

# EXPLORATION OF RACIAL AND GENDER DIVERSITY WITHIN UNDERGRADUATE AND GRADUATE PROGRAMS ACROSS THE US

*Edward Clay, College of Engineering, California State Polytechnic University, Pomona, CA 91768  
909-749-7358, [erclay@cpp.edu](mailto:erclay@cpp.edu)*

*Wen Cheng, College of Engineering, California State Polytechnic University, Pomona, CA 91768  
909-869-2957, [wcheng@cpp.edu](mailto:wcheng@cpp.edu)*

*Yasser Salem, College of Engineering, California State Polytechnic University, Pomona, CA 91768  
909-869-4312, [ysalem@cpp.edu](mailto:ysalem@cpp.edu)*

*Ranjithsudarshan Gopalakrishnan, College of Engineering, California State Polytechnic University,  
Pomona, CA 91768, 626-554-6182, [ranjith@cpp.edu](mailto:ranjith@cpp.edu)*

*Mankirat Singh, College of Engineering, California State Polytechnic University, Pomona, CA 91768  
909-282-9025, [mankirats@cpp.edu](mailto:mankirats@cpp.edu)*

## ABSTRACT

Students of all backgrounds shall have an equal opportunity to experience all that a university offers. The study aims to better understand the distribution of race and gender within the undergraduate and graduate programs across the US, based on the data collected from the National Center for Education Statistics (NCES). Several statistical tests were performed for a comprehensive exploration of student diversity within each university. The correlation analysis indicates that most races are negatively correlated with one another at both the undergraduate and graduate levels. Inversely, the correlation coefficients between the different races and genders are considerably more balanced.

**Keywords:** Undergraduate and Graduate Programs; Race and Gender Diversity; Correlation; t-test.

## INTRODUCTION

Universities have offered an environment where students can enhance their education to strengthen their ability to aid their communities and workplaces by providing various opportunities in various areas [1]. There are many ways that universities assist their students in achieving this goal, such as providing recreational activities [2], research opportunities [3], and internships in numerous different industries [4], to name a few. To further aid their students, various universities often specialize in specific opportunities, such as engineering, graphical design, sports, etc. [5]. To ensure that all students are given an equal opportunity to attend these universities, universities often review their admission requirements for their students. Such changes include being more lenient towards academic prowess and the eventual introduction of standardized exams [6] or reducing the price students need to pay for attendance in the form of grants or university-sponsored scholarships [7]. In addition to allowing more students to attend university, it is also necessary to understand student backgrounds.

Diversity among a population can strengthen it by providing different genetic traits to suit their environments better. This can be seen in improving the breeding objective in livestock [8], reducing a crop's susceptibility to parasites [9], as well as a species overall survivability in harsh environments [10]. Much like how diversity helps different populations in nature, it has also benefited human populations on varying scales. Research teams whose members come from diverse cultural and educational backgrounds have performed better compared to each member working individually [11]. Another example involves language and cultural diversity in creating language policies to provide more accurate translations [12]. In business, gender diversity could lead to potential growth in customer base and employment opportunities [13,14]. Such demographical diversity has shown to be beneficial to the populations it enters; therefore, it is logical to apply this line of reasoning to the university level.

Allowing diversity in a university environment encourages students to explore other cultures from a racial and economic perspective. In addition to benefiting students, diversity has also been shown to improve students' overall education [15,16]. To continue to promote diversity and the benefits it provides within universities, it is crucial to understand the backgrounds of students that different universities accept into their programs each year. One such area of focus involves the economic backgrounds of students in their acceptance to various universities. Economic diversity helps universities understand the impact of the loans, grants, and scholarships they offer to their students [17] or the overall enrollment that universities provide [18]. In recent years, the focus has shifted more towards a university's diversity regarding race and gender among the programs they offer. Racial diversity is often described as the diverse national origin or ethnic background of individuals within a group [19]. A number of literature focus on the impacts that racial diversity has on higher education [20-25]. Despite the plethora of research conducted on these topics, fewer efforts have been made to understand the correlation between gender and race.

