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Randomized Complete Block Design to identify the most Important Factors Affecting Traffic Accidents in Iraq

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Abstract

Traffic accidents in Iraq are considered one of the most dangerous phenomena because of the threat they cause to the lives of citizens, as well as causing significant human and material losses. Statistics indicate a significant increase in the number of traffic accidents in recent years. Therefore, traffic safety is an important requirement to preserve the lives of road users and mitigate the social and economic impacts and psychological consequences resulting from it. Therefore, work must be done to reduce its risks through the combined efforts of all concerned parties, including government, civil society, and drivers. For this purpose, the focus of this research will be on studying and diagnosing the most important factors that affect traffic accidents in the governorates of Iraq, where a completely randomized blocks design was used to study the effect of six factors (treatments) represented in the causes of traffic accidents (Type of road, Causes of accident, Accident time, Type of transport, Age groups, Causes of accidents) with blocks representing the Iraqi governorates (Nineveh, Kirkuk, Diala, Al-Anbar, Baghdad , Babylon, Karbala, Wasit, Salah Aldeen, Al-Najaf, Al-Qadysia, Al-Muthanna, Thi -Qar, Missan, Basrah) except for the Kurdistan region. The statistical program was used The ready (CoStat) in the analysis of the research data, where several conclusions were reached through the results of the ANOVA tables, the most important of which is the presence of significant differences for all the factors included in the research, meaning that these factors have a clear and effective impact and are considered important causes of traffic accidents in the Iraqi governorates. It was also concluded through the least significant difference (LSD) test that the most influential levels of the factors are highways, main roads, drivers, and others.

Keywords: Design of Experiments, Completely Randomized Blocks Design, Analysis of Variance, Lest Significant Difference.

1. Introduction:

Traffic accidents are considered one of the biggest problems facing Iraq, as they lead to large human and material losses. Therefore, traffic safety is an important requirement to preserve the lives of road users and mitigate the social, economic and psychological effects resulting from them. According to the United Nations definition of traffic accidents, they mean an unintentional incident that result in deaths or Injuries or damage due to traffic or its load on the public road. The interest and dealing with traffic accidents among the peoples of the world varies according to their degree of development and progress and the degree of concern for their citizens, as a World Health Organization study has proven that traffic accidents are still high in middle- and weak-income countries, as these accidents result in a large number of victims, including dead and injured, in addition to losses. It turns out that traffic accident injuries are comparable to current terrorist operations, as it is a scourge that constitutes an obsession and concern for all members of society and has become one of the problems that deplete material resources and incur social problems and losses in human energies, which affects the components of life in which the human element is the foundation of society [(7)].

2. Research Objective

The research aims to study and diagnose the most important factors that affect traffic accidents in the governorates of Iraq. For this purpose, a completely randomized block design was used to study the effect of six factors (treatments) represented in the causes of traffic accidents (Type of road, Causes of accident, Accident time, Type of transport, Age groups, Causes of accidents) with blocks representing the Iraqi governorates governorates (Nineveh, Kirkuk, Diala, Al-Anbar, Baghdad , Babylon, Karbala, Wasit, Salah Aldeen, Al-Najaf, Al-Qadysia, Al-Muthanna, Thi -Qar, Missan, Basrah) except for the Kurdistan region, Each type of treatment that includes different levels with blocks (Iraqi governorates) will be studied and observed whether there are significant differences between traffic accidents that occur in each Iraqi governorate, as well as arriving at the most important factors causing traffic accidents in Iraq.

3. Theoretical Side

3-1 Completely Randomized Blocks Design [1, 3, 6]

This design is considered one of the most widely used experimental designs in scientific research, as in this design the experimental units or experimental pieces are grouped into homogeneous groups called Blocks, meaning that each of these groups is characterized by the fact that the experimental units within it are homogeneous among themselves, The number of experimental units within each block are equal to the number of treatments used in the experiment. Then the treatments are distributed randomly among the experimental units within each block so that each block includes all the treatments used in the experiment. The purpose of grouping the experimental units into different groups represented by the blocks is due to the emergence of another influence that affects In the results of the experiment other than the treatments, here this effect must be separated from the experimental error so that its value does not increase unjustifiably and thus leads to a reduction in the experimental error. This design is used in experiments that include two factors, that is, a two-factor analysis of variance, which studies the effect of two variables, one of which represents the rows (treatments). In our research, the treatments are represented by the six factors (causes of traffic accidents) (Type of road, Causes of accident, Accident time, Type of transport, Age groups, Causes of accidents) and each of these factors has a number of treatment levels. The second variable represents the columns (blocks) represented by the Iraqi governorates governorates (Nineveh, Kirkuk, Diala, Al-Anbar, Baghdad , Babylon, Karbala, Wasit, Salah Aldeen, Al-Najaf, Al-Qadysia, Al-Muthanna, Thi -Qar, Missan, Basrah) on the response variable (the dependent variable) represented by traffic accidents.

