

# Package: etrm (via r-universe)

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**Type** Package

**Title** Energy Trading and Risk Management

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**Description** Provides a collection of functions to perform core tasks within Energy Trading and Risk Management (ETRM). Calculation of maximum smoothness forward price curves for electricity and natural gas contracts with flow delivery, as presented in F. E. Benth, S. Koekebakker, and F. Ollmar (2007) <doi:10.3905/jod.2007.694791> and F. E. Benth, J. S. Benth, and S. Koekebakker (2008) <doi:10.1142/6811>. Portfolio insurance trading strategies for price risk management in the forward market, see F. Black (1976) <doi:10.1016/0304-405X(76)90024-6>, T. Bjork (2009) <https://EconPapers.repec.org/RePEc:oxp:obooks:9780199574742>, F. Black and R. W. Jones (1987) <doi:10.3905/jpm.1987.409131> and H. E. Leland (1980) <http://www.jstor.org/stable/2327419>.

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 etrm-package

*etrm: Energy Trading and Risk Management*


---

### Description

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

### Author(s)

Anders D. Sleire <sleire@gmail.com>

### References

- F. E. Benth, S. Koekkebakker, and F. Ollmar. Extracting and applying smooth forward curves from average-based commodity contracts with seasonal variation. *The Journal of Derivatives*, 15(1):52–66, 2007b. <https://doi.org/10.3905/jod.2007.694791>
- F. E. Benth, J. S. Benth, and S. Koekebakker. Stochastic modelling of electricity and related markets, volume 11. World Scientific, 2008. <https://doi.org/10.1142/6811>
- F. Black. The pricing of commodity contracts. *Journal of financial economics*, 3(1):167–179, 1976. [https://doi.org/10.1016/0304-405X\(76\)90024-6](https://doi.org/10.1016/0304-405X(76)90024-6)

- T. Bjork. Arbitrage Theory in Continuous Time. Oxford University Press, 3 edition, 2009. <https://EconPapers.repec.org/RePEc:oup/ctbt>
- F. Black and R. W. Jones. Simplifying portfolio insurance. The Journal of Portfolio Management, 14(1):48–51, 1987. <https://doi.org/10.3905/jpm.1987.409131>
- H. E. Leland. Who should buy portfolio insurance? The Journal of Finance, 35(2):581–594, 1980. <http://www.jstor.org/stable/2327419>

---

 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

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

# implement cpqi strategy for seller
cpqi_s <- cpqi(q = - 10,
  tdate = tr_dates,
  f = f_gbm,
  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

---

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 pr 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.

```

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

# implement dppi strategy for seller
dppi_s <- dppi(q = - 10,
  tdate = tr_dates,
  f = f_gbm,
  tper = - 0.1,

```

```
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

msfc

*Maximum Smoothness Forward Curve (MSFC)***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)
contract <- c("JUL-21", "AUG-21", "SEP-21", "OCT-21", "NOV-21", "DEC-21",
"Q1-22", "Q2-22", "Q3-22", "Q4-22")

sdate <- as.Date(c("2021-07-01", "2021-08-01", "2021-09-01", "2021-10-01",
"2021-11-01", "2021-12-01", "2022-01-01", "2022-04-01", "2022-07-01", "2022-10-01"))

edate <- as.Date(c("2021-07-30", "2021-08-31", "2021-09-30", "2021-10-31",
"2021-11-30", "2021-12-31", "2022-03-31", "2022-06-30", "2022-09-30", "2022-12-31"))

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	<i>An S4 class for the Maximum Smoothness Forward Curve (MSFC) in etrm</i>
------------	--

---

**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	<i>Option Based Portfolio Insurance (OBPI)</i>
------	--

---

**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**

```
# 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,
```

```

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

```

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

```

```

    ylab.1 = "Price",
    ylab.2 = "Hedge %",
    pcols = c("#F8766D", "steelblue3", "gray60", "gray80"),
    legend = "bottom"
  )

```

### 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

---

plot,MSFC-method	<i>S4 method for the plot generic for class "MSFC"</i>
------------------	--

---

### Description

S4 method for the plot generic for class "MSFC"

### Usage

```

## S4 method for signature 'MSFC'
plot(
  x,
  y = NULL,
  plot.prior = FALSE,
  title = "",
  xlab = "",
  ylab = "Price",
  legend = "right"
)

```

**Arguments**

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

**Value**

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

---

<code>powcal</code>	<i>Historical daily closing prices for 11 calendar year power futures contracts</i>
---------------------	---

---

**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

---

powfutures130513	<i>Closing prices for power futures contracts at trading date 2013-05-13</i>
------------------	--

---

**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

---

powpriors130513	<i>Example priors at trading date 2015-05-13</i>
-----------------	--

---

**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

---

show,GenericStrat-method

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

---

### Description

S4 method for the show generic for portfolio insurance strategy classes

### Usage

```
## 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

---

show,MSFC-method

*S4 method for the show generic for class "MSFC"*

---

### Description

S4 method for the show generic for class "MSFC"

### Usage

```
## 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

---

shpi	<i>Step Hedge Portfolio Insurance (SHPI)</i>
------	--

---

**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	<i>An S4 class for the SHPI hedging strategy</i>
------------	--

---

### Description

An S4 class for the SHPI hedging strategy

---

slpi	<i>Stop Loss Portfolio Insurance (SLPI)</i>
------	---

---

### 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**

# 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)

```

---

 SLPI-class

---

*An S4 class for the SLPI hedging strategy*


---

**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 (numer 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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