Assignment on highway robbery exploration

Education, Learning

Traffic congestion is an inescapable condition that happens when there are too many vehicles for the size of the road, which results in vehicles traveling at slower speeds. Separation of work and residential areas, movement to obtain or provide goods and services, inadequate transport infrastructure and services, and the increase in the number of cars on the road are all causes of traffic. Being stuck in traffic increases stress levels, blood pressure, and anxiety and negatively impacts fitness and health. Traffic can be particularly frustrating for drivers when they finally start moving again and find no visible cause for the delay. Traffic causes many holdups, increases fuel consumption and pollution, and can lead to drivers engaging in road rage due to frustration. According to a report by the Organization for Economic Co-operation and Development, Toronto’s traffic problems cost the city $3. 3 billion in lost productivity per year due to traffic congestion on streets and highways. 1I chose this topic because I want to know how much faster I will travel at during rush hour, how much time I will save on the commute to and from work, and how much money I will save by purchasing a green vehicle, so I can use the HOV lane. I am thinking about purchasing a green vehicle because I am always stuck in traffic on the highway, whether it be when I drive to and from work, drive my kids to hockey, or go out for dinner. I want to know how fast I will travel at in the regular lanes as opposed to in the HOV lane during rush hour.

The aim of the exploration assignment is to compare the speed of cars on the highway during rush hour in the regular lanes, the HOV lane, and the regular lanes without cars that are eligible to use the HOV lane. By knowing the speeds of the lanes of the highway, the exploration can help decide if it

is worthwhile to carpool, buy a green vehicle, or use public transportation. Carpooling cuts down on the number of cars on the road, decreases the amount of pollution, and allows carpoolers to use the HOV lane. Purchasing a green vehicle allows the commuter to use the HOV lane, save money on gas, and help the environment. Public transportation reduces pollution and road congestion and is cheaper than owning and operating a car. According to a report from The American Public Transportation Association (APTA), the annual savings for a person who switches their mode of transportation from a car to public transportation is $9, 641.

To find the speed of the cars traveling in the regular lanes during rush hour, I converted the length of the highway from 100 kilometers to 100, 000 meters. The formula for a safe distance between cars (from the front of one car to the front of another car) is d(s) = 0. 004s2 + 0. 06s + 2. I divided 100, 000 by 50, 000 since there are 50, 000 cars on the highway, so a safe distance between cars is 2 meters. Since the highway has 3 lanes, I multiplied 3 by 2, which is 6. I set the safe distance between cars formula to equal 6, then I made the equation equal 0 by subtracting 6 from both sides of the equation. To find the speed of the cars traveling in the regular lanes during rush hour, I factored the equation 0. 004×2+0. 06x-4= 0. I found the two zeros, which are (25, 0) and (-40, 0), and since speed can’t be negative, the cars will travel at 25 km/hour.

Factoring to find the speed of 50, 000 cars traveling in the regular lanes 0. 004×2+0. 06x+2= 60. 004×2+0. 06x-4= 00. 004(x2+15x-1000)= 00. 004(x+40)(x-25)= 0 x=-40 and x= 25

Since cars are only traveling at 25 km/hour in the regular lanes during rush hour, I want to know how fast cars would travel if 1, 500 cars are eligible to use the HOV lane. Since 1, 500 cars are eligible to use the HOV lane, I divided 100, 000 by 1, 500 to find a safe distance between cars, which is 66. 66 meters. I set the safe distance between cars formula to equal 66. 66, then I made the equation equal 0 by subtracting 66. 66 from both sides. I used the quadratic formula to solve the equation 0. 004×2+0. 06x-64. 66= 0. Since speed can’t be negative, the cars in the HOV lane will travel at just under 120 km/hour during rush hour.

