

## DISTRIBUTION AND ANALYSIS OF ADMISSION SCORES (IN THE CASE OF AZERBAIJAN)

Yadulla Hasanli<sup>1</sup>, Nazim Hajiyev<sup>2</sup>, Gunay Rahimli<sup>3</sup>

<sup>1,3</sup> Scientific-Research Institute of Economic Studies, Azerbaijan State University of Economics (UNEC), Institute of Control Systems of ANAS e-mail: yadulla.hasanli@unec.edu.az, g.rahimli@unec.edu.az

<sup>2</sup> UNEC Business School, Research Center for Development Economics, Azerbaijan State University of Economics, e-mail: n.hajiyev@unec.edu.az

Received: July 30; accepted December 03, 2021; published online December 24, 2021

### ABSTRACT

The study assessed, using the Pearson  $\chi^2$  test, the distribution according to the normal and exponential law, the total scores obtained by applicants in admission exams held by the State Examination Center of the Republic of Azerbaijan (SEC). It was found that points scored by applicants do not follow the normal or exponential distribution, that is, they are asymmetric. Also, based on the dynamic series for the years of 1996-2020, an econometric evaluation was made of the dependence of the average scores obtained by the applicants and as well as deviation from the average score on time. According to the results of the model, it was found that with a time trend, the average score of applicants each year increases by about 1%. We can explain this result by the fact that with the development of science and technology, the opportunity for applicants to access information databases (electronic libraries, Internet, mobile phones, etc.) has increased, and this has a positive effect on the scores collected at the entrance exams and raises the average score.

**Keywords:** university entrance exams, applicant (enrollee), scores, normal distribution, statistical evaluation

**Jel classification:** C12, C51

### INTRODUCTION

In modern times, information, technology and knowledge have become the driving force and the factor of competitiveness for the economies of countries. A study of the Azerbaijan economy with the CES (Constant Elasticity of Substitution) production function has shown that there is a shortage of qualified personnel in the country to leverage the full potential of existing capital (Hasanli Y., 2013). It should be noted that the mobility of capital, including physical capital is much higher than the country's labor force.

This is because major assets created by high-tech and science-intensive products (for example, computers, phones, machinery and equipment) can be quickly imported into the country, however, there are certain problems with the transfer of qualified personnel who can leverage this asset in its full potential. Therefore, qualified workers should be mostly citizens of the country. Training of qualified personnel is related to education, especially higher education. The research in the field indicates positive effects of higher education on earnings over different stages of the work career and over a lifetime (Tamborini, C. R., Kim, C., & Sakamoto, A., 2015).

Admission to universities, in both bachelor and master level, is carried out according to the results of exams organized by the State Examination Center. It is obvious that qualified staff is mainly trained in universities, and their training at directly depends on the level of knowledge that they have when enrolling in the university. Therefore, the analysis of the results of these examinations is important not only because it reflects the quality of teaching in secondary schools in the country, but also it impacts the training of highly qualified personnel in universities.

In the research (Yagubov S., Hasanli Y., Shabanov S., Rahimli G., 2018), the distribution of scores obtained in the admission exams in certain years has been tested to determine if it is distributed normally and it has been concluded that the scores do not follow a normal distribution. The other result of this study is that the homogeneity of education in the country's schools varies dramatically and is heterogenous across the country.

In this article, the authors have tested whether the scores obtained in the admission exams during the years of 1996-2020, as well as the scores obtained in the first stage of the admission exams to master program follow a normal or exponential law, and it has been determined that exam results do not follow these distributions, that is, they are asymmetric. To assess the level of asymmetry, an analysis was carried out with the calculation of the moment and structural asymmetry coefficients and it was found that the distribution of points scored on all specialty groups is asymmetric to the left. Furthermore, on the base of the time series, econometric evaluation has been conducted to assess the dependence of the average scores obtained by applicants and standard deviation from average scores on time. Econometric modeling has been performed in the Eviews software. Afterward, the adequacy tests of the constructed model have been performed and the results of models have been interpreted.