3-2 Mathematical Model [3, 4, 5]

The mathematical model for an experiment conducted according to a completely randomized block design is according to the following formula:

$$y_{ij} = \mu + \tau_i + \beta_j + \epsilon_{ij} \quad \ldots\ldots(1)$$

$$i = 1، 2، \ldots، n \quad ، \quad j = 1، 2، \ldots، 15$$

Where:

y_{ij} : The response of the experimental piece under the influence of treatment i within block j.

μ : The overall mean effect that would be possible to obtain if each treatment were applied to each experimental unit in each block.

τ_i : The Effect of treatment i.

β_j : The Effect of block j.
ϵ_{ij}: The experimental error of the experimental unit under the influence of treatment i within block j.

3-3 Mathematical Formulas Used in Research [3, 4]

The mathematical formulas for the completely randomized block design used in the research can be presented in an analysis of variance (ANOVA) table as shown below:

Table 1: Analysis of Variance Table Formulas (ANOVA)

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Blocks	$b-1$	$SS(B)=t\sum_{j}(\bar{y}_{.j}-\bar{y}_{..})^2$	MS(B)= $\frac{SS(B)}{b-1}$	$\frac{MS(B)}{MS(E)}$
Treatments	$(t-1)$	$SS(T)=b\sum_{i,j}(\bar{y}_{i.}-\bar{y}_{..})^2$	$MS(T)=\frac{SS(T)}{(t-1)}$	$\frac{MS(T)}{MS(E)}$
Error	$(b-1)(t-1)$	$SS(E)=SS(TO)-SS(B)-SS(T)$	$MS(E)=\frac{SS(E)}{(b-1)(t-1)}$	
Total	$bt-1$	$SS(TO)=\sum_{ijk}(y_{ijk}-\bar{y}_{...})^2$		

3-4 Multiple Comparisons [2, 3]

These tests are usually applied after the significance of the Analysis of Variance (ANOVA) chart is proven by using the F test, where the null hypothesis asserting the equality of all treatment means is declined and the substitution hypothesis that there are at least two means that have significant differences between them is accepted. However, this test does not specify which means resulted in the significant differences. Therefore, post-hoc tests or multiple comparisons are used by conducting several comparisons between treatments means to find out which means resulted in the significant differences. In this research, the Least Significant Difference (LSD) test will be used.

3-4-1 Lest Significant Difference [2, 3, 5]

This test was proposed by Fisher in 1935 and is considered one of the simplest and most widely used tests. This test is used after the significance of the F test resulting from the analysis of variance (ANOVA) table has been proven, as the least significant difference (LSD) test depends on the t-test for the purpose of testing the significance of the differences between the means

of any two treatments. The steps of this test can be summarized in the state of a completely randomized blocks design as follows:

1. The absolute distinction between the means of each pair of treatments $(\bar{y}_{i.} - \bar{y}_{i.})$ is calculated and compared to the value of LSD as a table value.
2. The value of the least significant difference (LSD) at a significance level α is extracted using the following equation:

$$LSD = t_{(0.05\ ,\ d.f\ error)}\ S.E_{(\bar{y}_{i.}-\bar{y}_{i.})} \qquad \ldots\ldots(2)$$

3. The standard error of the distinction between the means of any two treatments $S.E_{(\bar{y}_{i.}-\bar{y}_{i.})}$ is estimated according to the formula:

$$S.E_{(\bar{y}_{i.}-\bar{y}_{i.})} = \sqrt{\frac{2\ MSEa}{rb}} \qquad \ldots\ldots(3)$$

