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RESEARCH ARTICLE

THE IMPACT OF CLASS ATTENDANCE ON THE CADETS' ACADEMIC PERFORMANCE IN A MILITARY UNIVERSITY

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Abstract

Purpose: This study aims to identify the quantitative relationship between cadets' academic performance and their class attendance, providing mathematic al evidence to support the hypothesis that attendance has a statistically significa nt impact on academic achievement in a military specialized educational institution.
Theoretical framework: The methodological foundation of this research is based on the principles of probability theory and correlation analysis. In this context, attendance and academic performance are treated as random variables, and their interrelationship is assessed using statistical methods. The theoretical underpinnings draw upon existing literature in pedagogical psychology, educational analytics, and mathematical statistics.
Method: This study applies two nonparametric statistical techniques - Spearman's rank correlation coefficient and Kendall's tau coefficient. These methods enable the identification and quantitative assessment of monotonic relationships between the number of class hours attended and students' academic performance. The selection of these approaches is motivated by their robustness to deviations from normality, a crucial consideration when analyzing empirical data in educational research.
Results and Discussion: The calculated correlation coefficients demonstrate a consistent positive relationship between class attendance and academic performance. In several instances, a strong degree of dependence was observed, reinforcing the conclusion that attendance is a significant predictor of educational outcomes. These findings highlight the practical relevance of attendance monitoring, suggesting that the proposed model may serve as an effective tool for the early identification of cadets at risk of academic underachievement. Furthermore, it can be utilized to enhance institutional systems for monitoring and managing educational quality.
Originality/Value: This study highlights the potential of applying mathematical analysis methods, particularly rank correlation, to solve practical pedagogical challenges — even within small student cohorts that exhibit specific characteristics (such as distinct psychological traits among cadets). The research gains particular relevance in the context of integrating digital monitoring and analytics tools into modern educational systems. The findings can provide a solid foundation for managerial decisions aimed at enhancing student discipline and
improving the overall effectiveness of the educational process through the use of objective quantitative indicators.

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Introduction:-

Academic performance in higher education institutions remains one of the central challenges in the field of education. A review of existing research demonstrates that student achievement is shaped by a complex interplay of factors, including both the internal psychological attributes of learners and the external organizational conditions of the educational process.

Traditionally, academic success is understood as the outcome of cognitive, motivational, and behavioral interactions. In recent years, however, growing attention has been directed toward the role of regular class attendance, which is increasingly recognized as a straightforward yet robust predictor of future academic achievement.

Numerous national and international studies have confirmed that attendance is among the key predictors of student performance. For instance, Blinova (2019) reported a stable positive correlation between class attendance and final academic results, particularly in traditional face-to-face learning environments [1]. Similarly, Khmelkov and Savina (2020) emphasized that even among technically proficient students with strong baseline abilities, consistent attendance plays a direct role in sustaining academic performance [2]. Gump (2005) and other researchers further highlight that even high intellectual capability cannot fully compensate for systematic absences [3].
Despite this substantial body of empirical evidence, many educational institutions continue to underestimate the importance of attendance as a tool for forecasting and managing academic outcomes. The relevance of the present study lies not only in assessing the degree to which attendance influences academic performance but also in identifying potential threshold points beyond which declining attendance has critically adverse effects.

This study aims to provide a quantitative assessment of the relationship between class attendance and academic performance among cadets, taking into account differences in motivation, academic preparedness, and fields of study.
Previous studies confirm the multifaceted nature of factors influencing academic performance and underscore the need for a systematic approach in pedagogical practice that incorporates motivational, cognitive, and organizational-methodological components.

The findings reaffirm the multifaceted nature of the factors influencing academic success and underscore the need for a systematic approach in pedagogical practice — one that integrates motivational, cognitive, and organizational-methodological components. This paper places particular emphasis on examining how attendance affects the academic outcomes of cadets at a military university.

Theoretical Background:

The academic performance of cadets is widely recognized as one of the key indicators of educational quality. It is shaped by a complex interplay of factors, including motivation, prior academic preparation, teaching methodologies, psychological well-being, and other contextual elements. Among these, pedagogical research identifies class attendance as one of the most consistent and quantifiable predictors of academic success.

Numerous observations and practical data confirm that regular participation in academic classes is closely associated with higher levels of academic performance. While it cannot be definitively stated that a cadet is unable to master the material without full attendance, learning outcomes largely depend on individual abilities, self-discipline, and personal learning styles. Nonetheless, systematic absences increase the likelihood of knowledge gaps, which may negatively impact academic achievement.

It is well established in educational research that student academic performance often follows a normal distribution. This means that most students fall within the average performance range (commonly referred to as "B-grade" students), while high achievers and low performers are located at the tails of the distribution, typically within three standard deviations ($\pm 3\sigma$). In military and specialized educational institutions—where training is shaped by distinct organizational and disciplinary frameworks—these patterns remain relevant, yet warrant separate, context-specific investigation.
International analytical studies confirm the significant impact of class attendance on academic outcomes. For instance, a meta-analysis by Credé et al. (2010), based on data from more than 28,000 students, found that attendance had a stronger influence on final grades than other variables such as academic motivation or intelligence level [4].

