Probabilistic estimation of passing the Pharmacist licensure examination

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Date received: 26 April 2016
Date accepted: 3 September 2016
Date published: 16 December 2016

ABSTRACT

This paper employed a simulation model to determine the probability of passing the Pharmacist licensure exam. The predictors of the study were the General Weighted Average and the results of the subject areas of the mock board examination. The average performance in the licensure examination was 72.29%. Pharmaceutics got the lowest results in mock board examination while Practice of Pharmacy got the highest results. The threshold of GWA is 85 and 72 for all subject areas. The graded weighted average significantly predict the success in the Pharmacist Licensure Examination (p<0.01) and Pharmaceutics and Pharmacology-Pharmacokinetics gives a significant predictions to the success of the licensure examination (p<0.10). It was also found out that Pharmaceutics and Quality Assurance/Quality Control pull down the chance of passing the licensure exam.

Keywords: Pharmacist Licensure Exam, Maximum Likelihood.

INTRODUCTION

The most important assets in any colleges and universities in the Philippines are the students. The performance of the students is an important role in generating graduates who are soon leaders and workers who are responsive to the demands of time and responsible for the sustainability and development of the country. In applying the job, one of the major requirements of the employer is to scrutinize the licensure examination of the applicant. Thus, it is an obligation of the institution to produce graduates who have better chance of passing the government licensure examination.

Before a pharmacy graduate can practice his or her profession, he or she needs to pass the licensure examination. The examination is conducted by the Professional Regulation Commission (PRC) under the supervision of the Board of Pharmacy. It is designed to assess the competency of each candidate to practice pharmacy which includes Pharmacy as science (Pharmaceutical Microbiology, Drug Delivery Systems, Manufacturing Pharmacy, Pharmaceutical Biochemistry, Pharmacognosy and Philippine Medicinal Plants) and pharmacy as Practice (Pharmaceutical Calculations, Hospital Pharmacy, Dispensing and Counseling, Jurisprudence and Ethics, Marketing, and Pharmaceutical Administration and Management). The examination is based upon an analysis of pharmacist practice functions determined by the Board of Pharmacy through a statewide survey of practicing pharmacists (Republic Act 5921, 1969).

The pharmacist licensure examination of the Philippines is waning. On the recent licensure examination for pharmacist, the Professional Regulation Commission (PRC) announces that 1,487 out of 2,710 or 54.87% passed the Pharmacist Licensure Examination given by the Board of Pharmacy on January 2016 and 2,004 out of 3,142 or 63.78 % passed the Pharmacist Licensure Examination on July 2015 and 1,292 out of 2,295 or 56.30 % passed the Pharmacist Licensure Examination on January 2015. In San Pedro College, the Professional Regulation Commission (PRC) reported 82.76 % passing rate for the January 2016 licensure examination, 87.76% passing rate for July 2015 and 64.47% passing rate for January 2015 licensure exam and 79.17 % passing rate for July 2014 (PRC, 2016).
Patricia Licuanan, chair of Commission on Higher Education (CHED), admitted serious concern over the PRC’s observation that while the number of takers of the examinations has been increasing in the past years, the performance of graduates in the various licensure exams was worsening, in view of the increasing number of flunkers among examinees. The CHED were investigating and looking to the track record of the different schools that got the low score of the board examination (Ronda, 2010).

Researchers reported that review classes and other preparation methods can significantly improve and boast the confidence of the students in passing the licensure exam (Burkiewicz & Fjortoft, 2002). An investigation was conducted to determine the relationship between academic performance, admission characteristics, student employment experiences, and successful North American Pharmacist Licensure Examination (NAPLEX) completion (Hill-Benisque, Wong, Louie & Rho, 2000; Birdwell & Escovitz, 1990; Lowenthal, 1981; Manasse, Purohit, Blake & Barnes, 1980; House & Pevonka, 1980; Lowenthal & Wergin, 1979). At Oklahoma College of Medicine, improvement of passing rate was observed among medical student after taking the NMBE Part I found a school sponsored review course (Hyde, Krug & Deamer, 1985).

