

# Package ‘PhenStat’

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**Type** Package

**Title** Statistical analysis of phenotypic data

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**Imports** methods, car, nlme, nortest, MASS, logistf

**Suggests** RUnit, BiocGenerics

**Description** Package contains methods for statistical analysis of phenotypic data.

**License** file LICENSE

**NeedsCompilation** no

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*analysedDataset*      *Method "analysedDataset"*

---

### **Description**

Method *analysedDataset* returns subset of the original dataset that was analysed

### **Methods**

signature(obj = "PhenTestResult")

---

*analysedDatasetPhenList*  
*Method "analysedDatasetPhenList"*

---

### **Description**

Method *analysedDatasetPhenList* returns subset of the original dataset that was analysed in the form of PhenList object

### **Methods**

signature(obj = "PhenTestResult")

---

analysedSubset	<i>Method "analysedSubset"</i>
----------------	--------------------------------

---

**Description**

Method analysedSubset returns name of the subset that was analysed by RR or FE frameworks

**Methods**

signature(obj = "htestPhenStat")

---

analysisResults	<i>Method "analysisResults"</i>
-----------------	---------------------------------

---

**Description**

Method analysisResults returns analysis results

**Methods**

signature(obj = "PhenTestResult")

---

batchIn	<i>Method "batchIn"</i>
---------	-------------------------

---

**Description**

Method batchIn returns TRUE/FALSE values depending on the batch column presence/absence in the dataset

**Methods**

signature(obj = "PhenList")

signature(obj = "PhenTestResult")

---

boxplotResidualBatch    *Method "boxplotResidualBatch"*

---

## Description

Graph function for the Mixed Model framework's results. Creates a box plot with residue versus batch split by genotype.

## Usage

```
boxplotResidualBatch(phenTestResult, outputMessages=TRUE)
```

## Arguments

phenTestResult    instance of the [PhenTestResult](#) class that comes from the function [testDataset](#); mandatory argument

outputMessages    flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

## Author(s)

Natalja Kurbatova, Natasha Karp, Jeremy Mason

## References

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

## See Also

[PhenList](#) and [PhenTestResult](#)

## Examples

```
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
result <- testDataset(test,
  depVariable="Lean.Mass")
boxplotResidualBatch(result)
```

---

boxplotSexGenotype      *Method "boxplotSexGenotype"*

---

### Description

Graph function for the phenotypic dataset. Creates a box plot split by sex and genotype.

### Usage

```
boxplotSexGenotype(phenList, depVariable=NULL, graphingName=NULL, outputMessages=TRUE)
```

### Arguments

phenList	instance of the <a href="#">PhenList</a> class; mandatory argument
depVariable	a character string defining the dependent variable of interest; mandatory argument
graphingName	a character string defining the name to be used on the graph for the dependent variable; mandatory argument
outputMessages	flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

### Author(s)

Natalja Kurbatova, Natasha Karp, Jeremy Mason

### References

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

### See Also

[PhenList](#)

### Examples

```
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
# box plot for dataset with two sexes: males and females
boxplotSexGenotype(test,
  depVariable="Bone.Mineral.Content",
  graphingName="BMC")

file <- system.file("extdata", "test4.csv", package="PhenStat")
```

```
test_1sex <- PhenList(dataset=read.csv(file),
  testGenotype="Mysm1/+")
# box plot for females only dataset
boxplotSexGenotype(test_1sex,
  depVariable="Lean.Mass",
  graphingName="Lean Mass (g)")
```

---

boxplotSexGenotypeBatch

*Method "boxplotSexGenotypeBatch"*

---

## Description

NB! Function is deprecated, please use scatterplotSexGenotypeBatch function instead. Graph function for the phenotypic dataset. Creates a box plot split by sex, genotype and batch.

Note: the batches are not ordered with time but allow assessment of how the treatment groups lie relative to the normal control variation.

## Usage

```
boxplotSexGenotypeBatch(phenList,depVariable=NULL,graphingName=NULL,outputMessages=TRUE)
```

## Arguments

phenList	instance of the <a href="#">PhenList</a> class; mandatory argument
depVariable	a character string defining the dependent variable of interest; mandatory argument
graphingName	a character string defining the name to be used on the graph for the dependent variable; mandatory argument
outputMessages	flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

## Author(s)

Natalja Kurbatova, Natasha Karp, Jeremy Mason

## References

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

## See Also

[PhenList](#)

**Examples**

```

file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
# box plot for dataset with two sexes: males and females
boxplotSexGenotypeBatch(test,
  depVariable="Bone.Mineral.Content",
  graphingName="BMC" )

file <- system.file("extdata", "test4.csv", package="PhenStat")
test_1sex <- PhenList(dataset=read.csv(file),
  testGenotype="Mysm1/+")
# box plot for females only dataset
boxplotSexGenotypeBatch(test_1sex,depVariable="Lean.Mass",
  graphingName="Lean Mass")

```

---

boxplotSexGenotypeBatchAdjusted

*Method "boxplotSexGenotypeBatchAdjusted"*

---

**Description**

Graph function for the phenotypic dataset. Creates a box plot split by sex and genotype after accounting for batch.

**Usage**

```
boxplotSexGenotypeBatchAdjusted(phenList,depVariable=NULL,graphingName=NULL,outputMessages=TRUE)
```

**Arguments**

phenList	instance of the <a href="#">PhenList</a> class; mandatory argument
depVariable	a character string defining the dependent variable of interest; mandatory argument
graphingName	a character string defining the name to be used on the graph for the dependent variable; mandatory argument
outputMessages	flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

**References**

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.



**See Also**[PhenList](#)**Examples**

```
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
# box plot for dataset with two sexes: males and females
boxplotSexGenotypeBatchAdjusted(test,
  depVariable="Bone.Mineral.Content",
  graphingName="BMC" )
```

---

`boxplotSexGenotypeResult`*Method "boxplotSexGenotypeResult"*

---

**Description**

Graph function for the phenotypic dataset. Creates a box plot split by sex and genotype. Is based on PhenTestResult object.

**Usage**

```
boxplotSexGenotypeResult(phenTestResult, graphingName=NULL, outputMessages=TRUE)
```

**Arguments**

`phenTestResult` instance of the [PhenTestResult](#) class; mandatory argument

`graphingName` a character string defining the name to be used on the graph for the dependent variable; mandatory argument

`outputMessages` flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

**References**

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

**See Also**[PhenList](#)

**Examples**

```

file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
result <- testDataset(test,
  depVariable="Lean.Mass")
# box plot for dataset with two sexes: males and females
boxplotSexGenotypeResult(result,
  graphingName="BMC")

file <- system.file("extdata", "test4.csv", package="PhenStat")
test_1sex <- PhenList(dataset=read.csv(file),
  testGenotype="Mysm1/+")
result_1sex <- testDataset(test_1sex,
  depVariable="Lean.Mass")
# box plot for females only dataset
boxplotSexGenotypeResult(result_1sex,
  graphingName="Lean Mass (g)")

```

---

boxplotSexGenotypeWeightBatchAdjusted

*Method "boxplotSexGenotypeWeightBatchAdjusted"*

---

**Description**

Graph function for the phenotypic dataset. Creates a box plot split by sex and genotype after accounting for batch and weight.

**Usage**

```
boxplotSexGenotypeWeightBatchAdjusted(phenList, depVariable=NULL, graphingName=NULL, outputMessages)
```

**Arguments**

phenList	instance of the <a href="#">PhenList</a> class; mandatory argument
depVariable	a character string defining the dependent variable of interest; mandatory argument
graphingName	a character string defining the name to be used on the graph for the dependent variable; mandatory argument
outputMessages	flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

## References

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

## See Also

[PhenList](#)

## Examples

```
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
                 testGenotype="Sparc/Sparc")
# box plot for dataset with two sexes: males and females
boxplotSexGenotypeWeightBatchAdjusted(test,
    depVariable="Bone.Mineral.Content",
    graphingName="BMC" )
```

---

categoricalBarplot      *Method "categoricalBarplot"*

---

## Description

Graph function for the Fisher Exact Test framework's results. Creates stacked bar plot(s) to compare proportions seen in a categorical variable between different genotypes. Graphs are created for all data and also for each sex individually.

## Usage

```
categoricalBarplot(phenTestResult, outputMessages=TRUE)
```

## Arguments

phenTestResult instance of the [PhenTestResult](#) class that comes from the function testDataset; mandatory argument

outputMessages flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

## Author(s)

Natalja Kurbatova, Natasha Karp, Jeremy Mason

## References

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

## See Also

[PhenList](#)

## Examples

```
file <- system.file("extdata", "test_categorical.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Aff3/Aff3")
result <- testDataset(test,
  depVariable="Thoracic.Processes",
  method="FE")
categoricalBarplot(result)
```

---

checkDataset

*Method "checkDataset"*

---

## Description

Checks dataset for the minimum required info:

1. Column names should present
2. Genotype column should present
3. Sex column should present
4. Two data points for each Genotype/Sex combination
5. Number of Genotype levels should be 2
6. Number of Sex levels should be 1 or 2
7. Sex levels have to be "Female" and/or "Male"
8. Records with reference genotype should be in the dataset
9. Records with test genotype should be in the dataset

Perform the following additional checks:

- presence of Weight column,
- presence of Batch column (Assay.Date).

