Computation and data:

1. Major data source:
2. Caltrans Performance Measurement System (PeMS): <http://pems.dot.ca.gov/>
3. New Jersey Crash Records Data: <http://www.state.nj.us/transportation/refdata/accident/>
4. NGSIM Vehicle Trajectory Data: <http://ngsim-community.org/>
5. ITS Public Data HUB – Connected Vehicles: <https://www.its.dot.gov/data/>
6. NYC Taxi Data: <http://publish.illinois.edu/dbwork/open-data/>
7. Uber Movements Data: [https://movement.uber.com](https://movement.uber.com/)

Downloaded Data:

Data Set Name: Crash Records Raw Data of Atlantic County, New Jersey in year 2001

Source: [http://www.state.nj.us/transportation/refdata/accident/rawdata01- current.shtm](http://www.state.nj.us/transportation/refdata/accident/rawdata01-%20%20%20current.shtm)

Data Format: Comma Delimited Format zipped in .TXT format file

Contents: The data set provides very detailed information of every crash accident happened in 2001, Atlantic County. It covers information in the following categories: geographical location (by administrative hierarchy and by geographic coordinates), time, severity of accidents, police resource involved, what dangerous driving behaviors are involved, etc. There are 30 fields in total.

1. HW1 Dataset
2. Dimension of the data set: 93 X 6 (93 observations and 6 fields / variables)

Column names (from left to right): Index, Local\_Time, Segment\_Name, Actual\_Speed.mph, Historical\_Speed.mph, Segment\_Length.mile.

1. Actual Travel Time (hour) = Segment Length (mile) / Actual Speed (mph)

Historical Travel Time (hour) = Segment Length (mile) / Historical Speed (mph)

The maximum of historical time: 0.02214743 hour

The maximum of actual time: 0.03894892 hour

1. Travel Time variance in each hour interval:

7:00-8:00: 1.778945e-05;

8:00-9:00: 3.220459e-05;

16:00-17:00: 3.996606e-06;

17:00-18:00: 3.732147e-05;

18:00-19:00: 4.295503e-05;

19:00-20:00: 3.43928e-05;

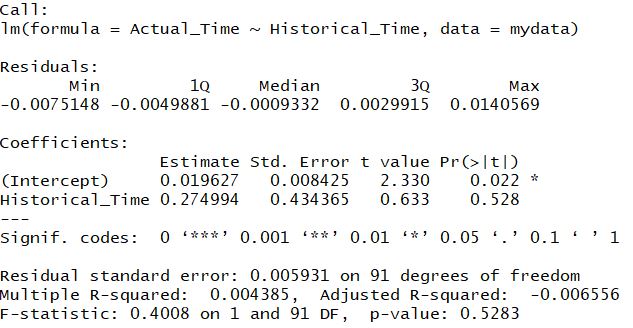
20:00-21:00: 4.236799e-05;

21:00-22:00: 4.880236e-05;

1. The Maximum time difference is 0.01980454 (hr), which is during the 5 minute interval *12/14/2010 8:15*.
2. Regressing actual time on istorical time, we got:

Actual time = 0.27499\*(Historical time) + 0.01963

The statistical diagnostics of this model is shown below:



Questions Based On Reading Assignments

1. Four Milestones in traffic theory development:
2. 1951: Wardrop started traffic observation from scratch and proposed “Wardrop’s Principles”.
3. 1953: Reuschel and Pipes proposed microscopic traffic model, describing the movement of a single car and its interaction with preceding car.
4. 1955: Lighthill and Whitham presented a fluid flow model of traffic.
5. 1958: Chandler et al. published a paper that described the relationship between the acceleration of the following car and the speed of preceding car, and proposed a “gain factor” which depended on the car distance.
6. major transportation problems in in Greenshields (1935) paper

In the paper Greenshields mentioned that to coordinate large-scale transportation planning, 4 major problems should be addressed by using the data collected from transportation surveys.

The first one is where to build roads. Planners should make use of the traffic counts in transportation surveys to get the vehicle types and volumes at present and to estimate their counterparts in the future. Planners should also pay attention to population, the locality of traffic, socioeconomic characteristics in the region and foreign traffic when considering planning the location of new high ways.

The second one is when to build roads. The fundamental principle is that an improvement of the highway system is needed when the annual improvement cost surpasses the annual cost of transportation.

The third problem is how to build roads. This problem mainly associates with the pavement types and lane configurations of the roads to be built. To find the optimal combinations of these physical features, planners should consider various factors including traffic speed, loads on vehicles, free passing requirements, etc.

The fourth problem is how to justify the project budgets and procedures to convince politicians and the public of the feasibility of the project plan.

Relevancy of the problems:

From a global perspective, the relevancy of “where to build roads” depends on wat countries or regions we are looking at. In developed countries such as United States France and Germany, the infrastructure system is relatively sophisticated and completed and there is no strong need for constructing new roads. Whereas in developing countries especially the emerging market countries who are experiencing high speed economic growth but have relatively poor infrastructure network, the demand for building new roads is very strong, so the question of where to build roads is more relevant to these countries and regions.

The second question of “when to build roads” is still relevant in developed countries today since the infrastructure in these countries are faced with a big problem: aging. Deterioration may significantly increase the cost of transportation (e.g., accidents) and renovation projects is needed when this cost exceeds project cost.

New technologies enhance the performance of vehicles so that they can run faster, cover much loner mileage and bear more loads. What’s more, the emergence of self-driving vehicles brings about revolutionary changes of people’s travelling paradigms. All these changes initiated from technological advancements become great challenges when it comes to designing our infrastructure.

The fourth question which is related with political gaming is always relevant throughout history in every society, whether in pre-Revolution France or Modern China. Since infrastructure constructions are huge engineering projects with high investment threshold and long investment return cycles, usually only government can organize such large scale cooperation among different social members. In addition, being a public goods, roads are naturally involved with the interests of various stakeholders. It is very important to strike a balance between different interest demand.

1. Two major characteristics of highway traffic:

High vehicle speed and large vehicle volume.

1. Why demographic change is a significant development of the highway traffic?
2. Elderly people tend to have poorer vision, mobility and hearing which makes them react slower than younger people when encountered with changes in road conditions or emergencies. To ensure a safe driving environment for old drivers, the signal systems of highway, including traffic lights and road markings, etc, should be re-designed to meet ederly people’s needs.
3. Elderly people tend to have poorer stamina than young people and may need more frequent stops and rests during a trip. Some old people may even need medical helps. Hence there should be more rest areas and better amenities along highways. First aid stations may also be necessary.
4. The driving habits of old people can be very different from those of younger drivers. For example, they may drive significantly less during the night. They may not have strong desires to travel for leisure like young people, so the average mileages per trip can be much smaller and short-distance trips may be more frequent. What’s more, the regularity of their driving patterns can be stronger than young drivers. These factors will all have great influence on the geographical distribution of traffic volumes. Planners should act accordingly to improve the highway system.