

# RanCh

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**Title** Tools for abstract discrete Random Choice

**URL** <http://github.com/mccauslw/RanCh>

**BugReports** <http://github.com/mccauslw/RanCh/issues>

**Version** 0.0.0.9000

**Description** This package provides tools for a research project whose purpose is to help us better understand the foundations of stochastic discrete choice. It includes datasets compiled from the literature on context effects and stochastic intransitivity and from some recent experiments. It provides graphical tools to display likelihood function and posterior density contours, as well as regions, in the space of choice probabilities, defined by various stochastic choice axioms, context effects and other conditions.

**Imports** klaR,  
MASS,  
bitops,  
Smisc,  
ggtern

**Depends** R (>= 3.6.0)

**License** CC0

**Encoding** UTF-8

**LazyData** true

**RoxygenNote** 6.1.1

**Suggests** knitr,  
rmarkdown

**VignetteBuilder** knitr

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create_P	<i>Random Choice Structure for a three-object universe</i>
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**Description**

create\_P creates a random choice structure for a three-object universe from

**Usage**

create\_P(p12, p23, p13, P1, P2, names = c("x", "y", "z"))

**Arguments**

- |     |  |
|-----|--|
| p12 | Probability of chosing object 1 when presented with objects 1 and 2    |
| p23 | Probability of chosing object 2 when presented with objects 2 and 3    |
| P1  | Probability of chosing object 1 when presented with objects 1, 2 and 3 |
| P2  | Probability of chosing object 2 when presented with objects 1, 2 and 3 |
| P13 | Probability of chosing object 1 when presented with objects 1 and 3    |

**Value**

A Random Choice Structure

**Examples**

```
P = create_P(21/40, 37/40, 28/40, 19/40, 15/40, names=c('Red', 'Purple', 'Pink'))
P
```

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dDir	<i>Dirichlet density</i>
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**Description**

dDir computes the Dirichlet density at a point  $p$  in the regular simplex, for a vector  $\alpha$  of Dirichlet parameters.

**Usage**

```
dDir(p, alpha, log = TRUE)
```

**Arguments**

<code>p</code>	vector of probabilities on the regular simplex
<code>alpha</code>	vector of Dirichlet parameters
<code>log</code>	logical; if TRUE, the log density is returned

**Value**

density or log density value

---

dDir3_quantile	<i>Quantile of third order Dirichlet density value</i>
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**Description**

dDir3\_quantile computes an approximation of the given quantile of a third order Dirichlet density value, under that Dirichlet distribution.

**Usage**

```
dDir3_quantile(quantile, alpha, normalized = FALSE)
```

**Arguments**

<code>quantile</code>	the quantile of the desired density value
<code>alpha</code>	a vector of Dirichlet parameters
<code>normalized</code>	binary; if TRUE, return the quantile as a fraction of the maximum density value; if FALSE, return the unnormalized quantile.

**Value**

The value of the quantile, normalized or not

---

dDir_max	<i>Maximum density of a Dirichlet distribution</i>
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**Description**

max\_dDir computes the maximum density of a Dirichlet distribution as a function of the parameter vector alpha.

**Usage**

```
dDir_max(alpha, log = TRUE)
```

**Arguments**

alpha	vector of Dirichlet parameters.
log	logical; if TRUE, the log maximum density is returned.

**Value**

Density or log density value.

---

dDir_moments	<i>Moments of Dirichlet density values</i>
--------------	--

---

**Description**

moments\_dDi computes a vector of the first n raw moments of Dirichlet density values, under that Dirichlet distribution.

**Usage**

```
dDir_moments(beta, n_mu, log = FALSE)
```

**Arguments**

n_mu	number of moments to compute.
log	logical; if true return log moments.
alpha	vector of Dirichlet parameters.

**Value**

vector of moments

---

Dir3_HD_region	<i>Compute highest density (HD) region for a third order Dirichlet distribution</i>
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---

**Description**

This function computes a polygon approximating the highest density region of a third order Dirichlet distribution. This can be used to compute highest prior density and highest posterior density (HPD) regions.

**Usage**

```
Dir3_HD_region(alpha, HD_probability)
```

**Arguments**

alpha                a vector of three (positive) Dirichlet parameters.  
 HD\_probability    probability of region to construct

**Value**

polygon approximation of HD region.

---

Dir_mult_ML	<i>Marginal likelihood for Dirichlet-multinomial model</i>
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---

**Description**

Dir\_mult\_ML computes the marginal likelihood for a Dirichlet prior and multinomial data generating process.

**Usage**

```
Dir_mult_ML(alpha, N, log = TRUE)
```

**Arguments**

alpha                vector of Dirichlet parameters  
 N                    vector of multinomial counts  
 log                  logical; if TRUE, return the log Bayes factor.

