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Investigating the Effect of Drivers' Training Courses on Commercial Drivers' Success Rate for Qualification

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Abstract: In training and examining professional drivers who serve as commercial drivers for trucks and coaches, studying the effects of training courses on their success rate for professional qualifications is a crucial concern for transport authorities in developing training programs. To this purpose, the statistical methods of Kolmogorov-Smirnov and paired two-sample mean analysis have been utilized to investigate the statistical similarity of success rates for two groups of drivers who receive permission by taking training courses and those who receive it without taking training courses. Data for commercial drivers across twenty-one provinces of the West-Asian country of Iran has been collected for a year and categorized into two groups and twenty-one observations. The results revealed that their distribution functions and the mean success rates are not different for the two groups of drivers. Since the results of success rates are the same, 1) training courses do not have enough efficiency to affect success rates, or 2) exams could not adequately evaluate the skill and knowledge of drivers. Therefore, transport authorities are recommended to redesign training courses and exams for drivers interested in serving as commercial drivers.

Keywords: Commercial Drivers, Training Succes Rate, Drivers' Training, Professional Qualification, Statistical Similarity

1. Introduction

Compliance with laws is one of the most prominent manifestations of civic rights in the social sphere nowadays (Nwagwu et al., 2020). While this commitment is discussed in various fields, some of which are neglected in transportation, leading to traffic violations (Ako, 2019). One of the major contributors to traffic issues and accidents across all communities is driving offenses believed to be preventable if drivers are put under comprehensive and efficient training courses (Gichaga, 2017). The prevalence of such offenses differs based on the cultural, social, economic, and geographic characteristics of each society (Kelacha, 2021), and the various environmental, regulatory, and enforcement factors contribute to driving offenses and human factors are also considered to be the leading cause (Lee and Al-Mansour, 2020). According to studies conducted in developed countries, the identification of human factors and the use of education to address and improve driving behaviors have been found to play a significant role in preventing and managing traffic accidents (Nancy, 2021). So, the Global Plan for the Decade of Action for Road Safety emphasizes the driver as a crucial element in its approach to reducing driving-related accidents and injuries worldwide (Timmermans et al., 2020). Education is additionally acknowledged as a sustainable competitive advantage for enhancing the awareness and skills of the workforce in modern times (Farooq and Juhasz, 2020), so in terms of road safety, providing driver education is regarded as the topmost priority for investment in human capital (Timmermans et al., 2019). One of the critical concerns of transportation authorities dealing with designing training programs for commercial drivers is to study their inclination toward training courses. This is because the effectiveness of training programs depends on the individual's willingness to engage in the activities and follow the guidelines provided (Nwakaire and Kobani, 2022). Therefore, managing the training process and developing driver education programs require careful consideration of individuals' motivations and drivers' desires to participate. By evaluating educational programs, decision-makers are empowered to devise tailored educational systems for each region, enhancing the knowledge and skills of the human resources involved in traffic and transportation. While maintaining productivity, an approach can be adapted to create desirable behavioral changes for both individual and societal needs, facilitating the achievement of organizational goals. On the other hand, it is essential to design training courses according to the real needs of participants to ensure their usefulness and that they lead to behavioral changes during and after these courses (Mahmoudabadi and Moghadam, 2020). In countries such as Iran, where commercial drivers do not legally take training courses prior to receiving qualifications, it is crucial to take care

of developing drivers' training courses, so the main aim of the present research work is to ensure that taking training courses have the significant effect on enhancing drivers' skills and their professional knowledge.

