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Determinants of Cumulative Grade Point Average of Private University Students in Bangladesh: Approaching of Multiple Classification Analysis

Md. Shahiduzzaman[1], M. K. Ali[2], Md. N. Islam[3], Md.I. Uddin[4] and Md. R. Islam[5*]

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[1]Assistant Professor, Department of Electrical and Electronic Engineering, Northern University Bangladesh, Dhaka-1230, Bangladesh, Email: shahidnub@yahoo.com

[2]Professor (Retired), Department of Population Science and Human Resource Development, University of Rajshahi, Rajshahi-6205, Bangladesh, Email: mkaseu@yahoo.com

[3]Professor, Department of Statistics, University of Rajshahi, Rajshahi-6205, Bangladesh, E- mail: mnurul58@yahoo.com

[4]Associate Professor, Department of Textile Engineering, Northern University Bangladesh, Dhaka-1230, Bangladesh, E- mail: islam_uddin7@yahoo.com

[5]Professor, Department of Population Science and Human Resource Development, University of Rajshahi, Rajshahi-6205, Bangladesh, Email: rafique_pops@yahoo.com

[*]Corresponding Author:
Dr. Md. Rafiqul Islam
Professor, Department of Population Science and Human Resource Development, University of Rajshahi, Rajshahi-6205, Bangladesh, Email: rafique_pops@yahoo.com

ABSTRACT

Cumulative Grade Point Average (CGPA) of undergraduate students is very much important for their future career. So, it is essential to identify the determinants of CGPA of private university students in Bangladesh for building up their better career as well as greater interest of the country. In this study, data were collected from different private universities in Bangladesh. Multiple Classification Analysis (MCA) was used to find out the effect of determinants of CGPA of the students. It was found that the grand mean of the respondents' CGPA was 3.2196. It was also found that respondents' results of SSC, faculty, results of HSC, monthly expenditure, place of birth, semester dropped, family type, gender, fathers' education and mothers' education were first, second, third, fourth, fifth, sixth, seventh, eighth, ninth and tenth influencing factors on CGPA of the students of private universities respectively. These factors were not influencing alone but with joint impact of other variables on CGPA. The results revealed that the students with GPA 3.5+ in SSC had greater mean value (3.2559) than who had GPA <3.5 in SSC (2.8896).The results also showed that the respondents with GPA 3.5+ in HSC had greater mean value (3.2507) than who had GPA <3.5 in HSC (3.0261). Furthermore, the female respondents had higher mean value (3.2926) than the male respondents (3.1794). Based on the above results, it is suggested to the guardians and teachers of SSC and HSC level to take more attention about their children and students respectively to develop their future academic career. Authority of universities as well as guardians of the students should take special care to the academic performance of male students.

Keywords: *Cumulative Grade Point Average, MCA, Determinants, Private University, Bangladesh*

INTRODUCTION

Education is a basic need of every people in the world and sustainable development of any country is not possible without proper education. According to Wikipedia (2023),Bangladesh is the eighth-most populated country in the world and its total population is nearly 2.2% of the world's population. As per the Population and Housing Census 2022 Preliminary Report, the total enumerated population of Bangladesh is 165,158,616 (BBS 2022). A number of people are deprived of education especially higher education in Bangladesh. Although number of universities in Bangladesh are increasing in recent years. There are 50 public and 107 private universities are

running in Bangladesh (UGC 2020). Presently a large number of students are studying in different private universities in Bangladesh. So, the private universities are performing a vital role for higher education in Bangladesh. Cumulative grade point average (CGPA) is one of the measurement tools of justifying the academic performance of students. Consequently, an attempt may be made to identify as well as their effect on CGPA among the students of private university in Bangladesh. Ahmed and Salim (2018) observed that academic performance of female students was 1.49 times better than their male counterparts. The performance of irregular students was found to be less likely (Odds ratio = 0.60) than the regular ones. Zeheen and Hossain (2016) found that fathers' education level influenced the academic performance of a student. Past academic performance of the students also plays a vital role in university performance. The performance of the students of business was better than that of other schools. Biswas et al. (2016) identified in their study that the results of SSC and HSC of the students, academic qualification of parents, higher family income, resident in hall, class attendance of students, study time not including class period had a positive impact and internet use of students for non-academic purpose, political status, mobile phone using of students for non-academic purpose in the university had a negative impact on academic performance of students. Easmin et al. (2015) found that education of mothers had significance effect on the academic results of the students. Alam et al. (2014) observed that average CGPA of IIUC (International Islamic University Chittagong) students was 3.25 (out of 4.00). The study also observed that age, gender, past academic results, medium of education and absence in the classes affected the academic performance of the students. Daniyal et al. (2011) observed from their study that income of family, education of fathers, education of mothers, family size, parents' motivation, involvement in co-curricular activities, teachers' regularity and interest in the subject developed by a concerned teacher were positively associated with the academic results of the students. Mutairi (2011) found that the academic performance of female students was better than male students. Ali et al. (2009) revealed in their study, the students whose parents were highly educated had high income had better CGPA. Harb and El-shaarawi (2007) found from their study that female students outperformed than the male students. The above studies encouraged us to investigate the CGPA of the students of private universities in Bangladesh and to identify the determinants as well as their effect of obtaining CGPA of private university students using multiple classification analysis.

