Some Common Indices of Group Diversity: Upper Boundaries

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Diversity, which is defined as the collective amount of differences among members within a social unit [2], has been an important concept applied in various ways across fields like ecology, demography, information systems, sociology, economics, and psychology. In organizational research, diversity has been prominent in studies using team members' characteristics to predict performance [3]. A review of the past diversity research shows that most scholars choose the indices according to methodological priority, theory, and familiarity of the indices [4]. Some researchers have suggested that theoretical refinement of the conceptualization of diversity is necessary before selection of an index. For example, Harrison and Klein [1] proposed organizing indices according to three types of diversity *separation*, *variety*, and *disparity*. They defined diversity as the distribution of differences among the members of a unit with respect to a common attribute. Consequently, separation, variety, and disparity are respectively understood as differences in attitude or position, differences in categorical characteristics, and differences in power or status hierarchy. Concerning the maximum diversity for variety, separation, and disparity, they correspond to a discrete uniform distribution, a bimodal distribution at extremes of a continuum, and a positively skewed distribution, respectively.

The current study shows that the maximum value of a group diversity measurement is a function of the group size and the distribution of members within a group across the respective properties. The main purpose is to obtain proper upper boundaries for each of the commonly used indices of diversity for all conditions featuring group size characteristics within the concept of the diversity types. Following Harrison and Sin's [2] suggestion to normalize the diversity indices, which reduces the inflating effects on group size, a normalized range for the discrete random variables was obtained. These results are useful to applied researchers interested in comparing index values with respect to suitable maximum boundaries and also to use the normalized indices to predict group outcome at group level of analysis.

Table 1 shows the results obtained for three indices, that is, the maximum value for all of them (Blau's index, standard deviation, and coefficient of variation). Blau's index, standard deviation, and coefficient of variation respectively correspond to measure diversity as variety, separation, and disparity. The minimum value equals 0 for all diversity indices, meaning that individuals are absolutely homogeneous as regards the characteristic of interest. On the contrary, the maximum value varies depending on several properties. Our research focused on maximum values as they had not been solved for group size parity and varying group size and thus we obtained normalized indices for the possible cases (Table 1). In fact, we have also obtained maximum values for other indices (not shown here), such as the Teachman's index (for diversity as variety), mean Euclidean distance (for diversity as separation) and Gini coefficient (for diversity as disparity).

Having derived general upper boundaries, researchers can compare the values obtained to their suitable maximum values and thus make proper conclusions for the specific conditions (e.g., group size and group size parity). Additionally, applied researchers may consider that normalized diversity indices could be useful to improve outcomes at group level as they are expressed in the same metric. These normalized indices allow social researchers to make proper comparisons among groups or organizations as these measures provide measurements of dispersion that can be applied to collectives of differing sizes. It should be noted that the present study was constrained to descriptive analysis and thus no conclusions are made about the statistical properties of the indices as estimators.

Table 1. Upper boundaries and normalized indices for some common diversity measures. All normalized indices range from 0 to 1. n, k, and p_i respectively denote group size, the number of categories, and the proportion for the ith category. The value a is equal to n – k × int[n/k], where *int[]* denotes the integer function. By means of x_{min} and x_{max}, we denote the minimum and maximum values of scales.

Diversity indices	Standard formula	Maximum value	Normalized index
Blau's index (Variety)	$B = 1 - \sum_{i=1}^{k} p_i^2$	$B_{\max} = \frac{n^2(k-1) + a(a-k)}{kn^2}$	$B_N = \frac{B}{B_{\max}}$
Standard deviation (Separation)	$SD = \sqrt{\sum_{i=1}^{n} \frac{(x_i - \bar{x})^2}{n}}$	$SD_{\max(even)} = \frac{x_{\max} - x_{\min}}{2}$ $SD_{\max(odd)} = \sqrt{\frac{n^2-1}{n^2}} \frac{x_{\max} - x_{\min}}{2}$	$SD_N = \frac{SD}{SD_{\max}}$
Coefficient of variation (Disparity)	$V = \frac{\sqrt{\sum_{i=1}^{n} (x_i - \bar{x})^2 / n}}{\bar{x}}$	$V_{\max(n)} = \frac{\sqrt{n-1}(x_{\max} - x_{\min})}{(n-1)x_{\min} + x_{\max}}$	$V_N = \frac{V}{V_{\max}}$

References

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