Package ‘ensembleMOS’

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brierScore

Description

Computes the Brier score for the probability of exceedance of precipitation threshold values for univariate ensemble forecasting models.

Usage

brierScore(fit, ensembleData, thresholds, dates=NULL, ...)

Arguments

fit A model fit to ensemble forecasting data, obtained using fitMOS or ensembleMOS. Only available for the censored and shifted gamma, and the censored generalized extreme value distribution model.

ensembleData An ensembleData object that includes ensemble forecasts, verification observations and possibly dates. Missing values (indicated by NA) are allowed. This need not be the data used for the model fit, although it must include the same ensemble members.

thresholds Threshold values for which the probability of exceedance is evaluated, set to 0 to evaluate probability of precipitation forecasts.

dates The dates for which the CRPS will be computed. These dates must be consistent with fit and ensembleData. The default is to use all of the dates in fit. The dates are ignored if fit originates from fitMOS, which also ignores date information.

... Included for generic function compatibility.

Details

Note that the Brier scores are only available for EMOS models suitable for precipitation accumulation, i.e. the censored and shifted gamma, and the censored generalized extreme value distribution EMOS model.
Value

BScores is a vector giving the Brier scores for each instance in the data.

References


See Also

ensembleMOS, fitMOS

Examples

data("ensBMAtest", package = "ensembleBMA")

ensMemNames <- c("gfs","cmcg","eta","gasp","jma","ngps","tcwb","ukmo")

obs <- paste("PCP24","obs", sep = ".")
ens <- paste("PCP24", ensMemNames, sep = ".")

prcpTestData <- ensembleData( forecasts = ensBMAtest[,ens],
    dates = ensBMAtest[,"vdate"],
    observations = ensBMAtest[,obs],
    station = ensBMAtest[,"station"],
    forecastHour = 48,
    initializationTime = "00")

prcpTestFitCSG0 <- ensembleMOScsg0(prcpTestData, trainingDays = 25,
    dates = "2008010100")

brierScore(prcpTestFitCSG0, ensembleData = prcpTestData,
    thresholds = 0)
Arguments

fit A model fit to ensemble forecasting data, obtained using fitMOS or ensembleMOS.
ensembleData An ensembleData object that includes ensemble forecasts, verification observations and possibly dates. Missing values (indicated by NA) are allowed. This need not be the data used for the model fit, although it must include the same ensemble members.
values The vector of desired values at which the CDF of the ensemble forecasting model is to be evaluated.
dates The dates for which the CDF will be computed. These dates must be consistent with fit and ensembleData. The default is to use all of the dates in fit. The dates are ignored if fit originates from fitMOS, which also ignores date information.

... Included for generic function compatibility.

Details

This method is generic, and can be applied to any ensemble forecasting model obtained using fitMOS or ensembleMOS.

For the EMOS models that allow for point masses at 0, i.e., the censored and shifted gamma, and the censored generalized extreme value distribution EMOS model, the function contains an addition logical argument randomizeAtZero that specifies whether the value of the CDF at zero should be chosen randomly from the interval between 0 and the value of the CDF at zero. The default choice if FALSE, setting randomizeAtZero = TRUE is practical for computing randomized PIT values.

Value

A matrix of probabilities corresponding to the CDF at the desired values. Useful for determining probability of freezing, precipitation, etc.

References


See Also

ensembleMOS, fitMOS, quantileForecast

Examples

data("ensBMATest", package = "ensembleBMA")
ensMemNames <- c("gfs","cmcg","eta","gasp","jma","ngps","tcwb","ukmo")
obs <- paste("T2", "obs", sep = ".")
ens <- paste("T2", ensMemNames, sep = ".")
tempTestData <- ensembleData(forecasts = ensBMATest[,ens],
controlMOScsg0

Control parameters for censored and shifted gamma EMOS models

Description

Specifies a list of values controlling the censored and shifted gamma EMOS fit of ensemble forecasts.

Usage

controlMOScsg0(scoringRule = c("crps", "log"),
               optimRule = c("Nelder-Mead", "BFGS", "L-BFGS-B"),
               coefRule = c("square", "none", "positive"),
               varRule = c("square", "none"),
               start = list(a = NULL, B = NULL,
                             c = NULL, d = NULL, q = NULL),
               maxIter = Inf)

Arguments

- **scoringRule**: The scoring rule to be used in optimum score estimation. Options are "crps" for the continuous ranked probability score and "log" for the logarithmic score.
- **optimRule**: Numerical optimization method to be supplied to optim. Options are "BFGS" for the Broyden-Fletcher-Goldfarb-Shanno algorithm and "Nelder-Mead" for the Nelder-Mead method, see optim for details. Note that these options are only available for scoringRule = "log". In case of scoringRule = "crps", the optimization method is set to "L-BFGS-B" by default.
- **coefRule**: Method to control non-negativity of regression estimates. Options are:
  - "square" EMOS coefficients are parameterized as squares and thus guaranteed to be non-negative.
  - "positive" finds non-negative coefficients iteratively by setting negative estimates at the current iteration to zero.
  - "none" no restriction on the coefficient estimates.
Control MOS CSG0

Method to control non-negativity of the scale parameters. Options "square" and "none" are the same as in coefRule.

A list of starting parameters, a, b, c, d, q specifying initial values for the intercept coefficient and variance parameters supplied to optim. See details.

An integer specifying the upper limit of the number of iterations used to fit the model.

If no value is assigned to an argument, the first entry of the list of possibly choices will be used by default. Note that optimMethod options are only available for scoringRule = "log". In case of scoringRule = "crps", the optimization method is set to "L-BFGS-B" by default.

Given an ensemble of size $m$: $X_1, \ldots, X_m$, the following shifted gamma model left-censored at 0 is fit by ensembleMOScsg0:

$$Y \sim \text{Gamma}_0(\kappa, \theta, q)$$

where $\text{Gamma}_0$ denotes the shifted gamma distribution left-censored at zero, with shape $\kappa$, scale $\theta$ and shift $q$. The model is parametrized such that the mean $k\theta$ is a linear function $a + b_1 X_1 + \ldots + b_m X_m$ of the ensemble forecasts, and the variance $k\theta^2$ is a linear function of the ensemble mean $c + d \bar{f}$, see ensembleMOScsg0 for details.

Value

A list whose components are the input arguments and their assigned values.

References


See Also

ensembleMOScsg0, fitMOScsg0

Examples

data("ensBMATest", package = "ensembleBMA")

ensMemNames <- c("gfs", "cmcg", "eta", "gasp", "jma", "ngps", "tcwb", "ukmo")

obs <- paste("PCP24", "obs", sep = ".")

c <- paste("PCP24", ensMemNames, sep = ".")

ensembleData(ingredients = ensBMATest[, c],
             dates = ensBMATest[, "vdate"],
             observations = ensBMATest[, obs],
             station = ensBMATest[, "station"],
             start = NA_all,
             varRule = "square",
             maxIter = 1000,
             crps = NA_all)
**controlMOSgev0**

Control parameters for censored generalized extreme value distribution EMOS models

**Description**

Specifies a list of values controlling the censored generalized extreme value distribution EMOS fit of ensemble forecasts.

**Usage**

```r
controlMOSgev0(optimRule = c("Nelder-Mead", "L-BFGS-B", "BFGS"),
              coefRule = c("square", "none", "positive"),
              varRule = c("square", "none"),
              start = list(a = NULL, B = NULL,
                            s = NULL, c = NULL,
                            d = NULL, q = NULL),
              maxIter = Inf)
```

**Arguments**

- `optimRule`: Numerical optimization method to be supplied to `optim`. Options are "BFGS" for the Broyden-Fletcher-Goldfarb-Shanno algorithm, "L-BFGS-B" for a constrained version thereof, and "Nelder-Mead" for the Nelder-Mead method, see `optim` for details.

- `coefRule`: Method to control non-negativity of regression estimates. Options are:
  - "square" EMOS coefficients are parameterized as squares and thus guaranteed to be non-negative.
  - "positive" finds non-negative coefficients iteratively by setting negative estimates at the current iteration to zero.
  - "none" no restriction on the coefficient estimates.

- `varRule`: Method to control non-negativity of the scale parameters. Options "square" and "none" are the same as in `coefRule`.

- `start`: A list of starting parameters, a, B, s, c, d and q specifying initial values for the location, scale and shape coefficients supplied to `optim`. See details.
maxIter  
An integer specifying the upper limit of the number of iterations used to fit the model.

Details

Note that only minimum CRPS estimation is available and chosen by default.
If no value is assigned to an argument, the first entry of the list of possibly choices will be used by default.
Given an ensemble of size \( m \): \( X_1, \ldots, X_m \), the following generalized extreme value distribution EMOS model left-censored at 0 is fit by `ensembleMOSgev0`:

\[
Y \sim GEV_0(\mu, \sigma, q)
\]

where \( GEV_0 \) denotes the generalized extreme value distribution left-censored at zero, with location \( \mu \), scale \( \sigma \) and shape \( q \). The model is parametrized such that the mean \( m \) is a linear function \( a + b_1X_1 + \ldots + b_mX_m + sp_0 \) of the ensemble forecasts, where \( p_0 \) denotes the ratio of ensemble forecasts that are exactly 0, and the shape parameter \( \sigma \) is a linear function of the ensemble variance \( c + dMD(X_1, \ldots, X_m) \), where \( MD(X_1, \ldots, X_m) \) is Gini's mean difference. See `ensembleMOSgev0` for details.

Value

A list whose components are the input arguments and their assigned values.

References


See Also

`ensembleMOScsg0`, `fitMOScsg0`

Examples

data("ensBMAtest", package = "ensembleBMA")
ensMemNames <- c("gfs", "cmcg", "eta", "gasp", "jma", "ngps", "tcwb", "ukmo")
obs <- paste("PCP24","obs", sep = ".")
ens <- paste("PCP24", ensMemNames, sep = ".")
prcpTestData <- ensembleData(forecasts = ensBMAtest[,ens],
    dates = ensBMAtest[,"vdate"],
    observations = ensBMAtest[,obs],
    station = ensBMAtest[,"station"],
    forecastHour = 48,
    initializationTime = "00")
prcpTestFitGEV0 <- ensembleMOSgev0(prcpTestData, trainingDays = 25,
    dates = "2008010100",
controlMOSlognormal

Descriptions

Specifies a list of values controlling the log-normal EMOS fit of ensemble forecasts.

Usage

controlMOSlognormal(scoringRule = c("crps", "log"),
optimRule = c("BFGS","Nelder-Mead"),
coefRule = c("square", "none", "positive"),
varRule = c("square", "none"),
start = list(a = NULL, b = NULL,
            c = NULL, d = NULL),
maxIter = Inf)

Arguments

scoringRule The scoring rule to be used in optimum score estimation. Options are "crps" for the continuous ranked probability score and "log" for the logarithmic score.

optimRule Numerical optimization method to be supplied to optim. Options are "BFGS" for the Broyden-Fletcher-Goldfarb-Shanno algorithm and "Nelder-Mead" for the Nelder-Mead method, see optim for details.

coefRule Method to control non-negativity of regression estimates. Options are:
  * "square" EMOS coefficients are parameterized as squares and thus guaranteed to be non-negative.
  * "positive" finds non-negative coefficients iteratively by setting negative estimates at the current iteration to zero.
  * "none" no restriction on the coefficient estimates.

varRule Method to control non-negativity of the variance parameters. Options "square" and "none" are the same as in coefRule.

start A list of starting parameters, a, b, c and d specifying initial values for the intercept coefficient and scale parameters supplied to optim. See details.

maxIter An integer specifying the upper limit of the number of iterations used to fit the model.
Details

If no value is assigned to an argument, the first entry of the list of possibly choices will be used by default. Given an ensemble of size \( m \): \( X_1, \ldots, X_m \), the following log-normal model is fit by ensembleMOSlognormal:

\[
Y \sim \text{LN}(\mu, \sigma)
\]

where \( \text{LN} \) denotes the log-normal distribution with meanlog parameter \( \mu \) and scalelog parameter \( \sigma \), see Lognormal. The model is parametrized such that the mean value of the log-normal distribution is a linear function \( a + b_1X_1 + \ldots + b_mX_m \) of the ensemble forecasts, and the variance is a linear function \( c + dS^2 \). For transformations between \( \mu, \sigma \) and mean and variance of the log-normal distribution, see Baran and Lerch (2015). See ensembleMOSlognormal for details.

Note that in case of scoringRule = "log", forecast cases in the training period with observation values of 0 are ignored in the model estimation as 0 is not included in the support of the log-normal distribution.

Value

A list whose components are the input arguments and their assigned values.

References


See Also

ensembleMOSlognormal, fitMOSlognormal

Examples

data("ensBMatest", package = "ensembleBMA")

ensMemNames <- c("gfs", "cmcg", "eta", "gasp", "jma", "ngps", "tcwb", "ukmo")

obs <- paste("MAXWSP10", "obs", sep = ".")

ens <- paste("MAXWSP10", ensMemNames, sep = ",")

windTestData <- ensembleData( 
  forecasts = ensBMatest[, ens],
  dates = ensBMatest[,"vdate"],
  observations = ensBMatest[, obs],
  station = ensBMatest[,"station"],
  forecastHour = 48,
  initializationTime = "00"
)

windTestFitLN <- ensembleMOSlognormal(windTestData, trainingDays = 25,
  dates = "2008010100",
  control = controlMOSlognormal(maxIter = as.integer(100),
    scoringRule = "log",
    optimRule = "BFGS",
  )
)
controlMOSnormal

Control parameters for Gaussian (normal) EMOS models

Description

Specifies a list of values controlling the Gaussian (normal) EMOS fit of ensemble forecasts.

Usage

controlMOSnormal(scoringRule = c("crps", "log"),
optimRule = c("BFGS","Nelder-Mead"),
coefRule = c("square", "none", "positive"),
varRule = c("square", "none"),
start = list(a = NULL, B = NULL,
c = NULL, d = NULL),
maxIter = Inf)

Arguments

scoringRule The scoring rule to be used in optimum score estimation. Options are "crps" for the continuous ranked probability score and "log" for the logarithmic score.

optimRule Numerical optimization method to be supplied to optim. Options are "BFGS" for the Broyden-Fletcher-Goldfarb-Shanno algorithm and "Nelder-Mead" for the Nelder-Mead method, see optim for details.

coefRule Method to control non-negativity of regression estimates. Options are:
- "square" EMOS coefficients are parameterized as squares and thus guaranteed to be non-negative.
- "positive" finds non-negative coefficients iteratively by setting negative estimates at the current iteration to zero.
- "none" no restriction on the coefficient estimates.

varRule Method to control non-negativity of the variance parameters. Options "square" and "none" are the same as in coefRule.

start A list of starting parameters, a, B, c and d specifying initial values for the intercept coefficient and variance parameters supplied to optim. See details.

maxIter An integer specifying the upper limit of the number of iterations used to fit the model.
Details

If no value is assigned to an argument, the first entry of the list of possibly choices will be used by default. Given an ensemble of size $m$: $X_1, \ldots, X_m$, the following Gaussian model is fit by `ensembleMOSnormal`:

$$Y \sim N(a + b_1 X_1 + \ldots + b_m X_m, c + dS^2).$$

$b$ is the array of fitted regression coefficients $b_1, \ldots, b_m$ for each date. See `ensembleMOSnormal` for details.

Value

A list whose components are the input arguments and their assigned values.

References


See Also

`ensembleMOSnormal`, `fitMOSnormal`

Examples

data("ensBMAtest", package = "ensembleBMA")

ensMemNames <- c("gfs","cmcg","eta","gasp","jma","ngps","tcwb","ukmo")

obs <- paste("T2", "obs", sep = ".")
ens <- paste("T2", ensMemNames, sep = ".")

tempTestData <- ensembleData( forecasts = ensBMAtest[,ens],
    dates = ensBMAtest[,"vdate"],
    observations = ensBMAtest[,obs],
    station = ensBMAtest[,"station"],
    forecastHour = 48,
    initializationTime = "00")

tempTestFit <- ensembleMOSnormal(tempTestData, trainingDays = 25,
    dates = "2008010100",
    control = controlMOSnormal(maxIter = as.integer(100),
        scoringRule = "log",
        optimRule = "BFGS",
        coefRule= "none",
        varRule = "square"))
controlMOStruncnormal  Control parameters for truncated normal EMOS models

Description

Specifies a list of values controlling the truncated normal EMOS fit of ensemble forecasts.

