Package ‘traseR’

October 15, 2018

Type Package
Title GWAS trait-associated SNP enrichment analyses in genomic intervals
Version 1.10.0
Depends R (>= 3.2.0), GenomicRanges, IRanges, BSgenome.Hsapiens.UCSC.hg19
Suggests BiocStyle, RUnit, BiocGenerics
Date 2015-11-20
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Description traseR performs GWAS trait-associated SNP enrichment analyses in genomic intervals using different hypothesis testing approaches, also provides various functionalities to explore and visualize the results.
License GPL
LazyLoad yes
biocViews Genetics, Sequencing, Coverage, Alignment, QualityControl, DataImport
NeedsCompilation no
git_url https://git.bioconductor.org/packages/traseR
git_branch RELEASE_3_7
git_last_commit add29fb
git_last_commit_date 2018-04-30
Date/Publication 2018-10-14

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**traseR-package**

GWAS trait-associated SNP enrichment analyses in genomic intervals

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**Description**

Perform GWAS trait-associated SNP enrichment analyses in genomic intervals. Explore and visualize the results.

**Details**

Package: traseR  
Type: Package  
Version: 1.0  
Date: 2015-11-18  
License: GPL

**Author(s)**

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**CEU**

Sampled SNPs from all SNPs of CEU population in 1000 genome project

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**Description**

A GRRange object CEU contains 5% of all SNPs from CEU by controlling genome-wide density is the same as all SNPs from CEU

**Usage**

data(CEU)

**Value**

The data frame CEU contains three columns,

- **SNP_ID**: SNP rs number
- **seqnames**: Chromosome number associated with rs number
- **ranges**: Chromosomal position, in base pairs, associated with rs number

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plots

Visualize of trait-associated SNPs

Description
These are a group of functions to generate plots to visualize the trait-associated SNPs.

Usage
plotContext(snpdb, region=NULL, keyword = NULL, pvalue = 1e-3)
plotPvalue(snpdb, region=NULL, keyword = NULL, plot.type = c("densityplot", "boxplot"), pvalue = 1e-3, xymax = 50)
plotSNP(snpdb, snpid, ext = 10000)
plotGene(snpdb, gene, ext = 10000)
plotInterval(snpdb,interval,ext = 10000)

Arguments
snpdb A GRange object or data frame, which is GWAS trait-associated SNPs downloaded from up-to-date dbGaP and NHGRI public database. It is maintained to be updated to the latest version. The data frame contains the following columns, Trait, SNP, p.value, Chr, Position, Context, GENE_NAME, GENE_START, GENE_END, GENE_STRAND. The data frame is in data subdirectory. Users are free to add more SNP records to the data frame for practical use.
region A data frame, which is genomic intervals with three columns, chromosome, genomic start position, genomic end position.
keyword The keyword is used when specific trait is of interest. If keyword is specified, only the SNPs associated to the trait are used for analyses. Otherwise, all traits will be analyzed.
snpid SNP rs number
gene Gene name
pvalue SNPs with p-value less than this threshold are used for analyses.
plot.type Either "densityplot" or "boxplot"
ext Bp extended upstream and downstream
xymax The maximum range on x-axis and y-axis
interval A data frame, genomic interval: chromosome, genomic start position, genomic end position

Value
plotContext A pie plot with the distribution of SNP function class
plotPvalue A density plot of -logPvalue of trait-associated SNPs
plotSNP A plot of trait-associated SNP on chromosome
plotGene A plot with the gene and possible nearby trait-associated SNPs
plotInterval A plot with chromosome interval with possible nearby genes and trait-associated SNPs

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Examples

data(taSNP)
plotContext(snpdb= taSNP,keyword="Autoimmune")
plotGene(snpdb= taSNP,gene="ZFP92",ext=50000)
plotSNP(snpdb= taSNP,snpid="rs766420",ext=50000)
plotInterval(snpdb= taSNP,data.frame(chr="chrX",start=152633780,end=152737085))

print.traseR
Print the outcome of taSNP enrichment analyses

Description
Print the outcome of taSNP enrichment analyses. Print the overall taSNP enrichment, trait-specific taSNP enrichment, trait-class-specific taSNP enrichment.

Usage
## S3 method for class 'traseR'
print(x,isTopK1=FALSE,topK1=10,isTopK2=FALSE,topK2=10,trait.threshold=10,traitclass.threshold=10,...)

