

# Package ‘sesame’

April 16, 2024

**Type** Package

**Title** SEnsible Step-wise Analysis of DNA MEthylation BeadChips

**Description** Tools For analyzing Illumina Infinium DNA methylation arrays. SeSAmE provides utilities to support analyses of multiple generations of Infinium DNA methylation BeadChips, including preprocessing, quality control, visualization and inference. SeSAmE features accurate detection calling, intelligent inference of ethnicity, sex and advanced quality control routines.

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**License** MIT + file LICENSE

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## R topics documented:

sesame-package . . . . .	5
addMask . . . . .	6
aggregateTestEnrichments . . . . .	7
assemble_plots . . . . .	7
betasCollapseToPfx . . . . .	9
BetaValueToMValue . . . . .	9
binSignals . . . . .	10
bisConversionControl . . . . .	10
calcEffectSize . . . . .	11
checkLevels . . . . .	12
chipAddressToSignal . . . . .	13
cnSegmentation . . . . .	13
compareDatabaseSetOverlap . . . . .	14
compareMouseStrainReference . . . . .	15
compareMouseTissueReference . . . . .	16
compareReference . . . . .	16
controls . . . . .	17
convertTo . . . . .	18
createDBNetwork . . . . .	19
createUCSCtrack . . . . .	19
dataFrame2sesameQC . . . . .	20
dbStats . . . . .	20
deIdentify . . . . .	21
detectionPnegEcdf . . . . .	22
diffRefSet . . . . .	23
dmContrasts . . . . .	23
DML . . . . .	24
DMLpredict . . . . .	25
DMR . . . . .	26

dyeBiasCorr . . . . .	27
dyeBiasCorrMostBalanced . . . . .	28
dyeBiasL . . . . .	28
dyeBiasNL . . . . .	29
ELBAR . . . . .	30
estimateCellComposition . . . . .	31
estimateLeukocyte . . . . .	31
formatVCF . . . . .	32
getAFs . . . . .	33
getAFTYPEIbySumAlleles . . . . .	34
getBetas . . . . .	34
getBinCoordinates . . . . .	35
getMask . . . . .	36
getRefSet . . . . .	36
getSexInfo . . . . .	37
imputeTo . . . . .	38
inferEthnicity . . . . .	38
inferInfiniumIChannel . . . . .	39
inferSex . . . . .	40
inferSexKaryotypes . . . . .	41
inferSpecies . . . . .	41
inferStrain . . . . .	42
inferTissue . . . . .	43
initFileSet . . . . .	44
KYCG_annoProbes . . . . .	45
KYCG_buildGeneDBs . . . . .	46
KYCG_getDBs . . . . .	47
KYCG_listDBGroups . . . . .	48
KYCG_loadDBs . . . . .	48
KYCG_plotBar . . . . .	49
KYCG_plotDot . . . . .	50
KYCG_plotEnrichAll . . . . .	51
KYCG_plotLollipop . . . . .	51
KYCG_plotManhattan . . . . .	52
KYCG_plotMeta . . . . .	53
KYCG_plotMetaEnrichment . . . . .	54
KYCG_plotPointRange . . . . .	54
KYCG_plotSetEnrichment . . . . .	55
KYCG_plotVolcano . . . . .	56
KYCG_plotWaterfall . . . . .	56
listAvailableMasks . . . . .	57
mapFileSet . . . . .	58
mapToMammal40 . . . . .	58
matchDesign . . . . .	59
meanIntensity . . . . .	60
medianTotalIntensity . . . . .	60
MValueToBetaValue . . . . .	61
negControls . . . . .	62

noMasked	62
noob	63
normControls	63
openSesame	64
openSesameToFile	65
palgen	66
parseGEOsignalMU	66
pOOBAH	67
predictAge	68
predictAgeHorvath353	69
predictAgeSkinBlood	69
predictMouseAgeInMonth	70
prefixMask	71
prefixMaskButC	71
prefixMaskButCG	72
prepSesame	72
prepSesameList	73
print.DMLSummary	74
print.fileSet	74
probeID_designType	75
probeSuccessRate	76
qualityMask	76
readFileSet	77
readIDATpair	78
recommendedMaskNames	79
reIdentify	79
resetMask	80
scrub	81
scrubSoft	81
SDFcollapseToPfx	82
sdfPlatform	82
sdf_read_table	83
sdf_write_table	84
searchIDATprefixes	84
segmentBins	85
sesameAnno_buildAddressFile	85
sesameAnno_buildManifestGRanges	86
sesameAnno_download	87
sesameAnno_get	88
sesameAnno_readManifestTSV	89
sesameData_getAnno	90
sesameQC-class	90
sesameQC_calcStats	91
sesameQC_getStats	92
sesameQC_plotBar	92
sesameQC_plotBetaByDesign	93
sesameQC_plotHeatSNPs	94
sesameQC_plotIntensVsBetas	94

sesameQC_plotRedGrnQQ . . . . .	95
sesameQC_rankStats . . . . .	96
sesame_checkVersion . . . . .	96
sesamize . . . . .	97
setMask . . . . .	97
SigDF . . . . .	98
signalMU . . . . .	99
sliceFileSet . . . . .	99
summaryExtractTest . . . . .	100
testEnrichment . . . . .	101
testEnrichmentFisher . . . . .	102
testEnrichmentGene . . . . .	102
testEnrichmentSEA . . . . .	103
testEnrichmentSpearman . . . . .	104
totalIntensities . . . . .	104
twoCompsEst2 . . . . .	105
updateSigDF . . . . .	106
visualizeGene . . . . .	106
visualizeProbes . . . . .	107
visualizeRegion . . . . .	108
visualizeSegments . . . . .	110

**Index****111**


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sesame-package	<i>Analyze DNA methylation data</i>
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---

**Description**

SEnsible and step-wise analysis of DNA methylation data

**Details**

This package complements array functionalities that allow processing >10,000 samples in parallel on clusters.

**Value**

package

**Author(s)**

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**References**

Zhou W, Triche TJ, Laird PW, Shen H (2018)

## See Also

Useful links:

- <https://github.com/zwdzwd/sesame>
- Report bugs at <https://github.com/zwdzwd/sesame/issues>

## Examples

```
sdf <- readIDATpair(sub('_Grn.idat', '', system.file(
  'extdata', '4207113116_A_Grn.idat', package='sesameData'))))

## The OpenSesame pipeline
betas <- openSesame(sdf)
```

---

addMask	<i>Add probes to mask</i>
---------	---------------------------

---

## Description

This function essentially merge existing probe masking with new probes to mask

## Usage

```
addMask(sdf, probes)
```

## Arguments

sdf	a SigDF
probes	a vector of probe IDs or a logical vector with TRUE representing masked probes

## Value

a SigDF with added mask

## Examples

```
sdf <- sesameDataGet('EPIC.1.SigDF')
sum(sdf$mask)
sum(addMask(sdf, c("cg14057072", "cg22344912"))$mask)
```

---

aggregateTestEnrichments  
*Aggregate test enrichment results*

---

**Description**

Aggregate test enrichment results

**Usage**

```
aggregateTestEnrichments(result_list, column = "estimate", return_df = FALSE)
```

**Arguments**

result\_list     a list of results from testEnrichment  
column          the column name to aggregate (Default: estimate)  
return\_df      whether to return a merged data frame

**Value**

a matrix for all results

**Examples**

```
## pick some big TFBS-overlapping CpG groups  
cg_lists <- KYCG_getDBs("MM285.TFBS")  
queries <- cg_lists[(sapply(cg_lists, length) > 40000)]  
result_list <- lapply(queries, testEnrichment, "MM285.chromHMM")  
mtx <- aggregateTestEnrichments(result_list)
```

---

assemble\_plots     *assemble plots*

---

**Description**

assemble plots

**Usage**

```
assemble_plots(  
  betas,  
  txns,  
  probes,  
  plt.txns,  
  plt.mapLines,  
  plt.cytoband,  
  heat.height = NULL,  
  mapLine.height = 0.2,  
  show.probeNames = TRUE,  
  show.samples.n = NULL,  
  show.sampleNames = TRUE,  
  sample.name.fontsize = 10,  
  dmin = 0,  
  dmax = 1  
)
```

**Arguments**

betas	beta value
txns	transcripts GRanges
probes	probe GRanges
plt.txns	transcripts plot objects
plt.mapLines	map line plot objects
plt.cytoband	cytoband plot objects
heat.height	heatmap height (auto inferred based on rows)
mapLine.height	height of the map lines
show.probeNames	whether to show probe names
show.samples.n	number of samples to show (default: all)
show.sampleNames	whether to show sample names
sample.name.fontsize	sample name font size
dmin	data min
dmax	data max

**Value**

a grid object

---

betasCollapseToPfx      *Collapse betas by averaging probes with common probe ID prefix*

---

**Description**

Collapse betas by averaging probes with common probe ID prefix

**Usage**

```
betasCollapseToPfx(betas)
```

**Arguments**

betas                    either a named numeric vector or a numeric matrix (row: probes, column: samples)

**Value**

either named numeric vector or a numeric matrix of collapsed beta value matrix

**Examples**

```
## input is a matrix
m <- matrix(seq(0,1,length.out=9), nrow=3)
rownames(m) <- c("cg00004963_TC21", "cg00004963_TC22", "cg00004747_TC21")
colnames(m) <- c("A", "B", "C")
betasCollapseToPfx(m)

## input is a vector
m <- setNames(seq(0,1,length.out=3),
  c("cg00004963_TC21", "cg00004963_TC22", "cg00004747_TC21"))
betasCollapseToPfx(m)
```

---

BetaValueToMValue      *Convert beta-value to M-value*

---

**Description**

Logit transform a beta value vector to M-value vector.

**Usage**

```
BetaValueToMValue(b)
```

**Arguments**

b                        vector of beta values

**Details**

Convert beta-value to M-value (aka logit transform)

**Value**

a vector of M values

**Examples**

```
BetaValueToMValue(c(0.1, 0.5, 0.9))
```

---

binSignals	<i>Bin signals from probe signals</i>
------------	---------------------------------------

---

**Description**

require GenomicRanges

**Usage**

```
binSignals(probe.signals, bin.coords, probeCoords)
```

**Arguments**

probe.signals	probe signals
bin.coords	bin coordinates
probeCoords	probe coordinates

**Value**

bin signals

---

bisConversionControl	<i>Compute internal bisulfite conversion control</i>
----------------------	--

---

**Description**

Compute GCT score for internal bisulfite conversion control. The function takes a SigSet as input. The higher the GCT score, the more likely the incomplete conversion.

**Usage**

```
bisConversionControl(sdf, extR = NULL, extA = NULL, verbose = FALSE)
```

**Arguments**

sdf                    a SigDF  
 extR                  a vector of probe IDs for Infinium-I probes that extend to converted A  
 extA                  a vector of probe IDs for Infinium-I probes that extend to original A  
 verbose                print more messages

**Value**

GCT score (the higher, the more incomplete conversion)

**Examples**

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
bisConversionControl(sdf)

## One can get extR and extA of other arrays using the sesameAnno
## mft = sesameAnno_buildManifestGRanges(sprintf(
##   "%s/EPIC/EPIC.hg38.manifest.tsv.gz",
##   "https://github.com/zhou-lab/InfiniumAnnotationV1/raw/main/Anno/"),
##   columns="nextBase")
## extR = names(mft)[!is.na(mft$nextBase) & mft$nextBase=="R"]
## extA = names(mft)[!is.na(mft$nextBase) & mft$nextBase=="A"]
```

---

calcEffectSize                    *Compute effect size for different variables from prediction matrix*

---

**Description**

The effect size is defined by the maximum variation of a variable with all the other variables controlled constant.

**Usage**

```
calcEffectSize(pred)
```

**Arguments**

pred                    predictions

**Value**

a data.frame of effect sizes. Columns are different variables. Rows are different probes.

**Examples**

```
data <- sesameDataGet('HM450.76.TCGA.matched')
res <- DMLpredict(data$betas[1:10,], ~type, meta=data$sampleInfo)
head(calcEffectSize(res))
```

---

checkLevels	<i>filter data matrix by factor completeness only works for discrete factors</i>
-------------	--

---

**Description**

filter data matrix by factor completeness only works for discrete factors

**Usage**

```
checkLevels(betas, fc)
```

**Arguments**

betas	matrix data
fc	factors, or characters

**Value**

a boolean vector whether there is non-NA value for each tested group for each probe

**Examples**

```
se0 <- sesameDataGet("MM285.10.SE.tissue")[1:100,]
se_ok <- checkLevels(SummarizedExperiment::assay(se0),
  SummarizedExperiment::colData(se0)$tissue)
sum(se_ok) # number of good probes
se1 <- se0[se_ok,]

sesameDataGet_resetEnv()
```

---

chipAddressToSignal      *Lookup address in one sample*

---

### Description

Lookup address and transform address to probe

### Usage

```
chipAddressToSignal(dm, mft)
```

### Arguments

dm	data frame in chip address, 2 columns: cy3/Grn and cy5/Red
mft	a data frame with columns Probe_ID, M, U and col

### Details

Translate data in chip address to probe address. Type I probes can be separated into Red and Grn channels. The methylated allele and unmethylated allele are at different addresses. For type II probes methylation allele and unmethylated allele are at the same address. Grn channel is for methylated allele and Red channel is for unmethylated allele. The out-of-band signals are type I probes measured using the other channel.

### Value

a SigDF, indexed by probe ID address

---

cnSegmentation      *Perform copy number segmentation*

---

### Description

Perform copy number segmentation using the signals in the signal set. The function takes a SigDF for the target sample and a set of normal SigDF for the normal samples. An optional arguments specifies the version of genome build that the inference will operate on. The function outputs an object of class CNSegment with signals for the segments ( seg.signals), the bin coordinates ( bin.coords) and bin signals (bin.signals).

**Usage**

```

cnSegmentation(
  sdf,
  sdfs.normal = NULL,
  genomeInfo = NULL,
  probeCoords = NULL,
  tilewidth = 50000,
  verbose = FALSE
)

```

**Arguments**

sdf	SigDF
sdfs.normal	a list of SigDFs for normalization, if not given, use the stored normal data from sesameData. However, we do recommend using a matched copy number normal dataset for normalization. assembly
genomeInfo	the genomeInfo files. The default is retrieved from sesameData. Alternative genomeInfo files can be found at <a href="https://github.com/zhou-lab/GenomeInfo">https://github.com/zhou-lab/GenomeInfo</a>
probeCoords	the probe coordinates in the corresponding genome if NULL (default), then the default genome assembly is used. Default genome is given by, e.g., sesameData_check_genome(NULL, "EPIC") For additional mapping, download the GRanges object from <a href="http://zwdzwd.github.io/InfiniumAnnotation">http://zwdzwd.github.io/InfiniumAnnotation</a> and provide the following argument ..., probeCoords = sesameAnno_buildManifestGRanges("downloaded_file"),... to this function.
tilewidth	tile width for smoothing
verbose	print more messages

**Value**

an object of CNSegment

**Examples**

