# A Statistical Analysis on the Number of Industrial Engineering Students of Bulacan State University who will take the IE Certification Examination.

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**Abstract.** The study provides the result of a statistical analysis on the number of Industrial Engineering Students of Bulacan State University who will take the Industrial Engineering Certification Examination offered by the Industrial Engineering Certification Board in the Philippines. With the study, the researchers aim to prove that at least eighty five per cent (85%) of the total population of Industrial Engineering Department in Bulacan State University (BulSU IE) AY 2015 -2016 will take the Industrial Engineering Certification Exam using the test of hypothesis specifically the proportion of one sample. After the test of hypothesis, the researchers were able to prove their claim. The figure shows that still a number of students planned not to take the certification despite of its rise as a new trend in the IE field, but this number is quite small compared to those who wanted to have the letters "CIE" (Certified Industrial Engineer) imprinted after their surnames. Moreover, the study also presented the main underlying reason why some BulSU IE students decided not to take the certification exam which is because they wanted to work immediately after they finish their bachelor's degree.

**Keywords:** Industrial Engineering Certification Examination, test of hypothesis, proportion of one sample, z-test, Minitab® 16.

## 1. INTRODUCTION

According to the Industrial Engineering Certification Board (IECB), the Industrial Engineering Certification is a voluntary process, which validates an individual's qualifications in the field of Industrial Engineering (IE) practice. It demonstrates to employers, clients, and peers the individual's knowledge and experience and signifies his or her commitment to continued excellence in IE professional practice. In addition, it increases visibility, builds credibility, and validates expertise with those outside the profession [1]. Since there's still no law dedicated to the industrial engineering practice here in the Philippines and no regulatory examination for IE's exists to this moment, the Philippine Institute for Industrial Engineers finds its own way to set credible Industrial Engineers from those who are not.

The IECB presented three (3) key reasons why an Industrial Engineer needs to be certified. First, it is a mark of professionalism. Employers tend to look for certifications in evaluating the professional advancements of their employees. Second, it enhances the status of an IE in the eyes of the public. Getting certified equates IE's with other licensed professionals in the field. Lastly, it adds credibility and respect. It will polish one's reputation as a practicing Industrial Engineer.

The Industrial Engineering Department of Bulacan State University recognizes the need of the certification in the IE practice. In fact, 100% of the IE Faculty were already duly certified by the IECB. However, for the past years, only few IE graduates from Bulacan State University have considered taking the certification.

To address this issue the IE Department became keener on imparting its students the importance of being certified. They have conducted several forums, seminars, talks, and the likes in their quest to encourage 85-100% of their students to take the IE Certification Examination.

On that note, the researchers, who have conducted the study, aims to know whether the proactive steps of the Industrial Engineering Department were effective to address the issue. In line with their goal, the researchers have claimed

that these activities were effective and in order to support their claim, they used inferential statistics to test their hypothesis.

## 1.1 Study Objectives

The study was conducted to:
- Prove the researchers' claim that the activities done by the IE Department were effective in encouraging students to take the IE Certification by proving that at least 85% of all Industrial Engineering (IE) students currently enrolled at the Bulacan State University A.Y. 2015- 2016 will take the Industrial Engineer Certification Exam offered by the Industrial Engineers Certification Board;
- Determine the major reason why some Industrial Engineering students choose not to take the certification exam if there's any; and
- To recommend how to address the issue on why some IE students decide not to take the examination.

## 1.2 Rationale of the Study

The study was done to prove if the Industrial Engineering Department was successful in encouraging its student to take the certification examination. The findings of this research will lead to the improvement of the current activities done by the department in encouraging students to take the certification examination for the reason that it presents recommendations to further reinforce such activities.

This also aims to know whether the majority of Industrial Engineering students will follow the new trend on the field of Industrial Engineering, and that is getting certified. The researchers firmly recognize the vital role of certification for the professional life of Industrial Engineers, and in that reason, the researchers believe that not getting a certification would be a problem some IE's will have to deal in the future.

