**Gini-Simpson Diversity Index**

Simpson’s index (D) is a metric that accounts for both richness and evenness of the species in a given area. The Gini-Simpson index is 1 – D and can be interpreted as a probability with values ranging from 0 to 1. For instance, if we calculate a Gini-Simpson value of 0.71, there is a 71% chance that if we select 2 individuals from random they would be from 2 different species. Similarly, this means that there is a 29% chance that they would be from the same species.

n = the total number of individuals of a particular species

N = the total number of individuals of all species (in a given sample)

Consider 3 communities, each made up of a total of 100 individuals, drawn from 10 combinations of species, A to J.

|  |  |  |  |
| --- | --- | --- | --- |
| **Species** | **Community 1 (n)** | **Community 2 (n)** | **Community 3 (n)** |
| A | 10 | 72 | 35 |
| B | 9 | 6 | 34 |
| C | 11 | 3 | 31 |
| D | 10 | 3 | 0 |
| E | 8 | 1 | 0 |
| F | 12 | 3 | 0 |
| G | 10 | 4 | 0 |
| H | 11 | 3 | 0 |
| I | 10 | 2 | 0 |
| J | 9 | 3 | 0 |
| Total (N) | 100 | 100 | 100 |

1. Calculate the Simpson and Gini-Simpson diversity index for each community.

Community 1

|  |  |  |  |
| --- | --- | --- | --- |
| **Species** | n | n-1 | n(n-1) |
| A | 10 | 9 | 90 |
| B | 9 | 8 | 72 |
| C | 11 | 10 | 110 |
| D | 10 | 9 | 90 |
| E | 8 | 7 | 56 |
| F | 12 | 11 | 132 |
| G | 10 | 9 | 90 |
| H | 11 | 10 | 110 |
| I | 10 | 9 | 90 |
| J | 9 | 8 | 72 |
| Total | N = 100 |  | = 912 |

**D1 = 912/(100\*99) = 0.092**

**GS1 = 1 – 0.09 = 0.908**

Community 2

|  |  |  |  |
| --- | --- | --- | --- |
| **Species** | n | n-1 | n(n-1) |
| A | 72 | 71 | 5112 |
| B | 6 | 5 | 30 |
| C | 3 | 2 | 6 |
| D | 3 | 2 | 6 |
| E | 1 | 0 | 0 |
| F | 3 | 2 | 6 |
| G | 4 | 3 | 12 |
| H | 3 | 2 | 6 |
| I | 2 | 1 | 2 |
| J | 3 | 2 | 6 |
| Total | N = 100 |  | = 5186 |

**D2 = 5186/(100\*99) = 0.524**

**GS2 = 1 – 0.524 = 0.476**

Community 3

|  |  |  |  |
| --- | --- | --- | --- |
| **Species** | n | n-1 | n(n-1) |
| A | 35 | 34 | 1190 |
| B | 34 | 33 | 1122 |
| C | 31 | 30 | 930 |
| D | 0 | -1 | 0 |
| E | 0 | -1 | 0 |
| F | 0 | -1 | 0 |
| G | 0 | -1 | 0 |
| H | 0 | -1 | 0 |
| I | 0 | -1 | 0 |
| J | 0 | -1 | 0 |
| Total | N = 100 |  | = 3242 |

**D3 = 3242 / (100\*99) = 0.327**

**GS3 = 1 – 0.327 = 0.672**

What do the values tell you about the diversity of each community (i.e. probabilistically)?

Comm 1: There is a 90.8% chance that 2 randomly selected individuals are from different species and a 9.2% chance the 2 randomly selected individuals are from the same species.

Comm2: There is a 47.6% chance that 2 randomly selected individuals are from different species and a 52.4% chance the 2 randomly selected individuals are from the same species.

Comm3: There is a 67.2% chance that 2 randomly selected individuals are from different species and a 32.7% chance the 2 randomly selected individuals are from the same species.

The effective number of species (ENS) is used to convert metrics like Simpson into values with more intuitive units of the number of species (as opposed to its native units of probability).

As it applies to the Simpson index, the effective number of species is the number of species in a hypothetical community which has the same Simpson value as the community under investigation, but is composed of equally-abundant species.

Where D is the Simpson diversity index value.

1. Calculate the effective number of species for the Simpson index for each community.

**ENSSimpson1 = 1/0.092 = 10.870**

**ENSSimpson2 = 1/0.524 = 1.908**

**ENSSimpson3 = 1/0.327 = 3.058**

**Simpson’s evenness** (also called equitability) is calculated from Simpson’s effective number of species divided by the observed number of species. The value can be interpreted as the number of equally abundant species that would need to be in a hypothetical community so that the hypothetical community has the same Simpson’s index as the one really calculated.

1. Calculate the equitability for each community.

**Equitability1 = 10.870 / 10 = 1.09**

**Equitability2 = 1.908 / 10 = 0.191**

**Equitability3 = 3.058 / 3 = 1.02**