

Running head: DIVERSITY MEASURES

Quantitative approaches to measuring student body diversity:

Some examples and thoughts

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There are currently many different approaches to measuring the composition of an undergraduate student body. The approaches differ not only by their operational definitions but also by their conceptualizations of "diversity." The central purpose of this paper is to describe some statistical approaches for capturing the student body racial composition. Another part of this project, which will be presented at the conference and eventually integrated into this paper, is to conduct exploratory analyses of those different measures in order to examine their relationships among each other and whether they are interchangeable.

I limit my discussion to what can be described as "racial diversity" because this is my primary area of research, and thus the area that I know best. This narrow focus, however, is not intended to minimize other critical facets of campus diversity, which include addressing differences associated with ethnicity, gender, class, sexual orientation, and physical disabilities. Some of the approaches to be discussed can be easily adapted to measure other facets of diversity. Whatever facet is to be captured, an obvious necessary key for making such calculations is to collect or have in possession large-scale systematic data. For the purposes of postsecondary educational research, perhaps the single most important level of data for calculating racial diversity is institution-level data.

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Fortunately, for researchers in the United States, a data source collected by individual institutions for the federal government is accessible to the public. The most systematic and current data on racial composition are compiled by the *National Center for Education Statistics* (NCES) in the *Integrated Postsecondary Education Data System* (IPEDS). NCES established the IPEDS as its core postsecondary education data collection program. IPEDS is a single, comprehensive system designed to encompass all institutions and educational organizations whose primary purpose is to provide postsecondary education. The IPEDS system is built around a series of interrelated surveys to collect institution-level data in such areas as enrollments, program completions, faculty, staff, and finances. Data are collected from approximately 9,900 postsecondary institutions.

The enrollment data by race/ethnicity are ultimately based on self-reporting by students, which is then aggregated by individual institutions and reported on the enrollment survey to NCES. IPEDS data use slightly different categories than census data. Presently, IPEDS data classify students as either (1) non-resident aliens [foreign students], (2) Black, non-Hispanic, (3) Native American/Alaska Native, (4) Asian/Pacific Islander, (5) Hispanic, (6) White, non-Hispanic, and (7) unknown. Although these categories are not arbitrarily constructed, they capture neither natural/permanent traits (i.e., biological, cultural, social, etc.) nor universal experiences of any particular group of individuals. For this reason, sociologists often refer to such group categorizations as social

constructs because they serve immediate societal purposes, although any category is mutable and somewhat imprecise for describing a group of individuals. Thus, rather than refer to these constructs as racial groups, which tends to suggest a natural, precise quality about them, I prefer to refer to them as racial groupings, which emphasizes their social construction and limited usefulness.

Early monitoring of student racial composition during the 1960s, particularly in relation to the enforcement of Title VI of the 1964 Civil Rights Act,¹ was mostly concerned with charting the increase or decrease of certain clearly identified minority populations on campus. The obvious statistical measure for monitoring this is to track the numbers and proportion of total enrollment for each racial grouping, which serves as "access indicators." The calculations can be conducted at different levels to more precisely target certain interests and concerns, such as reports for individual states, institutional types, academic departments, college majors, etc. Some good current examples of this approach to enrollment monitoring are reported by the Office of Minorities in Higher Education of the American Council of Education (ACE) in their annual status reports (see for example Wilds, 2000). Those reported figures, especially when viewed in light of historical trends, continue to be essential for providing a

¹ Title VI of the 1964 Civil Rights Act subjects all institutions that receive federal funds to any court determinations as to what constitutes "discrimination."

broad sense of racial disparities concerning postsecondary educational opportunities.

Along with monitoring the increase and decrease of certain racial groupings, there has been growing interest in studying the racial composition of a student body as a whole. Certainly the composition of the U.S. undergraduate population is much more diverse than it was in the 1960s. These changes can be attributed to a number of factors that include but are not limited to anti-discrimination laws and policies, shifts in immigration patterns, availability of financial aid, economic pressures to obtain college degrees, and increase in the numbers of postsecondary institutions, particularly community colleges. Paralleling these demographic changes on college campuses, are developments in "multiculturalism" and "diversity-related initiatives." Simply put, those developments, which have had a profound effect on curriculum, co-curricular activities, types of services provided on campus, outreach, dormitory arrangements, "town/gown" relationships, to name a few, encouraged researchers to think in more complex ways about the composition of a student body and its relationship to educational experiences and opportunities (see Chang, 2002 for discussion). Of particular interest regarding campus environments is to understand better the "racial climate"² and its effects on the college adjustment of

² Basically the degree to which environments are welcoming of or hostile to students of color.

various groupings of students (see for example Hurtado, 1992; Solórzano, Ceja, & Yosso, 2001).