SOURCES OF DATA

To conduct this study, primary data were used which were collected from the undergraduate students of Northern University Bangladesh, Manarat International University and Southeast University using convenient sampling technique through interviewing with the help of well-structured questionnaire. As study sample, socio-economic, demographic and educational information were collected from 535 students from the above mentioned three private universities of Bangladesh.

METHODS AND METHODOLOGICAL ISSUES

Multiple Classification Analysis (MCA)

The MCA was propounded by Yates in1934 and further modified by Anderson and Bancraft in 1952. After developing a computerized MCA program at the Survey Research Center of the University of Michigan in1963, the program has been thoroughly applied in various research fields. One response variable and two or more explanatory variables are required to perform the MCA. The criteria of MCA demands that the dependent variable have to be continuous but all the independent variables must be categorical in nature. Mathematically, the model can be expressed as:

$$y_{ijk} = \bar{y} + a_i + b_j + c_k + \ldots\ldots\ldots\ldots + e_{ijk}$$

Where,

y_{ijk} is the value of an individual in the i^{th} category of the factor A, j^{th} category of the factor B and k^{th} category of the factor C.

$\bar{y}$ is the grand mean of Y.

a_i is the effect of the factor A due to the i^{th} category, which is equal to the difference between $\bar{y}$and the mean of its category of factor A.

b_j is the effect of the factor B due to j^{th} category, which is equal to the difference between $\bar{y}$ and the mean of its category of factor B.

c_k is the effect due to the k^{th} category of the factor C, which is equal to the difference between $\bar{y}$ and the mean of its category of factor C.

e_{ijk} is the error term related with y_{ijk} score of the individuals.

By solving the normal equation systems, the adjusted or net effect of the predictors can be obtained. The adjusted and unadjusted effects of the predictors will be same if there is no interrelation among

the predictors exists. The unadjusted eta-square coefficient is a correlation ratio is usually estimated by solving the normal equations with only one predictor and explains how good is the predictor variable. Similarly, the beta-square coefficient shows the ratio of variation explained by the other predictor variables. The beta coefficient is compared to the partial correlation coefficient in multiple regression analyses. In this study, students' CGPA was considered as response variable which is continuous in nature. On the other hand, respondents' gender, place of birth, family type, father education, mother education, results of SSC, results of HSC, faculty, students' monthly expenditure and semester dropped were regarded as explanatory variables. The multiple classification analysis (MCA) was applied to assess the net effect of explanatory variables on the response variable. It was noted that data were analyzed using SPSS (SPSS Inc., Chicago, IL) in window's version.

Model Validation Technique

To identify how much the model is stable over the population, the Cross Validity Prediction Power (CVPP), ρ_{cv}^2, is applied in this study. The mathematical formula for CVPP is

$$\rho_{cv}^2 = 1 - \frac{(n-1)(n-2)(n+1)}{n(n-k-1)(n-k-2)}(1-R^2)$$; where, n is the number of cases, k is the number of predictors in the model and the cross validated R is the correlation between observed and predicted values of the dependent variable (Stevens, 1996). The shrinkage coefficient of the model is the absolute value of (ρ_{cv}^2 -R^2); where ρ_{cv}^2 is CVPP and R^2 is the coefficient of determination of the model. The information on model fittings and estimated CVPP has been demonstrated at the bottom of the MCA table. Some authors applied this technique as model validation technique (Islam, 2007; 2008; 2011; 2012a; 2012b; 2013; Islam & Hossain, 2013a; 2013b; 2014a; 2014b; Hossain & Islam, 2013; Islam et al., 2013; 2014; Islam and Hoque, 2015; Shahiduzzaman et al., 2017; Islam & Shitan, 2022; Shahiduzzaman et al., 2023).

