Entre CIENCIA e INGENIERIA 4

Amanda Fernandes Pereira da Silva
(Organizadora)

Atena Editora
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CIÊNCIAS EXATAS E DA TERRA E ENGENHARIAS

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APRESENTAÇÃO

A coleção "Entre Ciencia e Ingenieria 4" é uma obra que compreende os processos sob os quais se desenvolve, aplica e divulga a ciência, tecnologia e a inovação. Seu objetivo consiste em difundir trabalhos científicos que abrange diversos campos da Ciência e Engenharia que compõem os capítulos.

O volume abordará de forma categorizada e clara pesquisas e publicações com o objetivo central de analisar processos que possam ser utilizáveis em projetos e/ou trabalhos futuros. Além disso, apresenta uma análise ao desenvolvimento de temáticas que envolvem a saúde pública e coletiva, área das engenharias e ciência.

Desta forma, esse material se torna bem interessante por constituir temas, conhecimentos acadêmicos desenvolvidos e discutidos por diversas instituições de ensino e pesquisa do país e fora do país. Por isso, para necessária compreensão comum e explicitar trabalhos de forma altamente eficaz, a Atena Editora é capaz de oferecer e difundir a transferência de conhecimento com os mais debates centrados da liderança da ciência e engenharia com esta mais nova coleção.

Amanda Fernandes Pereira da Silva

SUMÁRIO

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CAPÍTULO 10

SYSTEM MODELING RESEARCH PROJECT OF STUDENT'S GRADE POINT AVERAGE

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ABSTRACT: This paper presents a general method to identify important factors involved in a comprehensive higher education scenario that can serve to obtain models that describe students' Academic Performance. Academic data were used without interfering with the procedure's capacity for generalization. The method is described with a novel combination of descriptive formalisms from computer science and mathematical symbols, the intention being to make the proposal as clear as possible and to identify possible areas of improvement and/or interest.

KEYWORDS: Educational research, academic performance, protocol formal description.

RESUMEN: Se presenta un método general que hace relevante los factores importantes, involucrados en un escenario completo de educación superior, relativos a obtener una clase de modelos que describan el Rendimiento Académico de los estudiantes. Se utilizan datos del ámbito académico sin que esto entorpezca la generalización del procedimiento. El método se describe de manera novedosa, utilizando formalismos descriptivos del área computacional y simbolismos matemáticos con la intensión de ser lo más claro posible en la exposición e identificar puntos de mejora y/o interés de la investigación.

PALABRAS CLAVE: Investigación educativa, rendimiento académico, descripción formal del protocolo.

1 I INTRODUCTION

Modeling methods are resources of interest to address topics in multiple areas, including social, economic, technological and/or educational issues. This paper focuses on the area of education and proposes a method to describe the *Academic Performance (AP)* of higher education students. AP is defined as the *Grade Point Average* (GPA) for each semester at the *Participating University* (PU). The proposed method looks at academic data taken from the domain of the *PU*; this does not mean, however, that the method overlooks the general educational environment. It is clear that the *AP* phenomenon involves multiple factors that for the time being are not addressed due to lack of data and/or because they are not relevant for the purpose of this study; these factors include family environment, economic condition, emotional state, professor-student empathy, political environment, historical moment, cultural development, personality, health, social media, habits, etc.

