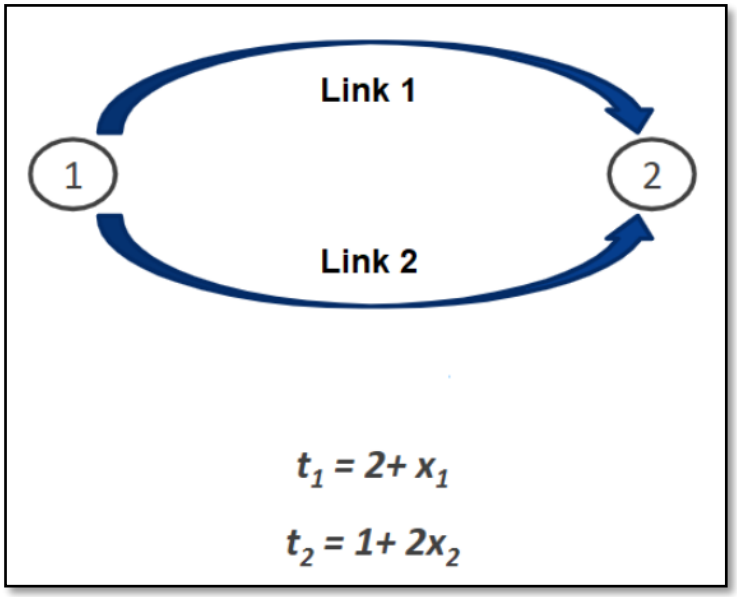
Module 6-1 tutorial
Solutions

Austroads

Network performance

Consider the following scenario:



The figure above shows two unidirectional links (roads) connecting the Origin (Point 1) and the Destination (Point 2). The equations shown in the figure represent the link cost functions, i.e. the relationship between travel time in minutes (denoted bt_iy) and the traffic flow in vehicles per hour (denoted by x_i) on a link (denoted by i).

Consider that there are 65 car trips per hour to be made between 1 and 2, of which 43 cars use Link 1 while the rest follow Link 2.

Also assume the lengths of Links 1 and 2 as 20 km and 15 km respectively.

Solve the following questions based on this information.

Question 1. What is the free-flow travel time on Link 1?

Solution to Question 1.

By definition, free-flow travel time corresponds to the time when there is not traffic on a road (i.e. $x \rightarrow 0$).

Upon substituting $x_1 = 0$ in the equation for t_1 we get $t_1 = 2$

Hence, the free-flow travel time on Link 1 is 2 minutes.

Question 2. What is the VHT for this road network?

Solution to Question 2.

By definition, Vehicle Hours Travelled (VHT) is the summation of travel times of all the travellers in a network.

In one hour, it is given that $x_1 = 43$ and $x_2 = 22$

Substituting the values in the equations for travel time gives:

$t_1 = 2 + 43 = 45$ *minutes*

$t_2 = 1 + 2 * 22 = 45$ *minutes*

Thus, the VHT under the given traffic scenario can be computed as follows:

$VHT = 43 * 45 + 22 * 45 = 2925$ *minutes or* 48.75 *hours*

Tip: $VHT = \sum_i x_i t_i$ *where i represents a link in the network.*

Question 3. What is the VKT for this road network?

Solution to Question 3.

By definition, Vehicle Kilometres Travelled (VKT) is the total distance travelled by all the travellers in a network.

In one hour, it is given that $x_1 = 43$ and $x_2 = 22$. The length (l) of Link 1 and 2 is 20 km and 15 km respectively.

Thus, the distance travelled by travellers on each link under the given traffic scenario is:

Link 1: $20 * 43 = 860$ *km*

Link 2: $15 * 22 = 330$ *km*

Hence, $VKT = 860 + 330 = 1190$ *km*

Tip: $VKT = \sum_i l_i t_i$ *where* i *represents a link in the network.*

Question 4. What is the average speed (in km/h) on Link 2?

Solution to Question 4.

By definition, average speed is equal to total distance travelled by vehicles on a link divided by total travel time taken by all the vehicles to traverse the link.

Thus, for Link 2 the average speed under the given traffic scenario is:

$Average\ Speed = \frac{Total\ Disyance}{Total\ Time} = \frac{15 * 43}{45/60 * 43} = 20$ *km/h*

Tip: Average speed is also referred to as the Space Mean Speed in Transport Modelling context.

Question 5. Which link has a higher delay?

Solution to Question 5.

By definition, delay is the difference between the prevailing travel time and the free flow travel time (FFTT).

Thus, the delay for Link 1 under the given traffic scenario is:

$Delay_1 = t_1 - FFTT_1 = 45 - 2 = 43$ *minutes*

$Delay_2 = t_2 - FFTT_2 = 45 - 1 = 44$ *minutes*

Hence, Link 2 has a higher delay.

Tip: $Delay_i = t_i - FFTT_i$ *where* i *represents a link in the network.*