4- The Application Side

For the purpose of achieving the previously specified research goal, data on traffic accidents in Iraq was obtained from the statistics of traffic accidents registered for the year 2022 in the Central Statistical Organization of the Ministry of Planning[7], which includes fifteen Iraqi governorates governorates (Nineveh, Kirkuk, Diala, Al-Anbar, Baghdad , Babylon, Karbala, Wasit, Salah Aldeen, Al-Najaf, Al-Qadysia, Al-Muthanna, Thi -Qar, Missan, Basrah) except for the Kurdistan region, which represent blocks and six factors (treatments) represented in the causes of traffic accidents (Type of road, Causes of accident, Accident time, Type of transport, Age groups, Causes of accidents). The following table represents the data obtained:

Table 2: Traffic Accident Data in Iraq for the Year 2022

		Blocks (Iraqi Governorates)														
treatments		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Type of Road	Highway	153	144	60	95	378	347	108	352	98	369	130	63	158	0	260
	Main	118	193	929	395	407	489	308	380	169	658	510	218	294	155	996
	Sub-road	106	37	76	32	232	95	34	227	46	89	116	85	116	168	305
	Rural	121	34	15	13	36	42	90	73	57	11	51	27	38	11	206
Causes of Accident	Road	53	5	0	2	106	9	31	271	67	28	7	5	5	1	124
	Car	71	18	3	23	167	30	19	189	62	28	58	34	62	4	170
	Driver	304	379	1077	500	649	907	441	287	187	1071	715	354	530	276	1449
	Walkers	66	4	0	6	126	18	49	201	48	0	24	0	4	1	24
	Passengers	4	2	0	0	3	3	0	84	6	0	0	0	3	0	0
	Others	0	0	0	4	2	6	0	0	0	0	3	0	2	52	0

Accident Time	Sunrise	28	124	38	23	230	34	65	204	22	54	48	49	33	4	94
	Sunset	85	59	102	31	217	49	154	292	99	154	96	23	59	37	149
	Morning	241	202	842	351	403	692	201	288	218	801	580	275	393	198	983
	Night	144	23	98	130	203	198	120	248	31	118	83	46	121	95	541
Type of Transport	Saloon	462	187	1344	475	615	705	383	354	162	933	538	233	421	135	853
	Station	37	132	140	80	56	67	23	181	48	1	97	11	6	23	276
	Farm	3	2	0	1	3	31	13	65	19	11	35	7	28	8	7
	Bus	25	21	65	13	95	103	69	174	22	97	394	33	42	7	61
	Pick up	79	112	48	128	58	119	37	168	81	39	74	81	63	37	323
	Van	0	7	0	4	1	0	20	119	4	0	13	0	0	0	1
	Lorries	50	38	15	84	80	144	38	77	34	40	54	65	87	34	164
	Motorcycles	31	107	58	105	227	284	221	372	0	356	121	195	303	165	736
Age Groups	17	32	5	1	33	27	47	72	174	10	147	16	23	34	46	109
	18-23	115	62	135	168	175	221	152	281	38	191	288	132	250	91	591
	24-29	137	100	434	205	183	311	188	272	63	251	379	109	156	60	462
	30-35	141	153	493	191	242	301	163	255	70	320	228	105	139	55	462
	36-41	96	132	377	161	272	243	103	235	71	250	218	100	100	60	269
	42-47	74	71	173	78	124	166	59	212	62	177	112	53	96	49	281
	48-53	52	43	24	35	78	76	36	107	34	136	60	48	83	25	154
	54-59	30	32	3	14	35	51	23	57	21	54	24	33	63	22	81
	more than 60	10	13	0	12	3	40	14	0	1	18	1	23	31	10	101
Causes of Accidents	High Speed	88	106	164	61	135	255	73	56	75	107	177	53	193	92	211
	Driving Reverse Direction	15	9	10	7	15	6	4	21	15	0	0	9	6	2	56
	The Wrong Pass	11	22	43	20	22	6	2	25	14	0	3	13	7	0	37
	Out Allowed Roundness	4	12	0	2	4	4	0	23	3	0	3	0	0	0	16
	Non Compliance with Traffic Priorities	12	3	0	3	11	0	0	11	5	0	1	0	0	0	16
	Non Compliance	16	11	6	2	3	0	0	8	0	0	0	0	0	0	3

	with the Traffic Signal														
	Driving under the Influence of Drugs or Alcohol	0	1	0	2	3	1	0	15	1	0	0	0	3	0	17
	Driving without Diving License	7	6	0	0	0	0	6	8	1	0	0	0	0	0	9
	Lack of Attention	16	33	29	35	42	26	74	14	28	67	9	11	5	12	35
	Preoccupation with the Mobile Phone	5	0	0	4	0	1	6	12	2	0	0	12	0	0	2
	Seat Belt	0	8	0	0	0	2	0	11	2	0	0	0	0	0	0

