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# The Predictions of the Termination of Undergraduate Students of Factor Analysis with a Logistic Regression and Factor Analysis with Fuzzy Logic

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**Abstract:** This paper was to forecast 199 undergraduates dismissal during academic year 2551-2554, the faculty of information technology, Rajamangala University of Technology Suvarnabhumi, Suphanburi Campus with 31 variables using personal, family, financial and learning data and analyzed factors influencing their dismissal. Correlation analysis with 31 variables had showed that there were 17 influencing variables including personal, family, financial and learning data. We, then, analyzed and classified their components into five factors including learning data from the former school, learning data at the new school, rank in the family and number of sibling, father's education background, and gender. These 5 factors were used to forecast student's dismissal with logistic regression analysis compared with the fuzzy logic. Testing showed that logistic regression analysis could forecast correctly at 92.46 percent and fuzzy logic could forecast correctly at 91.46 percent.

**Keywords:** Correlation Analysis, Factor Analysis, Logistic Regression, Fuzzy Logic

## 1. INTRODUCTION

Department of business information technology, the faculty of business administration and information technology, Rajamangala University of Technology Suvarnabhumi, Suphanburi Campus had been providing undergraduate degree teaching and learning since 2005 up to present time, and there have been 836 graduated students. In each academic year, the department admitted 90 freshmen and found many dismissed students each year. It was about 40.91 percent of students dismissed during academic year 2005 to 2011 caused by different reasons like dismissal further to measurement or financial regulation, resign and death. Students' dismissal tended to increase continuously and this affected to the department teaching and learning planning, determining numbers of instructors and budget provided for educational management. It also influenced graduate production in term of administration and management of the department which interested the

researcher to investigate what factor influencing their dismissal in order to find the solution. The research aimed to study about students' personal, family, financial and learning data as shown in table 1 to determine influencing factors towards students' dismissal and develop its forecast model by using 199 undergraduates' data during academic year 2008-2011. Among these students, 66 students were dismissed and the numbers tended to increase continuously. Classified influencing factors showed dismissal and status maintenance which made data classification easier and were applied for correlation and factor analysis to determine influencing factors towards students' dismissal. Logistic regression analysis compared with fuzzy logic was applied to develop students' dismissal forecast model [1-8].

**TABLE 1: Show Independent variable is used to study 31 variables.**

| List                  | Variable  |
|-----------------------|---|
| Profile               | Sex, Size of old school, Education Level graduate, Major graduated  |
| Family Information    | Number of brothers and sisters, Number of brother and sister is studying, Birth order, Staying with, Housing characteristics, Status of Parents, Education of father, income/year of father, job of father, Education of Mother, income/year of Mother, job of mother |
| Financial Information | The average cost / month, Source subsidized education   |
| Grades Information    | Thai, math, science, religion and culture, health and physical, art, career and technology, Foreign language, GPA old school, Computer mathematic, Operating System, Computer Programming 1, GPS Term 1   |

## 2. MATERIALS AND METHODS

Compare forecasting termination of undergraduates from technical Factor Analysis with logistic regression And Factor Analysis with fuzzy logic. The research process is as follows:

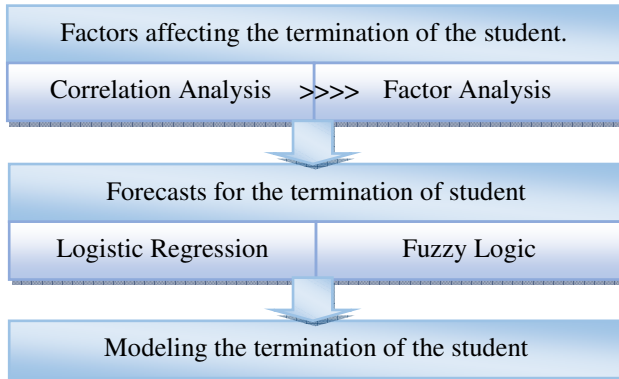


Fig. 1. A method to forecast the undergraduate students.

