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Modeling Graduate Employability in Malaysia Using Logistic Regression

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Abstract
Unemployment is a recurring phenomenon especially in developing countries. The unemployment rate is found to be one of the factors affecting the sustainability of economic growth in any country. In Malaysia, this issue frequently occurs among fresh graduates. It is important to solve the issue of unemployment because it is challenging for graduates as being the new entrants to the labour markets. The purpose of this research is to determine the factors of employment, specifically among fresh graduates in Malaysia. Taking this into account, statistical evidence showed that students remained unemployed for quite some time after graduation. Furthermore, this research recognised the importance of determinants of employability using the odds of ratio obtained. Therefore, the determinants of employability among graduates in Malaysia are analysed and explained. The use of binary logistic regression analysis has been executed in this study. Moreover, the data used in this research involve students who have graduated in Malaysia and are being analysed through the SPSS software. Through this method, the independent variables of educational stage, gender, field of study and Grade Point Average (GPA) are used to formulate a model that interprets the relationship with graduate employability. The findings showed that the main factors contributing significantly to graduate employability were GPA and the field of study in science. This study was able to identify factors that may help students to be employed. Evidently, Malaysia's unemployment rate can change when significant variables that are affecting the situation are identified. As a result, the graduate employability is known with the testing of the selected variables through this quantitative analysis. The unemployment rate may decrease and the economic situation has the potential to change and be enhanced in Malaysia.
Keywords: Graduate employability; binary logistic regression analysis; Malaysia universities; unemployment

1. Introduction

The trend of rising unemployment cases is apparent in many countries [3]. In this current economic situation, employability is precious to a lot of people. Generally, the definition of employment is when one has a full paid job. Therefore, an increasing rate of employment can contribute to economic growth and stabilise the economy [28]. In providing a stable economy, the government aims to maintain or reduce it by a percentage. In addition to that, the youth unemployment rate stands at 22.5% in 2020, following a report from the Department of Statistics Malaysia (DOSM). As can be seen, unemployment is a recurring issue especially among fresh graduates in Malaysia. It is significant to note that students are not being employed as fast as possible or right after they have graduated. As the trend continues throughout the years, action for solving this issue is needed.

Employability, generally, is a collection of skills, knowledge and personal characteristics that make an individual more employable or more likely to get a job. It is important for job seekers to take into account all these factors, especially fresh graduates. Other mechanisms, such as lack of professional training, may make it challenging for a job seeker to find a suitable job after graduation [24]. Overall, the prevention from the increase in unemployment rate will not only contribute to the economy of the country but will help future generations to implement better steps and find the optimal solutions to this issue.

According to the Ministry of Education in Malaysia, almost 20% of the estimate of 290,000 fresh graduates every year remain unemployed within six months after graduation. Undoubtedly, in the coming years, the job market is getting tougher and challenging with more graduates and advanced technology. Therefore, this research aims to identify the determinants of employability for fresh graduates in these recent times. The objectives of the study consist of identifying the factors of employment among fresh graduates using logistic regression analysis as well as recognising the solutions on maintaining a healthy unemployment rate and the importance of the solutions. In carrying out these objectives, the solutions to curb a high unemployment rate can be reviewed.

2. Literature Review

2.1. Unemployment

Unemployment is known as a global phenomenon, particularly in developing countries. Generally, unemployment describes a person who is unable to find a job to make a living [7]. The case of unemployment leaves an undesired impact to job seekers along with the society as a whole and national development [19]. Statistics from DOSM recorded that in February 2022, the unemployment rate for youth was recorded at 8.1 percent where unemployed persons were at 513,700 persons. It was discussed in other studies that the issue of unemployment is apparent in Malaysia and it concerned the government on the severity of it [13].

Malaysia happens to face a crucial issue of unemployment [27]. This significantly highlighted the issue that it happens among the youth as well. Specifically, graduates who just obtained their highest certificate would be affected by being the new entrants to the labour markets. It is evident that the necessary steps are essential to resolve this issue and to determine if the rate of unemployment will be maintained or reduced. It follows that the figures depicting the unemployment showed persistence among graduates. Therefore, graduate employability is important to understand in order to identify which element builds that aspect for a graduate.

