Regression II
Vanderbilt University
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60 total points

Problem Set 9 *Solutions*

Question 1. This problem will replicate some of the results in Lee (2008), one of the most influential studies using regression discontinuity. Each observation is a Congressional district election between 1948 and 1998. The running variable is *difdemshare*, the difference between the Democratic candidate's vote share and the largest vote share of the other parties. If the Democrat won, *difdemshare* is greater than zero.

Conduct a regression discontinuity analysis to estimate the effect of Democratic incumbency in year t on two outcomes: *difdemsharenext*, the difference between the Democratic vote share and the largest vote share of the other parties in the next election (year $t + 1$), and *demwinnext*, a binary variable equal to 1 if a Democrat won the next election and 0 otherwise. Your analysis should include the following elements: (**55 points**)

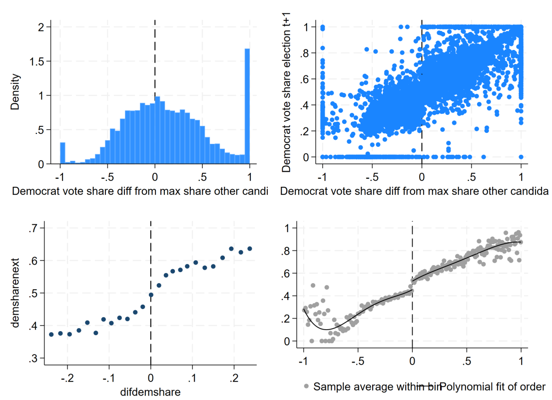
See the attached log file for all results.

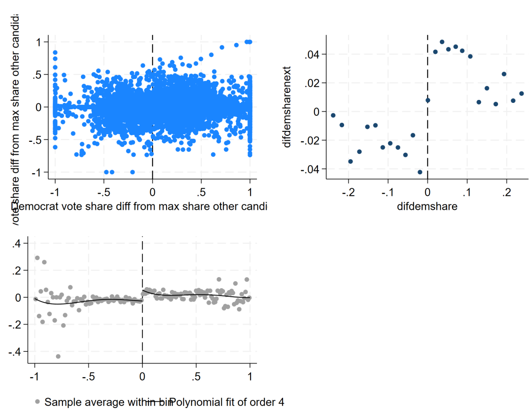
(a) Write down the assumptions that should hold in order for your RD estimate to be considered the causal effect of incumbency. (**5 points**)

There are four key assumptions. First, there is a discontinuous jump in "treatment" at the cutpoint. Define "treatment" as a Democrat winning the election. The running variable in this case is the net Democratic vote share. When this value is below zero, the non-Democratic candidate won. When it exceeds zero, the Democrat won. The discontinuity is sharp. Second, the relationship between the outcome and the running variable is continuous in the neighborhood of the cutpoint, in the absence of treatment. Consider the outcome *difdemsharenext*, which is the net Democratic vote share in election *t+1*. In the absence of a treatment effect, there is no reason to believe that Democratic support in election *t+1* would change discontinuously with the net vote share in election *t*. Third, the forcing variable has not been manipulated to affect who receives treatment. In the U.S., elections are generally conducted with integrity, so manipulation seems unlikely. More importantly, even if maleficent persons were working to influence the outcome of an election, it would be hard for them to do so precisely enough to have an impact right at the margin of victory (i.e., near the cutpoint). We can at least conduct a test to look for irregularities in the density of the running variable. Fourth, there are no other "treatments" with the same eligibility rule, and thus no confounders. In other words, there is not something else changing abruptly at the threshold, beyond the identity of the victor.

(b) A scatterplot and RD plot showing the relationship between *demsharenext* and the running variable across the full range of data. (If it helps visually, you can also show the scatter and RD plots for observations closer to the cutpoint, e.g., $abs(difdemshare) < 0.25$). Is there visual evidence of a discontinuity? (**5 points**)

Four plots are shown below, clockwise from upper left: (1) a histogram of the running variable *difdemshare*, (2) a scatterplot showing the relationship between *demsharenext* and *difdemshare* over the full range of data, (3) a binned scatter plot limited to the range +/- 0.25, and (4) an RD plot with a fitted 4th order polynomial. A discontinuity is not evident in the scatterplot, but is in the latter two plots. The second set of plots repeats this for the *difdemsharenext* variable, which is the outcome used in later regressions





(c) Parametric RD models using OLS for each outcome assuming a linear relationship with the running variable, then a quadratic ($p = 2$), and then a quartic ($p = 4$). In each case allow the slope coefficients to differ on each side of the cutoff. Repeat these models but include two covariates in the regression: *demofficeexp* and *othofficeexp* (measures of the Democrat's and opposition's experience in office). You may want to collect your regression results into one or more tables for easy comparison. (There will be a total of 12 regressions). What do these regressions show? Do the differing polynomial orders lead to different conclusions? (**10 points**)

Estimates from parametric RD models are reported in Tables 1-2. In Table 1, columns (1)-(3) report results from linear, quadratic, and quartic models in which the outcome is the net Democratic share in election *t+1*. Columns (4)-(6) do the same, but for the binary outcome of a Democratic victory in election *t+1*. Table 2 repeats the analysis in Table 1, but includes controls for the Democrat's and opponent's experience in political office. The models without controls indicate that—at the margin of victory—a Democratic win in election *t* increases the likelihood of a Democratic win in election *t+1* by 14.3 to 22.9 percentage points (columns 4-6). The impact on the net Democratic vote share is 5.2 to 8.1 percentage points (columns 1-3). The point estimates from the quartic model stand out as the largest of these (columns 3 and 6), and the inclusion of controls for prior experience in office generally produce larger point estimates (Table 2).

Table 1: Parametric RD models (no covariates)

	(1) difdemsharenext	(2) difdemsharenext	(3) difdemsharenext	(4) demwinnext	(5) demwinnext	(6) demwinnext
1.demwin	0.052***	0.055***	0.081***	0.143***	0.107***	0.229***
	(0.007)	(0.010)	(0.016)	(0.020)	(0.029)	(0.048)
N	6559	6559	6559	6559	6559	6559

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2: Parametric RD models (w/covariates)

	(1) difdemsharenext	(2) difdemsharenext	(3) difdemsharenext	(4) demwinnext	(5) demwinnext	(6) demwinnext
1.demwin	0.086***	0.067***	0.080***	0.242***	0.143***	0.226***
	(0.007)	(0.010)	(0.016)	(0.021)	(0.029)	(0.047)
demofficeexp	-0.008***	-0.008***	-0.008***	-0.021***	-0.023***	-0.022***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
othofficeexp	0.009***	0.010***	0.010***	0.029***	0.031***	0.029***
	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)
N	6559	6559	6559	6559	6559	6559

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

(d) Non-parametric RD models for each outcome using a local linear regression, the MSE-optimal bandwidth, and triangular kernel. Repeat, including the two covariates listed in part (c). (There should be 4 regressions for this part). What do these regressions show? Do the conclusions differ from part (c)? (**10 points**)

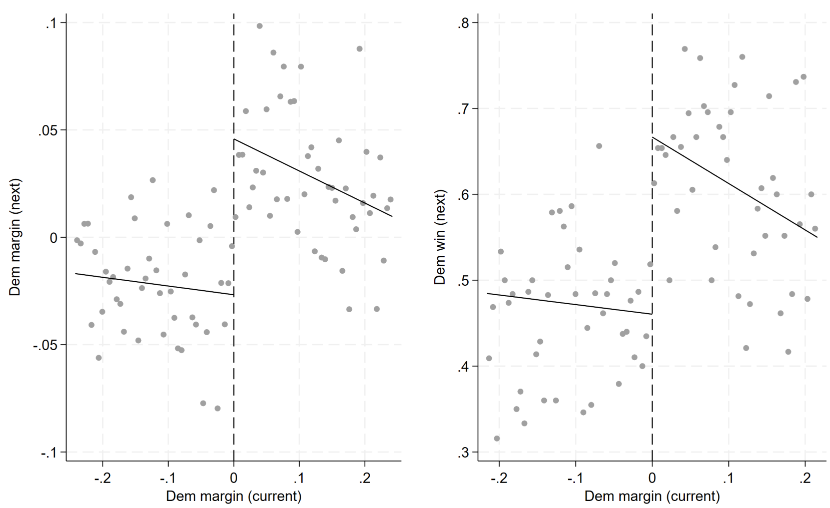
The non-parametric RD estimates using the optimal bandwidth are reported in the first row of Table 3. A Democratic win in election *t* increases the likelihood of a Democratic win in election *t+1* by 20.6 to 21.5 percentage points (columns 2 and 4). These are close to the point estimates from the quartic model. The estimated impact on the net Democratic share in election *t+1* is 7.3 to 7.6 percentage points (columns 1 and 3). These numbers are actually quite close to those in Table 2 of Lee (2008).

Table 3: Non-parametric RD models (no covariates)

	(1)	(2)	(3)	(4)
	difdemsharenext	demwinnext	difdemsharenext	demwinnext
RD_Estimate	0.073***	0.206***	0.076***	0.215***
	(0.012)	(0.044)	(0.012)	(0.042)
N	6559	6559	6559	6559

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

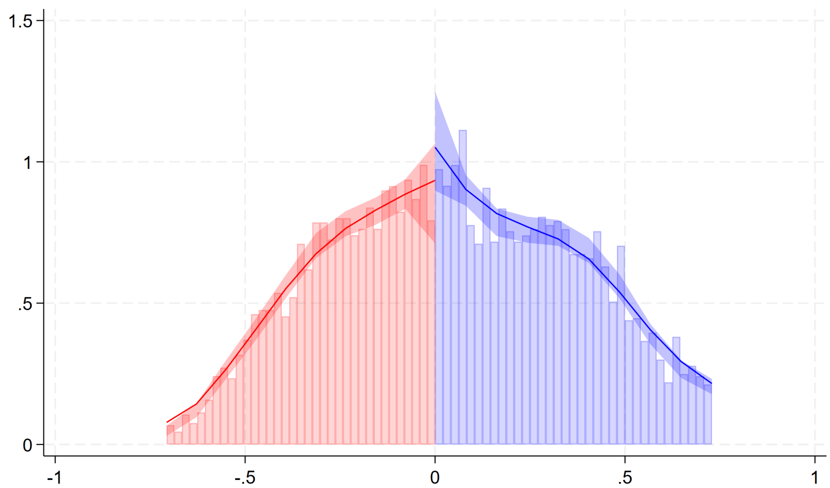
(e) An RD plot for each outcome based on the optimal bandwidths used in part (d) for the models without covariates. (**5 points**)



(f) A density test for manipulation around the cutoff. Provide the density plot and report the p-value of the test (and conclusion). Is manipulation theoretically plausible in this case? Why or why not? (**5 points**)

The density plot is shown below and shows no evidence of manipulation at the cutpoint. Manipulation seems unlikely in U.S. elections; it would imply

that an unexpectedly high proportion of elections result in the Democratic Party earning just over 50% of the vote (and unexpectedly fewer with the Democratic Party earning just under 50% of the vote). The test statistic for the density test is 1.42 with a p-value of 0.1545. We do not find significant evidence of manipulation at the cutpoint.



(g) As a validity check, repeat part (d)—without covariates—in which you use *demshareprev* and *demwinprev* as the outcome variables. (These represent the Democratic vote share and a Democratic win in the *previous* election, $t-1$). What does this accomplish and what do you find? (**5 points**)

Table 4 shows the non-parametric RD estimates in which the outcomes are the Democratic vote share in the *previous* election and a binary Democratic win in the previous election. While a small change in the vote share in the current election can produce a large change in the identity of the victor (and, as we have shown, the probability of winning in the following year) there is no reason to think a small change in this year's election would have an effect on the *prior* outcome. Indeed that is what we see here, at least using the optimal bandwidth, where there are no statistically significant effects.

Table 4: Validity test: outcome is previous election

	(1)	(2)
	demshareprev	demwinprev
RD_Estimate	0.001	0.041
	(0.012)	(0.050)
N	6559	6559

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

(h) One would not expect there to be a discontinuity in the covariates used in parts (c)-(d) at the cutpoint. Repeat part (d)—without covariates—in which you use *demofficeexp* and *othofficeexp* as the outcome variables. What do you find? (**5 points**)

Table 5 finds no discontinuities at the cutpoint in the two covariates: the Democratic candidate's political experience and the opposing candidate's political experience.

Table 5: Validity test: continuity in pre-determined covariates

	(1) demofficeexp	(2) othofficeexp
RD_Estimate	0.221	0.135
	(0.237)	(0.201)
N	6559	6559

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

(i) Finally, conduct some tests for discontinuities elsewhere the distribution of *difdemshare*. I suggest looking at "fake" cutpoints equal to the 1st, 2nd, 3rd, 4th, etc., deciles of the *difdemshare* distribution. Since there is a known "real" cutpoint at 0, limit these analyses to either values below 0 (Republican win) or above 0 (Democratic win), depending on where your "fake" cutpoint sits. Summarize what you find. (**5 points**)

See the log file for how this was done. The first four columns of Table 6 limit the sample to those with *difdemshare* less than 0 and test for discontinuities at the 1st, 2nd, 3rd, and 4th deciles. The latter four columns limit the sample to those with *difdemshare* above 0 and test for discontinuities at the 6th, 7th, 8th, and 9th deciles. There is a marginally significant jump at the 8th decile but no significant effects elsewhere, which is reassuring.

Table 6: Validity test: discontinuities elsewhere

	(1) difdemsharenext	(2) difdemsharenext	(3) difdemsharenext	(4) difdemsharenext	(5) difdemsharenext	(6) difdemsharenext	(7) difdemsharenext	(8) difdemsharenext
RD_Estimate	-0.026	0.010	-0.008	0.002	-0.023	-0.020	0.053*	0.116
	(0.027)	(0.017)	(0.029)	(0.032)	(0.026)	(0.019)	(0.021)	(0.140)
N	2740	2740	2740	2740	3818	3818	3818	3818

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Question 2. Consider the sharp RD model in which the running variable (x_i) is allowed to have a linear relationship with the outcome (Y_i) that varies on either side of the cutoff (c). Let the treatment status variable $D_i = 1$ whenever $x_i > c$.

$$Y_i = \pi_0 + \pi_1 x_i + \pi_2 D_i + \pi_3 (D_i \times x_i) + v_i$$

Suppose that the running variable x_i is *not* centered at c. (That is, we do not first subtract off c from x_i). Show that π_2 in this case is *not* the impact of the treatment at the threshold c. You can show this however you like: algebraically, using the simulated data, as in the in-class exercise, or any other valid method. **(5 points)**

Let the cutoff point be *c*. Intuitively, if $\mathbf{c \neq 0}$ the expected value of $\mathbf{Y_i}$ as we approach *c* from the left is $\boldsymbol{\pi_0 + \pi_1 c}$. The expected value of $\mathbf{Y_i}$ as we approach *c* from the right is $\boldsymbol{\pi_0 + \pi_1 c + \pi_2 + \pi_3 c}$. The difference between these two is: $\boldsymbol{\pi_2 + \pi_3 c}$, not $\boldsymbol{\pi_2}$. Put another way, $\boldsymbol{\pi_2}$ is the intercept shift when $\mathbf{x = 0}$; $\boldsymbol{\pi_3 c}$ is the difference in the intercept shift when $\mathbf{x = c}$. If the cutpoint were 0, the expected value of Y_i as we approach *c* from the left would be $\boldsymbol{\pi_0}$, while the expected value of Y_i as we approach *c* from the right would be $\boldsymbol{\pi_0 + \pi_2}$.

We can also see this using simulated data from the in-class exercise in which we generated 10,000 student observations with underlying "ability," a grade 3 test score, and a grade 4 test score. Students above the eligibility threshold for the gifted program (56) were assigned to the gifted treatment. When we fit an RD model in which the running variable (grade 3 score) is centered at 0, the coefficient on *inGT* (being at or above the treatment threshold) was 3.02. If we fit the model (using the same data) with a running variable *not* centered at 0, the coefficient on *inGT* is 2.76. To get the actual jump at the cutoff we would need to calculate $\boldsymbol{\hat{\pi}_2 + \hat{\pi}_3 * 56 = 2.76 + 0.0046 * 56 = 3.02}$. The Stata output is attached.

```
.
.
. // *********************************************************************
. // LPO-8852 Problem set 9 solutions
. // Last updated: December 5, 2024
. // *********************************************************************
.
. // *******
. // (1)
. // *******
. // ************************************************************************
. // Re-analysis of Lee (2008) on the effect of incumbency
. // ************************************************************************
.
. // Read source data
.
.         clear

.         use https://github.com/spcorcor18/LPO-8852/raw/main/data/Lee_2008_for_
> RD.dta

.
. // Scatterplot and RD plot showing relationship between demsharenext (or
. // difdemshare) and running variable difdemshare
.
.         histogram difdemshare, xline(0) name(xhist, replace)
(bin=38, start=-1, width=.05263158)

.
.         scatter demsharenext difdemshare, xline(0) name(gr1, replace)

.
.         binscatter demsharenext difdemshare if abs(difdemshare)<0.25, ///
>                 xline(0) linetype(none) nq(25) name(gr2, replace)

.
.         rdplot demsharenext difdemshare, c(0) binmethod(qsmv) ///
>                 graph_options(legend(position(6)) name(gr3, replace))
Mass points detected in the running variable.

RD Plot with evenly spaced mimicking variance number of bins using polynomial re
> gression.

         Cutoff c = 0 | Left of c  Right of c        Number of obs  =       6559
----------------------+----------------------        Kernel         =    Uniform
        Number of obs |      2740        3819
   Eff. Number of obs |      2740        3819
  Order poly. fit (p) |         4           4
     BW poly. fit (h) |     1.000       1.000
 Number of bins scale |     1.000       1.000

Outcome: demsharenext. Running variable: difdemshare.
---------------------------------------------
                      | Left of c  Right of c
----------------------+----------------------
        Bins selected |        87         146
   Average bin length |     0.011       0.007
    Median bin length |     0.011       0.007
----------------------+----------------------
    IMSE-optimal bins |        20          17
  Mimicking Var. bins |        87         146
----------------------+----------------------
Rel. to IMSE-optimal: |
        Implied scale |     4.350       8.588
    WIMSE var. weight |     0.012       0.002
    WIMSE bias weight |     0.988       0.998
---------------------------------------------
```

```
.
.         graph combine xhist gr1 gr2 gr3, rows(2) xsize(8) ysize(6)

.         graph export rdplots1a.png, as(png) replace
file rdplots1a.png saved as PNG format

.
.         // now difdemsharenext (used in later regressions)
.         scatter difdemsharenext difdemshare, xline(0) name(gr1, replace)

.
.         binscatter difdemsharenext difdemshare if abs(difdemshare)<0.25, ///
>                 xline(0) linetype(none) nq(25) name(gr2, replace)

.
.         rdplot difdemsharenext difdemshare, c(0) binmethod(qsmv) ///
>                 graph_options(legend(position(6)) name(gr3, replace))
Mass points detected in the running variable.

RD Plot with evenly spaced mimicking variance number of bins using polynomial re
> gression.

         Cutoff c = 0 | Left of c  Right of c        Number of obs  =       6559
----------------------+----------------------        Kernel         =    Uniform
        Number of obs |      2740        3819
   Eff. Number of obs |      2740        3819
  Order poly. fit (p) |         4           4
     BW poly. fit (h) |     1.000       1.000
 Number of bins scale |     1.000       1.000

Outcome: difdemsharenext. Running variable: difdemshare.
---------------------------------------------
                      | Left of c  Right of c
----------------------+----------------------
        Bins selected |        62          85
   Average bin length |     0.016       0.012
    Median bin length |     0.016       0.012
----------------------+----------------------
    IMSE-optimal bins |         6           7
  Mimicking Var. bins |        62          85
----------------------+----------------------
Rel. to IMSE-optimal: |
        Implied scale |    10.333      12.143
    WIMSE var. weight |     0.001       0.001
    WIMSE bias weight |     0.999       0.999
---------------------------------------------


.
.         graph combine gr1 gr2 gr3, rows(2) xsize(8) ysize(6)

.         graph export rdplots1b.png, as(png) replace
file rdplots1b.png saved as PNG format

.
. // Parametric RD models - no controls
.
.         gen demwin = difdemshare>0

.         estimates drop _all

.
.         // Outcome: Democratic advantage in the next election (t+1)
```

```
.         // Linear, then quadratic, then quartic. Note: should probably cluster
.         // by statedisdec, but I do not here.
.
.         _eststo: reg difdemsharenext c.difdemshare##i.demwin

      Source |       SS           df       MS      Number of obs   =     6,559
-------------+----------------------------------   F(3, 6555)      =     33.94
       Model |  2.7652678         3  .921755932   Prob > F        =    0.0000
    Residual |  178.041261     6,555  .027161138   R-squared       =    0.0153
-------------+----------------------------------   Adj R-squared   =    0.0148
       Total |  180.806529     6,558  .027570376   Root MSE        =    .16481

------------------------------------------------------------------------------
difdemshare~t | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
  difdemshare |   .0018766   .0137495     0.14   0.891     -.025077    .0288301
     1.demwin |   .0518415   .0067638     7.66   0.000     .0385823    .0651008
             |
      demwin#|
c.difdemshare |
           1  |  -.0347857   .0160789    -2.16   0.031    -.0663057   -.0032658
             |
        _cons |  -.0205111   .0050908    -4.03   0.000    -.0304907   -.0105316
------------------------------------------------------------------------------
(est1 stored)

.         _eststo: reg difdemsharenext c.difdemshare##c.difdemshare##i.demwin

      Source |       SS           df       MS      Number of obs   =     6,559
-------------+----------------------------------   F(5, 6553)      =     20.40
       Model |  2.7718307         5   .55436614   Prob > F        =    0.0000
    Residual |  178.034698     6,553  .027168426   R-squared       =    0.0153
-------------+----------------------------------   Adj R-squared   =    0.0146
       Total |  180.806529     6,558  .027570376   Root MSE        =    .16483

------------------------------------------------------------------------------
difdemshare~t | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
  difdemshare |  -.0012222   .0393918    -0.03   0.975    -.0784431    .0759986
             |
          c. |
 difdemshare#|
c.difdemshare |  -.0035163   .0418868    -0.08   0.933    -.0856282    .0785956
             |
     1.demwin |    .054634   .0097345     5.61   0.000     .0355513    .0737167
             |
      demwin#|
c.difdemshare |
           1  |  -.0468318    .050983    -0.92   0.358     -.146775    .0531114
             |
      demwin#|
          c. |
 difdemshare#|
c.difdemshare |
           1  |   .0179042   .0513539     0.35   0.727    -.0827663    .1185747
             |
        _cons |  -.0209308   .0071354    -2.93   0.003    -.0349185   -.0069431
------------------------------------------------------------------------------
(est2 stored)

.         _eststo: reg difdemsharenext ///
>                 c.difdemshare##c.difdemshare##c.difdemshare##c.difdemshare##i.
