

Detecting Successful Student Profiles At An Open University: The Case Of The UNED (Spain)

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ABSTRACT

At present, one of the major issues and most interesting discussions within the European Higher Education Area is the rate of success in university-level study, and therefore the adaptation of today's university education system to society's requirements. Moreover, we have seen significant growth in distance education throughout recent decades, as this type of education takes on a stronger leadership role in countries that are experiencing severe economic crises. Because the National Distance Education University (UNED) is the most important distance university in Spain, and the Economics Degree program has been offered by the School of Economics and Business for the first time, we have attempted to find a correlation between variables which describe student characteristics (age, gender, employment status, manner of admission, and nationality) and success rates in order to determine the influence that these variables have and achieve a better understanding of student success rates.

Keywords: European Higher Education Area; Distance Education System; Success Rate; Educational Indicators; Correlations

1. INTRODUCTION

Ascertaining the factors that affect student success rates in higher education can broaden the perspectives of policy-makers. Most research studies which describe student success have only examined the academic degrees that students receive and the grades they earn (see González, 1989; Salvador & García-Valcárcel, 1989; Latiesa, 1992; De Miguel & Arias, 1999; Solano et al., 2004; Tejedor & García-Valcárcel, 2007).

According to Garbanzo (2007) and the references therein, European convergence based on the European Credit Transfer System (ECTS) is meant to place a greater emphasis on independent work by students, the diversification of learning activities, the mentoring approach in education, the use of new technologies, etc. These new factors create a challenge for universities, which must adapt to the changing times that have arisen in our knowledge and information-based society. These changes can be seen at the National Distance Education University (UNED) in Spain, as well. At present, the UNED has more than 200,000 students. It is therefore the largest university in Spain. The curriculum has been changed to converge with the European Higher Education System (EHES), and the School of Economics and Business Administration has created an Economics Degree program for the first time ever.

The UNED provides the same qualifications as other universities in Spain and has made major efforts to continue offering high-quality services to its student body, within the framework of the new EHES. The economic crisis has affected the UNED a great deal and for many reasons. To begin with, the number of students has undergone major increases over the last five years, due to a higher demand for education and, above all, for higher education amongst the population. People are attempting to fit their jobs and family life in with the need to improve

their educational qualifications. At the same time, the university’s resources have decreased, along with the human resources it has available (professors and administrative staff) and its financial resources.

All university degrees must undergo a successful evaluation by Spain’s National Agency for Higher Education Quality, and one of the factors this agency takes into account is the student success rate. With this in mind, we decided to carry out this study in order to examine our students’ profiles and determine whether there are certain variables that can help explain student success rates.

We chose to study five variables: age, gender, nationality, employment status, and manner of admission. These variables are of great importance to the UNED, because they can use these variables to draw comparisons with other universities. At the UNED, students tend to be of a higher age than at other universities; there are students of different nationalities (because of immigration into Spain, they have become job-seekers); many students are currently employed, and because of the great differences in student age, they gain admission to the university in many different ways.

This paper is organized as follows: after this introduction, we provide a description of the methodology. Then, Section 3 describes the massive database which we used; Section 4 provides a description of the results, and last of all, we include a brief section with our main conclusions.

2. METHODOLOGY

2.1. The Model

In order to identify the factors and the interactions of such factors that explain the variability of the success rate, we initially propose a linear model including five main factors and the corresponding interactions. In other words, we propose an analysis of variance (ANOVA) of five factors with interactions, the model being a non-balanced fixed effects model as we have considered all the categories of the factors (see Medina & Fenrnández-Avilés, 2014). More specifically the model we propose is given by:

$$y_{ijklmp} = \mu + \alpha_i + \beta_j + \delta_k + \varphi_l + \psi_m + \sum_{\substack{a,b=i,j,k,l,m \\ a \neq b}} \gamma_{ab} + \sum_{\substack{a,b,c=i,j,k,l,m \\ a \neq b \neq c}} \gamma_{abc} + \sum_{\substack{a,b,c,d=i,j,k,l,m \\ a \neq b \neq c \neq d}} \gamma_{abcd} + \gamma_{ijklm} + \varepsilon_{ijklmp} \quad \left\{ \begin{array}{l} i = 1, \dots, I \\ j = 1, \dots, J \\ k = 1, \dots, K \\ l = 1, \dots, L \\ m = 1, \dots, M \\ p = 1, \dots, P \end{array} \right. \quad (1)$$

where:

