Package ‘multisite.accuracy’

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Type Package
Title Estimation of Accuracy in Multisite Machine-Learning Models
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Description The effects of the site may severely bias the accuracy of a multisite machine-learning model, even if the analysts removed them when fitting the model in the 'training set' and when applying the model in the 'test set'. This simple R package estimates the accuracy of a multisite machine-learning model unbiasedly as described in (Solanes et al, Psychiatry Research: Neuroimaging 2021, in Press). It currently supports the estimation of sensitivity, specificity, balanced accuracy, the area under the curve, correlation, mean squared error, and hazard ratio for binomial, gaussian, and survival (time-to-event) outcomes.
License GPL-3
Imports AROC, coxme, lme4, lmerTest, logistf, metafor, pROC, survival
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multisite.accuracy Estimate accuracy in multisite machine learning studies

Description

Function to estimate the accuracy of the predictions of a multisite machine-learning model, controlling the effects of the site.
multisite.accuracy

Usage

```r
multisite.accuracy(y, y.pred, site, estimate = c("auc", "bac", "cor", "hr", "mse"),
                   site.method = "covar", mixed = FALSE, min.n = 10, ...)
```

Arguments

- `y`: actual value of the variable that you want to predict. For "auc" and "bac" estimates, it must be a binary vector. For "cor" and "mse" estimates, it must be a numeric vector. For "hr" estimates, it must be an object of class "Surv".
- `y.pred`: predicted value of the variable. For "auc", "cor", "hr", and "mse" estimates, it must be a numeric vector. For "bac" estimates, it must be a binary vector.
- `site`: vector with the name of the site for each observation. Ignored if `site.method` is "none".
- `estimate`: "auc" (area under the ROC curve, when "y" is a binary variable and "y.pred" is a continuous variable), "bac" (balanced accuracy, along with sensitivity and specificity, when both "y" and "y.pred" are binary variables), "cor" and "mse" (correlation and mean squared error, when both "y" and "y.pred" are numeric variables), "hr" (hazard ratio, when "y" is an object of class "Surv" and "y.pred" is a numeric variable).
- `site.method`: "covar" (site as covariate, e.g., using lm), "meta" (meta-analysis across sites), or "none" (no control of the effects of the site).
- `mixed`: try to fit mixed-effects models, only for `site.method` = "covar" and `estimate` = "cor", "mse", or "hr".
- `min.n`: sites below this minimum sample size will be ignored.
- `...`: further arguments for logistf, lm, rma, etc.

Details

We refer the reader to the publication below for details on the calculations.

Value

A data frame with the estimated accuracy, the methods used, and any warning or error.

References


Examples

```r
for (real_effects in c(FALSE, TRUE)) {
  for (eos in c(FALSE, TRUE)) {
    # Simulate data
    site = rep(c("Site A", "Site B"), 200)
```
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```r
y = c(scale(rnorm(400)))
y.pred = c(scale(residuals(lm(rnorm(400) ~ y))))
# If real effects:
if (real_effects) {
  y.pred = c(scale(y.pred + y))
}
# If effects of the site:
if (eos) {
  y = c(scale(y + 2 * (site == "Site B")))
  y.pred = c(scale(y.pred + 2 * (site == "Site B")))
}
cat("\n=== Real effects: ", ifelse(real_effects, "yes", "no"),
  "\n=== Effects of the site: ", ifelse(eos, "yes", "no"), "\n\n")

# Numeric: without real effects, mse.pred should not be < mse.mean and cor should be 0
print(rbind(
  multisite.accuracy(y, y.pred, site, "mse", site.method = "covar"),
  multisite.accuracy(y, y.pred, site, "mse", site.method = "meta"),
  multisite.accuracy(y, y.pred, site, "mse", site.method = "none"))[,1:5])
print(rbind(
  multisite.accuracy(y, y.pred, site, "cor", site.method = "covar"),
  multisite.accuracy(y, y.pred, site, "cor", site.method = "meta"),
  multisite.accuracy(y, y.pred, site, "cor", site.method = "none"))[,1:3])
```

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