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Research Paper

Determining the Most Important Factor Affecting Taxi-related Crashes of Urban Roads Using the Friedman Test and Factor Analysis

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Abstract
Modeling the crash severity based on the influential variables makes it feasible to predict the occurrence of crashes that requires safety solutions. In addition, the influence of each factor in the crashes can be examined. This study aimed to identify the factors affecting the severity of the injury/fatal and property damage only (PDO) crashes of taxi vehicles in Rasht city, Iran, by collecting crash data from March 2015 to March 2021. In this regard, the Friedman test was used to determine the priority of factors, and the factor analysis was applied to specify the most effective factors on the severity of taxi-related crashes in Rasht city. According to the Friedman test, weather conditions were the most significant factor affecting the crashes. Based on the factor analysis, five factors were specified as the principal factors contributing to crashes that the environmental factor was the first factor involved in crashes, which includes weather conditions, road surface conditions, and daylight conditions. So weather conditions as the environmental factor was determined the main influential factor on the taxi-related crashes of urban roads.

Keywords: Safety; Taxi crashes; Friedman test; Factor analysis

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1. Introduction

Traffic and its related phenomena have been rising worldwide and significantly affect the lives and properties of the people of communities [Hosseinian and Gilani, 2020; Bargegol et al., 2022]. According to most economists in the world, the need for transportation facilities for economic, social, and even cultural development is strongly emphasized [Mirzahossein et al., 2022; Hosseinian et al., 2021b]. Transportation, along with its advantages, has its limitations and disadvantages for road users [Nejad et al., 2019]. Increasing transportation in Iran has dramatically intensified damages caused by crashes. The road traffic fatalities (RTF) reported in 2016 in Iran were 15,932, of which 78% were male. The estimated rate of the World Health Organization for RTF was 20.5 per 100,000 population, and previous studies indicated that the RTF rate has declined 47.5% in the past ten years [Najafi Moghaddam Gilani et al., 2021]. So the effect of factors affecting the crash severity should be investigated to provide practical solutions in order to improve safety and reduce the high number of crashes [Gilani et al., 2021c].

Various studies have been conducted on traffic safety in recent years. Sherafati et al. (2017) explored road traffic fatalities after receiving emergency services in Langerood. Results showed that males, motorbikes, and pedestrians had a positive and significant relationship with fatal crashes [Sherafati et al., 2017]. Intini et al. (2018) conducted a study to investigate the relationships between road familiarity/unfamiliarity and the occurrence of crashes. Factor analysis was illustrated as a very vital step in many applications. The factors of minor intersections/driveways, autumn/winter, and speed limit less than 80 km/h had higher odds of crashes for familiar drivers; however, the factors of head-on and rear-end crashes, summer, heavy vehicles, and young drivers had greater odds of having unfamiliar drivers involved in crashes [Intini et al., 2018]. Also, Casado-Sanz et al. (2019) investigated the impact of age on the crash severity. They concluded that female drivers and motorbikes had a negative effect on the likelihood of crashes [Casado-Sanz, Guirao and Gálvez-Pérez, 2019]. Hosseinian et al. (2021) examined the influential factors on the occurrence of crashes using the Friedman test and factor analysis. They revealed that clothing color and weather conditions were the most effective factors influencing the crash severity [Hosseinian et al., 2021a]. Ghasedi, Sarfjoo and Bargegol (2021) used the factor analysis to recognize the most effective variables on the severity of crashes and indicated the outstanding role of environmental factors, such as rainy weathers and inadequate light conditions, on the occurrence of crashes [Ghasedi, Sarfjoo and Bargegol, 2021]. Generally, the Friedman test, factor analysis and other statistical tests have been used in different engineering studies, especially in transportation problems. Also, various machine learning methods have been applied in different engineering problems by the emergence of various datasets [Gilani et al., 2017; Gilani et al., 2020a; Gilani et al., 2020b; Golrokh, Azeem and Hasan, 2020; Gilani et al., 2021a; Gilani, Mahani et al., 2021; Ziari et al., 2021].