- (i) y_{ijklmp} is the p th observation in the i th, j th, k th, l th, m th categories of the first, second, third, fourth, and fifth main factors, respectively.
- (ii) μ is a general mean.
- (iii) $\alpha_i, \beta_j, \delta_k, \varphi_l, \psi_m$ represent the effects of the i th level of the first factor, the j th level of the second, the k th level of the third factor, the l th category of the fourth and the m th category of the fifth, respectively.
- (iv) $\gamma_{ab}, \gamma_{abc}, \gamma_{abcd}$ are the interaction effect for whichever two, three and four categories correspond to the (two, three, four) different factors, respectively.
- (v) γ_{ijklm} indicates the effects of interaction of the categories for all five factors included in the model.

In accordance with the literature, the dependent variable, success rate (SR), was calculated as the ratio of the number of credits passed to the total number of credits in which the student was enrolled:

$$SR = \frac{\text{Number of credits passed}}{\text{Total number of credits}} \times 100$$

As usual, SR is expressed as a percentage.

The factors included in the model are age, gender, nationality, working, and the manner in which the student gained admittance into the university. Table 1 lists the categories of these factors.

Table 1: Factors Considered in the Study and their Categories

<i>Endogenous Variable</i>	
Success Rate	
<i>Exogenous Variables</i>	
Age	Working
(21-31)	Yes
(32-36)	No
(37-42)	
(43-76)	
Gender	Manner of Admission
Male	A: University access program for those over the age of 40
Female	B: University access courses for those over the age of 25
Nationality	C: Admission test
Spanish	D: Access from studies prior to Year 2007 Decree
EU	E: Transfer of academic records
Non-EU	F: Fulfillment of admission requirements in EU countries
	G: Studies abroad with homologated pre-university studies
	H: University degree or equivalent thereof

Source: Own elaboration

However, given that the third and fourth order interactions were proved not to be significant, we pruned Model (1) removing such interaction effects from it. Another reason for removing these interaction terms from the model is that the number of data in the combinations of the categories of four, and especially, the five factors was very scarce (in some cases there was any data for some combinations). The main factors working, nationality, and age were also found not to be significant, but they were not removed from the model because the interactions of some of their categories with the categories of some of the significant factors were found to be significant. Thus, the final model is as follows:

$$y_{ijklmp} = \mu + \alpha_i + \beta_j + \delta_k + \varphi_l + \psi_m + \sum_{\substack{a,b=i,j,k,l,m \\ a \neq b}} \gamma_{ab} + \sum_{\substack{a,b,c=i,j,k,l,m \\ a \neq b \neq c}} \gamma_{abc} + \epsilon_{ijklmp} \quad \begin{cases} i = 1, \dots, I \\ j = 1, \dots, J \\ k = 1, \dots, K \\ l = 1, \dots, L \\ m = 1, \dots, M \\ p = 1, \dots, P \end{cases} \quad (2)$$

2.2 Estimation and Testing

Both the main and the interaction effects can be estimated using usual direct formulae as above or by using the least squares approach (the outcome is the same) (see Searle, 1972). As for testing that there is no difference in the levels of the factors and in the first, second, and third order interactions of the categories of such factors we use the traditional *F*-test. If the null is rejected, we use Tukey’s Honest Significant Difference (HSD) for all pairwise comparisons to investigate which levels differ. If X_1, \dots, X_n is i.i.d. $N(\mu, \sigma^2)$ and $R = \max_i \{X_i\} - \min_i \{X_i\}$, then $R/\hat{\sigma}$ has the studentized range distribution $q_{n,\nu}$ where ν is the number of degrees of freedom used in estimating σ , and the Tukey confidence intervals are:

$$\hat{\alpha}_i - \hat{\alpha}_j \pm q_{1, n-1} \frac{\hat{\sigma}}{\sqrt{2}} \sqrt{\frac{1}{J_i} + \frac{1}{J_j}}$$

where J_i and J_j indicate the sample sizes corresponding to the levels of the main (or interaction) factor under comparison.

