

Package: fable (via r-universe)

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Title Forecasting Models for Tidy Time Series

Version 0.4.1

Description Provides a collection of commonly used univariate and multivariate time series forecasting models including automatically selected exponential smoothing (ETS) and autoregressive integrated moving average (ARIMA) models. These models work within the 'fable' framework provided by the 'fabletools' package, which provides the tools to evaluate, visualise, and combine models in a workflow consistent with the tidyverse.

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URL <https://fable.tidyverts.org>, <https://github.com/tidyverts/fable>

BugReports <https://github.com/tidyverts/fable/issues>

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Contents

AR	4
ARIMA	5
breusch_godfrey	8
components.ETS	9
CROSTON	9
ETS	11
fitted.AR	13
fitted.ARIMA	14
fitted.croston	15
fitted.ETS	15
fitted.fable_theta	16
fitted.model_mean	17
fitted.NNETAR	17
fitted.RW	18
fitted.TSLM	19
fitted.VAR	19
forecast.AR	20
forecast.ARIMA	21
forecast.croston	22
forecast.ETS	22
forecast.fable_theta	23
forecast.model_mean	24
forecast.NNETAR	25
forecast.RW	26
forecast.TSLM	28
forecast.VAR	29
generate.AR	30
generate.ARIMA	30
generate.ETS	31
generate.model_mean	32
generate.NNETAR	33
generate.RW	33
generate.TSLM	34
generate.VAR	35
generate.VECM	36
glance.AR	37
glance.ARIMA	37
glance.ETS	38
glance.fable_theta	39
glance.model_mean	40
glance.NNETAR	40
glance.RW	41
glance.TSLM	42
glance.VAR	42
glance.VECM	43
interpolate.ARIMA	44

interpolate.model_mean	44
interpolate.TSLM	45
IRF.ARIMA	46
IRF.VAR	46
IRF.VECM	47
MEAN	48
NNETAR	49
refit.AR	50
refit.ARIMA	51
refit.ETS	52
refit.model_mean	53
refit>NNETAR	54
refit.RW	55
refit.TSLM	56
residuals.AR	56
residuals.ARIMA	57
residuals.croston	58
residuals.ETS	58
residuals.fable_theta	59
residuals.model_mean	60
residuals>NNETAR	60
residuals.RW	61
residuals.TSLM	62
residuals.VAR	62
RW	63
THETA	64
tidy.AR	66
tidy.ARIMA	66
tidy.croston	67
tidy.ETS	68
tidy.fable_theta	68
tidy.model_mean	69
tidy>NNETAR	70
tidy.RW	70
tidy.TSLM	71
tidy.VAR	72
TSLM	72
unitroot_options	73
VAR	74
VARIMA	75
VECM	78

 AR *Estimate a AR model*

Description

Searches through the vector of lag orders to find the best AR model which has lowest AIC, AICc or BIC value. It is implemented using OLS, and behaves comparably to `stats::ar.ols()`.

Usage

```
AR(formula, ic = c("aicc", "aic", "bic"), ...)
```

Arguments

formula	Model specification (see "Specials" section).
ic	The information criterion used in selecting the model.
...	Further arguments for arima

Details

Exogenous regressors and `common_xregs` can be specified in the model formula.

Value

A model specification.

Specials

pdq: The order special is used to specify the lag order for the auto-regression.

```
order(p = 0:15, fixed = list())
```

p The order of the auto-regressive (AR) terms. If multiple values are provided, the one which minimises `ic` will be chosen.
fixed A named list of fixed parameters for coefficients. The names identify the coefficient, beginning with `ar`, and then follow the order of the `pdq` special.

xreg: Exogenous regressors can be included in an AR model without explicitly using the `xreg()` special. Common exogenous regressor specials as specified in `common_xregs` can also be used. These regressors are handled using `stats::model.frame()`, and so interactions and other functionality behaves similarly to `stats::lm()`.

The inclusion of a constant in the model follows the similar rules to `stats::lm()`, where including `1` will add a constant and `0` or `-1` will remove the constant. If left out, the inclusion of a constant will be determined by minimising `ic`.

```
xreg(..., fixed = list())
```

... Bare expressions for the exogenous regressors (such as `log(x)`)
fixed A named list of fixed parameters for coefficients. The names identify the coefficient, and should match the name of the corresponding special.

See Also

[Forecasting: Principles and Practices, Vector autoregressions \(section 11.2\)](#)

Examples

```
luteinizing_hormones <- as_tsibble(lh)
fit <- luteinizing_hormones %>%
  model(AR(value ~ order(3)))

report(fit)

fit %>%
  forecast() %>%
  autoplot(luteinizing_hormones)
```

ARIMA

*Estimate an ARIMA model***Description**

Searches through the model space specified in the specials to identify the best ARIMA model, with the lowest AIC, AICc or BIC value. It is implemented using `stats::arima()` and allows ARIMA models to be used in the fable framework.

Usage

```
ARIMA(
  formula,
  ic = c("aicc", "aic", "bic"),
  selection_metric = function(x) x[[ic]],
  stepwise = TRUE,
  greedy = TRUE,
  approximation = NULL,
  order_constraint = p + q + P + Q <= 6 & (constant + d + D <= 2),
  unitroot_spec = unitroot_options(),
  trace = FALSE,
  ...
)
```

Arguments

<code>formula</code>	Model specification (see "Specials" section).
<code>ic</code>	The information criterion used in selecting the model.
<code>selection_metric</code>	A function used to compute a metric from an Arima object which is minimised to select the best model.
<code>stepwise</code>	Should stepwise be used? (Stepwise can be much faster)

greedy	Should the stepwise search move to the next best option immediately?
approximation	Should CSS (conditional sum of squares) be used during model selection? The default (NULL) will use the approximation if there are more than 150 observations or if the seasonal period is greater than 12.
order_constraint	A logical predicate on the orders of p, d, q, P, D, Q and constant to consider in the search. See "Specials" for the meaning of these terms.
unitroot_spec	A specification of unit root tests to use in the selection of d and D. See <code>unitroot_options()</code> for more details.
trace	If TRUE, the selection_metric of estimated models in the selection procedure will be outputted to the console.
...	Further arguments for <code>stats::arima()</code>

Value

A model specification.

Parameterisation

The `fable` `ARIMA()` function uses an alternative parameterisation of constants to `stats::arima()` and `forecast::Arima()`. While the parameterisations are equivalent, the coefficients for the constant/mean will differ.

In `fable`, if there are no exogenous regressors, the parameterisation used is:

$$(1 - \phi_1 B - \dots - \phi_p B^p)(1 - B)^d y_t = c + (1 + \theta_1 B + \dots + \theta_q B^q) \varepsilon_t$$

In `stats` and `forecast`, an ARIMA model is parameterised as:

$$(1 - \phi_1 B - \dots - \phi_p B^p)(y'_t - \mu) = (1 + \theta_1 B + \dots + \theta_q B^q) \varepsilon_t$$

where μ is the mean of $(1 - B)^d y_t$ and $c = \mu(1 - \phi_1 - \dots - \phi_p)$.

If there are exogenous regressors, `fable` uses the same parameterisation as used in `stats` and `forecast`. That is, it fits a regression with ARIMA(p,d,q) errors:

$$y_t = c + \beta' x_t + z_t$$

where β is a vector of regression coefficients, x_t is a vector of exogenous regressors at time t , and z_t is an ARIMA(p,d,q) error process:

$$(1 - \phi_1 B - \dots - \phi_p B^p)(1 - B)^d z_t = (1 + \theta_1 B + \dots + \theta_q B^q) \varepsilon_t$$

For details of the estimation algorithm, see the `arima` function in the `stats` package.

Specials

The *specials* define the space over which ARIMA will search for the model that best fits the data. If the RHS of `formula` is left blank, the default search space is given by `pdq() + PDQ()`: that is, a model with candidate seasonal and nonseasonal terms, but no exogenous regressors. Note that a seasonal model requires at least 2 full seasons of data; if this is not available, ARIMA will revert to a nonseasonal model with a warning.

To specify a model fully (avoid automatic selection), the intercept and `pdq()/PDQ()` values must be specified. For example, `formula = response ~ 1 + pdq(1, 1, 1) + PDQ(1, 0, 0)`.

pdq: The `pdq` special is used to specify non-seasonal components of the model.

```
pdq(p = 0:5, d = 0:2, q = 0:5,
    p_init = 2, q_init = 2, fixed = list())
```

- `p` The order of the non-seasonal auto-regressive (AR) terms. If multiple values are provided, the one which minimises `ic`.
- `d` The order of integration for non-seasonal differencing. If multiple values are provided, one of the values will be selected.
- `q` The order of the non-seasonal moving average (MA) terms. If multiple values are provided, the one which minimises `ic`.
- `p_init` If `stepwise = TRUE`, `p_init` provides the initial value for `p` for the stepwise search procedure.
- `q_init` If `stepwise = TRUE`, `q_init` provides the initial value for `q` for the stepwise search procedure.
- `fixed` A named list of fixed parameters for coefficients. The names identify the coefficient, beginning with either `ar` or `ma`.

PDQ: The `PDQ` special is used to specify seasonal components of the model. To force a non-seasonal fit, specify `PDQ(0, 0, 0)` in the RHS of the model formula. Note that simply omitting `PDQ` from the formula will *not* result in a non-seasonal fit.

```
PDQ(P = 0:2, D = 0:1, Q = 0:2, period = NULL,
    P_init = 1, Q_init = 1, fixed = list())
```

- `P` The order of the seasonal auto-regressive (SAR) terms. If multiple values are provided, the one which minimises `ic`.
- `D` The order of integration for seasonal differencing. If multiple values are provided, one of the values will be selected.
- `Q` The order of the seasonal moving average (SMA) terms. If multiple values are provided, the one which minimises `ic`.
- `period` The periodic nature of the seasonality. This can be either a number indicating the number of observations in each season or `NULL`.
- `P_init` If `stepwise = TRUE`, `P_init` provides the initial value for `P` for the stepwise search procedure.
- `Q_init` If `stepwise = TRUE`, `Q_init` provides the initial value for `Q` for the stepwise search procedure.
- `fixed` A named list of fixed parameters for coefficients. The names identify the coefficient, beginning with either `sar` or `sm`.

xreg: Exogenous regressors can be included in an ARIMA model without explicitly using the `xreg()` special. Common exogenous regressor specials as specified in `common_xregs` can also be used. These regressors are handled using `stats::model.frame()`, and so interactions and other functionality behaves similarly to `stats::lm()`.

The inclusion of a constant in the model follows the similar rules to `stats::lm()`, where including `1` will add a constant and `0` or `-1` will remove the constant. If left out, the inclusion of a constant will be determined by minimising `ic`.

```
xreg(..., fixed = list())
```

- `...` Bare expressions for the exogenous regressors (such as `log(x)`)
- `fixed` A named list of fixed parameters for coefficients. The names identify the coefficient, and should match the name of the regressor.