Usage

```r
controlMOStruncnormal(scoringRule = c("crps", "log"),
optimRule = c("BFGS","Nelder-Mead"),
coefRule = c("square", "none", "positive"),
varRule = c("square", "none"),
start = list(a = NULL, B = NULL,
             c = NULL, d = NULL),
maxIter = Inf)
```

Arguments

scoringRule  The scoring rule to be used in optimum score estimation. Options are "crps" for the continuous ranked probability score and "log" for the logarithmic score.

optimRule  Numerical optimization method to be supplied to optim. Options are "BFGS" for the Broyden-Fletcher-Goldfarb-Shanno algorithm and "Nelder-Mead" for the Nelder-Mead method, see optim for details.

coefRule  Method to control non-negativity of regression estimates. Options are:

- "square" EMOS coefficients are parameterized as squares and thus guaranteed to be non-negative.
- "positive" finds non-negative coefficients iteratively by setting negative estimates at the current iteration to zero.
- "none" no restriction on the coefficient estimates.

varRule  Method to control non-negativity of the scale parameters. Options "square" and "none" are the same as in coefRule.

start  A list of starting parameters, a, B, c and d specifying initial values for the intercept coefficient and variance parameters supplied to optim. See details.

maxIter  An integer specifying the upper limit of the number of iterations used to fit the model.

Details

If no value is assigned to an argument, the first entry of the list of possibly choices will be used by default.

Given an ensemble of size $m$: $X_1, \ldots, X_m$, the following truncated normal model is fit by ensembleMOStruncnormal:

\[ Y \sim N_0(a + b_1X_1 + \ldots + b_mX_m, c + dS^2), \]
where \( N_0 \) denotes the normal distribution truncated at zero, with location \( a + b_1 X_1 + \ldots + b_m X_m \) and squared scale \( c + dS^2 \). \( B \) is a vector of fitted regression coefficients \( b_1, \ldots, b_m \). See `ensembleMOStruncnormal` for details.

**Value**

A list whose components are the input arguments and their assigned values.

**References**


**See Also**

`ensembleMOStruncnormal`, `fitMOStruncnormal`  

**Examples**

```r
data("ensBMATest", package = "ensembleBMA")

ensMemNames <- c("gfs", "cmcg", "eta", "gasp", "jma", "ngps", "tcwb", "ukmo")

obs <- paste("MAXWSP10", "obs", sep = ".")
ens <- paste("MAXWSP10", ensMemNames, sep = ".")
windTestData <- ensembleData(  
  forecasts = ensBMATest[, ens],
  dates = ensBMATest[, "vdate"],
  observations = ensBMATest[, obs],
  station = ensBMATest[, "station"],
  forecastHour = 48,
  initializationTime = "00")

windTestFitTN <- ensembleMOStruncnormal(windTestData, trainingDays = 25,
  dates = "2008010100",
  control = controlMOStruncnormal(maxIter = as.integer(100),
    scoringRule = "log",
    optimRule = "BFGS",
    coefRule = "none",
    varRule = "square")
```

---

**crps**  
*Continuous Ranked Probability Score*

**Description**

Computes the continuous ranked probability score (CRPS) for univariate ensemble forecasting models.
Usage

\begin{verbatim}
crps(fit, ensembleData, dates=NULL, ...)
\end{verbatim}

Arguments

- **fit**: A model fit to ensemble forecasting data, obtained using `fitMOS` or `ensembleMOS`.
- **ensembleData**: An `ensembleData` object that includes ensemble forecasts, verification observations and possibly dates. Missing values (indicated by `NA`) are allowed. This need not be the data used for the model fit, although it must include the same ensemble members.
- **dates**: The dates for which the CRPS will be computed. These dates must be consistent with `fit` and `ensembleData`. The default is to use all of the dates in `fit`. The dates are ignored if `fit` originates from `fitMOS`, which also ignores date information.
- **...**: Included for generic function compatibility.

Details

These methods are generic, and can be applied to all ensemble forecasting models. Missing values in forecasts and/or observations result in `NA` values in the CRPS vector.

Value

`crps` is a matrix giving the CRPS for each instance in the data for both the raw ensemble and the probabilistic forecast.

References


See Also

`ensembleMOS`, `fitMOS`

Examples

```r
data("ensBMAtest", package = "ensembleBMA")
ensMemNames <- c("gfs","cmcg","eta","gasp","jma","ngps","tcwb","ukmo")
obs <- paste("T2", "obs", sep = ".")
ens <- paste("T2", ensMemNames, sep = ".")
tempTestData <- ensembleData(forecasts = ensBMAtest[,ens],
   dates = ensBMAtest[,"vdate"],
   observations = ensBMAtest[,obs],
   station = ensBMAtest[,"station"],
   forecastHour = 48,
   ...)
```
ensembleMOS

### Description

Fits a EMOS model to ensemble forecasts. Allows specification of a model, training rule, and forecasting dates.

### Usage

```r
ensembleMOS(ensembleData, trainingDays, consecutive = FALSE,
            dates = NULL, control = NULL, warmStart = FALSE,
            model = NULL, exchangeable = NULL)
```

### Arguments

- **ensembleData**: An ensembleData object including ensemble forecasts with the corresponding verifying observations and their dates. Missing values (indicated by NA) are allowed.
- **trainingDays**: An integer giving the number of time steps (e.g. days) in the training period. There is no default.
- **consecutive**: If TRUE then the sequence of dates in the training set are treated as consecutive, i.e. date gaps are ignored
- **dates**: The dates for which EMOS forecasting models are desired. By default, this will be all dates in ensembleData for which modeling is allowed given the training rule.
- **control**: A list of control values for the fitting functions. The corresponding control function has to be chosen in accordance with the selected model. For the Gaussian (normal) EMOS model see controlMOSnormal, for the truncated normal model see controlMOSstruncnormal, for the log-normal model see controlMOSlognormal, for the censored and shifted gamma model see controlMOScsg0, and for the censored generalized extreme value distribution model see controlMOSgev0.
- **warmStart**: If TRUE, then starting values for parameters in optimization are set to the estimates of the preceding date’s fit.
model A character string describing the EMOS model to be fit. Current choices are "normal" (typically used for temperature or pressure data), "truncnormal" (typically used for wind speed data), "lognormal" (typically used for wind speed data), "csgθ" (typically used for precipitation accumulation data), and "gevθ" (typically used for precipitation accumulation data). For specific details on model fitting see ensembleMOSnormal, ensembleMOStruncnormal, ensembleMOSlognormal, ensembleMOSCsg0, or ensembleMOSgev0.

exchangeable A numeric or character vector or factor indicating groups of ensemble members that are exchangeable (indistinguishable). The model fit will have equal weights and parameters within each group. The default determines exchangeability from ensembleData.

Details

If dates are specified in dates that cannot be forecast with the training rule, the corresponding EMOS model parameter outputs will be missing (NA) but not NULL. The training rule uses the number of days corresponding to its length regardless of whether or not the dates are consecutive.

Value

A list containing information on the training (length, lag and the number of instances used for training for each modeling date), the exchangeability, and vectors and/or matrices containing the estimated regression and variance coefficient values depending on the specified model.

References

Gaussian (normal) EMOS model:

Truncated normal EMOS model:

Log-normal EMOS model:

Censored and shifted gamma EMOS model:
Censored generalized extreme value distribution EMOS model:

See Also
trainingData, ensembleMOSnormal, ensembleMOStruncnormal, ensembleMOSlognormal, ensembleMOScsg0, ensembleMOSgev0, controlMOSnormal, controlMOStruncnormal, controlMOSlognormal, controlMOScsg0, controlMOSgev0.

