

SCHOOL BICYCLE HELMET USAGE STUDY



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June 30, 2008

Signed and Sealed by:

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Date: _____

EXECUTIVE SUMMARY

State law requires elementary and middle school students commuting to and from school by bicycle to wear an approved safety helmet. Law enforcement agencies in Brevard however have been reluctant to issue citations to offending bicyclists. The Brevard Community Traffic Safety Team (CTST) in collaboration with law enforcement agencies in Brevard County is therefore currently pursuing the “Wear It or Walk It” program. Under this program bicycle safety helmets will be provided to non-compliant students free of charge, upon request. As a result law enforcement personnel will then require offending bicyclists to walk their bicycles to and from their destinations, and will notify the school. This report presents an evaluation of current usage of bicycle safety helmet usage by elementary school students in Palm Bay, Florida, prior to the commencement of the “Wear It or Walk It” program. Data was collected and statistical analyses performed to establish current trends. The analysis shows considerable variation in helmet usage from one school to another. The majority of the schools showed 30 – 35% compliance. Only one school, Discovery Elementary, showed helmet usage among bicyclists in excess of 50%. It is concluded that bicycle helmet usage in Palm Bay is too low, and it is recommended that the City participate in the “Wear It or Walk It” program to increase helmet usage and improve bicycle safety.

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INTRODUCTION

State law requires elementary and middle school students commuting to and from school by bicycle to wear an approved safety helmet. Law enforcement agencies in Brevard however have been reluctant to issue citations (tickets) to offending bicyclists due to their young age and potential challenges, and objections from parents, and school authorities for various reasons. The Brevard Community Traffic Safety Team (CTST) in collaboration with law enforcement agencies in Brevard County is therefore currently pursuing the “Wear It or Walk It” program. Under this program bicycle safety helmets will be provided to a non-compliant student free of charge upon request by parents or school administration. As a result law enforcement personnel will then require offending bicyclists to walk their bicycles to and from their destinations, and will notify the school who will then notify the parents.

In order to evaluate the resources required to pursue this program, and also to evaluate its impacts, member jurisdictions of the Brevard CTST have been tasked to conduct a before and after study of bicycle helmet usage in their area. This report presents the “before” implementation data and analysis for the City of Palm Bay, Florida.

OBJECTIVES

The objectives of this study are:

1. to collect data on school bicycle helmet compliance in the City of Palm Bay, Florida,
2. to perform a statistical analysis to establish current trends,
3. to identify areas for improvement, and
4. to establish thresholds and indicators for future performance/ compliance.

STUDY PROCEDURES

The data collection procedures used in this study are consistent with the Florida Department of Transportation (FDOT) references Manual on Uniform Traffic Studies (MUTS), and Pedestrian Planning and Design Handbook. The statistical analysis procedures are compliant with the Federal Engineering Statistics Handbook¹.

DATA COLLECTION

The data was collected at designated school crosswalks by Palm Bay school crossing guards crossing guards². A summary of the data is presented in Table 1. The field notes are in Appendix A.

¹ NIST/SEMATECH *e-Handbook of Statistical Methods*, <http://www.itl.nist.gov/div898/handbook/>, Accessed October 12, 2008

² under the supervision of Earline Taylor, S.C.G.S; and Erv Wall, S.C.G.S.

Table 1: Bicycle helmet use data

School	Intersection		Bicyclists	No Helmet
Christa McAuliffe	Minton	Americana	32	17
	Alcantara	Chamberlin	24	14
Columbia Elementary	San Filippo	Waco	22	17
	Waco	Zanzibar	29	19
Discovery Elementary	Emerson	Glendale	40	7
	Glendale	South Entrance	14	2
	Glendale	Jacobin	20	5
Jupiter Elementary	Jupiter	Walpole	15	1
	Jupiter	Garvey	9	1
	Town	Tupelo	18	4
	Tupelo	Wells	12	8
Lockmar Elementary	Emerson	Pepper	18	9
Odyssey Charter	Eldron	Raleigh	14	12
	Eldron	School Ent	7	5
Palm Bay Elementary	Glenham	School Driveway	5	2
Palm Bay Charter (Patriot)	Wyoming	Tradewinds	27	26
Port Malabar Elementary	Barker	Cambridge	28	18
	Pioneer	School Entrance	30	19
Riviera Elementary	Mariposa	Mascot	7	3
	Riviera	Crosswalk	6	3
Southwest Middle	Eldron	Malabar	15	3
	Eldron	Buzby	17	17
	Eldron	Jupiter	24	21
Turner Elementary	Eldron	Jupiter	58	27
	Eldron	Buzby	6	6
	Emerson	Jupiter	9	1
Westside Elementary	Degroodt	Gamwell	15	13
	Degroodt	Bayside High Ent	30	27

ANALYSIS

The first objective of the analysis is to establish if the usage/ non-usage rates at each school are consistent with each other. In other words is their reason to believe usage/ non-usage is the same at all locations, or does it differ based on the observed usage/ non-usage rates? Step 2 involves identifying locations which are distinguished from the others given the results in the first step, and to show that the usage/ non-usage rates are different from each other.

Step 1:

This analysis involves the comparison of several proportions. This is a problem well documented in the Statistics literature. It can that can be analyzed using the Chi-Square Test. The test notation and computation details can be found in Appendix B.

