https://doi.org/10.31272/jae.xxxx.xxx
https://admics.uomustansiriyah.edu.iq/index.php/admeco
P-ISSN: 1813–6729 E-ISSN: 2707-1359

JAE

Using Non-Parametric Tests to Analyse the Emergency Cases in Sulaymaniyah Governorate Hospitals

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Article Information

Article History:
Received: 08 / 04 / 2025
Accepted: 20 / 05 / 2025
Available Online: 01 / 06 / 2025
Page no: 98 – 107

Keywords:
Emergency cases, nonparametric tests, Mann-Whitney test, and Kruskal-Wallis test.

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Abstract

This research includes understanding and applying different types of nonparametric statistical tests. Nonparametric approaches provide an alternative set of statistical techniques that make no assumptions about the data. These methods are often used to analyse data behaviour that does not require the distribution or parametric methods.

The purpose is to use mathematical concepts to explain and implement these various nonparametric tests in emergencies. In this research we try to study the relationship between emergencies (traffic accidents, falls from a height, shots, sharp tools, military operations and civil rebellion) and between age, gender and the four seasons of the year through the use of tests and to the period (December 1, 2019 to December 30, 2021) Data was collected at Shar Hospital in Sulaymaniyah, Kurdistan Region of Iraq. Throughout, it was evident that non-parametric tests of independent samples were used. Non-parametric tests such as the Mann-Whitney and Kruskal-Wallis tests will be applied, and no significant relationship between the Season variable and all emergencies.

1. Introduction

In our daily lives, we may constantly encounter an emergency situation as we deal with many matters related to our lives, such as preparing children for school, children playing in the garden, or doing maintenance work inside the house. All of these may lead to an emergency situation that requires going to the hospital. [2,11] In this research, we try to use nonparametric tests in this field.

John Arbuthnot, a Scottish physician and mathematician, introduced nonparametric analysis methods in 1710 [1]. A statistical technique is called a nonparametric test. The assumptions of parametric methods do not apply to nonparametric methods. Much research has pointed out a fundamental difference between the assumptions of these methods. In general, inferences from unlabeled methods are less robust than those from parametric methods. [10]

Jacob Wolfowitz was the first to coin the term non-parametric, saying: We will refer to this condition as a boundary condition. To show the opposite. Where applicable, distribution models are unknown, as a non-parametric state [10,13]

Non-parametric methods of testing hypotheses are appropriate to behavioural science data; these tests are called "distribution free", and one of the main advantages is that when the results are analysed from the distribution of the population in a certain way, from a population that is distributed in the same way in nature. Instead, many of these tests are classified as "data analysis", and this article suggests some of their important advantages: non-parametric methods can be used with data that not accurate in any mathematical sense, but just data in depth. Another benefit of non-parametric tests is that we can use them with limited data (eg, samples from people with an abnormal type of mental illness or cultural samples).

In medical sciences, we manage research to determine whether assumptions derived from our behavioural theories are correct. After selecting a specific hypothesis that is important to a particular theorem, we collect experimental data that should provide specific information about the acceptance of that theory.

To reach an accurate conclusion about whether a set of data supports a particular theory, we must have an objective method to reject or accept that theory. The objective is emphasised because the scientific method requires that general methods reach scientific conclusions and can be replicated by other specialised researchers. [7,8]

2. Nonparametric Test Employed with Ordinal Data [9]

A nonparametric test is a statistical procedure where the data does not conform to a normal distribution. The data used in a non-normative proof is usually of the ordinal data type, meaning it does not depend on arithmetic properties. Therefore, all tests involving the order of the data are non-parametric, and no statement is made about the data distribution.

2.1. Kruskal–Wallis One-Way Analysis of Variance by Ranks [9]

The two researchers, William Kruskal and Allen Wallis, used a nonparametric test method to compare two or more groups by classifying the data [12]. Where more than two groups have different means.