Warning given in case of missed data indicating that you can only fit a glm or to use MM equation "withoutWeight".

Function [checkDataset](#) is called from [PhenList](#) function.

**Usage**

```
checkDataset(dataset, testGenotype, refGenotype="+/+",
             outputMessages=TRUE, dataset.clean=TRUE)
```

**Arguments**

dataset	data frame created from file or from another source; mandatory argument
testGenotype	defines the test genotype to be compared to the reference genotype; mandatory argument
refGenotype	defines the reference genotype; assigned default value is "+/+"
outputMessages	flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; assigned default value is TRUE
dataset.clean	flag: "FALSE" value for no modification of the dataset; "TRUE" value to clean dataset if needed; assigned default value is TRUE

**Value**

Returns an instance of the [PhenList](#) class.

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

**References**

- Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410
- West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

**See Also**

[PhenTestResult](#)

**Examples**

```
# "checkDataset" is called internally from "PhenList" function
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
                 testGenotype="Sparc/Sparc")
```

---

classificationTag      *Method "classificationTag"*

---

### Description

Returns a classification tag to assign a sexual dimorphism assessment of the phenotypic change.

### Usage

```
classificationTag(phenTestResult, userMode = "summaryOutput",
                 phenotypeThreshold = 0.01, outputMessages=TRUE)
```

### Arguments

phenTestResult	instance of the <a href="#">PhenTestResult</a> class that comes from the function <a href="#">testDataset</a> ; mandatory argument
userMode	flag: "vectorOutput" a sexual dimorphic classification is assigned with a proviso of later assessing the overall statistical significance; "summaryOutput" the phenotypeThreshold is used to assess the overall statistical significance and then if significant the sexual dimorphic classification determined; defaults to summaryOutput
phenotypeThreshold	a numerical value defining the threshold to use in classificationTag in determining whether the genotype effect is classed as significant or not; default value 0.01
outputMessages	flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages ; default value TRUE

### Value

Returns a classification tag to assign a sexual dimorphism assessment of the phenotypic change.

If you are working interactively with the data, the argument "userMode" set to the value "summaryOutput" will use the "phenotypeThreshold" argument's value to assess statistical significance of the genotype effect and if significant then assign a sexual dimorphic classification. Alternatively, if the "userMode" set to the value "vectorMode", a sexual dimorphic classification will be returned with the MM framework where later you can globally assess whether the variable had a significant genotype effect. With the FE framework and the vectorMode, a NA is returned as the type of the effect cannot be assessed without assessing the statistical significance of the genotype effect.

### Author(s)

Natalja Kurbatova, Natasha Karp, Jeremy Mason

**References**

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

**See Also**

[PhenTestResult](#)

**Examples**

```
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
result <- testDataset(test,
  depVariable="Lean.Mass")
classificationTag(result,
  userMode="summaryOutput",
  phenotypeThreshold=0.001)
classificationTag(result,
  userMode="vectorOutput")
```

---

comparison

*Method "comparison"*

---

**Description**

Method comparison returns name of the comparison that was performed by RR framework: "High vs Normal/Low" or "Low vs Normal/High"

**Methods**

signature(obj = "hctestPhenStat")

---

dataset

*Method "dataset"*

---

**Description**

Method dataset returns data frame stored in the object

**Methods**

signature(obj = "PhenList")

---

finalLRModel	Method "finalLRModel"
--------------	-----------------------

---

### Description

This is an internal function run within LR framework. It completes the final stage of the LR framework, which builds the final model and estimates effects. As an internal function, it doesn't include extensive error testing of inputs. Please use cautiously if calling directly.

Works with [PhenTestResult](#) object created by [startLRModel](#) function. The creation of LR final model is based on the significance of different fixed effects, depVariable and equation values stored in [PhenTestResult](#) object.

### Usage

```
finalLRModel(phenTestResult, outputMessages = TRUE)
```

### Arguments

`phenTestResult` instance of the [PhenTestResult](#) class that comes from the function [testDataset](#); mandatory argument

`outputMessages` flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

### Value

Returns results stored in instance of the [PhenTestResult](#) class

### Author(s)

Natalja Kurbatova, Natasha Karp, Jeremy Mason

### References

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

### See Also

[PhenTestResult](#) and [testDataset](#)



**Examples**

```

file <- system.file("extdata", "testLR.csv", package="PhenStat")
testLR <- PhenList(dataset=read.csv(file),
  testGenotype="Mock")
testLR2 <- LRDataset(testLR, "V2")

# when "testDataset" function's argument "callAll" is set to FALSE
# only "startLRModel" function is called - the first step of LR framework
resultLR <- testDataset(testLR2,
  depVariable="V2",
  callAll=FALSE,
  method="LR")
# print out formula that has been created
analysisResults(resultLR)$model.formula.genotype
# print out batch effect's significance
analysisResults(resultLR)$model.effect.batch
resultLR <- finalLRModel(resultLR)

```

---

finalModel	<i>Method "finalModel"</i>
------------	----------------------------

---

**Description**

This is an internal function run within MM framework. It completes the final stage of the MM framework, which builds the final model and estimates effects. As an internal function, it doesn't include extensive error testing of inputs. Please use cautiously if calling directly.

Works with [PhenTestResult](#) object created by [startModel](#) function. The creation of MM final model is based on the significance of different fixed effects, depVariable and equation values stored in [PhenTestResult](#) object.

**Usage**

```
finalModel(phenTestResult, outputMessages = TRUE)
```

**Arguments**

`phenTestResult` instance of the [PhenTestResult](#) class that comes from the function [testDataset](#); mandatory argument

`outputMessages` flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

**Value**

Returns results stored in instance of the [PhenTestResult](#) class

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

## References

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

## See Also

[PhenTestResult](#) and [testDataset](#)

## Examples

```
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
# when "testDataset" function's argument "callAll" is set to FALSE
# only "startModel" function is called - the first step of MM framework
result <- testDataset(test,
  depVariable="Lean.Mass",
  equation="withoutWeight",
  callAll=FALSE)
# print out formula that has been created
# result$model.formula.genotype
# print out batch effect's significance
# result$model.effect.batch
# change the model
# result <- testDataset(test,
#   depVariable="Lean.Mass",
#   equation="withWeight",
#   callAll=FALSE)
# print out new formula
#result$model.formula.genotype
# run the final model fitting when statisfied with the model
result <- finalModel(result)
```

---

finalTFModel

*Method "finalTFModel"*

---

## Description

This is an internal function run within TF framework. It completes the final stage of the TF framework, which builds the final model and estimates effects. As an internal function, it doesn't include extensive error testing of inputs. Please use cautiously if calling directly.

Works with [PhenTestResult](#) object created by [startTFModel](#) function. The creation of TF final model is based on the significance of different fixed effects, depVariable and equation values stored in [PhenTestResult](#) object.

**Usage**

```
finalTFModel(phenTestResult, outputMessages = TRUE)
```

**Arguments**

phenTestResult instance of the [PhenTestResult](#) class that comes from the function [testDataset](#); mandatory argument

outputMessages flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

**Value**

Returns results stored in instance of the [PhenTestResult](#) class

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

**References**

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

**See Also**

[PhenTestResult](#) and [testDataset](#)

**Examples**

```
file <- system.file("extdata", "test7_TFE.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
                testGenotype="het",
                refGenotype = "WT",
                dataset.colname.sex="sex",
                dataset.colname.genotype="Genotype",
                dataset.values.female="f",
                dataset.values.male= "m",
                dataset.colname.weight="body.weight",
                dataset.colname.batch="Date_of_procedure_start")

test_TF <- TFDataset(test,depVariable="Cholesterol")

# when "testDataset" function's argument "callAll" is set to FALSE
# only "startTFModel" function is called - the first step of TFE framework
result <- testDataset(test_TF,
                      depVariable="Cholesterol",
                      callAll=FALSE,
                      method="TF")
```

```
# print out formula that has been created
analysisResults(result)$model.formula.genotype
# print out batch effect's significance
analysisResults(result)$model.effect.batch
result <- finalTFModel(result)
```

---

FisherExactTest      *Method "FisherExactTest"*

---

### Description

The main function of the Fisher Exact Test framework. Creates  $n$  times 2 matrices with record counts, where  $n$  rows represent dependent variable levels and two columns represent genotype levels. Performs Fisher Exact Tests on calculated count matrices.

Three matrices can be created and three tests can be potentially perform depending on the dataset:

- all records together regardless the sex values - combined dataset,
- records where sex value is "Male" (if such exists) - males only dataset,
- records where sex value is "Female" (if such exists) - females only dataset.

Together with count matrices creates percentage matrices, calculates effect sizes and statistics for count matrices. Performs Fisher Exact Tests.

The results (matrices, statistics and Fisher Exact Test outputs) are stored in [PhenTestResult](#) object.

The function is called from "testDataset" function when "method" argument is set to "FE" meaning "Fisher Exact Test".

