Package 'Trading'

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Type Package

Title Trade Objects, Advanced Correlation & Beta Estimates, Betting Strategies

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Description Contains performance analysis metrics of track records including entropy-based correlation and dynamic beta based on a state/space algorithm. The normalized sample entropy method
has been implemented which produces accurate entropy estimation even on smaller datasets. On a separate stream, trades from the five major assets classes and also
functionality to use pricing curves, rating tables, Credit Support Annex and add-on tables. The implementation follows an object oriented logic whereby each trade inherits from
more abstract classes while also the curves/tables are objects. Furthermore, odds calculators and P&L back-
testing functionality has been implemented for the most widely used betting/trading strategies including martingale, 'DAlembert', 'Labouchere' and Fibonacci. Back testing has also been included for the 'EuroMillions',
the 'EuroJackpot', the UK Lotto, the Set For Life and the UK 'ThunderBall' lotteries. Furthermore, some basic functionality about climate risk has been included.

Imports methods, reticulate, PerformanceAnalytics, data.table,ggplot2,readxl, RcppAlgos

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Collate 'AngularDistance.R' 'Future.R' 'Swap.R' 'Vol.R' 'Option.R' 'Trade.R' 'IRD.R' 'Bond.R' 'CSA.R' 'CalcEuroLotteryPnL.R' 'CalcSetForLifePnL.R' 'CalcUKLotteryPnL.R' 'CalcUKThunderBallPnL.R' 'Chebyshev_distance.R' 'Collateral.R' 'Commodity.R' 'Credit.R' 'CrossSampleEntropy.R' 'Curve.R' 'DynamicBeta.R' 'Equity.R' 'EuroJackpotResults.R' 'EuroLotteryAllCombinations.R' 'EuroLotteryBacktesting.R' 'EuroMillionsResults.R' 'FX.R' 'GetTradeDetails.R'

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'globals.R' 'martingale_strategy_calculator.R' 'onLoad.R'
'roulette_pl_calculator_Labouchere.R'
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'roulette_pl_calculator_fibonacci.R'
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'roulette_pl_calculator_specific_number.R' 'tce.R' 'top5.R'
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RoxygenNote 7.3.2

NeedsCompilation no

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Contents

AngularDistance *Angular distance metrics*

Description

Calculates the angular distance between a matrix of the track records of various assets/strategies. The sign of the correlation can be ignored for long/short portfolios.

Usage

```
AngularDistance(returns_matrix, long_short = FALSE)
```

Arguments

returns_matrix	a matrix containing the track records of the underlying assets/strategies.
long_short	a boolean value which results in the sign of the correlation being ignored, default value is FALSE

Value

A matrix containing the angular distance values.

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

Lopez de Prado, Marcos, Codependence (Presentation Slides) (January 2, 2020). Available at SSRN: https://ssrn.com/abstract=3512994

Examples

```
## calling AngularDistance() without an argument loads the historical edhec data
##  for the "Short Selling" and "Convertible Arbitrage" strategies
returns_matrix = PerformanceAnalytics::edhec[,c("Short Selling","Convertible Arbitrage")]
angular_distance = AngularDistance(returns_matrix, long_short=FALSE)
```

Bond-class *Bond Class*

Description

Creates a Bond object with the relevant info needed to calculate the Exposure-at-Default (EAD)

Arguments

Notional	The notional amount of the trade
MTM	The mark-to-market valuation of the trade
Currency	The currency set that the trade belongs to
Si	The number of years that the trade will take to start (zero if already started)
BuySell	Takes the values of either 'Buy' or 'Sell'
yield	The yield of the Bond
ISIN	The ISIN of the Bond,
payment_frequency	the frequency that the bond pays coupon (Quarter, SA etc)
maturity_date	the maturity date of the bond
coupon_type	The coupon type of the bond (fixed, floating, flipper etc)
credit_risk_weight	The percentage weight of the exposure of the bond that should be attributed to the 'Credit' asset class
Issuer	The issuer of the bond

Value

An object of type Bond

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
tr1 = Bond(Notional=10000,MtM=30,Currency="EUR",Si=0,maturity_date="2026-04-04",
BuySell='Buy',payment_frequency="SA",
credit_risk_weight=0.2,coupon_type="Fixed",Issuer="FirmA",ISIN = "XS0943423")
```

BondFuture-class *Bond Future Class*

Description

Creates a Bond Future object with the relevant info needed to calculate the Exposure-at-Default (EAD)

Arguments

Notional	The notional amount of the trade
MTM	The mark-to-market valuation of the trade
Currency	The currency set that the trade belongs to
Si	The number of years that the trade will take to start (zero if already started)
Ei	The number of years that the trade will expire
BuySell	Takes the values of either 'Buy' or 'Sell'
yield	The yield of the Underlying Bond
isin	The ISIN of the Underlying Bond,
payment_frequency	the frequency that the bond pays coupon (Quarter, SA etc)
maturity_date	the maturity date of the bond
coupon_type	The coupon type of the bond (fixed, floating, flipper etc)
Issuer	The issuer of the bond

Value

An object of type Bond

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
example_trades = ParseTrades()
bondfuture_trade = example_trades[[17]]
tr1 = BondFuture(Notional=10000,MtM=30,Currency="EUR",Si=0,Ei=10,BuySell='Buy',
payment_frequency="SA",coupon_type="Fixed",Issuer="CountryA",ISIN = "XS0943423")
```

CalcEuroLotteryPnL *PnL calculation for EuroMillions/EuroJackpot backtesting*

Description

Calculates the PnL for a pay out structure created during backtesting

Usage

```
CalcEuroLotteryPnL(backtested_results, plot_results = FALSE)
```

Arguments

backtested_results	The EuroMillions/EuroJackpot results backtested against the user input
plot_results	(Optional) If TRUE, the P&L historical graphs are plotted, default FALSE

Value

PnL figures

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
euromillions_results = EuroMillionsResults()
user_input = c(10,20,30,40,50,5,10)
backtested_results = EuroLotteryBacktesting(euromillions_results, '2005-01-01', user_input)
pnl_result = CalcEuroLotteryPnL(backtested_results, plot_results = TRUE)
```

CalcSetForLifePnL *PnL calculation for Set For Life backtesting*

Description

Calculates the PnL for a pay out structure created during backtesting

Usage

```
CalcSetForLifePnL(backtested_results, plot_results = FALSE)
```

Arguments

backtested_results	The Set For Life results backtested against the user input
plot_results	(Optional) If TRUE, the P&L historical graphs are plotted, default FALSE

Value

PnL figures

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
setforlife_results = SetForLifeResults()
user_input = c(10,20,30,40,50,5)
backtested_results = SetForLifeBacktesting(setforlife_results, date_since='2005-01-01', user_input)
pnl_result = CalcSetForLifePnL(backtested_results, plot_results = FALSE)
```

CalcUKLotteryPnL *PnL calculation for UKLottery backtesting*

Description

Calculates the PnL for a pay out structure created during backtesting

Usage

```
CalcUKLotteryPnL(backtested_results, plot_results = FALSE)
```

Arguments

backtested_results	The UKLottery results backtested against the user input
plot_results	(Optional) If TRUE, the P&L historical graphs are plotted, default FALSE