1.1. Distribution Similarity and Concept

Checking the similarity of distribution functions is one of the statistical methods to examine the relevancy between two variables. In this case, two data sets are commonly compared based on the similarity of their distribution functions through statistical tests (Pastore and Calcagnì, 2019). There are many measures to check the similarity of two distribution functions (Lee, 1999), but they depend on the method used. The Kolmogorov-Smirnov test, also known as the KS test and primarily utilized in nonparametric hypothesis testing (Sahinturk and Özcan, 2017), is one of the statistical tests that compare the behavior of two related samples. It is a goodness of fit and nonparametric test of the equality of continuous or discrete one-dimensional probability distributions to compare the statistical probabilities of two samples (Vrbik, 2018), so it is conventionally utilized to compare an accurate distribution sample with a reference probability distribution (Arnold and Emerson, 2011). When comparing two samples, each record or sample in one population is compared individually to the same observation in another. The overall concept behind the KS test is to investigate the maximum distance between the cumulative distribution functions of two samples, which represents the unlikeness of two distribution shapes (Lopes et al., 2007). Therefore, it is utilized to assess the similarity between the expected and the experimental or observational distribution functions for checking the fitness of the experimental data to the expected distribution function (Simard and L'Ecuyer, 2011). Although this ability commonly supports data analyzers for testing normality, where the existing normality is necessary to perform analyzing procedures (Drezner et al., 2010), it can also be utilized in other distribution functions and existing similarities for two data sets (Mahmoudabadi and Abdous, 2020). It can likely be developed that the difference between two distribution functions is formulated to check if they are the same.

1.2. Research Statement

Following those mentioned above, the study has been conducted to investigate the similarities and dissimilarities between the distribution functions of drivers who receive commercial driving permissions (qualifications) in two groups, including those taking examination and training courses and examinations without training courses. The results would support transport authorities in investigating the effects of training courses and exams on drivers' skills and making decisions on training commercial drivers based on their willingness to take training courses. In other words, in a country where drivers can optionally select the way of receiving permission with or without examination and taking training courses, the study investigates whether the driving training programs would be successful.

2. Literature Review

Due to the importance of training programs for promoting road safety in traffic and enhancing transport productivity, many studies have been conducted in this area. In a study conducted by Nwadinigwe et al. (2018), the effectiveness of road safety education was evaluated on the knowledge and behavior of commercial drivers. The results of the study suggested that the educational program significantly impacted the behavior of commercial drivers. Furthermore, the study also highlighted the joint influence of factors such as the educational background of commercial drivers, the duration of their road safety learning, their behavior and knowledge, and eventually, their perception of the road safety education program on road safety (Nwadinigwe et al., 2018). The efficacy of training courses on transportation drivers was also investigated by Koushki et al. (2022). According to their research findings, attending these courses improves driver skills, increases learning levels, and reduces accidents (Koushki et al., 2020). In Mexico, a study was conducted by Bergoffen et al. (2022) to examine driver training for commercial vehicle operators. Their research showed that individuals who receive technical knowledge and skills training should undergo periodic validation and monitoring. Their study also revealed the necessity for a standardized national curriculum for each LFC class in the country, with certification granted to LFC drivers upon meeting national standards (Bergoffen et al., 2022).

Studied frequently, training with a progressive approach is another contributing factor. A study examined the effectiveness of a traffic safety education program for the Oman Traffic Safety Administration through program design and implementation. The study's findings demonstrated that implementing multiple educational systems for residents was highly desirable, but the program also required continuous planning, monitoring, and improvement (Hamdania et al., 2019). The results of another study conducted by researchers (Yahaya and Abubakar, 2022) demonstrate a significant difference in risky behavior in road accidents between commercial vehicle drivers who have participated in training programs and those who have not. The study's executive summary suggests that the government and other relevant organizations, such as the National Road Safety Corps and vehicle inspection officers, collaborate to organize a program that educates commercial vehicle drivers about behaviors that make them more prone to road accidents. Eventually, qualified drivers should be hired from among those who have received training (Yahaya and Abubakar, 2022). Nwadinigwe et al. evaluated commercial drivers' understanding of traffic safety training. The results of their study indicate that the road traffic safety training program significantly impacts drivers' compliance with road traffic laws and regulations.

Additionally, it was observed that drivers' experience would affect their adherence to road traffic laws and regulations (Nwadinigwe et al., 2019). In their review study, Garcia and colleagues examined the effectiveness of training techniques

for vehicle operators. In this review, some of the topics of the theoretical lessons and others convenient were taught to the operators. In the end, they were asked to participate in a test to evaluate the impact of the techniques learned in the classes on the performance of individuals. The test results showed that the selected plan was very successful as a desired short-term effect and required the continuation of the course in the long run (Garcia et al., 2019). In terms of evaluating the efficacy of training courses on improving drivers' skills, Mahmoudabadi and Moghadam (2020) had a field study by performing the Kirk-Patrick model in which truck drivers, consignees, customers, and experts who work in Road Maintenance and Transport Organization (RMTO) have been interviewed through filling out a standard questionnaire modified to transport courses. They showed that the written examination-based training courses do not significantly affect drivers' reactions, learning, behaviors, and performance in freight transportation.