### 2.1 CORRELATION ANALYSIS

The results are shown in Figure 3.

|                      | Thai     | Math     | Science  | Social and Culture | Physical | Art      | Work and Technology | Language | GPA school Old | Commath  | Operating System | Computer Programming | GPS Term 1 | Status student |
|----------------------|----------|----------|----------|--------------------|----------|----------|---------------------|----------|----------------|----------|------------------|----------------------|------------|----------------|
| Thai                 | 1.000    |          |          |                    |          |          |                     |          |                |          |                  |                      |            |                |
| Math                 | 0.448**  | 1.000    |          |                    |          |          |                     |          |                |          |                  |                      |            |                |
| Science              | 0.609**  | 0.655**  | 1.000    |                    |          |          |                     |          |                |          |                  |                      |            |                |
| Social and Culture   | 0.577**  | 0.529**  | 0.768**  | 1.000              |          |          |                     |          |                |          |                  |                      |            |                |
| Physical             | 0.513**  | 0.427**  | 0.678**  | 0.818**            | 1.000    |          |                     |          |                |          |                  |                      |            |                |
| Art                  | 0.436**  | 0.366**  | 0.568**  | 0.784**            | 0.898**  | 1.000    |                     |          |                |          |                  |                      |            |                |
| Work and Technology  | 0.456**  | 0.420**  | 0.782**  | 0.699**            | 0.635**  | 0.550**  | 1.000               |          |                |          |                  |                      |            |                |
| Language             | 0.509**  | 0.450**  | 0.686**  | 0.837**            | 0.807**  | 0.792**  | 0.674**             | 1.000    |                |          |                  |                      |            |                |
| GPA school Old       | 0.703**  | 0.660**  | 0.884**  | 0.905**            | 0.863**  | 0.799**  | 0.801**             | 0.858**  | 1.000          |          |                  |                      |            |                |
| Commath              | 0.203**  | 0.137    | 0.268**  | 0.102              | 0.022    | -0.048   | 0.281**             | -0.009   | 0.159*         | 1.000    |                  |                      |            |                |
| Operating System     | 0.234**  | 0.231**  | 0.291**  | 0.194**            | 0.136    | 0.091    | 0.323**             | 0.206**  | 0.267**        | 0.196**  | 1.000            |                      |            |                |
| Computer Programming | 0.259**  | 0.276**  | 0.373**  | 0.270**            | 0.236**  | 0.137    | 0.350**             | 0.219**  | 0.331**        | 0.504**  | 0.568**          | 1.000                |            |                |
| GPS Term 1           | 0.341**  | 0.321**  | 0.476**  | 0.308**            | 0.221**  | 0.118    | 0.460**             | 0.208**  | 0.387**        | 0.685**  | 0.689**          | 0.792**              | 1.000      |                |
| Status student       | -0.391** | -0.462** | -0.729** | -0.458**           | -0.426** | -0.252** | -0.777**            | -0.369** | -0.610**       | -0.422** | -0.360**         | -0.447**             | -0.577**   | 1.000          |

Fig. 3. The results of Point Biserial Correlation.

Results from the analysis of correlation Figure 2-3. Making variables were associated with the termination of the students have only 17 variables.

Table 1 taken from the variable Profile, family information and financial information 18 variables were analyzed correlations **Spearman Rank Correlation** is a variable scale Ordinal scale.

The results are shown in Fig. 2.

|                    | sex     | Count sister | order born | Wutti Study Father | status student |
|--------------------|---------|--------------|------------|--------------------|----------------|
| sex                | 1.000   |              |            |                    |                |
| Count_sister       | -0.053  | 1.000        |            |                    |                |
| order_born         | 0.008   | 0.676**      | 1.000      |                    |                |
| Wutti_Study_Father | 0.030   | 0.090        | 0.009      | 1.000              |                |
| status_student     | -0.176* | 0.179*       | -0.143*    | 0.182**            | 1.000          |

Fig. 2. The results of Spearman Rank Correlation

Table 1 taken from the variable Grades information 13 variables were analyzed correlations **Point Biserial Correlation** is a variable scale the Interval scale or Ratio Scale.

### 2.2 FACTOR ANALYSIS

Factor Analysis of 17 variable until only 5 factors. To include variables that are correlated in the same group.

The results are shown in Figure 4

**Rotated Component Matrix<sup>a</sup>**

|                              | Component |      |      |       |       |
|------------------------------|-----------|------|------|-------|-------|
|                              | 1         | 2    | 3    | 4     | 5     |
| Zscore: GPA_school_old       | .965      |      |      |       |       |
| Zscore: Social and Culture   | .921      |      |      |       |       |
| Zscore: Physical             | .913      |      |      |       |       |
| Zscore: Language             | .907      |      |      |       |       |
| Zscore: Art                  | .880      |      |      |       |       |
| Zscore: Science              | .809      | .330 |      | .212  |       |
| Zscore: Work and Technology  | .738      | .340 |      |       | -.254 |
| Zscore: Thai                 | .633      | .216 |      | .301  |       |
| Zscore: Math                 | .590      | .235 |      | .213  |       |
| Zscore: GPS_term1            | .208      | .934 |      |       |       |
| Zscore: Computer Programing1 |           | .843 |      |       |       |
| Zscore: Operating System     |           | .734 |      | -.308 |       |
| Zscore: Commath              |           | .705 |      | .371  | -.238 |
| Zscore: order_born           |           |      | .932 |       |       |
| Zscore: count_sister         |           |      | .922 |       |       |
| Zscore: sex                  |           |      |      | .859  |       |
| Zscore: wutti_study_father   |           |      |      |       | .933  |

Extraction Method: Principal Component Analysis.  
 Rotation Method: Varimax with Kaiser Normalization. <sup>a</sup>  
 a. Rotation converged in 5 iterations.