Examples
data("ensembleBMAtest", package = "ensembleBMA")

esMemNames <- c("gfs","cmcg","eta","gasp","jma","ngps","tcwb","ukmo")

obs <- paste("T2", "obs", sep = ".")
ens <- paste("T2", ensMemNames, sep = ".")

tempTestData <- ensembleData(forcasts = ensBMAtest[,ens],
dates = ensBMAtest[,"vdate"],
observations = ensBMAtest[,obs],
station = ensBMAtest[,"station"],
forecastHour = 48,
initializationTime = "00")

tempTestFit <- ensembleMOS(tempTestData, trainingDays = 25,
model = "normal")

# Same as
# tempTestFit <- ensembleMOSnormal(tempTestData, trainingDays = 25)

---

**ensembleMOScsg0**

*Censored and shifted gamma EMOS modeling*

**Description**
Fits a censored and shifted gamma EMOS model to ensemble forecasts for specified dates.

**Usage**

```r
ensembleMOScsg0(ensembleData, trainingDays, consecutive = FALSE,
dates = NULL, control = controlMOScsg0(),
warmStart = FALSE, exchangeable = NULL)
```

**Arguments**

- **ensembleData** An ensembleData object including ensemble forecasts with the corresponding verifying observations and their dates. Missing values (indicated by NA) are allowed.
trainingDays  An integer giving the number of time steps (e.g. days) in the training period. There is no default.

consecutive  If TRUE then the sequence of dates in the training set are treated as consecutive, i.e. date gaps are ignored.

dates  The dates for which EMOS forecasting models are desired. By default, this will be all dates in ensembleData for which modeling is allowed given the training rule.

control  A list of control values for the fitting functions specified via the function controlMOScsg0. For details and default values, see controlMOScsg0.

warmStart  If TRUE, then starting values for parameters in optimization are set to the estimates of the preceding date’s fit.

exchangeable  A numeric or character vector or factor indicating groups of ensemble members that are exchangeable (indistinguishable). The modeling will have equal parameters within each group. The default determines exchangeability from ensembleData.

Details

Given an ensemble of size \( m \): \( X_1, \ldots, X_m \), the following shifted gamma model left-censored at 0 is fit by ensembleMOScsg0:

\[
Y \sim \text{Gamma}_0(\kappa, \theta, q)
\]

where \( \text{Gamma}_0 \) denotes the shifted gamma distribution left-censored at zero, with shape \( \kappa \), scale \( \theta \) and shift \( q \). The model is parametrized such that the mean \( \kappa \theta \) is a linear function \( a + b_1 X_1 + \ldots + b_m X_m \) of the ensemble forecasts, and the variance \( \kappa \theta^2 \) is a linear function of the ensemble mean \( c + d \bar{f} \), see Baran and Nemoda (2016) for details.

\( \mathbf{B} \) is a vector of fitted regression coefficients: \( b_1, \ldots, b_m \). Specifically, \( a, b_1, \ldots, b_m, c, d, q \) are fitted to optimize control$scoringRule over the specified training period using optim with method = control$optimRule.

Value

A list with the following output components:

training  A list containing information on the training length and lag and the number of instances used for training for each modeling date.

a  A vector of fitted EMOS intercept parameters for each date.

B  A matrix of fitted EMOS coefficients for each date.

c,d  The fitted parameter for the variance, see details.

q  Fitted shift parameter, see details.

References


See Also

controlMOScsg0, fitMOScsg0

Examples

data("ensBMATest", package = "ensembleBMA")

ensMemNames <- c("gfs", "cmcg", "eta", "gasp", "jma", "ngps", "tcwb", "ukmo")

obs <- paste("PCP24", "obs", sep = ".")
ens <- paste("PCP24", ensMemNames, sep = ".")

prcpTestData <- ensembleData( forecasts = ensBMATest[, ens],
   dates = ensBMATest[,"vdate"],
   observations = ensBMATest[, obs],
   station = ensBMATest[,"station"],
   forecastHour = 48,
   initializationTime = "00")

fitDates <- c("2008010100", "2008010200")

prcpTestFitGEV0 <- ensembleMOSgev0(prcpTestData, trainingDays = 25,
   dates = fitDates)

ensembleMOSgev0  Censored generalized extreme value distribution EMOS modeling

Description

Fits a Censored generalized extreme value distribution EMOS model to ensemble forecasts for specified dates.

Usage

ensembleMOSgev0(ensembleData, trainingDays, consecutive = FALSE,
   dates = NULL, control = controlMOSgev0(),
   warmStart = FALSE, exchangeable = NULL)

Arguments

ensembleData An ensembleData object including ensemble forecasts with the corresponding verifying observations and their dates. Missing values (indicated by NA) are allowed.

trainingDays An integer giving the number of time steps (e.g. days) in the training period. There is no default.

consecutive If TRUE then the sequence of dates in the training set are treated as consecutive, i.e. date gaps are ignored.

dates The dates for which EMOS forecasting models are desired. By default, this will be all dates in ensembleData for which modeling is allowed given the training rule.
A list of control values for the fitting functions specified via the function controlMOSgev0. For details and default values, see controlMOSgev0.

If TRUE, then starting values for parameters in optimization are set to the estimates of the preceding date’s fit.

A numeric or character vector or factor indicating groups of ensemble members that are exchangeable (indistinguishable). The modeling will have equal parameters within each group. The default determines exchangeability from ensembleData.

Details

Given an ensemble of size \( m \): \( X_1, \ldots, X_m \), the following generalized extreme value distribution EMOS model left-censored at 0 is fit by ensembleMOSgev0:

\[
Y \sim GEV_0(\mu, \sigma, q)
\]

where \( GEV_0 \) denotes the generalized extreme value distribution left-censored at zero, with location \( \mu \), scale \( \sigma \) and shape \( q \). The model is parametrized such that the mean \( m \) is a linear function \( a + b_1X_1 + \ldots + b_mX_m + sp_0 \) of the ensemble forecasts, where \( p_0 \) denotes the ratio of ensemble forecasts that are exactly 0, and the shape parameter \( \sigma \) is a linear function of the ensemble variance \( c + dMD(X_1, \ldots, X_m) \), where \( MD(X_1, \ldots, X_m) \) is Gini’s mean difference. See ensembleMOSgev0 for details.

\( \mathbf{B} \) is a vector of fitted regression coefficients: \( b_1, \ldots, b_m \). Specifically, \( a, b_1, \ldots, b_m, s, c, d, q \) are fitted to optimize the mean CRPS over the specified training period using optim.

Value

A list with the following output components:

- training: A list containing information on the training length and lag and the number of instances used for training for each modeling date.
- \( a \): A vector of fitted EMOS intercept parameters for each date.
- \( \mathbf{B} \): A matrix of fitted EMOS coefficients for each date.
- \( s \): A vector of fitted EMOS coefficients for \( p_0 \) for each date, see details.
- \( c, d \): The fitted coefficients for the shape parameter, see details.
- \( q \): Fitted shape parameter, see details.

References


See Also

controlMOSgev0, fitMOSgev0
**Examples**

```r
data("ensBMAtest", package = "ensembleBMA")

ensMemNames <- c("gfs","cmcg","eta","gasp","jma","ngps","tcwb","ukmo")

obs <- paste("PCP24","obs", sep = ".")
ens <- paste("PCP24", ensMemNames, sep = ".")

prcpTestData <- ensembleData( 
  forecasts = ensBMAtest[,ens],
  dates = ensBMAtest[,"vdate"],
  observations = ensBMAtest[,obs],
  station = ensBMAtest[,"station"],
  forecastHour = 48,
  initializationTime = "00")

prcpTestFitGEV0 <- ensembleMOSgev0(prcpTestData, trainingDays = 25,
                                      dates = "2008010100")
```

---

**ensembleMOSLognormal**

*Log-normal EMOS modeling*

**Description**

Fits a log-normal EMOS model to ensemble forecasts for specified dates.