See Also

Forecasting: Principles and Practices, ARIMA models (chapter 9) Forecasting: Principles and Practices, Dynamic regression models (chapter 10)

Examples

```
# Manual ARIMA specification
USAccDeaths %>%
  as_tsibble() %>%
  model(arima = ARIMA(log(value) ~ 0 + pdq(0, 1, 1) + PDQ(0, 1, 1))) %>%
  report()

# Automatic ARIMA specification
library(tsibble)
library(dplyr)
tsibbledata::global_economy %>%
  filter(Country == "Australia") %>%
  model(ARIMA(log(GDP) ~ Population))
```

breusch_godfrey

Breusch-Godfrey Test

Description

Breusch-Godfrey test for higher-order serial correlation.

Usage

```
breusch_godfrey(x, ...)

## S3 method for class 'TSLM'
breusch_godfrey(x, order = 1, type = c("Chisq", "F"), ...)
```

Arguments

x	A model object to be tested.
...	Further arguments for methods.
order	The maximum order of serial correlation to test for.
type	The type of test statistic to use.

See Also

[lmtest::bgtest\(\)](#)

components.ETS	<i>Extract estimated states from an ETS model.</i>
----------------	--

Description

Extract estimated states from an ETS model.

Usage

```
## S3 method for class 'ETS'
components(object, ...)
```

Arguments

object	An estimated model.
...	Unused.

Value

A `fabletools::dable()` containing estimated states.

Examples

```
as_tsibble(USAccDeaths) %>%
  model(ets = ETS(log(value) ~ season("A"))) %>%
  components()
```

CROSTON	<i>Croston's method</i>
---------	-------------------------

Description

Based on Croston's (1972) method for intermittent demand forecasting, also described in Shenstone and Hyndman (2005). Croston's method involves using simple exponential smoothing (SES) on the non-zero elements of the time series and a separate application of SES to the times between non-zero elements of the time series.

Usage

```
CROSTON(
  formula,
  opt_crit = c("mse", "mae"),
  type = c("croston", "sba", "sbj"),
  ...
)
```

Arguments

formula	Model specification (see "Specials" section).
opt_crit	The optimisation criterion used to optimise the parameters.
type	Which variant of Croston's method to use. Defaults to "croston" for Croston's method, but can also be set to "sba" for the Syntetos-Boylan approximation, and "sbj" for the Shale-Boylan-Johnston method.
...	Not used.

Details

Note that forecast distributions are not computed as Croston's method has no underlying stochastic model. In a later update, we plan to support distributions via the equivalent stochastic models that underly Croston's method (Shenstone and Hyndman, 2005)

There are two variant methods available which apply multiplicative correction factors to the forecasts that result from the original Croston's method. For the Syntetos-Boylan approximation (type = "sba"), this factor is $1 - \alpha/2$, and for the Shale-Boylan-Johnston method (type = "sbj"), this factor is $1 - \alpha/(2 - \alpha)$, where α is the smoothing parameter for the interval SES application.

Value

A model specification.

Specials

demand: The demand special specifies parameters for the demand SES application.

```
demand(initial = NULL, param = NULL, param_range = c(0, 1))
```

initial	The initial value for the demand application of SES.
param	The smoothing parameter for the demand application of SES.
param_range	If param = NULL, the range of values over which to search for the smoothing parameter.

interval: The interval special specifies parameters for the interval SES application.

```
interval(initial = NULL, param = NULL, param_range = c(0, 1))
```

initial	The initial value for the interval application of SES.
param	The smoothing parameter for the interval application of SES.
param_range	If param = NULL, the range of values over which to search for the smoothing parameter.

References

- Croston, J. (1972) "Forecasting and stock control for intermittent demands", *Operational Research Quarterly*, **23**(3), 289-303.
- Shenstone, L., and Hyndman, R.J. (2005) "Stochastic models underlying Croston's method for intermittent demand forecasting". *Journal of Forecasting*, **24**, 389-402.
- Kourentzes, N. (2014) "On intermittent demand model optimisation and selection". *International Journal of Production Economics*, **156**, 180-190. doi:10.1016/j.ijpe.2014.06.007.

Examples

```

library(tsibble)
sim_poisson <- tsibble(
  time = yearmonth("2012 Dec") + seq_len(24),
  count = rpois(24, lambda = 0.3),
  index = time
)

sim_poisson %>%
  autoplot(count)

sim_poisson %>%
  model(CROSTON(count)) %>%
  forecast(h = "2 years") %>%
  autoplot(sim_poisson)

```

ETS

*Exponential smoothing state space model***Description**

Returns ETS model specified by the formula.

Usage

```

ETS(
  formula,
  opt_crit = c("lik", "amse", "mse", "sigma", "mae"),
  nmse = 3,
  bounds = c("both", "usual", "admissible"),
  ic = c("aicc", "aic", "bic"),
  restrict = TRUE,
  ...
)

```

Arguments

formula	Model specification (see "Specials" section).
opt_crit	The optimization criterion. Defaults to the log-likelihood "lik", but can also be set to "mse" (Mean Square Error), "amse" (Average MSE over first nmse forecast horizons), "sigma" (Standard deviation of residuals), or "mae" (Mean Absolute Error).
nmse	If opt_crit == "amse", nmse provides the number of steps for average multi-step MSE (1<=nmse<=30).
bounds	Type of parameter space to impose: "usual" indicates all parameters must lie between specified lower and upper bounds; "admissible" indicates parameters must lie in the admissible space; "both" (default) takes the intersection of these regions.

<code>ic</code>	The information criterion used in selecting the model.
<code>restrict</code>	If TRUE (default), the models with infinite variance will not be allowed. These restricted model components are AMM, AAM, AMA, and MMA.
<code>...</code>	Other arguments

Details

Based on the classification of methods as described in Hyndman et al (2008).

The methodology is fully automatic. The model is chosen automatically if not specified. This methodology performed extremely well on the M3-competition data. (See Hyndman, et al, 2002, below.)

Value

A model specification.

Specials

The *specials* define the methods and parameters for the components (error, trend, and seasonality) of an ETS model. If more than one method is specified, ETS will consider all combinations of the specified models and select the model which best fits the data (minimising `ic`). The method argument for each specials have reasonable defaults, so if a component is not specified an appropriate method will be chosen automatically.

There are a couple of limitations to note about ETS models:

- It does not support exogenous regressors.
- It does not support missing values. You can complete missing values in the data with imputed values (e.g. with `tidyr::fill()`), or by fitting a different model type and then calling `fabletools::interpolate()` before fitting the model.

error: The error special is used to specify the form of the error term.

```
error(method = c("A", "M"))
```

`method` The form of the error term: either additive ("A") or multiplicative ("M"). If the error is multiplicative, the data must be

trend: The trend special is used to specify the form of the trend term and associated parameters.

```
trend(method = c("N", "A", "Ad"),
      alpha = NULL, alpha_range = c(1e-04, 0.9999),
      beta = NULL, beta_range = c(1e-04, 0.9999),
      phi = NULL, phi_range = c(0.8, 0.98))
```

`method` The form of the trend term: either none ("N"), additive ("A"), multiplicative ("M") or damped variants ("Ad"),

`alpha` The value of the smoothing parameter for the level. If `alpha = 0`, the level will not change over time. Conversely,

`alpha_range` If `alpha=NULL`, `alpha_range` provides bounds for the optimised value of `alpha`.

`beta` The value of the smoothing parameter for the slope. If `beta = 0`, the slope will not change over time. Conversely,

`beta_range` If `beta=NULL`, `beta_range` provides bounds for the optimised value of `beta`.

phi The value of the dampening parameter for the slope. If $\phi = 0$, the slope will be dampened immediately (no slope).
 phi_range If $\phi = \text{NULL}$, phi_range provides bounds for the optimised value of phi.

season: The season special is used to specify the form of the seasonal term and associated parameters. To specify a nonseasonal model you would include `season(method = "N")`.

```
season(method = c("N", "A", "M"), period = NULL,
       gamma = NULL, gamma_range = c(1e-04, 0.9999))
```

method The form of the seasonal term: either none ("N"), additive ("A") or multiplicative ("M"). All specified methods are allowed.
 period The periodic nature of the seasonality. This can be either a number indicating the number of observations in a season or "none".
 gamma The value of the smoothing parameter for the seasonal pattern. If $\gamma = 0$, the seasonal pattern will not change.
 gamma_range If $\gamma = \text{NULL}$, gamma_range provides bounds for the optimised value of gamma.

References

Hyndman, R.J., Koehler, A.B., Snyder, R.D., and Grose, S. (2002) "A state space framework for automatic forecasting using exponential smoothing methods", *International J. Forecasting*, **18**(3), 439–454.

Hyndman, R.J., Akram, Md., and Archibald, B. (2008) "The admissible parameter space for exponential smoothing models". *Annals of Statistical Mathematics*, **60**(2), 407–426.

Hyndman, R.J., Koehler, A.B., Ord, J.K., and Snyder, R.D. (2008) *Forecasting with exponential smoothing: the state space approach*, Springer-Verlag. <http://www.exponentialsMOOTHING.net>.

See Also

[Forecasting: Principles and Practices, Exponential smoothing \(chapter 8\)](#)

Examples

```
as_tsibble(USAccDeaths) %>%
  model(ETS(log(value) ~ season("A")))
```

fitted.AR

Extract fitted values from a fable model

Description

Extracts the fitted values.

Usage

```
## S3 method for class 'AR'
fitted(object, ...)
```

Arguments

object A model for which forecasts are required.
 ... Other arguments passed to methods

Value

A vector of fitted values.

Examples

```
as_tsibble(lh) %>%
  model(AR(value ~ order(3))) %>%
  fitted()
```

fitted.ARIMA

Extract fitted values from a fable model

Description

Extracts the fitted values.

Usage

```
## S3 method for class 'ARIMA'
fitted(object, ...)
```

Arguments

object A model for which forecasts are required.
 ... Other arguments passed to methods

Value

A vector of fitted values.

Examples

```
USAccDeaths %>%
  as_tsibble() %>%
  model(arima = ARIMA(log(value) ~ pdq(0, 1, 1) + PDQ(0, 1, 1))) %>%
  fitted()
```

fitted.croston	<i>Extract fitted values from a fable model</i>
----------------	---

Description

Extracts the fitted values.

Usage

```
## S3 method for class 'croston'  
fitted(object, ...)
```

Arguments

object	A model for which forecasts are required.
...	Other arguments passed to methods

Value

A vector of fitted values.

Examples

```
library(tsibble)  
sim_poisson <- tsibble(  
  time = yearmonth("2012 Dec") + seq_len(24),  
  count = rpois(24, lambda = 0.3),  
  index = time  
)  
  
sim_poisson %>%  
  model(CROSTON(count)) %>%  
  tidy()
```

fitted.ETS	<i>Extract fitted values from a fable model</i>
------------	---

Description

Extracts the fitted values.

Usage

```
## S3 method for class 'ETS'  
fitted(object, ...)
```

Arguments

`object` A model for which forecasts are required.
`...` Other arguments passed to methods

Value

A vector of fitted values.