In the present study, we aim to examine whether this pattern holds in the context of a specialized military educational institution, specifically within a small group of cadets exhibiting varying levels of academic preparedness and motivation. The primary focus is to determine whether class attendance exerts a similarly significant influence on academic performance under the specific conditions of professional military training. To investigate this relationship, it is appropriate to apply elements of correlation theory.

Spearman's rank correlation coefficient is a nonparametric method used to assess the strength and direction of association between two variables [5]. It evaluates the degree of concordance between the ranks of values, thus capturing the closeness of their relationship on an ordinal scale. A key advantage of this method is its versatility: it can be applied to both quantitative and ordinal data. Furthermore, it does not require the assumption of a normal distribution within the population, making it particularly well-suited for analyzing empirical data in the field of education.

The coefficient is calculated using the following formula:

$$r_s = 1 - 6 \cdot \frac{\sum d^2}{n \cdot (n^2 - 1)}, \tag{1}$$

where:
n – the number of observations (ranked pairs);
d –he difference between the ranks of the two variables for each subject;,
$\sum d^2$ – the sum of squared rank differences.

In the presence of tied ranks, the formula for calculating Spearman's rank correlation coefficient differs from the standard formula (1) and is expressed as follows:

$$r_s = 1 - 6 \cdot \frac{\sum d^2 + \sum T_x + \sum T_y}{n \cdot (n^2 - 1)}, \tag{2}$$

where:
n — the number of observations (ranked pairs);
$\sum d^2$— the sum of squared differences between the ranks of the two variables;
$T_x$andT_y — correction terms for tied ranks in the respective rank series.

These correction terms are calculated using the following formulas:

$$T_x = \frac{\sum(x^3 - x)}{12}, \; T_y = \frac{\sum(y^3 - y)}{12}, \tag{3}$$

where:
x −the number of tied elements in each group of the rank series X;
y −the number of tied elements in each group of the rank series Y.
To calculate the rank correlation, two sets of values that can be ranked are required.

These sets may consist, for example, of two variables measured within the same group of subjects. It is then necessary to identify the critical value of r_s corresponding to the given sample size n. If the calculated r_s exceeds or is equal to this critical value, the correlation is considered significantly different from zero, and the null hypothesis (H_0) is rejected.

$$T_{кr} = t_{кr}(\alpha, k) \cdot \sqrt{\frac{1 - r_s^2}{n - 2}}, \tag{4}$$

wherenis the sample size, $r_s^2$is the sample Spearman rank correlation coefficient, and $t_{cr}(\alpha, k)$ is the critical value for the two-tailed critical region (based on the Student's t-distribution).
If $|r_s| < T_{cr}$, there is no basis to reject the null hypothesis; the rank correlation between the variables is not statistically significant.
If $|r_s| > T_{cr}$, the null hypothesis is rejected, indicating that a statistically significant rank correlation exists between the variables.
The relationship (correlation) between two variables measured on an ordinal scale can also be evaluated using Kendall's rank correlation coefficient, which is based on the number of concordant and discordant pairs. This test is

particularly suitable for small samples or datasets with many tied ranks, and it is more robust to outliers than Spearman's coefficient.

Kendall's tau-b formula with ties: τ_b

$$\tau_s = \frac{P - Q}{\sqrt{P + Q + T}\sqrt{P + Q + U}} \tag{5}$$

where:P – the number of concordant pairs;
Q – the number of discordant pairs;
T – the number of pairs tied only on variable X (ties in X);
U – the number of pairs tied only on variable Y (ties in Y).

To test the null hypothesis that Kendall's population rank correlation coefficient τ_r is equal to zero at a given level of significance, against the alternative hypothesis H_1: $\tau_r \neq 0$, it is necessary to calculate the critical value.

$$T_{cr} = Z_{cr}\sqrt{\frac{2(2n+5)}{9n(n-1)}}, \tag{6}$$

wheren is the sample size, and Z_{kr} is the critical value of the two-tailed critical region, determined from the Laplace function table based on the equation $\Phi(Z_{\text{ск}}) = (1 - \alpha) / 2$.

If $|\tau_b| < T_{cr}$crit, there is insufficient evidence to reject the null hypothesis; the rank correlation between the variables is not statistically significant.

If $|\tau_b| > T_{cr}$crit, the null hypothesis is rejected, indicating that the rank correlation between the variables is statistically significant.

Methodology: The results of cadets from the 218th training outpost, concerning the number of class hours attended and their academic performance in the 7th semester, are presented in Table 1. These values will be considered as realizations of the random variables X and Y.

Table 1:- Data for Training Group 218.

Cadet Number (Journal)	Number of Hours Attended	Number of Classes Missed	Academic Performance (Points)	Cadet Number (Journal)	Number of Hours Attended	Number of Classes Missed	Academic Performance (Points)
1	64		88	11	52	6	97
2	56	5	74	12	54	6	82
3	58	2	82	13	56	5	73
4	64		90	14	60	1	81
5	62	1	74	15	52	7	70
6	60	2	82	16	58	3	77
7	64		88	17	56	5	74
8	54	6	73	18	56	5	77
9	60	2	88	19	50	7	79
10	64		75	20	50	7	98

The values of the random variables X and Y may be interpreted as coordinates of a bivariate system (X, Y). These values can be plotted on a two-dimensional plane using Microsoft Excel. The resulting scatter plot of the (X, Y) pairs is presented in Figure 1.