Some studies have been performed in the field of taxi-related crashes. Wang et al. (2015) identified the risk factors associated with taxi crashes using comparative analysis to determine the significant factors contributing to crashes. Results indicated that middle-aged male drivers with limited education and less driving, as well as job experience, were much more likely to be involved in the crashes. Additionally, a large majority of taxi crashes occurred with the most frequent type of rear-end collisions on six-lane segments without median and four-legged intersections under adverse weather conditions at weekends and during winter days [Wang et al., 2015]. Meng et al. (2017) identified factors affecting taxi crash injuries and quantified the associations between these factors and taxi occupant injury severity using a logistic modeling approach. Results revealed that time of week, number of vehicles involved, weather, point of impact and driver age were closely associated with taxi drivers' injury severity level in a crash. Moreover, older drivers, urban taxis and fatigued driving were identified as factors that increased taxi occupant injury severity [Meng et al., 2017].

Wang, Li, and Prato (2019) examined the relationship between crash propensity, working conditions, and aberrant driving behavior among taxi drivers using property-damage-only (PDO) and personal injury (PI) crash data, sociodemographic characteristics, working conditions, and frequency of daily aberrant driving behavior. They showed that increasing levels of fatigue, reckless behavior, and aggressive behavior are positively related to a higher propensity of crash involvement [Wang, Li and Prato, 2019]. Li et al. (2019) examined a series of factors related to crash risk to find out the most important factors related to the high/low fatigue-related crash risk (FRAR) of taxi drivers. Results showed that high-risk taxi drivers had significantly longer driving hours per working day, lower rest ratios, less driving experience, and were more confident about their fatigue resistance. Also, taxi drivers' drive-rest habits, experience, and intention for fatigue driving are crucial and determine their FRAR, and the analysis can satisfactorily identify high-risk taxi drivers [Li et al., 2019]. Lee et al. (2020) developed a risk level of crash severity classifiers to predict high-risk taxi drivers using information related to drivers' working environments, living environments, and health characteristics. In addition, high-risk drivers were classified based on the crash severity they experienced. A random forest analysis was used to identify the priorities of factors affecting the risk level of crash severity that taxi drivers experienced. Results revealed that a driver's age, living satisfaction, level of job satisfaction, amount of sleeping time, and working hours per week were the top five variables that have the greatest influence on the risk level of crash severity [Lee et al., 2020].

Today, road crashes have become a major challenge in the world in the field of transportation. Therefore, identifying the factors affecting the occurrence of crashes and determining the impact of each factor on the severity of crashes should be one of the main priorities of the relevant institutions. The main purpose of this study was to investigate the effect of various factors affecting the severity of injury/fatal and PDO crashes of taxi vehicles in Rasht city by collecting crash data from March 2015 to March 2021 by the use of the Friedman test and factor analysis, so that the Friedman test was applied to prioritize the factors, and the factor analysis was used to determine the most effective factor in the occurrence of taxi vehicles. Finally, the most effective factor on the occurrence of crashes was presented.

2. Methodology

2.1. Data Collection

Data used in this study were 272 injury/fatal and PDO taxi crashes on urban roads of Rasht city, Iran, collected from traffic police from March 2015 to March 2021. The target variable was the crash severity that was first categorized into three classes: fatal, injury, and PDO crashes. Because the occurrence of fatal crashes was low and the significance of independent variables in the analysis was not satisfied by regarding three types of the target variable, fatalities were merged with injuries, and the target variable was classified into PDO and injury/fatal crashes. Table 1 indicates the independent variables influencing the occurrence of crashes.

Table 1. The variables applied in this research

Variables	Codes
Crash severity	1- Injury/fatal 2- PDO
Crash season	1- Spring 2- Summer 3- Autumn 4- Winter
Crash time	1- 07:00 to 13:00 2- 13:00 to 17:00 3- 17:00 to 21:00 4- 21:00 to 01:00 5- 01:00 to 07:00
Crash day	1- Weekdays 2- Weekends and holidays
Road classification	1- Arterial road 2- Access road
Road surface condition	1- Dry 2- Wet 3- Frost
Geometry of crash location	1- Alignment 2- Curve 3- Roundabout 4- U-turn/J-turn 5- Intersection- 4 Legs 6- Intersection- 3 Legs
Daylight condition	1- Day 2- Sunset and sunrise 3- Night with sufficient light 4- Night without sufficient light
Vehicle type	1- Peykan taxi 2- Kia Pride taxi 3- Samand taxi 4- Peugeot taxi 5- Van taxi 6- Other
Driver age	1- Less than 18 2- 18 to 30 3- 30 to 45 4- 45 to 60 5- 60 and over
Driver gender	1- Male 2- Female
Collision type	1- Rear-end collisions 2- Head-on collisions 3- Side collisions
Weather condition	1- Clear 2- Cloudy

