Logistics Regression Modelling on Student Career Path Choices at the Statistics Department, FMIPA UNM Makassar

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Abstract. Survey of career path that students plan after completing their undergraduate in statistics department was carried out through questionnaire on google form from May 6 to May 24, 2021. There were 114 students who filled out the questionnaire, consisting of 20 students from class 2018, 23 students from class 2019, and 71 students from class 2020. Dependent variable is career path plan (Y), while independent variables are tendency to choose career paradigm (CPC), gender (GDR), Grade Point Average (GPA), parental occupation (POC), number of siblings (NOS), place of birth (POB) and year of university entrance (YOE). The data are analysed by binary logistic model with logit transformation and the result is

\[
g(Y) = \ln \left( \frac{\pi(Y)}{1 - \pi(Y)} \right) = -13,525 + 2,332(CPC) - 1,036(GDR) + 4,466(GPA) + 2,421(POC_1) - 0,405(POC_2) + 2,390(POC_3) + 0,236(NOS) - 1,817(POB) + 0,448(YOE_1) - 2,660(YOE_2)
\]

Results of the analysis show that predictive power of the model to explain tendency of students to choose career according to statistics is around 34% to 56% based on variables in the model. Beside that tendency of career paradigm choice (CPC), Grade Point Average (GPA), parental occupation (POC, civil servant), place of birth (POB), and year of entry (YOE_2 2019) significantly affect chosen career goals by student.

Keywords: career path plan, career paradigm, conventional career, boundaryless career

1. Introduction

Currently, statistics cannot be separated from research. Academics, scientists, even agencies/companies need the services of statisticians. This situation becomes an opportunity for statisticians. Statistics are widely used in various fields and not many people know about statistics. Therefore, there is a high demand for human resources who are able to design and manage research data into information that can be used in decision making. The demand for statisticians will not slow down [1]. The need for statistical power can be achieved if there is an institution that is able to create reliable strength in the field of statistics. One of the institutions in question is Statistics Department, FMIPA UNM Makassar.

Opportunities are wide open for educational institutions and statistics graduates to meet the demand of human resources which competent in the fields of research and data management. The prospect of statisticians continues to grow, along with the number of jobs that require qualifications as statisticians, including the ability to analyze data and interpret analysis results. Currently, statisticians are sought after by large companies, and of course they offer great income [2]. In addition to working
in large companies, entrepreneurship in the field of statistics is also developing, which is called "statpreneur". Statpreneur is a statistical agency that provides services, such as designing survey, marketing research, data analysis, and data processing [3].

Responding to this situation, FMIPA UNM Makassar has opened a new department, that is statistics department in 2013. Questions that often arise are about jobs after completing their undergraduate in statistics department. Frequently asked questions are:

a. What skills do graduates of the statistics department have?
b. Are job opportunities available for graduates of the statistics department?
c. Can graduates of the statistics department create new jobs?

These questions were responded to by the Statistics Department, FMIPA UNM Makassar by offering a compulsory course, namely Statistics Orientation. This course discusses career prospects and skills that can be planned by students with the direction of their academic advisor. This course discusses career paradigms, both conventional and modern (boundaryless careers).

This study aims to examine the distribution and tendency of career path that students plan after completing their undergraduate in Statistics Department, FMIPA UNM Makassar. In addition, students’ views about the meaning of career in their life are also the target of discussion in this study. Practical needs can be obtained from the results of this study by finding the distribution and tendency of career plan for students of the Statistics Department, FMIPA UNM Makassar after completing their undergraduate studies as well as students’ views on the meaning of career in their life. This will be an input for the learning process in Statistics Department, FMIPA UNM Makassar.