The Chi-squared test requires:

1. Independence of events: In this study locations whose observation may be related to that of another location violate this requirement and were removed from the analysis. This was done by reviewing GIS maps and identifying locations where a stream of school bicyclists may move from one location to the next and hence violate the independence of the observations at these locations. For example at Discovery Elementary, it can be seen that bicyclist counted at Emerson/ Glendale may also be counted at Glendale/ School driveway as they head south to school in the morning or north in the afternoon. Therefore Glendale/ School driveway was eliminated from the analysis.

2. The expected value in any category (helmet usage or no helmet usage) shall not be less than 5, otherwise the validity of the test for that data set is in doubt. Therefore schools not meeting this requirement were eliminated from further consideration.

The counts associated with each school were then totaled and the analysis performed on a school-by-school basis. The test characteristic is the proportion wearing helmets. The results of the Chi-square test for the data collected in this study is presented in Table 2. The resulting calculated test statistic is 70.39. From the tables, the Chi-square value for 9 degrees of freedom and confidence level 95% ($\alpha = 0.05$), equals 16.919.

That is,

Chi-square calculated > Chi-square from Tables

Therefore we reject the null hypothesis and conclude that at least one of the observed helmet usage rates is not consistent with the others. In other words, statistically, the **helmet usage varies considerably from one school to another.**

Table 2: Chi-square test calculations

School	Intersection		Helmet	No Helmet	Bicyclists	Prop_H	Prop_NH	χ^2
Christa McAuliffe	Minton	Americana	15	17	32	0.4688	0.5313	
	Alcantara	Chamberlin	10	14	24	0.4167	0.5833	
Columbia Elementary	San Filippo	Waco	25	31	56	0.4464	0.5536	0.021193
	Waco	Zanzibar	5	17	22	0.2273	0.7727	
Discovery Elementary	Emerson	Glendale	10	19	29	0.3448	0.6552	
	Glendale	Jacobin	15	36	51	0.2941	0.7059	1.504659
Jupiter Elementary	Emerson	Glendale	33	7	40	0.8250	0.1750	
	Town	Tupelo	15	5	20	0.7500	0.2500	
Lockmar Elementary	Emerson	Pepper	48	12	60	0.8000	0.2000	6.698076
	Emerson	Pepper	14	4	18	0.7778	0.2222	
Port Malabar Elementary	Barker	Cambridge	14	5	18	0.7778	0.2222	1.751018
	Pioneer	School Entrance	9	9	18	0.5000	0.5000	
Riviera Elementary	Mariposa	Mascot	9	9	18	0.5000	0.5000	0.020952
	Riviera	Crosswalk	10	18	28	0.3571	0.6429	
Southwest Middle	Eldron	Malabar	11	19	30	0.3667	0.6333	
	Eldron	Jupiter	21	37	58	0.3621	0.6379	0.625079
Turner Elementary	Mariposa	Mascot	4	3	7	0.5714	0.4286	
	Riviera	Crosswalk	3	3	6	0.5000	0.5000	
Westside Elementary	Eldron	Malabar	7	6	13	0.5385	0.4615	0.068481
	Eldron	Jupiter	12	3	15	0.8000	0.2000	
Westside Elementary	Eldron	Jupiter	3	21	24	0.1250	0.8750	
	Emerson	Jupiter	15	24	39	0.3846	0.6154	0.257568
Westside Elementary	Eldron	Jupiter	31	27	58	0.5345	0.4655	
	Emerson	Jupiter	8	1	9	0.8889	0.1111	
Westside Elementary	Degroodt	Gamwell	39	28	67	0.5821	0.4179	0.904776
	Degroodt	Bayside High Ent	2	13	15	0.1333	0.8667	
Total	Degroodt	Bayside High Ent	3	27	30	0.1000	0.9000	
			5	40	45	0.1111	0.8889	5.663819
Total			198	228	425	0.4659	0.5341	70.39022

Step 2

The objective of this analysis is to identify which locations differ from others. Each location's proportion of helmet users is tested against a specified proportion of compliance at 95% confidence. This problem is the one-tail hypothesis test widely utilized in the statistical literature. A brief description of one-tail tests is provided in Appendix C. The test statistic is calculated from the standard normal distribution (z-score). For smaller sample sizes less than 30, the Student t-distribution is used. Also the expected value in any category (helmet usage or no helmet usage) shall not be less than 5, otherwise validity of the test for that data set is in doubt. Schools not meeting this requirement were not tested and can only be addressed in a more detailed study. The results are summarized in Table 3.

In Table 3 **the statistically valid percentage of helmet compliance is the lowest prescribed percentage for which the one cannot reject the hypothesis** that the actual proportion of usage equals the prescribed proportion based on the hypothesis test. For example the proportion of helmet usage at Christa McAuliffe Elementary is 35%.

Step 3

To meet the requirements for valid statistical conclusions some locations were eliminated from testing. Conclusions at these locations can be made by comparing the "raw" proportions of usage (deduced from Table 1) with those of other locations established by the statistical procedures (Step 2). A summary of the calculation methodology is shown in Appendix D. For example Palm Bay Charter School (Patriot) (which was deleted from the testing procedure of Step 2 due to expected number of helmet user of 2, which is less than 5) was compared with Columbia Elementary and it was found that the "raw" helmet usage percentages were not different, statistically. Therefore helmet usage rate at Palm Bay Charter School (Patriot) by inference is the same as at Columbia Elementary and equals 50%.

