Package ‘EBSeqHMM’

January 30, 2017

Type Package

Title Bayesian analysis for identifying gene or isoform expression changes in ordered RNA-seq experiments

Version 1.8.0

Date 2015-03-21

Author Ning Leng, Christina Kendziorski

Depends EBSeq

Maintainer Ning Leng <lengning1@gmail.com>

Description
The EBSeqHMM package implements an auto-regressive hidden Markov model for statistical analysis in ordered RNA-seq experiments (e.g. time course or spatial course data). The EBSeqHMM package provides functions to identify genes and isoforms that have non-constant expression profile over the time points/positions, and cluster them into expression paths.

License Artistic-2.0

‘EBHMMNBfunForMulti.R’ ‘f0.R’ ‘LikefuncHBMM.R’ ‘beta.mom.R’
‘GetAllPaths.R’ ‘PlotExp.R’

BuildVignettes yes

biocViews StatisticalMethod, DifferentialExpression,
MultipleComparison, RNASeq, Sequencing, GeneExpression,
Bayesian, HiddenMarkovModel, TimeCourse

NeedsCompilation no

R topics documented:

EBSeqHMM-package .................................................. 2
beta.mom ......................................................... 3
EBHMMNBfun ..................................................... 3
EBHMMNBfunForMulti ........................................... 5
EBHMMNBfunMultiEM_2chain ................................. 7
EBSeqHMMTest .................................................. 8
EBTest_ext ...................................................... 10
f0 ............................................................... 12
GeneExampleData ............................................... 12
GetAllPaths ...................................................... 13
EBSeqHMM-package

EBSeqHMM-package
EBSeqHMM: A Bayesian approach for identifying gene-expression changes in ordered RNA-seq experiments

Description
The EBSeqHMM package implements an auto-regressive hidden Markov model for statistical analysis in ordered RNA-seq experiments (e.g. time course or spatial course data). The EBSeqHMM package provides functions to identify genes and isoforms that have non-constant expression profile over the time points/positions, and cluster them into expression paths.

Details

<table>
<thead>
<tr>
<th>Package:</th>
<th>EBSeqHMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type:</td>
<td>Package</td>
</tr>
<tr>
<td>Version:</td>
<td>0.99.1</td>
</tr>
<tr>
<td>Date:</td>
<td>2014-09-16</td>
</tr>
<tr>
<td>License:</td>
<td>Artistic-2.0</td>
</tr>
</tbody>
</table>

Author(s)
Ning Leng, Christina Kendziorski Maintainer: Ning Leng <nleng@wisc.edu>

References

See Also
EBSeq

Examples

data(GeneExampleData)
CondVector <- rep(paste("t",1:5,sep=""),each=3)
Conditions <- factor(CondVector, levels=c("t1","t2","t3","t4","t5"))
Sizes <- MedianNorm(GeneExampleData)
EBSeqHMMGeneOut <- EBSeqHMMTest(Data=GeneExampleData, sizeFactors=Sizes, Conditions=Conditions, UpdateRd=2)
beta.mom

Method of moments estimation (beta distribution)

Description
Method of moments estimation (beta distribution)

Usage
beta.mom(qs.in)

Arguments
qs.in A vector contains the numbers that will be fitted with a beta distribution.

Details
beta.mom() function can be used to estimate parameters in a Beta function using method of moments

Value
alpha.hat, beta.hat: Returns the estimation of alpha and beta.

Author(s)
Ning Leng

Examples
beta.mom(rbeta(10, 1, 1))

EBHMMNBfun

Baum-Welch algorithm for a single hidden markov chain

Description
Baum-Welch algorithm for a single hidden markov chain

Usage
EBHMMNBfun(Data, NgVector=NULL, Conditions, sizeFactors, PriorFC=1.5, homo=TRUE, maxround=5, Pi0=NULL, Tran=NULL, NoTrend=FALSE, NumTranStage=3, FCParm=NULL, AlphaIn=NULL, BetaIn=NULL, StateNames=c("Up", "NC", "Down"), EM=TRUE, UpdateParam=TRUE, Print=TRUE, OnlyQ=FALSE, WithinCondR=TRUE, PenalizeLowMed=TRUE, PenalizeLowMedQt=.2, PenalizeLowMedVal=10)
Arguments