Examples

```
as_tsibble(USAccDeaths) %>%
  model(ets = ETS(log(value) ~ season("A"))) %>%
  fitted()
```

`fitted.fable_theta` *Extract fitted values from a fable model*

Description

Extracts the fitted values.

Usage

```
## S3 method for class 'fable_theta'
fitted(object, ...)
```

Arguments

`object` A model for which forecasts are required.
`...` Other arguments passed to methods

Value

A vector of fitted values.

Examples

```
library(tsibbledata)
vic_elec %>%
  model(avg = MEAN(Demand)) %>%
  fitted()
```

fitted.model_mean	<i>Extract fitted values from a fable model</i>
-------------------	---

Description

Extracts the fitted values.

Usage

```
## S3 method for class 'model_mean'  
fitted(object, ...)
```

Arguments

object	A model for which forecasts are required.
...	Other arguments passed to methods

Value

A vector of fitted values.

Examples

```
library(tsibbledata)  
vic_elec %>%  
  model(avg = MEAN(Demand)) %>%  
  fitted()
```

fitted.NNETAR	<i>Extract fitted values from a fable model</i>
---------------	---

Description

Extracts the fitted values.

Usage

```
## S3 method for class 'NNETAR'  
fitted(object, ...)
```

Arguments

object	A model for which forecasts are required.
...	Other arguments passed to methods

Value

A vector of fitted values.

Examples

```
as_tsibble(airmiles) %>%  
  model(nn = NNETAR(box_cox(value, 0.15))) %>%  
  fitted()
```

fitted.RW

Extract fitted values from a fable model

Description

Extracts the fitted values.

Usage

```
## S3 method for class 'RW'  
fitted(object, ...)
```

Arguments

object A model for which forecasts are required.
... Other arguments passed to methods

Value

A vector of fitted values.

Examples

```
as_tsibble(Nile) %>%  
  model(NAIVE(value)) %>%  
  fitted()  
  
library(tsibbledata)  
aus_production %>%  
  model(snaive = SNAIVE(Beer ~ lag("year"))) %>%  
  fitted()
```

fitted.TSLM	<i>Extract fitted values from a fable model</i>
-------------	---

Description

Extracts the fitted values.

Usage

```
## S3 method for class 'TSLM'  
fitted(object, ...)
```

Arguments

object	A model for which forecasts are required.
...	Other arguments passed to methods

Value

A vector of fitted values.

Examples

```
as_tsibble(USAccDeaths) %>%  
  model(lm = TSLM(log(value) ~ trend() + season())) %>%  
  fitted()
```

fitted.VAR	<i>Extract fitted values from a fable model</i>
------------	---

Description

Extracts the fitted values.

Usage

```
## S3 method for class 'VAR'  
fitted(object, ...)
```

Arguments

object	A model for which forecasts are required.
...	Other arguments passed to methods

Value

A vector of fitted values.

Examples

```
lung_deaths <- cbind(mdeaths, fdeaths) %>%
  as_tsibble(pivot_longer = FALSE)

lung_deaths %>%
  model(VAR(vars(mdeaths, fdeaths) ~ AR(3))) %>%
  fitted()
```

 forecast.AR

Forecast a model from the fable package

Description

Produces forecasts from a trained model.

Usage

```
## S3 method for class 'AR'
forecast(
  object,
  new_data = NULL,
  specials = NULL,
  bootstrap = FALSE,
  times = 5000,
  ...
)
```

Arguments

object	A model for which forecasts are required.
new_data	A tsibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
bootstrap	If TRUE, then forecast distributions are computed using simulation with resampled errors.
times	The number of sample paths to use in estimating the forecast distribution when <code>bootstrap = TRUE</code> .
...	Other arguments passed to methods

Value

A list of forecasts.

Examples

```
as_tsibble(lh) %>%
  model(AR(value ~ order(3))) %>%
  forecast()
```

forecast.ARIMA *Forecast a model from the fable package*

Description

Produces forecasts from a trained model.

Usage

```
## S3 method for class 'ARIMA'
forecast(
  object,
  new_data = NULL,
  specials = NULL,
  bootstrap = FALSE,
  times = 5000,
  ...
)
```

Arguments

object	A model for which forecasts are required.
new_data	A tsibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
bootstrap	If TRUE, then forecast distributions are computed using simulation with resampled errors.
times	The number of sample paths to use in estimating the forecast distribution when <code>bootstrap = TRUE</code> .
...	Other arguments passed to methods

Value

A list of forecasts.

Examples

```
USAccDeaths %>%
  as_tsibble() %>%
  model(arima = ARIMA(log(value) ~ pdq(0, 1, 1) + PDQ(0, 1, 1))) %>%
  forecast()
```

forecast.croston	<i>Forecast a model from the fable package</i>
------------------	--

Description

Produces forecasts from a trained model.

Usage

```
## S3 method for class 'croston'
forecast(object, new_data, specials = NULL, ...)
```

Arguments

object	A model for which forecasts are required.
new_data	A tsibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
...	Other arguments passed to methods

Value

A list of forecasts.

Examples

```
library(tsibble)
sim_poisson <- tsibble(
  time = yearmonth("2012 Dec") + seq_len(24),
  count = rpois(24, lambda = 0.3),
  index = time
)

sim_poisson %>%
  model(CROSTON(count)) %>%
  forecast()
```

forecast.ETS	<i>Forecast a model from the fable package</i>
--------------	--

Description

Produces forecasts from a trained model.

Usage

```
## S3 method for class 'ETS'
forecast(
  object,
  new_data,
  specials = NULL,
  simulate = FALSE,
  bootstrap = FALSE,
  times = 5000,
  ...
)
```

Arguments

object	A model for which forecasts are required.
new_data	A tsibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
simulate	If TRUE, prediction intervals are produced by simulation rather than using analytic formulae.
bootstrap	If TRUE, then forecast distributions are computed using simulation with resampled errors.
times	The number of sample paths to use in estimating the forecast distribution if simulated intervals are used.
...	Other arguments passed to methods

Value

A list of forecasts.

Examples

```
as_tsibble(USAccDeaths) %>%
  model(ets = ETS(log(value) ~ season("A"))) %>%
  forecast()
```

forecast.fable_theta *Forecast a model from the fable package*

Description

Produces forecasts from a trained model.

Usage

```
## S3 method for class 'fable_theta'
forecast(
  object,
  new_data,
  specials = NULL,
  bootstrap = FALSE,
  times = 5000,
  ...
)
```

Arguments

object	A model for which forecasts are required.
new_data	A tsibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
bootstrap	If TRUE, then forecast distributions are computed using simulation with resampled errors.
times	The number of sample paths to use in estimating the forecast distribution when <code>bootstrap = TRUE</code> .
...	Other arguments passed to methods

Value

A list of forecasts.

Examples

```
USAccDeaths %>%
  as_tsibble() %>%
  model(arima = ARIMA(log(value) ~ pdq(0, 1, 1) + PDQ(0, 1, 1))) %>%
  forecast()
```

forecast.model_mean *Forecast a model from the fable package*

Description

Produces forecasts from a trained model.

Usage

```
## S3 method for class 'model_mean'
forecast(
  object,
  new_data,
  specials = NULL,
  bootstrap = FALSE,
  times = 5000,
  ...
)
```

Arguments

object	A model for which forecasts are required.
new_data	A tsibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
bootstrap	If TRUE, then forecast distributions are computed using simulation with resampled errors.
times	The number of sample paths to use in estimating the forecast distribution when <code>bootstrap = TRUE</code> .
...	Other arguments passed to methods

Value

A list of forecasts.

Examples

```
library(tsibbledata)
vic_elec %>%
  model(avg = MEAN(Demand)) %>%
  forecast()
```

forecast.NNETAR

Forecast a model from the fable package

Description

Produces forecasts from a trained model.

Usage

```
## S3 method for class 'NNETAR'
forecast(
  object,
  new_data,
  specials = NULL,
  simulate = TRUE,
  bootstrap = FALSE,
  times = 5000,
  ...
)
```

Arguments

<code>object</code>	A model for which forecasts are required.
<code>new_data</code>	A tibble containing the time points and exogenous regressors to produce forecasts for.
<code>specials</code>	(passed by <code>fabletools::forecast.mdl_df()</code>).
<code>simulate</code>	If TRUE, forecast distributions are produced by sampling from a normal distribution. Without simulation, forecast uncertainty cannot be estimated for this model and instead a degenerate distribution with the forecast mean will be produced.
<code>bootstrap</code>	If TRUE, forecast distributions are produced by sampling from the model's training residuals.
<code>times</code>	The number of sample paths to use in producing the forecast distribution. Setting <code>simulate = FALSE</code> or <code>times = 0</code> will produce degenerate forecast distributions of the forecast mean.
<code>...</code>	Other arguments passed to methods

Value

A list of forecasts.

Examples

```
as_tibble(airmiles) %>%
  model(nn = NNETAR(box_cox(value, 0.15))) %>%
  forecast(times = 10)
```

forecast.RW

Forecast a model from the fable package

Description

Produces forecasts from a trained model.

Usage

```
## S3 method for class 'RW'
forecast(
  object,
  new_data,
  specials = NULL,
  simulate = FALSE,
  bootstrap = FALSE,
  times = 5000,
  ...
)
```

Arguments

<code>object</code>	A model for which forecasts are required.
<code>new_data</code>	A tibble containing the time points and exogenous regressors to produce forecasts for.
<code>specials</code>	(passed by <code>fabletools::forecast.mdl_df()</code>).
<code>simulate</code>	If TRUE, prediction intervals are produced by simulation rather than using analytic formulae.
<code>bootstrap</code>	If TRUE, then forecast distributions are computed using simulation with resampled errors.
<code>times</code>	The number of sample paths to use in estimating the forecast distribution when <code>bootstrap = TRUE</code> .
<code>...</code>	Other arguments passed to methods

Value

A list of forecasts.

Examples

```
as_tsibble(Nile) %>%
  model(NAIVE(value)) %>%
  forecast()

library(tsibbledata)
aus_production %>%
  model(snaive = SNAIVE(Beer ~ lag("year"))) %>%
  forecast()
```

forecast.TSLM	<i>Forecast a model from the fable package</i>
---------------	--

Description

Produces forecasts from a trained model.

Usage

```
## S3 method for class 'TSLM'
forecast(
  object,
  new_data,
  specials = NULL,
  bootstrap = FALSE,
  approx_normal = TRUE,
  times = 5000,
  ...
)
```

Arguments

object	A model for which forecasts are required.
new_data	A tibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
bootstrap	If TRUE, then forecast distributions are computed using simulation with resampled errors.
approx_normal	Should the resulting forecast distributions be approximated as a Normal distribution instead of a Student's T distribution. Returning Normal distributions (the default) is a useful approximation to make it easier for using TSLM models in model combinations or reconciliation processes.
times	The number of sample paths to use in estimating the forecast distribution when <code>bootstrap = TRUE</code> .
...	Other arguments passed to methods

Value

A list of forecasts.

Examples

```
as_tibble(USAccDeaths) %>%
  model(lm = TSLM(log(value) ~ trend() + season())) %>%
  forecast()
```

forecast.VAR	<i>Forecast a model from the fable package</i>
--------------	--

Description

Produces forecasts from a trained model.