Technically, the intervals constructed in this way would only apply to balanced designs where there is the same number of observations made at each level of the factor. This is why we used a function implemented in R software that incorporates an adjustment for sample size that produces sensible intervals for mildly unbalanced designs. We are aware that when the sample sizes are very unequal, Tukey’s HSD may be too conservative, although in general the confidence intervals are narrower than those produced by Scheffé’s theorem. The reason is that it takes the rather pessimistic approach based on the maximum difference. It is well known that there are several other methods for multiple comparisons, but we prefer Tukey’s HSD because in case of detecting a significant difference of effects we are sure that it is quantitatively relevant.

3. DATA

The data used in this paper was provided by the UNED. Initially, the database consisted of a sample of 6,591 students enrolled in the Economics Degree since it was introduced in the University, that is during the academic courses 2009/10, 2010/11, 2011/12, and 2012/13. This database collects information on the five main factors considered in the analysis as well as on the success rate of such students. Due to the large amount of missing values, the final database reduced to the information on 2,100 students.

As can be seen in Figure 1, 27% of the students’ ages are between 21 and 31 years, 25% are between 32 and 36 years, 26% have an age ranged between 37 and 42 years, and the remainder (22% of the total) are between 43 and 76 years. The categorization of this factor has been carried out so that its four categories have a similar number of students. As for gender, nearly three quarters of the students are male and the reminder quarter being female. As for the nationality of the students included in the sample, only 3% of them are foreign, 1% European, and 2% non-European. As for the students’ employment status while studying, 85% of them stated that they were working, while only 15% said they were full-time students. Last of all, when examining the way in which the students gained university admission, over half of the students, or more specifically 55.4%, had completed studies prior to the year 2007 Decree; 26.4%, or more than a quarter of the sample, had a university degree or equivalent thereto; 8.5% had studied abroad and their pre-university studies had been given official equivalency certification in Spain; 7.7% were admitted to the University by taking an entrance exam, and the remaining 2% were admitted through the program for university access by applicants over the age of 40, university access courses for students over the age of 25, by transferring academic records or by fulfilling admission requirements in EU countries.

