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Estimating Amman's Traffic Flow of Signalized Intersections and the Causes of Traffic Accidents

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Abstract

The intersection accident maps were created with ArcGIS software, and the descriptive statistics for the accidents were created with SPSS software. The multivariable linear regressions model is developed for evaluating annual accident prediction based on historical data for accidents at each intersection and adjustment factors depending on current conditions. The goal of this study is to create an accident prediction model for signalized crossings in Amman that evaluates accident frequency based on geometric features and traffic flow at intersections.

According to the report, the biggest cause of intersection accidents is driver behavior, namely "not keeping the proper distance," which accounts for 31.2 % of all incidents. The majority of accidents happened between 50 and 60 meters from the intersection's center. This behavior could be explained by the presence of side roads

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from which traffic joins with traffic at crossroads. The cars entering the intersection caused the most accidents (44.4 %), followed by the vehicles exiting the intersection (33.5%). The percentages of accidents at the intersection center and right turn are nearly equal, at 11.4 % and 10.7 %, respectively.

Accidents occur at almost the same frequency during the working days (Sunday through Thursday), with a substantial fall in the number of accidents occurring on Fridays (official vacation) and a little increase in accidents occurring on Saturdays compared to Fridays. The AM peak hour for accidents (at junctions) was discovered to be between 8.00 – 9.00 AM, and the PM peak hour was discovered to be between 14.00 -15.00 PM, followed by 17.00-18.00 PM. For the prediction of accidents at crossings, a multivariable linear regression model was presented. The model has a high degree of accuracy, with the prediction error relative to the actual number of accidents being less than 1%. Based on the study findings, recommendations were made for improving intersection safety, enforcing good driving behavior, facilitating traffic at crossroads, and conducting future research.

1. Introduction

The Highway Safety Manual (HSM, 2010) defines accidents as rare, accounting for a small proportion of total events on the transportation system, and random, implying that crashes occur as a result of a series of events influenced by a variety of factors, some of which are deterministic (controllable) and others that are stochastic (random and unpredictable). The following are a summary of the contributing factors:

- Human: age, judgment, driver skill, attention, fatigue, experience;
- Vehicle: design, manufacture and maintenance;

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- Roadway feature: geometric alignment, cross section, traffic control devices, surface friction, grade, signage, etc.

Traffic, in general, costs society a large amount of money in terms of injuries, lost productivity, probable fatalities, and property damage. According to Dedeitch (2002), one-third of all crashes occur at intersections or on the approach to intersections. Traffic accidents, particularly at signalized junctions, are extremely complex events influenced by a variety of geometric and traffic-related factors. There is a need to establish which parameters influence the occurrence of accidents at particular intersection designs and traffic volumes, in order to efficiently create countermeasures.

Jordan has seen a surge in traffic in general, and particularly considerable road congestion at intersections, in recent years. According to data from the Ministry of Transport, the average annual growth rate of the transportation fleet from 2009 to 2014 was 5.5 percent (JTI, 2015). Between 2004 and 2009, the overall number of accidents increased by 75%, approximately paralleling the increase of registers automobiles (JTI, 2015).

The city's transportation network is under immense strain as its population grows. Accident prediction is critical for managing existing road conditions and planning future road improvements in the city. This project aims to create a reliable model for traffic accident forecasting at existing crossroads that planners and decision-makers can use to manage traffic at existing crossings and forecast traffic accidents in the design of future intersections.

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1.1 Research Objectives

The primary purpose of this research is to build a multiple linear regression model that predicts accidents at signalized crossings in the city's major network using traffic patterns and intersection features. The research's primary goals are as follows:

- Provide a descriptive analysis of accidents at signalized intersections based on existing accident statistics, including accident causes, timing, and the use of Geographic Information Systems (GIS) to determine accident site.
- Provide quantitative predictive analysis by developing a model for predicting accidents based on the geometric properties of crossings.
- Recommendations for improving traffic safety at intersections are based on the results of the analyses.

1.2 Research Significance

A city's arterial network consists of a number of routes shared by traffic for conveying vehicles from one location to another in a city, with vehicle movement through cross-routes controlled by traffic lights at signalized intersections. One of the biggest causes of accidents and consequent congestion on the arterial network is the slowing or interruption of traffic flow at crossings. The United States Department of Transportation has chosen intersection safety as an emphasis area under the Highway Infrastructure and Operations theme since 50% of all automobile crashes occur at intersections (Masherawi and D'Souza, 2013).

Congestion caused by intersection accidents frequently degrades the effectiveness of a city's arterial network, offering substantial problems to the developing transportations industry. This study will create a statistical model based on associated traffic flow patterns and intersection layouts to forecast traffic accident frequency based on inherent features at an intersection. Based on traffic patterns and intersection layout design, the multiple regression analysis will be able to estimate accident frequency analytically. Previous research has identified multiple linear regression as an appropriate model for predicting accidents at specific crossings controlled by a sequence of signal timings. Policymakers could utilize the model to identify signalized crossings that pose safety issues, upgrading the architecture, road infrastructure, and/or changing administrative procedures to reduce accidents and congestion.

