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LOGISTIC REGRESSION FOR DETERMINING FACTORS INFLUENCING STUDENTS' PERCEPTION OF COURSE EXPERIENCE

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Abstract: In the new competitive environment of the higher education in the Republic of Macedonia, the South East European University (SEEU) has the considerable impact as the model institution. It offers the various benefits to the new generations. These benefits are on the direction of offering the new agilities, and the knowledge which guaranties the better future for the students in the area of the global trade of labor. In each new activity taken from the SEEU, the main focus is increasing the quality and the development of its educational and research capacities. In this direction very important role has the increasing the quality of the learning and teaching process. The aim of this research is to determine some of the so called satisfaction factors, which have the positive impact on students' perception concerning some teaching practices. In this paper the analyses is done using the logistic regression method. For this purpose there is build the corresponding mathematical model. This model considers the factor satisfaction/dissatisfaction on some subjects. This factor is taken as the function of the measured variables. In total there are considered 20 variables which have the impact on the teaching process. The variable "answer" is the satisfaction factor.The obtained results make possible to identify the relations between the teaching practices and the satisfaction/dissatisfaction quality of the course.

***Keyword*:** SEEU, teaching practices, satisfaction, logistic regression, the mathematical model

Introduction

South East European University (SEEU)

South East European University functions with its five faculties, in two campuses in the Republic of Macedonia, in Tetovo and Skopje. It unique style of western academic environment continues to attract students from Macedonia and the region. All five faculties offer programs in three study cycles of higher education, respectively undergraduate, postgraduate and doctoral studies.Considering the institutions of higher education around the world and particularly in Balkan are facing great difficulties including the difficulty of global economic situation, disloyal competition of universities, low investment rates in the field of searching and education, unemployment, youth emigration, the birth rate declension, the University of South Eastern Europe remains a stable and attractive institution of higher education.Along the Academic staff, the University has an administrative and technical staff that provides an excellent service and support to the institution and students.The academic staff includes teachers and active researchers who offer solid teaching and are supported by a good and modern infrastructure, and led by mechanisms for quality assurance.SEEU continues to be particular in the region because of its commitments and mission, which remains the only institution of higher education in the country that applies the policy of 'flexible use of languages, where every student and staff member is able to communicate in two of the three official languages of University-Albanian, Macedonian and English. Teaching takes place in all three above mentioned languages through a broad areas of specialization, as

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well as, other languages (German, French, Italian) that are available in the interest of students as 'free elective' subjects.In all study programs that function in five faculties, it can be noticed academic and cultural differences because they have been built in consultation with international experts and community of business in order to be closer to the needs of society and industry in general, following the profile of university's explorative, to provide innovative solutions to strengthen the capacity of small and medium enterprises in accordance with modern trends.

The University also maintains a strict policy of non-discrimination, to avoid making distinctions among staff or students based on language, ethnicity, gender, religion, or social background. University remains an important regional institution not only because of what students study, but because of the evidences that provides for cooperative efforts of all social groups, ethnic and linguistic.Despite the efforts towards positive contribution to ensure good institutional example, the university continues to have a strong role within the international community in Macedonia.A very important element on the reputation of the university is that students, who complete one cycle of studies at the University, apply again to return to their next cycle of studies.The managerial staff of universities around the world makes efforts to control the evaluation of teaching. The good results over good teaching and satisfaction of students in general contribute to the ranking of universities and are funded by the state. SEEU has also done a lot on quality assurance, such as academic staff training sessions, staff mobility, polls with students, observation of teaching by colleagues.As a result of all these achievements, the South East European University in ranking position of universities in Macedonia that has been conducted by external evaluators, University 'Shanghai Jiao Tong' came second at state level Also, considering the success of the university in the academic year 2014/15, the Government of Macedonia for the first time allocated a sum of 0.5 million euros for the university and the same will continue in the coming years.

It is understood that each of the factors has importance in the educational process itself, but teaching and learning are the main pillars of higher education. Therefore, the aim of this research is to see how much the students of SEEU are satisfied with the service of teaching subjects that they taught.Recent studies have shown that student satisfaction is positively related to the perception of reputation of the institution Oyvind Erik Helgesen & Nesset (2007).There is a number of studies that have illustrated disciplinary differences in the opinion of students of good teaching and the experience of the subject (Santhanam & Hicks, 2002). These studies along with their findings in the research provide the motivation for this research or this problem. Goe's (2007) examines the indicators of quality of teachers and should focus on four categories: qualification of teachers, teacher characteristics, practices that teachers use and effectiveness of teachers.

