CE 467 / 567 Highway Safety and Operations
Homework 5
Due Tuesday, October 31, 2006

Problem 1

A roadway site is recorded to have 90 crashes over a 5-year period. Over that same period, an equivalent comparison group of eight sites recorded 75, 78, 79, 81, 81, 84, 88, and 97 crashes.

After a safety treatment, the frequency of crashes averaged 14 crashes per year, at the original site.

(a) Ignoring the regression-to-the-mean effect, what is the net safety benefit of the treatment?

(b) Consider the regression-to-the-mean effect, and re-calculate the net safety benefit of the treatment. Use an Empirical Bayes analysis.

(c) Why does your estimate in part (b) differ from that in part (a)? Briefly explain (in a paragraph) why these estimates differ. In your explanation, you might try using your own words to describe why one might use the Empirical Bayes method.

Problem 2

A researcher has recently estimated a statistical model to describe the crash frequency at rural, signalized intersections of two-lane highways. The model was estimated as:

$$\ln(l) = -7.3834 + 0.7249 \cdot \ln(AADT1) + 0.3110 \cdot \ln(AADT2)$$
$$-0.7381 \cdot PROTLT - 0.0116 \cdot PKLEFT - 0.0740 \cdot VEICOM + 0.0233 \cdot PKTRUCK$$

where: l = crash frequency in the intersection
*AADT*1 = Average annual daily traffic (AADT) on the major road
*AADT*2 = AADT on the minor road
PROTLT = 1 if there is a separate (protected) left-turn lane in the intersection, 0 otherwise
PKLEFT = Percentage of movements in the peak hour that are left turns from the minor street
VEICOM = Average (absolute) percent change of grade across all approaches to the intersection
PKTRUCK = Percentage of vehicles that are trucks moving through the intersection in the peak hour

(a) From this model, what factors increase the crash frequency? Do these make sense to you, intuitively? [Some discussion is expected in your response.]

(b) From this model, what factors decrease the crash frequency? Again, do these make sense to you? [Some discussion is expected in your response.]

(c) Considering your answers to (a) and (b), would it make you feel better or worse about the model if the coefficients of *PKLEFT* and *VEICOM* were found to be statistically insignificant (i.e., not significantly different from zero)? Explain your answer.

(d) Does the crash frequency increase *linearly* with the traffic volume? Based on your answer, is it reasonable to use a crash *rate* (e.g., in crashes per million vehicle entries) rather than the crash frequency to describe crashes at these intersections? Discuss your answer in a brief paragraph.

(e) In the calibration data, the mean values of λ (crashes/yr), *AADT*1, *AADT*2, and *PKTRUCK* were 5.9, 9126, 3544, and 8.96 respectively. *PKLEFT* and *VEICOM* can be ignored. Finally, 30% of the signalized intersections had a protected left turn lane (*PROTLT* = 1). Based on this, what is the estimated benefit of installing a protected left turn lane? (A quantitative answer is expected).