

1 Factors Related to the Academic Performance of 2 Students in the Statistics Course in Psychology

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9 **Abstract.** Many studies have examined the factors that influence academic performance in
10 primary and secondary education as well as at university, with the purpose of enhancing
11 learning at these stages and reducing drop-out rates. It is within this research framework
12 that we want to emphasise the deficient performance of students enrolled on the statistics
13 course in the Faculty of Psychology at the University of Barcelona. Consequently, this paper
14 attempts to determine the factors that affect student performance in this subject by under-
15 taking an analysis of a structural equation model and determining its stability over time.
16 In order to accomplish our objective, we worked with two samples of students enrolled sta-
17 tistics classes. The first group comprised 211 students enrolled in the academic year 2000–
18 2001, while the second comprised 287 students enrolled in the academic year 2001–2002. By
19 administering a questionnaire, we obtained information concerning such variables as demo-
20 graphic data, previous academic record, information related to the subject and the degree of
21 satisfaction with it, and the final mark obtained by the students in the subject. The param-
22 eters for each group of students were estimated separately and the goodness of fit of the
23 proposed structural model was assessed. The data analysis showed a good fit with both
24 data bases, but the set of estimated parameters differed in the two academic years under
25 consideration.

26 **Key words:** academic performance, statistics, structural models.

27 1. Introduction

28 The difficulties encountered by psychology undergraduates in learning the
29 contents of the subject of statistics are well known in psychology facul-
30 ties, and among the lecturers of this subject, throughout Spain. We believe

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31 these difficulties are caused by two main factors: first, the great differences
32 encountered in the academic backgrounds of the new undergraduates on
33 being admitted to the university, especially in recent years following the
34 introduction of the educational reform act known as the *Ley de Ordenación*
35 *General del Sistema Educativo* (LOGSE) and, second, and directly linked
36 to this first factor, the fact that first-year undergraduates do not expect to
37 find a subject based on mathematics on the psychology curriculum. Indeed,
38 given these circumstances, it might be the case that not all the first-year
39 students in the Faculties of Psychology possess the academic pre-requisites
40 to cope successfully with the demands of the subject of statistics, which in
41 the case of the Psychology faculty of the University of Barcelona is entitled
42 *Anàlisi de Dades en Psicologia* (Data Analysis in Psychology).

43 Various attempts have been made to improve the performance of the
44 students enrolled on this subject. Since the academic year 1999–2000, the
45 faculty has introduced an optional subject to raise the level of those whose
46 mathematics skills are insufficient, known as *Fonaments Matemàtics* (Basic
47 Mathematics), specifically designed for those students with little training
48 in mathematics in their pre-university courses in which the presence of
49 mathematics is negligible (Arts and Humanities, for example). Furthermore,
50 and forming part of the framework of pedagogic research which we seek
51 to promote, a number of empirical studies have been undertaken in an
52 attempt to determine the factors influencing student performance in this
53 subject (Barrios et al., 2000; Guàrdia et al., 2002; Però et al., 2002). This
54 paper can be considered as a continuation of these previous studies and,
55 at the same time, as an attempt to provide a summary of contributions
56 reporting empirical evidence over the last few years concerning the factors
57 influencing academic performance in statistics.

58 The first question to undertake, and a vital element in any discus-
59 sion of the academic performance of students at whatever stage of their
60 education, is just how we might define academic performance and, simi-
61 larly, determine which indicators can be used in its measurement (Gabinet
62 d'Orientació Universitària, 2000a, b). In general, the question of academic
63 performance has been posed as a global question and has usually been
64 the object of very broad, general proposals as well as of theoretical mod-
65 els concerning its conceptual definition (Loeb, 1994; Liljander, 1998). How-
66 ever, the aim we set here has meant that we must centre our analysis on
67 aspects linked more specifically with the characteristics of the subject of
68 statistics. Various studies have been undertaken in primary, secondary and
69 university education that have examined performance in subjects such as
70 statistics or those of an analytical–methodological nature, either at a the-
71 oretical or empirical level. Examples of theoretical studies are those of
72 Hunt and Tyrrell (2000) and Hodgson and Burke (2000). Hunt and Tyrrell
73 (2000) highlight the significance of the introduction of new technologies,

74 in particular the Internet, in the teaching of statistics. On the other hand,
75 Hodgson and Burke (2000) argue in favour of the introduction of simula-
76 tions accompanied by a good introduction to the subject matter, as well as
77 the monitoring and appraisal of the work undertaken by the students as
78 essential elements in the best practice of the teaching of statistics and the
79 evaluation of academic performance.