**Fig. 4. The results of Factor Analysis.**

Component 1 = Factor 1 Information about the results of the original study. {GPA old school, religion and culture, health

and physical, foreign language, art, science, career and technology, Thai, math}

Component 2 = Factor 2 Information about the results of the new study. {GPS term1, Computer Programming 1, Operating System, Computer Mathematic}

Component 3 = Factor 3 birth order and number of siblings. {Birth order, Number of brothers and sisters}

Component 4 = Factor 4 sex. {Sex}

Component 5 = Factor 5 Education of father. {Education of father}

**2.3 FORECASTING TERMINATION OF UNDERGRADUATE STUDENTS THE LOGISTIC REGRESSION METHOD**

Factors affecting the student termination 5 factors predictions of the end of undergraduates using Binary Logistic Regression, because the dependent variable (status student) are two of the termination and untermination. Using selected variables into the equation, the **Enter** detailed below. The results are shown in Table 2

**TABLE 2: Results from logistic regression analysis 5 Factor**

| Factor  | B      | S.E. | Wald   | df | Exp(B) | p    |
|---|--------|------|--------|----|--------|------|
| Fac1  | -3.377 | .740 | 20.797 | 1  | .034   | .000 |
| Fac2  | -3.240 | .588 | 30.409 | 1  | .039   | .000 |
| Fac3  | .058   | .267 | .047   | 1  | 1.060  | .828 |
| Fac4  | -.769  | .311 | 6.100  | 1  | .464   | .014 |
| Fac5  | 1.021  | .333 | 9.413  | 1  | 2.776  | .002 |
| Chi-square (Omnibus test of Model Coefficients) Model = 171.362, df = 5, Sig = .000                                     |        |      |        |    |        |      |
| Chi-square (Hosmer and Lemeshow Test) = 7.586, df = 8, Sig = .475 Constant = -2.693                                     |        |      |        |    |        |      |
| 2 Log likelihood = 81.506, Cox & Snell R <sup>2</sup> = .577, Pseudo R <sup>2</sup> (Nagelkerke R <sup>2</sup> ) = .803 |        |      |        |    |        |      |

Method Enter Correct 92.46%

Model Logistic Regression Analysis (Sawadchai, 2548)

$$\text{Prob(event)} = \frac{e^{\beta_0 + \beta_1 X}}{1 + e^{-(\beta_0 + \beta_1 X)}}$$

or  $\text{Prob(event)} = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X)}}$  ..... (1)

When  $\beta_0$  and  $\beta_1$  the coefficient is estimated from the data.

**X** The independent variables

**e** Natural Logarithms) Estimated 2.718

From the above equation. We can write a new equation.

$$\text{Prob(event)} = \frac{e^z}{1 + e^z}$$

or  $Prob(event) = \frac{e^z}{1+e^{-z}}$  ..... (2)

By  $z = \beta_0 + \beta_1X_1 + \beta_2X_2 + \dots + \beta_pX_p$  The prospect of non-event is estimated from the equation.

Prob (no event) = 1-Prob (event) ..... (3)

