International Journal of Applied Sciences and Smart Technologies

Volume 3, Issue 2, pages 241–256

p-ISSN 2655-8564, e-ISSN 2685-9432

Independence Test and Plots in Correspondence Analysis to Explore Tracer Study Data

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(Received 17-11-2021; Revised 30-12-2021; Accepted 31-12-2021)

Abstract

The results of the exploration of tracer study data can be used as information about the career of graduates and the relevance of work to the field of study as well as the competencies obtained before graduation. The question items discussed were a description of the time and process of looking for a job, the length of time to get the first job, the relationship between length of study, gender, field of work, total income, alumni's perception of the closeness of the field of study to work, the suitability of the level of education on the job, and average level of competence. The aim of this study was to analyze the relationship between these variables in the 2020 tracer study data from graduates of all faculties at Sriwijaya University. Respondents studied were 2,669 people. The method used is descriptive statistics, biplot analysis, independence test and plots by simple correspondence analysis. Respondents' perceptions of the suitability of the level of education in employment are related to gender and also with respondents' perceptions of the closeness of the field of study to the field of work. Meanwhile,

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respondents' perceptions of the closeness of the field of study with work are related to the field of work. The average length of study, the average number of job applications, the number of companies or agencies that responded to applications, and invited interviews for female respondents were lower than male respondents.

Keywords: Alumni perception, to explore, field of work, field of study, tracer study data.

1 Introduction

Data from alumni resulting from tracer studies is useful for obtaining information that can be used for higher education development, to evaluate the relevance of hard skills, soft skills, and internal / external factors obtained by alumni when they become students and work [1]. The Career Development Center (CDC) is a character and career development center in Unsri, where the CDC was formed in 2013 to respond to the low achievement of tracking points for graduates who are blocked by AIPT forms. CDC has tracked alumni from 10 faculties at Sriwijaya University starting from the alumni in 2013 to 2020. The tracer study report can be seen at [2], [3], [4], [5], [6], [7].

CDC of Sriwijaya University (Unsri) conducted a tracer study to study alumni early careers, as well as obtaining alumni feedback for improving the learning system in Unsri and evaluating / developing a curriculum that meets stakeholder expectations and market needs. Apart from tracer studies, CDC also provides other services, including: Unsri Career Expo, soft skills training, online assessment, career training, and career counseling [6]. Reference to learn various things related to career center and its services, also to study the solution to the problems of graduates and employment faced such as problems of alignment of the world of education with the world of work can be seen in [8], [9], [10].

Interpretation of the questionnaire results in the form of descriptive statistics from the data, both in the form of numbers (percentages), graphics, and the interpretation is very helpful in providing information for further analysis. The results of the analysis are very useful for the successful implementation of the tracer study. Tracer study data can

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be big data which consists of many objects and many variables, so to extract as much information as possible from the data, it is necessary to use other analysis techniques, including multivariate analysis.

In [11], it was obtained a lot of information regarding the comparison between FKIP respondents (alumni) and FMIPA respondents (alumni) in each of the 4 departments/study programs, based on data from the 2013 to 2016 tracer study. Information obtained includes: the relationship between GPA, duration thesis, and length of study; profiles of alumni who received scholarships and those who did not during college were reviewed from the GPA, length of thesis, and length of study; field of work of each alumni; the relationship between the GPA and the length of time getting the first job and the relationship between the GPA and the suitability of the level of education in the job; the relationship between the closeness of the field of study and the suitability of the level of education with the job; alumni perceptions about the contribution of Higher Education (Unsri) to all competency items owned by alumni; the relationship between competency groups and GPA, level of education, and length of time to get a job.

Information on the relationship between the factors studied in [12] obtained after studying the descriptive statistics of the data obtained from the results of the tracer study. The description of the alumni of each faculty and the comparison of alumni between faculties in Unsri will provide a lot of input not only regarding the competencies of alumni needed by the world of work but also regarding the steps of all academicians to work together to prepare higher quality graduates in accordance with the vision and mission of the university which of course must be supported by vision and mission of the faculty and departments / study programs.

