

Application of the Pareto Principle for the Classification of Educational Programs under COVID-19

L. Kurmasheva, V. Kulikova, V. Levashenko

Abstract— The COVID-19 pandemic has dealt a devastating blow to all spheres of life. In this regard, the needs of the labor market in the world are changing quite quickly. The market mechanism for selecting popular educational programs will gradually lead to the elimination of weak, uncompetitive universities. In such circumstances, universities should quickly respond to these changes. The article presents the results of the classification of educational programs by demand and by the stability of recruitment using ABC-XYZ analysis on the example of a regional university.

Keywords— ABC-XYZ analysis, classification of educational programs, educational programs in demand, stable enrollment of students.

I. INTRODUCTION

The COVID-19 pandemic has had a massive shock effect on the global economy. It is obvious that many areas have suffered losses, for example, such areas as aviation and hospitality, were severely affected by the pandemic, while the demand for specialists in the fields of health, education and finance has increased significantly.

Also, the pandemic has posed many problems for higher education institutions in the field of teaching, training, and management. The impact of the pandemic, for example, is particularly noticeable in student mobility. According to the study [1], among 2,739 respondents, 84% showed no interest in studying abroad after the pandemic. But on the other hand, the current situation provides an opportunity for different stakeholders to rebuild higher education with an effective risk management plan to increase the sustainability of this sector in the future.

Competition among universities is increasing, therefore, it is necessary to introduce new solutions, develop anti-crisis management plans, and strategies for responding to crisis situations. For example, the EAIE (European Association for International Education) research found that nearly 60 percent of respondents' institutions were actively implementing a COVID-19 response plan, and another 14 percent were in the process of developing such a plan. In Canada, 45 percent of respondents indicated that their institution was currently implementing a response plan, while more than 43 percent reported a plan in development [2].

Annually, ratings are published to assess the compliance of educational programs with the demand in the labor market. The market mechanism for selecting popular educational programs will gradually lead to the elimination of weak, uncompetitive universities. In connection with the above, it can be argued that the university should take into account and analyze the most popular educational programs not only now, but also in the future. In connection with the above, it can be argued that the university should take into account and analyze the most popular educational programs not only now, but also in the future. There are many different possibilities to classify items, which can be applied depending on the objective [3]. The paper presents the results of the study of the analysis of the demand for the provided specialties, as well as the

L. Kurmasheva, M.Kozybaev North Kazakhstan University, Petropavl, Kazakhstan (e-mail: lb_kurmasheva@mail.ru).

V. Kulikova, M.Kozybaev North Kazakhstan University, Petropavl, Kazakhstan (e-mail: v4lentina@mail.ru).

V. Levashenko, University of Zilina, Zilina, Slovakia (e-mail: vitali.levashenko@fri.uniza.sk).

stability of the admission of students by two-parameter clustering based on the ABC-XYZ analysis of educational programs that form the contingent of the university.

II. The ABC-XYZ analysis

The ABC-XYZ analysis is widespread in modern business, especially in the inventory control, marketing and logistics [4]. Due to its broad application spectrum the ABC analysis is regularly applied as the primary analysis and supported by the XYZ analysis [3]. Wider application of these techniques prevents their binding in a particular subject area [5]. There are many modifications of this method - modified with observed merchandise deficit [6], a system of two-dimensional analysis method applied to a commodity resource [7] and others.

ABC analysis is a method by which you can classify the resources of an organization and the degree of their importance. This is a method of rationalization that can be applied in the activities of any organization (including in the work of a university). The analysis is very sensitive to the number of classes and cut-off points, as well as the number of elements considered. There is no better solution, because it always depends on the context of the decision. ABC analysis gives a snapshot in time and shows no dynamics.

When conducting ABC analysis, as a rule, they are guided by the Pareto principle: "20 % of efforts give 80 % of the result, and the remaining 80 % of efforts - only 20 % of the result"[8]. In the context of the purpose of the study, this means: 20% of the specialties form 80% of the contingent. In practice, the classification parameters are set by experts in the field under consideration.

XYZ analysis classifies an organization's resources based on how they are consumed and the accuracy in predicting changes in their need over a given time. When performing the analysis, adhere to the recommended class boundaries:

- X: V = 0%-10 %;
- Y: V = 10%-25 %;
- Z: V > 25 %.