Value

PnL figures

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
uklottery_results = UKLotteryResults()
user_input = c(5,10,20,30,40,50)
backtested_results = UKLotteryBacktesting(uklottery_results,, user_input)
pnl_result = CalcUKLotteryPnL(backtested_results, plot_results = FALSE)
```

CalcUKThunderBallPnL *PnL calculation for UKThunderBall backtesting*

Description

Calculates the PnL for a pay out structure created during backtesting

Usage

```
CalcUKThunderBallPnL(backtested_results, plot_results = FALSE)
```

Arguments

backtested_results	The UKThunderBall results backtested against the user input
plot_results	(Optional) If TRUE, the P&L historical graphs are plotted, default FALSE

Value

PnL figures

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
ukthunderball_results = UKThunderBallResults()
user_input = c(10,20,30,31,32,5)
backtested_results = UKThunderballBacktesting(ukthunderball_results, user_input = user_input)
pnl_result = CalcUKThunderBallPnL(backtested_results, plot_results = FALSE)
```

capped_fibonacci_seq *Fibonacci sequence up to a specified maximum number*

Description

Generates the Fibonacci sequence up to a specified maximum number

Usage

```
capped_fibonacci_seq(max_number)
```

Arguments

max_number	The maximum number up to which the sequence should be generated

Value

A vector containing the Fibonacci sequence

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

https://en.wikipedia.org/wiki/Fibonacci_number

Examples

```
fibonacci_seq = capped_fibonacci_seq(max_number = 6000)
```

Carbon_Footprint *Carbon Footprint*

Description

Returns the Total carbon emissions for a portfolio normalized by the market value of the portfolio, expressed in tons CO2e / $M invested.Scope 1 and Scope 2 GHG emissions are allocated to investors based on an equity

Usage

```
Carbon_Footprint(portfolio_exposure, emissions_capitalization_data)
```

Arguments

`portfolio_exposure`
: The exposure per issuer in the portfolio

`emissions_capitalization_data`
: The capitalization and the Scope 1 & 2 GHG emissions per issuer

Value

Total carbon emissions for a portfolio normalized by the market value of the portfolio, expressed in tons CO2e / $M invested.

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

https://www.tcfdhub.org/Downloads/pdfs/E09

Examples

```
portfolio_exposure     = data.table::data.table(Issuers = c('A','B','C'),
exposures = c(100, 200, 50))
emissions_capitalization_data = data.table::data.table(Issuers = c('A','B','C'),
emissions = c(1000, 5000, 6000),  Capitalization = c(20000, 10000, 30000))
Carbon_Footprint(portfolio_exposure, emissions_capitalization_data)
```

Carbon_Intensity *Carbon Intensity*

Description

Returns the Volume of carbon emissions per million dollars of revenue expressed in tons CO2e / $M revenue. Scope 1 and Scope 2 GHG emissions are allocated to investors based on an equity ownership approach. The company's (or issuer's) revenue is used to adjust for company size to provide a measurement of the efficiency of output.

Usage

```
Carbon_Intensity(portfolio_exposure, emissions_capitalization_revenue_data)
```

Arguments

`portfolio_exposure`
: The exposure per issuer in the portfolio

`emissions_capitalization_revenue_data`
: The capitalization, revenue and the Scope 1 & 2 GHG emissions per issuer

Value

Volume of carbon emissions per million dollars of revenue expressed in tons CO2e / $M revenue.

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

https://www.tcfdhub.org/Downloads/pdfs/E09

Examples

```
portfolio_exposure     = data.table::data.table(Issuers = c('A','B','C'),
 exposures = c(100, 200, 50))
emissions_capitalization_revenue_data = data.table::data.table(Issuers = c('A','B','C'),
 emissions = c(1000, 5000, 6000), revenue = c(2000, 5000, 3000),Capitalization =
 c(20000, 10000, 15000))
Carbon_Intensity (portfolio_exposure, emissions_capitalization_revenue_data)
```

CDOTranche-class *CDO tranche Class*

Description

Creates a CDO tranche Object with the relevant info needed to calculate the Exposure-at-Default (EAD)

Arguments

Notional	The notional amount of the trade
MTM	The mark-to-market valuation of the trade
Currency	The currency set that the belongs
Si	The number of years after which the trade will start (zero if already started)
Ei	The number of years that the trade will expire
BuySell	Takes the values of either 'Buy' or 'Sell'
attach_point	The attachment point of the tranche
detach_point	The detachment point of the tranche

Value

An object of type CDOTrance

Examples

```
## a CDO trance object
tr3 = CDOTranche(Notional=10000,MtM=0,Currency="USD",Si=0,Ei=5,
BuySell='Buy',SubClass='IG',RefEntity='CDX.IG',cdo_attach_point=0.3 ,cdo_detach_point=0.5)
```

CDS-class *CDS Class*

Description

Creates a CDS Object with the relevant info needed to calculate the Exposure-at-Default (EAD)

Arguments

Notional	The notional amount of the trade
MTM	The mark-to-market valuation of the trade
Currency	The currency set that the trade belongs to
Si	The number of years that the trade will take to start (zero if already started)
Ei	The number of years that the trade will expire
BuySell	Takes the values of either 'Buy' or 'Sell'
SubClass	Specifies the rating of the underlying entity (possible values are A, AA, BB etc)
RefEntity	The name of the underlying entity

Value

An object of type CDS

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

Basel Committee: The standardised approach for measuring counterparty credit risk exposures http://www.bis.org/publ/bcbs279.htm

Examples

```
## the CDS trade given in the Basel regulation Credit example
tr1 = CDS(Notional=10000,MtM=20,Currency="USD",Si=0,Ei=3,BuySell='Buy',
SubClass='AA',RefEntity='FirmA')
```

CDX-class *CDX Class*

Description

Creates a Credit Index Object with the relevant info needed to calculate the Exposure-at-Default (EAD)

Arguments

Notional	The notional amount of the trade
MTM	The mark-to-market valuation of the trade
Currency	The currency set that the belongs
Si	The number of years after which the trade will start (zero if already started)
Ei	The number of years that the trade will expire
BuySell	Takes the values of either 'Buy' or 'Sell'
SubClass	Specifies if the underlying Index is investment grade or not (possible values are IG & SG)
RefEntity	The name of the underlying Index

Value

An object of type CDX

Examples

```
## the CDX trade given in the Basel regulation Credit example
tr3 = CDX(Notional=10000,MtM=0,Currency="USD",Si=0,Ei=5,
BuySell='Buy',SubClass='IG',RefEntity='Portfolio_1')
```

Chebyshev_distance *Chebyshev distance*

Description

Calculates the Chebyshev distance

Usage

```
Chebyshev_distance(x, y)
```

Arguments

x	a vector containing the track record of the underlying asset/strategy
y	a vector containing the track record of the underlying asset/strategy