In [13], it was analyzed the relationship between GPA and the suitability of education level with the field of work of Sriwijaya University alumni from 5 faculties, namely FISIP, FMIPA, FE, FH, and FT based on 2019 tracer study data. The perception of the majority of respondents to the level of education and also the closeness of the field of study required in their work is not related to the GPA. Only in FT respondents, there is a relationship between GPA and the closeness of the field of study on the job. Based on [14], in 5 faculties data, both in the form of graduates and respondent data,

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women's GPA is higher than men. On the other hand, the length of study and income of women is lower than that of men. The average GPA of FH alumni is the highest compared to other faculties. The average length of study of FISIP alumni is the highest compared to other faculties. The average income and total income of FT respondents were the highest compared to respondents in other faculties.

Meanwhile in [15], based on the results of the analysis in the boxplot form, it was found that GPA did not affect the income and field of work of the 2010 ITB alumni. In [16], it was analyzed the comparison of 4 majors (study programs) at the Faculty of Mathematics and Natural Sciences (FMIPA) and the Faculty of Teacher Training and Education (FKIP) in terms of the relationship between gender variables, the average alumni perception of the competencies possessed and needed in the field of work, length of time study, length of time to get a first job, income, field of work, alumni's perception of the suitability of education level with the field of work, and respondents' perceptions of the closeness of the field of study to the field of work. This research is based on tracer study data from 2020 on each FKIP and FMIPA respondents, as many as 216 and 239 respondents.

In [17], it was examined the relationship between alumni perceptions of competencies mastered with competencies needed by the world of work for Unsri graduates in 2018. There are 8 out of 29 competencies that should be further improved. In addition, the types of competencies that are further enhanced between female graduates and male graduates are different.

This study aims to analyze the relationship between several variables from the question items of the tracer study questionnaire simultaneously and explore further the data using the objects of all 2020 tracer study respondents from 10 faculties at Unsri. Quantitative variable data were analyzed descriptively and exploratory using biplot analysis. Variable data of qualitative type, nominal and ordinal scale were analyzed using independence test and plots in correspondence analysis. Independence test used chi squares (□2) test. The output of correspondence analysis include symmetric and asymmetric plot. Because this study uses data from all respondents from all faculties, the results of the analysis can describe in general the characteristics of Unsri graduates

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in 2018 in their careers and the relevance between the competencies obtained from college and their work.

2 Research Methodology

This research is a case study, using secondary data from questionnaires in the 2020 tracer study conducted by CDC Unsri. Respondents in the 2020 tracer study are alumni who graduated in 2018. The data used includes the results of tracer studies in 10 faculties at Unsri.

This study only uses answers to several questionnaire questions used for descriptive analysis and exploratory analysis, namely gender, length of study, length of time looking for a job, number of job applications, number of responses to job applications, number of interview calls, length of time getting the first job, field of work, main income, total income, respondent's perception of the most appropriate level of education for alumni's work, closeness of field of study to alumni's job, average respondent's perception of competency level. Alumni (graduates) who filled out the tracer study questionnaire were declared as respondents. The analytical technique used is descriptive statistics, biplot analysis (including correlation between variables), chi square test (χ^2), and simple correspondence analysis.

The steps taken in the combined data of all faculties are:

1. Select the required questionnaire questions as variables.
2. Compile a data matrix from the answers to the questionnaire questions in Step 1 with the objects being all respondents from 10 faculties. The data matrix variables include: length of time looking for a job, both before graduation and after graduation (f3), length of time getting the first job (f5), number of job applications (f6), number of companies responding (f7), number of job interview calls (f7a), field of work (f11), income (f13), alumni's perception of the closeness of the field of study to alumni's work (f14), the suitability of the most appropriate level of education for alumni's work (f15), and the average alumni perception of the level of competencies that are mastered and needed in the field of work (f17).

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3. Develop a new data matrix by removing data on respondents who did not fill in questions about income.
4. Add gender and length of study variables.
5. Do descriptive statistics.
6. Perform a biplot analysis as a graphical representation of a data matrix whose variables are quantitative.
7. Perform the chi square test
    a. Arrange column and row categories in the contingency table.
    b. Calculate the frequency of cross-relation between column and row categories.
    c. Perform the chi square test on the contingency table.
    d. If the cell frequency from the contingency table is less than 5, then the categories can be merged, or if not, skip to Step 8.
8. Perform a correspondence analysis on the relationship between two interrelated variables based on the results of Step 7.
9. Interpretation of results.

Data processing is done with the help of Minitab 19 software.

