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**Description**

Compute the parameters of the beta distribution and plot normalized data.

**Usage**

```r
beta_parameters(data)
```

**Arguments**

- `data` A vector of interest rates.

**Author(s)**

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

**Source**


**Examples**

```r
# example 1
data=c(0.00,-0.05,-0.05,-0.06,-0.06,0.02,-0.06,-0.05,-0.04,-0.05,
-0.03,-0.06,0.04,-0.05,-0.08,-0.05,-0.12,-0.03,-0.05,-0.04,-0.06)
beta_parameters(data)

# example 2
data<-rnorm(n=200,m=0.075,sd=0.2)
beta_parameters(data)
```
Computes the final expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate \( X \), using the tetraparametric function approach.

**Description**

Compute the final expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate \( X \), using the tetraparametric function approach.

**Usage**

\[
\text{FV}_\text{post}_\text{artan}(\text{data}, \text{years})
\]

**Arguments**

- `data` A vector of interest rates.
- `years` The number of years of the income. Default is 10 years.

**Author(s)**

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

**Source**


**Examples**

```r
# example 1
data=c(0.298, 0.255, 0.212, 0.180, 0.165, 0.163, 0.167, 0.161, 0.154,
  0.128, 0.079, 0.059, 0.042, -0.008, -0.012, -0.002)
FV_post_artan(data,6)

# example 2
data<-rnorm(n=30,m=0.03,sd=0.01)
FV_post_artan(data,10)
```
FV_post_beta_kmom

Compute the final expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate \( X \), using the estimated moments of the beta distribution.

Description

Compute the final expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate \( X \), using the estimated moments of the beta distribution.

Usage

FV_post_beta_kmom(data,years)

Arguments

data
A vector of interest rates.

years
The number of years of the income. Default is 10 years.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Source


Examples

# example 1
data=c(0.00,-0.05,-0.05,-0.06,-0.06,0.02,-0.06,-0.05,-0.04,-0.05,
-0.03,-0.06,0.04,-0.05,-0.08,-0.05,-0.12,-0.03,-0.05,-0.04,-0.06)
FV_post_beta_kmom(data,8)

# example 2
data<-rnorm(n=200,m=0.075,sd=0.2)
FV_post_beta_kmom(data,8)
FV_post_mood

Compute the final expected value of an $n$-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate $X$, using the method of Mood et al.

Description

Compute the final expected value of an $n$-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate $X$, using the method of Mood et al.

Usage

FV_post_mood(data,years)

Arguments

data A vector of interest rates.
years The number of years of the income. Default is 10 years.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Source

Cruz Rambaud, S.; Maturo, F. and Sánchez Pérez A. M. (2017): “Expected present and final value of an annuity when some non-central moments of the capitalization factor are unknown: Theory and an application using R”. In Š. Hošková-Mayerová, et al. (Eds.), Mathematical-Statistical Models and Qualitative Theories for Economic and Social Sciences (pp. 233-248). Springer, Cham. doi:10.1007/978-3-319-54819-7_16.

Examples

```r
# example 1
data=c(0.298,0.255,0.212,0.180,0.165,0.163,0.167,0.161,0.154,
0.128,0.079,0.059,0.042,-0.008,-0.012,-0.002)
FV_post_mood(data,6)

# example 2
data<-rnorm(n=30,m=0.03,sd=0.01)
FV_post_mood(data,10)
```
Compute the final expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate \( x \), using the estimated moments of the normal distribution.

**Description**

Compute the final expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate \( x \), using the estimated moments of the normal distribution.

**Usage**

\[
\text{FV\_post\_norm\_kmom}(\text{data}, \text{years})
\]

**Arguments**

- **data**: A vector of interest rates.
- **years**: The number of years of the income. Default is 10 years.

**Author(s)**

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

**Source**


**Examples**

```r
# example 1
data = c(1.77, 1.85, 1.85, 1.84, 1.84, 1.83, 1.85, 1.85, 1.85, 1.85, 1.85, 1.85, 1.85, 1.85, 1.85, 1.85, 1.85, 1.85, 1.85, 1.85, 1.85)
data = data/100
FV_post_norm_kmom(data, 8)

# example 1
data = rnorm(n=200, m=0.075, sd=0.2)
orm_test_jb(data) # test data
FV_post_norm_kmom(data, 8)
```
Compute the final expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate \( X \), using the quadratic discount method.

**Description**

Compute the final expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate \( X \), using the quadratic discount method.

**Usage**

\[
\text{FV\textunderscore post\textunderscore quad(data, } years)\]

**Arguments**

- **data**: A vector of interest rates.
- **years**: The number of years of the income. Default is 10 years.

**Author(s)**

Salvador Cruz Ramínd, Fabrizio Maturo, Ana María Sánchez Pérez

**Source**


**Examples**

```r
# example 1
data\textasciitilde c(0.298, 0.255, 0.212, 0.188, 0.165, 0.163, 0.167, 0.161, 0.154, 0.128, 0.079, 0.059, 0.042, -0.008, -0.012, -0.002)
FV\textunderscore post\textunderscore quad(data, 8)

# example 2
data\textasciitilde rnorm(n=30, m=0.03, sd=0.01)
FV\textunderscore post\textunderscore quad(data, 10)
```
**Description**

Compute the final expected value of an n-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate $X$, using the tetraparametric function approach.

