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Using Disproportionate Impact Methods to Identify Equity Gaps

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Table of Contents

May 2022 Revisions

This paper was revised to align with the recently released California Community Colleges Chancellor's Office (CCCCO) brief on the methodology pertaining to the Percentage Point Gap Minus One (PPG-1; CCCCO, 2022). The examples originally presented in the 2018 version of this paper remain largely unchanged – however, all formulas, calculations, tables, and figures have been revised to reflect the PPG-1 methodology. Noteworthy, in particular, is the change to the formula presented for calculating the margin of error (MOE). The 2018 version of this paper highlighted the MOE formula presented in an earlier CCCCO publication (CCCCO, 2017); the current version of this paper specifically defines $\hat{p}$ and $\hat{q}$ in the context of an example. Margin of error calculations shown herein will also now align with the calculations completed using the Disproportionate Impact Calculator Version 4.0 (also cited).

Introduction

What Is Data Disaggregation?

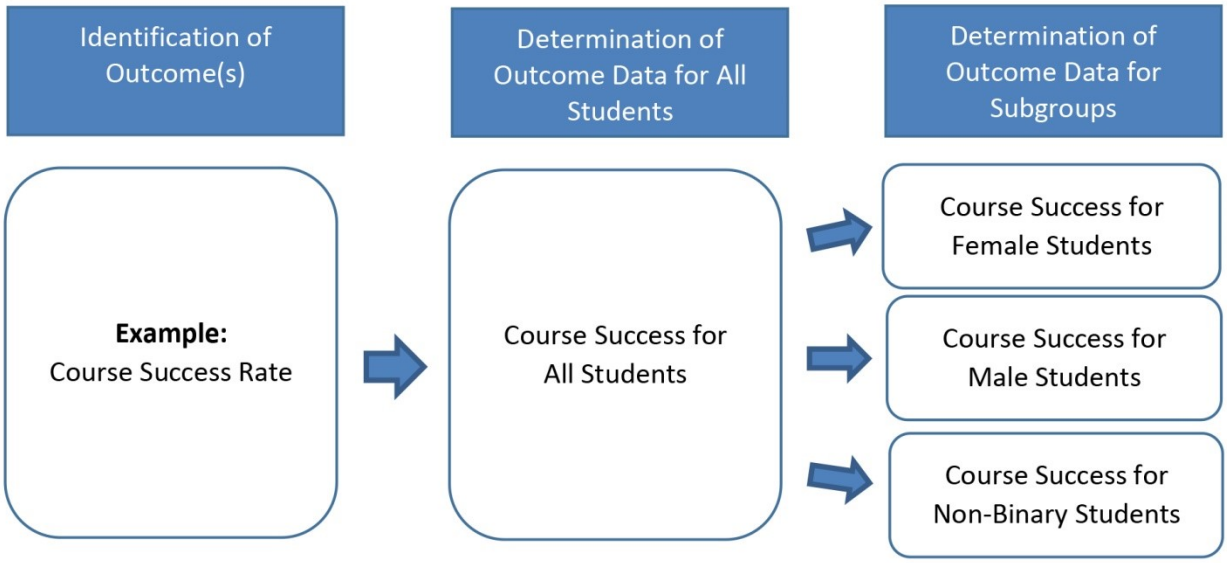
One of the most significant challenges that community colleges around the country face is how to achieve equity in educational outcomes, such as degree attainment or transfer to four-year universities, across various sub-populations of students (Bensimon, 2005). Indeed, a plethora of research studies point to gaps in educational outcomes, particularly among historically underrepresented groups, like African American students (Harper et al., 2009; Lee, 2002; Ward, 2006).

When examining student data, one of the first things colleges may do is look at whether there are differences among specific student groups, such as males and females, with respect to one or more educational outcomes, such as degree completion rates. The process of examining outcomes separately by student groups is known as data disaggregation.

Figure 1 illustrates the data disaggregation process. The first step is identification of an outcome of interest, such as course success rates. In this case, the average course success rate for all students would then be calculated to provide a starting point for comparison. Then, average course success rates would be determined for specific subgroups of students, such as males and females. By comparing success rates for these subgroups to the success rates among all students, variations in achievement of this educational outcome can be identified.

Although Figure 1 offers a visual representation of the data disaggregation process as it pertains to examining differences between the educational outcomes of male and female students, this process can be used with respect to any subgroup of students, such as students of different ethnicities, ages, or other characteristics.

Figure 1. Example of the data disaggregation process for gender



When one subgroup of students attains an outcome such as degree completion at a rate that is substantially lower than the benchmark rate, that subgroup may be referred to as "disproportionately impacted." According to the California Community Colleges Chancellor's Office (CCCCO), "disproportionate impact is a condition where some students' access to key resources and supports and ultimately their academic success may be hampered by inequitable practices, policies and approaches to student support" (Harris , 2013). Therefore, differences in educational outcomes between subgroups of students may suggest that one group has less access to support services, needs relatively greater support, and/or must address certain obstacles in order to attain those outcomes at rates comparable to their peers.

When examining student data for evidence of disproportionate impact, one of the questions faced by colleges is how to measure that impact. The most frequently cited method by the California Community Colleges Chancellor's Office is the percentage point gap minus one (PPG-1) (see CCCCO, 2017, 2021, 2022). However, there are two other methods to measuring disproportionate impact, both of which are also introduced in this paper: The 80% index and the proportionality index. This paper offers readers an overview of each method, as well as a variety of examples of actual data from colleges around the state.

Reader's Guide

The first step to addressing equity gaps is to identify them. How can we determine, with some degree of certainty, whether one or more student groups on our campus is in need of assistance in order to succeed?

This paper tackles this question by delving into the three methods typically used to identify equity gaps, comparing and contrasting the benefits of each approach, and then demonstrating how these methods can be utilized through examination of three case studies. While data and statistics are discussed, this review is intended for a general audience of educators and practitioners. The goal is to help readers garner the skills and knowledge that will facilitate dialogue, planning, and action concerning equity gaps.

Overview of Three Approaches to Measuring Disproportionate Impact

The Percentage Point Gap Minus One

California Assembly Bill 504 (2017) requires that the California Community College Chancellor's Office (CCCCO) establish a single standard method by which to measure disproportionate impact. The CCCCO selected the PPG-1 method as the standard method, largely due to ease with which it can be applied (CCCCO, 2022). The PPG-1 approach measures the difference in percentage points between a target demographic group's achievement outcome rate and the combined achievement outcome rate for all remaining demographic groups (CCCCO, 2022). Those differences may be positive (as when a subgroup of students achieves a higher rate than

all other students) or negative (as when a subgroup of students achieves a lower rate than all other students). For instance, if 40% of one subgroup of students completes transfer-level math within one year, but 50% of all remaining students achieve that milestone, then the PPG-1 value for the subgroup in question would be negative ten points (-10). In contrast, if 60% of a second subgroup of students completes transfer-level math within one year, but 50% of all remaining students achieve that milestone, then the PPG-1 value for the subgroup in question would be positive ten points (+10). Therefore, the PPG-1 approach can be expressed as follows:

% of outcome for students in subgroup – % of outcome for all remaining students = PPG-1

The larger the negative difference between these two figures, the more likely that said difference is reflective of disproportionate impact. The PPG-1 value necessary for identifying an instance of disproportionate impact depends upon the number of students in the subgroup (sometimes referred to as sample size). As described by the Chancellor's Office (CCCCO, 2022), one must compute what is known as the margin of error (E).[1] While an explanation of the statistical underpinnings of the margin of error falls beyond the scope of this paper, it is helpful to think of it as how large we can reasonably expect a PPG-1 value to be given how many students are in the target subgroup. A margin of error of 10 percentage points for a subgroup means that if we were to compare the outcome rate of that subgroup to all other students 100 different times, we would likely find the PPG-1 value to be within 10 points on 95 out those 100 times.[2] The margin of error, therefore, reflects our expectation for what a PPG-1 value should be for a given subgroup. When the margin of error for a subgroup is 10 percentage points and we find that the actual PPG-1 value for that same group is -11, then the group's achievement rate is lower than we expected – because the group has exceeded the expectation of 10 points, we conclude that a significant negative difference exists. This significant negative difference is what amounts to disproportionate impact.