To summarize, what can be realized from the above studies is that taking and examining, and training drivers' courses significantly influence road safety and transportation. However, the question here is why they do not significantly affect drivers' behavior in Iran. In addition, developing appropriate training courses is crucial to managing drivers who take examination and training courses, mainly commercial truck drivers whose exposure to traffic is higher than other road users.

3. Research Methodology

As stated in the previous section, comparing acceptance rates between two groups of drivers who received permission following training courses and without training courses is now being investigated in twenty-one selected provinces in the West-Asian country of Iran. The selection was based on data available in both groups. In the present research work, the well-known statistical goodness of the appropriate method of the Kolmogorov-Smirnov test is utilized, followed by checking the results by performing a simple test of two samples' mean difference test. Each sample has twenty-one observations attributed to each selected province. The main stages of this research work include descriptions of how the data was collected and the hypotheses defined, followed by utilizing the Kolmogorov-Smirnov and verified by the paired sample mean test. Figure 1 depicts an overall image of what is followed as the research methodology in the present study.

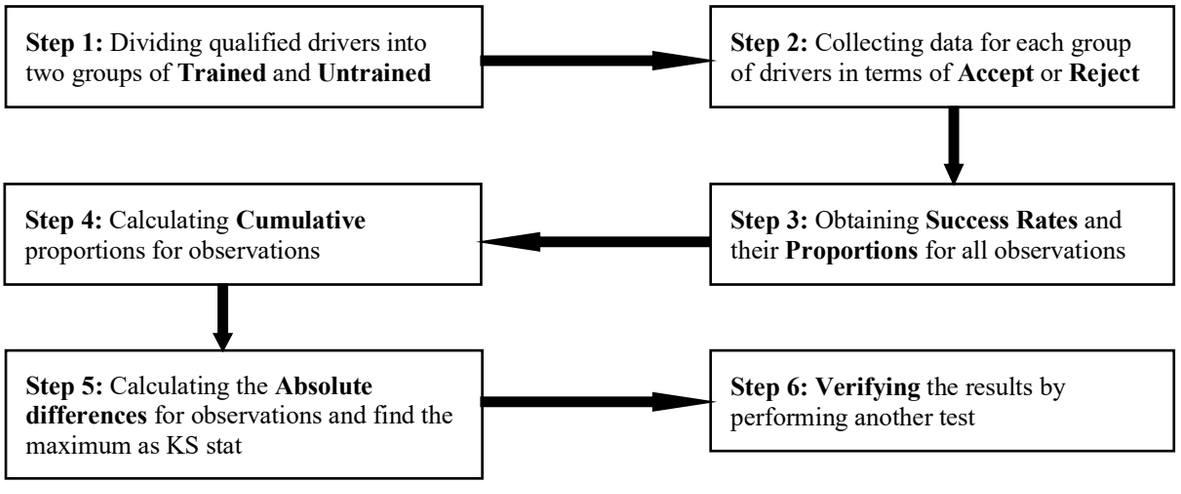

Figure 1: The overall steps of the research methodology

4. Data Collection and Analysis

The first step in implementing the research study is to collect appropriate data. Data from two groups of drivers, composed of those who receive commercial driving permission with training courses and without training, has been collected in each selected province in the country. Each selected province is a so-called observation where data has been received from the "Research, Training, and Innovation Center," the responsible branch directed by the Road Maintenance and Transportation Organization (www.rmto.ir). It composes all drivers' certificates issued in the 1401 Sonar calendar (March 21, 2022, to March 20, 2023). Table 1 tabulates the number of two groups of drivers mentioned above ordered alphabetically by the names of provinces. The number of trained and untrained drivers are tabulated, including accepted, rejected, and the success rate. As shown in Table 1, the success rate differs from province to province and drivers from group to group. In addition, the overall success rate for trained drivers is more significant than those examined as untrained drivers. However, it should be statistically checked to ensure that there is a significant effect on examination results.