Background information for testing: If you are testing a hypothesis involving two projects, perform a one-way Kruskal-Wallis ANOVA using serial data (Kruskal (1952) and Kruskal and Wallis (1952)). Or don't depend on the sample. It is an extension of the Mann-Whitney test for more than two independent groups, and Kruskal-Wallis analysis of the ranks of variance will give the same Mann-Whitney test results when k = 2. A one-way Kruskal-Wallis rank ANOVA is used on the rank-estimated data when one of the following is true: Integration is available. or (b) the data were converted to an interval/correlation format or a categorical format because the investigator had reason to believe one or more hypotheses for separate factors between subjects. [5,6]

One reason several sources use Kruskal-Wallis for univariate analysis of range variance is that researchers can reduce or eliminate the effect of outliers in the range of rank/correlation data, because outliers can significantly affect the variance; they may be responsible for the heterogeneity in the variance between two or more samples. Also, outliers can have a significant impact on the sample mean. [4,14]

$$H_0: \varphi_1 = \varphi_2 = \varphi_3 = \varphi_4$$
$$H_1: \varphi_1 \neq \varphi_2 \neq \varphi_3 \neq \varphi_4$$

Each sample has an equal observation, and the ranks sum will be equal for all four samples; two or more groups will have different ranks when the alternative hypothesis is accepted. [3]

The standard formation (which also involves different sizes of samples) when two or more groups have different means.

$$H_{kw} = \frac{12}{N_p(N_p+1)} \sum_{j=1}^{k} \left[\frac{(\sum r_j)^2}{n_j}\right] - 3(N_p+1) \tag{1}$$

Where $\sum_{j=1}^{k} \left[\frac{(\sum r_j)^2}{n_j}\right]$:The sum of the ranks of each sample is squared and then divided by the number of observations

2.2. Mann-Whitney Test [15]

As in the above Wilcoxon test, the Mann-Whitney test was used to determine differences between the two groups. Populations are not assumed to be normally distributed. However, if we extend this approach to analyses of social interest, we need additional perspectives.

If we make Assumption about the two distributions are identical. Defined $Dij = I(Y_j < X_i), i = 1, \ldots, n_1 \; and \; j = 1, \ldots, n_2$. Mann-Whitney test is the linear rank statistic [3]

$$U = \sum_{i=1}^{n1}\sum_{j=1}^{n2} Dij \quad (2)$$

It spins out that U test analog to test W:

$$\sum_{j=1}^{n2} Dij = Di1 + Di2 + \cdots .. + Di, n_2 \quad (3)$$

Sum in equation for which $Y_j < X_i$. Apparently is exact the number of values indexed by j, Then,

$$U = \sum_{i=1}^{n1}(r(xi) - ki) = \sum_{i=1}^{n1}(r(xi) - k1 + k2 + \cdots + kn_1) \quad (4)$$

$$U = \sum_{i=1}^{n1} iSi(X,Y) - \frac{n1(n1+1)}{2} U = Wn - \frac{n1(n1+1)}{2} \quad (5)$$

U-test and the Wilcoxon test are equal because of $kl + ka + \ldots + k,, = 1 + 2 + \ldots + n_1$.[9,15]

3. Statistical data analysis

To study the relationship between emergency cases (traffic accidents, falls from height, gunshots, sharp tools, military operations and civil rebellion.) and the variables (age, gender and the four seasons of the year) where age classified into five categories (less than 5, 5-19, 20-44, 45-64, more than or equal 65), through the use of non-parametric tests and For the period of (1st December of 2019 till 30 of November 2021), The data were collected from Shar Hospital in Sulaymaniyah, Kurdistan Region in Iraq by using some packages and functions in R and SPSS software and the results of statistical analysis as follow:.

Table (1): Mann-Whitey test values between (Gender) and (five emergency cases)

	H_0	Sig.	Decision
1	Dist. of Traffic_accidents does not differ across categories of Gender.	.015[1]	Reject H_0.
2	Dist. of falls_from_height does not differ across categories of Gender.	.005[1]	Reject H_0.
3	Dist. of gunshots does not differ across categories of Gender.	.007[1]	Reject H_0.
4	Dist. of sharp_tools does not differ across categories of Gender.	.001[1]	Reject H_0.
5	Dist. of military_operations_and_civil_rebellion does not differ across categories of Gender.	.174[1]	Retain H_0.

Table (1) shows a significant relationship between gender and emergencies (Traffic accidents, falls from height, gunshots, and sharp tools), except for emergency cases (military operations and civil rebellion), where no significant relationship exists.