It is common for university policies to include among their objectives an increase in *Graduation Efficiency Index* (GEI). The GEI remains an open discussion topic because there is no concrete consensus about how to calculate it. Ideally, a high GEI means that the students who initially enrolled graduated on time and earned good grades. When students graduate from college, they have presumably acquired the knowledge and skills needed to start working in their chosen field. An examination of this assumption is beyond the scope of this research project; it must be pointed out, however, that the concept of AP is based on the institution's vision, which could be seriously flawed. If it is generally accepted that human beings differ in interests and capabilities, then university programs should by rights deal with these differences by taking a different perspective on the AP concept so that it includes the responsibility of other actors, including the institution itself. In order to increase the GEI, it is proposed to give timely attention to cases in which there is a risk of students failing courses and/or earning low grades. The AP prognosis is a tool for deploying this attention effectively, since support, counseling, orientation and/or advisory resources are limited and can be employed inefficiently and/or be stretched too far. There are different modeling and/or analysis proposals to predict and/or explain AP. For example, (Tepper, 2017) (Covington & Covington, 2012) use linear regression models; (Nurhafizah, Ahmad, Siti, Hasfazila, & Mohd, 2018) uses multiple regression models; (Corengia, Pita, Mesurado, & Centeno, 2013) (Chatterjee, Shruti, Natekar, Rai, & Yeung, 2018) (Thompson, Bowling, & Markle, 2018) (Mclsaac, Kirk, & Kuhle, 2015) employ logistic regression models; (R. S., A. K., & S., 2014) (González-Castolo, Ramos-Cabral, & Herández-Gallardo, 2014) employ fuzzy sets; (Miñano, Castejón, Gilar Corbi, & Veas, 2017) use multivariable discriminant analysis; and (La Red Martínez, Karanik, Giovaninni, & Pinto, 2015) use data warehouse techniques and data mining. There are also differences in the variables involved in prediction proposals. For example, (Peled, Yovav, Barzyck, & Grinaustkid, 2019) identify some courses that are especially good predictors for specific undergraduate programs, while (Escolar-Llamazares, et al., 2019) employ socio-educational variables, especially mothers' level of education; (Talib & Sansgiry, 12) consider student-centered variables such as academic competence, test competence, time management, and test anxiety. Some studies consider more conventional proficiency factors, such as previous GPA, previous institution type, and number of passed courses in the first year, (Thompson, Bowling, & Markle, 2018). The relationship between alexithymia and AP is examined in (Faramarzi. & Khafri, 2017), although the author also looks at other variables such as intellectual capacity, mental health and socio-demographic indicators. (Corengia, Pita, Mesurado, & Centeno, 2013) make a proposal using data obtained from the *Differential Aptitude Test* (DAT). The work of (Chatterjee, Shruti, Natekar, Rai, & Yeung, 2018) finds elements that indicate that it is of vital importance for students to attend class, engage in complementary course activities, and study in groups; (Rogaten & Moneta, 2017) conclude that developing creative cognition tends to improve AP. Several results appear to contradict each other, as they consider different types of variables as important, which reveals the partiality of the studies. For example, (Tarun, 2015) consider endogenous variables, while (Mclsaac, Kirk, & Kuhle, 2015) look at exogenous variables. There are different approaches to AP as well: (Micari, 2016) draw a correspondence between AP and passing a mathematics course; (Corengia, Pita, Mesurado, & Centeno, 2013) (Thompson, Bowling, & Markle, 2018) (Talib & Sansgiry, 12) (Garton, Kitchel, & Ball, 2005) use the GPA, and other studies such as (Tepper, 2017) take into account the courses that students have passed. Many works indicate that in order to study and forecast AP, it is important to focus mostly on the first year of university and include the second year when appropriate (Covington & Covington, 2012) (Chatterjee, Shruti, Natekar, Rai, & Yeung, 2018) (Mclsaac, Kirk, & Kuhle, 2015) (Garton, Kitchel, & Ball, 2005) (You, 2015) (Valera, Sinha, Ponsot Balaguer, & Valera, 2009).

This work is organized as follows. Section 2 presents the variables' definition. Section 3 describes the method to identify relevant variables for modeling AP. The procedure to obtain the models is showed in Section 4. Section 5 provides the limitation of the study. Finally, conclusions and future work are presented in Section 6.

2 | CONTEXT OVERVIEW

An analysis is made of records classified in three *Data Banks* (BDs), which in turn are classified into *specific banks,* also called *fields.*

Data bank description

BD_1 *Academic History*

$BD_{1,1}$ Aptitude test

$BD_{1,2}$ GPA from the previous institution

$BD_{1,3}$ Grade in the academic term

BD_2 *Psychological Test*

$BD_{2,1}$ *Attention*

$BD_{2,2}$ *Study practice*

…

BD_3 *Record of Activities on Moodle of the courses in general*

$BD_{3,1}$ *Chats*

$BD_{3,2}$ *Forums*

$BD_{3,3}$ *Homework assignments*

Nomenclature

CU	*University Center*	*p*	Amount of *CU*
Ca	*Degree programs*	*q*	Amount of *Ca*
Ge	*Study groups*	*r*	Amount of *Ge*
Se	*Academic term*	*s*	Amount of *Se*
Cs	*Courses*	*t*	Amount of *Cs*
stu	*student*		

3 I METHOD FOR IDENTIFYING VARIABLES

The following sections formally present the methods proposed to evaluate the variables and identify those that are relevant for the purpose of predicting AP.

3.1 Considerations for data treatment

1. The variables correspond bijectively to the *fields.*

2. All the variables are *independent variables* (*VI*), with the exception of $BD_{1,3}$ which could be a *dependent variable* (*VD*) when considered as a result.

