AN ANALYSIS ON THE TRAFFIC ACCIDENTS TOURIST AT CASE STUDY: NANTOU COUNTY

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Abstract

In recent years, the tourism industry has flourished in Taiwan.Thus, many famous tourist attractions are packed with people on holidays.This study analyzes the tourists' traffic accidents in Nantou County as well as explores spatial and temporal analysis of traffic accidents. In addition, a Logistic regression is used to construct a model of traffic casualties. The study results indicated that because Provincial Highway 14a serves as the main road leading to renowned tourist attractions in Nantou County, the number and severity of the accidents that occurred on this highway were higher than those that occurred on the other roads. Furthermore, the analysis results and traffic improvement strategies proposed for the identified hazardous locations may serve as reference for road or traffic management agencies wanting to improve road safety facilities and promote traffic safety education.

Keywords: Traffic accident, Spatial analysis, Logistic Regression Model

1. Introduction

Nantou County is situated in the center of Taiwan, with a longitude of 120 degrees and latitude of 23 degrees; It is the only county in Taiwan not geographically close to the sea. With an area of 410km2, Nantou County has more mountainous terrain than plains; surrounded by mountains, Nantou is abundant in tourism resources, with picturesque sceneries everywhere.Sun Moon Lake and Yushan are both internationally renowned destinations(Figure. 1). According to Taiwan tourism statistics (Tourism Bureau.MOTC, 2016), 2014,the year is total of 9,910,204 passengers in Taiwan, There is a record high over the years, compared with 2013 at the same time which is growth of 23.63 percent. Chinese visitors 398, 7152millions, followed by 1.63 , 4,790 million Japanese visitors, including Sun Moon Lake is about 5.06 million tourist visited. They displayed as Sun Moon Lake in Nantou County where is an important tourist attraction; the other areas in Nantou County in 2012-2014 car accidents because tourism about 2,597 members, the death of 11 people, injured 1,059 people (Nantou County Police Bureau, 2015).

Fig. 1 Map of Nantou County in Taiwan

In recent years, due to the geographic information system (GIS) development can provide data collection, processing, analysis and display capabilities, geographic information systems analysis through powerful spatial attributes, will show existing tourist traffic accident in space attribute data, to have it help reduce the likelihood and severity of the accidents, and reduce the traditional data analysis work accidents in statement (Saffet Erdogan, 2008).The main purpose of this study is to establish the geographic information system Accidents attribute analysis are to establish traffic accident-prone road sections and location. After the accident data were input for spatial analysis, logistic regression was employed to construct models regarding tourist deaths and injuries and to determine the correlation coefficients in these models. Accordingly, traffic safety improvement strategies for hazardous locations were formulated to reduce the number of accident casualties, and the analysis results were offered to traffic management agencies for their further development of traffic-accident prevention and reduction strategies.

2. Literature review

Past the main tourist areas in the Discussion Document of traffic accidents, accident severity and patterns, etc. are discussed, and special analysis of traffic accident casualties relatively area for sightseeing. GIS technologies are the most commonly used techniques for identifying hazardous traffic-accident locations and involve the conversion of spatial attribute data into visualizations of traffic accident data and hazardous road sections. Numerous scholars have employed GIS technologies to conduct traffic accident analyses, thereby contributing to and offering substantial assistance to the identification of hazardous locations on highways and the enhancement of traffic safety management (Saffet Erdogan, 2008). When used with available databases, a GIS is useful for geospatial analysis and the application of

spatial analysis to traffic-accident research, and the analysis results can serve as reference for traffic management agencies when they are designing road signs or guidance (Dipali B. Gaikwad, 2014).Using geographic information systems to solve the traditional traffic accident reporting system analysis and spatial attributes to show the problem, according to research analysis related accidents characteristics and flow charts orders to construct the analysis model provided as a reference (Gufran Ahmad Ansari, 2012). Accident-prone locations are to collect data for analysis through geographic information system analysis soft wares ArcGIS, analyze traffic accident location distribution situation, and with the police recorded cross-analysis reports, confirmed the road to traffic accidents, and priority improve road references (Reshma EK, 2012).With computer processing speed, the use of various statistical soft wares are increasingly being used, especially logic regression models are also increasing the using of statistical analysis, researchers can use special logic regression model to analyze or edit other related capabilities, as a research topic of analysis method, logic especially the use of regression techniques can provide researchers in the study of the use of the article content (Chao-ying joanne peng, 2002).However, traffic accidents and other characteristics of tourist areas related cases are not the same accidents, the environment in Taiwan, driver characteristics, with passers-by road habits, automotive and locomotive mixed traffic flow characteristics adds complexity of the problems. Therefore there is a need for extensive data collection and analysis of relevant factors affecting the level of safety sightseeing areas, and important factors summarized to provide transport authorities and highway authorities by references.