**Usage**

```r
ensembleMOSLognormal(ensembleData, trainingDays, consecutive = FALSE,
                      dates = NULL, control = controlMOSlognormal(),
                      warmStart = FALSE, exchangeable = NULL)
```

**Arguments**

- **ensembleData**: An `ensembleData` object including ensemble forecasts with the corresponding verifying observations and their dates. Missing values (indicated by NA) are allowed.
- **trainingDays**: An integer giving the number of time steps (e.g. days) in the training period. There is no default.
- **consecutive**: If TRUE then the sequence of dates in the training set are treated as consecutive, i.e. date gaps are ignored.
- **dates**: The dates for which EMOS forecasting models are desired. By default, this will be all dates in `ensembleData` for which modeling is allowed given the training rule.
- **control**: A list of control values for the fitting functions specified via the function `controlMOSTruncnormal`. For details and default values, see `controlMOSTruncnormal`.
- **warmStart**: If TRUE, then starting values for parameters in optimization are set to the estimates of the preceding date’s fit.
ensembleMOSlognormal

exchangeable

A numeric or character vector or factor indicating groups of ensemble members that are exchangeable (indistinguishable). The modeling will have equal parameters within each group. The default determines exchangeability from ensembleData.

Details

Given an ensemble of size \( m \): \( X_1, \ldots, X_m \), the following log-normal model is fit by `ensembleMOSlognormal`:

\[
Y \sim LN(\mu, \sigma)
\]

where \( LN \) denotes the log-normal distribution with meanlog parameter \( \mu \) and scalelog parameter \( \sigma \), see Lognormal. The model is parametrized such that the mean value of the log-normal distribution is a linear function \( a + b_1 X_1 + \ldots + b_m X_m \) of the ensemble forecasts, and the variance is a linear function \( c + d S^2 \). For transformations between \( \mu, \sigma \) and mean and variance of the log-normal distribution, see Baran and Lerch (2015). See `ensembleMOSlognormal` for details. \( B \) is a vector of fitted regression coefficients: \( b_1, \ldots, b_m \). Specifically, \( a, b_1, \ldots, b_m, c, d \) are fitted to optimize \( \text{controlDscoringRule} \) over the specified training period using \( \text{optim} \) with method = \( \text{controlDoptimRule} \).

Value

A list with the following output components:

- **training**: A list containing information on the training length and lag and the number of instances used for training for each modeling date.
- **a**: A vector of fitted EMOS intercept parameters for each date.
- **B**: A matrix of fitted EMOS coefficients for each date.
- **c,d**: The fitted parameters for the variance, see details.

References


See Also

`controlMOSlognormal`, `fitMOSlognormal`

Examples

data("ensBMATest", package = "ensembleBMA")

essMemNames <- c("gfs", "cmcg", "eta", "gasp", "jma", "ngps", "tcwb", "ukmo")

obs <- paste("MAXWSP10","obs", sep = ".")

esn <- paste("MAXWSP10", ensMemNames, sep = ".")

windTestData <- ensembleData(forecasts = ensBMATest[, ens],

ensembleMOSlognormal

A numeric or character vector or factor indicating groups of ensemble members that are exchangeable (indistinguishable). The modeling will have equal parameters within each group. The default determines exchangeability from ensembleData.

Details

Given an ensemble of size \( m \): \( X_1, \ldots, X_m \), the following log-normal model is fit by `ensembleMOSlognormal`:

\[
Y \sim LN(\mu, \sigma)
\]

where \( LN \) denotes the log-normal distribution with meanlog parameter \( \mu \) and scalelog parameter \( \sigma \), see Lognormal. The model is parametrized such that the mean value of the log-normal distribution is a linear function \( a + b_1 X_1 + \ldots + b_m X_m \) of the ensemble forecasts, and the variance is a linear function \( c + d S^2 \). For transformations between \( \mu, \sigma \) and mean and variance of the log-normal distribution, see Baran and Lerch (2015). See `ensembleMOSlognormal` for details. \( B \) is a vector of fitted regression coefficients: \( b_1, \ldots, b_m \). Specifically, \( a, b_1, \ldots, b_m, c, d \) are fitted to optimize \( \text{controlDscoringRule} \) over the specified training period using \( \text{optim} \) with method = \( \text{controlDoptimRule} \).

Value

A list with the following output components:

- **training**: A list containing information on the training length and lag and the number of instances used for training for each modeling date.
- **a**: A vector of fitted EMOS intercept parameters for each date.
- **B**: A matrix of fitted EMOS coefficients for each date.
- **c,d**: The fitted parameters for the variance, see details.

References


See Also

`controlMOSlognormal`, `fitMOSlognormal`

Examples

data("ensBMATest", package = "ensembleBMA")

essMemNames <- c("gfs", "cmcg", "eta", "gasp", "jma", "ngps", "tcwb", "ukmo")

obs <- paste("MAXWSP10","obs", sep = ".")

esn <- paste("MAXWSP10", ensMemNames, sep = ".")

windTestData <- ensembleData(forecasts = ensBMATest[, ens],

ensembleMOSlognormal

A numeric or character vector or factor indicating groups of ensemble members that are exchangeable (indistinguishable). The modeling will have equal parameters within each group. The default determines exchangeability from ensembleData.

Details

Given an ensemble of size \( m \): \( X_1, \ldots, X_m \), the following log-normal model is fit by `ensembleMOSlognormal`:

\[
Y \sim LN(\mu, \sigma)
\]

where \( LN \) denotes the log-normal distribution with meanlog parameter \( \mu \) and scalelog parameter \( \sigma \), see Lognormal. The model is parametrized such that the mean value of the log-normal distribution is a linear function \( a + b_1 X_1 + \ldots + b_m X_m \) of the ensemble forecasts, and the variance is a linear function \( c + d S^2 \). For transformations between \( \mu, \sigma \) and mean and variance of the log-normal distribution, see Baran and Lerch (2015). See `ensembleMOSlognormal` for details. \( B \) is a vector of fitted regression coefficients: \( b_1, \ldots, b_m \). Specifically, \( a, b_1, \ldots, b_m, c, d \) are fitted to optimize \( \text{controlDscoringRule} \) over the specified training period using \( \text{optim} \) with method = \( \text{controlDoptimRule} \).

Value

A list with the following output components:

- **training**: A list containing information on the training length and lag and the number of instances used for training for each modeling date.
- **a**: A vector of fitted EMOS intercept parameters for each date.
- **B**: A matrix of fitted EMOS coefficients for each date.
- **c,d**: The fitted parameters for the variance, see details.

References


See Also

`controlMOSlognormal`, `fitMOSlognormal`

Examples

data("ensBMATest", package = "ensembleBMA")

essMemNames <- c("gfs", "cmcg", "eta", "gasp", "jma", "ngps", "tcwb", "ukmo")

obs <- paste("MAXWSP10","obs", sep = ".")

esn <- paste("MAXWSP10", ensMemNames, sep = ".")

windTestData <- ensembleData(forecasts = ensBMATest[, ens],
ensembleMOSnormal

Gaussian (normal) EMOS modeling

Description

Fits a Gaussian (normal) EMOS model to ensemble forecasts for specified dates.

Usage

ensembleMOSnormal(ensembleData, trainingDays, consecutive = FALSE,
                  dates = NULL, control = controlMOSnormal(),
                  warmStart = FALSE, exchangeable = NULL)

Arguments

ensembleData An ensembleData object including ensemble forecasts with the corresponding verifying observations and their dates. Missing values (indicated by NA) are allowed.

trainingDays An integer giving the number of time steps (e.g. days) in the training period. There is no default.

consecutive If TRUE then the sequence of dates in the training set are treated as consecutive, i.e. date gaps are ignored.

dates The dates for which EMOS forecasting models are desired. By default, this will be all dates in ensembleData for which modeling is allowed given the training rule.

control A list of control values for the fitting functions specified via the function controlMOSnormal. For details and default values, see controlMOSnormal.

warmStart If TRUE, then starting values for parameters in optimization are set to the estimates of the preceding date’s fit.

exchangeable A numeric or character vector or factor indicating groups of ensemble members that are exchangeable (indistinguishable). The modeling will have equal parameters within each group. The default determines exchangeability from ensembleData.
Details

Given an ensemble of size \( m \): \( X_1, \ldots, X_m \), the following Gaussian model is fit by ensembleMOSnormal:

\[
Y \sim N(a + b_1 X_1 + \ldots + b_m X_m, c + d S^2).
\]

\( B \) is a vector of fitted regression coefficients: \( b_1, \ldots, b_m \). Specifically, \( a, b_1, \ldots, b_m, c, d \) are fitted to optimize control\$scoringRule over the specified training period using optim with method = control\$optimRule.