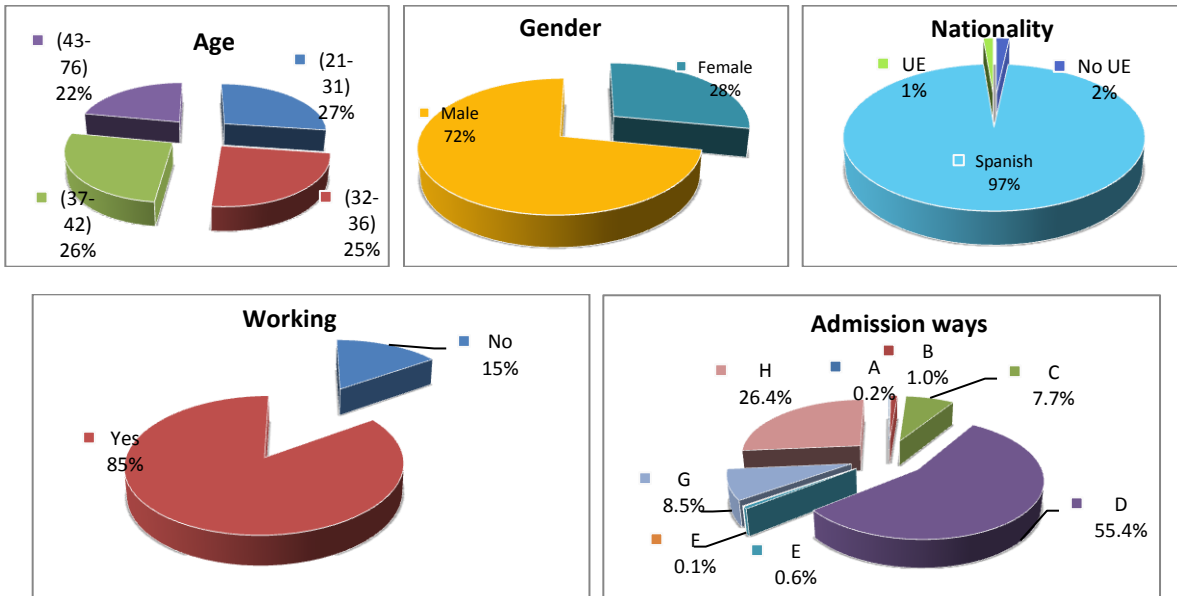


Figure 1: Percentage Distribution of the Exogenous Variables
Source: Own elaboration

Figure 2 depicts the box plots corresponding to the categories of each of the five factors involved in our analysis. It can be easily appreciated that the median, dispersion and asymmetry corresponding to the above mentioned modalities clearly indicate that the ANOVA of the data can be of interest to identify the sources of variation of the success rate of the students enrolled in the degree of Economics recently introduced by the UNED.

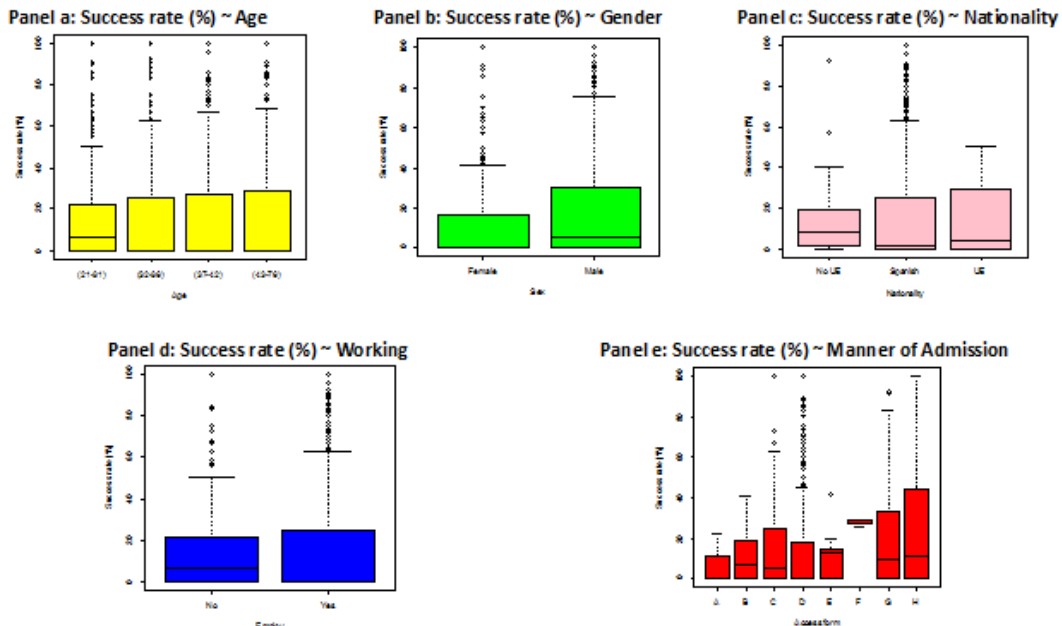


Figure 2: Box-Plot for Each Factor
Source: Own elaboration

4. RESULTS

The success rate of the students of the UNED in the Economics degree is 16.7% (with a standard deviation of 24.8 percentage points). However, as it can be seen in Table 2, the ANOVA of our data reveals that two of the

five main factors involved in Model (2) are statistically significant: The admission way and gender. In fact, they are highly significant (the p -values are $< 2.2E-16$ and $1.315E-09$ respectively). This means that at least two admission ways yield significantly different results in the success rate. Likewise, the effect on the success rate of being male or female is also different, with a high degree of significance.

