



# The Suitability of Students in Bachelor of Science in Statistics (BSS) Program

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## ABSTRACT

This study aims to assess the suitability of students in Bachelor of Science in Statistics program. Seemingly, several students who enrolled in the said program does not possess the qualities of being mathematically inclined. Hence, this study was conducted. By complete enumeration, the study employed all BSS students from different year level. Secondary data were used such as two psychological tests from the University Student Services Office which measures the intelligence and numerical aptitude. A primary data was also employed through an instrument called Brainard Occupational Preference Inventory which measures the interest of students in the field of statistics. The gathered data were then analyzed with the aid of some descriptive measures and correlational methods. Results revealed that there are only a few (11.9%) who have high levels of intelligence and numerical aptitude but they happen to have low level of interest in statistics. Of those students highly interested (47.6%) in the field of statistics one-fourth (11.9%) of them have low levels of intelligence and numerical aptitude. It is found out that there is a significant linear relationship between intelligence and numerical aptitude among BSS students. Moreover, intelligence and interest in statistics is inversely and significantly correlated among BSS junior students. Furthermore, results showed that there is no significant linear relationship between numerical aptitude and interest in statistics across year level. Hence, the interest of the BSS students must be cultivated in order to increase their level of achievement.

## 1. Introduction

In many schools today, psychological tests evaluation are probably the most widely used specialized techniques in guidance but in some cases fail as a guidance tool if not combined with appropriate planning for individual development (Bahník & Vranka, 2017; Bravo, Villarosa-Hurlocker, et al., 2018; Lakens et al., 2018; Maunah, 2020; Montgomery & Lilly, 2012). If not correctly used, it may lead to false assumption and unscientific conclusion. A psychological test is an objective, standardized measure of a sample of a person's behavior (Benson et al., 2019; Kaplan & Saccuzzo, 2017; Matlin, 1999; Xin et al., 2020). Psychological tests are measurement instruments. They are used to measure the individual differences that exist among people in abilities, aptitude, interests, and aspects of personality. Psychological tests are used extensively in research but most of them are developed to serve a practical purpose outside the laboratories (Kaplan & Saccuzzo, 2017; Weiten, 2001). Most tests can be placed in one of the two broad categories: mental ability test and personality test.

To date, psychologists and educators have many IQ tests available for their use. Basically, this tests fall into two categories: individual tests and group tests (Weiten, 2001). Individual IQ tests are administered only by psychologists who have special training for this purpose. A psychologist works faces to face with a single examinee at a time. The Stanford-Binet and the Wechsler scales are both individual IQ test (Krugman et al., 1951). The problem with individual IQ test is that they are expensive and time consuming to administer. Therefore, researchers have developed a number of IQ tests that can be administered to large groups of people at once. Because of cost effectiveness, group tests such as the Otis-Lennon School Ability Test and the Lorge-Thorndike Intelligence Test enjoy wide usage at all educational levels (Proger et al., 1971).

In Visayas State University, Philippines, the Otis-Lennon School Ability Test (OLSAT) and the Differential Aptitude-Numerical Ability Test (DA-NAT) was currently used as psychological test for freshmen students. Hence, in this study, the Otis-Lennon School Ability Test (OLSAT) and Differential

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Aptitude Test – Numerical Aptitude Test (DAT-NAT) were used to measure the intelligence and numerical aptitude of the present BSS students. The OLSAT is not focusing on the IQ, rather, it will give an idea of how smart a student is. The Otis-Lennon is a group-administered a multiple choice which measures verbal, quantitative, and spatial reasoning ability. It intends to indicate intrinsic ability (Ahmann, 1985) and allows the school to measure the scholastic achievement of BSS students (Tayaben et al., 2015). On the other hand, DAT-NA test covers areas on verbal reasoning, numerical ability, abstract reasoning, spelling and Language use (Bennett et al., 1947). It is an assessment designed to measure an individual's understanding of numerical relationships and facility in handling numerical concepts (Chand & Darolia, 2017; Lynn, 1992).