80 The studies that adopt an eminently practical approach are those that
81 examine the importance of variables related to the role of motivation,
82 personality and psychosocial factors (Castejón et al., 1996; Garrido and
83 Rojo, 1996; Pérez-Sánchez and Castejón, 1996; Rocés et al., 1997; García
84 and Fumero, 1998) in the performance of students. Further studies iden-
85 tify a wide range of factors related to academic performance in the study
86 of analytical subjects among university students, including previous aca-
87 demic record, in other words, the mark awarded in the University entrance
88 examinations, performance in the pre-university course (*bachillerato* in our
89 case) and the branch of studies selected during this pre-university course
90 (Alvarado and García, 1999–2000; García et al., 2000), as well as atten-
91 dance at and participation in the classroom (Alvarado and García, 1999–
92 2000; García et al., 2000; Huberty, 2000). Finally, findings such as those
93 made by Gal and Ginsburg (1994) and Garfield (1994) highlight the need
94 to take into consideration students' attitudes towards and beliefs concern-
95 ing statistics and Smith (1998), Boyle (1999) and Gardner and Hudson
96 (1999) comment on the utility of students undertaking practical tasks in
97 which they have to apply various statistical techniques while learning sta-
98 tistics. It is within this context that we should situate our traditional
99 approach and this present study.

100 It was Barrios et al. (2000) who established the path taken by students
101 in order to enter university (COU versus LOGSE), the branch of stud-
102 ies selected in the *bachillerato* (equivalent to the high school diploma, that
103 is, option A/B – science or health sciences – versus option C/D – social
104 sciences or humanities) and the mark awarded in the university entrance
105 examinations (PAAU) as the predictive variables based on the fit of a step-
106 wise optimal linear regression model. The results showed that each had a
107 slightly significant effect in predicting academic performance, measured by
108 the mark awarded in the final assessment of the subject.

109 In previous studies Guàrdia et al. (2002) and Però et al. (2002), we
110 proposed various modifications in the use of these variables, and extended
111 some of the measures that we considered to be linked to performance in
112 the subject of statistics. The main change was in the development of a
113 Likert-style satisfaction scale (assessed on a scale from 0 to 7) concern-
114 ing aspects related to the subject. This was based on the hypothesis that
115 a student's satisfaction might be directly linked to his or her performance.
116 This scale was generated *ad hoc* for each study, given the different teaching

117 programmes adopted in each academic year for the subject. In the first study
118 (Guàrdia et al., 2002), the scale comprised 16 items, while in the second
119 (Peró et al., 2002) 14 items were included, as the two items that referred to
120 the teachers of the practical sessions were eliminated since in that academic
121 year (2001–2002) the syllabus did not distinguish between the teachers of the
122 practical sessions and the teachers of theory. The databases for both years
123 were examined, among other analytical processes, using factorial analysis in
124 order to study the underlying structure of both scales of satisfaction. In the
125 data for the academic year 2000–2001 (Guàrdia et al., 2002), the 16 items
126 were grouped in five sets of factors (satisfaction with the teachers, knowl-
127 edge acquired, the teaching methods used in the subject, the teachers of the
128 practical sessions and the teaching conditions) which accounted for 64.7%
129 of the variability. For the data for the academic year 2001–2002, the facto-
130 rial analysis included three factors (satisfaction with the teachers, importance
131 attached to the subject and the organisation of the subject) which accounted
132 for 55.15% of the overall variability.

