Package 'crandep'

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Title Network Analysis of Dependencies of CRAN Packages

Version 0.0.2

Description The dependencies of CRAN packages can be analysed in a network fashion. For each package we can obtain the packages that it depends, imports, suggests, etc. By iterating this procedure over a number of packages, we can build, visualise, and analyse the dependency network, enabling us to have a bird's-eye view of the CRAN ecosystem. One aspect of interest is the number of reverse dependencies of the packages, or equivalently the in-degree distribution of the dependency network. This can be fitted by the power law and/or an extreme value mixture distribution, of which functions are provided.

Depends R (>= 3.4)

License GPL (>= 2)

Encoding UTF-8

LazyData true

Imports xml2, rvest, stringr, dplyr, igraph, Rcpp

Suggests ggplot2, tibble, knitr, rmarkdown

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NeedsCompilation yes

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`cran_dependencies` *Dependencies of CRAN packages*

Description

A dataset containing the dependencies of various types (Imports, Depends, Suggests, LinkingTo, and their reverse counterparts) of more than 14600 packages available on CRAN as of 2020-05-09.

Usage

```
cran_dependencies
```

Format

A data frame with 211408 rows and 4 variables:

from the name of the package that introduced the dependencies

to the name of the package that the dependency is directed towards

type the type of dependency, which can take the follow values (all in lowercase): "depends", "imports", "linking_to", "suggests"

reverse a boolean representing whether the dependency is a reverse one (TRUE) or a forward one (FALSE)

Source

The CRAN pages of all the packages available on https://cran.r-project.org/web/packages/available_packages_by_name.html

df_to_graph *Construct the giant component of the network from two data frames*

Description

Construct the giant component of the network from two data frames

Usage

```
df_to_graph(edgelist, nodelist = NULL, gc = TRUE)
```

Arguments

edgelist	A data frame with (at least) two columns: from and to
nodelist	NULL, or a data frame with (at least) one column: name, that contains the nodes to include
gc	Boolean, if 'TRUE' (default) then the giant component is extracted, if 'FALSE' then the whole graph is returned

Value

An igraph object & a connected graph

Examples

```
from <- c("1", "2", "4")
to <- c("2", "3", "5")
edges <- data.frame(from = from, to = to, stringsAsFactors = FALSE)
nodes <- data.frame(name = c("1", "2", "3", "4", "5"), stringsAsFactors = FALSE)
df_to_graph(edges, nodes)
```

dmix *Probability mass function (PMF) of discrete extreme value mixture distribution*

Description

dmix returns the PMF at x for the discrete extreme value mixture distribution.

Usage

```
dmix(x, xi1, xi2, sig, u, phi, geo, give_log = FALSE)
```

Arguments

x	Vector of positive integers
xi1	Scalar, shape parameter for values below or equal to u
xi2	Scalar, shape parameter of integer generalised Pareto distribution (IGPD), for values above u
sig	Scalar, scale parameter of IGPD, for values above u
u	Scalar, positive integer threshold
phi	Scalar, exceedance probability of u, between 0.0 and 1.0 exclusive
geo	Boolean. If 'TRUE', the geometric distribution is used for the values below u. If 'FALSE', the discrete power law is used.
give_log	Boolean, whether the PMF should be returned on the log scale. If 'FALSE', the PMF is returned on the original scale.

Value

A numeric vector of the same length as x

See Also

Smix for the corresponding survival function, dupp for the probability mass function of the discrete power law.

Examples

```
dmix(10:15, 2.0, 0.5, 1.0, 12, 0.2, TRUE)
dmix(10:15, 2.0, 0.5, 1.0, 12, 0.2, FALSE)
dmix(10:15, 2.0, 0.5, 1.0, 12, 0.2, FALSE, TRUE)
```

---

dupp *Probability mass function (PMF) of discrete power law*

Description

dupp returns the PMF at x for the discrete power law with exponent (1.0 / xi1 + 1.0), for values greater than or equal to u.

Usage

```
dupp(x, u, xi1, give_log = FALSE)
```

Arguments

x	Vector of positive integers
u	Scalar, non-negative integer threshold
xi1	Scalar, a positive real number representing the shape parameter
give_log	Boolean, whether the PMF should be returned on the log scale. If 'FALSE', the PMF is returned on the original scale.

Details

The PMF is proportional to x^(-alpha), where alpha = 1.0 / xi1 + 1.0. To be a proper PMF, it is normalised by 1/hzeta(alpha, u), where hzeta is the Hurwitz zeta function i.e. hzeta(y, z) = z^(-y) + (z+1)^(-y) + (z+2)^(-y) + ... Any values below u will have PMF equal to 0.0. That xi1 is used instead of alpha is for alignment with the parametrisation in `dmix`, `Smix` and `mcmc_mix`.

