

# Package ‘CyTOFpower’

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**Type** Package

**Title** Power analysis for CyTOF experiments

**Version** 1.15.0

**Description** This package is a tool to predict the power of CyTOF experiments in the context of differential state analyses. The package provides a shiny app with two options to predict the power of an experiment:  
i. generation of in-silico CyTOF data, using users input ii. browsing in a grid of parameters for which the power was already precomputed.

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**License** LGPL-3

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**Imports** CytoGLMM, diffcyt, DT, dplyr, ggplot2, magrittr, methods, rlang, stats, shiny, shinyFeedback, shinyjs, shinyMatrix, SummarizedExperiment, tibble, tidyr

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|                    |                            |
|--------------------|----------------------------|
| compute_effectsize | <i>Compute effect size</i> |
|--------------------|----------------------------|

---

### Description

Compute effect size

### Usage

```
compute_effectsize(raw_data_lg)
```

### Arguments

raw\_data\_lg      data.frame, cells values in long format.

### Details

Compute observed Cohen's effect size and observed fold change.

### Value

data.frame, Cohen's effect size and fold change that were observed in the data for each marker.

---

`compute_pwr`*Compute power*

---

**Description**

Compute power

**Usage**

```
compute_pwr(model_values, alpha = 0.05)
```

**Arguments**

|                           |                                                   |
|---------------------------|---------------------------------------------------|
| <code>model_values</code> | data.frame, output of <code>run_models()</code> . |
| <code>alpha</code>        | numeric, significance level.                      |

**Details**

Compute the power based on the model values.

**Value**

numeric, power.

---

`compute_variance`*Compute variance*

---

**Description**

Compute variance

**Usage**

```
compute_variance(raw_data_lg)
```

**Arguments**

|                          |                                          |
|--------------------------|------------------------------------------|
| <code>raw_data_lg</code> | data.frame, cells values in long format. |
|--------------------------|------------------------------------------|

**Details**

Compute the observed variance in the data.

**Value**

numeric, observed variance mean.

---

CyTOFpower

*CyTOFpower: R-package to predict the power of a CyTOF experiment*


---

### Description

This package provides functions and a shiny app to predict the power of a CyTOF experiment.  
Interactive shiny app to predict the power of a CyTOF experiment.

### Usage

```
CyTOFpower()
```

### Value

Interactive shiny app.

### Examples

```
# Launch the shiny app
if (interactive()) {
  CyTOFpower()
}
```

---

function\_apply\_modelcomputations\_modelchoice

*Run DS tests for one simulation.*


---

### Description

Run DS tests for one simulation.

### Usage

```
function_apply_modelcomputations_modelchoice(
  list_combined_output,
  model = c("cytoglm", "cytoglm", "testDS_limma_random", "testDS_limma_fixed",
    "testDS_lmm")
)
```

### Arguments

|                      |                                                                                               |
|----------------------|-----------------------------------------------------------------------------------------------|
| list_combined_output | list, of simulated data (output of the function_apply_onesimulation_withmarkerinfo function). |
| model                | vector, name(s) of models to test.                                                            |

### Details

Wrapper to run the models through the different simulations.

**Value**

data.frame of results for each simulation.

---

function\_apply\_onesimulation\_withmarkerinfo

*One simulation with markers NB information.*

---

**Description**

One simulation with markers NB information.

**Usage**

```
function_apply_onesimulation_withmarkerinfo(variation)
```

**Arguments**

variation      list, list of list containing the different input parameter variations @describeIn function\_create\_mock\_dataset\_withmarkerinfo.

**Details**

Apply one simulation for a given parameter combination number times (iterations), when we have prior information about the markers distribution parameters (mean and dispersion of the negative binomial).

**Value**

list of simulated data. Each list member contains 5 slots: - variation: the variation of input parameters which has been used in input; - df\_info: experimental information (donor IDs, group IDs, samples IDs); - DE\_markers\_names: name of the differentially expressed markers; - ls\_mock\_data: list of data.frames, each data.frame being one simulation of the cell values using the input parameters provided (list is length nb\_sim).