3. If *BD* corresponds to a specific semester and/or course, it is indicated with an extension of the subscript, i.e. $BD_{1,3Se_d}$ | d є {1,...,s}.

4. The nomenclature presented in the previous item is generalized to any other concept for the purpose of clarifying the specific area encompassed.

5. $BD = fields \cup data$

6. $\{BD_{x,x} \cdot BD_{x,x,x}\} \subseteq BD_x \subseteq BD$

7. The $\{VI \cdot VD\} \subseteq BD$

8. The *Independent variables of interest* (*VIi*) are the ones that provoke the greatest increase or decrease of $BD_{1,3,d}$.

9. The $\{VI \cdot VD\} \subseteq BD$

10. For the purposes of this study, we state that a series of courses, different from previous courses and different among themselves, are taken by students every academic term. This assumption implies that students are following an established route in their professional formation. Students who fall under this assumption are candidates to belong to a *Ge.*

3.2 Procedure 1

Identify independent variables of interest in the *first academic term*.

We state that,

$$Ge = \{stu\} \Longrightarrow (\exists data \in stu) \cdot (stu \in \{CU_a \cdot Ca_b \cdot Se_d \cdot Cs_e\})$$

Where

$$a \in \{1, \ldots, p\}; \forall b \in \{1, \ldots, q\}; d = 1; \forall e \in \{1, \ldots, t\}$$

$$\left.\begin{matrix} Cs_e \subseteq Se_d \\ Cs_e \subseteq Ca_b \end{matrix}\right\} \subseteq CU_a$$

then

$$\forall CU_a$$

$$\forall Ge_c | c \in \{1, \ldots, r\}$$

$$\forall Ca_b \in CU_a | b \in \{1, \ldots, q\}$$

conduct a statistical analysis with

$$VI: BD_{1,1}, BD_{1,2}, BD_2$$

$$VD: BD_{1,3,Se_1}$$

to obtain the

$$VIi \subset \{BD_{1,1}, BD_{1,2}, BD_2\}$$

$$VD \subset BD_{1,3,Se_1}$$

Notes

- *Ge's* are student groups with associated data
- *Ge*'s can be from different *Ca*
- The $BD_{1,3Se_1}$ correspond to the average of the grades obtained in the courses taken by the *Ge* in the first *Se*. The analysis of this point will not be carried out for now.
- The statistical analysis could include the evaluation of the correlation index, although this description is outside the interest of the described *procedure*.

Argumentation

The data used to obtain the *VIi* for the first *Se* come from the *Academic History* and the *Psychological Test*; it is therefore not important, in this case only, to distinguish among degree programs for the formation of the *Ge*, Fig. 1. The *VD* is the average of the grades earned in all the courses taken. The *Ge* with students from different degree programs are called *Hybrid study groups* (Geh). The effort to obtain the *VIi* for the *Se* after the first one increases prohibitively if *Geh* are used. A more general *procedure 2* is proposed to deal with the inconvenience caused by the complexity of following up on the academic life of the members of the *Ge*. Obviously, the members of the *Ge* belong to the same *Ca*. It must be added that the *VIi* of a *Ge,* made up of members of the same degree program, might not coincide with the *VIi* of a *Geh. Procedure 1* addresses the immediate need to identify the characteristics of a newly admitted student population, given the importance of the start of an undergraduate program for the actors involved in the teaching-learning process (institution, students, professors).

3.3 Procedure 2

Identifying *VIi* with a more general procedure. This procedure has some similar *procedure 1* steps that it is convenient shows again in order to be clear whit the description.

We state that,

$$Ge = \{stu\} \Longrightarrow (\exists data \in stu) \cdot (stu \in \{CU_a \cdot Ca_b \cdot Se_d \cdot Cs_e\})$$

where

$$a \in \{1, \ldots, p\}; b \in \{1, \ldots, q\}; d = 1 \gg n; n \in \{1, \ldots, s\}; \forall e \in \{1, \ldots, t\}$$

$$\left.\begin{matrix} Cs_e \subseteq Se_d \\ Cs_e \subseteq Ca_b \end{matrix}\right\} \subseteq CU_a$$