Johnson, T. and Johnson, W. (1986) agree that learning in cooperation 'cooperative learning' does not only have positive effect on student performance but also it has a positive effect in motivation, socialization in the classroom, the students' confidence in learning and attitude towards the subject in general.In this paper, the logistic regression is used (Fox J. 1997) to construct a model that explains the satisfaction/dissatisfaction of the students in the quality of the course (subject).

Logistic Regression with Binary Response

Let Y be a binary response variable, which is coded as 0 or 1, referred to as fail or pass, respectively. Then the logistic regression model is given as follows:

$$\pi(x)=\frac{e^{\beta_0+\beta_1 x}}{1+e^{\beta_0+\beta_1 x}},$$

$\pi(x)$ Represents the conditional mean of Y given *x*, i.e. $E(Y \setminus x)$. The value of response variable given *x* can be expressed as $y=\pi(x)+\varepsilon$, ε is the error term. If y =1, then $\varepsilon=1-\pi(x)$ with probability $\pi(x)$ and if y = 0, $\varepsilon=-\pi(x)$ with probability $1-\pi(x)$. Therefore, ε follows a binomial distribution with mean 0 and variance $\pi(x)\left[1-\pi(x)\right]$. A transformation of $\pi(x)$ which is called logit function is required:

$$g(x)=\ln\left[\frac{\pi(x)}{1-\pi(x)}\right]=\beta_0+\beta_1 x$$

The unknown parameters are estimated by the method of maximum likelihood estimation with given likelihood function for $\beta=(\beta_0,\beta_1)$ given as $L(\beta)=\prod_{i=1}^{n}\pi(x_i)^{y_i}\left[1-\pi(x_i)\right]^{1-y_i}$.

Fitting Logistic Model with Binary Explanatory Variables

Let us consider the interpretation of the coefficients for logistic regression model with the case where explanatory variables are at the nominal level of measurement. Assume that X is coded either 0 or 1. Then the difference between logit function when x=1 and x=0 is given as $g(1)-g(0)=\beta_1$. To interpret this result, a measure of association called odds ratio (OR) is required:

$$OR=\frac{\pi(1)/\left[1-\pi(1)\right]}{\pi(0)/\left[1-\pi(0)\right]}=e^{\beta_{11}}$$

Odds ratio provides an approximation how much more likely or unlikely it is for the response variable to occur among those with x = 1 than among those with x = 0. For details, one can see Hosmer and Lemeshow (2000).

Objective of Study

Main purpose of this project is to identify some of the main factors that affect students' satisfaction on the services of teaching and learning in some subjects that they pursue in winter semester at SEEU.
By identifying the factors of satisfaction in the teaching process, the institution will be able to have a better insight about the process of teaching and learning, and will attempt to improve those factors that students are not satisfied.

It is obvious that through the improvement of satisfaction over the process of teaching toward students will benefit the institution, because if current students are satisfied with teaching process, they will also recommend their descendants to study in this institution, so chances for increasing the number of students in this institution will be high.

Data and Methodology

Data are obtained using online questionnaires. Totally 377 students from SEEU participated in the study in the period November-December 2015. The composition of 377 students that were responded to this questioner is as following. Firstly, according to gender 57.3% are male and 42.7 female. Secondly, according to study' year 45.6,8% are the first year students, 31,4% second year and 23.0% therd year. Thirdly, according to the faculty majority of observations are from Faculty of Contemporary Sciences and Technologies with 30.5%. Fourthly, based on student's success majority of selected students have GPA between 8 and 9. The structure of selected sample is presented in table 1.

The questionnaire has been designed with questions related to some of the factors that contribute to the satisfaction of students in some practice teaching in their courses. Hence, besides the 20 factors that were included in the study, two main questions of the research have been included: 'The Student's perception of satisfaction on service quality in this subject?' and 'Would you encourage other students to study this subject? Students were asked to respond to the statement by using a five-point Likert scale ranging from 1 (Strongly Agree) -5 (Strongly Disagree). Whereas, two summary questions over current students' satisfaction and encouragement of other students to follow this course were Yes and No.Given that the structure of the study is with qualitative data, firstly, having collected the data, it has been realized their coding for committing statistical analyzes.