RESULTS

Intensity of the impact of various implicit factors on the CGPA of the students was evaluated by MCA and the results were illustrated in Table 1.From the model validation technique, it is found that the shrinkage coefficient of the model is very small (0.0325) which shows the better fit of the model. According to the results, respondents' gender, place of birth, family type, fathers'

education, mothers' education, results of SSC, results of HSC, faculty, monthly expenditure and semester dropped were the most potential determinants for interpreting the variations of the CGPA of the students. It was found that the grand mean of the respondents' CGPA was 3.2196. Respondents' results of SSC was observed as the most crucial influencing factor (β^2=0.238) for the variation in students' CGPA and the respondents with results (GPA) 3.5+ in SSC had greater mean value (3.2559) than who had results (GPA) <3.5 in SSC (2.8896). Respondents' faculty was found as the second most significant factor (β^2=0.223) and the highest adjusted mean (3.2991) was identified for the respondents who were in faculty of business and the lowest (2.9859) was found who were in faculty of arts. Respondents' results of HSC were observed as the third vital determinants (β^2=0.168) and the respondents with results (GPA) 3.5+ in SSC had greater mean value (3.2507) than who had results (GPA) <3.5 in HSC (3.0261). Respondents' monthly expenditure was the 4th most responsible factor that influenced their CGPA (β^2=0.131) and it was found that the respondents whose monthly expenditure was <BDT 20,000 had higher mean value (3.2741) than whose monthly expenditure was BDT 20,000+ (3.1532). Respondents' place of birth was the 5th most responsible factor that influences their CGPA (β^2=0.128) and it was observed that the respondents whose place of birth was rural had greater mean value (3.2761) than whose place of birth was urban (3.1581). Semester dropped of the respondents was 6th important indicator of students' CGPA (β^2=0.116) and the respondents who had never dropped a single semester had higher mean value (3.2377) than who dropped a semester at least once (3.0619). Respondents' family type was the 7th responsible factor that influences their CGPA (β^2=0.036) and it was found that respondents from joint family had a higher mean value (3.2897) than respondents from nuclear family (3.2011). Respondents' gender was the 8thsignificant factor that influences their CGPA (β^2=0.084) and it was revealed that the female respondents had higher mean value (3.2926) than the male respondents (3.1794). Respondents' fathers' education was found as the 9th significant factor (β^2=0.058) and respondents' fathers who were educated up to university level had the highest adjusted mean value (3.2453) and who were primary level educated had the lowest adjusted mean (3.1673). Respondents' mothers' education was also found be the important indicator of students' academic performance (β^2=0.056) and respondents' mother who were educated up to university level had the highest adjusted mean value (3.2553) and who were secondary level educated had the lowest adjusted mean (3.1943).

Table 1. Mean and intensity of CGPA by some selected demographic, socio-economic andacademic variables by using MCA

Explanatory variables	**Predicted mean**		**Correlation ratio**	
	Unadjusted	Adjusted	η^2 (Unadjusted)	β^2 (Adjusted)
Gender			0.118	0.084
Male	3.1794	3.1908		
Female	3.2926	3.2719		
Place of birth			0.070	0.128
Rural	3.2503	3.2761		
Urban	3.1862	3.1581		
Family type			0.065	0.094
Joint	3.2680	3.2897		
Nuclear	3.2011	3.1928		
Fathers' education			0.058	0.058
Primary	3.1641	3.1673		
Secondary	3.2084	3.2213		
Higher secondary	3.2090	3.1974		
University	3.2460	3.2453		
Mothers' education			0.025	0.056
Primary	3.2075	3.2048		
Secondary	3.2127	3.1943		
Higher secondary	3.2369	3.2460		
University	3.2197	3.2553		
Results of SSC			0.237	0.238
<3.5	2.8902	2.8896		
3.5+	3.2558	3.2559		
Results of HSC			0.223	0.168
<3.5	2.9635	3.0261		
3.5+	3.2607	3.2507		
Faculty			0.187	0.223
Business	3.3019	3.2991		
Science	3.1143	3.1343		
Law	3.2207	3.2634		
Arts	3.1002	2.9859		
Students' monthly expenditure			0.151	0.131
< 20000	3.2827	3.2741		
20000+	3.1427	3.1532		
Semester dropped			0.132	0.116
Yes	3.0396	3.0619		
No	3.2402	3.2377		
Grand Mean = 3.2196, Multiple R^2=0.197, Shrinkage coefficient=0.0325.				