**Usage**

```r
FV_pre_artan(data, years)
```

**Arguments**

- `data`: A vector of interest rates.
- `years`: The number of years of the income. Default is 10 years.

**Author(s)**

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

**Source**


**Examples**

```r
# example 1
data=c(0.298, 0.255, 0.212, 0.180, 0.165, 0.163, 0.167, 0.161, 0.154,
  0.128, 0.079, 0.059, 0.042, -0.008, -0.012, -0.002)
FV_pre_artan(data, 6)

# example 2
data<-rnorm(n=30, m=0.03, sd=0.01)
FV_pre_artan(data, 10)
```
**FV_pre_beta_kmom**

*compute the final expected value of an n-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate X, using the estimated moments of the beta distribution.*

**Description**

Compute the final expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate \( X \), using the estimated moments of the beta distribution.

**Usage**

\[
\text{FV}_\text{pre}\_beta\_kmom(data, \text{years})
\]

**Arguments**

- **data**
  - A vector of interest rates.

- **years**
  - The number of years of the income. Default is 10 years.

**Author(s)**

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

**Source**


**Examples**

```r
# example 1
data=c(0.00,-0.05,-0.05,-0.06,0.02,-0.06,-0.05,-0.04,-0.05,-0.03,-0.05,0.04,-0.05,-0.08,-0.05,-0.05,-0.01,-0.03,-0.05,-0.04,-0.06)
FV_pre_beta_kmom(data,8)

# example 2
data<-rnorm(n=200,m=0.075,sd=0.2)
FV_pre_beta_kmom(data,8)
```
FV_pre_mood

Compute the final expected value of an $n$-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate $X$, using the method of Mood et al.

Description

Compute the final expected value of an $n$-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate $X$, using the method of Mood et al.

Usage

FV_pre_mood(data, years)

Arguments

data: A vector of interest rates.
years: The number of years of the income. Default is 10 years.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Source

Cruz Rambaud, S.; Maturo, F. and Sánchez Pérez A. M. (2017): “Expected present and final value of an annuity when some non-central moments of the capitalization factor are unknown: Theory and an application using R”. In Š. Hošková-Mayerová, et al. (Eds.), Mathematical-Statistical Models and Qualitative Theories for Economic and Social Sciences (pp. 233-248). Springer, Cham. doi:10.1007/978-3-319-54819-7_16.

Examples

# example 1
data=c(0.298, 0.255, 0.212, 0.180, 0.165, 0.163, 0.167, 0.161, 0.154, 0.128, 0.079, 0.059, 0.042, -0.008, -0.012, -0.002)
FV_pre_mood(data, 6)

# example 2
data<-rnorm(n=30, m=0.03, sd=0.01)
FV_pre_mood(data, 10)
FV_pre_norm_kmom

FV_pre_norm_kmom  Compute the final expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate \( X \), using the estimated moments of the normal distribution.

Description

Compute the final expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate \( X \), using the estimated moments of the normal distribution.

Usage

\[
FV\_pre\_norm\_kmom(data, years)
\]

Arguments

data  A vector of interest rates.
years  The number of years of the income. Default is 10 years.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Source


Examples

```r
# example 1
data<-rnorm(n=30,m=0.03,sd=0.01)
norm_test_jb(data) # test data
FV_pre_norm_kmom(data,8)

# example 2
data<-rnorm(n=200,m=0.075,sd=0.2)
norm_test_jb(data) # test data
FV_pre_norm_kmom(data,8)
```
**FV_pre_quad**

*Compute the final expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate \( X \), using the quadratic discount method.*

---

**Description**

Compute the final expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate \( X \), using the quadratic discount method.

**Usage**

\[
FV\_pre\_quad(data, years)
\]

**Arguments**

- `data`: A vector of interest rates.
- `years`: The number of years of the income. Default is 10 years.

**Author(s)**

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

**Source**


**Examples**

```
# example 1
data=c(0.298,0.255,0.212,0.180,0.165,0.163,0.167,0.161,0.154,
     0.128,0.079,0.059,0.042,-0.008,-0.012,-0.002)
FV_pre_quad(data,6)

# example 2
data<-rnorm(n=30,m=0.03,sd=0.01)
FV_pre_quad(data,10)
```
moment

Compute the exact moments of a distribution.

Description

Compute the exact moments of a distribution.

Usage

\texttt{moment(x, order, central, absolute, na.rm)}

Arguments

- \texttt{x}: A vector \( X \) of interest rates.
- \texttt{order}: The order of moment that should be computed. Default is 1.
- \texttt{central}: If central moments are to be computed. Default is "FALSE".
- \texttt{absolute}: If absolute moments are to be computed. Default is "FALSE".
- \texttt{na.rm}: If missing values should be removed. Default is "FALSE".

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Source


Examples

```r
#example 1
data=c(1.77,1.85,1.85,1.84,1.84,1.83,1.85,1.85,1.88,1.85,1.85,1.80,1.84,1.91,1.85,1.84,1.85,
1.86,1.85,1.88,1.86)
moment(data,3)
```
norm_mom

**norm_mom**

*Fit the data to a normal curve and compute the moments of the normal distribution according to the definition (as integral).*

---

**Description**

Fit the data to a normal curve and compute the moments of the normal distribution according to the definition (as integral).

**Usage**

```r
norm_mom(data, order)
```

**Arguments**

- `data` A vector X of interest rates.
- `order` The order of moment that should be computed.