---

function\_check\_nbDEmarkers

*Number of DE markers greater than 1.*

---

**Description**

Number of DE markers greater than 1.

**Usage**

```
function_check_nbDEmarkers(nb_DEmarker)
```

**Arguments**

nb\_DEmarker      numeric, number of differentially expressed markers.

**Details**

Function to check that the number of DE markers is greater than 1.

**Value**

error message

---

function\_check\_nbmarkers

*Number of markers greater than 2.*

---

**Description**

Number of markers greater than 2.

**Usage**

```
function_check_nbmarkers(nb_marker)
```

**Arguments**

nb\_marker          numeric, total number of markers.

**Details**

Function to check that the number of markers is greater than 2.

**Value**

error message if the total number of markers is lower than 3.

---

function\_compute\_diffcyt\_features

*Compute cells counts and medians.*

---

**Description**

Compute cells counts and medians.

**Usage**

```
function_compute_diffcyt_features(mock_flowset)
```

**Arguments**

mock\_flowset      data.frame, cell values for each marker.

**Details**

Function to calculate features for diffcyt package models.

**Value**

list with cell counts and medians for each markers.

---

```
function_create_mock_dataset_withmarkerinfo
```

*Compute simulated cell values for one simulation with markers NB information.*

---

**Description**

Compute simulated cell values for one simulation with markers NB information.

**Usage**

```
function_create_mock_dataset_withmarkerinfo(variation)
```

**Arguments**

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| variation | list, list of data.frames containing the different variable input paramaters to generate the data: - marker_name: name of the marker (character); - nb_donor: number of donors; - rho: fold change; - subject_effect: standard deviation for the normal distribution from which the donor's means will be drawn; - mu0: mean of the negative binomial for the gamma distribution from which the means of the different donor will be drawn; - dispersion: dispersion of the negative binomial from which the DE marker's cell values will be drawn; - nb_cell_per_sample: number of cells per sample. |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Details**

Function to compute the simulated cell values using a combination of variable parameters, when we have prior information about the markers distribution parameters (mean and dispersion of the negative binomial).

**Value**

list with 4 slots: - df\_info: data.frame of experimental information; - DEmarkers\_names: vector of DE marker names; - raw\_data: data.frame of raw cell values; - data: data.frame of transformed cell values.

---

```
function_DEmarkers_sup_nbmarkers
```

*Check on the number of DE markers.*

---

**Description**

Check on the number of DE markers.

**Usage**

```
function_DEmarkers_sup_nbmarkers(nb_markers, nb_DEmarker)
```

**Arguments**

nb\_markers        numeric, total number of markers.  
 nb\_DEmarker      numeric, number of differentially expressed markers.

**Details**

Function to check that number of DE markers greater than number of markers.

**Value**

error message if the number of DE markers is greater than the total number of markers.

---

function\_desigmat\_contrast\_diffcytDSlimma\_fixedeffect  
*Design and contrast matrices for diffcyt-DS-limma with fixed effect.*

---

**Description**

Design and contrast matrices for diffcyt-DS-limma with fixed effect.

**Usage**

```
function_desigmat_contrast_diffcytDSlimma_fixedeffect(df_experiment_info)
```

**Arguments**

df\_experiment\_info  
                      data.frame, information about the experiment (donor IDs, group IDs and sample IDs).

**Details**

Function to create the design matrix and contrast for the diffcyt-DS-limma model with fixed effect.

**Value**

list with 3 slots: - design\_matrix: the design matrix; - contrast: the contrast matrix; - effect: the specification of the "fixed" effect.



---

```
function_desigmat_contrast_diffcytDSLlimma_randomeffect
```

*Design and contrast matrices for diffcyt-DS-limma with random effect.*

---

### Description

Design and contrast matrices for diffcyt-DS-limma with random effect.

### Usage

```
function_desigmat_contrast_diffcytDSLlimma_randomeffect(df_experiment_info)
```

### Arguments

`df_experiment_info`

data.frame, information about the experiment (donor IDs, group IDs and sample IDs).

### Details

Function to create the design matrix and contrast for the diffcyt-DS-limma model with random effect from the diffcyt package.