This research paper aims to help bridge the gap in understanding the correlation between racial and gender groups accepted by universities. This is done by implementing two distinct correlation models to understand racial and racial-gender diversity at the university level. Utilizing data collected from the National Center for Education Statistics (NCES) regarding student demographics of those accepted into undergraduate and graduate institutions across the USA, it becomes possible to comprehend the differences within racial and gender demographics. The first of these correlation models is a two-sample T-Test, specifically Welch's T-Test due to the data's unequal sample sizes [26]. The second correlation model is Pearson's correlation coefficient analysis. It has been selected due to its ability to handle non-normally distributed data better than other correlation coefficient analyses such as Spearman or Kendal [27].

### DATA DESCRIPTION

The data used for the correlation analyses originate from one source, the NCES [28]. This dataset provided by NCES contains information regarding the total number of students being accepted to the 5972 undergraduate and 2082 graduate programs at numerous universities across the US. Additionally, data regarding the total number of students from specific demographics, further divided into men and women, are provided. A summary of the data consulted for the correlation analyses is provided in Table I.

**TABLE 1. DESCRIPTIVE STATISTICS OF DATA**

<b>Racial Group</b>	<b>Mean (SD)</b>	<b>2.5%</b>	<b>97.5%</b>
American Indian /Alaska Native	884 (1793)	0	205
Asian	371 (538)	0	2669
Black /African American	3259 (7633)	0	4357
Hispanic /Latino	164 (452)	0	8060
Native Hawaiian /other Pacific Islander	292 (747)	0	97
White	477 (869)	0	15076
2 or more races	2555 (5799)	0	1327
Unknown	96 (271)	0	1652
Nonresident alien	159 (342)	0	1874
American Indian /Alaska Native	51 (110)	0	205
Asian	172 (433)	0	2669

Note: The values listed are rounded to the nearest whole number.

### METHODOLOGY

As previously mentioned, the primary focus of this research article is to comprehend the effects that different racial and gender groups have on one another within undergraduate and graduate programs. Firstly, Welch's T-Test was performed to understand the correlations between different racial groups within

undergraduate and graduate programs in the US. Then, Pearson’s correlation coefficient was generated to provide a different outlook among racial groups and to understand the effects among the two genders.

### Welch’s T-Test

Two distinct methods for performing a Two-Sample T-Test exist and are utilized for different purposes. The first is the Classical T-Test, also known as a Student’s T-Test [29] and is used primarily whenever the variances between the two populations are equal. Unfortunately, the data used in this research does not fit this criterion, and therefore it is not possible to perform a Classical T-Test. The alternative for the Classical T-Test is Welch’s T-Test. Welch’s T-Test performs better when compared to the Classical T-Test not only because it is capable of working with populations with unequal variances and can also perform with populations of varying sample sizes [30] is vital when consulted with the summary outlined in Table 1. Welch’s T-Test is performed using Equations (1) & (2).

$$t = \frac{m_b - m_a}{\sqrt{\frac{S_b^2}{n_b} + \frac{S_a^2}{n_a}}} \tag{1}$$

$$df = \left( \frac{S_b^2}{n_b} + \frac{S_a^2}{n_a} \right) / \left( \frac{S_b^2}{n_b^2(n_b - 1)} + \frac{S_a^2}{n_a^2(n_a - 1)} \right) \tag{2}$$

In the equations (1) and (2), the means (m), sample standard deviations (s), and sample sizes (n) for two sets of populations as denoted with the subscripts a and b respectively are taken into consideration for the assessment of the T-value and the number of degrees of freedom (df). In practice, the df between two variances will correlate to a T-test chart to give a p-value; this p-value determines if the correlation between the two sets of data is statistically significant or not. In general, lower p-values indicate a higher level of statistical significance [31].