Table (2): Mann-Whitey Test values for some tests between (Gender) with (five emergency cases)

	Traffic accidents	falls from height	Gun Shot	Sharps tools	military operations and civil rebellion
Total N	40	40	40	40	40
Mann-Whitney U	111.000	98.000	101.000	85.000	149.500
Wilcoxon W	321.000	308.000	311.000	295.000	359.500
Test Statistic	111.000	98.000	101.000	85.000	149.500
Standard Error	36.958	36.930	36.416	36.903	36.894
Standardized Test Statistic	-2.408	-2.762	-2.719	-3.116	-1.369
Asymptotic Sig. (2-sided test)	.016	.006	.007	.002	.171
Exact Sig. (2-sided test)	.015	.005	.007	.001	.174

From Table (2), we note the alternative hypothesis will accepted that means the relation between males and females are not same with Traffic accidents (Males is more), and we note the alternative hypothesis will accepted that means the relation between males and females are not same with falls from height (Males is more). then we note the alternative hypothesis will accepted that means the relation between males and females are not same with Gun Shot (Males is more), we note the alternative hypothesis will accepted that means the relation between males and females are not same with Sharps tools (Males is more), finally we notice the Null hypothesis will accepted that means the relation between males and females are same with falls from military operations and civil rebellion.

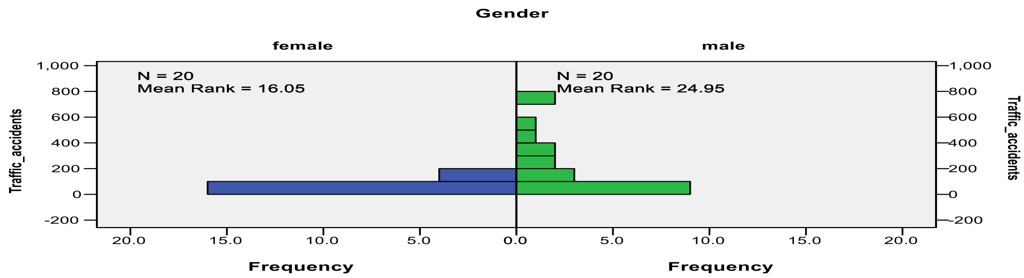

Figure (1): Independent-Samples Mann-Whitney Test between (Gender) and (Traffic accidents)

From the above figure, we note that the relationship between males and females is not the same with Traffic accidents (Males are more).

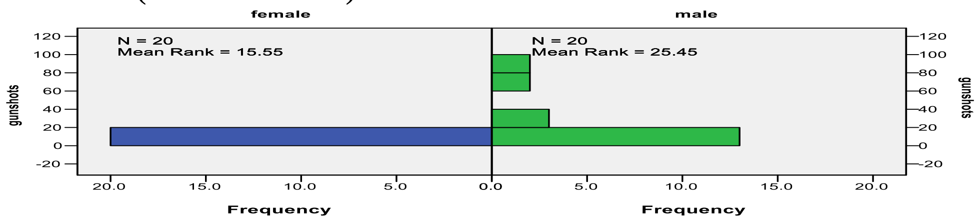

Figure (2): Independent-Samples Mann-Whitney Test between (Gender) and (falls from height)

From the above figure, we note that the relation between males and females is not the same with falls from height (Males are more likely).

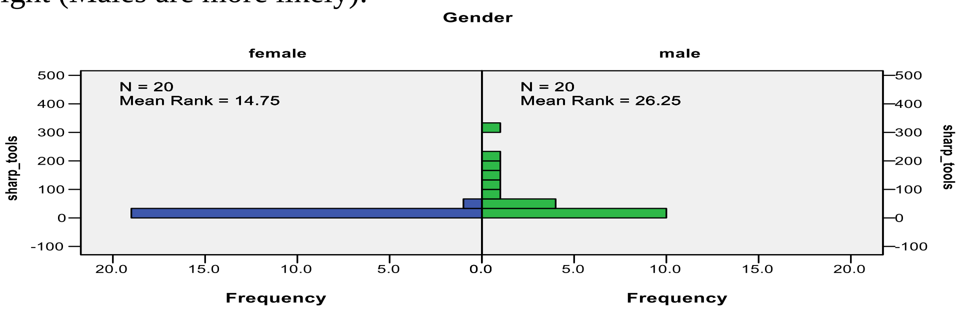

Figure (3): Independent-Samples Mann-Whitney Test between (Gender) and (Gun Shots)

From the above figure, we note that the relation between males and females is not the same with Gunshot (Males are more).