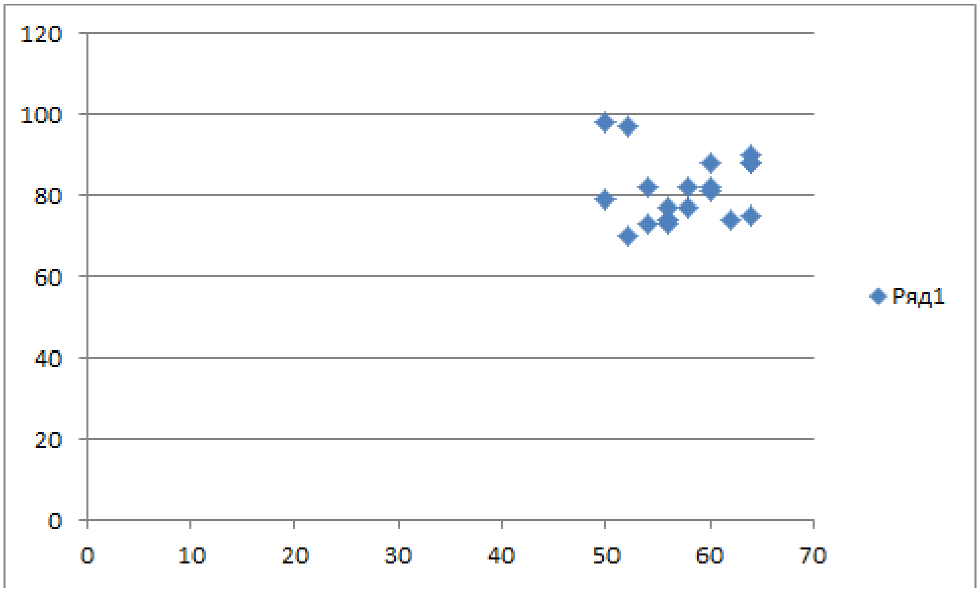

Figure 1:- The plot of the (X, Y) random variable points.

Let us draw attention to the results of cadets number 11 and 20. Despite irregular class attendance, they achieved high exam scores and, according to the Academy's ranking, are classified as top-performing students. It is well established that high-achieving individuals often possess certain psychological traits that enable them to maintain strong academic performance even with inconsistent attendance. This phenomenon—consistently high achievement despite irregular participation—is observed among certain cadets.

Although class absences generally tend to result in lower academic performance, some students are capable of independently mastering the material and achieving strong academic outcomes. Research suggests that more flexible attendance policies for high-performing cadets not only do not hinder their success, but may even enhance their academic results.

For example, in a natural experiment, permitting high-achieving students to miss up to 30% of classes without penalty led to improved performance in core subjects and higher university admission rates [6]. This suggests that certain psychological traits enable such students to learn effectively on their own. Their academic success can largely be attributed to cognitive, motivational, and personality-related factors.

In educational practice, understanding these characteristics underscores the importance of fostering students' independent learning skills, critical thinking, and intrinsic motivation—factors that support effective learning both inside and outside the classroom.

The data for these cadets will be excluded from the analysis as outliers or artifacts, as they have already demonstrated high academic achievement, and the hypothesis under examination does not pertain to their case.
The hypothesis to be tested is formulated as follows:
1. H_0: There is no correlation between variables X and Y ($\rho = 0$).
2. H_1: There is a statistically significant correlation between variables X and Y ($\rho \neq 0$).

First, the subject numbers will be entered sequentially in the first column of Table 2.
The values of the random variables X and Y will be placed in the third and fifth columns, respectively.

Initially, the values are ranked independently for each variable, with lower values typically assigned lower ranks.
The ranked values of these random variables are recorded in the respective columns, with rank 1 assigned to the lowest value, in accordance with standard ranking procedures. Then, the sum of the ranks for each variable is calculated.

To verify the correctness of the ranking, the following formula is used:

$$\sum_{i=1}^{n} r_i = \frac{n(n+1)}{2} \quad (7)$$

We calculate the squared difference (d^2) between the ranks of X and Y for each row in Table 2 and record the results in the sixth column. Then, we compute the sum of these squared differences, denoted as $\sum d^2$.

Table 2:- Calculations for the sum of squared rank differences ($\sum d^2$)).

Number of cadets	**Series of cadets' attended hours**	**Rank of the series by attended hours**	**Subject scores**	**Rank of the series by academic performance**	**Square of rank differences (d^2)**
1	64	16,5	88	16	0,25
2	56	6,5	74	5	2,25
3	58	9,5	82	13	12,25
4	64	16,5	90	18	2,25
5	62	14	74	5	81
6	60	12	82	13	1
7	64	16,5	88	16	0,25
8	54	3,5	73	2,5	1
9	60	12	88	16	16
10	64	16,5	75	7	90,25
11	54	3,5	82	13	72,25
12	56	6,5	73	2,5	16
13	60	12	81	11	1
14	52	2	70	1	1
15	58	9,5	77	8,5	1
16	56	6,5	74	5	2,25
17	56	6,5	77	8,5	4
18	50	1	79	10	81
$\sum$		171		171	385

Since tied ranks were assigned during the ranking process, it is necessary to verify the correctness of the rankings in the third and fifth columns of Table 2. The sum of the ranks in each of these columns is 171.
This verification is carried out using formula (7).