2. Research Methodology

The sample size for the study will be chosen in order to generate results that appropriately represent the occurrence of accidents at crossings. There are 112 signalized intersections with permanent traffic counters. Data from the Amman Traffic Police from 2013 to 2016 were used in this study. The traffic flow for each intersection in the study will be acquired from the Greater Amman Municipality's (GAM) Traffic Department for the relevant years. The SPSS software will be used to complete the descriptive statistics and model construction. The GIS ESRI ArcMap software will be used to identify the sites of accidents at signalized junctions and their position at the time of the accident.

SPSS software will be used to conduct a descriptive study of intersection accidents. GIS mapping of accidents will be done based on data gathered by the Central Traffic Department in order to evaluate the location and frequency of

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incidents. The geometric aspects of the crossings, such as the number of lanes, directions, land use, and presence of the right turn, were also examined. The GIS ArcMap program will be used to build maps at the study's selected intersections. The geo-database was constructed based on the mapping, and it included the information of the accidents for each intersection.

3. Literature Review

This chapter provides a complete discussion of intersection features as well as prior research on accident prediction models.

3.1 Traffic Flow

In traffic studies, the shape of the traffic flow profile is very essential. A traffic flow profile is typically depicted as a chart that shows the number of vehicles (y-axis) per time unit (hours, weekdays, and month) (Hoogendoorn, 1997). The hourly distribution of traffic flow profiles often show clear AM and PM peaks, with low traffic volume during the evening hours and a decline in flow throughout the middle of the day. In other circumstances, the decline in traffic flow between the peaks is minor, and the traffic flow profile during the daytime hours from AM to PM peaks has a more or less flat appearance, indicating a rather uniform distribution of traffic flow during specific hours. The more dramatic the peaks in traffic flow, the greater the variability in the traffic flow profile (NRA, 2012).

Traffic flow profiles are also created for the distribution of traffic over the course of a weekday. This type of traffic flow profile typically indicates a decrease in traffic volume on weekends but may show an increase in traffic volume on public holidays (Geroliminis, 2008). Due to the seasonal holiday period, the monthly or seasonal distribution of traffic flow may rise throughout particular months. As a result, it is best to use data from months with a somewhat consistent distribution of traffic flow over the course of the year (Zhao, 2004).

3.2 Principles of Intersection Design

The basic objective of intersection design is to reduce potential conflict between traffic flows, pedestrians, and turning traffic. As a result, the design should include amenities for both traffic and pedestrians. The design of an intersection typically includes the design of the intersecting roadway's alignment (horizontal and vertical), the determination of the minimum required width of turning roadways when traffic is expected to make turns at speeds greater than 15 miles per hour, and assurance that sight distances are adequate for the type of control at the intersection (Garber, 2009).

T (three-leg) crossings, four-leg intersections, multi-leg intersections with five or more approaches, and traffic circles are the most common forms of intersections. A simple T intersection is appropriate for minor road intersections. Four-leg crossroads are most commonly found where minor or local roads connect, although they can also be found where a minor route intersects a major highway.

Table 3-1: Planning of Intersections (AASHTO, 2009)

Geometric Parameters	Description
Number of lanes	• Each lane not to exceed 450 veh/h • Number of upstream/downstream lanes • Signal Design; • Right of Way constraints • Safety

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Geometric Parameters	Description
Exclusive left-turn lanes	Provision of an exclusive left-turn lane is based on the volume of left-turning and opposing traffic, intersection design, and safety implications. Exclusive left-turn lanes should be investigated when a left-turn volume exceeds 100 vehicles per hour. Dual left-turn lanes could be considered when the left-turn volume exceeds 300 vehicles per hour.
Exclusive right-turn lanes	The provision of right-turn lanes reduces conflict between lower speed right-turning vehicles and higher speed left-turning vehicles. Separating right turns also reduces the green time required for a through lane. Safety implications associated with pedestrians and bicyclists should be considered. In general, a right-turn lane at a signalized intersection should be considered when the right-turn volume and adjacent through lane volume each exceeds 300 vehicles per hour.
Left-turn storage bay length	Storage bays should accommodate twice the average number of left-turn arrivals during a cycle.

3.3 Typical Points of Conflict at Intersections

The main points of conflict at intersections are:

- Diverging traffic.
- Merging traffic.
- Crossing traffic.