```

sesameDataCache()

## sdf <- sesameDataGet('EPIC.1.SigDF')
## sdfs.normal <- sesameDataGet('EPIC.5.SigDF.normal')
## seg <- cnSegmentation(sdf, sdfs.normal)

```

---

compareDatabaseSetOverlap

*calculates the pairwise overlap between given list of database sets using a distance metric.*

---

**Description**

calculates the pairwise overlap between given list of database sets using a distance metric.

**Usage**

```
compareDatabaseSetOverlap(databases = NA, metric = "Jaccard")
```

**Arguments**

databases	List of vectors corresponding to the database sets of interest with associated meta data as an attribute to each element. Optional. (Default: NA)
metric	String representing the similarity metric to use. Optional. (Default: "Jaccard").

**Value**

An upper triangular matrix containing a metric (Jaccard) comparing the pairwise distances between database sets.

compareMouseStrainReference

*Compare Strain SNPs with a reference panel*

**Description**

Compare Strain SNPs with a reference panel

**Usage**

```
compareMouseStrainReference(
  betas = NULL,
  show_sample_names = FALSE,
  query_width = NULL
)
```

**Arguments**

betas	beta value vector or matrix (for multiple samples)
show_sample_names	whether to show sample name
query_width	optional argument for adjusting query width

**Value**

grid object that contrast the target sample with pre-built mouse strain reference

**Examples**

```
sesameDataCache() # if not done yet
compareMouseStrainReference()
```

---

compareMouseTissueReference

*Compare mouse array data with mouse tissue references*

---

### Description

Compare mouse array data with mouse tissue references

### Usage

```
compareMouseTissueReference(
  betas = NULL,
  ref = NULL,
  color = "blueYellow",
  query_width = 0.3
)
```

### Arguments

betas	matrix of betas for the target sample This argument is optional. If not given, only the reference will be shown.
ref	the reference beta values in SummarizedExperiment. This argument is optional. If not given, the reference will be downloaded from the sesameData package.
color	either blueYellow or fullJet
query_width	the width of the query beta value matrix

### Value

grid object that contrast the target sample with pre-built mouse tissue reference

### Examples

```
cat("Deprecated, see compareReference")
```

---

compareReference

*Compare array data with references (e.g., tissue, cell types)*

---

### Description

Compare array data with references (e.g., tissue, cell types)

**Usage**

```
compareReference(
  ref,
  betas = NULL,
  stop.points = NULL,
  query_width = 0.3,
  show_sample_names = FALSE
)
```

**Arguments**

`ref` the reference beta values in SummarizedExperiment. One can download them from the sesameData package. See examples.

`betas` matrix of betas for the target sample This argument is optional. If not given, only the reference will be shown.

`stop.points` stop points for the color palette. Default to blue, yellow.

`query_width` the width of the query beta value matrix

`show_sample_names` whether to show sample names (default: FALSE)

**Value**

grid object that contrast the target sample with references.

**Examples**

```
sesameDataCache() # if not done yet
compareReference(sesameDataGet("MM285.tissueSignature"))
sesameDataGet_resetEnv()
```

---

controls	<i>get the controls attributes</i>
----------	------------------------------------

---

**Description**

get the controls attributes

**Usage**

```
controls(sdf, verbose = FALSE)
```

**Arguments**

`sdf` a SigDF

`verbose` print more messages

**Value**

the controls data frame

**Examples**

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
head(controls(sdf))
```

---

convertTo	<i>Convert human arrays to previous platforms Missing probes are replaced using NAs.</i>
-----------	--

---

**Description**

Convert human arrays to previous platforms Missing probes are replaced using NAs.

**Usage**

```
convertTo(sdf, platform = c("HM450", "EPIC"))
```

**Arguments**

sdf	SigDF data frame
platform	HM450 or EPIC

**Value**

a new SigDF for the older platform

**Examples**

```
sdf <- sesameDataGet("EPIC.5.SigDF.normal")[[1]]
sdf_out <- convertTo(sdf, "HM450")
```

---

createDBNetwork	<i>createGeneNetwork creates database network using the Jaccard index.</i>
-----------------	--

---

**Description**

createGeneNetwork creates database network using the Jaccard index.

**Usage**

```
createDBNetwork(databases)
```

**Arguments**

databases      Vector of probes corresponding to a single database set of interest.

**Value**

ggplot lollipop plot

---

createUCSCtrack	<i>Turn beta values into a UCSC browser track</i>
-----------------	---

---

**Description**

Turn beta values into a UCSC browser track

**Usage**

```
createUCSCtrack(betas, output = NULL, platform = "HM450", genome = "hg38")
```

**Arguments**

betas	a named numeric vector
output	output file name
platform	HM450, EPIC etc.
genome	hg38, mm10, ..., will infer if not given. For additional mapping, download the GRanges object from <a href="http://zwdzwd.github.io/InfiniumAnnotation">http://zwdzwd.github.io/InfiniumAnnotation</a> and provide the following argument ..., genome = sesameAnno_buildManifestGRanges("downloaded_file"),... to this function.

**Value**

when output is null, return a data.frame, otherwise NULL

**Examples**

```

betas.tissue <- sesameDataGet('HM450.1.TCGA.PAAD')$betas
## add output to create an actual file
df <- createUCSCtrack(betas.tissue)

## to convert to bigBed
## sort -k1,1 -k2,2n output.bed >output_sorted.bed
## bedToBigBed output_sorted.bed hg38.chrom output.bb

```

---

dataFrame2sesameQC      *Convert data frame to sesameQC object*

---

**Description**

The function convert a data frame back to a list of sesameQC objects

**Usage**

```
dataFrame2sesameQC(df)
```

**Arguments**

df                      a publicQC data frame

**Value**

a list sesameQC objects

**Examples**

```

df <- sesameDataGet("MM285.publicQC")
qcs <- dataFrame2sesameQC(df[1:2,])

```

---

dbStats                      *dbStats builds dataset for a given betas matrix composed of engineered features from the given database sets*

---

**Description**

dbStats builds dataset for a given betas matrix composed of engineered features from the given database sets

**Usage**

```
dbStats(
  betas,
  databases,
  fun = mean,
  na.rm = TRUE,
  n_min = NULL,
  f_min = 0.1,
  long = FALSE
)
```

**Arguments**

betas	matrix of beta values where probes are on the rows and samples are on the columns
databases	List of vectors corresponding to probe locations for which the features will be extracted
fun	aggregation function, default to mean
na.rm	whether to remove NA
n_min	min number of non-NA for aggregation function to apply, overrides f_min
f_min	min fraction of non-NA for aggregation function to apply
long	produce long-form result

**Value**

matrix with samples on the rows and database set on the columns

**Examples**

```
library(SummarizedExperiment)
se <- sesameDataGet('MM285.467.SE.tissue20Kprobes')
head(dbStats(assay(se), "MM285.chromHMM")[,1:3])
sesameDataGet_resetEnv()
```

---

deIdentify

*De-identify IDATs by removing SNP probes*


---

**Description**

Mask SNP probe intensity mean by zero.

**Usage**

```
deIdentify(path, out_path = NULL, snps = NULL, mft = NULL, randomize = FALSE)
```

**Arguments**

path	input IDAT file
out_path	output IDAT file
snps	SNP definition, if not given, default to SNP probes
mft	sesame-compatible manifest if non-standard
randomize	whether to randomize the SNPs. if TRUE, randomize the signal intensities. one can use set.seed to reidentify the IDAT with the secret seed (see examples). If FALSE, this sets all SNP intensities to zero.

**Value**

NULL, changes made to the IDAT files

**Examples**

```
my_secret <- 13412084
set.seed(my_secret)
temp_out <- tempfile("test")
deIdentify(system.file(
  "extdata", "4207113116_A_Grn.idat", package = "sesameData"),
  temp_out, randomize = TRUE)
unlink(temp_out)
```

---

detectionPnegEcdf      *Detection P-value based on ECDF of negative control*

---

**Description**

The function takes a SigDF as input, computes detection p-value using negative control probes' empirical distribution and returns a new SigDF with an updated mask slot.

**Usage**

```
detectionPnegEcdf(sdf, return.pval = FALSE, pval.threshold = 0.05)
```

**Arguments**

sdf	a SigDF
return.pval	whether to return p-values, instead of a masked SigDF
pval.threshold	minimum p-value to mask

**Value**

a SigDF, or a p-value vector if return.pval is TRUE

**Examples**

```
sdf <- sesameDataGet("EPIC.1.SigDF")
sum(sdf$mask)
sum(detectionPnegEcdf(sdf)$mask)
```

---

diffRefSet	<i>Restrict refset to differentially methylated probes use with care, might introduce bias</i>
------------	--

---

**Description**

The function takes a matrix with probes on the rows and cell types on the columns and output a subset matrix and only probes that show discordant methylation levels among the cell types.

**Usage**

```
diffRefSet(g)
```

**Arguments**

`g` a matrix with probes on the rows and cell types on the columns

**Value**

`g` a matrix with a subset of input probes (rows)

**Examples**

```
g = diffRefSet(getRefSet(platform='HM450'))
sesameDataGet_resetEnv()
```

---

dmContrasts	<i>List all contrasts of a DMLSummary</i>
-------------	---

---

**Description**

List all contrasts of a DMLSummary

**Usage**

```
dmContrasts(smry)
```

**Arguments**

`smry` a DMLSummary object

**Value**

a character vector of contrasts

**Examples**

```
data <- sesameDataGet('HM450.76.TCGA.matched')
smry <- DML(data$betas[1:10,], ~type, meta=data$sampleInfo)
dmContrasts(smry)

sesameDataGet_resetEnv()
```

DML

*Test differential methylation on each locus***Description**

The function takes a beta value matrix with probes on the rows and samples on the columns. It also takes a sample information data frame (meta) and formula for testing. The function outputs a list of coefficient tables for each factor tested.

**Usage**

```
DML(betas, fm, meta = NULL, BPPARAM = SerialParam())
```

**Arguments**

betas	beta values, matrix or SummarizedExperiment rows are probes and columns are samples.
fm	formula
meta	data frame for sample information, column names are predictor variables (e.g., sex, age, treatment, tumor/normal etc) and are referenced in formula. Rows are samples. When the betas argument is a SummarizedExperiment object, this is ignored. colData(betas) will be used instead. The row order of the data frame must match the column order of the beta value matrix.
BPPARAM	number of cores for parallel processing, default to SerialParam() Use Multi-coreParam(mc.cores) for parallel processing. For Windows, try DoparParam or SnowParam.

**Value**

a list of test summaries, summary.lm objects

**Examples**

```
sesameDataCache() # in case not done yet
data <- sesameDataGet('HM450.76.TCGA.matched')
smry <- DML(data$betas[1:1000,], ~type, meta=data$sampleInfo)

sesameDataGet_resetEnv()
```

DMLpredict

*Predict new data from DML***Description**

This function is also important for investigating factor interactions.

**Usage**

```
DMLpredict(betas, fm, pred = NULL, meta = NULL, BPPARAM = SerialParam())
```

**Arguments**

betas	beta values, matrix or SummarizedExperiment rows are probes and columns are samples.
fm	formula
pred	new data for prediction, useful for studying effect size. This argument is a data.frame to specify new data. If the argument is NULL, all combinations of all contrasts will be used as input. It might not work if there is a continuous variable input. One may need to explicitly provide the input in a data frame.
meta	data frame for sample information, column names are predictor variables (e.g., sex, age, treatment, tumor/normal etc) and are referenced in formula. Rows are samples. When the betas argument is a SummarizedExperiment object, this is ignored. colData(betas) will be used instead.
BPPARAM	number of cores for parallel processing, default to SerialParam() Use Multi-coreParam(mc.cores) for parallel processing. For Windows, try DoparParam or SnowParam.

**Value**

a SummarizedExperiment of predictions. The colData describes the input of the prediction.

**Examples**

```
data <- sesameDataGet('HM450.76.TCGA.matched')

## use all contrasts as new input
res <- DMLpredict(data$betas[1:10,], ~type, meta=data$sampleInfo)

## specify new input
res <- DMLpredict(data$betas[1:10,], ~type, meta=data$sampleInfo,
  pred = data.frame(type=c("Normal", "Tumour")))

## note that the prediction needs to be a factor of the same
## level structure as the original training data.
pred = data.frame(type=factor(c("Normal"), levels=c("Normal", "Tumour")))
res <- DMLpredict(data$betas[1:10,], ~type,
```

```
meta=data$sampleInfo, pred = pred)
```

---

DMR

*Find Differentially Methylated Region (DMR)*


---

### Description

This subroutine uses Euclidean distance to group CpGs and then combine p-values for each segment. The function performs DML test first if `cf` is `NULL`. It groups the probe testing results into differential methylated regions in a coefficient table with additional columns designating the segment ID and statistical significance (P-value) testing the segment.

### Usage

```
DMR(
  betas,
  smry,
  contrast,
  platform = NULL,
  probe.coords = NULL,
  dist.cutoff = NULL,
  seg.per.locus = 0.5
)
```

### Arguments

<code>betas</code>	beta values for distance calculation
<code>smry</code>	DML
<code>contrast</code>	the pair-wise comparison or contrast check <code>colnames(attr(smry, "model.matrix"))</code> if uncertain
<code>platform</code>	EPIC, HM450, MM285, ...
<code>probe.coords</code>	<code>GRanges</code> object that defines CG coordinates if <code>NULL</code> (default), then the default genome assembly is used. Default genome is given by, e.g., <code>sesameData_check_genome(NULL, "EPIC")</code> For additional mapping, download the <code>GRanges</code> object from <a href="http://zwdzwd.github.io/InfiniumAnnotation">http://zwdzwd.github.io/InfiniumAnnotation</a> and provide the following argument ..., <code>probe.coords = sesameAnno_buildManifestGRanges("downloaded_file"),...</code> to this function.
<code>dist.cutoff</code>	cutoff of beta value differences for two neighboring CGs to be considered the same DMR (by default it's determined using the quantile function on <code>seg.per.locus</code> )
<code>seg.per.locus</code>	number of segments per locus higher value leads to more segments

### Value

coefficient table with segment ID and segment P-value each row is a locus, multiple loci may share a segment ID if they are merged to the same segment. Records are ordered by `Seg_Est`.

## Examples

```
sesameDataCache() # in case not done yet

data <- sesameDataGet('HM450.76.TCGA.matched')
smry <- DML(data$betas[1:1000,], ~type, meta=data$sampleInfo)
colnames(attr(smry, "model.matrix")) # pick a contrast from here
## showing on a small set of 100 CGs
merged_segs <- DMR(data$betas[1:1000,], smry, "typeTumour", platform="HM450")

sesameDataGet_resetEnv()
```

---

dyeBiasCorr	<i>Correct dye bias in by linear scaling.</i>
-------------	---

---

## Description

The function takes a SigDF as input and scale both the Grn and Red signal to a reference (ref) level. If the reference level is not given, it is set to the mean intensity of all the in-band signals. The function returns a SigDF with dye bias corrected.