Value

A numeric vector of the same length as x

See Also

`Supp` for the corresponding survival function, `dmix` for the PMF of the discrete extreme value mixture distribution.

Examples

```
dupp(c(10,20,30,40,50), 12, 2.0, FALSE)
dupp(c(10,20,30,40,50), 12, 2.0, TRUE)
```

`get_dep_all` *Obtain one type of dependencies of a package directly*

Description

Obtain one type of dependencies of a package directly

Usage

```
get_dep_all(name, type, scrape = TRUE)
```

Arguments

`name`	String, name of the package
`type`	One of the following dependency words: "Depends", "Imports", "LinkingTo", "Suggests", "Reverse_depends", "Reverse_imports", "Reverse_linking_to", "Reverse_suggests"
`scrape`	Boolean. If 'TRUE' (default), the page of the package will be scraped. If 'FALSE', tools::CRAN_package_db() will be used.

Value

A string vector of dependencies

Examples

```
get_dep_all("dplyr", "Imports")
get_dep_all("MASS", "Depends")
get_dep_all("MASS", "Depends", FALSE) # same result as above line
```

get_dep_df *Obtain the data frame of multiple kinds of dependencies*

Description

Obtain the data frame of multiple kinds of dependencies

Usage

```
get_dep_df(name, type, scrape = TRUE)
```

Arguments

name	String, name of the package
type	A character vector that contains one or more of the following dependency words: "Depends", "Imports", "LinkingTo", "Suggests", "Reverse_depends", "Reverse_imports", "Reverse_linking_to", "Reverse_suggests"
scrape	Boolean. If 'TRUE' (default), the page of the package will be scraped. If 'FALSE', tools::CRAN_package_db() will be used.

Value

A data frame of dependencies

Examples

```
get_dep_df("dplyr", c("Imports", "Depends"))
get_dep_df("MASS", c("Suggests", "Depends", "Imports"))
get_dep_df("MASS", c("Suggests", "Depends", "Imports"), FALSE) # same result as above line
```

mcmc_mix *Markov chain Monte Carlo for discrete extreme value mixture distribution*

Description

mcmc_mix returns the samples from the joint posterior of the parameters (u, xi1, xi2, sig), for fitting the discrete extreme value mixture distribution (DEVMD) to the data x. The samples are obtained using Markov chain Monte Carlo (MCMC).

Usage

```
mcmc_mix(
  x,
  u,
  xi1,
  xi2,
  sig,
  cont,
  geo,
  a_phi,
  b_phi,
  a_xi1,
  b_xi1,
  m_xi2,
  s_xi2,
  a_sig,
  b_sig,
  pcont,
  N = 20000L,
  thin = 100L,
  burnin = 20000L,
  print_freq = 10000L
)
```

Arguments

x	Vector of positive integers, representing the data
u	Scalar, initial value of the positive integer threshold
xi1	Scalar, initial value of the parameter for values below or equal to u
xi2	Scalar, initial value of the shape parameter of the integer generalised Pareto distribution (IGPD), for values above u
sig	Scalar, initial value of the scale parameter of IGPD, for values above u
cont	Boolean, whether the continuity constraint is imposed at u
geo	Boolean. If 'TRUE', the geometric distribution is used for the values below u. If 'FALSE', the discrete power law is used.
a_phi, b_phi, a_xi1, b_xi1, m_xi2, s_xi2, a_sig, b_sig	Scalars, representing the hyperparameters of the prior distributions of the respective parameters. See details for the specification of the priors.
pcont	Scalar, between 0.0 and 1.0, representing the prior probability of the continuity constrained version, for model selection.
N	Scalar, positive integer representing the length of the output chain i.e. the number of rows in the returned data frame
thin	Scalar, positive integer representing the thinning in the MCMC
burnin	Scalar, non-negative integer representing the burn-in of the MCMC
print_freq	Scalar, positive integer representing the frequency of printing the sampled values

Details

In the MCMC, a componentwise Metropolis-Hastings algorithm is used. Unlike mcmc_upp, the threshold u is treated as a parameter in mcmc_mix and therefore inferred. The 8 hyperparameters are used in the following priors: u is such that the implied exceedance probability phi ~ Uniform(a_phi, b_phi); xi1 ~ Uniform(a_xi1, b_xi1); xi2 ~ Normal(mean = m_xi2, sd = s_xi2); sig ~ Gamma(shape = a_sig, rate = b_sig). If pcont = 0.0, only the unconstrained version of the DEVMD is fitted; if pcont = 1.0, only the continuity constrained version is fitted. Setting pcont between 0.0 and 1.0 allows both versions to be fitted, if model selection between the two is of interest.