## 1.3 Significance of the Study

The result of this study will directly benefit the The Industrial Engineering Department of Bulacan State University, especially its Administrators and Faculty for the reason that this study assessed whether the activities that they have done were effective to encourage their students to take the IE Certification Exam. Moreover, the reason why some will not take the certification exam was also presented in this study thus, the IE Department would be aware of the thoughts of the students regarding the IE Certification. Also,

recommendations to further reinforce the current activities done by the IE Department were presented.

Since this study will recommend ways on how to educate and to address the dilemma of some students regarding the IE Certification, it will also help the students in making their decision regarding this matter.

With this, the research will be greatly beneficial to the IE Department as a whole.

## 1.4 Problem Statement

The problem of this study is to prove the effectiveness of the Bulacan State University IE Department on its strategies in encouraging 85 – 100 % of its student to take the IE Certification Examination.

In doing so, the study needed to prove that at least eighty five per cent (85%) of all the Industrial Engineering Students of Bulacan State University AY 2015 - 2016 will take the Industrial Engineering Certification Examination offered by the Industrial Engineering Certification Board under the Philippine Institute of Industrial Engineers.

## 1.5 Scope and Limitation of the Study

The study only covers the analysis on the number of Industrial Engineering students of Bulacan State University AY 2015 – 2016 who will take the Industrial Engineering Certification Examination and the underlying reasons why the student will not take the IE Certification Examination are also covered in this study. However, the reasons why some IE students consider taking the certification exam is not included in this study.

## 2. REVIEW OF RELATED LITERATURE

The related literature, presents a set of concepts and definitions, which present a view of phenomena which might explain the reason behind a course of action. These literatures are herein cited to add insights about the present study. Literatures are from books and journals. These are free-compositions from some experts that may agree or relate to this study.

One reason the researchers see why some students of Industrial Engineering of Bulacan State University choose not to take the certification exam is the fear of failing the said exam. Some students feel a fear of taking exam or test anxiety. In An article on Qatar University's website, test anxiety is defined:

*It is an emotional and psychological state occurs before and during exams, accompanied by physical and*

*psychological symptoms of tension, irritability and obsession with negative ideas, which can decrease the concentration needed to prepare for exams.*

*Among the factors leading to exam anxiety or fear are:*

- *Lack of self-confidence and lack of adequate preparation for exams from the beginning of the year.*
- *Subject difficulty, time constraints and difficult exam questions.*
- *Misconceptions about exam.*
- *Examination methodology and procedures.*
- *Predicting failure.*
- *Fear of parents' reactions, disappointment and punishment as well* [2].

The article presents the reasons why students fear examinations. This excerpt from an article is somehow related to the study in such a way that the certification examination is clearly an examination many of students feared. Maybe Industrial Engineers feared the certification examination for the reason of their low self-esteem or they feel they are not prepared to face that kind of examination. Some IE students may also feared the IE Certification for they believe, and from what they've heard from others, the examination is difficult, or some may fear the certification examination because they think if they fail the examination, they may experience rejection from people around them, including their family, peers and others.

One more reason why IE students don't want to take the Industrial Engineering Certification Examination is maybe because they wanted a License from Philippine Regulation Commission rather than a certification. In the year 2006, a Congressman from Romblon, Philippines, an Industrial Engineer, Jose F. Rafols, Jr., proposed a law on the Industrial Engineering practice. He stated in the Section 1 of his proposal:

*Section 1. Statement of Policy – the government recognizes the vital role industrial engineering in nation-building and sustainable development through the adoption, development and effective programs in productivity improvement, industrializations and full and efficient use of resources. The government shall therefore develop and nurture competent, virtuous, productive and well-rounded Professional Industrial Engineers, whose standards of practice and service shall be excellent, qualitative, world-class and globally competitive through inviolable, honest, effective, and credible licensure examinations and through regulatory measures, programs and activities that foster their integrity, continuing professional education, development and growth* [3].

The legislator from Romblon, Philippines, Engr.

Rafols, firmly recognizes the need for the Industrial Engineers to have a licensure examination that's why he proposed a law that will put that licensure to legal practice. Maybe because some IE students have the same thinking with that of Engr. Rafols and desired to be licensed, waiting for the legalization of IE Law, to the point that their minds were not open for accepting the necessity of having certified.