The margin of error (E) formula put forth by the Chancellor's Office (CCCCO, 2017; 2022), expressed as a percentage, is as follows:

$$\mathrm{MOE} = \left(1.96\sqrt{\frac{(\hat{p}\hat{q})}{n}}\right) * 100$$

Where $\hat{p}$ refers to the outcome rate for the target subgroup, and $\hat{q}$ is equal to 1- $\hat{p}$. The n refers to the number of students in the target subgroup. Thus, if one is examining the completion of

[1] An alternative approach recommended by the Chancellor's Office is to compute a standard score (or z-score) that reflects the difference between the subgroup and the overall average (Ramirez-Faghih & Fuller, 2017). Use of the normal distribution is an approximation of convenience for this method. Standard scores of two or greater (i.e., ≥ -2) would be indicative of disproportionate impact. For more information on standard scores, please see https://statistics.laerd.com/statistical-guides/standard-score.php.

[2] Please note that observing 95 out of 100 PPG-1 values withing the margin of error is based upon a 95% confidence level. For a brief overview of margin of error and confidence level, please see https://www.isixsigma.com/tools-templates/sampling-data/margin-error-and-confidence-levels-made-simple

transfer-level math within one year among 100 Asian students who have a completion rate of 50%, the margin of error (MOE) would be as follows:

$$\text{MOE} = \left(1.96\sqrt{\frac{(.25)}{100}}\right) * 100 = 9.8\%$$

In this example, PPG-1 values of -9.9 percentage points or greater (that is, more negative) would need to be observed for Asian students to be considered disproportionately impacted. In other words, values more positive than -9.8 percentage points (e.g., - 5.0, -3.0) would not be a large enough difference to conclude that disproportionate impact was present because one would expect to find PPG-1 values as low as -9.8 percentage points (in fact, you will likely find corresponding PPG-1 values for this subgroup to be between -9.8% and 9.8% 95 out of the 100 times that you examined such data) for this group. Values of -9.9% or -10.0%, on the other hand, would be considered large enough differences to conclude that a real difference exists between Asian students and all other students at the college. Also noteworthy is that the Chancellor's Office does not recommend colleges employ the PPG-1 method (and presumably, any other disproportionate impact method) in instances when the sample size for a given subgroup is lower than 10 –due in part to privacy concerns and the fact that the resulting margin of error would be greater than 30% (CCCCO, 2017). When faced with these circumstances (as may be the case at smaller colleges), it is recommended that colleges consider aggregating two or more years of data to achieve the recommended sample size of 10 (J. Lessard, personal communication, December 5, 2017).

In contrast—as might be the case at larger colleges— sample sizes exceeding 1,600 may result in calculated margin of error values below two (2). Observing a margin of error value of less than one (e.g., 0.75) means that if the outcome rate for a given subgroup is even one percent lower than that all other students (i.e., PPG-1), this difference would be identified as an instance of disproportionate impact. Thus, one would conclude that the group is disproportionately impacted based on a difference that some might say is not particularly meaningful and a result of the large sample size. It is for this reason that the Chancellor's Office has established a minimum margin of error of two (2). Thus, **disproportionate impact is defined as an instance when the observed negative PPG-1 value exceeds the corresponding margin of error and is equal to or less than negative two (-2).**

To facilitate the computational process required for this approach, the Chancellor's Office (CCCCO, 2022) has included Appendix A, which provides readers with a list of margin of error values for all sample sizes up to 400; thus a reader need only refer to this table to determine whether the PPG-1 value they have computed represents an instance of disproportionate impact.[3] Another tool designed to facilitate the computational process is the Disproportionate Impact Calculator developed by the Data Disaggregation Guided Pathways Team (Hayward,

[3]The appendix assumes the subgroup achieves an outcome rate of 50%, resulting in an overestimated margin of error (in fact, the highest possible margin of error for a given sample size). The author still recommends the use of it for ascertaining an approximate margin of error.

Holcroft, Lessard, & Sosa, 2020).[4] This Excel-based tool allows users to readily employ all the disproportionate impact methods discussed in this paper.

Applied Example of the PPG-1 Method

Table 1 on the following page illustrates course success rates across ethnic and racial groups reported by Fullerton College as part of a prior equity plan (Vurdien, DuBois, Nunez, Foster, & Greenhalgh, 2014). The first column from the right, PPG-1, reflects the difference between each group's specific course success rate and the course success rate of all other students. A positive sign in front of the PPG-1 value indicates that a group's course success rate is higher than the success rate of all other students, while a negative sign reflects a lower success rate. We are particularly interested in these negative values to identify possible instances of disproportionate impact. In this case, we have negative point gap values for four groups, African American students (-12.3), Pacific Islander students (-12.9), unknown ethnicity/race students (-6.4), and Hispanic/Latina/o/x students (-5.4). The question is whether such gaps are large enough to be considered instances of disproportionate impact.

Based on each group's margin of error, as defined by the Chancellor's calculation of margin of error (see the aforementioned formula), we are able to identify a margin of error (MOE Threshold in Table 1) threshold for each group. This threshold reflects the cut-off value beyond which a subgroup's percentage point gap minus one value would be considered an instance of disproportionate impact (assuming a minimum PPG-1 value of negative two, as described earlier). For example, in the case of African American students, the calculated MOE threshold value is -1.9 percentage points, which given the CCCCO requirements, translates to a value of negative two (-2); given that the observed value percentage point gap minus one value of -12.3 is more negative than its corresponding MOE threshold value, we can conclude that African American students are indeed disproportionately impacted.

Similarly, the MOE threshold for Pacific Islander students is -5.8 percentage points and the observed percentage point gap value is -12.9; because the observed value is more negative than its corresponding MOE threshold value, we can conclude that Pacific Islander students are also disproportionately impacted. The same conclusion holds true for Hispanic/Latina/o/x students as their corresponding PPG-1 value (-5.4) exceeds its corresponding margin of error (Calculated MOE = -0.5; CCCCO Adjusted MOE = -2.0). Lastly, because the observed negative PPG-1 value for students about whom we do not have any ethnicity or race information (-6.4) exceeds its corresponding MOE threshold (Calculated MOE = -1.9; CCCCO Adjusted MOE = -2.0), we also conclude that these students are disproportionately impacted as well. Note that all PPG-1 values identified as reflective of disproportionate impact in fact exceed the minimum required value of negative two (-2).