> demwin

      Source |       SS           df       MS      Number of obs   =     6,559
-------------+----------------------------------   F(9, 6549)      =     12.53
       Model |  3.06184582         9  .340205092   Prob > F        =    0.0000
    Residual |  177.744683     6,549  .027140736   R-squared       =    0.0169
-------------+----------------------------------   Adj R-squared   =    0.0156
       Total |  180.806529     6,558  .027570376   Root MSE        =    .16474
```

```
-------------------------------------------------------------------------------
difdemshare~t | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
--------------+----------------------------------------------------------------
  difdemshare |  -.0357651   .1915417    -0.19   0.852    -.4112493    .3397191
              |
           c. |
  difdemshare#|
c.difdemshare |    .240985   .8985005     0.27   0.789    -1.520369    2.002339
              |
           c. |
  difdemshare#|
           c. |
  difdemshare#|
c.difdemshare |   .9755776   1.514671     0.64   0.520    -1.993673    3.944828
              |
           c. |
  difdemshare#|
           c. |
  difdemshare#|
           c. |
  difdemshare#|
c.difdemshare |   .7171546   .8057804     0.89   0.373    -.8624379    2.296747
              |
     1.demwin |   .0811036   .0160571     5.05   0.000     .0496264    .1125809
              |
       demwin#|
c.difdemshare |
           1  |  -.3543812   .2536922    -1.40   0.162    -.8517007    .1429383
              |
       demwin#|
           c. |
  difdemshare#|
c.difdemshare |
           1  |   1.069223   1.150691     0.93   0.353    -1.186506    3.324952
              |
       demwin#|
           c. |
  difdemshare#|
           c. |
  difdemshare#|
c.difdemshare |
           1  |  -2.666132   1.883308    -1.42   0.157    -6.358031    1.025766
              |
       demwin#|
           c. |
  difdemshare#|
           c. |
  difdemshare#|
           c. |
  difdemshare#|
c.difdemshare |
           1  |  -.0028893   .9817663    -0.00   0.998    -1.927472    1.921693
              |
        _cons |  -.0272428    .011781    -2.31   0.021    -.0503375   -.0041481
-------------------------------------------------------------------------------
(est3 stored)

.
.         // Outcome: Democratic win in the next election (t+1)
.         // Linear, then quadratic, then quartic. Note: should probably cluster
.         // by statedisdec, but I do not here.
.
.         _eststo: reg demwinnext c.difdemshare##i.demwin

      Source |       SS           df       MS      Number of obs   =     6,559
-------------+----------------------------------   F(3, 6555)      =     65.65
       Model |  47.8281881         3  15.9427294   Prob > F        =    0.0000
    Residual |  1591.92177     6,555  .242856106   R-squared       =    0.0292
-------------+----------------------------------   Adj R-squared   =    0.0287
       Total |  1639.74996     6,558  .250038116   Root MSE        =     .4928
```

```
------------------------------------------------------------------------------
   demwinnext | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
  difdemshare |   .2254137   .0411138     5.48   0.000     .1448171    .3060102
     1.demwin |   .1428544   .0202251     7.06   0.000     .1032066    .1825021
              |
       demwin#|
c.difdemshare |
            1 |  -.4690135   .0480792    -9.76   0.000    -.5632644   -.3747625
              |
        _cons |   .5048468   .0152224    33.16   0.000     .4750058    .5346877
------------------------------------------------------------------------------
(est4 stored)

.         _eststo: reg demwinnext c.difdemshare##c.difdemshare##i.demwin

      Source |       SS           df       MS      Number of obs   =     6,559
-------------+----------------------------------   F(5, 6553)      =     40.91
       Model |  49.6306746         5  9.92613491   Prob > F        =    0.0000
    Residual |  1590.11929     6,553  .242655164   R-squared       =    0.0303
-------------+----------------------------------   Adj R-squared   =    0.0295
       Total |  1639.74996     6,558  .250038116   Root MSE        =     .4926

------------------------------------------------------------------------------
   demwinnext | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
  difdemshare |   .1954246   .1177251     1.66   0.097    -.0353549    .4262041
              |
           c. |
  difdemshare#|
c.difdemshare |  -.0340293   .1251815    -0.27   0.786    -.2794259    .2113672
              |
     1.demwin |   .1072047   .0290921     3.69   0.000     .0501747    .1642346
              |
       demwin#|
c.difdemshare |
            1 |  -.1855631   .1523658    -1.22   0.223    -.4842498    .1131236
              |
       demwin#|
           c. |
  difdemshare#|
c.difdemshare |
            1 |  -.2067638   .1534745    -1.35   0.178    -.5076239    .0940963
              |
        _cons |   .5007855   .0213245    23.48   0.000     .4589824    .5425885
------------------------------------------------------------------------------
(est5 stored)

.         _eststo: reg demwinnext ///
>                 c.difdemshare##c.difdemshare##c.difdemshare##c.difdemshare##i.
> demwin

      Source |       SS           df       MS      Number of obs   =     6,559
-------------+----------------------------------   F(9, 6549)      =     27.36
       Model |  59.4264016         9  6.60293351   Prob > F        =    0.0000
    Residual |  1580.32356     6,549  .241307613   R-squared       =    0.0362
-------------+----------------------------------   Adj R-squared   =    0.0349
       Total |  1639.74996     6,558  .250038116   Root MSE        =    .49123

------------------------------------------------------------------------------
   demwinnext | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
  difdemshare |  -.4008671   .5711339    -0.70   0.483    -1.520476    .7187418
              |
           c. |
  difdemshare#|
c.difdemshare |  -.3190757   2.679125    -0.12   0.905    -5.571035    4.932884
              |
           c. |
  difdemshare#|
           c. |
  difdemshare#|
c.difdemshare |   3.151483   4.516408     0.70   0.485     -5.70215    12.00512
              |
           c. |
```

```
  difdemshare#|
           c. |
  difdemshare#|
           c. |
  difdemshare#|
c.difdemshare |   2.984974   2.402655     1.24   0.214    -1.725014    7.694961
              |
     1.demwin |   .2290831   .0478788     4.78   0.000     .1352251    .3229411
              |
       demwin#|
c.difdemshare |
           1  |   -.365491   .7564528    -0.48   0.629    -1.848385    1.117403
              |
       demwin#|
           c. |
  difdemshare#|
c.difdemshare |
           1  |   1.664212   3.431099     0.49   0.628    -5.061862    8.390285
              |
       demwin#|
           c. |
  difdemshare#|
           c. |
  difdemshare#|
c.difdemshare |
           1  |  -3.216946   5.615599    -0.57   0.567    -14.22535    7.791461
              |
       demwin#|
           c. |
  difdemshare#|
           c. |
  difdemshare#|
           c. |
  difdemshare#|
c.difdemshare |
           1  |  -3.821473   2.927405    -1.31   0.192    -9.560142    1.917196
              |
        _cons |   .4431664   .0351284    12.62   0.000     .3743032    .5120295
-------------------------------------------------------------------------------
(est6 stored)

.
.         qui esttab _all using "Table1.tex", keep(1.demwin) b(3) se(3) tex repl
> ace

.
. // Parametric RD models - with controls
.
.         global cov "demofficeexp othofficeexp"

.         estimates drop _all

.
.         // Outcome: Democratic advantage in the next election (t+1)
.         // Linear, then quadratic, then quartic. Note: should probably cluster
.         // by statedisdec, but I do not here.
.
.         _eststo: reg difdemsharenext c.difdemshare##i.demwin $cov

      Source |       SS           df       MS      Number of obs   =     6,559
-------------+----------------------------------   F(5, 6553)      =     67.60
       Model |  8.86855206         5  1.77371041   Prob > F        =    0.0000
    Residual |  171.937977     6,553  .026238055   R-squared       =    0.0490
-------------+----------------------------------   Adj R-squared   =    0.0483