>> denoted that the previous value must exist

then

$$\forall CU_a$$

$$\forall Ca_b \in CU_a$$

$$\forall Ge_c | c \in \{1, \ldots, r\}$$

$$\forall Cs_e \in (Se_d \cdot Ca_b) | e \in \{1, \ldots, t\}$$

if *d=1* then

conduct statistical analysis with

$$VI: BD_{1,1}, BD_{1,2}, BD_2$$

$$VD: BD_{1,3,Se_1}$$

in order to obtain the

$$VIi \subset \{BD_{1,1}, BD_{1,2}, BD_2\}$$

$$VD \subset BD_{1,3,Se_1}$$

or else

conduct statistical analysis with

$$VI: BD_{3,Se_{d-1}}, BD_{1,3,Se_i} | i = d - 1, \ldots, 1$$

$$VD: BD_{1,3,Se_d}$$

to obtain

$$VIi \subset BD_{3,Se_{d-1}}, BD_{1,3,Se_i} | i = d-1, \ldots, 1$$

$$VD \subset BD_{1,3,Se_d}$$

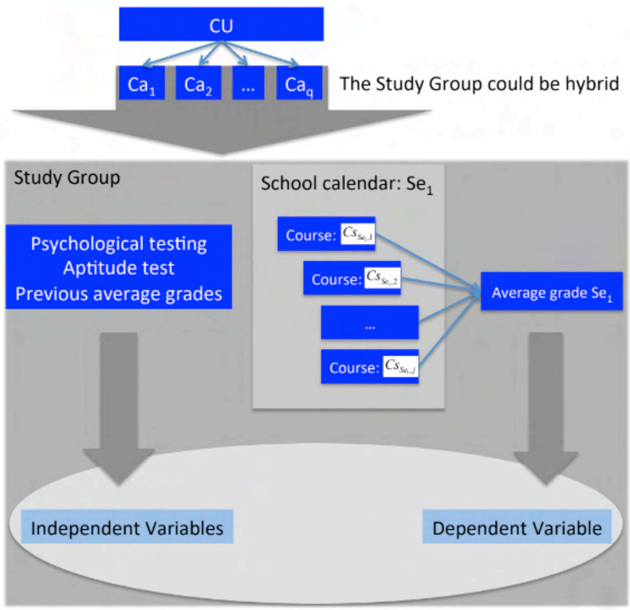

Figure 1. Process to obtain the *VIi* in the first academic term

Notes

- The *Ge* are made up of students from the same degree program
- *Ge* are groups of students with associated data
- The data of the *Ge* exist progressively, from their admission up to any academic term of their degree program
- The *Ge* are complete and consistent if there are data from their admission up to the last academic term of their degree program
- The selection of the *Cs* is determined by the existence of data of the *Ge* is said *Cs.*
- The $BD_{1,3,d}$ correspond to the average of the grades obtained in the courses taken by the *Ge* in a Se_d. The analysis of this point will not be conducted for now.

Argumentation

The process to obtain the *VIi* for the first *Se* is the same as the one shown in Fig. 1. Unlike *procedure 1,* here (*procedure 2*) the members of the *Ge* must come from the same degree program, Fig. 2.

Fig. 3 shows the procedure for obtaining the *VIi* of *Se* subsequent to the first one. This figure suggests that on the basis of a course or courses of a particular *Se*, different from the first one, the attempt is made to predict the student's grade average for the following *Se*. For now, no analysis will be made of the advisability of taking one course or another in each *Se* to obtain the *VIi*. The *VIi* can be different for *Ge* of different *Ca.*

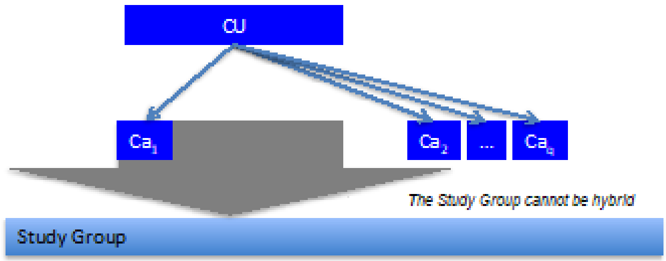

Figure 2. Note to obtain the *VIi* in the first academic term with *procedure 2*

4 I PROCEDURE TO OBTAIN THE REPRESENTATIONS AND MODELS

A *scenario* (En) involves the *dynamics and content* (event) of a student group in a course, and its analysis is done with data collected by the institution, which are seen as evidence of the event. It is acknowledged that the data are biased in the intention of describing these scenarios. For now, this point will not be discussed.