## Usage

```
dyeBiasCorr(sdf, ref = NULL)
```

## Arguments

sdf	a SigDF
ref	reference signal level

## Value

a normalized SigDF

## Examples

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
sdf.db <- dyeBiasCorr(sdf)
```

---

dyeBiasCorrMostBalanced

*Correct dye bias using most balanced sample as the reference*


---

### Description

The function chose the reference signal level from a list of SigDF. The chosen sample has the smallest difference in Grn and Red signal intensity as measured using the normalization control probes. In practice, it doesn't matter which sample is chosen as long as the reference level does not deviate much. The function returns a list of SigDFs with dye bias corrected.

### Usage

```
dyeBiasCorrMostBalanced(sdfs)
```

### Arguments

sdfs            a list of normalized SigDFs

### Value

a list of normalized SigDFs

### Examples

```
sesameDataCache() # if not done yet
sdfs <- sesameDataGet('HM450.10.SigDF')[1:2]
sdfs.db <- dyeBiasCorrMostBalanced(sdfs)
```

---

dyeBiasL

*Correct dye bias in by linear scaling.*


---

### Description

The function takes a SigDF as input and scale both the Grn and Red signal to a reference (ref) level. If the reference level is not given, it is set to the mean intensity of all the in-band signals. The function returns a SigDF with dye bias corrected.

### Usage

```
dyeBiasL(sdf, ref = NULL)
```

### Arguments

sdf            a SigDF  
ref            reference signal level

**Value**

a normalized SigDF

**Examples**

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
sdf.db <- dyeBiasL(sdf)
```

---

dyeBiasNL

*Dye bias correction by matching green and red to mid point*

---

**Description**

This function compares the Type-I Red probes and Type-I Grn probes and generates and mapping to correct signal of the two channels to the middle. The function takes one single SigDF and returns a SigDF with dye bias corrected.

**Usage**

```
dyeBiasNL(sdf, mask = TRUE, verbose = FALSE)
```

```
dyeBiasCorrTypeINorm(sdf, mask = TRUE, verbose = FALSE)
```

**Arguments**

sdf	a SigDF
mask	include masked probes in Infinium-I probes. No big difference is noted in practice. More probes are generally better.
verbose	print more messages

**Value**

a SigDF after dye bias correction.

**Examples**

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
sdf.db <- dyeBiasNL(sdf)
sdf <- sesameDataGet('EPIC.1.SigDF')
sdf <- dyeBiasCorrTypeINorm(sdf)
```

---

ELBAR

*ELiminate BAcground-dominated Reading (ELBAR)*

---

## Description

ELiminate BAcground-dominated Reading (ELBAR)

## Usage

```
ELBAR(  
  sdf,  
  return.pval = FALSE,  
  pval.threshold = 0.05,  
  margin = 0.05,  
  capMU = 3000,  
  delta.beta = 0.2,  
  n.windows = 500  
)
```

## Arguments

sdf	a SigDF
return.pval	whether to return p-values, instead of a SigDF
pval.threshold	minimum p-value to mask
margin	the percentile margin to define envelope, the smaller the value the more aggressive the masking.
capMU	the maximum M+U to search for intermediate betas
delta.beta	maximum beta value change from sheer background-dominated readings
n.windows	number of windows for smoothing

## Value

a SigDF with mask added

## Examples

```
sdf <- sesameDataGet("EPIC.1.SigDF")  
sum(sdf$mask)  
sum(ELBAR(sdf)$mask)
```

---

`estimateCellComposition`*Estimate cell composition using reference*

---

**Description**

This is a reference-based cell composition estimation. The function takes a reference methylation status matrix (rows for probes and columns for cell types, can be obtained by `getRefSet` function) and a query beta value measurement. The length of the target beta values should be the same as the number of rows of the reference matrix. The method assumes one unknown component. It outputs a list containing the estimated cell fraction, the error of optimization and methylation status of the unknown component.

**Usage**

```
estimateCellComposition(g, q, refine = TRUE, dichotomize = FALSE, ...)
```

**Arguments**

<code>g</code>	reference methylation
<code>q</code>	target measurement: <code>length(q) == nrow(g)</code>
<code>refine</code>	to refine estimate, takes longer
<code>dichotomize</code>	to dichotomize query beta value before estimate, this relieves unclean background subtraction
<code>...</code>	extra parameters for optimization, this includes <code>temp</code> - annealing temperature (0.5) <code>maxIter</code> - maximum iteration to stop after converge (1000) <code>delta</code> - delta score to reset counter (0.0001) <code>verbose</code> - output debug info (FALSE)

**Value**

a list of fraction, min error and unknown component methylation state

---

`estimateLeukocyte`*Estimate leukocyte fraction using a two-component model*

---

**Description**

The method assumes only two components in the mixture: the leukocyte component and the target tissue component. The function takes the beta values matrix of the target tissue and the beta value matrix of the leukocyte. Both matrices have probes on the row and samples on the column. Row names should have probe IDs from the platform. The function outputs a single numeric describing the fraction of leukocyte.

**Usage**

```
estimateLeukocyte(
  betas.tissue,
  betas.leuko = NULL,
  betas.tumor = NULL,
  platform = c("EPIC", "HM450", "HM27")
)
```

**Arguments**

betas.tissue	tissue beta value matrix (#probes X #samples)
betas.leuko	leukocyte beta value matrix, if missing, use the SeSAmE default by infinium platform
betas.tumor	optional, tumor beta value matrix
platform	"HM450", "HM27" or "EPIC"

**Value**

leukocyte estimate, a numeric vector

**Examples**

```
betas.tissue <- sesameDataGet('HM450.1.TCGA.PAAD')$betas
estimateLeukocyte(betas.tissue)
sesameDataGet_resetEnv()
```

---

formatVCF

---

*Convert SNP from Infinium array to VCF file*


---

**Description**

Convert SNP from Infinium array to VCF file

**Usage**

```
formatVCF(sdf, anno, vcf = NULL, genome = "hg38", verbose = FALSE)
```

**Arguments**

sdf	SigDF
anno	SNP variant annotation, available at <a href="https://github.com/zhou-lab/InfiniumAnnotationV1/tree/main/Anno/EPIC.hg38.snp.tsv.gz">https://github.com/zhou-lab/InfiniumAnnotationV1/tree/main/Anno/EPIC.hg38.snp.tsv.gz</a>
vcf	output VCF file path, if NULL output to console
genome	genome
verbose	print more messages

**Value**

VCF file. If vcf is NULL, a data.frame is output to console. The data.frame does not contain VCF headers.

Note the vcf is not sorted. You can sort with `awk '$1 ~ /^#/ print $0;next print $0 | "sort -k1,1 -k2,2n"'`

**Examples**

```
sesameDataCacheAll() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')

## Not run:
## download anno from
## http://zwdzwd.github.io/InfiniumAnnotation
## output to console
anno = read_tsv(sesameAnno_download("EPICv2.hg38.snp.tsv.gz"))
head(formatVCF(sdf, anno))

## End(Not run)
```

---

getAFs

*Get allele frequency*

---

**Description**

Get allele frequency

**Usage**

```
getAFs(sdf, ...)
```

**Arguments**

sdf	SigDF
...	additional options to getBetas

**Value**

allele frequency

**Examples**

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
af <- getAFs(sdf)
```

---

```
getAFTTypeIbySumAlleles
```

*Get allele frequency treating type I by summing alleles*

---

### Description

Takes a SigDF as input and returns a numeric vector containing extra allele frequencies based on Color-Channel-Switching (CCS) probes. If no CCS probes exist in the SigDF, then an numeric(0) is returned.

### Usage

```
getAFTTypeIbySumAlleles(sdf, known.ccs.only = TRUE)
```

### Arguments

```
sdf          SigDF
known.ccs.only  consider only known CCS probes
```

### Value

beta values

### Examples

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
af <- getAFTTypeIbySumAlleles(sdf)
```

---

```
getBetas
```

*Get beta Values*

---

### Description

sum.typeI is used for rescuing beta values on Color-Channel-Switching CCS probes. The function takes a SigDF and returns beta value except that Type-I in-band signal and out-of-band signal are combined. This prevents color-channel switching due to SNPs.

### Usage

```
getBetas(
  sdf,
  mask = TRUE,
  sum.TypeI = FALSE,
  collapseToPfx = FALSE,
  collapseMethod = c("mean", "minPval")
)
```

**Arguments**

sdf	SigDF
mask	whether to use mask
sum.TypeI	whether to sum type I channels
collapseToPfx	remove replicate to prefix (e.g., cg number) and remove the suffix
collapseMethod	mean or minPval

**Value**

a numeric vector, beta values

**Examples**

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
betas <- getBetas(sdf)
```

---

getBinCoordinates      *Get bin coordinates*

---

**Description**

requires GenomicRanges, IRanges

**Usage**

```
getBinCoordinates(seqLength, gapInfo, tilewidth = 50000, probeCoords)
```

**Arguments**

seqLength	chromosome information object
gapInfo	chromosome gap information
tilewidth	tile width for smoothing
probeCoords	probe coordinates

**Value**

bin.coords

---

getMask *get probe masking by mask names*

---

### Description

get probe masking by mask names

### Usage

```
getMask(platform = "EPICv2", mask_names = NULL, use_recommended = TRUE)
```

### Arguments

platform	EPICv2, EPIC, HM450, HM27, ...
mask_names	mask names (see listAvailableMasks), by default: NULL Note that setting this does not turn off recommended masking to turn off recommend masking, you need mask_names = "<your mask names>", use_recommended = FALSE to turn off all masking, you need mask_names = NULL, use_recommended = FALSE
use_recommended	whether or not to apply recommended masking, by default: TRUE. see recommendedMaskNames() for detail.

### Value

a vector of probe ID

### Examples

```
recommendedMaskNames()[["EPIC"]]
length(getMask("EPIC"))
length(getMask("HM450"))
length(getMask("MM285"))
```

---

getRefSet *Retrieve reference set*

---

### Description

The function retrieves the curated reference DNA methylation status for a set of cell type names under the Infinium platform. Supported cell types include "CD4T", "CD19B", "CD56NK", "CD14Monocytes", "granulocytes", "scFat", "skin" etc. See package sesameData for more details. The function output a matrix with probes on the rows and specified cell types on the columns. 0 suggests unmethylation and 1 suggests methylation. Intermediate methylation and nonclusive calls are left with NA.

**Usage**

```
getRefSet(cells = NULL, platform = c("EPIC", "HM450"))
```

**Arguments**

cells	reference cell types
platform	EPIC or HM450

**Value**

g, a 0/1 matrix with probes on the rows and specified cell types on the columns.

**Examples**

```
betas = getRefSet('CD4T', platform='HM450')
sesameDataGet_resetEnv()
```

---

getSexInfo	<i>Get sex-related information</i>
------------	------------------------------------

---

**Description**

The function takes a SigDF and returns a vector of three numerics: the median intensity of chrY probes; the median intensity of chrX probes; and fraction of intermediate chrX probes. chrX and chrY probes excludes pseudo-autosomal probes.

**Usage**

```
getSexInfo(sdf, verbose = FALSE)
```

**Arguments**

sdf	a SigDF
verbose	print more messages

**Value**

medianY and medianX, fraction of XCI, methylated and unmethylated X probes, median intensities of auto-chromosomes.

**Examples**

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
getSexInfo(sdf)
```

---

imputeTo	<i>Impute to platform</i>
----------	---------------------------

---

**Description**

Impute to platform

**Usage**

```
imputeTo(betas, platform = NULL, probes = NULL, tissue = "Blood")
```

**Arguments**

betas	named vector or matrix of beta values
platform	platform of target imputation
probes	Probe ID if not set to vector names
tissue	tissue context of imputation

**Value**

imputed data, vector or matrix

**Examples**

```
betas <- c("cg04707299"=0.2, "cg13380562"=0.9, "cg00000103"=0.1)
betas_imputed <- imputeTo(betas, "HM450")

betas <- setNames(seq(0,1,length.out=3),
  c("cg00004963_TC21", "cg00004963_TC22", "cg00004747_TC21"))
betas_imputed <- imputeTo(betas, "HM450")
```

---

inferEthnicity	<i>Infer Ethnicity</i>
----------------	------------------------

---

**Description**

This function uses both the built-in rsprobes as well as the type I Color-Channel-Switching probes to infer ethnicity.

**Usage**

```
inferEthnicity(sdf, verbose = FALSE)
```

**Arguments**

sdf	a SigDF
verbose	print more messages

**Details**

s better be background subtracted and dyebias corrected for best accuracy

Please note: the betas should come from SigDF *\*without\** channel inference.

**Value**

string of ethnicity

**Examples**

```
sdf <- sesameDataGet('EPIC.1.SigDF')
inferEthnicity(sdf)
```

---

inferInfiniumIChannel *Infer and reset color channel for Type-I probes instead of using what is specified in manifest. The results are stored to sdf@extra\$IGG and sdf@extra\$IRR slot.*

---

**Description**

IGG => Type-I green that is inferred to be green IRR => Type-I red that is inferred to be red

**Usage**

```
inferInfiniumIChannel(
  sdf,
  switch_failed = FALSE,
  mask_failed = FALSE,
  verbose = FALSE,
  summary = FALSE
)
```

**Arguments**

sdf	a SigDF
switch_failed	whether to switch failed probes (default to FALSE)
mask_failed	whether to mask failed probes (default to FALSE)
verbose	whether to print correction summary
summary	return summarized numbers only.

**Value**

a SigDF, or numerics if summary == TRUE

**Examples**

```
sdf <- sesameDataGet('EPIC.1.SigDF')
inferInfiniumIChannel(sdf)
```

---

inferSex

*Infer Sex*


---

**Description**

Infer Sex

**Usage**

```
inferSex(x, platform = NULL, verbose = FALSE)
```

**Arguments**

x	either a raw SigDF or a beta value vector named by probe ID SigDF is preferred over beta values.
platform	Only MM285, EPIC and HM450 are supported.
verbose	print more messages

**Value**

'F' or 'M' We established our sex calling based on the CpGs hypermethylated in inactive X (XiH), CpGs hypomethylated in inactive X (XiL) and signal intensity ratio of Y-chromosome over autosomes. Currently human inference uses a random forest and mouse inference uses a support vector machine.

The function checks the sample quality. If the sample is of poor quality the inference return NA.

Note many factors such as Dnmt genotype, XXY male (Klinefelter's), 45,X female (Turner's) can confuse the model sometimes. This function works on a single sample.

**Examples**

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
inferSex(sdf)
```

---

inferSexKaryotypes      *Infer Sex Karyotype*

---

### Description

The function takes a SigDF and infers the sex chromosome Karyotype and presence/absence of X-chromosome inactivation (XCI). chrX, chrY and XCI are inferred relatively independently. This function gives a more detailed look of potential sex chromosome aberrations.