[4] https://drive.google.com/file/d/1yeS3HzkbM90pj-ycYLlYOf1Ao__hKdQ7/view

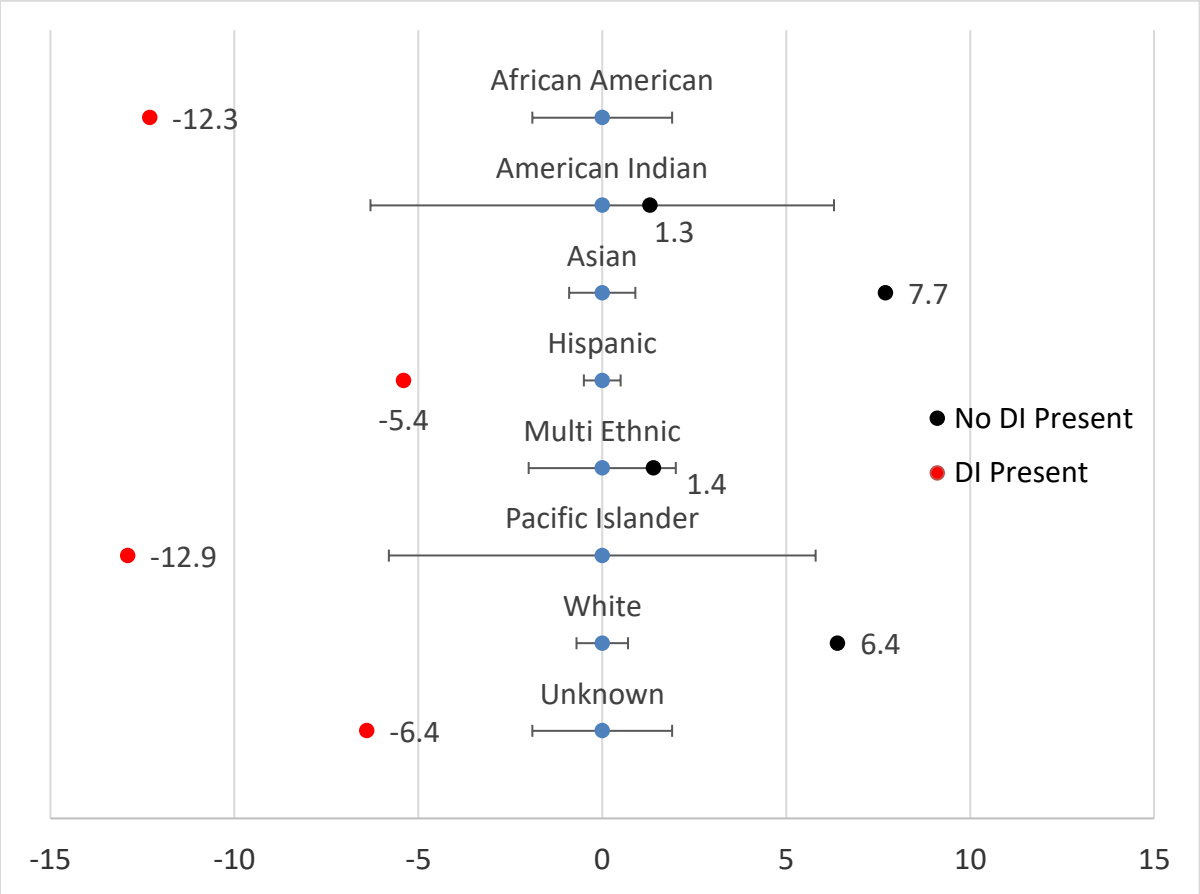
Table 1. Course Success Rates by Ethnicity Based on PPG-1 Method

Ethnicity	Cohort Count	Outcome Count	Success Rate (Per Group)	Calculated MOE Threshold	PPG-1
African American	2,547	1,388	54.5%	-1.9%	-12.3
American Indian	213	144	67.6%	-6.3%	+1.3
Asian	9,834	7,166	72.9%	-0.9%	+7.7
Hispanic/Latina/o/x	35,055	22,304	63.6%	-0.5%	-5.4
Multi Ethnic	2,261	1,468	64.9%	-2.0%	+1.4
Pacific Islander	286	153	53.5%	-5.8%	-12.9
White	16,696	11,878	71.1%	-0.7%	+6.4
Unknown	2,508	1,509	60.2%	-1.9%	-6.4
Total	69,400	100%	66.3%		

Note: The table illustrates the calculated margin of error (MOE). Bear in mind, however, that the minimum MOE for determining disproportionate impact is negative two (-2). In the current example, this minimum would apply to Asian, Hispanic/Latina/o/x, White, and unknown students, all of which have calculated MOE values below two. Red font was used to denote disproportionately impacted groups.
Source: Vurdien, et al. (2014)

Figure 2 illustrates the same findings illustrated in Table 1, except it offers readers a visual depiction of the point gap values and corresponding margin of errors. Negative PPG-1 values exceeding the range offered by a given margin of error are depicted as **red** dots; they denote instances of disproportionate impact, as is the case with African American, Pacific Islander, and students with unknown ethnicity or race (**black** dots denote the absence of disproportionate impact, and the midpoints for each range, always zero, are denoted via **blue** dots). Thus, findings stemming from the use of the percentage point gap minus one approach indicate that those groups are disproportionately impacted. As such, these are the student groups for which institutional strategies should be implemented to improve their chances for educational success.

Figure 2. Percentage Point Gap Minus One Values and Margin of Errors by Ethnicity



Limitations of the PPG-1 Method

The percentage point gap minus one method serves as the standard methodology for California community colleges – all colleges will likely be required to employ this method for all planning documents submitted to the Chancellor's Office. However, there are a few noteworthy limitations associated with using the percentage point gap minus one and margin of error approach. First, the use of the margin of error presumes one is working with samples rather than populations of students. The margin of error reflects one's best guess concerning the success rate of a given group in the population of students we are working with (e.g., African American students were hypothesized to have success rates between 52.6% and 56.4% due to the margin of error of 1.9 points). However, in many cases, colleges have access to the success rates of all the students at their campus, meaning that they have access to the entire population of students. For instance, there is no need to use a sample of Hispanic/Latina/o/x students at a college to estimate the success rates of all the Hispanic/Latina/o/x students when said college can simply examine the grades of each and every one of its Hispanic/Latina/o/x students, calculate a percentage point gap minus one to determine if the success rate among Hispanic/Latina/o/x students is lower than that of all other students, and if so, conclude that

Hispanic/Latina/o/x students are disproportionately impacted. From this standpoint, the margin of error represents an unnecessary step for many colleges.

On the other hand, if a college is interested drawing inferences to prospective students in its service area, or even to prior students not otherwise included in the original analysis, then the PPG-1 approach is a viable method by which to generalize to those populations. In addition, the margin of error approach does underscore the importance of the number of student records one is using to make potential institutional decisions. Even when working with populations of students, one should be mindful of the number of students belonging to a subgroup identified as disproportionately impacted.

Disproportionate impact findings based upon a small number of students (e.g., fewer than 30) should be examined with some caution as such findings are subject to greater variability than seen with larger groups. In other words, the results observed for such small groups may fluctuate greatly when examined in the future, calling into question the reliability of the findings. It is for this reason that colleges may want to establish a higher disproportionate impact threshold (e.g., a point gap greater than seven points) or rely on the CCCCO's margin of error approach to identify disproportionate impact among smaller groups. Correspondingly, a smaller threshold (e.g., a point gap value greater than three points) can be used to identify disproportionate impact in larger groups. To reiterate, **disproportionate impact findings stemming from fewer than 30 students should be viewed with caution**. Additional data collection or combining multiple years of data is recommended to increase confidence in the reliability of findings in these cases.

The 80% Rule Index

In light of the aforementioned limitations, the author recommends that colleges employ additional disproportionate impact methods to corroborate findings stemming from the use of the percentage point gap minus one method. Employing more than one method to identify disproportionate impact can increase colleges' certainty concerning which groups of students are disproportionately impacted, and the approach can help colleges identify groups of students that are consistently found to be disproportionately impacted across a variety of methods.

One of those additional method for assess disproportionate impact is the 80% rule index. This index helps answer the question, "Do any subgroups achieve a particular educational outcome less than 80% of the time that the highest achieving subgroup successfully attains that outcome?" The 80% criterion is drawn from the guidelines codified in the 1978 Uniform Guidelines on Employee Selection Procedures (U.S. Equal Opportunity Commission, 1979).

Table 2 below examines the same course success rate by ethnicity data from Fullerton College shown in the previous two tables. For each ethnic group, the total number of students in the cohort is identified (i.e., all students who took a graded class), along with the number of students who achieved a successful course outcome (grade C or better). The success rates (successful outcomes divided by total cohort count) are then listed in the adjacent column.