Researchers found a significant relationship of academic performance and Pharmacy Board Examination for small and private schools while low correlation for large and state universities (Manasse, Purohit, Blake & Barnes, 1980). Recent studies (Ong, Palompon & Bañico, 2012; Navarro, Vitamog, Tierra & Gonzales, 2011; Neri, 2009) confirmed a positive high correlation of academic performance and Nursing Licensure exam rate and high correlation on Scholastics Aptitude Scores towards the success of in passing the examination. Various studies were conducted on the factors that would significantly predict the success of the Licensure examination. Academic performance in terms of General Weighted Average of the students, performance in the mock board review and admission results were the factors to be considered as pillars in determining the success in passing the examination.

General Weighted Average of the students, performance in the mock board review and admission results were used to predict nursing licensure examinations (Truman, 2012), licensure examinations for dentistry, physical therapy examinations (Utzman, Riddle & Jewell, 2007; Galleher, Rundquist, Barker & Chang, 2012), pharmacist licensure examination (Hill-Benisque, Wong, Louie & Rho, 2000; McCall, MacLaughlin, Fike & Ruiz, 2007), medical licensing examinations (Donnon, Paolucci & Violato, 2007), physician assistant certifying examination (Oakes, MacLaren, Gorie, Finstuen, 1999), and athletic trainer’s certification examination (Harrelson, Gallasp, Knight & Leaver-Dunn, 1997).

Mock board exam results and academic performance was found predictors of success in board examination were observe by Filipino researchers in the field of Medical Technologist Licensure Examination (Pasia, Garzon & Bauyot, 2012), nursing examinations (Ong, Palompon & Bañico, 2012; Navarro, Vitamog, Tierra & Gonzales, 2011; Neri, 2009), Licensure Examination for Teachers (Hirmosisima, 2005; Pascua & Navalta, 2011).

Thus, the above scenario prompted the researcher to study factors that predict passing the licensure examination for pharmacist and determine the certain percentage of passing the board examination which is very essential as prerequisites to practice pharmacist as a professions. It will determine further the average rating of the licensure examination.

**METHOD**

This study utilized the descriptive and prediction-causation research design, such that the intention was to use variables and develop an empirical model to predict licensure examination outcome. Prediction-causation method of research will be employed in this study. Prediction refers to the effect of one variable on other variable while causation means the change in values of the dependent variable to a unit of change in the independent variable (Tamayo, Gevera, & Aguilar, 2012). The maximum likehood of estimation of conditional logit was employed (Ohlson, 1980) to obtain the
maximum outcome (and ordinary least square to approximate estimates (White, 1980) of the board exam outcome (Buizza, 2008). The variable that were used as factors to determine the outcome of the success in the licensure examination were General Weighted Average (GWA), mock board grade (Pharmaceutical Chemistry, Pharmacognosy, Practice of Pharmacy, Pharmacology-Pharmacokinetics, Pharmaceutics, and Quality Assurance/Quality Control) and students score in the licensure examination which covers from 2013-2014.

Model description

In this study the researcher used the linear regression and logistic regression to predict the maximum likelihood of the occurrence of the event. In the logistic regression model, the response variable is binary or dichotomous (passed or failed) (Hosmer & Lemeshow, 1989). The dependent variable of the study is the success of the result of the licensure examination which is dichotomous in nature. The logistic model used is $P(Passed) = \frac{e^{g(x)}}{1 + e^{g(x)}}$ and thus $P(Failed) = 1 - P(Passed) = 1 - \frac{1}{1 + e^{g(x)}}$ where $g(x)$ stands for the function of the independent variables:

$$g(x) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n$$

Logistic regression determines the coefficients that make the observed outcome (passed or failed) most likely using the maximum-likelihood technique. It examines relationship of independent variables to a dichotomous outcome (Peng, Lee, & Ingersoll, 2002). It assumes a direct relationship between the grade indicators. It is assumed that the probability of passing increases as the grade indicators increase until a threshold for passing is reached equal to probability of 1, thus the probability of passing the board exam is assumed to take a shaped $S$ Shape function. The independent variables could be continuous or dichotomous. For the latter, there should be special coding with the use of dummy variables. The linear regression was used to predict the score in the board exam given values of the variables that were found to show influence in the probability of passing the exam.

RESULTS AND DISCUSSION

The average rating of the Pharmacist Licensure Examination of San Pedro College was 72.94% from 2013 to 2014. It can be observed that the highest rating was on the June 2014 (79.17%) and the lowest rating was observed on January 2015 (64.47%). The rating was increased from the examination period of June 2013 to June 2014 and it went down to January 2015.

