Assessing a two-step posted speed reduction as a potential countermeasure to improve safety in school zones using driving simulation

SAFER SIM

SAFETY RESEARCH USING SIMULATION

UNIVERSITY TRANSPORTATION CENTER

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16. Abstract

According to NHTSA, speeding is a major contributory factor to severe injuries and deaths in school zones. In a study performed at the University of Puerto Rico at Mayaguez, data showed that in 68% of school zones in the western region of Puerto Rico, the average speed of users was higher than the posted speed limit and that in 89% of the school zones, the 85th percentile of the speed was higher than the posted speed limit. A research project was conducted to assess the (MUTCD) guidelines on where to install signs that alert the driver to slow down and reduce their speed. Although several countermeasures decreased speeding, proper compliance with the speed limit was not obtained. To address this issue, the University of Central Florida developed and tested four countermeasures to reduce speeding in school zones. The microsimulation data reported that significant speed limit compliance was obtained by implementing a Two-Step Reduction (TSR) signage strategy. Therefore, speeding in school zones can be reduced through the application of the TSR method. This study aims to analyze the effectiveness of four countermeasures for school zone speeding using a driving simulator. The countermeasures being evaluated are TSR signs, an overhead sign, forward reduce speed ahead (RSA) signs, and speed monitoring displays (SMD). A school zone located in the western region of Puerto Rico was used as the case study, because of the speeding issues that currently exist due to the proximity to PR-2, which is a six-lane urban arterial highway with a posted speed limit of 45 mph. The main findings associated with the TSR method are that it is effective in those roadway segments where the difference between the posted speed limit and the school zone speed is more than 10 mph. This recommendation is primarily associated with the level tangent segment that was tested in our study. These findings also ratify those obtained in a previous microsimulation study on the effectiveness of TSR in reducing speed in a school zone.

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List of Acronyms

AADT Average Annual Daily Traffic

AASHTO American Association of State Highway and Transportation Officials

ADAS Advanced Driver-Assistance Systems

ANOVA Analysis of Variance

ASP Average Speed Profile

CARE Crash Analysis Reporting Environment

EPDO Equivalent Property Damage Only

FHWA Federal Highway Administration

HSM Highway Safety Manual

ICT Information and Communication Technologies

ISA Internet Scene Assembler

ISP Ideal Speed Profile

MUTCD Manual on Uniform Traffic Control Devices

NHS National Highway System

NHTSA National Highway Transportation Safety Administration

PCR Pedestrian crossing the road

PDO Property Damage Only

PRDTPW Puerto Rico Department of Transportation and Public Works

PRHDM Puerto Rico Highway Design Manual

RSA Reduce Speed Ahead

RTI Realtime Technologies, Inc.

SMD Speed Monitoring Displays

SRTS Safe Routes to School

TCD Traffic Control Device

TOD Time Of Day

TWLTL Two-way left-turn lane

UCF University of Central Florida

UMass University of Massachusetts at Amherst

UPRM University of Puerto Rico at Mayagüez

UTC University Transportation Center

VPD Vehicles Per Day

VMT Vehicle Miles Traveled

VRU Vulnerable Road User

WHO World Health Organization

Units Conversion

Unit	**Equivalence**
1 km	1000 m
1 ft	0.3048 m
1 mile	1.609 km

1. Abstract

According to NHTSA, speeding is a major contributory factor to severe injuries and deaths in school zones. In a study performed at the University of Puerto Rico at Mayaguez, data showed that in 68% of school zones in the western region of Puerto Rico, the average speed of users was higher than the posted speed limit and that in 89% of the school zones, the 85th percentile of the speed was higher than the posted speed limit. A research project was conducted to assess the (MUTCD) guidelines on where to install signs that alert the driver to slow down and reduce their speed. Although several countermeasures decreased speeding, proper compliance with the speed limit was not obtained. To address this issue, the University of Central Florida developed and tested four countermeasures to reduce speeding in school zones. The microsimulation data reported that significant speed limit compliance was obtained by implementing a Two-Step Reduction (TSR) signage strategy. Therefore, speeding in school zones can be reduced through the application of the TSR method. This study aims to analyze the effectiveness of four countermeasures for school zone speeding using a driving simulator. The countermeasures being evaluated are TSR signs, an overhead sign, forward reduce speed ahead (RSA) signs, and speed monitoring displays (SMD). A school zone located in the western region of Puerto Rico was used as the case study, because of the speeding issues that currently exist due to the proximity to PR-2, which is a six-lane urban arterial highway with a posted speed limit of 45 mph. The main findings associated with the TSR method are that it is effective in those roadway segments where the difference between the posted speed limit and the school zone speed is more than 10 mph. This recommendation is primarily associated with the level tangent segment that was tested in our study. These findings also ratify those obtained in a previous microsimulation study on the effectiveness of TSR in reducing speed in a school zone.

2. Introduction

In a technological era where cities are implementing smart features and intelligent mobility as part of innovative transportation solutions, highway safety is of paramount importance. Today, cities seek to become livable communities where all users adapt to the transportation system. In terms of school zones, the interaction between each of the road's actors, specifically between drivers and pedestrians, is critical, without adding the problems related to the possibility of distracted children crossing the streets and speeding drivers in school zones.

The difficulties of motorized vehicles and interaction with pedestrians and other road users make children vulnerable to dangerous situations near schools where kids typically cross traffic to get to school. Statistics reported by state and federal agencies reflect that there is a safety problem in and around school zones [1]. For example, in the United States, five teenage pedestrians die each week, and the number increases to 13% in the 12 to 19 year old pedestrian death rate from 2013 [1]. The unsafe crossing of streets, distraction while walking, poor signage that marks the area of the school zone, and hazardous areas for picking up or dropping off children are some of the factors that most contribute to the increase in this fatality rate [1]. In Mayagüez, Puerto Rico, a study was conducted in two school zones where 89% of the student pedestrians did not cross using the marked crosswalk in front of the school to cross the street [2]. This behavior shows the presence of risky actions by the student population, but there is also dangerous action taken by drivers speeding in school zones.

In the Puerto Rico archipielago, some schools are located in the vicinity of urban arteries with high vehicular flow (more than 20,000 vehicles per day) and with speed limits labeled at 40 mph. In the Western Region of the mainland, speed studies were conducted at 19 schools and showed that more than half of the school zones studied had low driver compliance with the established speed limits [5,6]. This driver behavior significantly increases the risk of accidents in school zones. The Federal Highway Administration's (FHWA) "Safe Routes to School" (SRTS) initiative is a safety strategy that seeks to improve accessibility and road safety around schools. Later implemented in 18 U.S. states, this FHWA initiative achieved reductions of 14% in the risk of injury and 13% in the risk of pedestrian and bicycle fatalities [7].

This report contains an operational and road safety analysis that evaluates driver behavior in two school zones and surrounding areas using the University of Puerto Rico at Mayagüez (UPRM) driving simulator. A driving simulator is a versatile tool that provides data for the analysis and evaluation of driver behavior. Also, driving simulators help to understand human factors related to road safety and driver performance without putting lives at risk.

This research aimed to evaluate drivers' behavior when they enter a school zone and the effectiveness of a combination of different road signs. The strategy for employing these conditions in the school zone was to assess driver speed changes following four countermeasures designed to reduce speeding in school zones. These countermeasures, namely, overhead signs, two-step speed reduction signs (TSR), forward reduce speed ahead (RSA) signs, and speed monitoring displays (SMD), were evaluated through a series of driving simulation experiments.

Vulnerable road users (VRUs) are those with minimal protection of their outer shield. They are at the greatest risk of suffering more severe injuries in the event of a collision, i.e., pedestrians and bicyclists. Some road users are more vulnerable than others, such as children, the elderly, the disabled, and pregnant women [3]. According to the World Health Organization (WHO), pedestrians and cyclists contribute as a factor in 26% of all road deaths worldwide [3]. Also, pedestrian and bicycle deaths account for 18.2% of the 37,461 deaths on U.S. roads in 2016, according to the National Highway Traffic Safety Administration (NHTSA) [4]. Innovative road safety strategies are needed, coupled with established laws and regulations, engineering measures, and road safety education to reduce and prevent deaths and crashes of VRUs within the transportation system.

2.1 Research Problem Statement

According to NHTSA, speeding is a major contributory factor to severe injuries and deaths in school zones. In Puerto Rico, studies have been performed to assess and suggest measures to improve school zone safety. A recent study conducted at UPRM showed that the average speed of users was higher than the posted speed limit and that almost always, the 85th percentile of the speed was higher than the posted speed limit.

The Manual on Uniform Traffic Control Devices (MUTCD) has established guidelines on where to install signs intended to alert the driver to slow down and reduce their speed. However, research projects conducted using these guidelines indicate that compliance with the speed limit was not obtained. To address this issue, the University of Central Florida (UCF) developed and tested four countermeasures to reduce speeding in school zones. The microsimulation data reported significant speed limit compliance by implementing a (TSR). Studies conducted at UPRM and the University of Massachusetts at Amherst (UMass) reported that an overhead sign countermeasure was developed to reduce speeding in school zones. Other countermeasures available to reduce speeding include forward signs RSA and SMD. This research project presents an assessment of the previously mentioned countermeasures.

2.2 Research Objectives

This study aims to analyze the effectiveness of TSR, an overhead sign, forward RSA sign, and SMD countermeasures to reduce speeding in school zones using a driving simulator. A school zone located in the western region of Puerto Rico was used as a case study because of the speeding issues that currently exist due to the proximity to PR-2, which is a six-lane arterial highway with a posted speed limit of 45 mph.

3. Literature Review

This chapter summarizes pertinent literature related to the topics addressed in this research project. The literature review is presented in the following order: school zones, speed limit compliance, driving simulation, and road safety strategies.

3.1 School Zones

Well-designed school zones require a gradual transition from high to low posted speed limits. The transition zones represent a safety management problem. Drivers tend not to adequately comply with the posted speed limit of lower speed areas when driving along roads with high operating speeds [8]. In 2017, 26% of the US's traffic fatalities and 27% of those in Puerto Rico involved at least one speeding driver [9]. The interaction of speeding drivers in school zones with a high presence of VRUs increases the risk of severe crashes [10].

3.2 Speed Limit Compliance

Research studies have shown drivers' low compliance with posted speed limits in school zones. A study developed in the western region of Puerto Rico indicated that drivers' mean speeds were higher than the posted speed limit in 63% of the evaluated school zones [5]. Findings from a study performed in Sydney, Australia, indicated that over 23% of the distance driven in school zones is above the posted speed limit [11]. Other studies have focused on the effect of road and environment characteristics on drivers' mean speeds [12,13]. These studies indicated that non-compliance has been higher on four-lane undivided roads, collector roads, uncontrolled intersections, and roads with no speed display device.

3.3 Driving Simulation

Simulation is a useful and cost-effective tool for transportation system analysis in corridors, intersections, school zones, and new potential safety and operational treatments, such as proposed road signage and markings. One of the significant benefits of microsimulation and driving simulators is the analysis of potential innovative countermeasures to improve operations and safety on existing transportation infrastructure without risking human lives. Microsimulation allows the modeling of individual vehicles traveling in a predefined network following the road alignment while continuously making decisions concerning speed and lane choice [14]. Driving simulators allow the evaluation and analysis of driver performance, speed behavior, driving maneuvers, and lane choice, among others, assisting researchers and decision-makers in better understanding how human factors relate to road safety [15]

A microsimulation study was performed to evaluate the effect of three safety countermeasures around school zones: TSR, decreasing driveway density (DD), and replacing a two-way left-turn lane (TWLTL) with a raised median [16]. The results indicated that the TSR and DD application significantly reduced crash risk compared to the school zone's base condition. Furthermore, when evaluating TSR and DD combination, the outcome outperformed each countermeasure's results. Therefore, a lower crash risk will be present when implementing the two countermeasures simultaneously.

3.4 Road Safety Strategies

Driving simulation studies have been developed to understand the effect of safety countermeasures around school zones on drivers' behavior. Drivers' response after implementing a proposed overhead speed sign with flashing beacons and pavement markings to guide drivers entering a school zone was evaluated in a recent study [17]. Results showed a reduction in mean speed for 70.8% of the scenarios considered with the combination of overhead signage and pavement markings. These scenarios were used to assess the response of drivers unfamiliar with the language of the signage and pavement marking [18]. The performance of unfamiliar drivers along the scenarios indicated that it might be useful to consider using symbols in areas where unfamiliar drivers may be present on the roadway system.

Other countermeasures to increase speed compliance are RSA and SMD signs. As documented in the MUTCD, RSA signs should be used to alert road users of a zone where the speed limit is being reduced by more than 10 mph or where engineering judgment indicates the need for advance notice to comply with the posted speed limit ahead. [19]. This is the case in school zones located adjacent to arterial streets where the posted speed limit along the arterial is more than 10 mph higher than the school zone's speed limit.

Advanced driver-assistance systems (ADAS) are vehicle-related safety measures that have been successfully used to raise awareness and increase transportation safety and efficiency in existing roadways. These systems are infrastructure-based, using Information and Communication Technologies (ICT) for legal speed limit assistance [20]. In these cases, an SMD measures the speed of the traveling vehicle and automatically feeds the information back to the driver through road signage. A study examined the short-term (2 week) and long-term (12 month) performance of an SMD after its installation to reduce speeding in school zones. Short-term results indicate that the vehicle's speed was reduced by 17% (8.2 km/h), and the long-term study found that the speed was reduced by 12% at the SMD location [21]. Currently, ADAS is favoring speed monitoring displays integrated into the vehicle using a map-based system. A simulator-based study was conducted to investigate how drivers respond to a speed warning system that alerted participants if they exceeded the speed limit. The study revealed that drivers were speeding less with the warning system located in a smartphone and that they were more conscious of the simulator's speedometer when they had the speed warning system activated [22].

4. Research Methodology

The research methodology implemented to assess the effectiveness of the countermeasures under study consisted of the following primary tasks: literature review, selection of the school zone used as a testbed, description of the school zone selected, experiments with a driving simulator, analysis of results, and conclusions and recommendations. These tasks are illustrated in Figure 1 and are explained in this section of the report.

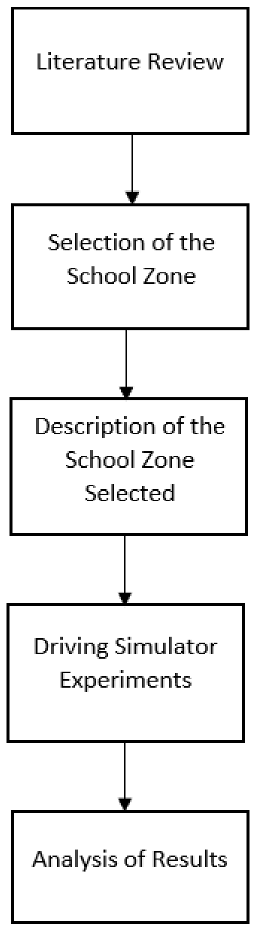


Figure 1 Research Methodology

4.1 Literature Review

The literature review was focused on the following topics: crash statistics, speeding in school zones, studies evaluating safety countermeasures in school zones, and the use of driving simulation to study safety countermeasures. A summary of the pertinent literature review is addressed in Section 3 of this report.

4.2 Selection of the School Zone

The school selection process was performed in a previous study where a group of school zones located in the western region of Puerto Rico were evaluated considering traffic exposure, crash rates, environment complexity, and safety perception [5]. A school zone was selected to develop the driving simulation study to evaluate drivers' behavior associated with the proposed implementation countermeasures.

Considering the analysis of all the variables mentioned before, the selected school for this study was S.U. Samuel Adams. This school is located in a rural area of the municipality of Aguadilla. The school includes grades from pre-kindergarten to ninth and has approximately 900 students. Figure 2 presents a plan view of the school's location, indicating the school area's location and the pedestrian bridge location that allows the students' safe crossing of the arterial.

Figure 2 S.U. Samuel Adams. Source: School Zone Final Report 2019

4.3 Description of School Zone Selected

The S.U. Samuel Adams school has direct access from the PR-2 arterial road; the highway is part of the National Highway System (NHS) and has two lanes in each direction with a speed limit of 45 mph. The section under study is located in the rural area of the municipality of Aguadilla. The road study section has a length of 1.5 km with 500 meters before and after the school zone. Since it is a rural area, it has some road segments without sidewalks, and it has a pedestrian bridge with ramps in front of the school to connect it with the surrounding area. The median of PR-2 consists of a New Jersey barrier with a five-foot-high fence at the top that precludes the possibility of pedestrians crossing the street at this point, forcing them to use the bridge.

The school has a drop-off area used incorrectly. According to interviews conducted in a previous investigation, this drop-off area is not suitable for parents of younger children who must be brought into the classroom. The geometry of the drop-off area and its lack of capacity forces parents to leave their vehicle wrongly parked on the shoulder of PR-2.

A visual inspection of the current school zone found that the speed limit and school zone signs have not been updated to the new colors of the latest version of the MUTCD. Also, it was found that there were lines to mark the beginning and end of the school zone, which is the recommended practice in Puerto Rico. Other states use the word "School" to indicate that vehicles are entering a school zone. That is not the case in the local environment; therefore, the word school was not marked on the pavement.

One of the fundamental problems in this school zone is the long line of vehicles with parents waiting to drop off or pick up their children. Once the students enter the school, a hazardous maneuver is performed when the driver of the vehicle intends to rejoin the highway from the shoulder. Exiting the highway to stop or suddenly accelerating to join the highway are maneuvers that create conflicts that typically worsen congestion and put the safety of all users at risk.

4.4 Driving Simulator Experiments

This section describes the experimental scenarios, the equipment used, the procedures to generate the scenarios, and the experimental design used.

For this research study, two groups of experimental scenarios were developed. The first group simulated the school zone’s base conditions, whereas the second group included implementing each of the countermeasures studied. The zones were based on the location of the speed limit signs, school zone signs, pavement marking, and other features included in the scenarios. The vehicle position and speed data were obtained from the driving simulator for each scenario. Figure 3 presents a comparison of a picture corresponding to the current highway view and the simulation of the PR-2 section.

Figure 3 Existing roadway vs. simulated road – Samuel Adams. Source: School Zone_2019

The following sections describe the equipment, the procedures to generate the scenario, and the experimental designs of the school zone’s research.

4.4.1 Driving Simulator Study

Participants were asked to drive on one group of the simulated scenarios, and their behavior was evaluated considering several zones of interest. Comparisons were made between drivers’ behavior in the base conditions versus the scenarios with the implementation of the countermeasures. The goal is to have speed compliance with the implemented countermeasures.

4.4.2 Equipment

The driving simulator located in the UPRM consists of a desktop simulator configured as a portable cockpit simulator with three main components: a driving cockpit, a visual display, and a computer system. The driving cockpit consists of a car seat, steering wheel, gear shifter, two turn signals, and the acceleration and braking pedals. It is mounted in a wooden base with six wheels for mobile applications. The visual display consists of three overhead projectors and three screens that generate 120 degrees of road visibility at 1080p resolution. Finally, the computer system uses a laptop and a desktop computer with Realtime Technologies, Inc. (RTI) SimCreator/SimVista simulation software and an audio system that represents the vehicle and environment noises.

4.4.3 Base Scenario Development

A school zone scenario is developed for each countermeasure. This scenario is designed to replicate the similar characteristics of the current school zone condition, using tools and software such as Google Maps®, AutoCAD®, SketchUp®, Blender®, and ISA®. From Google Maps, the images are initially used to draw details in AutoCAD, including lines corresponding to lanes, medians, pavement marks, and others. The next step is to process this information with the SketchUp tool, where the 3D environment is defined by adding colors, contours, elevations, and textures. Finally, the file is converted to a format that can read the last tool used (ISA). In this program, the scenario developer adds more features such as signage, vegetation, buildings, and animations, including sounds, cars, pedestrians, among others.

4.4.4 Experimental Design

Independent Variables

Table 1 shows the independent variables taken for the analysis of the research.

Table 1 Research Independent Variables

Variables	**Levels**	**Levels**
Age	3	18 - 24 25 - 45 46 - 70
Gender	2	Female Male
Configuration	2	Existing Signs Proposed Configuration (Overhead sign with Flashing Beacons)
Countermeasures	4	Two-Step Reduction Reduced Speed Limit Ahead Sign Speed Monitoring Display None

Dependent Variables

The dependent variables evaluated were: mean speed, acceleration noise, lane position, and compliance. The first three variables are the direct output of the driving simulator. Compliance was estimated based on the difference between the driver's mean speed versus the posted speed limit. Driver behavior was evaluated, considering several zones of interest. The zones were established based on the location of the speed limit sign, school zone sign, pavement marking, and other features included in the scenarios.

A factorial design was used for this experiment. The two factors considered were configuration and countermeasure. The Configuration factor refers to the signage and pavement markings implemented in the school zones with two levels, namely Configuration 1 and Configuration 2. “Configuration 1” refers to the existing conditions of the signage and pavement markings in the school zone. “Configuration 2” refers to the implementation of a new combination of signage and pavement markings. The proposed combination includes an overhead speed limit sign with flashing beacons and pavement markings. The word school in Spanish (Escuela) was part of the pavement marking treatment. Figure 4 shows the traffic control devices for both configurations and the eight scenarios evaluated.

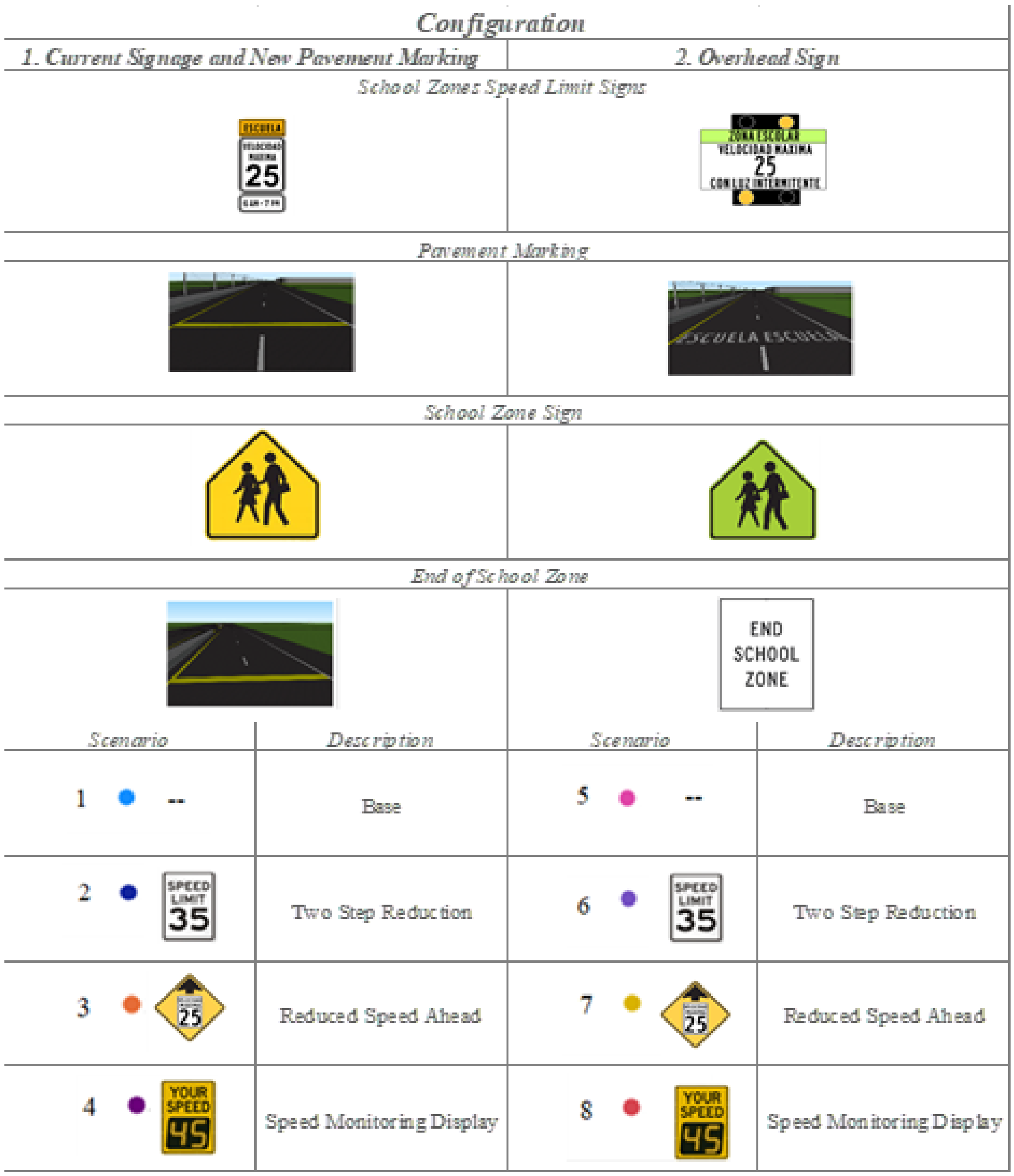


Figure 4 Signage and Pavement Markings Configuration

The signage and pavement markings associated with Scenarios 1 to 4 applied to Configuration 1 are described below:

1. Base scenario with the 25 mph regulatory school zone sign, a time-of-day plaque restriction at the lower part, and a warning “ESCUELA” upper plaque (S4-3P, R2-1, S4-1P). Transverse solid yellow lines were designating the start and end of the school zone.