The result of the verification is: $\sum_{i=1}^{n} r_i = \frac{18(18+1)}{2} = 171.$
Therefore, the rank differences were calculated correctly.
Before proceeding with the formula-based calculation, it is necessary to compute the adjustments for tied ranks in the third and fifth columns of Table 2.

In our case, in the column of ranks for the number of hours attended:
– there are two groups of tied ranks, each consisting of two identical ranks (3,5 and 9,5). According to formula (3), the correction term is calculated as follows:

$$T_x = \frac{(2^3 - 2)}{12} \cdot 2 = 1$$

– one group of three tied ranks (12); according to formula (3), the correction term is calculated as follows:

$$T_x = \frac{(3^3 - 3)}{12} = 2$$

– two groups of four tied ranks (6,5 and 16.,); according to formula (3), the correction term is calculated as follows:

$$T_x = \frac{(4^3 - 4)}{12} \cdot 2 = 10$$

Similarly, in the column of ranks ordered by academic performance, we will calculate the correction for tied ranks:
– two groups of two tied ranks (2,5 and 8,5); according to formula (3), the correction term is calculated as follows:

$$T_y = \frac{(2^3 - 2)}{12} \cancel{\cdot 2} = 1;$$

– three groups of three tied ranks (5, 13, and 16); according to formula (3), the correction term is calculated as follows:

$$T_x = \frac{(3^3 - 3)}{12} \cdot 3 = 6.$$

Thus, the total correction term is:

$$\sum T_x = 1 + 2 + 10 = 13;$$

$$\sum T_{\text{y}} = 1 + 6 = 7.$$

We calculate the rank correlation coefficient rsr_srs, taking into account the correction terms, using formula (2).

Theresultis:

$$r_s = 1 - 6 \cdot \frac{385 + 13 + 7}{18(18^2 - 1)} = 1 - 6 \cdot \frac{405}{5814} = 1 - 0{,}42 = 0.58.$$

Since the number of cadets is the same in both cases, we determine the critical values using formula (4).

$$T_{\text{кр}} = t_{\text{кр}}(\alpha, k) \cdot \sqrt{\frac{1 - r_{\text{в}}^2}{n - 2}} = 2{,}11 \cdot \sqrt{\frac{1 - 0{,}58^2}{18 - 2}} = 0{,}42.$$

$0{,}58 = \rho_{\text{в}} > T_{\text{кр}} = 0{,}42.$

Accordingly, the null hypothesis H_0_ is rejected.

The calculated rank correlation value is placed on the significance scale. The rank correlation coefficients fall within the critical region (Figure 2). Therefore, we reject the null hypothesisH_0, which assumes that the correlation coefficient is equal to zero, and accept the alternative hypothesis H_1, indicating that the correlation is statistically significantly different from zero. In other words, the result indicates that the more class hours a cadet attends, the higher their academic performance in the given subject

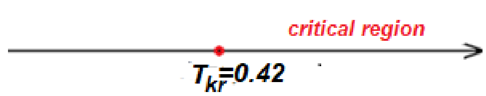

Figure 2:- Placement of the rank correlation value on the significance scale.

To calculate Kendall's sample rank correlation coefficient τ\tauτ, we first write the ranks of the values of the random variables in two rows (Table 3).

Table 3:- Ranks of the random variable values.

№	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Ранг X	16,5	6,5	9,5	16,5	14	12	16,5	3,5	12	16,5	3,5	6,5	12	2	9,5	6,5	6,5	1
Ранг У	16	5	13	18	5	13	16	2,5	16	7	13	2,5	11	1	8,5	5	8,5	10

There are 18 observations with paired values (x_i, y_i).
The total number of pairs is $\frac{18(18-1)}{2} = 153$.
The pairs are categorized as follows:
Concordant (P): when $(x_i - x_j)(y_i - y_j) > 0$;
Discordant (Q): when $(x_i - x_j)(y_i - y_j) < 0$;
Ties on X (T):if$x_i = x_j$, but $y_i \neq y_j$;
Ties on Y (U):if$y_i = y_j$, but $x_i \neq x_j$;
Complete ties (X and Y are both equal): such pairs are excluded from the analysis, as they do not provide information about ordering.

We begin calculating the pairs:

For the pairs (1, k), where $k = 2, \ldots, 18$:
– Pair (1,2): 16.5 < 6.5 and 16 > 5 → concordant → +1 P;
– Pair (1,3): 16.5 > 9.5 and 16 > 13 → concordant → +1 P;
– Pair (1,4): 16.5 = 16.5 and 16 < 18 → X values are equal → tied → +1 T;
– Pair (1,5): 16.5 > 14 and 16 > 5 → concordant → +1 P;
– Pair (1,6): 16.5 > 12 and 16 > 13 → concordant → +1 P;
– Pair (1,7): 16.5 = 16.5 and 16.5 = 16.5 → complete tie (X and Y are equal) → excluded from calculation;
– Pair (1,8): 16.5 > 3.5 and 16 > 2.5 → concordant → +1 P;
– Pair (1,9): 16.5 > 12 and 16 = 16 → Y values are equal → tied → +1 U;
– Pair (1,10): 16.5 = 16.5 and 16 > 7 → X values are equal → tied → +1 T;
– Pair (1,11): 16.5 > 3.5 and 16 > 13 → concordant → +1 P;
– Pair (1,12): 16.5 > 6.5 and 16 > 2.5 → concordant → +1 P;
– Pair (1,13): 16.5 > 12 and 16 > 11 → concordant → +1 P;
– Pair (1,14): 16.5 > 2 and 16 > 1 → concordant → +1 P;
– Pair (1,15): 16.5 > 9.5 and 16 > 8.5 → concordant → +1 P;
– Pair (1,16): 16.5 > 6.5 and 16 > 5 → concordant → +1 P;
– Pair (1,17): 16.5 > 6.5 and 16 > 8.5 → concordant → +1 P;
– Pair (1,18): 16.5 > 1 and 16 > 10 → concordant → +1 P;
Thus, for the pairs (1, k), where k=2,…,18, we have: P=13, Q=0, T=2, U=1.

For the pairs (2, k), where k=3,…,18:
-Pair (2,3): $6,5 < 9,5$и$5 < 13$ → concordant → +1 P;
-Pair (2,4): $6,5 < 16,5$и$5 < 18$ → concordant → +1 P;
-Pair (2,5): $6,5 < 14$и$5 = 5$ → Y equal → tied → +1U;
-Pair (2,6): $6,5 < 12$и$5 < 13$ → concordant → +1 P;
-Pair (2,7): $6,5 < 16,5$и$5 < 16$ → concordant → +1 P;
-Pair (2,8): $6,5 > 3,5$и$5 > 2,5$ → concordant → +1 P;
-Pair (2,9): $6,5 < 12$и$5 < 16$ → concordant → +1 P;
-Pair (2,10): $6,5 < 16,5$и$5 < 7$ → concordant → +1 P;
-Pair (2,11): $6,5 > 3,5$и$5 < 13$ → discordant. → +1 Q;
-Pair (2,12): $6,5, = 6,5$и$5 < 2,5$ → X equal → tied → +1T;
-Pair (2,13): $6,5 < 12$и$5 < 11$ → concordant → +1 P;
-Pair (2,14): $6,5 > 2$и$5 > 1$ → concordant → +1 P;
-Pair (2,15): $6,5 < 9,5$и$5 < 8,5$ → concordant → +1 P;
-Pair (2,16): $6,5, = 6,5$и$5 = 5$ → complete tie (X and Y are equal) → excluded from calculation
-Pair (2,17): $6,5 = 6,5$и$5 < 8,5$ → X equal → tied → +1T;
-Pair (2,18): $6,5 > 1$и$5 < 10$ → discordant. → +1 Q;
Thus, for the pairs (2, k), where k=3,…,18, we have:P=, Q=2, T=2, U=1
For the pairs (3,k), wherek=4, … , 18:
-Pair (3,4): $9,5 < 16,5$и$13 < 18$ → concordant → +1 P;
-Pair (3,5): $9,5 < 14$и$13 > 5$ → discordant. → +1 Q;
-Pair (3,6): $9,5 < 12$и$13 = 13$ → Y equal → tied → +1U;
-Pair (3,7): $9,5 < 16,5$и$13 < 16$ → concordant → +1 P;

-Pair (3,8): $9{,}5 > 3{,}5$и$13 > 2{,}5$ → concordant → +1 P;
-Pair (3,9): $9{,}5 < 12$и$13 < 16$ → concordant → +1 P;
-Pair (3,10): $9{,}5 < 16{,}5$и$13 > 7$ →discordant. → +1 Q;
-Pair (3,11): $9{,}5 > 3{,}5$и$13 = 13$ → Y equal → tied → +1U;
-Pair (3,12): $9{,}5 > 6{,}5$и$13 > 2{,}5$ → concordant → +1 P;
-Pair (3,13): $9{,}5 < 12$и$13 > 11$ → discordant. → +1 Q;
-Pair (3,14): $9{,}5 > 2$и$13 > 1$ → concordant → +1 P;
-Pair (3,15): $9{,}5 = 9{,}5$и$5 < 8{,}5$ → X equal → tied → +1T;
-Pair (3,16): $9{,}5 > 6{,}5$и$13 > 5$ → concordant → +1 P;
-Pair (3,17): $9{,}5 > 6{,}5$и$13 > 8{,}5$ → concordant → +1 P;
-Pair (3,18): $9{,}5 > 1$и$13 > 10$ → concordant → +1 P;
Thus, for the pairs (3,k), where k=4, … , 18 we have: P=9, Q =3, T=1, U=2.