The performance of San Pedro College is above the given standard set by CHED. The low performance rating of schools is a situation where institutions whose graduates failed those to score within the already low national passing percentage set in the 30 percentile level for several years (Ronda, 2010).

**Table 1. Number of passers and flunkers per exam period**

<table>
<thead>
<tr>
<th>Exam Period</th>
<th>Passers</th>
<th>Flunkers</th>
<th>% of Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 2013</td>
<td>68</td>
<td>25</td>
<td>73.12</td>
</tr>
<tr>
<td>January 2014</td>
<td>63</td>
<td>21</td>
<td>75.00</td>
</tr>
<tr>
<td>June 2014</td>
<td>76</td>
<td>20</td>
<td>79.17</td>
</tr>
<tr>
<td>January 2015</td>
<td>49</td>
<td>27</td>
<td>64.47</td>
</tr>
<tr>
<td>Average Passing</td>
<td></td>
<td></td>
<td>72.94</td>
</tr>
<tr>
<td>Rate</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
To prepare the students in taking the licensure examination, a review class was conducted and students were given a mock board examination. Depicted in Table 2 is the Mock board rating among Pharmacy students from the academic year 2013 – 2014. The Pharmaceutics got the lowest mean of 74.24 with the minimum and maximum score of 49.60 and 92.20 respectively. The Practice of Pharmacy obtained the highest mean of 80.80 with the minimum score of 59.20 and the maximum score of 91.60. It was further observed that the Pharmaceutical Chemistry got the mean score of 79.79; Pharmacognosy obtained the mean score of 77.13; Pharmacology-Pharmacokinetics had the mean score of 76.95; and Quality Assurance/Quality Control got the mean score of 78.02.

Table 2. Mock board rating among Pharmacy students from 2013 – 2014

<table>
<thead>
<tr>
<th>Area of Competency</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharmaceutical Chemistry (M1)</td>
<td>22</td>
<td>56.20</td>
<td>94.60</td>
<td>79.5</td>
<td>6.1</td>
</tr>
<tr>
<td>Pharmacognosy (M2)</td>
<td>22</td>
<td>58.00</td>
<td>95.80</td>
<td>77.1</td>
<td>7.1</td>
</tr>
<tr>
<td>Practice of Pharmacy (M3)</td>
<td>22</td>
<td>59.20</td>
<td>91.60</td>
<td>80.8</td>
<td>6.8</td>
</tr>
<tr>
<td>Pharmacology-Pharmacokinetics (M4)</td>
<td>22</td>
<td>59.20</td>
<td>88.00</td>
<td>76.9</td>
<td>5.1</td>
</tr>
<tr>
<td>Pharmaceutics (M5)</td>
<td>22</td>
<td>49.60</td>
<td>92.20</td>
<td>74.2</td>
<td>14.04</td>
</tr>
<tr>
<td>Quality Assurance/Quality Control (M6)</td>
<td>22</td>
<td>58.60</td>
<td>91.60</td>
<td>78.0</td>
<td>7.7</td>
</tr>
</tbody>
</table>

Moreover, shown in Table 3 is the General Weighted Average and Board Examination Results among Pharmacy students. The mean GWA of the Pharmacy student was 86.11 with the minimum grade of 75 and the maximum grade of 94. The Board Examination Rating had a mean of 79.23 with the minimum rating of 48.15 and maximum rating of 93.95.

Table 3. GWA and Board Examination Results among Pharmacy students

<table>
<thead>
<tr>
<th>Area of Competency</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>GWA</td>
<td>225</td>
<td>75.00</td>
<td>94.00</td>
<td>86.11</td>
<td>2.76</td>
</tr>
<tr>
<td>Board Exam Rating</td>
<td>225</td>
<td>48.15</td>
<td>93.95</td>
<td>79.23</td>
<td>6.22</td>
</tr>
</tbody>
</table>

An investigation on the strength of influence of the predictors towards passing the licensure exam; the GWA had the strongest influence, followed by the Pharmacology-Pharmacokinetics, Pharmaceutical Chemistry, Practice of Pharmacy and Pharmacognosy while the Pharmaceutics and Quality Assurance/Quality Control were the areas that pull down the chance of passing the licensure exam.