Data: input data, rows are genes/isoforms and columns are samples.
NgVector: Ng vector; NULL for gene level data.
Conditions: A factor indicates the condition (time/spatial point) which each sample belongs to.
sizeFactors: a vector indicates library size factors.
Tran: initial values for transition matrices.
Pi0: initial values for starting probabilities.
NumTranStage: number of states.
PriorFC: target FC for gradient change.
StateNames: name of the hidden states.
homo: whether the chain is assumed to be homogenious.
maxround: max number of iteration.
AlphaIn, BetaIn: If the parameters are known and the user doesn’t want to estimate them from the data, user may specify them here.
NoTrend: if NoTrend=TRUE, initial transition probabilities will be set to be equal.
FCParam: not in use.
EM: Whether estimate the prior parameters of the beta distribution by EM.
UpdateParam: Whether update starting probabilities and transition probabilities.
OnlyQ: If OnlyQ=TRUE, the function will only return estimated q’s.
WithinCondR: By defining WithinCondR=TRUE, estimation of r’s are obtained within each condition. (WithinCondR=FALSE is not suggested here).
Print: Whether print the elapsed-time while running the test.
PenalizeLowMed, PenalizeLowMedQt, PenalizeLowMedVal: Transcripts with median quantile ≤ PenalizeLowMedQt will be penalized.

Details

EBHMMNBfun() function implements the Balm-Welch algorithm that estimates the starting probabilities and transition probabilities of a single hidden Markov model. Here the emission distribution of each gene is assumed to be a Beta-Negative Binomial distribution with parameters (r_g, alpha, beta), in which alpha and beta are shared by all the genes and r_g is gene specific. If not specified, r_g, alpha and beta will be estimated using method of moments. For isoform data, we assume isoforms from the same Ig group share the same beta^Ig. alpha is shared by all the isoforms and r_gi is isoform specific. The user also needs to specify an expected FC.

Value

MAPTerm: the most likely path of each gene/isoform. MAPTermNum: numeric version of MAPTerm.
AllTerm: all possible expression paths considered in the model. PP: posterior probability of being each expression path.
WhichMax: index of the most likely path. Allf: prior probability of being each path.
Pi0Track: estimated starting probabilities of each iteration.
TranTrack: estimated transition probabilities of each iteration.
AlphaTrack, BetaTrack: estimated alpha and beta(s).
LLAll=PostSumForLL.Sum: log likelihood of the model.
Author(s)

Ning Leng

Examples

data(GeneExampleData)
CondVector <- rep(paste("t",1:5,sep=""),each=3)
Conditions <- factor(CondVector, levels=c("t1","t2","t3","t4","t5"))
Sizes <- MedianNorm(GeneExampleData)
tmp <- EBHMMNBfun(Data=GeneExampleData, sizeFactors=Sizes, Conditions=Conditions,
maxround=2, OnlyQ=TRUE)

EBHMMNBfunForMulti  Baum-Welch algorithm for multiple hidden markov chains

Description

Baum-Welch algorithm for multiple hidden markov chains

Usage

EBHMMNBfunForMulti(Data, PPIn, NgVector=NULL, Conditions, sizeFactors,
PriorFC=1.5, homo=TRUE, maxround=5,
Pi0=NULL, Tran=NULL, NumTranStage=3,
FCParam=NULL, AlphaIn=NULL, BetaIn=NULL,
StateNames=c("Up", "NC", "Down"),
EM=TRUE, UpdateParam=TRUE, Print=TRUE, WithinCondR=TRUE,
PenalizeLowMed=TRUE, PenalizeLowMedQt=.2, PenalizeLowMedVal=10)

Arguments

Data  input data, rows are genes/isoforms and columns are samples
PPIn  PPDE for all adjacent comparisons
NgVector NULL for gene level data
Conditions A factor indicates the condition (time/spatial point) which each sample belongs to.
sizeFactors a vector indicates library size factors
Tran  initial values for transition matrices
Pi0  initial values for starting probabilities
NumTranStage number of states in two chains
PriorFC target FC for gridient change
StateNames name of the hidden states
homo whether the chain is assumed to be homogenous
maxround max number of iteration
AlphaIn, BetaIn If the parameters are known and the user doesn’t want to estimate them from the data, user may specify them here.
EBHMMNBfunForMulti