## DATA SET OF RESEARCH AND ITS PROCESSING

Admission examinations to universities in Azerbaijan are conducted by the State Examination Center (formerly named State Student Admission Commission) since 1992, and to the Master's program since 2005. Admission to the Bachelor's program is carried out in 5 groups of specialties, and in the Master's program in 70 specialties. The maximum score for admission to the Bachelor's degree is 700 points and to the Master's degree 150 points. Each year, after exams, the State Examination Center publishes the journal of "Abituriyent, no.12" which provides scientific and statistical analysis of admission to bachelor's and master's programs and the database of our research is also based on the statistics in this journal, as well as the indicators obtained from the authors' calculations based on indicators from this journal (Abituriyent, no.12. Azerbaijan State Students Admission Commission 1996/1997-2020/2021).

In the journal, the distribution and some statistical characteristics of scores for both Azerbaijani and Russian sections and different specialty groups since 1996 have been presented in a form that is represented in Table 1.

**Table 1: The distribution of 1st group applicant in the Azerbaijani section in 2017**

Section: Azerbaijan 1st group	Statistical characteristics of scores attained in the exam										
	Mean: 203.89 Standard deviation: 162.55			Mod: 30 Median: 165.45		Minimum score: 0 Maximum score: 700		The number of applicants: 25590			
Group intervals	the number of applicants	frequencies (%)	Cumulative frequencies (%)	Group intervals	the number of applicants	frequencies (%)	Cumulative frequencies (%)	Group intervals	The number of applicants	frequencies (%)	Cumulative frequencies (%)
0-0	141	0.55	0.55	220-240	899	3.51	64.83	460-480	260	1.02	92.08
0-20	1578	6.17	6.72	240-260	892	3.49	68.32	480-500	306	1.2	93.27
20-40	2193	8.57	15.29	260-280	787	3.08	71.4	500-520	283	1.11	94.38
40-60	1994	7.79	23.08	280-300	745	2.91	74.31	520-540	243	0.95	95.33
60-80	1609	6.29	29.37	300-320	758	2.96	77.27	540-560	216	0.84	96.17
80-100	1334	5.21	34.58	320-340	658	2.57	79.84	560-580	214	0.84	97.01
100-120	1267	4.95	39.53	340-360	592	2.31	82.15	580-600	170	0.66	97.67
120-140	1191	4.65	44.19	360-380	555	2.17	84.32	600-620	146	0.57	98.24
140-160	1182	4.62	48.8	380-400	502	1.96	86.28	620-640	155	0.61	98.85
160-180	1122	4.38	53.19	400-420	437	1.71	87.99	640-660	118	0.46	99.31
180-200	1115	4.36	57.55	420-440	415	1.62	89.61	660-680	115	0.45	99.76
200-220	966	3.77	61.32	440-460	370	1.45	91.06	680-700	62	0.24	100

Source: Abituriyent, no.12, 2017, (<http://www.tqdk.gov.az/en/>)

In the table, scores collected by applicants are divided into 35 intervals each of which by 20 points. In the article, scores were regrouped using Stercess formula (Newbold et al., 2010). Based on this formula, the number of intervals is:  $1+\log_2 700=1+9,45=10,45$ . We took the number of intervals 12 and calculated the intervals by 60 points, dividing 0-700 points into equal portions. The data obtained as a result of the re-classification of scores is represented in the following table:

**Table 2: The distribution of 1st group applicant in the Azerbaijani section in 2017 (regrouped)**

No	group intervals	observed frequency
1	0-60	5906
2	61-120	4210
3	121-180	3495
4	181-240	2980
5	241-300	2424
6	301-360	2008
7	361-420	1494
8	421-480	1045
9	481-540	832
10	541-600	600
11	601-660	419
12	661-700	177
		n=25590

**Source:** authors' calculations

The results of the admission to the master's program have been divided into 20 intervals each one by 5 points in the journal. We took the numbers of intervals 10 and calculated the intervals by 10 points (based on Stercens formula:  $1 + \log_2 100 \approx 8$ ).