### Usage

```
inferSexKaryotypes(sdf)
```

### Arguments

sdf                      a SigDF

### Value

Karyotype string, with XCI

### Examples

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
inferSexKaryotypes(sdf)
```

---

inferSpecies              *Infer Species*

---

### Description

We infer species based on probes pvalues and alignment score. AUC was calculated for each specie, y\_true is 1 or 0 for pval < threshold.pos or pval > threshold.neg, respecively,

### Usage

```
inferSpecies(
  sdf,
  topN = 1000,
  threshold.pos = 0.01,
  threshold.neg = 0.1,
  return.auc = FALSE,
  return.species = FALSE,
  verbose = FALSE
)
```

**Arguments**

sdf	a SigDF
topN	Top n positive and negative probes used to infer species. increase this number can sometimes improve accuracy (DEFAULT: 1000)
threshold.pos	pvalue < threshold.pos are considered positive (default: 0.01).
threshold.neg	pvalue > threshold.neg are considered negative (default: 0.2).
return.auc	return AUC calculated, override return.species
return.species	return a string to represent species
verbose	print more messages

**Value**

a SigDF

**Examples**

```
sdf <- sesameDataGet("MM285.1.SigDF")
sdf <- inferSpecies(sdf)

## all available species
all_species <- names(sesameDataGet(sprintf(
  "%s.addressSpecies", sdfPlatform(sdf))))$species)
```

---

inferStrain	<i>Infer strain information for mouse array</i>
-------------	---

---

**Description**

Infer strain information for mouse array

**Usage**

```
inferStrain(
  sdf,
  return.strain = FALSE,
  return.probability = FALSE,
  return.pval = FALSE,
  min_frac_dt = 0.2,
  verbose = FALSE
)
```

**Arguments**

sdf	SigDF
return.strain	return strain name
return.probability	return probability vector for all strains
return.pval	return p-value
min_frac_dt	minimum fraction of detected signal (DEFAULT: 0.2) otherwise, we give up strain inference and return NA.
verbose	print more messages

**Value**

a list of best guess, p-value of the best guess and the probabilities of all strains

**Examples**

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('MM285.1.SigDF')
inferStrain(sdf, return.strain = TRUE)
sdf.strain <- inferStrain(sdf)
```

---

inferTissue	<i>inferTissue infers the tissue of a single sample (as identified through the branchIDs in the row data of the reference) by reporting independent composition through cell type deconvolution.</i>
-------------	--

---

**Description**

inferTissue infers the tissue of a single sample (as identified through the branchIDs in the row data of the reference) by reporting independent composition through cell type deconvolution.

**Usage**

```
inferTissue(
  betas,
  reference = NULL,
  platform = NULL,
  abs_delta_beta_min = 0.3,
  auc_min = 0.99,
  coverage_min = 0.8,
  topN = 15
)
```

**Arguments**

betas	Named vector with probes and their corresponding beta value measurement
reference	Summarized Experiment with either hypomethylated or hypermethylated probe selection (row data), sample selection (column data), meta data, and the betas (assay)
platform	String representing the array type of the betas and reference
abs_delta_beta_min	Numerical value indicating the absolute minimum required delta beta for the probe selection criteria
auc_min	Numeric value corresponding to the minimum AUC value required for a probe to be considered
coverage_min	Numeric value corresponding to the minimum coverage requirement for a probe to be considered. Coverage is defined here as the proportion of samples without an NA value at a given probe.
topN	number of probes to at most use for each branch

**Value**

inferred tissue as a string

**Examples**

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet("MM285.1.SigDF")
inferTissue(getBetas(dyeBiasNL(noob(sdf))))

sesameDataGet_resetEnv()
```

---

initFileSet	<i>initialize a fileSet class by allocating appropriate storage</i>
-------------	---

---

**Description**

initialize a fileSet class by allocating appropriate storage

**Usage**

```
initFileSet(map_path, platform, samples, probes = NULL, inc = 4)
```

**Arguments**

map_path	path of file to map
platform	EPIC, HM450 or HM27, consistent with sdfPlatform(sdf)
samples	sample names
probes	probe names
inc	bytes per unit data storage

**Value**

a sesame::fileSet object

**Examples**

```
fset <- initFileSet('mybetas2', 'HM27', c('s1','s2'))
```

---

KYCG\_annoProbes      *Annotate Probe IDs using KYCG databases*

---

**Description**

see sesameData\_annoProbes if you'd like to annotate by genomic coordinates (in GRanges)

**Usage**

```
KYCG_annoProbes(
  query,
  databases,
  db_names = NULL,
  platform = NULL,
  sep = ",",
  indicator = FALSE,
  silent = FALSE
)
```

**Arguments**

query	probe IDs in a character vector
databases	character or actual database (i.e. list of probe IDs)
db_names	specific database (default to all databases)
platform	EPIC, MM285 etc. will infer from probe IDs if not given
sep	delimiter used in paste
indicator	return the indicator matrix instead of a concatenated annotation (in the case of have multiple annotations)
silent	suppress message

**Value**

named annotation vector, or indicator matrix

**Examples**

```
query <- names(sesameData_getManifestGRanges("MM285"))
anno <- KYCG_annoProbes(query, "designGroup", silent = TRUE)
```

---

KYCG\_buildGeneDBs      *build gene-probe association database*

---

### Description

build gene-probe association database

### Usage

```
KYCG_buildGeneDBs(
  query = NULL,
  platform = NULL,
  genome = NULL,
  max_distance = 10000,
  silent = FALSE
)
```

### Arguments

query	the query probe list. If NULL, use all the probes on the platform
platform	HM450, EPIC, MM285, Mammal40, will infer from query if not given
genome	hg38, mm10, ..., will infer if not given. For additional mapping, download the GRanges object from <a href="http://zwdzwd.github.io/InfiniumAnnotation">http://zwdzwd.github.io/InfiniumAnnotation</a> and provide the following argument ..., genome = sesameAnno_buildManifestGRanges("downloaded_file"),... to this function.
max_distance	probe-gene distance for association
silent	suppress messages

### Value

gene databases

### Examples

```
query <- c("cg04707299", "cg13380562", "cg00480749")
dbs <- KYCG_buildGeneDBs(query, platform = "EPIC")
testEnrichment(query, dbs, platform = "EPIC")
```

---

`KYCG_getDBs`*Get databases by full or partial names of the database group(s)*

---

**Description**

Get databases by full or partial names of the database group(s)

**Usage**

```
KYCG_getDBs(  
  group_nms,  
  db_names = NULL,  
  platform = NULL,  
  summary = FALSE,  
  allow_multi = FALSE,  
  ignore.case = FALSE,  
  type = NULL,  
  silent = FALSE  
)
```

**Arguments**

<code>group_nms</code>	database group names
<code>db_names</code>	name of the database, fetch only the given databases
<code>platform</code>	EPIC, HM450, MM285, ... If given, will restrict to that platform.
<code>summary</code>	return a summary of database instead of db itself
<code>allow_multi</code>	allow multiple groups to be returned for
<code>ignore.case</code>	ignore case or not
<code>type</code>	numerical, categorical, default: all
<code>silent</code>	no messages each query.

**Value**

a list of databases, return NULL if no database is found

**Examples**

```
db1 <- KYCG_getDBs("MM285.chromHMM")  
db2 <- KYCG_getDBs(c("MM285.chromHMM", "MM285.probeType"))
```

---

KYCG\_listDBGroups      *List database group names*

---

**Description**

List database group names

**Usage**

```
KYCG_listDBGroups(filter = NULL, path = NULL, type = NULL)
```

**Arguments**

filter	keywords for filtering
path	file path to downloaded knowledgebase sets
type	categorical, numerical (default: all)

**Value**

a list of db group names

**Examples**

```
head(KYCG_listDBGroups("chromHMM"))
## or KYCG_listDBGroups(path = "~/Downloads")
```

---

KYCG\_loadDBs      *Load database groups*

---

**Description**

Load database groups

**Usage**

```
KYCG_loadDBs(in_paths, group_use_filename = FALSE)
```

**Arguments**

in_paths	folder that contains all databases
group_use_filename	whether to use file name for groups

**Value**

a list of db group names

## Examples

```
## download regulatory annotations from
## http://zwdzwd.github.io/InfiniumAnnotation
## unzip the file
if (FALSE) {
  dbs <- KYCG_loadDBs(path_to_unzipped_folder)
}
```

---

KYCG\_plotBar

*Bar plot to show most enriched CG groups from testEnrichment*

---

## Description

The input data frame should have an "estimate" and a "FDR" columns.

## Usage

```
KYCG_plotBar(df, y = "-log10(FDR)", n = 20, order_by = "FDR", label = FALSE)
```

## Arguments

df	KYCG result data frame
y	the column to be plotted on y-axis
n	number of CG groups to plot
order_by	the column by which CG groups are ordered
label	whether to label significant bars

## Details

Top CG groups are determined by estimate (descending order).

## Value

grid plot object

## Examples

```
KYCG_plotBar(data.frame(
  estimate=runif(10,0,10), FDR=runif(10,0,1), nD=10,
  overlap=as.integer(runif(10,0,30)), group="g", dbname=seq_len(10)))
```

---

`KYCG_plotDot`*Dot plot to show most enriched CG groups from testEnrichment*

---

### Description

The input data frame should have an "estimate" and a "FDR" columns.

### Usage

```
KYCG_plotDot(  
  df,  
  y = "-log10(FDR)",  
  n = 20,  
  order_by = "FDR",  
  title = "Enriched Databases",  
  label_by = "dbname",  
  size_by = "overlap",  
  color_by = "estimate",  
  short_label = FALSE  
)
```

### Arguments

<code>df</code>	KYCG result data frame
<code>y</code>	the column to be plotted on y-axis
<code>n</code>	number of CG groups to plot
<code>order_by</code>	the column by which CG groups are ordered
<code>title</code>	plot title
<code>label_by</code>	the column for label
<code>size_by</code>	the column by which CG group size plot
<code>color_by</code>	the column by which CG groups are colored
<code>short_label</code>	omit group in label

### Details

Top CG groups are determined by estimate (descending order).

### Value

grid plot object (by ggplot)

### Examples

```
KYCG_plotDot(data.frame(  
  estimate=runif(10,0,10), FDR=runif(10,0,1), nD=runif(10,10,20),  
  overlap=as.integer(runif(10,0,30)), group="g", dbname=seq_len(10)))
```

---

KYCG\_plotEnrichAll *plot enrichment test result*

---

**Description**

plot enrichment test result

**Usage**

```
KYCG_plotEnrichAll(  
  df,  
  fdr_max = 25,  
  n_label = 15,  
  min_estimate = 0,  
  short_label = TRUE  
)
```

**Arguments**

df	test enrichment result data frame
fdr_max	maximum fdr for capping
n_label	number of database to label
min_estimate	minimum estimate
short_label	use short label

**Value**

grid object

**Examples**

```
query <- KYCG_getDBs("MM285.designGroup")[[ "PGCMeth" ]]  
res <- testEnrichment(query, platform="MM285")  
KYCG_plotEnrichAll(res)
```

---

KYCG\_plotLollipop *creates a lollipop plot of log(estimate) given data with fields estimate.*

---

**Description**

creates a lollipop plot of log(estimate) given data with fields estimate.

**Usage**

```
KYCG_plotLollipop(df, label_column = "dbname", n = 20)
```

**Arguments**

df	DataFrame where each row is a database name with its estimate.
label_column	column in df to be used as the label (default: dbname)
n	Integer representing the number of top enrichments to report. Optional. (Default: 10)

**Value**

ggplot lollipop plot

**Examples**

```
KYCG_plotLollipop(data.frame(
  estimate=runif(10,0,10), FDR=runif(10,0,1), nD=runif(10,10,20),
  overlap=as.integer(runif(10,0,30)), group="g",
  dbname=as.character(seq_len(10))))
```

---

KYCG_plotManhattan	<i>KYCG_plotManhattan makes a manhattan plot to summarize EWAS results</i>
--------------------	--

---

**Description**

KYCG\_plotManhattan makes a manhattan plot to summarize EWAS results

**Usage**

```
KYCG_plotManhattan(
  vals,
  platform = NULL,
  genome = NULL,
  title = NULL,
  label_min = 100,
  col = c("wheat1", "sienna3"),
  ylabel = "Value"
)
```

**Arguments**

vals	named vector of values (P,Q etc), vector name is Probe ID.
platform	String corresponding to the type of platform to use for retrieving GRanges coordinates of probes. Either MM285, EPIC, HM450, or HM27. If it is not provided, it will be inferred from the query set probeIDs (Default: NA).

genome	hg38, mm10, ..., will infer if not given. For additional mapping, download the GRanges object from <a href="http://zwdzwd.github.io/InfiniumAnnotation">http://zwdzwd.github.io/InfiniumAnnotation</a> and provide the following argument ..., genome = sesameAnno_buildManifestGRanges("downloaded_file"),... to this function.
title	title for plot
label_min	Threshold above which data points will be labelled with Probe ID
col	color
ylabel	y-axis label

**Value**

a ggplot object

**Examples**

```
## see vignette for examples
sesameDataGet_resetEnv()
```

---

KYCG_plotMeta	<i>Plot meta gene or other meta genomic features</i>
---------------	--

---

**Description**

Plot meta gene or other meta genomic features

**Usage**

```
KYCG_plotMeta(betas, platform = NULL)
```

**Arguments**

betas	a named numeric vector or a matrix (row: probes; column: samples)
platform	if not given and x is a SigDF, will be inferred the meta features

**Value**

a grid plot object

**Examples**

```
sdf <- sesameDataGet("EPIC.1.SigDF")
KYCG_plotMeta(getBetas(sdf))
```

---

KYCG\_plotMetaEnrichment

*Plot meta gene or other meta genomic features*

---

**Description**

Plot meta gene or other meta genomic features

**Usage**

```
KYCG_plotMetaEnrichment(result_list)
```

**Arguments**

result\_list     one or a list of testEnrichment

**Value**

a grid plot object

**Examples**

```
cg_lists <- KYCG_getDBs("MM285.TFBS")
queries <- cg_lists[(sapply(cg_lists, length) > 40000)]
result_list <- lapply(queries, testEnrichment,
  "MM285.metagene", silent=TRUE, platform="MM285")

KYCG_plotMetaEnrichment(result_list)
```

---

KYCG\_plotPointRange     *Plot point range for a list of enrichment testing results against the same set of databases*

---

**Description**

Plot point range for a list of enrichment testing results against the same set of databases

**Usage**

```
KYCG_plotPointRange(result_list)
```

**Arguments**

result\_list     a list of testEnrichment resultsx

**Value**

grid plot object

**Examples**

```
## pick some big TFBS-overlapping CpG groups
cg_lists <- KYCG_getDBs("MM285.TFBS")
queries <- cg_lists[(sapply(cg_lists, length) > 40000)]
result_list <- lapply(queries, testEnrichment,
  "MM285.chromHMM", platform="MM285")
KYCG_plotPointRange(result_list)
```

---

KYCG\_plotSetEnrichment

*Plot Set Enrichment*

---

**Description**

Plot Set Enrichment

**Usage**