FCParam not in use
EM Whether estimate the prior parameters of the beta distribution by EM
UpdateParam Whether update starting probabilities and transition probabilities
WithinCondR By defining WithinCondR=TRUE, estimation of r's are obtained within each condition. (WithinCondR=FALSE is not suggested here)
Print Whether print the elapsed-time while running the test.
PenalizeLowMed, PenalizeLowMedQt, PenalizeLowMedVal
  Transcripts with median quantile \leq \text{PenalizeLowMedQt} will be penalized

Details

EBHMMNBfunForMulti() function implements the Balm-Welch algorithm that estimates the starting probabilities and transition probabilities of a hidden Markov model with multiple chains. Here the emission distribution of each gene is assumed to be a Beta-Negative Binomial distribution with parameters (r_g, alpha, beta), in which alpha and beta are shared by all the genes and r_g is gene specific. If not specified, r_g, alpha and beta will be estimated using method of moments. For isoform data, we assume isoforms from the same Ig group share the same beta^Ig. alpha is shared by all the isoforms and r_{gi} is isoform specific. The user also needs to specify an expected FC.

Value

MAPTerm: the most likely path of each gene/isoform.
MAPTermNum: numeric version of MAPTerm.
AllTerm: all possible expression paths considered in the model.
PP: posterior probability of being each expression path.
WhichMax: index of the most likely path.
Allf: prior probability of being each path.
Pi0Track: estimated starting probabilities of each iteration.
TranTrack: estimated transition probabilities of each iteration.
AlphaTrack, BetaTrack: estimated alpha and beta(s).
LLAll=PostSumForLL.Sum: log likelihood of the model.

Author(s)

Ning Leng

Examples

data(GeneExampleData)
CondVector <- rep(paste("t",1:5,sep=""),each=3)
Conditions <- factor(CondVector, levels=c("t1","t2","t3","t4","t5"))
Sizes <- MedianNorm(GeneExampleData)
tmp <- EBHMMNBfunForMulti(Data=GeneExampleData, PPIn=matrix(1,ncol=15, nrow=100), sizeFactors=Sizes, Conditions, maxround=2)
Run EBSeqHMM model with a fixed expected FC

Usage

EBHMMNBMultiEM_2chain(Data,
NgVector=NULL, Conditions, AllTran=NULL,
AllPi0=NULL, Terms=NULL,
sizeFactors, NumTranStage=c(3,2),PriorFC=2,
StateNames=c("Up","Down"),homo=FALSE,
UpdateRd=5, PIBound=.9, UpdatePI=FALSE,Print=FALSE,
WithinCondR=TRUE,
PenalizeLowMed=TRUE, PenalizeLowMedQt=.1,PenalizeLowMedVal=10)

Arguments

Data input data, rows are genes and columns are samples
NgVector Ng vector; NULL for gene level data
Conditions A factor indicates the condition (time/spatial point) which each sample belongs to.
AllTran initial values for transition matrices
AllPi0 initial values for starting probabilities
Terms Terms
sizeFactors a vector indicates library size factors
StateNames names of the hidden states
NumTranStage number of states in two chains
PriorFC target FC for gradient change
homo whether the chain is assumed to be homogenous
UpdateRd max number of iteration
UpdatePI whether update the mixture proportion of two chains
PIBound upper bound of the mixture proportion of the two chains
Print Whether print the elapsed-time while running the test.
WithinCondR By defining WithinCondR=TRUE, estimation of r’s are obtained within each condition. (WithinCondR=FALSE is not suggested here)
PenalizeLowMed,PenalizeLowMedQt,PenalizeLowMedVal
Transcripts with median quantile \leq PenalizeLowMedQt will be penalized
Details

EBHMMNBMultiEM_2chain() function implements the EBSeqHMM model to perform statistical analysis in an RNA-seq experiment with ordered conditions. EBHMMNBMultiEM_2chain() calls EBHMMNBFunForMulti() function to perform Balm-Welch algorithm that estimates the starting probabilities and transition probabilities. Here the emission distribution of each gene is assumed to be a Beta-Negative Binomial distribution with parameters (r_g, alpha, beta) , in which alpha and beta are shared by all the genes and r_g is gene specific. If not specified, r_g, alpha and beta will be estimated using method of moments. For isoform data, we assume isoforms from the same Ig group share the same beta^Ig. alpha is shared by all the isoforms and r_gi is isoform specific. The user also needs to specify an expected FC. Function EBSeqHMMTest() runs several models with varying FCs and returns the model with maximum likelihood.