**Author(s)**

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

**Source**


**Examples**

```r
#example 1
data=c(1.77,1.85,1.85,1.84,1.84,1.83,1.85,1.85,1.88,1.85,1.80,1.84,1.91,1.85,1.84,1.85,
       1.86,1.85,1.88,1.86)
data=data/100
norm_mom(data,5)
```
norm_test_jb  

Compute the Jarque-Bera test for checking the assumption of normality of the interest rates distribution and returns the parameters of the fitted normal distribution.

Description

Compute the Jarque-Bera test for checking the assumption of normality of the interest rates distribution and returns the parameters of the fitted normal distribution.

Usage

```r
norm_test_jb(data)
```

Arguments

- `data`  
  A vector of interest rates.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Source


Examples

```
# example 1
data=c(0.298, 0.255, 0.212, 0.180, 0.165, 0.163, 0.167, 0.161, 
0.154, 0.128, 0.079, 0.059, 0.042, -0.008, -0.012, -0.002)
norm_test_jb(data)

# example 2
data<-rnorm(n=30, m=0.03, sd=0.01)
norm_test_jb(data)

# example 3
data=runif(999, min = 0, max = 1)
norm_test_jb(data)

# example 4
data=c(0.00, -0.05, -0.05, -0.06, -0.06, 0.02, -0.06, -0.05, -0.04, -0.05, 
-0.03, -0.06, 0.04, -0.05, -0.08, -0.05, -0.12, -0.03, -0.05, -0.04, -0.06)
norm_test_jb(data)
```
Plot the final expected values of an $n$-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate $X$, using different approaches.

**Description**

Plot the final expected values of an $n$-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate $X$, using different approaches.

**Usage**

```r
plot_FVs_post(data, years, lwd, lty1, lty2, lty3)
```

**Arguments**

- `data` A vector of interest rates.
- `years` The number of years of the income. Default is 10 years.
- `lwd` The width of the curve. Default is 1.5.
- `lty1` The style of the curve for the "arctan" approximation. Default is 1.
- `lty2` The style of the curve for the "cubic" approximation. Default is 2.
- `lty3` The style of the curve for the "mood" approximation. Default is 3.

**Author(s)**

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

**Examples**

```r
# example 1
data <- c(1.77,1.85,1.85,1.84,1.84,1.83,1.85,1.85,1.85,1.88,1.85,1.85,1.80,1.84,1.91,1.85,1.84,1.85,1.86,1.85,1.88,1.86)
data <- data/100
plot_FVs_post(data)

# example 2
data <- rnorm(n=30, m=0.03, sd=0.003)
plot_FVs_post(data)
```
### Description

Plot the final expected values of an \( n \)-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate \( X \), using different approaches.

### Usage

```r
plot_FVs_pre(data, years, lwd, lty1, lty2, lty3)
```

### Arguments

- `data` A vector of interest rates.
- `years` The number of years of the income. Default is 10 years.
- `lwd` The width of the curve. Default is 1.5.
- `lty1` The style of the curve for the "arctan" approximation. Default is 1.
- `lty2` The style of the curve for the "cubic" approximation. Default is 2.
- `lty3` The style of the curve for the "mood" approximation. Default is 3.

### Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

### Examples

```r
# example 1
data = c(1.77, 1.85, 1.84, 1.84, 1.83, 1.85, 1.85, 1.85, 1.88, 1.85, 1.80, 1.84, 1.91, 1.85, 1.84, 1.85, 1.86, 1.85, 1.88, 1.86)
data=data/100
plot_FVs_pre(data)

# example 2
data<-rnorm(n=30,m=0.03,sd=0.003)
plot_FVs_pre(data)
```
plot_FV_post_beta_kmom

Plot the final expected value of an $n$-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate $X$, using the estimated moments of the beta distribution.

Description

Plot the final expected value of an $n$-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate $X$, using the estimated moments of the beta distribution.

Usage

plot_FV_post_beta_kmom(data, years, lwd, lty)

Arguments

data A vector of interest rates.
years The number of years of the income. Default is 10 years.
lwd The width of the curve. Default is 1.5.
lty The style of the curve. Default is 1.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Examples

# example 1
data<-runif(34, 0, 1)
plot_FV_post_beta_kmom(data, 8)

plot_FV_post_norm_kmom

Plot the final expected value of an $n$-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate $X$, using the estimated moments of the normal distribution.
plot_FV_pre_beta_kmom

Description
Plot the final expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate \( X \), using the estimated moments of the beta distribution.

Usage
plot_FV_pre_beta_kmom(data,years,lwd,lty)

Arguments
- **data**: A vector of interest rates.
- **years**: The number of years of the income. Default is 10 years.
- **lwd**: The width of the curve. Default is 1.5.
- **lty**: The style of the curve. Default is 1.

Author(s)
Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Examples

```r
# example 1
data<-rnorm(n=30,m=0.03,sd=0.01)
plot_FV_post_norm_kmom(data,8)

# example 2
data<-rnorm(n=200,m=0.075,sd=0.2)
plot_FV_post_norm_kmom(data,8)
```

---

plot_FV_pre_beta_kmom  
*Plot the final expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate \( X \), using the estimated moments of the beta distribution.*

---

Description
Plot the final expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate \( X \), using the estimated moments of the beta distribution.