```
KYCG_plotSetEnrichment(result, n_sample = 1000, n_presence = 200)
```

**Arguments**

result	result object as returned from an element of the list of testEnrichmentSEA(..., prepPlot=TRUE)
n_sample	number of CpGs to sample
n_presence	number of overlap to sample for the plot

**Value**

grid object for plot

**Examples**

```
query <- KYCG_getDBs("KYCG.MM285.designGroup")[[ "VMR" ]]
db <- KYCG_getDBs("MM285.seqContextN", "distToTSS")
res <- testEnrichmentSEA(query, db, prepPlot = TRUE)
KYCG_plotSetEnrichment(res[[1]])
```

---

KYCG\_plotVolcano      *creates a volcano plot of  $-\log_2(p.value)$  and  $\log(estimate)$  given data with fields estimate and p.value.*

---

**Description**

creates a volcano plot of  $-\log_2(p.value)$  and  $\log(estimate)$  given data with fields estimate and p.value.

**Usage**

```
KYCG_plotVolcano(df, label_by = "dbname", alpha = 0.05)
```

**Arguments**

df                      DataFrame where each field is a database name with two fields for the estimate and p.value.

label\_by                column in df to be used as the label (default: dbname)

alpha                    Float representing the cut-off alpha value for the plot. Optional. (Default: 0.05)

**Value**

ggplot volcano plot

**Examples**

```
KYCG_plotVolcano(data.frame(
  estimate=runif(10,0,10), FDR=runif(10,0,1), nD=runif(10,10,20),
  overlap=as.integer(runif(10,0,30)), group="g", dbname=seq_len(10)))
```

---

KYCG\_plotWaterfall      *create a waterfall plot of  $\log(estimate)$  given test enrichment*

---

**Description**

create a waterfall plot of  $\log(estimate)$  given test enrichment

**Usage**

```
KYCG_plotWaterfall(
  df,
  order_by = "Log2(OR)",
  size_by = " $-\log_{10}(FDR)$ ",
  label_by = "dbname",
  n_label = 10
)
```

**Arguments**

df	data frame where each row is a database with test enrichment result
order_by	the column by which CG groups are ordered
size_by	the column by which CG group size plot
label_by	column in df to be used as the label (default: dbname)
n_label	number of datapoints to label

**Value**

grid

**Examples**

```
library(SummarizedExperiment)
df <- rowData(sesameDataGet('MM285.tissueSignature'))
query <- df$Probe_ID[df$branch == "fetal_brain" & df$type == "Hypo"]
results <- testEnrichment(query, "TFBS", platform="MM285")
KYCG_plotWaterfall(results)
```

---

listAvailableMasks      *list existing quality masks for a SigDF*

---

**Description**

list existing quality masks for a SigDF

**Usage**

```
listAvailableMasks(platform, verbose = FALSE)
```

**Arguments**

platform	EPIC, MM285, HM450 etc
verbose	print more messages

**Value**

a tibble of masks

**Examples**

```
listAvailableMasks("EPIC")
```

---

mapFileSet	<i>Deposit data of one sample to a fileSet (and hence to file)</i>
------------	--

---

**Description**

Deposit data of one sample to a fileSet (and hence to file)

**Usage**

```
mapFileSet(fset, sample, named_values)
```

**Arguments**

fset	a sesame::fileSet, as obtained via readFileSet
sample	sample name as a string
named_values	value vector named by probes

**Value**

a sesame::fileSet

**Examples**

```
## create two samples
fset <- initFileSet('mybetas2', 'HM27', c('s1','s2'))

## a hypothetical numeric array (can be beta values, intensities etc)
hypothetical <- setNames(runif(fset$n), fset$probes)

## map the numeric to file
mapFileSet(fset, 's1', hypothetical)

## get data
sliceFileSet(fset, 's1', 'cg00000292')
```

---

mapToMammal40	<i>Map the SDF (from overlap array platforms) Replicates are merged by picking the best detection</i>
---------------	---

---

**Description**

Map the SDF (from overlap array platforms) Replicates are merged by picking the best detection

**Usage**

```
mapToMammal40(sdf)
```

**Arguments**

sdf                    a SigDF object

**Value**

a named numeric vector for beta values

**Examples**

```
sdf <- sesameDataGet("Mammal40.1.SigDF")
betas <- mapToMammal40(sdf[1:10,])
```

---

matchDesign	<i>normalize Infinium I probe betas to Infinium II</i>
-------------	--

---

**Description**

This is designed to counter tail inflation in Infinium I probes.

**Usage**

```
matchDesign(sdf, min_dbeta = 0.3)
```

**Arguments**

sdf                    SigDF

min\_dbeta            the default algorithm perform 2-state quantile-normalization of the unmethylated and methylated modes separately. However, when the two modes are too close, we fall back to a one-mode normalization. The threshold defines the maximum inter-mode distance.

**Value**

SigDF

**Examples**

```
library(RPMM)
sdf <- sesameDataGet("MM285.1.SigDF")
sesameQC_plotBetaByDesign(sdf)
sesameQC_plotBetaByDesign(matchDesign(sdf))
```

---

meanIntensity	<i>Whole-dataset-wide Mean Intensity</i>
---------------	--

---

### Description

The function takes one single SigDF and computes mean intensity of all the in-band measurements. This includes all Type-I in-band measurements and all Type-II probe measurements. Both methylated and unmethylated alleles are considered. This function outputs a single numeric for the mean.

### Usage

```
meanIntensity(sdf, mask = TRUE)
```

### Arguments

sdf	a SigDF
mask	whether to mask probes using mask column

### Details

Note: mean in this case is more informative than median because methylation level is mostly bimodal.

### Value

mean of all intensities

### Examples

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
meanIntensity(sdf)
```

---

medianTotalIntensity	<i>Whole-dataset-wide Median Total Intensity (M+U)</i>
----------------------	--

---

### Description

The function takes one single SigDF and computes median intensity of M+U for each probe. This function outputs a single numeric for the median.

### Usage

```
medianTotalIntensity(sdf, mask = TRUE)
```

**Arguments**

sdf                    a SigDF  
mask                    whether to mask probes using mask column

**Value**

median of all intensities

**Examples**

```
sesameDataCache() # if not done yet  
sdf <- sesameDataGet('EPIC.1.SigDF')  
medianTotalIntensity(sdf)
```

---

MValueToBetaValue        *Convert M-value to beta-value*

---

**Description**

Convert M-value to beta-value (aka inverse logit transform)

**Usage**

```
MValueToBetaValue(m)
```

**Arguments**

m                    a vector of M values

**Value**

a vector of beta values

**Examples**

```
MValueToBetaValue(c(-3, 0, 3))
```

---

negControls	<i>get negative control signal</i>
-------------	------------------------------------

---

**Description**

get negative control signal

**Usage**

```
negControls(sdf)
```

**Arguments**

sdf                    a SigDF

**Value**

a data frame of negative control signals

---

noMasked	<i>remove masked probes from SigDF</i>
----------	--

---

**Description**

remove masked probes from SigDF

**Usage**

```
noMasked(sdf)
```

**Arguments**

sdf                    input SigDF object

**Value**

a SigDF object without masked probes

**Examples**

```
sesameDataCache()  
sdf <- sesameDataGet("EPIC.1.SigDF")  
sdf <- p00BAH(sdf)  
  
sdf_noMasked <- noMasked(sdf)
```

---

noob	<i>Noob background subtraction</i>
------	------------------------------------

---

### Description

The function takes a SigDF and returns a modified SigDF with background subtracted. Background was modelled in a normal distribution and true signal in an exponential distribution. The Norm-Exp deconvolution is parameterized using Out-Of-Band (oob) probes. For species-specific processing, one should call inferSpecies on SigDF first. Multi-mapping probes are excluded.

### Usage

```
noob(sdf, combine.neg = TRUE, offset = 15)
```

### Arguments

sdf	a SigDF
combine.neg	whether to combine negative control probe.
offset	offset

### Details

When combine.neg = TRUE, background will be parameterized by both negative control and out-of-band probes.

### Value

a new SigDF with noob background correction

### Examples

```
sdf <- sesameDataGet('EPIC.1.SigDF')
sdf.nb <- noob(sdf)
```

---

normControls	<i>get normalization control signal</i>
--------------	---

---

### Description

get normalization control signal from SigDF. The function optionally takes mean for each channel.

### Usage

```
normControls(sdf, average = FALSE, verbose = FALSE)
```

**Arguments**

sdf	a SigDF
average	whether to average
verbose	print more messages

**Value**

a data frame of normalization control signals

---

openSesame	<i>The openSesame pipeline</i>
------------	--------------------------------

---

**Description**

This function is a simple wrapper of noob + nonlinear dye bias correction + pOOBAH masking.

**Usage**

```
openSesame(
  x,
  prep = "QCDPB",
  prep_args = NULL,
  manifest = NULL,
  func = getBetas,
  BPPARAM = SerialParam(),
  platform = "",
  ...
)
```

**Arguments**

x	SigDF(s), IDAT prefix(es)
prep	preprocessing code, see ?prepSesame
prep_args	optional preprocessing argument list, see ?prepSesame
manifest	optional dynamic manifest
func	either getBetas or getAFs, if NULL, then return SigDF list
BPPARAM	get parallel with MulticoreParam(n)
platform	optional platform string
...	parameters to getBetas

**Details**

Please use mask=FALSE to turn off masking.

If the input is an IDAT prefix or a SigDF, the output is the beta value numerics.

**Value**

a numeric vector for processed beta values

**Examples**

```
in_dir <- system.file("extdata", "", package = "sesameData")
betas <- openSesame(in_dir)
## or
IDATprefixes <- searchIDATprefixes(in_dir)
betas <- openSesame(IDATprefixes)
```

---

openSesameToFile	<i>openSesame pipeline with file-backed storage</i>
------------------	---

---

**Description**

openSesame pipeline with file-backed storage

**Usage**

```
openSesameToFile(map_path, idat_dir, BPPARAM = SerialParam(), inc = 4)
```

**Arguments**

map_path	path of file to be mapped (beta values file)
idat_dir	source IDAT directory
BPPARAM	get parallel with MulticoreParam(2)
inc	bytes per item data storage. increase to 8 if precision is important. Most cases 32-bit representation is enough.

**Value**

a sesame::fileSet

**Examples**

```
openSesameToFile('mybetas',
  system.file('extdata', package='sesameData'))
```

---

palgen	<i>Generate some additional color palettes</i>
--------	--

---

**Description**

Generate some additional color palettes

**Usage**

```
palgen(pal, n = 150, space = "Lab")
```

**Arguments**

pal	a string for adhoc pals
n	the number of colors for interpolation
space	rgb or Lab

**Value**

a palette-generating function

**Examples**

```
library(pals)
pal.bands(palgen("whiteturbo"))
```

---

parseGEOsignalMU	<i>Convert signal M and U to SigDF</i>
------------------	--

---

**Description**

This overcomes the issue of missing IDAT files. However, out-of-band signals will be missing or faked (sampled from a normal distribution).

**Usage**

```
parseGEOsignalMU(
  sigM,
  sigU,
  Probe_IDs,
  oob.mean = 500,
  oob.sd = 300,
  platform = NULL
)
```

**Arguments**

sigM	methylated signal, a numeric vector
sigU	unmethylated signal, a numeric vector
Probe_IDs	probe ID vector
oob.mean	assumed mean for out-of-band signals
oob.sd	assumed standard deviation for out-of-band signals
platform	platform code, will infer if not given

**Value**

SigDF

**Examples**

```
sigM <- c(11436, 6068, 2864)
sigU <- c(1476, 804, 393)
probes <- c("cg07881041", "cg23229610", "cg03513874")
sdf <- parseGEOsignalMU(sigM, sigU, probes, platform = "EPIC")
```

pOOBAH

*Detection P-value based on ECDF of out-of-band signal***Description**

aka pOOBAH (p-val by Out-Of-Band Array Hybridization)

**Usage**

```
pOOBAH(
  sdf,
  return.pval = FALSE,
  combine.neg = TRUE,
  pval.threshold = 0.05,
  verbose = FALSE
)
```

**Arguments**

sdf	a SigDF
return.pval	whether to return p-values, instead of a masked SigDF
combine.neg	whether to combine negative control probes with the out-of-band probes in simulating the signal background
pval.threshold	minimum p-value to mask
verbose	print more messages

**Details**

The function takes a SigDF as input, computes detection p-value using out-of-band probes empirical distribution and returns a new SigDF with an updated mask slot.

**Value**

a SigDF, or a p-value vector if return.pval is TRUE

**Examples**

```
sdf <- sesameDataGet("EPIC.1.SigDF")
sum(sdf$mask)
sum(p00BAH(sdf)$mask)
```

---

predictAge

*Predict age using linear models*

---

**Description**

The function takes a named numeric vector of beta values. The name attribute contains the probe ID (cg, ch or rs IDs). The function looks for overlapping probes and estimate age using different models.

**Usage**

```
predictAge(betas, model, na_fallback = FALSE, min_nonna = 10)
```

**Arguments**

betas	a probeID-named vector of beta values
model	a model object from sesameDataGet. should contain param, intercept, response2age. default to the Horvath353 model.
na_fallback	use fall back values if na
min_nonna	the minimum number of non-NA values.

**Details**

You can get the models such as the Horvath aging model (Horvath 2013 Genome Biology) from sesameDataGet. The function outputs a single numeric of age in years.

Here are some built-in age models: Anno/HM450/Clock\_Horvath353.rds Anno/HM450/Clock\_Hannum.rds Anno/HM450/Clock\_SkinBlood.rds Anno/EPIC/Clock\_PhenoAge.rds Anno/MM285/Clock\_Zhou347.rds see vignette inferences.html#Age\_\_Epigenetic\_Clock for details

**Value**

age in the unit specified in the model (usually in year, but sometimes can be month, like in the mouse clocks).

**Examples**

```
betas <- sesameDataGet('HM450.1.TCGA.PAAD')$betas
## Not run:
## download age models from
## https://github.com/zhou-lab/InfiniumAnnotationV1/tree/main/Anno
## e.g., Anno/HM450/Clock_Horvath353.rds
predictAge(betas, model)

## End(Not run)
```

---

predictAgeHorvath353 *Horvath 353 age predictor*

---

**Description**

The function takes a named numeric vector of beta values. The name attribute contains the probe ID (cg, ch or rs IDs). The function looks for overlapping probes and estimate age using Horvath aging model (Horvath 2013 Genome Biology). The function outputs a single numeric of age in years.

**Usage**

```
predictAgeHorvath353(betas)
```

**Arguments**

betas                    a probeID-named vector of beta values

**Value**

age in years

**Examples**

```
cat("Deprecated. See predictAge")
```

---

predictAgeSkinBlood *Horvath Skin and Blood age predictor*

---

**Description**

The function takes a named numeric vector of beta values. The name attribute contains the probe ID (cg, ch or rs IDs). The function looks for overlapping probes and estimate age using Horvath aging model (Horvath et al. 2018 Aging, 391 probes). The function outputs a single numeric of age in years.