       Total |  180.806529     6,558  .027570376   Root MSE        =    .16198
```

```
------------------------------------------------------------------------------
difdemshare~t | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
--------------+----------------------------------------------------------------
  difdemshare |   .0303334   .0137117     2.21   0.027      .003454    .0572128
     1.demwin |   .0864789   .0070302    12.30   0.000     .0726974    .1002604
              |
       demwin#|
c.difdemshare |
           1  |  -.0420087    .015894    -2.64   0.008    -.0731662   -.0108513
              |
 demofficeexp |  -.0077403     .00068   -11.38   0.000    -.0090733   -.0064073
 othofficeexp |   .0093216   .0010271     9.08   0.000     .0073081     .011335
        _cons |  -.0370097   .0055293    -6.69   0.000    -.0478489   -.0261705
------------------------------------------------------------------------------
(est1 stored)

.         _eststo: reg difdemsharenext c.difdemshare##c.difdemshare##i.demwin $c
> ov

      Source |       SS           df       MS      Number of obs   =     6,559
-------------+----------------------------------   F(7, 6551)      =     49.70
       Model |  9.11788579         7  1.30255511   Prob > F        =    0.0000
    Residual |  171.688643     6,551  .026208005   R-squared       =    0.0504
-------------+----------------------------------   Adj R-squared   =    0.0494
       Total |  180.806529     6,558  .027570376   Root MSE        =    .16189

------------------------------------------------------------------------------
difdemshare~t | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
--------------+----------------------------------------------------------------
  difdemshare |   .1030666   .0395998     2.60   0.009      .025438    .1806951
              |
           c. |
  difdemshare#|
c.difdemshare |   .0809306   .0417136     1.94   0.052    -.0008417    .1627028
              |
     1.demwin |   .0665156   .0095914     6.93   0.000     .0477133    .0853179
              |
       demwin#|
c.difdemshare |
           1  |   -.037541   .0505926    -0.74   0.458    -.1367191     .061637
              |
       demwin#|
           c. |
  difdemshare#|
c.difdemshare |
           1  |  -.1533416   .0516865    -2.97   0.003     -.254664   -.0520192
              |
 demofficeexp |  -.0080769    .000691   -11.69   0.000    -.0094316   -.0067223
 othofficeexp |   .0098052   .0010421     9.41   0.000     .0077624    .0118481
        _cons |  -.0282428   .0072026    -3.92   0.000    -.0423621   -.0141234
------------------------------------------------------------------------------
(est2 stored)

.         _eststo: reg difdemsharenext ///
>                 c.difdemshare##c.difdemshare##c.difdemshare##c.difdemshare##i.
> demwin $cov

      Source |       SS           df       MS      Number of obs   =     6,559
-------------+----------------------------------   F(11, 6547)     =     31.95
       Model |  9.21148008        11   .83740728   Prob > F        =    0.0000
    Residual |  171.595049     6,547  .026209722   R-squared       =    0.0509
-------------+----------------------------------   Adj R-squared   =    0.0494
       Total |  180.806529     6,558  .027570376   Root MSE        =    .16189
```

```
------------------------------------------------------------------------------
difdemshare~t | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
--------------+----------------------------------------------------------------
  difdemshare |   .1135237   .1885024     0.60   0.547    -.2560026      .48305
              |
           c. |
  difdemshare#|
c.difdemshare |   .3747881   .8831359     0.42   0.671    -1.356446    2.106023
              |
           c. |
  difdemshare#|
           c. |
  difdemshare#|
c.difdemshare |   .8159295   1.489182     0.55   0.584    -2.103352    3.735211
              |
           c. |
  difdemshare#|
           c. |
  difdemshare#|
           c. |
  difdemshare#|
c.difdemshare |   .5434684    .792405     0.69   0.493    -1.009904    2.096841
              |
     1.demwin |   .0801106     .01578     5.08   0.000     .0491766    .1110447
              |
       demwin#|
c.difdemshare |
           1  |  -.2700642   .2493648    -1.08   0.279    -.7589007    .2187723
              |
       demwin#|
           c. |
  difdemshare#|
c.difdemshare |
           1  |   .4981574   1.131399     0.44   0.660    -1.719754    2.716069
              |
       demwin#|
           c. |
  difdemshare#|
           c. |
  difdemshare#|
c.difdemshare |
           1  |  -2.206496   1.852545    -1.19   0.234    -5.838089    1.425096
              |
       demwin#|
           c. |
  difdemshare#|
           c. |
  difdemshare#|
           c. |
  difdemshare#|
c.difdemshare |
           1  |    .112238   .9648837     0.12   0.907    -1.779249    2.003725
              |
 demofficeexp |   -.008045    .000693   -11.61   0.000    -.0094034   -.0066865
 othofficeexp |   .0096291   .0010471     9.20   0.000     .0075764    .0116818
        _cons |  -.0301559   .0116901    -2.58   0.010    -.0530723   -.0072396
------------------------------------------------------------------------------
(est3 stored)

.
.         // Outcome: Democratic win in the next election (t+1)
.         // Linear, then quadratic, then quartic. Note: should probably cluster
.         // by statedisdec, but I do not here.
```

```
.
.         _eststo: reg demwinnext c.difdemshare##i.demwin $cov

      Source |       SS           df       MS      Number of obs   =     6,559
-------------+----------------------------------   F(5, 6553)      =     82.93
       Model |  97.5833698         5   19.516674   Prob > F        =    0.0000
    Residual |  1542.16659     6,553  .235337493   R-squared       =    0.0595
-------------+----------------------------------   Adj R-squared   =    0.0588
       Total |  1639.74996     6,558  .250038116   Root MSE        =    .48512

------------------------------------------------------------------------------
   demwinnext | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
  difdemshare |   .3100538   .0410649     7.55   0.000     .2295532    .3905545
     1.demwin |   .2422674   .0210546    11.51   0.000     .2009934    .2835414
              |
       demwin#|
c.difdemshare |
           1  |  -.4937646   .0476007   -10.37   0.000    -.5870775   -.4004518
              |
 demofficeexp |  -.0209044   .0020365   -10.26   0.000    -.0248967   -.0169121
 othofficeexp |   .0286803    .003076     9.32   0.000     .0226503    .0347104
        _cons |    .452476   .0165596    27.32   0.000     .4200139    .4849382
------------------------------------------------------------------------------
(est4 stored)

.         _eststo: reg demwinnext c.difdemshare##c.difdemshare##i.demwin $cov

      Source |       SS           df       MS      Number of obs   =     6,559
-------------+----------------------------------   F(7, 6551)      =     64.35
       Model |  105.503088         7  15.0718698   Prob > F        =    0.0000
    Residual |  1534.24687     6,551  .234200408   R-squared       =    0.0643
-------------+----------------------------------   Adj R-squared   =    0.0633
       Total |  1639.74996     6,558  .250038116   Root MSE        =    .48394

------------------------------------------------------------------------------
   demwinnext | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
  difdemshare |   .5145865   .1183778     4.35   0.000     .2825274    .7466455
              |
           c. |
  difdemshare#|
c.difdemshare |   .2245942   .1246966     1.80   0.072    -.0198518    .4690401
              |
     1.demwin |   .1425147   .0286721     4.97   0.000     .0863081    .1987212
              |
       demwin#|
c.difdemshare |
           1  |  -.1720347   .1512391    -1.14   0.255    -.4685126    .1244432
              |
       demwin#|
           c. |
  difdemshare#|
c.difdemshare |
           1  |  -.7193499    .154509    -4.66   0.000    -1.022238   -.4164618
              |
 demofficeexp |  -.0230569   .0020658   -11.16   0.000    -.0271065   -.0190073
 othofficeexp |   .0306831   .0031152     9.85   0.000     .0245764    .0367899