Arguments
x Object returned from traseR
isTopK1 If isTopK1 is TRUE, topK1 traits are printed; otherwise, traits with p-value below Bonferroni correction threshold are printed. Default is FALSE.
topK1 Top K1 traits are printed. Default is 10.
isTopK2 If isTopK2 is TRUE, topK2 trait class are printed; otherwise, trait class with p-value below Bonferroni correction threshold are printed. Default is FALSE.
topK2 Top K2 trait class are printed. Default is 10.
trait.threshold Traits above this threshold are reported. Default is 10.
traitclass.threshold Trait class above this threshold are reported. Default is 10.
... Other parameters to print

Value
Print a data frame of traits ranked by p-value
**Author(s)**

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**Examples**

```
data(taSNP)
data(Tcell)
x=traseR(snpdb=taSNP,region=Tcell)
print(x)
```

---

**Description**

These are a group of functions to retrieve the trait-associated SNPs based on input:

**Usage**

- `queryKeyword(snpdb, region=NULL, keyword = NULL, returnby = c("SNP_ID", "trait"), pvalue = 1e-3)`
- `queryGene(snpdb, genes = NULL)`
- `querySNP(snpdb, snpid, region = NULL)`

**Arguments**

- **snpdb**: A GRrange object or data frame, which is GWAS trait-associated SNPs downloaded from up-to-date dbGaP and NHGRI public database. It is maintained to be updated to the latest version. The data frame contains the following columns: Trait, SNP_ID, p.value, Chr, Position, Context, GENE_NAME, GENE_START, GENE_END, GENE_STRAND. The data frame is in data subdirectory. Users are free to add more SNP records to the data frame for practical use.
- **region**: A data frame, which is genomic intervals with three columns, chromosome, genomic start position, genomic end position.
- **keyword**: The keyword is used when specific trait is of interest. If `keyword` is specified, only the SNPs associated to the trait are used for analyses. Otherwise, all traits will be analyzed.
- **snpid**: SNP rs number
- **genes**: Gene name
- **pvalue**: SNPs with p-value less than this threshold are used for analyses.
- **returnby**: Either SNP or trait. If `returnby` is specified as `"SNP_ID"`, a data frame based on `"SNP_ID"` is returned. If `returnby` is specified as `trait`, a data frame based on `trait` is returned.
Value

queryKeyword: Return a data frame of traits containing the keyword queryGene: Return a data frame of traits associated with the gene querySNP: Return a data frame of traits associated with the SNP

Author(s)

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Examples

```r
data(taSNP)
data(Tcell)
x=queryKeyword(snpdb=taSNP,region=Tcell,keyword="Autoimmune",returnby="SNP_ID")
x=queryGene(snpdb=taSNP,genes=c("AGRN","UBE2J2","SSU72"))
x=querySNP(snpdb=taSNP,snpid=c("rs3766178","rs880051"))
```

Description

A GRange object taSNP contains trait-associated SNPs from dbGaP and NHGRI downloaded from Association Results Browser.

Usage

```r
data(taSNP)
```

Value

The data frame taSNP contains the following columns

<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait</td>
<td>Trait</td>
</tr>
<tr>
<td>Trait Class</td>
<td>Trait class which is formed based on the phenotype tree. Close traits are grouped together to form one class</td>
</tr>
<tr>
<td>SNP_ID</td>
<td>SNP rs number</td>
</tr>
<tr>
<td>p.value</td>
<td>GWAS SNP p-value</td>
</tr>
<tr>
<td>seqnames</td>
<td>Chromosome</td>
</tr>
<tr>
<td>ranges</td>
<td>Chromosome position</td>
</tr>
<tr>
<td>Context</td>
<td>SNP functional class</td>
</tr>
<tr>
<td>GENE_NAME</td>
<td>Nearest gene name</td>
</tr>
<tr>
<td>GENE_START</td>
<td>Gene start genomic position</td>
</tr>
<tr>
<td>GENE_END</td>
<td>Gene end genomic position</td>
</tr>
<tr>
<td>GENE_STRAND</td>
<td>Gene strand</td>
</tr>
</tbody>
</table>

Author(s)

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taSNPLD

Description
A GRange object taSNPLD contains linkage disequilibrium (>0.8) SNPs of all trait-associated SNPs from dbGaP and NHGRI.