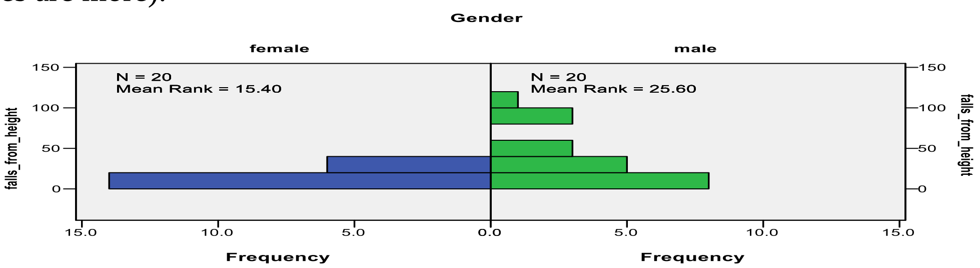

Figure (4): Independent-Samples Mann-Whitney Test between (Gender) and (Sharp Tools)

From the above figure, we note that the relation between males and females is not the same with Sharps tools (Males are more).

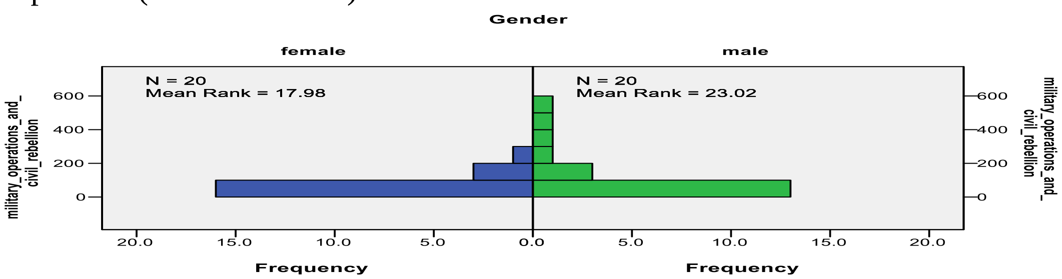

Figure (5): Independent-Samples Mann-Whitney Test between (Gender) and (military operations and civil rebellion)

From the above figure, we note that the relation between males and females is the same in military operations and civil rebellion.

Table (3): Kruskal-Wallis Test values between (Seasons) and (five emergency cases)

	H_0.	Sig.	Decision
1	Dist. of Traffic_accidents is the same across categories of Season.	.913	Retain H_0.
2	Dist. of falls_from_height is the same across categories of Season.	.463	Retain H_0.
3	Dist. of gunshots is the same across categories of Season.	.955	Retain H_0.
4	Dist. of sharp_tools is the same across categories of Season.	.785	Retain H_0.
5	Dist. of military_operations_and_civil_rebellion is the same across categories of Season.	.861	Retain H_0.
	Asymptotic significances are displayed. The significance level is .05.		

Table (3) shows no significant relationship between the seasonal variable and all emergency situations (Traffic accidents, falls from height, gunshots, sharp tools, military operations, and civil rebellion).

Table (4): Kruskal-Wallis test values inside some tests between (Seasons) with (five emergency cases)

	Traffic accidents	falls from height	Gun Shot	Sharps tools	military operations and civil rebellion
Total N	40	40	40	40	40
Test Statistics	0.527	2.571	0.324	1.066	0.750
D.F.	3	3	3	3	3
Asymptotic Sig. (2-sided test)	0.913	0.463	0.955	0.785	0.861

From Table (4), we notice the alternative hypothesis will not be accepted, which means the relation between the four seasons is the same for all emergency situations (Traffic accidents, falls from height, gunshots, sharp tools, military operations, and civil rebellion).

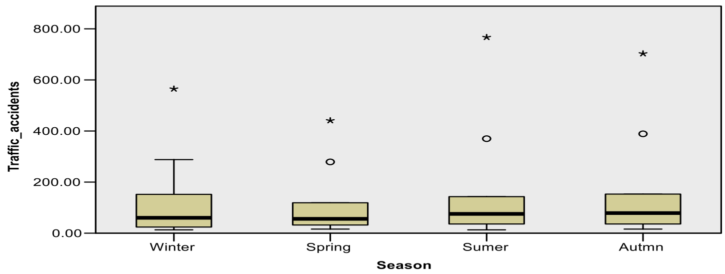

Figure (6): Kruskal-Wallis Test between (Season) and (Traffic accidents)