To evaluate the impact of satisfaction in general, by using logistic regression, it has been built a mathematical model that considers satisfaction / dissatisfaction in some subjects, as a function of the measured variables.To illustrate the data interpretation, the extraction of conclusions and making statistical decisions over data, the MedCalc software will be used.

Table 1. Description of Sample

Variable	Category	Frequency (%) N=377
Gender	Male	57.3
	Female	42.7
Year of study	First-Year	45.6
	Second-Year	31.4
	Third-Year	23.0
Faculty	Faculty of Business and Economics	26.4
	Faculty of Contemporary Sciences and Technologies	30.5

	Faculty of Public Administration and Political Sciences	18.7
	Faculty of Law	13.5
	Faculty of Languages, Cultures, and Communication	10.9
Success GPA until now: (# of students)	Between 6 and 7	22.5
	Between 7 and 8	27.6
	Between 8 and 9	29.3
	Above 9	20.6

Results and Discussion

The data about perception of students over teaching satisfaction in their faculty for attending the subjects in winter semester of the academic year 2015/16 were processed in total, then by removing those answers that were neutral and by classifying in variable Binary (where 1 =. Agree and Strongly Agree and 2 = Disagree and Strongly Disagree). From the data it can be seen that almost all variables from 1 to 20, students are over 90% satisfied and completely satisfied, such as the variable 'Q1-objectives "in total shows that 66.6% of students are indicated completely satisfied, 28.9% satisfied, 1.3% neutral and 3.2% disagree. Whereas, if we remove the selected answers "neutral" from the sample, we have 67.5% of students that are completely satisfied, 29.3% satisfied and 3.2% disagree. Whilst by classifying in Binary we have 96.8% of students that are satisfied versus 3.2% of dissatisfied.

But the results of the variable 'Q13- Computer use' in total appears that 21.0% of students said that they are completely satisfied, 26.3% satisfied, 8.5 % neutral, 30.0 disagree and 14.3% completely disagree.Whereas, if we remove the selected answers "neutral" from the sample, we have 22.9% of students that are completely satisfied, 28.7% satisfied and 32.8% disagree and 15.7% completely disagree. Whilst by classifying in Binary we have 51.6% of students that are satisfied versus 48.4% dissatisfied.
More detailed results are given in **table 2**.

Table 2. Student's perception on satisfaction on service quality in this subject?

		Total Semple (%) N=377					Selected Semple (%) **Without Neutral**					Selected Semple (%) **Binary classification**	
	Variable	SA	A	N	D	SD	VS	S	N	U	VU	S	U
Q1	The learning objectives in this course are clear to me (Objectives)	66.6	28.9	1.3	3.2	0.0	67.5	29.3	0.0	3.2	0.0	96.8	3.2
Q2	I am learning what I expected to in this course (Expectations)	75.9	14.1	5.8	3.7	0.5	80.6	14.9	0.0	3.9	0.6	95.5	4.5
Q3	This course is well organised (Organisation)	56.8	37.7	3.4	0.0	2.1	58.8	39.0	0.0	0.0	2.2	97.8	2.2
Q4	The teaching staff are extremely good at explaining things (Explaining)	55.4	37.9	3.4	2.1	1.1	57.4	39.3	0.0	2.2	1.1	96.7	3.3
Q5	The teaching staff normally give me helpful feedback on how I am going in this course (Feedback)	50.1	36.3	5.3	7.2	1.1	52.9	38.4	0.0	7.6	1.1	91.3	8.7
Q6	This course contributes to my confidence in tackling unfamiliar problems (Problem-solving)	49.3	37.1	7.7	3.7	2.1	53.4	40.2	0.0	4.0	2.3	93.7	6.3
Q7	Assessment tasks in this course require me to demonstrate what I am learning	36.6	57.0	2.1	4.2	0.0	37.4	58.3	0.0	4.3	0.0	95.7	4.3

