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### Catering To The Common Denominator: An Alternative Perspective On Measuring College Academic Achievement And Performance

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## Catering To The Common Denominator: An Alternative Perspective On Measuring College Academic Achievement And Performance

### Abstract

This study focuses on colleges offering B.A. Economics (H) in Delhi University and divides students into 3 distinct groups, based on their GPA, namely high performers, poor performers and the average. By proving that the average form the majority in all instances, I measure the capability of colleges to motivate the same to perform better. To do so, I propose a framework that captures the movement of students between the established groups over two years (i.e. 4 semesters). Furthermore, I enunciate that the high dispersion, not only between but within colleges, points towards an institutional inefficiency, suggesting unequal dissemination/absorption of knowledge. Gender Gap Hypothesis is also undertaken. By the end, I devise a supplementary ranking of colleges, keeping in mind the concerns raised above.

### Keywords

Academic Achievement, gender gap, GPA

### Cover Page Footnote

I take this opportunity to express my profound gratitude and deep regards to my guide Dr. Ranjanendra Narayan Nag along with all other faculty members for their complete guidance, monitoring and constant encouragement throughout the entire course of the dissertation. However, the usual disclaimer applies.

## Introduction

Hayek (1945) reminds us that prices provide crucial information about the desirability or scarcity of a product, which would be difficult to gather through other means. Grades serve this role, giving students incentives to work harder and measure their capabilities. Even though, many studies examine the determinants of student performance, these studies are predictive, and not inferential, in nature. This paper instead investigates what can be inferred about students (and their instructors) from the grades received in classes already taken. Individual course grades provide little information about student productivity. Averages can provide much more meaningful information, but this must be confirmed by a future examination of grades in multiple courses across multiple institutions. (Darren Grant 2005).

The University of Delhi, informally known as Delhi University (DU), is a collegiate public central university, located in New Delhi, India. Founded in 1922, the University of Delhi has since become India's largest institution of higher learning. It has 77 affiliated colleges and 5 other institutes with an enrollment of over 132,000 regular students and 261,000 non-formal students. Based on the Higher Secondary Examination results of the application pool, a series of 'cut-off' lists are announced for each college, until the seats are filled. These lists contain the aggregate percentage of 4 subjects required to be eligible for admission. There exist various social brackets, which ensure a percentage of the seats offered are reserved for the minority class. *The General Category faces the highest cut offs.* The Caste based reservation system in education, provides some degree of relaxation to the marginalized community (SC, ST and OBC). But DU cutoffs are notorious to be very high, reaching even 100%, with the General Category facing the brunt of it. In addition, there are reservation on grounds of athletic ability and extracurricular talent, as per the requirements of the college.

In the following study, we focus on a sample of 35 colleges, admitting students with identical level of high school achievement, and track their academic journey by means of their GPA. Despite initially being on a level field, we find huge variation in student academic achievement over the period of the course. Information about students' academic performance affects the use of indirect methods of inferring productivity, such as signaling (Spence, 1973) and early career wage dynamics (Altonji & Pierret, 2001). Thus, such heterogeneity within classrooms creates doubt on the efficiency of such institutions in imparting knowledge or the presence of negative externalities. Thus, the study of peer dynamics in classroom settings becomes crucial. This stratification is seen even in between sexes. Although, existing literature conveys that females having certain advantages over their male peers in scholastic areas, which would be discussed in the upcoming literature review.

College enrollment decisions are based on a variety of factors, namely the cost of college, particularly for low-income students (Avery & Hoxby, 2004; Dynarski, 2003; Hurwitz, 2012), proximity to their homes (Hossler, Braxton, & Coppersmith, 1989; Leppel, 1993), college quality (Long, 2004), where miniscule changes in college rankings affect the number of applicants to a given college (Luca & Smith, 2013) and the provision of amenities, such as hostels and student activities (Jacob, McCall, & Stange, 2013). The most sought out colleges have the highest 'cut-offs'.

