**RDD Replication**

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1. <https://github.com/rvt245/RDD>
2. Summary of Hansen Paper
   1. Research Question: Hansen is asking whether the harsher punishments received for higher blood-alcohol-content (BAC) cutoffs are effective in reducing future drunk driving. In Washington, there are two BAC thresholds for a DUI. If a driver has a BAC above 0.08, he or she receives a certain combination of fines, jail time, and license suspension. However, if the driver has a BAC above 0.15, he or she receives *harsher* penalties. Hansen wants to know whether the harsher penalties reduce future drunk driving *more* than the less harsh penalties at the lower BAC cutoff.
   2. Data: Hansen begins with data on DUI stops from the state of Washington from 1995 to 2011, including a total of 512,964 DUI BAC tests. He then narrows this to only DUI stops between 1999 and 2007. In 1999, Washington state legislated a new dual-threshold system (0.08 BAC for DUI and 0.15 BAC for “aggravated” DUI). Furthermore, Hansen stops looking at new DUIs in 2007 because he wants to allow for four years (up to 2011) of additional DUI stops to find repeated offenses. This is crucial because Hanses is analyzing “recidivism” (or repeated offenses). In Hansen’s data, recidivism is identified if an offender receives a DUI within four years of his or her initial DUI. The data is also restricted to persons above the drinking age.
   3. Research Design: This is a quasi-experiment because there is no direct randomization of the treatment assignment. More specifically, Hansen uses a Regression Discontinuity (RD) design because the BAC levels that legally determine a DUI provide *cutoffs* that lead to a natural treatment assignment. Since the DUI law generates a deterministic and discontinuous function of BAC, a Sharp RD can be used. Smoothness (or “continuity”) is assumed such that unobservables are expected to remain unchanged across the threshold. This assumption is predicated partly on the assumption that drunk drivers cannot discern their level of impairment prior to driving and thus will not sort themselves out of the running variable by not driving. Identification is established by assuming that it is locally random for a driver to have a BAC either just above or just below the BAC threshold. In other words, some people at the threshold are just lucky, and fall just below the legal limit. These assumptions are reinforced by the fact that BAC measurements are precise and difficult to manipulate (making sorting at the cutoff very unlikely), yet slight variation between different breathalyzer devices may allow for randomness to occur in the measurement of BAC around the cutoff. The running variable is the minimum BAC measurement at a DUI stop, where two BAC measurements are taken per stop, because the minimum determines legal guilt. For the regression models in the RD design, Hansen uses a local linear regression to estimate the effect of having a BAC above the DUI or aggravated DUI threshold on recidivism. A rectangular kernel is used to weight the regression near the cutoff. The running variable (BAC) is recentered around the relevant threshold (0.08 or 0.15). The outcome variable is recidivism. Predetermined characteristics related to DUI stops are stable. Bandwidths are varied from 0.05 to 0.025 BAC.
   4. Conclusions: Hansen generally finds that harsher penalties for BAC cutoffs do in fact reduce future drunk driving. When considering the 0.08 BAC threshold, Hansen finds that this threshold reduces recidivism in the following 4 years by 2 percentage points (and is statistically significant at 0.01 level). This finding is consistent across both 0.05 and 0.025 BAC bandwidths. Individuals with at least one prior BAC test reduce recidivism more than those with no prior tests. When considering both the 0.08 and 0.15 thresholds, Hansen finds a notable drop in recidivism for both, indicating that the increased punishments occurring at each increasing threshold *does* have an effect of reducing recidivism. Across offender with varying levels of prior tests, having a BAC over the legal cutoffs are associated with lower recidivism. At the 0.15 cutoff, for instance, drivers receiving an aggravated DUI reduce recidivism by an additional 1.1 percentage points. Those with at least one prior test reduce recidivism by an additional 2.2 percentage points, further indicating that harshness of punishment leads to less recidivism, as repeated offenses have harsher punishments. The regression is also carried out on disaggregated definitions of recidivism using a rectangular kernel. In these cases, having a BAC over a legal limit continues to be associated with lowered recidivism, except in the case of refusal to breathalyze. This disaggregation also reveals that having a BAC over either of the thresholds is associated with decreased future automobile accidents. Further analysis is conducted on the effect of exceeding a threshold on the punishments, sanctions, and treatments received in court. Hansen finds that surpassing a threshold is associated with harsher punishments and sanctions. Overall, Hansen finds that exceeding a threshold is associated with reduced drunk driving (recidivism) in the short run and the long run.
3. [see R]
4. If people could manipulate their BAC, we would want to use a density test to see whether there is bunching or “sorting” at the 0.08 BAC cutoff. The McCrary Density Test if a popular test to identify such manipulation. The McCrary Density Test gives a null hypothesis that the density in the data is continuous at the cutoff. The alternative hypothesis is that there is greater density (i.e. bunching) around the cutoff. The test separated the data into bins and calculates the frequency of observations in each bin. To reject the null, one would have to see a greater frequency of observations in the bins next to the cutoff, compared to bins further away. In R, we can use “rddensity” to run this test.