2. A 35 mph regulatory posted speed limit sign (R2-1)
3. Regulatory Reduced Speed Ahead sign (W3-5)
4. Warning Speed Monitoring Display sign

The same sequence of signage is applied to Configuration 2 with the difference that the roadside 25 mph regulatory school zone sign was replaced with an overhead regulatory speed sign with the text “VELOCIDAD MAXIMA 25 CON LUZ INTERMITENTE”, upper and lower flashing beacons with the words “ZONA ESCOLAR” written on a yellow-green background on the upper part of the sign, and the white letters “ESCUELA” painted on the pavement surface.

5. Analysis of Driving Simulation Scenarios

The analysis of the driving scenarios was carried out in the previously selected school zone of Samuel Adams School. This zone analysis emphasizes the effectiveness of the TSR countermeasure in school zones.

5.1 Points and Zones of Interest

This section describes the criteria to generate the areas of interest and the response variables evaluated, the comparisons of the speeds of the subjects to analyze the behavior in the two configurations, and each of the countermeasures.

Points and areas of interest were defined to evaluate the behavior of the drivers throughout the scenarios. Five points were selected to assess the point speed and acceleration of the drivers. Point 0 indicates a coordinate where drivers traveled at free-flowing speeds in the area with a posted speed limit of 45 mph before reaching the reduced speed areas. Points 1 and 2 correspond to the coordinates where the 35 mph and 25 mph speed limit signs, respectively, were located. Point 3 represents the location in the vicinity of the school entrance at the instant a pedestrian suddenly appears between vehicles parked on the right shoulder, in the driver's cone of vision, with an apparent / perceived intention to cross the four-lane highway. Instead, it continues its path by walking parallel to and against oncoming traffic. Point 4 corresponds to the coordinate where the school entrance is located.

Likewise, three areas of interest were defined to understand the drivers' behavior , specifically their delay in detecting the speed limit sign. Zone 1 corresponds to an area between the 35 mph and 25 mph speed limit signs, associated with possible delays in detecting the 35 mph regulatory sign before drivers notice the school zone. Zone 2 is the beginning of the school zone. It is immediately after the 25 mph regulatory speed sign that drivers are expected to maintain a constant compliance speed. Zone 3 is where the driver notices a pedestrian in her cone of vision.

Scenarios 2 and 6 implemented the TSR countermeasure, therefore, Point 1 and Zone 1 are crucial for the analysis in these scenarios. A visual representation of the points and areas of interest is presented in Figure 5. The blue, green, and pink lines represent Zones 1, 2, and 3, respectively.

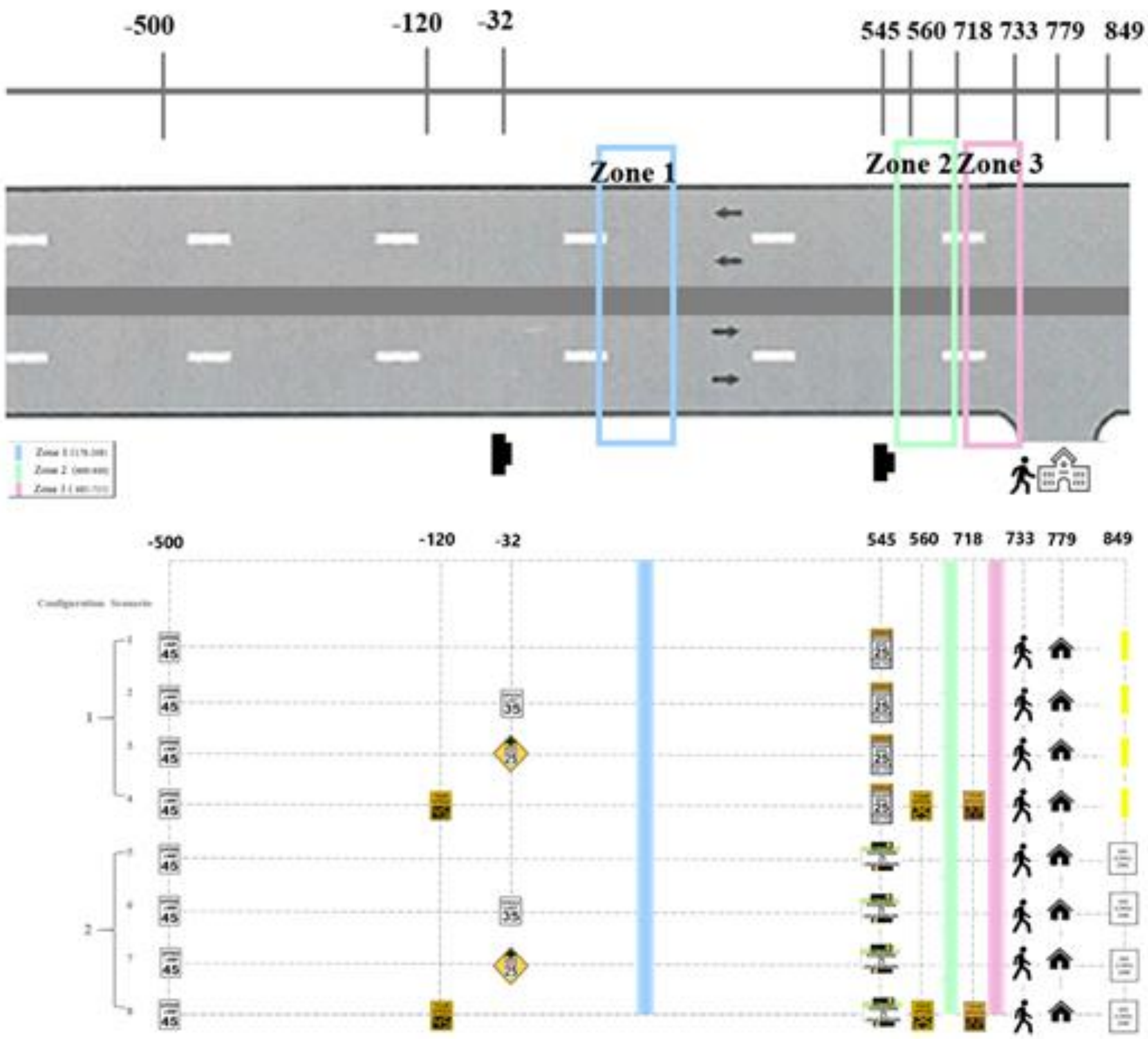


Figure 5 Zones and Points of Interest

5.2 Mean Speed

The dependent variables evaluated were speed behavior and speed compliance. The speed was obtained for all subjects at each zone and point of interest. The speed compliance was estimated based on the difference between drivers' mean speed versus the posted speed limit along with the scenarios. An innovative graphical analysis is proposed to evaluate the speed limit compliance in the segments in each scenario. This graphical analysis considers the actual average speed profile for all the subjects in each scenario and compares it with the expected theoretical behavior's speed profile.

Figure 6 represents the average speed of the eight scenarios evaluated. The driver's speed fluctuations are noticeable as they approach the regulatory and warning signs countermeasures throughout its trajectories. Each point of interest is illustrated with a vertical thin gray line and has its coordinate position in the figure's upper part (i.e., -500, -120, -32, etc.). In the lower part of the figure, the vertical gray lines' symbols correspond to the road signage, pedestrian, and school location in their respective coordinates. Appendix A shows the figures representing the average speed for each countermeasure evaluated.

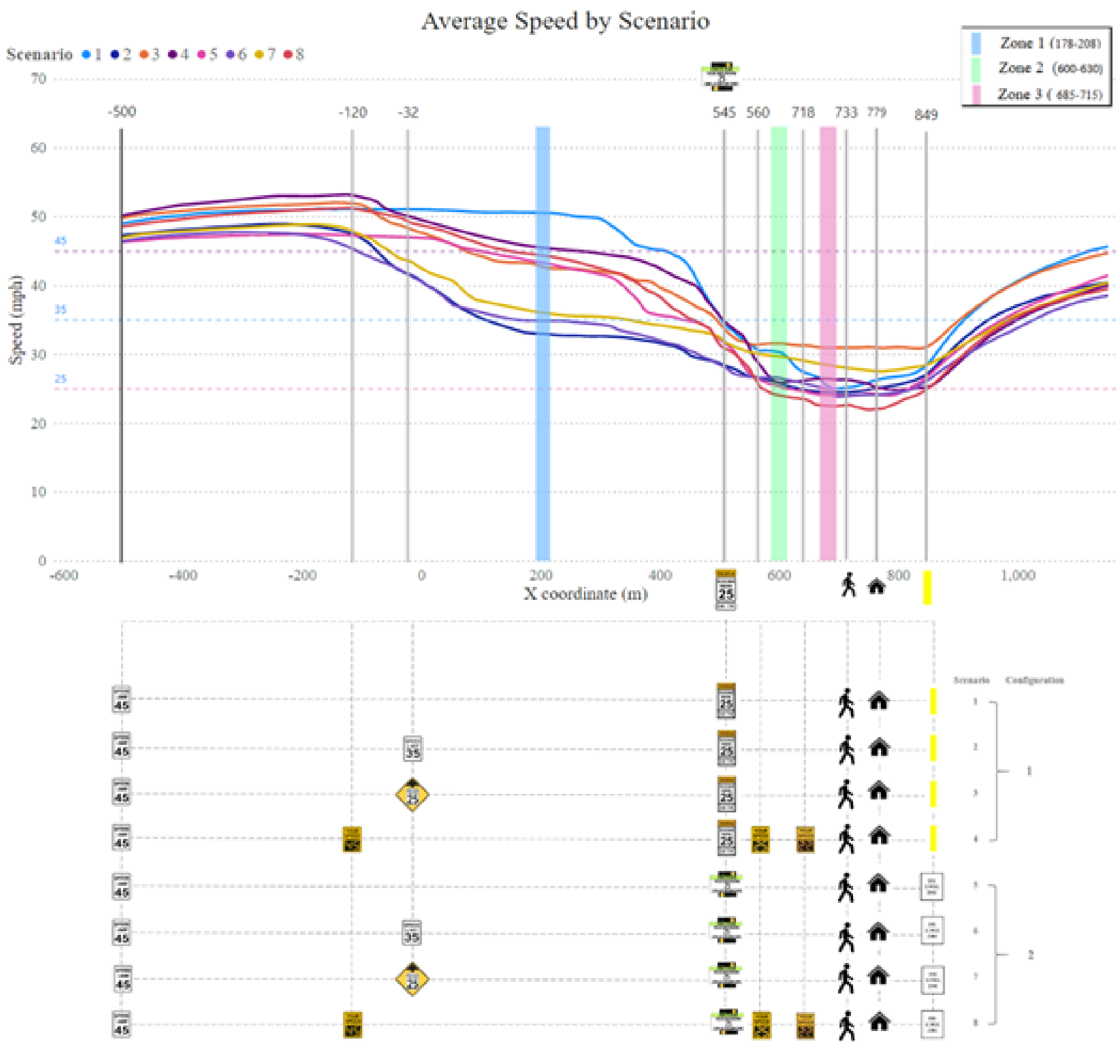


Figure 6 Average Speed by Scenario

The RTI SimCreator software used to record the driving simulator data records the values of the response variables every 0.02 seconds; therefore, depending on the speed of the drivers, the values are recorded in different coordinates for each stage. For the areas of interest, the overall average speed was calculated by averaging the speeds registered for each subject at the coordinates included in the range of the areas. The mean velocity for the point of interest was calculated by averaging the two velocity values corresponding to the closest before and after coordinates. Table 2 shows the drivers' average speed in the points and zones of interest throughout the eight scenarios.

Table 2 Average Speed at Points and Zones of Interest

		Average speed (mph)							
Configuration	**Scenario**	**Coord - 500 (45mph)**	**Point 1 (35mph)**	**Zone 1**	**Point 2 (25mph)**	**Zone 2**	**Zone 3**	**Point 3 (Ped)**	**Point 4 (School)**
Existing signs	1	49		50	30	29	24	24	26
	2	44	42	32	27	25	24	25	25
	3	59	49	39	27	29	28	27	29
	4	51		44	28	24	25	25	25
Overhead	5	43		42	27	25	24	23	24
	6	46	42	34	26	26	23	24	24
	7	48	39	33	29	28	27	25	27
	8	50		44	26	23	22	22	23

A series of data analyses were carried out to obtain more information about the evaluated subjects' behavior. In almost all scenarios, the 85th percentile of the speed was above the speed limit marked until Zone 3, where the drivers noticed the pedestrians' presence in their cone of vision. Table 3 shows the 85th percentile of the average speed for each driver in the points and zones of interest.

Table 3 Summary of 85th percentile of the Speed at Points and Zones of Interest

		85th Percentile (mph)							
Configuration	**Scenario**	**Coord - 500 (45mph)**	**Point 1 (35mph)**	**Zone 1**	**Point 2 (25mph)**	**Zone 2**	**Zone 3**	**Point 3 (Ped)**	**Point 4 (School)**
Current Signage	1	55		53	40	34	27	28	30
	2	49	48	35	30	29	27	27	28
	3	52	60	51	33	33	32	31	37
	4	59		47	33	27	29	30	27
Overhead Signage	5	50		51	30	30	28	28	28
	6	51	54	35	34	27	27	28	27
	7	55	50	47	40	34	32	32	31
	8	57		48	31	25	25	26	26

T-tests were performed to evaluate significant differences between the average speed at the points and areas of interest in the eight scenarios. The Bonferroni correction was applied to the data set to counteract the problem associated with multiple comparisons.

A comparison was made between the eight scenarios, in each of the countermeasures and the different points of interest. It is observed that 72 cells in Table 4 show significant differences between the speeds of the scenarios compared at a confidence level of 95%, indicated in the table with an asterisk (*). On the other hand, only one data point shows a significant difference between the speeds of the scenarios compared to a confidence level of 90%, marked with two asterisks (**) in Table 4. Most of the data in the three zones were evaluated. Furthermore, it can be observed that the analyzed point "35 mph" presents data with a significance value of at least 95% of the speeds in the three countermeasures evaluated. The average speed difference and the statistical significance are shown in Table 4.

Table 4 Average Speed Difference and Statistically Significant T-Test

Average Speed Difference (mph)									
Counter-measure	**Comparison among scenarios**	**Zones and Points of Interest**							
		Coord. -500	**35 mph** Coord. -32	**Zone 1** Coord. (178-208)	**25 mph** Coord. 545	**Zone 2** Coord (600-630)	**Zone 3** Coord (685-715)	**Pedestrian** Coord. 733	**School** Coord. 779
Two-Step Reduction (TSR)	**1-2**	-1.5	-	-	-3.9 *	-3.7 *	-0.2	-0.4	-0.4
	1-5	-3.1	-5.6 *	-8.2 *	-3.4 *	-4.1 *	-0.6 *	-0.9	-1.6
	1-6	-3.0	-	-	-4.6 *	-3.0 *	-1.1 *	-0.7	-1.3
	2-5	-1.6	-	-	0.5	-0.4 *	-0.4 *	-0.6	-1.2
	2-6	-1.5	-0.3	1.4 *	-0.7	0.7 *	-1.0 *	-0.3	-0.9
	5-6	0.1	-	-	-1.2	1.1 *	-0.6 *	0.3	0.3
Reduced Speed Ahead (RSA)	**1-3**	1.0	-4.2	-11.2 *	-1.7	-0.1	4.3 *	4.0 *	3.9 *
	1-5	-3.1	-5.6	-8.2 *	-3.4	-4.1 *	-0.6 *	-0.9	-1.6
	1-7	-2.2	-9.9 *	-17.3 *	-1.9	-0.9 *	2.5 *	2.0	0.8
	3-5	-4.1 *	-1.4	3.0 *	-1.7	-4.0 *	-4.9 *	-4.9 *	-5.5 *
	3-7	-3.2	-5.7 *	-6.1 *	-0.2	-0.8 *	-1.8 *	-2.0	-3.1 *
	5-7	0.9	-4.3	-9.0 *	1.5	3.2 *	3.1 *	2.9 *	2.4
Speed Monitoring Display (SMD)	**1-4**	0.8	-2.0	-6.3 *	1.0	-4.7 *	1.0 *	0.6	-1.3
	1-5	-3.1	-5.6 *	-8.2 *	-2.4	-4.1 *	-0.6 *	-0.9	-1.6
	1-8	-1.3	-2.6	-6.3 *	-0.6	-5.6 *	-2.0 *	-2.4*	-3.3 *
	4-5	-3.9	-3.5	-2.0 *	-3.4	0.6 *	-1.5 *	-1.5	-0.3
	4-8	-2.1	-0.5	0.0	-1.6	-0.9 *	-3.0 *	-3.0*	-2.0 **
	5-8	1.8	3.0	2.0 *	1.8	-1.5 *	-1.4 *	-1.5	-1.7
** 95% Level of Confidence*									
*** 90% Level of Confidence*									
- Scenarios with different signage that can not be compared									

5.3 Speed Compliance

The areas evaluated within the S.U. Samuel Adams school section presents scenarios with high speed limit compliance percentages. Values such as 67% and 75% can be observed within the data. Scenario 5 presents high percentages of compliance with the speed limit in four of the evaluated points, for example, Zone 3 and the pedestrian point with 64% in both. The 25 mph point reflects compliance percentages with the speed limit in most scenarios. The percentages range from 8% to 18%, except for Scenarios 6 and 7 with percentages of 58% and 33% of compliance, respectively.

Table 5 shows the percent of drivers complying with the posted speed limit for the five points and two zones of interest defined in the scenarios. As mentioned before, Scenarios 2 and 6 have the 35 mph sign while the other scenarios do not.

Table 5 Speed Compliance Along Scenarios

	Speed Compliance (%)							
Scenario	**Coord 500**	**35 mph**	**Zone 1**	**25 mph**	**Zone 2**	**Zone 3**	**Pedestrian**	**School**
1	33	-	0	17	1	50	50	25
2	25	8	67	17	35	50	42	33
3	0	-	50	17	8	25	25	25
4	8	-	0	8	58	41	25	42
5	36	-	18	18	60	64	64	55
6	42	17	59	58	33	58	58	67
7	42	-	67	33	33	42	50	42
8	25	-	0	17	75	67	67	75

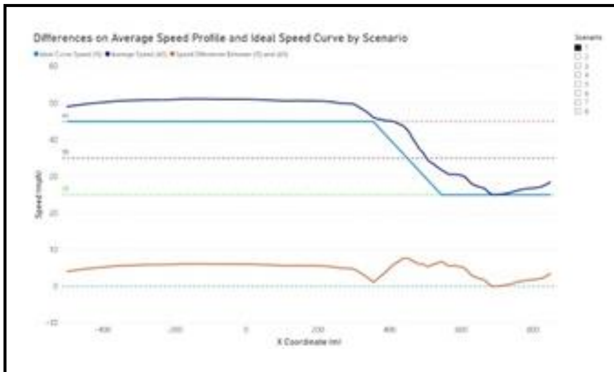
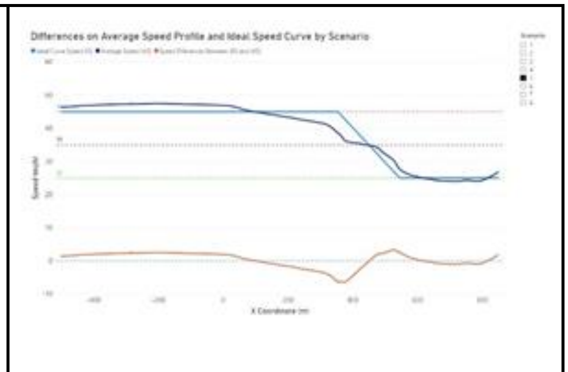
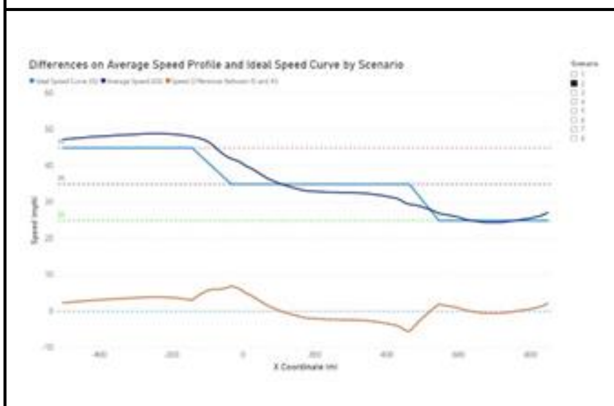
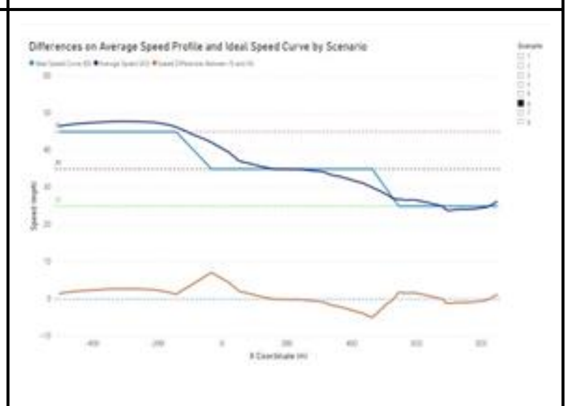
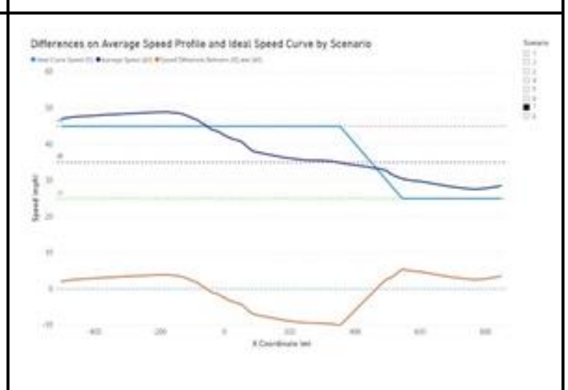
5.4 Speed Compliance (Difference between Observed and Expected Behaviors)

The actual average speed profile (ASP) combined with the theoretical/ideal speed profile (ISP) provided an integrated understanding of speed compliance for the eight scenarios evaluated. The ASP is calculated by averaging the speeds measured using all the subject driver’s data in each scenario. The ISP is obtained considering that drivers are expected to maintain their speed at or below the posted speed limit. The ideal variation in speed on transition segments was calculated using the average deceleration observed in previous studies when drivers approach a sharp horizontal curve or need to reduce their speed at a comfortable deceleration rate (25). Table 6 shows the speed compliance in terms of the difference between observed and expected driver behaviors in four comparison groups, namely Scenarios 2-6, 1-5, 3-7, and 4-8.

Table 6 Speed Compliance (Difference Between Observed and Expected Behaviors)

Comparison	Segment	Scenario	Above Avg Diff (mph)	Below Avg Diff (mph)	Above Non-Compliance (%)	Below Compliance (%)
2-6	**45 mph**	2	5.1	-2.5	77.62	22.38
		6	5.3	-3.1	64.86	35.14
	Trans-35	2	6.6	-3.1	88.94	11.06
		6	7.9	-3.0	65.98	34.02
	35 mph	2	3.8	-4.0	41.03	58.97
		6	8.4	-3.9	32.91	67.09
	Trans-25	2	2.8	-4.4	39.94	60.06
		6	6.8	-5.3	29.78	70.22
	25 mph	2	2.7	-2.9	59.10	40.90
		6	3.7	-2.1	39.93	60.07
1-5	**45 mph**	1	6.9	-1.1	82.07	17.93
		5	6.7	-4.7	47.19	52.81
	Trans-25	1	10.2	-5.5	70.70	29.30
		5	5.8	-6.8	46.92	53.08
	25 mph	1	4.9	-3.3	70.52	29.48
		5	3.9	-2.2	33.84	66.16
3-7	**45 mph**	3	8.3	-10.2	70.84	29.16
		7	8.3	-10.1	45.66	54.34
	Trans-25	3	14.9	-7.9	43.55	56.45
		7	10.4	-8.5	35.37	64.63
	25 mph	3	8.2	-1.9	79.90	20.10
		7	8.0	-1.8	55.47	44.53
4-8	**45 mph**	4	8.7	-4.0	68.10	31.90
		8	8.5	-4.0	56.03	43.97
	Trans-25	4	8.9	-6.0	68.79	31.21
		8	7.1	-6.3	47.09	52.91
	25 mph	4	5.9	-3.6	50.72	49.28
		8	3.9	-3.3	25.00	75.00

Figure 7 presents the ASP and ISP for each of the eight scenarios evaluated in the study. The line at the bottom of each graph represents the difference between the actual average speed and the ideal speed.