The distribution of scores in the admission exam to master's program in 2017 has been given in the table 3.

To conduct econometric evaluations based on dynamic time series, we use average scores and standard deviations from the average scores from 1996 to 2020. In the journal, the average scores and standard deviation of the applicants' scores from average in exams have been given separately for the Azerbaijani and Russian sections. To calculate the combined mean and standard deviation, we used the following formulas (Anderson D., Sweeney D., Williams T., Camm J., Cochran J., 2016):

$$\bar{x} = \frac{x_1 n_1 + x_2 n_2}{n_1 + n_2}$$

$$\sigma_x^2 = \frac{(\sigma_{x_1}^2 + \bar{x}_1^{-2})n_1 + (\sigma_{x_2}^2 + \bar{x}_2^{-2})n_2}{n_1 + n_2} - \bar{x}^2$$

**Table 3: The distribution of scores obtained in the admission exam to master’s program in 2017 (as in the journal and regrouped version)**

mean:	54.08	minimum score:	0
standard deviation:	14.76	maximum score:	0
mod:	52	the number of	
median:	52.99	bachelors:	12972
group intervals		(the number of	
		bachelors)	
0			2
1-5			6
6-10			14
11-15			88
16-20			333
21-25			797
26-30			1447
31-35			2136
36-40			2492
41-45			2734
46-50			2681
51-55			2377
56-60			1984
61-65			1504
66-70			1036
71-75			762
76-80			412
81-85			186
86-90			60
91-95			24
96-100			3

no	Group interval	observed frequency
1	0-10	22
2	11-20	421
3	21-30	2244
4	31-40	4628
5	41-50	5415
6	51-60	4361
7	61-70	2540
8	71-80	1174
9	81-90	246
10	91-100	27
		21078

Source: Abituriyent, no.12, 2017 and authors’ calculations

## METHODOLOGY

### Testing of the distribution of exam results

To determine if the given data follows any theoretical distribution, the goodness of fit tests are used. (D'Agostino, R. 2017). One of the most widely used goodness of fit test is the  $\chi^2$  test introduced by Carl Pearson in 1900.  $\chi^2$ - statistic is used to check if observed data fits any theoretical distribution (Магнус, 2004; , Heinz K.,2004).  $\chi^2$ - statistic is calculated by computing the sum of squares of deviations between observed frequencies and expected frequencies, which is divided by the expected frequencies.

$$\chi^2 = \sum_{i=1}^k \frac{(O_i - E_i)^2}{E_i} \quad (1)$$

Here,  $k$ - is the number of intervals,  $O_i$  – observed frequency in the  $i$ -th interval,  $E_i$  is expected frequency in the  $i$ -th interval and is obtained by multiplying event's theoretical probability (here, the event is that variables are in the  $i$ -th interval) by the number of trials. Probability of variables are in the  $i$ -th interval is found as follows:

$$p_i = f(y_i) - f(y_{i-1})$$

To determine if data follows any theoretical distribution using  $\chi^2$  test, the hypothesis is constructed as follows (Hein K., 2002):

$H_0$ : the variable is subject to the stated distribution;

$H_1$ : the variable is not subject to the stated distribution.

Then we compute the value of  $\chi_{experiment}^2$  for the random variable using formula (1). If we choose the distribution law correctly, then  $\chi_{experiment}^2$  variable will have  $\chi^2$  theoretical distribution, as the number of observations increases.