### Value

list with 3 slots: - `design_matrix`: the design matrix; - `contrast`: the contrast matrix; - `effect`: the specification of the "random" effect.

---

```
function_extract_marker_names
```

*Extract marker names.*

---

### Description

Extract marker names.

### Usage

```
function_extract_marker_names(mock_dataset)
```

### Arguments

`mock_dataset` data.frame, containing the cell values for each marker.

### Details

Function to extract the marker names.

### Value

vector of marker names.

---

```
function_formula_contrast_diffcytDSLMM_randomeffect
```

*Formula and contrast matrix for diffcyt-DS-LMM with random effect.*

---

### Description

Formula and contrast matrix for diffcyt-DS-LMM with random effect.

### Usage

```
function_formula_contrast_diffcytDSLMM_randomeffect(df_experiment_info)
```

### Arguments

`df_experiment_info`

data.frame, information about the experiment (donor IDs, group IDs and sample IDs).

### Details

Function to create formula and contrast for diffcyt-DS-LMM with random effect.

### Value

list with 3 slots: - formula: the formula for the model; - contrast: the contrast matrix.

---

```
function_is_data_paired
```

*Data paired.*

---

### Description

Data paired.

### Usage

```
function_is_data_paired(data)
```

### Arguments

`data`

data.frame, experimental information containing (sample IDS, donor IDS).

### Details

Function to check if the data is paired.

### Value

logical, TRUE is the data are paired - FALSE if the data are not paired

---

function\_names\_DE\_markers

*Generate name of the DE markers.*


---

**Description**

Generate name of the DE markers.

**Usage**

```
function_names_DE_markers(total_nb_marker, nb_DE_marker)
```

**Arguments**

total\_nb\_marker      numeric, total number of markers.  
 nb\_DE\_marker      numeric, number of DE markers.

**Details**

Function to generate the name of the DE markers.

**Value**

vactor of marker names.

---

function\_run\_bootstrapcytoGLMM

*Run cytoglm.*


---

**Description**

Run cytoglm.

**Usage**

```
function_run_bootstrapcytoGLMM(mock_dataset, nb_bootstrap = 500)
```

**Arguments**

mock\_dataset      data.frame, cell values for each marker.  
 nb\_bootstrap      numeric, number of bootstrap (by defaults nb\_bootstrap = 1000).

**Details**

Function to run the Generalized Linear Model with Bootstrap, from the CytoGLMM package.

**Value**

list of 3 slots: - model\_fit: fit of the model; - plot: plot of the effects; - results\_summary: data.frame containing the results of the models for each marker.

---

```
function_run_cytoGLMM
```

*Run cytoglmm*

---

### Description

Run cytoglmm

### Usage

```
function_run_cytoGLMM(mock_dataset)
```

### Arguments

`mock_dataset`      data.frame, cell values for each marker.

### Details

Function to run GLMM model from CytoGLMM package.

### Value

list of 3 slots: - `model_fit`: fit of the model; - `plot`: plot of the effects; - `results_summary`: data.frame containing the results of the models for each marker.

---

```
function_run_diffcytDSlimma
```

*Run diffcyt-DS-limma model.*

---

### Description

Run diffcyt-DS-limma model.

### Usage

```
function_run_diffcytDSlimma(
  ls_desigmat_contrast,
  df_experiment_info,
  ls_features
)
```

### Arguments

`ls_desigmat_contrast`      list, with design and contrast matrices.

`df_experiment_info`      data.frame, information about the experiment (donor IDs, group IDs and sample IDs).

`ls_features`      list, with cell counts and medians for each markers.

**Details**

Function to run diffcyt-DS-limma model from the diffcyt package.

**Value**

list with 2 slots: - model\_fit: the model fit; - result\_summary: results of the model for each marker.

---

```
function_run_diffcytDSLMM
```

*Run diffcyt-DS-LMM model.*

---

**Description**

Run diffcyt-DS-LMM model.

**Usage**

```
function_run_diffcytDSLMM(ls_form_contrast, df_experiment_info, ls_features)
```

**Arguments**

```
ls_form_contrast
```

list, with formula and constrat matrix.

```
df_experiment_info
```

data.frame, information about the experiment (donor IDs, group IDs and sample IDs).

```
ls_features
```

list, with cell counts and medians for each markers.