Accordingly, it is evident, that colleges with high entry requirements, have a higher concentration of exceptional students, who remain motivated enough to maintain a decent GPA track record, independent of the amenities at their disposal. Hence, measuring institutional performance merely on the average of the grade point earned by its students is misleading. The study recognizes 3 distinct groups, differing by GPA, namely high performers, poor performers and the average. The grade distribution of the students is found to be following a normal distribution, with average scorers forming

the majority. In the face of the enumerated disparities, this paper develops an index score, that strives to primarily measure the capability of colleges to augment the performance of 'average' students.

Section 2 exposes the pertinent literature review.

Section 3 discusses the data in hand and sample under study.

Section 4 proves the existence of heterogeneity and chalks out the G.A.P Framework, that elaborates the alternative metric proposed in this paper, to assess institutional efficiency, ranking the sample colleges in the process.

Section 5 confirms the presence of gender difference in GPA earned by means of hypothesis testing.

Section 6 concludes the study by enumerating its findings and discussing the caveats of the analysis.

## 2. Literature Review

The labor-intensive character of education, coupled with the fact that its outcome, learning, is jointly produced, requiring the cooperation of students and teachers (who vary in ability and motivation), makes productivity gains in education much more difficult to achieve than in many other sectors of the economy (Boyd and Hartman, 1988). Despite the concerns raised by the above citation, education and efficiency are not antithetical, because if we want to use educational resources as wisely and effectively as possible, to benefit as many students as possible, we must evaluate the relative success of alternative policies and practices (William Lowe Boyd, 2004). Educational history shows that instructional improvements need not be at odds with efforts at administrative efficiency (Gamson, 2003). School leaders are responsible for both educational leadership and stewardship of their organization's resources. In more recent decades, bureaucratic and political practices in school districts, particularly in our large cities, have maintained egregious inequalities, as well as inefficiencies,

that have been widely recognized and condemned, but seldom corrected (Ga'ndara et al., 2003; Hill and Guin, 2003).

Whether educators like it or not, pressures for greater efficiency, effectiveness, and accountability in education are inescapable and will not disappear (DeYoung, 1989; Hannaway, 2003). Further emphasized by pressures for higher student achievement, springing from the demands of the new economy for a smarter workforce, remaining competitive in the information age; and from growing pressures to close the yawning racial gap in educational achievement.

Coming to the point of gender imbalance in educational attainment, the last few decades have displayed a shift in attention: where in the mid-1970s it was girls' underperformance that was identified as vexed, in the 1990s boys' underachievement became the focus (Epstein et al., 1998; Frosh et al., 2002). It has been demonstrated repeatedly that in general girls outperform boys (e.g. Jackson, 1998).

While studying a large public university in Turkey, Meltem Dayioglu & Serap Türüt-Asik, 2004 identified a host of factors which affect student achievement, controlling all other possible predictors of CGPA, which are but not restricted to: (1) student age, (2) type of high school attended, (3) determinants of high school GPA, including (a) SAT, (b) High school GPA, (c) Class rank. After controlling for factors determining CGPA, a series of OLS estimations disaggregated by year (freshman, sophomore, junior, and senior) presented that female students, on average, outperform their male counterparts.

Similar findings have led some to conclude that females have higher non-cognitive skills, such as organization, dependability, and self-discipline (which are captured in grades once performance on academic exams is held constant) that increase their access to college (Jacob, 2002). Females are also said to be advantaged in nonacademic areas, such as parental, peer, and teacher expectations (Reynolds and Burge, 2004)

### 3. Data

#### 3.1 Context

The dataset under consideration contains the academic details of 2445 students enrolled under BA Economics (H) (Undergraduate degree) offered by 35 colleges in Delhi University, over 4 semesters.

Source:

[http://duexam2.du.ac.in/RSLT\\_ND2017/Students/Combine\\_GradeCard.aspx](http://duexam2.du.ac.in/RSLT_ND2017/Students/Combine_GradeCard.aspx)

The group under study is the batch of 2015, expected to graduate in 2018. The dataset was collated just after the declaration of the semester 4 result (July 2017), and represents the academic profile of the candidates as of that period. Therefore, it fails to capture the incidence of back logs and their subsequent clearance (or failure to do so) by students possessing them, within that time span. Furthermore, data points possessing 0 SGPA in any of the semesters were deemed to be anomalies and ignored. (26 cases, assumed to be sick, final total 2419).