Preparing oneself for the future through his occupational and educational plans may depend upon his interest and economic status (Bøler et al., 2018; Brainard & Brainard, 1956; Gaddis & Pieters, 2017). In the local setting, parents play a major role in the educational plan of their children. However, there is a need for a systematic study of a person's interest for their career planning (Nazareno et al., 2019; Pascual, 2014). The Brainard Occupational Preference Inventory (BOPI) is one instrument designed for this purpose. This questionnaire-type inventory does not necessarily analyze one's vocational fitness but his responses for attaining his goals which he can effectively discuss with his advisers or counselors (Brainard & Brainard, 1956). Extensive research on interest inventories reinforces an important but often overlooked point: interest inventories measure interests; they do not measure the chances that people will be successful in the job they find interesting (Kaplan & Saccuzzo, 2017). One of the difficult degree program in Visayas State University (VSU), Leyte, Philippines is Bachelor of Science in Statistics (BSS). The program contains intensive science subjects such as mathematics, computer science and statistics (Bryce et al., 2001). Hence, BSS students should have some desirable qualities to finish the program with ease. Another issue is whether the BSS program has the "right" students at present considering the increased public awareness about the field of statistics through the years. Aside from diligence and good study habits, the ideal students for the program are those who have the following qualities: analytical mind, excellent mathematical and problem-solving skills, logical reasoning ability, proficient in both oral and written English, and positive attitudes (Bryce et al., 2001; Mutambayi et al., 2016).

Through the years, the Department of Statistics (DoS) are experiencing students with low qualities. So, there are several students who did not finish the degree program on time. Perhaps, some of them did not continue to finish their studies as BSS students. Thus, the present study explores the psychological tests which is a great tool to assess the suitability of the current BSS students in the program. This study also aimed to provide remedies for students who are having difficulties in finishing BSS program in the university. Specifically, the study sought to answer the following objectives: (1) to determine the level of intelligence, numerical aptitude and interest of students; (2) to determine the relationship between type of BSS student and psychological test results; (3) to determine the correlations among the psychological test results of the present BSS students; and (4) to determine the correlations among the psychological test results by year level. The results of this study might help the instructors/professors in regards to students' capability. This also provides information to design educational programs and school policy that will enhance student's strengths and supports student's well-being.

## 2. Methods

The research design of this study was inferential in nature that determines the significant relationship of two variables. This design was based on the study of (Casinillo et al., 2020) which deals with correlational research approach. All BSS students officially enrolled at VSU in the second semester of SY 2012-2013 were included in the study regardless of when they started in the program. That is, students who did not enroll as BSS in their first year like transferees and shifters to the program were also included in the study. Only tests available at the University Student Services Office (USSO) were utilized in assessing the suitability of the BSS students in the program. Only data available at the University Registrar's Office were used in determining the graduation rate of BSS students in the University. Of the 52 BSS students (first year to fourth year) studied for the present period, 42 took two (2) psychological tests (OLSAT, for intelligence and DAT-NAT, for numerical aptitude) when they were still in their first year.

The OLSAT and DAT-NAT's raw scores can be translated into various types of derived scores based upon the performance of the students in carefully defined reference groups (Ahmann, 1985; Bennett et al., 1956). One meaningful frame of reference for the interpretation of scores using OLSAT is the student's group. DAT-NAT, on the other hand, uses the student's grade level and sex as frames of reference in interpreting the scores since this standardized test assumes that male and female subjects

have different levels of numerical aptitude. The raw scores that were obtained by the BSS students on both standardized tests (OLSAT and DAT-NAT) were converted into percentile ranks and stanine equivalents. Stanine scores are expressed as single digits ranging from a low of one to a high of nine with the nine units of the scale representing equal distances along the base line of the curve of a normal distribution (Otis & Lennon, 1967). This means that a stanine of seven is much better than a stanine of six as stanine of four is better than a stanine of three.