Value

A list with the following output components:

- training: A list containing information on the training length and lag and the number of instances used for training for each modeling date.
- a: A vector of fitted EMOS intercept parameters for each date.
- B: A matrix of fitted EMOS coefficients for each date.
- cLd: Vectors of the fitted variance parameters for each date, see details.

References


See Also

controlMOSnormal, fitMOSnormal

Examples

data("ensBMAtest", package = "ensembleBMA")

ensMemNames <- c("gfs", "cmcg", "eta", "gasp", "jma", "ngps", "tcwb", "ukmo")

obs <- paste("T2", "obs", sep = ".")
ens <- paste("T2", ensMemNames, sep = ",")
tempTestData <- ensembleData(forecasts = ensBMAtest[,ens],
                           dates = ensBMAtest[,"vdate"],
                           observations = ensBMAtest[,obs],
                           station = ensBMAtest[,"station"],
                           forecastHour = 48,
                           initializationTime = "00")

tempTestFit <- ensembleMOSnormal(tempTestData, trainingDays = 25)
Description

Fits a truncated normal EMOS model to ensemble forecasts for specified dates.

Usage

```r
ensembleMOStruncnormal(ensembleData, trainingDays, consecutive = FALSE, 
  dates = NULL, control = controlMOStruncnormal(), 
  warmStart = FALSE, exchangeable = NULL)
```

Arguments

- `ensembleData`: An `ensembleData` object including ensemble forecasts with the corresponding verifying observations and their dates. Missing values (indicated by NA) are allowed.
- `trainingDays`: An integer giving the number of time steps (e.g., days) in the training period. There is no default.
- `consecutive`: If TRUE then the sequence of dates in the training set are treated as consecutive, i.e., date gaps are ignored.
- `dates`: The dates for which EMOS forecasting models are desired. By default, this will be all dates in `ensembleData` for which modeling is allowed given the training rule.
- `control`: A list of control values for the fitting functions specified via the function `controlMOStruncnormal`. For details and default values, see `controlMOStruncnormal`.
- `warmStart`: If TRUE, then starting values for parameters in optimization are set to the estimates of the preceding date’s fit.
- `exchangeable`: A numeric or character vector or factor indicating groups of ensemble members that are exchangeable (indistinguishable). The modeling will have equal parameters within each group. The default determines exchangeability from `ensembleData`.

Details

Given an ensemble of size \( m \): \( X_1, \ldots, X_m \), the following truncated normal model is fit by `ensembleMOStruncnormal`:

\[
Y \sim N_0(a + b_1X_1 + \ldots + b_mX_m, c + dS^2),
\]

where \( N_0 \) denotes the normal distribution truncated at zero, with location \( a + b_1X_1 + \ldots + b_mX_m \) and squared scale \( c + dS^2 \). \( B \) is a vector of fitted regression coefficients: \( b_1, \ldots, b_m \). Specifically, \( a, b_1, \ldots, b_m, c, d \) are fitted to optimize `control$scoringRule` over the specified training period using `optim` with `method = control$optimRule`. 
fitMOS

Value

A list with the following output components:

- `training` - A list containing information on the training length and lag and the number of instances used for training for each modeling date.
- `a` - A vector of fitted EMOS intercept parameters for each date.
- `B` - A matrix of fitted EMOS coefficients for each date.
- `c, d` - The fitted parameters for the squared scale, see details.

References


See Also

`controlMOStruncnormal`, `fitMOStruncnormal`

Examples

data("ensBMAtest", package = "ensembleBMA")
ensMemNames <- c("gfs", "cmcg", "eta", "gasp", "jma", "ngps", "tcwb", "ukmo")
obs <- paste("MAXWSP10", "obs", sep = ".")
ens <- paste("MAXWSP10", ensMemNames, sep = ".")
windTestData <- ensembleData(forecasts = ensBMAtest[, ens],
  dates = ensBMAtest[, "vdate"],
  observations = ensBMAtest[, obs],
  station = ensBMAtest[, "station"],
  forecastHour = 48,
  initializationTime = "00")
windTestFitTN <- ensembleMOStruncnormal(windTestData, trainingDays = 25)
Arguments

ensembleData An ensembleData object including ensemble forecasts and verification observations. Missing values (indicated by NA) are allowed. Dates are ignored if they are included. This is the training set for the model.

control A list of control values for the fitting functions. The corresponding control function has to be chosen in accordance with the selected model. For the Gaussian (normal) EMOS model see controlMOSnormal, for the truncated normal model see controlMOStruncnormal, for the log-normal model see controlMOSlognormal, for the censored and shifted gamma model see controlMOScsg0, and for the censored generalized extreme value distribution model see controlMOSgev0.

model A character string describing the EMOS model to be fit. Current choices are "normal" (typically used for temperature or pressure data), "truncnormal" (typically used for wind speed data), "lognormal" (typically used for wind speed data), "csg0" (typically used for precipitation accumulation data), and "gev0" (typically used for precipitation accumulation data). For specific details on model fitting see ensembleMOSnormal, ensembleMOStruncnormal, ensembleMOSlognormal, ensembleMOScsg0, or ensembleMOSgev0.

exchangeable A numeric or character vector or factor indicating groups of ensemble members that are exchangeable (indistinguishable). The model fit will have equal weights and parameters within each group. The default determines exchangeability from ensembleData.

Value

A list with estimated coefficient values. The specific content depends on the chosen model.

References

Gaussian (normal) EMOS model:

Truncated (normal) EMOS model:

Log-normal EMOS model:

Censored and shifted gamma EMOS model:
**Censored generalized extreme value distribution EMOS model:**

**See Also**

`fitMOSnormal` `fitMOStruncnormal` `fitMOSlognormal` `fitMOScsg0` `fitMOSgev0` `controlMOSnormal` `controlMOStruncnormal` `controlMOSlognormal` `controlMOScsg0` `controlMOSgev0`

**Examples**

data("ensBMAtest", package = "ensembleBMA")

ensMemNames <- c("gfs","cmcg","eta","gasp","jma","ngps","tcwb","ukmo")

obs <- paste("T2", "obs", sep = ".")
ens <- paste("T2", ensMemNames, sep = ".")

tempTestData <- ensembleData(forecasts = ensBMAtest[,ens],
  dates = ensBMAtest[,"vdate"],
  observations = ensBMAtest[,obs],
  station = ensBMAtest[,"station"],
  forecastHour = 48,
  initializationTime = "00")

tempTrain <- trainingData(tempTestData, trainingDays = 30,
  date = "2008010100")

tempTrainFit <- fitMOS(tempTrain, model = "normal")

## equivalent to
## tempTrainFit <- fitMOSnormal(tempTrain)

---

**fitMOScsg0**

*Censored and shifted gamma EMOS modeling*

**Description**

Fits a censored and shifted gamma EMOS model to a given training set.

**Usage**

`fitMOScsg0(ensembleData, control = controlMOScsg0(),
  exchangeable = NULL)`
Arguments

ensembleData  An ensembleData object including ensemble forecasts and verification observations. Missing values (indicated by NA) are allowed. Dates are ignored if they are included. This is the training set for the model.

control  A list of control values for the fitting functions specified via the function controlMOScsg0. For details and default values, see controlMOScsg0.

exchangeable  An optional numeric or character vector or factor indicating groups of ensemble members that are exchangeable (indistinguishable). The models have equal EMOS coefficients within each group. If supplied, this argument will override any specification of exchangeability in ensembleData.