Table 2. Course Success Rates by Ethnicity with 80% Rule Indices

Ethnicity	Cohort Count	Outcome Count	Success Rate	80% Index
African American	2,547	1,388	54.5%	74.8%
American Indian	213	144	67.6%	92.8%
Asian	9,834	7,166	72.9%	100%
Hispanic/Latina/o/x	35,055	22,304	63.6%	87.3%
Multi-Ethnic	2,261	1,468	64.9%	89.1%
Pacific Islander	286	153	53.5%	73.4%
White	16,696	11,878	71.1%	97.6%
Unknown	2,508	1,509	60.2%	82.6%
Total	69,400	46,010	66.3%	

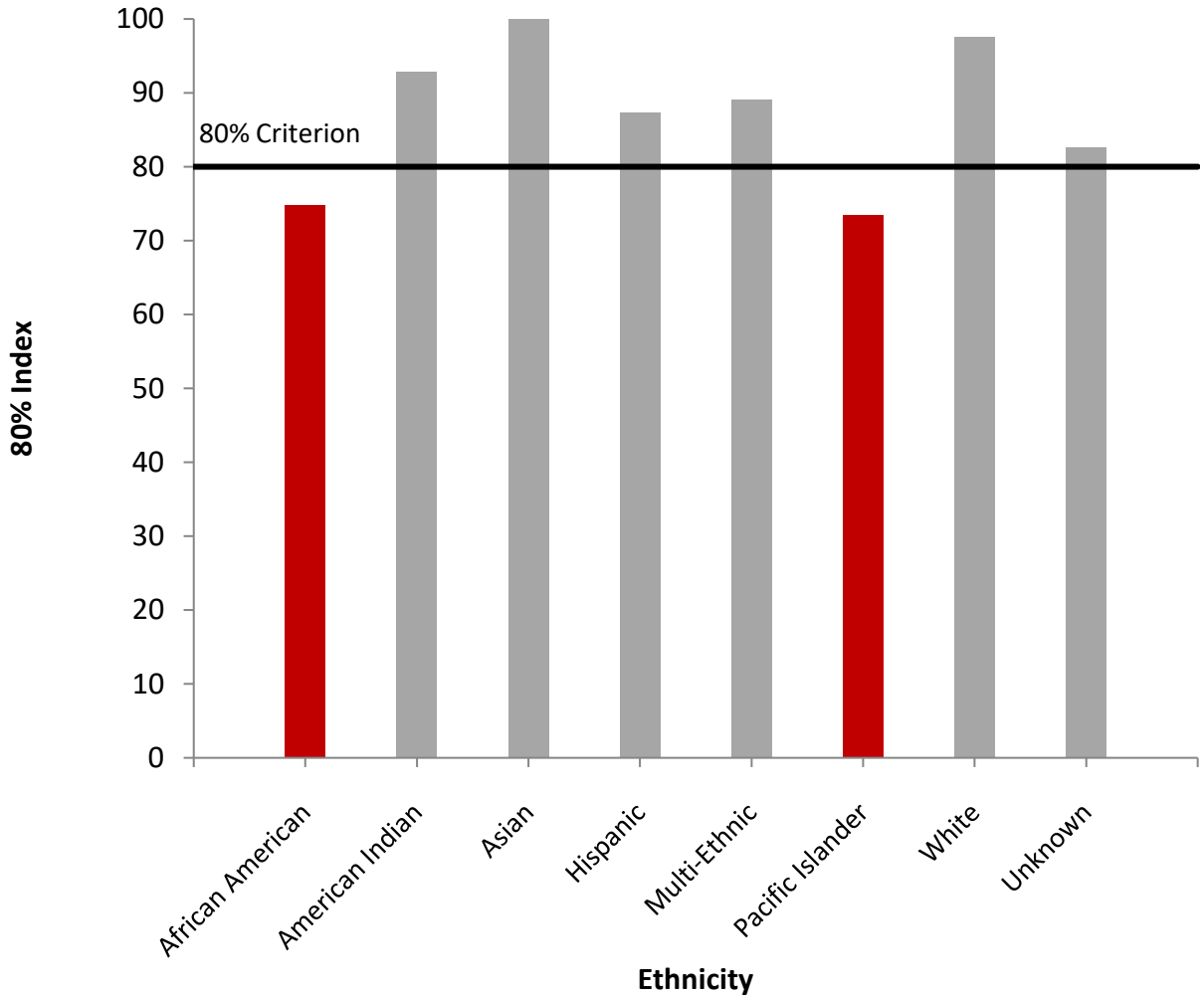
Note: Red font is used to denote disproportionately impacted groups.
Source: Vurdien et al. (2014)

Utilization of the 80% rule index to assess disproportionate impact starts with the identification of the subgroup with the highest rate of success, referred to as the "reference" group. In this case, Asian students represent the reference group, with a success rate of 73%. The next step is to divide the success rate of each ethnic group by that of the reference group. This method can be summarized as follows:

$$80\%\ \text{index} = \text{cohort group rate} \div \text{reference group rate}$$

The term cohort group rate refers to the success rate of the particular subgroup being examined (e.g., African American students), and the term reference group rate refers to that of the group earning the highest success rate (e.g., Asian students). As illustrated in the column in Table 1 labeled 80% Index, the majority of ethnic groups in this example achieved success rates that were within 80% of the rate achieved by Asian students. However, two groups—African American students and Pacific Islander students—had success rates that were less than 80% of the reference group's success rate. This indicates that African American and Pacific Islander students were disproportionately impacted. The disproportionate impact for African American and Pacific Islander students is also illustrated in Figure 3, which displays the 80% indices relative to the 80% criterion; again, African American and Pacific Islander students were to the two groups with success rates below the 80% criterion, pointing to disproportionate impact. As a result of these findings, Fullerton College proceeded to identify activities designed to address these gaps in educational success in their student equity plan.

Figure 3. The 80% Indices by Ethnicity



One limitation to using this index is the same one that can be leveled against any of the three disproportionate impact methods (and discussed earlier with respect to the percentage point gap minus one method) – practitioners should be mindful of the records of students that the corresponding percentages are based upon. Percentages based on fewer than 30 student records are subject to fluctuate more from year-to-year than are percentages based on more than 30 records. As noted earlier, colleges faced with a such a predicament are urged to aggregate across two or more years.

The Proportionality Index (PI)

The proportionality index (PI) is a third method for identifying disproportionate impact. This method addresses the question, "If a subgroup of students represents 45% of the student body, does that subgroup also represent at least 45% of the students who achieve a specific educational outcome?" Theoretically, if educational achievement was equitable across all

subgroups of students, the answer to this question would be "yes." However, when a group's representation with respect to one or more educational outcomes is found to be at a lower rate than its representation in the general student body, disproportionate impact may be indicated (depending on the size of the observed difference).

The calculation used to measure the PI can be described as follows:

$$\text{Proportionality index} = \text{proportion in outcome group} \div \text{proportion in cohort}$$

In the equation above, the proportion of students in a particular cohort reflects that subgroup's relative representation across an entire student body; the proportion of students in the outcome group reflects the representation of that same subgroup among all students achieving a certain educational outcome. A proportionality index of 1.00 indicates that a group's representation among those achieving an educational outcome is identical to that group's representation in the student population. In contrast, a PI value of less than 1.00 indicates that a group's representation among those achieving an educational outcome is lower compared to that same group's representation in the student population – it is this circumstance that reflects a possible instance of disproportionate impact.