Quadratic Formula to find the speed of 1, 500 cars traveling in the HOV lane

After calculating the speed of 1, 500 cars in the HOV lane during rush hour, I want to know how this impacts the speed of cars in the regular lanes. I subtracted 1, 500 from 50, 000 since 1, 500 cars are going to use the HOV lane, so 48, 500 cars will use the regular 3 lanes on the highway. I divided 100, 000 by 48, 500, so a safe distance between cars is 2. 062 meters. I multiplied that by 3, which is 6. 186. I entered the safe distance between cars formula (d(s) = 0. 004s2 + 0. 06s + 2) and y= 6. 186 into desmos. The point of intersection is (25. 708, 6. 186), so the new speed of cars in the regular 3 lanes will be traveling at 25. 71 km/hour. When 1, 500 cars are traveling in the HOV lane, cars in the regular lanes only travel 0. 71 km/hour faster than when all cars are using the regular lanes.

When 1, 500 cars are using the HOV lane, it does not increase the speed of cars in the regular lanes much, so I want to know if it is worth buying a green vehicle, so I can drive in the HOV lane on the highway and how long it will

take to pay off. If the drive to and from work is 20 kilometers each way in rush hour, the commute will take 48 minutes each way in the regular lanes. However, the trip will only take 10 minutes each way if the commuter can drive in the HOV lane during rush hour. This means that the commuter will save 76 minutes each day by taking the HOV lane to and from work. The 2017 Ford Focus Electric car’s fuel consumption in 12. 1L/100 kilometers and costs $29, 995. Since the price of gas is $1. 30 per liter, I multiplied 12. 1 by 0. 013, which is 15. 7 cents per kilometer. If the commuter travels 20 kilometers to work and 20 kilometers back, it will cost him/her $6. 28 each day. Assuming that the commuter works 5 days per week for 45 weeks, the gas to pay for the travel to and from work will cost $1, 413. If the commuter earns $20 per hour and spends the 76 minutes working instead of waiting in traffic, he/she will earn $25. 33 more by taking the HOV lane to and from work as opposed to driving in the regular lanes. To find how much additional money the commuter could make by working instead of waiting in traffic, I divided 76 by 60, then multiplied that number by 20, which is 25. 33. By taking the HOV lane to work every day, and working for 76 minutes instead of waiting in traffic, the commuter will earn an additional $5, 699. 25 annually. It will take the commuter just over 4 years to pay off the new green vehicle.

To find the amount of time saved by using the HOV lane, and the cost per day, week, and year for each interval of distance traveled, I found the amount of time saved, and the cost per day, week, and year when traveling 40 kilometers. I divided all of my results by 4, then multiplied them by the number of kilometers traveled, time saved, and cost per day, week, and

year, then divided by 10. In conclusion, during rush hour, when there are 50, 00 cars in the regular lanes, vehicles will travel at 25 km/hour, when there are 1, 500 cars in the HOV lane, vehicles will travel at just under 120 km/hour, and when there are 48, 500 cars in the regular lanes, vehicles will travel at 25. 71 km/hour. Cars that are eligible to use the HOV travel almost 95 km/hour faster than cars in the regular lanes during rush hour. The increase in the speed traveled on the highway, the decrease in the amount of time spent in traffic, and the money saved on fuel make it worth buying a green vehicle. This exploration has rounding error because I rounded what a safe distance between cars is for both parts of the extension question instead of keeping the real value because there were too many decimals. An assumption made when doing the calculations is that the length of all the cars is the same. This does not take into account trucks that travel on the highway, as truck take up more room than cars. The number of vehicles that can fit on the highway depends on the sizes of the vehicles.

A limitation of this assignment is that cars can only travel in 3 regular lanes. If all cars could travel in 4 regular lanes, the speed of cars would increase to 32 km/hour. A generalization reached from this exploration assignment is that when there are a certain number of cars on the highway, allowing some cars to use the HOV lane will not impact the speed of the regular lanes much. To conclude, I enjoyed problem-solving and using different methods to calculate the speed of the cars traveling on the highway.