On the other hand, some IE students, wants to take the certification examination on the grounds that the certification from the Industrial Engineering Certification Board would open many windows of opportunity for a better work in the field of Industrial Engineering. The official website of the Global Institute of Internal Auditors laid down some points on why being certified is essential for every individual's professional life:

*Earning your certification is like having a key to the vast world of opportunities the profession of internal auditing offers placed in the palm of your hand. It can open doors you did not even know existed, as the three or four letters that now follow your name will make one powerful statement about the expertise you bring to the table. Ultimately, becoming certified will:*

- *Help you earn credibility and respect in your field.*
- *Open more opportunities for advancement.*
- *Increase your earning potential by as much as 40%.*
- *Prove your willingness to invest in your own development.*
- *Demonstrate your commitment to your profession.*
- *Build confidence in your knowledge of the profession.*[4]

Maybe somehow the same applies to the certification for Industrial Engineers, that's why some may see this certification as a necessary tool for finding a better professional life, thus, this may suggest that more Industrial Engineering student will take the certification exam and less would plan not to take it.

Another reason that some IE students consider is that they want to have a job right after they finish their Bachelor's Degree. A website of an Interest Group on Occupational Services presented the reasons why people find it urgent to have a job. The said website stated:

*Employment is crucial for people's social integration, physical and mental health, well-being and self-realization…whatsoever your abilities and disabilities are.*

*Do you know why people want a job that bad?*

- *People need money to buy things. If you go to work, your boss will pay you. You will have money to pay the rent and to go shopping. You will be more independent.*
- *People want to be busy. They go to work because it is boring to stay at home and do nothing. At work one learns new things and meets new people. It can be fun to have a job.*
- *Going to work makes people feel useful. Other people have more respect for people that work.*

*Some people were afraid that they wouldn't find a job.*
- *They were worried because there are many unemployed people*
- *They worried because they have learning difficulties.*
- *And they thought they didn't have a good education* [5].

This article is somehow related to the study in a way that some of the IE students may choose to have a job right after their graduation. Maybe some of them according to the study were worried because of the rising unemployment rate, they were eager to find a job for self-fulfilment, earning money, and to buy things they want in a faster way possible. In this way, more Industrial Engineering students may not consider taking the IE Certification Examination.

## 3. RESEARCH DESIGN AND METHODOLOGY

In this section, the method and technique of the study agreed upon, the population, the sample size, and the sampling technique and strategies used, the data gathering method, the data processing and the statistical tools used under this study will be elaborated.

The focus of this study was to determine whether the IE Department's activities to encourage IE students to take the IE Certification Exam are effective through the test of hypothesis. In the execution of this study, first, the number of respondents was identified. The respondents of this study were the one hundred and sixty six (166) students of Bulacan State University Industrial Engineering Department from the third year to fifth year level enrolled on the first semester of the AY 2015 – 2016. Using the Slovin's Formula the number of respondents was determined. It is used to calculate the sample size (n) given the population size (N) and a margin of error (e).

Slovin's Formula is a random sampling technique formula to estimate sampling size. Slovin's formula is used when nothing about the behavior of a population is known at all. When taking statistical samples, sometimes a lot is known about a population, sometimes a little and sometimes nothing at all. For example, we may know that a population is normally distributed (e.g., for heights, weights or IQs), we may know that there is a bimodal distribution (as often happens with class grades in mathematics classes) or we may have no idea about how a population is going to behave (such as polling college students to get their opinions about quality of student life). [6]

$$n = \frac{N}{1+Ne^2} \quad (1)$$

*Where:*
 *n = sample size*
*N = Population*
*e = margin of error*

The agreed margin of error (e) that was used is five per cent (5%) and the total population of the Bulacan State University Industrial Engineering Students is two hundred eighty two (282) thus, the obtained number of respondents is one hundred sixty six (166).

The sampling used in this study is random sampling wherein the researchers randomly asked some Industrial Engineering students to answer their survey forms. In random sampling, a subset of a statistical population in which each member of the subset has an equal probability of being chosen. A simple random sample is meant to be an unbiased representation of a group [7].