3 Results and Discussion

The tracer study data for 2020 came from 3,850 respondents, consisting of 2018 graduates in 10 faculties at Unsri. The data is compiled in the form of a new data matrix, which consists of 2,669 respondents with variables as in Step 2. This new data matrix is formed with the assumption that respondents did not fill in their income (either because they have not found a job, are not working, or are graduates who are continuing their studies) not included in the data matrix. So, there are only 2,669 respondents who are all working. Furthermore, the length of study and gender variables were added to the data matrix.

Table 1 displays descriptive statistics from the answers to several questionnaire questions. The majority of respondents looked for work 1.63 months after graduation and got their first job 5.94 months after graduation. There are only 46 respondents who are looking for work, but did not fill in the question about the length of time they got their first job.

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Table 1. Descriptive statistics of variables regarding the process of respondents looking for and getting a job

Variable	*n*[e]	%age	Mean	StDev	Median
f302[a]	561	21.4	6.992	13.671	2
f303[b]	2061	78.6	1.625	2.8753	1
Bgrad[c]	290	11.3	11.14	17.52	3
Agrad[d]	2286	88.7	5.936	4.887	5

Note: [a]length of time to find a job before graduating (in months)
[b]length of time looking for a job after graduation (in months)
[c]length of time to get first job before graduating (in months)
[d]length of time to get first job after graduation (in months)
[e]number of respondents

Comparison of the length of study, the status of the job search process, income, and the average perception of alumni on the level of competence can be seen in Table 2. Male respondents had the number of job applications (f6), the number of companies that responded (f7), the number of interviews (f7a), which is more than female respondents. From the number of job applications that are made, only about a third are responded to by companies (or users). From the number of users (companies/agencies) who responded, only about half called respondents for job interviews.

Table 2. Descriptive statistics of study duration, status of the job search process, income, and perception of competence

Variable	Gender	*n*	Mean	StDev	Median
Length of study (in years)		2669	4.58	1.08	4
	0	1510	4.42	0.95	4
	1	1159	4.79	1.19	5
f6		2601	24.19	62.34	10
	0	1484	19.68	37.94	10
	1	1117	30.20	84.12	10
f7		2596	7.86	11.92	5
	0	1484	6.95	8.58	4
	1	1112	9.06	15.20	5
f7a		2586	4.67	6.00	3
	0	1480	4.20	5.00	3
	1	1106	5.30	7.09	3
Income		2669	4007294	4399354	3100000
	0	1510	3269989	3244314	3000000
	1	1159	4967890	5407720	4000000

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Total Income		2669	4546057	4781143	3700000
	0	1510	3703070	3514537	3000000
	1	1159	5644341	5868338	4500000
S-KK		2669	3.84	0.48	3.83
	0	1510	3.83	0.47	3.83
	1	1159	3.84	0.49	3.83
S-PT		2669	3.79	0.59	3.79
	0	1510	3.81	0.58	3.83
	1	1159	3.76	0.59	3.79

Based on Table 2, there are 1,510 (57%) female respondents and 1,159 (43%) male respondents. The length of study for male respondents (average 4.79 years) is higher than the length of study for female respondents (average 4.42 years). Male respondents also have higher average income and total income than female respondents. The average respondent's perception of the level of competency mastered (with notation S-KK) and the competencies required by the world of work (notation S-PT) are more likely to be the same. The correlation between the variables in Table 2 can be seen in Table 3 and the biplot graph in Figure 1.

Table 3. Correlation between length of study, status of job search process, income, and perception of competence