**Usage**

```
predictAgeSkinBlood(betas)
```

**Arguments**

betas            a probeID-named vector of beta values

**Value**

age in years

**Examples**

```
cat("Deprecated. See predictAge")
```

---

```
predictMouseAgeInMonth
```

*Mouse age predictor*

---

**Description**

The function takes a named numeric vector of beta values. The name attribute contains the probe ID. The function looks for overlapping probes and estimate age using an aging model built from 321 MM285 probes. The function outputs a single numeric of age in months. The clock is most accurate with the sesame preprocessing.

**Usage**

```
predictMouseAgeInMonth(betas, na_fallback = TRUE)
```

**Arguments**

betas            a probeID-named vector of beta values  
na\_fallback      use the fallback default for NAs.

**Value**

age in month

**Examples**

```
cat("Deprecated. See predictAge")
```

---

prefixMask	<i>Mask SigDF by probe ID prefix</i>
------------	--------------------------------------

---

**Description**

Mask SigDF by probe ID prefix

**Usage**

```
prefixMask(sdf, prefixes = NULL, invert = FALSE)
```

**Arguments**

sdf	SigDF
prefixes	prefix characters
invert	use the complement set

**Value**

SigDF

**Examples**

```
sdf <- resetMask(sesameDataGet("MM285.1.SigDF"))
sum(prefixMask(sdf, c("ctl", "rs"))$mask)
sum(prefixMask(sdf, c("ctl"))$mask)
sum(prefixMask(sdf, c("ctl", "rs", "ch"))$mask)
```

---

prefixMaskButC	<i>Mask all but C probes in SigDF</i>
----------------	---------------------------------------

---

**Description**

Mask all but C probes in SigDF

**Usage**

```
prefixMaskButC(sdf)
```

**Arguments**

sdf	SigDF
-----	-------

**Value**

SigDF

**Examples**

```
sdf <- resetMask(sesameDataGet("MM285.1.SigDF"))
sum(prefixMaskButC(sdf)$mask)
```

---

prefixMaskButCG	<i>Mask all but CG probes in SigDF</i>
-----------------	--

---

**Description**

Mask all but CG probes in SigDF

**Usage**

```
prefixMaskButCG(sdf)
```

**Arguments**

sdf	SigDF
-----	-------

**Value**

SigDF

**Examples**

```
sdf <- resetMask(sesameDataGet("MM285.1.SigDF"))
sum(prefixMaskButCG(sdf)$mask)
```

---

prepSesame	<i>Apply a chain of sesame preprocessing functions in an arbitrary order</i>
------------	--

---

**Description**

Notes on the order of operation: 1. qualityMask and inferSpecies should go before noob and pOOBAH, otherwise the background is too high because of Multi, uk and other probes 2. dyeBias correction needs to happen early 3. channel inference before dyebias 4. noob should happen last, pOOBAH before noob because noob modifies oob

**Usage**

```
prepSesame(sdf, prep = "QCDPB", prep_args = NULL)
```

**Arguments**

sdf	SigDF
prep	code that indicates preprocessing functions and their execution order (functions on the left is executed first).
prep_args	optional argument list to individual functions, e.g., prepSesame(sdf, prep_args=list(Q=list(mask_names = "design_issue"))) sets qualityMask(sdf, mask_names = "design_issue")

**Value**

SigDF

**Examples**

```
sdf <- sesameDataGet("MM285.1.SigDF")
sdf1 <- prepSesame(sdf, "QCDPB")
```

---

prepSesameList      *List supported prepSesame functions*

---

**Description**

List supported prepSesame functions

**Usage**

```
prepSesameList()
```

**Value**

a data frame with code, func, description

**Examples**

```
prepSesameList()
```

---

print.DMLSummary      *Print DMLSummary object*

---

**Description**

Print DMLSummary object

**Usage**

```
## S3 method for class 'DMLSummary'  
print(x, ...)
```

**Arguments**

x                    a DMLSummary object  
...                  extra parameter for print

**Value**

print DMLSummary result on screen

**Examples**

```
sesameDataCache() # in case not done yet  
data <- sesameDataGet('HM450.76.TCGA.matched')  
## test the first 10  
smry <- DML(data$betas[1:10,], ~type, meta=data$sampleInfo)  
smry  
  
sesameDataGet_resetEnv()
```

---

print.fileSet      *Print a fileSet*

---

**Description**

Print a fileSet

**Usage**

```
## S3 method for class 'fileSet'  
print(x, ...)
```

**Arguments**

x                    a sesame::fileSet  
...                  stuff for print

**Value**

string representation

**Examples**

```
fset <- initFileSet('mybetas2', 'HM27', c('s1','s2'))  
fset
```

---

probeID_designType	<i>Extract the probe type field from probe ID This only works with the new probe ID system. See <a href="https://github.com/zhou-lab/InfiniumAnnotation">https://github.com/zhou-lab/InfiniumAnnotation</a> for illustration</i>
--------------------	--

---

**Description**

Extract the probe type field from probe ID This only works with the new probe ID system. See <https://github.com/zhou-lab/InfiniumAnnotation> for illustration

**Usage**

```
probeID_designType(Probe_ID)
```

**Arguments**

Probe_ID	Probe ID
----------	----------

**Value**

a vector of '1' and '2' suggesting Infinium-I and Infinium-II

**Examples**

```
probeID_designType("cg36609548_TC21")
```

---

probeSuccessRate	<i>Whole-dataset-wide Probe Success Rate</i>
------------------	--

---

### Description

This function calculates the probe success rate using pOOBAH detection p-values. Probes that has a detection p-value higher than a specific threshold are considered failed probes.

### Usage

```
probeSuccessRate(sdf, mask = TRUE, max_pval = 0.05)
```

### Arguments

sdf	a SigDF
mask	whether or not we count the masked probes in SigDF
max_pval	the maximum p-value to consider detection success

### Value

a fraction number as probe success rate

### Examples

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
probeSuccessRate(sdf)
```

---

qualityMask	<i>Mask beta values by design quality</i>
-------------	---

---

### Description

Currently quality masking only supports three platforms see also listAvailableMasks(sdfPlatform(sdf))

### Usage

```
qualityMask(sdf, verbose = FALSE, ...)
```

### Arguments

sdf	a SigDF object
verbose	print more messages
...	masking details see getMask()

**Value**

a filtered SigDF

**Examples**

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
sum(sdf$mask)
sum(qualityMask(sdf)$mask)
sum(qualityMask(sdf, mask_names = NULL)$mask)

## list available masks, the dbname column
listAvailableMasks(sdfPlatform(sdf))
listAvailableMasks("EPICv2")
```

---

readFileSet	<i>Read an existing fileSet from storage</i>
-------------	--

---

**Description**

This function only reads the meta-data.

**Usage**

```
readFileSet(map_path)
```

**Arguments**

map\_path            path of file to map (should contain valid \_idx.rds index)

**Value**

a sesame::fileSet object

**Examples**

```
## create two samples
fset <- initFileSet('mybetas2', 'HM27', c('s1','s2'))

## a hypothetical numeric array (can be beta values, intensities etc)
hypothetical <- setNames(runif(fset$n), fset$probes)

## map the numeric to file
mapFileSet(fset, 's1', hypothetical)

## read it from file
fset <- readFileSet('mybetas2')
```

```
## get data  
sliceFileSet(fset, 's1', 'cg00000292')
```

---

readIDATpair

*Import a pair of IDATs from one sample*

---

### Description

The function takes a prefix string that are shared with `_Grn.idat` and `_Red.idat`. The function returns a `SigDF`.

### Usage

```
readIDATpair(  
  prefix.path,  
  manifest = NULL,  
  platform = "",  
  controls = NULL,  
  verbose = FALSE  
)
```

### Arguments

<code>prefix.path</code>	sample prefix without <code>_Grn.idat</code> and <code>_Red.idat</code>
<code>manifest</code>	optional design manifest file
<code>platform</code>	EPIC, HM450 and HM27 etc.
<code>controls</code>	optional control probe manifest file
<code>verbose</code>	be verbose? (FALSE)

### Value

a `SigDF`

### Examples

```
sdf <- readIDATpair(sub('_Grn.idat', '', system.file(  
  "extdata", "4207113116_A_Grn.idat", package = "sesameData")))
```

---

recommendedMaskNames    *Recommended mask names for each Infinium platform*

---

**Description**

The returned name is the db name used in KYCG.mask

**Usage**

```
recommendedMaskNames()
```

**Value**

a named list of mask names

**Examples**

```
recommendedMaskNames()[["EPIC"]]
recommendedMaskNames()[["EPICv2"]]
```

---

reIdentify                    *Re-identify IDATs by restoring scrambled SNP intensities*

---

**Description**

This requires setting a seed with a secret number that was used to de-identify the IDAT (see example). This requires a secret number that was used to de-identify the IDAT

**Usage**

```
reIdentify(path, out_path = NULL, snps = NULL, mft = NULL)
```

**Arguments**

path	input IDAT file
out_path	output IDAT file
snps	SNP definition, if not given, default to SNP probes
mft	sesame-compatible manifest if non-standard

**Value**

NULL, changes made to the IDAT files

**Examples**

```
temp_out <- tempfile("test")

set.seed(123)
reIdentify(system.file(
  "extdata", "4207113116_A_Grn.idat", package = "sesameData"), temp_out)
unlink(temp_out)
```

---

resetMask	<i>Reset Masking</i>
-----------	----------------------

---

**Description**

Reset Masking

**Usage**

```
resetMask(sdf, verbose = FALSE)
```

**Arguments**

sdf	a SigDF
verbose	print more messages

**Value**

a new SigDF with mask reset to all FALSE

**Examples**

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
sum(sdf$mask)
sdf <- addMask(sdf, c("cg14057072", "cg22344912"))
sum(sdf$mask)
sum(resetMask(sdf)$mask)
```

---

scrub	<i>SCRUB background correction</i>
-------	------------------------------------

---

**Description**

This function takes a SigDF and returns a modified SigDF with background subtracted. scrub subtracts residual background using background median

**Usage**

```
scrub(sdf)
```

**Arguments**

sdf                    a SigDF

**Details**

This function is meant to be used after noob.

**Value**

a new SigDF with noob background correction

**Examples**

```
sdf <- sesameDataGet('EPIC.1.SigDF')
sdf.nb <- noob(sdf)
sdf.nb.scrub <- scrub(sdf.nb)
```

---

scrubSoft	<i>SCRUB background correction</i>
-----------	------------------------------------

---

**Description**

This function takes a SigDF and returns a modified SigDF with background subtracted. scrubSoft subtracts residual background using a noob-like procedure.

**Usage**

```
scrubSoft(sdf)
```

**Arguments**

sdf                    a SigDF

**Details**

This function is meant to be used after noob.

**Value**

a new SigDF with noob background correction

**Examples**

```
sdf <- sesameDataGet('EPIC.1.SigDF')
sdf.nb <- noob(sdf)
sdf.nb.scrubSoft <- scrubSoft(sdf.nb)
```

---

SDFcollapseToPfx	<i>collapse to probe prefix</i>
------------------	---------------------------------

---

**Description**

collapse to probe prefix

**Usage**

```
SDFcollapseToPfx(sdf)
```

**Arguments**

sdf                    a SigDF object

**Value**

a data frame with updated Probe\_ID

---

sdfPlatform	<i>Convenience function to output platform attribute of SigDF</i>
-------------	---

---

**Description**

Convenience function to output platform attribute of SigDF

**Usage**

```
sdfPlatform(sdf, verbose = FALSE)
```

**Arguments**

sdf                    a SigDF object  
 verbose                print more messages

**Value**

the platform string for the SigDF object

**Examples**

```
sesameDataCache()  
sdf <- sesameDataGet('EPIC.1.SigDF')  
sdfPlatform(sdf)
```

---

sdf_read_table	<i>read a table file to SigDF</i>
----------------	-----------------------------------

---

**Description**

read a table file to SigDF

**Usage**

```
sdf_read_table(fname, platform = NULL, verbose = FALSE, ...)
```

**Arguments**

fname	file name
platform	array platform (will infer if not given)
verbose	print more information
...	additional argument to read.table

**Value**

read table file to SigDF

**Examples**

```
sesameDataCache() # if not done yet  
sdf <- sesameDataGet('EPIC.1.SigDF')  
fname <- sprintf("%s/sigdf.txt", tempdir())  
sdf_write_table(sdf, file=fname)  
sdf2 <- sdf_read_table(fname)
```

---

sdf_write_table	<i>write SigDF to table file</i>
-----------------	----------------------------------

---

**Description**

write SigDF to table file

**Usage**

```
sdf_write_table(sdf, ...)
```

**Arguments**

sdf	the SigDF to output
...	additional argument to write.table

**Value**

write SigDF to table file

**Examples**

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
sdf_write_table(sdf, file=sprintf("%s/sigdf.txt", tempdir()))
```

---

searchIDATprefixes	<i>Identify IDATs from a directory</i>
--------------------	--

---

**Description**

The input is the directory name as a string. The function identifies all the IDAT files under the directory. The function returns a vector of such IDAT prefixes under the directory.

**Usage**

```
searchIDATprefixes(dir.name, recursive = TRUE, use.basename = TRUE)
```

**Arguments**

dir.name	the directory containing the IDAT files.
recursive	search IDAT files recursively
use.basename	basename of each IDAT path is used as sample name This won't work in rare situation where there are duplicate IDAT files.

**Value**

the IDAT prefixes (a vector of character strings).

**Examples**

```
## only search what are directly under
IDATprefixes <- searchIDATprefixes(
  system.file("extdata", "", package = "sesameData"))

## search files recursively is by default
IDATprefixes <- searchIDATprefixes(
  system.file(package = "sesameData"), recursive=TRUE)
```

---

segmentBins

*Segment bins using DNACopy*


---

**Description**

Segment bins using DNACopy

**Usage**

```
segmentBins(bin.signals, bin.coords)
```

**Arguments**

bin.signals	bin signals (input)
bin.coords	bin coordinates

**Value**

segment signal data frame

---

sesameAnno\_buildAddressFile

*Build sesame ordering address file from tsv*


---

**Description**

Build sesame ordering address file from tsv

**Usage**

```
sesameAnno_buildAddressFile(tsv)
```

**Arguments**

tsv a platform name, a file path or a tibble/data.frame manifest file

**Value**

a list of ordering and controls

**Examples**

```
## Not run:
## download manifest from
## http://zwdzwd.github.io/InfiniumAnnotation
tsv_path = sesameAnno_download("HM450.hg38.manifest.tsv.gz")
addr <- sesameAnno_buildAddressFile(tsv_path)

## End(Not run)
```

---

sesameAnno\_buildManifestGRanges

*Build manifest GRanges from tsv*

---

**Description**

manifest tsv files can be downloaded from <http://zwdzwd.github.io/InfiniumAnnotation>

**Usage**

```
sesameAnno_buildManifestGRanges(
  tsv,
  genome = NULL,
  decoy = FALSE,
  columns = NULL
)
```

**Arguments**

tsv a file path, a platform (e.g., EPIC), or a tibble/data.frame object

genome a genome string, e.g., hg38, mm10

decoy consider decoy sequence in chromosome order

columns the columns to include in the GRanges

**Value**

GRanges

## Examples

```
## Not run:
## download tsv from
## http://zwdzwd.github.io/InfiniumAnnotation
tsv_path = sesameAnno_download("HM450.hg38.manifest.tsv.gz")
gr <- sesameAnno_buildManifestGRanges(tsv_path)

## End(Not run)
```

---

sesameAnno\_download     *Download SeSAmE annotation files*

---

## Description

see also <http://zwdzwd.github.io/InfiniumAnnotation>

## Usage

```
sesameAnno_download(
  url,
  destfile = tempfile(basename(url)),
  base = "https://github.com/zhou-lab/InfiniumAnnotationV1/raw/main/"
)
```

## Arguments

url	url or title of the annotation file
destfile	download to this file, a temp file if unspecified
base	base url, usually fixed.