Value

Pi0Out: estimated starting probabilities of each iteration.
TranOut: estimated transition probabilities of each iteration.
Pi: estimated probability of being each chain.
Alpha, Beta: estimated alpha and beta(s).
LLSum: log likelihood of the model.
QLList: estimated q’s.
MgAllPP: marginal PP for all paths.
MgAllMAPChar: Most likely path based on MgAllPP.
MgAllMaxVal: Highest PP based on MgAllPP.
PPMatW: Posterior probabilities of being each of the chains.

Author(s)

Ning Leng

Examples

data(GeneExampleData)
CondVector <- rep(paste("t",1:5,sep=""),each=3)
Conditions <- factor(CondVector, levels=c("t1","t2","t3","t4","t5"))
Sizes <- MedianNorm(GeneExampleData)
tmp <- EBHMMNBMultiEM_2chain(Data=GeneExampleData, sizeFactors=Sizes, Conditions=Conditions, UpdateRd=2)

EBSeqHMMTest

Identify DE genes and classify them into their most likely path in an RNA-seq experiment with ordered conditions

Description

Identify DE genes and classify them into their most likely path in an RNA-seq experiment with ordered conditions
Usage

EBSeqHMMTest(Data,
NgVector=NULL, Conditions, AllTran=NULL,
AllPi0=NULL, Terms=NULL,
sizeFactors, NumTranStage=c(3,2),FCV=2,
homo=FALSE, UpdateRd=10, PIBound=.9, UpdatePI=FALSE,
Print=FALSE,WithinCondR=TRUE,Qtrm=.75,QtrmCut=10,
PenalizeLowMed=TRUE, PenalizeLowMedQt=.1,PenalizeLowMedVal=10)

Arguments

Data       input data, rows are genes and columns are samples
NgVector   Ng vector; NULL for gene level data
Conditions A factor indicates the condition (time/spatial point) which each sample belongs to.
AllTran    initial values for transition matrices
AllPi0     initial values for starting probabilities
Terms      Terms
FCV        candidate values for expected FC. Default is 2. If user wants to search through a list of candidate FCs, he/she may define FCV as a vector. e.g. By defining FCV=seq(1.4,2,.2), the function will search over (1.4 1.6 1.8 2.0). Note that searching over a number of candidate FCs will increase the running time.
sizeFactors a vector indicates library size factors
NumTranStage number of states in two chains
homo       whether the chain is assumed to be homogenous
UpdateRd   max number of iteration
UpdatePI   whether update the mixture proportion of two chains
PIBound    upper bound of the mixture proportion of the two chains
Qtrm,QtrmCut Transcripts with Qtrm th quantile <= QtrmCut will be removed before testing. The default value is Qtrm = 0.75 and QtrmCut=10. By default setting, transcripts that have >75% of the samples with expression less than 10 won’t be tested.
WithinCondR By defining WithinCondR=TRUE, estimation of r’s are obtained within each condition. (WithinCondR=FALSE is not suggested here)
Print      Whether print the elapsed-time while running the test.
PenalizeLowMed,PenalizeLowMedQt,PenalizeLowMedVal
Transcripts with median quantile <= PenalizeLowMedQt will be penalized

Details

EBSeqHMMTest() function applies EBSeqHMM model with different expected FC’s and select the optimal FC that maximizes the log likelihood. EBSeqHMMTest() calls EBHMMNBMultiEM_2chain() function which implements the EBSeqHMM model to perform statistical analysis in an RNA-seq experiment with ordered conditions based on a fixed expected FC. EBSeqHMMTest() runs EBHMMNBMultiEM_2chain() with varying FCs (default is seq(1.4,2,.2)). And it will return the results of the model with optimal FC. Here the emission distribution of each gene is assumed to be a Beta-Negative Binomial distribution with parameters (r_g, alpha, beta), in which alpha and beta are shared by all the genes and r_g is gene specific. If not specified, r_g, alpha and beta will be estimated using method of moments. For isoform data, we assume isoforms from the same Ig group share the same beta^Ig. alpha is shared by all the isoforms and r_gi is isoform specific. The user also needs to specify an expected FC.
Value

Pi0Out: estimated starting probabilities of each iteration.
TranOut: estimated transition probabilities of each iteration.
Pi: estimated probability of being each chain.
Alpha, Beta: estimated alpha and beta(s).
LLSum: log likelihood of the model.
QList: estimated q’s.
MgAllPP: marginal PP for all paths.
MgAllMAPChar: Most likely path based on MgAllPP.
MgAllMaxVal: Highest PP based on MgAllPP.
PPMatW: Posterior probabilities of being each of the chains.
FCLikelihood: log likelihood of each FC.