Usage
plot_FV_pre_beta_kmom(data,years,lwd,lty)
Arguments

- **data**: A vector of interest rates.
- **years**: The number of years of the income. Default is 10 years.
- **lwd**: The width of the curve. Default is 1.5.
- **lty**: The style of the curve. Default is 1.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Examples

```r
# example 1
data<-runif(34, 0,1)
plot_FV_pre_beta_kmom(data,8)
```

Description

Plot the final expected value of an $n$-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate $X$, using the estimated moments of the normal distribution.

Usage

`plot_FV_pre_norm_kmom(data,years,lwd,lty)`

Arguments

- **data**: A vector of interest rates.
- **years**: The number of years of the income. Default is 10 years.
- **lwd**: The width of the curve. Default is 1.5.
- **lty**: The style of the curve. Default is 1.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez
Examples

# example 1
data<-rnorm(n=30,m=0.03,sd=0.01)
plot_FV_pre_norm_kmom(data,8)

# example 2
data<-rnorm(n=200,m=0.075,sd=0.2)
plot_FV_pre_norm_kmom(data,8)

plot_PVs_post

Plot the present expected values of an \( n \)-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate \( X \), using different approaches.

Description

Plot the present expected values of an \( n \)-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate \( X \), using different approaches.

Usage

plot_PVs_post(data,years,lwd,lty1,lty2,lty3,lty4,ltyU,ltyV)

Arguments

data A vector of interest rates.
years The number of years of the income. Default is 10 years.
lwd The width of the curve. Default is 1.5.
lty1 The style of the curve for the "arctan" approximation. Default is 1.
lty2 The style of the curve for the "cubic" approximation. Default is 2.
lty3 The style of the curve for the "mood with positive moments" approximation. Default is 3.
lty4 The style of the curve for the "mood with negative moments" approximation. Default is 4.
ltyU The style of the curve for the exact value. Default is 5.
ltyV The style of the curve for "triangular distribution" approximation. Default is 6.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez
Examples

# example 1
data = c(1.77, 1.85, 1.85, 1.84, 1.84, 1.83, 1.85, 1.85, 1.85, 1.88, 1.85, 1.80, 1.84, 1.91, 1.85, 1.84, 1.85, 1.86, 1.85, 1.88, 1.86)
data = data / 100
plot_PVs_pre(data)

# example 2
data = rnorm(n=30, m=0.03, sd=0.003)
plot_PVs_pre(data)

plot_PVs_pre  
Plot the present expected values of an $n$-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate $X$, using different approaches.

Description

Plot the present expected values of an $n$-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate $X$, using different approaches.

Usage

plot_PVs_pre(data, years, lwd, lty1, lty2, lty3, lty4, lty5, lty6)

Arguments

data  A vector of interest rates.
years  The number of years of the income. Default is 10 years.
lwd  The width of the curve. Default is 1.5.
lty1  The style of the curve for the "arctan" approximation. Default is 1.
lty2  The style of the curve for the "cubic" approximation. Default is 2.
lty3  The style of the curve for the "mood with positive moments" approximation. Default is 3.
lty4  The style of the curve for the "mood with negative moments" approximation. Default is 4.
lty5  The style of the curve for the exact value. Default is 5.
lty6  The style of the curve for "triangular distribution" approximation. Default is 6.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez
Examples

# example 1
data = c(1.77, 1.85, 1.84, 1.83, 1.85, 1.85, 1.88, 1.84, 1.91, 1.85, 1.84, 1.85, 1.86, 1.85, 1.88, 1.86)
data=data/100
plot_PVs_pre(data)

# example 2
data<-rnorm(n=30,m=0.03,sd=0.003)
plot_PVs_pre(data)

---

**PV_post_artan**

*Compute present expected value of an n-payment annuity, with payments of 1 unit each, made at the end of every year (annuity-immediate), valued at the rate X, using the tetraparametric function approach.*

Description

Compute present expected value of an n-payment annuity, with payments of 1 unit each, made at the end of every year (annuity-immediate), valued at the rate X, using the tetraparametric function approach.

Usage

```
PV_post_artan(data,years)
```

Arguments

- **data**: A vector of interest rates.
- **years**: The number of years of the income. Default is 10 years.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Source

**PV_post_cubic**

Compute the present expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the end of every year (annuity-due), valued at the rate \( X \), using the cubic discount method.

### Description

Compute the present expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the end of every year (annuity-due), valued at the rate \( X \), using the cubic discount method.

### Usage

\[
PV_post_cubic(data, years)
\]

### Arguments

- **data**: A vector of interest rates.
- **years**: The number of years of the income. Default is 10 years.

### Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

### Examples

#### #example 1
\[
data=\text{c}(0.298, 0.255, 0.212, 0.180, 0.165, 0.163, 0.167, 0.161, 0.154, 0.128, 0.079, 0.059, 0.042, -0.008, -0.012, -0.002)
data\]  
\[
PV_post_cubic(data)
\]

#### #example 2
\[
data<\text{rnorm}(n=30, m=0.03, sd=0.01)
data<\text{rnorm}(n=30, m=0.03, sd=0.2)
PV_post_cubic(data)
\]

#### #example 3
\[
data<\text{rnorm}(n=30, m=0.03, sd=0.01)
data<\text{rnorm}(n=30, m=0.03, sd=0.2)
PV_post_cubic(data)
\]
# example 3
data = c(1.77, 1.85, 1.85, 1.84, 1.84, 1.83, 1.85, 1.85, 1.85, 1.88, 1.85, 1.80, 1.84, 1.91, 1.85, 1.84, 1.85, 1.86, 1.85, 1.88, 1.86)
data=data/100
PV_post_cubic(data)

---

PV_post_exact Computes the present value of an annuity-immediate considering only non-central moments of negative orders.