### Pearson’s Correlation Coefficient

Pearson’s correlation coefficient, like Welch’s T-Test, measures the correlation between two samples. Unlike Welch’s T-Test, Pearson’s Correlation focuses primarily on the linear relationship between two populations and ignores other types of relationships. The equation that Pearson’s Correlation is outlined below (3).

$$r = \frac{\sum(x - m_x)(y - m_y)}{\sqrt{\sum(x - m_x)^2 \sum(y - m_y)^2}} \tag{1}$$

Within the equation (3) above, the variables are the same as Welch’s T-Test, with r representing the correlation coefficient. Pearson’s Correlation Coefficient showcases a range of values between +1 to -1 where +1 indicates a perfect positive correlation between two variables and -1 for perfect negative correlation [32].

## RESULTS

As previously mentioned, the correlation within the data categories outlined in Table 1 were determined using two distinct models. The first is Welch’s T-Test, which is used to understand the correlation between various Undergraduate and Graduate Racial groups. The second test is Pearson’s Correlation Coefficient and is used to comprehend the similarities and differences between racial groups for both Undergraduate

and Graduate students and Undergraduate and Graduate men. The statistical software ‘R’ is used to perform calculations in this study.

### Welch’s T-Test

Beginning with Welch’s T-Test, the racial groups for undergraduate admissions were analyzed to understand the correlation between said groups. The results from this test are outlined in Table 2.

When reviewing Table 2, it is essential to understand how the information is organized. The topmost row and the left most column contain the different racial groups previously outlined in Table 1. The intersection between any two racial groups will yield either the P-values or the correlation coefficient. Values closer to the top and right of the table showcase the P-values resulting from the correlation method. The values closer to the bottom and left of the table represent the Correlation Coefficient between two racial groups. From the top left to the bottom right, diagonally, a racial group intersects itself and should only act as a “barrier” between the two categories of values previously mentioned.

**TABLE 2. UNDERGRADUATE T-TEST RESULTS**

Racial Group	American Indian /Alaska Native	Asian	Black /African American	Hispanic /Latino	Native Hawaiian /other Pacific Islander	White	2 or more races	Unknown	Nonresident alien
American Indian /Alaska Native	1 (0)	-0.053	-0.091	-0.067	<b>0.007</b>	-0.095	<b>0.016</b>	<b>-0.029</b>	<b>-0.04</b>
Asian	18.582 (0)	1 (0)	-0.1311	<b>0.020</b>	0.091	-0.234	0.084	<b>-0.026</b>	0.141
Black /African American	56.471 (0)	47.325 (0)	1 (0)	-0.212	<b>-0.044</b>	<b>-0.481</b>	-0.110	0.067	-0.130
Hispanic /Latino	54.602 (0)	45.771 (0)	-0.103 (0.918)	1 (0)	<b>0.001</b>	-0.57	-0.112	-0.093	-0.077
Native Hawaiian /other Pacific Islander	-9.101 (0)	-31.36 (0)	-61.907 (0)	-59.721 (0)	1 (0)	-0.095	0.051	<b>0.004</b>	<b>0.008</b>
White	127.562 (0)	119.852 (0)	67.363 (0)	66.57 (0)	133.178 (0)	1 (0)	<b>0.008</b>	-0.15	-0.110
2 or more races	17.094 (0)	-7.017 (0)	-52.398 (0)	-50.537 (0)	42.563 (0)	-125.631 (0)	1 (0)	<b>-0.016</b>	<b>0.011</b>
Unknown	21.685 (0)	3.196 (0.001)	-45.629 (0)	-44.135 (0)	34.831 (0)	-118.384 (0)	10.94 (0)	1 (0)	<b>0.001</b>
Nonresident alien	7.422 (0)	-11.997 (0)	-53.548 (0)	-51.755 (0)	19.184 (0)	-125.42432 (0)	-8.285 (0)	-15.254 (0)	1 (0)

Notes: 1. Values in the upper right triangle represent the P-Values. 2. Bolded P-Values represent statistical significance of at least 95%. 3. Values in the lower left triangle represent the Correlation Coefficient Values.