	
Scenario 1: Base Current Signage and Markings	**Scenario 5: Base Overhead Signs and Markings**
	
Scenario 2: TSR	**Scenario 6: TSR with Overhead Sign**
	
Scenario 3: RSA	**Scenario 7: RSA with Overhead Sign**

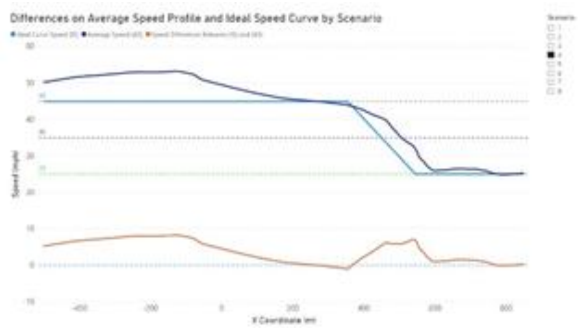
	
Scenario 4: SMD	**Scenario 8: SMD with Overhead Sign**

Figure 7 Comparison of actual and theoretical speed profiles

The first graph in Figure 7 corresponds to Scenario 1, which represents the base condition. In this scenario, the actual average speed is almost always higher than the theoretical speed. It is worth noting that the average speed is equal to the theoretical speed only in a very small segment within the school zone where the pedestrians are present. The graph that corresponds to Scenario 5 represents the base condition using the overhead sign with flashing beacons. By comparing these two scenarios, it can be noted that the presence of this special overhead sign conveys a clear message and has the effect of considerably reducing the speed in the school zone even below the posted speed limit.

The graph corresponding to Scenario 2 refers to the TSR treatment. In this scenario, the ASP is closer to ISP. Almost 60% of the segment with a 35 mph posted speed limit exhibits an ASP below the speed limit. In 40% of the school zone segment, the ASP was lower than the 25 mph school zone speed limit. The Scenario 6 graph, also with the TSR countermeasure plus the overhead sign with flashing beacons posted speed limit, has a similar result. However, in this scenario, the speed compliance is higher, with 60% of the segment registering operating speeds lower than the 25 mph school zone speed limit.

In the case of Scenario 3, the ASP reflects speeding in the 45 mph speed limit segment as well as in the 25 mph school zone segment speed limit. The ASP in the school zone is higher for the whole segment. This fact is an indication that the RSA regulatory sign, under the current signage condition, did not perform well in these experiments. Similarly, drivers in Scenario 7 presented an ASP higher than the posted speed limit in the entire school zone segment.

The graph of Scenario 4 corresponds to the SMD treatment. In this scenario, the ASP is close to the ISP in the school zone. Only 30% of the segment with a 35 mph posted speed limit exhibits an ASP below the speed limit. However, in 50% of the school zone segment, the ASP was lower than the 25 mph school zone speed limit. The graph of Scenario 8, also with the SMD countermeasure plus the overhead sign with flashing beacons posted speed limit, has a much better result. In fact, in this scenario, the speed compliance is the highest of all the scenarios, with more than 75% of the segment registering operating speeds lower than the 25 mph school zone speed limit. In this case, the outcome of combining SMD and the overhead sign outperformed the individual result of each countermeasure.

6. Conclusions

This study evaluated a combination of regulatory signs, warning signs, monitoring display speed signs, and pavement markings to assist in reducing speed and promoting speed compliance in school zones using a driving simulator. Eight scenarios were evaluated on two configurations with three zones of interest and five points of interest. The subject driver trajectories were monitored in the specific zones to assess the gradual transitions from the initially posted speed limit before entering the school zone. Within the school zone, the reaction towards a pedestrian suddenly entering the subject drivers' cone of vision and how they exited the zone that was delimited with a transverse yellow line was also evaluated. The proposed method, referred to herein as the Two-Step Reduction (TSR), is a gradual transition with the intent of providing positive guidance to the driver to change their normal path in a four-lane divided arterial to a restricted zone where they can be a potential hazard to children, pedestrians, and other VRUs.

The main conclusions for this research using simulation are:

1. Scenarios with the combined overhead speed sign and flashing beacon assembly and SMD exhibit the highest speed compliance (75%).
2. Scenarios with speed monitoring displays exhibit a greater speed compliance than the other scenarios.
3. The base scenario with the overhead sign achieved the second-highest speed compliance with 66%.
4. All the tested scenarios provided higher speed compliance when compared with the base scenario.
5. The traffic control devices that comprise the TSR in combination with the overhead sign achieved the third highest speed compliance with 60%.
6. Scenarios with TSR exhibit a greater speed compliance than RSA and the current base scenarios.

7. Recommendations

The three major recommendations that resulted from this driving simulation school zone study are:

1.The TSR method is effective in those roadway segments where the difference between the posted speed limit and the school zone speed is more than 10 mph. This recommendation is primarily associated with the level tangent segment that was tested in our study. These findings also ratify those obtained in a previous microsimulation study on the effectiveness of TSR in reducing speed in a school zone.

- Promote the use of ADAS to improve compliance with speed limits in school zones.
- The SMD presented the best result in our simulation study.

8. Future Research

Future research studies should consider defining the human factor parameters required to correctly implement the SMD in the vehicle.

In terms of geometric considerations, potential future research might include testing other scenarios under different geometric considerations. One research project could include horizontal curves with obstructions inside the curve approaching the school zone that limit the sight distance. A similar sight distance restriction could also be evaluated with adverse crest vertical curves or a combination of both. The effect of roadside vegetation as a sight distance obstruction in rural areas, such as parkways where a significant number of tourists, first-time drivers in the area, are expected in a particular season of the year, could also be considered in the near future.

9. References

1. MacKay, JM, Steel, A, Wilson, A, Rosenthal, K, Green, A. *Alarming Dangers in School Zones*. Washington D.C: Safe Kids Worldwide, 2016.
2. Figueroa, A., Alegría, M., & Valdés, D. (2010). *Simplified methodology for the evaluation of pedestrian safety in school zones*. ITE Journal, 80(6): 36–44.
3. World Health Organization. (2018). Global Status Report on Road Safety 2018: Summary. (WHO/NMH/NVI/18.20). Licence: CC BY-NC-SA 3.0 IGO.
4. National Highway Traffic Safety Administration. (2018). Traffic Safety Facts 2016. Washington D.C.: National Highway Traffic Safety Administration.
5. González-Compre, J. *Mejoras En Las Medidas Para La Seguridad de Las Zonas Escolares En El Área Oeste de Puerto Rico*. Universidad de Puerto Rico, Recinto Universitario de Mayagüez, 2016.
6. Garcia, R., Maldonado, K., & Molina, E. (2016). Six school zones spot speed study in three west-municipalities of Puerto Rico. University of Puerto Rico at Mayagüez.
7. DiMaggio, C., Frangos, S., & Li, G. (2016). National Safe Routes to School Program and risk of school-age pedestrian and bicyclist injury. Annals of Epidemiology, 26(6): 412–417. https://doi.org/10.1016/j.annepidem.2016.04.002
8. National Roads Authority. *Guidelines on Traffic Calming for Towns and Villages on National Routes*. Dublin, Ireland, 2005.
9. National Center for Statistics and Analysis. *Speeding: 2017 Data. (Traffic Safety Facts. DOT HS 812 687)*. Washington D.C.: National Highway Traffic Safety Administration, 2019.
10. World Health Organization. World Report on Road Traffic Injury Prevention. 2004.
11. Ellison, A., S. Greaves, and R. Daniels. Capturing Speeding Behavior in School Zones Using GPS Technology. *Road and Transport Research*, Vol. 22, No. 4, 2013, pp. 30–42.
12. Kattan, L., R. Tay, and S. Acharjee. Managing Speed at School and Playground Zones. *Accident Analysis and Prevention*, Vol. 43, No. 5, 2011, pp. 1887–1891. https://doi.org/10.1016/J.AAP.2011.04.009.
13. Tay, R., and A. Churchill. Effect of Different Median Barriers on Traffic Speed. *Canadian Journal of Transportation*, Vol. 1, No. 1, 2007, pp. 56–66.
14. Sykes, P. Transport Planning with Microsimulation. *Journal of Maps*, Vol. 3, No. 1, 2007, pp. 122–134. https://doi.org/10.1080/jom.2007.9710833.
15. Fisher, D. L., M. Rizzo, J. Caird, and J. D. Lee. *Handbook of Driving Simulation for Engineering, Medicine, and Psychology*. Taylor & Francis Group, Boca Raton, FL, 2011.

16. Rahman, M. H., M. Abdel-Aty, J. Lee, and M. S. Rahman. Enhancing Traffic Safety at School Zones by Operation and Engineering Countermeasures: A Microscopic Simulation Approach. *Simulation Modelling Practice and Theory*, Vol. 94, 2019, pp. 334–348. https://doi.org/10.1016/j.simpat.2019.04.001.

17. Valdés, D., B. Colucci, A. Figueroa, E. Colón, M. Rojas, R. García, Y. Taveras, I. Ramos, and C. Arroyo. Operational Analysis of School Zones Using a Driving Simulator. 2019.

18. Valdés, D., M. Knodler, B. Colucci, A. Figueroa, M. Rojas, E. Colón, N. Campbell, and F. Tainter. Speed Behavior in a Suburban School Zone: A Driving Simulation Study with Familiar and Unfamiliar Drivers from Puerto Rico and Massachusetts. *Advances in Human Factors of Transportation*, 2019, pp. 319–329.

19. Federal Highway Administration. The Manual on Uniform Traffic Control Devices for Streets and Highways, 2009.

20. Lu, M., Wevers, K., and Heijden, R. Van Der. (2005). "Technical Feasibility of Advanced Driver Assistance Systems (ADAS) for Road Traffic Safety." *Transportation Planning and Technology*, 167–187.

21. Lee, C., S. Lee, B. Choi, and Y. Oh. Effectiveness of Speed-Monitoring Displays in Speed Reduction in School Zones. *Transportation Research Board*, No. 1973, 2006, pp. 27–35. https://doi.org/https://doi.org/10.3141/2149-01.

22. Lehtonen, E., Malhotra, N., Starkey, N. J., and Charlton, S. G. (2020). "Speedometer monitoring when driving with a speed warning system." *European Transport Research Review*, European Transport Research Review, 12(1).

APPENDICES

Description of Appendices

This research project consisted of the assessment of four countermeasures for speeding in school zones including Two-step reduction signs (TSR), An overhead sign, Reduced Speed Ahead sign (RSA) and Speed Monitoring Display (SMD). These countermeasures were evaluated in a school zone of the S.U. Samuel Adams adjacent to PR-2, a high speed major arterial of the National Highway System. A comprehensive analysis of different scenarios and variables applicable to these school zones was performed using the data generated by experiments with the UPRM driving simulator.

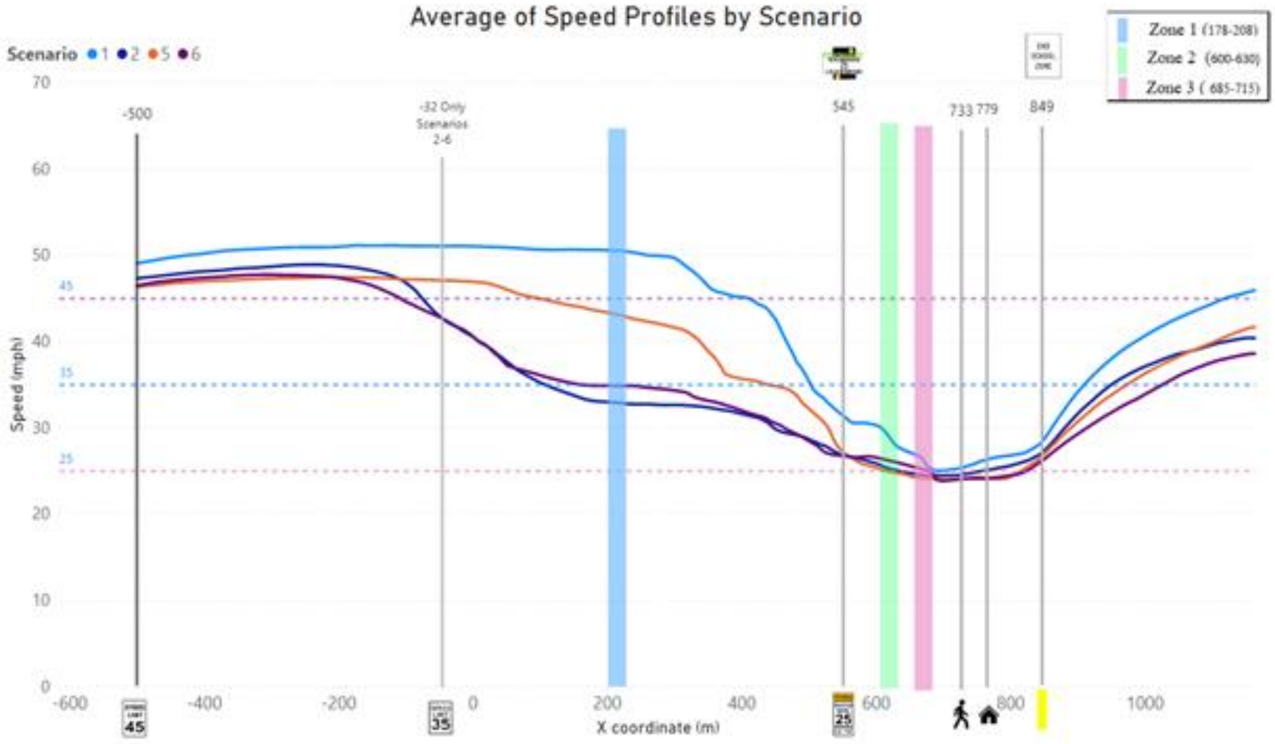
The appendices include the figures and tables representing the performance measures for each one of the countermeasures separately. (Appendix A) shows the figures representing the average speed for each one of the countermeasures including average speed, 85th percentile speed profiles, average speed by gender, and average speed by subject. In addition this appendix presents the figures of standard deviation of speed and acceleration noise (standard deviation of acceleration) for each countermeasure. (Appendix B), includes Minitab tables of the statistical analysis performed with the Bonferroni correction. (Appendix C) present the Tables summarizing the statistical analysis of each countermeasure.