2. Literature review

2.1. Statistics orientation

Statistics orientation course is designed to introduce a career or job orientation that students can plan after completing their undergraduate in statistics department. In addition, the types of skills that can be chosen to be pursued while studying in the statistics department are also introduced. Then attitudes, general skills, and special skills that students must have after completing statistics orientation course are also explained. Explanation taken from curriculum of the Statistics Department, FMIPA UNM Makassar, is as follows:

2.1.1 Attitudes

a. contribute to improving the quality of life in society, nation, state, and the progress of civilization based on Pancasila;
b. play a role as a proud citizen as a statistician and love the homeland, have nationalism and sense of responsibility to the state and nation;
c. internalize the spirit of independence, fighting, and entrepreneurship.

2.1.2 General skills

a. able to study the implications of statistical development on job field;
b. able to make the right decisions in choosing expertise in the field of statistics, based on the results of analysis of information and data.

2.1.3 Special skills

a. able to choose the right statistical analysis in solving problems;
b. able to find the source of the problem through the process of statistical investigation, analysis, interpretation of data, and information;
c. able to apply the basic concepts of statistics and statistical thinking concepts as well as job challenges in the fields of: education, agriculture, economics and business, industry, health and environment, finance and banking, administration and government.

2.2. Career paradigm

There are four types of employment in statistics, they are mathematical statistician, applied statistician, statistics administrator, and statistician assistant [4]. The use of statistics can be distinguished between general users and special users in statistics. The statistics labour consists of various types of jobs in various fields such as government, factories, banks, insurance companies, financial institutions, public
services, social institutions, educational and research institutions, trade organizations, and advertising companies. In government, statisticians work in the fields of social welfare, health, transportation, agriculture, taxation, banking, insurance, and educational institutions.

It started with the great depression in America which caused organizational changes both internally and externally, career development also changed from traditional career to protean career [5]. Many researchers prove and state that today's careers are different from previous decades. The impact of this change of course led to changes in the system and values of employees as well as management of the company's career development.

Furthermore, changes in internal and external organizations, have an impact on paradigm shift from the old paradigm to the new, and also the implications for individuals and companies [5]. Internal factors get pressure to increase stakeholder value, change the form of the company to become boundaryless, and change organizational management. External factors include changes in the nature of competition, policy decision of the 1980s, and labour market alternatives. This very basic change has an impact on demands for changes in employee attitudes and values, such as changes in the meaning of loyalty, views on career paths, employee positions, and new relationships between employees and the company. Any changes that occur will definitely have an impact on the organizational system. In this case, the change in career management from traditional to protean career which makes a shift from the old management paradigm to a new one, causing changes in the organizational structure and company responsibilities.

The transformation of organizational structure forms a shift in the characteristics and attributes of managerial careers [6]. In its development, the organization no longer acts as an employer but as a facilitator for promotion mechanism, application and improvement of knowledge intensive skills for its members. Organizations are expected to use a relational approach in the career development of their employees, as well as to support the creation of continuous learning. Employment contracts are more emphasized on the basis of the ability to work flexibly, management careers are more self-managed with lateral mobility. This condition indicates the occurrence of a boundaryless career. Career development is carried out through meta-competencies career that focus on skills to be able to learn something. Individuals must have skills which related to self-knowledge, interpersonal knowledge, and environmental knowledge for their career to be success. These requirements and practices skills underlies identity regeneration and flexibility which are the basis for managing a protean career. The success of a protean career will manifest in individual behaviour as an output that is sourced from psychological satisfaction that will lead the organization to achieve a sustainable competitive advantage.

Changes in career values in organizations require employees to always develop their skills and abilities from time to time as a result of environmental and individual changes [7]. These changes refer to the protean career, where the responsibility for competency development and career management lies in the individual, so that organizations need to carry out several stages of protean career adaptation process. Boundaryless career offers great opportunities for individuals to explore and build career based on their own presence [8].

