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` *Axel-Vogt Parameters*

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` *Durrleman Condition*

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 abritrage 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 $$x = log(\frac{strike\ price}{forward\ price})$$
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(strike/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

`x`	Vector of option's log moneyness. Preferably defined as $$x = log(\frac{strike\ price}{forward\ price})$$
`y`	Vector of implied variances corresponding to `x`. That is, the squared implied volatilities over `x`.
`fit`	Fitting method to be used. Possible vbalues are: • `direct`: direct least-squares • `direct_UC`: direct unconstrained least-squares • `vanish`: vanishing wings, i.e. flat extrapolation • `QE`: quasi-explicit fit, i.e. iterative routine
`na.rm`	Removing `NA`'s
`low_ecc`	Correction for the low eccentricity bias.
`W`	(optional) Weighting vector for a weighted least-squares.
`a`	(optional) For `vanish` fit: specify the y-level for the flat extrapolation.
`init`	(optional) For `QE` fit: Starting values of m and σ.

Details

The method is implemented as described by Schadner (2023).

Value

Returns a list of the following:

`yhat`	Fitted `y` values.
`par`	The SVI parameters a, b, ρ, m, σ.
`z`	The conic coefficients defining the hyperbola.
`input`	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 paramters, or other way around.

Usage

```
svipar(par)
```

Arguments

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

Details

A conic is generally defined as:

$$0 = Dz$$

for the coefficients z and the design matrix D

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

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

Value

Returns either the five SVI paramters:

$$par = (ab\rho m\sigma)$$

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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