Value

The Chebyshev distance of the two vectors

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

https://en.wikipedia.org/wiki/Chebyshev_distance

Examples

```
x = rnorm(1000)
y = rnorm(1000)

chebyshev_dist = Chebyshev_distance(x, y)
```

Collateral-class *Collateral Class*

Description

Creates a Collateral amount object which needs to be linked with a CSA ID

Arguments

ID	The ID of each object
Amount	The collateral amount
csa_id	The csa_id that this object is linked with
type	Describes the type of the collateral: can be "ICA", "VariationMargin" etc

Value

An object of type Collateral

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

Basel Committee: The standardised approach for measuring counterparty credit risk exposures http://www.bis.org/publ/bcbs279.htm

Examples

```
colls = list()
coll_raw = read.csv(system.file("extdata", "coll.csv", package = "Trading"),header=TRUE,
stringsAsFactors = FALSE)

for(i in 1:nrow(coll_raw))
{
 colls[[i]] = Collateral()
 colls[[i]]$PopulateViaCSV(coll_raw[i,])
}
```

`Commodity-class` *Commodity Class*

Description

Creates a Commodity Object with the relevant info needed to calculate the Exposure-at-Default (EAD)

Arguments

`Notional`	The notional amount of the trade
`MTM`	The mark-to-market valuation of the trade
`Currency`	The currency set that the trade belongs to
`Si`	The number of years that the trade will take to start (zero if already started)
`BuySell`	Takes the values of either 'Buy' or 'Sell'
`commodity_type`	Takes the values of 'Oil/Gas','Silver','Electricity' etc.

Value

An object of type Commodity

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

Basel Committee: The standardised approach for measuring counterparty credit risk exposures http://www.bis.org/publ/bcbs279.htm

Examples

```
tr1 = Commodity(Notional=10000,MtM=-50,
BuySell='Buy',SubClass='Energy',commodity_type='Oil')
```

CommodityForward-class
Commodity Forward Class

Description

Creates a Commodity Forward Object with the relevant info needed to calculate the Exposure-at-Default (EAD)

Arguments

Notional	The notional amount of the trade
MTM	The mark-to-market valuation of the trade
Currency	The currency set that the trade belongs to
Si	The number of years that the trade will take to start (zero if already started)
Ei	The number of years that the trade will expire
BuySell	Takes the values of either 'Buy' or 'Sell'
commodity_type	Takes the values of 'Oil','Gas','Silver','Electricity' etc.
SubClass	Defines the relevant hedging set. Possible values: 'Energy','Agriculture','Metal','Other','Climatic'

Value

An object of type Commodity Forward

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

Regulation (EU) 2019/876 of the European Parliament and of the Council of 20 May 2019 http://data.europa.eu/eli/reg/2019/8

Examples

```
## the Commodity Forward trade given in the Basel regulation Commodity example
tr1 = CommodityForward(Notional=10000,MtM=-50,Si=0,Ei=0.75,
BuySell='Buy',SubClass='Energy',commodity_type='Oil')
```

CommSwap-class *Commodity Swap Class*

Description

Creates a Commodity Swap Object with the relevant info needed to calculate the Exposure-at-Default (EAD)

Value

An object of type CommSwap

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

Basel Committee: The standardised approach for measuring counterparty credit risk exposures http://www.bis.org/publ/bcbs279.htm

CrossSampleEntropy *Angular distance metrics*

Description

Calculates the cross sample entropy between two track records of various assets/strategies.

Usage

```
CrossSampleEntropy(returns_matrix, m = 2, r = 0.2)
```

Arguments

returns_matrix	a matrix containing the track records of the underlying assets/strategies. These will be normalized during the algorithm
m	an integer value defining the embedding dimension , default value is 2
r	a double value defining the tolerance, default value is 0.2

Value

The value of cross sample entropy

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

https://physoc.onlinelibrary.wiley.com/doi/epdf/10.1113/expphysiol.2007.037150

Examples

```
## calling CrossSampleEntropy() without an argument loads the historical edhec data
## for the "Short Selling" and "Convertible Arbitrage" strategies
returns_matrix = PerformanceAnalytics::edhec[,c("Short Selling","Convertible Arbitrage")]
Cross_Sample_Entropy = CrossSampleEntropy(returns_matrix,m=2,r=0.2)
```

CSA-class *CSA Class*

Description

Creates a collateral agreement Object containing all the relevant data and methods regarding the maturity factor and the calculation of the exposures after applying the relevant threshold

Arguments

ID	The ID of the CSA ID
Counterparty	The counterparty the CSA is linked to
Currency	The currency that the CSA applies to (can be a list of different currencies)
TradeGroups	The trade groups that the CSA applies to
Values_type	The type of the numerical values (can be "Actual" or "Perc" whereby the values are percentages of the MtM)
thres_cpty	The maximum exposure that the counterparty can generate before collateral will need to be posted
thres_PO	The maximum exposure that the processing organization can generate before collateral will need to be posted
MTA_cpty	The minimum transfer amount for the counterparty
MTA_PO	The minimum transfer amount for the processing organization
IM_cpty	The initial margin that is posted by the counterparty
IM_PO	The initial margin that is posted by the processing organization
mpor_days	The margin period of risk in days
remargin_freq	The frequency of re-margining the exposure in days
rounding	The rounding amount of the transfers

Value

An object of type CSA

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

Basel Committee: The standardised approach for measuring counterparty credit risk exposures http://www.bis.org/publ/bcbs279.htm

Examples

```
  csa_raw = read.csv(system.file("extdata", "CSA.csv", package = "Trading"),
  header=TRUE,stringsAsFactors = FALSE)

csas = list()
for(i in 1:nrow(csa_raw))
{
 csas[[i]] = CSA()
 csas[[i]]$PopulateViaCSV(csa_raw[i,])
}
```

`Curve-class` *Curve Class*

Description

Creates a Curve Object containing pairs of Tenors with relevant rates and the interpolation function. Also, methods for populating the object via a .csv file and the generation of the interpolation function via cubic splines are included.

Arguments

`Tenors`	The Tenors of the curve
`Rates`	The rates on the corresponding tenors
`interp_function`	(Optional) The interpolation function of the curve. Can be populated via the 'CalcInterpPoints' method

Value

An object of type Curve

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
## generating a curve either directly or through a csv -
## the spot_rates.csv file can be found on the extdata folder in the installation library path
funding_curve =  Curve(Tenors=c(1,2,3,4,5,6,10),Rates=c(4,17,43,47,76,90,110))
spot_rates = Curve()
spot_rates$PopulateViaCSV('spot_rates.csv')
time_points = seq(0,5,0.01)
spot_curve     = spot_rates$CalcInterpPoints(time_points)
```

DynamicBeta *Time Varying Beta via Kalman filter & smoother*

Description

Calculates the beta of an investment strategy or stock by applying the Kalman filter & smoother. Apart from the beta timeseries, the state covariances are also returned so as to provide an estimate of the uncertainty of the results. The python package "Pykalman" is used for the calculations given its proven stability.

Usage