$$En_{Ge_c,Cs_e} | c \in \{1, \ldots, r\}; e \in \{1, \ldots, t\}$$

$$\{VIi_{Ge_c,Cs_e}, VD_{Ge_c,Se_d}\} \in En_{Ge_c,Cs_e} \Rightarrow Cs_{Se_d} \in Se_d | d \in \{1, \ldots, s\}$$

$$En_{Ge_c,Se_d} = \{\forall En_{Ge_c,Cs_e}\}$$

The abstraction of the *AP* of a *study group c* in a given *academic term d* is called a *representation* (RP),

$$RP_{Ge_c,Se_d} = f(En_{Ge_c,Se_d}) | c \in \{1, \ldots, r\}; d \in \{1, \ldots, s\}$$

Argumentation

To obtain the *RP* required to subsequently obtain a model, the members of the *Ge* must have consistent characteristics. This means that they must come from the same *CU*, the same *Ca*, the same *Se* (they do not necessarily have to belong to the same graduating class) and take the same *Cs* in each *Se*. The characteristics required for the *Ge* are inherited from the *VIi*, Fig. 4.

Models

A *Model* (Mo) is a general abstraction of the phenomenon and is obtained using an average operation of two or more *RP*.

$$Mo_{Se_d} = f(RP_{Ge_c,Se_d})|c \in \{1, \dots, r\}; d \in \{1, \dots, s\}$$

$$Mo_{Se_d} = \frac{\sum RP_{Ge_c,Se_d}}{|RP_{Ge_c,Se_d}|}$$

$$MO = \{Mo_{Se_d}\}$$

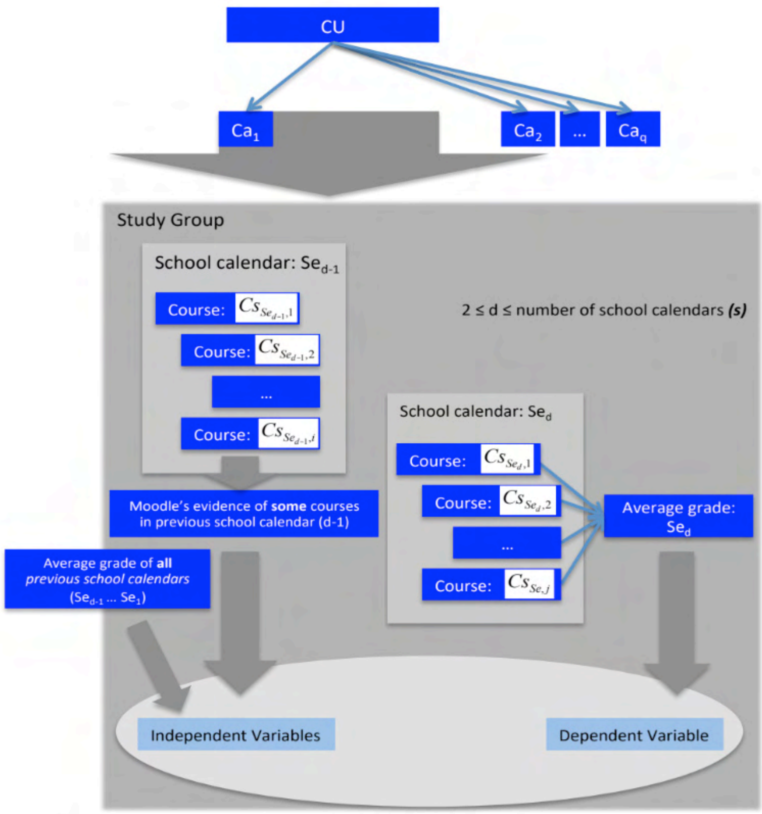

Figure 3. Process to obtain the *VIi* in academic terms other than the first *Se*