For the pairs (4,k), where k=5, … , 18:
-Pair (4,5): $16{,}5 > 14$и $18 > 5$→ concordant → +1 P;
-Pair (4,6): $16{,}5 > 12$и $18 > 13$→ concordant → +1 P;
-Pair (4,7): $16{,}5 = 16{,}5$и$16 = 16$ → complete tie (X and Y are equal) → excluded from calculation
-Pair (4,8): $16{,}5 > 3{,}5$и $18 > 2{,}5$→ concordant → +1 P;
-Pair (4,9): $16{,}5 > 12$и $18 > 16$→ concordant → +1 P;
-Pair (4,10): $16{,}5 = 16{,}5$и$18 > 7$ → X equal → tied → +1T;
-Pair (4,11): $16{,}5 > 3{,}5$и $18 > 13$→ concordant → +1 P;
-Pair (4,12): $16{,}5 > 6{,}5$и $18 > 2{,}5$→ concordant → +1 P;
-Pair (4,13): $16{,}5 > 12$и $18 > 11$→ concordant → +1 P;
-Pair (4,14): $16{,}5 > 2$и $18 > 1$→ concordant → +1 P;
-Pair (4,15): $16{,}5 > 9{,}5$и $18 > 8{,}5$→ concordant → +1 P;
-Pair (4,16): $16{,}5 > 6{,}5$и $18 > 5$→ concordant → +1 P;
-Pair (4,17): $16{,}5 > 6{,}5$и $18 > 8{,}5$→ concordant → +1 P;
-Pair (4,18): $16{,}5 > 1$и $18 > 10$→ concordant → +1 P;
Thus, for the pairs (4,k), wherek=5, … , 18 we have: P=12, Q =0, T=1, U=0.

For the pairs (5,k), where k=6, … , 18:
-Pair (5,6): $14 > 12$и$5 < 13$ → discordant. → +1 Q;
-Pair (5,7): $14 < 16{,}5$и $5 < 16$ → concordant → +1 P;
-Pair (5,8): $14 > 3{,}5$и $5> 2{,}5$ → concordant → +1 P;
-Pair (5,9): $14 > 12$и $5< 16$ → discordant. → +1 Q;
-Pair (5,10): $14 < 16{,}5$и $5 < 7$ → concordant → +1 P;
-Pair (5,11): $14 > 3{,}5$и $5< 13$ → discordant. → +1 Q;
-Pair (5,12): $14 > 6{,}5$и $5 >2{,}5$ → concordant → +1 P;
-Pair (5,13): $14 > 12$и $5< 11$ → discordant. → +1 Q;
-Pair (5,14): $14 > 2$и $5 >1$ → concordant → +1 P;
-Pair (5,15): $14 > 9{,}5$и $5< 8{,}5$ → discordant. → +1 Q;
-Pair (5,16): $14 > 6{,}5$и$5 = 5$ → Y equal → tied → +1U;
-Pair (5,17): $14 > 6.5$и $5< 8{,}5$ → discordant. → +1 Q;
-Pair (5,13): $14 > 1$и $5< 10$ → discordant. → +1 Q;
Thus, for the pairs (5,k), where k=6, … , 18 we have: P=5, Q =7, T=0, U=1.

For the pairs (6,k), where k=7, … , 18:
-Pair (6,7): $12 < 16{,}5$и$13< 16$ → concordant → +1 P;
-Pair (6,8): $12 > 3{,}5$и$13> 2{,}5$ → concordant → +1 P;
-Pair (6,9): $12 = 12$и$13 < 16$ → X equal → tied → +1T;
-Pair (6,10): $12 < 16{,}5$и $13> 7$ → discordant. → +1 Q;
-Pair (6,11): $12 > 3{,}5$и$13 = 13$ → Y equal → tied → +1U;
-Pair (6,12): $12 > 6{,}5$и$13> 2{,}5$ → concordant → +1 P;
-Pair (6,13): $12 = 12$и$13 > 11$ → X equal → tied → +1T;
-Pair (6,14): $12 > 2$и$13> 1$ → concordant → +1 P;

-Pair (6,15): 12 $>$ *9,5*и13$>$ *8,5* → concordant → +1 P;
-Pair (6,16): 12 $>$ *6,5*и13$>$ *5* → concordant → +1 P;
-Pair (6,17): 12 $>$ *6,5*и13$>$ *8,5* → concordant → +1 P;
-Pair (6,18): 12 $>$ *1*и13$>$ *10* → concordant → +1 P;
Thus, for the pairs (6,k), where k=7, … , 18 we have: P=8, Q =1, T=2, U=1.

For the pairs (7,k), where k=8, … , 18:
-Pair (7,8): 16,5 $>$ *3,5*и16$>$ *2,5* → concordant → +1 P;
-Pair (7,9): 16,5 $>$ *12*и16 = 16 → Y equal → tied → +1U;
-Pair (7,10): 16,5 = 16,5и16 $>$ *7* → X equal → tied → +1T;
-Pair (7,11): 16,5 $>$ *3,5*и16$>$ *13* → concordant → +1 P;
-Pair (7,12): 16,5 $>$ *6,5*и16$>$ *2,5* → concordant → +1 P;
-Pair (7,13): 16,5 $>$ *12*и16$>$ *11* → concordant → +1 P;
-Pair (7,14): 16,5 $>$ *2*и16$>$ *1* → concordant → +1 P;
-Pair (7,15): 16,5 $>$ *9,5*и16$>$ *8,5* → concordant → +1 P;
-Pair (7,16): 16,5 $>$ *6,5*и16$>$ *5* → concordant → +1 P;
-Pair (7,17): 16,5 $>$ *6,5*и16$>$ *8,5* → concordant → +1 P;
-Pair (7,18): 16,5 $>$ *1*и16$>$ *10* → concordant → +1 P.
Thus, for the pairs (7,k), where k=8, … , 18 we have: P=9, Q =0, T=1, U=1.

