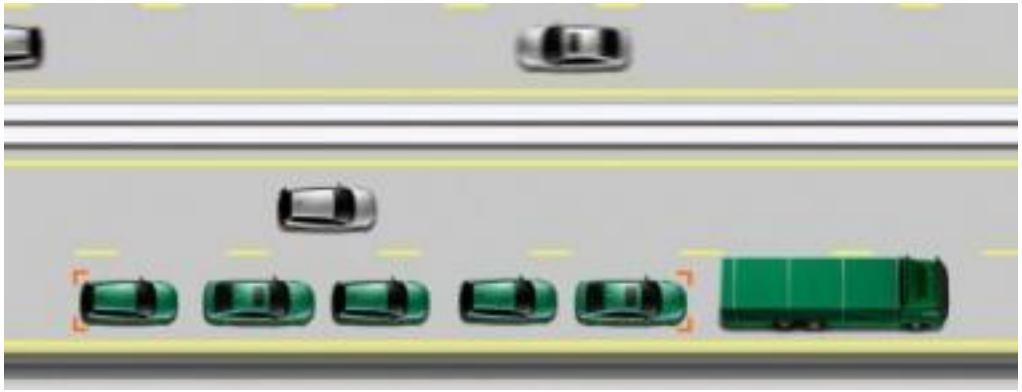

Traffic Flow Analysis
Lecture 12
CE 2710
Norman Garrick

Traffic Flow Patterns of the Future?



