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Type Package

Title Clock of Regimes Naive Bayes Classifier (Student-t)

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Description Computes and fits a heavy-tailed Student-t Naive Bayes classifier for non-stationary financial market regime analysis (Clock of Regimes, COR). The core innovation is a profile grid search over the degrees-of-freedom parameter ν that prevents numerical underflow and structural classification failures when identifying fat-tailed Stress regimes. Provides S3 methods for fitting, prediction, summarising, plotting, and parameter extraction.

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Contents

| | |
|---|---|
| coef.student_t_naive_bayes | 2 |
| plot.student_t_naive_bayes | 3 |
| predict.student_t_naive_bayes | 4 |
| print.student_t_naive_bayes | 5 |
| student_t_naive_bayes | 6 |
| summary.student_t_naive_bayes | 7 |
| tables | 8 |

| | |
|--------------|-----------|
| Index | 10 |
|--------------|-----------|

coef.student_t_naive_bayes
Coefficient extraction for student_t_naive_bayes

Description

Returns a data frame of fitted Student-t parameters (μ , σ , ν) organised by feature (rows) and class (column groups).

Usage

```
## S3 method for class 'student_t_naive_bayes'
coef(object, ...)
```

Arguments

object A fitted "student_t_naive_bayes" object.
 ... Additional arguments (currently unused).

Value

A data frame with p rows (features) and $3K$ columns, named `<class>:mu`, `<class>:sd`, `<class>:nu` for each of the K classes.

See Also

[student_t_naive_bayes](#)

Examples

```
set.seed(7)
X <- matrix(rnorm(120), 60, 2, dimnames = list(NULL, c("f1", "f2")))
y <- factor(rep(c("A", "B", "C"), 20))
m <- student_t_naive_bayes(X, y)
coef(m)
```

```
plot.student_t_naive_bayes
```

Plot method for student_t_naive_bayes

Description

Draws per-feature Student-t density curves, one curve per class, for a fitted "student_t_naive_bayes" model.

Usage

```
## S3 method for class 'student_t_naive_bayes'
plot(
  x,
  which = NULL,
  ask = FALSE,
  legend = TRUE,
  legend.box = FALSE,
  arg.num = list(),
  prob = c("marginal", "conditional"),
  ...
)
```

Arguments

| | |
|------------|--|
| x | A fitted "student_t_naive_bayes" object. |
| which | Integer or character vector selecting which features to plot. NULL (default) plots all features. |
| ask | Logical. If TRUE the user is prompted before each plot. Default: FALSE. |
| legend | Logical. If TRUE (default) a legend is added to each plot. |
| legend.box | Logical. If TRUE the legend is drawn with a box. Default: FALSE. |
| arg.num | Named list of graphical parameters (e.g. col, lty) applied to the density lines. Defaults: sequential integer colours and solid lines. |
| prob | Character string: "marginal" (default) scales each density by the class prior; "conditional" plots the raw conditional density. |
| ... | Additional graphical arguments passed to plot . |

Value

Invisibly returns NULL.

See Also

[student_t_naive_bayes](#)

predict.student_t_naive_bayes

Predict method for student_t_naive_bayes

Description

Computes MAP class assignments or posterior probabilities for new observations using a fitted [student_t_naive_bayes](#) model.

Usage

```
## S3 method for class 'student_t_naive_bayes'
predict(
  object,
  newdata = NULL,
  type = c("class", "prob"),
  threshold = 0.001,
  eps = 0,
  ...
)
```

Arguments

| | |
|-----------|--|
| object | A fitted "student_t_naive_bayes" object. |
| newdata | Optional numeric matrix of new observations with the same named columns as the training matrix. If NULL the training data stored in object are used. |
| type | Character string: "class" (default) returns a factor of predicted class labels; "prob" returns a numeric matrix of posterior probabilities (rows = observations, columns = classes). |
| threshold | Minimum log-density floor applied after the eps check. Prevents $-\infty$ contributions from absorbing the posterior. Default: 0.001. |
| eps | Densities at or below this value are replaced by threshold. Set to 0 (default) to use the machine minimum. |
| ... | Additional arguments (currently unused). |

Value

type = "class" A [factor](#) of length `nrow(newdata)` with levels matching the training classes.

type = "prob" A numeric matrix with `nrow(newdata)` rows and one column per class, containing softmax-normalised posterior probabilities.

See Also

[student_t_naive_bayes](#)

Examples

```
set.seed(1)
X <- matrix(rnorm(100), 50, 2, dimnames = list(NULL, c("f1", "f2")))
y <- factor(rep(c("A", "B"), 25))
m <- student_t_naive_bayes(X, y)
predict(m, type = "class")
predict(m, type = "prob")
```

```
print.student_t_naive_bayes
      Print method for student_t_naive_bayes
```

Description

Prints a concise summary of the model, including the call, prior probabilities, and the first five parameter tables.

Usage

```
## S3 method for class 'student_t_naive_bayes'
print(x, ...)
```

Arguments

| | |
|------------------|--|
| <code>x</code> | A fitted "student_t_naive_bayes" object. |
| <code>...</code> | Additional arguments (currently unused). |

Value

Invisibly returns `x`.

See Also

[student_t_naive_bayes](#), [summary.student_t_naive_bayes](#)

student_t_naive_bayes *Student-t Naive Bayes Classifier*

Description

Fits a Naive Bayes classifier where the per-class, per-feature likelihood is a scaled Student-t distribution. The degrees-of-freedom parameter ν is selected for every (class, feature) pair by a profile log-likelihood grid search over `nu_grid`, making the model robust to the fat-tailed returns that characterise financial Stress regimes.

