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Comparison among self-efficacy, Depression, Anxiety and stress of postgraduate students by mahalanobis distance

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Abstract
Present work is dealt with the application of Mahalanobis Distance to measure the difference in dependent variables Self-efficacy, Depression, Anxiety and Stress for two groups of postgraduate students. Difference between group of students for all the dependent variables taken together at a time is not considered. Mahalanobis Distance is a powerful measure to find out the dynamical nature of group of variables. Three different dichotomous groups of students are considered for this study. Mahalanobis Distance is applied to compare the dynamical nature of five dependent variables (general self-efficacy, specific self-efficacy, depression, anxiety and stress) considered as a branch. It is found that there is no significant difference in dynamical nature of five dependent variables for different groups of independent variables.

Keywords: mahalanobis distance, general self-efficacy, specific self-efficacy, depression, anxiety and stress

Introduction

It is found that depression, anxiety and stress level of the learners are increased. Self-efficacy is quite affected during pandemic situation. If we individually measure these dependent variables we can get a specific measure of single variable but the variables are interrelated. So, if we measure them together, it will present more valuable result. Dynamical nature of the group of variables for any dichotomous variable (like male vs female) will be reflected by such measures. Mahalanobis Distance is one of such measure we can apply for the present study. Different fields like anthropology, Classification, Clustering, Image Processing etc. are using Mahalanobis Distance in their research (Adhikari, 2023) [1]. At present Mahalanobis Distance is applied in different measures achievement analysis and educational psychology.

Literature Review

P C Mahalanobis introduced Mahalanobis Distance (Mahalanobis, 1936) [12] in the context of his studies on racial likeness. Following works such as Rosenbaum (2015) [14], Diedrichsen, Provost and Zareamoghaddam (2016) [7], Cristani and Murino (2018), Toma (2019), Imani (2019) and Etherington (2019) [8, 17] applied Mahalanobis Distance in various research areas.

Ahmed *et al*. (2019) studied the difference in achievement in mathematics for different learners in different grades of higher secondary level of Assam, India. The nature of mathematical success for two groups of higher secondary level students is the focus of a study project, according to Ahmed *et al*. (2020) in their article '*Application of Mahalanobis Δ^2 on Achievement Tests on Mathematics: A Study on Higher Secondary Level Students*'. In another study Sen and Pal (2020) applied this distance for achievement analysis. Using Mahalanobis Distance achievement in Physics, Chemistry, Biology and Mathematics between two groups of students of Bodoland Territorial Region (BTR) in the state Assam of India is done by Ahmed *et al*. (2021) [3]. A study on academic stress, self-efficacy in mathematics and anxiety in mathematics for two groups of higher secondary level students is done by Mahato and Sen (2021) [3] with the help of Mahalanobis Distance.

In their article '*A Study on Internet Dependency, Social Isolation, and Personality using Mahalanobis Distance*', Gorain *et al*. (2021) [9] discuss the following topics. Due to its detrimental effects on human personality and potential for social withdrawal, social isolation is a significant element in the development of the internet in the twenty-first century. Utilizing measures like internet dependence, social isolation, and five personality factors, Mahalanobis Distance is used to evaluate the psychological traits of postgraduate students.

The article '*A Comparative Study on Academic Achievement of Mathematics and English with Other Subjects of Secondary Level in the Bodoland Territorial Region of Assam, India, Using Mahalanobis Distance*' by Ahmed *et al*. (2022a) [5] examines a recent study that contrasts the academic achievements of two student groups in the Bodoland Territorial Region (BTR), Assam, India, in four different subject areas: Mathematics, English, General Sciences, and Social Studies.

Ahmed *et al*. (2022b) [4] research on the use of the Mahalanobis Distance to compare the academic performance of two groups of higher secondary students in the Bodoland Territorial Region (BTR) regions of the Indian state of Assam in five different subject areas, including mathematics, English, and other studies.

Present work is done to compare the dynamical nature of general and specific self-efficacy, depression, anxiety and stress for different group of postgraduate students of Sidho-Kanho-Birsha University, Purulia, West Bengal, India.

Objectives

Objectives of this study is to compare general and specific self-efficacy, depression, anxiety and stress taking together as a branch for different group of postgraduate students as follows

1. To compare the difference between male and female students regarding the present condition of above mentioned variables
2. To compare the difference between second and fourth semester students regarding the present condition of above mentioned variables
3. To compare the difference between students of education department and other departments regarding the present condition of above mentioned variables

Hypotheses

Following hypotheses may be considered for the present work

$H_0$1: There is no significant difference between male and female students on general and specific self-efficacy, depression, anxiety and stress taken together as a unit.

$H_0$2: There is no significant difference between second and fourth semester students on general and specific self-efficacy, depression, anxiety and stress taken together as a unit.

$H_0$3: There is no significant difference between students of education department and other department students on general and specific self-efficacy, depression, anxiety and stress taken together as a unit.

Methodology

Descriptive survey method is applied to curry out the research.

Scales used

- The Self-Efficacy Scale: Construction and Validation by Sherer *et al*. (1995)
- Depression Anxiety & Stress Scales by Lovibond and Lovibond (1995) [11]

Population: Students of Sidho-Kanho-Birsha University, Purulia, West Bengal, India.

Sample: 130 samples are taken randomly.

Independent Variables: Gender (Male and Female), Semester (Second and Fourth) and Department (education and others)

Dependent Variables: General Self-efficacy, Specific Self-efficacy, Depression, Anxiety and Stress

Mahalanobis Distance (Δ) may be defined as

Where X *and* Y are the column vectors representing means of each variable for two groups and Σ is pooled covariance matrix of two groups of data.