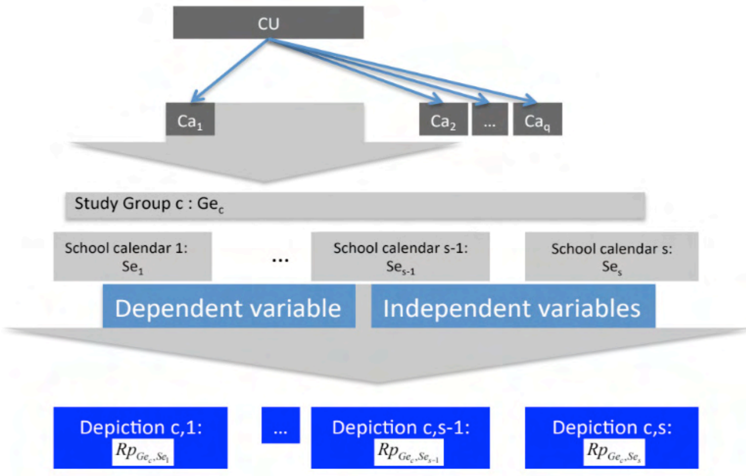

Figure 4. Depictions obtained in each academic term with one *Ge*

Argumentation

A valid *Mo* requires an average operation with at least two *Rp*. The *Rp* must be from *Ge* with the same characteristics. In other words, they must belong to the same *CU*, the same *Ca*, and study in the same *Se* (relative time), meaning the *Ge* do not necessarily have to belong to the same graduating class (absolute time). A *Mo* can be obtained from a *Ge* in each *Se* of the degree program. It should be noted that in terms of construction, the models have a succession . The integration of the *Mo* for all the *Se* of the *Ca* yields a *general model* (MO) of the AP in that *Ca*, Fig. 5.

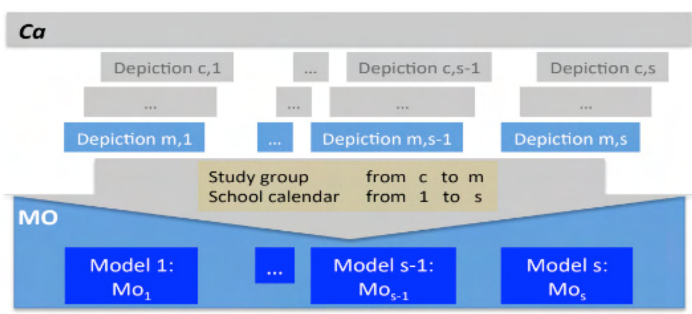

Figure 5. Models obtained in each academic term using depictions of different *Ge*

5 I DELIMITATION OF THE STUDY

- The study data come from one PU.
- The aim is that the courses of the *Ge* follow a single line of formation.

- The *Ge* must have course(s) consistent with each *Se* examined.
- The longitudinal study of the *Ge* must consider consecutive *Se* starting from the first, meaning that Se_n cannot be considered without having the analysis of Se_{n-1}.
- The aim is to predict the students' AP in their next academic term, which, except for the AP for the first academic term, involves the analysis of the available data from the *BD* of all the courses that the group has taken. In this analysis it is conceivable that only some of the *BD* fields have a strong correlation with the average.
- It is not advisable to predict AP in real time, since the academic dynamic of the PU does not lend itself to such a prediction. Real-time predictions would require uniform progress in course content and a study that could prove the reliability of the evidence collected in such programming.
- It is risky to predict a grade without analyzing an academic term, as it adds an element of uncertainty to the results and is beyond the scope of the present project.
- For the first *Se*, the members of the *Ge* can belong to different *Ca*. Since information is not processed in real time, it follows that it is not important to identify the *Cs* that the students of the *Ge* have taken.
- As of the second *Se*, some of the *Cs* taken by the students are exclusive to their area of study, which means that starting with this semester, the members of the *Ge* must belong to the same *Ca.* The data of all the *Cs* that students have taken in the first *Se* are processed and a study is made to identify which are directly correlated to the AP*.*
- As of the second *Se*, the average of the courses taken in the previous *Se* is calculated, as well as the *VD*, *VI*, the average of all previous *Se* and the fields of the *BD* that indicate a strong relationship with the average of the *Se* in question.
- The *Se* following the first are treated in the same way, Table 1.

Ge	Se_1	Se_2	$\cdots$	Se_{s-1}	Se_s
VI	$VIi \in \begin{Bmatrix} BD_{1,1} \\ BD_{1,2} \\ BD_2 \end{Bmatrix}$	$VIi \in BD_{3,Se_1}$ $BD_{1,3,Se_1}$	$\cdots$	$VIi \in BD_{3,Se_{s-2}}$ $BD_{1,3,Se_{s-2}}$ $BD_{1,3,Se_{s-3}}$ ... $BD_{1,3,Se_1}$	$VIi \in BD_{3,Se_{s-1}}$ $BD_{1,3,Se_{s-1}}$ $BD_{1,3,Se_{s-2}}$ ... $BD_{1,3,Se_1}$
VD	$BD_{1,3,Se_1}$	$BD_{1,3,Se_2}$	$\cdots$	$BD_{1,3,Se_{s-1}}$	$BD_{1,3,Se_s}$
Data obtained	BD_{3,Se_1}	BD_{3,Se_2}	$\cdots$	$BD_{3,Se_{s-1}}$	

Table1. BD involved to obtain *VIi* and *VD* in each scholar grade

Development

Any particular *CU* has a number *q* of *Ca* that make up their program catalogue. Among these *Ca* we can find, for example, Administration, Economics, International Business, Information Systems, etc.