2.2. Graduate Employability

A previous study highlighted the fact that the increase in the number of graduates does not tally with the increase in job opportunities [13]. One of the researchers stated that it is essential for students to have a substantial educational background and a set of skills to impress their future employers. Furthermore, several studies showed that employability skills are the features of skills and knowledge that students must possess in order to be prepared to meet diverse employment needs in the labour market once they have completed their education [28]. It can be regarded that it is significant to discover the factors that are influencing the rate of unemployment. Hence, it is suggested that fresh graduates should have familiarity and an extent of understanding towards this situation and prepare for any uncertainty in regard to this unemployment issue [21].

Most graduates lack the necessary skills and qualifications which are required by the employers. Besides their academic qualification, graduates have to take into account that they need to acquire additional skills and experiences. In this situation, graduates are required to be more valuable and marketable to prove themselves in this fast-paced and challenging environment [13]. In a past research, 81% of companies listed communication skills as a major deficit within graduates [11]. In addition to that, the importance of graduate employability and the need for higher-level skilled workers are recognised in order to survive the competition in this economic industry [22]. Thus, graduates' employability in Malaysia has to be evaluated for graduates to achieve the demands of a workplace [13].

2.3. Factors Affecting the Rate of Unemployment

There are many significant factors that influence the rate of unemployment. In previous research, the overgrowing supply is found to be more than the demand for labour [28]. Other factors that were found to affect the unemployment rate in other research were inflation rate and population growth in Malaysia [21]. It is noted that some of the common factors are out of graduates' capability. Besides that, situations as mentioned will cause intense competition in the job market. The availability of jobs are also discovered to be different following the field of study of the graduates [2]. Based on this situation, students need to be more alert and improve their skills, knowledge and experience that is required by the Industrial Revolution 4.0 and in line with future industrial needs [17]. Several studies have shown evidence that jobs and skill mismatches often happen too. Without a doubt, as the world progresses, the factors affecting the rate of unemployment develop as well.

Considering the factors stated earlier, it highlights the importance of solutions from other parties to handle this issue as well as decrease the unemployment rate to a healthy level. It was discovered that educational establishments hold a big role at developing and improving students' soft skills and other necessary skills to secure employment [26]. On that account, changes and improvements involving the skills matching for graduates can be executed. Based on this study, the unemployment rate can be stabilised to help the graduate employability as well as the economic state of the country.

3. Methodology

3.1. Quantitative Method

This research included quantitative methods in the research approach. In this technique, numerical data were used. Besides that, the used data in this research were from secondary data found from reliable open data sources. The secondary data assisted in demonstrating the research objectives and aim of this study. In efforts of analysing the results, the quantitative method was the most suitable method for this research. Furthermore, this research aimed to gather results from the target participants to explore and strengthen the research's hypothesis.

The research conducted involved the collection of methods through the internet. Thus, data were gathered from information which had already been collected prior to and used for other purposes. The data found was suitable to be used as it originated from valid sources such as the Ministry of Higher Education (MOHE). After the data was gathered, analysis was done to select the most fitted in the research. This study seeks to find the factors that help graduates to be employed as well as solutions on maintaining a healthy unemployment rate. In this research, it is not the objective to analyse graduate employability from all aspects. Therefore, some possible constraints and limitations that might occur is that the final analysis may not apply to all students who have graduated from university. Overall, this research hoped to contribute to any situations relating to this specific topic and knowledge.

3.2. Formulation

The formulation in this research was related to the components of logistic regression. In particular, the binary logistic regression analysis was utilised. This analysis was used to predict a dichotomous variable from a set of predictor variables [20]. The model involves a dichotomous dependent variable where it was recorded as '1' and '0' as well as one or more independent variables which were continuous or categorical. In the logistic regression model, the log of odds of the dependent variable is modelled as a linear combination of the independent variables [7].

The mathematical model of the binary logistic regression analysis is formulated as shown:

$$\ell = log_b \frac{p}{1-p} = \beta_0 + \beta_1 x_1 + \ldots + \beta_i x_i \quad (1)$$

where

ℓ : log-odds,
p : probability of the dependent variable = 1,
y : dependent variable,
x_i : independent variables,
β_0 : log-odds of the event that y = 1, when predictors $x_1 = x_2 = 0$,
β_1 : increasing x_1 by a value increases the log-odds by 1,
β_i : parameters of the model or coefficients of independent variables.