        _cons |   .4760063    .021531    22.11   0.000     .4337986     .518214
------------------------------------------------------------------------------
(est5 stored)

.         _eststo: reg demwinnext ///
>                 c.difdemshare##c.difdemshare##c.difdemshare##c.difdemshare##i.
> demwin $cov

      Source |       SS           df       MS      Number of obs   =     6,559
-------------+----------------------------------   F(11, 6547)     =     43.22
       Model |  111.010428        11  10.0918571   Prob > F        =    0.0000
    Residual |  1528.73953     6,547  .233502296   R-squared       =    0.0677
-------------+----------------------------------   Adj R-squared   =    0.0661
       Total |  1639.74996     6,558  .250038116   Root MSE        =    .48322
```

```
------------------------------------------------------------------------------
   demwinnext | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
  difdemshare |    .036322   .5626409     0.06   0.949    -1.066638    1.139282
             |
          c. |
  difdemshare#|
c.difdemshare |   .0405569   2.635979     0.02   0.988    -5.126822    5.207935
             |
          c. |
  difdemshare#|
          c. |
  difdemshare#|
c.difdemshare |   2.609839     4.4449     0.59   0.557    -6.103616    11.32329
             |
          c. |
  difdemshare#|
          c. |
  difdemshare#|
          c. |
  difdemshare#|
c.difdemshare |   2.433287   2.365166     1.03   0.304     -2.20321    7.069784
             |
     1.demwin |   .2259717   .0471002     4.80   0.000       .13364    .3183034
             |
       demwin#|
c.difdemshare |
          1  |  -.1227831   .7443027    -0.16   0.869    -1.581859    1.336293
             |
       demwin#|
          c. |
  difdemshare#|
c.difdemshare |
          1  |   .0072374   3.376994     0.00   0.998    -6.612772    6.627247
             |
       demwin#|
          c. |
  difdemshare#|
          c. |
  difdemshare#|
c.difdemshare |
          1  |  -1.751479   5.529465    -0.32   0.751    -12.59103    9.088077
             |
       demwin#|
          c. |
  difdemshare#|
          c. |
  difdemshare#|
          c. |
  difdemshare#|
c.difdemshare |
          1  |  -3.467152   2.879979    -1.20   0.229    -9.112851    2.178547
             |
 demofficeexp |  -.0224811   .0020683   -10.87   0.000    -.0265357   -.0184265
 othofficeexp |   .0293487   .0031255     9.39   0.000     .0232218    .0354756
        _cons |   .4318868   .0348924    12.38   0.000     .3634862    .5002873
------------------------------------------------------------------------------
(est6 stored)

.
.         qui esttab _all using "Table2.tex", keep(1.demwin $cov) b(3) se(3) tex
>  replace
```

```
.
. // Nonparametric RD models using rdrobust
.
.         estimates drop _all

.         _eststo: rdrobust difdemsharenext difdemshare, c(0) kernel(triangular)
Mass points detected in the running variable.

Sharp RD estimates using local polynomial regression.

      Cutoff c = 0 | Left of c  Right of c            Number of obs =       6559
-------------------+----------------------            BW type       =      mserd
     Number of obs |      2740        3819            Kernel        = Triangular
Eff. Number of obs |      1338        1359            VCE method    =         NN
    Order est. (p) |         1           1
    Order bias (q) |         2           2
       BW est. (h) |     0.242       0.242
       BW bias (b) |     0.380       0.380
         rho (h/b) |     0.637       0.637
        Unique obs |      2606        3210

Outcome: difdemsharenext. Running variable: difdemshare.
--------------------------------------------------------------------------------
            Method |   Coef.    Std. Err.    z     P>|z|    [95% Conf. Interval]
-------------------+------------------------------------------------------------
      Conventional |  .07257     .01217   5.9636   0.000    .048719       .09642
            Robust |     -          -     5.1275   0.000    .045894       .10269
--------------------------------------------------------------------------------
Estimates adjusted for mass points in the running variable.
(est1 stored)

.         _eststo: rdrobust demwinnext difdemshare, c(0) kernel(triangular)
Mass points detected in the running variable.

Sharp RD estimates using local polynomial regression.

      Cutoff c = 0 | Left of c  Right of c            Number of obs =       6559
-------------------+----------------------            BW type       =      mserd
     Number of obs |      2740        3819            Kernel        = Triangular
Eff. Number of obs |      1203        1221            VCE method    =         NN
    Order est. (p) |         1           1
    Order bias (q) |         2           2
       BW est. (h) |     0.216       0.216
       BW bias (b) |     0.333       0.333
         rho (h/b) |     0.648       0.648
        Unique obs |      2606        3210

Outcome: demwinnext. Running variable: difdemshare.
--------------------------------------------------------------------------------
            Method |   Coef.    Std. Err.    z     P>|z|    [95% Conf. Interval]
-------------------+------------------------------------------------------------
      Conventional |  .20623     .04368   4.7211   0.000    .120615      .291853
            Robust |     -          -     4.0162   0.000    .108119      .314232
--------------------------------------------------------------------------------
Estimates adjusted for mass points in the running variable.
(est2 stored)

.
.         _eststo: rdrobust difdemsharenext difdemshare, c(0) kernel(triangular)
>  covs($cov)
Mass points detected in the running variable.

Covariate-adjusted Sharp RD estimates using local polynomial regression.

      Cutoff c = 0 | Left of c  Right of c            Number of obs =       6559
-------------------+----------------------            BW type       =      mserd
     Number of obs |      2740        3819            Kernel        = Triangular
Eff. Number of obs |      1346        1361            VCE method    =         NN
    Order est. (p) |         1           1
    Order bias (q) |         2           2
       BW est. (h) |     0.243       0.243
       BW bias (b) |     0.383       0.383
         rho (h/b) |     0.634       0.634
        Unique obs |      2606        3210
```

```
Outcome: difdemsharenext. Running variable: difdemshare.
--------------------------------------------------------------------------------
            Method |   Coef.    Std. Err.    z     P>|z|    [95% Conf. Interval]
-------------------+------------------------------------------------------------
      Conventional |  .07595     .01151   6.6004   0.000    .053396      .098502
            Robust |     -          -     5.4290   0.000    .047435      .101035
--------------------------------------------------------------------------------
Covariate-adjusted estimates. Additional covariates included: 2
Estimates adjusted for mass points in the running variable.
(est3 stored)

.         _eststo: rdrobust demwinnext difdemshare, c(0) kernel(triangular) covs
> ($cov)
Mass points detected in the running variable.

Covariate-adjusted Sharp RD estimates using local polynomial regression.

      Cutoff c = 0 | Left of c  Right of c           Number of obs =       6559
-------------------+----------------------           BW type       =      mserd
     Number of obs |      2740        3819           Kernel        = Triangular
Eff. Number of obs |      1195        1209           VCE method    =         NN
    Order est. (p) |         1           1
    Order bias (q) |         2           2
       BW est. (h) |     0.213       0.213
       BW bias (b) |     0.331       0.331
         rho (h/b) |     0.643       0.643
        Unique obs |      2606        3210

Outcome: demwinnext. Running variable: difdemshare.
--------------------------------------------------------------------------------
            Method |   Coef.    Std. Err.    z     P>|z|    [95% Conf. Interval]
-------------------+------------------------------------------------------------
      Conventional |  .21546     .04179   5.1562   0.000     .13356      .297359
            Robust |     -          -     4.1926   0.000    .112239      .309302
