

A STUDY OF PEDESTRIAN COMPLIANCE AT SIGNALIZED INTERSECTION CROSSWALKS

Dr. Michael R. Williamson
Assistant Professor
Indiana State University

OVERVIEW

- Introduction
- Literature Review
- Data Collection
- Methodology
- Data Analysis
- Results

LITERATURE REVIEW

- Pedestrian Safety
 - Global Level
 - National Level
 - Local Level

GLOBAL LEVEL

- World Health Organization
 - Worldwide 270,000 pedestrians are killed annually
 - Pedestrians account for 22 percent of all deaths
 - Millions of pedestrian are disabled annually

GLOBAL LEVEL

- World Health Organization
 - Developed counties have highest fatality rates pedestrians
 - Age group at highest risk of 20 and 44
 - Pedestrian behavior as a key in pedestrian safety
 - Distractions
 - Compliance with traffic laws
 - Interaction with traffic

GLOBAL LEVEL

- Canada
 - Common pedestrian violations
 - Failure to yield to vehicles
 - Crossing against a pedestrian signal
 - Crossing outside of designated markings
 - Human behavior understudied factor
 - Resulting in increased risk to pedestrians
 - 21 percent of the pedestrians are in violation of traffic laws

GLOBAL LEVEL

- Belgium, France, Germany, Australia, and United States
 - Pedestrian compliance
 - 20 to 25 percent violate traffic laws
 - Increasing the chance of a pedestrian accident
 - Belgian cities pedestrian compliance
 - Compliance with the complexity of the intersection
 - Traffic volume
 - Pedestrian facilities



NATIONAL LEVEL

- United States
 - Pedestrians over the age of 75 have the highest fatality rate
 - Males represent 70 percent of pedestrian deaths
 - 76 percent of pedestrian collisions occur in the urban areas
 - 62 percent occur between 6am and 6pm on workdays
 - Concentrations occur between 3pm and 3am on weekends



STATE OR LOCAL LEVEL

- Safety plan that includes achieving zero fatalities
 - Indiana
 - Five year average 1671 pedestrian crashes
 - 90 percent injury
 - 4 percent fatal
 - 6 percent no injury/PDO
 - Illinois
 - Improve pedestrian compliance by 12 percent
 - Repainting crosswalks
 - Replacing faded signage



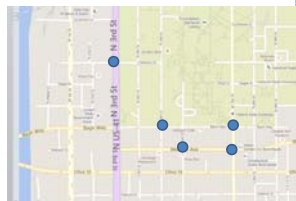
STUDY INTRODUCTION

- Study of pedestrian behavior
- Focused in University environment
- Purpose identify factors effecting compliance
- Focus on college age students
- Compare compliance to other studies

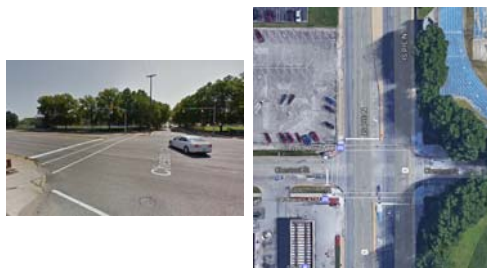


DATA COLLECTION

- 15 minute intervals
- Vehicle counts
- Pedestrian counts
- Compliance
- Push button presence
- Cycle length



PIC OF INTERSECTIONS



PRELIMINARY RESULTS

- 3 month period
- 2645 pedestrians observed
- 5 intersection near ISU campus
- Compliance rate near campus
 - 1424 compliant
 - 1221 non-compliant
 - 46.2 percent violate traffic laws
 - 53.8 percent compliant rate

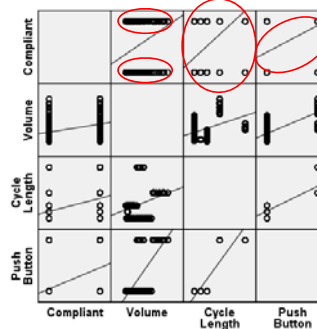
METHODOLOGY

- Observe pedestrians in a naturalistic environment
- Correlations between variables
- Binary Logistic Regression Modeling
 - Dependent Variable
 - Compliant vs. non-compliant
 - Independent Variables
 - Volume
 - Cycle Length
 - Push Button Presences

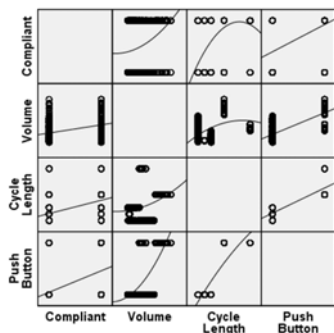
DATA ANALYSIS

| | | Correlations | | | |
|--------------|---------------------|--------------|--------|--------------|-------------|
| | | Compliant | Volume | Cycle Length | Push Button |
| Compliant | Pearson Correlation | 1 | .326** | .486** | .466** |
| | Sig. (2-tailed) | | .000 | .000 | .000 |
| | N | 2645 | 2645 | 2645 | 2645 |
| Volume | Pearson Correlation | .326** | 1 | .358** | .772** |
| | Sig. (2-tailed) | .000 | | .000 | .000 |
| | N | 2645 | 2645 | 2645 | 2645 |
| Cycle Length | Pearson Correlation | .486** | .358** | 1 | .815** |
| | Sig. (2-tailed) | .000 | .000 | | .000 |
| | N | 2645 | 2645 | 2645 | 2645 |
| Push Button | Pearson Correlation | .466** | .772** | .815** | 1 |
| | Sig. (2-tailed) | .000 | .000 | .000 | |
| | N | 2645 | 2645 | 2645 | 2645 |