4-1 Data Analysis

The ready-made statistical program (CoStat) was used for the purpose of analyzing the data on traffic accidents in Iraq, where the results shown in the following tables were obtained:

Table 3: Analysis of Variance Table (ANOVA) for Type of Road and Iraqi Governorates

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F	P value
Iraqi Governorates	14	560273.6	40019.543	2.097	.033
Type of Road	3	1109641.650	369880.550	19.381	.000
Error	42	801563.600	19084.848		
Total	59	2471478.850			
	R Squared = .676 (Adjusted R Squared = .544)				

1. We note from the table above that (P value) is less than 0.05. The null hypothesis, which states that all means of the treatments are equal (there are no significant differences), will be rejected, and the alternative hypothesis will be accepted, which states that there are significant differences between the means of the treatments, meaning that the factor Type of road (Highway -

Main - Sub-road - Rural) significant effect and one of the reasons for traffic accidents in the Iraqi governorates.

2. Data analysis also showed that the value of the determinant coefficient for the completely randomized block design model is $(R^2 = 67\%)$, which indicates that the model is appropriate to the data, meaning that (67%) of the changes occurring in the dependent variable (traffic accidents) were caused by changes in the factor Type of road.

Table 4: Multiple Comparisons for Type of Road

Type of Road	Mean Name	Mean	n	55	117.6	181
Highway 1	2	414.6	15	359.6	297	233.6
Main 2	1	181	15	126	63.4	
Sub-road 3	3	117.6	15	62.6		
Rural 4	4	55	15			
LSD at 0.05=101.801097833						

After arranging the means of the number of accidents for the first factor (Type of Road) in descending order using the Least Significant Difference ($(LSD\ at\ 0.05)$) test by taking the absolute difference between the means of any two classes to reach which of the means resulted in significant differences, we note that most of the differences were significant as they gave calculated values greater than the tabulated value of the (LSD at 0.05) test. We also note that the road class (Main, Highway) is the most influential roads in terms of traffic accidents compared to other roads (Sub-road, Rural) which showed no significant differences as they gave calculated values less than the tabulated value of the (LSD at 0.05) test which was shaded in the table above, meaning that the classes are equivalent in their influence on traffic accidents.

Table 5:Analysis of Variance Table(ANOVA)Causes of Accident and Iraqi Governorates

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F	P value
Iraqi Governorates	14	373515.733	26679.695	1.099	.374
Causes of Accident	5	4192361.433	838472.287	34.536	.000
Error	70	1699491.733	24278.453		
Total	89	6265368.900			
	R Squared = .729 (Adjusted R Squared = .655)				

1. We note from the table above that (P value) is less than 0.05. The null hypothesis, which states that all means of the treatments are equal (there are no significant differences), will be rejected, and the alternative hypothesis will be accepted, which states that there are significant differences between the means of the treatments, meaning that the factor Causes of accident (Road - Car - Driver - Walkers - Passengers - Other) has a significant effect. It is also considered one of the important reasons for traffic accidents in the Iraqi governorates, despite the fact that there are no significant differences between the Iraqi governorates.
2. The analysis of the data also showed that the value of the determinant coefficient for the completely randomized block design model is $(R^2 = 73\%)$, which indicates that the model is appropriate to the data, meaning that (73%) of the changes occurring in the dependent variable (traffic accidents) were caused by changes in the factor Causes of accident.

