Package ‘VarSwapPrice’

February 19, 2015

Type Package
Title Pricing a variance swap on an equity index
Version 1.0
Date 2012-03-14
Author Paolo Zagaglia
Maintainer Paolo Zagaglia <paolo.zagaglia@gmail.com>
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
Date/Publication 2012-03-15 18:43:58
NeedsCompilation no

R topics documented:

VarSwapPrice-package .......................................................... 1
black_scholes ................................................................. 2
VarSwap ......................................................................... 3

Index

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.
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)

Maintainer: Paolo Zagaglia, paolo.zagaglia@gmail.com

References


Examples

```r
rnm(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_varsnap <- 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)

Paolo Zagaglia, paolo.zagaglia@gmail.com

References


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
calls_vols implied volatility of each call 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 call option contract
calls_cont contribution of each call option strike level to the total cost of the replicating portfolio (multiplied by 10000)
Author(s)
Paolo Zagaglia, paolo.zagaglia@gmail.com

References

Examples

```r
rm(list=ls())

S <- 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(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