Value

A data frame containing N rows and 7 columns which represent (in this order) the 4 parameters (u, xi1, xi2, sig), the implied exceedance probability (phi), the log-posterior density (lpost), and whether the continuity constraint is imposed (cont).

See Also

mcmc_upp for MCMC for the discrete power law.

---

mcmc_upp *Markov chain Monte Carlo for discrete power law*

Description

mcmc_upp returns the samples from the posterior of xi1, for fitting the discrete power law to the data x. The samples are obtained using Markov chain Monte Carlo (MCMC).

Usage

```
mcmc_upp(
  x,
  u,
  xi1,
  a_xi1,
  b_xi1,
  N = 20000L,
  thin = 10L,
  burnin = 20000L,
  print_freq = 10000L
)
```

Arguments

x	Vector of positive integers, representing the data
u	Scalar, non-negative integer threshold
xi1	Scalar, initial value of the shape parameter

a_xi1	Scalar, lower bound of the uniform distribution as the prior of xi1
b_xi1	Scalar, upper bound of the uniform distribution as the prior of xi1
N	Scalar, positive integer representing the length of the output chain i.e. the number of rows in the returned data frame
thin	Scalar, positive integer representing the thinning in the MCMC
burnin	Scalar, non-negative integer representing the burn-in of the MCMC
print_freq	Scalar, positive integer representing the frequency of printing the sampled values

Details

In the MCMC, a componentwise Metropolis-Hastings algorithm is used. Unlike mcmc_mix, the threshold u is treated as fixed in mcmc_upp.

Value

A data frame containing N rows and 2 columns which represent xi1 and the log-posterior density (lpost)

See Also

mcmc_mix for MCMC for the discrete extreme value mixture distribution.

Smix *Survival function of discrete extreme value mixture distribution*

Description

Smix returns the survival function at x for the discrete extreme value mixture distribution.

Usage

```
Smix(x, xi1, xi2, sig, u, phi, geo)
```

Arguments

x	Vector of positive integers
xi1	Scalar, shape parameter for values below or equal to u
xi2	Scalar, shape parameter of integer generalised Pareto distribution (IGPD), for values above u
sig	Scalar, scale parameter of IGPD, for values above u
u	Scalar, positive integer threshold
phi	Scalar, exceedance probability of u, between 0.0 and 1.0 exclusive
geo	Boolean. If 'TRUE', the geometric distribution is used for the values below u. If 'FALSE', the discrete power law is used.

Value

A numeric vector of the same length as x

See Also

dmix for the corresponding probability mass function, Supp for the survival function of the discrete power law.

Examples

```
Smix(10:15, 2.0, 0.5, 1.0, 12, 0.2, TRUE)
Smix(10:15, 2.0, 0.5, 1.0, 12, 0.2, FALSE)
```

Supp *Survival function of discrete power law*

Description

Supp returns the survival function at x for the discrete power law with exponent (1.0 / xi1 + 1.0), for values greater than or equal to u.

Usage

```
Supp(x, u, xi1)
```

Arguments

x	Vector of positive integers
u	Scalar, non-negative integer threshold
xi1	Scalar, a positive real number representing the shape parameter

Details

The survival function used is S(x) = Pr(X >= x), where X is a random variable following the discrete power law. The inclusion of x in the sum means S(x) may not necessarily equal to Pr(X > x) as the distribution is discrete. In the case of discrete power law, it can be shown that S(x) = hzeta(alpha, x)/hzeta(alpha, u), where hzeta is the Hurwitz zeta function i.e. hzeta(y, z) = z^(-y) + (z+1)^(-y) + (z+2)^(-y) + ... and alpha = 1.0 / xi1 + 1.0. That xi1 is used instead of alpha is for alignment with the parametrisation in dmix, Smix and mcmc_mix.

Value

A numeric vector of the same length as x

See Also

dupp for the corresponding probability mass function, Smix for the survival function of the discrete extreme value mixture distribution.

Examples

```
Supp(c(10,20,30,40,50), 12, 2.0)
```

---

topo_sort_kahn *Return a sorted vector of nodes id*

Description

Return a sorted vector of nodes id

Usage

```
topo_sort_kahn(g, random = FALSE)
```

Arguments

g	An igraph object of a DAG
random	Boolean, whether the order of selected nodes is randomised in the process

Value

A data frame with two columns: "id" is the names of nodes in g, and "id_num" is the topological ordering

Examples

```
df0 <- data.frame(from = c("a", "b"), to = c("b", "c"), stringsAsFactors = FALSE)
g0 <- igraph::graph_from_data_frame(df0, directed = TRUE)
topo_sort_kahn(g0)
```

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