Traffic flow problem

1000 people share a road to get to work . They will each either drive their cars or ride the bus.

If there are no cars on the road, the bus takes 25 minutes to take the trip. Every extra car on the road delays the bus by 2 seconds.

Define a linear function $B(c)$ that gives how long the trip takes a BUS as a function of how many cars on the road (variable c).

What is the **intercept** of $B(c)$, in seconds? 25 min × 60 sec/min = 1500 sec.

What is the **slope** of $B(c)$, in seconds per car? 2 seconds/car

What is the **equation** for $B(c)$? $B(c) =$ 2c + 1500

Sketch the function $B(c)$. Remember to label your axes! $y-$axis (vertical): Trip time in seconds. $x-$axis (horizontal): # people driving cars. Make your $y-$axis scale go from 0 to 4000, and $x-$axis scale go from 0 to 1000.

No matter how many cars there are on the road, a driver in a car would take 10 minutes less than the bus to make the trip.

Define a linear function $D(c)$ (D for **Driver**) that gives how long the trip a DRIVER takes, as a function of how many cars on the road (variable c).

What is the **intercept** of $D(c)$, in seconds? (25min − 10min) × 60sec/min = 900 sec.

What is the **slope** of $D(c)$, in seconds per car? 2 seconds/car

What is the **equation** for $D(c)$? $D(c) =$ 2c + 900

Sketch the function $D(c)$ on the same axes as you sketched $B(c)$, in the space above, so you can compare the curves.

Question: You're a commuter. How much time should you set aside for the trip?

When we account for human behaviour, everyone ends up driving. The trip will therefore take D(1000) = 2 · 1000 + 900 = 2900 sec., approximately 48 minutes.

City planners add a dedicated bus lane.

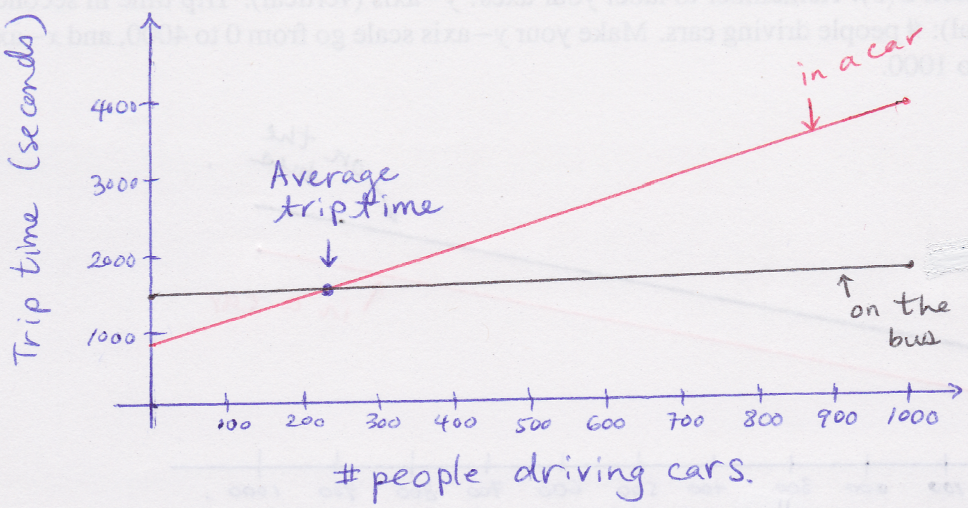
If there are no cars on the road, the bus still takes 25 minutes to take the trip. But now, every extra car on the road delays the bus by **0.2** seconds.

What is the **intercept** of the new $B(c)$, in seconds? 25min × 60sec/min = 1500 sec.

What is the **slope** of the new $B(c)$, in seconds per car? 0.2 seconds per car

What is the **equation** for the new $B(c)$? $B(c) =$ 0.2c + 1500

Sketch the function of the new $B(c)$. Remember to label your axes! $y-$axis (vertical): Trip time in seconds. $x-$axis (horizontal): # people driving cars. Make your $y-$axis scale go from 0 to 4000, and $x-$axis scale go from 0 to 1000.



If there are no cars on the road, someone who drives a car still would take 10 minutes less than a bus. But now, every extra car on the road delays the bus by **3** seconds.

What is the **intercept** of the new $D(c)$, in seconds? (25min − 10min) × 60sec/min = 900sec.

What is the **slope** of the new $D(c)$, in seconds per car? 3 seconds / car

What is the **equation** for the new $D(c)$? $D(c) =$ 3c + 900.

Sketch the function the new $D(c)$ on the same axes as you sketched the new $B(c)$, in the space above, so you can compare the curves.

Question: You're a commuter. How much time should you set aside for the trip?

Accounting for human behavior, average trip time lies at the intersection of the lines,

cars: $0.2c + 1500 = 3c + 900$
$600 = 2.8c$
$2.8c = 600$
$c = \frac{600}{2.8} = \frac{1500}{7}$ cars.

Triptime: $B(\frac{1500}{7}) = 0.2(\frac{1500}{7}) + 1500$
$= 10800/7$ seconds.

Average trip time is $\frac{10800}{7}$ seconds, or approximately 26 minutes.