#### 3.2 Structure

Name	College	SGPA1	SGPA2	SGPA3	SGPA4	CGPA1	CGPA2	CGPA
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The dataset contains the semester grade point (SGPA) earned by an individual over 4 semesters named as SGPA1, SGPA2, SGPA3, SGPA4. It also contains the cumulative grade point (CGPA) achieved by the student over 1st and 2nd years respectively, named as CGPA1 and CGPA2. The last column is the final cumulative grade point achieved by them as of the completion of 4 rounds of examinations, namely CGPA.

### 4. G.A.P Framework

#### 4.1 Goal

The framework captures the following elements:

- Class stratification and heterogeneity in terms of individual effort and achievement

- Intergroup transfer of pupils, suggesting improvement/decline in individual effort.

#### 4.2 Structure

Students are divided into 3 groups, based on their CGPA each year, as per the following rule\* (assumed, no standard followed):

- $X \geq 8$  are grouped under "Good"
- $5 < X < 8$  are grouped under "Average"
- $X \leq 5$  are grouped under "Poor"

Such classification is done for each year (1 & 2) using CGPA1 and CGPA2 respectively.

1 <sup>st</sup> Year	2 <sup>nd</sup> Year			
		Good (2)	Average (2)	Poor (2)
	Good (1)	$a_{G1-G2}$	$a_{G1-A2}$	$a_{G1-P2}$
	Average (1)	$a_{A1-G2}$	$a_{A1-A2}$	$a_{A1-P2}$
	Poor (1)	$a_{P1-G2}$	$a_{P1-A2}$	$a_{P1-P2}$

Consider a 3x3 matrix  $[a_{ij}]$ , having elements  $a_{ij}$ , where  $i$  and  $j$  represent the classification of students made in 1st and 2nd year respectively. Furthermore, each cell contains the proportion of the total class strength, belonging to a grouping pair (G1-G2, A1-G2 etcetera), over the two years. That is,

Sum of all elements of the matrix  $[a_{ij}] = 100\%$  of the class strength

Hence, if a student, over the course of 2 years, remained in the same group, that individual is represented by the diagonal elements:

- $a_{G1-G2}$  - (% of consistently Good students)
- $a_{A1-A2}$  - (% of consistently Average students)
- $a_{P1-P2}$  - (% of consistently Poor students)

All other elements, show either an improvement or decline in student effort over the 2 years, for example:

- a<sub>A1-G2</sub> -Average to Good (Rise in effort)
- a<sub>A1-P2</sub> - Average to Poor (Decline in effort)

#### 4.3 Rewards Penalties and G.A.P. Score

1 <sup>st</sup> Year	2 <sup>nd</sup> Year			
		Good (2)	Average (2)	Poor (2)
	Good (1)	+2	-3	-5
	Average (1)	+3	0	-4
	Poor (1)	+5	+4	-1

I introduce weight  $w$  for each cell, based on how favorable (detrimental) the change (or lack thereof) was, where the absolute values denote the relative importance and the sign denote the favorability of the change.

$$w_1 + w_2 + \dots + w_9 = 1 \text{ (Sum of weights equal 1)}$$

The G.A.P. Table is generated for all 35 colleges. The weight assigned to each cell is multiplied with its respective entry and summed across to obtain an index score for the colleges. This score is used to assign ranks to colleges. See Table 4A in the Annexure.

#### 4.4 Results

The top 5 positions are bagged by all girl's colleges (Daulat Ram College, Lady Sri Ram College, Kamla Nehru College, Miranda House and Maitreyi College). The top Co-educational college is ascertained to be Hindu College followed by Sri Venkateswara College.

#### 4.5 Correlation with existing measures

The National Assessment and Accreditation Council (NAAC) is an organization that assesses and accredits higher education Institutions (HEIs) in India. It is an autonomous body funded by University Grants Commission of Government of India headquartered in Bangalore.