Another driving force for examining the racial composition of student bodies is immediate and pressing policy concerns, most notably the use of race in making admissions decisions. Presently, the legal foundation for race-conscious admissions practices rests on the U.S. Supreme Court's 1978 Regents of the University of California v. Bakke decision. Although the Supreme Court was deeply splintered over this landmark case, the general outcome was that the Court prohibited racial quotas but allowed race to be used as a "plus factor." Because Justice Lewis Powell played a pivotal role in this decision, his opinion on Bakke is now regularly cited to defend race-conscious admissions practices. Justice Powell essentially reasoned that because there are educational benefits associated with a diverse student body and that the First Amendment allows a university the freedom to make its own judgments as to education, consideration of race is permissible when admitting students.

This opinion, however, has been the focus of intense legal and public debate. More recent lower court decisions regarding separate race-conscious admissions practices, for example, have both supported and rejected Powell's educational argument about the benefits of diversity (see Liu, 1998; Olivas, 1997 for a discussion). Because this controversy revolves around researchable educational assumptions, researchers have begun to conduct more studies to

inform this debate. As such, appropriately measuring student body racial composition is key to understanding whether and how undergraduate students might potentially benefit from a racially diverse student body.

Diversity Measures

The simplest way to measure racial composition is to calculate only the proportion of White students in the total undergraduate enrollment (% White). This was the most common measure in earlier studies of student body racial diversity (see for example Astin, 1993).³ A slightly different alternative, at least conceptually, is to calculate the percentage of students of color or racial minorities (students who reported their racial/ethnicity to be non-White). Recent studies are more likely to use this alternative (see for example Antonio, 2001; Gurin, Dey, Hurtado, & Gurin, 2002; Terenzini, Cabrera, Colbeck, Bjorklund, & Parente, 2001). This measure centers the focus of analysis on students of color and thus may be more advantageous than % White for interpreting findings. Still, the basic assumption underlying both measures is that as the proportion of White students decline and by definition the proportion of students of color increase, the student body necessarily becomes more diverse.

³ Until after the 1980s, it made little sense to measure the racial diversity of undergraduate enrollments because the numbers and proportions of students of color on nearly all four-year institutions were very small and therefore there was very little variance across a national sample of institutions. Instead, it made more sense for earlier studies to just dummy code institutions as 0 for historically black campuses and 1 for other (see for example Allen, 1993).

The major shortcoming with the above measures is that they are not sensitive to proportional differences within the broad racial grouping of students of color and subsequently, may wrongly treat equally two campuses that have meaningful differences in composition. To illustrate, consider two hypothetical campuses, both enrolling exactly 30% students of color, or 70% White students. Suppose for one campus, the breakdown for students of color is 10% Asian/Pacific Islanders, 10% Hispanic, and 10% African Americans, whereas for another it is 25% Asian/Pacific Islanders, 4% Hispanic, and 1% African Americans. If differences in composition of students of color mediate certain diversity-related opportunities, such as cross-racial interaction, than it may not be altogether appropriate to treat the above two campuses as having similar levels of racial diversity. Likewise, the experiences of African American students, for example, may be qualitatively different depending on their proportional representation on a campus (see Hurtado, Milem, Clayton-Pedersen, & Allen, 1998 for review). A more sophisticated measure would need to differentiate between the compositions of these two hypothetical campuses.