Variables	Codes
	3- Rainy
Crash reason	1- Lack of attentions 2- Back movements 3- Inability to control the taxi 4- Exceeding speed limit 5- Crossing a forbidden place 6- Failure to observe longitudinal space 7- Failure to observe lateral space 8- Unsafe lane changes 9- Hasty-caused crash 10- Failure to comply with the right of way 11- Improper turns 12- Wrong way movements
Job	1- Driver 2- Retiree 3- Second job

2.2. Kolmogorov-Smirnov Test

The Kolmogorov-Smirnov test is used to examine the data normality and is a non-parametric test about the distribution of data [Rao, Han and Senarathne, 2016; Najafi Moghaddam Gilani et al., 2022]. By comparison of the significance test with α, the decision about the data distribution normality can be performed. Regarding α = 0/05, if p-value > 0/05, the null hypothesis will be rejected, meaning that dataset distribution won't be normal [Bargegol, Gilani and Farghedayn, 2014; Ruxton, Wilkinson and Neuhäuser, 2015].

2.3. Friedman Test

The Friedman test is applied to make a comparison between classifiers and various datasets. This test is a widely-used non-parametric method to analyze related samples in various fields. The Friedman exploration procedure is to analyze variances by ranking the factors and is applied where there is no interest to make a robust distributional assumption [Xu et al., 2017; López-Vázquez and Hochsztain, 2019].

2.4. Factor Analysis

Factor analysis is one of the statistical techniques to model the correlation in a data set in order to decrease the dimensions of parameters and specify the most significant factors. Factor analysis is commonly split into two classes: confirmatory and exploratory factor analysis. Exploratory factor analysis is used to specify the hidden structures while the relationships in factors are unclear. However, confirmatory factor analysis is applied to determine factors in the dimension [Bandalos and Finney, 2018; Shrestha, 2021]. Exploratory factor analysis was applied in the study.

3. Results

3.1. Kolmogorov-Smirnov Test

The Kolmogorov-Smirnov test was used to examine the distribution normality. Table 2 shows the results of the test for variables.

Table 2. The Kolmogorov-Smirnov test results

Variables	Most extreme difference			Test statistics	P-value
	Absolute	Positive	Negative		
Crash season	0.421	0.421	-0.271	0.421	0.0
Crash time	0.528	0.528	-0.389	0.528	0.0
Crash day	0.539	0.397	-0.539	0.539	0.0

Variables	Most extreme difference			Test statistics	P-value
	Absolute	Positive	Negative		
Road classification	0.201	0.174	-0.201	0.201	0.0
Road surface condition	0.323	0.235	-0.323	0.323	0.0
Geometry of crash location	0.388	0.388	-0.267	0.388	0.0
Daylight condition	0.516	0.516	-0.342	0.516	0.0
Vehicle type	0.511	0.511	-0.336	0.511	0.0
Driver age	0.187	0.187	-0.166	0.187	0.0
Driver gender	0.233	0.217	-0.233	0.233	0.0
Collision type	0.268	0.172	-0.268	0.268	0.0
Weather condition	0.177	0.143	-0.177	0.177	0.0
Crash reason	0.184	0.184	-0.172	0.184	0.0
Job	0.472	0.472	-0.410	0.472	0.0

Table 2 shows that the significance level in the Kolmogorov-Smirnov test was lower than 5%, so the null hypothesis that represents the variable normal distribution was declined. Therefore, the distributions were not normal.

3.2. Friedman Test

In this study, there are 14 independent variables, the ranks of which were explored by the Friedman test. The results of the Friedman test are presented in Table 3.

Table 3. The Friedman test results

Dataset volume	Chi-square	Df	P-value
272	3018.345	13	0.0

Table 3 indicates that the significance level is lower than 0.05, so H_0 was declined, and one cannot claim the equality of ranks. As can be seen through Table 4, the rank of predictor factors was represented, which demonstrates the mean rate of variables. The lower the mean rating, the higher the significance of variables.