While PI values less than 1.00 reflect possible instances of disproportionate impact, Bensimon and Malcolm-Piqueux (as cited by Harris, 2015) have recommended using values equal to or less than 0.85 to identify instances of disproportionate impact. The author explored this further by reviewing 28 randomly selected student equity plans from community colleges around California. The author found that 14 of the 28 colleges utilized the PI index to help identify gaps in achievement between student demographic groups. Ten of these colleges (71%) employed a cut-off value between 0.80 and 0.89, and among them, six colleges (43% of original sample of 14) employed cut-off values between 0.80 and 0.85. Taken together, such evidence corroborates the 0.85 value recommended by Bensimon and Malcolm-Piqueux. More recently, the chancellor's office (Ramirez-Faghih & Fuller, 2017) offered a two-tiered approach whereby PI index values between 0.80 and 0.89 reflect "some evidence" of disproportionate impact and values below 0.80 reflect a clear instance of disproportionate impact. Thus, while this matter merits further investigation, the available sources suggest that readers should feel confident in employing a cut-off value between 0.80 and 0.89.

Table 3 presents the same data from Fullerton College's student equity plan that was shown in Table 2. However, this table compares the percentage of students in a particular subgroup found in the student population (i.e., cohort percentage) to the percentage of students in that subgroup who achieved a successful course outcome. A PI cut-off of 0.85 would identify the same groups as disproportionately impacted as the 80% rule did (see Table 2).

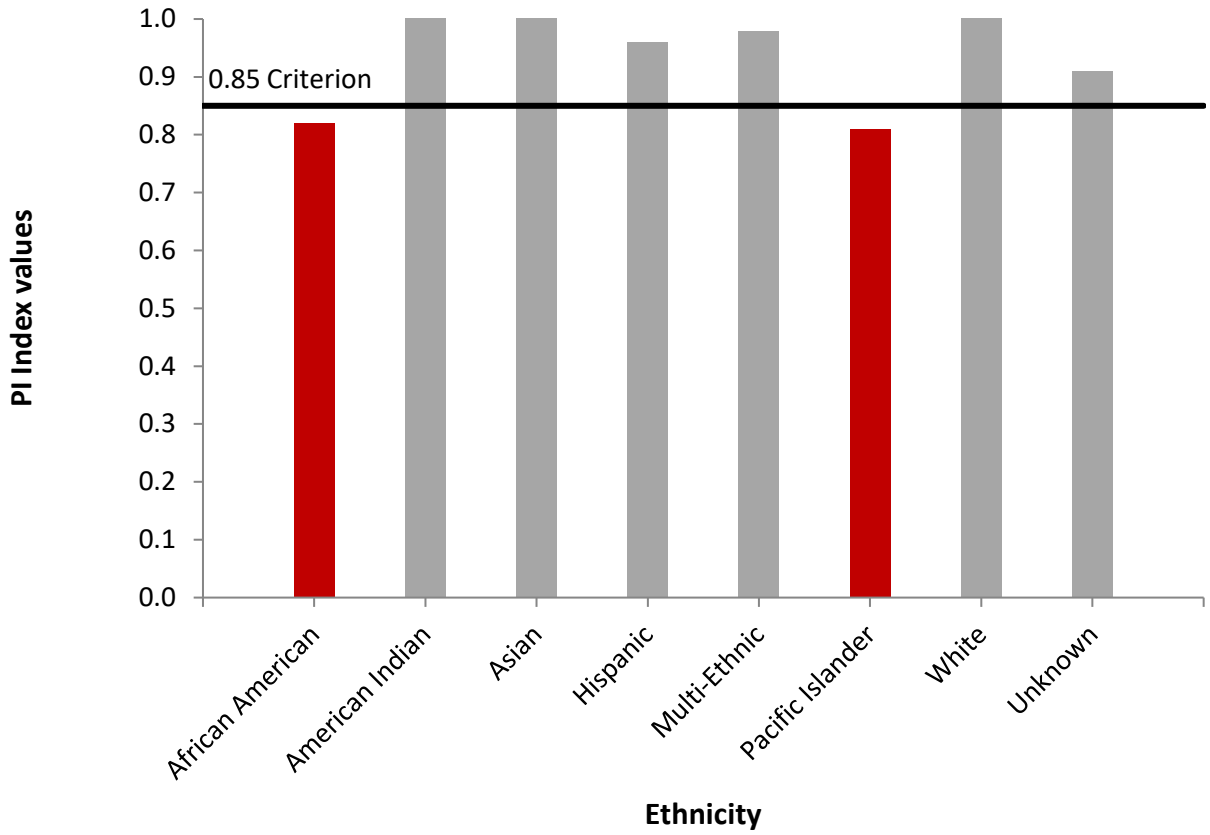
Table 3. Course Success Rates by Ethnicity and Proportionality Indices

Ethnicity	Proportion of Cohort		Proportion of Successful Grade Outcomes		Proportionality Index
	Count	Percent	Count	Percent	
African American	2,547	3.67%	1,388	3.02%	0.82
American Indian	213	0.31%	144	0.31%	1.02
Asian	9,834	14.17%	7,166	15.57%	1.10
Hispanic/Latina/o/x	35,055	50.51%	22,304	48.48%	0.96
Multi-Ethnic	2,261	3.26%	1,468	3.19%	0.98
Pacific Islander	286	0.41%	153	0.33%	0.81
White	16,696	24.06%	11,878	25.82%	1.07
Unknown	2,508	3.61%	1,509	3.28%	0.91
Total	69,400	100%	46,010	100%	1.00

Note: Red font is used to denote groups for which some evidence of disproportionate impact was found. Two decimal places are shown to highlight the interpretive importance of the range between .80 and .89 associated with the proportionality index.
Source: Vurdien, et al. (2014)

As illustrated in Table 3, proportionality indices are greater than 0.90 for all groups except two: African American students (0.82) and Pacific Islander students (0.81). These PI results reflect, for example, that although African American students make up 3.7% of the overall student population, they are successful in courses only 3.0% of the time (see Figure 4 for a graphical illustration). These discrepancies between students' representation in the overall student population and their representation in the course success population indicates, as Fullerton College concluded, that these two groups may be considered disproportionately impacted.

Figure 4. The Proportionality Indices by Ethnicity



Broad Considerations When Employing Disproportionate Impact Approaches and the Student Equity Number

The methods outlined in this paper offer readers some insight into the approaches typically utilized to determine instances of disproportionate impact. The methods are easy to employ from a mathematical standpoint (arguably, I suppose) and generally offer practitioners with standard benchmarks to work with. However, as noted earlier, there are some limitations associated with the methods (see Table 4 for an outline of the advantages and disadvantages of each of the three methods discussed in this paper). Additional work in this area should provide practitioners with practical advice concerning the circumstances when one or two of the indices are especially likely to yield findings consistent with a conclusion of disproportionate impact or when the methods may yield conflicting findings. Until such work is conducted, the author recommends that practitioners consistently employ the percentage point gap method minus one endorsed by the Chancellor's Office coupled with at least either the 80% index and/or the PI index. Indeed, a practical approach would be to employ all three methods and prioritize the instances of disproportionate impact in which two or three methods point to it.