Usage

```
student_t_naive_bayes(x, y, prior = NULL, nu_grid = c(3:30, 40, 60, 100), ...)
```

Arguments

| | |
|----------------------|---|
| <code>x</code> | A numeric matrix of predictors with named columns. Each column is one feature; each row is one observation. |
| <code>y</code> | A factor, character, or logical vector of class labels with length equal to <code>nrow(x)</code> . Must contain at least two distinct classes and at least two observations per class. |
| <code>prior</code> | Optional named numeric vector of prior class probabilities. Length must equal the number of class levels. Defaults to empirical class frequencies. Supplied values are normalised to sum to one. |
| <code>nu_grid</code> | Numeric vector of candidate degrees-of-freedom values used by the profile grid search. All values must be strictly greater than 2 (finite-variance requirement). Default: <code>c(3:30, 40, 60, 100)</code> . <ul style="list-style-type: none"> • Values near 3 capture extreme kurtosis typical of Stress regimes. • Values near 30+ approximate Gaussian behaviour for Calm regimes. • Including 60 and 100 provides a near-Gaussian safety net without imposing normality. |
| <code>...</code> | Additional arguments (currently unused). |

Details

****Classification rule (MAP)****

Under the Naive Bayes conditional-independence assumption the posterior log-odds reduce to the Maximum A Posteriori rule:

$$\hat{k} = \arg \max_{k \in \{1, \dots, K\}} \left[\log \pi_k + \sum_{j=1}^p \log f_t(x_j \mid \mu_{kj}, \sigma_{kj}, \nu_{kj}) \right]$$

where the scaled Student-t density is

$$f_t(x \mid \mu, \sigma, \nu) = \frac{1}{\sigma} f_{t,\nu} \left(\frac{x - \mu}{\sigma} \right)$$

and π_k is the prior probability of class k .

****Degrees-of-freedom grid search****

For each (class k , feature j) pair the algorithm runs one IRLS step at every candidate $\nu \in \text{nu_grid}$ and retains the triplet $(\hat{\mu}, \hat{\sigma}, \hat{\nu})$ that maximises the profile log-likelihood. This discrete search avoids the numerical instability of continuous ν optimisation and is the mechanism that prevents log-likelihood underflow when scoring crisis observations in the Stress regime.

Value

An S3 object of class "student_t_naive_bayes" with components:

`data` List with elements `x` (training matrix) and `y` (training labels).

`levels` Character vector of class levels.

`params` Named list with $K \times p$ matrices `mu`, `sd`, and `nu` ($K = \text{classes}$, $p = \text{features}$).

`prior` Named numeric vector of prior probabilities.

`nu_grid` The `nu_grid` vector used during fitting.

`call` The matched call.

See Also

[predict.student_t_naive_bayes](#), [tables.student_t_naive_bayes](#), [coef.student_t_naive_bayes](#)

Examples

```
set.seed(42)
n <- 150
y <- factor(rep(c("Calm", "Stress", "Trend"), each = n / 3))
X <- matrix(
  c(rnorm(50, 0, 1), rt(50, df = 4), rnorm(50, 1, 0.5),
    rnorm(50, 0, 1), rt(50, df = 4), rnorm(50, 1, 0.5)),
  nrow = n, ncol = 2,
  dimnames = list(NULL, c("ret", "vol")))
)
model <- student_t_naive_bayes(X, y)
print(model)
```

summary.student_t_naive_bayes

Summary method for student_t_naive_bayes

Description

Prints a high-level summary of a fitted "student_t_naive_bayes" model: sample size, feature count, ν grid range, and prior probabilities.

Usage

```
## S3 method for class 'student_t_naive_bayes'
summary(object, ...)
```

Arguments

```
object      A fitted "student_t_naive_bayes" object.
...         Additional arguments (currently unused).
```

Value

Invisibly returns object.

See Also

[student_t_naive_bayes](#), [print.student_t_naive_bayes](#)

tables

Parameter tables for Naive Bayes classifiers

Description

S3 generic that returns per-feature parameter tables for a fitted Naive Bayes model. For "student_t_naive_bayes" objects each table contains the fitted μ , σ , and ν parameters. For all other model classes the call is forwarded to `naivebayes::tables()`.

Usage

```
tables(object, which = NULL, ...)

## S3 method for class 'student_t_naive_bayes'
tables(object, which = NULL, ...)

## Default S3 method:
tables(object, which = NULL, ...)
```

Arguments

```
object      A fitted Naive Bayes model. Supported classes: "student_t_naive_bayes"
             (this package) and any class accepted by tables.
which       Integer or character vector selecting which feature tables to return. NULL (de-
             fault) returns all features.
...         Additional arguments passed to the method.
```

Value

A "naive_bayes_tables" object: a named list with one element per selected feature. For "student_t_naive_bayes" objects each element is a [table](#) with rows mu, sd, nu and one column per class level.

See Also

[tables](#), [student_t_naive_bayes](#)

Examples

```
set.seed(3)
X <- matrix(rnorm(120), 60, 2, dimnames = list(NULL, c("ret", "vol")))
y <- factor(rep(c("Calm", "Stress", "Trend"), 20))
m <- student_t_naive_bayes(X, y)
tables(m)
tables(m, which = "ret")
tables(m, which = 2L)
```

Index

`coef.student_t_naive_bayes`, 2, 7

`factor`, 4

`plot`, 3

`plot.student_t_naive_bayes`, 3

`predict.student_t_naive_bayes`, 4, 7

`print.student_t_naive_bayes`, 5, 8

`student_t_naive_bayes`, 2–5, 6, 8, 9

`summary.student_t_naive_bayes`, 5, 7

`table`, 8

`tables`, 8, 8, 9

`tables.student_t_naive_bayes`, 7