## Details

This function acts similarly as `sesameAnno_get` except that it directly download files without invoking `BiocFileCache`. This is needed in some situation because `BiocFileCache` may change the file name and downstream program may depend on the correct file names. It also lets you download files in a cleaner way without routing through `BiocFileCache`

## Value

the path to downloaded file

**Examples**

```
## avoid testing as this function uses external host
if (FALSE) {
  sesameAnno_download("Test/3999492009_R01C01_Grn.idat")
  sesameAnno_download("EPIC.hg38.manifest.tsv.gz")
  sesameAnno_download("EPIC.hg38.snp.tsv.gz")
}
```

---

sesameAnno_get	<i>download Infinium manifest from the associated Github repository</i>
----------------	---

---

**Description**

Since most of the annotation is not essential to sesame functioning, sesameData package no longer host the full manifest. This is the command to use to retrieve the full manifest and other annotation from the following Github host:

**Usage**

```
sesameAnno_get(title, return_path = FALSE, version = 1)
```

**Arguments**

title	the title of the resource
return_path	return cached file path
version	release version, default is the latest

**Details**

<https://github.com/zhou-lab/InfiniumAnnotationV1>

Please check the repo itself for what is available. See also <http://zwdzwd.github.io/InfiniumAnnotation>

Unless `return_path = TRUE`, This function calls import function depending on the resource name suffix. If the url ends with `.rds`, it will use `readRDS`. If the url ends with `.tsv.gz` it will use `read_tsv`. For all other cases, the function will return the cached file name.

This function replaces `sesameAnno_getManifestDF`.

**Value**

tibble

## Examples

```
## avoid testing since it depends on external host
if (FALSE) {
  mapping <- sesameAnno_get("Mammal40/hg38.tsv.gz")
  annoI <- sesameAnno_get("Anno/EPIC/EPIC.hg19.typeI_overlap_b151.rds")
  mft <- sesameAnno_get("Anno/MM285/MM285.mm10.manifest.tsv.gz")
}
```

---

sesameAnno\_readManifestTSV

*Read manifest file to a tsv format*

---

## Description

Read manifest file to a tsv format

## Usage

```
sesameAnno_readManifestTSV(tsv_fn)
```

## Arguments

tsv\_fn            tsv file path

## Value

a manifest as a tibble

## Examples

```
## Not run:
## download manifest from
## http://zwdzwd.github.io/InfiniumAnnotation
tsv_path = sesameAnno_download("HM450.hg38.manifest.tsv.gz")
mft <- sesameAnno_readManifestTSV(tsv_path)

## End(Not run)
```

---

sesameData\_getAnno      *retrieve additional annotation files*

---

**Description**

retrieve additional annotation files

**Usage**

```
sesameData_getAnno(title, version = 1, dest_dir = NULL)
```

**Arguments**

title	title of the annotation file
version	version number
dest_dir	if not NULL, download to this directory

**Value**

annotation file

**Examples**

```
cat("Deprecated!")
```

---

sesameQC-class      *An S4 class to hold QC statistics*

---

**Description**

An S4 class to hold QC statistics

**Value**

sesameQC object

**Slots**

stat a list to store qc stats

---

sesameQC_calcStats	<i>Calculate QC statistics</i>
--------------------	--------------------------------

---

## Description

It is a function to call one or multiple sesameQC\_calcStats functions

## Usage

```
sesameQC_calcStats(sdf, funs = NULL)
```

## Arguments

sdf	a SigDF object
funs	a sesameQC_calcStats_* function or a list of them default to all functions. One can also use a string such as "detection" or c("detection", "intensity") to reduce typing

## Details

currently supporting: detection, intensity, numProbes, channel, dyeBias, betas

## Value

a sesameQC object

## Examples

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
sesameQC_calcStats(sdf)
sesameQC_calcStats(sdf, "detection")
sesameQC_calcStats(sdf, c("detection", "channel"))
## retrieve stats as a list
sesameQC_getStats(sesameQC_calcStats(sdf, "detection"))
## or as data frames
as.data.frame(sesameQC_calcStats(sdf, "detection"))
```

---

sesameQC\_getStats      *Get stat numbers from an sesameQC object*

---

### Description

Get stat numbers from an sesameQC object

### Usage

```
sesameQC_getStats(qc, stat_names = NULL, drop = TRUE)
```

### Arguments

qc                    a sesameQC object  
stat\_names            which stat(s) to retrieve, default to all.  
drop                   whether to drop to a string when stats\_names has only one element.

### Value

a list of named stats to be retrieved

### Examples

```
sdf <- sesameDataGet("EPIC.1.SigDF")
qc <- sesameQC_calcStats(sdf, "detection")
sesameQC_getStats(qc, "frac_dt")
```

---

sesameQC\_plotBar      *Bar plots for sesameQC*

---

### Description

By default, it plots median\_beta\_cg, median\_beta\_ch, RGratio, RGdistort, frac\_dt

### Usage

```
sesameQC_plotBar(qcs, keys = NULL)
```

### Arguments

qcs                    a list of SigDFs  
keys                    optional, other key to plot, instead of the default keys can be found in the parenthesis of the print output of each sesameQC output.

**Value**

a bar plot comparing different QC metrics

**Examples**

```
sesameDataCache() # if not done yet
sdfs <- sesameDataGet("EPIC.5.SigDF.normal")[1:2]
sesameQC_plotBar(lapply(sdfs, sesameQC_calcStats, "detection"))
```

---

```
sesameQC_plotBetaByDesign
```

*Plot betas distinguishing different Infinium chemistries*

---

**Description**

Plot betas distinguishing different Infinium chemistries

**Usage**

```
sesameQC_plotBetaByDesign(  
  sdf,  
  prep = NULL,  
  legend_pos = "top",  
  mar = c(3, 3, 1, 1),  
  main = "",  
  ...  
)
```

**Arguments**

sdf	SigDF
prep	prep codes to step through
legend_pos	legend position (default: top)
mar	margin of layout when showing steps of prep
main	main title in plots
...	additional options to plot

**Value**

create a density plot

**Examples**

```
sdf <- sesameDataGet("EPIC.1.SigDF")
sesameQC_plotBetaByDesign(sdf, prep="DB")
```

---

```
sesameQC_plotHeatSNPs Plot SNP heatmap
```

---

**Description**

Plot SNP heatmap

**Usage**

```
sesameQC_plotHeatSNPs(sdfs, cluster = TRUE, filter.nonvariant = TRUE)
```

**Arguments**

```
sdfs          beta value matrix, row: probes; column: samples
cluster       show clustered heatmap
filter.nonvariant
               whether to filter nonvariant (range < 0.3)
```

**Value**

a grid graphics object

**Examples**

```
sdfs <- sesameDataGet("EPIC.5.SigDF.normal")[1:2]
plt <- sesameQC_plotHeatSNPs(sdfs, filter.nonvariant = FALSE)
```

---

```
sesameQC_plotIntensVsBetas
```

*Plot Total Signal Intensities vs Beta Values This plot is helpful in revealing the extent of signal background and dye bias.*

---

**Description**

Plot Total Signal Intensities vs Beta Values This plot is helpful in revealing the extent of signal background and dye bias.

**Usage**

```
sesameQC_plotIntensVsBetas(
  sdf,
  mask = TRUE,
  use_max = FALSE,
  intens.range = c(5, 15),
  pal = "whiteturbo",
  ...
)
```

**Arguments**

sdf	a SigDF
mask	whether to remove probes that are masked
use_max	to use max(M,U) or M+U
intens.range	plot range of signal intensity
pal	color palette, whiteturbo, whiteblack, whitejet
...	additional arguments to smoothScatter

**Value**

create a total signal intensity vs beta value plot

**Examples**

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
sesameQC_plotIntensVsBetas(sdf)
```

---

sesameQC\_plotRedGrnQQ *Plot red-green QQ-Plot using Infinium-I Probes*

---

**Description**

Plot red-green QQ-Plot using Infinium-I Probes

**Usage**

```
sesameQC_plotRedGrnQQ(sdf, main = "R-G QQ Plot", ...)
```

**Arguments**

sdf	a SigDF
main	plot title
...	additional options to qqplot

**Value**

create a qqplot

**Examples**

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
sesameQC_plotRedGrnQQ(sdf)
```

---

sesameQC\_rankStats      *This function compares the input sample with public data. Only overlapping metrics will be compared.*

---

### Description

This function compares the input sample with public data. Only overlapping metrics will be compared.

### Usage

```
sesameQC_rankStats(qc, publicQC = NULL, platform = "EPIC")
```

### Arguments

qc	a sesameQC object
publicQC	public QC statistics, filtered from e.g.: EPIC.publicQC, MM285.publicQC and Mammal40.publicQC
platform	EPIC, MM285 or Mammal40, used when publicQC is not given

### Value

a sesameQC

### Examples

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
sesameQC_rankStats(sesameQC_calcStats(sdf, "intensity"))
```

---

sesame\_checkVersion      *Check SeSAmE versions*

---

### Description

print package version of sesame and depended packages to help troubleshoot installation issues.

### Usage

```
sesame_checkVersion()
```

### Value

print the version of sesame, sesameData, bioconductor and R

**Examples**

```
sesame_checkVersion()
```

---

sesamize	<i>sesamize function is deprecated. Please check <a href="https://github.com/zwdzwd/sesamize">https://github.com/zwdzwd/sesamize</a> for previous scripts</i>
----------	---

---

**Description**

sesamize function is deprecated. Please check <https://github.com/zwdzwd/sesamize> for previous scripts

**Usage**

```
sesamize(...)
```

**Arguments**

... arguments for sesamize

**Value**

a message text for deprecated function

**Examples**

```
cat("Deprecated. see https://github.com/zwdzwd/sesamize")
```

---

setMask	<i>Set mask to only the probes specified</i>
---------	--

---

**Description**

Set mask to only the probes specified

**Usage**

```
setMask(sdf, probes)
```

**Arguments**

sdf a SigDF  
 probes a vector of probe IDs or a logical vector with TRUE representing masked probes

**Value**

a SigDF with added mask

**Examples**

```
sdf <- sesameDataGet('EPIC.1.SigDF')
sum(sdf$mask)
sum(setMask(sdf, "cg14959801")$mask)
sum(setMask(sdf, c("cg14057072", "cg22344912"))$mask)
```

---

SigDF

*SigDF validation from a plain data frame*

---

**Description**

SigDF validation from a plain data frame

**Usage**

```
SigDF(df, platform = "EPIC", ctl = NULL)
```

**Arguments**

df	a data.frame with Probe_ID, MG, MR, UG, UR, col and mask
platform	a string to specify the array platform
ctl	optional control probe data frame

**Value**

a SigDF object

**Examples**

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
```

---

signalMU	<i>report M and U for regular probes</i>
----------	--

---

**Description**

report M and U for regular probes

**Usage**

```
signalMU(sdf, mask = TRUE, MU = FALSE)
```

**Arguments**

sdf	a SigDF
mask	whether to apply mask
MU	add a column for M+U

**Value**

a data frame of M and U columns

**Examples**

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
head(signalMU(sdf))
```

---

sliceFileSet	<i>Slice a fileSet with samples and probes</i>
--------------	--

---

**Description**

Slice a fileSet with samples and probes

**Usage**

```
sliceFileSet(fset, samples = fset$samples, probes = fset$probes, memmax = 10^5)
```

**Arguments**

fset	a sesame::fileSet, as obtained via readFileSet
samples	samples to query (default to all samples)
probes	probes to query (default to all probes)
memmax	maximum items to read from file to memory, to protect from accidental memory congestion.

**Value**

a numeric matrix of length(samples) columns and length(probes) rows

**Examples**

```
## create two samples
fset <- initFileSet('mybetas2', 'HM27', c('s1','s2'))

## a hypothetical numeric array (can be beta values, intensities etc)
hypothetical <- setNames(runif(fset$n), fset$probes)

## map the numeric to file
mapFileSet(fset, 's1', hypothetical)

## get data
sliceFileSet(fset, 's1', 'cg00000292')
```

---

summaryExtractTest	<i>Extract slope information from DMLSummary</i>
--------------------	--

---

**Description**

Extract slope information from DMLSummary

**Usage**

```
summaryExtractTest(smry)
```

**Arguments**

smry                    DMLSummary from DML command

**Value**

a table of slope and p-value

**Examples**

```
sesameDataCache() # in case not done yet
data <- sesameDataGet('HM450.76.TCGA.matched')
smry <- DML(data$betas[1:10,], ~type, meta=data$sampleInfo)
slopes <- summaryExtractTest(smry)

sesameDataGet_resetEnv()
```

---

testEnrichment	<i>testEnrichment tests for the enrichment of set of probes (query set) in a number of features (database sets).</i>
----------------	--

---

### Description

testEnrichment tests for the enrichment of set of probes (query set) in a number of features (database sets).

### Usage

```
testEnrichment(
  query,
  databases = NULL,
  universe = NULL,
  alternative = "greater",
  include_genes = FALSE,
  platform = NULL,
  silent = FALSE
)
```

### Arguments

query	Vector of probes of interest (e.g., significant probes)
databases	List of vectors corresponding to the database sets of interest with associated meta data as an attribute to each element. Optional. (Default: NA)
universe	Vector of probes in the universe set containing all of the probes to be considered in the test. If it is not provided, it will be inferred from the provided platform. (Default: NA).
alternative	"two.sided", "greater", or "less"
include_genes	include gene link enrichment testing
platform	String corresponding to the type of platform to use. Either MM285, EPIC, HM450, or HM27. If it is not provided, it will be inferred from the query set probeIDs (Default: NA).
silent	output message? (Default: FALSE)

### Value

A data frame containing features corresponding to the test estimate, p-value, and type of test.