The NAACs grades institutes on an eight-grade ladder:

Range of Institutional Cumulative Grade Point Average (CGPA)	Letter Grade	Status
3.51-4.00	A++	Accredited
3.26-3.50	A+	Accredited
3.01-3.25	A	Accredited
2.76-3.00	B++	Accredited
2.51-2.75	B+	Accredited
2.01-2.50	B	Accredited
1.51-2.00	C	Accredited
≤ 1.50	D	Not Accredited

Source: [http://www.naac.gov.in/docs/Grading\\_System.pdf](http://www.naac.gov.in/docs/Grading_System.pdf)

Alongside our own ranking, we gather the available NAAC scores awarded to the colleges in the data set in the most recent cycle of accreditation. The author could not find the NAAC grade for 7 colleges, hence a new sample of 28 colleges were scored and ranked based on both G.A.P and NAAC. See Table 4B in the Annexure. We find a spearman rank correlation coefficient of 69%.

### 5. Gender Gap: A Hypothesis Test

#### 5.1 Methodology

The objective of this section is to confirm the existence of a gender gap in grades earned amongst the population and within colleges. The sample of 35 colleges used in this comprise of 11 all girl's colleges, leaving 24 co-educational colleges. Conventional parametric test such as the t test is used for the hypothesis, which also puts the burden of reconciling the assumptions made with the actual parameters of the dataset at hand. The test demands the division of the sample of students into Males and Females for each college. Even though, the Male and Female Grade Distribution of the entire dataset is approximately normal (See Fig 5A in Annexure), it is not true when the samples are taken college wise. For the central limit theorem to hold, existing literature suggests the sample size  $N_{\text{male}}, N_{\text{female}} > 25$  to 30. Hence, for answering this research question, the sample under consideration is reduced from 24 to 12 colleges. Variances are observed to be different, hence necessitating the use of Welch's t test.

#### 5.2 Research Hypothesis

One null hypothesis is tested in this study:

H0: There is no significant gender difference in student's academic performance in the sampled Colleges

H1: Female students score significantly higher than their male peers in the sampled Colleges

$$H0: \mu_{\text{Female}} = \mu_{\text{Male}}$$

$$H1: \mu_{\text{Female}} > \mu_{\text{Male}}$$

(Right tailed test)

Firstly, the test is applied to the whole sample.

Gender	Mean	SD	N	t	df	p
Female	6.56	1.31	1498	7.82	2417	.00
Male	6.09	1.48	921			

$p < 0.05$  (significance level)

Clearly, Females are outperforming boys.

Then, the test is applied to all the 12 colleges. The results showed an even split of 6 colleges where the null hypothesis was rejected and failed to be rejected respectively. It is to be noted that female CGPA earned was greater than male CGPA for all colleges, except for one (Hindu College). See Table 5B in the Annexure.

## 6. Conclusions

This paper recognized that the GPA earned by students can be extremely helpful in making inferences about the sample under study. However, this paper goes a step ahead from the existing literature, by tracing the changes in GPA earned over years, treated as a proxy for student motivation level and aptitude. The emphasis lies on the majority, the common denominator comprising of the average. With its help, this paper established that the 35 colleges are not perfect substitutes, and identifies the institutions demonstrating serious decline in academic standard over the 4 semesters.

Measuring the quality of academics of a college by the aggregate of the final GPA earned by its students portrays a very myopic view.

Through the means of hypothesis testing, gender disparity is also brought to light. The study hints that regardless of the entry requirement, females tend to be more successful in scholastic ventures than their male peers. The results provide some support for the existing literature.

The lack of control variables, which would possibly explain more of the GPA, are not presented in this study. It can only recognize the presence of an inefficiency but not identify its cause. Because of which, this paper didn't employ a regression analysis, but an inferential one. Some of the questions that remain unanswered are.

1. Why certain colleges perform poorly on the index?
  - The comparatively lower entry requirement (cut-off) may lead to intake of students not as motivated and thereby unable to cope with the rigor of the course.
  - The college in question falls behind on areas such as infrastructure, permanent experienced professors, student-teacher ratio etc.
2. What differentiates colleges with gender inequality from colleges, having no such disparity, in Delhi University?