3. Methodology

Taiwan's Nantou region is major tourist destination in the summer, the higher the frequency of traffic accidents, resulting in casualties is greater, for Traffic Accident Prevention, it is very much needed to explore and analyze and propose effective improvement strategies to reduce traffic accidents,the traffic fatality rate in 2013 tourism accounted for 10.6 percent of the region occur (Nantou County Police Bureau, 2016). Therefore, geographic information system can effectively analyze the phenomenon of spatial analysis of traffic accidents and more traffic accidents sites, which uses mainly consists of several steps, First year of the 2011-2013 police units to collect traffic accident data 2597, 5677 deaths and injuries and other accidents input data to MS Access database through Super GIS tools(Figure.2), to determine the relationship between the topology, followed by the brightest network traffic to find out easily happen discuss and analyze road accident prone locations defined for traffic: at least 1 km road more of the traffic accident occurred four (Saffet Erdogan, 2008), followed by the cross-correlation analysis of traffic accidents, especially through the logic regression models to explore accident factor. Properties with research data using

frequency analysis to understand Nantou Tourism accidents before, test selections and accidents related to the type of impact factor by chi-square, using logistic regression to build Taiwan's Nantou region traffic accident pattern, and finally synthesizes traffic accident type and the impact of related factors, the present study data analysis processes such as Figure.3. through geographic information system map display, a traffic accident-prone place emphasis on the two main roads linking provincial roads outside the station 14 A and 21-lines.

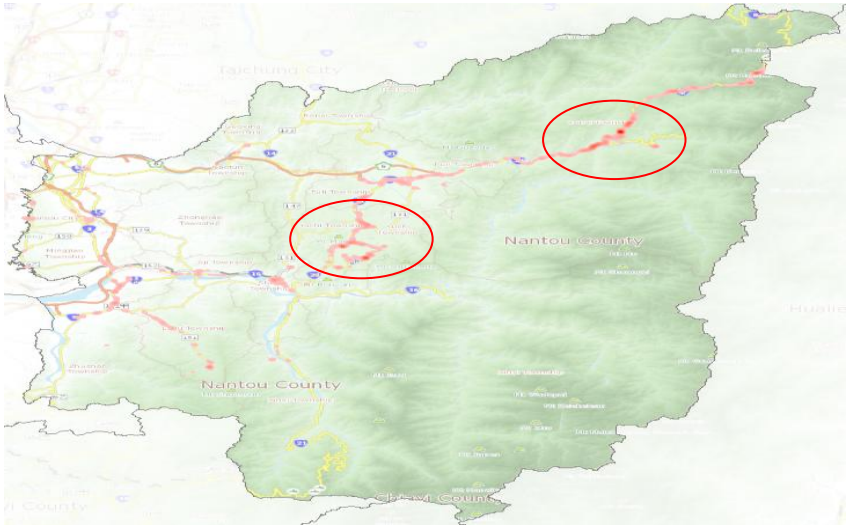

Figure.2. Accidents for GIS

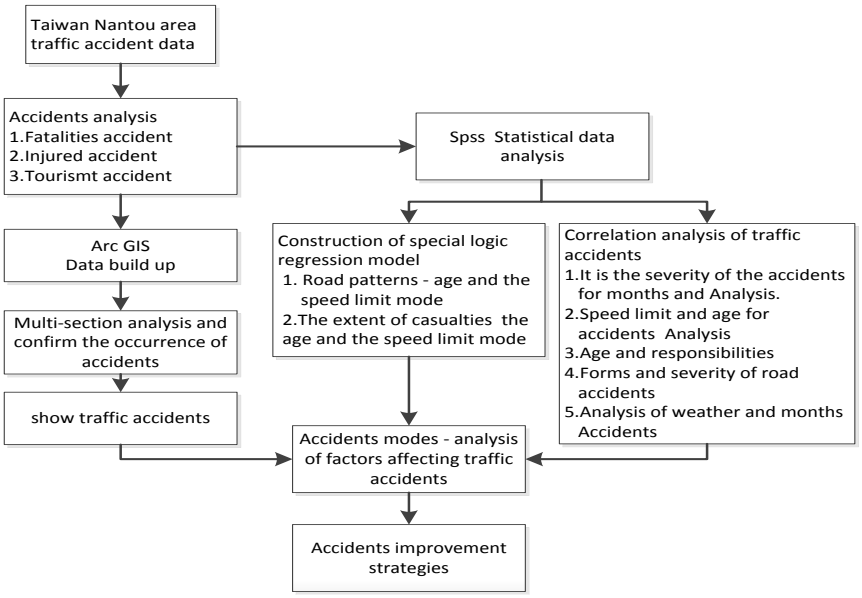

Figure.3. Accidents Data analysis flow chart

3.1 Data Collection

Selected the last three years (2011-2014) Taiwan Nantou region in number of traffic fatalities and injuries and casualties cases 2597, 5677 people hurt, as detailed traffic accident casualties and accident factors, the analysis portion casualties to 5677 people

