

Package ‘svi’

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Type Package

Title SVI Implied Volatility Surface

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Description The package provides methods for fitting the Stochastic Volatility Inspired (SVI) equation to a slice of implied volatilities. Supported methods are the direct least-squares, vanishing wings, and quasi-explicit.

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Encoding UTF-8

LazyData true

Depends Matrix

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axel	<i>Axel-Vogt Parameters</i>
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Description

Loads the Axel-Vogt parameters, which are a typical example of arbitrage SVI surface.

Usage

```
axel()
```

Details

The paramters are given as:

$$-0.041, 0.1331, 0.306, 0.3586, 0.4153$$

corresponding to $(a, b, rho, m, sigma)$. When inspecting the Durrleman condition, one recognizes that this setting is not entirely positive.

Value

Loads the parameters par and shows the Durrleman/SVI plot.

Author(s)

Wolfgang Schadner

References

Schadner, W. (2023): Direct Fit for SVI Implied Volatilities

See Also

svi

Examples

```
## Not run
# axel()
```

durrleman	<i>Durrleman Condition</i>
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Description

Calculates the the Durrleman condition of arbitrage.

Usage

```
durrleman(x, par, Gs=FALSE)
```

Arguments

x	Vector of option's log moneyness. Preferably defined as $x = \log(\frac{strike\ price}{forward\ price})$
par	Either the five SVI parameters (a, b, ρ, m, σ) or the conic coefficients z .
Gs	Returns additional values of $G_{1\pm}$ and G_2 , see Martini and Mingone (2022) for details.

Details

The Durrleman function $g(x)$ should be positive across all x for an arbitrage free volatility surface. If $g(x)$ is positive, then the risk-neutral density $q(x)$ is also positive. Let y be the implied variance for the moneyness x , then the durrleman function is defined as:

$$g(x) := (1 - \frac{xy'}{2y})^2 - \frac{y'^2}{4}(\frac{1}{y} + \frac{1}{4}) + \frac{y''}{2}$$

Alternatively, this might be expressed as:

$$g(x) = G_1(x) + \frac{1}{2\sigma}G_2(x)$$

(cp. Martini and Mingone (2022)).

Value

Returns the values g of the Durrleman function.

Author(s)

Wolfgang Schadner

References

Martini, C. and Mingone, A. (2022): *No Arbitrage SVI*, SIAM J. Financial Math., 13(1), pp. 227-261

See Also

[svi](#)

Examples

```
## Not run
# axel()
# g <- durrleman(x, par)
# plot(x, g); abline(h=0)
```

geom

Geometric Properties

Description

Calculates the center and asymptotes of the SVI hyperbola.

Usage

```
geom(par)
```

Arguments

par Either the five SVI parameters, or the six z coefficients defining the conic.

Details

Calculates the center and asymptotes of the SVI hyperbola.

Value

Returns the values of the Durrleman function.

Author(s)

Wolfgang Schadner

References

Schadner, W. (2023): Direct Fit for SVI Implied Volatilities

See Also

[svi](#)

Examples

```
## Not run
# load("sp500")
# df <- opt$`tau` = 7 days`
# x <- df$k
# y <- df$ivol^2
# fit <- svifit(x, y)
# plot(x, y)
# lines(x, fit$yhat)
```

`rnd`

Risk-Neutral Density

Description

Computes the risk-neutral density distribution for some SVI parameters `par`.

Usage

```
rnd(x, par)
```

Arguments

`x` Vector of option's log moneyness. Preferably defined as

$$x = \log\left(\frac{\text{strike price}}{\text{forward price}}\right)$$

`par` Either the five SVI parameters (a, b, ρ, m, σ) or the conic coefficients z .

Value

Returns the risk-neutral density distribution.

Author(s)

Wolfgang Schadner

References

Schadner, W. (2023): Direct Fit for SVI Implied Volatilities

See Also[svi](#)**Examples**

```
## Not run
# axel()
# q <- rnd(x, par)
# plot(x, q)
```

rnmoment

*Risk-Neutral Moments***Description**

Computes the risk-neutral variance (rnvar), skewness (rnskew), kurtosis (rnkurt) or more generally a moment of certain order (rnmoment) for the risk-neutral density distribution as specified by the SVI parameters par.

Usage

```
rnskew(par)
rnkurt(par)
rnmoment(par, order=2, absolute=FALSE, standardized=TRUE)
```

Arguments

par	either the five SVI parameters (a, b, ρ, m, σ) or the conic coefficients z .
order	order of the moment to be computed, the default is to compute the second moment, i.e., the variance.
absolute	a logical value indicating whether absolute moments are to be computed.
standardized	a logical value indicating whether standardized moments are to be computed.

