

# Package ‘MDTS’

November 15, 2024

**Title** Detection of de novo deletion in targeted sequencing trios

**Version** 1.26.0

**Description** A package for the detection of de novo copy number deletions in targeted sequencing of trios with high sensitivity and positive predictive value.

**Depends** R (>= 3.5.0)

**Imports** GenomicAlignments, GenomicRanges, IRanges, Biostrings, DNAcopy, Rsamtools, parallel, stringr

**Suggests** testthat, knitr

**VignetteBuilder** knitr

**License** Artistic-2.0

**Encoding** UTF-8

**LazyData** true

**RoxygenNote** 6.0.1

**biocViews** StatisticalMethod, Technology, Sequencing, TargetedResequencing, Coverage, DataImport

**git\_url** <https://git.bioconductor.org/packages/MDTS>

**git\_branch** RELEASE\_3\_20

**git\_last\_commit** f83f22a

**git\_last\_commit\_date** 2024-10-29

**Repository** Bioconductor 3.20

**Date/Publication** 2024-11-14

**Author** Jack M.. Fu [aut, cre]

**Maintainer** Jack M.. Fu <jmfu@jhsph.edu>

## Contents

MDTS-package . . . . .	2
calcBins . . . . .	2
calcCounts . . . . .	3
calcMD . . . . .	3
denovoDeletions . . . . .	4
getMetaData . . . . .	5
normalizeCounts . . . . .	5
segmentMD . . . . .	6
visualizeDeletion . . . . .	7

**Index****8**


---

MDTS-package	<i>The MDTS package for Detection of Denovo Deletions from Targeted Sequencing Data Using Minimum-Distance</i>
--------------	--

---

**Description**

The MDTS package for Detection of Denovo Deletions from Targeted Sequencing Data Using Minimum-Distance

---

calcBins	<i>Sample driven calculation of bins for counting</i>
----------	---

---

**Description**

This function will randomly select a sample of bam files to calculate dynamic MDTS bins for subsequent read-depth analysis.

**Usage**

```
calcBins(metaData, n, readLength, medianCoverage, minimumCoverage, genome,
         mappabilityFile, seed = 1337)
```

**Arguments**

metaData	A table in the format of the output of getMetaData().
n	The number of subsamples to use.
readLength	The read length of the experiment.
medianCoverage	The median number of reads across sub-samples to reach before creating a new bin.
minimumCoverage	The minimum number of coverage across all sub-samples required to create the proto-region.
genome	The BSGenome object that assists in calculations of the GC content of the bins.
mappabilityFile	A path to the bigwig file of 100mer mappability of the corresponding genome.
seed	Sets the seed so results are reproducible. Defaults to 1337.

**Value**

Returns a GRanges object depicting the dynamic bins that MDTS calculates.

**Examples**

```
load(system.file("extdata", 'bins.RData', package = "MDTS"))
bins
```

---

calcCounts	<i>Creating the raw count matrix</i>
------------	--------------------------------------

---

**Description**

This function will return a matrix of read counts where each column is a sample, and each row is a bin.

**Usage**

```
calcCounts(metaData, bins, rl, mc.cores = 1)
```

**Arguments**

metaData	A table in the format of the output of getMetaData().
bins	The set of bins determined by calcBins().
rl	The read length of the experiment.
mc.cores	The number of cores to use for multi-threaded analysis. Defaults to 1.

**Value**

A data.frame that contains the counts for each sample in the metaData input that fall into each segment of bins.

**Examples**

```
## Not run:
pD <- getMetaData(
  'https://raw.githubusercontent.com/JMF47/MDTSDData/master/data/pD.ped')
genome = BSgenome.Hsapiens.UCSC.hg19
map_file <-
  "https://raw.githubusercontent.com/JMF47/MDTSDData/master/data/chr1.map.bw"
bins = calcBins(pD, n=5, rl=100, med=150, min=5, genome, map_file)

## End(Not run)
load(system.file("extdata", 'bins.RData', package = "MDTS"))
load(system.file("extdata", 'counts.RData', package = "MDTS"))
counts
```

---

calcMD	<i>Calculating the Minimum Distance matrix</i>
--------	--

---

**Description**

This function will return a matrix of minimum distances where each column is a family, and each row is a bin.

**Usage**

```
calcMD(mCounts, metaData)
```

**Arguments**

mCounts            A matrix of normalized coverage output by `normalizeCounts()`.  
 metaData           A table in the format of the output of `metaData()`.

**Value**

A `data.frame` of minimum distances. Each column is a trio, while each row is an entry in bins

**Examples**

```
load(system.file("extdata", 'bins.RData', package = "MDTS"))
load(system.file("extdata", 'counts.RData', package = "MDTS"))
load(system.file("extdata", 'pD.RData', package = "MDTS"))
mCounts <- normalizeCounts(counts, bins)
md <- calcMD(mCounts, pD)
```

---

denovoDeletions            *Denovo Deletion Calling*

---

**Description**

This function will return a single `GRanges` object containing all denovo deletions that passed filtering from a `Circular Binary Segmentation` object with supplementary information.

**Usage**

```
denovoDeletions(cbs, mCounts, bins)
```

**Arguments**

cbs                    The output from `segmentMD()`.  
 mCounts              The normalized counts matrix output by `normalizeCounts()`.  
 bins                  The set of bins determined by `calcBins()`.

**Value**

A `GRanges` object that reports all detected denovo deletions passing requisite filters.