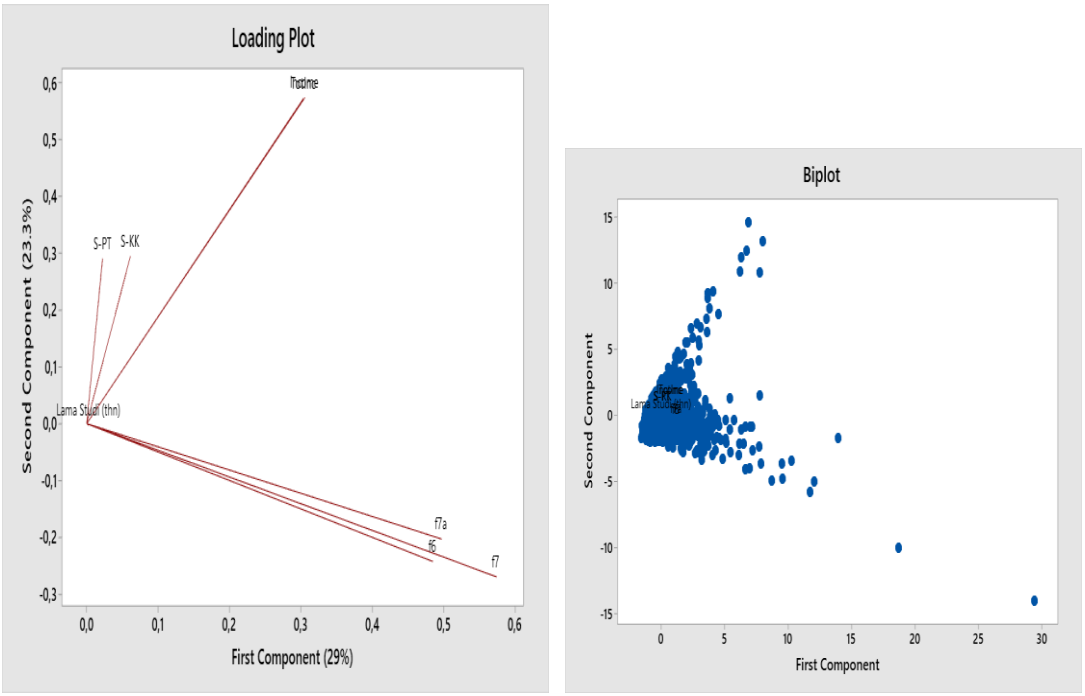
	Length of study (in years)	**f6**	**f7**	**f7a**	**Income**	**Total Income**	**S-KK**
f6	0.042						
f7	-0.016	**0.722**					
f7a	-0.024	0.383	**0.721**				
Income	0.007	0.058	0.080	0.088			
Total Income	0.007	0.051	0.077	0.089	**0.945**		
S-KK	-0.023	0.019	0.018	0.039	0.046	0.042	
S-PT	-0.023	-0.018	-0.024	-0.003	0.034	0.027	**0.773**

Based on Table 3, income is only correlated (very high) with total income. The number of job applications, the number of users who responded to the application, and the number of interview calls were highly correlated with each other. Likewise, a high correlation occurs between the average respondent's perception of the level of competence mastered with the competencies needed by the world of work. The same interpretation can be seen in Figure 1a.

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1a. Correlation between variables 1b. Biplot

Figure 1. Biplot of length of study, status of job search process, income, and perception of competence

Based on Figure 1a, the biplot can represent a data variation of 52.3%. The first component is dominant represented by the respondent's process status variable in looking for work (f6, f7, and f7a). While the second component is dominant represented by income and total income variables. Based on the distribution of respondents' positions tend to spread in the direction of the variable vectors. Only a small proportion of respondents have a high income, their number of job applications are responded and get the opportunity to be interviewed.

Furthermore, the relationship between several variables of the data matrix is explored using the independence test, i. e. by using chi squares test. If the test results state that there is a relationship between the two variables, the process is continued with a simple correspondence analysis. The cells in the contingency table represent the frequency of the number of respondents from the cross-relationship between the row variable category and the column variable category. Figure 2 is the partial output of the chi square test on the relationship between length of study and gender.

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Chi-Square Test for Association: Length of study (in years); Gender

Rows: Length of study (in years) Columns: Gender

	0	1	All
2	41	22	63
3	33	34	67
4	931	522	1453
5	349	350	699
6	67	78	145
7	86	122	208
8	3	31	34
All	1510	1159	2669

Cell Contents
Count

Chi-Square Test

	Chi-Square	DF	P-Value
Pearson	106,684	6	0,000
Likelihood Ratio	110,179	6	0,000

Figure 2. The output of the chi squares test on the relationship between length of study and gender

Based on Figure 2, the majority of respondents graduated in 4 years and were female respondents (931 people or around 35%). The value of □2 count (106.684) > □2 table (0.05; 6) (12.592); namely the relationship between the length of study with gender. The same thing can be seen from the p-value < 0.05.

