

RELATIONSHIP BETWEEN NUMBER  
OF CRASHES AND THE FACTORS IN THE  
ENVIRONMENT OF URBAN SIGNALISED  
INTERSECTIONS

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I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Master of Science.

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## **STUDENT'S DECLARATION**

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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## ABSTRAK

Kemalangan yang berlaku di persimpangan berlampu isyarat menjadi salah satu penyumbang utama kepada peningkatan kadar kemalangan jalan raya di Malaysia. Peningkatan drastic jumlah kemalangan jalan raya di persimpangan lampu isyarat sejak sepuluh tahun yang lalu dan menyumbang kepada peningkatan jumlah kemalangan jalan raya secara keseluruhannya. Faktor persekitaran telah dikenalpasti sebagai faktor yang paling kerap berada didalam senarai pembaikan persekitaran persimpangan berlampu isyarat di kawasan bandar. Tujuan kajian ini adalah untuk mengkaji hubungan antara jumlah bilangan kemalangan jalan raya dan faktor persekitaran di persimpangan lampu isyarat dalam kawasan bandar berdasarkan data yang dikumpulkan di dalam bandar Kuantan. 14 faktor persekitaran di persimpangan lampu isyarat telah diambil kira untuk menghasilkan model hubungan. Faktor persekitaran tersebut ialah jumlah lalu lintas, jenis penggunaan kawasan, bilangan lorong jalan, had laju, lebar lorong jalan, kewujudan lorong eksklusif, kewujudan pembahagi jalan, kewujudan perhentian bus, kewujudan lampu isyarat bernombor, lebar bahu jalan, jenis bahu jalan, kewujudan lorong belok yang tidak terkawal, lebar pembahagi jalan; dan kondisi penanda jalan dan papan tanda. Terdapat beberapa kaedah statistik yang dilakukan untuk menghasilkan model hubungan diantara faktor persekitaran dan jumlah bilangan kemalangan jalan raya di persimpangan berlampu isyarat tersebut. Pertama, analisis korelasi telah digunakan untuk menentukan nilai korelasi bagi setiap faktor persekitaran dengan jumlah kemalangan jalan raya di persimpangan lampu isyarat. Kemudian, ujian hipotesis telah dijalankan untuk mengetahui hubungan diantara setiap faktor persekitaran dengan jumlah kemalangan jalan raya di persimpangan lampu isyarat yang mempunyai risiko kemalangan. Akhir sekali, *regresi stepwise* digunakan untuk menghasilkan model terbaik bagi perhubungan antara faktor persekitaran dan jumlah kemalangan jalan raya di persimpangan lampu isyarat di kawasan bandar. Hasil analisis korelasi mendapati bahawa jumlah lalu lintas, jenis penggunaan kawasan, bilangan lorong jalan, had laju, lebar lorong jalan, kewujudan lorong eksklusif, kewujudan pembahagi jalan dan lebar pembahagi jalan mempunyai korelasi yang positif dengan kadar kemalangan jalan raya di persimpangan berlampu isyarat. Manakala, kewujudan lampu isyarat bernombor, lebar bahu jalan, jenis bahu jalan, kewujudan lorong belok yang tidak terkawal dan; kondisi papan tanda dan penanda jalan memberi korelasi negatif terhadap kemalangan jalan raya di persimpangan berlampu isyarat. Walau bagaimanapun, kewujudan perhentian bus tidak memberi sebarang impak terhadap kadar kemalangan jalan raya di persimpangan berlampu isyarat. Hasil daripada ujian hipotesis menunjukkan jumlah lalu lintas, jenis penggunaan kawasan, had laju kenderaan, lebar lorong jalan, kewujudan lorong belok yang tidak terkawal dan; kondisi papan tanda dan penanda jalan didapati mempunyai hubungan yang signifikan terhadap jumlah kemalangan jalan raya di persimpangan berlampu isyarat. Hasil utama daripada *regresi stepwise* menunjukkan kawasan pembangunan, had laju yang tinggi, kondisi papan tanda dan penanda jalan yang tidak diselenggara dengan baik dan; ketiadaan lampu isyarat digital telah menyumbang kepada peningkatan jumlah kemalangan jalan raya di persimpangan berlampu isyarat di kawasan bandar. Hasil kajian adalah amat berguna terutamanya bagi pasukan penambahbaikan jalan raya dalam memilih elemen yang tepat dan memerlukan penambahbaikan yang segera di persimpangan berlampu isyarat. Oleh itu, faktor persekitaran di persimpangan lampu isyarat akan dikawal selia untuk menghasilkan persekitaran yang lebih selamat bagi pengguna jalan raya dan kadar kemalangan di persimpangan berlampu isyarat dapat dikurangkan.