Upon closer inspection of Table 2, several points of interest begin to reveal themselves; for starters, American Indians/Alaska Natives and Asians are positively correlated with all races, except for Native Hawaiian and other Pacific Islanders. One potential explanation for this could be based on location, American Indian and Pacific Islanders may only consider going to universities near their areas, and since these groups are not as widespread as others and potential other career options available to these groups may deter most from pursuing a higher level of education [33]. The results for Asians could be explained by the plethora of international programs that universities across America offer, which allows them to attend most universities with relative ease [34]. Another critical point to note revolves around Black/African Americans and Hispanics/Latinos. Both groups are positively correlated with American Indians/Alaska Natives, Asians, and Whites but are negatively correlated with every other race.

One final notable point of interest revolves around the multiracial group and its interactions with the known racial groups presented in Table 1. American Indian/Alaskan Natives and Native Hawaiian/Other Pacific Islanders are positively correlated with multiracial groups. This phenomenon could be explained due to these racial groups' cultural practices in which these groups, in particular, would "isolate" themselves from other racial groups. Native Americans, who are a bit more open to socializing with members outside their racial group, would often only state that they are only Native American despite being multiracial [35]. Native Hawaiians, on the other hand, are more hostile towards other races, so much so that there is a significant social issue of open racism in Hawaii among the natives [36]. Other multiracial groups are more common and usually more open towards identifying themselves as such [35].

The Graduate T-Test in Table 3 is identical to the Undergraduate T-Test in Table 2 in terms of the format. Looking closer, the correlations between the Undergraduate and Graduate racial groups are similar, albeit the exact correlation value are different to varying degrees. One potential explanation for these inconsistencies originates deeper than the racial groups. Still, it could be a part of the specific majors that students had pursued, specifically that some careers only require a bachelor's degree and no further education [37]. These variations could again be explained by the financial cost of pursuing a higher level of degree in which the price is too much for the student or that the benefit is too low to justify the cost [38]. Upon closer examination of Table IV, several crucial points of interest become apparent. Focusing on the undergraduate triangle, the first thing to notice is that the correlations between the different racial groups are dissimilar to those presented in Table 2, with few correlations agreeing with one another. For instance, American Indian/Alaska Natives are negatively correlated with all racial groups except the multiracial group. The same pattern appears in Native Hawaiian/other Pacific Islanders, which suggests that these specific minority groups have fewer opportunities for students to attend higher education institutions, as implied by the need for additional programs aimed towards helping students adjust to college and university life [39,40]. Another interesting point arises when looking at Black/African Americans and Hispanics/Latinos where they are negatively correlated with racial groups. In more predominantly white colleges, it is suggested that specific groups are more prone to rejection and which could explain the negative correlation with these two groups in particular [41, 42]. This also is suggested by the more significant negative correlation values of Whites with other racial groups.