Table 2: Analysis of Variance

Panel a: Main Factors						
	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
Manner of Admission	7	52870	7552.8	13.127	< 2.2E-16	***
Gender	1	21372	21371.8	37.1448	1.315E-09	***
Working	1	5	4.7	0.0082	0.927781	
Nationality	2	782	390.9	0.6794	0.507052	
Age	3	2972	990.5	1.7216	0.160499	
Panel b: First-Order Interactions						
	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
Manner of Admission:Gender	6	5964	994	1.7275	0.110718	
Manner of Admission:Working	5	8827	1765.3	3.0682	0.00918	**
Gender:Working	1	35	34.6	0.0602	0.806194	
Manner of Admission:Nationality	8	2424	303	0.5266	0.837268	
Gender:Nationality	2	1923	961.3	1.6708	0.188362	
Working:Nationality	2	1110	554.8	0.9643	0.381427	
Manner of Admission:Age	15	13074	871.6	1.5149	0.091447	.
Gender:Age	3	2147	715.6	1.2438	0.292278	
Working:Age	3	1145	381.7	0.6634	0.574558	
Nationality:Age	5	3681	736.2	1.2795	0.26993	
Panel c: Second-Order Interactions						
	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
Manner of Admission:Gender:Working	5	1527	305.3	0.5306	0.753231	
Manner of Admission:Gender:Nationality	4	3656	914	1.5886	0.174667	
Manner of Admission:Employment Status:Nationality	2	1710	855.2	1.4864	0.226449	
Gender:Working:Nationality	2	2038	1019.2	1.7714	0.170371	
Manner of Admission:Gender:Age	12	2875	239.6	0.4164	0.957856	
Manner of Admission:Employment Status:Age	10	13568	1356.8	2.3582	0.009076	**
Gender:Working:Age	3	4186	1395.5	2.4254	0.063924	.
Manner of Admission:Nationality:Age	6	3923	653.8	1.1363	0.338479	
Gender:Nationality:Age	2	4800	2399.9	4.1711	0.015571	*
Working:Nationality:Age	1	132	131.9	0.2293	0.632091	
Panel d: Third Order Interactions						
	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
Manner of Admission:Gender:Working:Nationality	1	173	173.4	0.3014	0.583069	
Manner of Admission:Gender:Working:Age	6	3457	576.2	1.0014	0.422605	
Panel e: Residual						
	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
Residual errors errors	1981	1139797	575.4			

*** significant at the 0.001 level; ** significant at the 0.01 level; * significant at the 0.05 level; . significant at the 0.1 level. Source: Own elaboration.

In light of the Tukey's HSD test for all of the pairwise comparisons of the levels of the factor "Manner of Admission" (Table 3), the largest differences were between category F (fulfillment of admission requirements in EU countries) and the rest of categories, as expected, because the students who were admitted through this manner of admission are the highest ranked in terms of student success rates (27.9%, with a standard deviation of just 1.74). However, these differences, which reach more than 20 percentage points in some cases, cannot be considered statistically significant, because the students who are admitted in this way account for just 0.1% of all the students in the sample. Also as expected, the second largest differences are between category H (University degree of equivalent thereof) and the remaining categories. However, some of the differences are clearly significant in this case. More specifically, the success rate of the students admitted to the UNED by having a university degree or

equivalent thereof (24.6%) exceeds by (i) 14.0 percentage points the success rate of those whose manner of admission to the university was an access course for students over the age of 25 (just 5.6%), (ii) 11.1 points the success rate of the students admitted to the UNED due to studies prior to year 2007 Decree (10.5%), (iii) 8.1 points the success rate of the students required to pass an admissions test (16.4%), and (iv) 6.4 points the success rate of those who completed their pre-university studies abroad and had them officially certified for equivalency in Spain (18.2%). As stated above, the success rate of those students with a university degree or equivalent thereof is 3.3 percentage points lower than those who fulfilled the admission requirements in EU countries, but this difference was not found to be significant. These findings are certainly relevant, given that 26% of students enrolled in the Economics Degree program at the UNED were admitted in this manner.