Summary

Based on the statistical analysis, bicycle helmet usage percentages by students at selected schools in Palm Bay are presented in Table 4.

Table 3: Hypothesis tests for proportions of helmet users

School	Intersection	Helmet	No Helmet	Bicyclists	Prop_H	Prop_NH	test statistic for prescribed proportion of helmet usage (p ₀)													
							0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60					
Christa McAuliffe	Minton	15	17	32	0.4688	0.5313														
	Alcantara Chamberlin	10	14	24	0.4167	0.5833														
Columbia Elementary		25	31	56	0.4464	0.5536	4.6103	3.3947	2.3912	1.5129	0.7092	-0.0537	-0.8018	-1.5579						
	San Filippo Waco	5	17	22	0.2273	0.7727														
Discovery Elementary	Waco	10	19	29	0.3448	0.6552														
		15	36	51	0.2941	0.7059	1.6803	0.7276	-0.0917	-0.8367										
Jupiter Elementary	Emerson	33	7	40	0.8250	0.1750														
	Glendale Jacobin	15	5	20	0.7500	0.2500														
Lockmar Elementary		48	12	60	0.8000	0.2000	11.6190	9.8387												
	Town Tupelo	14	4	18	0.7778	0.2222														
Port Malabar Elementary	Emerson	9	9	18	0.5000	0.5000	6.1283	5.1711	4.4234	3.8051										
	Barker Pioneer	10	18	28	0.3571	0.6429	3.1820	2.4495	1.8516	1.3342	0.8660	0.4264	0.0000	-0.4264	-0.8660					
	School Entrance	11	19	30	0.3667	0.6333														
		21	37	58	0.3621	0.6379	3.0857	1.9711	1.0315	0.1927	-0.5897	-1.3461								

Notes:

- XXXX indicates reject the null hypothesis that proportion wearing helmets equals the prescribed proportion and conclude the proportion wearing helmets is greater than that prescribed proportion.
- XXXX indicates fail to reject the null hypothesis and conclude that proportion wearing helmets equals the prescribed proportion.
- blank cells indicate sample size is inadequate to make a statistical conclusion at the prescribed proportion of helmet usage.
- $Z_{0.05} = 1.645$
- $t_{0.05,17} = 1.7396$
- $t_{0.05,13} = 1.7709$

Table 3 (Continued): Hypothesis tests for proportions of helmet users

School	Intersection	Helmet	No Helmet	Bicyclists	Prop_H	Prop_NH	test statistic for prescribed proportion of helmet usage (p_0)													
							0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60					
Riviera Elementary	Mascot	4	3	7	0.5714	0.4286														
	Crosswalk	3	3	6	0.5000	0.5000														
Southwest Middle		7	6	13	0.5385	0.4615	3.0509	2.4019	1.8762	1.4246	1.0190	0.6411	0.2774	-0.0836	-0.4529					
	Malabar	12	3	15	0.8000	0.2000														
Turner Elementary	Jupiter	3	21	24	0.1250	0.8750														
		15	24	39	0.3846	0.6154	2.8823	1.9415	1.1531	0.4532	-0.1961	-0.8208								
Turner Elementary	Jupiter	31	27	58	0.5345	0.4655														
	Jupiter	8	1	9	0.8889	0.1111														
		39	28	67	0.5821	0.4179	7.8188	6.2776	5.0387	3.9829	3.0424	2.1733	1.3439							

Notes:

- **XXX** indicates reject the null hypothesis that proportion wearing helmets equals the prescribed proportion and conclude the proportion wearing helmets is greater than that prescribed proportion.
- **XXX** indicates fail to reject the null hypothesis and conclude that proportion wearing helmets equals the prescribed proportion.
- blank cells indicate sample size is inadequate to make a statistical conclusion at the prescribed proportion of helmet usage.
- $Z_{0.05} = 1.645$
- $t_{0.05,17} = 1.7396$
- $t_{0.05,13} = 1.7709$

Table 4: Results summary

School	Percent Helmet Compliance	Basis
Christa McAuliffe	35	Statistically established
Columbia Elementary	25	Statistically established
Discovery Elementary	50	Test shows greater than Turner
Jupiter Elementary	50	Test shows not different from Turner
Lockmar Elementary	35	Statistically established
Odyssey Charter	25	Test shows no different from Columbia
Palm Bay Elementary	50	Test shows no different from Turner
Palm Bay Charter (Patriot)	25	Cannot exceed 25%. Based comparison with Columbia
Port Malabar Elementary	30	Statistically established
Riviera Elementary	35	Statistically established
Southwest Middle	30	Statistically established
Turner Elementary	50	Statistically established
Westside Elementary	25	Cannot exceed 25%. Based comparison with Columbia

CONCLUSIONS

This report documents the collection of data on bicycle helmet usage among elementary school students in Palm Bay, Florida. Statistical analyses were performed that established the following:

- **Helmet usage varies from school to school.** Uniform usage among the schools does not currently occur.
- The level of helmet compliance can be grouped into three categories as
 - 25% compliance or less: Columbia Elementary, Odyssey Charter, Palm Bay Charter (Patriot), and Westside Elementary.
 - Between 25% and 50% (non-inclusive): Christa McAuliffe Elementary, Lockmar Elementary, Port Malabar Elementary, Riviera Elementary, and Southwest Middle.
 - 50% compliance or above: Discovery Elementary, Jupiter Elementary, Palm Bay Elementary, and Turner Elementary.
- Discovery Elementary has the highest compliance, in excess of 50%. No location was shown to have 75% compliance.
- The current **helmet usage in Palm Bay is too low.**

The following recommendations are provided:

- It is recommended that that bicycle safety awareness and education efforts be pursued by the schools in collaboration with City and County agencies, and law enforcement.
- It is **recommended that Palm Bay participate in the “Wear It or Walk It “ program** to increase bicycle helmet usage among elementary school students in the City.

APPENDIX A

Bicycle Volumes

Christa Mc Auliffe

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

FORM 750-020-09
TRAFFIC ENGINEERING
07/99

PEDESTRIAN VOLUME SHEET

LOCATION ID: Minton Rd. & Americana

COUNTY: Brevard

CITY: Palm Bay

TYPE OF CONTROL: Signal/w Ped signals

STUDY DATE: 09/29/08

TIME: FROM 7:15 TO 8:15

OBSERVER: J.B. / EOT.

REMARKS:

Total:			32
NO HELMET:			17

Distance _____ feet
Raised Median Yes • No •



Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

Minton Rd. Americana Street

Distance _____ feet
Raised Median Yes • No •



Christa McAuliffe

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

FORM 750-020-09
TRAFFIC ENGINEERING
07/99

PEDESTRIAN VOLUME SHEET

LOCATION ID: Alcantarra St. + Chamber Lin

COUNTY: Brevard

CITY: Palm Bay

TYPE OF CONTROL: No Traffic sig.

STUDY DATE: 09/26/08

TIME: FROM 7:15 TO 8:15

OBSERVER: J.A./EDT

REMARKS:

Distance _____ feet

Raised Median Yes • No •

TOTAL:			24
NO HELMET:			14

Distance _____ feet

Raised Median Yes • No •

Distance _____ feet

Raised Median Yes • No •

Alcantarra Street

Chamber Lin Street

Distance _____ feet

Raised Median Yes • No •

COLOMBIA ELEMENTARY

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION
PEDESTRIAN VOLUME SHEET

FORM 750-020-09
 TRAFFIC ENGINEERING
 07/89

LOCATION ID: SAN FILIPPO DR & WACO BLVD 1 YELLOW, 1 BLK

COUNTY: BREVARD CITY: PALM BAY TYPE OF CONTROL: 2 TRAFFIC LGTS W WALKER SIG

STUDY DATE: 9-30-68 TIME: FROM 2 TO 3 PM OBSERVER: TEW

REMARKS:

TOTAL:			22
NO HELMETS			17

Distance _____ feet
 Raised Median Yes • No •

Distance _____ feet
 Raised Median Yes • No •

WACO BLVD
 Street

SAN FILIPPO DR
 Street

Distance _____ feet
 Raised Median Yes • No •

COLUMBIA ELEMENTARY

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

FORM 750-020-09
TRAFFIC ENGINEERING
07/99

PEDESTRIAN VOLUME SHEET

LOCATION ID: WACO BLVD & ZANZIBAR RD

COUNTY: BREVARD

CITY: PALM BAY

TYPE OF CONTROL: TRAFFIC LOTS WITH WALKED SIGNAL

STUDY DATE: 10-3-08

TIME: FROM 7 TO 8 AM

OBSERVER: EW

REMARKS:

TOTALS:			29
NO HELMETS			19

Distance _____ feet
Raised Median Yes • No •

ZANZIBAR RD
Street

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

WACO BLVD
Street

Distance _____ feet
Raised Median Yes • No •



Discovery Elementary

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

FORM 750-020-09
TRAFFIC ENGINEERING
07/99

PEDESTRIAN VOLUME SHEET

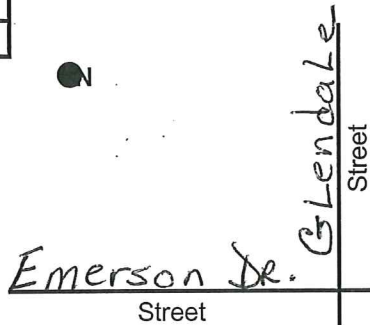
LOCATION ID: <u>Emerson Dr. & Glendale</u>			
COUNTY: <u>Brevard</u>	CITY: <u>Palm Bay</u>	TYPE OF CONTROL: <u>No Traffic Sig.</u>	
STUDY DATE: <u>09/26/08</u>	TIME: FROM <u>7:15 am</u> TO <u>8:15</u>	OBSERVER: <u>N.T./EDT</u>	

REMARKS:

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •



Distance _____ feet
Raised Median Yes • No •

Total: 40
No Helmet: 7

Discovery Elementary

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

FORM 750-020-09
TRAFFIC ENGINEERING
07/99

PEDESTRIAN VOLUME SHEET

LOCATION ID: Glendale So. Entrance

COUNTY: Brevard

CITY: Palm Bay

TYPE OF CONTROL: No Traffic sig.