133 The bivariable contrasts between academic performance and the factors
134 obtained in the factorial analysis and other variables collected in the ques-
135 tionnaire were not statistically significant in the 2000–2001 study, while
136 in the 2001–2002 study a statistically significant relation was only found
137 with the branch of studies selected in the *bachillerato* (technical science
138 and/or biology resulting in a better performance than humanities and/or
139 social sciences). Furthermore, in both samples a study of the goodness
140 of fit of a system of structural equations was undertaken, in order to
141 determine which structure and factors influenced the academic performance
142 of students enrolled in the subject of Data Analysis in Psychology. The
143 overall results showed the effect on the two models of the following facto-
144 rs: First, the effects of the academic record prior to initiating univer-
145 sity studies (the branch of studies selected in the *bachillerato*, the mark of
146 the university entrance examinations, the fact of having studied statistics
147 before or not, choosing of psychology as the first option when selecting
148 which university degree to take and, finally, whether or not the student was
149 repeating the subject); second, the estimated mark (the final mark that the
150 student expects to obtain in the subject) and, finally, the factor of satis-
151 faction expressed by the students (as regards the teachers, the information
152 taught, the teaching methods used in the subject, the teachers of the prac-
153 tical sessions and the conditions of study for the academic year 2000–2001
154 and similarly for the academic year 2001–2002). In both cases the good-
155 ness of fit of the model was adequate. In addition, the three latent facto-
156 rs that were defined were statistically significant, although their relative
157 weighting varied in the two studies. In the first (2000–2001), the latent var-
158 iable “previous academic record” had greater importance, followed by the
159 “estimate of the final mark” and finally the “degree of satisfaction”, while

160 in the second (2001–2002), the “degree of satisfaction” obtained a higher
161 importance, followed by “previous academic record” and finally the “esti-
162 mate of the final mark”.

163 The results of these studies show the well-known effect of dispersion
164 that is typical in studies of academic performance. It is difficult to adopt
165 a definitive position for a set of results since none is conclusive. However,
166 the results for the group of students in the academic year 2001–2002 (Peró
167 et al., 2002) provide a simpler factorial solution and, consequently, one
168 that is more parsimonious in detecting factors that have an effect on aca-
169 demic performance in this subject. The structural models analysed form
170 the two factorial solutions and, therefore, analysed in the two populations
171 also show the dispersion discussed above (Guàrdia et al., 2002; Peró et al.,
172 2002).

173 In this study we attempt to analyse the common information from the
174 studies undertaken by Guàrdia et al. (2002) and Peró et al. (2002), which
175 basically requires us to reconsider the factorial analysis undertaken in the
176 first study (Guàrdia et al., 2002) and consequently the structural model.
177 Once the structural model has been defined (identical in both years), we
178 can then proceed to the study of its goodness of fit, as well as to a com-
179 parison of the indices of fit of the two academic years, in order to eval-
180 uate the stability of the proposed structure. The structural model that we
181 propose studying for the two academic years is that analysed for the 2001–
182 2002 data (Peró et al., 2002), and which is shown in Figure 1.

183 2. Method

184 2.1. SUBJECTS

185 We studied two samples of students enrolled in the subject Data Analy-
186 sis in Psychology. The first sample comprised 211 students enrolled in the
187 course in the academic year 2000–2001, while the second sample comprised
188 287 students enrolled on the course in the academic year 2001–2002. The
189 choice of students that made up the two samples was determined entirely
190 on the basis of those students that attended the class when the question-
191 naire was administered, and which in addition made the final examination
192 (accidental sampling).

193 Of the students enrolled in 2000–2001, 18.7% were male and 81.3%
194 female, with an average age of 19.7 years and a standard deviation of
195 3.5 years. Among the students enrolled in 2001–2002, 14% were male and
196 86% female, with an average age of 19.48 years and a typical deviation of
197 3.02 years. Given these data, we can conclude that the distribution of both
198 variables was very similar in the two groups studied.