to understand the characteristics of traffic accidents, deaths and injuries accidents to collect information, travel accident refers to accidents that occur during travel, the number of deaths after 24 hours in traffic fatalities, the number of injuries are due to travel the number of injuries caused by traffic accidents, accident frequency: They refers to the period of observation, because the number of accidents caused by traffic accidents travel cases, the most for accident analysis.

3.2 Logistic Regression Model

A logistic regression model is typically used for constructing models describing driver fatality risk in traffic accidents, and it was suitable for the present study because the collected data were binary and because such models can be easily calibrated and have superior explanatory power than conventional models for the factors affecting traffic accidents. Therefore, a logistic regression model was employed to investigate the effect of various factors on mortality risk in traffic accidents. The binary logistic regression model and odds ratio for categorical variables are next described:

1. The main difference between logistic regression and normal regression is the type of dependent variables involved. The distribution of a logistic regression model is generally S-shaped; the numerical range of the dependent variable is between 0 and 1. Assume that Y is a binary variable, and x is an independent variable; when the jth accident occurs, the probability of Yj = 1 can be expressed as:

$$p(x_j) = P(Y_j = 1|x_j) = 1 - P(Y_j = 0|x_j) \quad \text{.....(1)}$$

2. A univariate logistic regression model can be expressed as:

$$p(x_j) = \frac{e^{\beta_0+\beta_1 x_j}}{1+e^{\beta_0+\beta_1 x_j}} \quad \text{.....(2)}$$

3. The employed logistic regression model was a nonlinear function that contained the variable xj and could be converted into a linear function. The probability that the dependent variable Y = 0 can be defined as:

$$1-p_j = 1 - \left(\frac{e^{\beta_0+\beta_1 x_j}}{1+e^{\beta_0+\beta_1 x_j}}\right) = \frac{1}{1+e^{\beta_0+\beta_1 x_j}} \quad \text{.....(3)}$$

4. Maximum likelihood was used to obtain the parameters of the logistic regression model.In the logistic regression model, a natural exponential equation was generated, with an odds (p/(1−p)) term being converted to an eβ term. After two groups of logistic regression coefficients were compared and a natural exponential was obtained, the odds ratio (OR) was determined from:

$$OR = \frac{p_i/1-p_i}{p_j/1-p_j} = \frac{e^{\beta_i}}{e^{\beta_j}} = e^{\beta_i-\beta_j} \quad \text{.....(4)}$$

5. The relative odds ratio can be obtained by comparing the difference between all coefficients of the dummy variables for the reference category. The coefficient of a dummy variable equals the odds ratio relative to the omitted level, or the reference category.

4. Results and Discussion

4.1 Accident Analysis

This study 2012-2014 tourist Traffic party as a sample, the most important regional tourism traffic accident in Nantou, Taiwan as the main object of study, analysis of the main tourist road traffic accidents more locations, and explore these accidents factors in place the highest density of traffic accidents in winter 1,416 people (31%) and summer 1173 people (27%) two times the highest frequency, time section to 12-18 when 3,459 people (64.8%) to a maximum of the highest frequency of traffic accident deaths during the period of 12-18 6 person maximum, this study focused on the number of traffic accidents is the empirical analysis of road accident, time, direction. such as Figure.4.

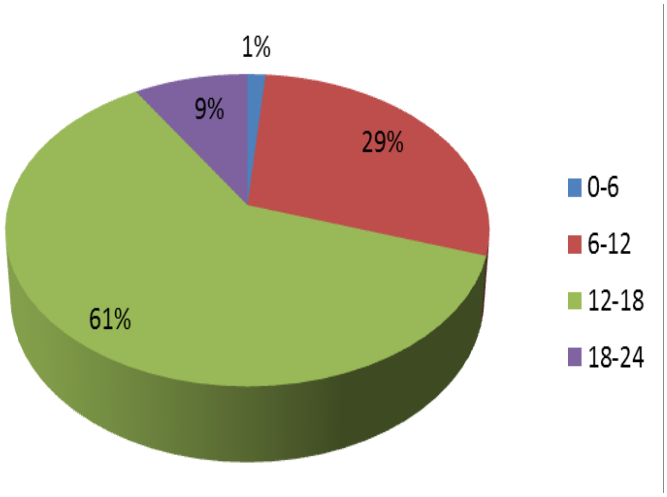

Fig.4.Accident rates according to the occurrence time.

