Package 'countts'

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Title Thomson Sampling for Zero-Inflated Count Outcomes

Version 0.1.0

Description A specialized tool is designed for assessing contextual bandit algorithms, particularly those aimed at handling overdispersed and zero-inflated count data. It offers a simulated testing environment that includes various models like Poisson, Overdispersed Poisson, Zero-inflated Poisson, and Zero-inflated Overdispersed Poisson. The package is capable of executing five specific algorithms: Linear Thompson sampling with log transformation on the outcome, Thompson sampling Poisson, Thompson sampling Negative Binomial, Thompson sampling Zero-inflated Poisson, and Thompson sampling Zero-inflated Negative Binomial. Additionally, it can generate regret plots to evaluate the performance of contextual bandit algorithms. This package is based on the algorithms by Liu et al. (2023) <arXiv:2311.14359>.

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Imports MASS, parallel, fastDummies, matrixStats, ggplot2, stats

NeedsCompilation no

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R topics documented:

`apply_laplacePoisson` *Apply the algorithms to make decisions for Thompson sampling Poisson (TS-Poisson) algorithms*

Description

Apply the algorithms to make decisions for Thompson sampling Poisson (TS-Poisson) algorithms

Usage

```
apply_laplacePoisson(context, beta_laplacePoisson)
```

Arguments

`context`	context at the current decision time
`beta_laplacePoisson`	the randomly sampled Bayesian estimate

Value

Intervention option

Examples

```
apply_laplacePoisson(matrix(1:10, nrow = 2),matrix(11:20, nrow = 5))
```

`apply_linearTS` *Apply the algorithms to make decisions for Linear Thompson sampling (TS) algorithms*

Description

Apply the algorithms to make decisions for Linear Thompson sampling (TS) algorithms

Usage

```
apply_linearTS(context, beta_linearTS)
```

Arguments

`context`	context at the current decision time
`beta_linearTS`	the randomly sampled Bayesian estimate

Value

Intervention option

Examples

```
apply_linearTS(matrix(1:10, nrow = 2),matrix(11:20, nrow = 5))
```

`apply_normalNB` *Apply the algorithms to make decisions for Thompson sampling Negative Binomial (TS-NB) algorithms*

Description

Apply the algorithms to make decisions for Thompson sampling Negative Binomial (TS-NB) algorithms

Usage

```
apply_normalNB(context, beta_normalNB)
```

Arguments

`context`	context at the current decision time
`beta_normalNB`	the randomly sampled Bayesian estimate

Value

Intervention option

Examples

```
apply_normalNB(matrix(1:10, nrow = 2),matrix(11:20, nrow = 5))
```

`apply_ZINB` *Apply the algorithms to make decisions for Thompson sampling Zero-inflated Negative Binomial (TS-ZINB) algorithm*

Description

Apply the algorithms to make decisions for Thompson sampling Zero-inflated Negative Binomial (TS-ZINB) algorithm

Usage

```
apply_ZINB(context, beta_ZINB, gamma_ZINB)
```

Arguments

context	context at the current decision time
beta_ZINB	the randomly sampled Bayesian estimate for the Poisson component
gamma_ZINB	the randomly sampled Bayesian estimate for the zero component

Value

Intervention option

Examples

```
apply_ZINB(matrix(1:10, nrow = 2),matrix(11:20, nrow = 5),matrix(21:30, nrow = 5))
```

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apply_ZIP *Apply the algorithms to make decisions for Thompson sampling Zero-inflated Poisson (TS-ZIP) algorithm*

Description

Apply the algorithms to make decisions for Thompson sampling Zero-inflated Poisson (TS-ZIP) algorithm

Usage

```
apply_ZIP(context, beta_ZIP, gamma_ZIP)
```

Arguments

context	context at the current decision time
beta_ZIP	the randomly sampled Bayesian estimate for the Poisson component
gamma_ZIP	the randomly sampled Bayesian estimate for the zero component

Value

Intervention option

Examples

```
apply_ZIP(matrix(1:10, nrow = 2),matrix(11:20, nrow = 5),matrix(21:30, nrow = 5))
```

output_summary *Summarize the simulation results and generate the regret plot*

Description

Summarize the simulation results and generate the regret plot

Usage

```
output_summary(
  S = 30,
  num_cov = 4,
  T.init = 20,
  T0 = 1000,
  alpha = 1,
  gam = 25,
  K = 20,
  dist_env = c("Negative Binomial", "Poisson", "Linear TS", "ZIP", "ZINB"),
  show_figure = TRUE
)
```

Arguments

S	number of replicates of the experiment (greater than 1). Default is 30.
num_cov	dimension for beta and gamma; we assume that they have the same dimensions for now. Default is 4.
T.init	length of the initial exploration stage. Default is 20.
T0	number of decision times. Default is 1000.
alpha	tuning parameter that controls the exploration-exploitation tradeoff. Default is 1.
gam	over dispersion level of the environment model; this is only useful when the environment model is negative binomial or zero-inflated negative binomial. Default is 25.
K	number of actions/intervention options. Default is 20.
dist_env	tuning parameter that controls which environment model to use, with the options "Negative Binomial", "Poisson", "Linear TS", "ZIP", "ZINB"
show_figure	A logical flag specifying that the regret plot of the model should be returned if true (default), otherwise, false.

Value

The summary of the simulation results with cumulative regret, regret, and parameters is generated along with the optional output of the regret plot (show_figure = TRUE).

References

- Liu, X., Deliu, N., Chakraborty, T., Bell, L., & Chakraborty, B. (2023). Thompson sampling for zero-inflated count outcomes with an application to the Drink Less mobile health study. arXiv preprint arXiv:2311.14359. https://arxiv.org/abs/2311.14359

Examples

```
output_summary(S = 2, num_cov = 2, T.init = 3, T0 = 5, dist_env = "Negative Binomial")
```

`update_algorithm` *Updating parameters in algorithm*

Description

Updating parameters in algorithm

Usage

```
update_algorithm(
  dist = c("Negative Binomial", "Poisson", "Linear TS", "ZIP", "ZINB"),
  Y_dist = 2,
  X_dist = 3,
  alpha_dist = 4,
  Bt = NULL,
  bt = NULL
)
```

Arguments

`dist`	tuning parameter that controls which algorithm should be updated, with the options "Negative Binomial", "Poisson", "Linear TS", "ZIP", "ZINB"
`Y_dist`	History of the observed stochastic outcome at the current decision time
`X_dist`	History of the observed context at the current decision time
`alpha_dist`	tuning parameter that controls the exploration-exploitation tradeoff. Default is 1.
`Bt`	Outer product of contexts, only for `dist` = "Linear TS", default is NULL
`bt`	Sum of contexts weighted by the outcome, only for `dist` = "Linear TS", default is NULL.

Value

The updated parameter estimates.

Examples

```
update_algorithm(dist = "Negative Binomial")
```

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