Figures (2-1) and (2-2) show the typical conflict points at 3-leg and 4-leg intersections:

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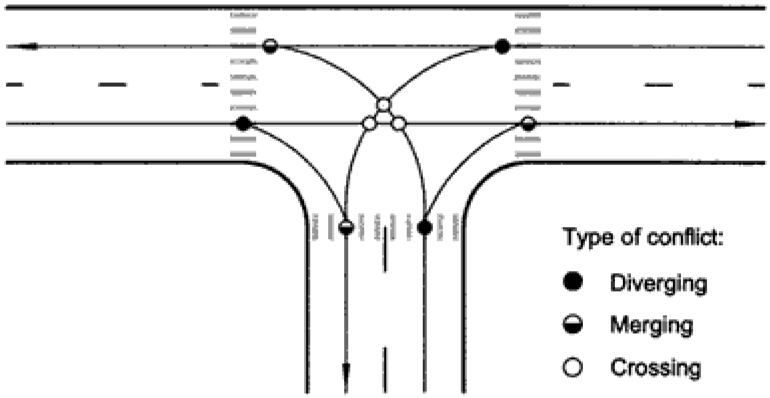

Figure 3-1: Main Points of Conflict at 3-leg Intersection (HSM, 2009)

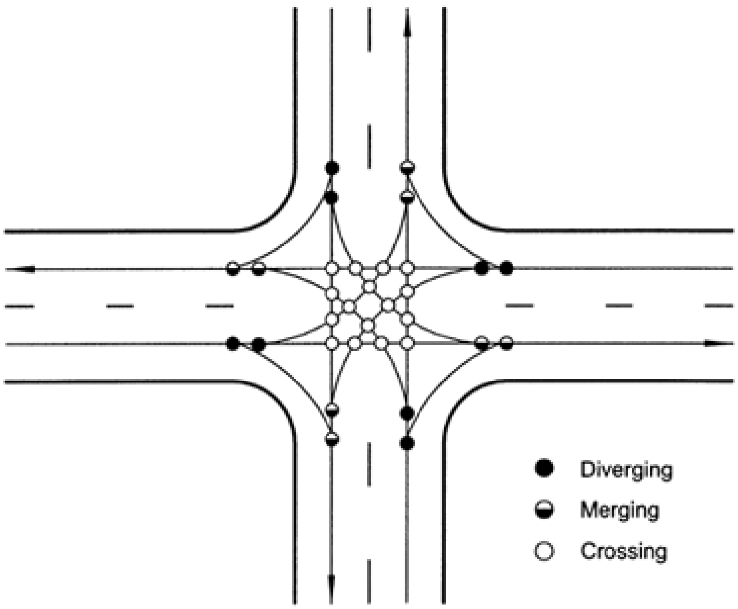

Figure 3-2: Main Points of Conflict at 4-leg Intersection (HSM, 2009)

3.4 Previous Research

Intersection-related crashes account for a large number of accidents involving cars, passengers, pedestrians, and cyclists. Intersections typically account for a sizable proportion of total fatal collisions. Significant attention is required to ensure the safe flow of road users in order to improve the safety of intersections. In general, the goal of junction safety analysis is to assess the influence of safety-related variables on pedestrians, bicycles, and cars in order to devise effective and efficient countermeasure techniques to improve intersection safety.

Although urban intersections have received significant attention in terms of signal timing optimization to decrease vehicle delay (Dong et al., 2014; Nesheli et al., 2009) or to jointly minimize vehicle and pedestrian delay (Dong et al., 2014; Nesheli et al., 2009), (Roshandeh et al., 2014). Ignoring the projected safety consequences may result in a loss of overall performance gains. Pedestrians and cyclists are substantially more prone to intersection crashes than vehicle drivers because of their interactions with automobiles (Dong et al., 2014; Zhou et al., 2014). Clearly, pedestrians account for more than 22% of the 1.24 million individuals killed in traffic accidents globally (World Health Organization, 2014).

Several research on intersection safety analysis have been undertaken in recent years. Agbelie and Roshandeh (2015) investigated the effects of signal-related factors on accident frequency using a random-parameters negative binomial model. The findings revealed that increasing the number of signal phases and traffic volume at an intersection increased crash frequency, although increasing the number of approach lanes and the maximum green period also increased crash frequency at many crossings.

Wu et al. (2013) estimated a random-parameter negative binomial model of crash frequency using intersection crash data from all intersection approaches with signal-warning flashers. The estimation results revealed that lowering the speed limit by 5 miles per hour reduced the likelihood of crashes in certain cases while increasing the frequency of crashes in others.

Oh et al. (2010) evaluated traffic safety at signalized crossings using a traffic conflict technique and investigated traffic conflicts that occurred during a signal violation. Traffic photos from two crossings in South Korea were examined utilizing image procedure technology, and it was discovered that major and deadly disputes occurred at the time of the signal infraction. Gomes et al. (2012) developed predictive models for predicting the safety performance of signalized and un-signalized junctions in Lisbon, Portugal, using the Poisson-gamma modeling framework. They contend that roadway geometry features influence crash severity at metropolitan three- and four-leg crossings.

In Shanghai, Zhou et al. (2013) proposed a root cause degree procedure to measure intersection safety and discovered that clearance time, safety education, enforcement, trajectory inside the intersection, crossing a refuge island, speeding, and the right turn control pattern all affect crash frequency.