Intensity of the Effects of the Variables on Cumulative Grade Point Average

Socio-economic and demographic variables that are considered in the analysis have differential effects on students' CGPA and producing different levels by various socio-economic and demographic subgroups. The intensity of the influences of the variables considered is yet to be analyzed. In this study an attempt has been made to observe the extent of influences of the variables on students' CGPA on the basis of the results produced by MCA. Here, the students' CGPA are taken as the dependent variable. The results of multiple classification analysis are given in the Table 1. It presents students' CGPA together with the values of η^2 and β^2 produced from multiple classification analysis with collected data. Table 2 produce the results of zero order correlation coefficients of students' CGPA with various socio-economic and demographic variables.

These variables will have to affect students' CGPA through one or more proximate determinants. Therefore, the mechanisms of the relationship are investigated using the technique of MCA. Using the value of β^2 in Table 1 with the values of Table 2 the indirect effects of the variables are to be estimated. The causal model for the major sources of the variation in students' CGPA is presented in figure 1.

Table 1shows that respondents' results of SSC has a highest significant contribution on students' CGPA producing a positive association with students' CGPA. The correlation coefficient is found to be r=0.237. Among the included variables respondents' results of SSC has the strongest influence on students' CGPA. The proportion of variance explained (unadjusted) by the respondents' CGPA is $\eta^2 = 0.237$ and the proportion of variance explained (adjusted) by this variable is $\beta^2 = 0.238$. Respondents' results of SSC has the direct effect on students' CGPA and also has the indirect effect through respondents' results of HSC, students' monthly expenditure and semester dropped. The indirect effect of respondents' results of SSC on students' CGPA through results of HSC is 0.035, through students' monthly expenditure is 0.001, through faculty is 0.004 and semester dropped is 0.001.

Faculty of the respondents has also a significant contribution on students' CGPA and found to be negative association (r=-0.133). The strength of the explaining variability (unadjusted) is η^2 =0.187 and the explaining variability (adjusted) β^2 =0.223.

Respondents' results of HSC have an impact on students' CGPA producing a positive association(r=0.223) with students' CGPA. The proportion of variance explained (unadjusted) by respondents' results of HSC is η^2=0.223 and the proportion of variance explained (adjusted) by this variable is β^2=0.168. The indirect effect of respondents' results of HSC on students' CGPA through students' monthly expenditure is 0.007, through faculty is 0.007 and semester dropped is 0.003.

Respondents' monthly expenditure has an impact on students' CGPA producing a negative association (r =-0.151) with students' CGPA. The proportion of variance explained (unadjusted) by respondents' monthly expenditure is η^2=0.151 and the proportion of variance explained (adjusted) by this variable is β^2=0.131. The indirect effect of respondents' monthly expenditure on students' CGPA through semester dropped is 0.003.

Table 2. Zero order correlation coefficient among selected socio-economic and demographic variables

Variable	Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
Y	1.00	0.118**	-0.070	-0.065	0.055	0.017	0.237**	0.223**	-0.133**	-0.151**	0.132**
X_1		1.000	0.196**	0.075	0.204**	0.143**	-0.028	0.094*	0.035	-0.083	0.058
X_2			1.000	0.040	0.242**	0.300**	0.042	0.004	-0.135**	0.156**	-0.008
X_3				1.000	0.103*	0.095*	0.089*	-0.006	-0.005	0.048	-0.003
X_4					1.000	0.667**	0.091*	0.010	0.081	0.038	0.019
X_5						1.000	0.046	-0.047	0.020	0.117**	-0.009
X_6							1.000	0.211**	-0.019	0.011	0.011
X_7								1.000	0.032	-0.051	-0.029
X_8									1.000	-0.030	-0.026
X_9										1.000	-0.028
X_{10}											1.000