http://www.youtube.com/watch?v=KX46uhpAQaw

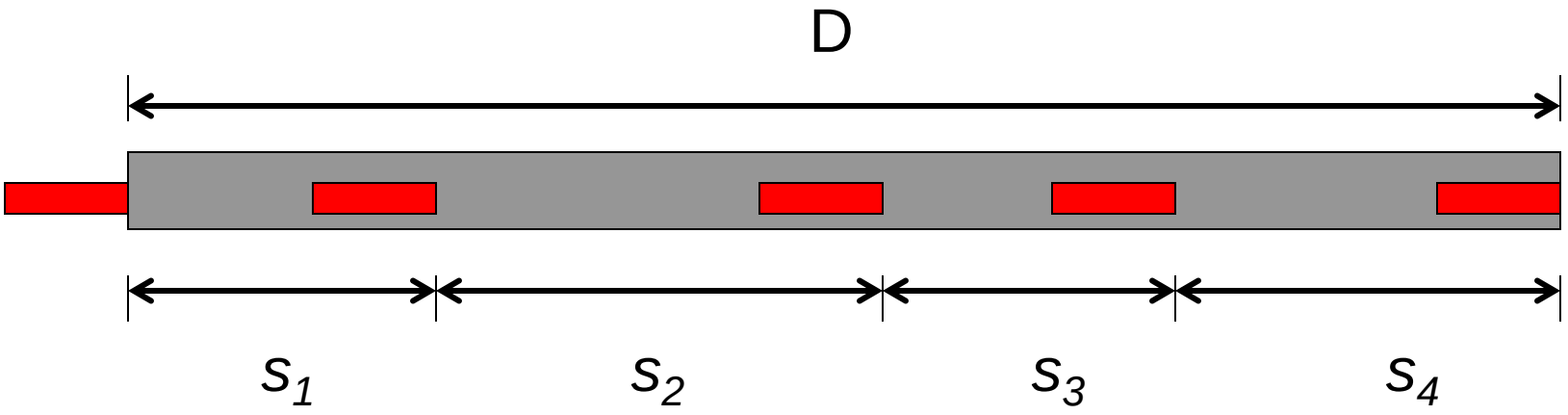
European SATRE Car Platoon Road Test

Basic Parameters
for Understanding Stream Flow

Three basic classes of parameters

1. Spacing and Concentration
2. Headway and Flow
3. Speed

Spacing and Concentration

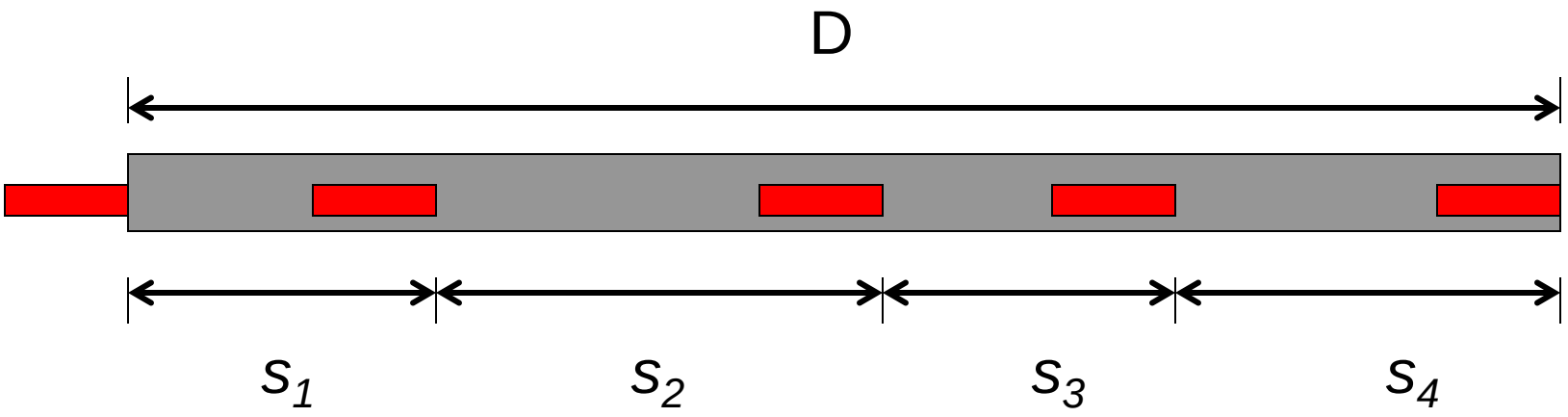


Spacing is the distance between vehicles, *s*

Concentration (or density) is the number of vehicles per unit length, *k*

$$s_{(ave)} = 1 / k$$

Spacing and Concentration
Example



If *D* = *1/10 mile*

What is the concentration, *k*?