Wang and Abdel-Aty (2006) investigated the crash temporal or spatial correlation among the data by using generalized estimating equations with the negative binomial link function to model rear-end crash frequency at signalized junctions. Intersections with heavy traffic, more right and left-turn lanes, a large number of phases per cycle, high-speed restrictions, and densely populated areas were found to have a greater rate of rear-end collisions. As well, Das and Abdel-Aty (2011) used genetic programming to evaluate rear-end crash counts and discovered that crashes dropped with higher skid resistance during morning peak hours but increased during afternoon peak hours.

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Dong et al. (2014) investigated the factors that contribute to crash frequency at urban signalized intersections and discovered that the Multivariate Poisson-lognormal (MVPLN) model outperforms the Univariate Poisson-Lognormal (UVPLN) and Multivariate Poisson (MVP) models in identifying significant factors and predicting crash frequencies. According to their findings, traffic volume, truck proportion, lighting condition, and intersection angle all have a substantial impact on intersection safety.

Park and Lord (2007) used a new multivariate technique based on MVPLN models to model data on crash counts by severity. The approach was applied to multivariate crash counts from 451 intersections in California collected over a ten-year period. It demonstrated that the novel MVPLN regression method could deal with both over dispersion and a completely generic correlation structure in the data.

El-Basyouny and Sayed (2013) investigated the association between conflicts and collisions using a dataset corresponding to 51 signalized junctions in British Columbia. A lognormal model was utilized to predict conflicts, and a Negative Binomial (NB) safety performance function based on conflicts was used to forecast collisions. Explanatory variables included collision frequency, average hourly conflicts, average hourly volumes, area type (urban/suburban), the number of through lanes, and the existence of right and left-turn lanes. The findings revealed that the effects of conflicts on collisions are non-linear and decreasing in rate.

For crash frequency modeling, Dong et al. (2014) used a multivariate random-parameters zero-inflated negative binomial model, which outperformed Poisson, negative binomial, and Poisson-lognormal models. Dong et al. (2014) employed a Bayesian multivariate zero-inflated Poisson model in another investigation and

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demonstrated that it could solve correlations among various crash severity levels as well as properly manage observations with zero accidents.

The available research has extensively accounted for the effects of many variables on the frequency of crashes at crossings. However, more research is needed to investigate the contributory effects of pavement condition and intersection work zones on collision frequency. As a result, the purpose of this study is to close this gap by examining the effects of pavement condition, intersection work zone, traffic, and environmental variables on total crash frequency at intersections.

4. Discussion and Findings

4.1 Descriptive Statistics of Accidents

4.1.1 Number of Accidents

For the study period (2013-2016), the number of accidents at each intersection of the study has increased as shown in Table (4-1) and Figure (4-1).

Table 4-1: Number of Accidents at Intersections per Year (Central Traffic Department)

Intersection	Number of Accidents			
	2013	2014	2015	2016
Abdali Intersection	25	46	71	100
Arab Bank Intersection	24	57	60	81
Jabal Al Hussein Intersection	33	148	152	158
Mercedes Intersection	1	4	30	37
Wahidat Intersection	126	325	402	531
Mahatta Intersection	48	85	148	284

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Elba House Intersection	94	229	282	403
Ras Al Ain Intersection	45	127	144	146
External Patrol Intersection	122	334	528	636
Immigrations Office Intersection	90	256	298	341
King Abdullah Park Intersection	75	162	167	199
Tabarbur Intersection	65	144	190	258
Cumulative	748	1917	2472	3174

