Preference analysis of determining jobs using conjoint analysis

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Abstract. Nowadays, there are many graduates who are not directly employed after receiving bachelor’s degree. The graduates who are not employed seem largely unaware of career opportunities and unsure of how to apply their skills in the workforce. This indicates a lack of career guidance, coaching and counselling. This research aims to study people’s preferences on determining their jobs by using conjoint analysis. Four factors are evaluated: (1) income, (2) suitability of the workplace with educational background, (3) field of works, and (4) working hours, which has different level category values. Monotonic analysis of variance is used to analyze the data and the results are (1) utility value which is useful to know the most desirable level of each attribute and (2) its relative importance value to know the most considered attribute on determining their jobs. The full profile method of conjoint analysis shows that income is the most considered attribute value.

Keyword: conjoint analysis, jobs, monotonic analysis of variance, preference.

1. Introduction
Conjoint analysis was introduced for the first time by the mathematical psychology in 1964 [1], then developed according to the need of the researcher. In the beginning, this analysis is more widely used by research companies in developing their product, but over the times, conjoint analysis can also be applied to other fields of study.

In its application, conjoint analysis can be used by the university to determine the preferences of its college students on the factors or attributes that are considered in choosing a job. Salary, the work field, the suitability of educational background to the workplace, and distance of the workplace, are some of the many things that they consider in choosing a job.

2. Conjoint analysis
Conjoint analysis is a multivariate technique that is specifically used to study consumers’ product or service preferences by measuring utility of each level of each attribute and relative importance value of various attributes [2].

In general, conjoint analysis model can be formulated as follows [3]:

\[ U(X) = \sum_{i=1}^{m_i} \sum_{j=1}^{k_j} \beta_{ij} X_{ij} \]  

(1)

in practical, intercept is usually added to the conjoint analysis model so that the model becomes:

\[ U(X) = \beta_0 + \sum_{i=1}^{m_i} \sum_{j=1}^{k_j} \beta_{ij} X_{ij} \]  

(2)
where:

- $U(X)$ = total utility
- $\beta_{ij}$ = part-worth or utility value of the $i$-th attribute, $j$-th level
- $k_j$ = $j$-th level from $i$-th attribute
- $m_i$ = $i$-th attribute
- $X_{ij}$ = dummy variable $i$-th attribute, $j$-th level.

The utility value is used to determine the importance of a level relative to another level in an attribute. Utility value is derived from the dummy variable for the level of an attribute that constructed conjoint model, where the value of the dummy variable for the other attribute is fixed or zero. The best product or service is a combination of a level attribute that has the highest utility value. Relative importance value is used to know the importance of an attribute to another attribute. Relative importance is formulated as follows:

$$RI = \frac{UH_i - UL_i}{\sum_{j=1}^{k} (UH_i - UL_j)}$$

where:

- $RI$ = relative importance
- $UH_i$ = highest utility score $i$-th attribute
- $UL_i$ = lowest utility score $i$-th attribute
- $k$ = total attribute.

The following are the steps in conjoint analysis:

- Designing stimulus
  Stimulus is a combination of each level from different attribute. Respondents are asked to evaluate these stimuli, so that the researcher could know about their preferences. Conjoint analysis used full factorial design to construct stimulus. However, as the number of attributes and level increases, there are many stimuli to evaluate. This condition will make respondents difficult and inconsistent to trade-offs, so it is necessary to reduce stimulus, and then this is called fractional factorial design.
- Choosing a Conjoint method
  There are three methods that can be used in conjoint analysis:
  a. **Traditional conjoint analysis**

  Traditional conjoint analysis is the simplest method of conjoint analysis where data analyze single or full profile can be done manually or computerized. Estimation of utility score in traditional conjoint analysis if the data is metric (rating data) then used OLS (Ordinary Least Square), and if the data is nonmetric (ranking data) then used monotone regression.

  b. **Adaptive conjoint analysis**

  ACA (Adaptive Conjoint Analysis) is developed specifically to accommodate a large number of factors (many rimes up to 30), which would not be feasible in traditional conjoint analysis. The term “adaptive” means that the interview is employed computerized process and the question must be different for each respondent. Previous answer is used to determine which questions will be presented to respondents to obtain the most dominant information on respondent preferences.

  When ACA was introduced, the utility was estimated using OLS (Ordinary Least Square). But as the times goes by, ACA has grown and improved, which ACA-Hierarchical Bayes has been widely used to estimate the utility value of a product.

  c. **Choice based conjoint**

  The CBC (Choice Based Conjoint) is a new method in the conjoint study, which has been very popular in recent years. Compared to other method, CBC allows respondents to choose one preference profile from a set of profiles or not choosing at all. The estimation of utility is obtained in aggregate by using multinomial logit. As the time goes by, Hierarchical Bayes Estimation have been found for CBC that make it possible to calculate the utility of each respondent.
### Table 1. Attributes and levels in this research

| No | Attributes                                 | Levels                                                                 |
|----|--------------------------------------------|------------------------------------------------------------------------|
| 1  | Salary and Allowance                       | High Salary (> Rp 6 million) and Low Allowance                          |
|    |                                            | Medium Salary (Rp 4-6 million) and Medium Allowance                     |
|    |                                            | Low Salary (< Rp 4 million) and High Allowance                          |
| 2  | Suitability of Educational Background       | Suitable (Statistics)                                                  |
|    | to the Workplace                           | Suitable (Actuary)                                                     |
|    |                                            | Not Suitable                                                           |
| 3  | Work Fields                                | Government Companies                                                   |
|    |                                            | Private Companies                                                      |
|    |                                            | Entrepreneur                                                           |
| 4  | Working Hours                              | Normal                                                                 |
|    |                                            | Flexible                                                               |
|    |                                            | Shift                                                                  |

- Data analysis
  Some common methods in conjoint analysis are:
  
  a. *Multidimensional scaling* [4], commonly used to provide an overview of the pair attributes performed in the measurement pairwise comparison. This method is limited to a small number of attributes.

  b. Regression analysis with dummy variables widely used for metric and nonmetric data types. Metrics are scaled-up interval or ratio data that gives ratings or values to each stimulus. While nonmetric are data in the form of nominal, ordinal or category, rank or sort the stimulus.

