## Method to calculate the travel time and cost between census tracts on the driving network

**Step 1:** **Calculate link free flow travel time (FFTT):** For each link, we set the default free flow speed based on the link types specified in the OSM data (e.g., motorway, trunk, primary, residential, etc.), following the values provided in <https://osm2gmns.readthedocs.io/en/latest/quick-start.html>. Then we calculate FFTT through link length and speed. The FFTT on the connects are defined as 30 miles/hour.

**Step 2: Estimate fuel cost on each link:** If fuel efficiency is 25 miles per gallon and fuel price is 4 dollars per gallon, the travel cost for each link based on its link length can be calculated.

**Step 3: Find the shortest path between an OD pair (i.e., two centroids):** The generalized cost on each link are calculated using “FFTT + Fuel cost \* (60/25)” by adopting the mean VOT around 25 dollars/hour for local trips and business purposes provided by the US department of transportation ( <https://www.transportation.gov/office-policy/transportation-policy/revised-departmental-guidance-valuation-travel-time-economic>). Then, we search the shortest path between centroids using the calculated generalized cost.

**Step 4: Calculate travel time and cost between OD pairs:** The travel time between the centroids are the summation of the FFTT along the path. The travel cost between the OD pair not only includes the summation of the fuel cost along the routes and add the average auto depreciation cost and insurance cost per trip.

1. Average vehicle price was about 20,700 dollars (used vehicle average transaction price, in U.S., 2019, <https://static.ed.edmunds-media.com/unversioned/img/industry-center/insights/2019-used-vehicle-report.pdf>)
2. Assume average length of car ownership was about 4 years since 64% of Americans have only owned their current cars for 5 years or less <https://www.thezebra.com/resources/driving/average-length-of-car-ownership/>
3. The average age of a purchased vehicle is assumed as 5 years. <https://www.powernationtv.com/post/used-car-higher-post-pandemic>
4. Depreciation cost percentage is set as 40% of the purchased price (for 4 years) with low future depreciation

<https://www.navyfederal.org/makingcents/tools/car-depreciation-calculator.html>

1. Average cost of car insurance is set as 2.7 dollars/day (= 80 dollars / 30 days )

<http://www.rmiia.org/auto/steering_through_your_auto_policy/Cost_of_Auto_Insurance.asp>

1. The average trip number per day is 2.5 trips per day

<https://aaafoundation.org/wp-content/uploads/2023/09/202309_2022-AAAFTS-American-Driving-Survey-Brief_v3.pdf>

## Method to calculate the travel time and cost between census tracts on the driving network