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Y=Students' CGPA, X_1=Gender, X_2=Place of birth, X_3=Family type, X_4=Fathers' Education, X_5=Mothers' Education, X_6=Results of SSC, X_7=Results of HSC, X_8=Faculty, X_9=Students' Monthly Expenditure and X_{10}= Semester Dropped

Respondents' place of birth has an impact on students' CGPA producing a positive association (r =0.017) with students' CGPA. The proportion of variance explained (unadjusted) by respondents' place of birth is η^2 =0.070 and the proportion of variance explained (adjusted) by this variable is β^2 =0.128. The indirect effect o respondents' place of birth on students' CGPA through results of SSC is 0.010, through results of HSC0.0007, through faculty is0.030, through respondents' monthly expenditure is 0.020 and through semester dropped is 0.0009.

Semester dropped has an impact on students' CGPA producing a positive association (r =0.132) with students' CGPA. The proportion of variance explained (unadjusted) by semester dropped is η^2 =0.132 and the proportion of variance explained (adjusted) by this variable is β^2 =0.116.

Family type of the respondents has also a significant contribution on students' CGPA. Family type of the respondents has the negative association (r= -0.065) with students' CGPA. The proportion of variance explained (unadjusted) by family type of the respondents is η^2 =0.065 and the proportion of variance explained (adjusted) is β^2 =0.094. This is the important determinants of students' CGPA. Family type affects students' CGPA through results of SSC is0.021, through results of HSC is0.001, through faculty is0.001 and through semester dropped is 0.0003.

Gender of the respondents has also a significant contribution on students' CGPA. Gender of the respondents shows a positive association(r= 0.118) with students' CGPA. The proportion of variance explained (unadjusted) by gender of the respondents is η^2 =0.118 and also the explaining variability (adjusted) is β^2 =0.084. The indirect effect of gender of the respondents on students' CGPA through results of SSC is0.007, through results of HSC is0.016, through faculty is0.008, through students' monthly expenditure is 0.010 and through semester dropped is0.007.

Fathers' education of the respondents has also a significant contribution on students' CGPA and shows a positive association (r=-0.055) with students' CGPA. The strength of explaining variability (unadjusted) is η^2 = 0.058 and the strength of explaining variability (adjusted) is β^2 = 0.058. The indirect effect of fathers' education of the respondents on students' CGPA through mothers' education is 0.005, through results of SSC is 0.022, through results of HSC is 0.002, through faculty is 0.018, through students' monthly expenditure is 0.005 and through semester dropped is 0.002.

Mothers' education of the respondents has also a significant contribution on students' CGPA and shows a positive association (r=-0.017) with students' CGPA. The strength of explaining variability (unadjusted) is η^2 = 0.025 and the strength of explaining variability (adjusted) is β^2 = 0.056. The indirect effect of mothers' education of the respondents on students' CGPA through results of SSC is 0.011, through results of HSC is 0.008, through faculty is 0.004, through students' monthly expenditure is 0.015 and through semester dropped is 0.001.