The logit function or also known as log of odds is where the odds equal to the probability of success divided by the probability of failure. The approximated parameter gives the change in log of odds considering one unit change in the independent variable. In addition to that, maximum likelihood estimation is used to estimate the parameters of the logistic regression model. In this research, the independent variables consisted of the educational stage, gender, field of study and Grade Point Average (GPA) of graduates. With the predictive modelling method, the best fitting and simplest model is formed to interpret the relationship between the dependent variable and independent variables.

3.2. Binary Logistic Regression Approach in the Analysis

The data collected for this research were analysed and the method of quantitative analysing was executed. The descriptive analysis was used to explain and interpret the information gathered. Besides this analysis, the research mainly focused on the usage of logistic regression analysis. Logistic regression analysis is a statistical technique to evaluate the relationship between one or more independent variables and one dependent binary variable which is dichotomous [25]. In order to execute the quantitative analysis successfully, the software IBM Statistical Package for Social Sciences (SPSS) Statistics was utilised. This statistical software eased the quantitative analysis with the available range of statistical functions such as descriptive and inferential analysis.

4. Results and Discussion

The variables in this research were used to identify determinants of employability for fresh graduates. The binary dependent variable which is Y was employed or unemployed in this research. Moreover, the independent variables that helped in modelling the graduate employability were educational stage, gender, field of study and Grade Point Average (GPA). The research conducted involved collecting data from an open data source, data.gov.my.

4.1. Classification of Variables

The secondary data used in this research involved the data from a total number of 400 graduates. This research was focused on independent variables that will fit in the logistic regression equation which established the factors of employment between graduates. Therefore, the independent variables such as the educational stage achieved, gender, field of study and Grade Point Average (GPA) were analysed. Before analysing the data for the study, the variables were classified into the appropriate levels of measurement to ease the process of analysis using SPSS. The classification of data were as shown in the table below:

Table 1: Classification of variables

Variables (as in SPSS)	Description	Type	Levels of Measurement
FieldStudy	The field of study taken by the student	Categorical	1 (Engineering), 2 (Science), 3(Communications), 4 (Social Science and Humanities)
Gender	The gender of the student	Categorical	0 (female), 1 (male)
EduStage	The educational stage achieved by student	Categorical	1 (Graduated with a degree), 2 (Pursue further studies)
GPA	-	Continuous	-
Employment	Whether the graduate is employed or not employed	Binary	0 (unemployed), 1 (employed)

This research involved the independent variables of gender, field of study, educational stage and Grade Point Average (GPA) to find the determinants that help graduates to be employed. Based on the data obtained, there were 214 unemployed graduates and 186 employed graduates. In addition to that, the gender of the graduates consisted of 218 female graduates as well as 182 male graduates in this research. Furthermore, there were 193 graduates that pursued further studies and 207 graduates that did not. The independent variable of Grade Point Average (GPA) was recorded too. This variable had values ranging from 2.26 to 4.00. It was calculated that the average of this independent variable was 3.3899.

4.2. Binary Logistic Regression Model

Binary logistic regression was the method chosen and performed to attain the objectives of this study. The classified independent variables will assist in identifying the determinants of employability among graduates in this research. By executing the binary logistic regression analysis in SPSS, the results achieved are as shown below.

Table 2: Selected and unselected cases in the analysis

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	400	100.0
	Missing Cases	0	.0
	Total	400	100.0
Unselected Cases		0	.0
Total		400	100.0

a. If weight is in effect, see classification table for the total number of cases.

The summary described the cases that were included and excluded in the analysis. A total number of 400 graduates were included along with the data of the independent variables. In Table 3, the binary logistic regression analysis also displayed the coding of the dependent variable and categorical variables that were introduced in this research. Moreover, the "null" model was explained through Table 4. The model only included the intercept, without the predictors or independent variables in the model. It showed that there was a 53.5% greater likelihood of being employed based on the "null" model.