--------------------------------------------------------------------------------
Covariate-adjusted estimates. Additional covariates included: 2
Estimates adjusted for mass points in the running variable.
(est4 stored)

.
.         qui esttab _all using "Table3.tex",  b(3) se(3) tex replace

.
. // RD plot for the two outcomes based on optimal bandwidth (no covariates)
.
.         qui rdrobust difdemsharenext difdemshare, c(0) kernel(triangular)

.         local bandwidth = e(h_l)

.         rdplot difdemsharenext difdemshare if abs(difdemshare) <= `bandwidth',
>  ///
>                p(1) h(`bandwidth') kernel(triangular) graph_options(name(rdp1
> , replace) ///
>                legend(off) ytitle(Dem margin (next)) xtitle(Dem margin (curre
> nt)))

RD Plot with evenly spaced mimicking variance number of bins using spacings esti
> mators.

         Cutoff c = 0 | Left of c  Right of c        Number of obs  =       2697
----------------------+----------------------        Kernel         = Triangular
        Number of obs |      1338        1359
   Eff. Number of obs |      1338        1359
  Order poly. fit (p) |         1           1
     BW poly. fit (h) |     0.242       0.242
 Number of bins scale |     1.000       1.000
```

```
Outcome: difdemsharenext. Running variable: difdemshare.
---------------------------------------------
                      | Left of c  Right of c
----------------------+----------------------
        Bins selected |       44          46
   Average bin length |    0.005       0.005
    Median bin length |    0.005       0.005
----------------------+----------------------
    IMSE-optimal bins |        6           6
  Mimicking Var. bins |       44          46
----------------------+----------------------
Rel. to IMSE-optimal: |
        Implied scale |    7.333       7.667
    WIMSE var. weight |    0.003       0.002
    WIMSE bias weight |    0.997       0.998
---------------------------------------------


.
.         qui rdrobust demwinnext difdemshare, c(0) kernel(triangular)

.         local bandwidth = e(h_l)

.         rdplot demwinnext difdemshare if abs(difdemshare) <= `bandwidth', ///
>                 p(1) h(`bandwidth') kernel(triangular) graph_options(name(rdp2
> , replace) ///
>                 legend(off) ytitle(Dem win (next)) xtitle(Dem margin (current)
> ))

RD Plot with evenly spaced mimicking variance number of bins using spacings esti
> mators.

         Cutoff c = 0 | Left of c  Right of c        Number of obs  =       2424
----------------------+----------------------        Kernel         = Triangular
        Number of obs |     1203        1221
   Eff. Number of obs |     1203        1221
  Order poly. fit (p) |        1           1
     BW poly. fit (h) |    0.216       0.216
 Number of bins scale |    1.000       1.000

Outcome: demwinnext. Running variable: difdemshare.
---------------------------------------------
                      | Left of c  Right of c
----------------------+----------------------
        Bins selected |       42          43
   Average bin length |    0.005       0.005
    Median bin length |    0.005       0.005
----------------------+----------------------
    IMSE-optimal bins |        4           4
  Mimicking Var. bins |       42          43
----------------------+----------------------
Rel. to IMSE-optimal: |
        Implied scale |   10.500      10.750
    WIMSE var. weight |    0.001       0.001
    WIMSE bias weight |    0.999       0.999
---------------------------------------------


.
.         graph combine rdp1 rdp2, rows(1) xsize(8) ysize(5)

.         graph export rdplots2.png, as(png) replace
file rdplots2.png saved as PNG format
```

```
.
. // Density test
.
.         rddensity difdemshare, plot graph_opt(name(denstest, replace) legend(o
> ff))
Computing data-driven bandwidth selectors.

Point estimates and standard errors have been adjusted for repeated observations
> .
(Use option nomasspoints to suppress this adjustment.)

RD Manipulation test using local polynomial density estimation.

     c =     0.000 | Left of c  Right of c          Number of obs =         6559
-------------------+----------------------          Model         = unrestricted
     Number of obs |      2740        3819          BW method     =         comb
Eff. Number of obs |      1297        1361          Kernel        =   triangular
    Order est. (p) |         2           2          VCE method    =    jackknife
    Order bias (q) |         3           3
       BW est. (h) |     0.236       0.243

Running variable: difdemshare.
------------------------------------------
            Method |      T          P>|T|
-------------------+----------------------
            Robust |    1.4240      0.1545
------------------------------------------

P-values of binomial tests. (H0: prob = .5)
-----------------------------------------------------
 Window Length / 2 |       <c          >=c |     P>|T|
-------------------+-----------------------+----------
             0.002 |        6           14 |    0.1153
             0.003 |       14           21 |    0.3105
             0.005 |       26           30 |    0.6889
             0.006 |       33           42 |    0.3557
             0.008 |       40           47 |    0.5203
             0.009 |       45           50 |    0.6817
             0.011 |       50           60 |    0.3909
             0.012 |       57           67 |    0.4191
             0.014 |       68           75 |    0.6160
             0.015 |       75           84 |    0.5259
-----------------------------------------------------

.         graph export denstest.png, as(png) replace
file denstest.png saved as PNG format

.
. // Validity check - using demshareprev and demwinprev as outcomes
>
.
.         estimates drop _all

.         _eststo: rdrobust demshareprev difdemshare, c(0) kernel(triangular)
Mass points detected in the running variable.

Sharp RD estimates using local polynomial regression.

      Cutoff c = 0 | Left of c  Right of c            Number of obs =       6559
-------------------+----------------------            BW type       =      mserd
     Number of obs |      2740        3819            Kernel        = Triangular
Eff. Number of obs |      1061        1082            VCE method    =         NN
    Order est. (p) |         1           1
    Order bias (q) |         2           2
       BW est. (h) |     0.187       0.187
       BW bias (b) |     0.291       0.291
         rho (h/b) |     0.642       0.642
        Unique obs |      2606        3210
```

```
Outcome: demshareprev. Running variable: difdemshare.
--------------------------------------------------------------------------------
            Method |   Coef.    Std. Err.    z     P>|z|    [95% Conf. Interval]
-------------------+------------------------------------------------------------
      Conventional |  .00087     .01206   0.0722  0.942   -.022765      .024505
            Robust |     -          -    -0.1120  0.911   -.029851      .026625
--------------------------------------------------------------------------------
Estimates adjusted for mass points in the running variable.
(est1 stored)

.         _eststo: rdrobust demwinprev difdemshare, c(0) kernel(triangular)
Mass points detected in the running variable.

Sharp RD estimates using local polynomial regression.

      Cutoff c = 0 | Left of c  Right of c            Number of obs =       6559
-------------------+----------------------            BW type       =      mserd
     Number of obs |      2740        3819            Kernel        = Triangular
Eff. Number of obs |       865         896            VCE method    =         NN
    Order est. (p) |         1           1
    Order bias (q) |         2           2
       BW est. (h) |     0.150       0.150
       BW bias (b) |     0.291       0.291
         rho (h/b) |     0.513       0.513
        Unique obs |      2606        3210

Outcome: demwinprev. Running variable: difdemshare.
--------------------------------------------------------------------------------
            Method |   Coef.    Std. Err.    z     P>|z|    [95% Conf. Interval]
-------------------+------------------------------------------------------------
      Conventional |  .04075     .04961   0.8214  0.411   -.056486       .13798