Usage

```
## S3 method for class 'VAR'
forecast(
  object,
  new_data = NULL,
  specials = NULL,
  bootstrap = FALSE,
  times = 5000,
  ...
)
```

Arguments

object	A model for which forecasts are required.
new_data	A tsibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
bootstrap	If TRUE, then forecast distributions are computed using simulation with resampled errors.
times	The number of sample paths to use in estimating the forecast distribution when <code>bootstrap = TRUE</code> .
...	Other arguments passed to methods

Value

A list of forecasts.

Examples

```
lung_deaths <- cbind(mdeaths, fdeaths) %>%
  as_tsibble(pivot_longer = FALSE)

lung_deaths %>%
  model(VAR(vars(mdeaths, fdeaths) ~ AR(3))) %>%
  forecast()
```

generate.AR	<i>Generate new data from a fable model</i>
-------------	---

Description

Simulates future paths from a dataset using a fitted model. Innovations are sampled by the model's assumed error distribution. If `bootstrap` is `TRUE`, innovations will be sampled from the model's residuals. If `new_data` contains the `.innov` column, those values will be treated as innovations.

Usage

```
## S3 method for class 'AR'
generate(x, new_data = NULL, specials = NULL, bootstrap = FALSE, ...)
```

Arguments

<code>x</code>	A fitted model.
<code>new_data</code>	A tibble containing the time points and exogenous regressors to produce forecasts for.
<code>specials</code>	(passed by <code>fabletools::forecast.mdl_df()</code>).
<code>bootstrap</code>	If <code>TRUE</code> , then forecast distributions are computed using simulation with resampled errors.
<code>...</code>	Other arguments passed to methods

See Also

[fabletools::generate.mdl_df](#)

Examples

```
as_tibble(1h) %>%
  model(AR(value ~ order(3))) %>%
  generate()
```

generate.ARIMA	<i>Generate new data from a fable model</i>
----------------	---

Description

Simulates future paths from a dataset using a fitted model. Innovations are sampled by the model's assumed error distribution. If `bootstrap` is `TRUE`, innovations will be sampled from the model's residuals. If `new_data` contains the `.innov` column, those values will be treated as innovations.

Usage

```
## S3 method for class 'ARIMA'
generate(x, new_data, specials, bootstrap = FALSE, ...)
```

Arguments

x	A fitted model.
new_data	A tibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
bootstrap	If TRUE, then forecast distributions are computed using simulation with resampled errors.
...	Other arguments passed to methods

See Also

`fabletools::generate.mdl_df`

Examples

```
fable_fit <- as_tsibble(USAccDeaths) %>%
  model(model = ARIMA(value ~ 0 + pdq(0,1,1) + PDQ(0,1,1)))
fable_fit %>% generate(times = 10)
```

generate.ETS

Generate new data from a fable model

Description

Simulates future paths from a dataset using a fitted model. Innovations are sampled by the model's assumed error distribution. If `bootstrap` is TRUE, innovations will be sampled from the model's residuals. If `new_data` contains the `.innov` column, those values will be treated as innovations.

Usage

```
## S3 method for class 'ETS'
generate(x, new_data, specials, bootstrap = FALSE, ...)
```

Arguments

x	A fitted model.
new_data	A tibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
bootstrap	If TRUE, then forecast distributions are computed using simulation with resampled errors.
...	Other arguments passed to methods

See Also

[fabletools::generate.mdl_df](#)

Examples

```
as_tsibble(USAccDeaths) %>%
  model(ETS(log(value) ~ season("A"))) %>%
  generate(times = 100)
```

generate.model_mean *Generate new data from a fable model*

Description

Simulates future paths from a dataset using a fitted model. Innovations are sampled by the model's assumed error distribution. If `bootstrap` is `TRUE`, innovations will be sampled from the model's residuals. If `new_data` contains the `.innov` column, those values will be treated as innovations.

Usage

```
## S3 method for class 'model_mean'
generate(x, new_data, bootstrap = FALSE, ...)
```

Arguments

<code>x</code>	A fitted model.
<code>new_data</code>	A tsibble containing the time points and exogenous regressors to produce forecasts for.
<code>bootstrap</code>	If <code>TRUE</code> , then forecast distributions are computed using simulation with resampled errors.
<code>...</code>	Other arguments passed to methods

See Also

[fabletools::generate.mdl_df](#)

Examples

```
library(tsibbledata)
vic_elec %>%
  model(avg = MEAN(Demand)) %>%
  generate()
```

generate.NNETAR	<i>Generate new data from a fable model</i>
-----------------	---

Description

Simulates future paths from a dataset using a fitted model. Innovations are sampled by the model's assumed error distribution. If `bootstrap` is `TRUE`, innovations will be sampled from the model's residuals. If `new_data` contains the `.innov` column, those values will be treated as innovations.

Usage

```
## S3 method for class 'NNETAR'
generate(x, new_data, specials = NULL, bootstrap = FALSE, ...)
```

Arguments

<code>x</code>	A fitted model.
<code>new_data</code>	A tibble containing the time points and exogenous regressors to produce forecasts for.
<code>specials</code>	(passed by <code>fabletools::forecast.mdl_df()</code>).
<code>bootstrap</code>	If <code>TRUE</code> , then forecast distributions are computed using simulation with resampled errors.
<code>...</code>	Other arguments passed to methods

See Also

[fabletools::generate.mdl_df](#)

Examples

```
as_tibble(airmiles) %>%
  model(nn = NNETAR(box_cox(value, 0.15))) %>%
  generate()
```

generate.RW	<i>Generate new data from a fable model</i>
-------------	---

Description

Simulates future paths from a dataset using a fitted model. Innovations are sampled by the model's assumed error distribution. If `bootstrap` is `TRUE`, innovations will be sampled from the model's residuals. If `new_data` contains the `.innov` column, those values will be treated as innovations.

Usage

```
## S3 method for class 'RW'
generate(x, new_data, bootstrap = FALSE, ...)
```

Arguments

x	A fitted model.
new_data	A tsibble containing the time points and exogenous regressors to produce forecasts for.
bootstrap	If TRUE, then forecast distributions are computed using simulation with resampled errors.
...	Other arguments passed to methods

See Also

[fabletools::generate.mdl_df](#)

Examples

```
as_tsibble(Nile) %>%
  model(NAIVE(value)) %>%
  generate()

library(tsibbledata)
aus_production %>%
  model(snaive = SNAIVE(Beer ~ lag("year"))) %>%
  generate()
```

generate.TSLM

Generate new data from a fable model

Description

Simulates future paths from a dataset using a fitted model. Innovations are sampled by the model's assumed error distribution. If `bootstrap` is TRUE, innovations will be sampled from the model's residuals. If `new_data` contains the `.innov` column, those values will be treated as innovations.

Usage

```
## S3 method for class 'TSLM'
generate(x, new_data, specials, bootstrap = FALSE, ...)
```

Arguments

x	A fitted model.
new_data	A tibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
bootstrap	If TRUE, then forecast distributions are computed using simulation with resampled errors.
...	Other arguments passed to methods

See Also

[fabletools::generate.mdl_df](#)

Examples

```
as_tibble(USAccDeaths) %>%
  model(lm = TSLM(log(value) ~ trend() + season())) %>%
  generate()
```

generate.VAR

Generate new data from a fable model

Description

Simulates future paths from a dataset using a fitted model. Innovations are sampled by the model's assumed error distribution. If `bootstrap` is TRUE, innovations will be sampled from the model's residuals. If `new_data` contains the `.innov` column, those values will be treated as innovations.

Usage

```
## S3 method for class 'VAR'
generate(x, new_data, specials, ...)
```

Arguments

x	A fitted model.
new_data	A tibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
...	Other arguments passed to methods

See Also

[fabletools::generate.mdl_df](#)

Examples

```
as_tsibble(USAccDeaths) %>%
  model(ETS(log(value) ~ season("A"))) %>%
  generate(times = 100)
```

generate.VECM	<i>Generate new data from a fable model</i>
---------------	---

Description

Simulates future paths from a dataset using a fitted model. Innovations are sampled by the model's assumed error distribution. If `bootstrap` is `TRUE`, innovations will be sampled from the model's residuals. If `new_data` contains the `.innov` column, those values will be treated as innovations.

Usage

```
## S3 method for class 'VECM'
generate(x, new_data, specials, ...)
```

Arguments

<code>x</code>	A fitted model.
<code>new_data</code>	A tsibble containing the time points and exogenous regressors to produce forecasts for.
<code>specials</code>	(passed by <code>fabletools::forecast.mdl_df()</code>).
<code>...</code>	Other arguments passed to methods

See Also

[fabletools::generate.mdl_df](#)

Examples

```
as_tsibble(USAccDeaths) %>%
  model(ETS(log(value) ~ season("A"))) %>%
  generate(times = 100)
```

`glance.AR`*Glance a AR*

Description

Construct a single row summary of the AR model.

Usage

```
## S3 method for class 'AR'  
glance(x, ...)
```

Arguments

`x` model or other R object to convert to single-row data frame
`...` other arguments passed to methods

Details

Contains the variance of residuals (`sigma2`), the log-likelihood (`log_lik`), and information criterion (AIC, AICc, BIC).

Value

A one row tibble summarising the model's fit.

Examples

```
as_tsibble(lh) %>%  
  model(AR(value ~ order(3))) %>%  
  glance()
```

`glance.ARIMA`*Glance an ARIMA model*

Description

Construct a single row summary of the ARIMA model.

Usage

```
## S3 method for class 'ARIMA'  
glance(x, ...)
```

Arguments

`x` model or other R object to convert to single-row data frame
`...` other arguments passed to methods

Format

A data frame with 1 row, with columns:

sigma2 The unbiased variance of residuals. Calculated as $\text{sum}(\text{residuals}^2) / (\text{num_observations} - \text{num_parameters} + 1)$

log_lik The log-likelihood

AIC Akaike information criterion

AICc Akaike information criterion, corrected for small sample sizes

BIC Bayesian information criterion

ar_roots, ma_roots The model's characteristic roots

Value

A one row tibble summarising the model's fit.

Examples

```
USAccDeaths %>%
  as_tibble() %>%
  model(arima = ARIMA(log(value) ~ pdq(0, 1, 1) + PDQ(0, 1, 1))) %>%
  glance()
```

glance.ETS

Glance an ETS model

Description

Construct a single row summary of the ETS model.

Usage

```
## S3 method for class 'ETS'
glance(x, ...)
```

Arguments

`x` model or other R object to convert to single-row data frame
`...` other arguments passed to methods

Details

Contains the variance of residuals (`sigma2`), the log-likelihood (`log_lik`), and information criterion (AIC, AICc, BIC).

Value

A one row tibble summarising the model's fit.

Examples

```
as_tsibble(USAccDeaths) %>%  
  model(ets = ETS(log(value) ~ season("A"))) %>%  
  glance()
```

`glance.fable_theta` *Glance a theta method*

Description

Construct a single row summary of the average method model.