Students who were not able to take at least one of the said tests in the past were not included in the analysis. Hence, there were 42 BSS students who have taken the two tests and were requested to take the third test, that is, the BOPI (for interest in statistics). The BOPI provides scores in the six general occupational fields for each sex. Both sexes are expected to give responses in the following fields: commercial, mechanical, professional, aesthetic, and scientific. Another two fields are answered separately for each sex. Agricultural fields are for boys and personal services are for girls. The BOPI, uses the scores of the students in the different questions (Brainard & Brainard, 1956). There are five possible occupational responses to the different questions in this standardized test and different rates or points are paired with each response for the analysis. The different responses and their respective rates or points are: strongly dislikes the activity (1 point), dislikes it (2 points), neutral about it (3 points), likes it (4 points), and strongly likes the activity (5 points). Since there are five questions under "Statistical Research," the highest possible score in this test is 25 while the lowest possible score is 5. The student who earns a score of 25 has a very high interest in statistics while the student who only earns a score of 5 has a very low interest in statistics.

To determine whether the percentile score (ratio) on a psychological test of the BSS students are associated with the type of semestral load (regular and irregular; discrete dichotomy), the point biserial ( $r_{pb}$ ) correlation coefficient was used in this study (Siegel & Castellan, 1988). Furthermore, to determine the relationship between the three psychological test results, the Pearson product moment correlation coefficient ( $r_p$ ) was used (Siegel & Castellan, 1988). Correlation analysis on three psychological test results was also done by year level using Pearson product moment correlation coefficient ( $r_p$ ).

### 3. Result and Discussion

#### Results

##### *Suitability of the Present BSS Students in the Program*

A relative frequency table was initially constructed based on the verbal description corresponding to the percentile ranks and stanine scores obtained by each BSS student on the two psychological tests (intelligence and numerical aptitude). Scores on the level of interest in statistics were then categorized into high and low, and were considered in coming up with the characteristics presented in Table 1.

**Table 1.** Percentage distribution of BSS students with respect to intelligence, numerical aptitude, and interest in statistics based on three psychological tests

Verbal Description	Percent (%) of Total
High levels of intelligence and numerical aptitude with low level of interest in statistics	11.90
High levels of intelligence, average level of numerical aptitude with high interest in statistics	4.76
High levels of intelligence, average level of numerical aptitude and low level of interest in statistics	7.14
Average level of intelligence, with high levels of numerical aptitude and interest in statistics	11.90
Average level of intelligence, high level of numerical aptitude and low interest in statistics	2.38
Average levels of intelligence and numerical aptitude with high level of interest in statistics	16.67
Average levels of intelligence and numerical aptitude with low level of interest in statistics	16.67
Average level of intelligence, low level of numerical aptitude with high level of interest in statistics	2.38
Average level of intelligence, low levels of numerical aptitude and interest in	2.38

Verbal Description	Percent (%) of Total
statistics	
Low level of intelligence, average level of numerical aptitude and low level of interest in statistics	4.76
Low levels of intelligence and numerical aptitude, high level of interest in statistics	11.90
Low levels of intelligence, numerical aptitude, and interest in statistics	7.14
<b>Total</b>	<b>100.00</b>

### **Relationship between Type of BSS Student and Psychological Test Results**

The present BSS student was classified as either "1" – started since first semester of first year (regular) or "0" – shifter or transferee to the program (irregular). Apparently, there are 67% of the BSS students are regular and 33% are irregular students. The "raw score" obtained by the BSS students on each psychological test were converted into a percentile score. A percentile score indicates the percentage of people who scored at or below the score one has obtained in a test. Such a score is a ratio variable. Of the three percentile scores, those indicated to be positively associated with the type of BSS student were those of Otis-Lennon School Ability Test (OLSAT) and Brainard Occupational Preference Inventory (BOPI) while that of Differential Aptitude Test – Numerical Aptitude Test (DAT-NAT) was negatively associated with type of BSS student (Table 2). The negative sign indicates that BSS students who are transferees or shifters to the program tend to have higher numerical aptitude compared to those who started the program since first semester of first year. However, the association is not significant and explains less than 1% of the variation in DAT-NAT percentile scores. On the other hand, the positive sign indicates that the BSS students who started the program since first semester of first year tend to have higher intelligence quotient (IQ) than the transferees and shifters to the program. The association, however, is not significant and explains only 2.43% of the variation in OLSAT percentile scores. Also, BSS students who started the program since first semester of first year tend to have higher interest in the field of statistics than the transferees and shifters to the program but the association is not significant and explains only 1.54% of the variation in BOPI percentile scores. This goes to infer that students who started their college as BSS students already developed their interest towards the program. In the study of (Sriyono, 2017), it reveals that students' interest in learning is a very important factor to perform better in class. Hence, transferees and shifters students in the BSS program must cultivate their interest towards learning the different subjects in the curriculum especially the difficult topics.