	(Assessment)												
Q8	The amount of work required in this course is about right (Workload)	46.7	46.9	2.1	4.2	0.0	47.7	48.0	0.0	4.3	0.0	95.7	4.3
Q9	The teaching staff in this course motivate me to do my best work (Motivating)	46.9	39.5	4.2	7.2	2.1	49.0	41.3	0.0	7.5	2.2	90.3	9.7
Q10	I enjoy doing the work for this course (Enjoyment)	48.3	39.8	7.4	4.5	0.0	52.1	43.0	0.0	4.9	0.0	95.1	4.9
Q11	I find the learning resources for this course useful (eg. notes, handouts, readings, AV materials, Classroom) (Resources)	54.4	39.3	2.1	2.1	2.1	55.6	40.1	0.0	2.2	2.2	95.7	4.3
Q12	The web-based (online) materials for this course are effective in assisting my learning (Online materials)	43.5	47.5	4.8	3.2	1.1	45.7	49.9	0.0	3.3	1.1	95.5	4.5
Q13	It used computer (eg. Program, Softwere) on this subject (Computer Use)	21.0	26.3	8.5	30.0	14.3	22.9	28.7	0.0	32.8	15.7	51.6	48.4
Q14	The facilities (such as classrooms, lecture theatres, studios, labs) are adequate for this course (Facilities)	63.4	32.6	4.0	0.0	0.0	66.0	34.0	0.0	0.0	0.0	100.0	0.0
Q15	I feel I can actively participate in my classes (Participation)	75.2	18.2	0.0	6.6	0.0	75.2	18.2	0.0	6.6	0.0	93.4	6.6
Q16	There is good balance between theory and practice (Theory)	36.3	35.8	5.0	22.8	0.0	38.3	37.7	0.0	24.0	0.0	76.0	24.0
Q17	The teaching staff work hard to make this course interesting (Interesting)	56.0	39.8	2.1	2.1	0.0	57.2	40.7	0.0	2.2	0.0	97.8	2.2
Q18	I can see how I'll be able to use what I am learning in this course in my career (Application)	50.7	37.9	8.2	0.0	3.2	55.2	41.3	0.0	0.0	3.5	96.5	3.5
Q19	The staff make a real effort to understand difficulties I might be having with my work (Understanding)	62.6	29.7	5.6	1.1	1.1	66.3	31.5	0.0	1.1	1.1	97.8	2.2
Q20	The staff put a lot of time into commenting on my work (Commenting)	49.1	31.8	8.0	9.0	2.1	53.3	34.6	0.0	9.8	2.3	87.9	12.1

In this paper, beside the 20 variables that consist students' satisfaction over good practices used in educational subject, at the end of questionnaire there were two direct questions for how much are students generally satisfied with the quality of the subject.In addition, in order to verify the first question, another question has been raised that will encourage a forthcoming student to attend the subject. In case they are satisfied with the service of the subject, then they will encourage another forthcoming student to come, otherwise they will do the opposite.

The results show that 87.3% of students in general are satisfied with the quality of subject, while 79.3% indicate that they will encourage a forthcoming student to attend this subject.

Table 3. Student's perception on satisfaction on service quality and encourage other students to study in this subject?

Variable	Category	Frequency (%) N=377
The Student's perception on satisfaction on service quality in this subject?	Satisfied	87.3
	Not Satisfied	12.7
Would you encourage other students to study this subject?	Yes	79.3
	No	20.7

For having more detailed overview on our research, mathematical models are built by using logistic regression. The goal is to see the impact of general satisfaction on quality of subject in general against several other factors that affect the satisfaction.

Therefore, the implementation of logistic regression the variable 'answer' is the satisfaction of our study where we have written the code 0 if the student is dissatisfied, and 1 if the student is satisfied. While the independent variables were analyzed separately against the dependent variable were coded as 1 (disagree and strongly disagree) and 2 (agree and strongly agree).

By setting dialoguing table of MedCalc program for logistic regression of data's questionnaire, the results of **table 4** detail this.

For example, for 'Q1-objectives' variable, cases in which Y = 0 are 19.9% of students that are dissatisfied, and cases in which Y = 1 are 80.1% of students that are satisfied.

For this variable, we obtain the logit model:

$$\log it\,(p) = \ln \frac{p}{1-p} = -2.15 + 1.81 X_{objc}$$

The report of odds (odds ratios) for this variable is XObjec = 6:12> 1, which means that if the teacher gives (made) learning objectives clear to the students, and the students are satisfied completely, then chances to satisfy the students in general with the subjects service will be 6 times higher.

The percentage of provided cases for this variable is 80.65%, which means that 80.65% of the provided cases are alike.

Whilst other models have other factors shown in Table 4.

