Package ‘treasuryTR’

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Type Package
Title Generate Treasury Total Returns from Yield Data
Version 0.1.5
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Description Generate Total Returns (TR) from bond yield data with fixed maturity, e.g. reported treasury yields. The generated TR series are very close to alternative series that can be purchased (e.g. CRSP, Bloomberg), suggesting they are a high-quality alternative for those, see Swinkels (2019) <doi:10.3390/data4030091>.

URL https://github.com/mgei/treasuryTR
Depends R (>= 3.2.0), quantmod, zoo, dplyr
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convexity

**Calculate the convexity of a bond**

**Description**

Calculates the convexity of a bond.

This function is normally used in combination with `total_return()` to compute bond total returns.

**Usage**

```
convexity(yields, maturity, format_out = "xts")
```

**Arguments**

- **yields**: a series of yields
- **maturity**: constant bond maturity in years
- **format_out**: xts or tibble

**Details**

This function is normally used in combination with `total_return()` to compute bond total returns. The convexity is the interest rate sensitivity of the modified duration.

\[
convexity = C_1 - C_2
\]

where

\[
C_1 = \frac{2}{y_t^2} (1 - z_t^{-2M})
\]

\[
C_2 = \frac{2M}{y_t} z_t^{-2M-1}
\]

\[
z_t = 1 + \frac{y_t}{2}
\]

*M* is the maturity in years (e.g. 10), *y_t* is the yield at time *t*.

**Value**

The convexity or a series of convexities of a bond with the given yield and maturity.
get_yields

Load data from FRED

Description
Load data from FRED

Usage
get_yields(
  series = "DGS10",
  na_locf = TRUE,
  percent_adjust = TRUE,
  format_out = "xts",
  ...
)

Arguments
- series: The series code as found on https://fred.stlouisfed.org/, see details
- na_locf: replace NA's with last observation
- percent_adjust: divide raw data by 100
- format_out: xts or tibble
- ...: Additional parameters handed to quantmod::getSymbols

Details
The function is a wrapper for quantmod::getSymbols().
Commonly used constant-maturity yield series are:

- **DGS1MO**: 1-Month Treasury Constant Maturity Rate
- **DGS3MO**: 3-Month Treasury Constant Maturity Rate
- **DGS6MO**: 6-Month Treasury Constant Maturity Rate
- **DGS1**: 1-Year Treasury Constant Maturity Rate
- **DGS2**: 2-Year Treasury Constant Maturity Rate
- **DGS3**: 3-Year Treasury Constant Maturity Rate
- **DGS5**: 5-Year Treasury Constant Maturity Rate
- **DGS7**: 7-Year Treasury Constant Maturity Rate
- **DGS10**: 10-Year Treasury Constant Maturity Rate
- **DGS20**: 20-Year Treasury Constant Maturity Rate
- **DGS30**: 30-Year Treasury Constant Maturity Rate
Value

The yields data as an xts object

Examples

# US 1-Month yields
yields_us_1m <- get_yields(series = "DGS1MO")

mod_duration(yields, maturity, format_out = "xts")

mod_duration

Calculate the modified duration of a bond

Description

Calculate the modified duration of a bond

Usage

mod_duration(yields, maturity, format_out = "xts")

Arguments

yields        a series of yields
maturity      constant bond maturity in years
format_out    xts or tibble

Details

This function is normally used in combination with total_return() to compute bond total returns. The modified duration is the interest rate sensitivity of the price of bond.

\[
\text{duration} = \frac{1}{y_t} z_t^{2M}
\]

with

\[
z_t = 1 + \frac{y_t}{2}
\]

\(M\) is the maturity in years (e.g. 10), \(y_t\) is the yield at time \(t\).

Value

A series of modified duration
**tibble_to_xts**  
*Convert a tibble data frame to an xts object*

**Description**

Convert a tibble data frame to an xts object

**Usage**

```r
tibble_to_xts(x)
```

**Arguments**

- `x`  
  a tibble with a column 'date'

**Value**

An xts object

---

**total_return**  
*Calculate bond total returns from constant-maturity yield data*

**Description**

Calculate bond total returns from constant-maturity yield data

**Usage**

```r
total_return(
  yields,
  maturity,
  mdur = mod_duration(yields, maturity),
  convex = convexity(yields, maturity),
  scale = 261,
  format_out = "xts"
)
```

**Arguments**

- `yields`  
  xts series or vector or yields
- `maturity`  
  bond constant-maturity in years
- `mdur`  
  modified duration, by default calculated using `mod_duration()`
- `convex`  
  convexity, by default calculated using `convexity()`
- `scale`  
  number of periods in a year (for US treasury data daily `scale = 261`, weekly `scale = 52`, monthly `scale = 12`, quarterly `scale = 4`)
- `format_out`  
  xts or tibble
Details

Calculate bond total returns from constant-maturity yield data.

\[ R_t = \text{yieldincome} - \text{duration} \cdot \Delta y + \frac{1}{2} \cdot \text{convexity} \cdot (\Delta y)^2 \]

where

\[ \text{yieldincome} = (1 + y_t)^{\Delta t} - 1 \approx y_t \Delta t \]

\[ \text{duration} = \frac{1}{y_t} z_t^{2M} \]

\[ \text{convexity} = C_1 - C_2 \]

and

\[ C_1 = \frac{2}{y_t^2} (1 - z_t^{-2M}) \]

\[ C_2 = \frac{2M}{y_t} z_t^{-(2M-1)} \]

\[ z_t = 1 + \frac{y_t}{2} \]

\( M \) is the maturity in years (e.g. 10), \( y_t \) is the yield at time \( t \)

Value

Bond total returns

Examples

library(dplyr)

# download US treasury 10Y constant-maturity yield data and compute a total return series

t10_yield <- get_yields("DGS10")
t10_tr <- total_return(yields = t10_yield, maturity = 10)
head(t10_tr)

# step-by-step calculation

t10_yield <- get_yields("DGS10", format_out = "tibble")
t10_tr <- t10_yield %>%
mutate(convexity = convexity(DGS10, 10),
       mod_duration = mod_duration(DGS10, 10),
       TR = total_return(DGS10, 10, mod_duration, convexity))
head(t10_tr)
xts_to_tibble

Convert an xts object to a tibble data frame

Description
Convert an xts object to a tibble data frame

Usage
xts_to_tibble(x)

Arguments
x
  an xts object

Value
A tibble data frame with first column `date`

Note
If this function is used outside of the package's functions, i.e. using other data than FRED's, then make sure that the tibble does not contain non-numeric columns. An xts object is a matrix with an index attribute (date) and one cannot mix types in a matrix.
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