Table 6: Multiple Comparisons for Causes of Accident

Causes of Accident	Mean Name	Mean	n	4.6	7	38.067	47.6	62.533
Road 1	3	608.4	15	603.8	601.4	570.333	560.8	545.867
Car 2	2	62.533	15	57.933	55.533	24.466	14.933	
Driver 3	1	47.6	15	43	40.6	9.533		
Walkers 4	4	38.067	15	33.467	31.067			
Passengers 5	5	7	15	2.4				
Others 6	6	4.6	15					
		LSD at 0.05=113.475008326						

After arranging the means of the number of accidents for the second factor (Causes of Accident) in descending order using the least significant difference test (LSD at 0.05) by taking the absolute difference between the means of any two causes to reach which of the means resulted in the significant differences, we note that the cause of accident (Driver) is the most influential cause in the occurrence of traffic accidents compared to other causes, as it gave significant differences, while some differences showed calculated values less than the tabulated value of the test (LSD at 0.05) that were shaded in the table above, which means that there are no significant differences between them, meaning that the causes are equivalent in their influence on traffic accidents.

Table 7: Analysis of Variance Table (ANOVA) Accident Time and Iraqi Governorates

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F	P value
Iraqi Governorates	14	560273.600	40019.543	2.112	.031
Accident Time	3	1318978.583	439659.528	23.205	.000
Error	42	795768.667	18946.873		
Total	59	2675020.850			
	R Squared = .703 (Adjusted R Squared = .582)				

1. We note from the table above that (P value) is less than 0.05. The null hypothesis, which states that all means of the treatments are equal (there are no significant differences), will be rejected, and the alternative hypothesis will be accepted, which states that there are significant differences between the means of the treatments, the factor Accident time (Sunrise - Sunset - Morning - Night) has a significant effect. It was also one of the important reasons for traffic accidents in the Iraqi governorates.
2. The analysis of the data also showed that the value of the determinant coefficient for the completely randomized block design model is $(R^2 = 70\%)$, which indicates that the model is appropriate to the data, meaning that (70%) of the changes occurring in the dependent variable (traffic accidents) were caused by changes in the factor Accident time.

Table 8: Multiple Comparisons for Accident Time

Accident Time	Mean Name	Mean	n	70	107.067	146.6
Sunrise 1	3	444.533	15	374.533	337.466	297.933
Sunset 2	4	146.6	15	76.6	39.533	
Morning 3	2	107.067	15	37.067		
Night 4	1	70	15			
		LSD at 0.05=101.432442945				

After arranging the means of the number of accidents for the third factor (Accident Time) in descending order using the least significant difference test (LSD at 0.05) by taking the absolute difference between the means of any two times to reach which of the means resulted in significant differences, we note that the time (Morning) is the most influential time in the occurrence of traffic accidents compared to other times, as it gave significant differences, while some differences showed calculated values less than the tabulated value of the test (LSD at 0.05) that were shaded in the table above, which means that there are no significant differences between them, meaning that the times are equivalent in their influence on traffic accidents.

Table 9: Analysis of Variance Table (ANOVA) Type of Transport and Iraqi Governorates

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F	P value
Iraqi Governorates	14	545005.967	38928.998	2.132	.016
Type of Transport	7	2954819.992	422117.142	23.120	.000
Error	98	1789267.633	18257.833		
Total	119	5289093.592			
	R Squared = .662 (Adjusted R Squared = .589)				

1. We note from the table above that (P value) is less than 0.05. The null hypothesis, which states that all means of the treatments are equal (there are no significant differences), will be rejected, and the alternative hypothesis will be accepted, which states that there are significant differences between the means of the treatments, for Type of transport factor (saloon - Station - Farm - Bus – Pick up - Van - lorries - Motorcycles) has a significant effect. It

was also one of the important reasons for traffic accidents in the Iraqi governorates.

2. The analysis of the data also showed that the value of the determinant coefficient for the completely randomized block design model is $(R^2 = 66\%)$, which indicates that the model is appropriate to the data, meaning that (66%) of the changes occurring in the dependent variable (traffic accidents) were caused by changes in the factor the Type of transport.