**Details**

Function to run diffcyt-DS-LMM model from the diffcyt package.

**Value**

list with 2 slots: - model\_fit: the model fit; - result\_summary: results of the model for each marker.

---

```
function_run_diffcyt_full_pipeline
```

*Run diffcyt pipeline*

---

**Description**

Run diffcyt pipeline

**Usage**

```
function_run_diffcyt_full_pipeline(
  onevariation,
  model = c("limma", "LMM"),
  effect = c("random", "fixed")
)
```

**Arguments**

|              |                                                                                             |
|--------------|---------------------------------------------------------------------------------------------|
| onevariation | list, of simulated data (output of the function_wrapper_apply_simulation_nbtimes function). |
| model        | character, model to run: "limma" or "LMM".                                                  |
| effect       | character, effect: "random" or "fixed".                                                     |

**Details**

Function to run diffcyt pipeline. We do not used the diffcyt function directly because of the limma model run differently with the effects.

**Value**

list with 2 slots: - model\_fit: the model fit; - result\_summary: results of the model for each marker.

---

function\_summary\_results\_models  
*Summarize data and results.*

---

**Description**

Summarize data and results.

**Usage**

```
function_summary_results_models(summary_from_model, package)
```

**Arguments**

|                    |                                                                   |
|--------------------|-------------------------------------------------------------------|
| summary_from_model | list, output from the functions running the models.               |
| package            | character, package used to run the test: "CytoGLMM" or "diffcyt". |

**Details**

Function to do a summary of the tested data and model's results for the CytoGLMM and diffcyt packages.

**Value**

data.frame of results for each simulation.

---

function\_to\_compute\_model\_computation\_onesimulation\_modelchoice  
*Run DS tests for one simulation.*

---

**Description**

Run DS tests for one simulation.

**Usage**

```
function_to_compute_model_computation_onesimulation_modelchoice(
  onevariation,
  model
)
```

**Arguments**

|              |                                                                                             |
|--------------|---------------------------------------------------------------------------------------------|
| onevariation | list, of simulated data (output of the function_wrapper_apply_simulation_nbtimes function). |
| model        | vector, name(s) of models to test.                                                          |

**Details**

Function to run the DS tests through the different models.

**Value**

data.frame of results for each simulation all models combined.

---

function\_to\_transform\_data  
*arcsinh transformation.*

---

**Description**

arcsinh transformation.

**Usage**

```
function_to_transform_data(data, cofactor = 5)
```

**Arguments**

|          |                                                                   |
|----------|-------------------------------------------------------------------|
| data     | data.frame, cell values to transform.                             |
| cofactor | numeric, co-factor used in the arcsinh (by default cofactor = 5). |

**Details**

Function to transform the data with the recommended transformation for cyTOF data: arcsinh with cofactor equals to 5.

**Value**

data.frame of transformed data.

---

function\_value\_onemarker

*Compute simulated cell values for one marker with markers NB informations*

---

**Description**

Compute simulated cell values for one marker with markers NB informations

**Usage**

```
function_value_onemarker(
  marker_name,
  mu0,
  dispersion,
  subject_effect,
  nb_donor,
  nb_cell_per_sample,
  rho = 1
)
```

**Arguments**

|                    |                                                                                                                                        |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| marker_name        | character, name of the marker.                                                                                                         |
| mu0                | numeric, general donor mean from which the individual $\mu_{0i}$ will be drawn.                                                        |
| dispersion         | numeric, dispersion of the markers.                                                                                                    |
| subject_effect     | numeric, standard deviation for the normal distribution from which the donor's means will be drawn (by default subject_effect = 0.01). |
| nb_donor           | numeric, number of donors.                                                                                                             |
| nb_cell_per_sample | numeric, number of cells per sample (by default nb_cell_per_sample = 500).                                                             |
| rho                | numeric, fold change.                                                                                                                  |

**Details**

Function to generate value for one marker with a mean and dispersion specified for the negative binomiale.

**Value**

data.frame of cell values.



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