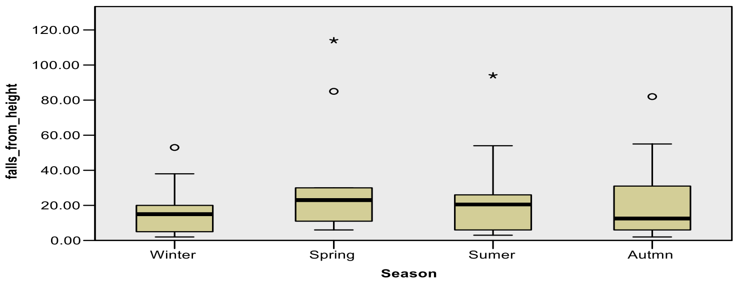

Figure (7): Kruskal Wallis Test between (Season) and (falls from height)

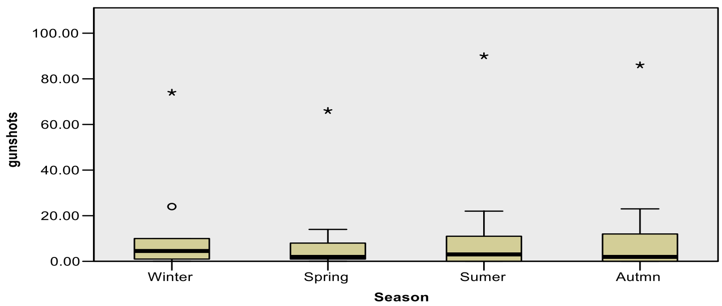

Figure (8): Kruskal Wallis Test between (Season) and (gun shots)

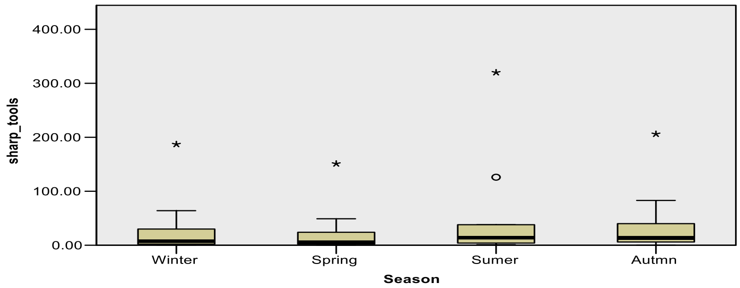

Figure (9): Kruskal Wallis Test between (Season) and (Sharp tools)

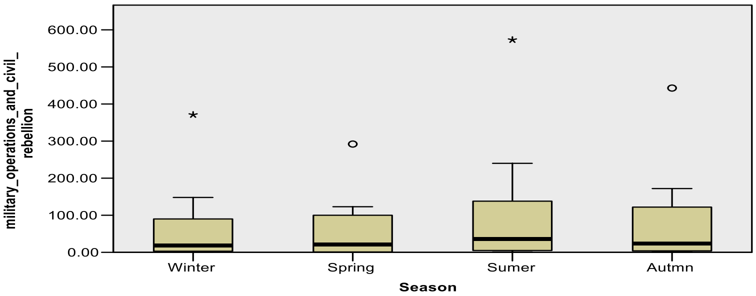

Figure (10): Kruskal Wallis Test between (Season) and (military operations and civil rebellion)

Table (5): Kruskal-Wallis Test values between (Age) and (five emergency cases)

	H_0	Sig.	Decision
1	Dist. of Traffic_accidents is the same across categories of Age.	.000	Reject H_0.
2	Dist. of falls_from_height is the same across categories of Age.	.000	Reject H_0.
3	Dist. of gunshots is the same across categories of Age.	.000	Reject H_0.
4	Dist. of sharp_tools is the same across categories of Age.	.000	Reject H_0.
5	Dist. of military_operations_and_civil_rebellion is the same across categories of Age.	.000	Reject H_0.
Asymptotic significances are displayed. The significance level is .05.			

Table (5) shows a significant relationship between the Age variable and all emergencies (Traffic accidents, falls from height, gunshots, sharp tools, military operations, and civil rebellion).

Table (6): Kruskal-Wallis Test values between (Age) and (five emergency cases)

	Traffic accidents	falls from height	Gun Shot	Sharps tools	military operations and civil rebellion
Total N	40	40	40	40	40
Test Statistics	31.219	22.591	24.399	25.839	34.358
D.F.	4	4	4	4	4
Asymptotic Sig. (2-sided test)	0.000	0.000	0.000	0.000	0.000

From Table (6), we notice that the alternative hypothesis will be accepted, which means the relation between the Age categories is not the same for all emergency situations (Traffic accidents, falls from height, gunshots, sharp tools, military operations, and civil rebellion); there are significant differences among them.