Close-ended survey form with dichotomous or two-point questions was used. Closed ended questions are just direct questions that ask for specific pieces of information from a client. Closed questions have their greatest value when we need to obtain facts and specific pieces of information. By their nature they limit the client's field of choice and length of response [8]. When a question has two possible responses, we consider it dichotomous. Surveys often use dichotomous questions that ask for a Yes/No, True/False or Agree/Disagree response [9].

The survey form includes a question about the plan of the respondent's plan on taking the Industrial Engineering certification examination answerable by yes or no. Follow up question is provided to root out the reasons behind the decision of some who decided not to take the said examination.

The study used inferential statistics to test the hypotheses in the researchers' quest to answer the problem. This study utilized an application for data processing, the Minitab® 16 to determine the z value, the confidence interval (CI) , and the p-value necessary in conducting the test of hypothesis. Minitab® is a statistics package developed at the Pennsylvania State University by researchers Barbara F. Ryan, Thomas A. Ryan, Jr., and Brian L. Joiner in 1972 [10]. The researcher agreed to use the proportion of one sample in

the test of the hypothesis to see whether their claim that the number of Industrial Engineering Students of Bulacan State University who will take the IE Certification Exam is at least eighty five per cent (85%) is statistically acceptable.

In the test of hypothesis, the z-test method was used in the assessment of proportions. The z-test for proportions is used to investigate whether two populations differ significantly in proportion – for example, whether there is a difference in the proportions of two groups that went voting for the last election [11]. In the case of this study, the researchers used the z-test functioning as an investigator for proportion in test. For this method, the z-value computed by the Minitab® 16 would be plotted in the critical region (CR) determined by the significant level. The z-value of the probability of the significant level will determine the boundary of the critical region or the rejection region. The inequality carried by the alternative hypothesis will identify the area of the rejection region. Anything identified within the rejection region will lead to the rejection of the null hypothesis.

Confidence interval (CI) method was also used in the test of hypothesis. Confidence intervals provide different information from that arising from hypothesis tests. Confidence intervals provide a range about the observed effect size. This range is constructed in such a way that we know how likely it is to capture the true – but unknown – effect size. Thus, the formal definition of a confidence interval is: 'a range of values for a variable of interest constructed so that this range has a specified probability of including the true value of the variable. The specified probability is called the confidence level, and the end points of the confidence interval are called the confidence limits. [12]. In this method, the hypothesised proportion ($P_0$) would be plotted in the confidence interval computed by the software, Minitab® 16. If the $P_0$ is within the CI, the null hypothesis would be accepted, if not, the alternative hypothesis would be accepted.

Also, in the test of hypothesis, the p-value method was used. A p-value may help the researchers to determine the significance of their results. Hypothesis tests are used to test the validity of a claim that is made about a population. This claim that's on trial, in essence, is called the null hypothesis. The alternative hypothesis is the one you would believe if the null hypothesis is concluded to be untrue. The evidence in the trial is your data and the statistics that go along with it. All hypothesis tests ultimately use a p-value to weigh the strength of the evidence [13]. If the p-value is less that the significant level ($\alpha$), the null hypothesis would be rejected and if the p-value is greater than the significant level, the null hypothesis would be accepted. With that, the p-value is the smallest value of the level of significance to reject the null hypothesis.

Those essential methods lead the researchers to what hypothesis will be accepted and rejected. There are