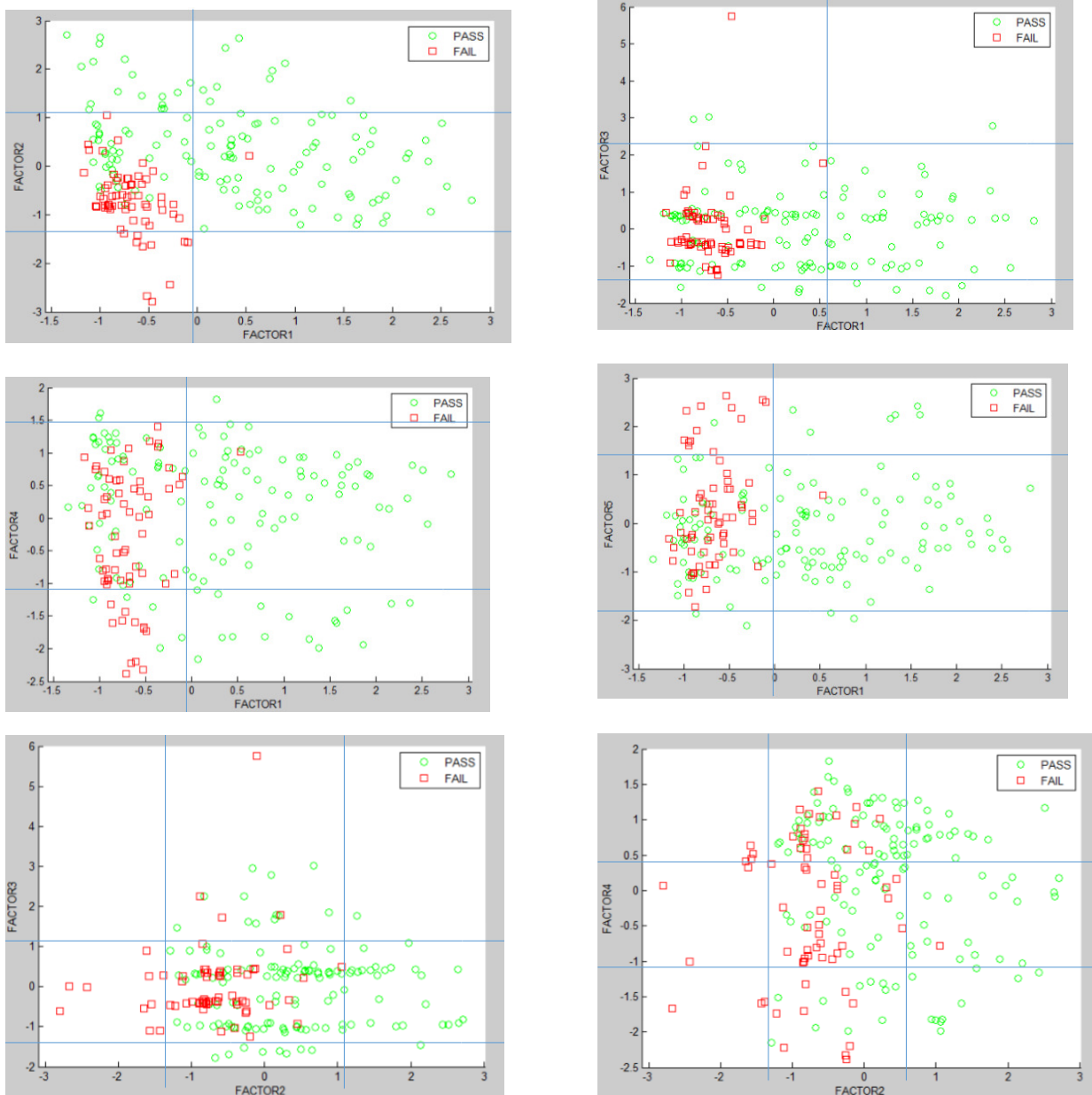
From the Table 2 can be represented by Equation 3.

Prob (The termination of student) =  $Prob(\text{การพ้นสภาพนักศึกษา}) = \frac{e^z}{1+e^{-z}}$

$Z = -2.693 + 1.021 (\text{Fac5}) - 0.769 (\text{Fac4}) + 0.058 (\text{Fac3}) - 3.240 (\text{Fac2}) - 3.377 (\text{Fac1})$

**2.4 FORECASTING TERMINATION OF UNDERGRADUATE STUDENTS THE FUZZY LOGIC METHOD**

Create fuzzy systems by using of the Membership Function Mamdani is Trapezoidal and Triangular.