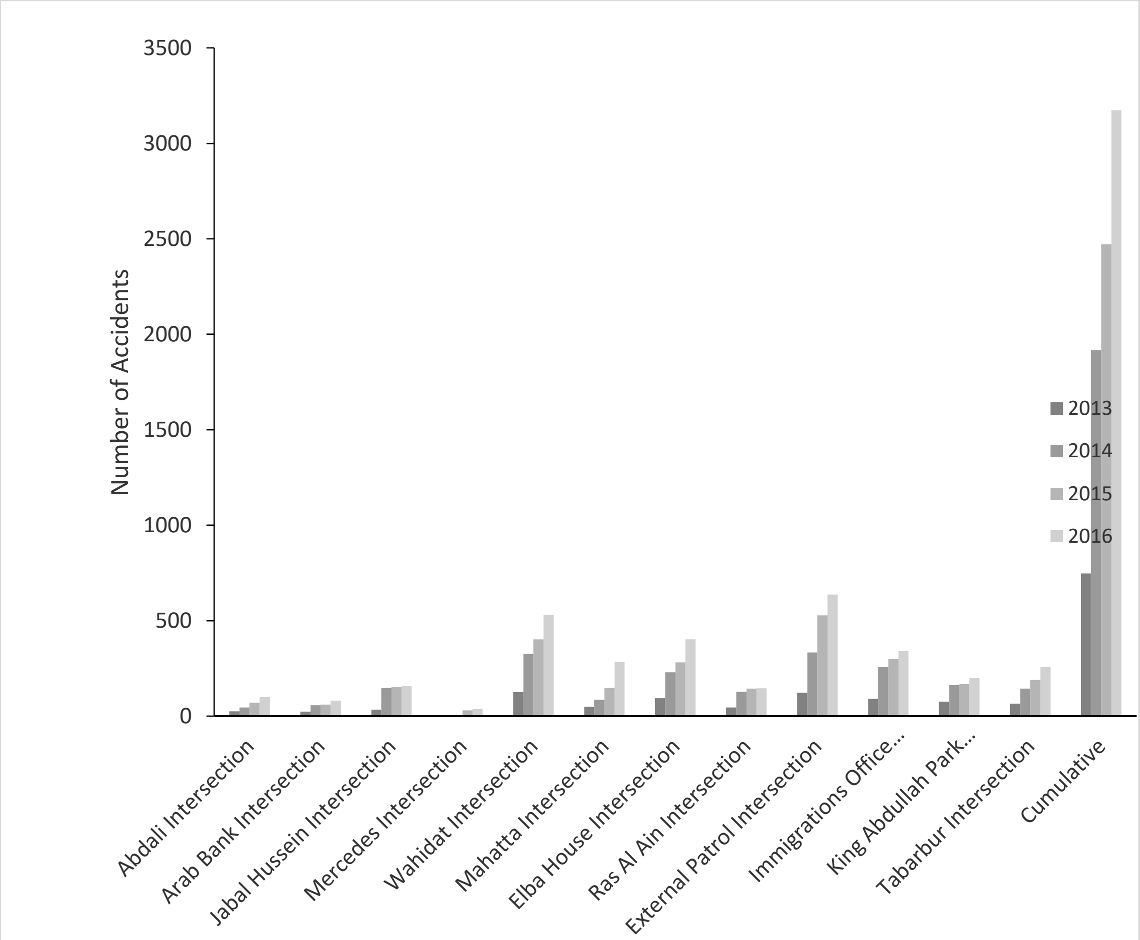

Figure 4-1: Accidents per Year at Intersections

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At particular intersections there might be only a slight increase of accidents or almost on the same level; however, the cumulative data for all intersections combined shows the trend in increase of accidents per year.

4.1.2 Hourly Distribution of Accidents

The distribution of accidents per time of day is shown in Figure (4-2):

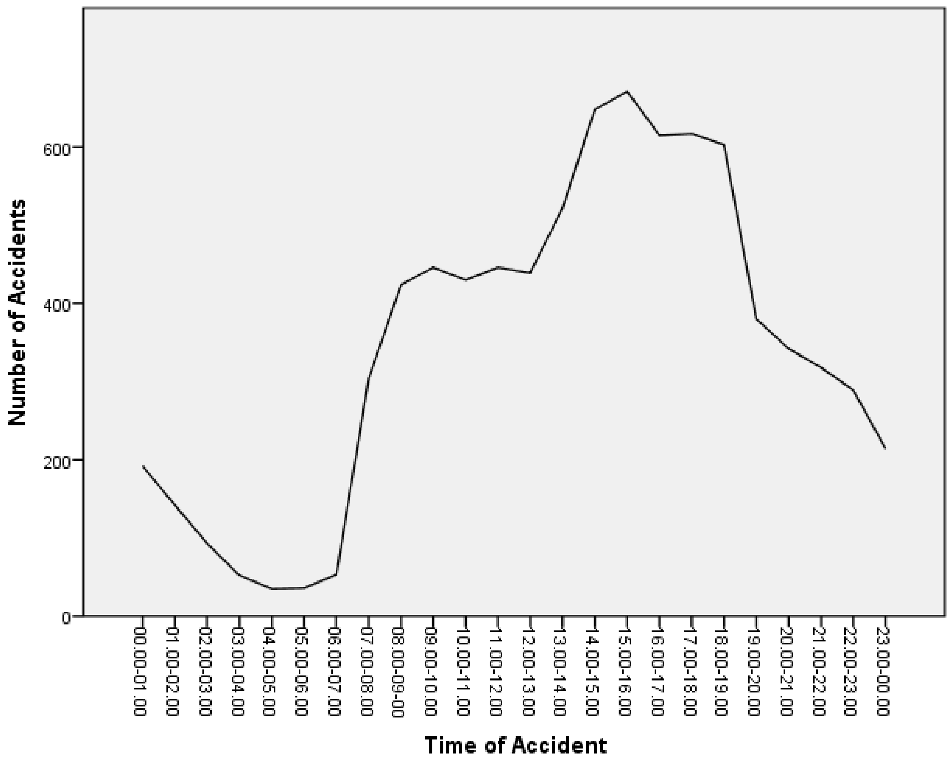

Figure 4-2: Hourly Distribution of Accidents

The lowest number of accidents occurred during the night hours. In the morning, there could be observed the sharp increase of accidents, and further increase of accidents' number is observed during the afternoon.

