Package ‘cqn’

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Title Conditional quantile normalization
Description A normalization tool for RNA-Seq data, implementing the conditional quantile normalization method.
Author Jean (Zhijin) Wu, Kasper Daniel Hansen
Maintainer Kasper Daniel Hansen <kasperdanielhansen@gmail.com>
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Description
This function implements CQN (conditional quantile normalization) for RNA-Seq data.

Usage

cqn(counts, x, lengths, sizeFactors = NULL, subindex = NULL, tau = 0.5, sqn = TRUE, lengthMethod = c("smooth", "fixed"), verbose = FALSE)
## S3 method for class 'cqn'
print(x, ...)

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Arguments

- **counts**: An object that can be coerced to a matrix of region by sample counts. Ought to have integer values.
- **x**: This is a covariate whose systematic influence on the counts will be removed. Typically the GC content. Has to have the same length as the number of rows of counts.
- **lengths**: The lengths (in bp) of the regions in counts. Has to have the same length as the number of rows of counts.
- **sizeFactors**: An optional vector of sizeFactors, i.e., the sequencing effort of the various samples. If NULL this is calculated as the column sums of counts.
- **subindex**: An optional vector of indices into the rows of counts. If not given, this becomes the indices of genes with row means of counts greater than 50.
- **tau**: This argument is passed to `rq`, it indicates what quantile is being fit. The default should only be changed by expert users.
- **sqn**: This argument indicates whether the residuals from the systematic fit are (subset) quantile normalized. The default should only be changed by expert users.
- **lengthMethod**: Should length enter the model as a smooth function or not.
- **verbose**: Is the function verbose?
- **...**: Not used.

Details

These functions implement the CQN (conditional quantile normalization) for RNA-Seq data. The functions remove a single systematic effect, contained in the argument `x`, which will typically be GC content. The effect of `lengths` will either be modelled as a smooth function (which we recommend), if you are using `lengthMethod = "smooth"` or as an offset (equivalent to modelling using RPKMs), if you are using `lengthMethod = "fixed"`. Length can be completely removed from the model by having `lengthMethod = "fixed"` and setting all lengths to 1000.

Final corrected values are equal to `value$y + value$offset`.

Value

A list with the following components

- **counts**: The value of argument `counts`.
- **x**: The value of argument `x`.
- **lengths**: The value of argument `lengths`.
- **sizeFactors**: The value of argument `sizeFactors`. In case the argument was NULL, this is the value used internally.
- **subindex**: The value of argument `subindex`. In case the argument was NULL, this is the value used internally.
- **y**: The dependent value used in the systematic effect fit. Equal to log2 transformed reads per millions.
- **offset**: The estimated offset.
- **offset0**: A single number used internally for identifiability.
- **glm.offset**: An offset useful for supplying to a GLM type model function. It is on the natural log scale and includes correcting for sizeFactors.
**Description**

This function plots the estimated systematic effect which are removed during CQN normalization.

**Usage**

```r
cqnplot(x, n = 1, col = "grey60", ylab = "QR fit", xlab = ", type = ", lty = 1, ...)```

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**Note**

Internally, the function uses a custom implementation of subset quantile normalization, contained in the (not exported) SQN2 function.

**Author(s)**

Kasper Daniel Hansen, Zhijin Wu

**References**


**See Also**

The package vignette.
Arguments

- **x**: The result of a call to `cqn`; an object of class `cqn`.
- **n**: Which systematic effect is plotted.
- **col**: A vector of colors, as in `plot`.
- **ylab**: y-label as in `plot`.
- **xlab**: x-label as in `plot`.
- **type**: type, as in `plot`.
- **lty**: line type, as in `plot`.
- **...**: These arguments are passed to `matplot`.

Value

This function is invoked for its side effect.

Author(s)

Kasper Daniel Hansen

Examples

```r
data(montgomery.subset)
data(sizeFactors.subset)
data(uCovar)
cqn.subset <- cqn(montgomery.subset, lengths = uCovar$length,
                   x = uCovar$gccontent, sizeFactors = sizeFactors.subset,
                   verbose = TRUE)
cqnplot(cqn.subset, n = 1)
```

Description

A gene by sample count matrix for 10 samples from Montgomery et al. Also included is information about these genes (length and gc content) as well as sequencing depth for each of the samples.

Usage

```r
data(montgomery.subset)
data(sizeFactors.subset)
data(uCovar)
```

Format

`montgomery.subset` is a data frame with 23552 observations on 10 different samples, the column names are the sample ids. `sizeFactors.subset` a a named vector of length 10 containing the number of mapped reads for each of the 10 samples. `uCovar` is a data frame with 23552 observations on 2 different covariates: gc content and genic length in bp.
Details

Gene models are union models based on Ensembl 61. These gene models were constructed using Genominator. Genes that have zero counts in all 10 samples were excluded.

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