Table 1: The number of commercial drivers accepted (Acc.) and rejected (Rej.) in the process of qualification

Row	Province	Trained Drivers				Untrained Drivers			
		Acc.	Rej.	Total	Rate	Acc.	Rej.	Total	Rate
1	Ardabil	342	268	610	56.07%	538	266	804	66.92%
2	Bushehr	26	70	96	27.08%	227	246	473	47.99%
3	Chehar-Mahal-o-B	923	576	1499	61.57%	36	53	89	40.45%
4	East-Azerbaijan	144	64	208	69.23%	3480	3249	6729	51.72%
5	Fars	1595	736	2331	68.43%	1784	1155	2939	60.70%
6	Golestan	101	155	256	39.45%	560	291	851	65.80%
7	Guilan	446	200	646	69.04%	299	171	470	63.62%
8	Hamedan	530	291	821	64.56%	1186	420	1606	73.85%
9	Isfahan	56	23	79	70.89%	1924	769	2693	71.44%
10	Kerman	312	99	411	75.91%	1203	589	1792	67.13%
11	Kermanshah	1724	608	2332	73.93%	5	6	11	45.45%
12	Kohgiluye	156	62	218	71.56%	152	17	169	89.94%
13	Kordestan	1224	597	1821	67.22%	169	296	465	36.34%
14	Markazi	120	43	163	73.62%	333	264	597	55.78%
15	Mazandaran	1076	301	1377	78.14%	69	38	107	64.49%
16	North-Khorasan	305	195	500	61.00%	364	263	627	58.05%
17	Qazvin	0	31	31	0.00%	938	370	1308	71.71%
18	Razavi-Khorasan	775	448	1223	63.37%	3	6	9	33.33%
19	Sistan-O-Baluchestan	884	690	1574	56.16%	4	126	130	3.08%
20	South-Khorasan	754	228	982	76.78%	259	112	371	69.81%
21	West-Azerbaijan	1073	537	1610	66.65%	1699	990	2689	63.18%
Total		12566	6222	18788	66.88%	15232	9697	24929	61.10%

4.1. Defining the Hypotheses

The first step of performing a statistical test is to define its hypothesis. Since the Kolmogorov-Smirnov and the Paired Two Sample for Means tests here are utilized to check the similarity between drivers who have taken the training courses or not, the null and competitive hypotheses are defined as follows:
For the Kolmogorov-Smirnov test:
H0: Trained and untrained drivers have the same success rates and come from the same distribution functions.
H1: Trained and untrained drivers have different success rates and come from different distribution functions.
For Paired Two-Sample for Means test:
H0: Trained and untrained drivers have the same means of acceptance rates.
H1: Trained and untrained drivers have different means of acceptance rates.

4.2. Mathematical Analysis and Discussion

The first step for utilizing the Kolmogorov-Smirnov test is calculating the proportion for each observation here, known as a province. The acceptance rate for the first observation of trained drivers in the province of Ardabil is calculated as $\frac{342}{610} = 0.561 = \%56.1$, followed by the same role for untrained drivers, resulting in %66.9. The above role has been performed, and the results are tabulated in the third and the sixth columns of Table 2.
The next step is to calculate the proportion of the rate based on the observations. Since the sum of all success rates for the trained group equals 12.907, the proportion for the first observation (province) is calculated as $\frac{0561}{12.907} = 0.0434$. The others have been obtained by following the same role and tabulated in columns four and seven in Table 2.
The third step is to calculate the cumulative proportion for all observations. For each observation (province), the cumulative proportion of success rates of both trained and untrained groups are calculated and represented in the fifth and eighth columns of Table 2. As shown, both end at 1 for both trained and untrained groups.
The fourth step is to calculate the absolute difference between the cumulative proportions. The first observation of the province of Ardabil is calculated as $|0.0434 - 0.0557| = 0.011229$, and the rest are calculated and tabulated as the same the above way and tabulated in the last column of Table 2.
The Kolmogorov-Smirnov stat is the maximum difference between the cumulative proportions of two groups of trained and untrained drivers for the seventeenth observation (Qazvin), equal to 0.06266. The obtained value should be compared to the critical values of the KS test. The test here is applicable in 21 observations, so the critical value of KS(0.95%, 21)=0.287 is greater than the obtained value of 0.06266. It shows that the success rates for two groups of trained and untrained drivers come from the same distribution functions. Training courses do not significantly affect success rates, so whether the courses have not been designed well or if exams should be performed effectively should be investigated.
The results may be better depicted by a graph like Figure 2, composed of two lines. The dashed line represents the cumulative proportions for trained drivers' acceptance rate, and the solid line represents the above measure for untrained