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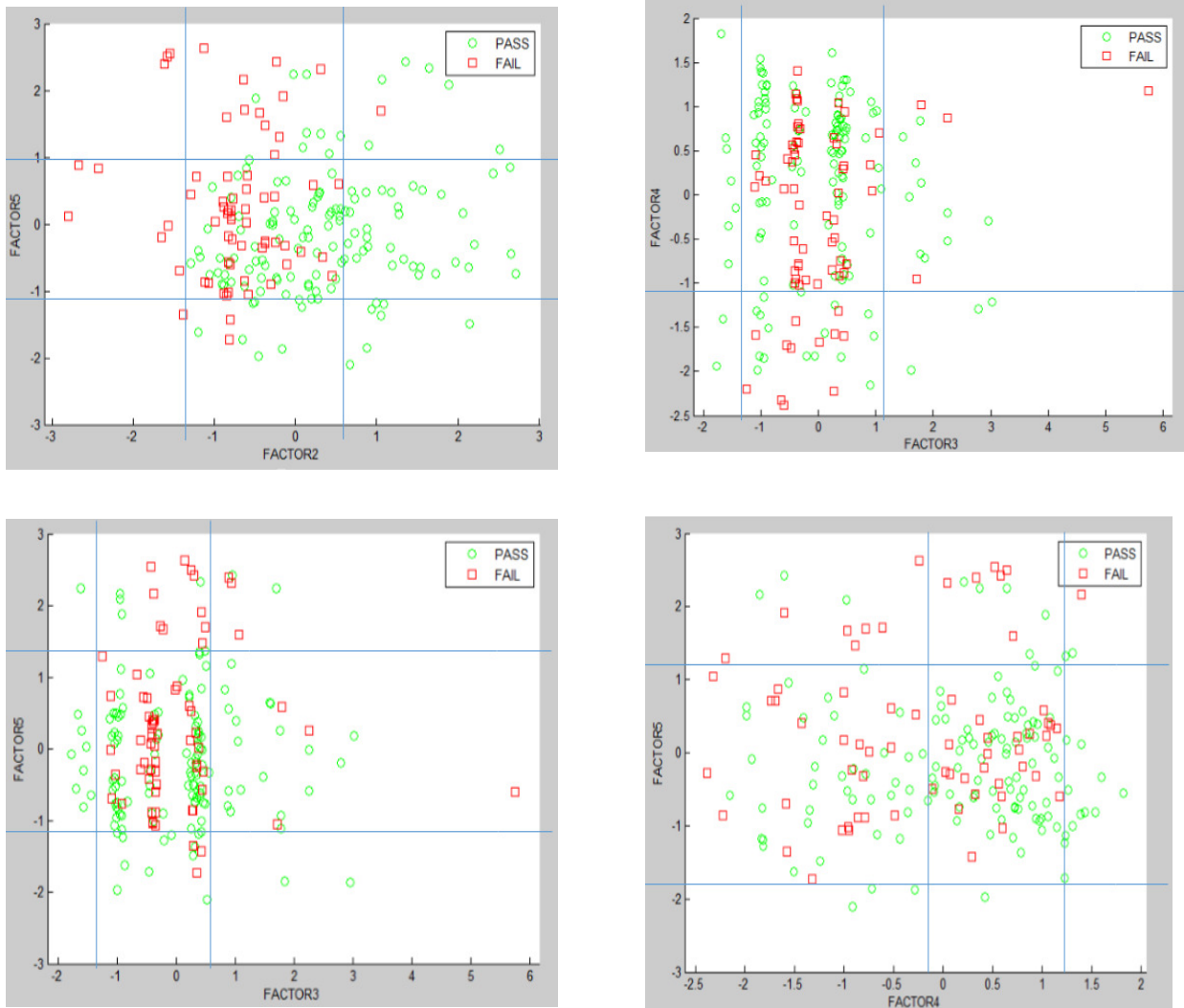