**Table 2.** Correlation between type of BSS student and psychological test results using point biserial

Test (Characteristics)	Estimated Point Biserial Correlation Coefficient $r_{pb}$	Coefficient Of Determination (%) $r_{pb}^2$
OLSAT (intelligence)	0.156 <sup>ns</sup>	2.43
DAT-NAT (numerical aptitude)	-0.074 <sup>ns</sup>	0.55
BOPI (interest in Statistics)	0.124 <sup>ns</sup>	1.54

ns – not significant

### **Correlations among the Psychological Test Results of the Present BSS Students**

There is a relatively high positive linear relationship between OLSAT percentile score and DAT-NAT percentile score and the association is highly significant (Table 3).

**Table 3.** Correlation among the three psychological test results using Pearson

Tests (Characteristics)	Estimated Pearson $r_p$	Coefficient of Determination $r_p^2$ (%)
OLSAT vs. DAT-NAT (intelligence vs. numerical aptitude)	0.708**	50.13
OLSAT vs. BOPI (intelligence vs. interest in statistics)	-0.332*	11.02

Tests (Characteristics)	Estimated Pearson $r_p$	Coefficient of Determination $r_p^2$ (%)
DAT-NAT vs. BOPI (numerical aptitude vs. interest in Statistics)	-0.243 <sup>ns</sup>	5.90

\*\* – Significant at the 0.01 level (2-tailed)

\* – Significant at the 0.05 level (2-tailed)

ns – not significant

### Correlations among the Psychological Test Results by Year Level

It is seen in Table 4 that the linear relationship between intelligence and numerical aptitude is significant across year levels.

**Table 4.** Correlations among the three psychological test results by year level using Pearson  $r_p$

Year Level	Correlated Tests/Results	Estimated Pearson $r_p$	Coefficient of Determination $r_p^2$ (%)
First Year (n = 8)	OLSAT vs. DAT-NAT	0.934**	87.94
	OLSAT vs. BOPI	-0.591 <sup>ns</sup>	34.93
	DAT-NAT vs. BOPI	-0.593 <sup>ns</sup>	35.16
Second Year (n = 10)	OLSAT vs. DAT-NAT	0.725*	52.56
	OLSAT vs. BOPI	-0.357 <sup>ns</sup>	12.74
	DAT-NAT vs. BOPI	0.017 <sup>ns</sup>	0.03
Third Year (n = 17)	OLSAT vs. DAT-NAT	0.648**	41.99
	OLSAT vs. BOPI	-0.495*	24.50
	DAT-NAT vs. BOPI	-0.457 <sup>ns</sup>	20.88
Fourth Year (n = 8)	OLSAT vs. DAT-NAT	0.722*	52.13
	OLSAT vs. BOPI	0.188 <sup>ns</sup>	3.54
	DAT-NAT vs. BOPI	0.281 <sup>ns</sup>	7.90

\*\* – Significant at the 0.01 level (2-tailed)

\* – Significant at the 0.05 level (2-tailed)

ns – not significant

OLSAT (intelligence)

DAT-NAT (numerical aptitude)

BOPI (interest in statistics)