Table 3: Codings of variables

Dependent Variable Encoding

Original Value	Internal Value
0	0
1	1

Categorical Variables Codings

		Frequency	Parameter coding (1)	(2)	(3)
FieldStudy	Engineering	99	1.000	.000	.000
	Science	111	.000	1.000	.000
	Communications	91	.000	.000	1.000
	Social science and Humanities	99	.000	.000	.000
0 – female, 1 – male	0	218	1.000		
	1	182	.000		
EduStage	Graduated Degree	207	1.000		
	Further Studies	193	.000		

Table 4: Prediction for "null" model

Classification Table[a,b]

			Predicted		
			Employment		Percentage Correct
	Observed		0	1	
Step 0	Employment	0	214	0	100.0
		1	186	0	.0
	Overall Percentage				53.5

a. Constant is included in the model.

b. The cut value is .500

The "null" model equation included the intercept as shown in Table 5. In addition to that, the independent variables introduced in this research can be found in the table of "Variables not in the Equation" in Table 5 too.

Table 5: "Null" model equation

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-.140	.100	1.957	1	.162	.869

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	EduStage(1)	.426	1	.514
		Gender(1)	.006	1	.941
		GPA	104.118	1	.000
		FieldStudy	6.547	3	.088
		FieldStudy(1)	1.368	1	.242
		FieldStudy(2)	4.415	1	.036
		FieldStudy(3)	.412	1	.521
	Overall Statistics		110.525	6	.000

The overall test of the model, the coefficients and odds ratios were taken into account in this research. Based on Table 6, the Chi-Square of the model is shown with the degree of freedom and significance. The overall model was found to be statistically significant with $X^2(6, N = 400) = 126.630$ and $p < 0.05$.

Table 6: Omnibus Tests of Model Coefficients

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	126.630	6	.000
	Block	126.630	6	.000
	Model	126.630	6	.000

In Table 7, the -2 Log likelihood, Cox & Snell R Square and Nagelkerke R Square were calculated too. The model explained between the Cox & Snell R Square value of 27.1% and Nagelkerke R Square value of 36.2% of the variance in employment.

Table 7: Model Summary with Hosmer and Lemeshow Test

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	425.926[a]	.271	.362

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	18.323	8	.019

In the table below, the Hosmer and Lemeshow Test produced a contingency table for the analysis. The observed and expected values of employed and unemployed graduates are as shown in Table 8.

Table 8: Contingency Table for Hosmer and Lemeshow Test

Contingency Table for Hosmer and Lemeshow Test

		Employment = 0		Employment = 1		Total
		Observed	Expected	Observed	Expected	
Step 1	1	35	37.386	5	2.614	40
	2	31	33.824	9	6.176	40
	3	31	30.670	9	9.330	40
	4	34	27.478	6	12.522	40
	5	28	23.938	12	16.062	40
	6	21	19.814	19	20.186	40
	7	15	16.157	25	23.843	40
	8	5	12.295	35	27.705	40
	9	7	7.672	32	31.328	39
	10	7	4.765	34	36.235	41

Table 9: Prediction for logistic model

Classification Table[a]

Observed			Predicted		
			Employment		Percentage Correct
			0	1	
Step 1	Employment	0	170	44	79.4
		1	46	140	75.3
	Overall Percentage				77.5

a. The cut value is .500

In the table above, the prediction for the logistic regression analysis is made. Table 9 explained that 75.3% of the employed graduates were predicted by the model to be employed. Besides that, the analysis was able to estimate 79.4% of unemployed graduates accurately using the model. The predictive capacity of the model recorded in Table 9 was 77.5% and illustrated that a 24% increase occurred in the classification accuracy. The results indicate that the unemployment in this research is predicted with a greater likelihood than the employment.

Using the SPSS functions, the analysis produced the table below where it showed the output resulting from including all of the independent variables in the equation. The analysis included the statistical significance of the test which is recorded under the “Sig.” column. Moreover, independent variables added significantly to the model if $p < 0.05$. It is noted as well that the regression coefficient is recorded, under the “B” column.

Table 10: Variables in the Equation

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	EduStage(1)	-.254	.240	1.119	1	.290	.775	.484	1.242
	Gender(1)	.094	.239	.153	1	.695	1.098	.687	1.756
	GPA	3.568	.395	81.566	1	.000	35.441	16.340	76.874
	FieldStudy			7.675	3	.053			
	FieldStudy(1)	.049	.338	.021	1	.884	1.050	.542	2.036
	FieldStudy(2)	.801	.331	5.852	1	.016	2.229	1.164	4.266
	FieldStudy(3)	.426	.351	1.477	1	.224	1.531	.770	3.045
	Constant	-12.558	1.392	81.330	1	.000	.000		

a. Variable(s) entered on step 1: EduStage, Gender, GPA, FieldStudy.