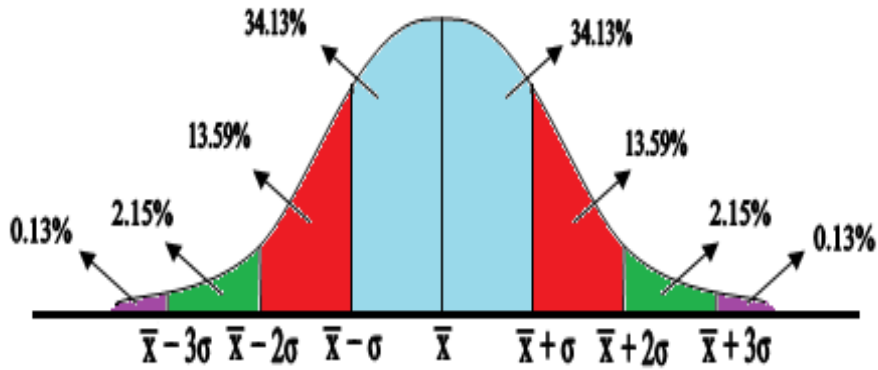
This is a continuous distribution and this distribution depends on a parameter  $r$  called the degree of freedom:  $r=k-1-s$ . Here,  $k$  is the number of intervals,  $s$ - is the number of parameters of the distribution law.

There is a table especially designed for  $\chi^2$  distribution. Using this table, firstly we find the critic value of  $\chi^2$  for the given value of the degree of freedom and it is compared with  $\chi_{experiment}^2$ . If  $\chi_{experiment}^2 < \chi_{critic}^2$ , then  $H_0$  hypothesis, that is, the law of distribution is accepted. Otherwise, the proposed hypothesis is rejected (Палий И.,2004).

### Tested distributions

Most natural and economic processes follow a normal or asymptotic normal distribution (for these processes, as the number of trials increase, their distribution is approaching normal distribution). When analysing exam results, checking whether the results have a normal distribution or not is one of the widely used methods in the literature (W.Yuan, C.Deng, H. Zhu, J.Li., 2013; Akella, S., Diaz, P. M., & Babu, B. S., 2017). Therefore, firstly, we will check whether the scores obtained in the admission exams follow a normal and exponential distribution.

**Normal distribution-** is the theoretical distribution law of observations in the population and is related to probability distributions. This distribution is symmetric to the average value of the random variable and the graph of the density function is in the form of the bell curve.



The normal distribution density function is as follows (Patel J., 1982):

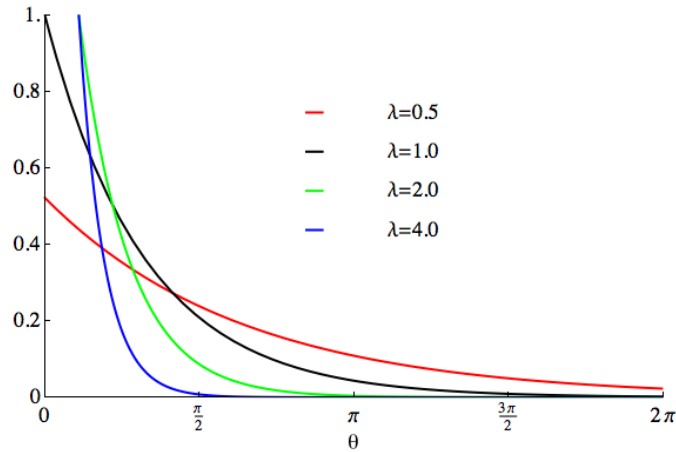
$$f(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

*Exponential distribution-* A continuous nonnegative random variable  $x$  is called to have an exponential distribution if its probability density function is as follows (Gupta, Arjun&Zeng, Wei-Bin & Wu, Yanhong, 2010):

$$f(x) = \lambda e^{-\lambda x}$$

$\lambda$ - is called the parameter of an exponential distribution. For the variable which follows an exponential distribution, its mean is found by the following formula:

$$E(x)=1/\lambda$$



### Defining the level of asymmetry

Asymmetry means that the variable is not symmetrically distributed. To assess the level of asymmetry, the moment and structural asymmetry coefficients are used (Anderson D., Sweeney D., Williams T., Camm J., Cochran J., 2016).

