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Description

Tools for energy market risk management (forward curves and trading strategies)

Author(s)

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References


cppi

Constant Proportion Portfolio Insurance (CPPI)

Description
Implements CPPI strategy for commodity price risk management

Usage
cppi(q, tdate, f, tper, rper, tcost = 0, int = TRUE)

Arguments
q numeric value for quantity to be hedged, either positive (net buyer) or negative (net seller)
tdate date vector with trading days
f numeric futures price vector
tper numeric target price markup/down to the price on the first trading day
rper numeric risk factor as a percentage of the price on the first trading day
tcost numeric transaction costs pr unit
int TRUE/FALSE integer restriction on tradable volume

Value
instance of the CPPI class

Examples
# CPPI for a buyer (seller), where stop loss is set 10% above (below) initial market price.
set.seed(5)
# GBM price process parameters
mu <- 0.2
sigma <- 0.1
S0 <- 100
Y <- 2
N <- 500
delta <- Y/N
t <- seq(0, 1, length = N + 1)

# price process and date vector
W <- c(0, cumsum(sqrt(delta) * rnorm(N)))
f_gbm <- S0 * exp(mu * t + sigma * W)
tr_dates <- seq(Sys.Date(), Sys.Date()+500, by = "day")

# implement cppi strategy for buyer
cppi_b <- cppi(q = 10, tdate = tr_dates, tper = 0.1, rper = 0.1, tcost = 0, int = TRUE)

# implement cppi strategy for seller
cppi_s <- cppi(q = -10, tdate = tr_dates, tper = -0.1, rper = 0.1, tcost = 0, int = TRUE)

---

**CPPI-class**

An S4 class for the CPPI hedging strategy

**Description**

An S4 class for the CPPI hedging strategy

**Slots**

- **RiskFactor**  The risk factor (cushion) used in the CPPI model

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**dppi**

Dynamic Proportion Portfolio Insurance (DPPI)

**Description**

Implements DPPI strategy for commodity price risk management

**Usage**

dppi(q, tdate, f, tper, rper, tcost = 0, int = TRUE)
Arguments

- **q**: numeric value for quantity to be hedged, either positive (net buyer) or negative (net seller)
- **tdate**: date vector with trading days
- **f**: numeric futures price vector
- **tper**: numeric target price factor, markup/down to the price on the first trading day
- **rper**: numeric risk factor as a percentage of the price on the first trading day
- **tcost**: numeric transaction costs per unit
- **int**: TRUE/FALSE integer restriction on tradable volume

Value

instance of the DPPI class

Examples

# DPPI for a buyer (seller), where stop loss is set 10% above (below) initial market price.

```r
set.seed(5)
# GBM price process parameters
mu <- 0.2
sigma <- 0.1
S0 <- 100

# time
Y <- 2
N <- 500
delta <- Y/N
t <- seq(0, 1, length = N + 1)

# price process and date vector
W <- c(0, cumsum(sqrt(delta) * rnorm(N)))
f_gbm <- S0 * exp(mu * t + sigma * W)
tr_dates <- seq(Sys.Date(), Sys.Date()+500, by = "day")

# implement dpdi strategy for buyer
dppi_b <- dpdi(q = 10,
tdate = tr_dates,
f = f_gbm,
tper = 0.1,
rper = 0.1,
tcost = 0,
int = TRUE)

# implement dpdi strategy for seller
dppi_s <- dpdi(q = -10,
tdate = tr_dates,
f = f_gbm,
tper = -0.1,
rper = 0.1,
tcost = 0,
int = TRUE)
```
GenericStrat-class

```r
rper = 0.1,
tcost = 0,
int = TRUE)
```

---

**DPPI-class**

*An S4 class for the DPPI hedging strategy*

**Description**

An S4 class for the DPPI hedging strategy

**Slots**

- **TargetPercent** A percentage of first trading day’s market price used to set target price (cap or floor)
- **RiskFactor** The risk factor (cushion) used in the DPPI model

---

**GenericStrat-class**

*An S4 VIRTUAL parent class for the hedging strategy classes in etrm*

**Description**

An S4 VIRTUAL parent class for the hedging strategy classes in etrm

**Slots**

- **Name** A string with the portfolio insurance strategy name
- **Volume** The quantity to be hedged
- **TargetPrice** The target price(s) for the portfolio (cap or floor)
- **TransCost** Transaction costs pr unit traded
- **TradeisInt** TUE/FALSE integer restriction on tradable volume, TRUE sets smallest transacted unit to 1
- **Results** Data frame with strategy results, daily values for market price, transactions, exposure, position, hedge and portfolio price
Description