```
DynamicBeta(csvfilename, do_not_set_to_true = FALSE)
```

Arguments

csvfilename	the name of csv file containing the track record of the fund & the benchmark
do_not_set_to_true	function returns zero when TRUE - used only so as to pass the CRAN tests where pykalman couldn't be installed

Value

A list of beta values based on Kalman Filter & smoother and the respective covariance matrices

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
## calling DynamicBeta() without an argument loads a test file containing a sample track
## record and a benchmark index
## ATTENTION!!: set do_not_set_to_true to FALSE when running the example
##-- this is only used to pass CRAN tests whereby
## pykalman was not installable!
dyn_beta_values = DynamicBeta(do_not_set_to_true = TRUE)
```

Equity-class *Equity Class*

Description

Creates an Equity object

Arguments

Notional	The notional amount of the trade
MTM	The mark-to-market valuation of the trade
Currency	The currency set that the trade belongs to
BuySell	Takes the values of either 'Buy' or 'Sell'
ISIN	the ISIN of the Equity
traded_price	the price that trade was done
Issuer	the issuer of the stock

Value

An object of type Equity

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
tr1 = Equity(external_id="ext1",Notional=10000,MtM=30,Currency="EUR",BuySell='Buy',
traded_price = 10,ISIN = "XS04340432",Issuer='FirmA')
```

EquityIndexFuture-class *Equity Index Future Class*

Description

Creates an Equity Index Future object with the relevant info needed to calculate the Exposure-at-Default (EAD)

Arguments

Notional	The notional amount of the trade
MTM	The mark-to-market valuation of the trade
Currency	The currency set that the trade belongs to
Si	The number of years that the trade will take to start (zero if already started)
Ei	The number of years that the trade will expire
BuySell	Takes the values of either 'Buy' or 'Sell'
traded_price	the price that trade was done

Value

An object of type EquityIndexFuture

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
example_trades = ParseTrades()
Equity_Index_Future_trade = example_trades[[18]]
```

EquityOptionIndex-class

Equity Option Index Class

Description

Creates an Equity Option Index object with the relevant info needed to calculate the Exposure-at-Default (EAD)

Arguments

Notional	The notional amount of the trade
MTM	The mark-to-market valuation of the trade
Currency	The currency set that the trade belongs to
Si	The number of years that the trade will take to start (zero if already started)
Ei	The number of years that the trade will expire
BuySell	Takes the values of either 'Buy' or 'Sell'
traded_price	the price that trade was done

Value

An object of type EquityOption

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

EquityOptionSingle-class *Equity Option Single Class*

Description

Creates an Equity Option Single object with the relevant info needed to calculate the Exposure-at-Default (EAD)

Arguments

Notional	The notional amount of the trade
MTM	The mark-to-market valuation of the trade
Currency	The currency set that the trade belongs to
Si	The number of years that the trade will take to start (zero if already started)
Ei	The number of years that the trade will expire
BuySell	Takes the values of either 'Buy' or 'Sell'
traded_price	the price that trade was done

Value

An object of type EquityOption

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

EuroJackpotExample *Eurojackpot analysis example*

Description

Displays how the functionality related to the eurojackpot analysis can be utilized

Usage

```
EuroJackpotExample()
```

Value

The final results

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
# This software is covered by GPL license and provided strictly for educational
# reasons (no actual investment/betting decisions should be taken based on this)

final_results = EuroJackpotExample()
```

EuroJackpotResults *Returns all the EuroJackpot results until the end of 2023*

Description

Returns all the EuroJackpot results since the first draw on Feb 2004 until the end of 2023

Usage

```
EuroJackpotResults()
```

Value

A dataframe with all the EuroJackpot results

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
eurojackpot_results = EuroJackpotResults()
```

EuroLotteryAllCombinations *Returns all the possible number combinations for EuroMillions/EuroJackpot*

Description

Returns all the possible number combinations for EuroMillions/EuroJackpot

Usage

```
EuroLotteryAllCombinations()
```

Value

PnL figures

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
# returns all the 139,838,160 possible combinations, can create memory issues.
# all_combinations = EuroLotteryAllCombinations()
```

`EuroLotteryBacktesting`

Euromillions/EuroJackpot Backtesting

Description

Backtests the numbers the user has selected against the full (or the specified) history of Euromillions/EuroJackpot results

Usage

```
EuroLotteryBacktesting(euroLottery_results, date_since, user_input)
```

Arguments

`euroLottery_results`	The full list of EuroMillions/EuroJackpot results
`date_since`	The date after which the analysis is to be performed, i.e. 2022-12-22
`user_input`	The seven numbers the user has selected

Value

The backtested results

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
euromillions_results = EuroMillionsResults()
user_input = c(10,20,30,40,50,5,10)
backtested_results = EuroLotteryBacktesting(euromillions_results, '2005-01-01', user_input)
```

EuroMillionsExample *Euromillions analysis example*

Description

Displays how the functionality related to the euromillions analysis can be utilized

Usage

```
EuroMillionsExample()
```

Value

The final results

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
# This software is covered by GPL license and provided strictly for educational
# reasons (no actual investment/betting decisions should be taken based on this)

final_results = EuroMillionsExample()
```

EuroMillionsResults *Returns all the EuroMillions results until the end of 2023*

Description

Returns all the EuroMillions results since the first draw on Feb 2004 until the end of 2023

Usage

```
EuroMillionsResults()
```

Value

A dataframe with all the EuroMillions results

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
euromillions_results = EuroMillionsResults()
```

FxForward-class *FX Forward Class*

Description

Creates a FX Forward Object with the relevant info needed to calculate the Exposure-at-Default (EAD)

Arguments

Notional	The notional amount of the trade
MTM	The mark-to-market valuation of the trade
Currency	The currency that the input amounts are in
ccyPair	The currency Pair of the trade
Si	The number of years that the trade will take to start (zero if already started)
Ei	The number of years that the trade will expire
BuySell	Takes the values of either 'Buy' or 'Sell'
traded_price	the price that trade was done

Value

An object of type FX Forward

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

Basel Committee: The standardised approach for measuring counterparty credit risk exposures http://www.bis.org/publ/bcbs279.htm

Examples

```
## an FX Forward trade
tr1 = FxForward(Notional=10000,MtM=-50,Si=0,Ei=0.75,BuySell='Buy',ccyPair="EUR/USD")
## a dynamic version of the same trade
tr2 = FxForward(MtM=-50,Si=0,Ei=0.75,ccy_paying="USD",amount_paying=10000,
ccy_receiving="EUR",amount_receiving=9900)
tr2$base_ccy="EUR"
tr2$setFXDynamic()
```

FxSwap-class *Fx Swap Class*

Description

Creates an FX Swap object with the relevant info needed to calculate the Exposure-at-Default (EAD)

Arguments

Notional	The notional amount of the trade
MTM	The mark-to-market valuation of the trade
Currency	The currency that the input amounts are in
ccyPair	The currency Pair of the trade
Si	The number of years that the trade will take to start (zero if already started)
Ei	The number of years that the trade will expire
BuySell	Takes the values of either 'Buy' or 'Sell'
traded_price	the price that trade was done
fx_near_leg_fields	(Optional) In case the near leg hasn't settled yet, its notional, MtM, settlement date should be provided separated via a semicolon