Table 4. Comparison of Disproportionate Impact Methods

Method	Advantages	Disadvantages
80% Rule Index	• Clearly establishes cutoff value for determining DI • Effective method for comparisons between subgroups	• Rigid 80% cutoff can curtail discussion or further exploration • May be subject to error if sample size is very small
Proportionality Index	• Effective method for assessing equitable group representation	• No universally agreed-upon benchmark value for DI • May be subject to error if sample size is very small
Percentage Point Gap Minus One/ Margin of Error (MOE)	• Easy to calculate • Places emphasis on number of student records	MOE is based on sample estimates when colleges typically work with populations

Another method that may offer users a practical way by which to gauge the magnitude of equity gaps that exist at their colleges is to examine the number of students needed to close said gap (CCCCO, 2022; Ramirez-Faghih & Fuller, 2017). The author refers to this as the student equity number because it reflects the number of students you need to experience a successful outcome to eliminate an observed equity gap. The benefit to this approach is that rather than relying on metrics and thresholds, it places the focus on the actual number of students whose outcomes must change to close an observed gap. For instance, if the success rate of African American students at one's college is 60% and the success rate of all other students is 70%, the equity number reflects the number of African American students that would need to achieve a successful grade to increase that success rate of 60% to 70%. In this way, the equity number offers practitioners – faculty, staff, and administrators – some perspective as to the scope of the challenge they face in minimizing or eliminating that gap (after all, an equity number of 1,000 would likely present a greater institutional challenge than would an equity number of 10). The Chancellor's Office has offered a method by which to readily obtain the equity number, based on the obtained percentage point gap minus one (CCCCO, 2017; 2022):

$$\text{Equity Number} = \frac{|\text{PPG} - 1|}{100} * (\text{Cohort Count})$$

Where the |PPG-1| refers to the absolute value of the observed percentage point gap minus one (i.e., any negative values would be converted to positive values) and Cohort Count refers to the number of individuals in a given cohort (or the sample size, as described throughout this paper). Consider Table 5 – it depicts all the negative PPG-1 values illustrated in Table 1. Since they are negative values, we know that they reflect instances in which the corresponding ethnic group achieved a lower-than-average success rate. Employing the aforementioned approach to calculating the equity number, we can then see, for each ethnic group, the number of additional students that would need to achieve a successful outcome in order to eliminate the observed percentage point gap minus one.

In our example, 313 additional African American students in the cohort would have to achieve a successful outcome to eliminate the observed gap in success. Similarly, we would need 37 additional Pacific Islander students to eliminate the observed gap in success. Also notable is the equity number of for Hispanic/Latina/o/x students: Almost 1,900 students would have to achieve a successful outcome to eliminate the observed gap in success (more than six times the number of African American students). The discrepancy in the equity number between African American and Hispanic/Latina/o/x students is due to the number of students in the cohort (sample size), the larger the cohort, the larger the corresponding equity number. In this way, the observed gap is driven both by the observed percentage point gap minus one value and the number of individuals in each cohort (i.e., cohort count). To be clear, just because a group is not identified as disproportionately impacted, it does not mean that no equity gap exists; in fact, depending on the size of the cohort, the observed gap for a group not found to be disproportionately impacted may be a larger than that of another group found to be disproportionately impacted. See Figure 5 for a visual depiction of these equity numbers.

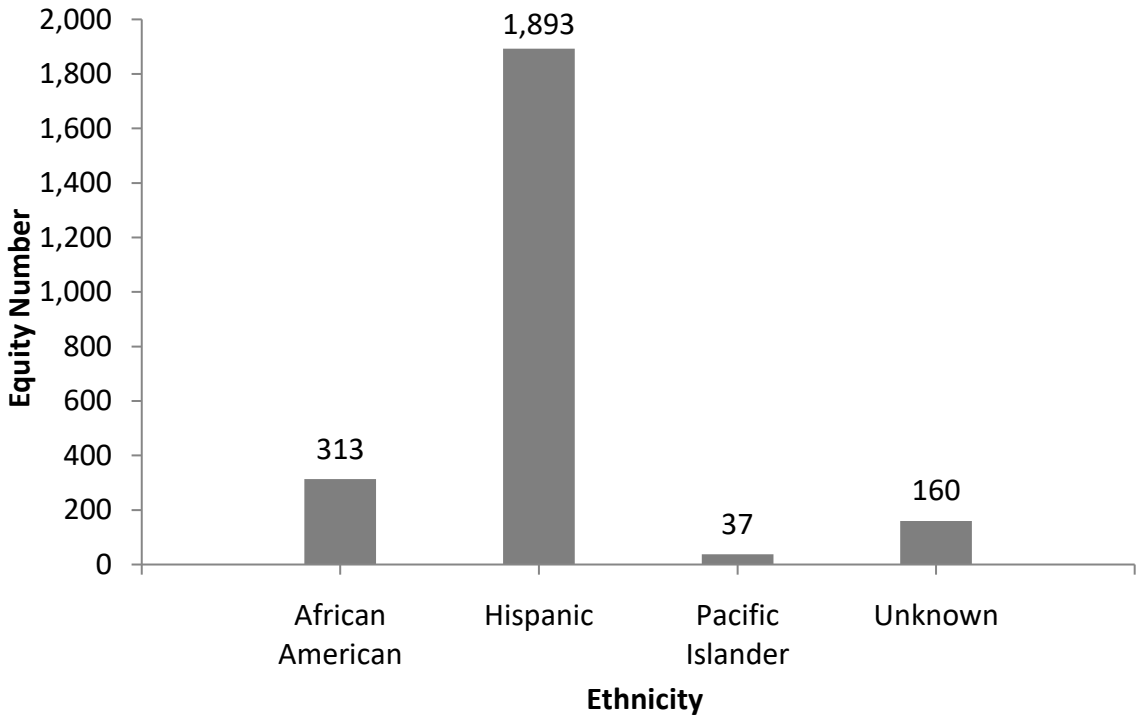
Practitioners should still use the aforementioned methods to identify instances of disproportionate impact, including the percentage point gap minus one method. Nevertheless, the equity number offers practitioners another tool in their efforts to identify and address local equity gaps. Indeed, the Chancellor's Office stresses that the equity number should not be construed as a quota in any way – but rather, an estimate of the number of students a college should strive to reach out to address the observed gap (CCCCO, 2022). One way to conceptualize the benefits of examining the equity number is to consider these approaches (i.e., PPG-1, 80% Index, Proportionality Index) as ways to identify potential instances of disproportionate impact and the equity number as a key method by which to examine how large that disproportionate impact might be.

Table 5. Equity Numbers Stemming from the Negative Percentage Point Gap Minus One Values Depicted in Table 1

Ethnicity	|PPG-1|	Decimal Equivalent	Multiply	Cohort Count	Equity Number
African American	12.3	0.123	X	2,547	313
Hispanic/Latina/o/x	5.4	0.054	X	35,055	1,893
Pacific Islander	12.9	0.129	X	286	37
Unknown	6.4	0.064	X	2,508	161

Note: The formatting of this table was adapted from Chancellor's Office documentation (CCCCO, 2022). Red font is used to denote disproportionately impacted groups, as per the PPG-1 method. Equity number values were rounded up (or down) to the nearest whole number.

Figure 5. Equity Numbers by Ethnic Groups



The Use of DI Measurement Approaches in Two Case Studies

In the following section, the report offers two case studies to demonstrate the results of utilizing each of the previously described data disaggregation measurement methods with real-world California Community College data.

Case Study 1: Identifying Disproportionate Impact among Students Applying but Not Partaking in Orientation

This first case study addresses potential disproportionate impact among prospective students applying to a community college but not participating in the college's orientation. Are certain subgroups more likely than others to apply but not complete their orientation? If so, then which aspect of the matriculation process appears to present the largest obstacle? The data for this case study come from the fall 2016 semester at Crafton Hills College in Yucaipa, California. A key question the college sought to answer was whether disproportionate impact existed with respect to the percentage of prospective students that participated in the college's student orientation. Such findings would shed light on the demographic groups that might need additional outreach and education to complete a key step in the matriculation process.

Table 6 illustrates the orientation participation rates for prospective Crafton Hills students of various age groups. Additionally, the table presents findings based on the three disproportionate impact indices.