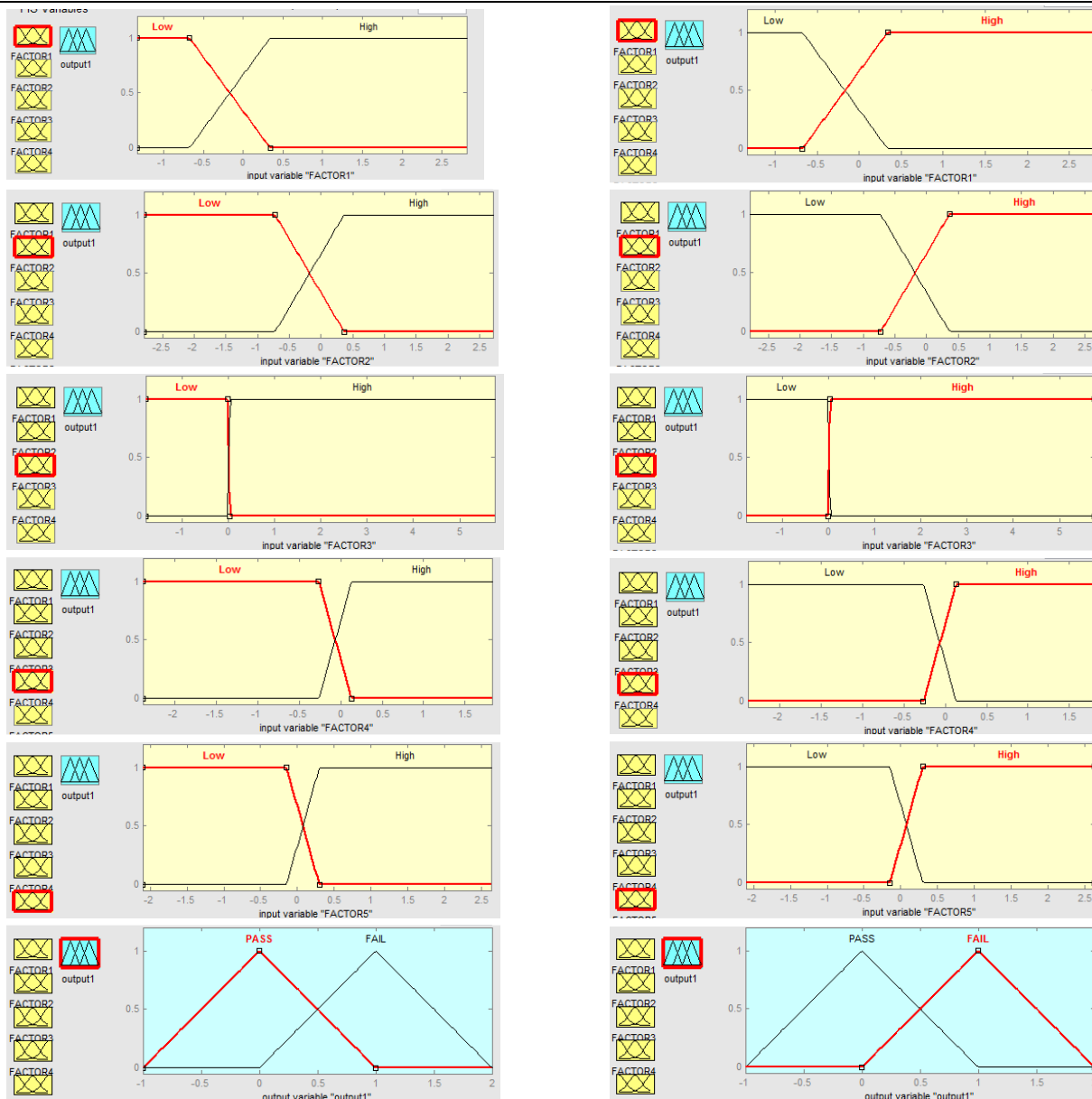
Fig. 5. Show Scatter Plot Compare 5 Factor

TABLE 4: Statistical data shows the value of Class 0 and Class 1

| Factor | Class 0 graduation |          |         |          |         | Class 1 Undergraduate |          |         |          |         |
|--------|--------------------|----------|---------|----------|---------|-----------------------|----------|---------|----------|---------|
|        | N                  | mean     | stdev   | minimum  | maximum | N                     | mean     | stdev   | minimum  | maximum |
| F1     | 133                | 0.33666  | 1.05541 | -1.33660 | 2.80995 | 66                    | -0.67842 | 0.29127 | -1.16324 | 0.52950 |
| F2     | 133                | 0.36144  | 0.93559 | -1.29356 | 2.70979 | 66                    | -0.72836 | 0.68014 | -2.79690 | 1.05636 |
| F3     | 133                | -0.01158 | 1.01342 | -1.78728 | 3.02041 | 66                    | 0.02334  | 0.97964 | -1.25264 | 5.75558 |
| F4     | 133                | 0.13164  | 0.97679 | -2.15667 | 1.82409 | 66                    | -0.26527 | 1.00082 | -2.38620 | 1.40094 |
| F5     | 133                | -0.14757 | 0.91877 | -2.10536 | 2.42834 | 66                    | 0.29737  | 1.09433 | -1.72208 | 2.63495 |

Scatter Plot from Figure 5 and the statistics in Table 4. The researchers designed a fuzzy set (Linguistic Terms) in each dimension follows.

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**Fig. 6. The design of fuzzy sets of dimensions 6 variable output status students.**

Dimension 1-5 Factor1-5 divided into two fuzzy sets = {Low, High} Types of Membership function = {trapmf, trapmf}

Dimension 1 Factor 1

Low Parameter = [-1.336 -1.336 -0.678 0.337]

High Parameter = [-0.678 0.337 2.81 2.81]

Dimension 2 Factor 2

Low Parameter = [-2.796 -2.796 -0.728 0.361]

High Parameter = [-0.728 0.361 2.71 2.71]

Dimension 3 Factor 3

Low Parameter = [-1.786 -1.786 -0.012 0.023]

High Parameter = [-0.012 0.023 5.756 5.756]

Dimension 4 Factor 4

Low Parameter = [-2.386 -2.386 -0.265 0.132]

High Parameter = [-0.265 0.132 1.825 1.825]

Dimension 5 Factor 5

Low Parameter = [-2.105 -2.105 -0.148 0.297]

High Parameter = [-0.148 0.297 2.635 2.635]

Dimension 6 Output divided into two fuzzy sets = {PASS, FAIL}

Types of Membership function = {Triangular, Triangular} PASS = [-1 0 1]

FAIL = [0 1 2]

Rules to be used for prediction by Fuzzy Logic 44 rules.

