

Max flow in D12 occurs at 60 mph

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We analyze PeMS data from all loops in D12 for a 24-hour period on October 10, 2001.

It was observed in D7 that loops report maximum flow under free flow conditions, i.e., during any 5-minute interval when a detector reports maximum flow (vehicles/hour), the speed during that interval is close to 60 mph. On the other hand, during congestion, the flow is lower and the speed is much lower.

We repeat the experiment for D12. We look at data from every detector. There are about 800 detectors. We eliminate those detectors that never report an occupancy larger than 0.2, since the corresponding sections are never congested. (If those detectors are included, the speed at max flow will be even larger than that reported here.) This leaves us with 271 detectors.

Figure 1 below summarizes the findings for detectors in lane 1 (the fast lane). The top right gives the distribution of maximum flows. As can be seen these are typically around 2,500 vph. The figure on the bottom left gives the distribution of speeds in those detectors at the time they report the maximum flow. The top left is the corresponding cumulative distribution function. We see that 80 % of the detectors have a speed in excess of 55 mph when the flow is at a maximum. (The true proportion is larger than 80 %, since the detectors showing very low speeds are likely to be faulty.) The bottom right plot shows the flow in the same detectors when they are most congested—defined as the five-minute interval when the occupancy is highest. Evidently, there is a significant drop in flow with the average and median being about 1,300 vph. Thus the sections that are observed to support flows around 2,500 vph, only support 1,300 vph under congestion—a large reduction. Of course, the speeds under congestion are much lower than 60 mph, but they are not shown.

Figure 2, 3, 4 below shows similar plots for lanes 2, 3, 4. They confirm what we see in Figure 1. The expected difference is that the speeds at maximum flow and the maximum flow itself are slightly smaller as one goes to slower lanes.

The analysis supports three observations that were prompted by D7 data:

1. Congestion should be defined as the excess time spent driving below 60 mph.
2. Ramp metering should maintain maximum flow, which occurs at 60 mph.
3. Freeways in D12 are very inefficiently operated during congestion—when demand is greatest.

Figure 1 Distribution of speed at max flow and distribution of flow at max occupancy, in lane 1.

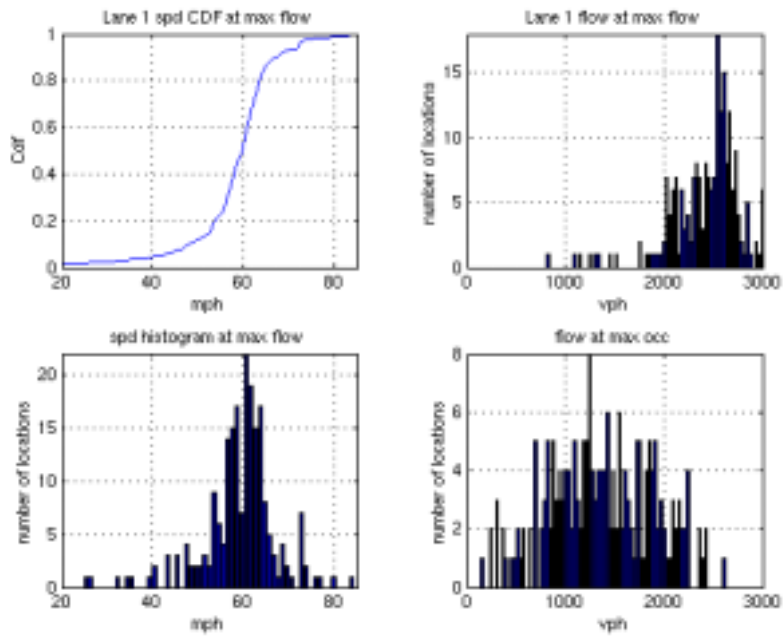


Figure 2 Distribution of speed at max flow and distribution of flow at max occupancy, in lane 2.

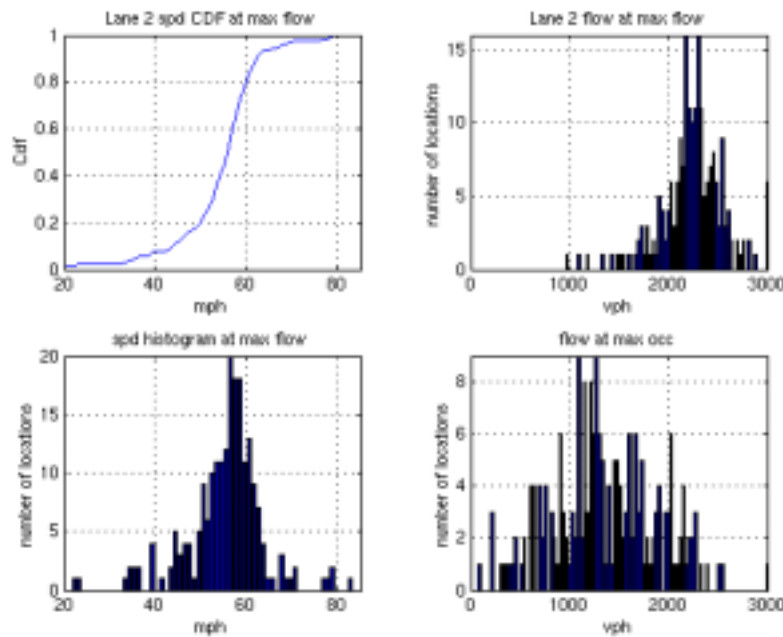


Figure 3 Distribution of speed at max flow and distribution of flow at max occupancy, in lane 3.

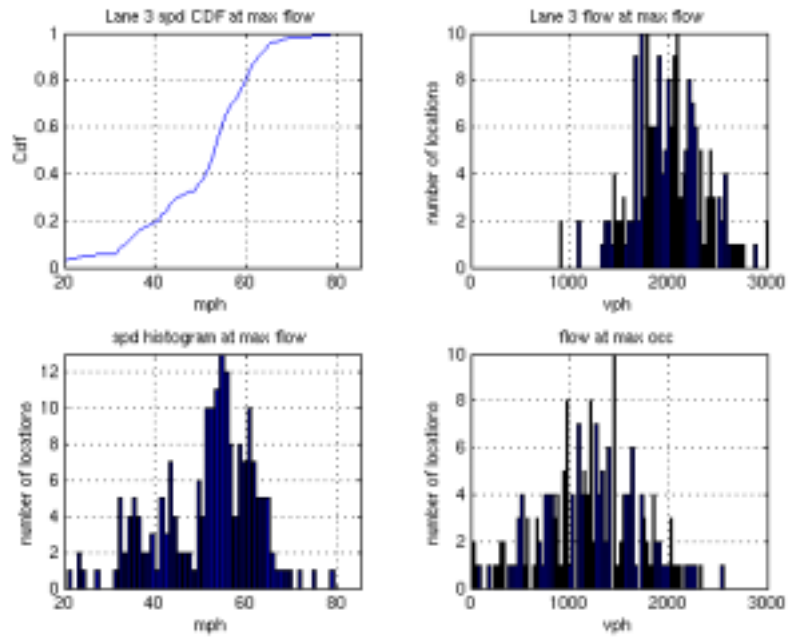


Figure 4 Distribution of speed at max flow and distribution of flow at max occupancy, in lane 4.