Appendix A: Speed Graphs

COUNTERMEASURES

1. Two Step Reduction

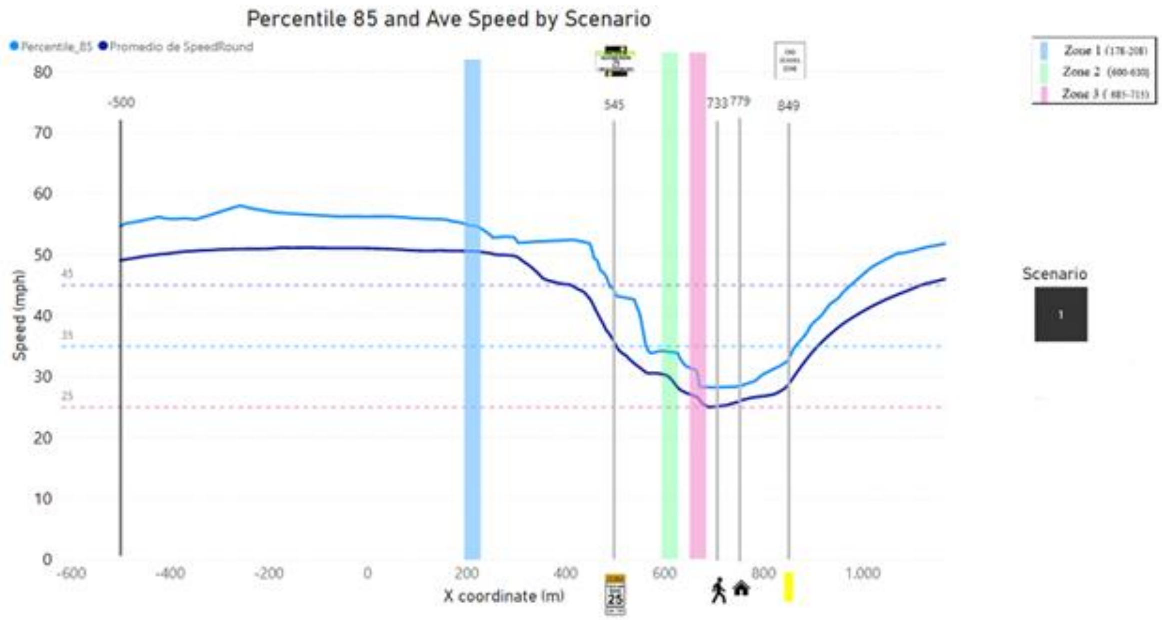
a. Average Speed



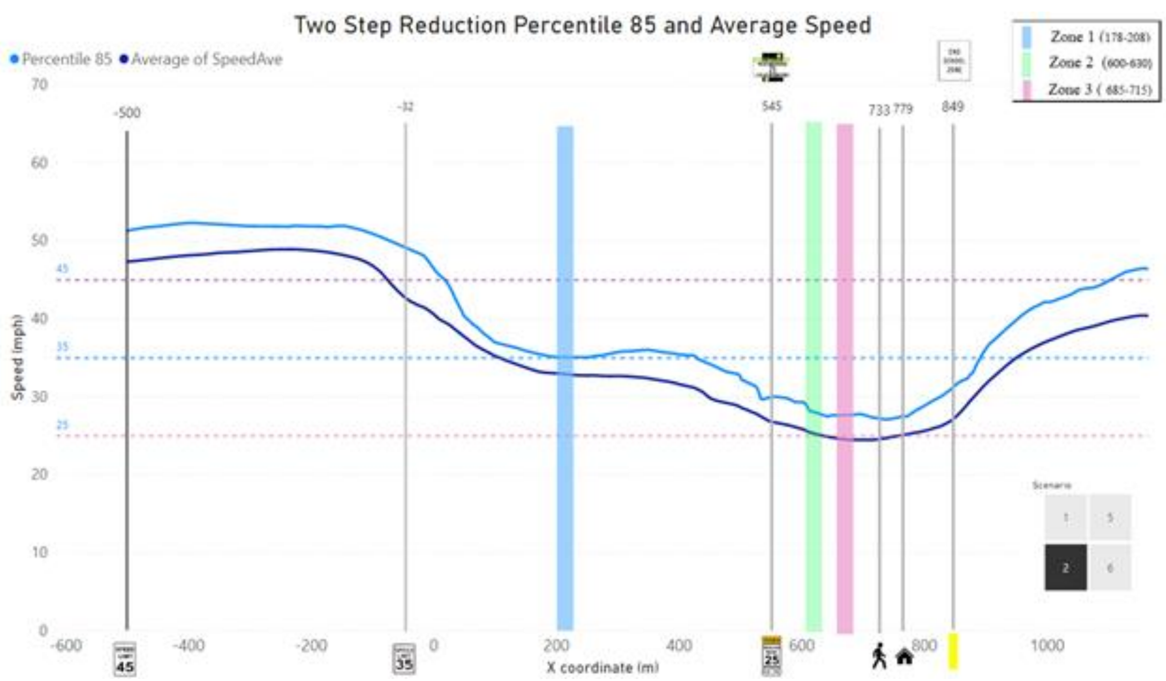
b. Standard Deviation Speed

c. Percentile 85 vs Average Speed by Scenario

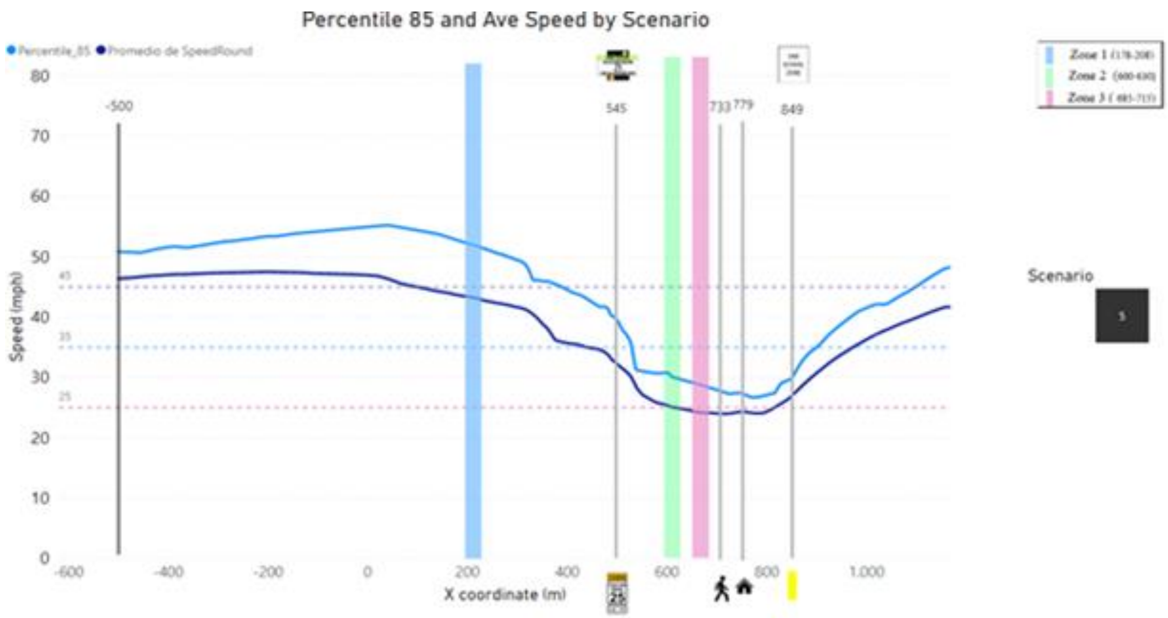
Escenario 1



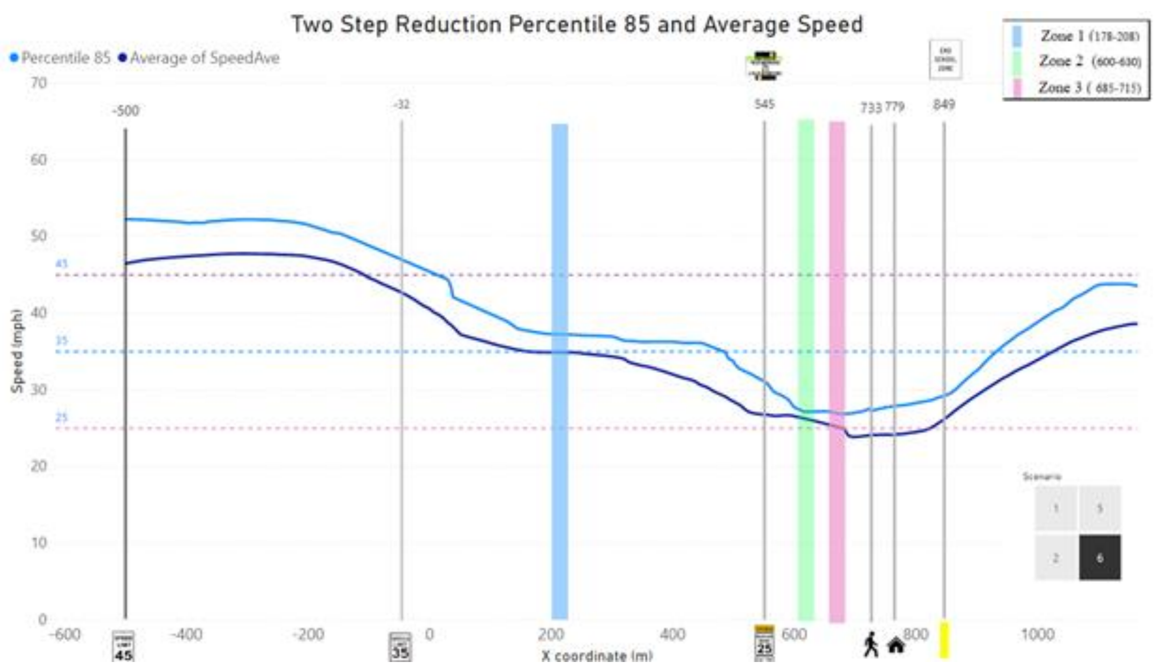
Escenario 2



Escenario 5

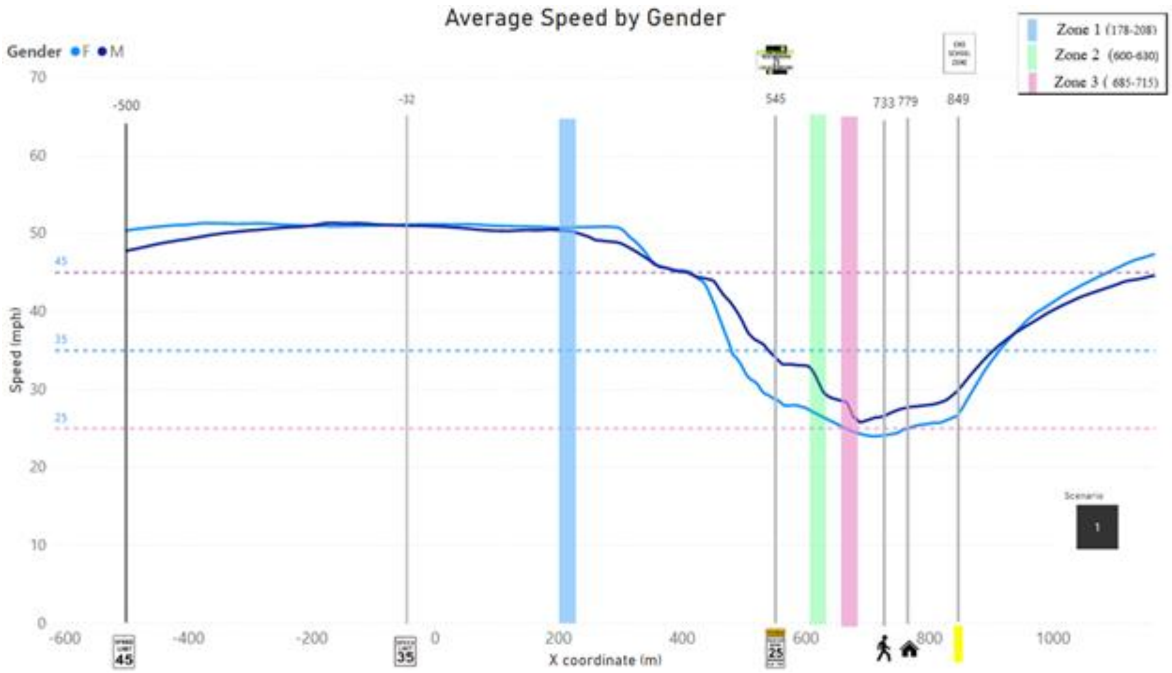


Escenario 6

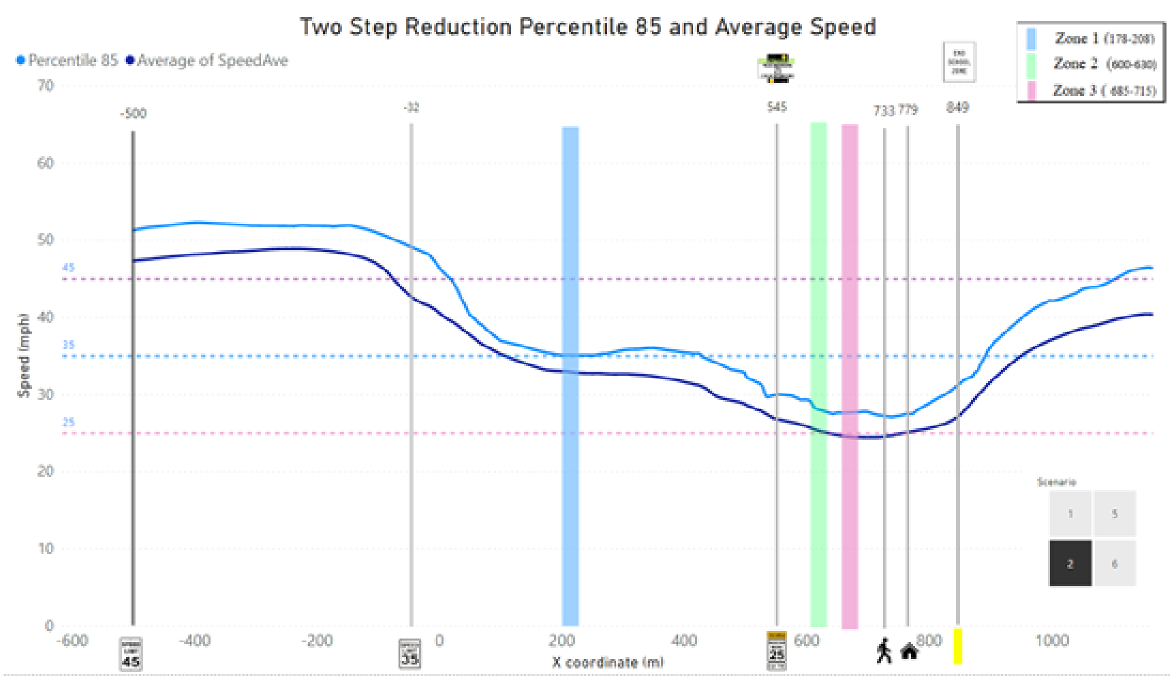


d. Average Speed by Gender

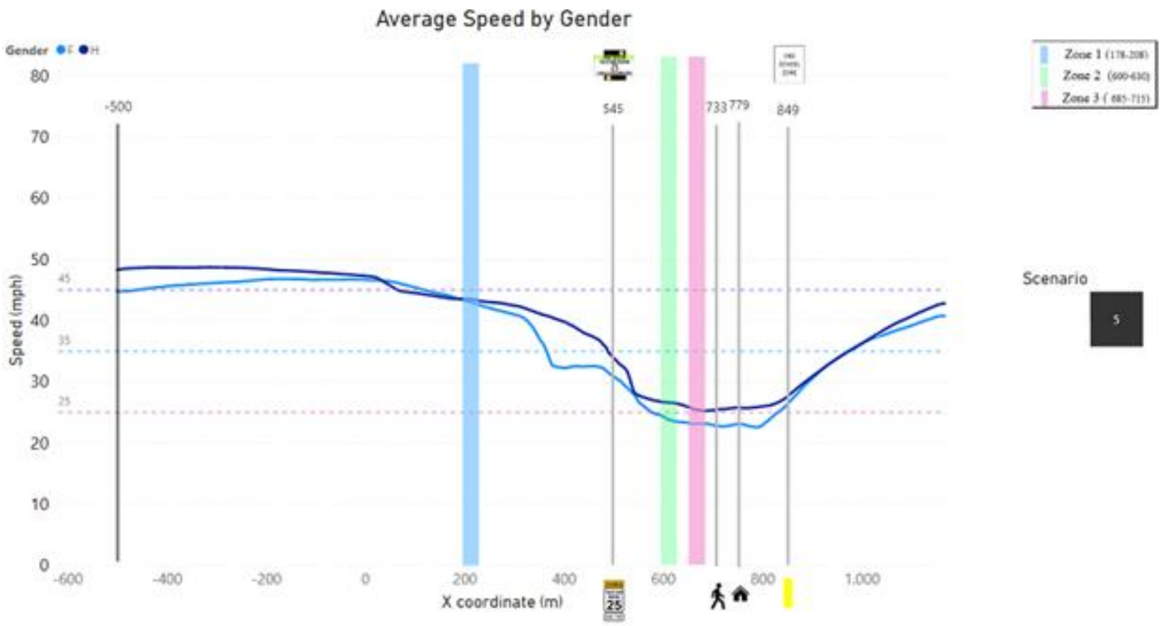
Escenario 1



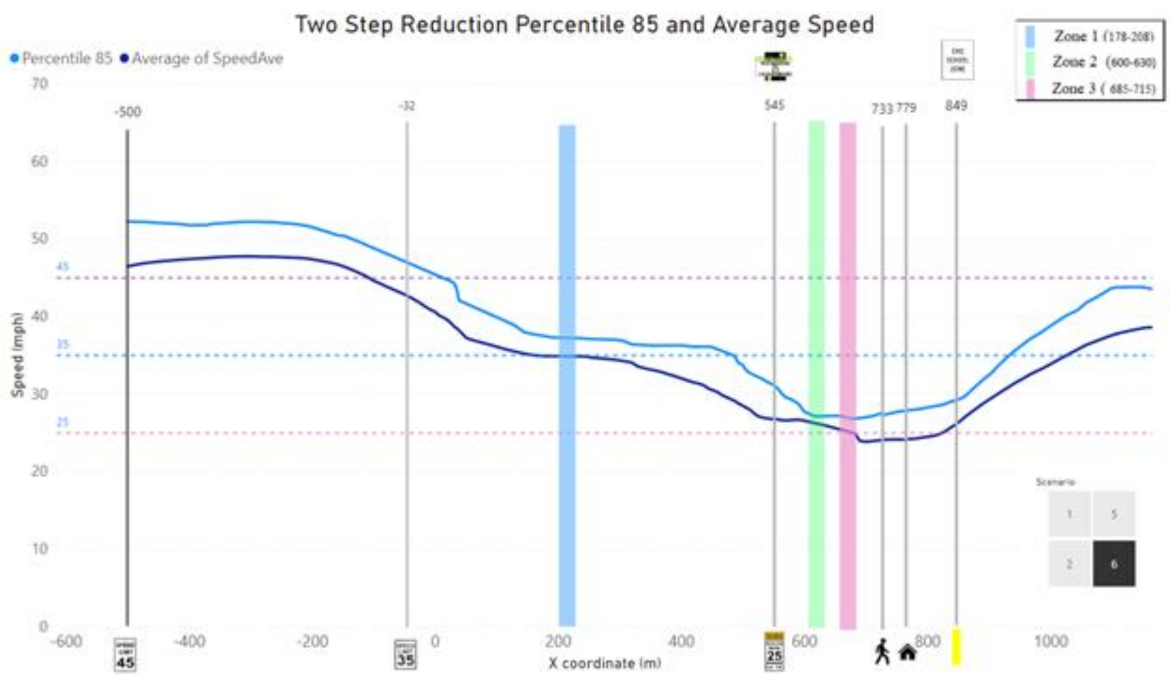
Escenario 2



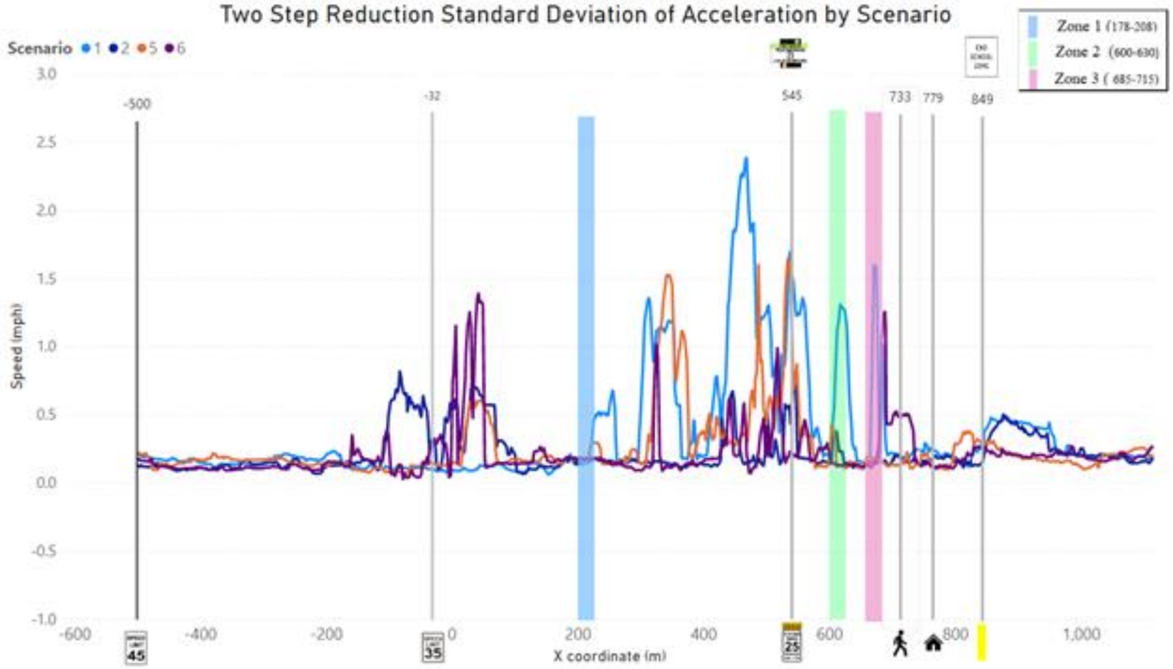
Escenario 5



Escenario 6

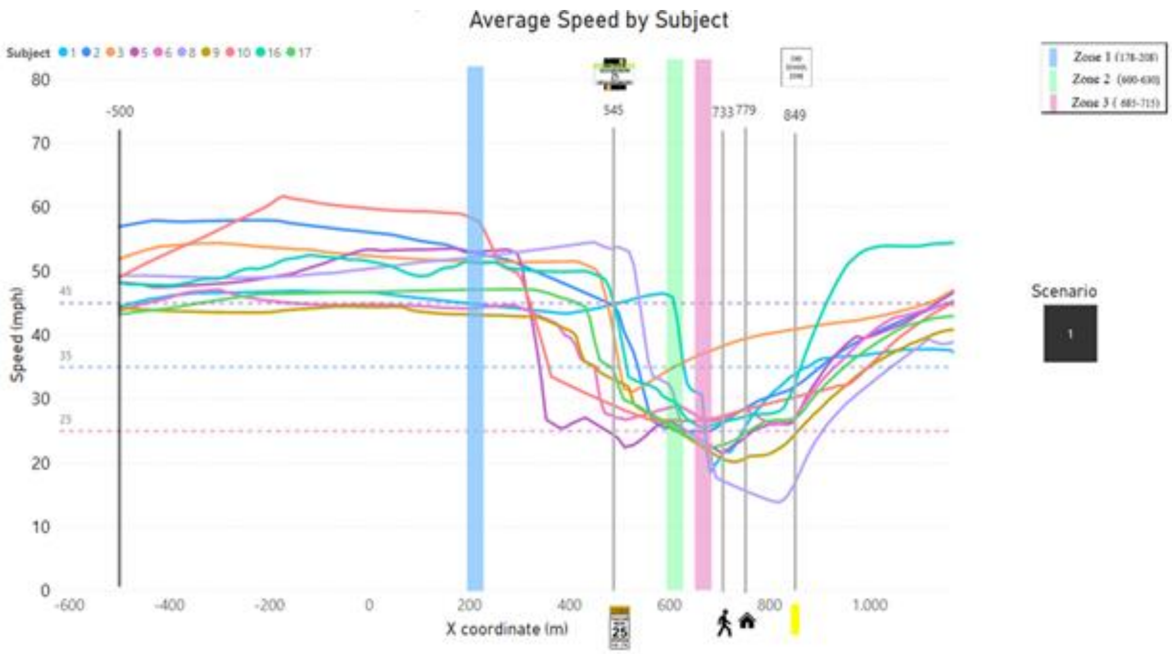


e. Standard Deviation Acceleration

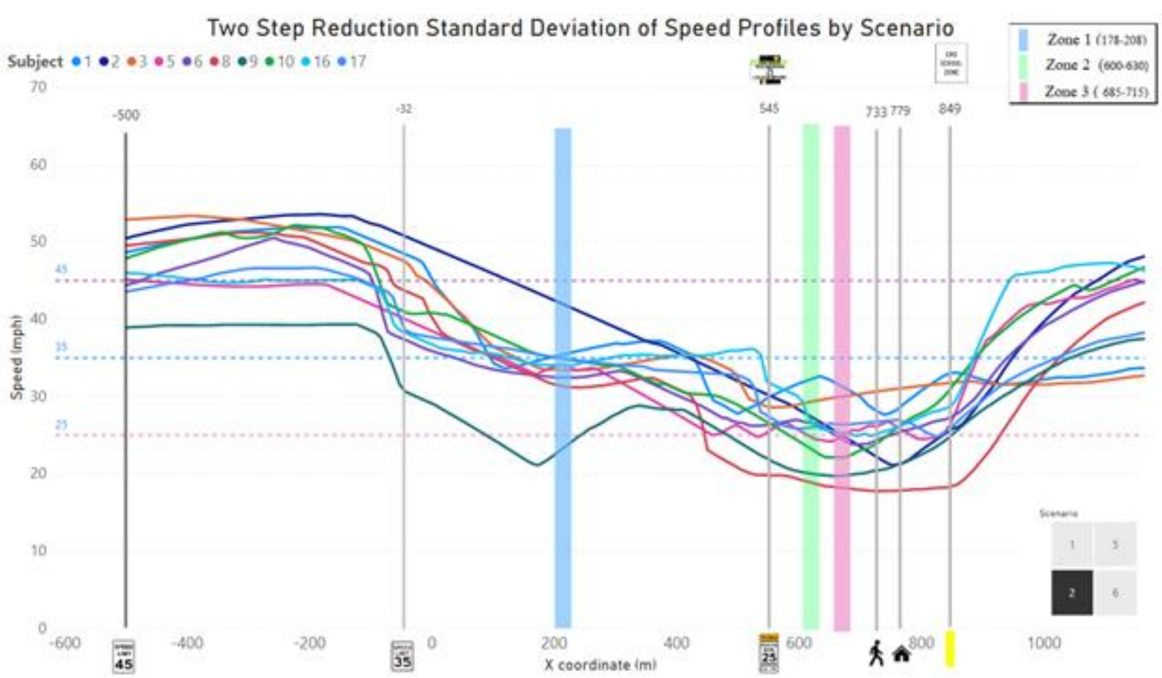


f. Average Speed by Subject

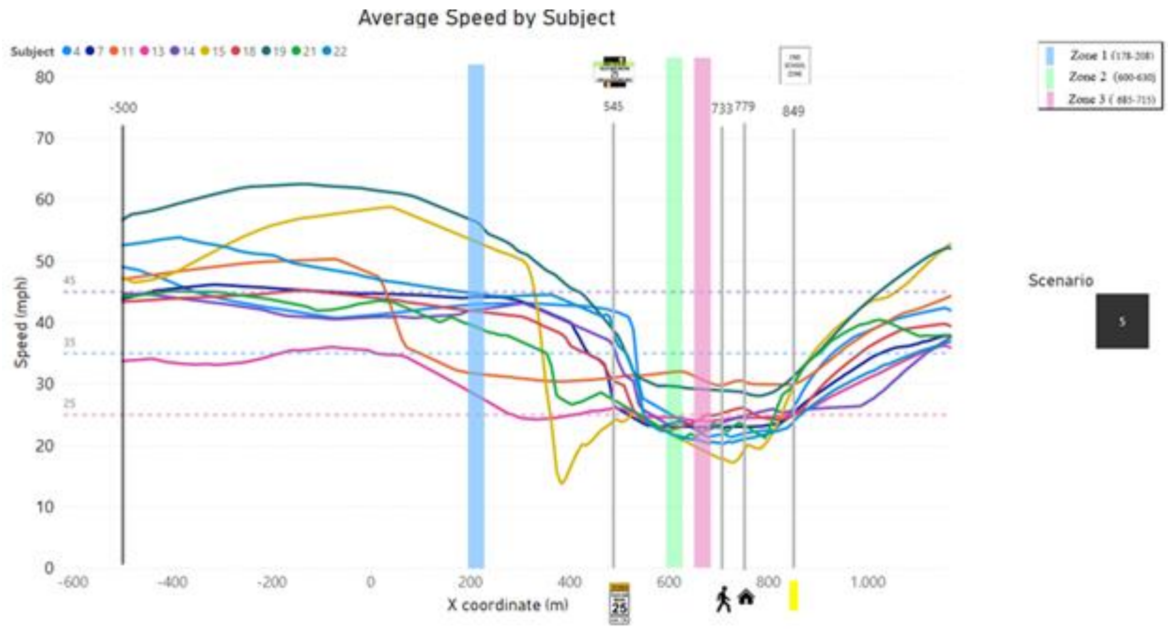