Creates a smooth forward curve from futures prices for a flow delivery

Usage

msfc(tdate, include, contract, sdate, edate, f, prior = 0)

Arguments

tdate trading date
include logical vector to determine if contracts should be included in calculation
contract vector with contract names
sdate date vector with contract delivery start dates
edate date vector with contract delivery end dates
f numeric vector with futures contract prices
prior numeric vector with prior forward price curve

Value

instance of the MSFC class

Examples

# calculate forward curve for synthetic futures contracts, without prior

# date for curve calculation and contract information
tdate <- as.Date("2021-06-17")
include <- rep(TRUE, 10)
 "Q1-22", "Q2-22", "Q3-22", "Q4-22")

sdate <- as.Date(c("2021-07-01", "2021-08-01", "2021-09-01", "2021-10-01",

edate <- as.Date(c("2021-07-30", "2021-08-31", "2021-09-30", "2021-10-31",

f <- c(32.55, 32.50, 32.50, 32.08, 36.88, 39.80, 39.40, 25.20, 21.15, 29.50)

fwd_curve <- msfc(tdate = tdate,
include = include,
contract = contract,
sdate = sdate,
edate = edate,
f = f)
**MSFC-class**

An S4 class for the Maximum Smoothness Forward Curve (MSFC) in etrm

**Description**

An S4 class for the Maximum Smoothness Forward Curve (MSFC) in etrm

**Slots**

- **Name** A string with the acronym for Maximum Smoothness Forward Curve, "MSFC"
- **TradeDate** The trading date
- **BenchSheet** A data frame with futures contracts selected for calculation with MSFC computed prices
- **Polynomials** The number of polynomials in the MSFC spline
- **PriorFunc** A numeric vector with the prior function values
- **Results** A data frame with daily values for the calculated MSFC and contracts in "BenchSheet"
- **SplineCoef** List with coefficients for the polynomials in the MSFC spline
- **KnotPoints** Vector with spline knot points
- **CalcDat** Data frame extending "Results" with daily values for time vectors and polynomial coefficients used in calculation

**obpi**

*Option Based Portfolio Insurance (OBPI)*

**Description**

Implements OBPI strategy for commodity price risk management

**Usage**

    obpi(
        q,
        tdate,
        f,
        k = f[1],
        vol,
        r = 0,
        tdays = 250,
        daysleft,
        tcost = 0,
        int = TRUE
    )
Arguments

- **q**: numeric value for quantity to be hedged, either positive (net buyer) or negative (net seller)
- **tdate**: date vector with trading days
- **f**: numeric futures price vector
- **k**: numeric value for option strike price
- **vol**: value for volatility
- **r**: value for interest rate
- **tdays**: integer assumed number of trading days per year
- **daysleft**: integer with days left to option expiry
- **tcost**: numeric transaction costs pr unit
- **int**: TRUE/FALSE integer restriction on tradable volume

Value

instance of the OBPI class

Examples

```r
# OBPI for a buyer (seller), where stop loss is set 10% above (below) initial market price.

set.seed(5)
# GBM price process parameters
mu <- 0.2
sigma <- 0.1
S0 <- 100

# time
Y <- 2
N <- 500
delta <- Y/N
t <- seq (0, 1, length = N + 1)

# price process and date vector
W <- c(0, cumsum (sqrt(delta) * rnorm (N)))
f_gbm <- S0 * exp(mu * t + sigma * W)
tr Dates <- seq(Sys.Date(), Sys.Date()+500, by = "day")

# implement obpi strategy for buyer
obpi_b <- obpi(q = 10, 
tdate = tr_dates, 
f = f_gbm, 
k = f_gbm[1], 
vol = 0.2, 
r = 0, 
tdays = 250, 
daysleft = length(f_gbm), 
tcost = 0, 
```
```r
int = TRUE)

# implement obpi strategy for seller
obpi_s <- obpi(q = -10,
tdate = tr_dates,
f = f_gbm,
k = f_gbm[1],
vol = 0.2,
r = 0,
tdays = 250,
daysleft = length(f_gbm),
tcost = 0,
int = TRUE)
```