Usage

```
## S3 method for class 'fable_theta'  
glance(x, ...)
```

Arguments

`x` model or other R object to convert to single-row data frame
`...` other arguments passed to methods

Details

Contains the variance of residuals (`sigma2`).

Value

A one row tibble summarising the model's fit.

glance.model_mean	<i>Glance a average method model</i>
-------------------	--------------------------------------

Description

Construct a single row summary of the average method model.

Usage

```
## S3 method for class 'model_mean'  
glance(x, ...)
```

Arguments

x	model or other R object to convert to single-row data frame
...	other arguments passed to methods

Details

Contains the variance of residuals (sigma2).

Value

A one row tibble summarising the model's fit.

Examples

```
library(tsibbledata)  
vic_elec %>%  
  model(avg = MEAN(Demand)) %>%  
  glance()
```

glance.NNETAR	<i>Glance a NNETAR model</i>
---------------	------------------------------

Description

Construct a single row summary of the NNETAR model. Contains the variance of residuals (sigma2).

Usage

```
## S3 method for class 'NNETAR'  
glance(x, ...)
```


Arguments

x model or other R object to convert to single-row data frame
 ... other arguments passed to methods

Value

A one row tibble summarising the model's fit.

Examples

```
as_tsibble(airmiles) %>%
  model(nn = NNETAR(box_cox(value, 0.15))) %>%
  glance()
```

glance.RW

Glance a lag walk model

Description

Construct a single row summary of the lag walk model. Contains the variance of residuals (σ^2).

Usage

```
## S3 method for class 'RW'
glance(x, ...)
```

Arguments

x model or other R object to convert to single-row data frame
 ... other arguments passed to methods

Value

A one row tibble summarising the model's fit.

Examples

```
as_tsibble(Nile) %>%
  model(NAIVE(value)) %>%
  glance()

library(tsibbledata)
aus_production %>%
  model(snaive = SNAIVE(Beer ~ lag("year"))) %>%
  glance()
```

glance.TSLM

Glance a TSLM

Description

Construct a single row summary of the TSLM model.

Usage

```
## S3 method for class 'TSLM'
glance(x, ...)
```

Arguments

```
x          model or other R object to convert to single-row data frame
...        other arguments passed to methods
```

Details

Contains the R squared (`r_squared`), variance of residuals (`sigma2`), the log-likelihood (`log_lik`), and information criterion (AIC, AICc, BIC).

Value

A one row tibble summarising the model's fit.

Examples

```
as_tibble(USAccDeaths) %>%
  model(lm = TSLM(log(value) ~ trend() + season())) %>%
  glance()
```

glance.VAR

Glance a VAR

Description

Construct a single row summary of the VAR model.

Usage

```
## S3 method for class 'VAR'
glance(x, ...)
```

Arguments

`x` model or other R object to convert to single-row data frame
`...` other arguments passed to methods

Details

Contains the variance of residuals (`sigma2`), the log-likelihood (`log_lik`), and information criterion (AIC, AICc, BIC).

Value

A one row tibble summarising the model's fit.

Examples

```
lung_deaths <- cbind(mdeaths, fdeaths) %>%
  as_tibble(pivot_longer = FALSE)

lung_deaths %>%
  model(VAR(vars(mdeaths, fdeaths) ~ AR(3))) %>%
  glance()
```

glance.VECM

Glance a VECM

Description

Construct a single row summary of the VECM model.

Usage

```
## S3 method for class 'VECM'
glance(x, ...)
```

Arguments

`x` model or other R object to convert to single-row data frame
`...` other arguments passed to methods

Details

Contains the variance of residuals (`sigma2`), the log-likelihood (`log_lik`), the cointegrating vector (`beta`) and information criterion (AIC, AICc, BIC).

Value

A one row tibble summarising the model's fit.

```
interpolate.ARIMA      Interpolate missing values from a fable model
```

Description

Applies a model-specific estimation technique to predict the values of missing values in a tsibble, and replace them.

Usage

```
## S3 method for class 'ARIMA'
interpolate(object, new_data, specials, ...)
```

Arguments

object	A model for which forecasts are required.
new_data	A tsibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
...	Other arguments passed to methods

Value

A tibble of the same dimension of `new_data` with missing values interpolated.

Examples

```
library(tsibbledata)

olympic_running %>%
  model(arima = ARIMA(Time ~ trend())) %>%
  interpolate(olympic_running)
```

```
interpolate.model_mean
      Interpolate missing values from a fable model
```

Description

Applies a model-specific estimation technique to predict the values of missing values in a tsibble, and replace them.

Usage

```
## S3 method for class 'model_mean'
interpolate(object, new_data, specials, ...)
```

Arguments

object	A model for which forecasts are required.
new_data	A tibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
...	Other arguments passed to methods

Value

A tibble of the same dimension of `new_data` with missing values interpolated.

Examples

```
library(tsibbledata)

olympic_running %>%
  model(mean = MEAN(Time)) %>%
  interpolate(olympic_running)
```

`interpolate.TSLM` *Interpolate missing values from a fable model*

Description

Applies a model-specific estimation technique to predict the values of missing values in a tibble, and replace them.

Usage

```
## S3 method for class 'TSLM'
interpolate(object, new_data, specials, ...)
```

Arguments

object	A model for which forecasts are required.
new_data	A tibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
...	Other arguments passed to methods

Value

A tibble of the same dimension of `new_data` with missing values interpolated.

Examples

```
library(tsibbledata)

olympic_running %>%
  model(lm = TSLM(Time ~ trend())) %>%
  interpolate(olympic_running)
```

IRF.ARIMA*Calculate impulse responses from a fable model*

Description

Calculate impulse responses from a fable model

Usage

```
## S3 method for class 'ARIMA'
IRF(x, new_data, specials, ...)
```

Arguments

<code>x</code>	A fitted model.
<code>new_data</code>	A tsibble containing the time points and exogenous regressors to produce forecasts for.
<code>specials</code>	(passed by <code>fabletools::forecast.mdl_df()</code>).
<code>...</code>	Other arguments passed to methods

IRF.VAR*Calculate impulse responses from a fable model*

Description

Simulates future paths from a dataset using a fitted model. Innovations are sampled by the model's assumed error distribution. If `bootstrap` is `TRUE`, innovations will be sampled from the model's residuals. If `new_data` contains the `.innov` column, those values will be treated as innovations.

Usage

```
## S3 method for class 'VAR'
IRF(x, new_data, specials, impulse = NULL, orthogonal = FALSE, ...)
```

Arguments

x	A fitted model.
new_data	A tibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
impulse	A character string specifying the name of the variable that is shocked (the impulse variable).
orthogonal	If TRUE, orthogonalised impulse responses will be computed.
...	Other arguments passed to methods

IRF.VECM

*Calculate impulse responses from a fable model***Description**

Simulates future paths from a dataset using a fitted model. Innovations are sampled by the model's assumed error distribution. If `bootstrap` is TRUE, innovations will be sampled from the model's residuals. If `new_data` contains the `.innov` column, those values will be treated as innovations.

Usage

```
## S3 method for class 'VECM'
IRF(x, new_data, specials, impulse = NULL, orthogonal = FALSE, ...)
```

Arguments

x	A fitted model.
new_data	A tibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
impulse	A character string specifying the name of the variable that is shocked (the impulse variable).
orthogonal	If TRUE, orthogonalised impulse responses will be computed.
...	Other arguments passed to methods

MEAN

Mean models

Description

MEAN() returns an iid model applied to the formula's response variable.

Usage

```
MEAN(formula, ...)
```

Arguments

formula	Model specification.
...	Not used.

Value

A model specification.

Specials

window: The window special is used to specify a rolling window for the mean.

```
window(size = NULL)
```

size The size (number of observations) for the rolling window. If NULL (default), a rolling window will not be used.

See Also

[Forecasting: Principles and Practices, Some simple forecasting methods \(section 3.2\)](#)

Examples

```
library(tsibbledata)
vic_elec %>%
  model(avg = MEAN(Demand))
```


Description

Feed-forward neural networks with a single hidden layer and lagged inputs for forecasting univariate time series.

Usage

```
NNETAR(formula, n_nodes = NULL, n_networks = 20, scale_inputs = TRUE, ...)
```

Arguments

formula	Model specification (see "Specials" section).
n_nodes	Number of nodes in the hidden layer. Default is half of the number of input nodes (including external regressors, if given) plus 1.
n_networks	Number of networks to fit with different random starting weights. These are then averaged when producing forecasts.
scale_inputs	If TRUE, inputs are scaled by subtracting the column means and dividing by their respective standard deviations. Scaling is applied after transformations.
...	Other arguments passed to <code>nnet::nnet()</code> .

Details

A feed-forward neural network is fitted with lagged values of the response as inputs and a single hidden layer with `size` nodes. The inputs are for lags 1 to `p`, and lags `m` to `mP` where `m` is the seasonal period specified.

If exogenous regressors are provided, its columns are also used as inputs. Missing values are currently not supported by this model. A total of `repeats` networks are fitted, each with random starting weights. These are then averaged when computing forecasts. The network is trained for one-step forecasting. Multi-step forecasts are computed recursively.

For non-seasonal data, the fitted model is denoted as an NNAR(`p`,`k`) model, where `k` is the number of hidden nodes. This is analogous to an AR(`p`) model but with non-linear functions. For seasonal data, the fitted model is called an NNAR(`p`,`P`,`k`)[`m`] model, which is analogous to an ARIMA(`p`,0,0)(`P`,0,0)[`m`] model but with non-linear functions.

Value

A model specification.

Specials

AR: The AR special is used to specify auto-regressive components in each of the nodes of the neural network.

```
AR(p = NULL, P = 1, period = NULL)
```

- p** The order of the non-seasonal auto-regressive (AR) terms. If `p = NULL`, an optimal number of lags will be selected for the model.
- P** The order of the seasonal auto-regressive (SAR) terms.
- period** The periodic nature of the seasonality. This can be either a number indicating the number of observations in each season or a vector of seasonal periods.

xreg: Exogenous regressors can be included in an NNETAR model without explicitly using the `xreg()` special. Common exogenous regressor specials as specified in `common_xregs` can also be used. These regressors are handled using `stats::model.frame()`, and so interactions and other functionality behaves similarly to `stats::lm()`.

```
xreg(...)
```

```
... Bare expressions for the exogenous regressors (such as log(x))
```

See Also

[Forecasting: Principles and Practices, Neural network models \(section 11.3\)](#)

Examples

```
as_tsibble(airmiles) %>%
  model(nn = NNETAR(box_cox(value, 0.15)))
```

refit.AR

Refit an AR model

Description

Applies a fitted AR model to a new dataset.

Usage

```
## S3 method for class 'AR'
refit(object, new_data, specials = NULL, reestimate = FALSE, ...)
```

Arguments

- object** A model for which forecasts are required.
- new_data** A tsibble containing the time points and exogenous regressors to produce forecasts for.
- specials** (passed by `fabletools::forecast.mdl_df()`).
- reestimate** If TRUE, the coefficients for the fitted model will be re-estimated to suit the new data.
- ...** Other arguments passed to methods

Value

A refitted model.