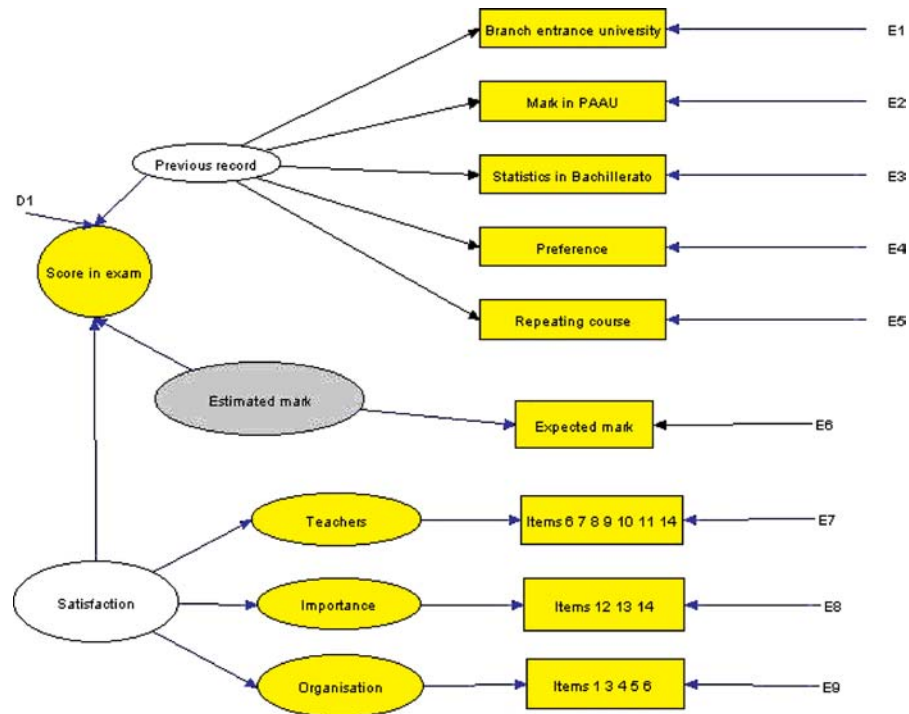


Figure 1. Diagram illustrating the proposed structural model.

199 2.2. MATERIAL

200 The material used comprised the subject examination and an *ad hoc* ques-
 201 tionnaire based on an extension of that used by Barrios et al. (2000). The
 202 questionnaire aimed to gather information that might have an influence on
 203 the students' academic performance in the subject of statistics. The ques-
 204 tionnaire contained the following information:

- 205 • Demographic variables: gender and age.
- 206 • Previous computer knowledge, how this had been acquired, if they have
 207 a computer at home and if they have an internet connection at home.
- 208 • Use of the electronic dossiers on the UB Web produced for the study-
 209 ing of the subject (syllabus, bibliography, statistical equation summary
 210 and solution of practical problems).
- 211 • Whether the student had taken previous courses in statistics, either the
 212 option offered as part of the studies in LOGSE or as a part of other
 213 courses.
- 214 • Whether the student had taken the subject of Basic Mathematics. A
 215 course designed to raise the level of those students encountering diffi-
 216 culties in analytical–methodological subjects in Psychology.

- 217 • Survey of satisfaction comprising 16 items on the questionnaire
218 administered to students in the academic year 2000–2001 and by 14
219 items on that administered to students in the academic year 2001–2002.
220 All the items were presented on a Likert-style scale where students
221 responses range from *strongly disagree* (1) to *strongly agree* (7). The
222 14 items on the questionnaire administered in the academic year
223 2001–2002 can be grouped in the following four areas:
- 224 ■ Aspects related to the subject, comprising the following three items:
 - 225 – the knowledge acquired is important for the rest of the degree
226 (question 12)
 - 227 – the knowledge acquired is important for one’s professional career
228 (question 13)
 - 229 – overall, the subject deserves a favourable evaluation (question 14)
 - 230 ■ Aspects related to the teachers, comprising the following six items:
 - 231 – the teacher seems to master all aspects of the subject (question 6)
 - 232 – the teacher is able to motivate the class (question 7)
 - 233 – the teacher is able to awaken the interest of the students for the
234 subject (question 8)
 - 235 – the teacher makes good use of the examples chosen (question 9)
 - 236 – the teacher has been willing at all times to deal with students’
237 queries (question 10)
 - 238 – the teacher creates a friendly atmosphere which encourages par-
239 ticipation (question 11)
 - 240 ■ Aspects related to the methodology adopted, comprising the follow-
241 ing four items:
 - 242 – the time dedicated to each subject within the course is sufficient
243 (question 2)
 - 244 – the system of evaluation used in the subject is understood and
245 meets the requirements of the syllabus (question 3)
 - 246 – the dossier of practical problems is useful for the student
247 (question 4)
 - 248 – the recommended reading list is useful for understanding the sub-
249 ject (question 5)
 - 250 ■ Aspects related to the conditions in the classroom, comprising one
251 item, including the lighting, heating and ventilation of the classrooms
252 are sufficient (question 1)
- 253 The two items that were eliminated for the academic year 2001–2002
254 referred to the mastery of the subject demonstrated by the teacher of
255 the practical sessions and to the degree of coordination between this
256 teacher and the teacher of theory, because the course structure differed
257 in the second year.