Description

Computes the present value of an annuity-immediate considering only non-central moments of negative orders.

Usage

PV_post_exact(data,years)

Arguments

data A vector of interest rates.
years The number of years of the income. Default is 10 years.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Examples

# example 1
data=c(0.0177, 0.0185, 0.0185, 0.0184, 0.0184, 0.0183, 0.0185, 0.0185, 0.0188, 0.0185, 0.0188, 0.0184, 0.0184, 0.0191, 0.0185, 0.0185, 0.0188, 0.0186)
PV_post_exact(data,10)
PV_post_mood_nm  Compute the present expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate \( X \), with the method of Mood et al. using some negative moments of the distribution.

Description

Compute the present expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate \( X \), with the method of Mood et al. using some negative moments of the distribution.

Usage

\[
PV_{\text{post.mood}}(\text{data}, \text{years})
\]

Arguments

- data: A vector of interest rates.
- years: The number of years of the income. Default is 10 years.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Source


Examples

```r
# example 1
data<-c(0.298, 0.255, 0.212, 0.180, 0.165, 0.163, 0.167, 0.161, 0.154,
0.128, 0.079, 0.059, 0.042, -0.008, -0.012, -0.002)
PV_post_mood_nm(data)

# example 2
data<-rnorm(n=30, m=0.03, sd=0.01)
PV_post_mood_nm(data)

# example 3
data = c(1.77, 1.85, 1.85, 1.84, 1.84, 1.83, 1.85, 1.85, 1.85, 1.88, 1.85, 1.80, 1.84, 1.91, 1.85, 1.84, 1.85,
1.86, 1.85, 1.88, 1.86)
data=data/100
PV_post_mood_nm(data)
```
PV_post_mood_pm  Compute the present expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate \( X \), with the method of Mood et al. using some positive moments of the distribution.

Description

Compute the present expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the end of every year (annuity-immediate), valued at the rate \( X \), with the method of Mood et al. using some positive moments of the distribution.

Usage

\[
\text{PV\_post\_mood\_pm}(\text{data}, \text{years})
\]

Arguments

- **data**: A vector of interest rates.
- **years**: The number of years of the income. Default is 10 years.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Source


Examples

```r
# example 1
data=c(0.298,0.255,0.212,0.180,0.165,0.163,0.167,0.161,0.154,
0.128,0.079,0.059,0.042,-0.008,-0.012,-0.002)
PV_post_mood_pm(data)

# example 2
data<-rnorm(n=30,m=0.03,sd=0.01)
PV_post_mood_pm(data)
```
PV_post_triang_3

# example 3
data = c(1.77, 1.85, 1.85, 1.84, 1.84, 1.83, 1.85, 1.85, 1.88, 1.85, 1.80, 1.84, 1.91, 1.85, 1.84, 1.85, 1.86, 1.85, 1.88, 1.86)
data=data/100
PV_post_mood_pm(data)

---

PV_post_triang_3

Compute the present value of an annuity-immediate considering only non-central moments of negative orders. The calculation is performed by using the function triangular\_moments\_3 for the moments greater than $-2$ (in absolute value).

Description

Compute the present value of an annuity-immediate considering only non-central moments of negative orders. The calculation is performed by using the function triangular\_moments\_3 for the moments greater than $-2$ (in absolute value).

Usage

PV_post_triang_3(data, years)

Arguments

data A vector of interest rates expressed as percentages.

years The number of years of the income. Default is 10 years.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Examples

data=c(1.77, 1.85, 1.85, 1.84, 1.84, 1.83, 1.85, 1.85, 1.88, 1.85, 1.80, 1.84, 1.91, 1.85, 1.84, 1.85, 1.86, 1.85, 1.88, 1.86)
PV_pre_triang_3(data, 10)
PV_post_triang_dis  
Compute the present value of an annuity-immediate considering only non-central moments of negative orders. The calculation is performed by using the moments of the fitted triangular distribution of the random variable "capitalization factor" $U$ (which are obtained from the definition of negative moment of a continuous random variable).

Description

Compute the present value of an annuity-immediate considering only non-central moments of negative orders. The calculation is performed by using the moments of the fitted triangular distribution of the random variable "capitalization factor" $U$ (which are obtained from the definition of negative moment of a continuous random variable).

Usage

PV_post_triang_dis(data,years)

Arguments

data  
A vector of interest rates expressed as percentages.

years  
The number of years of the income. Default is 10 years.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Examples

data=c(1.77,1.85,1.84,1.84,1.83,1.85,1.85,1.85,1.85,1.85,1.84,1.85,1.85,1.85,1.85,1.86,1.85,1.88,1.86)
PV_post_triang_dis(data,10)

PV_pre_artan  
Compute the present expected value of an $n$-payment annuity, with payments of 1 unit each, made at the beginning of every year (annuity-due), valued at the rate $X$, using the tetraparametric function approach.

Description

Compute the present expected value of an $n$-payment annuity, with payments of 1 unit each, made at the beginning of every year (annuity-due), valued at the rate $X$, using the tetraparametric function approach.
Usage

PV_pre_artan(data,years)

Arguments

data A vector of interest rates.
years The number of years of the income. Default is 10 years.