### Usage

```
FisherExactTest(phenList, depVariable, outputMessages=TRUE)
```

### Arguments

phenList	instance of the <a href="#">PhenList</a> class; mandatory argument
depVariable	a character string defining the dependent variable of interest; mandatory argument
outputMessages	flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

### Value

Returns results stored in instance of the [PhenTestResult](#) class

### Author(s)

Natalja Kurbatova, Natasha Karp, Jeremy Mason

## References

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

## See Also

[PhenTestResult](#)

## Examples

```
file <- system.file("extdata", "test_categorical.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Aff3/Aff3")
# "FisherExactTest" function is called from "testDataset" function.
result <- testDataset(test,depVariable="Thoracic.Processes",method="FE")
# Fisher Exact Test results can be printed out using function "summaryOutput"
summaryOutput(result)
```

---

generateGraphs

*Method "generateGraphs"*

---

## Description

Function generates graphs for the Mixed Model and Time as Fixed Effect frameworks' results and stores generated graphs in the defined directory.

## Usage

```
generateGraphs(phenTestResult, dir,
  graphingName=NULL, type="Xlib")
```

## Arguments

phenTestResult	instance of the <a href="#">PhenTestResult</a> class that comes from the function <a href="#">testDataset</a> ; mandatory argument
dir	directory where to store generated graphs; mandatory argument
graphingName	a character string defining the name to be used on the graph for the dependent variable; defaults to NULL then the depVariable name will be plotted
type	character string, one of "Xlib" or "quartz" (some OS X builds) or "cairo", or "window", or "cairo-png"; mandatory argument

## Author(s)

Natalja Kurbatova, Natasha Karp, Jeremy Mason

**References**

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

**See Also**

[PhenTestResult](#)

---

getColumn	<i>Method "getColumn"</i>
-----------	---------------------------

---

**Description**

Method getColumn returns column of interest

**Methods**

signature(obj = "PhenList")

---

getColumnBatchAdjusted	<i>Method "getColumnBatchAdjusted"</i>
------------------------	--

---

**Description**

Method getColumnBatchAdjusted returns column of interest adjusted for batch

**Methods**

signature(obj = "PhenList")

---

getColumnView	<i>Method "getColumnView"</i>
---------------	-------------------------------

---

**Description**

Method getColumnView returns RR or FE frameworks results in a column format

**Methods**

signature(obj = "hstestPhenStat")

---

getColumnWeightBatchAdjusted  
*Method "getColumnWeightBatchAdjusted"*

---

**Description**

Method getColumnWeightBatchAdjusted returns column of interest adjusted for weight and batch

**Methods**

signature(obj = "PhenList")

---

getCountMatrices *Method "getCountMatrices"*

---

**Description**

Method getCountMatrices returns count matrices for FE and RR frameworks

**Methods**

signature(obj = "PhenTestResult")

---

getDataset *Method "getDataset"*

---

**Description**

Method getDataset returns data frame stored in the object

**Methods**

signature(obj = "PhenList")

---

getGenotypeEffect *Method "getGenotypeEffect"*

---

**Description**

Method getGenotypeEffect returns genotype effect and standard error for the linear regression frameworks

**Methods**

signature(obj = "PhenTestResult")

---

getMatrix	<i>Method "getMatrix"</i>
-----------	---------------------------

---

**Description**

Method getMatrix returns RR or FE frameworks results in a matrix format

**Methods**

signature(obj = "htestPhenStat")

---

getPercentageMatrix	<i>Method "getPercentageMatrix"</i>
---------------------	-------------------------------------

---

**Description**

Method getPercentageMatrix returns percentage matrix calculated out of counts

**Methods**

signature(obj = "htestPhenStat")

---

getStat	<i>Method "getStat"</i>
---------	-------------------------

---

**Description**

Method getStat returns simple statistics about variables in the dataset

**Methods**

signature(obj = "PhenList")

---

getVariable	<i>Method "getVariable"</i>
-------------	-----------------------------

---

**Description**

Method getVariable returns dependent variable name

**Methods**

signature(obj = "PhenTestResult")



---

getVariables	<i>Method "getVariables"</i>
--------------	------------------------------

---

**Description**

Method getVariables returns names of variables in the dataset

**Methods**

signature(obj = "PhenList")

---

hemiGenotype	<i>Method "hemiGenotype"</i>
--------------	------------------------------

---

**Description**

Method hemiGenotype returns hemi genotype if defined

**Methods**

signature(obj = "PhenList")

signature(obj = "PhenTestResult")

---

JSONOutput	<i>Method "JSONOutput"</i>
------------	----------------------------

---

**Description**

Wrapper for the model fitting results. Returns model fitting and testing results in a JSON format. Assumes that modelling results are stored in the [PhenTestResult](#) object (output from function [testDataset](#)).

**Usage**

```
JSONOutput(phenTestResult, phenotypeThreshold = 0.01)
```

**Arguments**

phenTestResult instance of the [PhenTestResult](#) class that comes from the function [testDataset](#); mandatory argument

phenotypeThreshold a numerical value defining the threshold to use in classificationTag; default value 0.01

**Value**

Returns a vector with model fitting results in JSON format: model output summary and other values

**Author(s)**

Natalja Kurbatova

**See Also**

[PhenTestResult](#)

**Examples**

```
# Mixed Model framework
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
result <- testDataset(test,
  depVariable="Lean.Mass")
JSONOutput(result)

# Fishe Exact Test framework
file <- system.file("extdata", "test_categorical.csv", package="PhenStat")
test2 <- PhenList(dataset=read.csv(file),
  testGenotype="Aff3/Aff3")
result2 <- testDataset(test2,
  depVariable="Thoracic.Processes",
  method="FE")
JSONOutput(result2)
```

---

LRDataset

*Method "LRDataset"*

---

**Description**

Prepares dataset for the LR framework - maps values of dependent variable to 0/1, where 1 is modeled.

**Usage**

```
LRDataset(phenList = NULL, depVariable = NULL, abnormalValues =
  c("abnormal", "Abnormal", "TRUE", "deviant"),
  outputMessages = TRUE)
```

**Arguments**

- phenList instance of the [PhenList](#) class; mandatory argument
- depVariable a character string defining the dependent variable of interest; mandatory argument
- abnormalValues a list of abnormal values that will be mapped to 0; mandatory argument
- outputMessages flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

**Value**

Returns dataset suitable for LR framework, where provided abnormal values are mapped to 1 and all other values of dependent variable are assumed to be normal and are mapped to 0.

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

**References**

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* **7**(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

**Examples**

```
file <- system.file("extdata", "testLR.csv", package="PhenStat")
testLR <- PhenList(dataset=read.csv(file),
                  testGenotype="Mock")
testLR2 <- LRDataset(testLR, "V2")
```

---

matrixCount

*Method "matrixCount"*

---

**Description**

Method `matrixCount` returns matrix of counts that was created by RR or FE framework.

**Methods**

signature(obj = "hstestPhenStat")

---

method	<i>Method "method"</i>
--------	------------------------

---

**Description**

Method method returns method abbreviation, for example: "RR", "MM".

**Methods**

signature(obj = "PhenTestResult")

---

methodText	<i>Method "methodText"</i>
------------	----------------------------

---

**Description**

Method methodText returns method's name, for example: "Reference Range Plus", "Linear Mixed Model".

**Methods**

signature(obj = "PhenTestResult")

---

multipleBatches	<i>Method "multipleBatches"</i>
-----------------	---------------------------------

---

**Description**

Method multipleBatches returns TRUE if there are multiple batches in the dataset, FALSE otherwise

**Methods**

signature(obj = "PhenList")

---

noSexes	<i>Method "noSexes"</i>
---------	-------------------------

---

**Description**

Method noSexes returns number of sex levels: 1/2

**Methods**

signature(obj = "PhenList")  
signature(obj = "PhenTestResult")

---

parameters	<i>Method "parameters"</i>
------------	----------------------------

---

**Description**

Method parameters returns parameters specific for applied method/dataset combination

**Methods**

signature(obj = "PhenTestResult")

---

parserOutputSummary	<i>Method "parserOutputSummary"</i>
---------------------	-------------------------------------

---

**Description**

Parsers model output summary and returns it in readable named vector format

**Usage**

```
parserOutputSummary(linearRegressionOutput)
```

**Arguments**

linearRegressionOutput  
linear regression output that comes from the MM methods; mandatory argument

**Value**

Returns a named vector with linear regression model output summary results

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

**References**

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410  
West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

**See Also**

[PhenTestResult](#)

## Examples

```
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
result <- testDataset(test,
  depVariable="Lean.Mass")
linearRegressionOutput <- analysisResults(result)
parserOutputSummary(linearRegressionOutput)
```

---

parserOutputSummaryLR *Method "parserOutputSummaryLR"*

---

## Description

Parsers model output summary and returns it in readable named vector format

## Usage

```
parserOutputSummaryLR(linearRegressionOutput)
```

## Arguments

linearRegressionOutput  
linear regression output that comes from the MM methods; mandatory argument

## Value

Returns a named vector with logistic regression model output summary results

## Author(s)

Natalja Kurbatova, Natasha Karp, Jeremy Mason

## References

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

## See Also

[PhenTestResult](#)

## Examples

```
file <- system.file("extdata", "testLR.csv", package="PhenStat")
testLR <- PhenList(dataset=read.csv(file),
  testGenotype="Mock")
testLR2 <- LRDataset(testLR, "V2")
resultLR <- testDataset(testLR2,
  depVariable="V2",
  method="LR")
linearRegressionOutput <- analysisResults(resultLR)
parserOutputSummaryLR(linearRegressionOutput)
```

---

parserOutputTFSummary *Method "parserOutputTFSummary"*

---

## Description

Parsers model output summary from TF framework and returns it in readable named vector format

## Usage

```
parserOutputTFSummary(linearRegressionOutput)
```

## Arguments

linearRegressionOutput  
linear regression output that comes from the TF method; mandatory argument

## Value

Returns a named vector with model output summary results

## Author(s)

Natalja Kurbatova, Natasha Karp, Jeremy Mason

## References

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

## See Also

[PhenTestResult](#)

## Examples

```
file <- system.file("extdata", "test6_RR.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="0xr1/0xr1")
result <- testDataset(test,
  depVariable="Ca",
  method="TF",
  dataPointsThreshold=2)
linearRegressionOutput <- analysisResults(result)
parserOutputTFSummary(linearRegressionOutput)
```

---

PhenList

*Method "PhenList"*

---

## Description

Function to create data object from the data frame.