The moment coefficient of the asymmetry is calculated by the following formula:

$$a_3 = \frac{m_3}{\sigma^3}$$

Where,  $m_3$  is the third central moment,  $\sigma^3$  - average cubic deviation (that is, it represents the third level of deviation from the average of a sequence).

$$m_3 = \frac{\sum_i (x_i - \bar{x})^3 n_i}{n}$$

Where  $\sigma^3 = \sqrt{(m_2)^3}$

$m_2$  is the second central moment and  $m_2 = \frac{\sum_i (x_i - \bar{x})^2 n_i}{n}$

The sign of the moment coefficient of the asymmetry determines the direction of the asymmetry. If,

$a_3 = 0$  then the sequence is symmetric;

$a_3 > 0$  then it is asymmetric to right;

$a_3 < 0$  then it is asymmetric to left.

The main disadvantage of the moment coefficient of asymmetry is that its value is very sensitive to the sharp difference of any certain value of the variable in the collection. The structural coefficient of asymmetry characterizes the asymmetry in the central part. Unlike the moment coefficient of asymmetry, any sharp difference in the value of variables does not affect the value of this coefficient. In practice, the structural coefficient of asymmetry proposed by Karl Pearson is widely used.

$$As_{\text{pirson}} = \frac{\bar{x} - \text{mod}}{\sigma}$$

In a variation sequence, if mode=median=mean, this means the sequence is symmetric.

If the mode of a variation sequence is less than mean, then the structural coefficient of asymmetry becomes greater than 0, and thus the sequence is asymmetric to the right. By contrast, if the mode of a sequence is greater than mean, in this case, the structural coefficient of asymmetry becomes less than 0, which means the sequence is asymmetric to the left.

## RESULTS

### Testing distributions of scores

For example, we will test the admission scores of bachelors for the 2017/2018 academic year on the basis of table 3, by Pearson's criterion, to find out if the admission scores are distributed normally. For this we will make the table 4.

**Table 4: Testing normality of scores obtained by bachelors in the year of 2017**

no	interval	up to b	observed frequency	p(x<a)	p(a<x<b)	expected frequency	(O-E) <sup>2</sup> /E
<b>1</b>	0-10	10	22	0.00551	0.00551	116.14877	76.31584
<b>2</b>	11-20	20	421	0.031548	0.026038	548.82669	29.77199
<b>3</b>	21-30	30	2244	0.120001	0.088452	1864.4009	77.28782
<b>4</b>	31-40	40	4628	0.311552	0.191551	4037.517	86.35758
<b>5</b>	41-50	50	5415	0.576157	0.264605	5577.3384	4.725149
<b>6</b>	51-60	60	4361	0.809376	0.233219	4915.7896	62.61284
<b>7</b>	61-70	70	2540	0.940517	0.131141	2764.1878	18.18261
<b>8</b>	71-80	80	1174	0.98754	0.047024	991.1668	33.72589
<b>9</b>	81-90	90	246	0.998284	0.010744	226.45914	1.686155
<b>10</b>	91-100	100	27	0.999847	0.001562	32.934262	1.069265
			<b>21078</b>				<b>391.7351</b>
mean	47.19						
st.dev	14.63						

Source: authors' calculations

As can be seen  $\chi^2_{experiment}=391.7$ . As the number of intervals  $k=10$ , the number of parameters of the distribution  $s=2$ , the value of the degree of freedom  $r=k-1-s=7$ . At this price of the degree of freedom,  $\chi^2(0,05;7)=14.07$ -dir. Thus, because inequality of  $\chi^2_{experiment} < \chi^2$ -critic is not true in this case, we reject the hypothesis that scores distributed normally.

Now based on table 2, let's check whether the scores of azerbaijan section's applicants for the 1st group exam in the schooling year of 2017/2018 are subject to exponential distribution. For this, we will make the table 5.

Since the mathematical expectation of a random variable in exponential distribution is  $E(x)=1/\lambda$ , to find  $\lambda$ , we can use the following formula:  $\lambda = 1/\bar{x}$ .

Here, because the number of intervals  $k=12$  and the number of parameters of tested distribution  $s=1$ , we get for the degree of freedom that  $r=10$ , and in this value of the degree of freedom  $\chi^2(0,05;10)=18,31$ . In this case,  $\chi^2_{experiment} < \chi^2$ -critic inequality is not true meaning that we should reject the  $H_0$  hypothesis which says that scores have exponential distribution.