At last, it cannot be denied that educators should together demand fairer and more appropriate testing and accountability policies.

## Annexure

Table 4A

College	CGPA1	CGPA2	CGPA	G1_G2	G1_A2	G1_P2	A1_G2	A1_A2	A1_P2	P1_G2	P1_A2	P1_P2	GAP_SCORE	Rank
(014) Daulat Ram College	6.72	6.6	6.65	11.76	1.18	0	18.82	51.76	4.71	0	0	11.76	45.84	1
(039) Lady Sri Ram College For Women	7.08	7.04	7.06	21.21	3.03	0	16.16	44.44	7.07	0	0	8.08	45.45	2
(034) Kamla Nehru College	7.15	7.28	7.22	11.11	0	0	15.56	66.67	6.67	0	0	0	42.22	3
(047) Miranda House	6.98	6.7	6.82	14.52	0	0	9.68	64.52	8.06	0	0	3.23	22.61	4
(043) Maitreyi College	7.01	6.83	6.91	8.33	2.08	0	10.42	72.92	6.25	0	0	0	16.68	5
(026) Hindu College	7.25	6.95	7.08	17.39	2.9	0	8.7	57.97	10.14	0	0	2.9	8.72	6
(079) Sri Venkateswara College	6.86	6.66	6.75	2.63	0	0	9.21	78.95	5.26	0	0	3.95	7.9	7
(032) Jesus & Mary College	6.69	6.8	6.75	1.92	0	0	5.77	88.46	3.85	0	0	0	5.75	8
(075) Shyama Prasad Mukherjee College	6.88	6.71	6.79	0	0	0	15.79	73.68	10.53	0	0	0	5.25	9
(072) Sri Ram College Of Commerce	7.36	6.97	7.14	24.29	8.57	0	7.86	45	9.29	0	0	5	4.29	10
(078) Sri Guru Gobind Singh College Of Commerce	6.74	6.55	6.63	7.29	1.04	0	11.46	67.71	10.42	0	0	2.08	2.08	11
(064) Shaheed Bhagat Singh College (Day)	6.55	6.48	6.51	4.17	0	0	2.08	81.25	4.17	0	2.08	6.25	-0.03	12
(080) St. Stephens College	7.3	6.77	7	31.37	3.92	0	0	47.06	15.69	0	1.96	0	-3.94	13
(025) Hans Raj College	6.82	6.51	6.65	11.59	2.9	0	7.97	60.87	12.32	0	0.72	3.62	-11.63	14
(056) Ramjas College	6.57	6.43	6.49	5.08	0	0	8.47	67.8	10.17	0	0	8.47	-13.58	15
(036) Kirori Mal College	6.8	6.58	6.67	4.3	3.23	0	8.6	69.89	11.83	0	1.08	1.08	-19.37	16
(068) S.G.T.B. Khalsa College	6.42	6.04	6.21	3.28	3.28	0	3.28	70.49	8.2	0	3.28	8.2	-21.32	17
(029) I.P. College For Women	6.88	6.51	6.67	4.76	3.17	0	9.52	66.67	14.29	0	0	1.59	-30.18	18
(016) Delhi College Of Arts & Commerce	6.67	6.21	6.41	3.13	0	0	6.25	71.88	12.5	0	0	6.25	-31.24	19
(055) Rajdhani College	6.39	6.03	6.19	2.27	0	0	6.82	68.18	11.36	0	0	11.36	-31.8	20
(048) Moti Lal Nehru College (Day)	6.16	5.76	5.94	2.38	0	0	1.19	77.38	7.14	0	0	11.9	-32.13	21
(019) Deshbandhu College (Day)	6.27	5.88	6.05	0	0	0	2.94	75	12.5	0	2.21	7.35	-39.69	22
(013) College Of Vocational Studies	6.4	6.01	6.18	0	0	0	10.71	66.07	19.64	0	1.79	1.79	-41.06	23
(031) Janki Devi Memorial College	6.06	5.62	5.81	0	4	0	18	42	18	0	0	18	-48	24
(003) Atma Ram Sanatan Dharam College	6.19	5.72	5.93	2.67	0	0	5.33	62.67	16	0	0	13.33	-56	25
(063) Satyawati College (Eve)	6.16	5.84	5.98	0	0	0	0	80.95	12.7	0	0	6.35	-57.15	26
(021) Dyal Singh College (Day)	6.27	5.88	6.05	0.53	0.53	0	4.23	73.54	16.4	0	0	4.76	-58.2	27
(071) Shivaji College	6.45	5.8	6.09	10	0	0	0	60	17.5	0	0	12.5	-62.5	28
(074) Shyam Lal College (Eve)	5.8	5.34	5.54	0	0	0	0	67.44	11.63	0	0	20.93	-67.45	29
(062) Satyawati College (Day)	6.14	5.46	5.75	4.69	0	0	3.13	57.81	20.31	0	1.56	12.5	-68.73	30
(073) Shyam Lal College (Day)	6.32	5.56	5.9	1.85	0	0	1.85	68.52	22.22	0	0	5.56	-85.19	31
(033) Kalindi College	5.9	5.08	5.44	2.99	1.49	0	2.99	43.28	25.37	0	1.49	22.39	-107.43	32
(059) Aryabhata College [Formerly Ram Lal Anand	5.79	5.42	5.58	0	0	0	0	54.05	27.03	0	2.7	16.22	-113.54	33
(053) P.G.D.A.V. College (Day)	6.3	5.19	5.68	0	0	0	0	60	26.67	0	0	13.33	-120.01	34
(040) Lakshmibai College	6.1	5.19	5.59	5.88	0	0	1.96	45.1	31.37	0	0	15.69	-123.53	35