A meta description of the investigation procedure follows:

1. A *CUP* is selected
2. From any given *Ca* and students from the first *Se*, the following are formed:
    2.1. one *Ge*
    2.2. different *Ge*
3. From a particular *Ca* and students from the first *Se*, the following are formed:
    3.1. one *Ge*
    3.2. different *Ge*
4. From a particular *Ca* and students with an academic record that goes beyond the first *Se*, the following are formed:
    4.1. one *Ge*
    4.2. different *Ge*
5. From a particular *Ca* and students with an academic record that includes their whole academic history, the following are formed:
    5.1. one *Ge*
    5.2. different *Ge*
6. For different *Ca*, proceed to point 3
7. For different *CU's*, proceed to point 1

Note: Some points can be omitted and/or modified in terms of order if the required data are available.

Notes on the different stages

- Point 1 ties the study to a particular *CU*
- Point 2 is important because
    - Findings are obtained quickly
    - It is easier to have data from an unclassified population
    - It allows academic directors to make assertive decisions as students of a particular graduating class begin their academic formation
- Point 3 makes it possible to compare findings with those obtained in point 2

- Point 4 makes it possible to generate findings beyond the first *Se*, meaning the members of the *Ge* must belong to the same graduating class and *Ca*
- Point 5 makes it possible to complete the study of the academic life of a particular *Ca*
- Point 6 extends the study to different *Ca*
- Point 7 extends the study to different *CU's*

6 | CONCLUSIONS

This article focuses on the area of education and addresses the problem of modeling the multifactorial phenomenon of AP. The process of analyzing and modeling AP is rigorously described using formalisms from computer science and mathematical symbols. The proposed technique suggests a need to expand on the research topic and/or strengthen the models. Due to the complexity involved in the study of education, the proposed technique could be applied without problems in the areas of economics, administration, politics and/or the social-sciences.

REFERENCES

Chatterjee, A., Shruti, R., Natekar, S., Rai, C., & Yeung, F. (2018, 09). USING LOGISTIC REGRESSION MODEL TO IDENTIFY STUDENT CHARACTERISTICS TO TAILOR GRADUATION INITIATIVES. (C. S. Journal, Ed.) *Revista de Formación e Innovación Educativa Universitaria, 3*(52), 172-181. Retrieved 06 06, 2019, from https://www.questia.com/library/journal/1G1-559831820/using-logistic-regression-model-to-identify-student

Corengia, A., Pita, M., Mesurado, B., & Centeno, A. (2013, 01). Predicting academic performance and attrition in undergraduate students. (Scielo, Ed.) *Reunión de la Red SciELO, 1*(19), 101-112. Retrieved 06 10, 2019, from Liberabit: http://www.scielo.org.pe/scielo.php?script=sci_isoref&pid=S1729-48272013000100010&lng=es&tlng=en

Covington, K., & Covington, K. C. (2012). Student Perceptions of E-learning environments, Self-Regulated Learning,and Academic Performance. *Dissertation Abstracts International, 1*(1), 189. Recuperado el 10 de 06 de 2019, de http://wdg.biblio.udg.mx:2048/login?url=https://search.proquest.com/docview/1238003187?accountid=28915

Escolar-Llamazares, M. C., Luis-Rico, I., de la Torre-Cruz, T., Herrero, A. J., Palmero-Cámara, C., & Jiménez-Egizábal, A. (2019, 02 27). The socio-educationa, psychonological and family-related antecedents of entrepreneurial intentions among spanish youth. *11*(5), 2-21. doi:https://doi.org/10.3390/su11051252

Faramarzi., & Khafri, S. (2017, 06 5). Rol of alexithymia, anxiety, and depression in predicting self-efficacy in academic students. (Hindawi, Ed.) *2017*(s/n), 1-7. doi:https://doi.org/10.1155/2017/5798372

Garton, B. L., Kitchel, T., & Ball, A. L. (2005, 01). University Admission Criteria and Learning Style: Predictors of Academic Success? *NACTA Journal; Twin Falls, 49*(2), 10-14. Retrieved 06 27, 2019, from https://search.proquest.com/docview/214371912/citation/1CB4F2B3A004844PQ/1?accountid=28915