For the pairs (8,k), where k=9, … , 18:
-Pair (8,9): 3,5 $<$ *12*и 2,5 < 12 → concordant → +1 P;
-Pair (8,10): 3,5 $<$ *16,5*и 2,5 < 7 → concordant → +1 P;
-Pair (8,11): 3,5 = 3,5 и 2,5 < 13→ X equal → tied → +1T;
-Pair (8,12): 3,5 $<$ *6,5*и2,5 = 2,5 → Y equal → tied → +1U;
-Pair (8,13): 3,5 $<$ *12*и 2,5 < 11 → concordant → +1 P;
-Pair (8,14): 3,5 $>$ *2*и 2,5 >1 → concordant → +1 P;
-Pair (8,15): 3,5 $<$ *9,5*и 2,5 < 8,5 → concordant → +1 P;
-Pair (8,16): 3,5 $<$ *6,5*и 2,5 < 5 → concordant → +1 P;
-Pair (8,17): 3,5 $<$ *6,5*и 2,5 < 8,5 → concordant → +1 P;
-Pair (8,18): 3,5 $>$ *16,5*и 2,5 <10 → discordant. → +1 Q;
Thus, for the pairs (8,k), where k=9, … , 18 we have: P=7, Q =1, T=1, U=1.

For the pairs (9,k), where k=10, … , 18:
-Pair (9,10): 12$<$ *16,5*и 16 > 7 → discordant. → +1 Q;
-Pair (9,11): 12 $>$ *3,5*и 16 > 13 → concordant → +1 P;
-Pair (9,12): 12 $>$ *6,5*и 16 > 2,5 → concordant → +1 P;
-Pair (9,13): 12 = 12и16 $>$ *11* → X equal → tied → +1T;
-Pair (9,14): 12 $>$ *2*и 16 > 1 → concordant → +1 P;
-Pair (9,15): 12 $>$ *9,5*и 16 > 8,5 → concordant → +1 P;
-Pair (9,16): 12 $>$ *6,5*и 16 > 5 → concordant → +1 P;
-Pair (9,17): 12 $>$ *6,5*и 16 > 8,5 → concordant → +1 P;
-Pair (9,18): 12 $>$ *1*и 16 > 10 → concordant → +1 P;
hus, for the pairs (9,k), where k=10, … , 18 we have: P=7, Q =1, T=1, U=0.
For the pairs (10,k), where k=11, … , 18:
-Pair (10,11): 16,5>3, 5и 7 < 13 →discordant. → +1 Q;
-Pair (10,12): 16,5 $>$ *6,5*и 7 < 2,5→ concordant → +1 P;
-Pair (10,13): 16,5> 12 и 7 < 11 →discordant. → +1 Q;
-Pair (10,14): 16,5 $>$ *2*и 7 > 1→ concordant → +1 P;
-Pair (10,15): 16,5> 9,5 и 7 <8,5 → discordant. → +1 Q;
-Pair (10,16): 16,5 $>$ *6,5*и 7 > 5→ concordant → +1 P;
-Pair (10,17): 16,5> 6,5 и 7 <8,5 → discordant. → +1 Q;
-Pair (10,15): 16,5> 1 и 7 <10 → discordant. → +1 Q;
Thus, for the pairs (10,k), where k=11, … , 18 имеем: P=3, Q =5, T=0, U=0.

For the pairs (11,k), where k=12, … , 18:
-Pair (11,12): 3,5< 6, 5и 13 > 2,5 → discordant. → +1 Q;
-Pair (11,13): 3, 5< 12 и 13 > 11 →discordant. → +1 Q;
-Pair (11,14): 3,5> 2 и 13 > 1 → concordant → +1 P;
-Pair (11,15): 3,5< 9, 5и 13 > 8,5 → discordant. → +1 Q;
-Pair (11,16): 3, 5< 6,5 и 13 > 5 → discordant. → +1 Q;
-Pair (11,17): 3,5< 6, 5и 13 > 8,5 → discordant. → +1 Q;
-Pair (11,18): 3, 5> 1 и 13 > 10 → concordant → +1 P;

Thus, for the pairs (11,k), wherek=12, … , 18 we have: P=2, Q =5, T=0, U=0.
For the pairs (12,k), where k=13, … , 18:

-Pair (12,13): 6,5 < *12*и 2,5 < 11 → concordant → +1 P;
-Pair (12,14): 6,5 > *2*и 2,5 > 1 → concordant → +1 P;
-Pair (12,15): 6,5 < *9,5*и 2,5 < 8,5 → concordant → +1 P;
-Pair (12,16): 6, 5 = 6,5 и 2,5 < 5 → X equal → tied → +1T;
-Pair (12,17): 6, 5 = 6,5 и 2,5 <8, 5 → X equal → tied → +1T;
-Pair (12,18): 6,5> 1 и 2,5 < 10 → discordant. → +1 Q;
Thus, for the pairs (12,k), where k=13, … , 18 we have: P=3, Q =1, T=2, U=0.
For the pairs (13,k), where k=14, … , 18:
-Pair (13,14): 12 > *2*и 11 > 1 → concordant → +1 P;
-Pair (13,15): 12 > *9,5*и 11 > 8,5 → concordant → +1 P;
-Pair (13,16): 12 > *6,5*и 11 > 5 → concordant → +1 P;
-Pair (13,17): 12 > *6,5*и 11 > 8,5 → concordant → +1 P;
-Pair (13,18): 12 > *1*и 11 > 10 → concordant → +1 P;
Thus, for the pairs (13,k), where k=14, … , 18 we have: P=5, Q =0, T=0, U=0.