Usage

data(taSNPLD)

Value
The data frame taSNPLD contains four columns,

- **SNP_ID**  
  SNP rs number

- **seqnames**  
  Chromosome number associated with rs number

- **ranges**  
  Chromosomal position, in base pairs, associated with rs number

- **Trait**  
  Trait the SNP is associated with

- **Trait Class**  
  Trait class which is formed based on the phenotype tree. Close traits are grouped together to form one class

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Tcell

Description
A GRange object Tcell contains three columns: chromosome, genomic start position and genomic end position.

Usage

data(Tcell)

Value
The data frame Tcell contains three columns,

- **seqnames**  
  Chromosome id

- **ranges**  
  Chromosome position

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**traseR**  
*TRait-Associated SNP EnRichment analyses*

**Description**

Perform GWAS trait-associated SNP enrichment analyses in genomic intervals using different approaches.

**Usage**

```
traseR(snpdb, region, snpdb.bg=NULL, keyword = NULL, rankby = c("pvalue", "odds.ratio"),
test.method = c("binomial", "fisher", "chisq", "nonparametric"), alternative = c("greater", "less",
ntimes=100,nbatch=1,
trait.threshold = 0, traitclass.threshold=0, pvalue = 1e-3)
```

**Arguments**

- **snpdb**: A GRange object. It could be GWAS trait-associated SNPs downloaded from up-to-date dbGaP and NHGRI public database. It is maintained to be updated to the latest version. The data frame contains the following columns: **Source**, **Trait**, **SNP**, **p.value**, **Chr**, **Position**, **Context**, **GENE_NAME**, **GENE_START**, **GENE_END**, **GENE_STRAND**. The data frame is in data subdirectory. Users are free to add more SNP records to the data frame for practical use. It could also be a data frame with columns as, **SNP**, **Chr**, **Position**.

- **region**: A GRange object or data frame, which is genomic intervals with three columns, chromosome, genomic start position, genomic end position.

- **snpdb.bg**: A GRange object contains non-trait-associated SNPs. They are treated as background for statistical testing instead of whole genome as background if specified.

- **keyword**: The keyword is used when specific trait is of interest. If **keyword** is specified, only the SNPs associated to the trait are used for analyses. Otherwise, all traits will be analyzed.

- **rankby**: Traits could be ranked by either p-value or adds.ratio based on the enrichment level of trait-associated SNPs in genomic intervals.

- **test.method**: Several hypothesis testing options are provided: **binomial**(binomial test), **fisher**(Fisher’s exact test), **chisq**(Chi-squared test), **chisq**(nonparametric test). Default is **binomial**(binomial test).

- **alternative**: Indicate the alternative hypothesis. If **greater**, test if the genomic intervals are enriched in trait-associated SNPs than background. If **less**, test if the genomic intervals are depleted in trait-associated SNPs than background. If **two.sided**, test if there is difference between the enrichment of trait-associated SNPs in genomic intervals and in background.

- **ntimes**: The number of shuffling time for one batch. See nbatch.

- **nbatch**: The number of batches. The product of **ntimes** and **nbatch** is the total number of shuffling time.

- **trait.threshold**: Test traits with number of SNPs more than the threshold.

- **traitclass.threshold**: Test trait class with number of SNPs more than the threshold.

- **pvalue**: SNPs with p-value less than this threshold are used for analyses.
Details

Return a list that contains three data frames. One data frame `tb.all` contains the results of enrichment analyses for all trait-associated SNPs in genomic intervals. Another data frame `tb1` contains the results of enrichment analyses for each trait-associated SNPs in genomic intervals separately. Another data frame `tb2` contains the results of enrichment analyses for each trait-class-associated SNPs in genomic intervals separately.

Value

The data frame `tb1` has columns,

- **Trait**: Name of trait
- **p.value**: P-value calculated from hypothesis testing
- **q.value**: Adjusted p-value from multiple testing using FDR correction
- **odds.ratio**: Odds ratio calculated based on number of trait-associated SNPs in genomic intervals, number of trait-associated SNPs across whole genome, genomic intervals size (bps) and genome size (bps)
- **taSNP.hits**: Number of trait-associated SNPs in genomic intervals
- **taSNP.num**: Number of SNPs for specific trait

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See Also

`print.traseR`

Examples

data(taSNP)
data(Tcell)
x=traseR(snpdb=taSNP,region=Tcell)
print(x)
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