Table 10: Multiple Comparisons for Type of Transport

Type of Transport	Mean Name	Mean	n	11.267	15.533	66.933	78.533	81.4	96.467	218.733
Saloon 1	1	520	15	508.733	504.467	453.067	441.467	438.6	423.533	301.267
Station 2	8	218.733	15	207.466	203.2	151.8	140.2	137.333	122.266	
Farm 3	5	96.467	15	85.2	80.934	29.534	17.934	15.067		
Bus 4	4	81.4	15	70.133	65.867	14.467	2.867			
Pick up 5	2	78.533	15	67.266	63	11.6				
Van 6	7	66.933	15	55.666	51.4					
Lorries 7	3	15.533	15	4.266						
Motorcycles 8	6	11.267	15							
LSD at 0.05=97.9124604742										

After arranging the means of the number of accidents for the fourth factor (Type of Transport) in descending order using the least significant difference test (LSD at 0.05) by taking the absolute difference between the averages of any two types to reach which of the means resulted in significant differences, we note that most of the differences were significant as they gave calculated values greater than the tabulated value of the test (LSD at 0.05). We also note that the type of transport (Saloon, Motorcycles) is the most influential transport in terms of traffic accidents compared to other transports which showed no significant differences as they gave calculated values less than the tabulated value of the test (LSD at 0.05) which was shaded in the table above, meaning that the transports are equivalent in their influence on traffic accidents.

Table 11: Analysis of Variance Table (ANOVA) Age Groups and Iraqi Governorates

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F	P value
Iraqi Governorates	14	519822.770	37130.198	9.047	.000
Age Groups	8	809742.459	101217.807	24.663	.000
Error	112	459659.763	4104.105		
Total	134	1789224.993			
	R Squared = .743 (Adjusted R Squared = .693)				

1. We note from the table above that (P value) is less than 0.05. The null hypothesis, which states that all means of treatments are equal (there are no significant differences), will be rejected, and the alternative hypothesis will be accepted, which states that there are significant differences between the means of treatments, for the factor of Age groups (17 , 18-23, 24-29, 30-35, 36-41, 42-47, 48-53, 54-59, more than 60) has a significant effect and is one of the important reasons for traffic accidents in the Iraqi governorates.
2. The analysis of the data also showed that the value of the determinant coefficient for the completely randomized block design model is $(R^2 = 74\%)$, which indicates that the model is appropriate to the data, meaning that (74%) of the changes occurring in the dependent variable (traffic accidents) were caused by changes in the factor Age groups.

Table 12: Multiple Comparisons for Age Groups

Age Groups	Mean Name	Mean	n	18.467	36.2	51.733	66.067	119.133	179.133	192.667	220.667
17	4	221.2	15	202.733	185	169.467	155.133	102.067	42.067	28.533	0.533
18-23	3	220.667	15	202.2	184.467	168.934	154.6	101.534	41.534	28	
24-29	2	192.667	15	174.2	156.467	140.934	126.6	73.534	13.534		
30-35	5	179.133	15	160.666	142.933	127.4	113.066	60			
36-41	6	119.133	15	100.666	82.933	67.4	53.066				
42-47	7	66.067	15	47.6	29.867	14.334					
48-53	1	51.733	15	33.266	15.533						
54-59	8	36.2	15	17.733							
more than 60	9	18.467	15								
	LSD at 0.05=46.3494496991										

After arranging the means of the number of accidents for the fifth factor (Age Groups) in descending order using the least significant difference test (LSD

at 0.05) by taking the absolute difference between the means of any two groups to reach which of the means resulted in significant differences, we note that most of the differences were significant as they gave calculated values greater than the tabulated value of the (LSD at 0.05) test. We also note that the age groups (30-35, 24-29, 18-23, 36-41, 42-47) are the most influential age groups in terms of traffic accidents compared to the other groups that showed no significant differences as they gave calculated values less than the tabulated value of the (LSD at 0.05) test, which was shaded in the table above, meaning that the age groups are equivalent in their influence on traffic accidents.

Table 13: Analysis of Variance Table (ANOVA) Causes of Accidents and Iraqi Governorates

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F	P value
Iraqi Governorates	14	7648.812	546.344	1.252	.245
Causes of Accidents	10	191455.879	19145.588	43.864	.000
Error	140	61106.121	436.472		
Total	164	260210.812			
	R Squared = .765 (Adjusted R Squared = .725)				

1. We note from the table above that (P value) is less than 0.05. The null hypothesis, which states that all means of treatments are equal (there are no significant differences), will be rejected, and the alternative hypothesis will be accepted, which states that there are significant differences between the means of treatments, the factor Causes of accidents (High Speed – Driving reverse direction – The wrong pass – Out allowed roundness – Non compliance with traffic priorities- Non compliance with the traffic signal – Driving under the influence of drugs or alcohol – Driving without a driving license – Lack of attention - Preoccupation with a mobile phone - Seat belt) significant effect and one of the reasons The important factor in the occurrence of traffic accidents in the Iraqi governorates, despite the fact that there are no significant differences between the Iraqi governorates.
2. The analysis of the data also showed that the value of the determinant coefficient for the completely randomized block design model is $(R^2 = 76\%)$, which indicates that the model is appropriate to the data, meaning that (76%)

of the changes occurring in the dependent variable (traffic accidents) were caused by changes in the factor Causes of accidents.