Details

Given an ensemble of size $m$: $X_1, \ldots, X_m$, the following shifted gamma model left-censored at 0 is fit by ensembleMOScsg0:

$$ Y \sim \text{Gamma}_0(\kappa, \theta, q) $$

where $\text{Gamma}_0$ denotes the shifted gamma distribution left-censored at zero, with shape $\kappa$, scale $\theta$ and shift $q$. The model is parametrized such that the mean $\kappa \theta$ is a linear function $a + b_1 X_1 + \ldots + b_m X_m$ of the ensemble forecasts, and the variance $\kappa \theta^2$ is a linear function of the ensemble mean $c + df$, see Baran and Nemoda (2016) for details.

$b$ is a vector of fitted regression coefficients: $b_1, \ldots, b_m$. Specifically, $a, b_1, \ldots, b_m, c, d$ are fitted to optimize control$\$scoringRule over the specified training period using optim with method = control$\$optimRule.

Value

A list with the following output components:

training  A list containing information on the training length and lag and the number of instances used for training for each modeling date.

a  A vector of fitted EMOS intercept parameters for each date.

b  A matrix of fitted EMOS coefficients for each date.

c, d  The fitted parameters for the variance, see details.

q  Fitted shift parameter, see details.

References


See Also

controlMOScsg0, ensembleMOScsg0,
**fitMOSgev**

*Censored generalized extreme value distribution EMOS modeling*

---

**Description**

Fits a censored generalized extreme value distribution EMOS model to a given training set.

**Usage**

```r
fitMOSgev0(ensembleData, control = controlMOSgev0(),
            exchangeable = NULL)
```

**Arguments**

- **ensembleData**
  - An `ensembleData` object including ensemble forecasts and verification observations. Missing values (indicated by NA) are allowed. Dates are ignored if they are included. This is the training set for the model.

- **control**
  - A list of control values for the fitting functions specified via the function `controlMOSgev0`. For details and default values, see `controlMOSgev0`.

- **exchangeable**
  - An optional numeric or character vector or factor indicating groups of ensemble members that are exchangeable (indistinguishable). The models have equal EMOS coefficients within each group. If supplied, this argument will override any specification of exchangeability in `ensembleData`. 

---

**Examples**

```r
data("ensBMatest", package = "ensembleBMA")
ensMemNames <- c("gfs", "cmcg", "eta", "gasp", "jma", "ngps", "tcwb", "ukmo")
obs <- paste("PCP24","obs", sep = ".")
ens <- paste("PCP24", ensMemNames, sep = ".")
prcpTestData <- ensembleData( forecasts = ensBMatest[,ens],
                               dates = ensBMatest[,"vdate"],
                               observations = ensBMatest[,obs],
                               station = ensBMatest[,"station"],
                               forecastHour = 48,
                               initializationTime = "00")
prcpTrain <- trainingData(prcpTestData, trainingDays = 30,
                           date = "2008010100")
prcpTestFit <- fitMOScsg0(prcpTrain)
```
Details

Given an ensemble of size \( m \): \( X_1, \ldots, X_m \), the following generalized extreme value distribution EMOS model left-censored at 0 is fit by \texttt{ensembleMOSgev0}:

\[
Y \sim GEV_0(\mu, \sigma, q)
\]

where \( GEV_0 \) denotes the generalized extreme value distribution left-censored at zero, with location \( \mu \), scale \( \sigma \) and shape \( q \). The model is parametrized such that the mean \( m \) is a linear function \( a + b_1 X_1 + \ldots + b_m X_m + sp_0 \) of the ensemble forecasts, where \( p_0 \) denotes the ratio of ensemble forecasts that are exactly 0, and the shape parameter \( \sigma \) is a linear function of the ensemble variance \( c + d MD(X_1, \ldots, X_m) \), where \( MD(X_1, \ldots, X_m) \) is Gini’s mean difference. See \texttt{ensembleMOSgev0} for details.

\( \beta \) is a vector of fitted regression coefficients: \( b_1, \ldots, b_m \). Specifically, \( a, b_1, \ldots, b_m, s, c, d, q \) are fitted to optimize the mean CRPS over the specified training period using \texttt{optim}.

Value

A list with the following output components:

- training: A list containing information on the training length and lag and the number of instances used for training for each modeling date.
- \( a \): A vector of fitted EMOS intercept parameters for each date.
- \( \beta \): A matrix of fitted EMOS coefficients for each date.
- \( s \): A vector of fitted EMOS coefficients for \( p_0 \) for each date, see details.
- \( c, d \): The fitted coefficients for the shape parameter, see details.
- \( q \): Fitted shape parameter, see details.

References


See Also

\texttt{controlMOSgev0, ensembleMOSgev0}.

Examples

```r
data("ensBMAtest", package = "ensembleBMA")
ensMemNames <- c("gfs", "cmcg", "eta", "gasp", "jma", "ngps", "tcwb", "ukmo")
obs <- paste("PCP24", "obs", sep = ".")
ens <- paste("PCP24", ensMemNames, sep = ".")
prcpTestData <- ensembleData( forecasts = ensBMAtest[, ens], dates = ensBMAtest[,"vdate"], observations = ensBMAtest[, obs], station = ensBMAtest[,"station"],
```
**Description**

Fits a log-normal EMOS model to a given training set.

**Usage**

```r
fitMOSlognormal(ensembleData, control = controlMOSlognormal(),
exchangeable = NULL)
```

**Arguments**

- `ensembleData`:
  An `ensembleData` object including ensemble forecasts and verification observations. Missing values (indicated by `NA`) are allowed. Dates are ignored if they are included. This is the training set for the model.

- `control`:
  A list of control values for the fitting functions specified via the function `controlMOSlognormal`. For details and default values, see `controlMOSlognormal`.

- `exchangeable`:
  An optional numeric or character vector or factor indicating groups of ensemble members that are exchangeable (indistinguishable). The models have equal EMOS coefficients within each group. If supplied, this argument will override any specification of exchangeability in `ensembleData`.

**Details**

Given an ensemble of size $m$: $X_1, \ldots, X_m$, the following log-normal model is fit by `ensembleMOSlognormal`:

$$ Y \sim LN(\mu, \sigma) $$

where $LN$ denotes the log-normal distribution with mean log parameter $\mu$ and scale log parameter $\sigma$, see `Lognormal`. The model is parametrized such that the mean value of the log-normal distribution is a linear function $a + b_1X_1 + \ldots + b_mX_m$ of the ensemble forecasts, and the variance is a linear function $c + dS^2$. For transformations between $\mu, \sigma$ and mean and variance of the log-normal distribution, see Baran and Lerch (2015). See `ensembleMOSlognormal` for details.
Value

A list with the following output components:

a  The fitted intercept.

b  The fitted EMOS coefficients.

c, d  The fitted parameters for the variance, see details.

References


See Also

c manipMOSlognormal, ensembleMOSlognormal.

Examples

data("ensBMAtest", package = "ensembleBMA")

ensMemNames <- c("gfs","cmcg","eta","gasp","jma","ngps","tcwb","ukmo")

obs <- paste("MAXWSP10","obs", sep = ".")
ens <- paste("MAXWSP10", ensMemNames, sep = ".")
windTestData <- ensembleData( forecasts = ensBMAtest[,ens],
    dates = ensBMAtest[,"vdate"],
    observations = ensBMAtest[,obs],
    station = ensBMAtest[,"station"],
    forecastHour = 48,
    initializationTime = "00")

windTrain <- trainingData(windTestData, trainingDays = 30,
    date = "2008010100")

windTestFit <- fitMOSlognormal(windTrain)

---

**fitMOSNormal**

*Gaussian (normal) EMOS model fit to a training set*

Description

Fits a Gaussian (normal) EMOS model to a given training set.

Usage

```r
fitMOSNormal(ensembleData, control = controlMOSNormal(),
    exchangeable = NULL)
```
Arguments

ensembleData  An ensembleData object including ensemble forecasts and verification observations. Missing values (indicated by NA) are allowed. Dates are ignored if they are included. This is the training set for the model.

control  A list of control values for the fitting functions specified via the function controlMOSnormal. For details and default values, see controlMOSnormal.

echangeable  An optional numeric or character vector or factor indicating groups of ensemble members that are exchangeable (indistinguishable). The models have equal EMOS coefficients within each group. If supplied, this argument will override any specification of exchangeability in ensembleData.