**TABLE 5: Show rules apply to forecast the termination of the student.**

| No      | Rule  |
|---------|---|
| Rule 1  | IF Factor1 is High and Factor2 is High and Factor3 is low and Factor4 is low and Factor5 is High Then Class is PASS (1)     |
| Rule 2  | IF Factor1 is low and Factor2 is High and Factor3 is low and Factor4 is High and Factor5 is High Then Class is PASS (1)     |
| Rule 3  | IF Factor1 is low and Factor2 is High and Factor3 is High and Factor4 is low and Factor5 is low Then Class is PASS (1)      |
| Rule 4  | IF Factor1 is low and Factor2 is High and Factor3 is low and Factor4 is low and Factor5 is High Then Class is PASS (1)      |
| Rule 5  | IF Factor1 is High and Factor2 is High and Factor3 is High and Factor4 is low and Factor5 is High Then Class is PASS (1)    |
| Rule 6  | IF Factor1 is High and Factor2 is High and Factor3 is low and Factor4 is High and Factor5 is low Then Class is PASS (1)     |
| Rule 7  | IF Factor1 is High and Factor2 is low and Factor3 is low and Factor4 is High and Factor5 is low Then Class is PASS (1)      |
| Rule 8  | IF Factor1 is High and Factor2 is High and Factor3 is low and Factor4 is High and Factor5 is High Then Class is PASS (1)    |
| Rule 9  | IF Factor1 is High and Factor2 is High and Factor3 is High and Factor4 is High and Factor5 is low Then Class is PASS (1)    |
| Rule 10 | IF Factor1 is High and Factor2 is High and Factor3 is low and Factor4 is low and Factor5 is low Then Class is PASS (1)      |
| Rule 11 | IF Factor1 is High and Factor2 is High and Factor3 is High and Factor4 is low and Factor5 is low Then Class is PASS (1)     |
| Rule 12 | IF Factor1 is High and Factor2 is low and Factor3 is High and Factor4 is High and Factor5 is low Then Class is PASS (1)     |
| Rule 13 | IF Factor1 is High and Factor2 is low and Factor3 is low and Factor4 is low and Factor5 is low Then Class is PASS (1)       |
| Rule 14 | IF Factor1 is High and Factor2 is low and Factor3 is High and Factor4 is low and Factor5 is low Then Class is PASS (1)      |
| Rule 15 | IF Factor1 is High and Factor2 is low and Factor3 is High and Factor4 is low and Factor5 is High Then Class is PASS (1)     |
| Rule 16 | IF Factor1 is low and Factor2 is low and Factor3 is low and Factor4 is low and Factor5 is low Then Class is FAIL (1)        |
| Rule 17 | IF Factor1 is low and Factor2 is low and Factor3 is low and Factor4 is High and Factor5 is High Then Class is FAIL (1)      |
| Rule 18 | IF Factor1 is low and Factor2 is low and Factor3 is low and Factor4 is low and Factor5 is High Then Class is FAIL (1)       |
| Rule 19 | IF Factor1 is High and Factor2 is low and Factor3 is High and Factor4 is High and Factor5 is High Then Class is FAIL (0.33) |
| Rule 20 | IF Factor1 is High and Factor2 is low and Factor3 is High and Factor4 is High and Factor5 is High Then Class is PASS (0.67) |
| Rule 21 | IF Factor1 is low and Factor2 is High and Factor3 is low and Factor4 is High and Factor5 is low Then Class is PASS (0.67)   |
| Rule 22 | IF Factor1 is low and Factor2 is High and Factor3 is low and Factor4 is High and Factor5 is low Then Class is FAIL (0.33)   |
| Rule 23 | IF Factor1 is low and Factor2 is High and Factor3 is High and Factor4 is High and Factor5 is High Then Class is FAIL (0.14) |
| Rule 24 | IF Factor1 is low and Factor2 is High and Factor3 is High and Factor4 is High and Factor5 is High                           |