Escenario 1



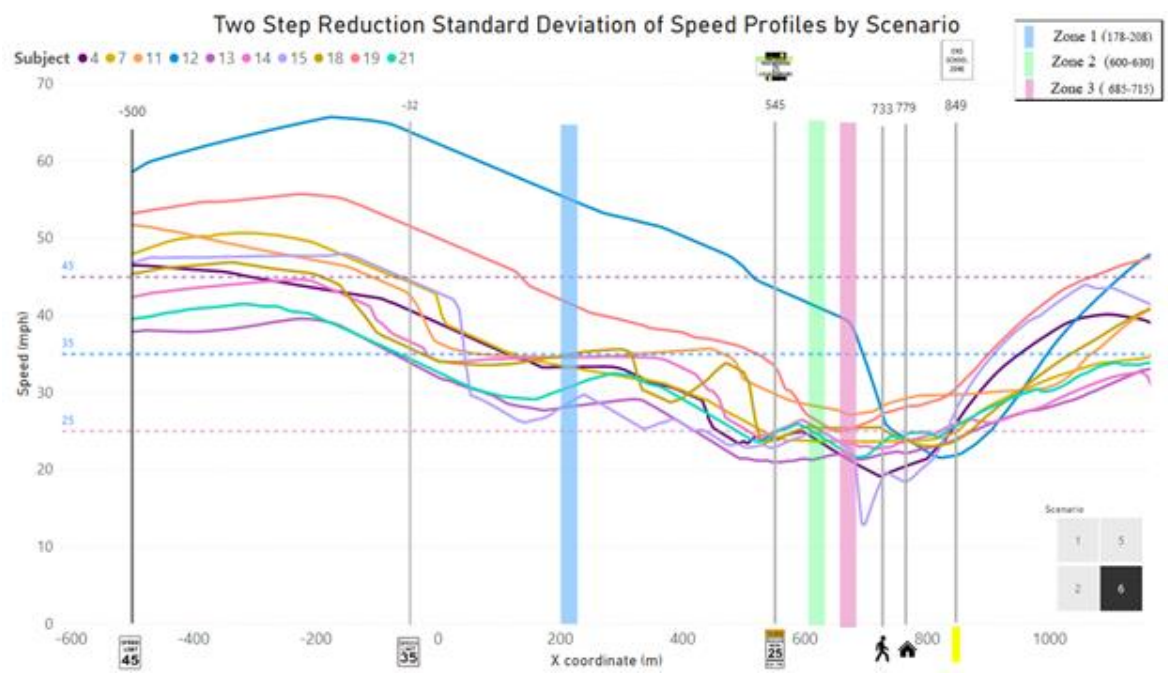
Escenario 2



Escenario 5

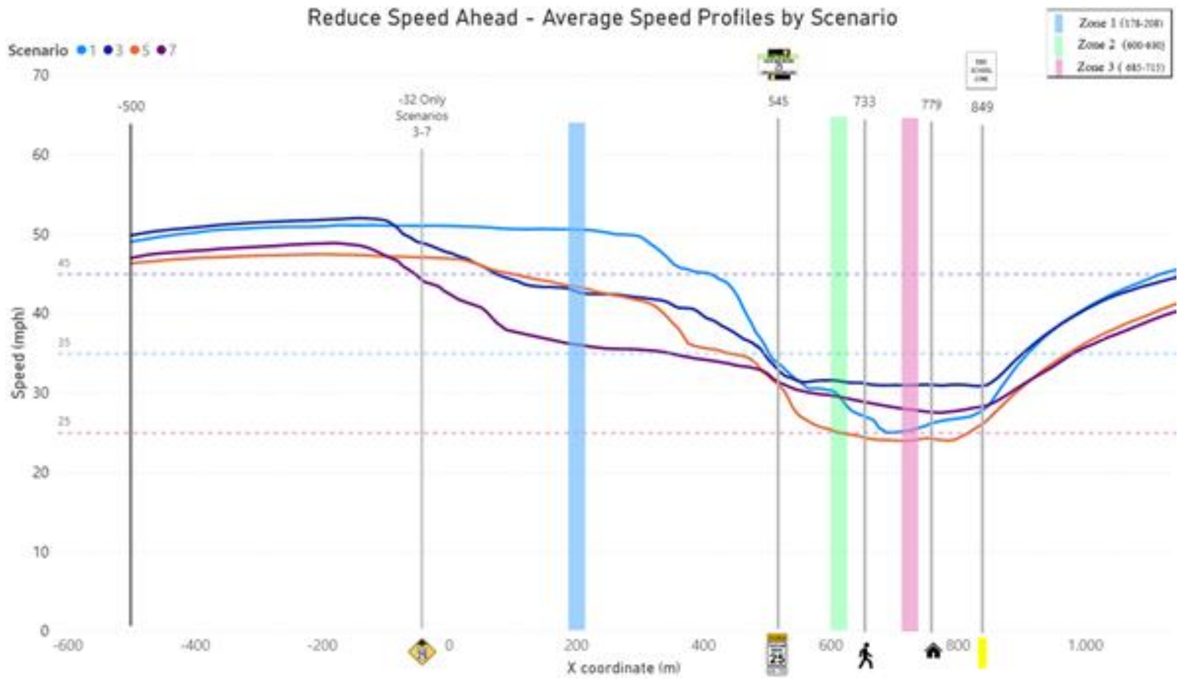


Escenario 6

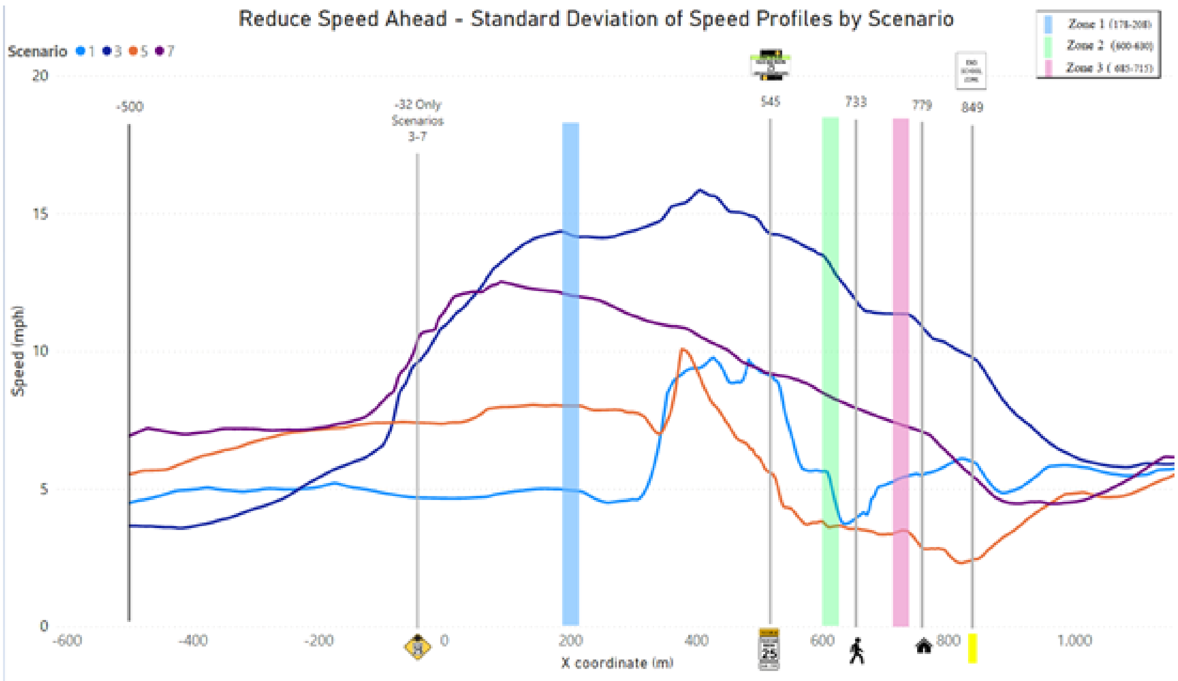


2. Reduce Speed Ahead

a. Average Speed

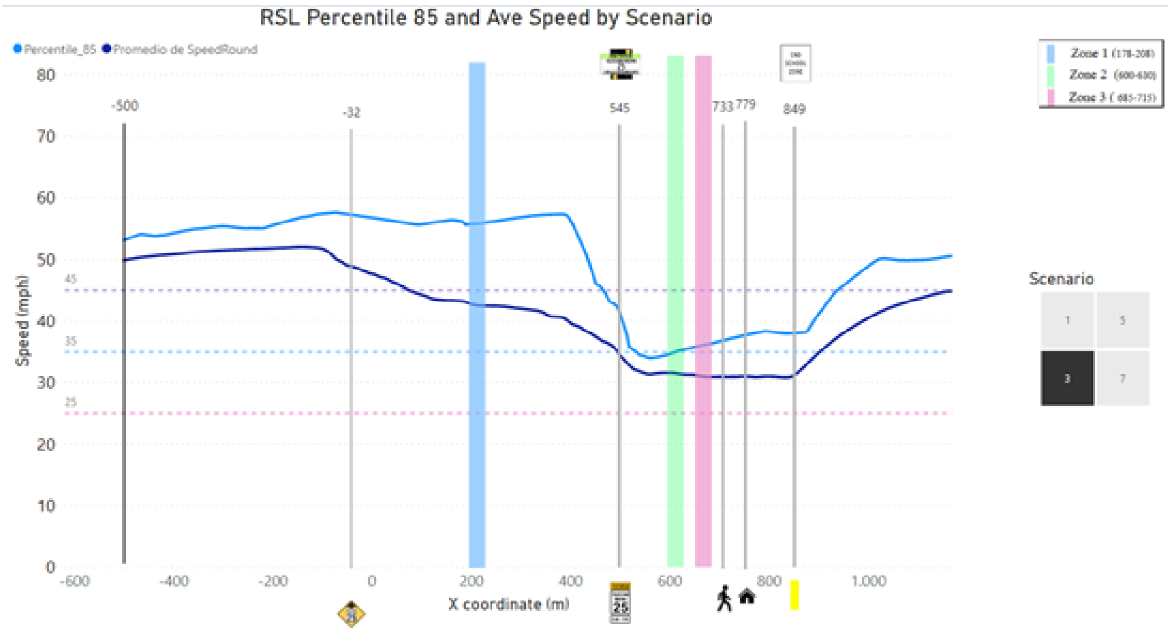


b. Standard Deviation

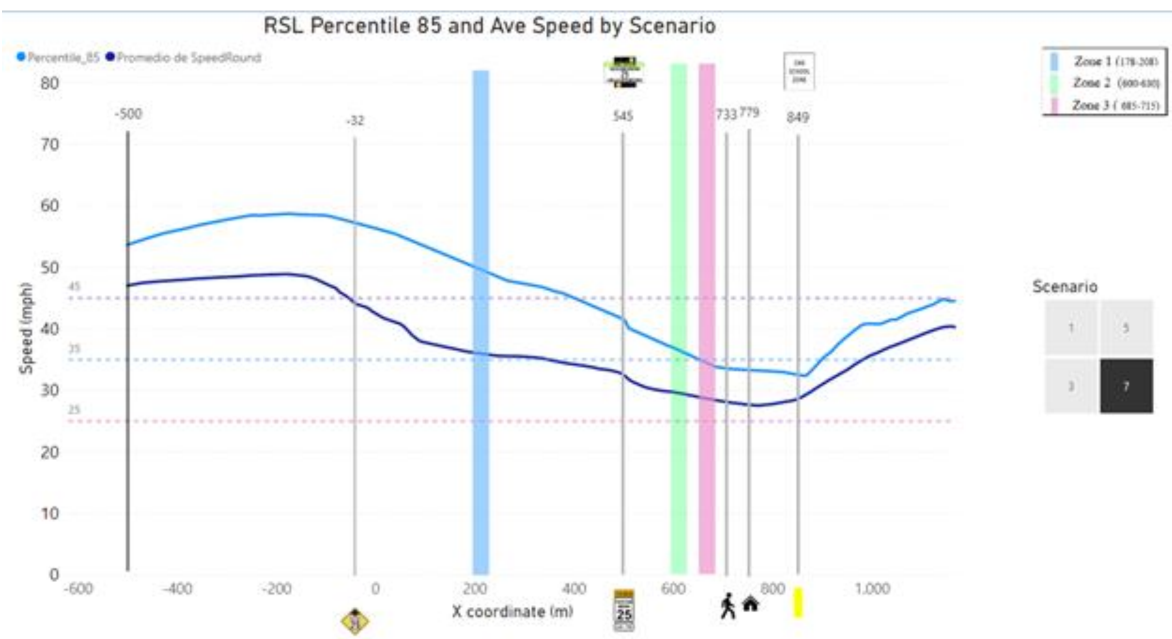


c. Percentile 85 vs Average Speed by Scenario

Escenario 3

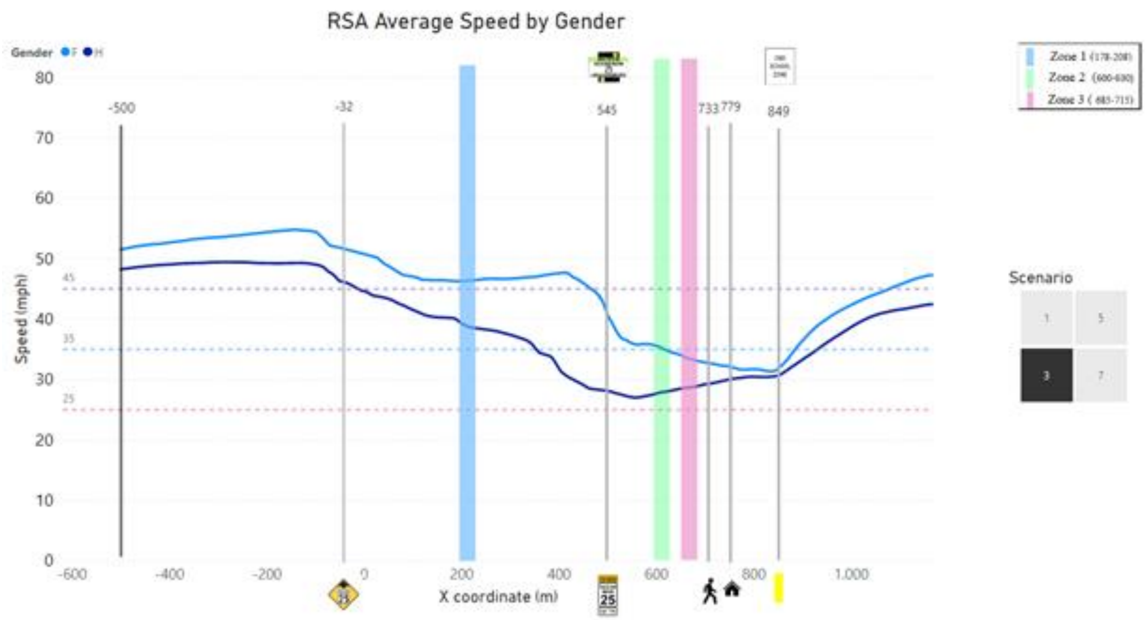


Escenario 7

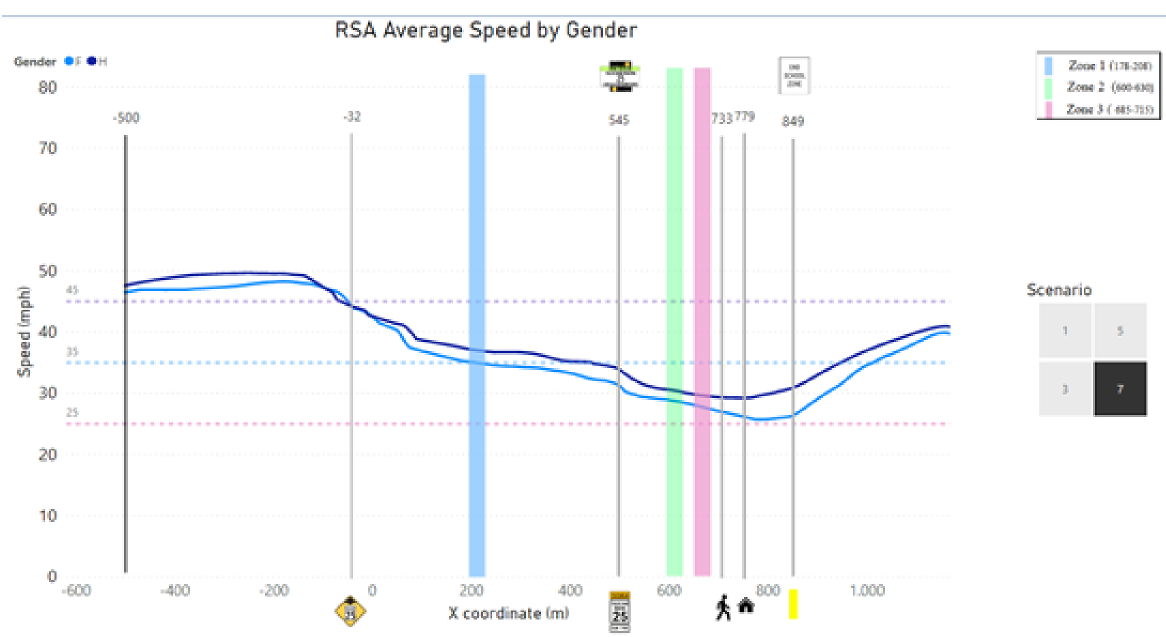


d. Average Speed by Gender

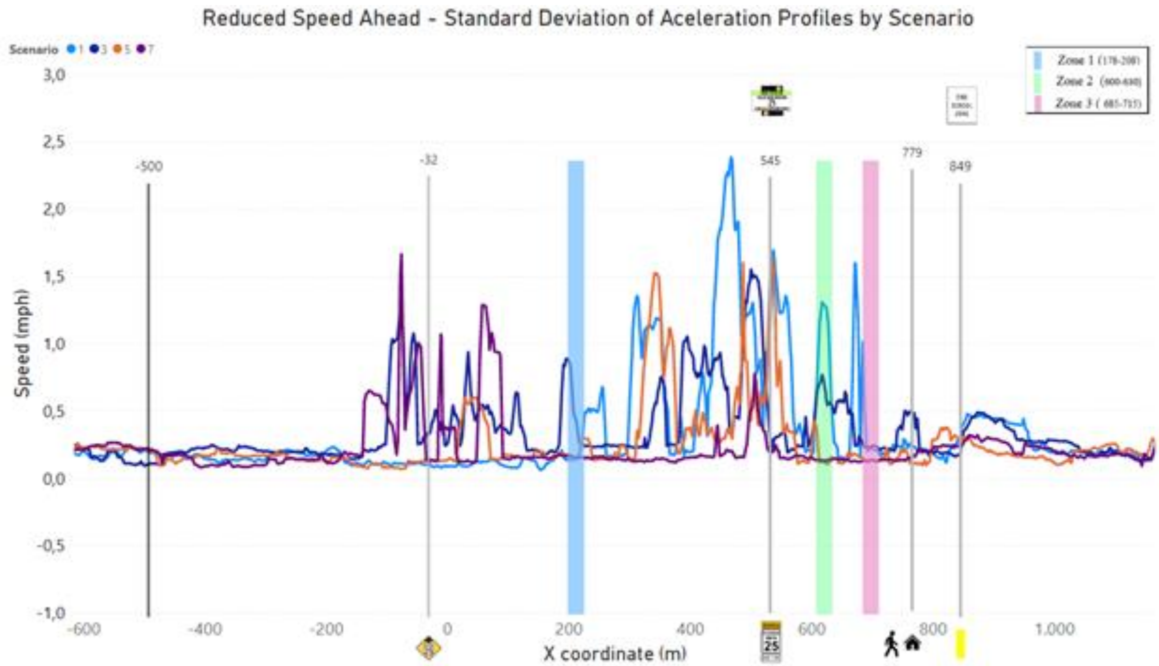
Escenario 3



Escenario 7

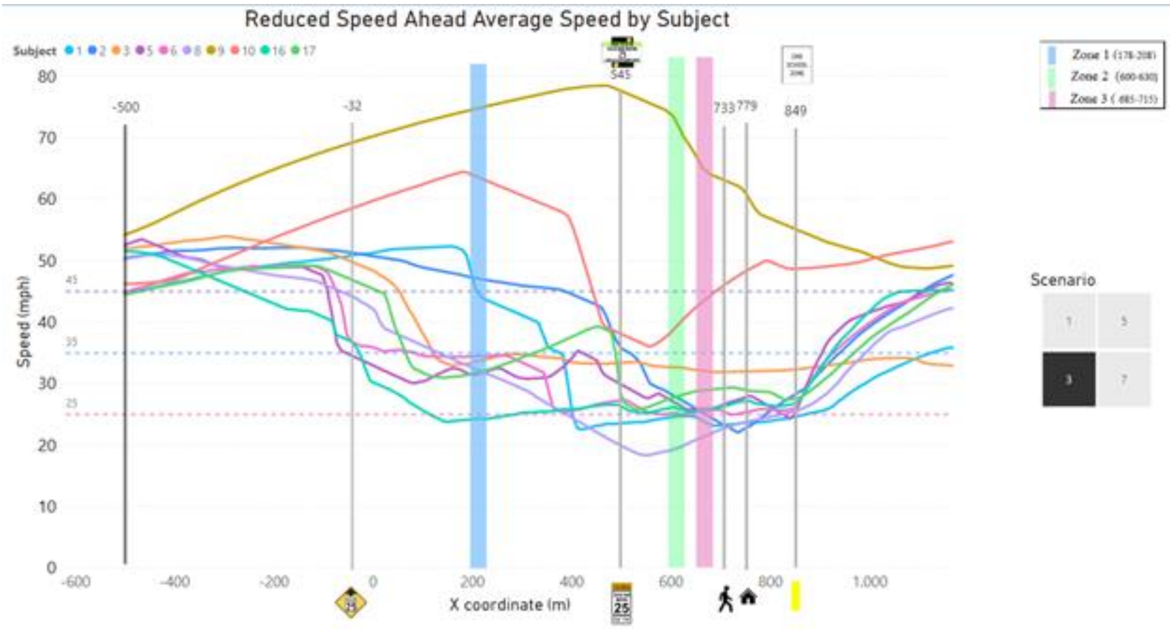


e. Standard Deviation Acceleration

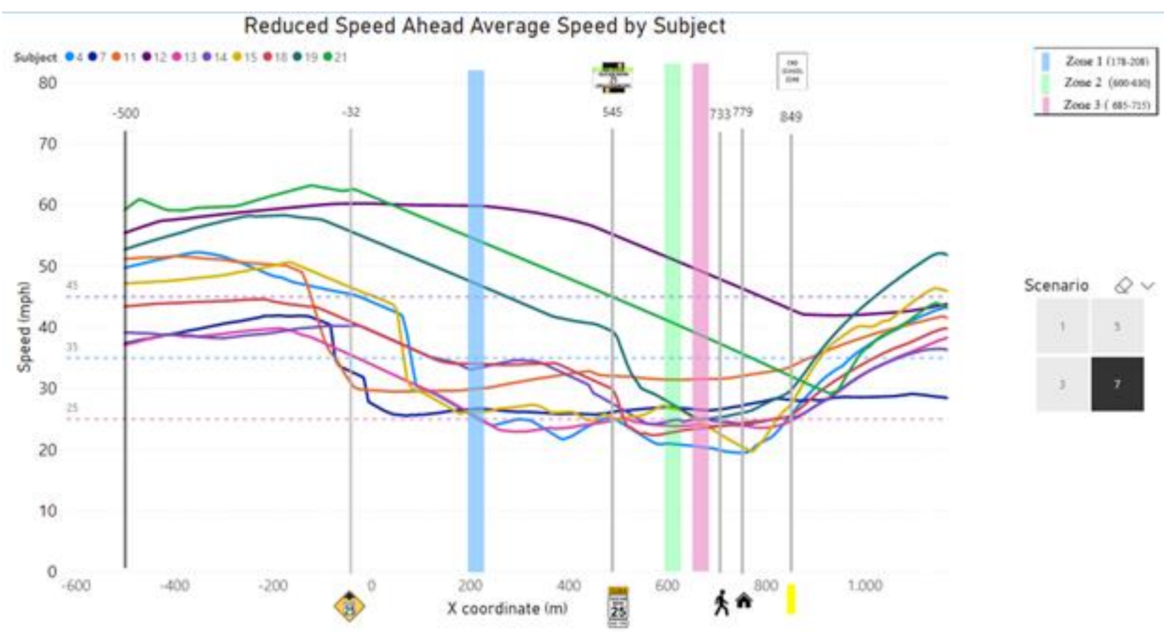


f. Average Speed by Subject

Escenario 3



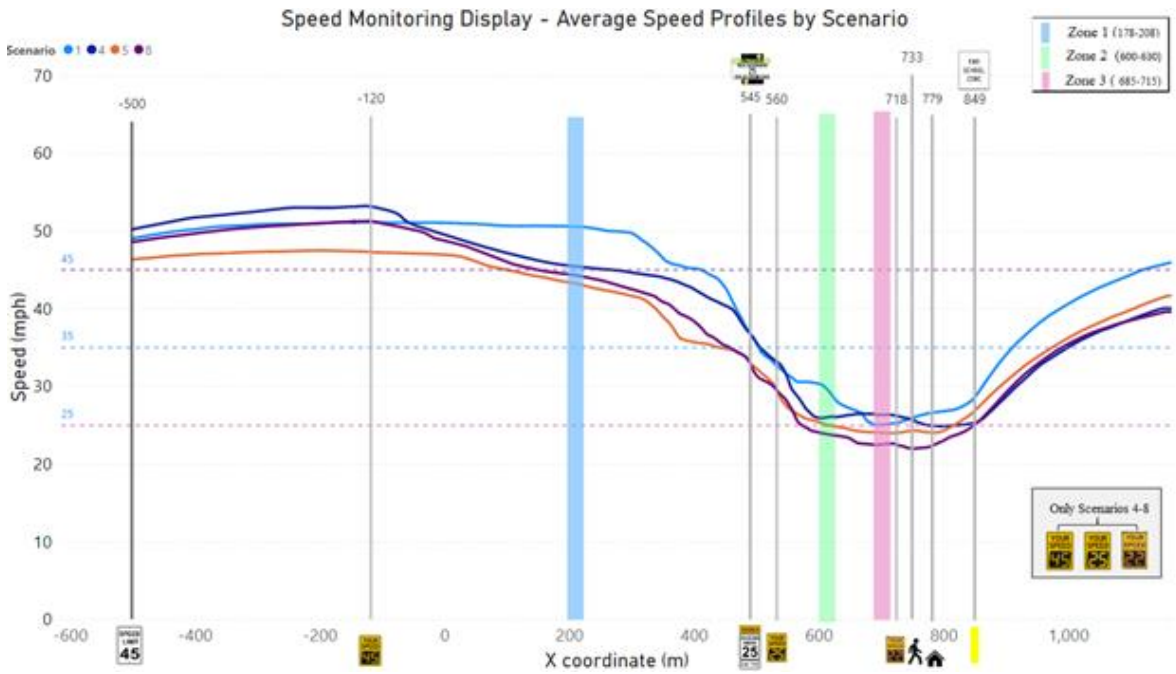
Escenario 7



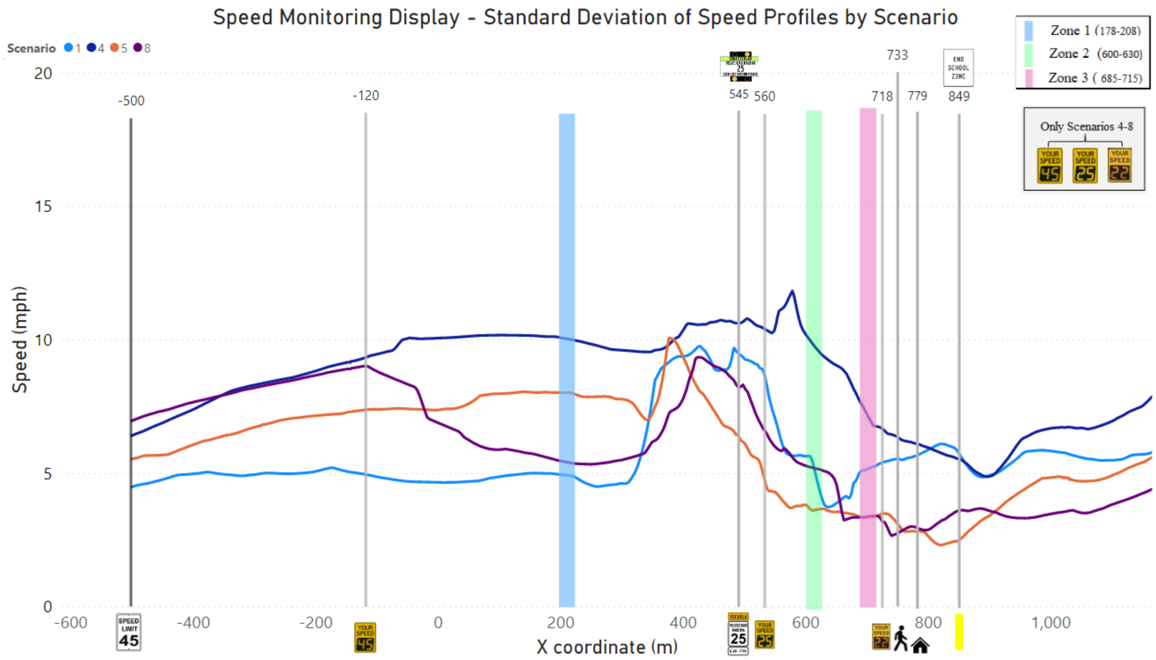
3. Speed Monitoring Display

.