STUDY DATE: 10/01/08

TIME: FROM 7:15 AM TO 8:15

OBSERVER: EE/EST

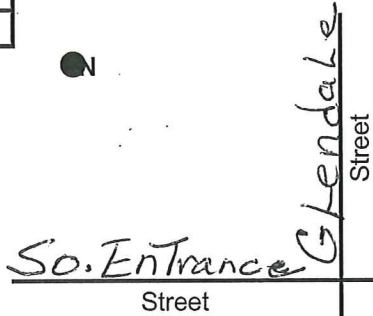
REMARKS:

Distance _____ feet
Raised Median Yes • No •

TOTAL:			14
NO HELMETS:			2

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •



Distance _____ feet
Raised Median Yes • No •

Discovery Elementary

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

FORM 750-020-09
TRAFFIC ENGINEERING
07/99

PEDESTRIAN VOLUME SHEET

LOCATION ID: Glendale St. & Jacobin

COUNTY: Brevard

CITY: Palm Bay

TYPE OF CONTROL: No Traffic sig.

STUDY DATE: 10/01/08

TIME: FROM 7:15 Am TO 8:15

OBSERVER: A.G./EXT

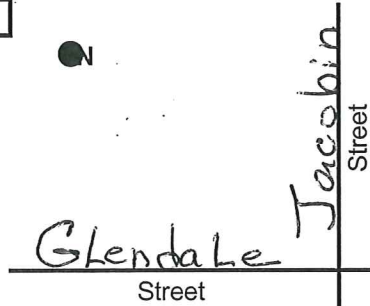
REMARKS:

TOTAL:			20
NO HELMET:			5

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •



Distance _____ feet
Raised Median Yes • No •

Jupiter Elementary

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

FORM 750-020-09
TRAFFIC ENGINEERING
07/99

PEDESTRIAN VOLUME SHEET

LOCATION ID: Jupiter Blvd. & Walpole

COUNTY: Brevard

CITY: Palm Bay

TYPE OF CONTROL: No Traffic sig.

STUDY DATE: 09/29/08

TIME: FROM 7:15 TO 8:15

OBSERVER: S.M. / EDT

REMARKS:

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

Jupiter Blvd.
Street

Walpole St.
Street

TOTAL: 15
No Helmet: 1

Jupiter Elementary

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

PEDESTRIAN VOLUME SHEET

FORM 750-020-09
TRAFFIC ENGINEERING
07/99

LOCATION ID: Jupiter Blvd. & Garvey

COUNTY: Brevard

CITY: Palm Bay

TYPE OF CONTROL: 4 way stop sign
No Traffic sig.

STUDY DATE: 10/01/08

TIME: FROM 7:00 TO 8:00

OBSERVER: E.L./EDT

REMARKS:

Distance _____ feet

Raised Median Yes • No •

Total: 9

No HELMET: 1

Distance _____ feet

Raised Median Yes • No •

Distance _____ feet

Raised Median Yes • No •

Jupiter Blvd.
Street

Garvey
Street

Distance _____ feet

Raised Median Yes • No •



Jupiter Elementary

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

FORM 750-020-09
TRAFFIC ENGINEERING
07/99

PEDESTRIAN VOLUME SHEET

LOCATION ID: Town St. & Tupelo

COUNTY: Brevard

CITY: Palm Bay

TYPE OF CONTROL: No Traffic sig

STUDY DATE: 10/02/08

TIME: FROM 7:15 TO 8:15

OBSERVER: J.S./E.D.T.

REMARKS:

Distance _____ feet

Raised Median Yes • No •

TOTALS			18
NO HELMET:			4

Distance _____ feet

Raised Median Yes • No •

Distance _____ feet

Raised Median Yes • No •

Town St. Street

Tupelo Street

Distance _____ feet

Raised Median Yes • No •

Jupiter Elementary

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

PEDESTRIAN VOLUME SHEET

FORM 750-020-09
TRAFFIC ENGINEERING
07/89

LOCATION ID: Tupelo St. + Wells

COUNTY: Brevard CITY: Palm Bay TYPE OF CONTROL: No Traffic sig.

STUDY DATE: 10/01/08 TIME: FROM 7:00 AM. TO 8:00 AM OBSERVER: M.S./EDT

REMARKS:

Distance _____ feet

Raised Median Yes • No •

Total:			12
No HELMET:			8

Distance _____ feet

Raised Median Yes • No •

Distance _____ feet

Raised Median Yes • No •

Tupelo St.
Street

Wells
Street

Distance _____ feet

Raised Median Yes • No •

LOCKMAR ELEMENTARY

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

FORM 750-020-09
TRAFFIC ENGINEERING
07/99

PEDESTRIAN VOLUME SHEET

LOCATION ID: EMERSON DR + PEPPER ST

COUNTY: BREVARD

CITY: PALM BAY

TYPE OF CONTROL: TRAFFIC LGTS WITH WALKER SIGNALS

STUDY DATE: 10-3-08

TIME: FROM 2 TO 3 PM

OBSERVER: EW

REMARKS:

TOTAL!			18
NO HELMETS			9

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

EMERSON DR
Street

PEPPER ST
Street

Distance _____ feet
Raised Median Yes • No •

Odyssey Charter

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

FORM 750-020-09
TRAFFIC ENGINEERING
07/99

PEDESTRIAN VOLUME SHEET

LOCATION ID: Eldron Blvd. + Raleigh Rd.