In addition to dependent variable column (the variable of interest) mandatory columns that should present in the data frame are "Genotype" and "Sex". The "Assay.Date" column is used to model "Batch" effect if not specified differently. "Weight" column is used to model body weight effect.

Function creates [PhenList](#) object, checks data integrity, renames columns when requested, provides simple statistics about dataset.

Returns an instance of the [PhenList](#) object created from the data file.

Dataset is cleaned to ensure there is a maximum two sex levels and there are exactly two levels for genotype. Data cleaning can be switched off by defining the argument "dataset.clean" as FALSE.

## Usage

```
PhenList(dataset, testGenotype, refGenotype="+/+", hemiGenotype=NULL,
  outputMessages=TRUE, dataset.clean=TRUE,
  dataset.colname.batch=NULL, dataset.colname.genotype=NULL,
  dataset.colname.sex=NULL, dataset.colname.weight=NULL,
  dataset.values.missingValue=" ", dataset.values.male=NULL,
  dataset.values.female=NULL)
```

## Arguments

dataset	data frame created from file or from another source; mandatory argument
testGenotype	defines the test genotype to be compared to the reference genotype; mandatory argument
refGenotype	defines the reference genotype; assigned default value is "+/+"
hemiGenotype	defines the genotype value for hemizygous that will be changed to test genotype value



outputMessages flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; assigned default value is TRUE

dataset.clean flag: "FALSE" value for no modification of the dataset; "TRUE" value to clean dataset if needed; assigned default value is TRUE

dataset.colname.batch  
column name within dataset for the batch effect

dataset.colname.genotype  
column name within dataset for the genotype info

dataset.colname.sex  
column name within dataset for the sex info

dataset.colname.weight  
column name within dataset for the weight info

dataset.values.missingValue  
value used as missing value in the dataset

dataset.values.male  
value used to label "males" in the dataset

dataset.values.female  
value used to label "females" in the dataset

**Value**

Returns an instance of the [PhenList](#) class.

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

**References**

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

**See Also**

[PhenList](#)

**Examples**

```
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")

file <- system.file("extdata", "test2.csv", package="PhenStat")
test2 <- PhenList(dataset=read.csv(file),
  testGenotype="Arid4a/Arid4a",
  refGenotype="+/+",
  hemiGenotype="Arid4a/+",
```

```

dataset.colname.weight="Weight.Value")

file <- system.file("extdata", "test3.csv", package="PhenStat")
test3 <- PhenList(dataset=read.csv(file),
  dataset.clean=TRUE,
  dataset.values.female=1,
  dataset.values.male=2,
  testGenotype="Mysm1/+")

```

---

PhenList-class

*Class "PhenList"*


---

### Description

A list-based S4 class for storing phenotypic data. Helps to support data integrity checks and statistics calculation. The PhenList object can be created by using function [PhenList](#).

### Explore PhenList object

PhenList object instance contains the following slots:

1. "datasetPL" where cleaned and checked dataset is stored: `getDataset(phenList)`
2. "testGenotype" where the genotype level to test is stored: `testGenotype(phenList)`
3. "refGenotype" where reference genotype value is stored with default value set to "+/+":  
`refGenotype(phenList)`
4. "hemiGenotype" if defined contains the genotype value for hemizygous: `hemiGenotype(phenList)`
6. "dataset.clean" flag value is stored, see [PhenList](#) for more details:  
`phenList@dataset.clean`
7. "dataset.colname" if defined contains dataset column names that have been renamed:
  - `phenList@dataset.colname.batch` column name for batch values
  - `phenList@dataset.colname.genotype` column name for genotype values
  - `phenList@dataset.colname.sex` column name for sex values
  - `phenList@dataset.colname.weight` column name for weight values
8. "dataset.values" if defined contains dataset values that have been changed during dataset cleaning process:
  - `phenList@dataset.values.missingValue` value used as missing value in the original dataset
  - `phenList@dataset.values.male` value used to label "males" in the original dataset
  - `phenList@dataset.values.female` value used to label "females" in the original dataset

**Slots**

**datasetPL**: Object of class "data.frame" ~~ dataset to work with  
**refGenotype**: Object of class "character" ~~ reference genotype  
**testGenotype**: Object of class "character" ~~ test genotype  
**hemiGenotype**: Object of class "character" ~~ hemi genotype  
**dataset.colname.batch**: Object of class "character" ~~ column name for batch values  
**dataset.colname.genotype**: Object of class "character" ~~ column name for genotype values  
**dataset.colname.sex**: Object of class "character" ~~ column name for sex values  
**dataset.colname.weight**: Object of class "character" ~~ column name for weight values  
**dataset.values.missingValue**: Object of class "character" ~~ value used as missing value in the original dataset  
**dataset.values.male**: Object of class "character" ~~ value used to label "males" in the original dataset  
**dataset.values.female**: Object of class "character" ~~ value used to label "females" in the original dataset  
**dataset.clean**: Object of class "logical" ~~ flag value is stored

**Methods**

**getDataset** (accessor): Returns dataset  
**refGenotype** (accessor): Returns reference genotype  
**testGenotype** (accessor): Returns test genotype  
**hemiGenotype** (accessor): Returns hemi genotype if specified  
**getColumn** Returns specified column if exists  
**getColumnBatchAdjusted** Returns specified column adjusted for batch effect  
**getColumnWeightBatchAdjusted** Returns specified column adjusted for batch and weight effects  
**getStat** Returns simple dataset statistics  
**getVariables** Returns dataset column names  
**batchIn** Returns TRUE if the batch is in the dataset, FALSE otherwise  
**weightIn** Returns TRUE if the weight is in the dataset, FALSE otherwise  
**multipleBatches** Returns TRUE if the batches are variable in the dataset, FALSE otherwise  
**noSexes** Returns number of sexes in the dataset  
**setBatch** Sets the batch column - change the column names  
**setGenotype** Sets the genotype column - change the column names  
**setMissingValue** Sets the missing value  
**setSex** Sets the sex column - change the column names  
**setWeight** Sets the weight column - change the column names

**Author(s)**

Natalja Kurbatova

**See Also**[PhenList](#)**Examples**

```

file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
class(test)

file <- system.file("extdata", "test2.csv", package="PhenStat")
test2 <- PhenList(dataset=read.csv(file),
  testGenotype="Arid4a/Arid4a",
  refGenotype="+/+",
  hemiGenotype="Arid4a/+",
  dataset.colname.weight="Weight.Value")
getStat(test2)
testGenotype(test2)
refGenotype(test2)
hemiGenotype(test2)

```

PhenTestResult

*Method "PhenTestResult"***Description**

Creates [PhenTestResult](#) object based on test results or model building results. Internal function for the package. Not build for users to directly call.

**Usage**

```

PhenTestResult(model.output=NULL, model.dataset=NULL,
  depVariable=NULL,
  refGenotype=NULL,
  equation="withWeight",
  method="MM", model.effect.batch=NULL,
  model.effect.variance=NULL,model.effect.sex=NULL,
  model.effect.interaction=NULL, model.output.interaction=NULL,
  model.effect.weight=NULL, numberSexes=NULL,pThreshold=0.05,
  model.formula.null=NULL,model.formula.genotype=NULL,
  model.output.genotype.nulltest.pVal=NULL,
  model.output.quality=NULL,model.output.summary=NULL,
  model.output.averageRefGenotype = NULL,
  model.output.percentageChanges = NULL)

```

**Arguments**

<code>model.output</code>	representing the model fit gls object or lme object
<code>model.dataset</code>	dataset used for modeling
<code>depVariable</code>	depending variable in the model
<code>refGenotype</code>	reference genotype in the model
<code>equation</code>	possible values: "withWeight" to include weight effect into model, "withoutWeight" to exclude weight effect from the model
<code>method</code>	possible values: "MM" to work with Mixed Model framework, "FE" to work with Fisher Exact Test framework
<code>model.effect.batch</code>	Result of the test for batch effect significance
<code>model.effect.variance</code>	Result of the test for residual variance effect
<code>model.effect.sex</code>	Result of the test for sex effect significance
<code>model.effect.weight</code>	Result of the test for weight effect significance
<code>model.effect.interaction</code>	Result of the test for genotype by sex interaction significance
<code>model.output.interaction</code>	Interaction test result: p-value
<code>numberSexes</code>	number of possible sex values in the dataset
<code>pThreshold</code>	p-value threshold used to evaluate the effect significance, default value 0.05
<code>model.formula.null</code>	formula for the model without genotype effect
<code>model.formula.genotype</code>	formula for the model with genotype effect
<code>model.output.genotype.nulltest.pVal</code>	Genotype test results: p-value
<code>model.output.quality</code>	vector that contains diagnostic test output for mixed model quality of fit
<code>model.output.summary</code>	named vector that contains summary of the model output
<code>model.output.averageRefGenotype</code>	named vector that contains mean values calculated for reference genotype records
<code>model.output.percentageChanges</code>	named vector that contains percentage changes values per sex

**Value**

Returns an instance of the [PhenTestResult](#) class.