2.3. Types of skills of statistician

Individuals with a strong aptitude for mathematics often find that statistical science provides excellent job satisfaction and opportunities [9]. Statistician obtains data, develop mathematical and statistical techniques, and solve important problems in the social sciences, economics, medical science, politics, ecology, and so on. The following are some career paths for statistician with specialization areas.

| 1. Biostatistician | 7. Risk analyst | 13. Data scientist |
|--------------------|----------------|-------------------|
| 2. Data analyst    | 8. Software engineer | 14. Banking       |
| 3. Environmental scientist | 9. Statistics professor | 15. Mining industry |
| 4. Forensic investigator | 10. Project manager | 16. Naval operations research |
| 5. Marketing research | 11. Economist | 17. Government statistics |
| 6. Quality analyst  | 12. Research     |                   |
Statisticians use mathematical models and probabilistic models to collect, analyse, and interpret data. This leads to better decision making. Statistics are commonly required in almost any field of science, technology, or business. The following areas of specialization include, but are not limited to:

a. Awareness of the value of statistics has grown and large companies are increasingly hiring people with a certain level of statistical qualification.

b. Places where people with statistics qualification can be found at organizations where statistics are applied sporadically, that is organizations with well-structured divisions for statistical consulting and research.

c. Careers in statistics often require additional areas of specialization because statistics are applied in so many areas of interest.

Forty students who participated in an opinion survey and obtained the following results. The student work plan after graduating with a statistics degree is grouped into four options, they are businessmen and economic entrepreneurs, further studies to become professors of statistics, non-faculty Civil Servants, and professional statisticians [10].

2.4. Job meaning

Meaning of job chosen by students is grouped into five, they are job as a tool to achieve self and parental happiness, job as a struggle to achieve life goals, job as identity and pride, job as a duty, responsibility, and worship in life [11]. Meaning of job as an activity to meet needs, concrete actions to achieve something in life, the need to achieve obligations in harmonizing and adjusting conditions and situations in modern times as it is now, the prefix to be able to appreciate the knowledge possessed and practice in work, positive thing in meeting the needs of life and sustaining life for each individual, as well as obligations and processes that are carried out actively and diligently [12].

3. Research methodology

This research was conducted in the even semester of the 2020/2021 academic year. Subject of this research are students of Statistics Department, Universitas Negeri Makassar. The research subjects were selected from students who have attended or have not attended Statistics Orientation course, they are students from generations 2018, 2019, and 2020. They are subjected to explore their understanding and plan towards careers and skills that must be prepared since they are still undergraduate students.

Students who take Statistics Orientation course were given individual assignment, where each student makes an essay. Then their essay was analysed by qualitative and quantitative method so that can be reduced to a summary. An instrument in the form of a questionnaire was also given to confirm the results of the student's essay as an application of the qualitative data triangulation method and the quantitative data ellipse method [13].

| No | Plan                  | Class 01 | Class 02 | Total |
|----|-----------------------|----------|----------|-------|
| 1  | Statistics Professor  | 10       | 5        | 15    |
| 2  | Forensic Investigator | 3        | 1        | 4     |
| 3  | Project Manager       | 5        | 7        | 12    |
| 4  | Data Analyst          | 13       | 7        | 20    |
| 5  | Biostatistician       | 2        | 0        | 2     |
| 6  | Economist             | 1        | 1        | 2     |
| 7  | Software Engineer     | 1        | 3        | 4     |
| 8  | Business Analyst      | 1        | 4        | 5     |
| 9  | Marketing Analyst     | 0        | 1        | 1     |
| 10 | Risk Analyst          | 0        | 1        | 1     |
| 11 | BPS Member            | 0        | 1        | 1     |
| 12 | Accountant            | 0        | 1        | 1     |
| 13 | Environmental Scientist| 0    | 1        | 1     |
| 14 | Market Researcher     | 0        | 1        | 1     |
| 15 | Have not chosen yet   | 4        | 4        | 8     |
|    | **Total**             | **40**   | **38**   | **78**|
Students of the Statistics Department generation 2019 who took statistical orientation course for the odd semester 2020/2021 were assigned to choose one of 14 types of skills which are summarized in Table 1. From this table, it can be seen that from 78 students who have attended in the statistics orientation course, 70 of them have determined their plan and there are 8 students have not submitted their essay.