4.1.3 Distribution of Accidents per Day of Week

Accidence occurrence per day of week follows the pattern of the traffic flow distribution: the frequency of accidents is approximately on the same level during the working days (Sunday through Thursday), with the sharp decrease in number of accidents during Fridays (official holiday) and a slight increase in accidents during Saturdays compared to Fridays. Figure (4-3) shows the decrease in accidents during the weekend (Fridays and Saturdays).

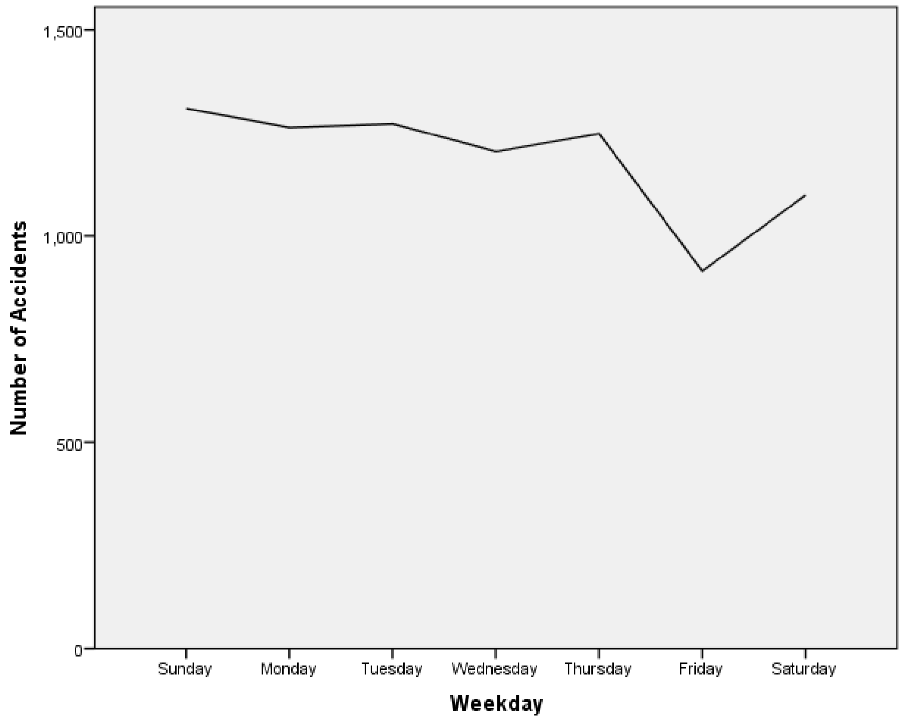

Figure 4-3: Number of Accidents per Day

4.1.4 Types of Accidents

The Traffic Police classifies accidents into three types:

1. Collision with a pedestrian.
2. Skidding of the car.
3. Collision between vehicles.

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The main type of accidents at intersections is collision between vehicles, 97.6%. The number of accidents due to skidding is less than 1 %.

4.1.5 Severity of Accidents

Three categories of severity of accidents are recognized:

1. Property damage only.
2. Injury and property damage.
3. Fatality and property damage.

The majority of accidents 96.5 % result in material damage only, and 3.5% result in injury of persons, while fatalities are less than 1%. As well, it was found that 85.1% of accidents had two vehicles involved, followed by 7.8% with 1 vehicle involvement, and 6.1% with 3 vehicles involvement. Additionally, the majority of accidents, 94.2% do not result in injuries, while only 4.3% of accidents result in injuring one person.

4.1.6 Causes of Accidents

The following categories were identified for the cause of accidents at intersections:

- Backing the vehicle leading to an accident;
- Blocking the traffic;
- Loss of control of the vehicle;
- Noncompliance with the Stop sign;
- Noncompliance with the compulsory regulations;
- Not keeping the safe distance;
- Not taking necessary precautions;
- Opening doors of the vehicle without precautions;
- Overtaking in a place where it's forbidden;
- Reversing with the speed exceeding 20 km/h;

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- Sudden lane change;
- Turning in a forbidden place;
- Turning in the middle of the street;
- Violations of traffic rules and priorities;
- Wrong Lane;
- Wrong turn;
- Crossing a red light

The number and percentage of the main causes of traffic accidents at intersections are presented in Table (4-2):

Table 4-2: Main Causes of Accidents

Cause of Accident	Frequency	Percentage	Cumulative Percentage
Backing the vehicle leading to an accident	654	7.9	7.9
Loss of control of the vehicle	72	.9	8.7
Noncompliance with the Stop sign	139	1.7	10.4
Noncompliance with the compulsory regulations	3	.0	10.4
Not keeping the safe distance	2589	31.2	41.6
Not taking necessary precautions	2355	28.3	69.9
Opening doors of the vehicle without precautions	170	2.0	72.0
Overtaking in a place where it's forbidden	26	.3	72.3