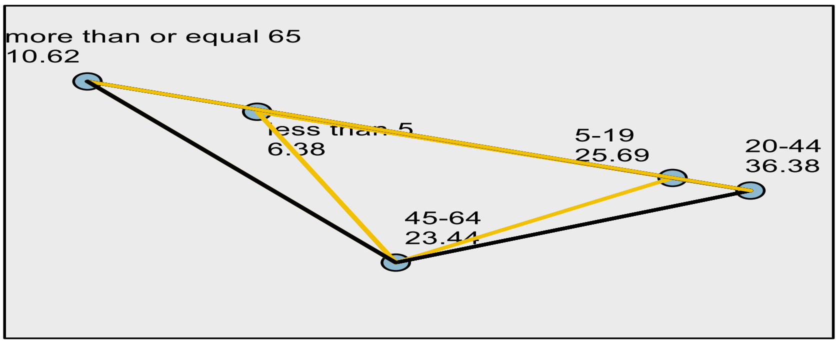

Figure (11): Pairwise Comparison of Age

From the above Figure, we notice that the relation between the Age categories is not the same for all emergency situations (Traffic accidents, falls from height, gunshots, sharp tools, military operations, and civil rebellion); there are significant differences among them.

Table (7): Show Pairwise Comparison test values of Age

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
less than 5-more than or equal 65	-4.250	5.833	-.729	.466	1.000
less than 5-45-64	-17.062	5.833	-2.925	.003	.034
less than 5-5-19	-19.312	5.833	-3.311	.001	.009
less than 5-20-44	-30.000	5.833	-5.143	.000	.000
more than or equal 65-45-64	12.812	5.833	2.196	.028	.281
more than or equal 65-5-19	15.062	5.833	2.582	.010	.098
more than or equal 65-20-44	25.750	5.833	4.414	.000	.000
45-64-5-19	2.250	5.833	.386	.700	1.000
45-64-20-44	12.938	5.833	2.218	.027	.266
5-19-20-44	-10.688	5.833	-1.832	.067	.669

Each row tests H_0The distances of sample one and sample two are identical, and the asymptotic mean (two-tailed test) is shown. The significance level is 0.05. Significant values were adjusted with Bonferroni corrections for different tests.

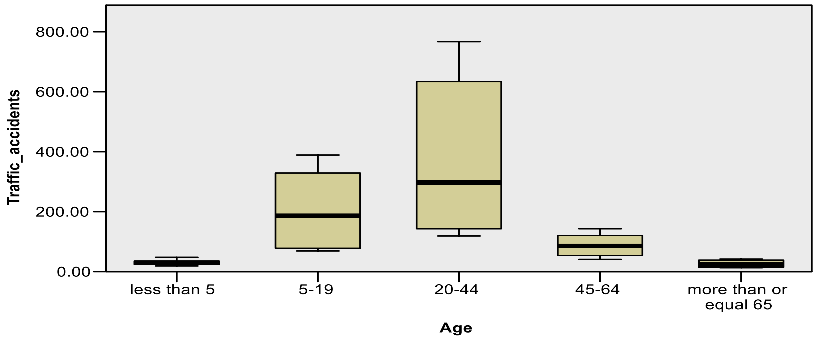

Figure (12): Kruskal Wallis Test between (Age) and (Traffic accidents)

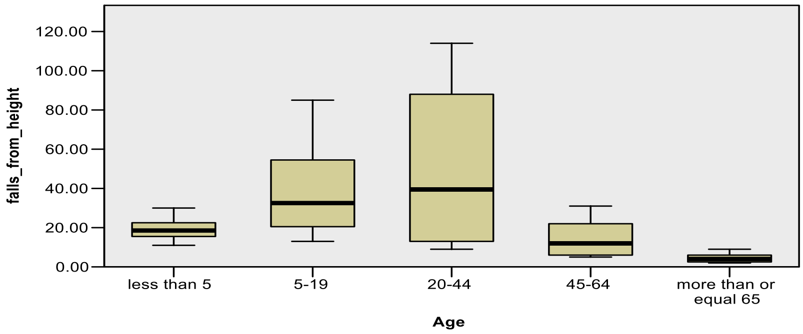

Figure (13): Kruskal Wallis Test between (Age) and (falls from height)