Toward addressing legally driven debates about diversity, I have measured the racial composition of a student body in other ways. In my 1996 doctoral dissertation (Chang, 1996), I employed three measures using 1986 IPEDS data. Each measure was calculated based on the following undergraduate enrollment percentages for each institution: % Asian/Pacific Islander, % Hispanic, % African

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American, and % White (non-Hispanic). One measure (Diversity Range) was defined as the difference between the lowest and highest of those four percentages at an institution. So, if White students composed the largest proportion of the student body and African American students was the smallest, then Diversity Range = % White — % African American. This measure basically reflects the skewness of the racial distribution. Since this was an inverse measure (the greater the difference, the less diversity), the reciprocal of this value was used as the measure of Diversity Range.

Another measure calculated the variability of the four percentages (Diversity Variability), using a formula similar to that for calculating standard deviation (square root).

$$\sqrt{\frac{(\% \text{Asians}-m)^2 + (\% \text{Hispanics}-m)^2 + (\% \text{Blacks}-m)^2 + (\% \text{Whites}-m)^2}{4}}$$

The mean (m) was calculated by dividing the sum of the four percentages at an institution by four. Similar to Diversity Range, this was also an inverse measure, so its reciprocal was used.

The above two diversity measures were expected to be highly correlated because they both measured variance. For example, if the percentages of the four groupings were very close (e.g., 25%, 25%, 30%, 20%) then an institution would have a very small range and a very low standard deviation, and thus a high level

of diversity. Whereas, if there were a great deal of variability among the four percentages (e.g., 80%, 5%, 0%, 15%), an institution would have a large range and a large standard deviation, and therefore, a low level of diversity. Although the two measures were expected to be strongly associated, each was slightly different in its emphasis. Diversity Range measured skewness and accounted for only the two most extreme percentages, whereas Diversity Variability measured the variance across all four racial groupings.

The third measure (Diversity Heterogeneity) was designed to assess the heterogeneity of the student body or the extent to which one grouping accounted for most of the students. Diversity Heterogeneity was defined by the difference between one hundred and the highest percentage at an institution. If the proportion of White students, for example, is very large (i.e., 95%), then the difference ($100 - 95 = 5$) would by definition be small. Conversely, if White students are still the largest grouping but the proportion is relatively smaller (i.e., 75%), then the difference ($100 - 75 = 25$) would be larger and the student body would be considered more diverse. Note that Diversity Range and Diversity Heterogeneity differed mainly in terms of the smallest grouping — it was used to define the former but not the latter.

Perhaps the most simplistic of the above three measures is the last one, Diversity Heterogeneity. This still has an advantage over even simpler calculations described earlier. Unlike using just the proportion of White students,

the Diversity Heterogeneity measure does not assume that the White student population will always be the largest racial grouping on every campus. Even though among American 4-year institutions, with the exception of tribal colleges and historically Black colleges and universities (HBCUs), it is still rare that another racial grouping is proportionally larger than Whites. However, this does indeed occur. For example, Asian Americans are the largest racial grouping in the student body at U.C. Irvine, U.C. Riverside, and the University of Hawaii (Manoa), whereas Hispanics are the largest at the University of Texas (El Paso), University of Houston (downtown), and Florida International University. When Whites are not the largest racial grouping, the Diversity Heterogeneity measure is better equipped than simpler calculations for assessing the racial diversity of a student body.

Another way to approach the calculation of racial composition is to measure levels of segregation. The dissimilarity index is one of the most commonly used measures of segregation between two racial groupings. It is typically used when analyzing census data to measure the relative separation (high dissimilarity) or integration (low dissimilarity) between two groupings across neighborhoods within a city or metropolitan area. The index indicates the percentage of one grouping that would have to move across neighborhoods to be distributed the same way as the second grouping. Because it is a symmetrical measure, this interpretation can be applied to either grouping in the calculation.

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The index ranges from a value of 0 (complete integration), indicating that both groupings are distributed in the same proportions across all neighborhoods, to 100 (complete segregation), indicating that the members of one grouping are located in completely different neighborhoods than members in the second grouping. The formula used to calculate the dissimilarity index for two racial groupings within the same city (or metropolitan area) is as follows:

$$D = \frac{1}{2} \sum_{i=1}^n \left| \frac{P_{1i}}{P_1} - \frac{P_{2i}}{P_2} \right|$$

where:

P_1 = city-wide population of Group 1

P_2 = city-wide population of Group 2

P_{1i} = neighborhood i population of Group 1

P_{2i} = neighborhood i population of Group 2

n = number of neighborhoods in city

The exposure index is also popular for analyzing relationship between racial groupings using census data. Unlike the dissimilarity index, which is a comparison of the degree of segregation between two groupings, the exposure index measures a single grouping's average exposure to all other groupings, including itself. More precisely, it measures exposure in the form of a weighted average depicting the racial composition of the neighborhood of the average person of a given racial grouping. This calculation is then compared to the racial

distribution for the city or metro area as a whole in order to gauge whether different groupings are relatively evenly spread out over the city or, conversely, clustered into neighborhoods where one grouping tends to be disproportionately represented while others are underrepresented. In making these calculations, the exposure index basically accounts for two factors: 1) the portion of the metropolitan area's total population of a given racial grouping that lives in a specific neighborhood, and 2) the racial makeup of that neighborhood. The concentration of a given racial grouping in a neighborhood affects how heavily the racial composition of that neighborhood will be weighted when calculating the exposure index for the metro as a whole.

Exposure between two racial groupings can be derived using the following formula:

$$P = \sum_{i=1}^n \left(\frac{P_{1i}}{P_1} \right) \left(\frac{P_{2i}}{T_i} \right)$$

where:

P_1 = city-wide population of Group 1

P_{1i} = neighborhood i population of Group 1

P_{2i} = neighborhood i population of Group 2

T_i = neighborhood i total population

n = number of neighborhoods in city

Both the dissimilarity and exposure indices require two levels of data. The above examples, which apply to census data, require both city-wide and neighborhood-level data. It is not altogether clear how these two indices can be adapted for postsecondary educational research. The issue is not so much creating multiple levels of data, as other data sources can be easily merged with IPEDS data. Instead, the issue is whether to treat IPEDS data as city-wide or neighborhood data in the formula. If student-level data about the racial composition of a student's friendship group were merged with IPEDS data, then it would make sense to substitute into the formula, IPEDS data for city-wide data and student data for neighborhood data. Yet, if we were to do this, how would "n" or in this case the number of friendship groups in an institution be calculated? Would this number be the total number of students enrolled at the institution or just those who reported the racial composition of their friendship group? Even if multiple levels of data can be obtained, researchers would need to think carefully about how to apply these indices to measure either levels of segregation or exposure. As it stands, they are not easily adaptable, which perhaps explains why they are not widely used in higher education research, yet finding a sensible way to apply them will be worthwhile.

Another index that has gained in popularity, largely because it is used by a high profile ranking of postsecondary institutions conducted by *US News and World Reports*, is the "Diversity Index." This index was created in 1991 by Philip

Meyer and Shawn McIntosh for *USA Today* to measure racial and ethnic diversity with a single number. The Diversity Index calculates the probability that any two randomly selected students will be in the same racial grouping — in other words, the probability that both are White, Black, Native American, Asian, or Hispanic. The calculation for this index is based on two basic principles of probability theory: (1) the probability that all of several independent events will occur, and (2) the probability that at least one of several independent events will occur.

To illustrate better the calculation for this formula,⁴ consider the Fall 2002 undergraduate enrollment figures on my campus, UCLA (approximates to equal 100%): 41% White, 39% Asian/Pacific Islander (Asian), 15% Hispanic (Hisp), 4% African American (Black), and 1% American Indian (NatAm). When these percentages are converted to decimals, they report the probability that ONE student chosen at random will be of that racial grouping. The probability that TWO students chosen at random will be of that particular grouping is simply the single probability multiplied by itself (squared). For example, the probability that one randomly selected student from UCLA will be Asian is .39 and the probability that two randomly selected would be Asian is .152 (.39²).