Value

Returns the risk-neutral moment.

Author(s)

Wolfgang Schadner

References

Schadner, W. (2023): Direct Fit for SVI Implied Volatilities

See Also

[svi, rnd](#)

Examples

```
## Not run
# data(sp500)
# df <- sp500$`tau = 7 days`
# x <- df$k
# y <- df$ivol^2
# mdl <- svifit(x,y)
# rnskew(mdl$par)
# rnmoment(mdl$par)
```

sp500

Example options of the S&P 500

Description

This data set covers option data for the S&P 500 as observed on

Usage

```
data(sp500)
```

Format

A list of the options with different maturities and strikes.

Source

OptionMetrics.

References

...

svi

Calculate SVI predicted values

Description

Calculates the y values as predicted by SVI for some given x and parameter set.

Usage

```
svi(x, par)
```

Arguments

x	Values of forward log moneyness. I.e., $\log(\text{strike}/\text{forward})$.
par	Either the five SVI parameters, or the six z coefficients defining the conic.

Details

...

Value

Returns the predicted y values.

Author(s)

Wolfgang Schadner

References

Schadner, W. (2023): [Direct Fit for SVI Implied Volatilities](#)

See Also

[svipar](#)

Examples

```
## Not run
# load("sp500")
# df <- opt$`tau` = 7 days`
# x <- df$k
# y <- df$ivol^2
# fit <- svifit(x, y)
# plot(x, y)
# lines(x, fit$yhat)
```

svifit

Fitting SVI volatilities

Description

Fits the Stochastic Volatility Inspired (SVI) equation to an implied volatility surface of given maturity. The input variable x represents the log-moneyness (logarithm of strike over forward-price) and y the implied variance (implied volatility squared).

Usage

```
svifit(x, y, fit="direct", na.rm=TRUE, low_ecc=TRUE, W=NA, a=NA, init=c(0, 0.2))
```

Arguments

<code>x</code>	Vector of option's log moneyness. Preferably defined as $x = \log\left(\frac{\text{strike price}}{\text{forward price}}\right)$
<code>y</code>	Vector of implied variances corresponding to <code>x</code> . That is, the squared implied volatilities over <code>x</code> .
<code>fit</code>	Fitting method to be used. Possible values are: <ul style="list-style-type: none"> • <code>direct</code>: direct least-squares • <code>direct_UC</code>: direct unconstrained least-squares • <code>vanish</code>: vanishing wings, i.e. flat extrapolation • <code>QE</code>: quasi-explicit fit, i.e. iterative routine
<code>na.rm</code>	Removing NA's
<code>low_ecc</code>	Correction for the low eccentricity bias.
<code>W</code>	(optional) Weighting vector for a weighted least-squares.
<code>a</code>	(optional) For <code>vanish</code> fit: specify the y-level for the flat extrapolation.
<code>init</code>	(optional) For <code>QE</code> fit: Starting values of m and σ .

Details

The method is implemented as described by [Schadner \(2023\)](#).

Value

Returns a list of the following:

<code>yhat</code>	Fitted y values.
<code>par</code>	The SVI parameters a, b, ρ, m, σ .
<code>z</code>	The conic coefficients defining the hyperbola.
<code>input</code>	The input data.

Author(s)

Wolfgang Schadner

References

[Schadner, W. \(2023\): Direct Fit for SVI Implied Volatilities](#)

See Also

[svipar](#)

Examples

```
## Not run
# library(svi)
# data(sp500)
# df <- sp500$`tau = 7 days`
# x <- df$k
# y <- df$ivol^2
# fit <- svifit(x, y)
# plot(x, y)
# lines(x, fit$yhat)
#
# # Risk-Neutral Density:
# q <- rnd(x, fit$par)
# plot(x, q)
```

svipar

*Translating conic coefficients into SVI parameters, and vice versa***Description**

This function transforms the 6 conic coefficients z into the 5 SVI parameters, or other way around.

Usage

```
svipar(par)
```

Arguments

`par` Either the six conic coefficients z , or the 5 SVI parameters: $(a b \rho m \sigma)$.

Details

A conic is generally defined as:

$$0 = Dz$$

for the coefficients z and the design matrix D

$$D = (x^2 x y y^2 x y 1)$$

. There exists a direct mapping between z and the 5 SVI parameters, see Schadner 2023.

Value

Returns either the five SVI parameters:

$$par = (a b \rho m \sigma)$$

Or the z coefficients.

Author(s)

Wolfgang Schadner

References

Schadner, W. (2023): Direct Fit for SVI Implied Volatilities

See Also

[svipar](#)

Examples

```
## Not run  
# TBD
```

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