### Discussion

A relative frequency table was initially constructed based on the verbal description corresponding to the percentile ranks and stanine scores obtained by each BSS student on the two psychological tests (intelligence and numerical aptitude). Scores on the level of interest in statistics were then categorized into high and low, and were considered in coming up with the characteristics presented in Table 1. Of the present 42 BSS students who took all the three (3) tests, not even one has a high level of intelligence, numerical aptitude, and interest in statistics. These three attributes has a good impact to perform better in the degree program of statistics (Akhmetshin et al., 2019; Bryce et al., 2001; Evans et al., 2020; Mutambayi et al., 2016). About 12% have high levels of intelligence and numerical aptitude but with low level of interest in statistics. About 5% have high levels of intelligence and interest in statistics and average level of numerical aptitude. About 7% have high level of intelligence and average level of numerical aptitude but with low level of interest in statistics. Some (11.9%) have high levels of numerical aptitude and interest in statistics but with an average level of intelligence. One-third have average levels of intelligence and numerical aptitude but half of them have low level of interest in statistics. Close to 5% have average level of intelligence and low level of numerical aptitude but half of them have high level of interest in statistics. In the study of (Casinillo & Aure, 2018), interest in the subject is very important factor in academic performance. Hence, cultivating interest in statistics has a major role to perform better and achieve good performance despite of the difficulty of the topics. Close to one-fourth (23.8%) have low level of intelligence. Of those who have low level of intelligence, 20% have average level of numerical aptitude but low level of interest in statistics, 50% have low level of numerical aptitude but high level of interest in statistics, and the remaining 30% have low levels of numerical aptitude and interest in

statistics. According to (Chand & Darolia, 2017), in order for the students to perform better in school, their interest must be accompanied by their level of intelligence and aptitudes. Hence, it goes to infer that students must be motivated and encouraged to do their task in schools which leads to a good academic performance.

The present BSS student was classified as either "1" – started since first semester of first year (regular) or "0" – shifter or transferee to the program (irregular). Apparently, there are 67% of the BSS students are regular and 33% are irregular students. The "raw score" obtained by the BSS students on each psychological test were converted into a percentile score. A percentile score indicates the percentage of people who scored at or below the score one has obtained in a test. Such a score is a ratio variable. Of the three percentile scores, those indicated to be positively associated with the type of BSS student were those of Otis-Lennon School Ability Test (OLSAT) and Brainard Occupational Preference Inventory (BOPI) while that of Differential Aptitude Test – Numerical Aptitude Test (DAT-NAT) was negatively associated with type of BSS student (Table 2). The negative sign indicates that BSS students who are transferees or shifters to the program tend to have higher numerical aptitude compared to those who started the program since first semester of first year. However, the association is not significant and explains less than 1% of the variation in DAT-NAT percentile scores. On the other hand, the positive sign indicates that the BSS students who started the program since first semester of first year tend to have higher intelligence quotient (IQ) than the transferees and shifters to the program. The association, however, is not significant and explains only 2.43% of the variation in OLSAT percentile scores. Also, BSS students who started the program since first semester of first year tend to have higher interest in the field of statistics than the transferees and shifters to the program but the association is not significant and explains only 1.54% of the variation in BOPI percentile scores. This goes to infer that students who started their college as BSS students already developed their interest towards the program. In the study of (Sriyono, 2017), it reveals that students' interest in learning is a very important factor to perform better in class. Hence, transferees and shifters students in the BSS program must cultivate their interest towards learning the different subjects in the curriculum especially the difficult topics.

There is a relatively high positive linear relationship between OLSAT percentile score and DAT-NAT percentile score and the association is highly significant (Table 3). That is, BSS students with high level of IQ tend to have high numerical aptitude and 50% of the variation in IQ levels can be attributed to numerical aptitude. This findings is parallel to the existing studies of (Chand & Darolia, 2017; McGrew et al., 2018; Tayaben et al., 2015). OLSAT and BOPI percentile scores, on the other hand, have a low negative linear relationship and this association is significant but not meaningful. That is, students with low level of intelligence tend to have high interest in statistics and vice versa but only 11% of the variation in intelligence can be attributed to its linear relationship with interest in statistics. This result is in consonant with the findings of (Casinillo, 2019) that even students are not knowledgeable enough, they are still interested and perceived the subject well. On the other hand, there is little, if any, negative linear relationship between numerical aptitude and interest in statistics. That is, students with high numerical aptitude tend to have low interest in statistics. The association however, is not significant. Only 6% of the variation in a BSS student's interest in statistics can be attributed to his or her level of numerical aptitude. This result is somehow contradictory to the study of (Chand & Darolia, 2017; Sriyono, 2017) which states that a high interest in the subject tend to have high numerical aptitude and vice versa.

