Suppose that we have 3 groups and that, after we remove the i-th individual, we have .

Furthermore, after removing the i-th individual, we also have and

The Poisson distribution is given by:

Here is what we get for the Poisson part:

More generally, this implies that the Poisson part is:

The Multinomial distribution is given by:

Here is what we get for the Multinomial part. Say there are 4 species and the species identity of this individual is 3 (i.e., ):

Numerator:

Denominator:

Step 1: write expression

Numerator:

Denominator:

Step 2: Simplify numerator and denominator

Numerator:

Denominator:

Step 3: Expand factorials to further simplify these expressions

Numerator:

Denominator:

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Combine Poisson and Multinomial pieces together: