



Moody's Mega Math Challenge® 2016

A contest for high school students

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Share and (Car) Share Alike Modeling new approaches to mobility

The introduction of the mass-produced car in the early 20th century represented a revolution in mobility and convenience, and car ownership rapidly became the standard of passenger transport in developed countries. Today, the consequences of heavy automotive use are the subject of much controversy. Increasingly, car sharing has become an attractive option for consumers who want the benefits of using a private car without the costs and responsibilities of owning a car. Automakers are responding, investing millions of dollars [1,2] to get in to the car-sharing arena, trying to “stay ahead of the curve in a rapidly shifting automotive landscape”[3].

Shared ownership can mean less traffic, less pollution, and less oil dependence. While currently focused on urban environments and college towns, companies involved in car sharing are interested in expanding and are looking at new technologies to foster new markets.

- 1. Who's driving?** Car-sharing companies have found that two of the main factors that drivers consider when making decisions about car sharing are the amount of time using the car and miles driven per day. Build a mathematical model to determine the percentage of current U.S. drivers in each category—low, medium, and high—for all combinations of the two specified factors. For example, one of the nine car usage characterizations your model will return is the percentage of drivers who are “low” mileage drivers that use their vehicle for a “medium” number of hours.
- 2. Zippity do or don't?** Zipcar paved the way for car sharing, but options other than pay-by-the-hour are emerging. Consider the following four car-sharing business options, as described in [4]:
 - Round trip car sharing: vehicles are rented by the day, hour, or mile, or some combination of the three, and are picked up from and returned to the same point.
 - One-way car sharing floating model: cars are rented on demand and are returned to defined areas. Usually requires a “jockey” to manually reposition vehicles.
 - One-way car sharing station model: customers pick up and drop off cars at existing stations.
 - Fractional ownership: multiple owners jointly purchase a private car.

Create a model to determine which of these car-sharing options would garner the most participation in a given city. Use your model to rank the following cities (each of which already has Zipcars) so that a car-sharing company can decide if they should move forward investigating legalities and implementation issues in these cities:

- Poughkeepsie, NY; Richmond, VA; Riverside, CA; Knoxville, TN.

- 3. Road map to the future.** A number of recent reports suggest self-driving cars and vehicles that run entirely on alternative fuel or renewable energy are close to entering the mainstream [1,2]. These technologies have the potential to dramatically change participation in car sharing as individuals could have environmentally friendly vehicles delivered to their doorstep on demand. Adjust your model to account for the inclusion of emerging automobile technologies. Use your updated model to re-rank the four cities identified in part 2.

Links to help get started:

- [1] <http://recode.net/2016/01/04/gm-invests-500-million-in-lyft-and-strikes-strategic-autonomous-car-alliance/>
- [2] <http://www.businessinsider.com/r-ford-rd-chief-says-automaker-wants-to-develop-ride-hailing-services-2015-12>
- [3] <http://time.com/4188430/general-motors-maven-car-sharing/>
- [4] <http://www.greenbiz.com/article/zipcar-google-and-why-carsharing-wars-are-just-beginning>
- [5] <http://nhts.ornl.gov>