Table 6. Orientation Participation Rates by Age Groups among Prospective Crafton Hills College Students

Age Group	Cohort Count	Outcome Count	Orientation Participation Rate	80% Index	PPG-1	Proportionality Index
19 or younger	957	322	33.7%	100%	+12.3	1.25
20 – 24	562	130	23.1%	68.7%	-5.3	0.86
25+	574	113	19.7%	58.5%	-10.1	0.73
Total	2,093	565	27.0%			

Note. Red font was used to denote the specific DI methods yielding significant findings by age group. *Source:* Sosa (2016)

PPG-1 Analysis

To analyze the above data using the percentage point gap minus one approach, one measures the difference between the orientation participation rate for each age group relative to applicants in all remaining age groups and calculates the margin of error for each age group. The findings suggest that both 20–24-year-olds (PPG-1 = -5.3) and those 25 or older (PPG-1 = -10.1) were disproportionately impacted.

80% Rule Index Analysis

The youngest age group (19 or younger) was identified as the reference group, as these students had the highest orientation participation rate. The participation rates of the two older age groups were then divided by that of the rate for students age 19 or younger. This approach

also revealed that the two older age groups were disproportionately impacted: 20–24-year-olds (68.7%) and those 25 or older (58.5%).

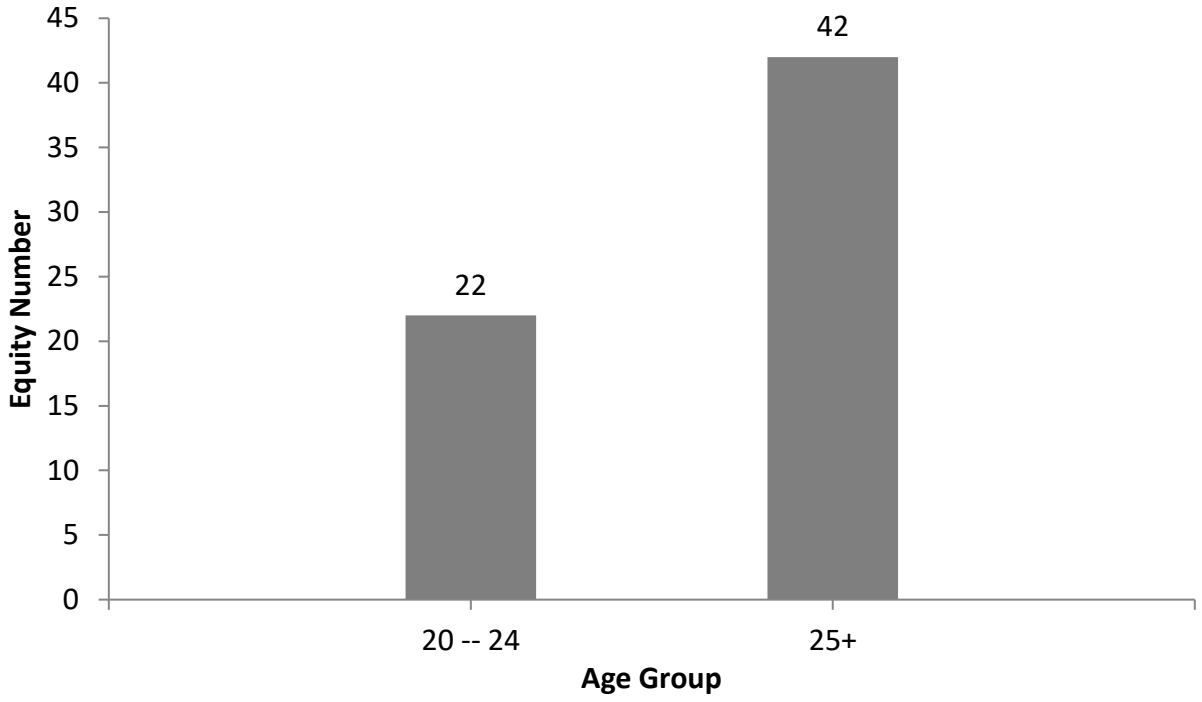
Proportionality Index Analysis

As described earlier, the proportionality index (PI) compares a demographic group's representation across the college to the same demographic group's representation among those achieving a particular educational outcome. To use the proportionality index in this case study, the number of individuals in a specific age group who participated in orientation is divided by the total number of individuals that participated in orientation. For instance, one would divide the number of students ages 25 or older who participated in orientation (113) by the total number of individuals participating in orientation (565), producing a result of .20. The second step in this process would be to divide the total number of individuals in that age group (574 total students over age 25) by the number of individuals in the entire cohort (2,093), which comes to .27. Finally, the PI is determined by dividing those resulting ratios (0.20 ÷ 0.27 = 0.73). The same approach would yield a PI value of 0.86 for those between the ages of 20 and 24, and a PI value of 1.25 for those students 19 years of age or younger. On the basis of these findings, and using the 0.85 discussed earlier, we conclude that students 25 or older were disproportionately impacted.

Equity Number Analysis

Figure 6 for illustrates the equity numbers among the age groups with negative PPG-1 values (both bars in the figure are in red because, as noted earlier, both groups were identified as disproportionately impacted based upon the chancellor's office margin of error approach). The equity number reflects the number of students in potentially disproportionately impacted groups that would have to achieve a successful outcome to eliminate the observed equity gap. It thus functions as a practical approach by which to gauge the magnitude of the observed equity gap. In the context of this case study, the equity numbers were examined among the two age groups with lower than expected orientation participation – those between the ages of 20 and 24, and those 25 or older. In the case of those between 20 and 24, the equity number was 22, indicating that 22 additional students out of the 562 total students in that cohort would have to participate in the orientation for the observed gap to be eliminated. Similarly, in the case of those 25 or older, the equity number was found to be 42, indicating that 42 additional students out of the 574 total students in the cohort would have to participate in the orientation to eliminate the observed equity gap.

Figure 6. Equity Numbers by Age Groups with Negative PPG Values



Overall Data Disaggregation Determination

Given the evidence generated using the three disproportionate impact methods, it appears that two groups in this example are disproportionately impacted: Applicants between the ages of 20 and 24 and those 25 or older.[5] In addition, the respective equity numbers indicate that over 20 additional students in each age group would have to participate in the college's orientation to eliminate the observed equity gaps. Such findings suggest that the institution should prioritize developing and implementing strategies designed to mitigate (or eliminate) obstacles that older applicants might be experiencing by exploring, perhaps via survey or focus groups, why such applicants are not taking the next step in the matriculation process.

Case Study 2: Investigating Disproportionate Impact in the Context of Course Placements

This second case study addresses possible disproportionate impact among ethnic groups in the context of course placements. This case examines fall 2015 data submitted by Riverside City

[5] *Note*: The Proportionality Index (PI) with a 0.85 cutoff only identified the older group as disproportionately impacted. Nevertheless, since two of the three methods of disproportionate impact found both age groups to be disproportionately impacted, it is reasonable to conclude that both groups are indeed affected.

College as part of their participation in the California Acceleration Project[6]and shared with the author (personal communication, July 14, 2016).

Table 7 below displays data related to placement rates into transfer-level English courses, disaggregated by ethnic group. In addition, the table illustrates the findings stemming from the use of the three disproportionate impact indices. Due to the small number of students within several ethnic groups at Riverside City College, this analysis focuses on only four groups: (1) African American, (2) Asian, (3) Hispanic/Latina/o/x, and (4) White.

Table 7. Course Placement Rates in Transfer-Level English at Riverside City College by Ethnicity and the Three Disproportionate Impact Indices

Ethnicity	Cohort Count	Outcome Count	Placement Rate	80% Index	Percentage Point Gap	Proportionality Index
African American	335	38	11.3%	39.0%	-7.2	0.64
Asian	141	30	21.3%	73.1%	3.6	1.20
Hispanic/Latina/o/x	2,310	357	15.5%	53.1%	-7.3	0.87
White	625	182	29.1%	100.0%	13.9	1.64
Total	3,411	607	17.8%			

Source: Riverside City College (2015).