It is seen in Table 4 that the linear relationship between intelligence and numerical aptitude is significant across year levels. It goes to infer that a student with high intelligence is expected to have a good foundation in numerical aptitude which is parallel to the existing studies (Chansky, 1966; Hussar & Bailey, 2011; Kish & Busse, 1968; Martin & Beena, 2012; Nichols, 2011; Soares et al., 2015). However, that between intelligence and interest in statistics is only significant among juniors. Moreover, there is no significant linear relationship between numerical aptitude and interest in statistics across year level. Among the first year BSS students, there is a very high positive linear relationship between the level of intelligence and numerical aptitude. Students who have high level of intelligence or IQ tend to have high numerical aptitude. Moreover, association is not only highly significant but also meaningful with 88% of the variation in intelligence attributed to numerical aptitude. There is a moderate negative linear relationship between intelligence and interest in statistics. That is, first year BSS students who have high level of intelligence tend to have low interest in the field of statistics. The association, however, is both not significant and not meaningful with only 35% of the variation in interest in statistics attributed to level of intelligence. There is also a moderate negative linear relationship between interest in statistics and numerical aptitude. That is, first year BSS students who have high numerical aptitude tend to have low interest in the field of statistics. The correlation, however, is not significant and only 35% of the variation in interest in statistics can be attributed to numerical aptitude. There is a relatively high positive linear relationship between intelligence and numerical aptitude among the second year BSS students.

Approximately 53% of the variation in their intelligence levels can be attributed to their numerical aptitude. The correlation between level of intelligence and interest in statistics, however, is negatively low. That is, second year BSS students with high level of intelligence tend to have low interest in the field of statistics. The association, however, is not significant and only about 13% of the variation in intelligence levels can be attributed to level of interest in statistics.

For the third year BSS students, there is a moderate positive linear relationship between level of intelligence and numerical aptitude. That is, third year BSS students with high intelligence tend to have high numerical aptitude. Although the degree of association is significant, only 42% of the variation in numerical aptitude can be attributed to intelligence. There is a low negative linear relationship between intelligence and interest in the field of statistics and this association is significant. However, only 25% of the variation in level of interest in statistics can be attributed to intelligence level. There is a relatively low negative linear relationship between numerical aptitude and interest in statistics of third year BSS students. That is, the third year BSS student with high level of numerical aptitude tend to have low interest in the field of statistics but the association is not significant and only 21% of the variation in interest in statistics can be attributed to numerical aptitude. For the fourth year BSS students, the positive linear relationship between intelligence and numerical aptitude is relatively high. Although the degree of association is significant and strong, only 52% of the variation in numerical aptitude can be attributed to its linear relationship with intelligence. Both intelligence and numerical aptitude are weakly related with interest in statistics. These results are inconsistent to the existing studies in literature (Ackerman & Heggestad, 1997; Bravo, Pearson, et al., 2018; Siegle et al., 2010; Sriyono, 2017; Zapko et al., 2018).

#### 4. Conclusion

Results showed that type of student is independent on the psychological results. Hence, it is concluded that regular and irregular BSS students enrolled in the university has no association in regards to their level of intelligence and numerical aptitude, and interest in statistics. On the quality of students admitted to the program, intelligence and numerical aptitude can further be enhanced through proper study habits and right attitude towards work given their already high level of interest in the field of statistics. The University Student Services Office, through its Guidance Counselors, should advice the freshman BSS students on their choice of degree program using the results of the intelligence and numerical aptitude tests taken during this time to improve the graduation rate of BSS students in the university.

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