González-Castolo, J. C., Ramos-Cabral, S., & Herández-Gallardo, S. C. (Enero-Junio de 2014). Construcción de un modelo difuso optimizado del aprovechamiento académico de estudiantes en educación superior. *Revista Iberoamericana para la Investigación y el Desarrollo Educativo, 4*(12), 13. Recuperado el 06 de 06 de 2019, de https://pdfs.semanticscholar.org/a1c9/97ed40f26be392dfe4484ed5edaeea3b172a.pdf

La Red Martínez, D. L., Karanik, M., Giovaninni, M., & Pinto, N. (03 de 2015). Academic Performance Profiles: A Descriptive Model Based on Data Mining. *European Scientific Journal, 11*(9), 17-38. Recuperado el 10 de 06 de 2019, de http://hdl.handle.net/123456789/1028

Mclsaac, J.-L. D., Kirk, S. F., & Kuhle, S. (2015, 11 20). The Association between Health Behaviours and Academic Performance in Canadian Elementary School Students: A Cross-Sectional Study. (P. Tchounwou, Ed.) *Environmental Research and Public Health, 12*(11), 14857-14871. doi:https://www.mdpi.com/1660-4601/12/11/14857

Micari, M. W. (2016, 08 24). Among friends: the role of academic-preparedness diversity in individual performance within a small-group STEM learning environment. *38*(12), 1904-1922. doi:https://doi.org/10.1080/09500693.2016.1218091

Miñano, P., Castejón, J. L., Gilar Corbi, R., & Veas, A. (2017). The SAAS-R: A New Instrument to Assess the School Attitudes of Students With High and Low Academic Achievement in Spain. *Measurement and evaluation in counseling and development, 20*(1-2). doi:10.1080/07481756.2017.1325701

Nurhafizah, A., Ahmad, Z. U., Siti, A. M., Hasfazila, A., & Mohd, F. Z. (28 de 06 de 2018). The impact of class absenteeism on student´s academic performance using regression models. *1974*(1), 050012-1 - 050012-5. doi:https://aip.scitation.org/doi/abs/10.1063/1.5041712

Peled, Y., Yovav, E., Barzyck, C., & Grinaustkid, K. (2019, 04). Predictors of Academic Dishonesty among undergraduate students in online and face-to-face courses. *Computer & Education, 131*(S/n). doi:https://doi.org/10.1016/j.compedu.2018.05.012

R. S., Y., A. K., S., & S., P. (05-14 de 10 de 2014). A study of academic performance evaluation using Fuzzy Logic techniques. *International Conference on Computing for Sustainable Global Development, s/n*(s/n), 48-53. doi:http://10.1109/IndiaCom.2014.6828010

Rogaten, J., & Moneta, G. B. (08 de 2017). Positive and Negative Structures and Processes Underlying Academic Performance: A Chained Mediation Model. *Journal of Happiness Studies, 18*(4), 1095-1119. doi:https://doi.org/10.1007/s10902-016-9765-6

Talib, N., & Sansgiry, S. S. (12). Determinants of Academic Performance of University Students. *Pakistan Journal of Psychological Research, 27*(2), 265-278. Recuperado el 12 de 06 de 2019, de http://www.pjprnip.edu.pk/pjpr/index.php/pjpr/article/view/198/168

Tarun, J. M. (03 de 2015). The impact of study groups and roommates on academic performance. *97*(1), 44-54.

Tepper, R. J. (10 de 11 de 2017). Beyond ACT & GPA: self-efficacy as a non-cognitive predictor of academic sucess. *International Journal of Accountig & Information Management, 26*(1), 171-186. doi:https://doi.org/10.1108/IJAIM-05-2017-0060

Thompson, E., Bowling, B. V., & Markle, R. E. (2018, 02). Predicting Student Success in a Major's Introductory Biology Course via Logistic Regression Analysis of Scientific Reasoning Ability and Mathematics Scores. *Research in Science Education, 48*(1), 151-163. doi:http://dx.doi.org/10.1007/s11165-016-9563-5

Valera, J. L., Sinha, S., Ponsot Balaguer, E., & Valera, J. (2009, 12). Valor pronóstico del k-ésimo período académico en el rendimiento de los alumnos de la FACES-ULA. *Redalyc.org, 12*(19), 133-146. Retrieved from UL http://www.redalyc.org/articulo.oa?id=25715409011

You, J. W. (2015, 07). Examining the Effect of Academic Procrastination on Achievement Using LMS Data in E-Learning. *Educational Technology & Society, 18*(3), 64-74. Retrieved 06 27, 2019, from https://www.researchgate.net/publication/282318438_Examining_the_Effect_of_Academic_Procrastination_on_Achievement_Using_LMS_Data_in_e-Learning

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