Author(s)

Ning Leng

Examples

data(GeneExampleData)
CondVector <- rep(paste("t",1:5,sep=""),each=3)
Conditions <- factor(CondVector, levels=c("t1","t2","t3","t4","t5"))
Sizes <- MedianNorm(GeneExampleData)
EBSeqHMMGeneOut <- EBSeqHMMTest(Data=GeneExampleData, sizeFactors=Sizes, Conditions=Conditions, UpdateRd=2)

EBTest_ext  Extented EBTest function

Description

Extented EBTest function

Usage

EBTest_ext(Data,NgVector=NULL,Conditions,
sizeFactors, maxround, Pool=FALSE, NumBin=1000,
ApproxVal=10^-10, Alpha=NULL, Beta=NULL,
PInput=NULL,RInput=NULL,PoolLower=.25,
PoolUpper=.75,OnlyCalcR=FALSE,Print=TRUE)

Arguments

Data  Input data, rows are genes/isoforms and columns are samples. Data should come from a two condition experiment
NgVector  Ng vector; NULL for gene level data
Conditions  A factor indicates the condition (time/spatial point) which each sample belongs to. Only two levels are allowed.
sizeFactors  a vector indicates library size factors
maxround number of iteration
Pool While working without replicates, user could define the Pool = TRUE in the EBTest function to enable pooling.
NumBin By defining NumBin = 1000, EBSeq will group the genes with similar means together into 1,000 bins.
PoolLower,PoolUpper With the assumption that only subset of the genes are DE in the data set, we take genes whose FC are in the PoolLower - PoolUpper quantile of the FCs as the candidate genes (default is 25 bin, the bin-wise variance estimation is defined as the median of the cross condition variance estimations of the candidate genes within that bin. We use the cross condition variance estimations for the candidate genes and the bin-wise variance estimations of the host bin for the non-candidate genes.
ApproxVal The variances of the transcripts with mean < var will be approximated as mean/(1-ApproxVal).
Alpha,Beta,PInput,RInput If the parameters are known and the user doesn’t want to estimate them from the data, user may specify them here.
Print Whether print the elapsed-time while running the test.
OnlyCalcR if OnlyCalcR=TRUE, the function will only return estimation of r’s.

Details

EBSeq_ext() function is an extension of EBTest() function, which is used to calculate the conditional probability P(X_g,t | X_g,t-1). In EBSeqHMM, we assume the conditional distribution is Beta-Negative Binomial.

Value

See EBTest

Author(s)

Ning Leng

Examples

data(GeneExampleData)
Data=GeneExampleData[,1:6]
CondVector <- rep(paste("t",1:2,sep=""),each=3)
Conditions <- factor(CondVector, levels=c("t1","t2"))
Sizes <- MedianNorm(Data[1:10,])
Out <- EBTest_ext(Data=Data[1:10,], sizeFactors=Sizes, Conditions=Conditions, maxround=1)
f0

Calculate the prior predictive distribution of the Beta-Negative Binomial model

Description

Calculate the prior predictive distribution of the Beta-Negative Binomial model

Usage

f0(Input, AlphaIn, BetaIn, EmpiricalR, NumOfGroups, log)

Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>expression values</td>
</tr>
<tr>
<td>AlphaIn, BetaIn, EmpiricalR</td>
<td>The parameters estimated from last iteration of EM.</td>
</tr>
<tr>
<td>NumOfGroups</td>
<td>How many transcripts within each Ng group</td>
</tr>
<tr>
<td>log</td>
<td>If set as TRUE, the output will in log scale.</td>
</tr>
</tbody>
</table>

Details

Function f0() will calculate the Beta-Negative Binomial prior predictive probability for a given set of parameters

Value

output a numeric vector, each element shows the prior predictive probability of one gene/isoform

Author(s)

Ning Leng

Examples

f0(matrix(rnorm(100,100,1),ncol=10), .5, .6, matrix(rnorm(100,200,1),ncol=10), 100, TRUE)

---

GeneExampleData

Simulated gene level data set with 5 ordered conditions

Description

'GeneExampleData' gives the gene level simulated data with 5 ordered conditions, triplicates for each condition. The data set was simulated following the Negative Binomial distribution. The parameters of each gene (mean and overdispersion) were sampled from the empirical estimates from an empirical RNA-Seq data set from Thomson lab at Morgridge Institute for Research.
GetAllPaths

Format
GeneExampleData is a matrix with 100 genes (rows) and 15 samples (columns).