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

## References

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

## See Also

[PhenTestResult](#)

## Examples

```
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
# "testDataset" function calls "PhenTestResult" function internally
result <- testDataset(test,
  equation="withoutWeight",
  depVariable="Lean.Mass")
class(result)
```

---

PhenTestResult-class    *Class "PhenTestResult"*

---

## Description

A list-based S4 class for storing of model fitting results and other information like dependent variable, method used to build a model, etc. Helps to support operations needed for model fitting process and modelling/testing results storage. In the package PhenTestResult object is created by function [testDataset](#).

## Explore PhenTestResult object

PhenTestResults object instance contains the following slots:

1. "analysedDataset" contains subdataset that was used for the modelling/testing:

`analysedDataset(phenTestResult)`

2. "depVariable" contains dependent variable that was tested: `getVariable(phenTestResult)`

3. "refGenotype" contains reference genotype which is usually is wildtype: `refGenotype(phenTestResult)`

4. "testGenotype" contains test genotype: `testGenotype(phenTestResult)`

5. "method" contains method name that was used for modelling/testing: `method(phenTestResult)`

6. "transformationRequired" contains TRUE/FALSE value indicating transformation of dependent variable:

`transformationText(phenTestResult)` or `phenTestResult@transformationRequired`

7. "lambdaValue" contains lambda value for the Box-Cox transformation:

transformationText(phenTestResult) or phenTestResult\$lambdaValue

8. "scaleShift" contains the value of scale shift for Box-Cox transformation:

transformationText(phenTestResult) or phenTestResult@scaleShift

9. "transformationCode" contains the code of transformation. Possible values:

0 - transformation is not applicable (methods "FE", "RR", "LR") or switched off by user  
 1 - transformation is not needed (1 is within the 95% CI)  
 2 - log transformation  
 3 - power transformation  
 4 - transformation is not performed since optimal lambda value is not found ( $-5 < \lambda < 5$ )

transformationText(phenTestResult) or phenTestResult@transformationCode

10. "parameters" contains the parameters used during method application, e.g. pThreshold for MM and TF:

parameters(phenTestResult)

11. Modelling/testing results are stored in the sections "analysisResults": analysisResults(phenTestResult)

The contents of the analysisResults slot depend on framework that was used.

The results of MM and TF frameworks: 1. Equation used during linear modeling: analysisResults(phenTestResult)\$equation

2. Batch effect significance: analysisResults(phenTestResult)\$model.effect.batch

3. Variance equality: analysisResults(phenTestResult)\$model.effect.variance

4. Weight effect significance: analysisResults(phenTestResult)\$model.effect.weight

5. Sex effect significance: analysisResults(phenTestResult)\$model.effect.interaction

6. Evidence of sex effect (p-value): analysisResults(phenTestResult)\$model.output.interaction

7. Evidence of genotype effect (p-value): analysisResults(phenTestResult)\$model.output.genotype.nulltest.pvalue

8. Formula for the final genotype model: analysisResults(phenTestResult)\$model.formula.genotype

9. Formula for the final null model: analysisResults(phenTestResult)\$model.formula.null

10. Model fitting output: analysisResults(phenTestResult)\$model.output

11. Model fitting summary: summary(analysisResults(phenTestResult)\$model.output)\$tTable

The results of FE and RR frameworks are stored as a list of htestPhenStat S4 objects: analysisResults(phenTestResult)[c("FE", "RR")]

Each one htestPhenStat object contains:

1. Output of Fisher Exact Test: pvalue(analysisResults(phenTestResult)[[1]]).

2. Effect size: ES(analysisResults(phenTestResult)[[1]]).

3. Name of the table analysed (all, males, females): analysedSubset(analysisResults(phenTestResult)[[1]]).

4. Comparison, used for RR only (High vs Normal/Low, Low vs High/Normal): comparison(analysisResults(phenTestResult)[[1]]).

5. Matrix of counts: matrixCount(analysisResults(phenTestResult)[[1]]).

## Slots

analysedDataset: Object of class "data.frame" ~~ analysed dataset

transformationRequired: Object of class "logical" ~~ flag indicating was or not transformation performed

lambdaValue: Object of class "numeric" ~~ Box-Cox transform lambda value

scaleShift: Object of class "numeric" ~~ Box-Cox transform scale shift

**transformationCode**: Object of class "numeric" ~~ code explaining the transformation output  
**depVariable**: Object of class "character" ~~ dependent variable  
**refGenotype**: Object of class "character" ~~ reference genotype  
**testGenotype**: Object of class "character" ~~ test genotype  
**method**: Object of class "character" ~~ analysis method  
**parameters**: Object of class "matrix" ~~ parameters of method  
**analysisResults**: Object of class "list" ~~ results of the analysis

## Methods

**getVariable** (accessor): Returns dependent variable  
**refGenotype** (accessor): Returns reference genotype  
**testGenotype** (accessor): Returns test genotype  
**method** (accessor): Returns method used  
**methodText** (accessor): Returns full name of the method used  
**parameters** (accessor): Returns parameteres used during the method application  
**analysisResults** (accessor): Returns analysis results depending on method  
**analysedDataset** (accessor): Returns analysed dataset  
**transformationText** (accessor): Returns the info about transformation  
**batchIn** Returns TRUE if the batch is in the dataset, FALSE otherwise  
**weightIn** Returns TRUE if the weight is in the dataset, FALSE otherwise  
**noSexes** Returns number of sexes in the dataset  
**show** Prints out the PhenTestResult object  
**getCountMatrices** Returns count matrices if they are present (for methods "FE" and "RR"), NULL otherwise.

## Author(s)

Natalja Kurbatova

## Examples

```

# Mixed Model framework
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
result <- testDataset(test,
  equation="withoutWeight",
  depVariable="Bone.Area")
getVariable(result)
method(result)
# Batch effect is significant
analysisResults(result)$model.effect.batch
# Variance homogeneosity
  
```



```

analysisResults(result)$model.effect.variance
# Weight effect is significant
analysisResults(result)$model.effect.weight
# Sex effect is significant
analysisResults(result)$model.effect.interaction
# Sex effect p-value - the result of the test
analysisResults(result)$model.output.interaction
# Genotype effect p-value
analysisResults(result)$model.output.genotype.nulltest.pVal
# Final model formula with genotype
analysisResults(result)$model.formula.genotype
# Final model formula without genotype
analysisResults(result)$model.formula.null
# Final model fitting output
# result$model.output
# Final model fitting summary
# summary(result$model.output)$tTable

# Fisher Exact Test framework
file <- system.file("extdata", "test_categorical.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Aff3/Aff3")
result <- testDataset(test,
  depVariable="Thoracic.Processes",
  method="FE")
getVariable(result)
method(result)
for (i in seq_along(analysisResults(result))) {
  val <- analysisResults(result)[[i]]
  val
}

```

---

plotResidualPredicted *Method "plotResidualPredicted"*

---

### Description

Graph function for the Mixed Model framework's results. Creates predicted versus residual values plots split by genotype.

### Usage

```
plotResidualPredicted(phenTestResult, outputMessages=TRUE)
```

### Arguments

**phenTestResult** instance of the [PhenTestResult](#) class that comes from the function [testDataset](#); mandatory argument

**outputMessages** flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

**References**

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

**See Also**

[PhenList](#) and [PhenTestResult](#)

**Examples**

```
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
result <- testDataset(test,
  depVariable="Lean.Mass")
plotResidualPredicted(result)
```

---

pvalue	<i>Method "pvalue"</i>
--------	------------------------

---

**Description**

Method pvalue returns p-value that was calculate by RR or FE framework.

**Methods**

```
signature(obj = "htestPhenStat")
```

---

qqplotGenotype	<i>Method "qqplotGenotype"</i>
----------------	--------------------------------

---

**Description**

Graph function for the Mixed Model framework's results. Creates a Q-Q plot of residuals for each genotype.

**Usage**

```
qqplotGenotype(phenTestResult, outputMessages=TRUE)
```

**Arguments**

- phenTestResult instance of the [PhenTestResult](#) class that comes from the function [testDataset](#); mandatory argument
- outputMessages flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

**References**

- Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* **7**(12): e52410. doi:10.1371/journal.pone.0052410
- West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

**See Also**

[PhenList](#) and [PhenTestResult](#)

**Examples**

```
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
result <- testDataset(test,
  depVariable="Lean.Mass")
qqplotGenotype(result)
```

---

qqplotRandomEffects *Method "qqplotRandomEffects"*

---

**Description**

Graph function for the Mixed Model framework's results. Creates a Q-Q plot of blups (best linear unbiased predictions).