formulas being used in determining the z-value, confidence interval and the p-value needed in the test of hypothesis but since this study will utilize a statistical software, which is Minitab® 16, in identifying such values, the researchers decided not to present the said formulas.
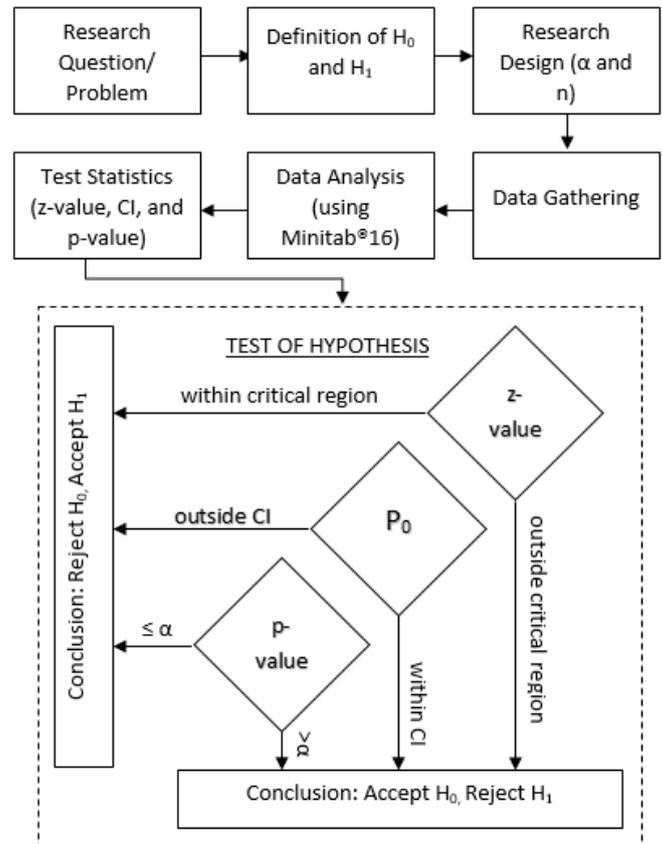


Figure 1: Proportion of One Sample Test of Hypothesis Flow Chart

## 4. DEMOGRAPHIC PROFILE

In this part of the study, the figures from the data gathered are presented. The graphs show how the number of students who will take the certification exam differs from those who will plan not to take the certification examination.

Table 1: The gathered data

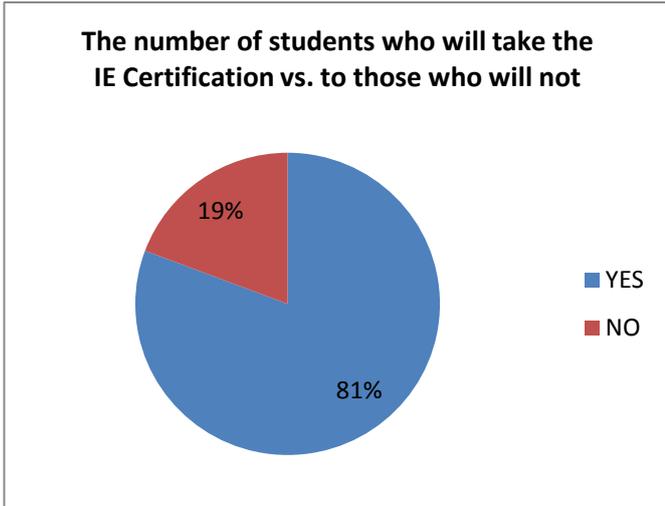| The number of students who will take the IE Certification vs. to those who will not | |
|---|---|
| YES | 134 |
| NO | 32 |

Figure 2: The takers vs. the non-takers

Table 2: The gathered data

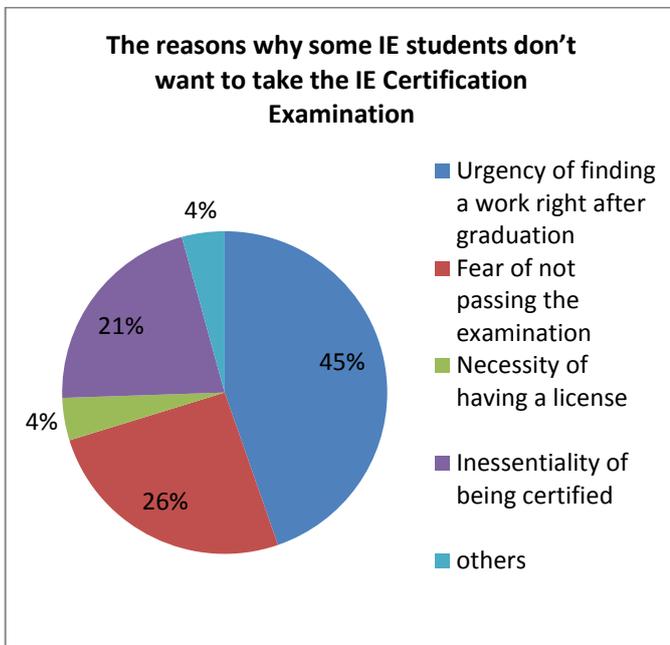| The reasons why some IE students don't want to take the IE Certification Examination | |
|---|---|
| Urgency of finding a work right after graduation | 21 |
| Fear of not passing the examination | 12 |
| Necessity of having a license | 2 |
| Inessentiality of being certified | 10 |
| Others | 2 |



Figure 3: The graph of the factors why the IE Students don't want to take the IE Certification Exam

## 5. STATISTICAL ANALYSIS AND DISCUSSION OF RESULTS

This section of the study will discuss the hypotheses used and will show the result of the test of hypothesis using the proportion of one sample with the help of Minitab® 16.