Table 14: Multiple Comparisons for Causes of Accidents

Causes of Accidents	Mean Name	Mean	n	1.533	2.467	2.867	2.933	3.267	4.133	4.733	11.667	15	29.067
High Speed	1	123.067	15	121.534	120.6	120.2	120.134	119.8	118.934	118.334	111.4	108.067	94
Driving Reverse Direction	9	29.067	15	27.534	26.6	26.2	26.134	25.8	24.934	24.334	17.4	14.067	
The Wrong Pass	3	15	15	13.467	12.533	12.133	12.067	11.733	10.867	10.267	3.333		
Out Allowed Roundness	2	11.667	15	10.134	9.2	8.8	8.734	8.4	7.534	6.934			
Non Compliance with Traffic Priorities	4	4.733	15	3.2	2.266	1.866	1.8	1.466	0.6				
Non Compliance with the Traffic Signal	5	4.133	15	2.6	1.666	1.266	1.2	0.866					
Driving under the Influence of Drugs or Alcohol	6	3.267	15	1.734	0.8	0.4	0.334						
Driving without Diving License	10	2.933	15	1.4	0.466	0.066							
Lack of Attention	7	2.867	15	1.334	0.4								
Preoccupation with the Mobile Phone	8	2.467	15	0.934									
Seat Belt	11	1.533	15										
		LSD at 0.05= 15.0822515185											

After arranging the means of the number of accidents for the sixth factor (Causes of Accidents) in descending order using the least significant difference test (LSD at 0.05) by taking the absolute difference between the means of any two causes to reach which of the means resulted in significant differences, we note that most of the differences were significant as they gave calculated values greater than the tabulated value of the (LSD at 0.05) test. We also note that the causes (High Speed, Lack of Attention) are the most influential causes in terms of traffic accidents compared to the other causes that showed no significant differences as they gave calculated values less than the tabulated value of the (LSD at 0.05) test, which were shaded in the table above, meaning that the causes are equivalent in their influence on traffic accidents.

5- Conclusions

We conclude from this research a number of things, the most important of which are:

1. Through the results of the analysis of variance tables, the differences were significant between all the factors used in the research. That is, these factors have a clear and effective effect, as they are considered one of the important causes of traffic accidents in the Iraqi governorates.
2. Through the results of the analysis of variance tables, there are significant differences between the blocks represented by the Iraqi governorates, with the exception the two factors: the first Causes of accident (Road - Car - Driver - Walkers - Passengers - Other) and the second: Causes of accidents (High Speed – Driving reverse direction – The wrong pass – Out allowed roundness – Non compliance with traffic priorities- Non compliance with the traffic signal – Driving under the influence of drugs or alcohol – Driving without a driving license – Lack of attention - Preoccupation with a mobile phone - Seat belt), as the results did not give significant differences between the Iraqi governorates, meaning they are equal in their effect on traffic accidents.
3. The results of the data analysis also showed that the value of the determinant coefficient (R^2) for most of the completely randomized block design models was good, not less than (60%). This indicates that the model was appropriate to the data and that all the changes occurring in the dependent variable (traffic accidents) were actually caused by the changes in the factors (Type of road, Causes of accident, Accident time, Type of transport, Age groups, Causes of accidents).
4. It was concluded through the value of the determinant coefficient $(R^2 = 73\% - 74\% - 76\%)$ that the most appropriate data for the completely randomized block design model are the factors (Causes of accident - Age groups, Causes of accidents), which indicates the influence of these factors It is effective in the occurrence of traffic accidents in most Iraqi governorates, so it can be considered one of the most important factors that affect traffic accidents or one of the most important factors that cause traffic accidents in Iraq.
5. The results of the least significant difference (LSD) test for the six factors used in the research showed that the majority of the differences between the means of any two treatments gave calculated values greater than the tabulated value of the test (LSD at 0.05). This indicates the existence of significant

differences between them, thus these factors have an effective impact on increasing traffic accidents than the other factors that were compared with them, as this test reached the most influential levels of factors are (Highways and Main, Driver, Morning, Saloon Transport and Motorcycles, age groups 18-47, High Speed, Lack of Attention).