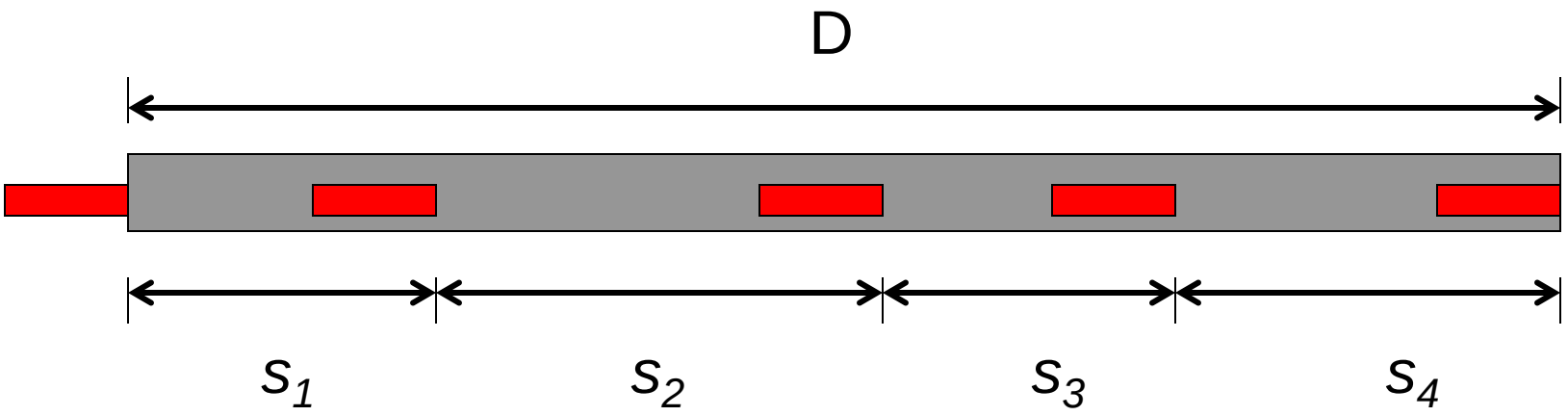
We have 4 vehicles in 1/10 mile

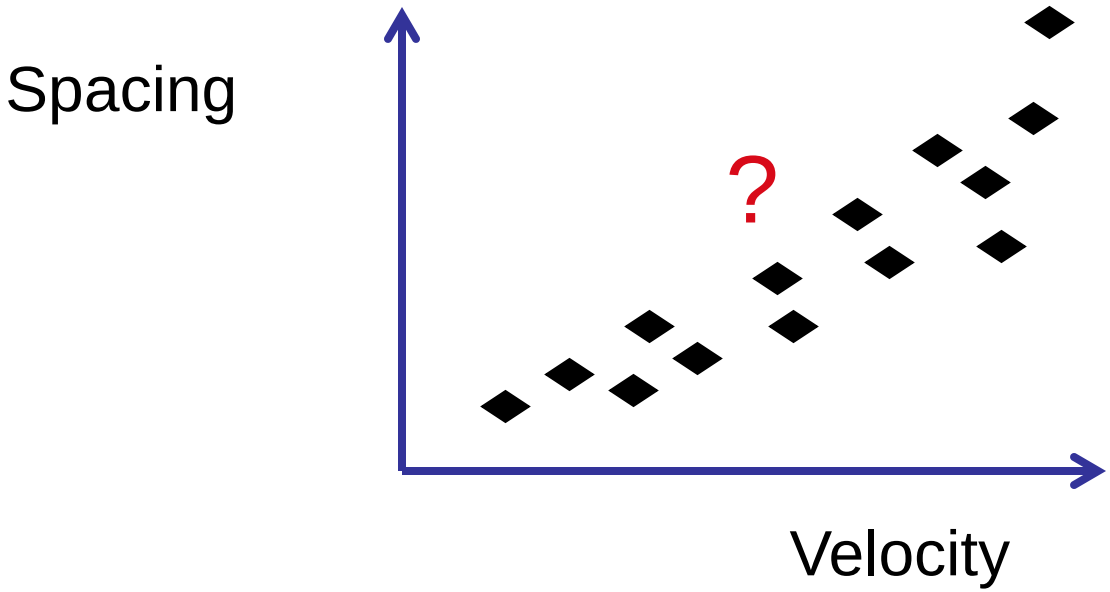
Therefore, the concentration is 40 vehicles/mile

What is the average spacing, *s*?

$s = 1 / k = 1 / 40 = 0.025$ miles = 132 feet

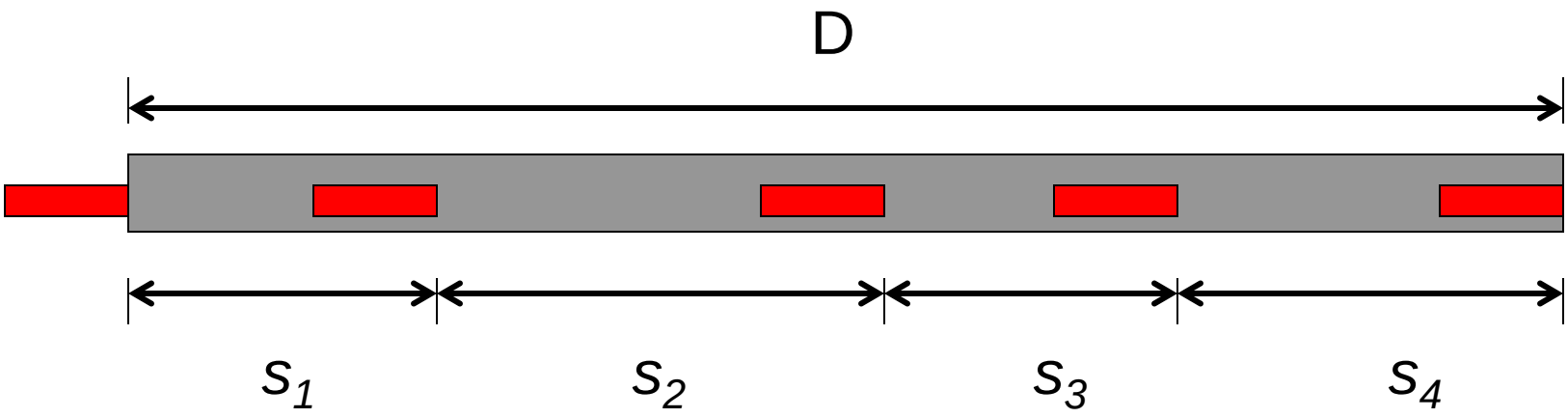
Spacing and Speed?