## ABSTRACT

Road traffic crash at signalised intersection had becoming one of the main contributors to the increasing number of road traffic crashes in Malaysia. The number of crashes at urban signalised intersection has also recorded a drastic increase for the past ten years and it contributed to the increment in overall number of crashes. Road environment factor appear as most popular factor listed in the road maintenance department's procedure in improving the signalised intersection in the urban area. In light of that, this study aimed to establish the relationship between number of road traffic crashes and the factors in environment of urban signalised intersection based on the data collected in Kuantan town. In order to model the relationship, 14 intersection environment factors at signalised intersection into account which were the traffic volume, type of land use within 100 m radius from intersection area, number of lanes, approaching speed, width of lane, presence of left-turn channel, presence of median, presence of bus stop, presence of digital traffic signal, width of road shoulder, type of shoulder, presence of uncontrolled turning lane, width of road median; and condition of signage and road markings. Several statistical methods were carried out to develop the model. Firstly, a correlation analysis was used to determine the correlation between each intersection environment factor and signalised intersection crashes. Then, a hypothesis testing was done to determine any possible relationship between intersection environment factors and number of crashes at risky signalised intersection. Lastly, a stepwise regression was used to develop the best relationship model between the intersection environment factors and number of road traffic crashes for signalised intersection in Kuantan Town. The correlation analysis revealed that traffic volume, type of land use within 100 m radius from intersection area, number of lanes, approaching speed, width of lane, presence of left-turn channel, presence of median and width of road median had positive correlation with number of road traffic crashes at urban signalised intersection. Meanwhile, presence of digital traffic signal, width of road shoulder, type of shoulder, presence of uncontrolled turning lane and; condition of signage and road marking has a negative correlation against number of road traffic crashes at urban signalised intersection. Surprisingly, the presence of bus stop had no effect on the number of road traffic crashes at signalised intersection. Results from the hypothesis testing revealed that traffic volume, type of land use within 100 m radius from intersection area, approaching speed, width of lane, presence of uncontrolled turning lane and; condition of signage and road marking were found to be significant in describing the relationship between intersection environment factors and number of crashes at signalised intersection. Main outcome from stepwise regression revealed that developed area, higher approaching speed, poor condition of signage and road marking and; absence of digital traffic signal have significantly contributed to an increase in number of crashes at urban signalised intersection. The outcome from the model is very useful especially for the road improvement team in selecting specific signalised intersection's element that requires urgent modification. Hence, the signalised intersection's environment could be control and maintain as to provide safer environment for all road users and consequently, road traffic crashes at signalised intersection also can be reduced.

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## LIST OF ABBREVIATIONS

PDRM	Royal Malaysian Police
RTD	Malaysia Road Transport Department
PWD	Malaysia Public Works Department
WHO	World Health Organization
MIROS	Malaysian Institute of Road Safety Research
FARS	Fatality Analysis Reporting System
FDOT	Florida Department of Transportation
RCI	Roadway Characteristic Inventory
MPK	Kuantan Municipal Council
VRU	Vulnerable road users
REAM	The Road Engineering Association of Malaysia
TV	Traffic Volume
LU	Type of land use
NOL	Number of lanes
AS	Approaching speed
WL	Width of lane
LTC	Presence of left-turn channel
PM	Presence of median
PBS	Presence of bus stop
PDTS	Presence of digital traffic signal
WS	Width of road shoulder
TS	Type of shoulder
UTL	Presence of uncontrolled turning lanes
WM	Width of road median
PSC	Presence of surveillance camera
LC	Condition of signage and road marking
$r$	Correlation coefficient
$r^2$	Coefficient of determination
SE	Standard error
VIF	Variance Inflation Factor

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