Value

An object of type FXSwap

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

Basel Committee: The standardised approach for measuring counterparty credit risk exposures http://www.bis.org/publ/bcbs279.htm

Examples

```
tr1 = FxSwap(Notional=10000,MtM=30,ccyPair="EUR/USD",Si=0,Ei=10,
BuySell='Buy',fx_near_leg_fields='1000;-20;2020-02-11')
```

GetTradeDetails *Returns a list with the populated fields of a Trade Object*

Description

Returns a list with the populated fields of a Trade Object

Usage

```
GetTradeDetails(trade)
```

Arguments

trade	A trade Object

Value

A list of fields

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
example_trades = ParseTrades()
Equity_Index_Future_trade = example_trades[[18]]
populated_fields = GetTradeDetails(Equity_Index_Future_trade)
```

HashTable-class *Hashtable Class*

Description

Creates a hashtable-like object so as to represent data with a key structure (for example addon tables, rating-based factors etc). Also, it includes methods for populating the object via a .csv file and finding a value based on a specific key on an interval of keys For examples of the format of the CSVs files, please view RatingsMapping.csv or AddonTable.csv on the extdata folder in the installation folder of the library

Arguments

keys	A vector of keys
values	A vector of values mapping to the keys
keys_type	The type of the keys
values_type	The type of the values

Value

An object of type HashTable

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
## loading a ratings' mapping matrix from the extdata folder
rating_table = HashTable('RatingsMapping.csv',"character","numeric")
reg_weight =rating_table$FindValue("AAA")
```

InformationAdjustedBeta

Information Adjusted Beta

Description

Calculates the Information-Adjusted Beta between the track records of two assets/strategies which covers for cases whereby the 'typical' linearity and Gaussian I.I.D assumptions do not hold. The normalized cross sample entropy has been utilized for the mutual information estimation.

Usage

```
InformationAdjustedBeta(x, y, m = 2, r = 0.2)
```

Arguments

x	a vector containing the track record of the underlying asset/strategy (can be a data.table, data.frame, vector etc)
y	a vector containing the track record of the underlying asset/strategy (can be a data.table, data.frame, vector etc)
m	an integer value defining the embedding dimension for the sample entropy calculation, default value is 2
r	a double value defining the tolerance for the sample entropy calculation, default value is 0.2

Value

The information adjusted Beta

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

https://github.com/devisechain/Devise/blob/master/yellow_paper.pdf

Examples

```
x = PerformanceAnalytics::edhec[,c("Short Selling")]
y = PerformanceAnalytics::edhec[,c("Convertible Arbitrage")]
Information_Adjusted_Beta = InformationAdjustedBeta(x, y, m=2, r=0.2)
```

`InformationAdjustedCorr`

Information Adjusted Correlation

Description

Calculates the Information-Adjusted Correlation between the track records of various assets/strategies which covers for cases whereby the 'typical' Pearson's correlation assumptions do not hold. The normalized cross sample entropy has been utilized for the mutual information estimation.

Usage

```
InformationAdjustedCorr(x, y, m = 2, r = 0.2)
```

Arguments

`x`	a vector containing the track record of the underlying asset/strategy (can be a data.table, data.frame, vector etc)
`y`	a vector containing the track record of the underlying asset/strategy (can be a data.table, data.frame, vector etc)
`m`	an integer value defining the embedding dimension for the sample entropy calculation, default value is 2
`r`	a double value defining the tolerance for the sample entropy calculation, default value is 0.2

Value

The information adjusted correlation

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

https://github.com/devisechain/Devise/blob/master/yellow_paper.pdf

Examples

```
x = PerformanceAnalytics::edhec[,c("Short Selling")]
y = PerformanceAnalytics::edhec[,c("Convertible Arbitrage")]
Information_Adjusted_Corr = InformationAdjustedCorr(x, y, m=2, r=0.2)
```

IRDFuture-class *IRD Future Class*

Description

Creates an IRD Future Object with the relevant info needed to calculate the Exposure-at-Default (EAD)

Arguments

Notional	The notional amount of the trade
MTM	The mark-to-market valuation of the trade
Currency	The currency set that the trade belongs to
Si	The number of years that the trade will take to start (zero if already started)
Ei	The number of years that the trade will expire
BuySell	Takes the values of either 'Buy' or 'Sell'

Value

An object of type IRDFuture

IRDSwap-class *IRD Swap Class*

Description

Creates an IRD Swap Object with the relevant info needed to calculate the Exposure-at-Default (EAD)

Arguments

Notional	The notional amount of the trade
MTM	The mark-to-market valuation of the trade
Currency	The currency set that the trade belongs to
Si	The number of years that the trade will take to start (zero if already started)
Ei	The number of years that the trade will expire
BuySell	Takes the values of either 'Buy' or 'Sell'

Value

An object of type IRDSwap

Examples

```
# the IRD Swap trade given in the Basel regulation IRD example
tr1 = IRDSwap(Notional=10000,MtM=30,Currency="USD",Si=0,Ei=10,BuySell='Buy')
```

IRDSwaption-class *IRD Swaption Class*

Description

Creates an IRD Swaption Object with the relevant info needed to calculate the Exposure-at-Default (EAD)

Arguments

Notional	The notional amount of the trade
MTM	The mark-to-market valuation of the trade
Currency	The currency set that the trade belongs to
Si	The number of years that the trade will take to start (zero if already started)
Ei	The number of years that the trade will expire
BuySell	Takes the values of either 'Buy' or 'Sell'
OptionType	Takes the values of either 'Put' or 'Call'
UnderlyingPrice	The current price of the underlying
StrikePrice	The strike price of the option

Value

An object of type IRDSwaption

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

Basel Committee: The standardised approach for measuring counterparty credit risk exposures http://www.bis.org/publ/bcbs279.htm

Examples

```
# the Swaption trade given in the Basel regulation IRD example
tr3 = IRDSwaption(Notional=5000,MtM=50,Currency="EUR",Si=1,Ei=11,BuySell='Sell',
OptionType='Put',UnderlyingPrice=0.06,StrikePrice=0.05)
```

IRDSwapVol-class *IRD Swap Volatility Class*

Description

Creates an IRD Swap Volatility-based Object with the relevant info needed to calculate the Exposure-at-Default (EAD)

Value

An object of type IRDSwapVol

martingale_strategy_repetitions *Martingale Strategy Repetitions*

Description

Calculates the number of repetitions needed for a specific number of consequtive failed trades/bet to appear. This can apply to roulette betting but also trading algorithms which use the same logic on doubling down after a failed trade.

Usage

```
martingale_strategy_repetitions(
  length_of_targeted_sequence,
  prob_of_success = 18/37,
  simulations_num,
  trials_per_sim,
  quantile_perc
)
```

Arguments

length_of_targeted_sequence	The number of consecutive failed trades/bets that we try to calculate the expected number of repetitions for
prob_of_success	The probability of a sucessful trade/bet
simulations_num	The number of simulations to be run
trials_per_sim	The number of trials in each simulation
quantile_perc	(Optional) When set, the number of repetitions expected with such probability is returned.

