**Traffic Flow and Linear Regression**

The variables used to model traffic flow are mean speed, v (mi/hr), traffic density, k (veh/mi), and traffic flow, q (veh/hr). The variables are related as follows: q = kv.

One model for traffic flow is to assume v is linear function of k (called the Greenshields model). When the density k is 0 the velocity is a maximum. This maximum velocity, vf is called the free flow speed. When the density is at a maximum the velocity is 0. This maximum density, kj is called the jam density.

The linear equation for this model is $v=v\_{f}-\frac{v\_{f}}{k\_{j}}k$.



When both sides of the linear equation are multiplied by k (recall q = kv) the relationship becomes:

$q=v\_{f}(k-\frac{k^{2}}{k\_{j}})$



By taking the derivative $\frac{dq}{dk}$ and setting it equal to zero you can show that the maximum flow rate $q\_{max}$ occurs when $k=\frac{k\_{j}}{2}$ and $q\_{max}=\frac{v\_{f}k\_{j}}{4}$.

You may want to check out the following web site that shows traffic speeds and volumes, in real time, in Chicago: http://www.chicagotraffictracker.com/

**Traffic Flow Example Using Linear Regression**

The following traffic data was collected for a stretch of road.

|  |  |
| --- | --- |
| **Speed V (mi/hr)** | **Density k (veh/mi)** |
| 65 | 12 |
| 60 | 20 |
| 55 | 28 |
| 50 | 37 |
| 45 | 52 |
| 40 | 61 |

a) Use linear regression to find V as a function of k. Assume the traffic flow follows the Greenshields (linear) model.

b) What is the free flow speed (mi/hr)?

c) What is the jam density (veh/mi)?

d) What is the road’s capacity (veh/hr)?

**Traffic Flow Example Using Speed Study Data**

a) Use the results of the speed study (traffic flow rates and average speeds from “Speed Study North Montana. pdf”) to estimate V as a function of k for North Montana Avenue. Assume the traffic flow follows the Greenshields (linear) model.

b) What is the free flow speed on North Montana Avenue (mi/hr)?

c) What is the jam density on North Montana Avenue (veh/mi)?

d) What is North Montana’s capacity (veh/hr)?