LINEAR FIT OF THE CORRELATIONS

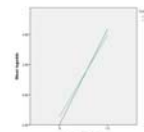


QUADRATIC FIT OF THE CORRELATIONS



BINARY LOGISTIC REGRESSION MODELING

- One or more explanatory variables
- Independence in the observations
- Predicting a dichotomous outcome
- Linearity between one or more independent variable
- Similar to multiply regression modeling
- Estimates the probability of an event of interest



BINARY LOGISTIC REGRESSION MODEL

$$P(\beta) = \frac{1}{e^{-\beta_0 + \beta_1 X_1 + \dots + \beta_{n-1} X_{n-1}}}$$

- Where:
 - $P(\beta)$ is the probability of compliance
 - β_i are coefficients for the effect of the independent variables
 - X_i are the independent variables
 - Volume
 - Cycle Length
 - Push Button Presences

MODEL TESTING

- Null hypothesis test
 - Block without predictors vs. full model with predictors
- Omnibus test of model coefficients
- Chi-Square to measure the effectiveness
- Significance level of 0.05

Omnibus Tests of Model Coefficients

| | | Chi-square | df | Sig. |
|--------|-------|------------|----|------|
| Step 1 | Step | 869.648 | 3 | .000 |
| | Block | 869.648 | 3 | .000 |
| | Model | 869.648 | 3 | .000 |

TESTING OF THE MODEL

- Null model
- Predicting compliance

Classification Table^{a,b}

| | Observed | Predicted | | Percentage Correct |
|--------------------|-----------|-----------|------|--------------------|
| | | .0 | 1.0 | |
| Step 0 | Compliant | .0 | 1221 | .0 |
| | 1.0 | 0 | 1424 | 100.0 |
| Overall Percentage | | | | 53.8 |

TESTING OF THE MODEL

- Full model
- Predicting compliance

Classification Table^a

| | Observed | Predicted | | Percentage Correct | |
|--------------------|-----------|-----------|------|--------------------|------|
| | | .0 | 1.0 | | |
| Step 1 | Compliant | .0 | 983 | 238 | 80.5 |
| | 1.0 | 312 | 1112 | 78.1 | |
| Overall Percentage | | | | 79.2 | |

PREDICTOR VARIABLES

| | | Score | df | Sig. |
|--------------------|---------------|---------|----|------|
| Step 0 | Variables | | | |
| | Volume | 281.928 | 1 | .000 |
| | CycleLength | 625.315 | 1 | .000 |
| | PushButton(1) | 574.873 | 1 | .000 |
| Overall Statistics | | 702.869 | 3 | .000 |

MODELING RESULTS

- B is the model constant
- SE is standard error in B
- Wald statistic which is Chi-Square $W = \frac{B_i^2}{SE_{B_i}^2}$
- Sig. is the p-value (alpha of 0.05)
- Exp(B) is the odds ratios
- Greater than one indicates greater chance of compliance

| | | B | S.E. | Wald | df | Sig. | Exp(B) |
|---------------------|---------------|---------|-------|---------|----|------|--------|
| Step 1 ^a | Volume | .004 | .001 | 38.764 | 1 | .000 | 1.004 |
| | CycleLength | .172 | .013 | 165.550 | 1 | .000 | 1.188 |
| | PushButton(1) | 1.264 | .409 | 9.565 | 1 | .002 | 3.538 |
| | Constant | -15.462 | 1.463 | 111.639 | 1 | .000 | .000 |

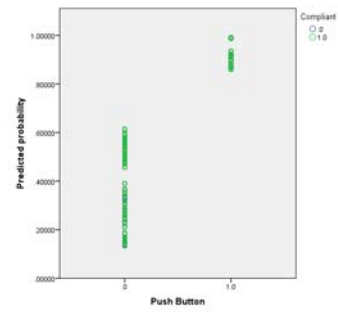
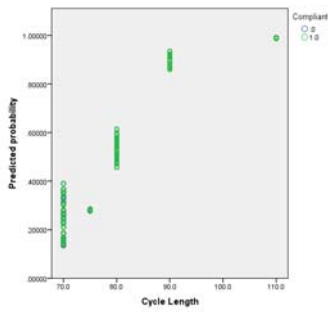
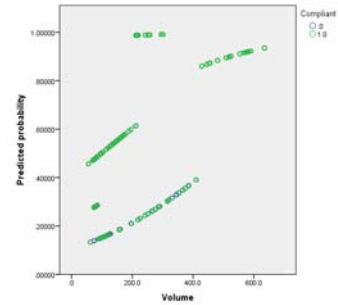
FINAL MODEL

$$P(\beta) = \frac{1}{e^{-\beta_1 + \beta_2 \chi_1 + \dots + \beta_{n-1} \chi_{n-1}}}$$

$$P(\beta) = \frac{1}{e^{-15.462 + 1.264 \cdot \chi_1 + 0.172 \cdot \chi_2 + 0.004 \cdot \chi_3}}$$

Where:

- P(β) is the probability of compliance
- χ₁ is the push button presence (0 or 1)
- χ₂ is the cycle length in seconds
- χ₃ is the volume in vehicles entering (15 minute interval)



RESULTS

- Identified compliance rate of college age students
 - More violations than average
 - 46.2 percent violate traffic laws vs. 20 to 25 percent
- Developed a model to predict compliance based on:
 - Volume
 - Cycle Length
 - Push Button

FURTHER STUDY NEED

- Traffic volume breaking point
- Push button effect
 - Need more locations

CONTACT INFORMATION

- Michael R. Williamson Ph.D.
 - Assistant Professor, Dept. of Civil Engineering,
Indiana State University, Terre Haute, IN 47809
Phone: 217-343-7512;
email: michael.williamson@indstate.edu