a. Average Speed

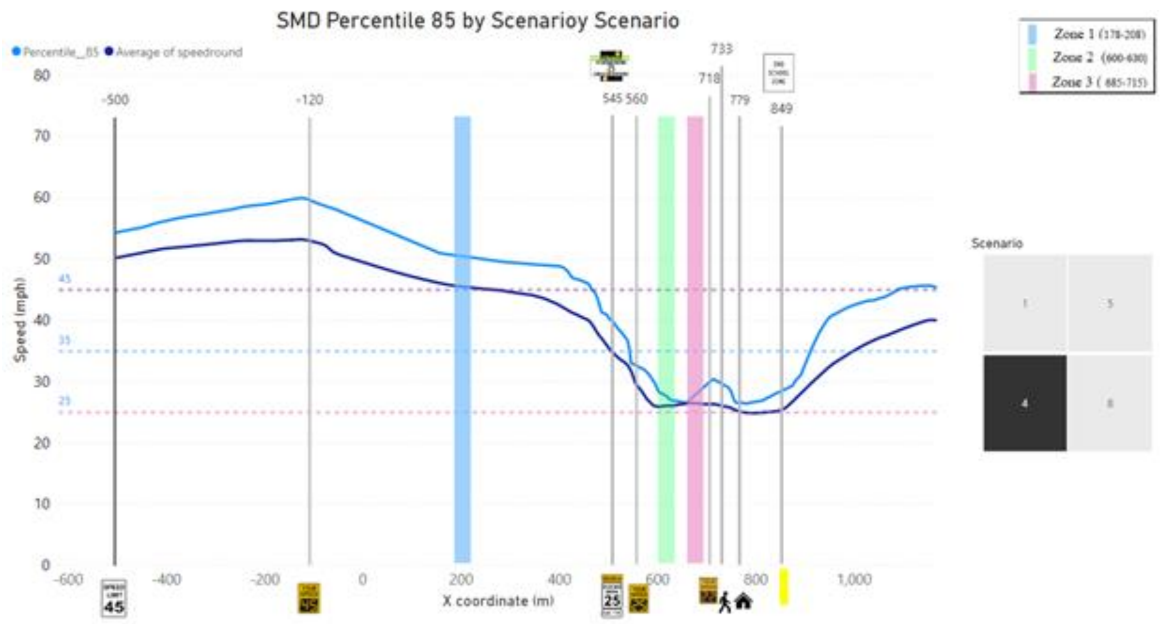


b. Standard Deviation Speed

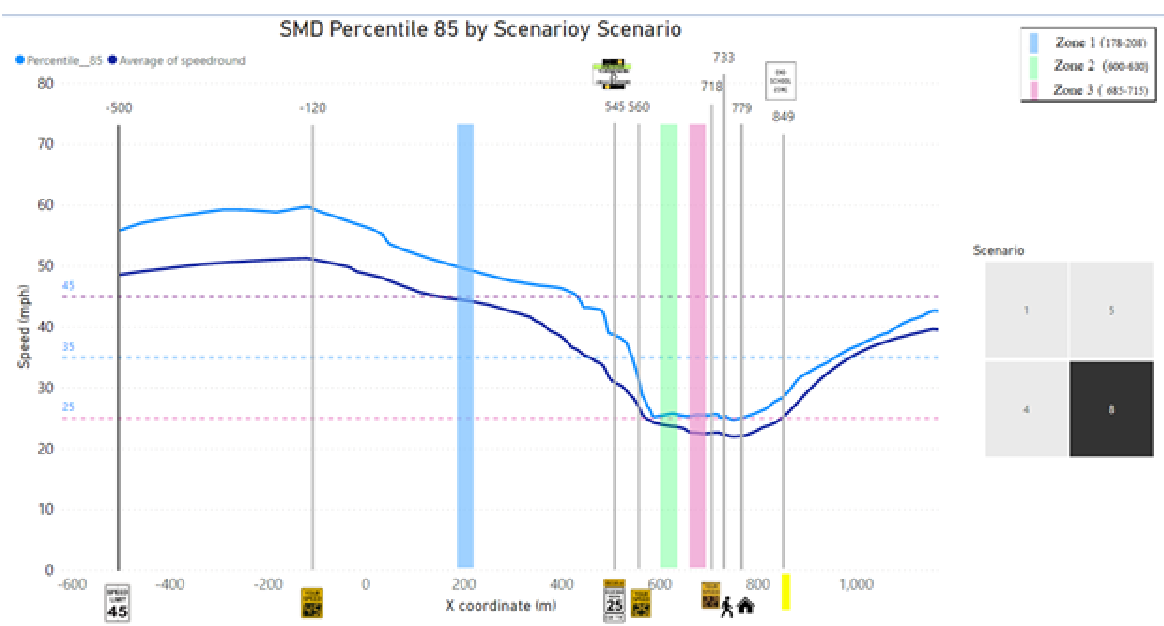


c. *Percentile 85 vs Average Speed by Scenario*

Escenario 4

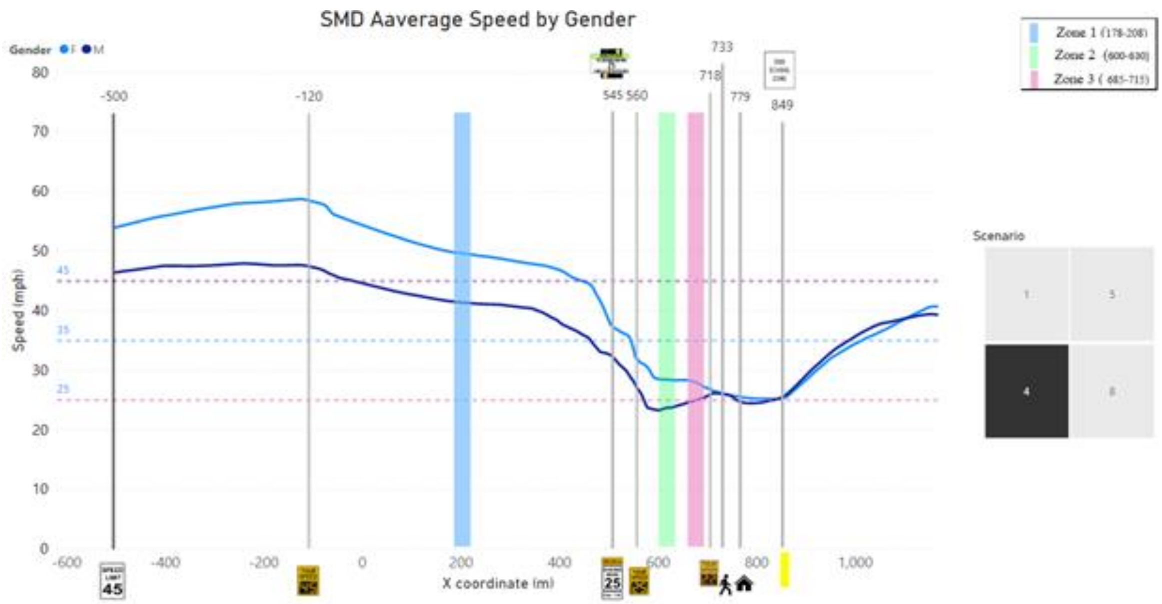


Escenario 8

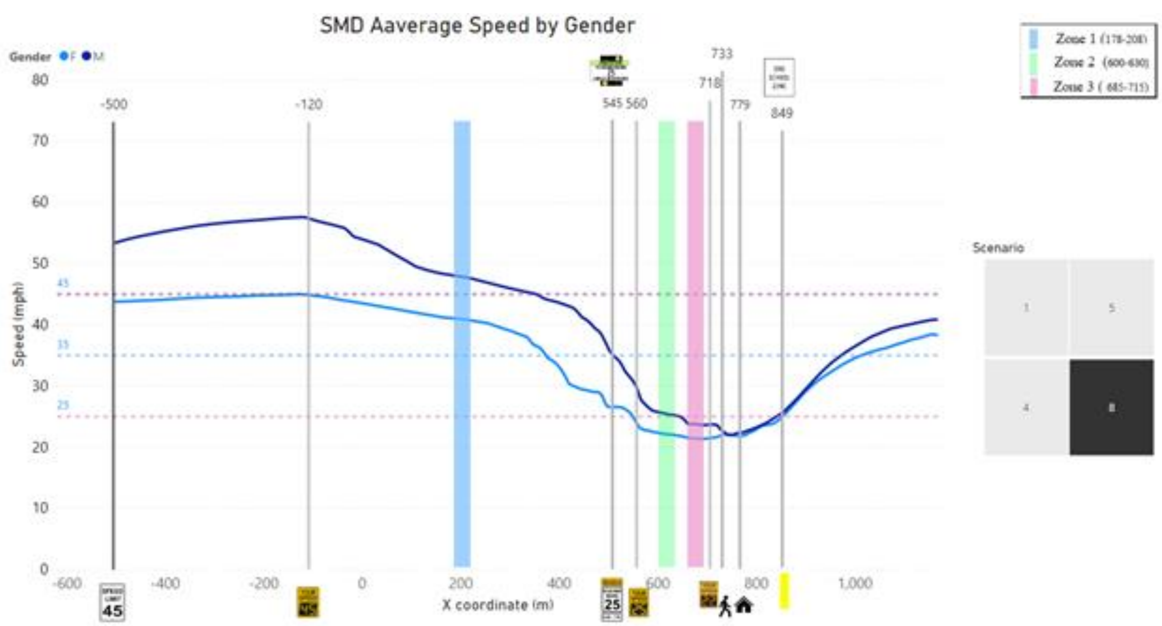


d. Average Speed by Gender

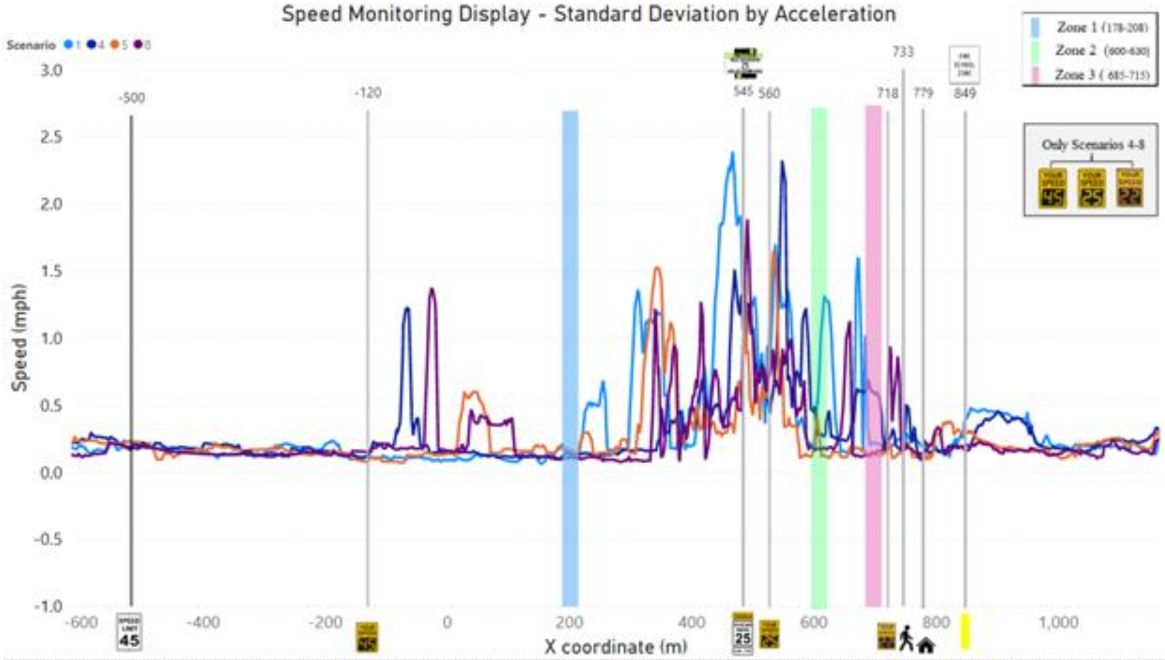
Escenario 4



Escenario 8

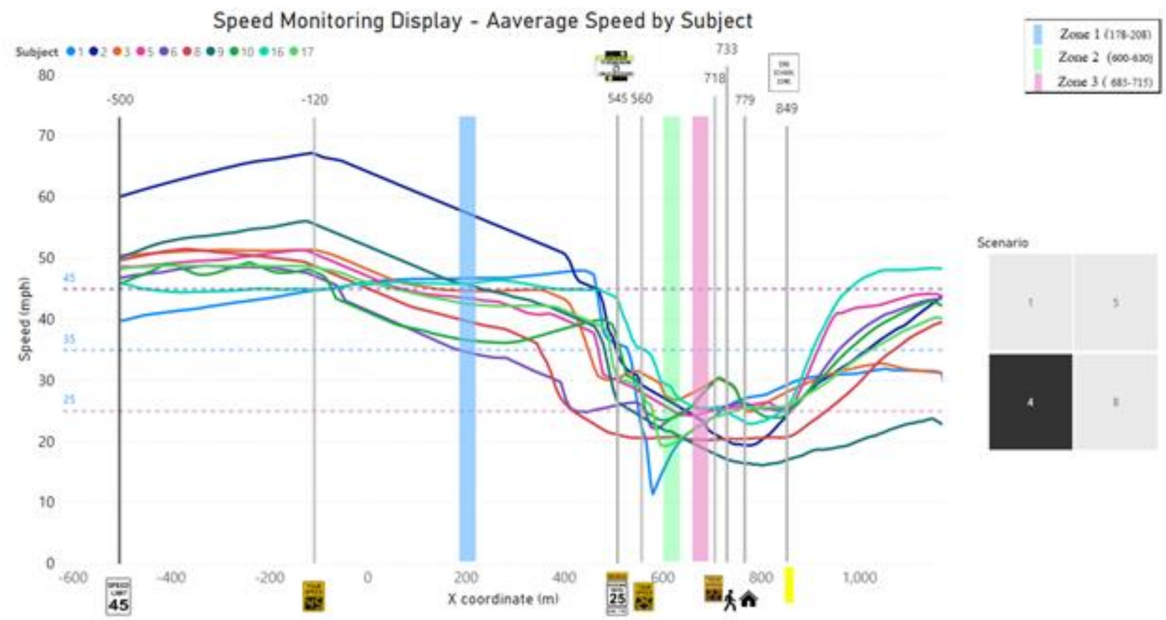


e. Standard Deviation Acceleration

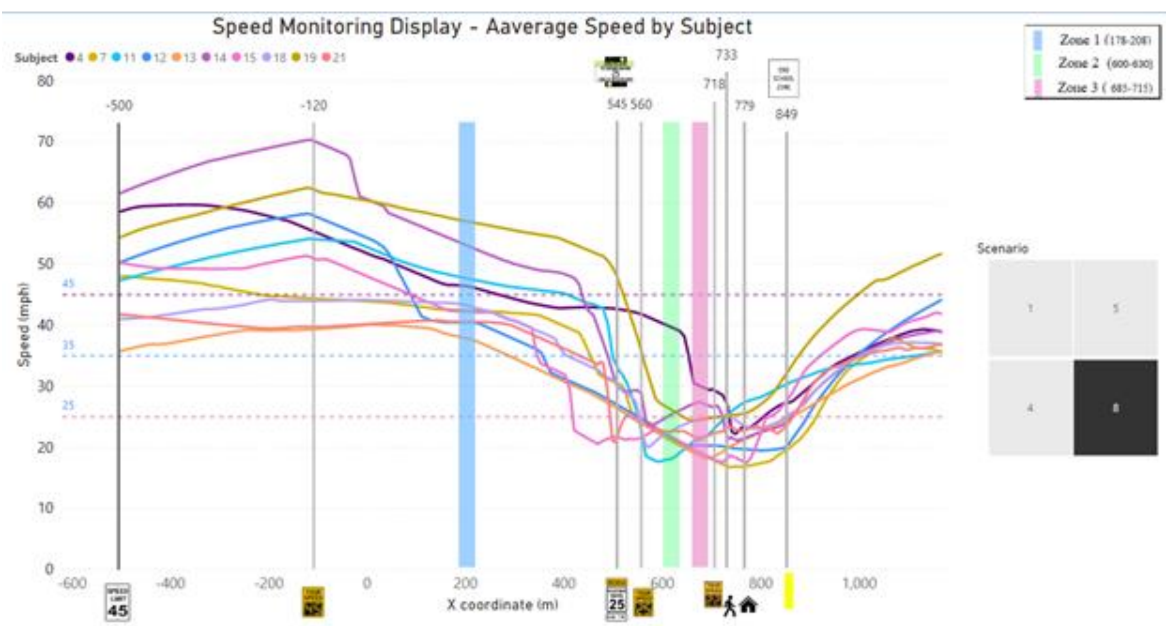


f. Average Speed by Subject

Escenario 4



Escenario 8



Appendix B: Statistical Results

TWO STEP REDUCTION

Coordinate 500

General Linear Model: Velocidad versus Escenario

Factor	Type	Levels	Values
Escenario	fixed	4	1, 2, 5, 6

Analysis of Variance for Velocidad, using Sequential SS for Tests

Source	DF	Seq SS	Adj SS	Seq MS	F	P
Escenario	3	205.90	205.90	68.63	2.81	0.042
Error	126	3076.02	3076.02	24.41		
Total	129	3281.92				

S = 4.94093   R-Sq = 6.27%   R-Sq(adj) = 4.04%

```
Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable Velocidad
All Pairwise Comparisons among Levels of Escenario
Escenario = 1  subtracted from:

Escenario   Lower  Center   Upper    -+---------+---------+---------+-----
2          -4.732  -1.470  1.7922         (----------*----------)
5          -6.420  -3.082  0.2553    (----------*----------)
6          -6.298  -3.012  0.2741    (----------*----------)
                                     -+---------+---------+---------+-----
                                   -6.0      -3.0       0.0       3.0

Escenario = 2  subtracted from:

Escenario   Lower  Center  Upper    -+---------+---------+---------+-----
5          -4.902  -1.612  1.677         (----------*----------)
6          -4.778  -1.542  1.695         (----------*----------)
                                    -+---------+---------+---------+-----
                                  -6.0      -3.0       0.0       3.0

Escenario = 5  subtracted from:

Escenario   Lower   Center  Upper    -+---------+---------+---------+-----
6          -3.242  0.07058  3.383              (----------*----------)
                                     -+---------+---------+---------+-----
                                   -6.0      -3.0       0.0       3.0
```

Bonferroni Simultaneous Tests
Response Variable Velocidad
All Pairwise Comparisons among Levels of Escenario
Escenario = 1 subtracted from:

Escenario	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
2	-1.470	1.217	-1.208	1.0000
5	-3.082	1.245	-2.475	0.0878
6	-3.012	1.226	-2.457	0.0922

Escenario = 2 subtracted from:

Escenario	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	-1.612	1.227	-1.314	1.000
6	-1.542	1.207	-1.277	1.000

Escenario = 5 subtracted from:

Escenario	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
6	0.07058	1.236	0.05711	1.000

Coordinate -32

General Linear Model: VEL versus ESC

```
Factor  Type   Levels  Values
ESC     fixed       4  1, 2, 5, 6


Analysis of Variance for VEL, using Sequential SS for Tests

Source   DF   Seq SS   Adj SS  Seq MS      F      P
ESC       3  2503.84  2503.84  834.61  20.22  0.000
Error   134  5530.76  5530.76   41.27
Total   137  8034.60


S = 6.42451   R-Sq = 31.16%   R-Sq(adj) = 29.62%



Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable VEL
All Pairwise Comparisons among Levels of ESC
ESC = 1  subtracted from:

ESC   Lower  Center   Upper     -+---------+---------+---------+-----
2    -14.43  -10.27  -6.120     (-----*-----)
5     -9.92   -5.59  -1.252            (-----*-----)
6    -14.68  -10.55  -6.421     (-----*-----)
                                -+---------+---------+---------+-----
                             -14.0      -7.0       0.0       7.0


ESC = 2  subtracted from:

ESC   Lower   Center  Upper     -+---------+---------+---------+-----
5     0.497   4.6858  8.875                           (-----*-----)
6    -4.248  -0.2748  3.699                    (-----*----)
                                -+---------+---------+---------+-----
                             -14.0      -7.0       0.0       7.0


ESC = 5  subtracted from:

ESC   Lower  Center    Upper     -+---------+---------+---------+-----
6    -9.125  -4.961  -0.7967            (-----*-----)
                                 -+---------+---------+---------+-----
                              -14.0      -7.0       0.0       7.0
```

Bonferroni Simultaneous Tests
Response Variable VEL
All Pairwise Comparisons among Levels of ESC
ESC = 1 subtracted from:

ESC	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
2	-10.27	1.551	-6.624	0.0000
5	-5.59	1.619	-3.451	0.0045
6	-10.55	1.541	-6.843	0.0000

ESC = 2 subtracted from:

ESC	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	4.6858	1.564	2.9955	0.0196
6	-0.2748	1.484	-0.1852	1.0000

ESC = 5 subtracted from:

ESC	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
6	-4.961	1.555	-3.190	0.0106

ZONA 1

General Linear Model: Velo versus Esce

```
Factor  Type   Levels  Values
Esce    fixed       4  1, 2, 5, 6


Analysis of Variance for Velo, using Sequential SS for Tests

Source    DF  Seq SS  Adj SS  Seq MS        F      P
Esce       3  231058  231058   77019  2073.98  0.000
Error   4946  183674  183674      37
Total   4949  414732


S = 6.09392   R-Sq = 55.71%   R-Sq(adj) = 55.69%



Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable Velo
All Pairwise Comparisons among Levels of Esce
Esce = 1  subtracted from:

Esce   Lower  Center   Upper   ---+---------+---------+---------+---
2     -18.44  -17.77  -17.11   (*)
5      -8.96   -8.24   -7.53              (*)
6     -17.05  -16.38  -15.71     (*
                               ---+---------+---------+---------+---
                                -16.0      -8.0       0.0       8.0


Esce = 2  subtracted from:

Esce   Lower  Center   Upper   ---+---------+---------+---------+---
5     8.8850   9.531  10.178                                     (*)
6     0.8013   1.396   1.991                          (*
                               ---+---------+---------+---------+---
                                -16.0      -8.0       0.0       8.0


Esce = 5  subtracted from:

Esce   Lower  Center   Upper   ---+---------+---------+---------+---
6     -8.787  -8.135  -7.483              (*)
                               ---+---------+---------+---------+---
                                -16.0      -8.0       0.0       8.0
```

Bonferroni Simultaneous Tests

Response Variable Velo
All Pairwise Comparisons among Levels of Esce
Esce = 1 subtracted from:

Esce	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
2	-17.77	0.2517	-70.61	0.0000
5	-8.24	0.2713	-30.38	0.0000
6	-16.38	0.2537	-64.55	0.0000

Esce = 2 subtracted from:

Esce	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	9.531	0.2449	38.920	0.0000
6	1.396	0.2253	6.195	0.0000

Esce = 5 subtracted from:

Esce	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
6	-8.135	0.2470	-32.94	0.0000

25 mph

General Linear Model: V versus E

```
Factor  Type   Levels  Values
E       fixed       4  1, 2, 5, 6


Analysis of Variance for V, using Sequential SS for Tests

Source   DF   Seq SS   Adj SS  Seq MS     F      P
E         3   687.24   687.24  229.08  8.94  0.000
Error   224  5739.59  5739.59   25.62
Total   227  6426.83


S = 5.06193   R-Sq = 10.69%   R-Sq(adj) = 9.50%



Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable V
All Pairwise Comparisons among Levels of E
E = 1  subtracted from:

E   Lower  Center   Upper  ----+---------+---------+---------+--
2  -6.443  -3.900  -1.356     (-------*-------)
5  -6.069  -3.439  -0.809      (--------*-------)
6  -7.149  -4.616  -2.082  (--------*-------)
                           ----+---------+---------+---------+--
                            -6.0      -3.0       0.0       3.0


E = 2  subtracted from:

E   Lower   Center  Upper  ----+---------+---------+---------+--
5  -2.069   0.4610  2.991                 (--------*-------)
6  -3.146  -0.7161  1.714              (-------*-------)
                           ----+---------+---------+---------+--
                            -6.0      -3.0       0.0       3.0


E = 5  subtracted from:

E   Lower  Center  Upper  ----+---------+---------+---------+--
6  -3.698  -1.177  1.344             (-------*-------)
                          ----+---------+---------+---------+--
                           -6.0      -3.0       0.0       3.0
```