Data analysis combines quantitative and qualitative method, that is quantitative descriptive followed by qualitative for deepening results. Respondents of this research are students of Statistics Department FMIPA UNM Makassar who have attended or have not attended statistics orientation course. The data collected is the result of filling out a questionnaire that was previously shared online. Data analysis concerns:

a. Student views on the current career paradigm.

b. Career path that students plan after completing their undergraduate in statistics department.

Student's preparations during their studies to achieve their career plan.

4. Result and discussion

Indicator instrument of career orientation for statistics department students is developed through the following steps:

a. formulate an operational definition of career orientation;

b. make instrument grids;

c. make draft of assessment instrument which contains items of the instrument;

d. conduct expert tests on validity of the material;

e. conduct empirical tests to describe quality and qualifications of the questions.

4.1. Descriptive analysis results

There were 114 students of the Statistics Department, FMIPA UNM Makassar, who filled out the questionnaire. The distribution can be seen in Table 2.

| Class of Student | Amount |
|------------------|--------|
| 2018             | 20     |
| 2019             | 23     |
| 2020             | 71     |
| **Total**        | **114**|

Students' answers to the questionnaire were concluded as follows:

a. There were 57 students who answered “operational competence” (conventional career) when asked about competencies that they need in a career and 57 students answered “the competence of developing team work (boundaryless career).

b. The questions that almost all students view towards boundaryless career are “development orientation” answered by 111 students and “specialization” answered by 105 students.

c. There are 15 indicators that are dominantly chosen towards the boundaryless career, they are: skills needed in a job, company organization, payroll system, award, mobility, risk, career supervision, career age, focus on career continuity, skill development goal, responsibility, promotion opportunity, relationship with company, development orientation, and specialization.

d. There are 12 indicators that are dominantly chosen towards conventional career, they are: employee loyalty attitude towards job, job orientation, company employee relationship model, Empowerment (career promotion) of employees, manager role, evaluation, contract, career management, career development, organization role, development of employees' competency, and task orientation.

e. Student career path choices is shown in Table 3. BPS statistician are the most dominant choice among students, followed by education and government statistician and data analyst.
The three classes agreed on a number of dominant indicators towards boundaryless career and conventional career as shown in Table 4.

In Item 10 Payroll system, classes 2019 and 2020 agreed on boundaryless career, while class 2018 balanced between boundaryless career and conventional career. Item 18 Career age, classes 2018 and 2020 agreed on boundaryless career, while class 2019 agreed on conventional career. Item 12 Contract, classes 2019 and 2020 agreed on conventional career, while class 2018 agreed on boundaryless career. Item 22 Task orientation, class 2019 agreed on boundaryless career, class 2020 agreed on conventional career, while class 2018 balanced between boundaryless career and conventional career.

Table 4. Career paradigm choice that leads to boundaryless career and conventional career.

| No. | Agreement items | Agreement items |
|-----|----------------|----------------|
| 1   | Item 2 Skills needed in the job | Item 1 Employee loyalty attitude towards job |
| 2   | Item 6 Company organization | Item 3 Job orientation |
| 3   | Item 11 Award | Item 4 Company employee relationship model |
| 4   | Item 14 Mobility | Item 5 Empowerment (career promotion) of employees |
| 5   | Item 15 Risk | Item 7 Manager role |
| 6   | Item 16 career supervision | Item 9 Evaluation |
| 7   | Item 21 Focus on career continuity | Item 13 Career management |
| 8   | Item 23 Skill development goal | Item 17 Career development |
| 9   | Item 24 Responsibility | Item 19 Organization role |
| 10  | Item 25 Promotion opportunity | Item 20 Development of employees’ competency |
| 11  | Item 26 Relationship with company |
| 12  | Item 27 Development orientation |
| 13  | Item 28 Specialization |