Examples

```
lung_deaths_male <- as_tsibble(mdeaths)
lung_deaths_female <- as_tsibble(fdeaths)

fit <- lung_deaths_male %>%
  model(AR(value ~ 1 + order(10)))

report(fit)

fit %>%
  refit(lung_deaths_female) %>%
  report()
```

 refit.ARIMA

Refit an ARIMA model

Description

Applies a fitted ARIMA model to a new dataset.

Usage

```
## S3 method for class 'ARIMA'
refit(object, new_data, specials = NULL, reestimate = FALSE, ...)
```

Arguments

object	A model for which forecasts are required.
new_data	A tsibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
reestimate	If TRUE, the coefficients for the fitted model will be re-estimated to suit the new data.
...	Other arguments passed to methods

Value

A refitted model.

Examples

```

lung_deaths_male <- as_tsibble(mdeaths)
lung_deaths_female <- as_tsibble(fdeaths)

fit <- lung_deaths_male %>%
  model(ARIMA(value ~ 1 + pdq(2, 0, 0) + PDQ(2, 1, 0)))

report(fit)

fit %>%
  refit(lung_deaths_female) %>%
  report()

```

refit.ETS

Refit an ETS model

Description

Applies a fitted ETS model to a new dataset.

Usage

```

## S3 method for class 'ETS'
refit(
  object,
  new_data,
  specials = NULL,
  reestimate = FALSE,
  reinitialise = TRUE,
  ...
)

```

Arguments

<code>object</code>	A model for which forecasts are required.
<code>new_data</code>	A tibble containing the time points and exogenous regressors to produce forecasts for.
<code>specials</code>	(passed by <code>fabletools::forecast.mdl_df()</code>).
<code>reestimate</code>	If TRUE, the coefficients for the fitted model will be re-estimated to suit the new data.
<code>reinitialise</code>	If TRUE, the initial parameters will be re-estimated to suit the new data.
<code>...</code>	Other arguments passed to methods

Examples

```
lung_deaths_male <- as_tsibble(mdeaths)
lung_deaths_female <- as_tsibble(fdeaths)

fit <- lung_deaths_male %>%
  model(ETS(value))

report(fit)

fit %>%
  refit(lung_deaths_female, reinitialise = TRUE) %>%
  report()
```

refit.model_mean	<i>Refit a MEAN model</i>
------------------	---------------------------

Description

Applies a fitted average method model to a new dataset.

Usage

```
## S3 method for class 'model_mean'
refit(object, new_data, specials = NULL, reestimate = FALSE, ...)
```

Arguments

object	A model for which forecasts are required.
new_data	A tsibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
reestimate	If TRUE, the mean for the fitted model will be re-estimated to suit the new data.
...	Other arguments passed to methods

Examples

```
lung_deaths_male <- as_tsibble(mdeaths)
lung_deaths_female <- as_tsibble(fdeaths)

fit <- lung_deaths_male %>%
  model(MEAN(value))

report(fit)

fit %>%
  refit(lung_deaths_female) %>%
  report()
```

refit.NNETAR	<i>Refit a NNETAR model</i>
--------------	-----------------------------

Description

Applies a fitted NNETAR model to a new dataset.

Usage

```
## S3 method for class 'NNETAR'
refit(object, new_data, specials = NULL, reestimate = FALSE, ...)
```

Arguments

object	A model for which forecasts are required.
new_data	A tsibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
reestimate	If TRUE, the networks will be initialized with random starting weights to suit the new data. If FALSE, for every network the best individual set of weights found in the pre-estimation process is used as the starting weight vector.
...	Other arguments passed to methods

Value

A refitted model.

Examples

```
lung_deaths_male <- as_tsibble(mdeaths)
lung_deaths_female <- as_tsibble(fdeaths)

fit <- lung_deaths_male %>%
  model(NNETAR(value))

report(fit)

fit %>%
  refit(new_data = lung_deaths_female, reestimate = FALSE) %>%
  report()
```

refit.RW	<i>Refit a lag walk model</i>
----------	-------------------------------

Description

Applies a fitted random walk model to a new dataset.

Usage

```
## S3 method for class 'RW'
refit(object, new_data, specials = NULL, reestimate = FALSE, ...)
```

Arguments

object	A model for which forecasts are required.
new_data	A tibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
reestimate	If TRUE, the lag walk model will be re-estimated to suit the new data.
...	Other arguments passed to methods

Details

The models NAIVE and SNAIVE have no specific model parameters. Using `refit` for one of these models will provide the same estimation results as one would use `fabletools::model(NAIVE(...))` (or `fabletools::model(SNAIVE(...))`).

Examples

```
lung_deaths_male <- as_tibble(mdeaths)
lung_deaths_female <- as_tibble(fdeaths)

fit <- lung_deaths_male %>%
  model(RW(value ~ drift()))

report(fit)

fit %>%
  refit(lung_deaths_female) %>%
  report()
```

refit.TSLM	<i>Refit a TSLM</i>
------------	---------------------

Description

Applies a fitted TSLM to a new dataset.

Usage

```
## S3 method for class 'TSLM'
refit(object, new_data, specials = NULL, reestimate = FALSE, ...)
```

Arguments

object	A model for which forecasts are required.
new_data	A tibble containing the time points and exogenous regressors to produce forecasts for.
specials	(passed by <code>fabletools::forecast.mdl_df()</code>).
reestimate	If TRUE, the coefficients for the fitted model will be re-estimated to suit the new data.
...	Other arguments passed to methods

Examples

```
lung_deaths_male <- as_tibble(mdeaths)
lung_deaths_female <- as_tibble(fdeaths)

fit <- lung_deaths_male %>%
  model(TSLM(value ~ trend() + season()))

report(fit)

fit %>%
  refit(lung_deaths_female) %>%
  report()
```

residuals.AR	<i>Extract residuals from a fable model</i>
--------------	---

Description

Extracts the residuals.

Usage

```
## S3 method for class 'AR'
residuals(object, type = c("innovation", "regression"), ...)
```

Arguments

object	A model for which forecasts are required.
type	The type of residuals to extract.
...	Other arguments passed to methods

Value

A vector of fitted residuals.

Examples

```
as_tsibble(lh) %>%
  model(AR(value ~ order(3))) %>%
  residuals()
```

residuals.ARIMA	<i>Extract residuals from a fable model</i>
-----------------	---

Description

Extracts the residuals.

Usage

```
## S3 method for class 'ARIMA'
residuals(object, type = c("innovation", "regression"), ...)
```

Arguments

object	A model for which forecasts are required.
type	The type of residuals to extract.
...	Other arguments passed to methods

Value

A vector of fitted residuals.

Examples

```
USAccDeaths %>%
  as_tsibble() %>%
  model(arima = ARIMA(log(value) ~ pdq(0, 1, 1) + PDQ(0, 1, 1))) %>%
  residuals()
```

residuals.croston	<i>Extract residuals from a fable model</i>
-------------------	---

Description

Extracts the residuals.

Usage

```
## S3 method for class 'croston'  
residuals(object, ...)
```

Arguments

object	A model for which forecasts are required.
...	Other arguments passed to methods

Value

A vector of fitted residuals.

Examples

```
library(tsibble)  
sim_poisson <- tsibble(  
  time = yearmonth("2012 Dec") + seq_len(24),  
  count = rpois(24, lambda = 0.3),  
  index = time  
)  
  
sim_poisson %>%  
  model(CROSTON(count)) %>%  
  residuals()
```

residuals.ETS	<i>Extract residuals from a fable model</i>
---------------	---

Description

Extracts the residuals.

Usage

```
## S3 method for class 'ETS'  
residuals(object, ...)
```

Arguments

object A model for which forecasts are required.
... Other arguments passed to methods

Value

A vector of fitted residuals.

Examples

```
as_tsibble(USAccDeaths) %>%  
  model(ets = ETS(log(value) ~ season("A"))) %>%  
  residuals()
```

residuals.fable_theta *Extract residuals from a fable model*

Description

Extracts the residuals.

Usage

```
## S3 method for class 'fable_theta'  
residuals(object, ...)
```

Arguments

object A model for which forecasts are required.
... Other arguments passed to methods

Value

A vector of fitted residuals.

Examples

```
library(tsibbledata)  
vic_elec %>%  
  model(avg = MEAN(Demand)) %>%  
  residuals()
```

residuals.model_mean *Extract residuals from a fable model*

Description

Extracts the residuals.

Usage

```
## S3 method for class 'model_mean'
residuals(object, ...)
```

Arguments

object A model for which forecasts are required.
 ... Other arguments passed to methods

Value

A vector of fitted residuals.

Examples

```
library(tsibbledata)
vic_elec %>%
  model(avg = MEAN(Demand)) %>%
  residuals()
```

residuals.NNETAR *Extract residuals from a fable model*

Description

Extracts the residuals.

Usage

```
## S3 method for class 'NNETAR'
residuals(object, ...)
```

Arguments

object A model for which forecasts are required.
 ... Other arguments passed to methods

Value

A vector of fitted residuals.

Examples

```
as_tsibble(airmiles) %>%
  model(nn = NNETAR(box_cox(value, 0.15))) %>%
  residuals()
```

residuals.RW

Extract residuals from a fable model

Description

Extracts the residuals.

Usage

```
## S3 method for class 'RW'
residuals(object, ...)
```

Arguments

`object` A model for which forecasts are required.
`...` Other arguments passed to methods

Value

A vector of fitted residuals.

Examples

```
as_tsibble(Nile) %>%
  model(NAIVE(value)) %>%
  residuals()

library(tsibbledata)
aus_production %>%
  model(snaive = SNAIVE(Beer ~ lag("year"))) %>%
  residuals()
```

residuals.TSLM	<i>Extract residuals from a fable model</i>
----------------	---

Description

Extracts the residuals.

Usage

```
## S3 method for class 'TSLM'
residuals(object, ...)
```

Arguments

object	A model for which forecasts are required.
...	Other arguments passed to methods

Value

A vector of fitted residuals.

Examples

```
as_tsibble(USAccDeaths) %>%
  model(lm = TSLM(log(value) ~ trend() + season())) %>%
  residuals()
```

residuals.VAR	<i>Extract residuals from a fable model</i>
---------------	---

Description

Extracts the residuals.

Usage

```
## S3 method for class 'VAR'
residuals(object, ...)
```

Arguments

object	A model for which forecasts are required.
...	Other arguments passed to methods

Value

A vector of fitted residuals.

Examples

```
lung_deaths <- cbind(mdeaths, fdeaths) %>%
  as_tsibble(pivot_longer = FALSE)

lung_deaths %>%
  model(VAR(vars(mdeaths, fdeaths) ~ AR(3))) %>%
  residuals()
```

RW

*Random walk models***Description**

`RW()` returns a random walk model, which is equivalent to an ARIMA(0,1,0) model with an optional drift coefficient included using `drift()`. `naive()` is simply a wrapper to `rwf()` for simplicity. `snaive()` returns forecasts and prediction intervals from an ARIMA(0,0,0)(0,1,0)_m model where *m* is the seasonal period.

