	vector of implied volatilities for put contracts
vol_call	vector of implied volatilities for call contracts
r	risk-free interest rate
T	time to maturity
SQ	strike price that is nearest to forward price

Details

Variance swaps forward contracts on future realised variance. They can be used to speculate on future variance levels or to hedge the variance exposure of other positions. Demeterfi, Derman, Kamal and Zou (1999) show that variance swaps can be theoretically replicated by a portfolio of standard options with suitably chosen strikes. The basic assumption is that the underlying stock index has no jumps. The fair value of the variance swap is the cost of the replicating portfolio. Demeterfi, Derman, Kamal and Zou (1999) obtain analytical formulas for a theoretical fair value with volatility skews.

Value

fairvol	analytical estimate of fair volatility
fairprice	fair rate for variance swap, obtained from equation (27) of Demeterfi, Derman, Kamal and Zou (1999)
total_cost	total weighted cost of portfolio of European options replicating the theoretical variance swap
puts_strikes	strike prices of (discretely-sampled) put options available in the market
puts_vols	implied volatility of each put option available in the market (multiplied by 100)
puts_weight	weights of each put option contract in the replication strategy (multiplied by 10000)
puts_vpo	value of each put option contract
puts_cont	contribution of each put option strike level to the total cost of the replicating portfolio (multiplied by 10000)
calls_strikes	strike prices of (discretely-sampled) call options available in the market
cals_vols	implied volatility of each put option available in the market (multiplied by 100)
calls_weight	weights of each call option contract in the replication strategy (multiplied by 10000)
calls_vpo	value of each put option contract
calls_cont	contribution of each call option strike level to the total cost of the replicating portfolio (multiplied by 10000)

Author(s)

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References

Kresimir Demeterfi, Emanuel Derman, Michael Kamal and Joseph Zou, "More Than You Ever Wanted To Know About Volatility Swaps", Goldman Sachs Quantitative Strategies Research Notes, March 1999.

Examples

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rm(list=ls())

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r <- c( 0.05 ) #risk free rate
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SQ <- c( 100 ) #strike price which is nearest to forward price

equity_varswap <- VarSwap(S, puts, calls, vol_put, vol_call, r, T, SQ)
```

Index

*Topic **Black-Scholes option pricing**

[black_scholes](#), 2

*Topic **Package description**

[VarSwapPrice-package](#), 1

*Topic **Variance swap pricing
function**

[VarSwap](#), 3

[black_scholes](#), 2

[VarSwap](#), 3

[VarSwapPrice \(VarSwapPrice-package\)](#), 1

[VarSwapPrice-package](#), 1