ENGR 1181 – Lab 3 – Spot Speed Lab

Note: Special thanks to The Ohio State University. Content for the Spot Speed Lab is copied and adapted from the Department of Engineering Education's ENGR 1181 course

Background:

Spot Speed Studies can be described in general terms as experiments that collect the average speed of vehicles passing a particular point on a road or highway. These studies are usually best conducted under free flow conditions, where observed speeds are not impeded by volume or density conditions. In the field of Civil Engineering, traffic engineers conduct spot speed studies for the following purposes:

- To determine whether posted speed limits are appropriate for a particular location.
- Investigation of locations with high accident frequency and severity, where it is surmised that speeding is the principal contributing factor.
- For specific traffic control applications such as the timing of traffic light (red, yellow, green) intervals of traffic signals and for the appropriate placement of traffic signs.
- For roadway design applications such as determining appropriate sight distances (the length of roadway visible to a driver), relationships between alignment of roadways and speed, speed performance with regards to length and relative steepness of grade.

Engineering is multi-disciplinary - electrical engineering is responsible for the technology which complements the proven traffic engineering theories and principles. In partnership with traffic engineers, electrical engineers have developed smart traffic infrastructure that use GPS and dedicated short-range communication to monitor high speeds and alert drivers of possible collisions. As population and vehicle volumes increase, infrastructure ages, and land availability becomes sparse in the urban setting, it becomes imperative that state-of-the-art traffic management techniques be employed to improve traffic flow and emphasize road safety. In this lab, to interpret traffic data, students will use statistical analysis - which is a skill that is important to many engineering, science, and math majors.

Learning Objectives – Students will be able to:

- Outline examples of engineering applications in infrastructure.
- Utilize accepted statistical methods in the literature to correctly reduce and analyze speed data from a speed trap.
- Evaluate the findings of their study and make qualified recommendations.

Introduction to Scenario

As part of the college's expansion, Columbus State Community College is assessing pedestrian safety. To ensure the safety of students, staff, faculty, and guests E Spring Street, the engineers at Cougar Engineering, Inc. have recruited our class to assess traffic on E Spring Avenue, closest to Davidson Hall.

Transportation safety involves a focus on measures for mitigating traffic congestion and road traffic accidents, particularly those resulting in fatalities. The World Health Organization (WHO) lists speeding as a key factor in traffic fatalities and pedestrians are among the most vulnerable road users. The advent and rapid advances to autonomous vehicle usage requires, among other elements, a determination of the appropriateness of posted speed limits.

The chosen area is a stretch of road on E Spring Street, shown in Figure 1, where concerns for pedestrian safety have been raised regarding speeding vehicles. The start and stop points for the speed trap are noted on Figure 1, represented by the orange dashed lines. These points are 150 feet apart. The point where traffic was recorded is shown in white on Figure 1.

Figure 1: Areas identified for data collection

Procedure:

The following steps delineate how data can be successfully obtained for analysis regarding the Spot Speed Study of traffic on East Spring Avenue.

1. Divide your 4-person team into 2 2-person teams. Each 2-person team will be assigned to a different clip and will be responsible for recording the speed of 20 vehicles.
2. The first person in each 2-person team will open the video clip in blackboard, call out the vehicle description, time the vehicle entered the speed trap, and time the vehicle exited the speed trap. The second person will record this data in the provided Spot Speed Lab Field Sheet. After 10 vehicles, the members of each 2-person team will switch roles. This means that each person is required to record **10 vehicles**, and each 2-person team is required to record **20 vehicles**. If your team does not have four members, then each team member is required to record **10 vehicles**.
3. Collect the data from both 2-person teams into one data sheet, so that each 4-person team has recorded the speed of **40 vehicles**.
4. Record time, location, and observations about the road and weather on the field sheet.
5. After all vehicles and speeds have been recorded, group observations into speed groups in the Frequency Record sheet, similar to that in Figure 3. Use tally marks to keep track of the number of cars in each time group.

SPEED GROUP		TIME GROUP		Vehicles
Min (mph)	Max (mph)	Min (sec)	Max (sec)	
9	10	10	12	
10	12	8.57	9.99	
12	14	7.5	8.56	
14	15	6.67	7.49	
15	17	6	6.66	
17	19	5.45	5.99	
19	20	5	5.44	
20	22	4.62	4.99	

Figure 2: Field sheet example.

Make sure you have all the necessary data/observations before departing (these are necessary for replicating and analyzing the experiment)

- □ Date
- □ Number of vehicles traveling in each speed range
- □ Weather
- □ Time
- □ Location
- □ Road Condition
- □ Posted Speed Limit

Creating and submitting the final memo:

Deliverables – **Each member** of the team is required to submit an **Individual Formal Email as a PDF**, addressed to the Columbus State Traffic Management Director, Sam Fakename (sfakename.42@cscc.edu). This e-mail should contain your full analysis, as described below in the Analysis Tasks. The analysis should include, but is not limited to, answers to all questions outlined in the Questions section. In addition, your recommendations should be made concerning the efficacy of the posted speed limit. You should write this email in Word or a similar application, include any "attachments" at the end of the document, and export it to PDF for submission.

Please refer to Chapter 6. Writing Common Professional Documents in the Technical Communications Guide website. A link to this section can be found here:

https://ohiostate.pressbooks.pub/feptechcomm/chapter/6-professional-documents/

Audience:

The Columbus State Traffic Management Director can be assumed to understand the basics of a spot speed study. It should not be assumed, however, that they are familiar with all the statistics used in this report.

Analysis Tasks:

1. Your frequency record sheet likely has several rows at the top and bottom with zero vehicles observed in each speed group. To make your data table easier to read, remove these empty rows leaving one row with 0 vehicles on either end.
   For example - If the fastest cars observed were between 50 and 51 mph, recorded in row 27, you would then remove rows 29 through 42 so that the last row has zero vehicles and the second to last has a non-zero number of vehicles. If, the slowest vehicles observed were between 19 and 20 mph, recorded in row 9, you would then delete rows 3 through 7, leaving one row with zero cars and a non-zero number in the second row.
2. Save a copy of this edited raw data table and include it as an attachment to your email.
3. In Column E, calculate the **relative frequency** of vehicles in each speed group. Relative frequency is the percentage of the total number of vehicles observed in each speed group. Make sure to use appropriate mixed cell referencing for your calculation and represent it with one digit after the decimal.
4. In Column F, calculate the **cumulative frequency** of vehicles for each speed group. The cumulative frequency at a given speed is the sum of all the relative frequencies at that speed and lower. Like relatively frequency, the unit of cumulative frequency is percent.

Questions:

Results and Statistics

While answering these questions, be sure to define the terms “central tendency” and “dispersion” since your audience may not be familiar with them.

1. Central tendency is defined as “the tendency of samples of a given measurement to cluster around some central value.” Does your data exhibit central tendency? Why or why not?
2. Relate your numerical results to the purpose of the experiment: How does your data compare to the posted speed limit? What does this relationship mean for driver and pedestrian safety?

Experimental Validity

1. Discuss any circumstances particular to your experiment that may have affected your results and discuss their effect.
2. Identify and discuss at least three different sources of error associated with this experiment. Describe how each of the problems affected your data.
3. Propose changes to the experiment that could reduce the three sources of error.

The City of Columbus and Columbus State Community College has suggested that if this experiment proved insightful, a funding grant of $350 will be available to your team to improve the accuracy and validity of the experiment. If this funding were provided, what would you purchase and why? How would you use the new equipment to improve the experiment? Cite all references for this aspect of your work.