The null hypothesis ($H_0$) carries the statement that at least eighty five per cent (85%) of all Industrial Engineering students of Bulacan State University AY 2015 – 2016 will take the Industrial Engineering Certification Examination while the alternative hypothesis ($H_1$), which negates the null hypothesis, states that less than eighty five per cent (85%) of all the Industrial Engineering students of Bulacan State University AY 2015 - 2016 will take the Industrial Engineering Certification Examination.

$$H_0: p = 0.85$$
$$H_1: p < 0.85 \quad\quad (2)$$

The IE Department's goal was to encourage 85 – 100% of its student to take the IE Certification by conducting different activities in order to do so. With this, the researcher can say that at least 85% is the criterion in order to infer that the department was effective with its objective to encourage its student to take the said examination. Eighty five per cent (85%) or zero point eighty five (0.85) was set as the hypothesized proportion ($P_0$) in conformance to the 85% criterion. In order to prove the effectiveness of the activities that were done by the IE Department, the null hypothesis to be tested was the number of IE Student who will take the IE Certification Examination is at least 85%, the criterion of the effectiveness of the department's goal to encourage its student to take the IE Certification.

Of all the one hundred sixty six (166) respondents, one hundred thirty four (134) answered that they will take the IE Certification examination. Therefore the number of trials is one hundred sixty six (166) and the number of events is one hundred thirty four (134). The researchers decided to use ninety eight per cent (98%) of confidence level, thus the significant level is 2% or 0.02.

After the necessary data was inputted to the Minitab® 16, the results necessary to draw a conclusion will be displayed, such as the value of z needed for the z-test, the confidence interval and the p-value. Proportion of one sample test of hypothesis was used and the data was assumed to be approximately normally distributed. The figure 4 shows the Minitab® 16 results.

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Test and CI for One Proportion

Test of p = 0.85 vs p < 0.85

                                98% Upper
Sample    X     N   Sample p      Bound   Z-Value  P-Value
1        134   166  0.807229    0.870109    -1.54    0.061

Using the normal approximation.
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Figure 4: The Minitab Results

The z-value obtained from the data is -1.54. This value would be plotted in the critical region determined by the significant level. The z-value of the probability of the significant level will determine the boundary of the critical region or the rejection region. Anything identified within the rejection region will lead to the rejection of the null hypothesis. The inequality carried by the alternative hypothesis will identify the area of the rejection region. In the case of this study, the significant level of 0.02 corresponds to the z-value which is 2.0538, the boundary of the critical region, and since the alternative hypothesis carries the less than inequality, the area of the critical region in the test of hypothesis is determined by $z < -z_\alpha$, where the z corresponds to area of the critical region and the $z_\alpha$ is the z-value of the probability of the significant level. Meaning, the critical region of the test of hypothesis in this study is to the left of the $-z_\alpha = -2.0538$.

Table 3: The Critical Region for Proportion of One Sample Test of Hypothesis

| Alternative Hypothesis | Critical Region |
|---|---|
| $p < p_0$ | $z < -z_\alpha$ |
| $p > p_0$ | $z > z_\alpha$ |
| $p \neq p_0$ | $z < -z_{\alpha/2}$ or $z < z_{\alpha/2}$ |
| where: p = proportion to be tested | where: z = area of the critical region |
| $p_0 =$ hypothesized proportion | $z_\alpha =$ z-value of the probability of the significant level. |