Value

A list containing the number of repetitions needed to reach the targeted sequence for the first time in each simulation (will be zero if the sequence is not found) and, when the quantile_perc is set, the above number of repetitions.

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

https://en.wikipedia.org/wiki/Roulette#Betting_strategies_and_tactics

Examples

```
# This software is covered by GPL license and provided strictly for educational
# reasons (no actual investment or betting decisions should be taken based on this)
# On top of these, the below example contains a tiny number of simulations and
# trials just to pass CRAN tests - the user would have to highly increase both
# variables when running these.
repetitions_for_failed_sequence = martingale_strategy_repetitions(length_of_targeted_sequence = 8,
prob_of_success = 18/37, simulations_num = 1000, trials_per_sim = 10000, quantile_perc = 0.1)
repetitions_for_failed_sequence$relevant_quantile
summary(repetitions_for_failed_sequence$num_of_trials_needed)
```

NormXASampEn *Normalized Cross Sample Entropy*

Description

Calculates the Normalized Cross Sample Entropy of the track records of two assets/strategies based on the sample entropy.

Usage

```
NormXASampEn(x, y, m = 2, r = 0.2)
```

Arguments

x	a vector containing the track record of the underlying asset/strategy, this will be normalized during the algorithm
y	a vector containing the track record of the underlying asset/strategy, this will be normalized during the algorithm
m	an integer value defining the embedding dimension , default value is 2
r	a double value defining the tolerance, default value is 0.2

Value

A value containing the NormXASampEn

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

Lopez de Prado, Marcos, Codependence (Presentation Slides) (January 2, 2020). Available at SSRN: https://ssrn.com/abstract=3512994

Examples

```
x = PerformanceAnalytics::edhec[,c("Short Selling")]
y = PerformanceAnalytics::edhec[,c("Convertible Arbitrage")]
Normalized_Cross_Sample_Entropy = NormXASampEn(x, y, m=2, r=0.2)
```

OtherExposure-class *OtherExposure Class*

Description

Creates a OtherExposure Object with the relevant info needed to calculate the Exposure-at-Default (EAD)

Arguments

Notional	The notional amount of the trade
MTM	The mark-to-market valuation of the trade
Currency	The currency set that the trade belongs to
Si	The number of years that the trade will take to start (zero if already started)
Ei	The number of years that the trade will expire
BuySell	Takes the values of either 'Buy' or 'Sell'
SubClass	Defines the hedging set the relevant trade will belong to

Value

An object of type OtherExposure

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

Regulation (EU) 2019/876 of the European Parliament and of the Council of 20 May 2019 http://data.europa.eu/eli/reg/2019/8

Examples

```
tr1 = OtherExposure(Notional=10000,MtM=-50,Si=0,Ei=10,
BuySell='Buy',SubClass='Other_1')
```

`OuterJoinMerge` *Returns all possible combinations of two dataframes*

Description

Returns all possible combinations of two dataframes

Usage

```
OuterJoinMerge(df_a, df_b)
```

Arguments

`df_a`	The first dataframe
`df_b`	The second dataframe

Value

A dataframe with all combinations

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
df_a = data.frame(matrix(seq(1,20),nrow = 5, ncol = 4))
df_b = data.frame(matrix(seq(21,40),nrow = 5, ncol = 4))
joined_df = OuterJoinMerge(df_a, df_b)
```

`ParseTrades` *Parse trades through a .csv file.*

Description

Parse trades through a .csv file. In case no file name is given, an example file is automatically loaded containing trades corresponding to Basel's SA-CCR regulation (the example trades file can be found on the extdata folder in the installation library path)

Usage

```
ParseTrades(csvfilename)
```

Arguments

`csvfilename`	the name of csv file containing the trades

Value

A list of trades

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
## calling ParseTrades() without an argument loads a test file containing all
## the different trade types supported
example_trades = ParseTrades()
```

`roulette_pl_calculator_dalembert` *Roulette P&L betting based on the D'Alembert Betting System*

Description

Calculates the potential profit or loss when someone is betting in the roulette based on the D'Alembert Betting System

Usage

```
roulette_pl_calculator_dalembert(
  bet_minimum,
  bet_maximum,
  initial_capital,
  simulations_num,
  trials_per_sim
)
```

Arguments

bet_minimum	The minimum betting amount that the casino allows
bet_maximum	The maximum betting amount that the casino allows
initial_capital	The initial capital to be used
simulations_num	The number of simulations to be run
trials_per_sim	The number of trials in each simulation

Value

A list containing the minimum, the maximum and the final balance for each simulation. Also the P&L graph for the last simulation will be plotted.

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

https://en.wikipedia.org/wiki/Roulette#Betting_strategies_and_tactics

Examples

```
# This software is covered by GPL license and provided strictly for educational
# reasons (no actual investment/betting decisions should be taken based on this)
# On top of these, the below example contains a tiny number of simulations and
# trials just to pass CRAN tests - the user would have to highly increase both
# variables when running these.
pl_results = roulette_pl_calculator_dalembert(bet_minimum = 0.1 , bet_maximum = 3276.8,
initial_capital = 20000, simulations_num = 100, trials_per_sim = 100)
summary(pl_results$min_capital)
summary(pl_results$max_capital)
summary(pl_results$final_capital)
```

`roulette_pl_calculator_fibonacci` *Roulette P&L betting based on the Fibonacci Betting System*

Description

Calculates the potential profit or loss when someone is betting in the roulette based on the Fibonacci Betting System.

Usage

```
roulette_pl_calculator_fibonacci(
  bet_minimum,
  bet_maximum,
  initial_capital,
  simulations_num,
  trials_per_sim
)
```

Arguments

`bet_minimum`	The minimum betting amount that the casino allows
`bet_maximum`	The maximum betting amount that the casino allows
`initial_capital`	The initial capital to be used
`simulations_num`	The number of simulations to be run
`trials_per_sim`	The number of trials in each simulation

Value

A list containing the minimum, the maximum and the final balance for each simulation. Also the P&L graph for the last simulation will be plotted.

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

https://en.wikipedia.org/wiki/Roulette#Betting_strategies_and_tactics

Examples

```
# This software is covered by GPL license and provided strictly for educational
# reasons (no actual investment or betting decisions should be taken based on this)
# On top of these, the below example contains a tiny number of simulations and
# trials just to pass CRAN tests - the user would have to highly increase both
# variables when running these.
pl_results = roulette_pl_calculator_fibonacci(bet_minimum = 0.1 , bet_maximum = 6000,
 initial_capital = 20000, simulations_num = 100, trials_per_sim = 100)
summary(pl_results$min_capital)
summary(pl_results$max_capital)
summary(pl_results$final_capital)
```

---

roulette_pl_calculator_labouchere

Roulette P&L betting based on the Labouchere Betting System

Description

Calculates the potential profit or loss when someone is betting in the roulette based on the Labouchere Betting System.