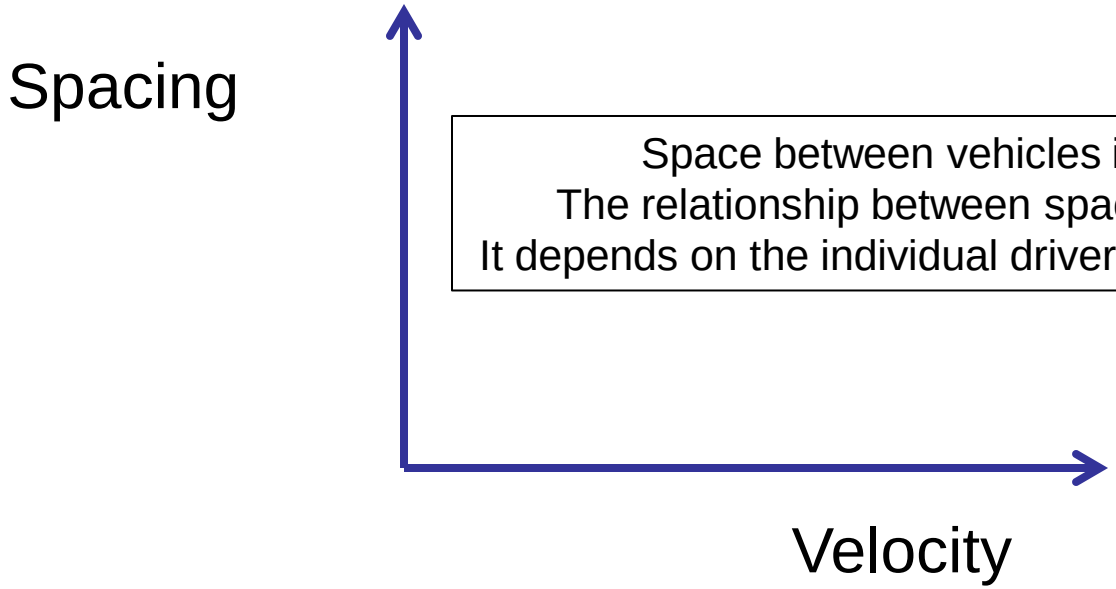




Norman W. Garrick

Spacing and Speed?

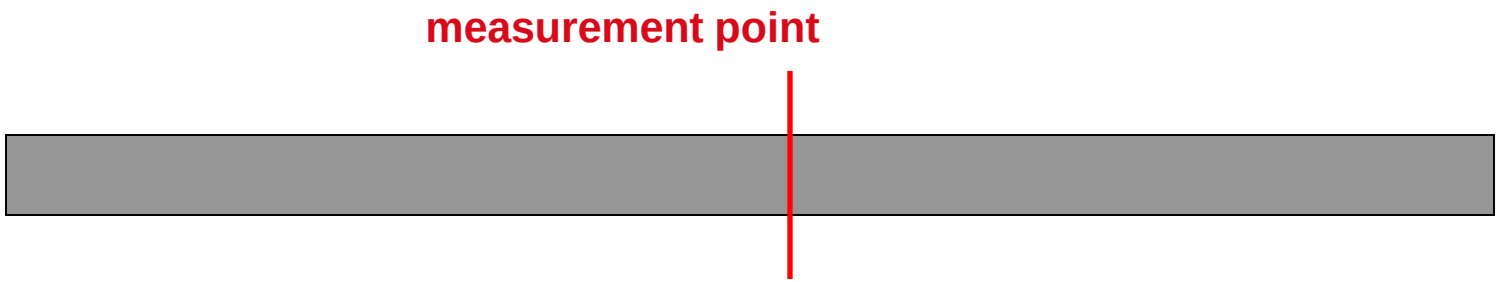




Space between vehicles increases with speed
The relationship between space and speed is not exact
It depends on the individual driver, cultural factors, weather etc.