Table 4. The mean rate in the Friedman test

Variable	Mean rate	Rank
Weather condition	3.27	1
Crash reason	4.61	2
Road surface condition	5.94	3
Daylight condition	6.02	4
Geometry of crash location	8.10	5
Collision type	8.37	6
Vehicle type	9.04	7
Crash time	10.97	8
Job	11.03	9
Crash day	11.79	10
Crash season	12.04	11
Driver age	13.45	12
Road classification	14.98	13
Driver gender	15.67	14

According to Table 4, the variable whose mean rank was lower was more important; therefore, the variables of weather condition, crash reason, and road surface condition had the greatest ranking with the mean rate of 3.27, 4.61, and 5.94, respectively. However, driver age, road classification, and driver gender were the low importance variables in crash severity. So the results indicated that weather condition as an environmental factor had the highest effect on the occurrence of crashes, and crash reason as a human factor was then the second most important factor on the severity of crashes.

3.3. Factor Analysis

Table 5 shows the results of factor analysis, including the KMO index and Bartlett test. The higher the KMO amount to 1, the preferable the data for this analysis [Hosseinian et al., 2021a].

Table 5. The KMO index & Bartlett test

KMO index		0.839
Bartlett test	Approx. chi-square	1054.162
	Df	82
	Sig.	0.0

As illustrated in Table 5, the KMO amount was 0.839, showing that it was suitable to use factor

analysis. The results of the Bartlett test indicated that approx. X^2 was much greater than 5. Moreover, the significance level was lower than 5%, which indicates that all factors were influential in examining the crash occurrence.
In the following, initial eigenvalues, eigenvalues of non-rotating and post-rotating extraction components, and their related variances are presented in Table 6. The greater the eigenvalues, the more variance can be indicated in those components [Hosseinian et al., 2021a].

Table 6. The variance of components in the analysis

Components	Initial eigenvalue			Non-rotating eigenvalue			Post-rotating eigenvalue		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.393	14.934	14.934	2.393	14.934	14.934	2.126	13.504	13.504
2	1.751	13.486	28.420	1.751	13.486	28.420	1.994	14.462	27.966
3	1.452	10.765	39.185	1.452	10.765	39.185	1.261	10.511	38.477
4	1.274	10.582	49.767	1.274	10.582	49.767	1.157	10.426	48.903
5	1.083	9.477	59.244	1.083	9.477	59.244	1.124	10.075	58.978
6	0.941	8.605	67.849						
7	0.894	8.124	75.973						
8	0.812	7.265	83.238						
9	0.732	6.573	89.811						
10	0.422	3.680	93.491						
12	0.386	2.317	95.808						
13	0.279	2.508	98.316						
14	0.184	1.684	100.000						

In Table 6, components 1 to 5 had an eigenvalue higher than 1. Therefore, these components remained in this analysis. The remaining component matrix is indicated in Table 7. The amounts in the matrix table indicate the correlation of variables with the related component.

Table 7. The components matrix

Variables	Component				
	1	2	3	4	5
Crash season	0.067	0.150	0.185	0.672	-0.007
Crash time	-0.042	0.027	-0.728	-0.047	-0.012
Crash day	0.016	0.143	-0.042	0.738	-0.025
Road classification	-0.013	-0.048	0.132	-0.512	-0.624
Road surface condition	0.917	0.124	0.033	-0.073	0.175
Geometry of crash location	0.036	-0.046	0.741	0.002	-0.051
Daylight condition	0.734	-0.082	-0.017	0.044	-0.211
Vehicle type	0.031	-0.046	0.692	0.003	-0.051
Driver age	0.053	-0.002	-0.141	0.241	0.729
Driver gender	0.152	0.195	-0.013	-0.103	-0.647
Collision type	0.072	0.875	-0.001	0.035	-0.028
Weather condition	0.951	0.114	0.000	-0.007	0.113

Variables	Component				
	1	2	3	4	5
Crash reason	0.179	0.928	-0.076	-0.034	0.010
Job	0.024	0.161	0.383	0.618	0.103

The factor analysis identified five components as the main components. The analysis indicated that weather condition, road surface condition, and daylight condition were the first component affecting the severity of crashes, and the significant coefficient between the first component and each variable was 0.951, 0.917, and 0.734, respectively. So weather condition, road surface condition, and daylight condition were the first factor influential on the taxi-related crash occurrence that had a positive effect on the severity of crashes. Moreover, crash reason and collision type were the second most effective component (0.928 and 0.875, respectively). Similarly, geometry of crash location, crash time, and vehicle type were the third component (0.741, -0.728, and 0.692, respectively), crash day, crash season, and job (0.738, 0.672, and 0.618, respectively) were the fourth component, and finally, driver age, driver gender, and road classification (0.729, -0.647 and, -0.624, respectively) were regarded the fifth most influential factor in the crashes.