4.2. Inferential analysis results

Dependent variable in this study is career path goal (Y), while independent variables are tendency to choose career paradigm (PK), gender (JK), grade point average (IPK), parents’ job (X=X1, X2, X3), number of siblings (BS), place of birth (TL) and year of entry or class (AK=AK1, AK2). The units of measurement for each variable is shown in Table 5.
A transformation of $\pi(Y)$ called logit (logit transformation) used in logistic regression and the formula is expressed by:

$$g(Y) = \ln\left(\frac{\pi(Y)}{1 - \pi(Y)}\right) = \beta_0 + \beta_1 PK + \beta_2 JK + \beta_3 IPK + \beta_4 X_1 + \beta_5 X_2 + \beta_6 X_3 + \beta_7 BS + \beta_8 TL + \beta_9 AK_1 + \beta_{10} AK_2$$

For simpler notation, $\pi(x)=H(Y|x)$ which describes conditional mean of $Y$ given $x$. The data were analyzed using binary logistic model whose formula is as follows:

$$\pi(Y) = \frac{e^{\theta_0 + \theta_1 PK + \theta_2 JK + \theta_3 IPK + \theta_4 X_1 + \theta_5 X_2 + \theta_6 X_3 + \theta_7 BS + \theta_8 TL + \theta_9 AK_1 + \theta_{10} AK_2}}{1 + e^{\theta_0 + \theta_1 PK + \theta_2 JK + \theta_3 IPK + \theta_4 X_1 + \theta_5 X_2 + \theta_6 X_3 + \theta_7 BS + \theta_8 TL + \theta_9 AK_1 + \theta_{10} AK_2}}$$

Results of the analysis are shown in Table 6. This table shows that estimated model is:

$$g(Y) = \ln\left(\frac{\pi(Y)}{1 - \pi(Y)}\right) = -13.525 + 2.332 PK - 1.036 JK + 4.466 IPK + 2.421 X_1 - 0.405 X_2 + 2.390 X_3 + 0.236 BS - 1.817 TL + 0.448 AK_1 - 2.660 AK_2$$

### Table 5. Units of measurement variable.

| No | Variable                  | Symbols and units of measurement |
|----|----------------------------|----------------------------------|
| 1  | Career path goal          | $Y = 1$                        |
|    |                            | according to statistics         |
|    |                            | $Y = 0$                        |
|    |                            | not suitable for statistics     |
| 2  | Career paradigm           | PK = 1                         |
|    |                            | modern                         |
| 3  | Gender                    | JK = 1                         |
|    |                            | Male                           |
| 4  | Grade point average (GPA) | IPK interval $0.00 - 4.00$     |
| 5  | Parents’ job              | $X_1$ = Civil servant (dummy variable 1, 0, 0) |
|    |                            | $X_2$ = Entrepreneur (dummy variable 0, 1, 0) |
|    |                            | $X_3$ = Private employee (dummy variable 0, 0, 1) |
|    |                            | Others job as base level (dummy variable 0, 0, 0) |
| 6  | Number of siblings        | BS = 1 number of siblings ≤ 3  |
|    |                            | BS = 0 number of siblings > 3  |
| 7  | Place of birth            | TL = 1 City                    |
|    |                            | TL = 0 Regency                 |
| 8  | Class                     | AK1 = Class 2018 (dummy variable 1, 0) |
|    |                            | AK2 = Class 2019 (dummy variable 0, 1) |
|    |                            | Class 2020 as base level (dummy variable 0, 0) |