Traffic Spacing in India

Headway and Flow

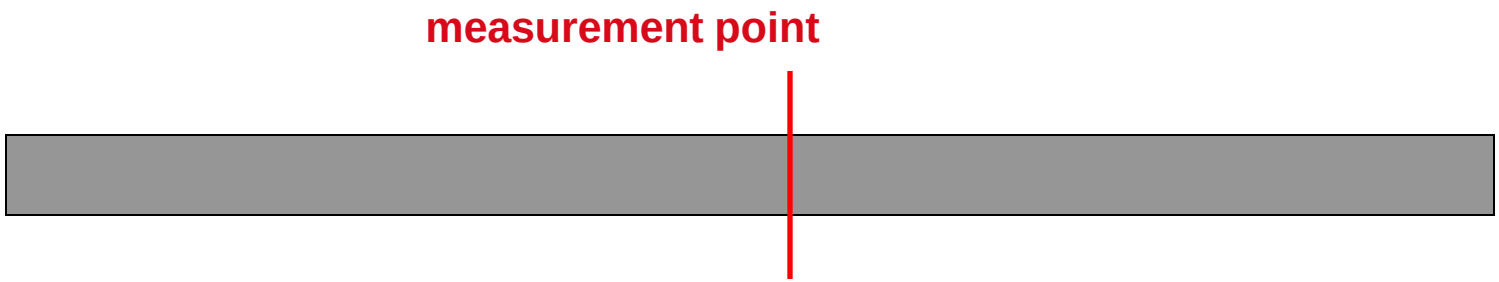


Headway is the time between vehicles passing a specific location, *h*

Flow is the amount of vehicles passing a specific location in a specific time, *q*

$$h_{(ave)} = 1 / q$$

Headway and Flow
Example



If the total time for all the vehicles to cross the measurement points is 1/20 hour, what is the flow per hour?

5 vehicles cross in 1/20 hour
Flow, q = 100 vehicles per hour

What is the average headway?

h = 1/q = 1/100 = 0.01 hour = 36 sec

Space Parameters and Time Parameters?

Is there a relationship between the space parameters and the time parameters?

What links these two parameters?

Speed!

Measuring Average or Mean Speed

The average speed of vehicles in a traffic stream can be measured in a number of different ways.