Usage

```
RW(formula, ...)

NAIVE(formula, ...)

SNAIVE(formula, ...)
```

Arguments

<code>formula</code>	Model specification (see "Specials" section).
<code>...</code>	Not used.

Details

The random walk with drift model is

$$Y_t = c + Y_{t-1} + Z_t$$

where Z_t is a normal iid error. Forecasts are given by

$$Y_n(h) = ch + Y_n$$

. If there is no drift (as in `naive`), the drift parameter $c=0$. Forecast standard errors allow for uncertainty in estimating the drift parameter (unlike the corresponding forecasts obtained by fitting an ARIMA model directly).

The seasonal naive model is

$$Y_t = Y_{t-m} + Z_t$$

where Z_t is a normal iid error.

Value

A model specification.

Specials

lag: The lag special is used to specify the lag order for the random walk process. If left out, this special will automatically be included.

```
lag(lag = NULL)
```

lag The lag order for the random walk process. If lag = m, forecasts will return the observation from m time periods ago. This

drift: The drift special can be used to include a drift/trend component into the model. By default, drift is not included unless drift() is included in the formula.

```
drift(drift = TRUE)
```

drift If drift = TRUE, a drift term will be included in the model.

See Also

[Forecasting: Principles and Practices, Some simple forecasting methods \(section 3.2\)](#)

Examples

```
library(tsibbledata)
aus_production %>%
  model(rw = RW(Beer ~ drift()))

as_tsibble(Nile) %>%
  model(NAIVE(value))
library(tsibbledata)
aus_production %>%
  model(snaive = SNAIVE(Beer ~ lag("year")))
```

THETA

Theta method

Description

The theta method of Assimakopoulos and Nikolopoulos (2000) is equivalent to simple exponential smoothing with drift. This is demonstrated in Hyndman and Billah (2003).

Usage

```
THETA(formula, ...)
```


Arguments

formula	Model specification.
...	Not used.

Details

The series is tested for seasonality using the test outlined in A&N. If deemed seasonal, the series is seasonally adjusted using a classical multiplicative decomposition before applying the theta method. The resulting forecasts are then reseasonalized.

More general theta methods are available in the `forecTheta` package.

Value

A model specification.

Specials

season: The season special is used to specify the parameters of the seasonal adjustment via classical decomposition.

```
season(period = NULL, method = c("multiplicative", "additive"))
```

`period` The periodic nature of the seasonality. This can be either a number indicating the number of observations in each season or a character string indicating the seasonality type.

`method` The type of classical decomposition to apply. The original Theta method always used multiplicative seasonal decomposition.

Author(s)

Rob J Hyndman, Mitchell O'Hara-Wild

References

Assimakopoulos, V. and Nikolopoulos, K. (2000). The theta model: a decomposition approach to forecasting. *International Journal of Forecasting* **16**, 521-530.

Hyndman, R.J., and Billah, B. (2003) Unmasking the Theta method. *International J. Forecasting*, **19**, 287-290.

Examples

```
# Theta method with transform
deaths <- as_tsibble(USAccDeaths)
deaths %>%
  model(theta = THETA(log(value))) %>%
  forecast(h = "4 years") %>%
  autoplot(deaths)

# Compare seasonal specifications
library(tsibbledata)
library(dplyr)
aus_retail %>%
```

```

filter(Industry == "Clothing retailing") %>%
model(theta_multiplicative = THETA(Turnover ~ season(method = "multiplicative")),
      theta_additive = THETA(Turnover ~ season(method = "additive"))) %>%
accuracy()

```

tidy.AR

Tidy a fable model

Description

Returns the coefficients from the model in a tibble format.

Usage

```

## S3 method for class 'AR'
tidy(x, ...)

```

Arguments

`x` An object to be converted into a tidy `tibble::tibble()`.

`...` Additional arguments to tidying method.

Value

The model's coefficients in a tibble.

Examples

```

as_tsibble(lh) %>%
model(AR(value ~ order(3))) %>%
tidy()

```

tidy.ARIMA

Tidy a fable model

Description

Returns the coefficients from the model in a tibble format.

Usage

```

## S3 method for class 'ARIMA'
tidy(x, ...)

```

Arguments

x An object to be converted into a tidy `tibble::tibble()`.
 ... Additional arguments to tidying method.

Value

The model's coefficients in a tibble.

Examples

```
USAccDeaths %>%
  as_tsibble() %>%
  model(arima = ARIMA(log(value) ~ pdq(0, 1, 1) + PDQ(0, 1, 1))) %>%
  tidy()
```

tidy.croston

Tidy a fable model

Description

Returns the coefficients from the model in a tibble format.

Usage

```
## S3 method for class 'croston'
tidy(x, ...)
```

Arguments

x An object to be converted into a tidy `tibble::tibble()`.
 ... Additional arguments to tidying method.

Value

The model's coefficients in a tibble.

Examples

```
library(tsibble)
sim_poisson <- tsibble(
  time = yearmonth("2012 Dec") + seq_len(24),
  count = rpois(24, lambda = 0.3),
  index = time
)

sim_poisson %>%
  model(CROSTON(count)) %>%
  tidy()
```

tidy.ETS	<i>Tidy a fable model</i>
----------	---------------------------

Description

Returns the coefficients from the model in a tibble format.

Usage

```
## S3 method for class 'ETS'
tidy(x, ...)
```

Arguments

x An object to be converted into a tidy `tibble::tibble()`.
 ... Additional arguments to tidying method.

Value

The model's coefficients in a tibble.

Examples

```
as_tsibble(USAccDeaths) %>%
  model(ets = ETS(log(value) ~ season("A"))) %>%
  tidy()
```

tidy.fable_theta	<i>Tidy a fable model</i>
------------------	---------------------------

Description

Returns the coefficients from the model in a tibble format.

Usage

```
## S3 method for class 'fable_theta'
tidy(x, ...)
```

Arguments

x An object to be converted into a tidy `tibble::tibble()`.
 ... Additional arguments to tidying method.

Value

The model's coefficients in a tibble.

Examples

```
USAccDeaths %>%
  as_tsibble() %>%
  model(arima = ARIMA(log(value) ~ pdq(0, 1, 1) + PDQ(0, 1, 1))) %>%
  tidy()
```

tidy.model_mean	<i>Tidy a fable model</i>
-----------------	---------------------------

Description

Returns the coefficients from the model in a tibble format.

Usage

```
## S3 method for class 'model_mean'
tidy(x, ...)
```

Arguments

`x` An object to be converted into a tidy `tibble::tibble()`.
`...` Additional arguments to tidying method.

Value

The model's coefficients in a tibble.

Examples

```
library(tsibbledata)
vic_elec %>%
  model(avg = MEAN(Demand)) %>%
  tidy()
```

tidy.NNETAR

Tidy a fable model

Description

Returns the coefficients from the model in a tibble format.

Usage

```
## S3 method for class 'NNETAR'
tidy(x, ...)
```

Arguments

x An object to be converted into a tidy `tibble::tibble()`.
 ... Additional arguments to tidying method.

Value

The model's coefficients in a tibble.

Examples

```
as_tsibble(airmiles) %>%
  model(nn = NNETAR(box_cox(value, 0.15))) %>%
  tidy()
```

tidy.RW

Tidy a fable model

Description

Returns the coefficients from the model in a tibble format.

Usage

```
## S3 method for class 'RW'
tidy(x, ...)
```

Arguments

x An object to be converted into a tidy `tibble::tibble()`.
 ... Additional arguments to tidying method.

Value

The model's coefficients in a tibble.

Examples

```
as_tsibble(Nile) %>%
  model(NAIVE(value)) %>%
  tidy()

library(tsibbledata)
aus_production %>%
  model(snaive = SNAIVE(Beer ~ lag("year"))) %>%
  tidy()
```

tidy.TSLM

Tidy a fable model

Description

Returns the coefficients from the model in a tibble format.

Usage

```
## S3 method for class 'TSLM'
tidy(x, ...)
```

Arguments

x An object to be converted into a tidy `tibble::tibble()`.
 ... Additional arguments to tidying method.

Value

The model's coefficients in a tibble.

Examples

```
as_tsibble(USAccDeaths) %>%
  model(lm = TSLM(log(value) ~ trend() + season())) %>%
  tidy()
```

tidy.VAR	<i>Tidy a fable model</i>
----------	---------------------------

Description

Returns the coefficients from the model in a tibble format.

Usage

```
## S3 method for class 'VAR'
tidy(x, ...)
```

Arguments

x An object to be converted into a tidy `tibble::tibble()`.
 ... Additional arguments to tidying method.

Value

The model's coefficients in a tibble.

Examples

```
lung_deaths <- cbind(mdeaths, fdeaths) %>%
  as_tsibble(pivot_longer = FALSE)

lung_deaths %>%
  model(VAR(vars(mdeaths, fdeaths) ~ AR(3))) %>%
  tidy()
```

TSLM	<i>Fit a linear model with time series components</i>
------	---

Description

The model formula will be handled using `stats::model.matrix()`, and so the the same approach to include interactions in `stats::lm()` applies when specifying the formula. In addition to `stats::lm()`, it is possible to include `common_xregs` in the model formula, such as `trend()`, `season()`, and `fourier()`.

Usage

```
TSLM(formula)
```

Arguments

formula Model specification.

Value

A model specification.

Specials

xreg: Exogenous regressors can be included in a TSLM model without explicitly using the `xreg()` special. Common exogenous regressor specials as specified in `common_xregs` can also be used. These regressors are handled using `stats::model.frame()`, and so interactions and other functionality behaves similarly to `stats::lm()`.

```
xreg(...)
```

```
... Bare expressions for the exogenous regressors (such as log(x))
```

See Also

`stats::lm()`, `stats::model.matrix()` [Forecasting: Principles and Practices, Time series regression models \(chapter 6\)](#)

Examples

```
as_tsibble(USAccDeaths) %>%
  model(lm = TSLM(log(value) ~ trend() + season()))
```

```
library(tsibbledata)
olympic_running %>%
  model(TSLM(Time ~ trend())) %>%
  interpolate(olympic_running)
```

unitroot_options

Options for the unit root tests for order of integration

Description

By default, a kpss test (via `feasts::unitroot_kpss()`) will be performed for testing the required first order differences, and a test of the seasonal strength (via `feasts::feat_stl()` `seasonal_strength`) being above the 0.64 threshold is used for determining seasonal required differences.

Usage

```
unitroot_options(
  ndiffs_alpha = 0.05,
  nsdiffs_alpha = 0.05,
  ndiffs_pvalue = ~feasts::unitroot_kpss(.)["kpss_pvalue"],
  nsdiffs_pvalue = ur_seasonal_strength(0.64)
)
```

Arguments

- `ndiffs_alpha, nsdiffs_alpha`
The level for the test specified in the `pval` functions. As long as `pval < alpha`, differences will be added.
- `ndiffs_pvalue, nsdiffs_pvalue`
A function (or lambda expression) that provides a p-value for the unit root test. As long as `pval < alpha`, differences will be added.
For the function for the seasonal p-value, the seasonal period will be provided as the `.period` argument to this function. A vector of data to test is available as `.` or `.x`.