### Examples

```
library(SummarizedExperiment)
df <- rowData(sesameDataGet('MM285.tissueSignature'))
query <- df$Probe_ID[df$branch == "B_cell"]
res <- testEnrichment(query, "chromHMM", platform="MM285")
```

```
sesameDataGet_resetEnv()
```

---

```
testEnrichmentFisher  testEnrichmentFisher uses Fisher's exact test to estimate the association between two categorical variables.
```

---

### Description

Estimates log2 Odds ratio

### Usage

```
testEnrichmentFisher(query, database, universe, alternative = "greater")
```

### Arguments

query	Vector of probes of interest (e.g., significant probes)
database	Vectors corresponding to the database set of interest with associated meta data as an attribute to each element.
universe	Vector of probes in the universe set containing all of
alternative	greater or two.sided (default: greater) the probes to be considered in the test. (Default: NULL)

### Value

A DataFrame with the estimate/statistic, p-value, and name of test for the given results.

---

```
testEnrichmentGene  Convenient function for testing enrichment of gene linkage
```

---

### Description

Convenient function for testing enrichment of gene linkage

### Usage

```
testEnrichmentGene(query, platform = NULL, silent = FALSE, ...)
```

### Arguments

query	probe set of interest
platform	string corresponding to the type of platform to use. Either MM285, EPIC, HM450, or HM27. If it is not provided, it will be inferred from the query set probe IDs.
silent	whether to output message
...	addition argument provided to testEnrichment

**Value**

A data frame containing features corresponding to the test estimate, p-value, and type of test etc.

**Examples**

```
query <- c("cg04707299", "cg13380562", "cg00480749")
testEnrichment(query, platform = "EPIC")
```

---

testEnrichmentSEA      *uses the GSEA-like test to estimate the association of a categorical variable against a continuous variable.*

---

**Description**

estimate represent enrichment score and negative estimate indicate a test for depletion

**Usage**

```
testEnrichmentSEA(
  query,
  databases,
  platform = NULL,
  silent = FALSE,
  precise = FALSE,
  prepPlot = FALSE
)
```

**Arguments**

query	query, if numerical, expect categorical database, if categorical expect numerical database
databases	database, numerical or categorical, but needs to be different from query
platform	EPIC, MM285, ..., infer if not given
silent	suppress message (default: FALSE)
precise	whether to compute precise p-value (up to numerical limit) of interest.
prepPlot	return the raw enrichment scores and presence vectors for plotting

**Value**

A DataFrame with the estimate/statistic, p-value, and name of test for the given results.

**Examples**

```
query <- KYCG_getDBs("KYCG.MM285.designGroup")["TSS"]
res <- testEnrichmentSEA(query, "MM285.seqContextN")
```

---

testEnrichmentSpearman

*testEnrichmentSpearman uses the Spearman statistical test to estimate the association between two continuous variables.*

---

### Description

testEnrichmentSpearman uses the Spearman statistical test to estimate the association between two continuous variables.

### Usage

```
testEnrichmentSpearman(query, database)
```

### Arguments

query	Vector of probes of interest (e.g., significant probes)
database	List of vectors corresponding to the database set of interest with associated meta data as an attribute to each element.

### Value

A DataFrame with the estimate/statistic, p-value, and name of test for the given results.

---

totalIntensities      *M+U Intensities Array*

---

### Description

The function takes one single SigDF and computes total intensity of all the in-band measurements by summing methylated and unmethylated alleles. This function outputs a single numeric for the mean.

### Usage

```
totalIntensities(sdf, mask = FALSE)
```

### Arguments

sdf	a SigDF
mask	whether to mask probes using mask column

### Value

a vector of M+U signal for each probe

**Examples**

```
sesameDataCache() # if not done yet
sdf <- sesameDataGet('EPIC.1.SigDF')
intensities <- totalIntensities(sdf)
```

---

`twoCompsEst2`*Estimate the fraction of the 2nd component in a 2-component mixture*

---

**Description**

Estimate the fraction of the 2nd component in a 2-component mixture

**Usage**

```
twoCompsEst2(  
  pop1,  
  pop2,  
  target,  
  use.ave = TRUE,  
  diff_1m2u = NULL,  
  diff_1u2m = NULL  
)
```

**Arguments**

<code>pop1</code>	Reference methylation level matrix for population 1
<code>pop2</code>	Reference methylation level matrix for population 2
<code>target</code>	Target methylation level matrix to be analyzed
<code>use.ave</code>	use population average in selecting differentially methylated probes
<code>diff_1m2u</code>	A vector of differentially methylated probes (methylated in population 1 but unmethylated in population 2)
<code>diff_1u2m</code>	A vector of differentially methylated probes (unmethylated in population 1 but methylated in population 2)

**Value**

Estimate of the 2nd component in the 2-component mixture

---

updateSigDF	<i>Set color and mask using strain/species-specific manifest</i>
-------------	--

---

**Description**

also sets attr("species")

**Usage**

```
updateSigDF(sdf, species = NULL, strain = NULL, addr = NULL, verbose = FALSE)
```

**Arguments**

sdf	a SigDF
species	the species the sample is considered to be
strain	the strain the sample is considered to be
addr	species-specific address species, optional
verbose	print more messages

**Value**

a SigDF with updated color channel and mask

**Examples**

```
sdf <- sesameDataGet('Mamma140.1.SigDF')  
sdf_mouse <- updateSigDF(sdf, species="mus_musculus")
```

---

visualizeGene	<i>Visualize Gene</i>
---------------	-----------------------

---

**Description**

Visualize the beta value in heatmaps for a given gene. The function takes a gene name which is taken from the UCSC refGene. It searches all the transcripts for the given gene and optionally extend the span by certain number of base pairs. The function also takes a beta value matrix with sample names on the columns and probe names on the rows. The function can also work on different genome builds (default to hg38, can be hg19).

**Usage**

```
visualizeGene(
  gene_name,
  betas,
  platform = NULL,
  genome = NULL,
  upstream = 2000,
  dwstream = 2000,
  ...
)
```

**Arguments**

gene_name	gene name
betas	beta value matrix (row: probes, column: samples)
platform	HM450, EPIC, or MM285 (default)
genome	hg19, hg38, or mm10 (default)
upstream	distance to extend upstream
dwstream	distance to extend downstream
...	additional options, see visualizeRegion, assemble_plots

**Value**

None

**Examples**

```
betas <- sesameDataGet('HM450.76.TCGA.matched')$betas
visualizeGene('ADA', betas, 'HM450')
```

---

visualizeProbes	<i>Visualize Region that Contains the Specified Probes</i>
-----------------	--

---

**Description**

Visualize the beta value in heatmaps for the genomic region containing specified probes. The function works only if specified probes can be spanned by a single genomic region. The region can cover more probes than specified. Hence the plotting heatmap may encompass more probes. The function takes as input a string vector of probe IDs (cg/ch/rs-numbers). if draw is FALSE, the function returns the subset beta value matrix otherwise it returns the grid graphics object.

**Usage**

```
visualizeProbes(
  probeNames,
  betas,
  platform = NULL,
  genome = NULL,
  upstream = 1000,
  dwestream = 1000,
  ...
)
```

**Arguments**

probeNames	probe names
betas	beta value matrix (row: probes, column: samples)
platform	HM450, EPIC or MM285 (default)
genome	hg19, hg38 or mm10 (default)
upstream	distance to extend upstream
dwestream	distance to extend downstream
...	additional options, see visualizeRegion and assemble_plots

**Value**

None

**Examples**

```
betas <- sesameDataGet('HM450.76.TCGA.matched')$betas
visualizeProbes(c('cg22316575', 'cg16084772', 'cg20622019'), betas, 'HM450')
```

---

visualizeRegion

*Visualize Region*

---

**Description**

The function takes a genomic coordinate (chromosome, start and end) and a beta value matrix (probes on the row and samples on the column). It plots the beta values as a heatmap for all probes falling into the genomic region. If 'draw=TRUE' the function returns the plotted grid graphics object. Otherwise, the selected beta value matrix is returned. 'cluster.samples=TRUE/FALSE' controls whether hierarchical clustering is applied to the subset beta value matrix.

**Usage**

```
visualizeRegion(
  chrm,
  beg,
  end,
  betas,
  platform = NULL,
  genome = NULL,
  draw = TRUE,
  cluster.samples = FALSE,
  na.rm = FALSE,
  nprobes.max = 1000,
  txn.types = "protein_coding",
  txn.font.size = 6,
  ...
)
```

**Arguments**

chrm	chromosome
beg	begin of the region
end	end of the region
betas	beta value matrix (row: probes, column: samples)
platform	EPIC, HM450, or MM285
genome	hg38, mm10, ..., will infer if not given. For additional mapping, download the GRanges object from <a href="http://zwdzwd.github.io/InfiniumAnnotation">http://zwdzwd.github.io/InfiniumAnnotation</a> and provide the following argument ..., genome = sesameAnno_buildManifestGRanges("downloaded_file"),... to this function.
draw	draw figure or return betas
cluster.samples	whether to cluster samples
na.rm	remove probes with all NA.
nprobes.max	maximum number of probes to plot
txn.types	default to protein_coding, use NULL for all
txn.font.size	transcript name font size
...	additional options, see assemble_plots

**Value**

graphics or a matrix containing the captured beta values

**Examples**

```
betas <- sesameDataGet('HM450.76.TCGA.matched')$betas
visualizeRegion('chr20', 44648623, 44652152, betas, 'HM450')
```

---

visualizeSegments      *Visualize segments*

---

**Description**

The function takes a CNSegment object obtained from cnSegmentation and plot the bin signals and segments (as horizontal lines).

**Usage**

```
visualizeSegments(seg, to.plot = NULL)
```

**Arguments**

seg	a CNSegment object
to.plot	chromosome to plot (by default plot all chromosomes)

**Details**

require ggplot2, scales

**Value**

plot graphics

**Examples**

```
sesameDataCache()  
## sdf <- sesameDataGet('EPIC.1.SigDF')  
## sdfs.normal <- sesameDataGet('EPIC.5.SigDF.normal')  
## seg <- cnSegmentation(sdf, sdfs.normal)  
## visualizeSegments(seg)  
  
sesameDataGet_resetEnv()
```

# Index

- \* **DNAMethylation**
  - sesame-package, 5
- \* **Microarray**
  - sesame-package, 5
- \* **QualityControl**
  - sesame-package, 5
- \_PACKAGE (sesame-package), 5
  
- addMask, 6
- aggregateTestEnrichments, 7
- assemble\_plots, 7
  
- betasCollapseToPfx, 9
- BetaValueToMValue, 9
- binSignals, 10
- bisConversionControl, 10
  
- calcEffectSize, 11
- checkLevels, 12
- chipAddressToSignal, 13
- cnSegmentation, 13
- compareDatbaseSetOverlap, 14
- compareMouseStrainReference, 15
- compareMouseTissueReference, 16
- compareReference, 16
- controls, 17
- convertTo, 18
- createDBNetwork, 19
- createUCSCtrack, 19
  
- dataFrame2sesameQC, 20
- dbStats, 20
- deIdentify, 21
- detectionPnegEcdf, 22
- diffRefSet, 23
- dmContrasts, 23
- DML, 24
- DMLpredict, 25
- DMR, 26
- dyeBiasCorr, 27
  
- dyeBiasCorrMostBalanced, 28
- dyeBiasCorrTypeINorm (dyeBiasNL), 29
- dyeBiasL, 28
- dyeBiasNL, 29
  
- ELBAR, 30
- estimateCellComposition, 31
- estimateLeukocyte, 31
  
- formatVCF, 32
  
- getAFs, 33
- getAFTYPEIbySumAlleles, 34
- getBetas, 34
- getBinCoordinates, 35
- getMask, 36
- getRefSet, 36
- getSexInfo, 37
  
- imputeTo, 38
- inferEthnicity, 38
- inferInfiniumIChannel, 39
- inferSex, 40
- inferSexKaryotypes, 41
- inferSpecies, 41
- inferStrain, 42
- inferTissue, 43
- initFileSet, 44
  
- KYCG\_annoProbes, 45
- KYCG\_buildGeneDBs, 46
- KYCG\_getDBs, 47
- KYCG\_listDBGroups, 48
- KYCG\_loadDBs, 48
- KYCG\_plotBar, 49
- KYCG\_plotDot, 50
- KYCG\_plotEnrichAll, 51
- KYCG\_plotLollipop, 51
- KYCG\_plotManhattan, 52
- KYCG\_plotMeta, 53
- KYCG\_plotMetaEnrichment, 54

KYCG\_plotPointRange, 54  
KYCG\_plotSetEnrichment, 55  
KYCG\_plotVolcano, 56  
KYCG\_plotWaterfall, 56

listAvailableMasks, 57

mapFileSet, 58  
mapToMammal40, 58  
matchDesign, 59  
meanIntensity, 60  
medianTotalIntensity, 60  
MValueToBetaValue, 61

negControls, 62  
noMasked, 62  
noob, 63  
normControls, 63

openSesame, 64  
openSesameToFile, 65

palgen, 66  
parseGEOsignalMU, 66  
pOOBAH, 67  
predictAge, 68  
predictAgeHorvath353, 69  
predictAgeSkinBlood, 69  
predictMouseAgeInMonth, 70  
prefixMask, 71  
prefixMaskButC, 71  
prefixMaskButCG, 72  
prepSesame, 72  
prepSesameList, 73  
print.DMLSummary, 74  
print.fileSet, 74  
probeID\_designType, 75  
probeSuccessRate, 76

qualityMask, 76

readFileSet, 77  
readIDATpair, 78  
recommendedMaskNames, 79  
reIdentify, 79  
resetMask, 80

scrub, 81  
scrubSoft, 81  
sdf\_read\_table, 83  
sdf\_write\_table, 84  
SDFcollapseToPfx, 82  
sdfPlatform, 82  
searchIDATprefixes, 84  
segmentBins, 85  
sesame (sesame-package), 5  
sesame-package, 5  
sesame\_checkVersion, 96  
sesameAnno\_buildAddressFile, 85  
sesameAnno\_buildManifestGRanges, 86  
sesameAnno\_download, 87  
sesameAnno\_get, 88  
sesameAnno\_readManifestTSV, 89  
sesameData\_getAnno, 90  
sesameQC-class, 90  
sesameQC\_calcStats, 91  
sesameQC\_getStats, 92  
sesameQC\_plotBar, 92  
sesameQC\_plotBetaByDesign, 93  
sesameQC\_plotHeatSNPs, 94  
sesameQC\_plotIntensVsBetas, 94  
sesameQC\_plotRedGrnQQ, 95  
sesameQC\_rankStats, 96  
sesamize, 97  
setMask, 97  
SigDF, 98  
signalMU, 99  
sliceFileSet, 99  
summaryExtractTest, 100

testEnrichment, 101  
testEnrichmentFisher, 102  
testEnrichmentGene, 102  
testEnrichmentSEA, 103  
testEnrichmentSpearman, 104  
totalIntensities, 104  
twoCompsEst2, 105

updateSigDF, 106

visualizeGene, 106  
visualizeProbes, 107  
visualizeRegion, 108  
visualizeSegments, 110