Mahalanobis Distance

$$\text{Mahalanobis Distance } (\Delta) = \left[(X-Y)^T \Sigma^{-1} (X-Y)\right]^{\frac{1}{2}}$$

Pooled Covariance Matrix

$$\Sigma = \left[n_1 \Sigma_1 + n_2 \Sigma_2\right] / N$$

Where Σ_1 and Σ_2 be the Covariance Matrices, n_1 and n_2 be the sample size for first

and second group respectively and $N = n_1 + n_2$.

Results and Discussions

Table 1: Descriptive statistics for different group of students

Male Students (N=66)					
Dependent variable	**General Self-efficacy**	**Specific Self-efficacy**	**Depression**	**Anxiety**	**Stress**
Mean	144.38	45.59	16.89	21.45	20.8
Female Students (N=64)					
Dependent variable	General Self-efficacy	Specific Self-efficacy	Depression	Anxiety	Stress
Mean	165.72	45.92	17.16	20.67	20.7
Second Semester Students (N=44)					
Dependent variable	General Self-efficacy	Specific Self-efficacy	Depression	Anxiety	Stress
Mean	150.8	47.3	16.66	20.25	21.2
Fourth Semester Students (N=86)					
Dependent variable	General Self-efficacy	Specific Self-efficacy	Depression	Anxiety	Stress
Mean	156.98	44.97	17.21	21.49	20.52
Students of Education Department (N=78)					
Dependent variable	General Self-efficacy	Specific Self-efficacy	Depression	Anxiety	Stress
Mean	155.42	46.17	16.58	21.05	21.08
Students of Other Departments (N=52)					
Dependent variable	General Self-efficacy	Specific Self-efficacy	Depression	Anxiety	Stress
Mean	154.08	45.13	17.69	21.1	20.27

Table 1 represents the statistics required for calculating Mahalanobis Distance. Researchers have to compare different groups to test the hypotheses $H_0$1, $H_0$2 and $H_0$3 by calculating Mahalanobis Distance.

Table 2: Pooled Variance-Covariance Matrix for Male and Female Students

	Stress	**Anxiety**	**Depression**	**General Self-efficacy**	**Specific Self-efficacy**
Stress	28.87289	5.341862	6.411692	-11.2243	2.306446
Anxiety	5.341862	36.9276	16.66178	-24.01	-11.3873
Depression	6.411692	16.66178	54.14658	-28.6329	-20.416
General Self-efficacy	-11.2243	-24.01	-28.6329	1459.429	115.1726
Specific Self-efficacy	2.306446	-11.3873	-20.416	115.1726	135.2802

Pooled variance-covariance matrix for dichotomous variable gender (male and female) is represented in Table 2. From Table 2 it is found that positive and negative covariances are recorded.

Table 3: Pooled Variance-Covariance Matrix for Male and Female Students

	Stress	Anxiety	Depression	General Self-efficacy	Specific Self-efficacy
Stress	28.7292	5.3716	6.6382	-12.0284	2.0926
Anxiety	5.3716	37.0964	16.613	-28.1882	-11.4602
Depression	6.6382	16.613	53.8802	-26.8328	-20.1348
General Self-efficacy	-12.0284	-28.1882	-26.8328	1574.38	116.5864
Specific Self-efficacy	2.0926	-11.4602	-20.1348	116.5864	135.0354

Pooled variance-covariance matrix for dichotomous variable department (education and other) is represented in Table 3. From the above table it is found that positive and negative covariances are recorded.

Table 4: Pooled Variance-Covariance Matrix for Male and Female Students

	Stress	Anxiety	Depression	General Self-efficacy	Specific Self-efficacy
Stress	28.75625	5.533154	6.472754	-10.9778	1.943508
Anxiety	5.533154	36.70051	16.43215	-30.1542	-10.7739
Depression	6.472754	16.43215	54.04863	-28.0828	-20.0868
General Self-efficacy	-10.9778	-30.1542	-28.0828	1565.921	120.2201
Specific Self-efficacy	1.943508	-10.7739	-20.0868	120.2201	133.992

Pooled variance-covariance matrix for dichotomous variable semester (second and fourth) is represented in table 4. From Table 4 it is found that positive and negative covariances are recorded.

Mahalanobis Distance can compare two or more than two variables as a unit of variables. Here the unit is general self-efficacy, specific self-efficacy, depression, anxiety and stress. Mahalanobis Distance is represented by a number as measure of distance. If it is found that Mahalanobis Distance is greater than 1, it may be concluded that the difference between two sets of multiple variable is significant. Obviously Mahalanobis Distance may be treated as insignificant if it is less than 1.

Table 5: MD for three dependent variables general self-efficacy, specific self-efficacy, depression, anxiety and stress

Independent variables	Male vs Female	Second Semester vs Fourth Semester	Education Department vs Other Departments
Mahalanobis Distance	0.5884	0.3830	0.2417

Table 5 represents the Mahalanobis Distance between dichotomous variables. Values of Mahalanobis Distance listed in Table 2 express that the differences are insignificant. So, there is no significant difference in dynamical nature of the dichotomous groups when five dependent variables general self-efficacy, specific self-efficacy, depression, anxiety and stress composed as a branch. So, $H_0 1$, $H_0 2$ and $H_0 3$ are failed to be rejected.

Conclusion

If we consider the detection of one variable separately, it may convey partial attribution of present state. Researchers can measure a group of dependent variables considering as a branch attribution by Mahalanobis Distance detects the overall dynamical nature of the present state. From Table 1 we can see that general self-efficacy between male and female students and second and fourth semester students are significantly different when general self-efficacy is the only variable considered. In present study we found differences between groups are insignificant as result one may conclude that dynamical nature of the five dependent variables taken at a time are similar.

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