---

### OBPI-class

*An S4 class for the OBPI hedging strategy*

**Description**

An S4 class for the OBPI hedging strategy

**Slots**

- **StrikePrice**  Strike price for the synthetic option hedging
- **AnnVol**  Annualized volatility for the contract to be traded
- **InterestRate**  Risk-free rate of interest
- **TradingDays**  The number of trading days per year

---

### plot.GenericStrat-method

*S4 method for the plot generic for portfolio insurance strategy classes*

**Description**

S4 method for the plot generic for portfolio insurance strategy classes

**Usage**

```r
## S4 method for signature 'GenericStrat'
plot(
  x,
y = NULL,
title = "Strategy plot",
xlab = "",
```
Arguments

x  instance of the strategy class created by the corresponding strategy function
y  NULL
title  plot title
xlab  label for x-axis
ylab.1  label for y-axis on price plot in top panel
ylab.2  label for y-axis on hedge plot in bottom panel
pcols  vector with four color codes for plot
legend  legend position in c("top", "bottom")

Value

a two-panel chart with daily values for (top panel) target price, market price and portfolio price and (bottom) portfolio hedge rate

Description

S4 method for the plot generic for class "MSFC"

Usage

```r
## S4 method for signature 'MSFC'
plot(  
x,  
y = NULL,  
plot.prior = FALSE,  
title = "",  
xlab = "",  
ylab.1 = "Price",  
ylab.2 = "Hedge %",  
pcols = c("#F8766D", "steelblue3", "gray60", "gray80"),  
legend = "bottom"
)
```
Arguments

- **x**: instance of the MSFC class created by the msfc function
- **y**: NULL
- **plot.prior**: TRUE/FALSE for including prior function in plot
- **title**: plot title
- **xlab**: x-axis title
- **ylab**: y-axis title
- **legend**: position of legend, as implemented in ggplot2

Value

A chart with daily values for the forward curve and contracts used in calculation

Description

A synthetic dataset containing the closing prices and other attributes of 11 power futures contracts for calendar year delivery for 2006 - 2016.

Usage

powcal

Format

A data frame with 3253 rows and 12 columns:

- **Date**: the trading date
- **CAL-06**: the closing price for the 2006 futures contract
- **CAL-07**: the closing price for the 2007 futures contract
- **CAL-08**: the closing price for the 2008 futures contract
- **CAL-09**: the closing price for the 2009 futures contract
- **CAL-10**: the closing price for the 2010 futures contract
- **CAL-11**: the closing price for the 2011 futures contract
- **CAL-12**: the closing price for the 2012 futures contract
- **CAL-13**: the closing price for the 2013 futures contract
- **CAL-14**: the closing price for the 2014 futures contract
- **CAL-15**: the closing price for the 2015 futures contract
- **CAL-16**: the closing price for the 2016 futures contract
Description

A synthetic dataset containing the closing prices and other attributes of 38 power futures contracts.

Usage

powfutures130513

Format

A data frame with 38 rows and 5 columns:

- **Include** boolean variable to determine if contract should be included in forward curve calculation
- **Contract** the name of the futures contract
- **Start** delivery start date for the futures contract
- **End** delivery start date for the futures contract
- **Closing** the futures contract closing price

Description

An example of two simple priors for forward market price to be used with powfutures130513

Usage

powpriors130513

Format

A data frame with 3885 rows and 3 columns:

- **Date** vector of dates ranging from 2013-05-13 to final end date of contracts in powfutures130513
- **trig.prior** a simple smooth trigonometric prior describing power price seasonality
- **mod.prior** a trigonometric prior adjusted for typical calendar effects
Description

S4 method for the show generic for portfolio insurance strategy classes

Usage

```r
## S4 method for signature 'GenericStrat'
show(object)
```

Arguments

- `object` instance of a strategy class

Value

a data frame with daily observations for market price, transactions, exposed volume, forward positions, hedge rate, target price and portfolio price

---

Description

S4 method for the show generic for class "MSFC"

Usage

```r
## S4 method for signature 'MSFC'
show(object)
```

Arguments

- `object` instance of the MSFC class

Value

data frame with daily values for forward curve and forward contracts used in calculation
Description