For the pairs (14,k), where k=15, … , 18:
-Pair (14,15): 2 < *9,5*и 1 < 8,5 → concordant → +1 P;
-Pair (14,16): 2 < *6,5*и 1 < 5 → concordant → +1 P;
-Pair (14,17): 2 < *6,5*и 1 < 8,5→ concordant → +1 P;
-Pair (14,18): 2 > 1 и 1 < 10 → discordant. → +1 Q;
Thus, for the pairs (14,k), where k=15, … , 18 имеем: P=3, Q =1, T=0, U=0.

For the pairs (15,k), where k=16, 17, 18:
-Pair (15,16): 9,5 > *6,5*и 8,5 >5 → concordant → +1 P;
-Pair (15,17): 9,5 > *6,5*и8,5 = 8,5 → Y equal → tied → +1U;
-Pair (15,18): 9,5 > *1*и8,5< 10 → discordant. → +1 Q;

Thus, for the pairs (15,k), where k=16, 17, 18 we have: P=1, Q =1, T=0, U=1.

For the pairs (16,k), where k=17, 18:

-Pair (16,17): 6, 5 = 6,5 и 5 <8, 5 → X equal → tied → +1T;
-Pair (16,18): 6,5 > 1 и 5 < 10 → discordant. → +1 Q;

Thus, for the pairs (16,k), where k=17, 18 we have: P=0, Q =1, T=1, U=0.
For the pairs (17,18):
-Pair (17,18): 6,5 > 1 и 8,5 < 10 → discordant. → +1 Q;
Thus, for the pairs (17,18): P=0, Q =1, T=0, U=0.

There are a total of 153 pairs. Of these, 97 are concordant, 30 are discordant, 14 are tied on X, 9 are tied on Y, and 3 are complete ties (i.e., X and Y are equal). No calculation errors were found.
According to formula (5), Kendall’s rank correlation coefficient is calculated as follows:

$$\tau_b = \frac{97-30}{\sqrt{97+30+14}\sqrt{97+30+9}} \approx 0{,}48.$$

To test the null hypothesis that the population Kendall rank correlation coefficient τ_b is equal to zero at a given level of significance, under the alternative hypothesis $H_1\colon \tau_b \neq 0$, it is necessary to compute the critical value for the two-tailed critical region. This value is$Z_{cr} = 1{,}96$, obtained from the Laplace function table based on the equality

$$\Phi(Z_{cr}) = \frac{1-0{,}05}{2} = 0{,}475.$$

Then, the critical value of Kendall's test statistic, as defined by formula (6), is:

$$T_{\text{кр}} = 1{,}96\sqrt{\frac{2(2\cdot 18+5)}{9\cdot 18\cdot(18-1)}} = 0{,}34.$$

Since,

$$0{,}48 = |\tau_b| > T_{\text{кр}} = 0{,}34$$

the null hypothesis is rejected. Therefore, a statistically significant rank correlation exists between the variables.

Results and Discussion:

Despite the limited sample size, the present study identified a statistically significant relationship between the number of class hours attended and exam performance. When interpreting the findings, it is important to acknowledge that data from high-achieving students may represent an artifact, influenced by their strong academic motivation and distinct psychological characteristics. Nevertheless, the observed correlation provides support for the hypothesis that class attendance positively affects academic achievement.

The results obtained have practical significance for the educational process in military and specialized academic institutions. Promoting a culture of mandatory class attendance, along with incorporating attendance indicators into the evaluation of cadets' academic performance, can serve as effective tools for enhancing overall academic success. Moreover, the implementation of measures to encourage regular attendance contributes to strengthening discipline, which is particularly important in the context of military education.
In conclusion, we propose several concrete actions for academic administrators responsible for cadet performance:
- Strengthen the monitoring of cadet attendance as a means of improving overall academic achievement.
- Regular monitoring will facilitate the early identification of cadets with frequent absences and allow timely intervention to prevent academic decline.

-Develop adaptive support mechanisms for cadets with consistently low attendance. Additional classes, individual consultations, or mentoring can help address knowledge gaps and prevent further declines in academic performance.
-Utilize attendance data as part of the academic monitoring system. Analyzing this data will make it possible to identify at-risk groups and develop targeted support measures.
- Conduct regular analyses of the relationship between attendance and academic performance.
Such analyses will support the improvement of academic programs and allow for adjustments to the educational process based on identified patterns.

It is important to recognize that cadet absences are often not the result of low motivation, but rather due to the fulfillment of official duties and assigned shifts. Addressing this issue requires coordinated planning of academic and duty schedules, which calls for the attention and active involvement of the leadership.

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