In practice, the most commonly used integrated (combined) ABC-XYZ analysis. The summary of this ABC XYZ analysis is a matrix of nine categories:

- AX: large volumes, stable;
- AY: large volumes a little less stable and therefore more volatile;
- AZ: large volumes, very volatile;
- BX: medium volumes, stable;
- BY: medium volumes, volatile;
- BZ: medium volumes, very volatile;
- CX: low volumes, stable;
- CY: low volumes, volatile;
- CZ: low volumes, very volatile.

III. The results obtained from testing on real data

55 bachelor's degree programs of the M.Kozybayev North Kazakhstan university were selected as the object of analysis. The study was conducted on real data. An ABC-XYZ analysis was conducted, which revealed the contribution of each educational program to the overall enrollment of students of the university.

We calculated the total enrollment for all educational programs and for each educational program for the studied years. Then we calculated the share of each educational program in the

total admission of students, the share with the cumulative total, and assigned the values of the groups.

Group A included such educational programs, which in total amount to 50% of the total set, group B - from 50% to 80%, group C-from 80% to 100%. Thus, Group A includes a limited number of the most valuable types of positions. The specialties of this group (their number is 11) form the majority of the recruited students (Table I). Group B consists of educational programs that form a smaller contingent than the educational programs of group A (14 educational programs were included in this group). Group C includes a larger number of remaining specialties (30), which play a smaller role in the formation of the number of applicants.

TABLE I. The result of the ABC analysis

	Recruitment of applicants in the specialty (human)	Share (in %)	Number of university educational program	Share (in %)
group A	6688	48	11	20
group B	4453	32	14	25
group C	2656	19	30	55
total	13797	100	55	100

According to the results of the ABC analysis, we saw that 11 specialties of group A form a set of 6688 people, while 30 specialties of group C – a total of 2656 people.

The purpose of XYZ-analysis in this case is to group educational programs according to the criterion of uniformity of admission and relative accuracy of forecasting. Educational programs were divided into three groups - X, Y, and Z - based on the value of the coefficient of variation V for the time period under consideration. This analysis divides objects by the degree of deviation from the average calculated over several periods.

The grouping of educational programs during the XYZ analysis was carried out in ascending order of the coefficient of variation, which shows (as a percentage) the degree of deviation of the data from the average value.

Group X (Table II) includes educational programs whose coefficient of variation does not exceed 10%, so, with a 99% probability, it can be argued that the forecast for this group will differ from the average value by $\pm 10\%$. Group Y – educational programs, the coefficient of variation for which is 10% - 25%, so the forecast will differ from the average value by no more than 25%. Group Z – educational programs, the coefficient of variation for which exceeds 25%, so deviations from the average value exceed 25%.

TABLE II. The result of the XYZ analysis

	Recruitment of applicants in the specialty (human)	Share (in %)	Number of university specialties	Share (in %)
group X	0	0	0	0
group Y	7024	51	23	42
group Z	6773	49	32	58
total	13797	100	55	100

Analyzing Table II, we can draw conclusions about which educational programs provide more stable recruitment, and which do not.

In connection with the above, a combination of the conducted analyses was carried out, the results of the ABC-XYZ analysis are presented in Table III.

TABLE III. Results of the integrated ABC-XYZ analysis

	X	Y	Z
A	-	Agronomy, preschool education and upbringing, foreign language, Kazakh language and literature, pedagogy and methods of primary education, pedagogy and psychology, physical culture and sports	Defectology, accounting and audit, finance, specialty law
B	-	Biology, journalism, computer science, mathematics, music education, radio engineering, electronics and telecommunications, social pedagogy and self-knowledge	Information systems, basic military training, general medicine, construction, food technology, electric power industry
C	-	Geography, design, history, mechanical engineering, translation, instrumentation, physics, chemistry, ecology.	Computer engineering and software, geography-history, state and local administration, foreign philology, computer science, cultural and leisure work, forest resources and forestry, mathematics-computer science, mathematics-physics, fundamentals of law and economics, Russian language and literature, economics, standardization and certification (by industry), tourism, etc.