Fig 5A

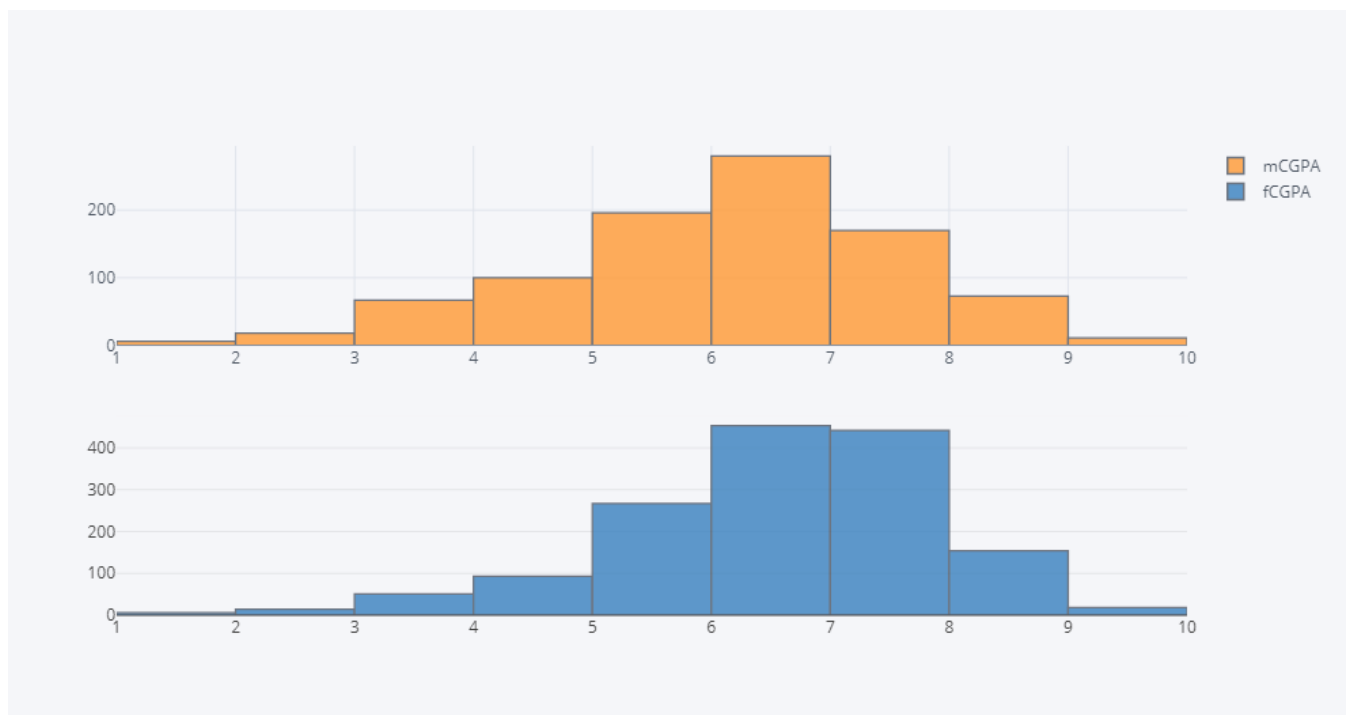


Table 4B



College	GAP_SCORE	NAAC Score	GAP Rank	NAAC Rank
(014) Daulat Ram College	45.84	3.36	1	8
(039) Lady Sri Ram College For Women	45.45	3.61	2	3
(034) Kamla Nehru College	42.22	3.33	3	9
(047) Miranda House	22.61	3.61	4	4
(043) Maitreyi College	16.68	3.11	5	15
(026) Hindu College	8.72	3.6	6	5
(079) Sri Venkateswara College	7.9	3.16	7	14
(032) Jesus & Mary College	5.75	3.26	8	11
(072) Sri Ram College Of Commerce	4.29	3.65	9	1
(078) Sri Guru Gobind Singh College Of Commerce	2.08	3.02	10	21
(064) Shaheed Bhagat Singh College (Day)	-0.03	3.26	11	12
(080) St. Stephens College	-3.94	3.21	12	13
(025) Hans Raj College	-11.63	3.62	13	2
(036) Kirori Mal College	-19.37	3.54	14	6
(068) S.G.T.B. Khalsa College	-21.32	3.41	15	7
(029) I.P.College For Women	-30.18	3.33	16	10
(016) Delhi College Of Arts & Commerce	-31.24	2.52	17	28
(048) Moti Lal Nehru College (Day)	-32.13	2.6	18	27
(019) Deshbandhu College (Day)	-39.69	2.8	19	22
(013) College Of Vocational Studies	-41.06	3.05	20	19
(031) Janki Devi Memorial College	-48	2.76	21	23
(003) Atma Ram Sanatan Dharam College	-56	3.11	22	16
(071) Shivaji College	-62.5	3.06	23	18