See Also
IsoExampleList

Examples

```r
data(GeneExampleData)
str(GeneExampleData)
```

<table>
<thead>
<tr>
<th>GetAllPaths</th>
<th>Obtain all possible gene paths for an RNA-seq experiments with ordered conditions</th>
</tr>
</thead>
</table>

Description
Obtain all possible gene paths for an RNA-seq experiments with ordered conditions

Usage

```r
GetAllPaths(EBSeqHMMOut, OnlyDynamic=TRUE)
```

Arguments

- `EBSeqHMMOut` output from EBSeqHMMTest function
- `OnlyDynamic` if specifies as TRUE, only dynamic paths will be shown

Details
GetAllPaths() function may be used to generate all possible expression paths of a particular design.

Value
output: a vector of paths. For example, Up-Up-Up-Up, Up-Up-EE-EE, Up-Down-Up-EE, etc.

Author(s)
Ning Leng

Examples

```r
data(GeneExampleData)
CondVector <- rep(paste("t",1:5,sep=""),each=3)
Conditions <- factor(CondVector, levels=c("t1","t2","t3","t4","t5"))
Sizes <- MedianNorm(GeneExampleData)
EBSeqHMMGeneOut <- EBSeqHMMTest(Data=GeneExampleData, sizeFactors=Sizes, Conditions=Conditions, UpdateRd=2)
AllPaths <- GetAllPaths(EBSeqHMMGeneOut)
```
GetConfidentCalls

Obtain confident gene calls for classifying genes into expression paths

Description

Obtain confident gene calls for classifying genes into expression paths

Usage

GetConfidentCalls(EBSeqHMMOut, FDR=.05, cutoff=0.5, OnlyDynamic=TRUE, Paths=NULL)

Arguments

EBSeqHMMOut  output from EBSeqHMMTest function
FDR          Target FDR, default is 0.05.
cutoff       cutoff to use for defining a confident call. Genes with PP_path greater or equal
to cutoff will be called as a confident call. Default is 0.5.
OnlyDynamic  if specifies as T, only dynamic paths will be shown
Paths        paths that are of interest. Default is NULL. If it is not specified, all possible
             paths will be considered.

Details

Function GetConfidentCalls() can be used to obtain a list of DE genes/isoforms with user specific
cutoffs. To obtain a list of DE genes/isoforms with a target FDR alpha, the user may specify
FDR=alpha. To further choose genes/isoforms with high posterior probability of being its most
likely path, the user may specify the option cutoff (default is 0.5). Then genes or isoforms with
PP(most likely path) >= 0.5 will be selected

Value

Overall: a list of genes/isoforms that are identified as DE under the target FDR, shown are their
names and PPs; EachPath: a list object, each sublist contains confident calls (genes/isoforms) that
have PP(path)>=cutoff for a particular expression path, shown are their names and PPs; NumEach:
length of each sublist in EachPath. EachPathName: gene/isoform names in each of the sublists in
EachPath

Note

Output: output a list of genes that are classified to a expression path as a confident assignment.

Author(s)

Ning Leng
### GetDECalls

**Examples**

```r
data(GeneExampleData)
CondVector <- rep(paste("t",1:5,sep=""),each=3)
Conditions <- factor(CondVector, levels=c("t1","t2","t3","t4","t5"))
Sizes <- MedianNorm(GeneExampleData)
EBSeqHMMGeneOut <- EBSeqHMMTest(Data=GeneExampleData, sizeFactors=Sizes, Conditions=Conditions, UpdateRd=2)
GeneDECalls <- GetDECalls(EBSeqHMMGeneOut, FDR=.05)
GeneConfCalls <- GetConfidentCalls(EBSeqHMMGeneOut, FDR=.05,cutoff=.5, OnlyDynamic=TRUE)
```

**Description**

Obtain DE gene/isoform list at a certain FDR

**Usage**

```r
GetDECalls(EBSeqHMMOut,FDR=.05)
```

**Arguments**

- **EBSeqHMMOut**: output from EBSeqHMMTest function
- **FDR**: Target FDR; default is 0.05

**Details**

Function GetDECalls() can be used to obtain a list of DE genes/isoforms with user specific cutoffs. To obtain a list of DE genes/isoforms with a target FDR alpha, the user may specify FDR=alpha.