drivers. The most significant difference between the two lines is detected in the seventeenth observation, known as the KS stat. The results are the same as what was concluded in a previous study (Mahmoudabadi and Moghadam, 2020), where a field study evaluated the effects of training courses on drivers' skills and the other of intercity transport.

Table 2: Success rates, proportions, cumulative proportions, and differences for two groups of drivers

		Trained			Untrained			
Row	**Province**	**Success Rate**	**Proportion**	**Cumulative Proportion**	**Success Rate**	**Proportion**	**Cumulative Proportion**	**Difference**
1	Ardabil	0.561	0.0434	0.0434	0.669	0.0557	0.0557	0.01229
2	Bushehr	0.271	0.0210	0.0644	0.480	0.0400	0.0957	0.03127
3	Chehar-Mahal	0.616	0.0477	0.1121	0.404	0.0337	0.1294	0.01725
4	East-Azerbaijan	0.692	0.0536	0.1658	0.517	0.0431	0.1724	0.00667
5	Fars	0.684	0.0530	0.2188	0.607	0.0506	0.2230	0.00421
6	Golestan	0.395	0.0306	0.2494	0.658	0.0548	0.2778	0.02844
7	Guilan	0.690	0.0535	0.3028	0.636	0.0530	0.3308	0.02793
8	Hamedan	0.646	0.0500	0.3529	0.738	0.0615	0.3923	0.03941
9	Isfahan	0.709	0.0549	0.4078	0.714	0.0595	0.4518	0.04398
10	Kerman	0.759	0.0588	0.4666	0.671	0.0559	0.5077	0.04107
11	Kermanshah	0.739	0.0573	0.5239	0.455	0.0379	0.5455	0.02165
12	Kohgiluye	0.716	0.0554	0.5793	0.899	0.0749	0.6204	0.04110
13	Kordestan	0.672	0.0521	0.6314	0.363	0.0303	0.6507	0.01929
14	Markazi	0.736	0.0570	0.6885	0.558	0.0465	0.6972	0.00870
15	Mazandaran	0.781	0.0605	0.7490	0.645	0.0537	0.7509	0.00186
16	North-Khorasan	0.610	0.0473	0.7963	0.581	0.0483	0.7992	0.00294
17	Qazvin	0.000	0.0000	0.7963	0.717	0.0597	0.8589	0.06266
18	Razavi-Khorasan	0.634	0.0491	0.8454	0.333	0.0278	0.8867	0.04133
19	Sistan-O-Baluch.	0.562	0.0435	0.8889	0.031	0.0026	0.8892	0.00037
20	South-Khorasan	0.768	0.0595	0.9484	0.698	0.0581	0.9474	0.00098
21	West-Azerbaijan	0.666	0.0516	1.0000	0.632	0.0526	1.0000	0.00000
Total		12.907			12.008		**Max**	0.06266