Usage

```
roulette_pl_calculator_labouchere(
  bet_minimum,
  bet_maximum,
  initial_capital,
  profit_target,
  profit_sequence,
  simulations_num,
  trials_per_sim
)
```

Arguments

`bet_minimum`	The minimum betting amount that the casino allows
`bet_maximum`	The maximum betting amount that the casino allows
`initial_capital`	The initial capital to be used
`profit_target`	The profit amount to be earned
`profit_sequence`	(Optional) the amounts of the bets to reach this profit amount. If omitted, the minimum betting amount will be used
`simulations_num`	The number of simulations to be run
`trials_per_sim`	The number of trials in each simulation

Value

A list containing the minimum, the maximum and the final balance for each simulation. Also the P&L graph for the last simulation will be plotted.

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

https://en.wikipedia.org/wiki/Roulette#Betting_strategies_and_tactics

Examples

```
# This software is covered by GPL license and provided strictly for educational
# reasons (no actual investment/betting decisions should be taken based on this)
# On top of these, the below example contains a tiny number of simulations and
# trials just to pass CRAN tests - the user would have to highly increase both
# variables when running these.
pl_results = roulette_pl_calculator_labouchere(bet_minimum = 0.1 , bet_maximum = 3276.8,
initial_capital = 20000, profit_target = 100, profit_sequence = rep(10,10),
 simulations_num = 100, trials_per_sim = 100)
summary(pl_results$min_capital)
summary(pl_results$max_capital)
summary(pl_results$final_capital)
```

---

roulette_pl_calculator_martingale

Roulette P&L betting based on a modified martingale strategy

Description

Calculates the potential profit or loss when someone is betting in the roulette based on the martingale system while trying to reduce the risk by 1. Starting to double after the first loss 2. Not doubling if the second number is zero.

Usage

```
roulette_pl_calculator_martingale(
  bet_minimum,
  bet_maximum,
  initial_capital,
  simulations_num,
  trials_per_sim
)
```

Arguments

bet_minimum	The minimum betting amount that the casino allows
bet_maximum	The maximum betting amount that the casino allows
initial_capital	The initial capital to be used
simulations_num	The number of simulations to be run
trials_per_sim	The number of trials in each simulation

Value

A list containing the minimum, the maximum and the final balance for each simulation. Also the P&L graph for the last simulation will be plotted.

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

https://en.wikipedia.org/wiki/Roulette#Betting_strategies_and_tactics

Examples

```
# This software is covered by GPL license and provided strictly for educational
# reasons (no actual investment/betting decisions should be taken based on this)
# On top of these, the below example contains a tiny number of simulations and
# trials just to pass CRAN tests - the user would have to highly increase both
# variables when running these.
pl_results = roulette_pl_calculator_martingale(bet_minimum = 0.1 , bet_maximum = 3276.8,
initial_capital = 20000, simulations_num = 100, trials_per_sim = 100)
summary(pl_results$min_capital)
summary(pl_results$max_capital)
summary(pl_results$final_capital)
```

---

roulette_pl_calculator_specific_number

Roulette P&L betting on a specific number

Description

Calculates the potential profit or loss when someone is betting on a specific number in the roulette and keeps doubling every eighteen spins if the number hasn't appeared yet.

Usage

```
roulette_pl_calculator_specific_number(
  bet_minimum,
  bet_maximum,
  initial_capital,
  targeted_number,
  simulations_num,
  trials_per_sim,
  stop_loss
)
```

Arguments

bet_minimum	The minimum betting amount that the casino allows
bet_maximum	The maximum betting amount that the casino allows
initial_capital	The initial capital to be used
targeted_number	The specific number that we expect to be drawn (statistically speaking, this should have zero effect on the results)
simulations_num	The number of simulations to be run
trials_per_sim	The number of trials in each simulation
stop_loss	(Optional) The number of spins after which the betting amount will go back to the minimum if the targeted number hasn't appeared.

Value

A list containing the minimum, the maximum and the final balance for each simulation. Also the P&L graph for the last simulation will be plotted.

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

https://en.wikipedia.org/wiki/Roulette#Betting_strategies_and_tactics

Examples

```
# This software is covered by GPL license and provided strictly for educational
# reasons (no actual investment or betting decisions should be taken based on this)
# On top of these, the below example contains a tiny number of simulations and
# trials just to pass CRAN tests - the user would have to highly increase both
# variables when running these.
pl_results = roulette_pl_calculator_specific_number(bet_minimum =0.1 , bet_maximum = 3276.8,
initial_capital = 20000, targeted_number = 0, simulations_num = 100,
```

```
trials_per_sim = 100, stop_loss = 180)
summary(pl_results$min_capital)
summary(pl_results$max_capital)
summary(pl_results$final_capital)
```

SampleEntropy *Sample Entropy*

Description

Calculates the sample entropy of a track record. Sample entropy is an improvement of the approximate entropy and should produce accurate results for timeseries of smaller length like historical returns of strategies

Usage

```
SampleEntropy(returns, m = 2, r = 0.2)
```

Arguments

returns	a vector containing the track record of the underlying asset/strategy, these will be normalized during the algorithm
m	an integer value defining the embedding dimension , default value is 2
r	a double value defining the tolerance, default value is 0.2

Value

The sample Entropy of the input returns

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

https://en.wikipedia.org/wiki/Sample_entropy

Examples

```
## calling SampleEntropy() without an argument loads the historical edhec
## data for the "Short Selling" strategy
returns = PerformanceAnalytics::edhec[,c("Short Selling")]
Sample_Entropy = SampleEntropy(returns,m=2,r=0.2)
```

SelectDerivatives *Select the derivatives out of a trades' list*

Description

Select the derivatives out of a trades' list which will be utilized to calculate the CCR Exposure.

Usage

```
SelectDerivatives(trades_list)
```

Arguments

trades_list	the file holding the trades of the portfolio

Value

The derivatives out of a trades' list

Author(s)

Tasos Grivas <info@openriskcalculator.com>

References

Regulation (EU) 2019/876 of the European Parliament and of the Council of 20 May 2019 http://data.europa.eu/eli/reg/2019/8

SetForLifeBacktesting *Set For Life Backtesting*

Description

Backtests the numbers the user has selected against the full (or the specified) history of Set For Life results

Usage

```
SetForLifeBacktesting(setforlife_results, date_since, user_input)
```

Arguments

setforlife_results	The full list of Set For Life results
date_since	The date after which the analysis is to be performed, i.e. 2022-12-22
user_input	The seven numbers the user has selected

Value

The backtested results

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
setforlife_results = SetForLifeResults()
user_input = c(10,20,30,40,50,5,10)
backtested_results = SetForLifeBacktesting(setforlife_results, '2005-01-01', user_input)
```

SetForLifeExample *Set For Life analysis example*

Description

Displays how the functionality related to the Set For Life analysis can be utilized

Usage

```
SetForLifeExample()
```

Value

The final results

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
# This software is covered by GPL license and provided strictly for educational
# reasons (no actual investment/betting decisions should be taken based on this)

final_results = SetForLifeExample()
```

SetForLifeResults *Returns all the EuroJackpot results until the end of 2023*

Description

Returns all the SetForLifeResults results since the first draw on Feb 2004 until the end of 2023