COUNTY: Brevard CITY: Palm Bay TYPE OF CONTROL: No Traffic sig.

STUDY DATE: 10/02/08 TIME: FROM 7:15 TO 8:15 OBSERVER: G.G./EDT

REMARKS:

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

Total:			14
No HelmeT:			12

Distance _____ feet
Raised Median Yes • No •

Eldron BLV.
Street

Raleigh
Street

Distance _____ feet
Raised Median Yes • No •

Odyssey Charter

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PEDESTRIAN VOLUME SHEET

LOCATION ID: Eldron Blvd. & School Entrance

COUNTY: Brevard CITY: Palm Bay TYPE OF CONTROL: No Traffic sig.

STUDY DATE: 10/02/08 TIME: FROM 7:15 TO 8:15 " OBSERVER: E.S. / EST

REMARKS:

			7
			5

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

Eldron Blvd.
Street

School Entrance
Street

Distance _____ feet
Raised Median Yes • No •

PALM BAY ELEMENTARY

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PEDESTRIAN VOLUME SHEET

LOCATION ID: GLENHAM DR & SCHOOL DR

COUNTY: BREVARD

CITY: PALM BAY

TYPE OF CONTROL: YELLOW BLINKERS

STUDY DATE: 10-2-08

TIME: FROM 7 TO 8 AM

OBSERVER: EW

REMARKS:

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

School Dr
Street

GLENHAM DR
Street

<u>TOTAL</u>	<u>5</u>
<u>NO HELMETS</u>	<u>2</u>

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

PALM BAY CHARTER - PATRIOT CAMPUS

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

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PEDESTRIAN VOLUME SHEET

LOCATION ID: WYOMING DR + TRADE WINDS AVE

COUNTY: BREVARD

CITY: PALM BAY

TYPE OF CONTROL: NONE

STUDY DATE: 9-30-08

TIME: FROM 7 TO 8 AM

OBSERVER: EW

REMARKS:

TOTAL			27
NO HELMETS			26

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

WYOMING DR
Street

TRADE WINDS AVE
Street

Distance _____ feet
Raised Median Yes • No •

PORT MALABAR ELEMENTARY

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION
PEDESTRIAN VOLUME SHEET

FORM 750-020-09
TRAFFIC ENGINEERING
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LOCATION ID: BARKER ST & CAMBRIDGE AVE

COUNTY: BREVARD CITY: PALM BAY TYPE OF CONTROL: NONE

STUDY DATE: 9-29-08 TIME: FROM 7 TO 8 AM OBSERVER: EW

REMARKS:

TOTAL	28
NO HELMETS	18

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •



Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

Page 2

PORT MALABAR ELEMENTARY

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FORM 750-020-09
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PEDESTRIAN VOLUME SHEET

LOCATION ID: PIONEER AVE + School ENTRANCE

COUNTY: BREVARD

CITY: PALM BAY

TYPE OF CONTROL: NONE

STUDY DATE: 9-29-08

TIME: FROM 2 TO 3 PM

OBSERVER: EW

REMARKS:

TOTAL			30
NO HELMETS			19

Distance _____ feet
Raised Median Yes • No •

School ENTRANCE
Street

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

PIONEER AVE
Street

Distance _____ feet
Raised Median Yes • No •

RIVIERA ELEMENTARY

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

FORM 750-020-09
TRAFFIC ENGINEERING
07/99

PEDESTRIAN VOLUME SHEET

LOCATION ID: MARIPOSA DR & MASCOT ST

COUNTY: BREVARD CITY: PALM BAY TYPE OF CONTROL: 4 WAY STOP

STUDY DATE: 10-1-08 TIME: FROM 7 TO 8 AM OBSERVER: KW

REMARKS:

TOTAL:			7
NO HELMETS:			3

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

MARIPOSA DR
Street

MASCOT ST
Street

Distance _____ feet
Raised Median Yes • No •



RIVIERA ELEMENTARY

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION
PEDESTRIAN VOLUME SHEET

FORM 750-020-09
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LOCATION ID: RIVIERA DR + CHILDREN HOMES

COUNTY: BREVARD CITY: PALM BAY TYPE OF CONTROL: TRAFFIC LGS/WALK SIGNAL
YELLOW BLINKERS

STUDY DATE: 10-1-08 TIME: FROM 2 TO 3PM OBSERVER: EW

REMARKS:

Distance _____ feet

Raised Median Yes • No •

↑ HOMES
Street

Distance _____ feet

Raised Median Yes • No •

Distance _____ feet

Raised Median Yes • No •

Street

Distance _____ feet

Raised Median Yes • No •

Distance _____ feet

Raised Median Yes • No •

Street

Distance _____ feet

Raised Median Yes • No •

TOTAL NO HELMETS	6 3

RIVIERA DR
Street

School

Southwest Middle

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FORM 750-020-09
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07/99

PEDESTRIAN VOLUME SHEET

LOCATION ID: Eldron Blvd. + Malabar Rd.

COUNTY: Brevard CITY: Palm Bay TYPE OF CONTROL: Signal/w Ped. sig.