Bonferroni Simultaneous Tests
Response Variable V
All Pairwise Comparisons among Levels of E
E = 1 subtracted from:

E	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
2	-3.900	0.9554	-4.082	0.0004
5	-3.439	0.9880	-3.480	0.0036
6	-4.616	0.9519	-4.849	0.0000

E = 2 subtracted from:

E	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	0.4610	0.9505	0.4850	1.000
6	-0.7161	0.9129	-0.7845	1.000

E = 5 subtracted from:

E	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
6	-1.177	0.9470	-1.243	1.00

ZONA 2

General Linear Model: VE versus ES

```
Factor  Type   Levels  Values
ES      fixed       4  1, 2, 5, 6


Analysis of Variance for VE, using Sequential SS for Tests

Source    DF    Seq SS    Adj SS  Seq MS       F      P
ES         3   17869.0   17869.0  5956.3  392.01  0.000
Error   7301  110933.0  110933.0    15.2
Total   7304  128802.0


S = 3.89798   R-Sq = 13.87%   R-Sq(adj) = 13.84%



Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable VE
All Pairwise Comparisons among Levels of ES
ES = 1  subtracted from:

ES   Lower  Center   Upper  --------+---------+---------+--------
2   -4.051  -3.709  -3.366     (-*-)
5   -4.425  -4.076  -3.728  (--*-)
6   -3.359  -3.014  -2.669         (-*-)
                            --------+---------+---------+--------
                                 -3.2      -1.6      -0.0


ES = 2  subtracted from:

ES    Lower   Center     Upper  --------+---------+---------+--------
5   -0.7048  -0.3678  -0.03074                        (-*-)
6    0.3614   0.6947   1.02801                              (-*-)
                                --------+---------+---------+--------
                                     -3.2      -1.6      -0.0


ES = 5  subtracted from:

ES   Lower  Center  Upper  --------+---------+---------+--------
6   0.7235   1.062  1.401                                  (-*-)
                           --------+---------+---------+--------
                                -3.2      -1.6      -0.0
```

Bonferroni Simultaneous Tests

Response Variable VE
All Pairwise Comparisons among Levels of ES
ES = 1 subtracted from:

ES	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
2	-3.709	0.1299	-28.56	0.0000
5	-4.076	0.1319	-30.90	0.0000
6	-3.014	0.1306	-23.08	0.0000

ES = 2 subtracted from:

ES	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	-0.3678	0.1277	-2.880	0.0240
6	0.6947	0.1263	5.500	0.0000

ES = 5 subtracted from:

ES	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
6	1.062	0.1284	8.272	0.0000

ZONA 3

General Linear Model: VE. versus S

Factor	Type	Levels	Values
S	fixed	4	1, 2, 5, 6

Analysis of Variance for VE., using Sequential SS for Tests

Source	DF	Seq SS	Adj SS	Seq MS	F	P
S	3	1601.79	1601.79	533.93	31.31	0.000
Error	7975	136018.37	136018.37	17.06		
Total	7978	137620.16				

S = 4.12984   R-Sq = 1.16%   R-Sq(adj) = 1.13%

Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable VE.
All Pairwise Comparisons among Levels of S
S = 1 subtracted from:

```
S   Lower  Center    Upper     +---------+---------+---------+------
2  -0.499  -0.155   0.1898                         (------*------)
5  -0.935  -0.584  -0.2338                (------*------)
6  -1.479  -1.138  -0.7972     (------*------)
                               +---------+---------+---------+------
                            -1.50     -1.00     -0.50      0.00
```

S = 2 subtracted from:

```
S   Lower   Center    Upper     +---------+---------+---------+------
5  -0.780  -0.4299  -0.0800                   (------*------)
6  -1.323  -0.9834  -0.6434         (-----*------)
                                +---------+---------+---------+------
                             -1.50     -1.00     -0.50      0.00
```

S = 5 subtracted from:

```
S    Lower   Center    Upper     +---------+---------+---------+------
6  -0.9000  -0.5535  -0.2071                 (------*------)
                                 +---------+---------+---------+------
                              -1.50     -1.00     -0.50      0.00
```

Bonferroni Simultaneous Tests
Response Variable VE.
All Pairwise Comparisons among Levels of S
S = 1 subtracted from:

S	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
2	-0.155	0.1305	-1.184	1.0000
5	-0.584	0.1329	-4.399	0.0001
6	-1.138	0.1291	-8.813	0.0000

S = 2 subtracted from:

S	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	-0.4299	0.1326	-3.242	0.0072
6	-0.9834	0.1289	-7.632	0.0000

S = 5 subtracted from:

S	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
6	-0.5535	0.1313	-4.217	0.0002

Pedestrian

General Linear Model: SPEED versus SCENARIO

```
Factor    Type   Levels  Values
SCENARIO  fixed       4  1, 2, 5, 6

Analysis of Variance for SPEED, using Sequential SS for Tests

Source     DF   Seq SS   Adj SS  Seq MS     F      P
SCENARIO    3    31.03    31.03   10.34  0.68  0.567
Error     261  3992.53  3992.53   15.30
Total     264  4023.56


S = 3.91114   R-Sq = 0.77%   R-Sq(adj) = 0.00%


Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable SPEED
All Pairwise Comparisons among Levels of SCENARIO
SCENARIO = 1  subtracted from:

SCENARIO   Lower   Center   Upper  --------+---------+---------+--------
2         -2.169  -0.3648  1.4388      (-----------*-----------)
5         -2.727  -0.9166  0.8943  (-----------*-----------)
6         -2.447  -0.6640  1.1192    (-----------*----------)
                                   --------+---------+---------+--------
                                        -1.5       0.0       1.5

SCENARIO = 2  subtracted from:

SCENARIO   Lower   Center  Upper  --------+---------+---------+--------
5         -2.383  -0.5517  1.279    (-----------*------------)
6         -2.103  -0.2992  1.504      (-----------*-----------)
                                  --------+---------+---------+--------
                                       -1.5       0.0       1.5

SCENARIO = 5  subtracted from:

SCENARIO   Lower  Center  Upper  --------+---------+---------+--------
6         -1.558  0.2525  2.063         (-----------*-----------)
                                 --------+---------+---------+--------
                                      -1.5       0.0       1.5
```

Bonferroni Simultaneous Tests

```
Response Variable SPEED
All Pairwise Comparisons among Levels of SCENARIO
SCENARIO = 1  subtracted from:

          Difference       SE of             Adjusted
SCENARIO    of Means  Difference  T-Value     P-Value
2            -0.3648      0.6785   -0.538       1.000
5            -0.9166      0.6812   -1.346       1.000
6            -0.6640      0.6708   -0.990       1.000


SCENARIO = 2  subtracted from:

          Difference       SE of             Adjusted
SCENARIO    of Means  Difference  T-Value     P-Value
5            -0.5517      0.6887  -0.8011       1.000
6            -0.2992      0.6785  -0.4410       1.000


SCENARIO = 5  subtracted from:

          Difference       SE of             Adjusted
SCENARIO    of Means  Difference  T-Value     P-Value
6             0.2525      0.6812   0.3707       1.000
```

School

General Linear Model: SPEE versus SCEN

Factor	Type	Levels	Values
SCEN	fixed	4	1, 2, 5, 6

Analysis of Variance for SPEE, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
SCEN	3	106.38	106.38	35.46	2.22	0.086
Error	256	4090.89	4090.89	15.98		
Total	259	4197.27				

S = 3.99751   R-Sq = 2.53%   R-Sq(adj) = 1.39%

Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable SPEE
All Pairwise Comparisons among Levels of SCEN
SCEN = 1 subtracted from:

```
SCEN   Lower  Center   Upper   --+---------+---------+---------+----
2     -2.312  -0.440  1.4314           (----------*-----------)
5     -3.488  -1.594  0.3005   (-----------*-----------)
6     -3.161  -1.316  0.5286     (-----------*----------)
                               --+---------+---------+---------+----
                              -3.2      -1.6      -0.0       1.6
```

SCEN = 2 subtracted from:

```
SCEN   Lower  Center   Upper   --+---------+---------+---------+----
5     -3.040  -1.153  0.7337      (-----------*-----------)
6     -2.713  -0.876  0.9616        (-----------*----------)
                               --+---------+---------+---------+----
                              -3.2      -1.6      -0.0       1.6
```

SCEN = 5 subtracted from:

```
SCEN   Lower  Center  Upper   --+---------+---------+---------+----
6     -1.582  0.2775  2.138              (-----------*----------)
                              --+---------+---------+---------+----
                             -3.2      -1.6      -0.0       1.6
```

Bonferroni Simultaneous Tests
Response Variable SPEE
All Pairwise Comparisons among Levels of SCEN
SCEN = 1 subtracted from:

SCEN	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
2	-0.440	0.7039	-0.626	1.0000
5	-1.594	0.7123	-2.237	0.1569
6	-1.316	0.6937	-1.897	0.3538

SCEN = 2 subtracted from:

SCEN	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	-1.153	0.7096	-1.625	0.6323
6	-0.876	0.6910	-1.267	1.0000

SCEN = 5 subtracted from:

SCEN	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
6	0.2775	0.6995	0.3968	1.000

REDUCED SPEED AHEAD

Coordenada 500

General Linear Model: Velocidad versus Escenario

Factor	Type	Levels	Values
Escenario	fixed	4	1, 3, 5, 7

Analysis of Variance for Velocidad, using Sequential SS for Tests

Source	DF	Seq SS	Adj SS	Seq MS	F	P
Escenario	3	356.74	356.74	118.91	3.93	0.010
Error	130	3935.77	3935.77	30.28		
Total	133	4292.51				

S = 5.50229   R-Sq = 8.31%   R-Sq(adj) = 6.19%

Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable Velocidad
All Pairwise Comparisons among Levels of Escenario
Escenario = 1 subtracted from:

```
Escenario   Lower  Center   Upper   --+---------+---------+---------+----
3          -2.624   1.033  4.6907                 (---------*---------)
5          -6.797  -3.082  0.6327      (---------*----------)
7          -5.738  -2.201  1.3360         (---------*---------)
                                    --+---------+---------+---------+----
                                   -7.0      -3.5       0.0       3.5
```

Escenario = 3 subtracted from:

```
Escenario   Lower  Center    Upper   --+---------+---------+---------+----
5          -7.803  -4.116  -0.4284   (---------*----------)
7          -6.742  -3.234   0.2735      (---------*---------)
                                     --+---------+---------+---------+----
                                    -7.0      -3.5       0.0       3.5
```

Escenario = 5 subtracted from:

```
Escenario   Lower  Center  Upper   --+---------+---------+---------+----
7          -2.686  0.8814  4.449                 (----------*---------)
                                   --+---------+---------+---------+----
                                  -7.0      -3.5       0.0       3.5
```

Bonferroni Simultaneous Tests
Response Variable Velocidad
All Pairwise Comparisons among Levels of Escenario
Escenario = 1 subtracted from:

Escenario	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
3	1.033	1.365	0.757	1.0000
5	-3.082	1.387	-2.223	0.1677
7	-2.201	1.320	-1.667	0.5873

Escenario = 3 subtracted from:

Escenario	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	-4.116	1.376	-2.990	0.0200
7	-3.234	1.309	-2.470	0.0888

Escenario = 5 subtracted from:

Escenario	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
7	0.8814	1.332	0.6619	1.000

Coordenada -32

General Linear Model: VEL versus ESC

```
Factor  Type   Levels  Values
ESC     fixed       4  1, 3, 5, 7


Analysis of Variance for VEL, using Sequential SS for Tests

Source   DF    Seq SS   Adj SS  Seq MS     F      P
ESC       3   1750.41  1750.41  583.47  8.13  0.000
Error   133   9545.95  9545.95   71.77
Total   136  11296.36


S = 8.47196   R-Sq = 15.50%   R-Sq(adj) = 13.59%


Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable VEL
All Pairwise Comparisons among Levels of ESC
ESC = 1  subtracted from:

ESC   Lower  Center   Upper  -----+---------+---------+---------+-
3     -9.71  -4.160   1.390           (--------*--------)
5    -11.31  -5.588   0.130        (---------*--------)
7    -15.26  -9.850  -4.438  (--------*--------)
                             -----+---------+---------+---------+-
                              -12.0      -6.0       0.0       6.0


ESC = 3  subtracted from:

ESC   Lower  Center    Upper  -----+---------+---------+---------+-
5     -7.02  -1.428   4.1685               (---------*--------)
7    -10.97  -5.690  -0.4067         (--------*-------)
                              -----+---------+---------+---------+-
                               -12.0      -6.0       0.0       6.0


ESC = 5  subtracted from:

ESC   Lower  Center  Upper  -----+---------+---------+---------+-
7    -9.722  -4.262  1.198           (--------*--------)
                            -----+---------+---------+---------+-
                             -12.0      -6.0       0.0       6.0
```

Bonferroni Simultaneous Tests

Response Variable VEL
All Pairwise Comparisons among Levels of ESC
ESC = 1 subtracted from:

ESC	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
3	-4.160	2.072	-2.008	0.2802
5	-5.588	2.135	-2.617	0.0593
7	-9.850	2.021	-4.874	0.0000

ESC = 3 subtracted from:

ESC	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	-1.428	2.089	-0.683	1.0000
7	-5.690	1.973	-2.884	0.0275

ESC = 5 subtracted from:

ESC	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
7	-4.262	2.039	-2.091	0.2307

ZONA 1

General Linear Model: Velo versus Esce

Factor	Type	Levels	Values
Esce	fixed	4	1, 3, 5, 7

Analysis of Variance for Velo, using Sequential SS for Tests

Source	DF	Seq SS	Adj SS	Seq MS	F	P
Esce	3	179320	179320	59773	625.59	0.000
Error	4728	451744	451744	96		
Total	4731	631064				

S = 9.77480   R-Sq = 28.42%   R-Sq(adj) = 28.37%

Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable Velo
All Pairwise Comparisons among Levels of Esce
Esce = 1 subtracted from:

```
Esce   Lower  Center   Upper  ------+---------+---------+---------+
3     -12.32  -11.21  -10.10          (-*-)
5      -9.39   -8.24   -7.09               (*-)
7     -18.35  -17.28  -16.21  (*-)
                              ------+---------+---------+---------+
                                -14.0      -7.0       0.0       7.0
```

Esce = 3 subtracted from:

```
Esce   Lower  Center   Upper  ------+---------+---------+---------+
5      1.887   2.967   4.047                             (*-)
7     -7.063  -6.068  -5.073                  (*-)
                              ------+---------+---------+---------+
                                -14.0      -7.0       0.0       7.0
```

Esce = 5 subtracted from:

```
Esce   Lower  Center   Upper  ------+---------+---------+---------+
7     -10.07  -9.035  -7.994              (*-)
                              ------+---------+---------+---------+
                                -14.0      -7.0       0.0       7.0
```

Bonferroni Simultaneous Tests
Response Variable Velo
All Pairwise Comparisons among Levels of Esce
Esce = 1 subtracted from:

Esce	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
3	-11.21	0.4197	-26.71	0.0000
5	-8.24	0.4351	-18.94	0.0000
7	-17.28	0.4050	-42.66	0.0000

Esce = 3 subtracted from:

Esce	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	2.967	0.4092	7.25	0.0000
7	-6.068	0.3770	-16.10	0.0000

Esce = 5 subtracted from:

Esce	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
7	-9.035	0.3941	-22.93	0.0000

25 mph

General Linear Model: V versus E

Factor	Type	Levels	Values
E	fixed	4	1, 3, 5, 7

Analysis of Variance for V, using Sequential SS for Tests

Source	DF	Seq SS	Adj SS	Seq MS	F	P
E	3	311.59	311.59	103.86	1.74	0.161
Error	213	12749.13	12749.13	59.86		
Total	216	13060.71				

S = 7.73660   R-Sq = 2.39%   R-Sq(adj) = 1.01%

.

Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable V
All Pairwise Comparisons among Levels of E
E = 1 subtracted from:

```
E   Lower  Center   Upper  ---------+---------+---------+-------
3  -5.656  -1.705  2.2461       (---------*---------)
5  -7.460  -3.439  0.5829  (---------*---------)
7  -5.881  -1.896  2.0897      (---------*---------)
                           ---------+---------+---------+-------
                                 -4.0       0.0       4.0
```

E = 3 subtracted from:

```
E   Lower  Center  Upper  ---------+---------+---------+-------
5  -5.665  -1.734  2.198       (---------*--------)
7  -4.085  -0.191  3.704           (---------*--------)
                          ---------+---------+---------+-------
                                -4.0       0.0       4.0
```

E = 5 subtracted from:

```
E   Lower  Center  Upper  ---------+---------+---------+-------
7  -2.423   1.543  5.509               (---------*---------)
                          ---------+---------+---------+-------
                                -4.0       0.0       4.0
```

Bonferroni Simultaneous Tests
Response Variable V
All Pairwise Comparisons among Levels of E
E = 1 subtracted from:

E	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
3	-1.705	1.484	-1.149	1.0000
5	-3.439	1.510	-2.277	0.1426
7	-1.896	1.496	-1.267	1.0000

E = 3 subtracted from:

E	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	-1.734	1.476	-1.174	1.000
7	-0.191	1.462	-0.130	1.000

E = 5 subtracted from:

E	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
7	1.543	1.489	1.036	1.000

ZONA 2

General Linear Model: VE versus ES

```
Factor  Type   Levels  Values
ES      fixed       4  1, 3, 5, 7


Analysis of Variance for VE, using Sequential SS for Tests

Source    DF    Seq SS    Adj SS  Seq MS       F      P
ES         3   19440.9   19440.9  6480.3  157.47  0.000
Error   6928  285101.1  285101.1    41.2
Total   6931  304542.0


S = 6.41498   R-Sq = 6.38%   R-Sq(adj) = 6.34%



Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable VE
All Pairwise Comparisons among Levels of ES
ES = 1  subtracted from:

ES   Lower  Center   Upper  ---------+---------+---------+-------
3   -0.690  -0.108   0.474                (--*-)
5   -4.649  -4.076  -3.503  (--*-)
7   -1.479  -0.901  -0.323             (-*--)
                            ---------+---------+---------+-------
                                  -2.5       0.0       2.5


ES = 3  subtracted from:

ES   Lower  Center   Upper  ---------+---------+---------+-------
5   -4.541  -3.968  -3.396   (-*-)
7   -1.371  -0.793  -0.215              (-*-)
                            ---------+---------+---------+-------
                                  -2.5       0.0       2.5


ES = 5  subtracted from:

ES  Lower  Center  Upper  ---------+---------+---------+-------
7   2.607   3.175  3.744                             (--*-)
                          ---------+---------+---------+-------
                                -2.5       0.0       2.5
```

Bonferroni Simultaneous Tests
Response Variable VE
All Pairwise Comparisons among Levels of ES
ES = 1 subtracted from:

ES	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
3	-0.108	0.2205	-0.49	1.0000
5	-4.076	0.2171	-18.77	0.0000
7	-0.901	0.2189	-4.12	0.0002

ES = 3 subtracted from:

ES	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	-3.968	0.2171	-18.28	0.0000
7	-0.793	0.2189	-3.62	0.0018

ES = 5 subtracted from:

ES	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
7	3.175	0.2155	14.74	0.0000

ZONA 3

_General Linear Model: VE. versus S

```
Factor  Type   Levels  Values
S       fixed       4  1, 3, 5, 7


Analysis of Variance for VE., using Sequential SS for Tests

Source    DF    Seq SS    Adj SS  Seq MS       F      P
S          3   27539.4   27539.4  9179.8  258.23  0.000
Error   7369  261958.4  261958.4    35.5
Total   7372  289497.9


S = 5.96227   R-Sq = 9.51%   R-Sq(adj) = 9.48%



Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable VE.
All Pairwise Comparisons among Levels of S
S = 1  subtracted from:

S   Lower   Center     Upper  --------+---------+---------+--------
3   3.754   4.2732   4.79276                                (*-)
5  -1.091  -0.5844  -0.07821                 (-*-)
7   2.008   2.5193   3.03020                          (*-)
                              --------+---------+---------+--------
                                   -3.0       0.0       3.0


S = 3  subtracted from:

S   Lower  Center   Upper  --------+---------+---------+--------
5  -5.385  -4.858  -4.330  (-*-)
7  -2.286  -1.754  -1.222            (-*-)
                           --------+---------+---------+--------
                                -3.0       0.0       3.0


S = 5  subtracted from:

S  Lower  Center  Upper  --------+---------+---------+--------
7  2.585   3.104  3.622                           (*-)
                         --------+---------+---------+--------
                              -3.0       0.0       3.0
```

Bonferroni Simultaneous Tests
Response Variable VE.
All Pairwise Comparisons among Levels of S
S = 1 subtracted from:

S	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
3	4.2732	0.1969	21.703	0.0000
5	-0.5844	0.1918	-3.047	0.0139
7	2.5193	0.1936	13.013	0.0000

S = 3 subtracted from:

S	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	-4.858	0.1998	-24.31	0.0000
7	-1.754	0.2015	-8.70	0.0000

S = 5 subtracted from:

S	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
7	3.104	0.1966	15.79	0.0000

Pedestrian

General Linear Model: SPEED versus SCENARIO

```
Factor    Type   Levels  Values
SCENARIO  fixed       4  1, 3, 5, 7


Analysis of Variance for SPEED, using Sequential SS for Tests

Source     DF    Seq SS   Adj SS  Seq MS     F      P
SCENARIO    3    857.03   857.03  285.68  7.70  0.000
Error     247   9158.01  9158.01   37.08
Total     250  10015.03

S = 6.08908   R-Sq = 8.56%   R-Sq(adj) = 7.45%



Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable SPEED
All Pairwise Comparisons among Levels of SCENARIO
SCENARIO = 1  subtracted from:

SCENARIO   Lower   Center  Upper     +---------+---------+---------+------
3          1.065   3.9870  6.909                           (------*------)
5         -3.737  -0.9166  1.904                 (------*------)
7         -0.855   1.9768  4.809                        (------*------)
                                     +---------+---------+---------+------
                                  -8.0      -4.0       0.0       4.0


SCENARIO = 3  subtracted from:

SCENARIO   Lower  Center   Upper     +---------+---------+---------+------
5         -7.867  -4.904  -1.940     (-------*------)
7         -4.985  -2.010   0.964             (------*------)
                                     +---------+---------+---------+------
                                  -8.0      -4.0       0.0       4.0

SCENARIO = 5  subtracted from:

SCENARIO    Lower  Center  Upper     +---------+---------+---------+------
7         0.01909   2.893  5.768                          (------*------)
                                     +---------+---------+---------+------
                                  -8.0      -4.0       0.0       4.0
```

Bonferroni Simultaneous Tests
Response Variable SPEED
All Pairwise Comparisons among Levels of SCENARIO
SCENARIO = 1 subtracted from:

SCENARIO	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
3	3.9870	1.099	3.6285	0.0021
5	-0.9166	1.060	-0.8643	1.0000
7	1.9768	1.065	1.8565	0.3874

SCENARIO = 3 subtracted from:

SCENARIO	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	-4.904	1.114	-4.401	0.0001
7	-2.010	1.118	-1.798	0.4408

SCENARIO = 5 subtracted from:

SCENARIO	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
7	2.893	1.081	2.677	0.0475

School

General Linear Model: SPEE versus SCEN

```
Factor  Type   Levels  Values
SCEN    fixed       4  1, 3, 5, 7


Analysis of Variance for SPEE, using Sequential SS for Tests

Source   DF    Seq SS   Adj SS  Seq MS     F      P
SCEN      3    937.18   937.18  312.39  8.13  0.000
Error   240   9217.25  9217.25   38.41
Total   243  10154.44

S = 6.19720   R-Sq = 9.23%   R-Sq(adj) = 8.09%


Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable SPEE
All Pairwise Comparisons among Levels of SCEN
SCEN = 1  subtracted from:

SCEN   Lower  Center  Upper  -------+---------+---------+---------
3      0.912   3.943  6.975                  (-----*-----)
5     -4.531  -1.594  1.344         (-----*-----)
7     -2.094   0.832  3.758              (-----*-----)
                             -------+---------+---------+---------
                                 -5.0       0.0       5.0

SCEN = 3  subtracted from:

SCEN   Lower  Center   Upper  -------+---------+---------+---------
5     -8.591  -5.537  -2.483  (-----*-----)
7     -6.154  -3.112  -0.069       (-----*-----)
                              -------+---------+---------+---------
                                  -5.0       0.0       5.0

SCEN = 5  subtracted from:

SCEN    Lower  Center  Upper  -------+---------+---------+---------
7     -0.5241   2.425  5.374                  (-----*-----)
                              -------+---------+---------+---------
                                  -5.0       0.0       5.0
```