**Examples**

```
load(system.file("extdata", 'bins.RData', package = "MDTS"))
load(system.file("extdata", 'counts.RData', package = "MDTS"))
load(system.file("extdata", 'pD.RData', package = "MDTS"))
mCounts = normalizeCounts(counts, bins)
md = calcMD(mCounts, pD)
cbs = segmentMD(md, bins)
denovo = denovoDeletions(cbs, mCounts, bins)
```

---

getMetaData	<i>Constructor for metadata</i>
-------------	---------------------------------

---

### Description

This function allows constructor of phenotype information necessary for downstream analysis. See format of required fields. Function will also rearrange the rows such that trios are grouped together - with proband first, mother second, and father third.

### Usage

```
getMetaData(path, id = "subj_id", familyId = "family_id",
  fatherId = "father_id", motherId = "mother_id", bamPath = "bam_path")
```

### Arguments

path	The path pointing to the file that contains information on each subject in the dataset.
id	The column name that identifies each sample. Defaults to 'subj_id'.
familyId	The column name that identifies which family the sample belongs to. Defaults to 'family_id'.
fatherId	The column name that identifies the id of the father. Defaults to 'father_id'.
motherId	The column name that identifies the id of the mother. Defaults to 'mother_id'.
bamPath	The column name that identifies where to find the bam file for each subject. Defaults to 'bam_path'.

### Value

Returns a data.frame of required sample information for running MDTS.

### Examples

```
meta <- getMetaData(
  'https://raw.githubusercontent.com/JMF47/MDTSData/master/data/pD.ped')
```

---

normalizeCounts	<i>Calculating the normalized M scores</i>
-----------------	--

---

### Description

This function will return a matrix of normalized M scores where each column is a sample, and each row is a bin.

### Usage

```
normalizeCounts(counts, bins, GC = TRUE, map = TRUE, mc.cores = 1)
```

**Arguments**

counts	A matrix of raw coverage output by calcCounts().
bins	The set of bins determined by calcBins().
GC	Whether to loess adjust for GC. Defaults to TRUE.
map	Whether to loess adjust for mappability. Defaults to TRUE. Defaults to 1.
mc.cores	The number of cores to use for multi-threaded analysis.

**Value**

A data.frame of normalized counts. Each column is a sample, and each row is a entry of bins.

**Examples**

```
load(system.file("extdata", 'bins.RData', package = "MDTS"))
load(system.file("extdata", 'counts.RData', package = "MDTS"))
load(system.file("extdata", 'pD.RData', package = "MDTS"))
mCounts <- normalizeCounts(counts, bins)
```

---

segmentMD

---

*Circular Binary Segmentation on Minimum Distances*


---

**Description**

This function will return a GRanges object containing the copy number segments of all families in the input minimum distance matrix. It calls segment() from DNACopy (alpha=0.001, undo.splits="sdundo", undo.SD=4).

**Usage**

```
segmentMD(md, bins, alpha = 0.001, undo.splits = "sdundo", undo.SD = 4,
mc.cores = 1)
```

**Arguments**

md	The minimum distance matrix produced by calcMD.
bins	The set of bins determined by calcBins.
alpha	Controls the alpha option in calling DNACopy::segment()
undo.splits	Controls the undo.splits option in DNACopy::segment()
undo.SD	Controls the undo.SD option in calling DNACopy::segment()
mc.cores	The number of cores to use for multi-threaded analysis. Defaults to 1.

**Value**

A data.frame containing the segmented regions based to be parsed by denovoDeletions() minimum distance.

## Examples

```
load(system.file("extdata", 'bins.RData', package = "MDTS"))
load(system.file("extdata", 'counts.RData', package = "MDTS"))
load(system.file("extdata", 'pD.RData', package = "MDTS"))
mCounts <- normalizeCounts(counts, bins)
md <- calcMD(mCounts, pD)
cbs <- segmentMD(md, bins)
```

---

visualizeDeletion      *Visualization for deletions*

---

## Description

This function plots the raw read information from the location of interest for a trio.

## Usage

```
visualizeDeletion(deletion, bins, metaData, mCounts, md, save = FALSE)
```

## Arguments

deletion	A GRanges object in the format of the output of <code>denovoDeletions()</code> .
bins	The set of bins determined by <code>calcBins()</code> .
metaData	A table in the format of the output of <code>getMetaData()</code> .
mCounts	A matrix of normalized coverage output by <code>normalizedCounts()</code> .
md	The minimum distance matrix output by <code>calcMD()</code>
save	If TRUE will save plot to current working directory instead of rendering.

## Value

The file name if the plot was saved.

## Examples

```
## Not run:
load(system.file("extdata", 'bins.RData', package = "MDTS"))
load(system.file("extdata", 'counts.RData', package = "MDTS"))
load(system.file("extdata", 'pD.RData', package = "MDTS"))
mCounts <- normalizeCounts(counts, bins)
md <- calcMD(mCounts, pD)
cbs <- segmentMD(md, bins)
denovo <- denovoDeletions(cbs, mCounts, bins)
visualizeDeletion(denovo[1], bins, pD, mCounts, md)

## End(Not run)
```

# Index

- \* **calcBins**
  - calcBins, [2](#)
- \* **calcCounts**
  - calcCounts, [3](#)
- \* **calcMD**
  - calcMD, [3](#)
- \* **denovoDeletions**
  - denovoDeletions, [4](#)
- \* **normalizeCounts**
  - normalizeCounts, [5](#)
- \* **segmentMD**
  - segmentMD, [6](#)
- \* **visualizeDeletion**
  - visualizeDeletion, [7](#)

calcBins, [2](#)  
calcCounts, [3](#)  
calcMD, [3](#)

denovoDeletions, [4](#)

getMetaData, [5](#)

MDTS (MDTS-package), [2](#)  
MDTS-package, [2](#)

normalizeCounts, [5](#)

segmentMD, [6](#)

visualizeDeletion, [7](#)