6. We also conclude that using a completely randomized block design in analyzing traffic accident data was appropriate and successful in studying the factors that affect traffic accidents, which helps in developing effective strategies to reduce these accidents and improve traffic safety.

6- References:

1. Abbis, S. A. M. (2018). Compression of some parametric and nonparametric tests in the Randomized complete Blocks (Applied Study), Master's thesis, College of Administration and Economics / University of Karbala.
2. Al-Darini, Mahmoud Mohamed, "Multiple and Orthogonal Comparisons", Cairo.
3. Al-Mashhadani, K. A. K. (2010). Design and Analysis of Experiments, College of Administration and Economics / University of Baghdad.
4. HINKELMANN K. & KEMPTHORNE O. (1994). Design and Analysis of Experiments, volume 1: Introduction to experimental design. John Wiley & Sons, Inc.
5. Montgomery, D. C. (2013). DESIGN AND ANALYSIS OF EXPERIMENTS. John wiley & sons, Inc.
6. Oehlert, G. W. (2010). A First Course in Design and Analysis of Experiments. University of Minnesota.
7. Statistics of registered traffic accidents for the year 2022, Central Statistical Organization - Ministry of Planning / Iraq.
8. Williams, L. J., & Abdi, H. (2010). "Fisher's least significant difference (LSD) test". *Encyclopedia of research design*, *218*(4), 840-853.

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تصميم قطاعات كاملة العشوائية لتحديد اهم العوامل المؤثرة على حوادث المرور في العراق

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مستخلص البحث:
تعد حوادث المرور في العراق من اكثر الظواهر خطورة لما تسببه من تهديد لحياة المواطنين وكذلك تخلف خسائر بشرية ومادية كبيرة حيث تشير الاحصائيات الى ارتفاع ملحوظ في عدد الحوادث المرورية في السنوات الاخيرة لذا تعد السلامة المرورية مطلب مهم للحفاظ على أرواح مستخدمي الطريق والتخفيف من الآثار الاجتماعية والاقتصادية والنفسية الناتجة عنها، لذلك يجب العمل على الحد من مخاطرها من خلال تضافر جهود جميع الجهات المعنية من حكومة ومجتمع مدني وسائقين، لهذا الغرض سوف يتم التركيز في هذا البحث على دراسة وتشخيص اهم العوامل التي تؤثر على حوادث المرور في محافظات العراق حيث تم استخدام تصميم القطاعات العشوائية الكاملة لدراسة تأثير ست عوامل (المعالجات) متمثلة في مسببات الحوادث المرورية (صنف الطريق، اسباب الحادث، وقت حصول الحادث، نوع المركبة، الفئات العمرية، اسباب الحوادث) مع القطاعات التي تمثل المحافظات العراقية (نينوى، كركوك، ديالى، الانبار، بغداد، بابل، كربلاء، واسط، صلاح الدين، النجف، القادسية، المثنى، ذي قار، ميسان، البصرة) عدا اقليم كردستان، تم استخدام البرنامج الاحصائي الجاهز (CoStat) في تحليل بيانات البحث، حيث تم التوصل إلى عدة استنتاجات من خلال نتائج جداول تحليل التباين (ANOVA) اهمها وجود فروقات معنوية لجميع العوامل الداخلة في البحث اي لهذه العوامل تأثير واضح وفعال وتعتبر من الاسباب المهمة في وقوع حوادث المرور في المحافظات العراقية، كما تم الاستنتاج من خلال اختبار اقل فرق معنوي (LSD) اكثر اصناف العوامل تأثيراً مثل الطرق السريعة والرئيسية والسائق وغيرها.

الكلمات المفتاحية: تصميم التجارب، تصميم قطاعات كاملة العشوائية، تحليل التباين، اختبار اقل فرق معنوي.