- 258 • The students previous academic record. Specifically, the mark awarded
259 in the university entrance examination (PAAU) and the branch of stud-
260 ies selected during the pre-university courses (sciences or health sciences
261 vs. social sciences or humanities).
- 262 • Data related to the subject studied. In other words, whether the stu-
263 dent attended the class regularly, whether or not they were repeating
264 the course, the mark they expected to obtain and whether the degree
265 of psychology had been their first choice.

266 2.3. PROCEDURE

267 The questionnaire was administered to the students enrolled in the aca-
268 demic year 2000–2001 during the first fortnight of December 2000, while
269 for the students enrolled in the academic year 2001–2002 it was adminis-
270 tered between 17 and 21 December 2001. In both cases, the instructions
271 given to the students emphasised the importance of answering the ques-
272 tionnaire sincerely given that its aim was to determine the factors influ-
273 encing performance in the subject Data Analysis in Psychology and that
274 it was very important to know the students' national identity number so
275 that the results of the questionnaire could be compared with the final mark
276 obtained in the subject. Students were reassured that the data gathered
277 would be kept confidential and that the information would only be used
278 for the purposes of the study.

279 The date of examination was on the 16 January 2001 in the case of the
280 first sample and on 16 January 2002 in the case of the second. The score
281 obtained in the examination, together with that awarded for the assignment
282 undertaken as part of the course, gave the final mark for the subject out of
283 10, where 5 was considered the cut-off point between a pass and a fail.

284 The data analysis undertaken consisted of the fit of the structural model
285 proposed in the introduction using the EQS program (version 5.1).

286 3. Results

287 As discussed above, we estimated the parameters and undertook a study
288 of the goodness of fit of the structural model proposed in the introduc-
289 tion (Figure 1). In this figure, it can be seen that the mark obtained in this
290 subject is determined by the student's previous academic record, the mark
291 expected and their degree of satisfaction. The previous academic record
292 factor is defined by the observable variables of the branch of studies taken
293 by students in order to enter university, the mark obtained in the univer-
294 sity entrance examination (PAAU), whether or not the student had studied
295 statistics before, whether or not the student was repeating this subject of
296 data analysis and whether or not psychology had been the student's first

Table I. Factor structure of the satisfaction scale based on the data obtained in the academic year 2001–2002.

Factor structure of the satisfaction scale established in Peró et al. (2002)	
Factors	Items
Teachers	– The teacher seems to master all aspects of the subject (6)
	– The teacher is able to motivate the class (7)
	– The teacher is able to awaken the interest of the students for the subject (8)
	– The teacher makes good use of the examples chosen (9)
	– The teacher has been willing at all times to deal with students' queries (10)
	– The teacher creates a friendly atmosphere which encourages participation (11)
Importance	– Overall, the subject deserves a favourable evaluation (14)
	– The knowledge acquired is important for the rest of the degree (12)
	– The knowledge acquired is important for one's professional career (13)
Organisation	– Overall, the subject deserves a favourable evaluation (14)
	– The lighting, heating and ventilation of the classrooms are sufficient (1)
	– The system of evaluation used in the subject is understood and meets the requirements of the syllabus (3)
	– The dossier of practical problems is useful for the student (4)
	– The recommended reading list is useful in furthering understanding of the subject (5)
	– The teacher seems to master all aspects of the subject (6)

297 choice of study at university. The factor of “mark expected” is defined by
 298 the observable variable mark expected in the subject (fail, pass, good, excel-
 299 lent and pass with distinction), while the factor of satisfaction is defined by
 300 three factors, namely, the teachers, the importance of the subject and the
 301 organisation of the subject, obtained by factor analysis based on the items
 302 on the satisfaction scale contained on the questionnaire administered in the
 303 academic year 2001–2002 (Peró et al., 2002). The resulting factor structure
 304 is shown in Table I.

305 The method of parameter estimation used in the two structural models
 306 studied was the elliptical robust least square method (ERLS) given the
 307 existence of categorical variables among the observable variables (Lee and
 308 Poon, 1994). Table II shows the indices of fit of the model analysed for the

Table II. Indices of fit for the model studied in the two academic years 2000–2001 and 2001–2002.