4.2 Logistic Regression Model analysis

To collect samples of all accidents Taiwan Nantou region for the object, a total of 5,677 data applications are associated logistic regression models to explore tourist traffic casualties of each factor against weather impact - limited models are age and speed, road type and the speed limit modes, the extent of casualties - the age and the speed limit modes are for analysis, the two can be reasonable explanations casualties (Table 1).

Table 1 Tourism regional tourism association accident analysis ($\alpha = 0.05$)

	Road patterns age and the speed limit mode	The extent of casualties the age and the speed limit mode
Mode Construction	Strain patterns in the number of road divided highway and road, the speed limit for the independent variables, age.	Degree of strain with the number of casualties, divided highway and roads, the speed limit for the independent variables, age.
Mode Evaluation	mode $\chi 2$ statistics: P = 0.00> 0.05, help predict accidents.	mode $\chi 2$ statistics: P = 0.00> 0.05, help predict accidents.
Wald test mode	Roads and age, the speed of relevance, young accident casualties compared with other age story	The extent of casualties and age, speed is relevant, it is reasonable to explain the extent of casualties.
Explanation	Speed limit and age can reasonably explain the impact of road patterns.	Speed limit and age could reasonably explain casualties extent.

4.3 Tourist Area Traffic Accident Analysis and Improvement Strategy

In this study, Nantou, Taiwan region to collect traffic accident data for statistical analysis, to understand the most important tourist areas of traffic accidents occurred up to the summer and during the winter, a large of tourists' sightseeing area, the number of traffic accidents caused by the more pieces, showing a positive relationship, through analysis of traffic accidents each tourist route leading to the main road and other factors and the severity of the accident, to understand Taiwan Nantou region to the tourist route up to the provincial road traffic accident casualties occurred to the relevant factors to the accident did not pay attention most car accidents before the state, provincial road traffic accidents occurred up to 14-A line, this road is quite famous in Taiwan winter snow leading to tourist attractions, 42 km route length of the mountain road, is the gateway to eastern Taiwan one of the important areas of road, the road accident prone mainly because on the road alpine downhill section, the driver had a little negligent accidents may occur(Table 2).

Table 2 accident-related traffic accidents analysis.

Road	Accident factor ago 3	Traffic improvement suggestions
14-A line	1.The state did not pay attention to the vehicle in front. 2.Not keeping a safe distance from traffic. 3.Failing to reverse provisions.	The corresponding traffic improvement suggestions are as follows: 1.Winding roads, single-lane road sections, narrow road width, and multiple turns can easily lead to traffic accidents. In response, the road's construction and engineering design must be improved and changeable message signs must be installed to warn road users. 2.In response to high traffic volume during vacations, shuttle bus routes must be well designed to reduce the number of self-owned vehicles on the mountain highway.
21-A line	1.The state did not pay attention to the vehicle in front. 2.Failing versing provisions 3.The violation of specific markers (line) prohibition	1. This four-lane highway features straight downgraded roads, resulting in speeding, improper lane changing, poor visibility of farm road intersections, and improper turning or U-turns at intersections. 2.Most of the accidents occurring on express lanes and intersections were caused by speeding or improper turning or U-turns. In response, left turns or improper turning or U-turns must be banned or the law enforcement in this regard must be increased.

5.Conclusion

In this study, Nantou, Taiwan region tourist traffic accidents associated with factors of influence, and based on traffic accident data features will be discussed separately to collect information through geographic information systems and logic special mode. the study showed accidents to occurred mainly in the summer and winter, we explore these factors position the accident occurred in traffic accidents, accidents in winter is the use of large sets of 14 A visit Acacia mountain snow or hot water soak trip times, places Provincial Highway 21 Summer Vacation Sun Moon Lake tourist crowded are more characteristic of summer and winter accidents vary, analyze the extent of casualties through the logic Laid back age and the speed limit mode, road patterns age and the speed limit mode analysis, the degree of correlation can reasonably explain the accident, traffic accident factor in the state did not pay attention to the vehicle in front, not keeping a safe distance from the traffic and parking regulations Failing to most, make relevant factors for the improvement of accident Measures and Prevention Strategies. However, accurate spatial analysis results rely on the accurate recording of traffic accident locations. Therefore, this study suggests that traffic accident location reporting should be integrated with smartphone positioning or other GPS devices. If the coordinates of the accident location are correctly recorded, a hazardous location can be accurately visualized, thereby leading to more accurate analysis results and useful information.

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