Chi-Square Test for Association: Level of education; Gender

Rows: Level of education Columns: Gender

	0	1	All
1	28	35	63
2	1475	1113	2588
4	7	11	18
All	1510	1159	2669

Cell Contents
Count

Chi-Square Test

	Chi-Square	DF	P-Value
Pearson	6,250	2	0,044
Likelihood Ratio	6,183	2	0,045

Figure 3. The output of the chi squares test on the relationship between respondents' perceptions of education level and gender

Based on Figure 3, the majority of female respondents have the perception that the level of education that is most suitable for their job is at “the same level” (there are

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1,475 people or 55%). The value of □2 count (6.25) > □2 table (0.05; 2) (5.99); namely the existence of a relationship between perceptions of the suitability of the level of education on the job with gender. The same thing can be seen from the p-value < 0.05. Furthermore, the same way is also carried out to analyze the close relationship between the categories on the two variables, so that the recapitulation is obtained as in Table 4.

Table 4. Recapitulation of chi square test on correspondence analysis results

No	Row Variable	Column Variable	Majority category (%)	χ^2_{count} Value	χ^2_{table} value	χ^2 Test results	Conclusion
1	Length of study	Gender	4 years for female respondents (35)	106.68	$\chi^2_{0,05;\ 6}$ (= 12.59)	Reject H_0	There is a relationship
2	f15[a]	Gender	The same level for female respondents (55)	6.25	$\chi^2_{0,05;\ 2}$ (= 5.99)	Reject H_0	There is a relationship
3	f14[b]	Gender	Very Close to female respondents (21.5)	2.484	$\chi^2_{0,05;\ 4}$ (= 9.49)	Accept H_0	No relationship
4	f14	f15	Very Close and Same Level (36)	39.809	$\chi^2_{0,05;\ 8}$ (= 1551)	Reject H_0	There is a relationship
5	f11[c]	f15	Same rate in private companies (54)	6.256	$\chi^2_{0,05;\ 8}$ (=15.51)	Accept H_0	No relationship *)
6	f14	f11	Very close to private companies (21) and government agencies (16)	212.95	$\chi^2_{0,05;\ 16}$ (=26.3)	Reject H_0	There is a relationship

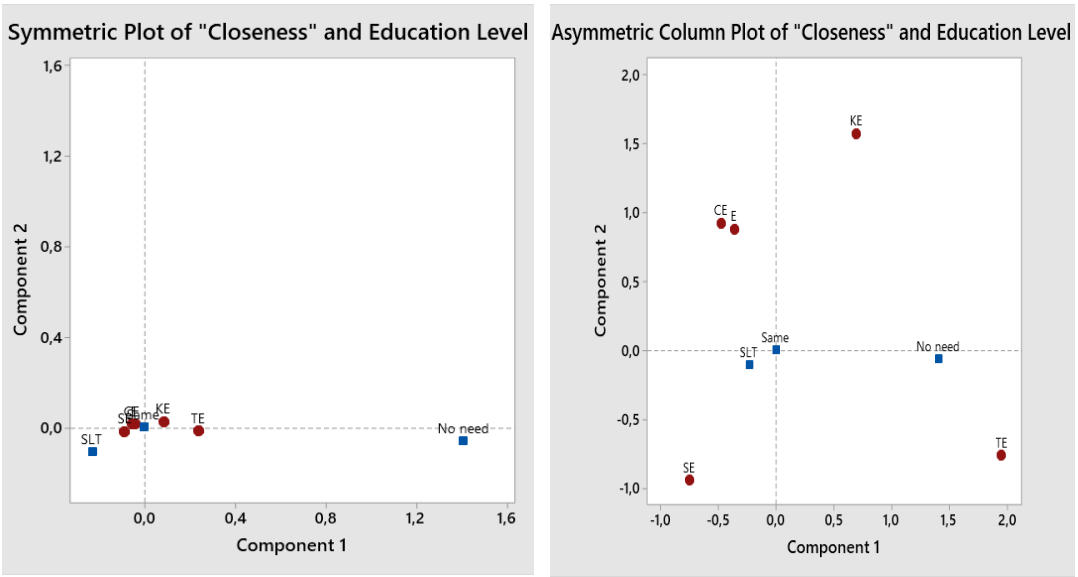
Note: [a]The most appropriate level of education for the respondent's job
[b]Close relationship between the field of study and work
[c]Field of work
*) the test results of both categories of variables are invalid

Based on Table 4, only 2 forms of relationship from the chi squares test whose □2value < □2 table; namely the relationship between gender and the respondent's perception of the closeness of the field of study on the job, and also the relationship between the field of work and the respondent's perception of the suitability of the level of education on the job. Furthermore, the existence of a relationship between row variables and column variables whose categories are more than 2 can be described

