

Package ‘gibbsTI’

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Title Calibrated Gibbs Posteriors for Tolerance Intervals

Version 0.1.0

Description Provides tools for constructing one-sided and two-sided nonparametric tolerance intervals using calibrated Gibbs posteriors. The methods target population quantiles and content levels while achieving nominal frequentist coverage through data-driven calibration. The methodology is described in Pourmohamad, Richardson, and Sansó (2026) <[doi:10.1080/00401706.2026.2699103](https://doi.org/10.1080/00401706.2026.2699103)>.

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gibbsTI

*Fit a Gibbs Posterior Tolerance Interval***Description**

Constructs a one-sided or two-sided nonparametric tolerance interval from a calibrated Gibbs posterior. The learning rate η is chosen automatically by Gibbs posterior calibration (GPC) so that the interval attains the nominal frequentist coverage, or it can be fixed by the user.

Usage

```
gibbsTI(
  x,
  side = c("one", "two"),
  type = c("upper", "lower"),
  target = c("content", "quantile"),
  content = 0.95,
  confidence = 0.9,
  tau = NULL,
  tau_lower = NULL,
  tau_upper = NULL,
  eta_method = c("GPC", "fixed"),
  eta = NULL,
  max_iter = 15,
  control = list(),
  n_mcmc = 5000,
  burnin = 1000,
  thin = 1,
  seed = NULL,
  verbose = TRUE
)
```

Arguments

<code>x</code>	Numeric vector of observations (at least 5, all finite).
<code>side</code>	Direction of the interval: "one" (one-sided) or "two" (two-sided, centered).
<code>type</code>	For one-sided intervals only, "upper" (bound above) or "lower" (bound below). Ignored when <code>side = "two"</code> .
<code>target</code>	Calibration target: "content" (default; the interval is defined by a population proportion) or "quantile" (the interval targets explicit population quantiles supplied through <code>tau</code> , <code>tau_lower</code> , <code>tau_upper</code>).
<code>content</code>	Population proportion the interval should contain, in (0, 1) (e.g. 0.95). Used when <code>target = "content"</code> ; when <code>target = "quantile"</code> it only supplies defaults for any unset <code>tau_*</code> argument.
<code>confidence</code>	Frequentist confidence level in (0, 1) (e.g. 0.90). This is both the GPC coverage target ($1 - \alpha$) and the posterior level read off as the reported limit.

<code>tau</code>	Target quantile for a one-sided "quantile" interval, in (0, 1). Only used when <code>target = "quantile"</code> ; ignored when <code>target = "content"</code> .
<code>tau_lower, tau_upper</code>	Lower/upper target quantiles for a two-sided "quantile" interval, in (0, 1) with <code>tau_lower < tau_upper</code> . Only used when <code>target = "quantile"</code> ; ignored when <code>target = "content"</code> .
<code>eta_method</code>	How the Gibbs learning rate <code>eta</code> is chosen: "GPC" (default; data-driven calibration) or "fixed" (use the supplied <code>eta</code>).
<code>eta</code>	Gibbs learning rate (positive). Optional starting value when <code>eta_method = "GPC"</code> (defaults to 1); required when <code>eta_method = "fixed"</code> .
<code>max_iter</code>	Maximum number of Robbins-Monro iterations for the GPC search (default 15). Only used when <code>eta_method = "GPC"</code> .
<code>control</code>	A list of control parameters for the MCMC samplers and GPC: • <code>B</code>: Number of bootstrap replicates for calibration (default 200). • <code>tol</code>: Convergence tolerance for <code>eta</code> (default $1e-3$). • <code>c, gamma</code>: Step-size parameters for Robbins-Monro (defaults 0.5, 0.75). • <code>w, m</code>: Slice sampler width and max steps for one-sided intervals. • <code>prop_sd</code>: Proposal standard deviation for Metropolis-Hastings in the two-sided case. • <code>n_samps_calib</code>: MCMC samples used per bootstrap during calibration (default 1000). • <code>burnin_calib</code>: Burn-in used per bootstrap during calibration (default 200).
<code>n_mcmc</code>	Number of posterior draws retained for the final interval, after burn-in and thinning (default 5000).
<code>burnin</code>	Number of initial iterations discarded as burn-in (default 1000).
<code>thin</code>	Thinning interval: every <code>thin</code> -th post-burn-in draw is kept (default 1).
<code>seed</code>	Optional integer random seed for reproducibility.
<code>verbose</code>	Logical; if TRUE, prints progress messages.

Value

An object of class "gibbsTI": a list with the fitted interval (a numeric limit for one-sided fits, or a list with lower and upper for two-sided fits), the calibrated `eta`, the retained posterior samples, the data, the quantile level(s) `tau_used`, calibration diagnostics (`calibrated_coverage`, `eta_history`), and the settings used. Use `print()`, `summary()`, and `plot()` on the result.

Examples

```
set.seed(1)
x <- rnorm(50)

# Fast: fix the learning rate (no calibration search)
fit <- gibbsTI(x, side = "one", type = "upper", eta_method = "fixed",
              eta = 1, n_mcmc = 500, burnin = 200, verbose = FALSE)
print(fit)
```

```
# Data-driven GPC calibration (slower) for a two-sided 95%/90% interval
fit2 <- gibbsTI(x, side = "two", content = 0.95, confidence = 0.90,
               seed = 1, verbose = FALSE)
summary(fit2)
```

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