STUDY DATE: 09/26/08 TIME: FROM 8:15 TO 9:15 OBSERVER: S.K./EDT

REMARKS:

Total:			15
No. Helmet:			3

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

Malabar Rd.
Street

Eldron Blvd.
Street

Distance _____ feet
Raised Median Yes • No •

Southwest Middle

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PEDESTRIAN VOLUME SHEET

LOCATION ID: Eldron Blvd. & Buzby

COUNTY: Brevard

CITY: Palm Bay

TYPE OF CONTROL: No Traffic sig

STUDY DATE: 09/30/08

TIME: FROM 8:15

TO 9:15

OBSERVER: D.N./EDT

REMARKS:

Distance _____ feet

Raised Median Yes • No •

Total:			17
No HELMET:			17

Distance _____ feet

Raised Median Yes • No •

Distance _____ feet

Raised Median Yes • No •

Eldron Blvd.
Street

Buzby St.
Street

Distance _____ feet

Raised Median Yes • No •

Southwest Middle

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

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PEDESTRIAN VOLUME SHEET

LOCATION ID: ELdron Blvd. / Jupiter Blvd.

COUNTY: Brevard

CITY: PALM Bay

TYPE OF CONTROL: Signal/w Ped. sig.

STUDY DATE: 09/30/08

TIME: FROM 8:15 TO 9:15

OBSERVER: J.T. / EDT

REMARKS:

<u>TOTAL:</u>	<u>24</u>
<u>NB HELMET:</u>	<u>21</u>

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

ELdron Blvd
Street

Jupiter
Street

Distance _____ feet
Raised Median Yes • No •



Turner Elementary

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

FORM 750-020-09
TRAFFIC ENGINEERING
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PEDESTRIAN VOLUME SHEET

LOCATION ID: Eldron Blvd. & Jupiter

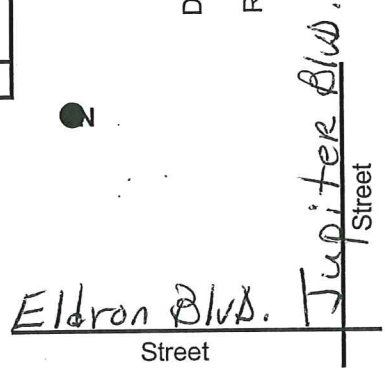
COUNTY: Brevard CITY: Palm Bay TYPE OF CONTROL: Signal/W. Ped sig.

STUDY DATE: 10/01/08 TIME: FROM 7:15 TO 8:15 OBSERVER: J.T. / EDT.

REMARKS:

<table border="1" style="width: 100%; height: 100%; border-collapse: collapse;"> <tr><td style="width: 25%; height: 25px;"></td><td style="width: 25%; height: 25px;"></td><td style="width: 25%; height: 25px;"></td><td style="width: 25%; height: 25px;"></td></tr> <tr><td style="width: 25px; height: 25px;"></td><td style="width: 25px; height: 25px;"></td><td style="width: 25px; height: 25px;"></td><td style="width: 25px; height: 25px;"></td></tr> </table>									•	Distance _____ feet Raised Median Yes • No •	•	<table border="1" style="width: 100%; height: 100%; border-collapse: collapse;"> <tr><td style="width: 25%; height: 25px;"></td><td style="width: 25%; height: 25px;"></td><td style="width: 25%; height: 25px;"></td><td style="width: 25%; height: 25px;"></td></tr> <tr><td style="width: 25px; height: 25px;"></td><td style="width: 25px; height: 25px;"></td><td style="width: 25px; height: 25px;"></td><td style="width: 25px; height: 25px;"></td></tr> </table>								
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Total:	58
No HELMET:	27



Turner Elementary

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PEDESTRIAN VOLUME SHEET

LOCATION ID: Eldron Blvd. + Buzby

COUNTY: Brevard CITY: Palm Bay TYPE OF CONTROL: No Traffic sig.

STUDY DATE: 10/01/08 TIME: FROM 7:15 TO 8:15 OBSERVER: D.N./EST

REMARKS:

TOTAL:			6
NO HELMET:			6

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

Eldron Blvd.
Street

Buzby
Street

Distance _____ feet
Raised Median Yes • No •

Turner Elementary

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

PEDESTRIAN VOLUME SHEET

FORM 750-020-09
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LOCATION ID: Emerson Dr. + Jupiter Blvd.

COUNTY: Brevard

CITY: Palm Bay

TYPE OF CONTROL: signal/w Ped. sig.

STUDY DATE: 10/02/08

TIME: FROM 7:00 TO 8:00

OBSERVER: J.D./EDT.

REMARKS:

Total:			9
No HELMET:			1

Distance _____ feet

Raised Median Yes • No •

Distance _____ feet

Raised Median Yes • No •

Distance _____ feet

Raised Median Yes • No •

Emerson Dr.
Street

Jupiter
Street

Distance _____ feet

Raised Median Yes • No •

Westside Elementary

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PEDESTRIAN VOLUME SHEET

LOCATION ID: Degrood T. St. & Gamewell

COUNTY: Brevard CITY: Palm Bay TYPE OF CONTROL: No Traffic sig.