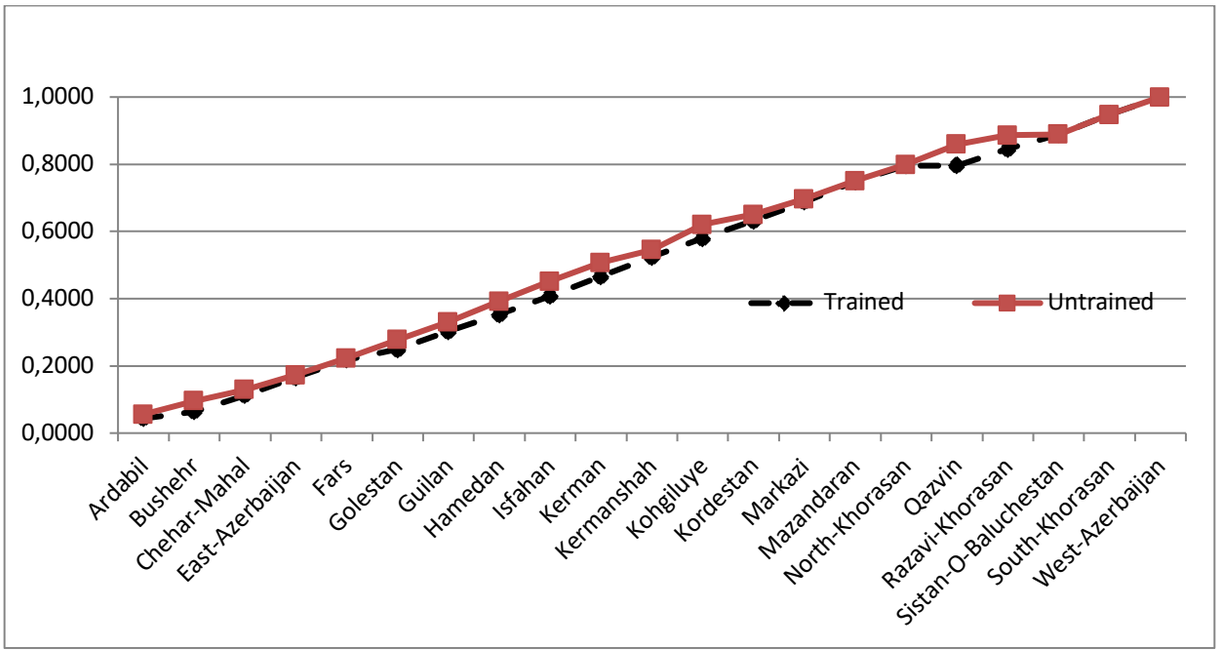

Figure 2: The difference between cumulative proportions of Success Rates for Trained and Untrained drivers

Another statistical test can also be utilized to check the similarity between the success rates for two groups of drivers over the selected provinces, the so-called Paired Two Sample for Means, which investigates whether the two samples are the same or different. In most cases, the paired differences are compared to zero, and the t-test is utilized to make the

final decision. Table 3 tabulates the test results where two samples are the proportion of success rates of trained and untrained drivers in provinces. As shown, the t-stat, obtained by the calculation process, is near zero, and the P-value for the two-tail test is equal to 0.459. The two-tail test is utilized because both sides' differences should be checked. It means that the state is not in the binding domain, so the null hypothesis is accepted, and that means that the two means of success rates over the observations are the same. Since they were defined as the proportion of the success rates of trained and untrained drivers, transport authorities are recommended to redesign training courses and exams to qualify drivers for serving as commercial drivers.

Table 3: Paired Two Sample for Means for proportions acceptance rates of trained and untrained drivers

Statistical Measure	Trained	Untrained
Mean	0.614595371	0.571807619
Variance	0.034782195	0.034005579
Observations	21	21
Pearson Correlation	0.034393887	
Hypothesized Mean Difference	0	
Degree of Freedom	40	
t Stat	0.747607223	
P(T<=t) one-tail	0.229534933	
t Critical one-tail	1.683851014	
P(T<=t) two-tail	0.459069866	
t Critical two-tail	2.02107537	

5. Conclusion

Since in managing training courses for commercial drivers, the efficiency of training courses is essential; it is necessary to investigate the similarity of success rates of drivers, those who have taken training courses, and others without training courses. The overall concept behind the research work is to check the similarity between the drivers who received commercial certificates after taking training courses and without training courses. Data for two groups of drivers, one examined following taking training courses and the other examined without taking training courses, have been collected in each province. The well-known goodness of fit test of Kolmogorov-Smirnov has been utilized to check if the distribution functions for both success rates are the same or different. The results revealed that their distribution functions for success rates of trained and untrained drivers are the same, approved by performing the simple statistical test of Paired Two Sample Means. It means that the training courses have little effect on improving drivers' professional skills, so the transport authorities should redesign training courses and exams in the process of drivers' qualifications.

Further research in this field should focus on specific measures, such as the quality of training courses for commercial drivers. Transport authorities are also recommended to check the difference between the training materials applied in other countries, such as Europe, where they follow a harmonized procedure for drivers' training programs to adapt training courses with them.

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