**Table 5: Testing if scores obtained in admission exam to universities in 2017 have exponential distribution**

No	group interval	up to b	observed frequency	p(x<a)	p(a<x<b)	expected frequency	(O-E)^2/E
1	0-60	60	5906	0.2549294	0.2549294	6523.6438	58.47712
2	61-120	120	4210	0.4448698	0.1899404	4860.5751	87.07775
3	121-180	180	3495	0.5863888	0.141519	3621.4715	4.416725
4	181-240	240	2980	0.6918305	0.1054417	2698.2519	29.41979
5	241-300	300	2424	0.770392	0.0785615	2010.3881	85.09541
6	301-360	360	2008	0.8289258	0.0585338	1497.881	173.7263
7	361-420	420	1494	0.8725377	0.0436118	1116.0271	128.0108
8	421-480	480	1045	0.9050316	0.0324939	831.51895	54.80832
9	481-540	540	832	0.9292418	0.0242103	619.54031	72.85905
10	541-600	600	600	0.9472802	0.0180383	461.60126	41.49515
11	601-660	660	419	0.96072	0.0134398	343.92552	16.38779
12	661-700	700	177	0.9677173	0.0069973	179.06112	0.023725
		n=	<b>25590</b>		<b>0.9677173</b>		<b>751.798</b>
mean	st.dev	$\lambda$					
203.89	162.55	0.0049046					

Source: authors' calculations

It should be noted that the study examined the normal and exponential distribution of the scores collected by applicant in all specialty groups for both Azerbaijani and Russian sections, as well as the scores obtained by bachelors in the admission exams to master level. However, the results for all of these groups are subject to neither normal nor exponential distribution. That is to say that the scores are assymmetrically distributed.

As it can be seen from tables 2 and 3 in both cases the mean of sequence is greater than its mod, and this means that these sequences are asymmetric to the right.

**ECONOMETRIC EVALUATION OF SCORES OBTAINED IN THE ADMISSION EXAMS**

*Evaluation of the dependence of average scores on time.* An econometric evaluation was made of the dependence of the average scores obtained by the applicants from time. For this, the following specification of the regression equation was considered:

$$\text{Log}(\text{mean\_total})=c(1)+ c(2) \text{ @TREND} \quad (2)$$

The result of the econometric evaluation of the regression equation in the EViews application package (Eviews 9) was as follows:

$$\text{LOG}(\text{MEAN\_TOTAL}) = 5.1093116842 + 0.0101236457358*\text{@TREND} \quad (3)$$

The main statistical characteristics of model (3), residual diagnostics tests and other relevant tests indicates that, the model is adequate. It means, residuals meet Gauss-Markov assumptions and the values of parameters found by the Least Squares method are unbiased and effective.

**Table 6: The main statistical characteristics of the model (3)**

Sample (adjusted): 1996 2020				
Included observations: 24 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.109312	0.032906	155.2690	0.0000
@TREND	0.010124	0.002682	3.774222	0.0012
R-squared	0.415969	Mean dependent var		5.215610
Adjusted R-squared	0.386767	S.D. dependent var		0.101927
S.E. of regression	0.079819	Akaike info criterion		-2.131614
Sum squared resid	0.127420	Schwarz criterion		-2.032428
Log likelihood	25.44775	Hannan-Quinn criter.		-2.108249
F-statistic	14.24475	Durbin-Watson stat		1.540931
Prob(F-statistic)	0.001192			

The results of the model based on data show that over time the average score of applicant across the country has increase each year by 1%. Applicants' base average score is 165.6 without considering trend factor. ( $\exp(5.1093116842)=165,6$ )

This result can be explained by the fact that the development of science and technology, expanding the access of applicants to information and knowledge (e-library, internet, mobile phones, etc.) positively influenced their scores on the entrance exams and increased their average score.