**TABLE 3. GRADUATE T-TEST RESULTS**

Racial Group	American Indian /Alaska Native	Asian	Black /African American	Hispanic /Latino	Native Hawaiian /other Pacific Islander	White	2 or more races	Unknown	Nonresident alien
American Indian /Alaska Native	1 (0)	<b>-0.047</b>	<b>-0.042</b>	-0.057	<b>0.0008</b>	<b>-0.044</b>	<b>0.006</b>	<b>-0.002</b>	-0.062
Asian	23.637 (0)	1 (0)	-0.10	<b>-0.04</b>	0.124	-0.263	0.063	-0.076	0.110
Black /African American	30.417 (0)	17.341 (0)	1 (0)	-0.13	-0.090	-0.431	<b>-0.026</b>	-0.072	-0.171
Hispanic /Latino	24.929 (0)	12.012 (0)	-4.324 (0)	1 (0)	<b>-0.017</b>	-0.452	-0.063	-0.102	-0.110
Native Hawaiian /other Pacific Islander	-4.441 (0)	-27.932 (0)	-32.101 (0)	-26.549 (0)	1 (0)	-0.089	0.113	<b>0.0041</b>	<b>-0.021</b>
White	95.002 (0)	83.744 (0)	61.548 (0)	65.355 (0)	96.615 (0)	1 (0)	-0.063	-0.201	-0.360
2 or more races	13.767 (0)	-15.357 (0)	-26.271 (0)	-20.711 (0)	22.156 (0)	-92.171 (0)	1 (0)	<b>-0.019</b>	-0.066
Unknown	26.506 (0)	6.617 (0)	-12.023 (0)	-6.929 (0)	29.624 (0)	-77.884 (0)	10.941 (0)	1 (0)	-0.10
Nonresident alien	23.337 (0)	8.489 (0)	-8.435 (0)	-3.823 (0)	25.290 (0)	-71.326 (0)	-8.285 (0)	2.971 (0)	1 (0)

Notes: 1. Values in the upper right triangle represent the P-Values. 2. Bolded P-Values represent statistical significance of at least 95% 3. Values in the lower left triangle represent the Correlation Coefficient Values.

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Multiracial groups presented appear to maintain a positive correlation between American Indians/Alaska Natives and Native Hawaiian/other Pacific Islanders as seen in Table 2 and Table 3; however, multiracial groups also have positive correlations with Asians and Whites. This suggests that multiracial students and Asian students, both of which could be considered minority groups, could have some difficulty fitting into the college and university setting [43]. For multiracial groups and Whites, the positive correlation could be explained from a more social perspective, in which multiracial race and cultural flexibility and friendships [44,45] in which these groups are often “closer” to one another.

### **Pearson’s Correlation Coefficient**

Following Welch’s T-Test, Pearson’s Correlation Coefficient was calculated between the racial groups of both undergraduate and graduate admissions. The results from this test are summarized in Table 4.

The formatting of Table 4 is different from Table 2 and Table 3. The only similarity is the division between the two sets of data being represented in the table, in which these values are set as 1. Additionally, the racial groups are organized along the topmost row and leftmost column. The upper right triangle contains the correlation coefficients of the different racial groups of graduate students, whereas the lower-left triangle contains the correlation coefficients of undergraduate students.

The graduate correlation coefficients present in Table 4 present similar results to their undergraduate counterpart. American Indian/Alaska Natives demonstrate a positive correlation with Native Hawaiian/other Pacific Islanders in addition to multiracial groups. Like the results outlined in Table 3, many of these differences originate primarily from the majors that students had initially chosen rather than the race themselves [37]. This phenomenon warrants further investigation.

Table 5 dives into the gender differences among different racial groups. The results outlined in Table 5 showcase the correlations between all students, male and female, of a specific racial group and the male Undergraduate and Graduates belonging to the said racial group.

Examining Undergraduate groups in Table 5, several racial groups are positively correlated. This suggests that males of these racial groups are more likely to enroll in undergraduate programs than their female counterparts. This could be explained due to these groups having some cultural preference for male students over female students [46,47]. Female students of specific minority races have ample opportunities and extra aid [48-50].

Moving onto male graduate students in Table 5, the results differ in specific racial groups in male undergraduate students. This is likely due to specific racial groups' preferences and the majors they will choose [51]. In addition to these differences in correlation direction, the intensities of these correlations also change drastically. Such examples include American Indian/Alaska Natives increasing its correlation by ten times between its undergraduate to graduate male students. Asian male students increase over three times from undergraduate to graduate programs, indicating that these changes originate from the majors themselves rather than racial groups [53].