PPG-1 Analysis

The aim here is to take the difference between the placement rate for all 3,411 students in the cohort and that of each individual ethnic group. African American students were found to be disproportionately impacted with a -7.2 percentage point gap minus one (MOE = 3.4). Similarly, Hispanic/Latina/o/x students were found to be disproportionately impacted with a -7.3 percentage point gap minus one (Calculated MOE = 1.5; CCCCO Adjusted MOE = -2.0).

80% Rule Index Analysis

White students served as the reference group, so the placement rates of the remaining groups were divided by those of White students. Using this approach, the three remaining groups appear to be disproportionately impacted: African American (39.0%), Asian (73.1%), and Hispanic/Latina/o/x (53.1%) students.

Proportionality Index Analysis

The proportionality index compares a demographic group's representation across the college to the same demographic group's representation among all students who achieve a particular

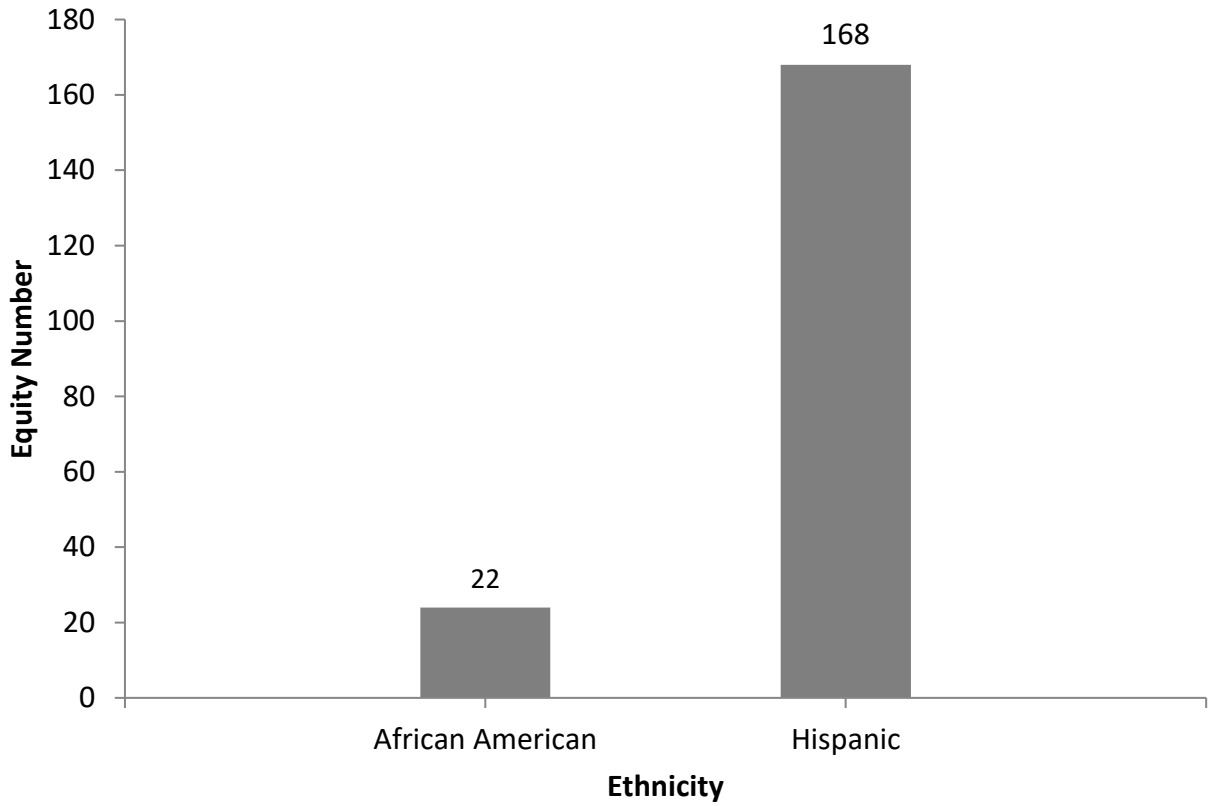
[6] https://accelerationproject.org/

outcome. In the current context, this method entails dividing a group's representation among students being placed into a course one level below transfer English by that same ethnic group's representation among all students being placed into transfer-level English courses. Using this approach, along with the aforementioned cutoff of 0.85, African American (0.062 ÷ 0.098 = 0.64) were identified as disproportionally impacted.

Equity Number Analysis

Figure 7 illustrates the equity numbers among the ethnic groups with negative percentage point gap minus one values. The equity number reflects the number of students in potentially disproportionately impacted groups that would have to achieve a successful outcome to eliminate the observed equity gap. Such analysis revealed that 22 additional African American and 168 additional Hispanic/Latina/o/x students would have to place into transfer-level English in order to eliminate the observed gaps. Note that while Hispanic/Latina/o/x students were not identified as disproportionately impacted (as per CCCCO, 2017), Hispanic/Latina/o/x students are the group for which a larger number of students would have to place into transfer-level coursework to eliminate the observed equity gap. The larger equity number for Hispanic/Latina/o/x students, despite not being identified as disproportionately impacted, demonstrates that the observed equity gap is driven both by the observed percentage point gap minus one value and the number of individuals in a given cohort (i.e., cohort count). A combination of both large negative PPG-1 values and large cohort counts will yield a relatively large equity number, while a combination of small negative PPG-1 values coupled with small cohort counts will yield a relatively small equity number.

Figure 7. Equity Numbers by Ethnic/Racial Groups with Negative PPG-1 Values



Overall Disproportionate Impact Determination

Given the evidence generated using the three disproportionate impact methods, it appears that at least one group—African American students—is disproportionately impacted with respect to course placement in transfer-level English classes regardless of method. Two of the three methods suggested that Hispanic/Latina/o/x students were also disproportionately impacted. In addition, on the basis of the observed equity numbers, a larger gap exists among Hispanic/Latina/o/x than African American students. These findings suggest that the institution should prioritize developing and implementing strategies designed to ameliorate, if not eliminate, the disproportionate impact that African American and Hispanic/Latina/o/x students are experiencing.

Concluding Remarks

Data disaggregation is a key first step in identifying potential equity gaps across an array of academic outcomes. With disaggregated data, it is possible to complete the critical task of conducting disproportionate impact analyses. Disproportionate impact analyses help practitioners better understand the extent to which one or more student demographic groups are potentially disadvantaged in their quest for academic success.

There are various approaches to determining disproportionate impact, each of which offers certain advantages and disadvantages. While the author recommends that practitioners always examine the percentage point gap minus one and employ its corresponding margin of error approach, the author also recommends that colleges consider using more than one method to identify disproportionate impact; in doing so, colleges can increase their certainty that the student groups they identify as disproportionately impacted are indeed in need of institutional intervention. One comprehensive approach, for instance, would be to apply all three disproportionate impact methods described in this paper and identify equity gaps only in cases for which at least two of the methods pointed to disproportionate impact. In addition, the author recommends that the equity number be consistently examined to glean the practical significance of the observed equity gaps. Further, these quantitative metrics can and should be combined with qualitative information from student surveys and focus groups to provide context, nuance, and help inform action plans.

Finally, while this paper has focused on methodological and statistical methods underlying the identification of disproportionate impact, readers are urged to consider that the most important step in this process comes after the data have been analyzed: The resulting institutional dialogue that ideally leads to substantive changes in students' educational outcomes. Upon the identification of likely equity gaps, it is incumbent upon colleges to develop and implement a plan for how to ameliorate the obstacles faced by disproportionately impacted groups. Objective evidence that does not lead to informed dialogue, planning, and ultimately action will do little to close equity gaps.

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Data Disaggregation Applied Solution Kits and the Multiple Measures Assessment Project Teams

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