Based on the table produced, the determinants of graduate employability can be analysed. Of the four independent variables, two variables were found to be significant in this research. After the analysis was done using binary logistic regression, the model included the independent variable of GPA and field of study in Science. The variable GPA had a significance value of $p < 0.05$ and a regression coefficient of 3.568. Moreover, a category in field of study which is “2” representing Science graduates, had significantly contributed to the model with a regression coefficient of 0.801. Two of these independent variables were found to be positively associated with the likelihood of graduates being employed. Through the binary logistic regression analysis, it is apparent that independent variables can be found to have significance in graduate employability. Hence, the analysis produced the following logistic regression equation:

$$logit(Employment) = -12.558 + 3.568GPA + 0.801FieldStudy(2) \quad (2)$$

4.5 Odds of Ratio Analysis

Logistic regression was utilised in this study to calculate the odds ratio in the presence of more than one independent variable. The odds of ratio are the chances of an event occuring divided by the chance of the event not occurring. Moreover, the probability of an event occurring can be calculated in SPSS and predicted based on a one unit change in an independent variable when all the other independent variables are constant [25]. The adjusted odds ratio was explained in Table 10 under the "Exp(B)" column. It is stated that the exposure to the independent variable increases the odds of the outcome when the adjusted odds ratio is above 1.0. On the other hand, if the adjusted odds ratio is less than 1.0, then the exposure to the independent variable decreases the odds of the outcome.

Based on the analysis done, it is seen that the model included two out of the four independent variables in this research. The two variables that were found to significantly contribute to the model were GPA and field of study in Science. Using the odds ratio, the interpretation was able to estimate the potential of the prediction. It is found in the analysis that the odds of being employed increased 3.568 times with every one unit change in GPA. Besides that, for a graduate studying in the field of study in Science, the odds of being employed is 35.441 times more likely than the odds of being unemployed. The predicted model was established using the independent variable of GPA and field of study in Science and found to be significant using Wald's value as well. Therefore, the analysis showed how significant the independent variables were in the model and how they contributed to the likelihood of graduates being employed.

Conclusion

The tendency of rising unemployment rate is not foreign to Malaysia. The research aimed to highlight the issues of unemployment especially among graduates. It is apparent in this research that unemployment is a recurring issue among fresh graduates in Malaysia. The competition in the labour market rises as other elements are reviewed above academic qualifications when hiring. This study showed the impact of the selected independent variables towards the dependent variable. In order to model the graduate employability, the independent variables that were tested in this research were educational stage, gender, field of study and Grade Point Average (GPA).

Through the binary logistic regression analysis, the determinants of employability for this research were identified while satisfying the objectives in this research. Based on the analysis done, it explained that with the increase in GPA, the likelihood of getting employed increases. Moreover, the increased likelihood of getting employed is also associated with the increasing value of graduates studying Science. Besides that, the research was able to recognise the importance of determinants of employability using the odds of ratio obtained. The final results introduced the model of graduate employability, explained the regressions and tests as well as justified the inclusion of the independent variables in the model. Hence, logistic regression analysis was the most suitable method to describe the relationship between dichotomous dependent variable and independent variables in this research.

In conclusion, the determinants of employability for graduates were identified and can be found through a quantitative analysis. Therefore, this research showed that future job seekers are able to secure a job while focusing on the right elements to work and improve on. It is claimed that the percentage of unemployment lies in the responsibility of a whole nation [21]. Based on the result of the analysis, a number of recommendations were introduced to reach optimal future research in this topic. In hopes of further studies, other independent variables can be taken into account when analysing the graduate employability. This was due to the independent variables relating to external factors that may also contribute to the study and leave an impact in the research. In extensive future studies, it is

significant to consider the element of income-ability of graduates too since this element is realised to be more relevant than marketability and employability. With this research approach, the studies done in the future can relate to more people and specific groups of people.

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