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Cause of Accident	Frequency	Percentage	Cumulative Percentage
Reversing with the speed exceeding 20 km/h	24	.3	72.6
Sudden lane change	502	6.0	78.6
Turning in a forbidden place	24	.3	78.9
Turning in the middle of the street	62	.7	79.7
Violations of traffic rules and priorities	1151	13.8	93.5
Wrong Lane	381	4.6	98.1
Wrong turn	63	.8	98.8
Crossing at red light	96	1.2	100.0
Total	8311	100.0	

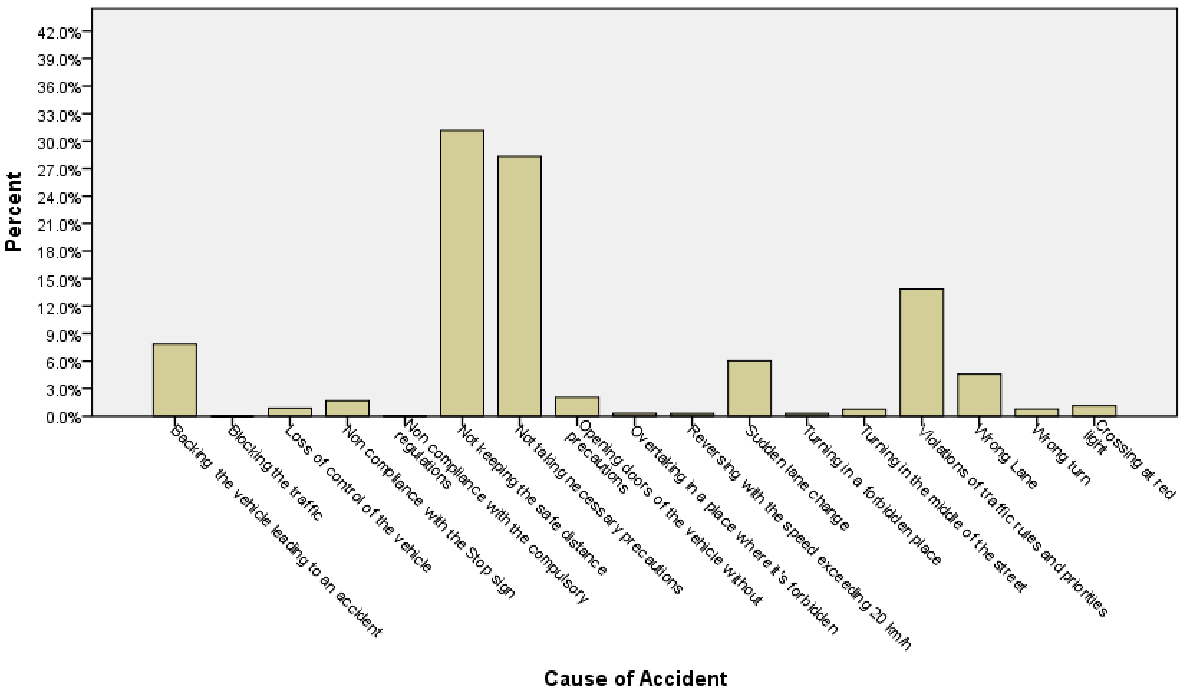

Figure 4-4: Causes of Accidents

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As can be seen from the Table and chart above, the main cause of accidents at the intersections is "Not keeping the safe distance", 31.2%, followed by "Not taking the necessary precautions", 28.3%. The third most common cause of traffic accidents is "Violations of traffic rules and priorities", 13.8%. 1.2% of accidents at intersections are due to crossing the intersection at red light. Therefore, accidents at intersections are attributed to drivers' behavior.

4.2 Location of Accidents

The biggest percentage of accidents happened at a distance of 50-60 m from the center of junctions (28.1%), followed by 15.1 percent and 14.5 percent at a distance of >100 m and 40-50 m, respectively. This phenomenon is explained by the presence of side roads where traffic mixes with traffic at intersections. Another aspect of accident site is the position of the vehicle(s) at the time of the accident, such as whether the accident occurred in the center of the junction, at the right turn at the intersection, or when entering or exiting the intersection. The position of the vehicles is presented in Table 4-3:

Table 4-3: Position at the Time of the Accident

Position	Frequency	Percentage	Cumulative Percentage
Center	947	11.4	11.4
Right turn	887	10.7	22.1
Exiting	2784	33.5	55.6
Entering	3693	44.4	100.0
Total	8311	100.0	

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The cars approaching intersections had the highest percentage of accidents (44.4 percent), followed by the vehicles departing the intersection (33.5 percent). The percentages of accidents at the intersection center and right turn are nearly equal, at 11.4 percent and 10.7 percent, respectively. As a result, the point of merging traffic is the most common place for accidents at intersections.