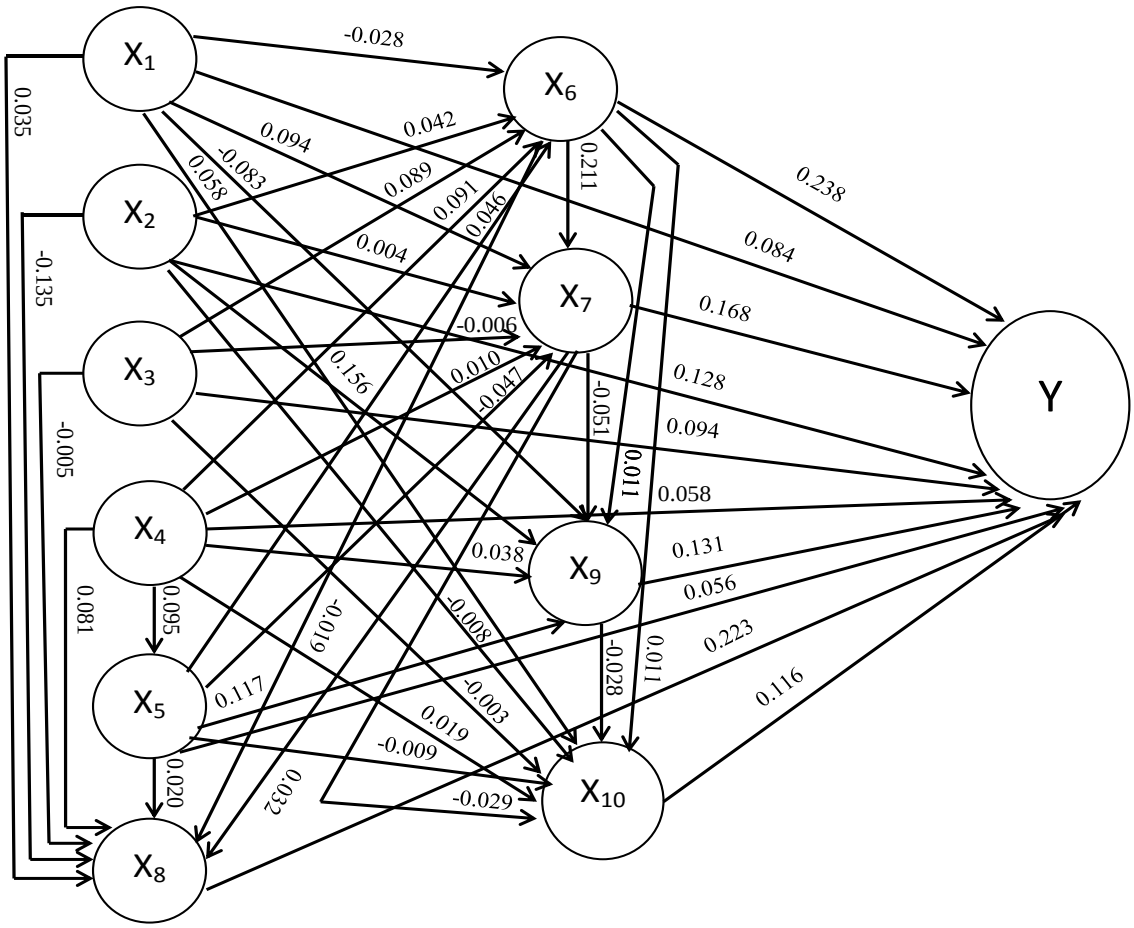

Figure 1: MCA path of socio-economic and demographic variables with students' CGPA

Y=Students' CGPA, X_1=Gender, X_2=Place of birth, X_3=Family type, X_4=Fathers' education, X_5=Mothers' education, X_6=Results of SSC, X_7=Results of HSC, X_8=Faculty, X_9=Students' monthly expenditure and X_{10}=Semester dropped

DISCUSSION

The result of this study showed that the grand mean CGPA of the respondents was 3.2196. It is a closer estimate of Alam et al. (2014). The results of SSC of the respondents was observed as the most influencing factor (β^2=0.238) for the variation in CGPA of students at university level. It was found that the students with results (GPA) 3.5+ in SSC had greater mean value (3.2559) than the students with results (GPA) <3.5 in SSC (2.8896) which support the findings of Zeheen and Hossain (2016) and Biswas et al. (2016). Faculty of the respondent's was also observed as the second most significant factor (β^2=0.223) and the highest adjusted mean (3.2991) was identified for the students who were in faculty of business and the lowest (2.9859) was identified who were in faculty of arts. It means that the academic performance of the students of business faculty was better than that of other faculties which also support the finding of Zeheen and Hossain (2016).The results of HSC of the students was observed as the third vital determinants (β^2=0.168) and the students who obtained GPA 3.5+ in SSC had greater mean value (3.2507) than the students who obtained GPA <3.5 in HSC (3.0261) which is similar results of the study of Zeheen and Hossain (2016) and Biswas et al. (2016). Monthly expenditure of the respondents was the 4thmost responsible factor that influenced their CGPA (β^2=0.131) and it was found that the students whose monthly expenditure was <BDT 20,000 had higher mean value (3.2741) than the students whose monthly expenditure was BDT 20,000+ (3.1532). Place of birth of the students was the 5th most responsible factor that influences their CGPA (β^2=0.128) and it was observed that the respondents whose place of birth was rural had greater mean value (3.2761) than the respondents whose place of birth was urban (3.1581). Sixth important indicator of student's CGPA (β^2=0.116) was semester dropped and the students who had never dropped a single semester had higher mean value (3.2377) than who dropped a semester at least once (3.0619). It indicates that the performance of irregular student was less than that of the regular students which support the study of Ahmmed and Salim (2018) and Alam et al. (2014).