**Value**

A list of genes/isoforms that are identified as DE under the target FDR, shown are their names and PPs;

**Note**

Output: output a list of genes that are DE in at least one condition in an RNA-seq experiment with multiple ordered conditions

**Author(s)**

Ning Leng

**Examples**

```r
data(GeneExampleData)
CondVector <- rep(paste("t",1:5,sep=""),each=3)
Conditions <- factor(CondVector, levels=c("t1","t2","t3","t4","t5"))
Sizes <- MedianNorm(GeneExampleData)
EBSeqHMMGeneOut <- EBSeqHMMTest(Data=GeneExampleData, sizeFactors=Sizes, Conditions=Conditions, UpdateRd=2)
GeneDECalls <- GetDECalls(EBSeqHMMGeneOut, FDR=.05)
```
IsoExampleList

Simulated isoform level data set with 5 ordered conditions

Description

'IsoExampleList' gives the isoform level simulated data with 5 ordered conditions, triplicates for each condition. The data set was simulated following the Negative Binomial distribution. The parameters of each isoform (mean and overdispersion) were sampled from the isoform level empirical estimates from an empirical RNA-Seq data set from Thomson lab at Morgridge Institute for Research.

Format

IsoExampleList is a list with three components. IsoExampleList$IsoExampleData contains a matrix with 200 isoform (rows) and 15 samples (columns). IsoExampleList$IsoNames contains a vector of isoform names. IsoformExampleList$IsosGeneNames contains a vector indicating the gene each isoform belongs to.

See Also

GeneExampleData

Examples

data(IsoExampleList)
str(IsoExampleList)

LikefunNBHMM

Likelihood function of the Beta-Negative Binomial HMM Model

Description

Likelihood function of the Beta-Negative Binomial HMM Model

Usage

LikefunNBHMM(ParamPool, InputPool)

Arguments

ParamPool The parameters that will be estimated in EM.
InputPool The control parameters that will not be estimated in EM

Details

The likelihood function of the Beta-Negative Binomial HMM model used in EBSeqHMM. EBSeqHMM uses optim() function to obtain the optimal estimates that minimizes the likelihood.

Value

optimal estimates of the parameters of interest
**PlotExp**

**Author(s)**

Ning Leng

**Examples**

data(GeneExampleData)
tmp <- GeneExampleData[1:10,]
In <- list(tmp,1,5,10,3,tmp,rep(1,15),as.factor(rep(1:5,each=3)),10,cbind(rep(.5,10),rep(1,10),rep(2,10)))
Start <- c(1,1)
LikeFunNBHMM(Start,In)

**PlotExp**  
*Plot expression of a single gene*

**Description**

Plot expression of a single gene

**Usage**

PlotExp(NormalizedData, Conditions, Name)

**Arguments**

- **NormalizedData**: Expression data after adjusting for library size factors
- **Conditions**: sample conditions
- **Name**: name of the gene/isoform of interest

**Details**

PlotExp() function will generate line plots for genes or isoforms of interest.

**Value**

PlotExp() function will generate line plots for genes or isoforms of interest.

**Author(s)**

Ning Leng

**Examples**

data(GeneExampleData)
CondVector <- rep(paste("t",1:5,sep=""),each=3)
Conditions <- factor(CondVector, levels=c("t1","t2","t3","t4","t5"))
Sizes <- MedianNorm(GeneExampleData)
NormData <- GetNormalizedMat(GeneExampleData, Sizes)
PlotExp(NormData, Conditions, "Gene_1")
Index

*Topic **datasets**
   GeneExampleData, 12
   IsoExampleList, 16

*Topic **package**
   EBSeqHMM-package, 2

beta.mom, 3

EBHMMNBfun, 3
EBHMMNBfunForMulti, 5
EBHMMNBMultiEM_2chain, 7
EBSeqHMM (EBSeqHMM-package), 2
EBSeqHMM-package, 2
EBSeqHMMTest, 8
EBTest, 11
EBTest_ext, 10

f0, 12

GeneExampleData, 12
GetAllPaths, 13
GetConfidentCalls, 14
GetDECalls, 15

IsoExampleList, 16

LikefunNBHMM, 16

PlotExp, 17