The highest percent of accidents occurred at a distance of 50-60 m from the center of intersections (28.1%), followed by 15.1% and 14.5% at a distance >100m and 40-50 m, respectively. This phenomenon is explained by existing of side roads from which the traffic merges with the traffic at the intersections. Another assessment of location of accidents is related to the position of the vehicle(s) at the time of the accident, whether the accident happened at the center of the intersection, or at the right turn at the intersection, or entering or exiting the intersection.

The highest percentage of accidents (44.4%) is for the vehicles entering intersections, followed by 33.5% of vehicles exiting the intersection. The percentage of accidents at the center of intersection and right turn is almost equal, 11.4% and 10.7%, respectively. Therefore, the main location of accidents at intersections is the point of merging traffic.

4.3 Parameters of Intersections

The intersections in the study were assessed for patterns of land use, existence of the right turn before the traffic light, number of lanes and number of directions at intersections. The data is summarized in Table:

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Table 4-4: Summary of Intersections' Parameters (Central Traffic Department)

Intersection	**Number of Directions**	**Number of Lanes**	**Right Turn**	**Land Use**
Abdali Intersection	4	4	Yes	Residential and Commercial Mix
Arab Bank Intersection	2	4	No	Residential and Commercial Mix
Jabal Al Hussein Intersection	4	4	Yes	Residential and Commercial Mix
Mercedes Intersection	4	6	Yes	Industrial
Wahidat Intersection	2	6	No	Commercial and Healthcare Mix
Mahatta Intersection	4	4	Yes	Residential and Commercial Mix
Elba House Intersection	4	4	Yes	Industrial
Ras Al Ain Intersection	4	4	Yes	Commercial and Healthcare Mix
External Patrol Intersection	4	4	Yes	Residential and Commercial Mix
Immigrations Office Intersection	4	4	Yes	Residential
King Abdullah Park Intersection	4	6	Yes	Commercial and Healthcare Mix

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Tabarbur Intersection	4	6	Yes	Residential

5. Conclusion and Recommendations

Although the number of injuries and fatalities in all traffic accidents is quite low, vehicle property damage can have major financial consequences for the owners. According to the survey, the biggest cause of intersection accidents is driver behavior, namely "not keeping the appropriate distance" at 31.2 percent, followed by "not taking the essential precautions" at 28.3 percent. At 13.8 percent, "violations of traffic laws and priority" were the third most common cause of traffic accidents. Crossing the red light caused only 1.2 percent of intersection accidents. As a result, incidents at intersections are blamed on driving error.

The majority of accidents happened between 50 and 60 meters from the intersection's center. The side roads from which traffic merges at crossings could explain this behavior. The cars entering the intersection caused the most accidents (44.4 %), followed by the vehicles exiting the intersection (33.5 %). The percentages of accidents at the intersection center and right turn are nearly equal, at 11.4 percent and 10.7 percent, respectively.

Accidents occur at almost the same frequency during the working days (Sunday through Thursday), with a substantial fall in the number of accidents occurring on Fridays (official vacation) and a little increase in accidents occurring on Saturdays compared to Fridays. The AM peak hour for accidents (at junctions) was discovered to be between 8.00 – 9.00 AM, and the PM peak hour was discovered to be between 14.00 -15.00 PM, followed by 17.00-18.00 PM.

The junction data was used to create a multivariate linear regression model with the number of accidents as a dependent variable and the number of lanes, approaches, right turns, and land use as independent variables. The SPSS software was used to compute the model. The established model accurately forecasts the number of accidents and the rate of accidents.

Because of a lack of equipment at the Traffic Police between the years 2013 and 2014, accident recording was disorganized, and not all accidents were recorded. However, with enhanced accident recording in 2015 and 2016, the forecast error ranges from 0.5 to 1.5 %. The model was tested so that it could be used to predict accidents at existing and planned crossings in Amman.

5.1 Recommendations

According to the study, the geometric aspects of the intersection influence the number of accidents, and as traffic increases, the number of accidents increases in a linear fashion each year. Changes in geometric parameters are now not possible; consequently, it is advised that:

- Large advance warning signs, such as yield signs, be installed.
- Use rumble strips ahead of the intersection.
- Pavement markings all over the place.
- Use of speed limit signage.

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According to the survey, the majority of accidents are caused by the drivers' actions. It is suggested that stricter enforcement of traffic restrictions be implemented, as well as increased penalties for violations of traffic rules. Vehicle monitoring could be performed through CCTV cameras installed at intersections. Furthermore, because the bulk of accidents occur during high traffic hours, it is advised that traffic police employees be stationed at intersections during peak hours. The created model offers a high precision method for anticipating traffic accidents at crossings and could be applied to both current and planned intersections. Finally, it is advised that additional research be undertaken in order to increase the model's accuracy by incorporating traffic counts for each approach and lane. More research is needed to evaluate crossings in Jordan's other cities and rural areas.

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