**Value**

Marginal likelihood or log marginal likelihood

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Ind_Dir_mult_ML	<i>Marginal likelihood for independent Dirichlet-multinomial model</i>
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**Description**

Ind\_Dir\_mult\_ML computes the marginal likelihood for a model where rows of a count matrix are independent multinomial and the rows of the unknown random choice structure are a priori independent Dirichlet.

**Usage**

```
Ind_Dir_mult_ML(A, N, log = TRUE)
```

**Arguments**

A	matrix of Dirichlet parameters, each row giving the Dirichlet distribution of the corresponding row of a random choice structure.
N	count matrix for a universe of objects.
log	logical; if TRUE, return the log Bayes factor

---

marginalize	<i>Routines for simple manipulations of count matrices and random choice structures.</i>
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---

**Description**

Marginalize a count matrix or random choice structure

**Usage**

```
marginalize(input_N, objects)
```

**Arguments**

input_N	A count matrix
objects	A vector of objects to retain

**Details**

This function takes as input a count matrix or random choice structure on a universe of objects and returns a marginalization of it to a universe that is a subset of the original universe.

**Value**

A count matrix

**Examples**

```
N_bce = marginalize(PC_counts, c(2,3,5))
P_abd = marginalize()
N
```

---

multiplicative_X3	<i>Compute a cross section of the multiplicative inequality region</i>
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---

**Description**

multiplicative\_X3 computes the region (a triangle) of ternary probabilities consistent with given binary probabilities and the multiplicative inequality.

**Usage**

```
multiplicative_X3(P)
```

**Arguments**

P	A random choice structure
---	---------------------------

**Value**

A 3x3 matrix where each row gives one of the three vertices, in barycentric coordinates, of the triangular region where the multiplicative inequality holds.

**Examples**

```
P = create_P(0.7, 0.6, 0.8, 0.6, 0.3, 0.1, names = c('x', 'y', 'z'))
multiplicative_X3(P)
```

---

PC_counts	<i>Counts</i>
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**Description**

A 32x26x5 matrix with count data.

**Usage**

```
PC_counts
```

**Format**

An object of class array of dimension 32 x 31 x 5.

---

PC_demographics	<i>Demographic information for subjects</i>
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**Description**

Demographic information for subjects

**Usage**

PC\_demographics

**Format**

A data frame with demographic information on subjects

sex Sex of subject

age Age of subject in years

location Province or territory in Canada

---

PC_raw	<i>Population Choice experiment data</i>
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---

**Description**

Record of every choice made by every respondent.

**Usage**

PC\_raw

**Format**

A data frame with 17 variables:

design

gender Sex of respondent: 1 for male, 2 for female



---

PC_trials	<i>Record of all choice trials</i>
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**Description**

Record of all choice trials

**Usage**

```
PC_trials
```

**Format**

A data frame with 14 variables

subj Subject identifier

domain Factor indicating choice domain

trial Trial identifier (gives the order in which a subject sees choice sets)

subs Factor indicating the choice subset presented: 'ab', 'cde', etc., objects always in alphabetical order

choice Factor indicating the choice made: 'a', 'b', 'c', 'd' or 'e'

subs\_conf Subset configuration, the order objects appear on the screen: 'ba', 'ecd', etc., objects not necessarily in alphabetical order

subs\_bin Code for subset where digits of binary representation indicate object membership

choice\_int Integer code for chosen object

ab Revealed preference indicator: 1 for a revealed preferred to b, -1 for b revealed preferred to a, 0 otherwise. This is the first of ten revealed preference columns, each pertaining to a particular doubleton set.

---

plot_HD_Dir3	<i>Plot highest density region for a third order Dirichlet distribution</i>
--------------	---

---

**Description**

This function plots the Dirichlet highest density region in barycentric coordinates.

**Usage**

```
plot_HD_Dir3(A, HD_probability)
```

**Arguments**

HD\_probability probability of highest density region

alpha vector of Dirichlet parameters

**Examples**

```
plot_HD_Dir_3(0.95, c(23, 13, 4))
```

---

plot_P3	<i>Plot a Random Choice Structure in barycentric coordinates</i>
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---

**Description**

plot\_P3 plots four points specifying a Random Choice Structure for a universe of three objects.