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| No      | Rule   |
|---------|--|
|         | Then Class is PASS (0.86)  |
| Rule 25 | IF Factor1 is low and Factor2 is High and Factor3 is High and Factor4 is High and Factor5 is low Then Class is PASS (0.82)   |
| Rule 26 | IF Factor1 is low and Factor2 is High and Factor3 is High and Factor4 is High and Factor5 is low Then Class is FAIL (0.18)   |
| Rule 27 | IF Factor1 is low and Factor2 is low and Factor3 is High and Factor4 is low and Factor5 is low Then Class is PASS (0.13)     |
| Rule 28 | IF Factor1 is low and Factor2 is low and Factor3 is High and Factor4 is low and Factor5 is low Then Class is FAIL (0.88)     |
| Rule 29 | IF Factor1 is low and Factor2 is low and Factor3 is High and Factor4 is low and Factor5 is High Then Class is PASS (0.17)    |
| Rule 30 | IF Factor1 is low and Factor2 is low and Factor3 is High and Factor4 is low and Factor5 is High Then Class is FAIL (0.83)    |
| Rule 31 | IF Factor1 is low and Factor2 is low and Factor3 is low and Factor4 is High and Factor5 is low Then Class is FAIL (0.73)     |
| Rule 32 | IF Factor1 is low and Factor2 is low and Factor3 is low and Factor4 is High and Factor5 is low Then Class is PASS (0.27)     |
| Rule 33 | IF Factor1 is low and Factor2 is low and Factor3 is High and Factor4 is High and Factor5 is low Then Class is FAIL (0.6)     |
| Rule 34 | IF Factor1 is low and Factor2 is low and Factor3 is High and Factor4 is High and Factor5 is low Then Class is PASS (0.4)     |
| Rule 35 | IF Factor1 is High and Factor2 is High and Factor3 is High and Factor4 is High and Factor5 is High Then Class is PASS (0.92) |
| Rule 36 | IF Factor1 is High and Factor2 is High and Factor3 is High and Factor4 is High and Factor5 is High Then Class is FAIL (0.08) |
| Rule 37 | IF Factor1 is low and Factor2 is High and Factor3 is low and Factor4 is low and Factor5 is low Then Class is FAIL (0.17)     |
| Rule 38 | IF Factor1 is low and Factor2 is High and Factor3 is low and Factor4 is low and Factor5 is low Then Class is PASS (0.83)     |
| Rule 39 | IF Factor1 is High and Factor2 is low and Factor3 is low and Factor4 is High and Factor5 is High Then Class is FAIL (0.25)   |
| Rule 40 | IF Factor1 is High and Factor2 is low and Factor3 is low and Factor4 is High and Factor5 is High Then Class is PASS (0.75)   |
| Rule 41 | IF Factor1 is low and Factor2 is low and Factor3 is High and Factor4 is High and Factor5 is High Then Class is FAIL (0.83)   |
| Rule 42 | IF Factor1 is low and Factor2 is low and Factor3 is High and Factor4 is High and Factor5 is High Then Class is PASS (0.17)   |
| Rule 43 | IF Factor1 is low and Factor2 is High and Factor3 is High and Factor4 is low and Factor5 is High Then Class is FAIL (0.75)   |
| Rule 44 | IF Factor1 is low and Factor2 is High and Factor3 is High and Factor4 is low and Factor5 is High Then Class is PASS (0.25)   |

### 3. RESULTS

TABLE 6: Comparison of forecast analysis using logistic regression with fuzzy logic

| The results of predictive | Logistic Regression |         | Fuzzy Logic |         |
|---------------------------|---------------------|---------|-------------|---------|
|                           | Amount              | Percent | Amount      | Percent |
| correct                   | 184                 | 92.46%  | 182         | 91.46%  |
| Mistake                   | 15                  | 7.54%   | 17          | 8.54%   |
| Total                     | 199                 | 100.00% | 199         | 100.00% |



Regression analysis logistics can predict the termination of the students were required percentage 92.46 and use equations to predict only one equation in comparison to how fuzzy logic can predict the termination of the student's correct. 91.46 percent and the 44 Rules of prediction.

#### 4. CONCLUSIONS

The results showed that factors affecting the termination of a student with 17 variables and apply Factor Analysis grouping variables that are related to the same group until only five factors is Information about the results of the original study, Information about the results of the new study, Birth order and number of siblings, sex, Education of father and factors were analyzed Regression analysis logistics can predict the termination of the students were required percentage 92.46 and use equations to predict only one equation in comparison to how fuzzy logic can predict the. Termination of the student's correct. 91.46 percent and the 44 Rules of prediction.

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