Indices of fit	Academic year 2000–2001	Academic year 2001–2002
BBNFI	0.801	0.978
BBNNFI	0.911	0.966
SRMR	0.002	0.008
$\chi^2 =$	35.392; df = 29; $p = 0.15875$	55.1278; df = 29; $p = 0.11$

Where BBNFI is the Bentler–Bonett normed fit index, BBNNFI is the Bentler–Bonett non-normed fit index, SRMR is the standardised root mean square residual and χ^2 is the chi-square index of fit.

309 student samples studied. In both cases, it should be noted that the fit of the
 310 model is good, with a goodness of fit of $\chi^2 = 35.39 (p = 0.159)$ for the data
 311 corresponding to the academic year 2000–2001 and $\chi^2 = 55.128 (p = 0.11)$
 312 for the data corresponding to the academic year 2001–2002, and that the
 313 SRMR value (standardised root mean square residual) is 0.002 and 0.008,
 314 respectively, which indicates only a slight error and, consequently, a good
 315 data fit with the model in the two samples analysed.

316 Table III shows the standardised estimate of the parameters for the two
 317 groups under study. In the two analyses conducted, the parameters corre-
 318 sponding to the three factors that predict the mark obtained in the subject
 319 were statistically significant, with the exception of γ_{13} (satisfaction – exam-
 320 ination score) for the data corresponding to the academic year 2000–2001.
 321 It should be noted that the relationship between these three latent variables
 322 and academic performance differs in the two analyses conducted. The first
 323 point to highlight is the fact that in the data corresponding to the academic
 324 year 2000–2001 the parameter estimate value is markedly lower than that
 325 obtained for the data corresponding to the academic year 2001–2002, the
 326 highest value in the estimate for the academic year 2000–2001 is 0.948 cor-
 327 responding to the factor of previous academic record, while the parame-
 328 ter with the lowest value for the 2001–2002 data is 3.29 corresponding to
 329 the factor of expected mark in the subject. A second aspect to highlight
 330 is the fact that although the three factors have an influence on the final
 331 mark obtained by the students in the subject, their importance is not the
 332 same in the two groups analysed; thus for the data corresponding to the
 333 academic year 2000–2001 the factor with the greatest weight in the predic-
 334 tion of the mark is that of the previous academic record, followed by the
 335 mark expected in the subject and finally by the satisfaction with the vari-
 336 ous aspects related to the teaching of the subject. As for the results of the
 337 model for the data corresponding to the academic year 2001–2002, the fac-
 338 tor that has the greatest weight in the prediction of the mark obtained by

Table III. Estimate of the model's standardised parameters based on the ERLS method for the data corresponding to the academic years 2000–2001 and 2001–2002.

Estimates	Academic year 2000–2001	Academic year 2001–2002
γ_{11}	0.948 *	4.07 *
γ_{12}	0.313 *	3.29 *
γ_{13}	0.053 **	5.12 *
λ_{43}	0.421 *	0.842 *
λ_{53}	0.759 *	0.718 *
λ_{63}	0.377 *	0.601 *

* $p < 0.05$; ** Non-significant.

γ_{11} : previous record – score in exam; γ_{12} : estimate mark – score in exam; γ_{13} : satisfaction – score in exam, λ_{43} : satisfaction with teachers – satisfaction; λ_{53} : importance attached to the subject – satisfaction; and λ_{63} : organisation of the subject – satisfaction.

339 the students is satisfaction with the various aspects related with the teach-
 340 ing of the subject, followed by the previous academic record and finally the
 341 mark expected in the subject.

342 Finally, Table III also shows the standardised estimate of the parame-
 343 ters corresponding to the latent factors that account for the factor of satis-
 344 faction, that is, in relation to the teachers, the importance attached to the
 345 subject and the organisation of the subject. Here once again there was a
 346 repetition of the phenomenon described earlier, the estimated value of the
 347 parameters is notably lower in the case of the data corresponding to the
 348 academic year 2000–2001 than for the data corresponding to the academic
 349 year 2001–2002.

