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Rademacher Distribution

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What is a Rademacher Distribution?

The **Rademacher distribution** is a recoding of the [Bernoulli distribution](#) with two possible values $\{-1, 1\}$. Its second moment (the [variance](#)) equals 1; all other [moments](#) equal 0 [1]. It is named after German-American mathematician [Hans Rademacher](#) and denoted $\text{Rad}_{1/2}$.

Like the Bernoulli, a [random variable](#) has a 50% chance of a success and 50% chance of failure.

- Bernoulli: 0 (failure) and 1 (success),
- Rademacher: -1 (failure) and 1 (success).

The distribution is used for formulating statistical proofs, random [sampling](#) [1], and [bootstrapping](#), where weights $d_g = \{-1, 1\}$ are called *Rademacher weights* [2].

PMF of the Rademacher Distribution

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The Rademacher distribution is a [discrete probability distribution](#) and so can be described by a [probability mass function](#):

$$P(X=x) = \begin{cases} p & x = 1 \\ 1 - p & x = -1 \end{cases}$$

The distribution can also be written in terms of the [Dirac Delta function](#):
 $f(k) = \frac{1}{2} (\delta(k - 1) + \delta(k + 1)).$

Rademacher Random Variables

Rademacher random variables can be defined in terms of Bernoulli random variables. If Y is a Bernoulli random variable, then $X = 2Y - 1$ is a Rademacher random variable [3]. Conversely, if X is a Rademacher random variable, then $(X + 1) / 2$ is a Bernoulli random variable.

These variables can also be defined in terms of the [Laplace distribution](#). Given a Rademacher random variable X, if $Y \sim \text{Exp}(\lambda)$ is independent from X, then $XY \sim \text{Laplace}(0, 1/\lambda)$.

A sequence of successive sums of Rademacher random variables is a [random walk](#).

References

[1] Contreras, D. (2021). [Estimation of Flexibility Potentials in Active Distribution Networks](#). Books on Demand.
[2] Miller, D. & Cameron, C. [A Practitioner's Guide to Cluster-Robust Inference](#).
[3] Border, C. [Supplement 2: Review Your Distributions](#). Retrieved January 1, 2022 from: <http://www.math.caltech.edu/~2016-17/2term/ma003/Notes/DistributionReview.pdf>.

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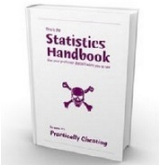
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