Family type of the respondents was 7th responsible factor that influenced their CGPA (β^2=0.036) and it was found that students from joint family had a higher mean value (3.2897) than the students from nuclear family (3.2011). Respondents' gender was the 8thimportant indicators that influences their CGPA(β^2=0.084) and it was revealed that the female students had higher mean value (3.2926) than the male students (3.1794).It indicates that the academic performance of female students was

better than male students which support the studies of Ahmmed and Salim (2018), Mutairi (2011) and Harb and El-shaarawi (2007).

Ninth significant factor (β^2=0.058) was fathers' education of the respondents and it was found that the respondents' fathers who were educated up to university level had the highest adjusted mean value (3.2453) and who was primary level educated had the lowest adjusted mean (3.1673). It is the similar estimate of the Ahmmed and Salim (2018), Daniyal et al. (2011) and Biswas et al. (2016). Mothers' education of the students was 10th important indicator of their academic performance (β^2=0.056) and respondents mother who were educated up to university level had the highest adjusted mean value (3.2553) and who were secondary level educated had the lowest adjusted mean (3.1943).It indicates that the mothers' education had significance effect on the CGPA of the students which support the study of Easmin et al. (2015), Daniyal et al. (2011) and Ali et al. (2009).

Conclusions

The contributing factors of CGPA of private university students in Bangladesh were investigated in this study. MCA results revealed that respondents' results of SSC, faculty, results of HSC, monthly expenditure, place of birth, semester dropped, family type, gender, fathers' education and mothers' education were first, second, third, fourth, fifth, sixth, seventh, eighth, ninth and tenth influencing factors respectively for explaining their academic performance, i. e., CGPA. Considering the MCA results guardians and teachers of SSC and HSC level may be suggested to take more care about their children and students respectively to develop their future academic study. It is also suggested to the parents who are staying in urban area to take more attention to their children. Authority of universities as well as guardians of the students should take special attention to the male students for improving their academic performance. Moreover, the students should maintain the regularity of semesters and reduce their daily life expenditure.

REFERENCES

Ahmmed, M.M. and Salim, Z.R. (2018). Determinants of Academic Performance of Undergraduate Students in Private Universities in Bangladesh: A Case Study, Global Journal of Human-Social Science: G Linguistics & Education, Vol. 18(11): 28-34.

Alam, M.M., Billah, M.A. and Alam M.S. (2014). Factors Affecting Academic Performance of Under graduate Students at International Islamic University Chittagong (IIUC), Bangladesh. Journal of Education and Practice, Vol. 5(39): 143-154.

Ali, N., Jusoff, K., Ali, K., Mokhtar, N. and Salamat, A.S.A. (2009). The Factors Influencing Students' Performance at Universiti Teknologi MARA Kedah, Malaysia, Management Science and Engineering, Vol. 3(4): 81-90.

Anderson RL, Bancroft TA. Statistical theory in research: McGraw-Hill Book Company, Inc.; New York; 1952.

BBS (2022). Population and Housing Census 2022 Preliminary Report. Bangladesh Bureau of Statistics. August 2022.Retrieved 8 October 2022.

Biswas, S., Khatun, M.S., Parh, M.Y.A. and Hossain, M.S. (2016). Factors that Affect the Academic Results: A Case Study of Islamic University, Kushtia, Bangladesh, Global Journal of Human-Social Science: G Linguistics & Education, Vol. 16(1): 6-14.

Daniyal, M., Nawaz, T., Aleem, M. and Hassan, A. (2011). The Factors Affecting the Students' Performance: A Case Study of Islamia University of Bahawalpur, Pakistan, African Journal of Education and Technology, Vol. 1(2): 45-51.

Easmin, S., Hossain, M.A. and Das, P.C. (2015). Effect of Socioeconomic Background on the Academic Performance of the Students: A Study on Undergraduate Students of Bangladesh, The Cost and Management, 43(4): 28-36.

Harb, N. and Shaarawi, A.E. (2007). Factors Affecting Business Students' Performance: The Case of Students in United Arab Emirates, Journal of Education for Business, Vol.82(5): 282-290.

Hossain, S. and Islam, M. R. (2013). Age Specific Participation Rates of Curacao in 2011: Modeling Approach, American Open Computational and Applied Mathematics Journal, Vol. 1(2): 08 - 21.