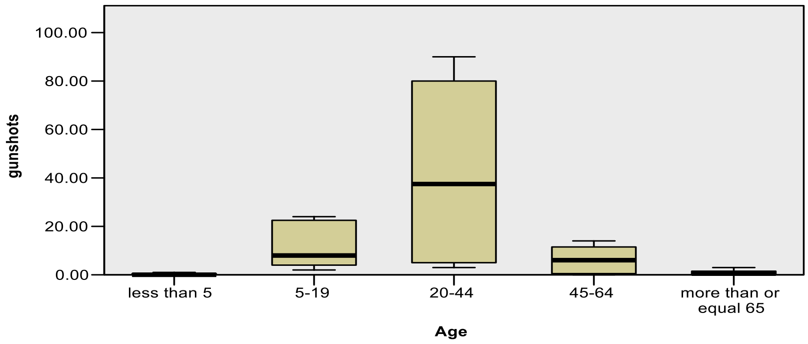

Figure (14): Kruskal Wallis Test between (Age) and (gun Shots)

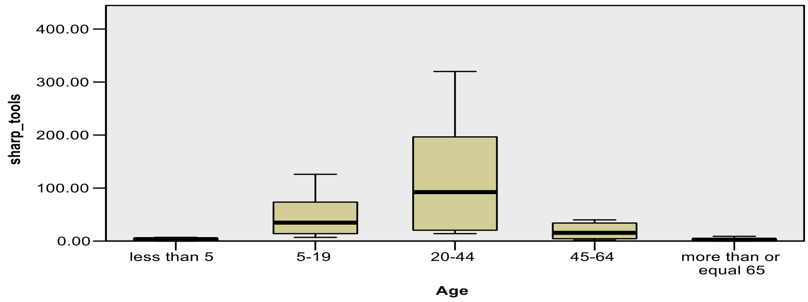

Figure (15): Kruskal Wallis Test between (Age) and (Sharp tools)

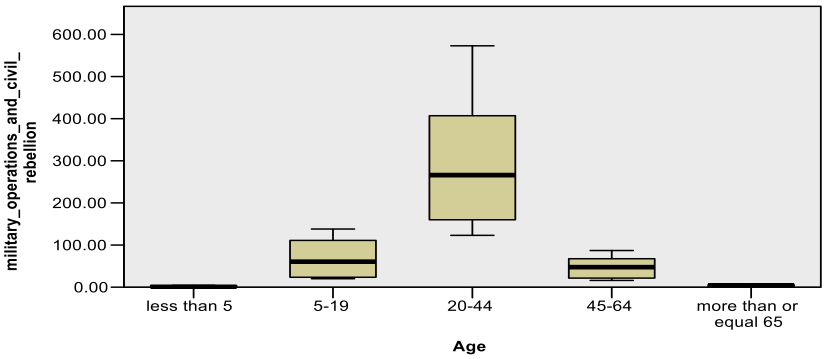

Figure (16): Kruskal Wallis Test between (Age) and (military operations and civil rebellion)

4. Conclusions

We have applied the different nonparametric techniques and their importance, such as the Mann-Whitney and Kruskal-Wallis tests. The nonparametric Approach has succeeded in analysing emergencies through its use in this paper. It has been shown that the gender variable and emergencies (Traffic accidents, falls from height, gunshots, sharp tools) have a significant relationship, except for emergency cases (military operations and civil rebellion), where there is no significant relationship. There is no significant relationship between the Season variable and all emergencies, and the Age variable has an essential relationship with all emergencies. There is a strong relationship between Age and all five emergency cases inside.

5. Recommendations

We recommend the following recommendations for future studies:

1. Expanding the sample size by taking different cities and regions to compare emergencies on a regional basis
2. Using the parametric method, such as principal components analysis or post-experimental tests, such as (Duncan), (Dunnett), (Bartlett), etc. or other post hoc tests.
3. Taking other emergency cases such as (stroke or heart attacks) and (spontaneous abortion), etc. or other risk variables such as (marital status), (educational achievement), (occupation), etc.

Reference:

[1] Arbuthnott J. An argument for divine providence, taken from the constant regularity Observ'd in the births of both sexes. Philos Trans 1710; 27: 186-90.

[2] Bartel Van de Walle & Murray Turoff,2008, Decision support for emergency situations, https://www.researchgate.net/publication/220385037, DOI: 10.1007/s10257-008-0087-z · Source: DBLP

[3] Bell, C. B. and Doksum, K. A. (1965). Some new distribution-free statistics. Annals of Mathematical Statistics, 36, 203–214.

[4] C. A. HESSE & et al, 2018, INTRODUCTION TO NONPARAMETRIC STATISTICAL METHODS, Akrong Publications Ltd.