The results of this research considering the Friedman test and factor analysis showed that weather condition as the environmental factor was the main influential factor on the taxi-related crashes, which is in consistent with the results of previous studies [Wang et al., 2015; Meng et al., 2017]. Moreover, it was illustrated that driver age, driver gender, and road classification had the least effect on the occurrence of crashes, which was in contrast with some previous studies [Meng et al., 2017; Lee et al., 2020].

4. Conclusion

The main purpose of this study was to examine the effect of various factors affecting the severity of injury/fatal and PDO crashes of taxi vehicles in Rasht city by collecting crash data from March 2015 to March 2021 using the Friedman test and factor analysis. Finally, the most effective factor on the occurrence of crashes was presented.

In the Friedman test, the most important factors were identified weather condition, crash reason, and road surface condition, showing that the most effective factor on the crash occurrence was weather condition as an environmental factor, and the second most significant factor was crash reason as a human factor influencing the crash occurrence.

Based on factor analysis, five factors were specified as the principal factors that affect the crash severity. This analysis indicated that weather condition, road surface condition, and daylight condition were the first factor in the occurrence of crashes. The variables of crash reason and collision type were the second factor. Geometry of crash location, crash time, and vehicle type were determined the third influential factor in the crashes of Rasht city.

For future research works, other machine learning techniques [Bargegol et al., 2016; Ziari et al., 2017; Liu and Fan, 2021; Heidarian et al., 2022] and deep learning methods [Ahmed and Hanif, 2020; Addeh and Iri, 2021] can be provided to be incorporated into the proposed approaches to obtain more accurate results.

5. References

-Addeh, A. and Iri, M. (2021) “Brain tumor type classification using deep features of MRI images and optimized RBFNN”, ENG Transactions, Vol. 2, pp. 1-7.

-Ahmed, S.S. and Hanif, U. (2020) “News Recommendation Algorithm Based on Deep Learning”, Computational Research Progress in Applied Science & Engineering (CRPASE), Vol. 6, pp. 132-140.

-Bandalos, D. L. and Finney, S. J. (2018) "Factor analysis: Exploratory and confirmatory, The reviewer's guide to quantitative methods in the social sciences", Routledge, pp. 98-122.

-Bargegol, I., Gilani, V. N. M. and Farghedayn, S. (2014) "Analysis of the effect of vehicles conflict on pedestrian's crossing speed in signalized and un-signalized intersection", Advances in Environmental Biology, Vol. 8, No. 21, pp. 502-510.

-Bargegol, I., Gilani, V. N. M., Ghasedi, M. and Ghorbanzadeh, M. (2016) "Delay modeling of un-signalized roundabouts using neural network and regression", Computational Research Progress in Applied Science & Engineering (CRPASE), Vol. 2, No. 1, pp. 28-34.

-Bargegol, I., Hosseinian, S. M., Gilani, V. N. M., Nikookar, M. and Orouei, A. (2022) "Presentation of regression analysis, GP and GMDH models to predict the pedestrian density in various urban facilities", Frontiers of Structural and Civil Engineering.

-Casado-Sanz, N., Guirao, B. and Gálvez-Pérez, D. (2019) "Population ageing and rural road accidents: Analysis of accident severity in traffic crashes with older pedestrians on Spanish crosstown roads", Research in Transportation Business & Management, Vol. 30, pp. 100377.

-Ghasedi, M., Sarfjoo, M. and Bargegol, I. (2021) "Prediction and Analysis of the Severity and Number of Suburban Accidents Using Logit Model, Factor Analysis and Machine Learning: A case study in a developing country", SN Applied Sciences, Vol. 3, No. 1, pp. 1-16.

-Gilani, V. N. M., Ghasedi, M., Ghorbanzadeh, M. and Samet, M. J. (2017) "Estimation delay variation and probability of occurrence of different level of services based on random variations of vehicles entering signalized intersections", IOP Conference Series: Materials Science and Engineering, Vol. 245, No. 4, pp. 042023.