The probability that two students are of the SAME racial grouping is the sum of the squared probabilities for the separate racial groupings or:

⁴ Description of the calculation draws from my personal correspondence with Ron Feemster who in the fall of 2000 was writing an article about this index for *University Business* magazine.

$$\%(\text{SAME}) = \%(\text{White})^2 + \%(\text{Asian})^2 + \%(\text{Hispanic})^2 + \%(\text{Black})^2 + \%(\text{NatAm})^2$$

Using enrollments from our hypothetical campus, the calculation would be:

$$\%(\text{SAME}) = .41^2 + .39^2 + .15^2 + .04^2 + .01^2 \text{ or } .168 + .152 + .023 + .002 + .00$$

$$\%(\text{SAME}) = .345$$

To calculate the probability that any two randomly chosen students are of DIFFERENT racial groupings, subtract the probability of their being of the same racial grouping from one:

$$\%(\text{DIFFERENT}) = 1 - \%(\text{SAME})$$

Inserting figures from our example:

$$\%(\text{DIFFERENT}) = 1 - .345 = .655$$

Finally, to simply presentation, the above calculation can be multiplied by 100 to get an integer for the diversity index (e.g., Diversity index = 65.5). Thus, the higher the number, the more racially diverse the student body.

This index is especially useful for studies that focus on cross-racial interaction because the index captures the probability for having such interaction on campus. Unlike the dissimilarity and exposure indices, which are typically used with census data, the diversity index does not require multiple levels of data and IPEDS enrollment figures will suffice. As with all of the formulas presented so far, they can be slightly modified to address specific research questions and aims.

For example, I have tried a version of the Diversity Index for a study that examined the relationship between opinion diversity and the proportion of underrepresented students (African American, Hispanics, & Native Americans). Given the current affirmative action admissions debates, I was particularly interested in how the inclusion of proportionally more underrepresented students affected the dispersion of opinions held by a student body on a particular issue. As such, I modified the index to calculate the probability at an institution that of any two randomly selected students, one of them will be an underrepresented student, and if both are underrepresented, the likelihood that each would be of a different race: $1 - [(\%Black)^2 + (\%Hisp)^2 + (\%NatAm)^2 + (\%Whites + \%Asian)^2]$). The difference in calculation between this index measure and the Diversity Index is that the former combines the percentages of White and Asian American students into one grouping so that the probability of encountering an underrepresented student can be more accurately gauged. Plugging in the enrollment figures from the previous example, the Underrepresented Index for UCLA would be .335, compared to a Diversity Index score of .655. Thus, even though UCLA is quite diverse, the probability of encountering an underrepresented student is comparably lower.

After running several analyses using the above index measure, however, we settled in the end on using just the sum of the percentage of underrepresented students ($\%Black + \%Hisp + \%NatAm$) at each institution. It turned out that the

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correlation between this and the index measure was .93 and it was just much more intuitive and easier to explain the straight percentage calculation.

Summary

To summarize, ten different measures of racial composition were described and only the dissimilarity and exposure measures cannot be calculated using just IPEDS data. Of those that can be calculated with only institution-level enrollment data by racial groupings (see Table 1), some measures consider all available racial groupings in the calculation (i.e., Diversity Index), whereas others consider only one grouping (i.e., % White). No doubt, researchers will need to consider carefully their research interests and aims when choosing a measure. There are obvious conceptual differences between them, but I am curious to see if there are actually statistical differences? In other words, are the different diversity measures interchangeable? My previous analyses suggest that the measures are likely to be highly correlated with each other. To see if this is still the case, I will conduct several analyses using data from IPEDS and the Higher Educational Research Institute (HERI) at UCLA. The results of these exploratory analyses will be reported at the Bellagio conference.

Table 1

Diversity Measures that can be calculated using only IPEDS data.

Diversity Measure	Formula
% White	# White students/ total enrollment
% Students of Color	% Asian + % Black + % Hisp + % NatAm
Diversity Range	1 — (% largest grouping — % smallest grouping)
Diversity Variability	$1 - \frac{(\% \text{Asians}-m)^2 + (\% \text{Hisp}-m)^2 + (\% \text{Blacks}-m)^2 + (\% \text{Whites}-m)^2}{4}$
Diversity Heterogeneity	1 — % largest grouping
Diversity Index	$1 - [(\% \text{White})^2 + (\% \text{Asian})^2 + (\% \text{Hisp})^2 + (\% \text{Black})^2 + (\% \text{NatAm})^2]$
Underrepresented Index	$1 - [(\% \text{Black})^2 + (\% \text{Hisp})^2 + (\% \text{NatAm})^2 + (\% \text{Whites} + \% \text{Asian})^2]$
% Underrepresented Students	% Black + % Hisp + % NatAm

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