[5] Dunn, Olive J., (1964). Basic Statistics: A Primer for the Biomedical Sciences, New York: Wiley.

[6] Francis Sahngun Nahm,2016, Nonparametric statistical tests for the continuous data: the basic concept and the practical use, Korean Journal of Anesthesiology. pISSN 2005-6419 . eISSN 2005-7563.

[7] Gregory W. Corder & Dali I. Foreman, 2014, NONPARAMETRIC STATISTICS, John Wiley & Sons, Inc., Hoboken, New Jersey.

[8] Hajar, F. T., & Ibrahim, W. S. (2019). Use the logistic regression model to find the most important factors affecting lung cancer in Iraq in 2017. Journal of Administration and Economics, 44(121).

[9] Jagoo Girish & et al, 2012, Non-parametric Tests, https://www.researchgate.net/publication/323546900.

[10] Luigi Lombardi, Marco D Alessandro and Hans Colonius, 2018, A new nonparametric test for the race model inequality, Behavior Research Methods (2019) 51:2290–2301, © Psychonomic Society.

[11] Mohammed, A. J., & Ibrahim, W. S. (2020). Study of the probability of change in share prices based on the value of the Babylon Hotel using logistic regression. Journal of Administration and Economics, 45(123).

[12] Mohammad, A. J. (2021). Using the penalized splines regression method to estimate the logistic model and using a practical application. journal of the college of basic education, 27(113/العلمي).

[13] Paul H. Kvam & Brani Vidakovic, 2007, Nonparametric Statistics with Applications to Science and Engineering, A John Wiley & Sons, Inc., Publication.

[14] Sheskin, David, 2000, Handbook of parametric and nonparametric statistical procedures, Chapman & Hall/CRC.

[15] Sidney Siegel, 1956, Non Parametric Statistics for the behavioral Sciences, McGRAW-Hill Book Company, INC.

https://doi.org/10.31272/jae.xxxx.xxx
https://admics.uomustansiriyah.edu.iq/index.php/admeco
P-ISSN: 1813–6729 E-ISSN: 2707-1359

JAE

استخدام الاختبارات غير المعلمية لتحليل حالات الطوارئ في مستشفيات محافظة السليمانية

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المستخلص

يتضمن هذا البحث فهمًا وتطبيقًا لأنواع مختلفة من الاختبارات الإحصائية غير المعلمية ، اذ تقدم المناهج غير المعلمية مجموعة بديلة من التقنيات الإحصائية التي تضع افتراضات محدودة للبيانات أو لا تضع أي افتراضات على الإطلاق وغالباً ما تُستخدم هذه الطرق لتحليل سلوك البيانات التي لا تحتاج إلى توزيع أو تتطلب طرقًا معلمية

الهدف هو استعمال المفاهيم الرياضية لشرح وتنفيذ هذه الأنواع المختلفة من الاختبارات غير المعلمية في حالات الطوارئ، نحاول دراسة العلاقة بين حالات الطوارئ (حوادث المرور، السقوط من ارتفاع، الطلقات النارية، الأدوات الحادة، العمليات العسكرية والتمرد المدني) وبين العمر والجنس وفصول السنة الأربعة من خلال استعمال الاختبارات غير المعلمية للعينات المستقلة التي تم جمع بياناتها في مستشفى شار في السليمانية، إقليم كردستان العراق للفترة (1 ديسمبر 2019 إلى 30 ديسمبر 2021). سيتم تطبيق الاختبارات غير المعلمية مثل اختبار مان-ويتني واختبار كروسكال-واليس, ومن خلال النتائج العملية تم التوصل الى أن هناك علاقة ذات دلالة إحصائية بين الجنس وحالات الطوارئ (حوادث المرور، السقوط من المرتفعات، إطلاق النار، الأدوات الحادة)، باستثناء حالات الطوارئ (العمليات العسكرية والتمرد المدني) حيث لا توجد علاقة ذات دلالة إحصائية.. وأنه لا توجد علاقة ذات دلالة إحصائية بين متغير الموسم وجميع حالات الطوارئ .

معلومات البحث

تواريخ البحث:

تاريخ تقديم البحث: 08/ 04 / 2025
تاريخ قبول البحث: 20/ 05 /2025
عدد صفحات البحث 98 - 107

الكلمات المفتاحية:
حالات الطوارئ، الاختبارات غير المعلمية، اختبار مان-ويتني، اختبار كروسكال-واليس.

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