-Gilani, V. N. M., Hosseinian, S. M., Behbahani, H. and Hamedi, G. H. (2020a) "Prediction and pareto-based multi-objective optimization of moisture and fatigue damages of asphalt mixtures modified with nano hydrated lime", Construction and Building Materials, Vol. 261, pp. 120509.

-Gilani, V. N. M., Hosseinian, S. M., Hamedi, G. H. and Safari, D. (2021a) "Presentation of predictive models for two-objective optimization of moisture and fatigue damages caused by deicers in asphalt mixtures", Journal of Testing and Evaluation, Vol. 49, No. 6.

-Gilani, V. N. M., Hosseinian, S. M. and Nikookar, M. (2021b) "Presentation of a new deicer with the least moisture and fatigue failures in asphalt mixtures", Arabian Journal for Science and Engineering, pp. 1-15.

-Gilani, V. N. M., Hosseinian, S. M., Safari, D. and Movahhed, M. B. (2020b) "Investigation of the Impact of Deicer Materials on Thermodynamic Parameters and Its Relationship with Moisture Susceptibility in Modified Asphalt Mixtures by Carbon Nanotube", Arabian Journal for Science and Engineering, Vol. 46, No. 5, pp. 4489-4502.

-Gilani, V. N. M., Sashurpour, M., Hassanjani, S. and Hosseinian, S. M. (2021c) "Analysis of the effect of the speed factor on highway safety using the machine learning method", Slovak Journal of Civil Engineering, Vol. 29, No. 4, pp. 19-28.

-Golrokh, F. J. and Hasan, A. (2020) "A comparison of machine learning clustering algorithms based on the DEA optimization approach for pharmaceutical companies in developing countries", ENG Transactions, Vol. 1, pp. 1-8.

-Heidarian, M., Abdi Kordani, A., Sarkar, A. and Hosseinian, S. M. (2022) "Location of Emergency Escape Ramps on Two-Lane Rural Highways Based on the Fuzzy Multicriteria Decision-Making Method", Journal of Engineering, Vol. 2022.

-Hosseinian, S. M. and Gilani, V. N. M. (2020) "Analysis of factors affecting urban road accidents in rasht metropolis", ENG Transactions, Vol. 1, pp. 1-4.

-Hosseinian, S. M., Najafi Moghaddam Gilani, V., Mehraban Joobani, P. and Arabani, M. (2020) "Investigation of Moisture Sensitivity and Conductivity Properties of Inductive Asphalt Mixtures Containing Steel Wool Fiber", Advances in Civil Engineering, Vol. 2020.

-Hosseinian, S. M., Najafi Moghaddam Gilani, V., Mirbaha, B. and Abdi Kordani, A. (2021a) "Statistical Analysis for Study of the Effect of Dark Clothing Color of Female Pedestrians on the Severity of Accident Using Machine Learning Methods", Mathematical Problems in Engineering, Vol. 2021.

-Hosseinian, S. M., Najafi Moghaddam Gilani, V., Tahmasbi Amoli, H., Nikookar, M. and Orouei, A. (2021b) "Presentation of analytical methods for better decision making about the most important factor influencing rural accidents", Mathematical Problems in Engineering, Vol. 2021.

-Intini, P., Berloco, N., Colonna, P., Ranieri, V. and Ryeng, E. (2018) "Exploring the relationships between drivers' familiarity and two-lane rural road accidents. A multi-level study", Accident Analysis & Prevention, Vol. 111, pp. 280-296.

-Lee, S., Kim, J. H., Park, J., Oh, C. and Lee, G. (2020) "Deep-learning-based prediction of high-risk taxi drivers using wellness data", International journal of environmental research and public health, Vol. 17, No. 24, pp. 9505.

-Li, M. K., Yu, J. J., Ma, L. and Zhang, W. (2019) "Modeling and mitigating fatigue-related accident risk of taxi drivers", Accident Analysis & Prevention, Vol. 123, pp. 79-87.

-Liu, S. and Fan, W. (2021) "Investigating factors affecting injury severity in bicycle–vehicle crashes: A day-of-week analysis with partial proportional odds logit models", Canadian Journal of Civil Engineering, Vol. 48, No. 8, pp. 941-947.