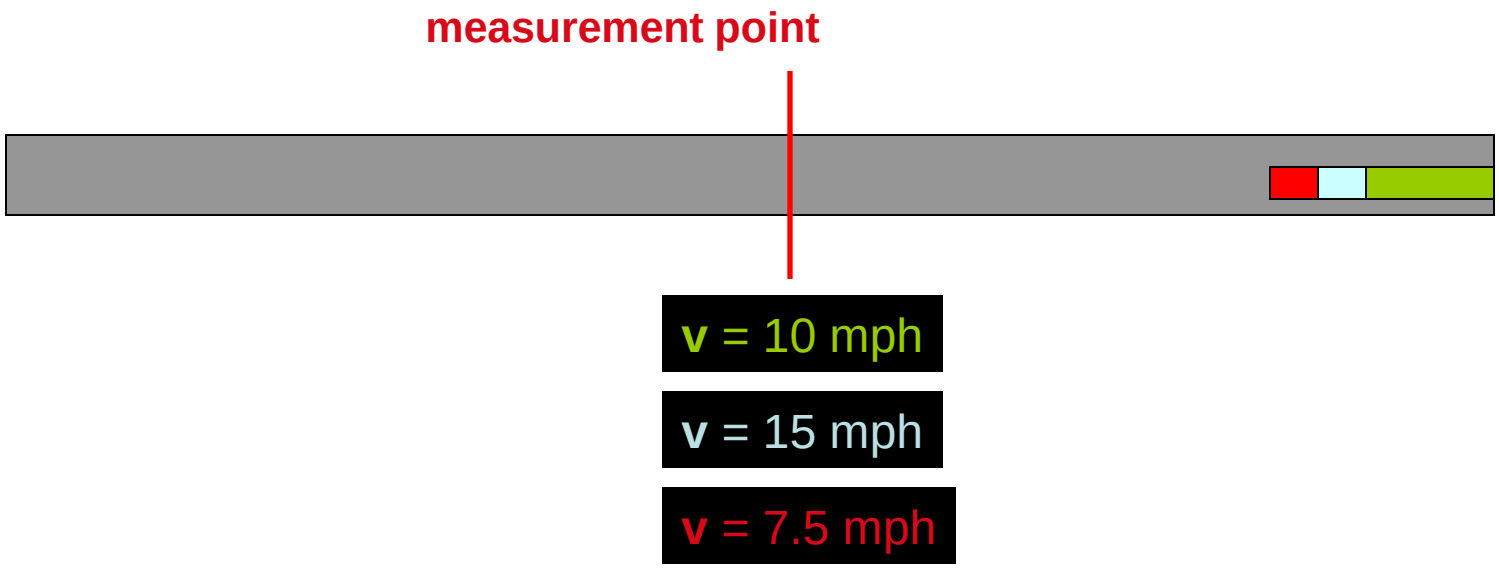
Two common methods are used in transportation characterization

Time Mean Speed - is based on the spot speed of the vehicles passing a specific point

Space Mean Speed - is based on the average time it takes vehicles to cover a certain specified distance

Different traffic flow models use different definition of speed – some TMS and some SMS

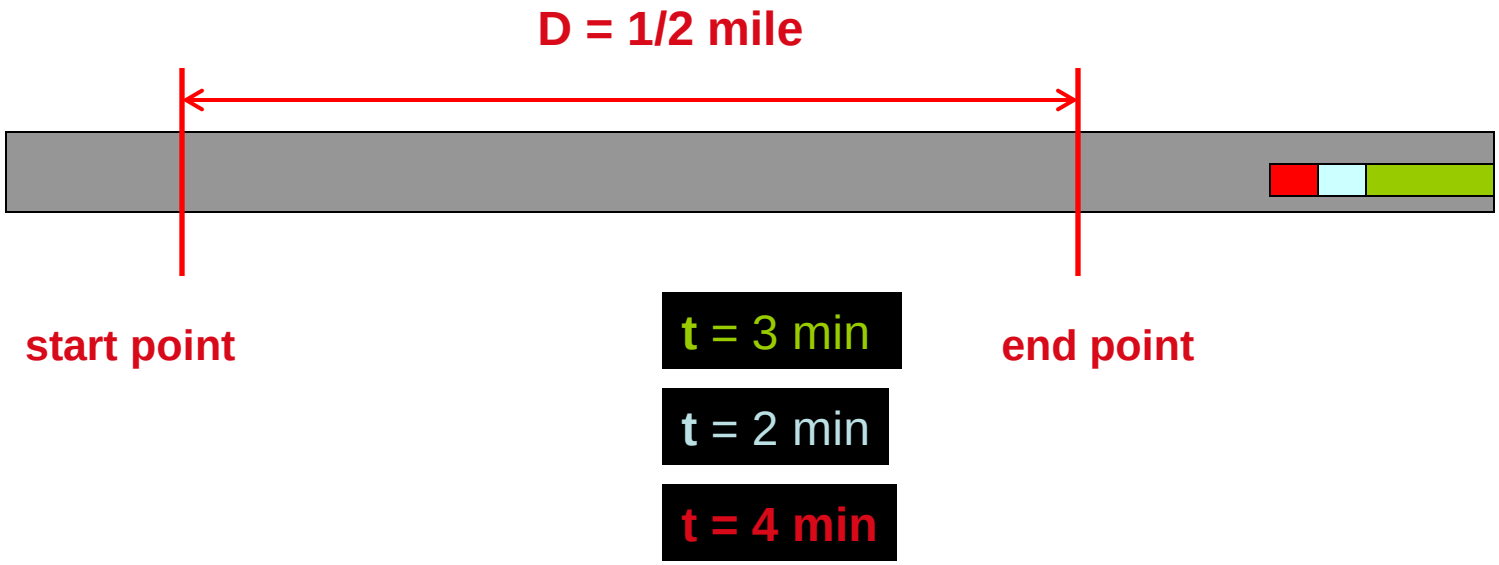
Time Mean Speed is the Arithmetic Average of the Spot Speeds