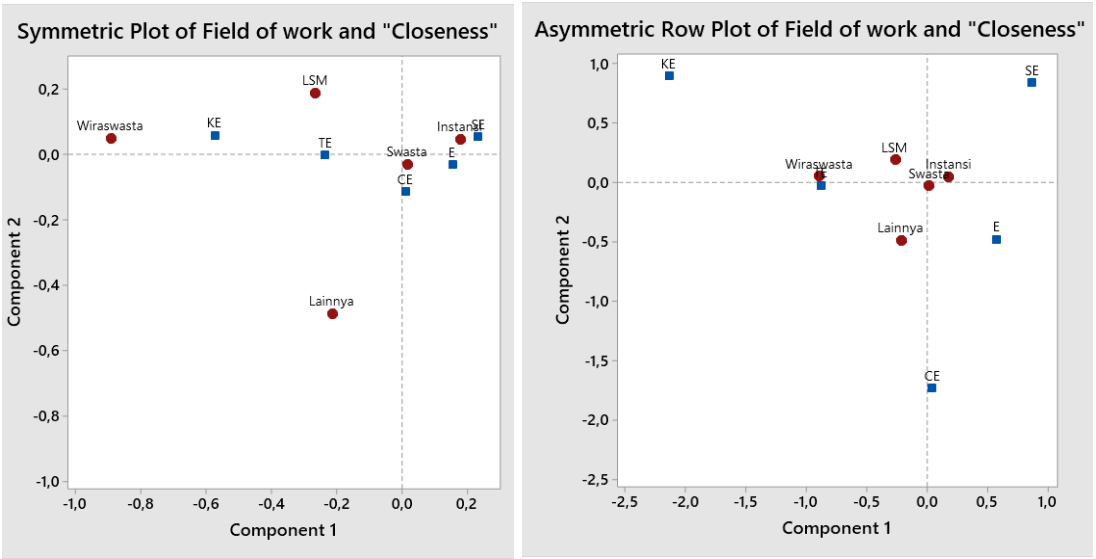
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through the output of correspondence analysis. The output of the correspondence analysis includes the distance of chi squares and the total inertia of the two axes on the graph. The output plot of this simple correspondence analysis has a total inertia of 100% (Figure 4a) and 95.7% (Figure 4b), so it is very representative in presenting data diversity.



a. The Relationship of respondents' perceptions on closeness of fields of study and suitability of education level with employment



b. The relationship between the field of work and respondents' perceptions of the closeness between the field of study and work

Figure 4. Plot of the relationship between two variables of correspondence analysis results

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Based on Figure 4a, respondents who have the perception that their field of study is “not closely” related to their work, tend to have the perception that their work does “not need higher education”. Meanwhile, respondents who have the perception that their field of study is related "quite closely" to "very closely" with their work, tend to have the perception that their work is "the same" with their level of education.

Based on Figure 4b, respondents who work in government agencies (including BUMN) and the private sector have the perception that the field of study is “very closely” related to work. Meanwhile, respondents who work as entrepreneurs have the perception that the field of study is not closely related to work.

4 Conclusion

Based on the results and discussion, it is concluded that the majority of respondents are looking for and getting their first job after graduation. The number of job applications, the number of users who responded to the application, and the number of interview calls were highly correlated with each other. Likewise, a high correlation occurs between the average respondent's perception of the level of competence mastered with the competencies needed by the world of work. Male respondents have a higher length of study, average income, and total income than female respondents. The average respondent's perception of the level of competence mastered and the competencies needed by the world of work are more likely to be the same.

Based on the independence test, gender is related to the length of study and respondents' perceptions of the suitability of the level of education on the job. There is a relationship between respondents' perceptions of the closeness of the field of study and the suitability of the level of education with the field of work. The results of the correspondence analysis show that respondents who have the perception that the field of study is not closely related to their work, tend to have the perception that their work "does not need higher education", and work as entrepreneurs. Respondents who work in government agencies (including BUMN) and the private sector have the perception that the field of study is “very closely” related to work.

The study describes the general characteristics of all respondents from 10 faculties at Unsri based on 10 question items on the tracer study questionnaire. For further research, it is better to examine the comparison of these characteristics in each faculty at Unsri.

Acknowledgements

Authors wishing to acknowledge assistance or encouragement from our discussion group and also special thanks for the staff of CDC (Career Development Center) University of Sriwijaya that had provided tracer study data.

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p-ISSN 2655-8564, e-ISSN 2685-9432

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