### Table 6. Results of binary logistics regression analysis.

| Variables | B     | S.E.  | Wald  | Df  | P   | Exp(B) |
|-----------|-------|-------|-------|-----|-----|--------|
| PK        | 2.332 | 0.810 | 8.294 | 1   | 0.004 | 10.302 |
| JK        | -1.036| 0.813 | 1.622 | 1   | 0.203 | 0.355  |
| IPK       | 4.466 | 1.678 | 7.081 | 1   | 0.008 | 87.051 |
| $X_1$     | 2.421 | 1.236 | 3.837 | 1   | 0.050 | 11.254 |
| $X_2$     | -0.405| 0.850 | 0.227 | 1   | 0.634 | 0.667  |
| $X_3$     | 2.390 | 1.558 | 2.353 | 1   | 0.125 | 10.910 |
| BS        | 0.236 | 0.825 | 0.082 | 1   | 0.775 | 1.266  |
| TL        | -1.817| 0.714 | 6.480 | 1   | 0.011 | 0.163  |
| AK1       | 0.448 | 1.564 | 0.082 | 1   | 0.774 | 1.566  |
| AK2       | -2.660| 1.244 | 4.575 | 1   | 0.032 | 0.070  |
| Constant  | -13.525| 5.781 | 5.473 | 1   | 0.019 | 0.000  |
Results of the analysis show that value of -2 Log likelihood = 61.278, Cox Snell R Square = 0.342 and Nagelkerke R Square = 0.555. These results indicate that predictive power of the model to explain the tendency of students to choose career in the field of statistics is around 34% to 56% based on the variables in the model. This shows that there are other variables that might influence students in determining their career goal. Table 6 shows that the tendency of choosing a career paradigm (PK) significantly affects the career goal because value of $p = 0.004 < \alpha = 0.05$. Table 6 also shows that $\exp(B) = 10.302$ with $B = 2.332 > 0$ for PK, which means that students who choose the modern career paradigm have a ten times greater chance to choose career goal in the field of statistics than students who choose conventional career paradigm orientation.

The Grade Point Average (GPA) also significantly affects the career goal chosen by students because value of $p = 0.008 < \alpha = 0.05$. Value of $\exp(B) = 87.051$ with $B = 4.466 > 0$ for IPK shows that students with high IPKs are 87 times more likely to have career goal in the field of statistics than students with low IPKs. Next, parents’ job ($X_1$ PNS) significantly affects the career goal chosen by students because value of $p = 0.050 \leq \alpha = 0.05$. Table 6 also shows that $\exp(B) = 11.254$ with $B = 2.421 > 0$ for $X_1$, which means that students whose parents are public servants are 11 times more likely to have career goal in the field of statistics than students whose parents are entrepreneurs, private employees, and other jobs.

Next, from Table 6, it is found that place of birth (TL) significantly affects the career goal chosen by students because value of $p = 0.011 < \alpha = 0.05$. Value of $\exp(B) = 0.163$ with $B = -1.817 < 0$ for TL, which means that students whose place of birth was in a City have a 1.6 times lower chance of having career goal in the field of statistics than students whose place of birth was in a regency. Furthermore, the results obtained that the year of entry or class (2019) significantly affects the career goal chosen by students because value of $p = 0.032 < \alpha = 0.05$. Value of $\exp(B) = 0.070$ with $B = -2.660 < 0$ for AK2, shows that students of class 2019 have a 0.7 times lower chance of having career goal in the field of statistics than students of classes 2018 and 2020.

5. Conclusion
Based on the results of the descriptive analysis, it can be concluded that:

a. There is no difference in the tendency to choose conventional and modern career paradigms based on the year of student entry (2018, 2019, and 2020).

b. The tendencies to choose the careers of the students in the classes 2018 and 2019 are the majority of choices as Statisticians of the Central Statistics Agency and Data Analysts, while the majority of students in class 2020 are Statisticians of the Central Statistics Agency and Bank Employees.

Based on the results of data analysis using the binary logistic model, the following interesting things were found:

a. Students with high GPAs have the greatest chance of choosing career plan according to the field of statistics than students with low GPAs.

b. Students whose parents work as civil servants have a greater chance of choosing career plan according to the field of statistics than students whose parents work is not civil servants.

c. Students who tend to choose modern paradigm or boundaryless career also have a great opportunity to choose their career plan according to the field of statistics than students who tend to choose conventional career paradigm.

d. The tendency of students to choose career plan cannot be predicted based on gender, number of siblings, place of birth, and year of entering college, especially in the Statistics Department, FMIPA UNM Makassar.

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