Value

A list of parameters

VAR

Estimate a VAR model

Description

Searches through the vector of lag orders to find the best VAR model which has lowest AIC, AICc or BIC value. It is implemented using OLS per equation.

Usage

```
VAR(formula, ic = c("aicc", "aic", "bic"), ...)
```

Arguments

- `formula` Model specification (see "Specials" section).
- `ic` The information criterion used in selecting the model.
- `...` Further arguments for `arma`

Details

Exogenous regressors and `common_xregs` can be specified in the model formula.

Value

A model specification.

Specials

AR: The AR special is used to specify the lag order for the auto-regression.

```
AR(p = 0:5)
```

- p The order of the auto-regressive (AR) terms. If multiple values are provided, the one which minimises `ic` will be chosen.

xreg: Exogenous regressors can be included in an VAR model without explicitly using the `xreg()` special. Common exogenous regressor specials as specified in `common_xregs` can also be used. These regressors are handled using `stats::model.frame()`, and so interactions and other functionality behaves similarly to `stats::lm()`.

The inclusion of a constant in the model follows the similar rules to `stats::lm()`, where including 1 will add a constant and 0 or -1 will remove the constant. If left out, the inclusion of a constant will be determined by minimising `ic`.

```
xreg(...)
```

```
... Bare expressions for the exogenous regressors (such as log(x))
```

See Also

[Forecasting: Principles and Practices, Vector autoregressions \(section 11.2\)](#)

Examples

```
lung_deaths <- cbind(mdeaths, fdeaths) %>%
  as_tsibble(pivot_longer = FALSE)

fit <- lung_deaths %>%
  model(VAR(vars(mdeaths, fdeaths) ~ AR(3)))

report(fit)

fit %>%
  forecast() %>%
  autoplot(lung_deaths)
```

 VARIMA

Estimate a VARIMA model

Description

Estimates a VARIMA model of a given order.

Usage

```

VARIMA(formula, identification = c("kronecker_indices", "none"), ...)

## S3 method for class 'VARIMA'
forecast(
  object,
  new_data = NULL,
  specials = NULL,
  bootstrap = FALSE,
  times = 5000,
  ...
)

## S3 method for class 'VARIMA'
fitted(object, ...)

## S3 method for class 'VARIMA'
residuals(object, ...)

## S3 method for class 'VARIMA'
tidy(x, ...)

## S3 method for class 'VARIMA'
glance(x, ...)

## S3 method for class 'VARIMA'
report(object, ...)

## S3 method for class 'VARIMA'
generate(x, new_data, specials, ...)

## S3 method for class 'VARIMA'
IRF(x, new_data, specials, impulse = NULL, orthogonal = FALSE, ...)

```

Arguments

<code>formula</code>	Model specification (see "Specials" section).
<code>identification</code>	The identification technique used to estimate the model.
<code>...</code>	Further arguments for <code>arma</code>
<code>object</code>	A model for which forecasts are required.
<code>new_data</code>	A tibble containing the time points and exogenous regressors to produce forecasts for.
<code>specials</code>	(passed by <code>fabletools::forecast.mdl_df()</code>).
<code>bootstrap</code>	If TRUE, then forecast distributions are computed using simulation with resampled errors.
<code>times</code>	The number of sample paths to use in estimating the forecast distribution when <code>bootstrap = TRUE</code> .

<code>x</code>	A fitted model.
<code>impulse</code>	A character string specifying the name of the variable that is shocked (the impulse variable).
<code>orthogonal</code>	If TRUE, orthogonalised impulse responses will be computed.

Details

Exogenous regressors and `common_xregs` can be specified in the model formula.

Value

A model specification.

A one row tibble summarising the model's fit.

Specials

pdq: The `pdq` special is used to specify non-seasonal components of the model.

```
pdq(p = 0:5, d = 0:2, q = 0:5)
```

`p` The order of the non-seasonal auto-regressive (AR) terms. If multiple values are provided, the one which minimises `ic` will be selected.

`d` The order of integration for non-seasonal differencing. If multiple values are provided, one of the values will be selected which minimises `ic`.

`q` The order of the non-seasonal moving average (MA) terms. If multiple values are provided, the one which minimises `ic` will be selected.

xreg: Exogenous regressors can be included in an VARIMA model without explicitly using the `xreg()` special. Common exogenous regressor specials as specified in `common_xregs` can also be used. These regressors are handled using `stats::model.frame()`, and so interactions and other functionality behaves similarly to `stats::lm()`.

The inclusion of a constant in the model follows the similar rules to `stats::lm()`, where including `1` will add a constant and `0` or `-1` will remove the constant. If left out, the inclusion of a constant will be determined by minimising `ic`.

```
xreg(...)
```

```
... Bare expressions for the exogenous regressors (such as log(x))
```

See Also

`MTS::VARMA()`, `MTS::Kronfit()`.

Examples

```
library(tsibbledata)

aus_production %>%
  autoplot(vars(Beer, Cement))

fit <- aus_production %>%
```

```

model(VARIMA(vars(Beer, Cement) ~ pdq(4,1,1), identification = "none"))

fit

fit %>%
  forecast(h = 50) %>%
  autoplot(tail(aus_production, 100))

fitted(fit)

residuals(fit)

tidy(fit)

glance(fit)

report(fit)

generate(fit, h = 10)

IRF(fit, h = 10, impulse = "Beer")

```

 VECM

Estimate a VECM model

Description

Searches through the vector of lag orders to find the best VECM model which has lowest AIC, AICc or BIC value. The model is estimated using the Johansen procedure (maximum likelihood).

Usage

```
VECM(formula, ic = c("aicc", "aic", "bic"), r = 1L, ...)
```

Arguments

formula	Model specification (see "Specials" section).
ic	The information criterion used in selecting the model.
r	The number of cointegrating relationships
...	Further arguments for arima

Details

Exogenous regressors and `common_xregs` can be specified in the model formula.

Value

A model specification.

Specials

AR: The AR special is used to specify the lag order for the auto-regression.

`AR(p = 0:5)`

`p` The order of the auto-regressive (AR) terms. If multiple values are provided, the one which minimises `ic` will be chosen.

xreg: Exogenous regressors can be included in an VECM model without explicitly using the `xreg()` special. Common exogenous regressor specials as specified in `common_xregs` can also be used. These regressors are handled using `stats::model.frame()`, and so interactions and other functionality behaves similarly to `stats::lm()`.

The inclusion of a constant in the model follows the similar rules to `stats::lm()`, where including 1 will add a constant and 0 or -1 will remove the constant. If left out, the inclusion of a constant will be determined by minimising `ic`.

`xreg(...)`

`...` Bare expressions for the exogenous regressors (such as `log(x)`)

Examples

```
lung_deaths <- cbind(mdeaths, fdeaths) %>%
  as_tsibble(pivot_longer = FALSE)

fit <- lung_deaths %>%
  model(VECM(vars(mdeaths, fdeaths) ~ AR(3)))

report(fit)

fit %>%
  forecast() %>%
  autoplot(lung_deaths)
```

Index

AR, 4
ARIMA, 5
arima, 6

breusch_godfrey, 8

common_xregs, 4, 7, 50, 72–75, 77, 79
components.ETS, 9
CROSTON, 9

ETS, 11

fabletools::dable(), 9
fabletools::forecast.mdl_df(), 20–31,
33, 35, 36, 44–47, 50–56, 76
fabletools::generate.mdl_df, 30–36
fabletools::interpolate(), 12
feasts::feat_stl(), 73
feasts::unitroot_kpss(), 73
fitted.AR, 13
fitted.ARIMA, 14
fitted.croston, 15
fitted.ETS, 15
fitted.fable_theta, 16
fitted.model_mean, 17
fitted.NNETAR, 17
fitted.RW, 18
fitted.TSLM, 19
fitted.VAR, 19
fitted.VARIMA (VARIMA), 75
forecast.AR, 20
forecast.ARIMA, 21
forecast.croston, 22
forecast.ETS, 22
forecast.fable_theta, 23
forecast.model_mean, 24
forecast.NNETAR, 25
forecast.RW, 26
forecast.TSLM, 28
forecast.VAR, 29
forecast.VARIMA (VARIMA), 75
forecast::Arima(), 6

generate.AR, 30
generate.ARIMA, 30
generate.ETS, 31
generate.model_mean, 32
generate.NNETAR, 33
generate.RW, 33
generate.TSLM, 34
generate.VAR, 35
generate.VARIMA (VARIMA), 75
generate.VECM, 36
glance.AR, 37
glance.ARIMA, 37
glance.ETS, 38
glance.fable_theta, 39
glance.model_mean, 40
glance.NNETAR, 40
glance.RW, 41
glance.TSLM, 42
glance.VAR, 42
glance.VARIMA (VARIMA), 75
glance.VECM, 43

interpolate.ARIMA, 44
interpolate.model_mean, 44
interpolate.TSLM, 45
IRF.ARIMA, 46
IRF.VAR, 46
IRF.VARIMA (VARIMA), 75
IRF.VECM, 47

lmtest::bgtest(), 8

MEAN, 48
MTS::Kronfit(), 77
MTS::VARMA(), 77

NAIVE (RW), 63
nnet::nnet(), 49

NNETAR, 49

refit.AR, 50
refit.ARIMA, 51
refit.ETS, 52
refit.model_mean, 53
refit.NNETAR, 54
refit.RW, 55
refit.TSLM, 56
report.AR (AR), 4
report.ARIMA (ARIMA), 5
report.ETS (ETS), 11
report.model_mean (MEAN), 48
report.NNETAR (NNETAR), 49
report.RW (RW), 63
report.TSLM (TSLM), 72
report.VAR (VAR), 74
report.VARIMA (VARIMA), 75
residuals.AR, 56
residuals.ARIMA, 57
residuals.croston, 58
residuals.ETS, 58
residuals.fable_theta, 59
residuals.model_mean, 60
residuals.NNETAR, 60
residuals.RW, 61
residuals.TSLM, 62
residuals.VAR, 62
residuals.VARIMA (VARIMA), 75
RW, 63

SNAIVE (RW), 63
stats::ar.ols(), 4
stats::arima(), 5, 6
stats::lm(), 4, 7, 50, 72, 73, 75, 77, 79
stats::model.frame(), 4, 7, 50, 73, 75, 77,
79
stats::model.matrix(), 72, 73

THETA, 64
tibble::tibble(), 66–72
tidy.AR, 66
tidy.ARIMA, 66
tidy.croston, 67
tidy.ETS, 68
tidy.fable_theta, 68
tidy.model_mean, 69
tidy.NNETAR, 70
tidy.RW, 70
tidy.TSLM, 71
tidy.VAR, 72
tidy.VARIMA (VARIMA), 75
tidyr::fill(), 12
TSLM, 72

unitroot_options, 73
unitroot_options(), 6

VAR, 74
VARIMA, 75
VECM, 78