Author(s)
Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Source
Cruz Rambaud, S.; Maturo, F. and Sánchez Pérez A. M. (2017): “Expected present and final value of an annuity when some non-central moments of the capitalization factor are unknown: Theory and an application using R”. In Š. Hošková-Mayerová, et al. (Eds.), Mathematical-Statistical Models and Qualitative Theories for Economic and Social Sciences (pp. 233-248). Springer, Cham. doi:10.1007/978-3-319-54819-7_16.

Examples

# example 1
data=c(0.298,0.255,0.212,0.180,0.165,0.163,0.167,0.161,0.154,0.128,
0.079,0.059,0.042,-0.008,-0.012,-0.002)
PV_pre_artan(data)

# example 2
data<-rnorm(n=30,m=0.03,sd=0.01)
PV_pre_artan(data)

PV_pre_cubic

Compute the present expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate \( X \), using the cubic discount method.

Description

Compute the present expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate \( X \), using the cubic discount method.

Usage

PV_pre_cubic(data,years)
Arguments

- data: A vector of interest rates.
- years: The number of years of the income. Default is 10 years.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Examples

```r
# example 1
data <- c(0.298, 0.255, 0.212, 0.180, 0.165, 0.163, 0.167, 0.161, 0.154,
0.128, 0.079, 0.059, 0.042, -0.008, -0.012, -0.002)
PV_pre_cubic(data)

# example 2
data <- rnorm(n=30, m=0.03, sd=0.01)
PV_pre_cubic(data)

# example 3
data <- c(1.77, 1.85, 1.85, 1.84, 1.84, 1.83, 1.85, 1.85, 1.85, 1.85, 1.80, 1.84, 1.91, 1.85, 1.84, 1.85,
1.86, 1.85, 1.88, 1.86)
data = data/100
PV_pre_cubic(data)
```

---

**PV_pre_exact**

*Compute the present value of an annuity-due considering only non-central moments of negative orders.*

Description

Compute the present value of an annuity-due considering only non-central moments of negative orders.

Usage

```
PV_pre_exact(data, years)
```

Arguments

- data: A vector of interest rates.
- years: The number of years of the income. Default is 10 years.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez
PV_pre_mood_nm

Examples

# example 1
data = c(0.0177, 0.0185, 0.0184, 0.0184, 0.0183, 0.0185, 0.0185, 0.0188,
    0.0185, 0.0180, 0.0184, 0.0191, 0.0185, 0.0184, 0.0185, 0.0186, 0.0185, 0.0188, 0.0186)
PV_pre_exact(data, 10)

PV_pre_mood_nm Compute the present expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate \( X \), with the method of Mood et al. using some negative moments of the distribution.

Description

Compute the present expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate \( X \), with the method of Mood et al. using some negative moments of the distribution.

Usage

PV_pre_mood_nm(data, years)

Arguments

data A vector of interest rates.

years The number of years of the income. Default is 10 years.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Examples

# example 1
data = c(0.298, 0.255, 0.212, 0.180, 0.165, 0.163, 0.167, 0.161, 0.154,
    0.128, 0.079, 0.059, 0.042, -0.008, -0.012, -0.002)
PV_pre_mood_nm(data)

# example 2
data = rnorm(n=30, m=0.03, sd=0.01)
PV_pre_mood_nm(data)

# example 3
data = c(1.77, 1.85, 1.85, 1.84, 1.84, 1.83, 1.85, 1.85, 1.88, 1.85, 1.85, 1.80, 1.84, 1.91, 1.85, 1.85, 1.85, 1.88, 1.85, 1.85, 1.85, 1.88, 1.85, 1.80, 1.84, 1.91, 1.85)
Compute the present expected value of an \( n \)-payment annuity, with payments of 1 unit each made at the beginning of every year (annuity-due), valued at the rate \( X \), with the method of Mood et al. using some positive moments of the distribution.

**Usage**

\[
\text{PV\_pre\_mood\_pm}(\text{data}, \text{years})
\]

**Arguments**

- **data**: A vector of interest rates.
- **years**: The number of years of the income. Default is 10 years.

**Author(s)**

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

**Source**


**Examples**

```r
# example 1
data=c(0.298, 0.255, 0.212, 0.188, 0.165, 0.163, 0.167, 0.161, 0.154, 0.128, 0.079, 0.059, 0.042, -0.008, -0.012, -0.002)
PV\_pre\_mood\_pm(data)

# example 2
data<-rnorm(n=30, m=0.3, sd=0.01)
PV\_pre\_mood\_pm(data)
```
PV_pre_triang_3

# example 3
data = c(1.77, 1.85, 1.85, 1.84, 1.84, 1.83, 1.85, 1.85, 1.85, 1.85, 1.88, 1.85, 1.80, 1.84, 1.91, 1.85, 1.84, 1.85, 1.86, 1.85, 1.88, 1.88, 1.86)
data=data/100
PV_pre_mood_pm(data)

---

PV_pre_triang_3

Compute the present value of an annuity-due considering only non-central moments of negative orders. The calculation is performed by using the function `triangular_moments_3` for the moments greater than $-2$ (in absolute value).

**Description**

Compute the present value of an annuity-due considering only non-central moments of negative orders. The calculation is performed by using the function `triangular_moments_3` for the moments greater than $-2$ (in absolute value).

**Usage**

`PV_pre_triang_3(data, years)`

**Arguments**

- `data` A vector of interest rates expressed as percentages.
- `years` The number of years of the income. Default is 10 years.