-López-Vázquez, C. and Hochsztain, E. (2019) "Extended and updated tables for the Friedman rank test", Communications in Statistics-Theory and Methods, Vol. 48, pp. 268-281.

-Mahani, A. G., Bazoobandi, P., Hosseinian, S. M. and Ziari, H. (2021) "Experimental investigation and multi-objective optimization of fracture properties of asphalt mixtures containing nano-calcium carbonate", Construction and Building Materials, Vol. 285, pp. 122876.

-Meng, F., Xu, P., Wong, S. C., Huang, H. and Li, Y. C. (2017) "Occupant-level injury severity analyses for taxis in Hong Kong: A Bayesian space-time logistic model", Accident Analysis & Prevention, Vol. 108, pp. 297-307.

-Mirzahossein, H., Sashurpour, M., Hosseinian, S. M. and Najafi Moghaddam Gilani, V. (2022) "Presentation of Machine Learning Methods to Determine the Most Important Factors Affecting Road Traffic Accidents on Rural Roads", Frontiers of Structural and Civil Engineering.

-Najafi Moghaddam Gilani, V., Hosseinian, S. M., Ghasedi, M. and Nikookar, M. (2021) “Data-driven urban traffic accident analysis and prediction using logit and machine learning-based pattern recognition models”, Mathematical problems in engineering, Vol. 2021.

-Najafi Moghaddam Gilani, V., Ghanbari Tamrin, M. R., Hosseinian, S. M., Nikookar, M., Safari, D. and YektaParast, S. (2022) “Investigation of Bus Special Lane Performance Using Statistical Analysis and Optimization of the Signalized Intersection Delay by Machine Learning Methods”, Journal of Optimization, Vol. 2022.

-Nejad, M. A. R. S., Agha, F. N. J., Chenari, H. M. and Badkoobeh, F. (2019) “Analysis of Parking Situation in Rasht Using Multi-criteria Evaluation Method”, Computational Research Progress in Applied Science & Engineering (CRPASE), Vol. 5, No. 3, pp. 79-84.

-Rao, A., Han, W. and Senarathne, P. (2016) “A Comparison of SLAM Prediction Densities Using the Kolmogorov Smirnov Statistic”, Unmanned Systems, Vol. 4, pp. 245-254.

-Ruxton, G. D., Wilkinson, D. M. and Neuhäuser, M. (2015) “Advice on testing the null hypothesis that a sample is drawn from a normal distribution”, Animal Behaviour, Vol. 107, pp. 249-252.

-Sherafati, F., Rad, E. H., Afkar, A., Gholampoor-Sigaroodi, R. and Sirusbakht, S. (2017) “Risk factors of road traffic accidents associated mortality in northern iran; a single center experience utilizing oaxaca blinder decomposition”, Bulletin of Emergency & Trauma, Vol. 5, pp. 116.

-Shrestha, N. (2021) “Factor analysis as a tool for survey analysis”, American Journal of Applied Mathematics and Statistics, Vol. 9, pp. 4-11.

-Wang, Y., Li, M., Du, J. and Mao, C. (2015) “Prevention of taxi accidents in Xi'an, China: what matters most?”, Central European journal of public health, Vol. 23, No. 1, pp. 77-83.

-Wang, Y., Li, L. and Prato, C. G. (2019) “The relation between working conditions, aberrant driving behaviour and crash propensity among taxi drivers in China”, Accident Analysis & Prevention, Vol. 126, pp. 17-24.

-Xu, J., Shan, G., Amei, A., Zhao, J., Young, D. and Clark, S. (2017) “A modified Friedman test for randomized complete block designs”, Communications in Statistics-Simulation and Computation, Vol. 46, pp. 1508-1519.

-Ziari, H., Amini, A., Saadatjoo, A., Hosseini, S. M. and Gilani, V. N. M. (2017) “A prioritization model for the immunization of accident prone using multi-criteria decision methods and fuzzy hierarchy algorithm”, Computational Research Progress in Applied Science & Engineering (CRPASE), Vol. 3, No. 3, pp. 123-131.

-Ziari, H., Divandari, H., Seyed Ali Akbar, S. M. and Hosseinian, S. M. (2021) “Investigation of the effect of crumb rubber powder and warm additives on moisture resistance of SMA mixtures”, Advances in Civil Engineering, Vol. 2021.