**TABLE 4. TEST RESULTS OF PEARSON’S CORRELATION ACROSS VARIOUS RACIAL GROUPS FOR BOTH UNDERGRADUATE AND GRADUATE PROGRAMS**

	American Indian /Alaska Native	Asian	Black /African American	Hispanic /Latino	Native Hawaiian /other Pacific Islander	White	2 or more races	Unknown	Nonresident alien
American Indian /Alaska Native	1	-0.04682	-0.04179	-0.03683	0.009265	-0.04424	0.035047	-0.03249	-0.06191
Asian	-0.05316	1	-0.10092	-0.03982	0.119641	-0.26031	0.059618	-0.07614	0.106665
Black /African American	-0.09103	-0.12953	1	-0.12563	-0.03017	-0.43414	-0.02568	-0.07004	-0.16529
Hispanic /Latino	-0.06689	0.020221	-0.20997	1	-0.01729	-0.45469	-0.0633	-0.10309	-0.10849
Native Hawaiian /other Pacific Islander	-0.00369	0.08971	-0.04413	-0.01518	1	-0.08896	0.105149	-0.00411	-0.02097
White	-0.09525	-0.23176	-0.48054	-0.57014	-0.09541	1	-0.06293	-0.20162	-0.35643
2 or more races	0.015854	0.084254	-0.10879	-0.10535	0.051369	0.008579	1	-0.04874	-0.06567
Unknown	-0.02852	-0.02566	-0.06709	-0.09257	-0.00236	-0.1453	-0.01841	1	-0.10489
Nonresident alien	-0.04012	0.143367	-0.12783	-0.07701	-0.00692	-0.1093	0.011019	0.001081	1

Notes: 1. Values in the upper right triangle represent Graduate Correlation Coefficients. 2. Values in the upper right triangle represent Undergraduate Correlation Coefficients.

**TABLE 5. TEST RESULTS OF PEARSON’S CORRELATION BETWEEN MALE AND TOTAL STUDENTS ACROSS VARIOUS RACIAL GROUPS FOR BOTH UNDERGRADUATE AND GRADUATE PROGRAMS**

	American Indian /Alaska Native	Asian	Black /African American	Hispanic /Latino	Native Hawaiian /other Pacific Islander	White	2 or more races	Unknown	Nonresident alien
Undergraduate	-0.0036	0.0147	-0.0981	-0.0086	0.0113	0.0458	-0.0295	0.0319	0.1497
Graduate	-0.0367	0.0526	-0.1439	-0.0303	0.0109	-0.0224	0.0074	-0.0585	0.2666

Note: The values in the table represent the Pearson’s correlation coefficients.

### CONCLUSIONS

The current study employs two distinct correlation methodologies to understand the differences in undergraduate and graduate acceptances among different racial groups. Another goal this study aimed to achieve was to illustrate the differences in gender among racial groups in undergraduate and graduate programs. The data utilized were obtained from the NCES website, considering data from universities across the United States. The data contained information regarding the demographics of students enrolled in the universities’ undergraduate and graduate programs. After performing the correlation analyses and comparing the results, the following conclusions are drawn:

- Among undergraduate students, several racial groups appear to have some priority or preference over others.
- Correlations among graduate students vary from the correlations of undergraduate students, indicating a deeper cause of variation among racial groups.
- The correlation of male students in undergraduate and graduate programs among different racial groups can indicate cultural preference rather than only racial preference by the university or college.

These findings show that some racial groups are more likely to be enrolled in undergraduate and graduate programs than other racial groups. Despite this, it is also clear that some results suggest a deeper meaning behind the acceptance than just looking at racial and gender preferences. For this reason, further research

must be conducted, focusing on total applied student and their acceptances as well as some educational merit from students who were accepted and denied. Another area of focus should revolve around the major that students were admitted in, as some careers only require one to have a bachelor's degree. Through these suggested future research topics, a clearer understanding of university and college diversity will become apparent and could help aim future enrollment of undergraduate and graduate programs.

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