**Usage**

```
qqplotRandomEffects(phenTestResult, outputMessages=TRUE)
```

**Arguments**

- phenTestResult instance of the [PhenTestResult](#) class that comes from the function [testDataset](#); mandatory argument
- outputMessages flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

**References**

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

**See Also**

[PhenList](#) and [PhenTestResult](#)

**Examples**

```
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
                 testGenotype="Sparc/Sparc")
result <- testDataset(test,
                      depVariable="Lean.Mass")
qqplotRandomEffects(result)
```

---

qqplotRotatedResiduals

*Method "qqplotRotatedResiduals"*

---

**Description**

Graph function for the Mixed Model framework's results. Creates a Q-Q plot of rotated residuals.

**Usage**

```
qqplotRotatedResiduals(phenTestResult, outputMessages=TRUE)
```

**Arguments**

`phenTestResult` instance of the [PhenTestResult](#) class that comes from the function [testDataset](#); mandatory argument

`outputMessages` flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

## References

- Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410
- Houseman, E. A., Ryan, L. M., Coull, B. A. (2004): Cholesky residuals for assessing normal errors in a linear model with correlated outcomes. *Journal of the American Statistical Association* 99:466: pg 383-394. Doi 10.1198
- West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

## See Also

[PhenList](#) and [PhenTestResult](#)

## Examples

```
file <- system.file("extdata", "test2.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  dataset.colname.weight="Weight.Value",
  testGenotype="Arid4a/Arid4a",
  hemiGenotype="Arid4a/+")
result <- testDataset(test,
  depVariable="C1")
qqplotRotatedResiduals(result)
```

---

recommendMethod	<i>Method "recommendMethod"</i>
-----------------	---------------------------------

---

## Description

Checks the dependent variable and dataset to make choose the appropriate statistical method. Returns the method or the list of methods that are appropriate for statistical analysis.

## Usage

```
recommendMethod(phenList=NULL, depVariable=NULL, outputMessages=TRUE)
```

## Arguments

- |                |   |
|----------------|---|
| phenList       | instance of the <a href="#">PhenList</a> class; mandatory argument  |
| depVariable    | a character string defining the dependent variable of interest; mandatory argument                        |
| outputMessages | flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE |

## Value

Returns the method or the list of methods that are appropriate for statistical analysis.

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

**References**

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

**See Also**

[PhenList](#)

**Examples**

```
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
                 testGenotype="Sparc/Sparc")
recommendMethod(test, "Lean.Mass")
```

---

refGenotype	<i>Method "refGenotype"</i>
-------------	-----------------------------

---

**Description**

Method refGenotype returns reference genotype

**Methods**

```
signature(obj = "PhenList")
signature(obj = "PhenTestResult")
```

---

RRTest	<i>Method "RRTest"</i>
--------	------------------------

---

**Description**

This is an internal function run within RR framework. It performs Reference Ranges Plus test and after that Fisher Exact test on calculated count matrices. As an internal function, it doesn't include extensive error testing of inputs. Please use cautiously if calling directly.

Works with [PhenList](#) object created by [PhenList](#) function.

**Usage**

```
RRTest(phenList, depVariable, outputMessages=TRUE, naturalVariation=95, controlPointsThreshold=60)
```

**Arguments**

phenList	instance of the <a href="#">PhenList</a> class; mandatory argument
depVariable	a character string defining the dependent variable of interest; mandatory argument
outputMessages	flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE
naturalVariation	number defining the natural variation range in percents for normal values; default value 95
controlPointsThreshold	number defining how many control points is needed to perform RR plus method; default value 60

**Value**

Returns results stored in instance of the [PhenTestResult](#) class

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

**References**

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

**See Also**

[PhenList](#) and [testDataset](#)

**Examples**

```
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
                 testGenotype="Sparc/Sparc")
# "RRTest" function is called from "testDataset" function
result <- testDataset(test,
                     depVariable="Lean.Mass",
                     method="RR")
# RR test results can be printed out using function "summaryOutput"
summaryOutput(result)
```

---

 scatterplotGenotypeWeight

*Method "scatterplotGenotypeWeight"*


---

### Description

Graph function for the phenotypic dataset. Creates a scatter plot body weight versus dependent variable.

Both a regression line and a loess line (locally weighted line) is fitted for each genotype.

### Usage

```
scatterplotGenotypeWeight(phenList, depVariable=NULL, graphingName=NULL, outputMessages=TRUE)
```

### Arguments

phenList	instance of the <a href="#">PhenList</a> class; mandatory argument
depVariable	a character string defining the dependent variable of interest; mandatory argument
graphingName	a character string defining the name to be used on the graph for the dependent variable; mandatory argument
outputMessages	flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

### Author(s)

Natalja Kurbatova, Natasha Karp, Jeremy Mason

### References

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

### See Also

[PhenList](#)

### Examples

```
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
scatterplotGenotypeWeight(test,
  depVariable="Bone.Mineral.Content",
  graphingName="BMC" )
```



```
file <- system.file("extdata", "test4.csv", package="PhenStat")
test_1sex <- PhenList(dataset=read.csv(file),
  testGenotype="Mysm1/+")
scatterplotGenotypeWeight(test_1sex,
  depVariable="Lean.Mass",
  graphingName="Lean Mass")
```

---

scatterplotGenotypeWeightResult

*Method "scatterplotGenotypeWeightResult"*

---

### Description

Graph function for the phenotypic dataset. Creates a scatter plot body weight versus dependent variable. It is based on PhenTestResult object. Both a regression line and a loess line (locally weighted line) is fitted for each genotype.

### Usage

```
scatterplotGenotypeWeightResult(phenTestResult, graphingName=NULL, outputMessages=TRUE)
```

### Arguments

phenTestResult instance of the [PhenTestResult](#) class; mandatory argument

graphingName a character string defining the name to be used on the graph for the dependent variable; mandatory argument

outputMessages flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

### Author(s)

Natalja Kurbatova, Natasha Karp, Jeremy Mason

### References

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

### See Also

[PhenList](#)

**Examples**

```

file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
result <- testDataset(test,
  depVariable="Lean.Mass")
scatterplotGenotypeWeightResult(result,
  graphingName="BMC" )
file <- system.file("extdata", "test4.csv", package="PhenStat")
test_1sex <- PhenList(dataset=read.csv(file),
  testGenotype="Mysm1/+")
result_1sex <- testDataset(test_1sex,
  depVariable="Lean.Mass")
scatterplotGenotypeWeightResult(result_1sex,
  graphingName="Lean Mass")

```

---

scatterplotSexGenotypeBatch

*Method "scatterplotSexGenotypeBatch"*


---

**Description**

Graph function for the phenotypic dataset. Creates a scatterplot split by sex, genotype and batch. refGenotype data points are shown in black and the testGenotype data points are shown in red.

Note: the batches are not ordered with time but allow assessment of how the testGenotype data lie relative to the variation within the refGenotype data.

**Usage**

```
scatterplotSexGenotypeBatch(phenList, depVariable=NULL, graphingName=NULL, outputMessages=TRUE)
```

**Arguments**

phenList	instance of the <a href="#">PhenList</a> class; mandatory argument
depVariable	a character string defining the dependent variable of interest; mandatory argument
graphingName	a character string defining the name to be used on the graph for the dependent variable; mandatory argument
outputMessages	flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

## References

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

## See Also

[PhenList](#)

## Examples

```
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
# box plot for dataset with two sexes: males and females
scatterplotSexGenotypeBatch(test,
  depVariable="Bone.Mineral.Content",
  graphingName="BMC" )

file <- system.file("extdata", "test4.csv", package="PhenStat")
test_1sex <- PhenList(dataset=read.csv(file),
  testGenotype="Mysm1/+")
# box plot for females only dataset
scatterplotSexGenotypeBatch(test_1sex, depVariable="Lean.Mass",
  graphingName="Lean Mass")
```

---

scatterplotSexGenotypeBatchResult

*Method "scatterplotSexGenotypeBatchResult"*

---

## Description

Graph function for the phenotypic dataset. Creates a scatterplot split by sex, genotype and batch. refGenotype data points are shown in black and the testGenotype data points are shown in red. It is based on PhenTestResult object.

Note: the batches are not ordered with time but allow assessment of how the testGenotype data lie relative to the variation within the refGenotype data.

## Usage

```
scatterplotSexGenotypeBatchResult(phenTestResult, graphingName=NULL, outputMessages=TRUE)
```

**Arguments**

- phenTestResult instance of the [PhenTestResult](#) class; mandatory argument
- graphingName a character string defining the name to be used on the graph for the dependent variable; mandatory argument
- outputMessages flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

**References**

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

**See Also**

[PhenList](#)

**Examples**

```
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
result <- testDataset(test,
  depVariable="Lean.Mass")
# box plot for dataset with two sexes: males and females
scatterplotSexGenotypeBatchResult(result,
  graphingName="BMC" )

file <- system.file("extdata", "test4.csv", package="PhenStat")
test_1sex <- PhenList(dataset=read.csv(file),
  testGenotype="Mysm1/+")
result_1sex <- testDataset(test_1sex,
  depVariable="Lean.Mass")
# box plot for females only dataset
scatterplotSexGenotypeBatchResult(result_1sex,
  graphingName="Lean Mass")
```

---

setBatch	<i>Method "setBatch"</i>
----------	--------------------------

---

**Description**

Method setBatch sets batch column in the dataset

**Methods**

signature(obj = "PhenList")

---

setGenotype	<i>Method "setGenotype"</i>
-------------	-----------------------------

---

**Description**

Method setGenotype sets genotype column in the dataset

**Methods**

signature(obj = "PhenList")

---

setMissingValue	<i>Method "setMissingValue"</i>
-----------------	---------------------------------

---

**Description**

Method setMissingValue sets missing value in the dataset

**Methods**

signature(obj = "PhenList")

---

setSex	<i>Method "setSex"</i>
--------	------------------------

---

**Description**

Method setSex sets sex column in the dataset

**Methods**

signature(obj = "PhenList")

---

setWeight	<i>Method "setWeight"</i>
-----------	---------------------------

---

**Description**

Method setWeight sets weight column in the dataset

**Methods**

signature(obj = "PhenList")

---

startLRModel	<i>Method "startLRModel"</i>
--------------	------------------------------

---

**Description**

This is an internal function run within LR framework. It completes the testing stage of which effects are significant. As an internal function, it doesn't include extensive error testing of inputs. Please use cautiously if calling directly.