Table 4. Model summary in the logistic regression equation

Variable	Dependent Y			Overall Model Fit					Coefficients and Standard Errors				Odds Ratios and 95% Confidence Intervals		Percent of cases correctly classified (%)
	Selected sample	Cases with Y=0 (%)	Cases with Y=1 (%)	Null model -2 Log Likelihood	Full model -2 Log Likelihood	Chi-square	DF	Significance level-P	Coefficient Variable	Coefficient Constant	Std. Error	P	Odds ratio	95% CI	
Q1	372	19.9	80.1	371.2	362.3	8.90	1	0.0028	1.81	-2.15	0.60	0.0026	6.1224	1.89 to 19.88	**80.65**
Q2	355	20.0	80.0	355.3	352.5	2.75	1	0.0971	0.93	-0.42	0.53	0.08	2.5292	0.89 to 7.21	**80.00**
Q3	364	20.6	79.4	370.3	366.8	3.49	1	0.0618	1.39	-1.39	0.72	0.0534	4.0141	0.98 to16.44	**79.40**

Q4	364	20.3	79.7	367.6	358.9	8.65	1	0.0033	1.78	-2.12	0.60	0.003	5.9552	1.83 to 19.34	**80.22**
Q5	357	21.9	78.2	374.8	313.5	61.32	1	0.0001	3.31	-4.96	0.51	0.000	27.4	10.05 to 74.63	**84.03**
Q6	348	18.4	81.6	332.2	312.6	19.63	1	0.0001	2.05	-2.42	0.46	0.000008	7.7887	3.16 to 19.17	**82.76**
Q7	369	21.1	78.9	380.6	362.9	17.70	1	0.0001	2.24	-3.03	0.56	0.0000565	9.391	3.16 to 27.93	**80.49**
Q8	369	21.1	78.9	380.6	376.3	4.33	1	0.0375	1.13	-0.88	0.52	0.03044	3.0892	1.11 to 8.58	**78.86**
Q9	361	19.7	80.3	357.9	301.6	56.33	1	0.0001	2.89	-3.95	0.42	0.00	18.0395	7.94 to 40.99	**85.04**
Q10	349	15.8	84.2	304.1	286.5	17.59	1	0.0001	2.21	-2.57	0.52	0.00002	9.1111	3.29 to 25.16	**85.10**
Q11	369	21.1	78.9	380.6	376.3	4.33	1	0.0375	1.13	-0.88	0.52	0.03044	3.0892	1.11 to 8.58	**78.86**
Q12	359	20.6	79.4	365.3	347.0	18.26	1	0.0001	2.28	-3.07	0.56	0.00004	9.7778	3.28 to 29.14	**81.06**
Q13	345	20.3	79.7	348.0	280.4	67.67	1	0.0001	2.69	-2.19	0.42	0.000	14.7981	6.53 to 33.53	**79.71**
Q15	377	20.7	79.3	384.4	384.2	0.23	1	0.6325	0.26	0.84	0.53	0.6257	1.2968	0.46 to 3.69	**79.31**
Q16	358	21.8	78.2	375.3	335.4	39.95	1	0.0001	1.76	-1.66	0.28	0.000	5.7868	3.34 to 10.00	**78.21**
Q17	369	21.1	78.9	380.6	377.3	3.33	1	0.068	1.36	-1.36	0.72	0.05942	3.8784	0.95 to 15.88	**78.86**
Q18	346	17.1	83.0	316.0	218.9	34.18	1	0.0001	4.18	-6.58	1.06	0.00007	65.5417	8.27 to 519.33	**85.84**
Q19	356	19.4	80.6	350.1	327.7	22.42	1	0.0001	2.47	-3.35	0.55	0.000007	11.8737	4.03 to 35.01	**82.58**
Q20	347	21.6	78.4	362.3	336.4	25.84	1	0.0001	1.77	-1.96	0.35	0.0000003	5.8897	2.99 to 11.59	**79.54**

Conclusion

The findings show that the logistic regression method is a very useful technique for the educative process analysis. In our case, it gives a qualitative contribution to the understanding how the teaching process impacts in satisfaction of the students.On the other hand, the results prove that SEEU is an institution that in its focus is the student, by offering them capacity, skills and new knowledge. From descriptive statistics of 20 variables almost all students over 90% stated that they are satisfied and completely satisfied. Whilst in the direct general question, it turned out that 87.3% of students are satisfied with the servicing of subject. Also the question of whether the results would encourage a forthcoming student to follow the subject has turned out close to 79.3%.

It is important that teachers should be focused more on those subjects where one can practice programs or computer- software and a bit more to do over the balance between theory and practice
We think that with this paper will contribute on how much our students are satisfied over teacher's strategies over the use of some good practices in process of teaching.

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