Based on the data obtained, the following conclusions can be drawn: the educational programs that fall into groups A and B form the main recruitment of applicants of the M.Kozybayev North Kazakhstan university, while those that are in groups A and Z differ in the greatest set and regularity.

Due to the fact that the North Kazakhstan region is agrarian, the demand for agricultural educational programs (as a result of the analysis, the specialty - Agronomy was identified) is obvious. Pedagogical educational programs have always been relevant among young people, and our region is no exception. Such specialties as "Accounting and Audit", "Finance", "Law" are still popular and are in demand among applicants.

The educational programs that fall into group C have less impact on the overall student recruitment, especially those that fall into group CZ. Perhaps this is because most of them are recently opened in our university ("Physics-Computer Science", "Chemistry-Biology", "Mathematics-Computer Science", "Mathematics-Physics"). Another small set may be influenced by the number of grants allocated, the demographic situation in the country, etc. In other words, other factors must be taken into account when conducting this analysis.

It should be noted that the labor market is constantly changing, so you need to constantly update the analytical base, because the elements of groups can migrate from one group to another.

It is also necessary to take into account the opening of new educational programs. When conducting the analysis, it is not recommended to include them in the overall data analysis, while allocating the necessary time period to identify the demand for them.

Currently, there are special software tools that allow the formation of ABC-XYZ groups in an interactive automated mode. This simplifies and makes clear the application of this analysis in the work of any organization, including educational ones.

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REFERENCES

- [1] Weiyang Xiong, Ka Ho Mok, Guoguo Ke & Joyce Oi Wun Cheung, “Impact of COVID-19 pandemic on international higher education and student mobility: Student perspectives from mainland China and Hong Kong”, Published by the Centre for Global Higher Education, Department of Education, University of Oxford in Working paper no. 54 September 2020, pp.5-6.
- [2] L.E. Rumbley, “COVID-19 and Internationalization: Mobility, Agility, and Care” in International higher education, the Boston college center for international higher education, Number 102 special issue 2020, pp.14-16.
- [3] B. Scholz-Reiter, J. Heger, Ch. Meinecke, J. Bergmann, “Integration of demand forecasts in ABC-XYZ analysis: practical investigation at an industrial” in International Journal of Productivity and Performance Management 61(4), 2012, pp.445-451.
- [4] Zh. Zenkova, T. Kabanova, “The ABC-XYZ analysis modified for data with outliers” IEEE 2018 4th International Conference on Logistics Operations Management (GOL).
- [5] A. Konikov, G. Konikov, “Marketing Research of Construction Sites based on ABC-XYZ Analysis and Relational Data”, MATEC Web Conf. 2017, Volume 106.
- [6] Zh. Zenkova, W. Musoni, S. Tarima, “Accounting for deficit in ABC-XYZ analysis”, 2020 5th International conference on logistics operations management (GOL), 2020. pp. 79-84.
- [7] V.N. Zemlyanskaya, “The classical method of ABC analysis and its modern modification” in Eurasian Council of Scientists, e-LIBRARY, 2017, pp.76-81.
- [8] O.L. Ksenofontova, N.A. Novoselskaya, “ABC-XYZ-analysis as a tool for managing the product range of a trading enterprise” in Modern high-tech technologies. Regional application №2 (34) 2013, pp.70-76.
- [9] S. S. Kabanov, D. O. Pyzhov, M. P. Makarov., “Basic concepts and principles of system management of technical and economic development of the enterprise”, proceedings of the IV International Scientific Conference 2015, pp.180-183.
- [10] Strategic development plan of the North Kazakhstan University named after M. Kozybayev.
- [11] N.A. Novoselskaya, “Application of ABC-XYZ analysis to optimize the activity of a trading company” in Electronic collection of articles based on the materials of the XIV Student International Scientific and Practical Conference № 4 (31) 2015.
- [12] A. N. Sterligova, “Inventory management of a wide range of products: where to start?” in Loginfo №12 2003, pp.50-55.
- [13] L. S. Nurpeisova, “Criteria and methods for assessing the competitiveness of an enterprise in the field of educational services” in Global challenges and current trends in the development of higher education, 2013.
- [14] E. A. Sosnin, *Methods of solving scientific, technical and social problems*, Tomsk State University Publishing House, 2016.