It creates start model and modify it after testing of different hypothesis.

The tested effects are:

-batch effect (TRUE if batch variation is significant, FALSE if not), though it is never used in final LR model;

-interaction effect (TRUE if genotype by sex interaction is significant),

-sex effect (TRUE if sex is significant),

-weight effect and variance effect are not tested and used in LR model.

**Usage**

```
startLRModel(phenList, depVariable, outputMessages=TRUE, pThreshold=0.05)
```

**Arguments**

phenList	instance of the <a href="#">PhenList</a> class; mandatory argument
depVariable	a character string defining the dependent variable of interest; mandatory argument
outputMessages	flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages ; default value TRUE
pThreshold	a numerical value for the p-value threshold used to determine which fixed effects to keep in the model, default value 0.05

**Value**

Returns results stored in instance of the [PhenTestResult](#) class

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

**References**

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

**See Also**

[PhenList](#)

**Examples**

```
file <- system.file("extdata", "testLR.csv", package="PhenStat")
testLR <- PhenList(dataset=read.csv(file),
                  testGenotype="Mock")
testLR2 <- LRDataset(testLR, "V2")

# when "testDataset" function's argument "callAll" is set to FALSE
# only "startLRModel" function is called - the first step of LR framework
resultLR <- testDataset(testLR2,
                       depVariable="V2",
                       callAll=FALSE,
                       method="LR")
# print out formula that has been created
analysisResults(resultLR)$model.formula.genotype
# print out batch effect's significance
analysisResults(resultLR)$model.effect.batch
```

---

startModel

*Method "startModel"*

---

**Description**

This is an internal function run within MM framework. It completes the testing stage of which effects are significant. As an internal function, it doesn't include extensive error testing of inputs. Please use cautiously if calling directly.

It creates start model and modify it after testing of different hypothesis (the model fixed effects).

The model random effects are:

-batch effect (TRUE if batch variation is significant, FALSE if not)

The model fixed effects are:

- variance effect (TRUE if residual variances for genotype groups are homogeneous and FALSE if they are heterogeneous),
- interaction effect (TRUE if genotype by sex interaction is significant),
- sex effect (TRUE if sex is significant),
- weight effect (TRUE if weight is significant).

If user would like to assign other TRUE/FALSE values to the fixed effects of the model then he or she has to define keepList argument which is vector of TRUE/FALSE values.

If user has defined model fixed effects (keepList argument) then function prints out calculated and user defined effects (only when outputMessages argument is set to TRUE), checks user defined effects for consistency (for instance, if there are no "Weight" column in the dataset then weight effect can't be assigned to TRUE, etc.) and modifies start model according to user defined effects.

As the result PhenTestResult object that contains calculated or user defined model fixed effects and MM start model is created.

## Usage

```
startModel(phenList, depVariable,
           equation="withWeight", outputMessages=TRUE,
           pThreshold=0.05, keepList=NULL)
```

## Arguments

phenList	instance of the <a href="#">PhenList</a> class; mandatory argument
depVariable	a character string defining the dependent variable of interest; mandatory argument
equation	a character string defining the equation to use. Possible values "withWeight" (default),"withoutWeight"
outputMessages	flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages ; default value TRUE
pThreshold	a numerical value for the p-value threshold used to determine which fixed effects to keep in the model, default value 0.05
keepList	a logical vector defining the significance of different model effects: keep_batch, keep_equalvar, keep_weight, keep_sex, keep_interaction; default value NULL

## Value

Returns results stored in instance of the [PhenTestResult](#) class

## Author(s)

Natalja Kurbatova, Natasha Karp, Jeremy Mason



## References

- Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410
- West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

## See Also

[PhenList](#)

## Examples

```
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
# when "testDataset" function's argument "callAll" is set to FALSE
# only "startModel" function is called - the first step of MM framework
result <- testDataset(test,
  depVariable="Lean.Mass",
  callAll=FALSE)
# print out formula that has been created
analysisResults(result)$model.formula.genotype
# print out batch effect's significance
analysisResults(result)$model.effect.batch
# change the model
result <- testDataset(test,
  depVariable="Lean.Mass",
  equation="withWeight",
  callAll=FALSE)
# print out new formula
analysisResults(result)$model.formula.genotype
```

---

startTFModel

*Method "startTFModel"*

---

## Description

This is an internal function run within TF framework. It completes the testing stage of which effects are significant. As an internal function, it doesn't include extensive error testing of inputs. Please use cautiously if calling directly.

It creates start model and modify it after testing of different hypothesis.

The tested fixed effects are:

- batch effect (TRUE if batch variation is significant, FALSE if not),
- variance effect (TRUE if residual variances for genotype groups are homogeneous and FALSE if they are heterogeneous),
- interaction effect (TRUE if genotype by sex interaction is significant),

- sex effect (TRUE if sex is significant),
- weight effect (TRUE if weight is significant).

### Usage

```
startTFModel(phenList, depVariable,
              equation="withWeight", outputMessages=TRUE,
              pThreshold=0.05, keepList=NULL)
```

### Arguments

phenList	instance of the <a href="#">PhenList</a> class; mandatory argument
depVariable	a character string defining the dependent variable of interest; mandatory argument
equation	a character string defining the equation to use. Possible values "withWeight" (default),"withoutWeight"
outputMessages	flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages ; default value TRUE
pThreshold	a numerical value for the p-value threshold used to determine which fixed effects to keep in the model, default value 0.05
keepList	a logical vector defining the significance of different model effects: keep_batch, keep_equalvar, keep_weight, keep_sex, keep_interaction; default value NULL

### Value

Returns results stored in instance of the [PhenTestResult](#) class

### Author(s)

Natalja Kurbatova, Natasha Karp, Jeremy Mason

### References

- Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410
- West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

### See Also

[PhenList](#)

**Examples**

```

file <- system.file("extdata", "test7_TFE.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
                testGenotype="het",
                refGenotype = "WT",
                dataset.colname.sex="sex",
                dataset.colname.genotype="Genotype",
                dataset.values.female="f",
                dataset.values.male= "m",
                dataset.colname.weight="body.weight",
                dataset.colname.batch="Date_of_procedure_start")

test_TF <- TFDataset(test,depVariable="Cholesterol")

# when "testDataset" function's argument "callAll" is set to FALSE
# only "startTFModel" function is called - the first step of TFE framework
result <- testDataset(test_TF,
                     depVariable="Cholesterol",
                     callAll=FALSE,
                     method="TF")
# print out formula that has been created
analysisResults(result)$model.formula.genotype
# print out batch effect's significance
analysisResults(result)$model.effect.batch

```

subsetText

*Method "subsetText"***Description**

Method subsetText returns full name of subset that was analysed by RR or FE framework: Males only, Females only, All.

**Methods**

```
signature(obj = "hTestPhenStat")
```

summaryOutput

*Method "summaryOutput"***Description**

Wrapper for the model fitting results. Returns model fitting and testing results in a user friendly format.

**Usage**

```
summaryOutput(phenTestResult, phenotypeThreshold = 0.01)
```

## Arguments

- `phenTestResult` instance of the [PhenTestResult](#) class that comes from the function [testDataset](#); mandatory argument
- `phenotypeThreshold`  
a numerical value defining the threshold to use in `classificationTag`; default value 0.01

## Value

Returns model fitting results in a text format for the screen

## Author(s)

Natalja Kurbatova, Natasha Karp, Jeremy Mason

## References

- Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410
- West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

## See Also

[PhenTestResult](#)

## Examples

```
# Mixed Model framework
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
result <- testDataset(test,
  depVariable="Lean.Mass")
summaryOutput(result)

# Fishe Exact Test framework
file <- system.file("extdata", "test_categorical.csv", package="PhenStat")
test2 <- PhenList(dataset=read.csv(file),
  testGenotype="Aff3/Aff3")
result2 <- testDataset(test2,
  depVariable="Thoracic.Processes",
  method="FE")
summaryOutput(result2)
```

---

testDataset	<i>Method "testDataset"</i>
-------------	-----------------------------

---

### Description

Statistical analysis manager function in PhenStat package.

Firstly, it performs the checks for dependent variable in the dataset. Some checks are generic, some depends on selected statistical framework/method.

Secondly, if checks are passed it runs the stages of selected framework to analyse dependent variable.