Details

Given an ensemble of size $m$: $X_1, \ldots, X_m$, the following Gaussian model is fit by ensembleMOSnormal:

$$Y \sim N(a + b_1X_1 + \ldots + b_mX_m, c + dS^2).$$

$b$ is a vector of fitted regression coefficients: $b_1, \ldots, b_m$. Specifically, $a, b_1, \ldots, b_m, c, d$ are fitted to optimize control$\$scoringRule over the specified training period using optim with method = control$\$optimRule.

Value

A list with the following output components:

- $a$  The fitted intercept.
- $b$  The fitted EMOS coefficients.
- $c, d$  The fitted variance parameters, see details.

References


See Also

controlMOSnormal, ensembleMOSnormal

Examples

data("ensBMAttest", package = "ensembleBMA")

ensMemNames <- c("gfs", "cmcg", "eta", "gasp", "jma", "ngps", "tcwb", "ukmo")

obs <- paste("T2", "obs", sep = ".")
ens <- paste("T2", ensMemNames, sep = ".")
tempTestData <- ensembleData( forecasts = ensBMAttest[,ens],
                               dates = ensBMAttest[,"vdate"],
                               model = "temp",
                               method = "MOS",
                               ensembleMemNames = ensMemNames,
                               verificationPeriod = tempTestData[,"vdate"]
)
fitMOStruncnormal

Truncated normal EMOS model fit to a training set

Description

Fits a truncated normal EMOS model to a given training set.

Usage

fitMOStruncnormal(ensembleData, control = controlMOStruncnormal(),
exchangeable = NULL)

Arguments

ensembleData An ensembleData object including ensemble forecasts and verification observations. Missing values (indicated by NA) are allowed. Dates are ignored if they are included. This is the training set for the model.
control A list of control values for the fitting functions specified via the function controlMOStruncnormal. For details and default values, see controlMOStruncnormal.
exchangeable An optional numeric or character vector or factor indicating groups of ensemble members that are exchangeable (indistinguishable). The models have equal EMOS coefficients within each group. If supplied, this argument will override any specification of exchangeability in ensembleData.

Details

Given an ensemble of size $m$: $X_1, \ldots, X_m$, the following truncated normal model is fit by ensembleMOStruncnormal:

$$Y \sim N_0(a + b_1X_1 + \ldots + b_mX_m, c + dS^2),$$

where $N_0$ denotes the normal distribution truncated at zero, with location $a + b_1X_1 + \ldots + b_mX_m$ and squared scale $c + dS^2$. $B$ is a vector of fitted regression coefficients: $b_1, \ldots, b_m$. Specifically, $a, b_1, \ldots, b_m, c, d$ are fitted to optimize control$\textsc{scoringRule}$ over the specified training period using optim with method = control$\textsc{optimRule}$. 
Value

A list with the following output components:

- **a**: The fitted intercept.
- **b**: The fitted EMOS coefficients.
- **c, d**: The fitted parameters for the squared scale, see details.

References


See Also

`controlMOStruncnormal`, `ensembleMOStruncnormal`.

Examples

```r
data("ensBMAtest", package = "ensembleBMA")
ensMemNames <- c("gfs","cmcg","eta","gasp","jma","ngps","tcwb","ukmo")
obs <- paste("MAXWSP10","obs", sep = ".")
ens <- paste("MAXWSP10", ensMemNames, sep = ".")
windTestData <- ensembleData( forecasts = ensBMAtest[,ens],
   dates = ensBMAtest[,"vdate"],
   observations = ensBMAtest[,obs],
   station = ensBMAtest[,"station"],
   forecastHour = 48,
   initializationTime = "00")
windTrain <- trainingData(windTestData, trainingDays = 30,
   date = "2008010100")
windTestFit <- fitMOStruncnormal(windTrain)
```

### pars

**Forecast distribution parameters**

Description

Computes the parameters of the forecast distribution resulting for univariate ensemble forecasting models.

Usage

`pars(fit, ensembleData, dates=NULL, ...)"
Arguments

**fit**

A model fit to ensemble forecasting data, obtained using `fitmos` or `ensemblemos`.

**ensembleData**

An `ensembleData` object that includes ensemble forecasts, verification observations and possibly dates. Missing values (indicated by `NA`) are allowed. This need not be the data used for the model fit, although it must include the same ensemble members.

**dates**

The dates for which the parameters will be computed. These dates must be consistent with `fit` and `ensembleData`. The default is to use all of the dates in `fit`. The dates are ignored if `fit` originates from `fitmos`, which also ignores date information.

... Included for generic function compatibility.

Details

These methods are generic, and can be applied to all ensemble forecasting models.

Value

`pars` is a matrix giving the distribution parameter values for each instance in the data. The returned parameters denoted in the column names depend on the model used to generate the `fit` object.

See Also

`ensembleMOS`, `fitMOS`

Examples

data("ensBMATest", package = "ensembleBMA")

ensMemNames <- c("gfs", "cmcg", "eta", "gasp", "jma", "ngps", "tcwb", "ukmo")

obs <- paste("T2", "obs", sep = ".")
ens <- paste("T2", ensMemNames, sep = ".")
tempTestData <- ensembleData(forecasts = ensBMATest[,ens],
    dates = ensBMATest[,"vdate"],
    observations = ensBMATest[,obs],
    station = ensBMATest[,"station"],
    forecastHour = 48,
    initializationTime = "00")

tempTestFit <- ensembleMOS(tempTestData, trainingDays = 25,
    dates = c("2008010100", "2008010200"),
    model = "normal")

parValues <- pars(tempTestFit, tempTestData)
parValues
quantileForecast

Quantile forecasts at observation locations

Description
Computes quantiles for the probability distribution function (PDF) for ensemble forecasting models.

Usage
quantileForecast(fit, ensembleData, quantiles = 0.5, dates = NULL, ...)

Arguments
- **fit**: A model fit to ensemble forecasting data.
- **ensembleData**: An `ensembleData` object that includes ensemble forecasts, verification observations and possibly dates. Missing values (indicated by `NA`) are allowed. This need not be the data used for the model fit, although it must include the same ensemble members.
- **quantiles**: The vector of desired quantiles for the PDF of the EMOS model.
- **dates**: The dates for which the quantile forecasts will be computed. These dates must be consistent with `fit` and `ensembleData`. The default is to use all of the dates in `fit`. If `ensembleData` does not include dates, they will be inferred from `fit` and `dates`.
- ... Included for generic function compatibility.

Details
This method is generic, and can be applied to any ensemble forecasting model. This can be used to compute prediction intervals for the PDF.

Value
A matrix of forecasts corresponding to the desired quantiles.

References

See Also
ensembleMOS, fitMOS, cdf
trainingData

Extract Training Data

Description
Extraction a subset of an ensembleData object corresponding to a given date and number of training days.

Usage
trainingData(ensembleData, trainingDays, consecutive = FALSE, date)

Arguments
- ensembleData: An ensembleData object that includes ensemble forecasts, observations and dates.
- trainingDays: An integer specifying the number of days in the training period.
- consecutive: If TRUE then dates in training set are treated as consecutive, i.e. date gaps are ignored.
- date: The date for which the training data is desired.

Value
An ensembleData object corresponding to the training data for the given date relative to ensembleData.
References


See Also

`ensembleMOSnormal, fitMOSnormal`

Examples

data("ensBMAtest", package = "ensembleBMA")

ensMemNames <- c("gfs","cmcg","eta","gasp","jma","ngps","tcwb","ukmo")

obs <- paste("T2", "obs", sep = ".")
ens <- paste("T2", ensMemNames, sep = ".")
tempTestData <- ensembleData(  
  forecasts = ensBMAtest[,ens],  
  dates = ensBMAtest[,"vdate"],  
  observations = ensBMAtest[,obs],  
  station = ensBMAtest[,"station"],  
  forecastHour = 48,  
  initializationTime = "00")

tempTrain <- trainingData(tempTestData, trainingDays = 30,  
  date = "2008010100")

tempTrainFit <- fitMOSnormal(tempTrain)
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