What is the definition of Shannon Diversity Index and can you provide an example?

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The Shannon Diversity Index, also known as the Shannon-Wiener Index, is a measure of biodiversity that takes into account the number of species present in a given area and their relative abundance. It is calculated using the logarithm of the probability of each species occurring in the area multiplied by the probability of all species occurring in the area. This index provides a quantitative measure of diversity, with higher values indicating a more diverse ecosystem. For example, if a forest has 100 trees, with 80 being oak trees and 20 being maple trees, the Shannon Diversity Index would be higher than a forest with 100 trees, all being oak trees, as the latter has less diversity in terms of tree species.

Shannon Diversity Index: Definition & Example

The Shannon Diversity Index (sometimes called the Shannon-Wiener Index) is a way to measure the diversity of species in a community.

Denoted as *H*, this index is calculated as:

$$H = -\Sigma p_i * ln(p_i)$$

where:

Σ: A Greek symbol that means "sum"*ln*: Natural logp_i: The proportion of the entire community made up of species *i*

The higher the value of *H*, the higher the diversity of species in a particular community. The lower the value of *H*, the lower the diversity. A value of *H* = 0 indicates a community that only has one species.

The Shannon Equitability Index is a way to measure the evenness of species in a community. The term "evenness" simply refers to how similar the abundances of different species are in the community.

Denoted as *EH*, this index is calculated as:

$$EH = H / ln(S)$$

where:

***H*: The Shannon Diversity Index*S*: The total number of unique species**

This value ranges from 0 to 1 where 1 indicates complete evenness.

The following step-by-step example shows how to calculate the Shannon Diversity Index and the Shannon Equitability Index for a given community.

Step 1: Collect the Data

Suppose a biologist wants to measure the diversity of species in a local forest. She collects the following data:

Species	Frequency
A	40
B	20
C	15
D	8
E	22

Step 2: Calculate the Proportions

For example, there are a total of 105 individuals and 40 are classified as species A. Thus, species A makes up 40 /105 = 0.38 of the total community.

She can perform a similar calculation for each species:

Species	Frequency	p_i
A	40	0.38
B	20	0.19
C	15	0.14
D	8	0.08
E	22	0.21

Step 3: Calculate the Natural Log of the Proportions

Next, she can calculate the natural log of each proportion:

Species	Frequency	p_i	$ln(p_i)$
A	40	0.38	-0.97
B	20	0.19	-1.66
C	15	0.14	-1.95
D	8	0.08	-2.57
E	22	0.21	-1.56

Step 4: Multiply the Proportions by the Natural Log of the Proportions

Next, she can multiply the proportions by the natural log of the proportions:

Species	Frequency	p_i	$ln(p_i)$	$p_i * ln(p_i)$
A	40	0.38	-0.97	-0.37
B	20	0.19	-1.66	-0.32
C	15	0.14	-1.95	-0.28
D	8	0.08	-2.57	-0.20
E	22	0.21	-1.56	-0.33

Step 5: Calculate the Shannon Diversity Index

Lastly, she can use the following formula to calculate the Shannon Diversity Index:

$H = -\Sigma pi * ln(pi)$

For this example, she can take the sum of the last

column and multiply by negative one:

Species	Frequency	p_i	$ln(p_i)$	$p_i * ln(p_i)$
A	40	0.38	-0.97	-0.37
B	20	0.19	-1.66	-0.32
C	15	0.14	-1.95	-0.28
D	8	0.08	-2.57	-0.20
E	22	0.21	-1.56	-0.33
			H	**1.49**

The Shannon Diversity Index for this community is 1.49.

She can also use the following formula to calculate the Shannon Equitability Index:

$EH = H / ln(S)$

For this example, there are $S = 5$ total species, so see can calculate this index to be:

$EH = 1.49 / ln(5) = 0.92$.

Feel free to use this to automatically calculate the Shannon Diversity Index for any dataset.