- Interpreting the result
  The most commonly used interpretation method is to make a utility score (part-worth) estimate for each attribute. The part-worth estimates are usually scaled, so that the higher the part-worth value the more it gives more impact to the total utility. Conjoint analysis can also measure the relative importance of each attribute. Since usually part-worth estimates are converted to a general scale, the greatest contribution to the total utility and the most considered attributes is the attribute with the largest part-worth range.

### 3. Data and methods

#### 3.1. Data

The data of this research is the data preference of determining jobs study on college students of University of Indonesia, majoring Statistics. The data is used for the application of the traditional conjoint analysis method. The number of respondents taken is 96 respondents.

The result of previous research shows that salary, suitability of educational background to the workplace, and work fields affect college student in choosing a job. Here are four attributes with each attribute consisting of three levels that affect college student in choosing a job in this research; the attributes can be seen in table 1.

#### 3.2. Methods

These are some steps in this research as follows:

1. Determine the purpose of the research, determine the attributes and levels, and construct stimulus design.
2. Choose the conjoint method (table 2) and construct the questionnaire.
3. Data collection is done by spreading questionnaires directly to respondent. In this method, respondents were asked to give ranking to each stimulus in questionnaire.
4. Monotonic analysis of variance is used to analyse the data. MONANOVA is used to fit data to an additive model by way of a nonmetric scaling procedure [5]. There are two parallel processes. First, ranking data from questionnaire will be transformed to numeric data and second, ordinary least square between variable independent X (attributes) and variable dependent Y (transformed data).
Table 2. Fractional factorial design

| Profile | A | B | C | D |
|---------|---|---|---|---|
| 1       | 1 | 1 | 1 | 1 |
| 2       | 1 | 2 | 2 | 3 |
| 3       | 1 | 3 | 3 | 2 |
| 4       | 2 | 1 | 2 | 2 |
| 5       | 2 | 2 | 3 | 1 |
| 6       | 2 | 3 | 1 | 3 |
| 7       | 3 | 1 | 3 | 3 |
| 8       | 3 | 2 | 1 | 2 |
| 9       | 3 | 3 | 2 | 1 |

Table 3. Utility and relative importance

| Attribute                     | Level                                         | Utility | RI (%) |
|-------------------------------|----------------------------------------------|---------|--------|
| Salary and Allowance          | High Salary and Low Allowance                | 1.5249  |        |
|                               | Medium Salary and Medium Allowance           | -0.1317 | 47.35  |
|                               | Low Salary and High Allowance                | -1.3932 |        |
| Suitability of Educational Background to the Workplace | Suitable (Statistics) | 0.6374 |        |
|                               | Suitable (Actuary)                           | 0.1903  | 23.77  |
|                               | Not Suitable                                 | -0.8277 |        |
|                               | Government Companies                         | 0.1595  |        |
|                               | Private Companies                            | 0.4437  | 16.99  |
|                               | Entrepreneur                                 | -0.6031 |        |
| Work Fields                   | Normal                                       | -0.2829 |        |
|                               | Flexible                                     | 0.4499  | 11.89  |
|                               | Shift                                        | -0.1670 |        |

4. Results and study

Data analysis is done by using monotonic analysis of variance. MONANOVA is used to estimate utility value of each level of each attribute [6]. Level of attribute that has high value is the most desirable level of determining jobs. There are two parallel processes in this estimation. First, ranking data transforms to numeric data by monotone transformation, which ranking data is close enough with numeric data. Second, ordinary least square variable independent X and variable dependent Y so that we get coefficient regression which is utility value. We also can obtain relative importance value of each attribute by using equation (3), attribute that has high importance relative value is the most considered attribute. Table 3 is the result of utility value estimation and importance relative value of this research:

Based on the result of parameter estimation, hence can be determined the utility of each levels and relative importance each attributes. Salary and allowance attribute gives the highest relative importance compared to other attributes, which is 47.35 %. The suitability of educational background to the workplace has a relative importance of 23.77 %, which is less than the relative importance value of the salary and allowance attribute, which means that the student puts salary and allowance as the most considered attribute when they choose a job. The work fields and working hours attribute have their respective relative importance of 16.99 % and 11.89 %, this indicates that these two attributes are less than the relative importance value of suitability background, but work fields attribute gives more contribution to students’ preferences than working hours attribute.

Then for the highest utility of each levels from each attribute will be described as follows: the highest utility on salary and allowance attributes are at the high salary and low allowance that is equal to 1.5249, that level is the most desirable level compared to other levels. Then on the suitability of educational background to the workplace, students prefer a workplace that suits the background of education that is statistics with utility of 0.6374. Then the highest utility on work fields and working
hours is government companies and flexible working hour with each utility value is 0.4437 and 0.4499.

5. Conclusions
By using conjoint analysis method, we get found the preference of determining jobs study on college students of University of Indonesia majoring Statistics. Based on the result, it shows that the most considered attributes by the student is salary and allowance attributes, followed by suitability of educational background to the workplace attribute which land in the second place. Attributes that are in the third position are work fields and in the last position is working hours. At the salary and allowance attribute, the most considered level is the high salary and low allowance. The suitability of educational background to the workplace attribute, the most considered is suitable with educational background, which is statistics. The most considered level on works fields and working hours attribute is government companies and flexible working hours.

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