Time Mean Speed, $u_t = 1/n \sum v_i$

= (10 + 15 + 7.5) / 3 = 10.8 mph

Space Mean Speed



Space Mean Speed is based on the average time

$t(ave) = (t1 + t2 + t3) / n$

= (3 + 2 + 4) / 3 = 3 minutes = 1/20 hour

Space mean speed, $u_s = D / t(ave)$

= (1/2) / (1/20) = 10 mph

Average speed measured by TMS and SMS is different even though the individual bike speed are exactly the same

TMS versus SMS

v = 10 mph

v = 15 mph

v = 7.5 mph

Average speed measured by TMS and SMS is different even though the individual bike speed are exactly the same

Time Mean Speed, $u_t = 1/n \sum v_i$

Space mean speed, $u_s = D / t(ave)$

SMS

v = 10 mph | **v** = 15 mph | **v** = 7.5 mph

Space mean speed, $u_s = D / t(ave)$

but, $t(ave) = 1/n \sum t_i$

and, $v_i = D/t_i$

>>> $t_i = D/v_i$

therefore, $u_s = D / \{1/n \sum D/v_i\}$

$= D / \{D/n \sum 1/v_i\}$

$= 1 / \{1/n \sum 1/v_i\}$

SMS is the Harmonic Average of the Spot Speeds

v = 10 mph

v = 15 mph

v = 7.5 mph

Space mean speed, $u_s = D / t(ave)$

$= 1 / \{1/n \sum 1/v_i\}$

$= 1 / \{(1/3)*[(1/10)+(1/15)+(1/7.5)]\}$

$= 10$ mph

TMS and SMS

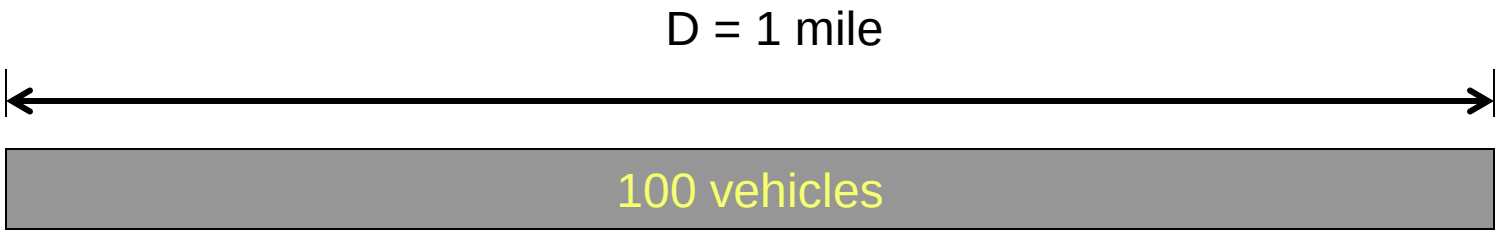
Time Mean Speed - is based on the spot speed of the vehicles passing a specific point

Space Mean Speed - is based on the average time it takes vehicles to cover a certain specified distance

Time Mean Speed, $u_t = 1/n \sum v_i$

Space mean speed, $u_s = 1 / \{1/n \sum 1/v_i\}$

Relationship between Space and Time Parameters



What is the concentration?

k = 100 vehicles/mile

What is the space?

s = *1/k* = 1/100 miles = 52.8 feet

If the average speed = 10 miles

What is the flow (*q*)?

Flow is total number of vehicles passing any point

Flow = 10*100 = 1000 vehicles/hr

In other words, $q = uk$