Table 3: Tukey’s HSD Test (Multiple Comparisons of Means)

Age					Manner of Admission				
	diff	lwr	upr	p-adj		Diff	lwr	upr	p-adj
(32-36)-(21-31)	0.5640	-3.1840	4.3120	0.9803	B-A	4.9944	-34.5652	44.5540	0.9999
(37-42)-(21-31)	1.7601	-1.9196	5.4398	0.6079	C-A	10.8773	-25.9615	47.7162	0.9865
(43-76)-(21-31)	3.0600	-0.8017	6.9218	0.1746	D-A	7.4448	-29.0072	43.8968	0.9986
(37-42)-(32-36)	1.1961	-2.5808	4.9729	0.8478	E-A	6.1636	-35.4495	47.7766	0.9998
(43-76)-(32-36)	2.4960	-1.4584	6.4504	0.3658	F-A	22.3847	-33.2013	77.9706	0.9256
(43-76)-(37-42)	1.2999	-2.5898	5.1896	0.8258	G-A	12.6104	-24.1858	49.4065	0.9683
					H-A	19.0306	-17.4899	55.5510	0.7618
					C-B	5.8829	-10.6598	22.4257	0.9612
					D-B	2.4504	-13.2121	18.1129	0.9998
					E-B	1.1692	-24.2908	26.6292	1.0000
					F-B	17.3903	-27.4022	62.1827	0.9382
					G-B	7.6160	-8.8316	24.0635	0.8553
					H-B	14.0362	-1.7849	29.8573	0.1256
					D-C	-3.4325	-9.5522	2.6871	0.6861
					E-C	-4.7137	-25.6981	16.2707	0.9975
					F-C	11.5073	-30.9014	53.9161	0.9918
					G-C	1.7330	-6.1826	9.6486	0.9979
					H-C	8.1533	1.6384	14.6681	0.0038
					E-D	-1.2812	-21.5789	19.0165	1.0000
					F-D	14.9399	-27.1333	57.0130	0.9615
					G-D	5.1656	-0.6917	11.0229	0.1306
					H-D	11.5858	7.8316	15.3400	0.0000
					F-E	16.2211	-30.3949	62.8370	0.9655
					G-E	6.4468	-14.4626	27.3562	0.9826
					H-E	12.8670	-7.5533	33.2873	0.5428
					G-F	-9.7743	-52.1460	32.5974	0.9970
					H-F	-3.3541	-45.4865	38.7784	1.0000
					H-G	6.4202	0.1512	12.6893	0.0402

Legend: diff: difference in the observed means; lwr: lower end point of the interval; upr: upper end point; and p adj: p-value after adjustment for the multiple comparisons. Source: Own elaboration.

In brief, as expected, fulfillment of admission requirements in EU countries and having an university or equivalent title are the two ways that guaranties the higher success rate of the students enrolled in the Economics degree in the UNED (although the small number of students enrolled in the UNED following the first does not allow the *F*-test to qualify the success rate differences between this admission way and most of the others as significant).

It is of note that the success rate (16.4%) of the most common way of admission in the UNED (admission test - more than half of the students enroll in the Economics degree in the UNED using this) only surpasses that of the very infrequent levels A and B (only 1.2% of the students enrolled in the degree belongs to these two categories), although the ANOVA of the data do not find significant such differences due, mainly, to the small number of students in these infrequent categories.

As for the second significant factor (gender), the success rate of men (18.8%) exceeds in 7.1 percentage points that of women (11.5%), this difference having been found highly significant. Of course, this finding invites to investigate the reasons why male and female success rate are not significantly equal, as it would be expected, but this analysis goes beyond the scope of this paper.