**Usage**

```
plot_P3(P, perm = c(1, 2, 3), binary_pch = 1, ternary_pch = 20)
```

**Arguments**

P	A random choice structure for a universe of three objects
perm	A permutation of (1, 2, 3) specifying which objects in the universe correspond to the bottom left, top, and bottom right vertex, respectively of the ternary plot.
binary_pch	Plotting character (pch) for binary choice probabilities. Defaults to a hollow circle.
ternary_pch	Plotting character (pch) for ternary choice probability. Defaults to a solid circle. The convention established with the defaults for binary_pch and ternary_pch allow one to distinguish between a binary choice probability and a ternary choice probability that happens to be on the boundary of the triangle.

**Examples**

```
P = create_P(0.7, 0.6, 0.8, 0.6, 0.3, 0.1, names = c('x', 'y', 'z'))
plot_P3(P)
```

---

proportions	<i>Random Choice Structure from count proportions</i>
-------------	---

---

**Description**

proportions takes a count matrix as input, and returns choice proportions as a random choice structure.

**Usage**

```
proportions(N)
```

**Arguments**

N	A count matrix.
---	-----------------

**Value**

A random choice structure.

**Examples**

```
PC_P = proportions(PC_counts)
```

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RanCh

*RanCh: A package for abstract discrete Random Choice*


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**Description**

The RanCh package provides data, graphical tools and inference tools for abstract discrete random choice analysis.

**Data sets**

NA

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RCD\_prior\_1

*One-parameter Dirichlet prior for a RCS*


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**Description**

RCS\_prior\_1 computes a matrix of Dirichlet parameters for a one-parameter Dirichlet prior for a random choice structure.

**Usage**

```
RCD_prior_1(alpha, n_objects)
```

**Arguments**

alpha	univariate parameter for the one-parameter Dirichlet prior.
n_objects	number of objects in the universe.

**Value**

a matrix of Dirichlet parameters with the same dimensions as a count matrix for a universe of the same size.

---

regularity\_X3

*Compute a cross section of the regularity region*


---

**Description**

regularity\_X3 computes the region (a triangle or the empty set) of ternary probabilities consistent with given binary probabilities and the regularity condition.

**Usage**

```
regularity_X3(P)
```

Arguments

P                      A random choice structure.

Value

If the region is empty, the output is NULL. Otherwise, a 3x3 matrix where each row gives one of the three vertices in barycentric coordinates.

Examples

```
P = create_P(0.7, 0.6, 0.8, 0.6, 0.3, 0.1, names = c('x', 'y', 'z'))
reg_region = regularity_X3(P)
```

---

YG_counts	<i>Counts</i>
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---

Description

A 3x16x15x4 matrix with count data.

Usage

YG\_counts

Format

An object of class table of dimension 16 x 11 x 4.

---

YG_demographics	<i>Demographic information for subjects</i>
-----------------	---

---

Description

Demographic information for subjects

Usage

YG\_demographics

Format

- A data frame with demographic information on subjects
- sex Sex of subject
  - educ Educational attainment by subject
  - region Region of subject’s residence in US
  - race Race of subject
  - age\_range Age range of subject

YG\_raw

*YouGov Experiment data***Description**

Record of every choice made by every respondent.

**Usage**

YG\_raw

**Format**

A data frame with 17 variables:

design

card

domain

combo

perm

choiceset Choice set as a character string

option\_1 Object presented in first position: 1, 2, 3 or 4

option\_2 Object presented in second position

option\_3 Object presented in third position

option\_4 Object presented in fourth position

response Object chosen: 1, 2, 3 or 4

order

gender Sex of respondent: 1 for male, 2 for female

educ Education of respondent: 1 for No high school, 2 for High school graduate, 3 for Some college, 4 for 2-year college, 5 for 4-year college, 6 for post-graduate

region Region of respondent: 1 for northeast, 2 for midwest, 3 for south, 4 for west

race Race of respondent: 1 for White, 2 for Black, 3 for Hispanic, 4 for Asian, 5 for Native American, 6 for Mixed, 7 for Other, 8 for Middle Eastern

age\_cross Age category of respondent: 1 for 18-34, 2 for 35-54, 3 for 55 and over

---

YG_trials	<i>Record of all choice trials</i>
-----------	------------------------------------

---

**Description**

Record of all choice trials

**Usage**

YG\_trials

**Format**

A data frame with 14 variables

subj Subject identifier

domain Factor indicating choice domain

trial Trial identifier (gives the order in which a subject sees choice sets)

subs Factor indicating the choice subset presented: 'ab', 'cde', etc.

choice Factor indicating the choice made: 'a', 'b', 'c' or 'd'

subs\_conf Subset configuration, the order objects appear on the screen

subs\_bin Code for subset where digits of binary representation indicate object membership

choice\_int Integer code for chosen object

ab Revealed preference indicator: 1 for a revealed preferred to b, -1 for b revealed preferred to a, 0 otherwise

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