**Author(s)**

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

**Examples**

data=c(1.77, 1.85, 1.85, 1.84, 1.84, 1.83, 1.85, 1.85, 1.85, 1.85, 1.88, 1.85, 1.80, 1.84, 1.91, 1.85, 1.84, 1.85, 1.86, 1.85, 1.88, 1.88, 1.86)
data=data/100
PV_pre_triang_3(data,10)
Compute the present value of an annuity-due considering only non-central moments of negative orders. The calculation is performed by using the moments of the fitted triangular distribution of the random variable "capitalization factor" $U$ (which are obtained from the definition of negative moment of a continuous random variable).

**Usage**

```
PV_pre_triang_dis(data, years)
```

**Arguments**

- **data**: A vector of interest rates expressed as percentages.
- **years**: The number of years of the income. Default is 10 years.

**Author(s)**

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

**Examples**

```
data = c(1.77, 1.85, 1.85, 1.84, 1.84, 1.83, 1.85, 1.85, 1.88, 1.85, 1.88, 1.85, 1.84, 1.91, 1.85, 1.84, 1.85, 1.85, 1.86, 1.85, 1.88, 1.86)
PV_pre_triang_dis(data, 10)
```

Compute the negatives moments (different from orders 1 and 2) of the fitted triangular distribution of the random variable X.

**Description**

Compute the negatives moments (different from orders 1 and 2) of the fitted triangular distribution of the random variable X.
triangular_moments_3_U

Usage

triangular_moments_3(data, order)

Arguments

data A vector X of interest rates.

order The order of moment that should be computed.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Examples

# example 1
data = c(1.77, 1.85, 1.85, 1.84, 1.84, 1.83, 1.85, 1.85, 1.88, 1.85, 1.85, 1.88, 1.84, 1.91, 1.85, 1.84, 1.85, 1.86, 1.85, 1.88, 1.86)
triangular_moments_3(data, 3)
triangular_moments_3(data, 4)

# example R - first 10 negative moments of fitted triangular distribution
# (an example from normal distributed simulated data)
data = rnorm(n = 200, m = 0.75, sd = 0.2)
triangular_parameters(data)
first10negmoments = rep(NA, 10)  # except first and second
for (i in 3:10) first10negmoments[i] = triangular_moments_3(data, i)
first10negmoments

triangular_moments_3_U

Compute the negatives moments (different from orders 1 and 2) of the fitted triangular distribution of the random variable "capitalization factor" U.

Description

Compute the negatives moments (different from orders 1 and 2) of the fitted triangular distribution of the random variable "capitalization factor" U.

Usage

triangular_moments_3_U(data, order)
 Arguments

data A vector X of interest rates.
order The order of moment that should be computed.

Author(s)
Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Examples

# example 1
data=c(1.77,1.85,1.85,1.84,1.84,1.83,1.85,1.85,1.88,1.85,1.80,1.84,1.91,1.85,1.84,1.85,1.86,1.85,1.88,1.86)
triangular_moments_3_U(data,3)
triangular_moments_3_U(data,4)

# example 2 - first 10 negative moments of fitted triangular distribution
#(an example from normal distributed simulated data)
data<-rnorm(n=200,m=0.75, sd=0.2)
triangular_parameters(data)
first10negmoments=rep(NA,10) #except first and second
for (i in 3:10) first10negmoments[i]=triangular_moments_3_U(data,i)
first10negmoments

triangular_moments_dis

Compute the negative moments of the fitted triangular distribution of the random variable X according to the definition (as integral).

Description

Compute the negative moments of the fitted triangular distribution of the random variable X according to the definition (as integral).

Usage

triangular_moments_dis(data,order)

Arguments

data A vector of interest rates as percentage.
order The order of moment of the triangular distribution
Author(s)
Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Examples

# example 1
data=c(1.77,1.85,1.85,1.84,1.84,1.83,1.85,1.85,1.85,1.88,1.85,1.80,1.84,1.91,1.85,1.84,1.85,
1.86,1.85,1.88,1.86)
triangular_moments_dis(data,1)
triangular_moments_dis(data,2)
triangular_moments_dis(data,3)
triangular_moments_dis(data,4)

# example 2 - first 10 negative moments of fitted triangular distribution
#(an example from normal distributed simulated data)
data<-rnorm(n=200,m=0.75,sd=0.2)
triangular_parameters(data)
first10negmoments=rep(NA,10)
for (i in 1:10) first10negmoments[i]=triangular_moments_dis(data,i)
first10negmoments

triangular_moments_dis_U

\text{Compute the negative moments of the fitted triangular distribution of the random variable "capitalization factor" \( U \) according to the definition (as integral).}

Description
Compute the negative moments of the fitted triangular distribution of the random variable "capitalization factor" \( U \) according to the definition (as integral).

Usage
\text{triangular\_moments\_dis\_U(data,order)}

Arguments
\begin{itemize}
  \item \texttt{data} \quad A vector of interest rates as percentage.
  \item \texttt{order} \quad The order of moment of the triangular distribution
\end{itemize}

Author(s)
Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez
Examples

# example 1
data=c(1.77,1.85,1.85,1.84,1.84,1.83,1.85,1.85,1.88,1.85,1.80,1.84,1.91,1.85,1.84,1.85,1.86,1.85,1.88,1.86)
triangular_moments_dis_U(data,1)
triangular_moments_dis_U(data,2)
triangular_moments_dis_U(data,3)
triangular_moments_dis_U(data,4)

# example 2 - first 10 negative moments of fitted triangular distribution
# (an example from normal distributed simulated data)
data<-rnorm(n=200,m=0.75,sd=0.2)
triangular_parameters(data)
first10negmoments=rep(NA,10)
for (i in 1:10) first10negmoments[i]=triangular_moments_dis_U(data,i)
first10negmoments

triangular_parameters  Compute the parameters and plot the fitted triangular distribution of the random variable X.

