Fundamentals of Traffic Operations and Control
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Exercise
On-demand transportation
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Consider an MFD represented by the following speed *vs* accumulation relationship.

$$v(m) = 36 \cdot \exp\left(-\frac{29}{600}m\right), \qquad \text{where } m = \frac{n}{1000} = \frac{n_{PV} + n_{RS}}{1000}$$

Where n_{PV} and n_{RS} represent the number of private vehicles and ride-sourcing drivers in the area respectively. The unit of speed is km/hr.

Private vehicles will only have to drive their trip length to reach their destinations. However, ride-sourcing drivers must first pick-up their passengers and then drive them to their destinations. For this reason, assume that each group of drivers will have the following trip length (in kilometers):

$$\begin{aligned} L_{PV} &= 3.8 \\ L_{RS} &= 1.05 \cdot L_{PV} \end{aligned}$$

a) If there are 3'000 ride-sourcing drivers and the network is at its critical production, what is the accumulation of private vehicles?

Hint: production P in the network is the product of accumulation and speed.

b) Assume the same scenario as in part **a)**. If 80% of ride-sourcing drivers are occupied or on their way to pick-up a passenger, compute the total trip-completion rate O of each mode in the network using the following relationship:

$$O_i = \frac{n_i}{\sum_j n_j} \frac{P(n)}{L_i} \qquad i = \{RS, PV\}$$

c) If the system had only private vehicles, what would be the trip completion rate in this case? How big is the difference between the total trip completion rates?

d) What are some of the policies that can be implemented by regulators to minimize this difference?