$z = -1.54$

Critical region,      Acceptance region.
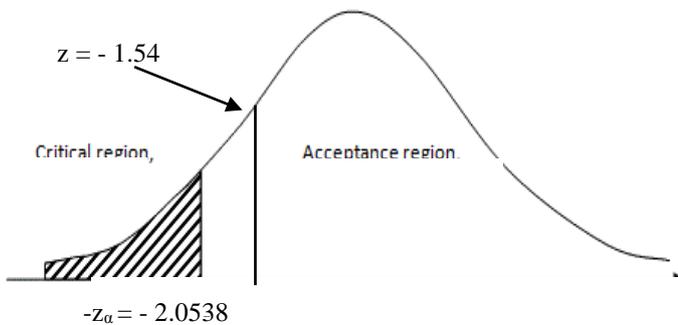
$-z_\alpha = -2.0538$

Figure 6. The Critical Region

The figure 6 shows that the z-value obtained, which is -1.54, is outside the critical region or the rejection region of the null hypothesis, therefore the *null hypothesis is accepted considering the z-value*.
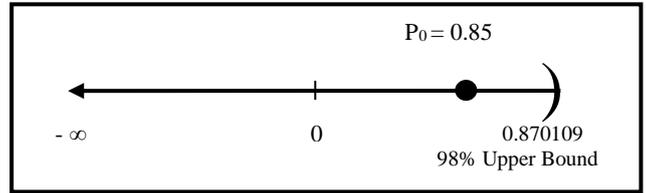


$P_0 = 0.85$

$-\infty$          0          0.870109
                            98% Upper Bound

Figure 7. The 98% Confidence Interval $(-\infty, 0.870109)$

The figure 7 shows that the hypothesized proportion $(P_0)$ which is 0.85, is within the confidence interval which is identified as $(-\infty, 0.870109)$, thus, the *null hypothesis is accepted considering the confidence interval*.

The p-value of the proportion, computed by the Minitab® 16 which is 0.061, is greater than the significant level, which is 0.02, therefore the *null hypothesis is accepted considering the p-value*.

## 6. CONCLUSION

With the results from the test of hypothesis, we can draw the conclusion that at least eighty five per cent (85%) of all the Industrial Engineering Students currently enrolled at the Bulacan State University for the first semester of AY 2015 - 2016 will take the IE Certification Examination offered by the Industrial Engineering Certification Board of the Philippine Institute of Industrial Engineers. This suggests that the activities done by the Industrial Engineering Department to encourage the IE students to take the IE Certification Board is effective. Furthermore, the majority of IE students who will not take the certification examination stated that their reason was because they will focus themselves on working immediately after graduation. The said reason garnered the forty five per cent (45%) of all those who responded that they will not take the IE Certification.

## 7. RECOMMENDATIONS

The researchers suggest the following in order to address issues on why some IE Students don't want to take the IE Certification Exam:

- Publish literary outputs such as news articles and features in the Official Newsletter of the IE Department of Bulacan State University regarding the IE Certification Examination to educate the student more about its importance and what it can offer to the professional life of Industrial Engineers.

- Since the most likely reason why the IE students don't want to take the IE certification exam is because they plan to work immediately after their graduation, the researchers recommend to invite some graduates who have passed the certification exam to have a talk for them to give their testimonies on how the certification help them with their job and how this certification can open a wider and bigger job opportunities for them in the future.

- Also one of the reasons is that the students think they'll have the same opportunity even without a certification and for that, the researchers recommend the IE Department to provide its students with concrete evidence that most of the graduates that are already certified were more likely to have better jobs than that of those who were not considering they are of the same batch. However, this would require further studies and alumni tracing to make their evidence more credible.

- Fear of not passing the examination was also included in the top reasons why the IE students decided not to pursue their certification. On this issue, the researchers recommend to conduct a mock certification exam for the graduating students to let them know what certification exam feels like. Assessment after the mock examination must be made for the Faculty to know what the student felt regarding the exam in order to be reconciled immediately. The result of this mock exam will be the parameter on the preparedness of the students to take the certification examination.

Moreover, the researchers believe that the IE Department's role doesn't stop from encouraging students to take the certification examination. In order to support the IE students with their aspiration to be certified industrial engineers, the researchers suggest the department to conduct review sessions regarding the scope of the certification examination. This way, the large number of the students who will take the certification examination can be translated to a high university's passing rate on the said exam.

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