Usage

```
SetForLifeResults()
```

Value

A dataframe with all the EuroJackpot results

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
eurojackpot_results = EuroJackpotResults()
```

top5 *Top 5 most or least lucky numbers for EuroMillions/EuroJackpot*

Description

Returns the top 5 most or least lucky euromillion numbers

Usage

```
top5(eurolottery_results, date_since, least_lucky = FALSE)
```

Arguments

eurolottery_results	The full list of EuroMillions/EuroJackpot results
date_since	The date after which the analysis is to be performed, i.e. 2022-12-22
least_lucky	If TRUE, the least lucky numbers will be returned (default FALSE)

Value

Top 5 numbers

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
euromillions_results = EuroMillionsResults()
top_5 = top5(euromillions_results, '2022-12-22', least_lucky=TRUE)
```

Total_Carbon_Emissions

Total Carbon Emissions

Description

Returns the absolute greenhouse gas emissions associated with a portfolio, expressed in tons CO2e. Under this approach, if an investor owns 5 percent of a company's total market capitalization, then the investor owns 5 percent of the company as well as 5 percent of the company's GHG (or carbon) emissions.

Usage

```
Total_Carbon_Emissions(portfolio_exposure, emissions_capitalization_data)
```

Arguments

`portfolio_exposure`
: The exposure per issuer in the portfolio

`emissions_capitalization_data`
: The capitalization and the Scope 1 & 2 GHG emissions per issuer

Value

The absolute greenhouse gas emissions associated with a portfolio, expressed in tons CO2e

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

https://www.tcfdhub.org/Downloads/pdfs/E09

Examples

```
portfolio_exposure     = data.table::data.table(Issuers = c('A','B','C'),
exposures = c(100, 200, 50))
emissions_capitalization_data = data.table::data.table(Issuers = c('A','B','C'),
 emissions = c(1000, 5000, 6000),
 Capitalization = c(20000, 10000, 30000))
Total_Carbon_Emissions(portfolio_exposure, emissions_capitalization_data)
```

`UKLotteryBacktesting` *UKLottery Backtesting*

Description

Backtests the numbers the user has selected against the full (or the specified) history of UKLottery results

Usage

```
UKLotteryBacktesting(uklottery_results, date_since, user_input)
```

Arguments

`uklottery_results`	The full list of UKLottery results
`date_since`	The date after which the analysis is to be performed, i.e. 2022-12-22
`user_input`	The seven numbers the user has selected

Value

The backtested results

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
uklottery_results = UKLotteryResults()
user_input = c(5,10,20,30,40,50)
backtested_results = UKLotteryBacktesting(uklottery_results, '2005-01-01', user_input)
```

UKLotteryExample *UK Lottery analysis example*

Description

Displays how the functionality related to the UK Lottery analysis can be utilized

Usage

```
UKLotteryExample()
```

Value

The final results

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
# This software is covered by GPL license and provided strictly for educational
# reasons (no actual investment/betting decisions should be taken based on this)

final_results = UKLotteryExample()
```

UKLotteryResults *Returns all the UKLottery results until the beginning of 2025*

Description

Returns all the UKLottery results since the first draw on Nov 1994 until the beginning of 2025

Usage

```
UKLotteryResults()
```

Value

A dataframe with all the UKLottery results

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
UKLotto_results = UKLotteryResults()
```

UKThunderballBacktesting *UK ThunderBall Backtesting*

Description

Backtests the numbers the user has selected against the full (or the specified) history of UK ThunderBall results

Usage

```
UKThunderballBacktesting(ukthunderball_results, date_since, user_input)
```

Arguments

ukthunderball_results	The full list of UK ThunderBall results
date_since	The date after which the analysis is to be performed, i.e. 2022-12-22
user_input	The seven numbers the user has selected

Value

The backtested results

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
ukthunderball_results = UKThunderBallResults()
user_input = c(10,20,30,31,32,5)
backtested_results = UKThunderballBacktesting(ukthunderball_results, user_input = user_input)
```

UKThunderballExample *UK ThunderBall analysis example*

Description

Displays how the functionality related to the UK ThunderBall analysis can be utilized

Usage

```
UKThunderballExample()
```

Value

The final results

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
# This software is covered by GPL license and provided strictly for educational
# reasons (no actual investment/betting decisions should be taken based on this)

final_results = EuroJackpotExample()
```

UKThunderBallResults *Returns all the UK ThunderBall results until the beginning of 2025*

Description

Returns all the UK ThunderBall results until the beginning of 2025

Usage

```
UKThunderBallResults()
```

Value

A dataframe with all the UK ThunderBall results

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

Examples

```
UKThunderBall_Results = UKThunderBallResults()
```

`VariationOfInformation` *Variation of Information*

Description

Calculates the variation of information of the track records of two assets/strategies based on the sample entropy.

Usage

```
VariationOfInformation(x, y, m = 2, r = 0.2, normalized = TRUE)
```

Arguments

`x`	a vector containing the track record of the underlying asset/strategy, this will be normalized during the algorithm
`y`	a vector containing the track record of the underlying asset/strategy, this will be normalized during the algorithm
`m`	an integer value defining the embedding dimension , default value is 2
`r`	a double value defining the tolerance, default value is 0.2
`normalized`	a boolean value so as to bound the return value between 0 and 1, default value is TRUE

Value

A value containing the variation of information

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

Lopez de Prado, Marcos, Codependence (Presentation Slides) (January 2, 2020). Available at SSRN: https://ssrn.com/abstract=3512994

Examples

```
x = PerformanceAnalytics::edhec[,c("Short Selling")]
y = PerformanceAnalytics::edhec[,c("Convertible Arbitrage")]
variation_of_information = VariationOfInformation(x, y, m=2, r=0.2, normalized = TRUE)
```

`Weighted_Average_Carbon_Intensity` *Weighted Average Carbon Intensity*

Description

Returns the portfolio's exposure to each issuer expressed in tons CO2e / $M revenue. Scope 1 and Scope 2 GHG emissions are allocated based on portfolio weights (the current value of the investment relative to the current portfolio value), rather than the equity ownership approach

Usage

```
Weighted_Average_Carbon_Intensity(portfolio_exposure, emissions_revenue_data)
```

Arguments

`portfolio_exposure`
: The exposure per issuer in the portfolio

`emissions_revenue_data`
: The capitalization, revenue and the Scope 1 & 2 GHG emissions per issuer

Value

Total carbon emissions for a portfolio normalized by the market value of the portfolio, expressed in tons CO2e / $M invested.

Author(s)

Tasos Grivas <tasos@openriskcalculator.com>

References

https://www.tcfdhub.org/Downloads/pdfs/E09

Examples

```
portfolio_exposure     = data.table::data.table(Issuers = c('A','B','C'),
 exposures = c(100, 200, 50))
emissions_revenue_data = data.table::data.table(Issuers = c('A','B','C'),
emissions = c(1000, 5000, 2000),
 revenue = c(2000, 5000, 3000))
Weighted_Average_Carbon_Intensity(portfolio_exposure, emissions_revenue_data)
```

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