Table 4. Empirical test to determine strength of relationship of the Modules in Pharmacy and GWA towards passing the board exam

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Coefficients</th>
<th>SE</th>
<th>Wald</th>
<th>p value</th>
<th>Exp(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-.36.656</td>
<td>8.343</td>
<td>19.30</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Pharmaceutical</td>
<td>.078</td>
<td>.078</td>
<td>1.00</td>
<td>.317</td>
<td>1.081</td>
</tr>
</tbody>
</table>
The GWA (32.5%), Pharmaceutical (8.1%), Chemistry Pharmacognosy (2%), Practice of Pharmacy (2.9%), Pharmacology-Pharmacokinetics (16.8%) are the areas that give impact to the success in the licensure exam and Pharmaceutics (7.3%) while Quality Assurance/Quality Control (2%) are the areas that hinder the takers to pass the licensure exam.

The graded weighted average significantly predict the success in the Pharmacist Licensure Examination \((p<0.01)\). Also the Pharmaceutics and Pharmacology-Pharmacokinetics gives a significant predictions to the success of the licensure examination \((p<0.10)\). The finding is in conformity with the study Herrara and Blair (2015) that the probability that a student will successfully complete a nursing program and ultimately pass the National Council Licensure Examination-Registered Nurse (NCLEX-RN) is predicted by the academic performance and system which was prepared for these programs.

<table>
<thead>
<tr>
<th>Simulations</th>
<th>Constant</th>
<th>M 1</th>
<th>M 2</th>
<th>M 3</th>
<th>M 4</th>
<th>M 5</th>
<th>M 6</th>
<th>GWA</th>
<th>Prob of Success</th>
<th>Predicted Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>GWA=8.5; m1=80; m2=80; m3=80; m4=80; m5=80; m6=80</td>
<td>0.00</td>
<td>86.47</td>
<td>81.58</td>
<td>82.34</td>
<td>93.47</td>
<td>74.19</td>
<td>78.38</td>
<td>11.26</td>
<td>0.998</td>
<td>78.13</td>
</tr>
<tr>
<td>GWA=8.5; m1=70; m2=70; m3=7; m4=70; m5=70; m6=70</td>
<td>0.0</td>
<td>75.66</td>
<td>71.39</td>
<td>72.05</td>
<td>81.78</td>
<td>64.92</td>
<td>68.58</td>
<td>11.26</td>
<td>0.998</td>
<td>74.10</td>
</tr>
<tr>
<td>GWA=9.5; m1=90; m2=90;</td>
<td>0.0</td>
<td>97.27</td>
<td>91.78</td>
<td>92.63</td>
<td>10.51</td>
<td>83.47</td>
<td>88.18</td>
<td>12.58</td>
<td>0.999</td>
<td>92.62</td>
</tr>
</tbody>
</table>

### Table 5. Simulation of Module and GWA as indicators to determine probability of passing
A simulation was conducted to determine the baseline of each module and GWA. Table 5 shows the simulation of six modules and GWA as indicators to determine probability of passing. The simulation of rating was grounded on the Republic Act No. 5921, article 3 section 20 that in order to pass the examination, a candidate must obtained on the basis of one hundred percent a general average of 75% or over in both theoretical and practical examination with no rating of 50% in more than two subjects in the theoretical examinations.

The simulation score column would be indicative of the target score in the board and the predicted score column would represent the overall rating. In order for the student to pass the licensure exam, given that the student has GWA of 85, he needs to have a score of more than 72 in all areas for him to pass the examination.

CONCLUSION

The average performance in the licensure examination was 72.29%. Pharmaceutics got the lowest results in mock board examination while Practice of Pharmacy got the highest results. The threshold of GWA is 85 and 72 for all subject areas. After the empirical analysis of the different modules in the mock board exam and GWA, it was found out in the model developed, the variables predict the success in passing the licensure exam are the General Weighted Average, Pharmaceutical Chemistry, Pharmacognosy, Practice of Pharmacy, Pharmacology-Pharmacokinetics, Pharmaceutics, and Quality Assurance/Quality Control. The GWA gives the strongest probability in passing the licensure exam. It can also be concluded that the Pharmaceutics and Quality Assurance/Quality Control pull down the chance of passing the licensure exam.
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