*Econometric evaluation of the dependence of the deviations from the mean score ( $\sigma$ -standard deviation) from time.* An econometric evaluation was made of the dependence of the deviations from the mean score from time. For this, the following specification of the regression equation was considered:

$$\text{Standart\_deviation}=c(1)+ c(2) @\text{TREND} \quad (4)$$

The result of the econometric evaluation of the regression equation in the EViews application package was as follows:

$$\text{STDEV\_TOTAL} = 120.706446091 + 2.37442438611 * @\text{TREND} \quad (5)$$

The main statistical characteristics of model (5), residual diagnostics tests and other relevant tests indicates that, the model is adequate. From model (5), it can be seen that, if not to take into account the time trend, base value of the standard deviations of scores is 120,7.

## CONCLUSIONS

It was found that in any of the groups points scored by applicants and bachelors do not have a normal or exponential distribution, that is, they are asymmetric. To assess the level of asymmetry, an analysis was carried out with the calculation of the moment and structural asymmetry coefficients and it was found that the distribution of points scored on all specialty groups is asymmetric to the right. Also, on the basis of the time series, an econometric evaluation was made of the dependence of the average scores obtained by the applicants, as well as deviations from the mean score ( $\sigma$ -standard deviation) from time. It was found that if not to take into account the time trend, then the basic average score of applicants is 165.6, and the deviation from this score is 120.7. According to the results of the model, it was found that with a time trend, the average score of applicants each year increases by about 1%. We can explain this result by the fact that with the development of science and technology, the opportunity for applicants to access information databases (electronic libraries, Internet, mobile phones, etc.) has increased, and this has a positive effect on the scores collected at the entrance exams and raises the average score.

## REFERENCES

- Akella, S., Diaz, P. M., & Babu, B. S. (2017). Exam Results Fit to a Normal Distribution. *DJ Journal of Engineering and Applied Mathematics*, 4(1).
- Anderson, D. R., Sweeney, D. J., Williams, T. A., Camm, J. D., & Cochran, J. J. (2016). *Statistics for business & economics*. Cengage Learning.
- D'Agostino, R. (2017). *Goodness-of-fit-techniques*. Routledge.
- Eviews 9.0. Software Package
- Gupta, Arjun & Zeng, Wei-Bin & Wu, Yanhong. (2010). Exponential Distribution. 10.1007/978-0-8176-4987-6\_2.
- Hasanli Y., “The evaluation of mutual substitution elasticity of capital and labour factors by application CES function for economy of Azerbaijan”, *The journal of economic sciences: Theory and practice*, 2013, p.77-96, Year: 19, Volume 70, #1/2013, ISSN 2220-8739
- Heinz Kohler “Statistics for business and economics”, pp.1226, 2002.
- Newbold, P., Carlson, W., Carlson, W.L., Thorne, B., Thorne, B.M. (2010). *Statistics for Business and Economics*. Seventh Edition. New Jersey, USA. 986 p.
- Patel, J. K. (1982). *Handbook of the normal distribution* (No. 04; QA273. 6, P3.)
- Statistical analysis of the results of the final exams for the 2012/2013 academic year and final exams for general education institutions (2012). *Abituriyent*, no.12. Azerbaijan State Students Admission Commission. Baku.
- Tamborini, C. R., Kim, C., & Sakamoto, A. (2015). Education and lifetime earnings in the United States. *Demography*, 52( 4), 1383-1407.
- W.Yuan, C.Deng, H. Zhu, J.Li. The statistical analysis and evaluation of examination results of materials research methods course, *Creative Education*, Vol 3, No.07, 2013, pp.162-164.
- Yagubov S., Hasanli Y., Shabanov S., Rahimli G., (2019) Assessment of distribution of examination points and passing scores of exams obtained in the admission to higher education institutions in Azerbaijan. 37th Int. Scie. Conf. on Econ. and Social Development – “Socio Economic Problems of Sustainable Development”. 4-15 February, 2019. pp. 592-602.
- Магнус, П.К.Катышев, А.А.Пересецкий “Эконометрика”, Начальный курс, учеб.-6-е изд. Перераб. и доп.-М.: Дело, 2004 – 576 с.
- Палий И.А. “Прикладная статистика”, Москва, Высшая школа, 2004, 176 стр.