Bonferroni Simultaneous Tests
Response Variable SPEE
All Pairwise Comparisons among Levels of SCEN
SCEN = 1 subtracted from:

SCEN	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
3	3.943	1.139	3.461	0.0038
5	-1.594	1.104	-1.443	0.9019
7	0.832	1.100	0.756	1.0000

SCEN = 3 subtracted from:

SCEN	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	-5.537	1.148	-4.823	0.0000
7	-3.112	1.144	-2.721	0.0419

SCEN = 5 subtracted from:

SCEN	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
7	2.425	1.109	2.188	0.1780

SPEED MONITORING DISPLAY

Coordenada 500

General Linear Model: Velocidad versus Escenario

```
Factor     Type   Levels  Values
Escenario  fixed       4  1, 4, 5, 8

Analysis of Variance for Velocidad, using Sequential SS for Tests
Source      DF   Seq SS   Adj SS  Seq MS     F      P
Escenario    3   277.29   277.29   92.43  2.59  0.055
Error      128  4559.91  4559.91   35.62
Total      131  4837.20

S = 5.96861   R-Sq = 5.73%   R-Sq(adj) = 3.52%

Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable Velocidad
All Pairwise Comparisons among Levels of Escenario
Escenario = 1  subtracted from:

Escenario   Lower  Center   Upper     +---------+---------+---------+------
4          -3.144   0.824  4.7925                 (---------*---------)
5          -7.113  -3.082  0.9485       (---------*---------)
8          -5.185  -1.299  2.5871            (---------*--------)
                                      +---------+---------+---------+------
                                   -8.0      -4.0       0.0       4.0

Escenario = 4  subtracted from:

Escenario   Lower  Center    Upper     +---------+---------+---------+------
5          -7.907  -3.906  0.09427     (---------*---------)
8          -5.978  -2.123  1.73164          (---------*--------)
                                       +---------+---------+---------+------
                                    -8.0      -4.0       0.0       4.0

Escenario = 5  subtracted from:

Escenario   Lower  Center  Upper     +---------+---------+---------+------
8          -2.136   1.783  5.702                     (--------*---------)
                                     +---------+---------+---------+------
                                  -8.0      -4.0       0.0       4.0
```

Bonferroni Simultaneous Tests

Response Variable Velocidad
All Pairwise Comparisons among Levels of Escenario
Escenario = 1 subtracted from:

Escenario	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
4	0.824	1.481	0.557	1.0000
5	-3.082	1.504	-2.049	0.2549
8	-1.299	1.450	-0.896	1.0000

Escenario = 4 subtracted from:

Escenario	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	-3.906	1.493	-2.617	0.0597
8	-2.123	1.438	-1.476	0.8543

Escenario = 5 subtracted from:

Escenario	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
8	1.783	1.462	1.219	1.000

Coordenada -32

General Linear Model: VEL versus ESC

```
Factor  Type   Levels  Values
ESC     fixed       4  1, 4, 5, 8


Analysis of Variance for VEL, using Sequential SS for Tests

Source   DF   Seq SS   Adj SS  Seq MS     F      P
ESC       3   501.98   501.98  167.33  3.04  0.031
Error   126  6928.57  6928.57   54.99
Total   129  7430.55


S = 7.41543   R-Sq = 6.76%   R-Sq(adj) = 4.54%



Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable VEL
All Pairwise Comparisons among Levels of ESC
ESC = 1  subtracted from:

ESC   Lower  Center    Upper     -+---------+---------+---------+-----
4     -7.06  -2.047   2.9626            (---------*---------)
5    -10.60  -5.588  -0.5786     (---------*---------)
8     -7.39  -2.561   2.2686           (---------*---------)
                                 -+---------+---------+---------+-----
                              -10.0      -5.0       0.0       5.0


ESC = 4  subtracted from:

ESC   Lower  Center  Upper     -+---------+---------+---------+-----
5    -8.590  -3.541  1.508         (---------*---------)
8    -5.385  -0.514  4.356               (---------*---------)
                               -+---------+---------+---------+-----
                            -10.0      -5.0       0.0       5.0


ESC = 5  subtracted from:

ESC   Lower  Center  Upper     -+---------+---------+---------+-----
8    -1.843   3.027  7.898                      (---------*---------)
                               -+---------+---------+---------+-----
                            -10.0      -5.0       0.0       5.0
```

Bonferroni Simultaneous Tests

```
Response Variable VEL
All Pairwise Comparisons among Levels of ESC
ESC = 1  subtracted from:

     Difference       SE of            Adjusted
ESC    of Means  Difference  T-Value    P-Value
4        -2.047       1.869   -1.095     1.0000
5        -5.588       1.869   -2.990     0.0201
8        -2.561       1.802   -1.421     0.9461


ESC = 4  subtracted from:

     Difference       SE of            Adjusted
ESC    of Means  Difference  T-Value    P-Value
5        -3.541       1.884   -1.880     0.3744
8        -0.514       1.817   -0.283     1.0000


ESC = 5  subtracted from:

     Difference       SE of            Adjusted
ESC    of Means  Difference  T-Value    P-Value
8         3.027       1.817    1.666     0.5891
```

ZONA 1

General Linear Model: Velo versus Esce

```
Factor  Type   Levels  Values
Esce    fixed       4  1, 4, 5, 8


Analysis of Variance for Velo, using Sequential SS for Tests

Source    DF  Seq SS  Adj SS  Seq MS       F      P
Esce       3   38308   38308   12769  259.20  0.000
Error   4219  207842  207842      49
Total   4222  246150


S = 7.01879   R-Sq = 15.56%   R-Sq(adj) = 15.50%



Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable Velo
All Pairwise Comparisons among Levels of Esce
Esce = 1  subtracted from:

Esce   Lower  Center   Upper  ------+---------+---------+---------+
4     -7.089  -6.271  -5.454        (-*-)
5     -9.067  -8.242  -7.417  (-*--)
8     -7.074  -6.257  -5.440        (-*-)
                              ------+---------+---------+---------+
                                 -7.0      -3.5       0.0       3.5


Esce = 4  subtracted from:

Esce   Lower  Center   Upper  ------+---------+---------+---------+
5     -2.769  -1.971  -1.173                    (-*--)
8     -0.776   0.014   0.804                          (-*-)
                              ------+---------+---------+---------+
                                 -7.0      -3.5       0.0       3.5


Esce = 5  subtracted from:

Esce  Lower  Center  Upper  ------+---------+---------+---------+
8     1.187   1.985  2.782                             (--*-)
                            ------+---------+---------+---------+
                               -7.0      -3.5       0.0       3.5
```

Bonferroni Simultaneous Tests

Response Variable Velo
All Pairwise Comparisons among Levels of Esce
Esce = 1 subtracted from:

Esce	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
4	-6.271	0.3096	-20.25	0.0000
5	-8.242	0.3124	-26.38	0.0000
8	-6.257	0.3095	-20.22	0.0000

Esce = 4 subtracted from:

Esce	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	-1.971	0.3023	-6.519	0.0000
8	0.014	0.2993	0.047	1.0000

Esce = 5 subtracted from:

Esce	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
8	1.985	0.3022	6.569	0.0000

25 mph

General Linear Model: V versus E

```
Factor  Type   Levels  Values
E       fixed       4  1, 4, 5, 8

Analysis of Variance for V, using Sequential SS for Tests

Source   DF   Seq SS   Adj SS  Seq MS     F      P
E         3   210.31   210.31   70.10  2.12  0.101
Error   130  4306.14  4306.14   33.12
Total   133  4516.46


S = 5.75536   R-Sq = 4.66%   R-Sq(adj) = 2.46%

Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable V
All Pairwise Comparisons among Levels of E
E = 1  subtracted from:

E   Lower  Center  Upper    -+---------+---------+---------+-----
4  -2.778   1.018  4.814                 (----------*----------)
5  -6.190  -2.422  1.347       (----------*----------)
8  -4.392  -0.624  3.144            (----------*----------)
                            -+---------+---------+---------+-----
                          -7.0      -3.5       0.0       3.5


E = 4  subtracted from:

E   Lower  Center   Upper    -+---------+---------+---------+-----
5  -7.208  -3.440  0.3283    (----------*----------)
8  -5.411  -1.643  2.1255          (---------*----------)
                             -+---------+---------+---------+-----
                           -7.0      -3.5       0.0       3.5

E = 5  subtracted from:

E   Lower  Center  Upper    -+---------+---------+---------+-----
8  -1.943   1.797  5.537                   (----------*----------)
                            -+---------+---------+---------+-----
                          -7.0      -3.5       0.0       3.5
```

Bonferroni Simultaneous Tests
Response Variable V
All Pairwise Comparisons among Levels of E
E = 1 subtracted from:

E	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
4	1.018	1.417	0.719	1.0000
5	-2.422	1.406	-1.722	0.5249
8	-0.624	1.406	-0.444	1.0000

E = 4 subtracted from:

E	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	-3.440	1.406	-2.446	0.0948
8	-1.643	1.406	-1.168	1.0000

E = 5 subtracted from:

E	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
8	1.797	1.396	1.287	1.000

ZONA 2

General Linear Model: VE versus ES

Factor	Type	Levels	Values
ES	fixed	4	1, 4, 5, 8

Analysis of Variance for VE, using Sequential SS for Tests

Source	DF	Seq SS	Adj SS	Seq MS	F	P
ES	3	33016	33016	11005	431.80	0.000
Error	7602	193752	193752	25		
Total	7605	226768				

S = 5.04846   R-Sq = 14.56%   R-Sq(adj) = 14.53%

Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable VE
All Pairwise Comparisons among Levels of ES
ES = 1 subtracted from:

```
ES   Lower  Center   Upper     +---------+---------+---------+------
4   -5.164  -4.725  -4.285         (-*--)
5   -4.527  -4.076  -3.625            (--*-)
8   -6.028  -5.593  -5.157     (-*-)
                               +---------+---------+---------+------
                            -6.0      -4.0      -2.0       0.0
```

ES = 4 subtracted from:

```
ES   Lower   Center    Upper     +---------+---------+---------+------
5    0.216   0.6482   1.0801                                    (-*-)
8   -1.284  -0.8683  -0.4526                             (-*-)
                                 +---------+---------+---------+------
                              -6.0      -4.0      -2.0       0.0
```

ES = 5 subtracted from:

```
ES   Lower  Center   Upper     +---------+---------+---------+------
8   -1.944  -1.517  -1.089                         (-*--)
                               +---------+---------+---------+------
                            -6.0      -4.0      -2.0       0.0
```

Bonferroni Simultaneous Tests
Response Variable VE
All Pairwise Comparisons among Levels of ES
ES = 1 subtracted from:

ES	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
4	-4.725	0.1664	-28.38	0.0000
5	-4.076	0.1709	-23.86	0.0000
8	-5.593	0.1650	-33.89	0.0000

ES = 4 subtracted from:

ES	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	0.6482	0.1636	3.961	0.0005
8	-0.8683	0.1575	-5.513	0.0000

ES = 5 subtracted from:

ES	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
8	-1.517	0.1622	-9.351	0.0000

ZONE 3

General Linear Model: VE. versus S

Factor	Type	Levels	Values
S	fixed	4	1, 4, 5, 8

Analysis of Variance for VE., using Sequential SS for Tests

Source	DF	Seq SS	Adj SS	Seq MS	F	P
S	3	9413.5	9413.5	3137.8	160.08	0.000
Error	7865	154162.9	154162.9	19.6		
Total	7868	163576.4				

S = 4.42732   R-Sq = 5.75%   R-Sq(adj) = 5.72%

Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable VE.
All Pairwise Comparisons among Levels of S
S = 1 subtracted from:

S	Lower	Center	Upper
4	0.585	0.961	1.338
5	-0.960	-0.584	-0.209
8	-2.383	-2.019	-1.656

```
--+---------+---------+---------+----
                          (-*--)
                (-*--)
      (--*-)
--+---------+---------+---------+----
-3.0      -1.5       0.0       1.5
```

S = 4 subtracted from:

S	Lower	Center	Upper
5	-1.928	-1.546	-1.163
8	-3.351	-2.981	-2.610

```
--+---------+---------+---------+----
         (--*-)
(-*--)
--+---------+---------+---------+----
-3.0      -1.5       0.0       1.5
```

S = 5 subtracted from:

S	Lower	Center	Upper
8	-1.804	-1.435	-1.065

```
--+---------+---------+---------+----
          (-*--)
--+---------+---------+---------+----
-3.0      -1.5       0.0       1.5
```

Bonferroni Simultaneous Tests
Response Variable VE.
All Pairwise Comparisons among Levels of S
S = 1 subtracted from:

S	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
4	0.961	0.1427	6.74	0.0000
5	-0.584	0.1424	-4.10	0.0002
8	-2.019	0.1378	-14.66	0.0000

S = 4 subtracted from:

S	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	-1.546	0.1449	-10.67	0.0000
8	-2.981	0.1403	-21.24	0.0000

S = 5 subtracted from:

S	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
8	-1.435	0.1401	-10.24	0.0000

Pedestrian

General Linear Model: SPEED versus SCENARIO

```
Factor    Type   Levels  Values
SCENARIO  fixed       4  1, 4, 5, 8


Analysis of Variance for SPEED, using Sequential SS for Tests

Source     DF   Seq SS   Adj SS  Seq MS     F      P
SCENARIO    3   344.40   344.40  114.80  5.57  0.001
Error     261  5378.85  5378.85   20.61
Total     264  5723.25


S = 4.53967   R-Sq = 6.02%   R-Sq(adj) = 4.94%



Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable SPEED
All Pairwise Comparisons among Levels of SCENARIO
SCENARIO = 1  subtracted from:

SCENARIO   Lower  Center    Upper     +---------+---------+---------+------
4         -1.539   0.562   2.6643                   (-------*--------)
5         -3.018  -0.917   1.1853             (-------*--------)
8         -4.491  -2.429  -0.3662       (-------*--------)
                                      +---------+---------+---------+------
                                   -5.0      -2.5       0.0       2.5


SCENARIO = 4  subtracted from:

SCENARIO   Lower  Center    Upper     +---------+---------+---------+------
5         -3.613  -1.479   0.6545           (-------*--------)
8         -5.085  -2.991  -0.8965     (-------*-------)
                                      +---------+---------+---------+------
                                   -5.0      -2.5       0.0       2.5


SCENARIO = 5  subtracted from:

SCENARIO   Lower  Center   Upper     +---------+---------+---------+------
8         -3.606  -1.512  0.5825           (-------*-------)
                                     +---------+---------+---------+------
                                  -5.0      -2.5       0.0       2.5
```

Bonferroni Simultaneous Tests

Response Variable SPEED
All Pairwise Comparisons among Levels of SCENARIO
SCENARIO = 1 subtracted from:

SCENARIO	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
4	0.562	0.7906	0.711	1.0000
5	-0.917	0.7906	-1.159	1.0000
8	-2.429	0.7757	-3.131	0.0117

SCENARIO = 4 subtracted from:

SCENARIO	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	-1.479	0.8025	-1.843	0.3988
8	-2.991	0.7878	-3.796	0.0011

SCENARIO = 5 subtracted from:

SCENARIO	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
8	-1.512	0.7878	-1.919	0.3363

School

General Linear Model: SPEE versus SCEN

```
Factor  Type   Levels  Values
SCEN    fixed       4  1, 4, 5, 8

Analysis of Variance for SPEE, using Sequential SS for Tests

Source   DF   Seq SS   Adj SS  Seq MS     F      P
SCEN      3   388.88   388.88  129.63  6.07  0.001
Error   261  5569.50  5569.50   21.34
Total   264  5958.38

S = 4.61943   R-Sq = 6.53%   R-Sq(adj) = 5.45%


Bonferroni 95.0% Simultaneous Confidence Intervals
Response Variable SPEE
All Pairwise Comparisons among Levels of SCEN
SCEN = 1  subtracted from:

SCEN   Lower  Center   Upper  -------+---------+---------+---------
4     -3.436  -1.281   0.873            (----------*---------)
5     -3.782  -1.594   0.595          (----------*----------)
8     -5.432  -3.329  -1.226  (---------*----------)
                              -------+---------+---------+---------
                                  -4.0      -2.0       0.0

SCEN = 4  subtracted from:

SCEN   Lower  Center    Upper  -------+---------+---------+---------
5     -2.484  -0.312  1.85957                (---------*----------)
8     -4.134  -2.048  0.03759        (----------*---------)
                               -------+---------+---------+---------
                                   -4.0      -2.0       0.0

SCEN = 5  subtracted from:

SCEN   Lower  Center   Upper  -------+---------+---------+---------
8     -3.857  -1.736  0.3851          (---------*----------)
                              -------+---------+---------+---------
                                  -4.0      -2.0       0.0
```

Bonferroni Simultaneous Tests
Response Variable SPEE
All Pairwise Comparisons among Levels of SCEN
SCEN = 1 subtracted from:

SCEN	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
4	-1.281	0.8104	-1.581	0.6908
5	-1.594	0.8232	-1.936	0.3238
8	-3.329	0.7910	-4.209	0.0002

SCEN = 4 subtracted from:

SCEN	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
5	-0.312	0.8170	-0.382	1.0000
8	-2.048	0.7846	-2.611	0.0574

SCEN = 5 subtracted from:

SCEN	Difference of Means	SE of Difference	T-Value	Adjusted P-Value
8	-1.736	0.7978	-2.176	0.1828

Appendix C: Results Tables

TWO STEP REDUCTION

Scenario	Average speed							
	Coord 500	Point 1 (35 mph)	Zone 1	Point 2 (25 mph)	Zone 2	Zone 3	Point 3 (Pedestrian)	Point 4 (School)
1	49		50	30	29	24	24	25
2	47	38	32	27	25	24	24	28
5	46		42	27	25	24	23	31
6	46	37	34	26	26	23	24	27

Scenario	85th Percentile							
	Coord 500	Point 1 (35 mph)	Zone 1	Point 2 (25 mph)	Zone 2	Zone 3	Point 3 (Pedestrian)	Point 4 (School)
1	55		53	41	34	27	28	30
2	51	47	35	30	29	27	27	32
5	51		51	31	30	28	26	27
6	52	47	35	30	27	27	27	33

P - value Average speed						
Zones and Points of Interest	Scenarios					
	1-2	1-5	1-6	2-5	2-6	5-6
Coord 500	1.0000	0.0878	0.0922	1.0000	1.0000	1.0000
Point 1 (35 mph)	0.0000	0.0045	0.0000	0.0196	1.0000	0.0106
Zone 1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Point 2 (25 mph)	0.0004	0.0036	0.0000	1.0000	1.0000	1.0000
Zone 2	0.0000	0.0000	0.0000	0.0240	0.0000	0.0000
Zona 3	1.0000	0.0010	0.0000	0.0072	0.0000	0.0002
Point 3 (Pedestrian)	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Point 4 (School)	1.0000	0.1569	0.3538	0.6323	1.0000	1.0000

REDUCED SPEED AHEAD

Scenario	Average speed							
	Coord 500	Point 1 (35 mph)	Zone 1	Point 2 (25 mph)	Zone 2	Zone 3	Point 3 (Pedestrian)	Point 4 (School)
1	49		50	30	29	24	24	25
3	50	44	39	29	29	28	28	28
5	46		42	27	25	24	23	24
7	46	37	33	29	28	27	26	27

Scenario	85th Percentile							
	Coord 500	Point 1 (35 mph)	Zone 1	Point 2 (25 mph)	Zone 2	Zone 3	Point 3 (Pedestrian)	Point 4 (School)
1	55		53	41	34	27	28	30
3	53	54	51	33	33	32	31	32
5	51		51	31	30	28	26	27
7	54	43	47	36	34	32	32	33

P - value Average speed						
Zones and Points of Interest	Scenarios					
	1-3	1-5	1-7	3-5	3-7	5-7
Coord 500	1.0000	0.1677	0.5873	0.0200	0.0888	1.0000
Point 1 (35 mph)	0.2802	0.0593	0.0000	1.0000	0.0275	0.2307
Zone 1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Point 2 (25 mph)	1.0000	0.1426	1.0000	1.0000	1.0000	1.0000
Zone 2	1.0000	0.0000	0.0002	0.0000	0.0018	0.0000
Zona 3	0.0000	0.0139	0.0000	0.0000	0.0000	0.0000
Point 3 (Pedestrian)	0.0021	1.0000	0.3874	0.0001	0.4408	0.0475
Point 4 (School)	0.0038	0.9019	1.0000	0.0000	0.0419	0.1780

SPEED MONITORING DISPLAY

	Average speed							
Scenario	Coord 500	Point 1 (35 mph)	Zone 1	Point 2 (25 mph)	Zone 2	Zone 3	Point 3 (Pedestrian)	Point 4 (School)
1	49		50	30	29	24	24	25
4	49	49	44	30	24	25	25	24
5	46		42	27	25	24	23	24
8	46	47	44	27	23	22	22	22

	85th Percentile							
Scenario	Coord 500	Point 1 (35 mph)	Zone 1	Point 2 (25 mph)	Zone 2	Zone 3	Point 3 (Pedestrian)	Point 4 (School)
1	55		53	41	34	27	28	30
4	51	53	47	33	27	29	30	26
5	51		51	31	30	28	26	27
8	54	55	48	32	25	25	25	25

P - value Average speed						
Zones and Points of Interest	Scenarios					
	1-4	1-5	1-8	4-5	4-8	5-8
Coord 500	1.000	0.255	1.000	0.060	0.854	1.000
Point 1 (35 mph)	1.000	0.020	0.946	0.374	1.000	0.589
Zone 1	0.000	0.000	0.000	0.000	1.000	0.000
Point 2 (25 mph)	1.000	0.525	1.000	0.095	1.000	1.000
Zone 2	0.000	0.000	0.000	0.005	0.000	0.000
Zona 3	0.000	0.000	0.000	0.000	0.000	0.000
Point 3 (Pedestrian)	1.000	1.000	0.012	0.399	0.001	0.336
Point 4 (School)	0.691	0.234	0.0002	1.000	0.057	0.183

Average Speed Difference (mph)									
Counter-measure	Comparison among scenarios	Zones and Points of Interest							
		Coord. -500	35 mph Coord. -32	Zone 1 Coord. (178-208)	25 mph Coord. 545	Zone 2 Coord (600-630)	Zone 3 Coord (685-715)	Pedestrian Coord. 733	School Coord. 779
Two-Step Reduction	1-2	-1.5	-	-	-3.9 *	-3.7 *	-0.2	-0.4	-0.4
	1-5	-3.1	-5.6 *	-8.2 *	-3.4 *	-4.1 *	-0.6 *	-0.9	-1.6
	1-6	-3.0	-	-	-4.6 *	-3.0 *	-1.1 *	-0.7	-1.3
	2-5	-1.6	-	-	0.5	-0.4 *	-0.4 *	-0.6	-1.2
	2-6	-1.5	-0.3	1.4 *	-0.7	0.7 *	-1.0 *	-0.3	-0.9
	5-6	0.1	-	-	-1.2	1.1 *	-0.6 *	0.3	0.3
Reduced Speed Ahead	1-3	1.0	-4.2	-11.2 *	-1.7	-0.1	4.3 *	4.0 *	3.9 *
	1-5	-3.1	-5.6	-8.2 *	-3.4	-4.1 *	-0.6 *	-0.9	-1.6
	1-7	-2.2	-9.9 *	-17.3 *	-1.9	-0.9 *	2.5 *	2.0	0.8
	3-5	-4.1 *	-1.4	3.0 *	-1.7	-4.0 *	-4.9 *	-4.9 *	-5.5 *
	3-7	-3.2	-5.7 *	-6.1 *	-0.2	-0.8 *	-1.8 *	-2.0	-3.1 *
	5-7	0.9	-4.3	-9.0 *	1.5	3.2 *	3.1 *	2.9 *	2.4
Speed Monitoring Display	1-4	0.8	-2.0	-6.3 *	1.0	-4.7 *	1.0 *	0.6	-1.3
	1-5	-3.1	-5.6 *	-8.2 *	-2.4	-4.1 *	-0.6 *	-0.9	-1.6
	1-8	-1.3	-2.6	-6.3 *	-0.6	-5.6 *	-2.0 *	-2.4*	-3.3 *
	4-5	-3.9	-3.5	-2.0 *	-3.4	0.6 *	-1.5 *	-1.5	-0.3
	4-8	-2.1	-0.5	0.0	-1.6	-0.9 *	-3.0 *	-3.0*	-2.0 **
	5-8	1.8	3.0	2.0 *	1.8	-1.5 *	-1.4 *	-1.5	-1.7

* *95% Level of Confidence*

** *90% Level of Confidence*

\- *Scenarios with different signage that can not be compared*