Islam, M. R. and Shitan, M. (2022). Modeling and Projection of Some Fertility Parameters of Malaysian Population, Human Biology Review, Vol. 11(2): 66-78.

Islam, M. R. (2007). Predicting Population for Male of Rural Area in Bangladesh, Journal of Statistical Research of Iran, Vol. 4(2): 227-238.

Islam, M. R. (2008). Modeling Age Structure for Female Population in Rural Area of Bangladesh, Journal of Interdisciplinary Mathematics, Vol. 11(1): 29-37.

Islam, M. R. (2011). Modeling of Diabetic Patients Associated with Age: Polynomial Model Approach, International Journal of Statistics and Applications, Vol. 1(1): 1-5.

Islam, M. R. (2012a). Mathematical Modeling of Age and of Income Distribution Associated with Female Marriage Migration in Rajshahi, Bangladesh, Research Journal of Applied Sciences, Engineering and Technology, Vol. 4(17): 3125-3129.

Islam, M. R. (2012b). Modeling and Projecting Population for Muslim of Urban Area in Bangladesh, International Journal of Probability and Statistics, Vol. 1(1): 4-10.

Islam, M. R. (2013).Modeling Age Structure and ASDRs for Human Population of Both Sexes in Bangladesh, International Journal of Anthropology, Vol. 28(1): 47-53.

Islam, M. R. and Hoque, M.N. (2015). Mathematical Modeling and Projecting Population of Bangladesh by Age and Sex from 2002 to 2031.Emerging Techniques in Applied Demography, Applied Demography Series 4, Chapter 5: 53-60.

Islam, M. R. and Hossain, M. S. (2013a). Mathematical Modeling of Age Specific Adult Literacy Rates of Rural Area in Bangladesh, American Open Demography Journal, Vol. 1(1): 01-12.

Islam, M. R. and Hossain, M. S. (2013b). Mathematical Modeling of Age Specific Participation Rates in Bangladesh, International Journal of Scientific and Innovative Mathematical Research (IJSIMR), Vol. 1(2): 150-159.

Islam, M. R. and Hossain, M. S. (2014a). Some Models Associated with Age Specific Adult Literacy Rates of Urban Area in Bangladesh, International Journal of Ecosystem, Vol. 4(2). 66-74.

Islam, M. R. and Hossain, M. S. (2014b). Mathematical Modeling of Age Specific Adult Literacy Rates in Bangladesh, Advances in Life Sciences, Vol. 4(3): 106-113.

Islam, M. R., Ali, K. and Islam, N. (2013).Construction of Life Table and Some Mathematical Models for Male Population of Bangladesh, American Journal ofComputational and Applied Mathematics, Vol. 3(6): 269-276.

Islam, M. R., Hossain, M. S. and Faroque, O. (2014). U-Shaped Pattern of Employees' Job Satisfaction: Polynomial Model Approach, International Journal of Ecosystem, Vol. 4(4): 170-175.

Mutairi, A.A. (2011). Factors Affecting Business Students' Performance in Arab Open University: The Case of Kuwait, International Journal of Business and Management, Vol. 6(5): 146-155.

Shahiduzzaman, M., Ali M.K. and Islam M.R. (2017). Factors Influencing the Academic Performance of Undergraduate Students of Private Universities in Bangladesh: Modeling Approach, Human Evolution, Vol. 32 (1-2): 43-55.

Shahiduzzaman, **M.**, Ali, M.K., Islam, M.N. and Islam, M.R. (2023). Factors Affecting the Drug Addiction among Street Children of Dhaka City in Bangladesh: Approaching of Multivariate Technique, Human Biology Review, Vol.12 (1): 1-12.

Stevens, J. (1996). Applied Multivariate Statistics for the Social Sciences, Third Edition, Lawrence Erlbaum Associates, Inc., Publishers, New Jersey.

UGC (2020).47thAnnual Report 2020 (Executive Summary), University Grants Commission of Bangladesh.

Wikipedia (2023).https://en.wikipedia.org/wiki/Demographics_of_Bangladesh

Yates F. he analysis of multiple classifications with unequal numbers in the different classes, Journal of the American Statistical Association. 1934;29(185):51-66.

Zeheen, A. and Hossain, A. (2016). Socio-Economic Background and Performance of the Students of a Private University: A Case Study, Daffodil International University Journal of Business and Economics, Vol. 10(2): 59-70.