STUDY DATE: 10/02/08 TIME: FROM 7:15 TO 8:15 OBSERVER: A.T./EDT

REMARKS:

<u>Total:</u>			<u>15</u>
<u>No HELMET:</u>			<u>13</u>

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

Degrood T Street
Gamewell Street

Distance _____ feet
Raised Median Yes • No •

Westside Elementary

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

FORM 750-020-09
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PEDESTRIAN VOLUME SHEET

LOCATION ID: Degroot ST. (Bayside High Entrance)

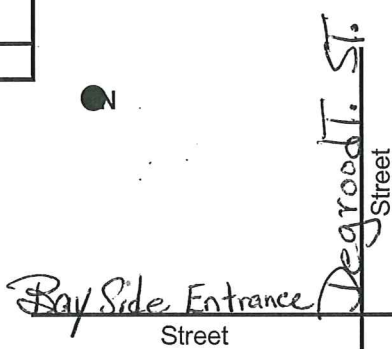
COUNTY: Brevard CITY: Palm Bay TYPE OF CONTROL: No Traffic sig.

STUDY DATE: 10/02/08 TIME: FROM 7:00 AM TO 8:00 AM OBSERVER: R.S. / EDT.

REMARKS:

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •



TOTAL:	30
NO HELMET:	27

Distance _____ feet
Raised Median Yes • No •

Distance _____ feet
Raised Median Yes • No •

APPENDIX B

Chi-Square Test Methodology

Notation for Observed proportions at the study locations

Location	Total at location	Number with helmet	Number without helmet	Proportion with helmet
1	$n_{1.}$	n_{11}	n_{12}	p_1
2	$n_{2.}$	n_{21}	n_{22}	p_2
3	$n_{3.}$	n_{31}	n_{32}	p_3
:	:	:	:	:
i	$n_{i.}$	n_{i1}	n_{i2}	p_i
:	:	:	:	:
m	$n_{m.}$	n_{m1}	n_{m2}	p_m
All	$n_{..}$	$n_{.1}$	$n_{.2}$	\bar{p}

So for any location, i:

$$n_i = n_{i1} + n_{i2}$$

and

$$p_i = \frac{n_{i1}}{n_i}$$

and

$$\bar{p} = \frac{n_{.1}}{n_{..}} = \frac{\sum n_{i.} p_i}{\sum n_{i.}}$$

The Chi-square test statistic has $(m - 1)$ degrees of freedom.

The hypothesis is that all proportions (the test characteristic) are the equal. The hypothesis test is therefore formulated as:

Null hypothesis,

$$H_0: \pi_1 = \pi_2 = \dots = \pi_m$$

Alternate hypothesis,

H_A : at least one is not equal

The Chi-square statistic of the data is computed as:

$$X^2 = \frac{1}{pq} \sum_{i=1}^m n_i (p_i - \bar{p})^2$$

where $\bar{q} = 1 - \bar{p}$

The Chi-square calculated above is compared with a value from a Chi-square distribution table with $m - 1$ degrees of freedom and a specified confidence value.

If $X_{\text{calc}}^2 > X_{\text{Table}}^2$, then we reject the null hypothesis and conclude there that at least one location has a proportion that differs from others.

On the other hand if $X_{\text{calc}}^2 < X_{\text{Table}}^2$, then we fail to reject the null hypothesis and conclude that there is insufficient evidence to show that the at least one proportion differs from the others.

APPENDIX C

Hypothesis Tests for Proportions

Let \hat{p} be the observed proportion of helmet usage at a school

Let p_0 be a prescribed proportion of helmet usage, or a proportion that is desired at a location.

We can formulate the hypothesis test as follows:

Null hypothesis,

$$H_0: \hat{p} = p_0$$

Alternate hypothesis,

$$H_A: \hat{p} > p_0$$

For a sample size $N > 30$, the test statistic is

$$z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{N}}}$$

The z-statistic is compared to a z-statistic at a prescribed confidence level α (from Normal distribution tables).

$$\text{If } z_{\text{calc}} > z_{\alpha},$$

We reject the null hypothesis and conclude that the proportion of helmet usage observed is greater than the prescribed usage. Note that for samples with $N < 30$ the student t-distribution is used at $N-1$ degrees of freedom.

The test statistic for the t-test is

$$t = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{N}}}$$

APPENDIX D

Comparison of Proportions from Two Processes

Case 1: Large Samples (Normal Approximation to Binomial)

The hypothesis of equal proportions can be tested using a z statistic

If the samples are reasonably large we can use the normal approximation to the binomial to develop a test similar to testing whether two normal means are equal.

Let sample 1 have x_1 defects out of n_1 and sample 2 have x_2 defects out of n_2 . Calculate the proportion of defects for each sample and the z statistic below:

$$z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}(1 - \hat{p})(1/n_1 + 1/n_2)}}$$

where

$$\hat{p} = \frac{n_1\hat{p}_1 + n_2\hat{p}_2}{n_1 + n_2} = \frac{x_1 + x_2}{n_1 + n_2}$$

Compare z to the normal $z_{\alpha/2}$ table value for a 2-sided test. For a one sided test, assuming the alternative hypothesis is $p_1 > p_2$, compare z to the normal z_{α} table value. If the alternative hypothesis is $p_1 < p_2$, compare z to $-z_{\alpha}$.

Source: NIST/SEMATECH *e-Handbook of Statistical Methods*, <http://www.itl.nist.gov/div898/handbook/> § 7.3.3. Accessed October 12, 2008