Regarding the interaction effects, there is no interaction between "Admission way" and "Gender" (Table 2, Panel b), which makes absolute reliable the above findings about the main effects of these factors. However, it has been found a highly significant first order interaction between the way of admission and whether the student is working or not, and a second order interaction of these two factors with "Age" (Table 2, Panel c). Also identified was a significant first order interaction (at a 0.10 significant level) between "Manner of Admission" and two second order significant interactions: between "Gender," "Nationality," and "Age" (at the 0.05 significant level), and between "Gender," "Working," and "Age" (at the 0.10 significant level).

These findings firstly suggest that the interaction between "Admission way" and "Working" and that of these two factors with "Age" could be masking small albeit significant differences in the effects of the levels of the "Working" factor and probably of the "Age" factor (supposedly in the effects of the extreme categories). The existing interactions between "Admission way" and "Age" and "Gender," "Working," and "Age" reinforce this hypotheses.

Secondly, the success rate of modalities "University access courses for over the age of 25" and "Admission test" of the admission way factor increases substantially in the case that the student is not working (from 10.5% to 22.5% and from 16.4% to 27.5%, respectively). On the contrary, it decreases to 7.1% and 12.5% when the student is enrolled in the labor market. It is of note that the rate of success of the most successful admission ways ("Fulfillment of admission requirements in EU countries" and "University title or equivalent" is independent on whether the student is working or not. As for the other significant first order interaction (between "Admission way" and "Age"), the effect on the success rate of the ways of admission university access courses for over the age of 25, access from studies previous to Decree 2007, transfer of academic records, and University title or equivalent is clearly reinforced when the age of the student is above 43 years. On the contrary, the rate of success of those who have enrolled in the degree by transferring their academic records decreases dramatically in the interval 37-42 years.

As for the second-order interactions, we must first mention that among the students between the ages of 32 and 36 years with an employment status of "working," the success rate for men (19.7%) is significantly greater than for women (8.5%). A similar claim can be made for the age range of 37-42 years, which may be linked, in general, to issues involving gender equality and, more specifically, to the use of time on non-paid work. Secondly, in the age range of 32-36 years the success rate of Spanish and non-EU women is especially low (only 8.8%), whereas amongst men this rate is nearly 50%. On the other hand, among EU students, the female success rate exceeds the males' rate by more than 12 percentage points. This finding reinforces the hypotheses that a gender equality issue may lie behind the results found for Spanish and non-EU students.

CONCLUSIONS

The above analysis leads us to draw the following conclusions. The success rate of UNED students in the Economics degree is 16.7%. As for the first significant factor (manner of admission), fulfillment of admission requirements in EU countries, and having a university degree or equivalent thereof are the two manners of admission which lead to higher success rates among the students enrolled in the UNED Economics Degree program, as expected. As for the second significant factor (gender), the success rate of men (18.8%) exceeds that of women (11.5%) by 7.1 percentage points. This difference was therefore found to be highly significant.

As for the first-order interactions, the interaction between "Manner of Admission" and "Employment Status" and the interaction of these two factors with "Age," could be masking small but significant differences in the effects of the factor "Employment Status" and probably the factor "Age" (supposedly in terms of effects at these categories' extremes).

As for the second-order interactions, it must first be noted that among the students between the ages of 32 and 36 years who have an employment status of “working,” the success rate for men (19.7%) is significantly greater than for women (8.5%). A similar claim can be made for the age range of 37-42 years, which may be linked, in general, to issues involving gender equality and, more specifically, to the use of time on non-paid work. Secondly, in the age range of 32-36 years the success rate of Spanish and non-EU women is especially low (only 8.8%), whereas amongst men this rate is nearly 50%. On the other hand, among EU students, the female success rate exceeds the males’ rate by more than 12 percentage points. This finding reinforces the hypotheses that a gender equality issue may lie behind the results found for Spanish and non-EU students.

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