For instance, runs startModel and finalModel for the MM framework if the argument "callAll" is set to TRUE. If framework contains only one stage like in Fisher Exact Test case then runs that one stage regardless "callAll" value.

### Usage

```
testDataset(phenList=NULL, depVariable=NULL,
            equation="withWeight", outputMessages=TRUE,
            pThreshold=0.05, method="MM", callAll=TRUE, keepList=NULL, dataPointsThreshold=4,
            RR_naturalVariation=95, RR_controlPointsThreshold=60, transformValues=FALSE)
```

### Arguments

phenList	instance of the <a href="#">PhenList</a> class; mandatory argument
depVariable	a character string defining the dependent variable of interest; mandatory argument
equation	a character string defining the equation to use. Possible values "withWeight" (default), "withoutWeight"
outputMessages	flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE
pThreshold	a numerical value for the p-value threshold used to determine which fixed effects to keep in the model, default value 0.05
method	a character string ("MM", "FE" or "RR") defining the method to use for model building; default value "MM" for mixed model
callAll	flag: "FALSE" value to run only the first stage of the selected framework; "TRUE" value (default) to run all stages of framework one after another
keepList	a logical vector defining the significance of different model effects: keep_batch, keep_equalvar, keep_weight, keep_sex, keep_interaction; default value NULL
dataPointsThreshold	threshold for the number of data points in the MM framework; default value is 4 ; minimal value is 2
RR_naturalVariation	threshold for the variation ranges in the RR framework; default value is 95 ; minimal value is 60

RR\_controlPointsThreshold  
 threshold for the number of control data points in the RR framework ; default value is 60; minimal value is 40

transformValues  
 flag: "FALSE" value to suppress transformation; "TRUE" value to perform transformation if needed; default value FALSE

**Value**

Returns results stored in instance of the [PhenTestResult](#) class

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

**References**

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

**See Also**

[PhenList](#)

**Examples**

```
# Mixed Model framework
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
result <- testDataset(test,
  depVariable="Lean.Mass")
# print out formula that has been created
analysisResults(result)$model.formula.genotype
summaryOutput(result)

# Mixed Model framework with user defined effects
user_defined_effects <- c(keep_batch=TRUE,
  keep_equalvar=TRUE,
  keep_weight=TRUE,
  keep_sex=TRUE,
  keep_interaction=TRUE)
result3 <- testDataset(test,
  depVariable="Lean.Mass",
  keepList=user_defined_effects)
# print out formula that has been created
analysisResults(result3)$model.formula.genotype
summaryOutput(result3)
```

```
# Fisher Exact Test framework
file <- system.file("extdata", "test_categorical.csv", package="PhenStat")
test2 <- PhenList(dataset=read.csv(file),
  testGenotype="Aff3/Aff3")
result2 <- testDataset(test2,
  depVariable="Thoracic.Processes",
  method="FE")
summaryOutput(result2)
```

---

testFinalLRModel	<i>Method "testFinalLRModel"</i>
------------------	----------------------------------

---

## Description

Performs diagnostic tests for Logistic Regression model quality of fit. There are no arguments checks assuming that function is called internally from the "finalLRModel" function. Otherwise should be used with precaution.

## Usage

```
testFinalLRModel(phenTestResult)
```

## Arguments

phenTestResult instance of the [PhenTestResult](#) class that comes from the function testDataset ; mandatory argument

## Value

Returns a vector with model fitting results

## Author(s)

Natalja Kurbatova, Natasha Karp, Jeremy Mason

## References

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

## See Also

[PhenTestResult](#)

## Examples

```
file <- system.file("extdata", "testLR.csv", package="PhenStat")
testLR <- PhenList(dataset=read.csv(file),
  testGenotype="Mock")
testLR2 <- LRDataset(testLR, "V2")
resultLR <- testDataset(testLR2,
  depVariable="V2",
  method="LR")
testFinalLRModel(resultLR)
```

---

testFinalModel	<i>Method "testFinalModel"</i>
----------------	--------------------------------

---

## Description

Performs diagnostic tests for Mixed Model quality of fit. There are no arguments checks assuming that function is called internally from the "finalModel" function. Otherwise should be used with precaution.

## Usage

```
testFinalModel(phenTestResult)
```

## Arguments

phenTestResult instance of the [PhenTestResult](#) class that comes from the function testDataset ; mandatory argument

## Value

Returns a vector with model fitting results

## Author(s)

Natalja Kurbatova, Natasha Karp, Jeremy Mason

## References

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

## See Also

[PhenTestResult](#)



**Examples**

```
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
result <- testDataset(test,
  depVariable="Lean.Mass")
testFinalModel(result)
```

---

testGenotype	<i>Method "testGenotype"</i>
--------------	------------------------------

---

**Description**

Method testGenotype returns test genotype

**Methods**

```
signature(obj = "PhenList")
signature(obj = "PhenTestResult")
```

---

TFDataset	<i>Method "TFDataset"</i>
-----------	---------------------------

---

**Description**

Removes of all non-concurrent batches from the dataset. Returns dataset suitable for TF framework or original dataset if data removal was not successful.

**Usage**

```
TFDataset(phenList, depVariable, outputMessages=TRUE, forDecisionTree = FALSE)
```

**Arguments**

phenList	instance of the <a href="#">PhenList</a> class; mandatory argument
depVariable	a character string defining the dependent variable of interest; mandatory argument
outputMessages	flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE
forDecisionTree	flag: "FALSE" value for normal procedure; "TRUE" value to indicate that is called form decisionTree function; default value FALSE

**Value**

Returns dataset suitable for TF framework or original dataset if data removal was not successful.

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

**References**

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

**See Also**

[PhenList](#)

**Examples**

```
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
                 testGenotype="Sparc/Sparc")
test2 <- TFDataset(test, "Lean.Mass")
```

---

transformation	<i>Method "transformation"</i>
----------------	--------------------------------

---

**Description**

Method transformation returns transformation values: lamda=value, scaleShift=value

**Methods**

```
signature(obj = "PhenTestResult")
```

---

transformationJSON	<i>Method "transformationJSON"</i>
--------------------	------------------------------------

---

**Description**

Method transformationJSON returns transformation values as JSON string

**Methods**

```
signature(obj = "PhenTestResult")
```

---

transformationText	<i>Method "transformationText"</i>
--------------------	------------------------------------

---

**Description**

Method transformationText returns transformation values as one string

**Methods**

signature(obj = "PhenTestResult")

---

vectorOutput	<i>Method "vectorOutput"</i>
--------------	------------------------------

---

**Description**

Wrapper for the model fitting results. Returns model fitting and testing results in a vector format. Assumes that modelling results are stored in the [PhenTestResult](#) object (output from function [testDataset](#)).

**Usage**

```
vectorOutput(phenTestResult, phenotypeThreshold = 0.01)
```

**Arguments**

phenTestResult instance of the [PhenTestResult](#) class that comes from the function [testDataset](#); mandatory argument

phenotypeThreshold  
a numerical value defining the threshold to use in classificationTag; default value 0.01

**Value**

Returns a vector with model fitting results: model output summary and other values

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

**References**

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

**See Also**[PhenTestResult](#)**Examples**

```
# Mixed Model framework
file <- system.file("extdata", "test1.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Sparc/Sparc")
result <- testDataset(test,
  depVariable="Lean.Mass")
vectorOutput(result)

# Fisher Exact Test framework
file <- system.file("extdata", "test_categorical.csv", package="PhenStat")
test2 <- PhenList(dataset=read.csv(file),
  testGenotype="Aff3/Aff3")
result2 <- testDataset(test2,
  depVariable="Thoracic.Processes",
  method="FE")
vectorOutput(result2)
```

---

vectorOutputMatrices *Method "vectorOutputMatrices"*

---

**Description**

Returns count matrices from Fisher Exact Test framework in a vector form.

Note: Maximal supported number of dependent variable levels is 10.

**Usage**

```
vectorOutputMatrices(phenTestResult, outputMessages=TRUE)
```

**Arguments**

`phenTestResult` instance of the [PhenTestResult](#) class that comes from the function [testDataset](#); mandatory argument

`outputMessages` flag: "FALSE" value to suppress output messages; "TRUE" value to show output messages; default value TRUE

**Value**

Returns a vector with count values.

**Author(s)**

Natalja Kurbatova, Natasha Karp, Jeremy Mason

## References

Karp N, Melvin D, Sanger Mouse Genetics Project, Mott R (2012): Robust and Sensitive Analysis of Mouse Knockout Phenotypes. *PLoS ONE* 7(12): e52410. doi:10.1371/journal.pone.0052410

West B, Welch K, Galecki A (2007): Linear Mixed Models: A practical guide using statistical software *New York: Chapman & Hall/CRC* 353 p.

## See Also

[PhenTestResult](#)

## Examples

```
file <- system.file("extdata", "test_categorical.csv", package="PhenStat")
test <- PhenList(dataset=read.csv(file),
  testGenotype="Aff3/Aff3")
result <- testDataset(test,
  depVariable="Thoracic.Processes",
  method="FE")
vectorOutputMatrices(result)
```

---

weightIn

*Method "weightIn"*

---

## Description

Returns TRUE if the weight is in the dataset, FALSE otherwise

## Methods

signature(obj = "PhenList")

signature(obj = "PhenTestResult")

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