Description

Compute the parameters and plot the fitted triangular distribution of the random variable X.

Usage

triangular_parameters(data)

Arguments

data  A vector of interest rates.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Examples

# example 1
data=c(0.00,-0.05,-0.05,-0.06,-0.06,0.02,-0.06,-0.05,-0.05,-0.05,-0.03,-0.06,0.04,-0.05,-0.08,-0.05,-0.12,-0.03,-0.05,-0.04,-0.06)
triangular_parameters(data)
triangular_parameters_U

# example 2
data<-rnorm(n=200,m=0.75,sd=0.2)
triangular_parameters(data)

# example 3
data = c(1.77,1.85,1.85,1.84,1.84,1.83,1.85,1.85,1.85,1.85,1.88,1.85,1.80,1.84,1.91,1.85,1.84,1.85, 1.86,1.85,1.88,1.86)
triangular_parameters(data)

triangular_parameters_U

Return the parameters of the fitted triangular distribution of the random variable "capitalization factor" U.

Description

Return the parameters of the fitted triangular distribution of the random variable "capitalization factor" U.

Usage

triangular_parameters_U(data)

Arguments

data A vector of interest rates expressed as percentage.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Examples

# example 1
data = c(1.77,1.85,1.85,1.84,1.84,1.83,1.85,1.85,1.85,1.88,1.85,1.80,1.84,1.91,1.85,1.84,1.85, 1.86,1.85,1.88,1.86)
triangular_parameters_U(data)
variance_drv

Compute the variance of the present value of an annuity using "discrete random variable" approach.

Description

Compute the variance of the present value of an annuity using "discrete random variable" approach.

Usage

variance_drv(data,years)

Arguments

data A vector X of interest rates.
years The number of years of the income. Default is 10 years.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Examples

# example 1
data = c(1.77,1.85,1.85,1.84,1.84,1.83,1.85,1.85,1.85,1.88,1.85,1.88,1.84,1.91,1.85,1.85,1.86,1.86,1.85,1.85,1.86)
data=data/100
variance_drv(data)

variance_post_mood_nm

Compute the variance of the present value of an annuity-immediate using the Mood et al. approximation and some non-central moments of negative order.

Description

Compute the variance of the present value of an annuity-immediate using the Mood et al. approximation and some non-central moments of negative order.

Usage

variance_post_mood_nm(data,years)
variance_post_mood_pm

Arguments

data A vector X of interest rates.
years The number of years of the income. Default is 10 years.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Examples

# example 1
data = c(1.77, 1.85, 1.85, 1.84, 1.84, 1.83, 1.85, 1.85, 1.85, 1.85, 1.88, 1.85, 1.88, 1.84, 1.84, 1.91, 1.85, 1.84, 1.85, 1.85, 1.86, 1.85, 1.88, 1.86)
data=data/100
variance_post_mood_pm(data)

variance_post_mood_pm Compute the variance of the present value of an annuity-immediate using the Mood et al. approximation and some non-central moments of positive order.

Description

Compute the variance of the present value of an annuity-immediate using the Mood et al. approximation and some non-central moments of positive order.

Usage

variance_post_mood_pm(data, years)

Arguments

data A vector X of interest rates.
years The number of years of the income. Default is 10 years.

Author(s)

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

Examples

# example 1
data = c(1.77, 1.85, 1.85, 1.84, 1.84, 1.83, 1.85, 1.85, 1.85, 1.85, 1.88, 1.85, 1.88, 1.84, 1.84, 1.91, 1.85, 1.84, 1.85, 1.85, 1.86, 1.85, 1.88, 1.86)
data=data/100
variance_post_mood_pm(data)
<table>
<thead>
<tr>
<th>Usage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>variance_pre_mood_pm(data)</td>
<td>Compute the variance of the present value of an annuity-due using the Mood et al. approximation and some non-central moments of positive order.</td>
</tr>
</tbody>
</table>

**Examples**

```r
# example 1
data <- c(1.7, 1.8, 1.9, 1.6, 1.8, 1.7, 1.9, 1.6, 1.8, 1.7)
variance_pre_mood_pm(data)
```

**Usage**

```r
variance_pre_mood_pm(data, years)
```

**Arguments**

- `data`: A vector of interest rates.
- `years`: The number of years of the income. Default is 10 years.

**Author(s)**

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez
**Arguments**

- **data**: A vector \( X \) of interest rates.
- **years**: The number of years of the income. Default is 10 years.

**Author(s)**

Salvador Cruz Rambaud, Fabrizio Maturo, Ana María Sánchez Pérez

**Examples**

```r
# example 1
data = c(1.77, 1.85, 1.85, 1.84, 1.84, 1.83, 1.85, 1.85, 1.85, 1.88, 1.85, 1.85, 1.85, 1.88, 1.91, 1.85, 1.84, 1.85, 1.86, 1.85, 1.88, 1.86)
data = data/100
variance_pre_mood_pm(data)
```
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