(074) Shyam Lal College (Eve)	-67.45	2.65	24	25
(062) Satyawati College (Day)	-68.73	3.07	25	17
(073) Shyam Lal College (Day)	-85.19	2.62	26	26
(033) Kalindi College	-107.43	3.03	27	20
(053) P.G.D.A.V. College (Day)	-120.01	2.74	28	24

Table 5B

College	male-n	female-n	df	t-score	p-value	t-crit	Outcome
(026) Hindu College	38	31	67	-0.16	0.87	1.67	Fail to Reject H0
(078) Sri Guru Gobind Singh College Of Commerce	44	52	94	0.53	0.60	1.66	Fail to Reject H0
(072) Sri Ram College Of Commerce	59	81	138	1.00	0.32	1.66	Fail to Reject H0
(013) College Of Vocational Studies	29	27	54	1.15	0.26	1.67	Fail to Reject H0
(036) Kirori Mal College	61	32	91	1.31	0.19	1.66	Fail to Reject H0
(063) Satyawati College (Eve)	27	36	61	1.58	0.12	1.67	Fail to Reject H0
(079) Sri Venkateswara College	43	33	74	2.01	0.05	1.67	Reject H0
(025) Hans Raj College	71	67	136	2.08	0.04	1.66	Reject H0
(019) Deshbandhu College (Day)	106	30	134	2.36	0.02	1.66	Reject H0
(021) Dyal Singh College (Day)	49	140	187	4.12	0.00	1.65	Reject H0
(003) Atma Ram Sanatan Dharam College	28	47	73	4.94	0.00	1.67	Reject H0
(048) Moti Lal Nehru College (Day)	49	35	82	5.10	0.00	1.66	Reject H0

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