Implements SHPI strategy for commodity price risk management

Usage

shpi(q, tdate, f, daysleft, tper, tcost = 0, int = TRUE)

Arguments

q  numeric value for quantity to be hedged, either positive (net buyer) or negative (net seller)
tdate  date vector with trading days
f  numeric futures price vector
daysleft  integer with days left to contract expiry
tper  numeric target price markup/down to the price on the first trading day
tcost  numeric transaction costs pr unit
int  TRUE/FALSE integer restriction on tradable volume

Value

instance of the SHPI class

Examples

# SHPI for a buyer (seller), where stop loss is set 10% above (below) initial market price.

set.seed(5)
# GBM price process parameters
mu <- 0.2
sigma <- 0.1
S0 <- 100
# time
Y <- 2
N <- 500
delta <- Y/N
t <- seq(0, 1, length = N + 1)
# price process and date vector
W <- c(0, cumsum ( sqrt(delta) * rnorm (N)))
f_gbm <- S0 * exp(mu * t + sigma * W)
tr_dates <- seq(Sys.Date(), Sys.Date()+500, by = "day")
# implement step-hedge strategy for buyer
shpi_b <- shpi(q = 10,
tdate = tr_dates,
f = f_gbm,
daysleft = length(tr_dates),
tper = 0.1,
tcost = 0,
int = TRUE)

# implement step-hedge strategy for seller
shpi_s <- shpi(q = -10,
tdate = tr_dates,
f = f_gbm,
daysleft = length(tr_dates),
tper = -0.1,
tcost = 0,
int = TRUE)

---

**SHPI-class**

An S4 class for the SHPI hedging strategy

---

**Description**

An S4 class for the SHPI hedging strategy

---

**slpi**

*Stop Loss Portfolio Insurance (SLPI)*

---

**Description**

Implements SLPI strategy for commodity price risk management

**Usage**

slpi(q, tdate, f, tper, tcost = 0, int = TRUE)

**Arguments**

- **q**: numeric value for quantity to be hedged, either positive (net buyer) or negative (net seller)
- **tdate**: date vector with trading days
- **f**: numeric futures price vector
- **tper**: numeric target price markup/down to the price on the first trading day
- **tcost**: numeric transaction costs pr unit
- **int**: TRUE/FALSE integer restriction on tradable volume
Value

instance of the SLPI class

Examples

```r
# SLPI for a buyer (seller), where stop loss is set 10% above (below) initial market price.

set.seed(5)
# GBM price process parameters
mu <- 0.2
sigma <- 0.1
S0 <- 100

# time
Y <- 2
N <- 500
delta <- Y/N
t <- seq (0, 1, length = N + 1)

# price process and date vector
W <- c(0, cumsum ( sqrt(delta) * rnorm (N))
f_gbm <- S0 * exp(mu * t + sigma * W)
tr_dates <- seq(Sys.Date(), Sys.Date()+500, by = "day")

# implement stop-loss strategy for buyer
slpi_b <- slpi(q = 10,
tdate = tr_dates,
f = f_gbm,
tper = 0.1,
tcost = 0,
int = TRUE)

# implement stop-loss strategy for seller
slpi_s <- slpi(q = -10,
tdate = tr_dates,
f = f_gbm,
tper = -0.1,
tcost = 0,
int = TRUE)
```

Description

An S4 class for the SLPI hedging strategy
summary,GenericStrat-method

S4 method for the summary generic for portfolio insurance strategy classes

Description

S4 method for the summary generic for portfolio insurance strategy classes

Usage

## S4 method for signature 'GenericStrat'
summary(object)

Arguments

object instance of a strategy class

Value

a list with five elements. 1) A string describing the type of portfolio insurance trading strategy and number of observations, 2) volume to be hedged, calculated churn rate (number of times volume to be hedged has been traded) and 5) a data frame with summary statistics for achieved results

summary,MSFC-method

S4 method for the summary generic for class "MSFC"

Description

S4 method for the summary generic for class "MSFC"

Usage

## S4 method for signature 'MSFC'
summary(object)

Arguments

object instance of the MSFC class

Value

a list with three elements. 1) A string describing length of forward curve, number of polynomials used in spline and trading date, 2) a vector with a sample of the prior used via head(prior) and 3) a data frame with all forward contracts used in the calculation along with computed forward curve prices
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