350 4. Discussion

351 The analysis of the proposed structural model shows satisfactory indices of
 352 fit for the two data bases studied ($\chi^2 = 35.392$; $p = 0.159$ for the data cor-
 353 responding to the academic year 2000–2001 and $\chi^2 = 55.128$; $p = 0.11$ for
 354 the data corresponding to the academic year 2001–2002). In fact, the values
 355 of these indices are very similar, with the Bentler-Bonett normed fit index
 356 showing the greatest discrepancy between the two analyses (0.801 for the
 357 academic year 2000–2001 as opposed to 0.978 for the academic year 2001–
 358 2002).

359 The three factors (previous academic record, estimate of the mark and
 360 satisfaction) proposed here as predicting the final mark obtained in the
 361 subject do have such an influence, as has already been demonstrated, albeit

362 only in part, in earlier studies (Alvarado and García, 1999–2000; Alvarado
363 et al., 2000; Barrios et al., 2000; Guàrdia et al., 2002; Però et al., 2001).
364 However, the importance of these three factors in predicting the mark is
365 not the same in the two databases. For the data corresponding to the aca-
366 demic year 2000-01, the most important factor is that of the previous aca-
367 demic record, followed by the mark expected in the subject and finally
368 by the satisfaction, which, moreover, is not statistically significant; indeed,
369 this is the same pattern as that found in the structural model analysed by
370 Guàrdia et al. (2002); by contrast, in the case of the data for the academic
371 year 2001–2002, the factor with the greatest weight in the prediction of the
372 mark obtained by the students is satisfaction, followed by the previous aca-
373 demic record and finally the mark expected. This result suggest that there
374 is no stability in the proposed structure. A further argument against the
375 stability of the structure is the marked difference in the estimate of the
376 standardised parameters for the two data bases studied, with the estimated
377 values for the data corresponding to the academic year 2001–2002 being
378 much higher than those estimated for the academic year 2000–2001.

379 The results obtained show the well known dispersion effect in the study
380 of academic performance. Despite the good fit of the data with the model
381 for the two samples studied here, we have to conclude that there is no sta-
382 bility in the proposed structure, and that possibly the factors that influence
383 the students' academic performance in the subject of Data Analysis in Psy-
384 chology should be sought adopting a different approach.

385 Here again the difficulty in predicting a person's academic performance
386 accurately is patent. It might be the case that there exists a very large
387 group of factors that are not readily operationalised, but which influence
388 the outcome. Furthermore, the difficulties faced in the statistical model-
389 ling of a phenomenon such as academic performance should be consid-
390 ered, particularly where individual differences and those that are generated
391 between the times of measurement have a marked influence on the pro-
392 cess. Prior information will not always be a good predictor of the sub-
393 sequent performance of all people, and this can be attributed to varying
394 degrees of motivation in a person's academic studies. Students at univer-
395 sity are assumed to be studying a subject that they have chosen and it is to
396 be hoped that their motivation and interest for this subject will be greater
397 than that shown during primary and secondary education, which would
398 uphold a more dynamic conception of the educational process.

399 To conclude, taking into consideration the three latent factors that we
400 studied in the structural model what seems to be needed are procedures
401 of direct intervention. Indeed, as regards the factor of previous academic
402 record, we believe that it is vital to strengthen subjects that might raise the
403 level of the students who have little training in maths, such as Basic Math-
404 ematics discussed in the introduction, in order to homogenise the prior

405 mathematical knowledge needed to perform successfully in the subject of
 406 the Data Analysis in Psychology. If this occurs, it seems logical to think
 407 that the second factor, students' expectations, will be influenced by the
 408 degree of prior preparation. Thus the students, in line with their level of
 409 knowledge at the outset will express greater expectations concerning their
 410 own future performance in the subject.

411 It would be interesting to examine in more detail the effect on the
 412 degree of satisfaction expressed of recent developments in the quality of
 413 teaching, including:

- 414 • The use of new technologies of information and communication:
 - 415 – computer presentation of subject matter
 - 416 – use of computer-based statistics programs
 - 417 – e-mail correspondence with the tutor
 - 418 – virtual presentation of exercises by the students
- 419 • evaluation system based on continuous tests.

420 Clearly these changes in the delivery of the subject will need to be anal-
 421 ysed and studied, in the near future, in order to obtain sufficient evidence
 422 so that they might be adopted in the actual teaching setting.

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