            Robust |     -          -     0.3345  0.738   -.090115      .127209
--------------------------------------------------------------------------------
Estimates adjusted for mass points in the running variable.
(est2 stored)

.
.         qui esttab _all using "Table4.tex", se(3) b(3) tex replace

.
. // Validity check - continuity in covariates
.
.         estimates drop _all

.         _eststo: rdrobust demofficeexp difdemshare, c(0) kernel(triangular)
Mass points detected in the running variable.

Sharp RD estimates using local polynomial regression.

      Cutoff c = 0 | Left of c  Right of c            Number of obs =       6559
-------------------+----------------------            BW type       =      mserd
     Number of obs |      2740        3819            Kernel        = Triangular
Eff. Number of obs |      1056        1075            VCE method    =         NN
    Order est. (p) |         1           1
    Order bias (q) |         2           2
       BW est. (h) |     0.185       0.185
       BW bias (b) |     0.344       0.344
         rho (h/b) |     0.539       0.539
        Unique obs |      2606        3210

Outcome: demofficeexp. Running variable: difdemshare.
--------------------------------------------------------------------------------
            Method |   Coef.    Std. Err.    z     P>|z|    [95% Conf. Interval]
-------------------+------------------------------------------------------------
      Conventional |  .22067     .23674   0.9321  0.351   -.243325      .684664
            Robust |     -          -     0.4723  0.637   -.399783      .653661
--------------------------------------------------------------------------------
Estimates adjusted for mass points in the running variable.
(est1 stored)
```

```
.         _eststo: rdrobust othofficeexp difdemshare, c(0) kernel(triangular)
Mass points detected in the running variable.

Sharp RD estimates using local polynomial regression.

      Cutoff c = 0 | Left of c  Right of c            Number of obs =       6559
-------------------+----------------------            BW type       =      mserd
     Number of obs |      2740        3819            Kernel        = Triangular
Eff. Number of obs |       995         999            VCE method    =         NN
    Order est. (p) |         1           1
    Order bias (q) |         2           2
       BW est. (h) |     0.172       0.172
       BW bias (b) |     0.307       0.307
         rho (h/b) |     0.561       0.561
        Unique obs |      2606        3210

Outcome: othofficeexp. Running variable: difdemshare.
--------------------------------------------------------------------------------
            Method |   Coef.    Std. Err.    z     P>|z|    [95% Conf. Interval]
-------------------+------------------------------------------------------------
      Conventional |   .1351     .20128   0.6712   0.502   -.259402      .529602
            Robust |     -          -     0.9082   0.364   -.242887       .66234
--------------------------------------------------------------------------------
Estimates adjusted for mass points in the running variable.
(est2 stored)

.
.         qui esttab _all using "Table5.tex", se(3) b(3) tex replace

.
. // Test for continuities at other ``fake'' cutpoints
.
.         // Here is one way to determine the deciles and save as local macros
.         forvalues j=10(10)90 {
  2.            qui centile difdemshare, centile(`j')
  3.            local d`j' = r(c_1)
  4.            }

.         // Fake cutpoints below 0
.         estimates drop _all

.         forvalues j=10(10)40 {
  2.            _eststo: rdrobust difdemsharenext difdemshare if difdemshare<0,
> ///
>               c(`d`j'') kernel(triangular)
  3.            }
Mass points detected in the running variable.

Sharp RD estimates using local polynomial regression.

 Cutoff c = -.412547379732132 | Left of cRight of c   Number of obs =       2740
-------------------+----------------------            BW type       =      mserd
     Number of obs |       655        2085            Kernel        = Triangular
Eff. Number of obs |       326         481            VCE method    =         NN
    Order est. (p) |         1           1
    Order bias (q) |         2           2
       BW est. (h) |     0.116       0.116
       BW bias (b) |     0.185       0.185
         rho (h/b) |     0.628       0.628
        Unique obs |       557        2049

Outcome: difdemsharenext. Running variable: difdemshare.
--------------------------------------------------------------------------------
            Method |   Coef.    Std. Err.    z     P>|z|    [95% Conf. Interval]
-------------------+------------------------------------------------------------
      Conventional | -.02609     .02656  -0.9822   0.326   -.078156      .025975
            Robust |     -          -    -0.9441   0.345   -.093055       .03255
--------------------------------------------------------------------------------
Estimates adjusted for mass points in the running variable.
(est1 stored)

Sharp RD estimates using local polynomial regression.
```

```
 Cutoff c = -.2570122480392456 | Left of cRight of c  Number of obs =       2740
-------------------+----------------------            BW type       =      mserd
     Number of obs |      1311         1429           Kernel        = Triangular
Eff. Number of obs |       503          565           VCE method    =         NN
    Order est. (p) |         1            1
    Order bias (q) |         2            2
       BW est. (h) |     0.108        0.108
       BW bias (b) |     0.175        0.175
         rho (h/b) |     0.614        0.614

Outcome: difdemsharenext. Running variable: difdemshare.
--------------------------------------------------------------------------------
            Method |   Coef.    Std. Err.    z     P>|z|    [95% Conf. Interval]
-------------------+------------------------------------------------------------
      Conventional | .00986      .01682   0.5862  0.558   -.023109      .042833
            Robust |    -           -     0.5666  0.571   -.027794      .050398
--------------------------------------------------------------------------------
(est2 stored)

Sharp RD estimates using local polynomial regression.

 Cutoff c = -.1327327489852905 | Left of cRight of c  Number of obs =       2740
-------------------+----------------------            BW type       =      mserd
     Number of obs |      1968          772           Kernel        = Triangular
Eff. Number of obs |       241          266           VCE method    =         NN
    Order est. (p) |         1            1
    Order bias (q) |         2            2
       BW est. (h) |     0.045        0.045
       BW bias (b) |     0.068        0.068
         rho (h/b) |     0.665        0.665

Outcome: difdemsharenext. Running variable: difdemshare.
--------------------------------------------------------------------------------
            Method |   Coef.    Std. Err.    z     P>|z|    [95% Conf. Interval]
-------------------+------------------------------------------------------------
      Conventional | -.00783     .02886  -0.2713  0.786    -.06439      .048734
            Robust |    -           -    -0.3483  0.728   -.079243      .055327
--------------------------------------------------------------------------------
(est3 stored)

Sharp RD estimates using local polynomial regression.

 Cutoff c = -.0208561420440674 | Left of cRight of c  Number of obs =       2740
-------------------+----------------------            BW type       =      mserd
     Number of obs |      2620          120           Kernel        = Triangular
Eff. Number of obs |       354          120           VCE method    =         NN
    Order est. (p) |         1            1
    Order bias (q) |         2            2
       BW est. (h) |     0.060        0.060
       BW bias (b) |     0.070        0.070
         rho (h/b) |     0.855        0.855

Outcome: difdemsharenext. Running variable: difdemshare.
--------------------------------------------------------------------------------
            Method |   Coef.    Std. Err.    z     P>|z|    [95% Conf. Interval]
-------------------+------------------------------------------------------------
      Conventional |  .0018      .03183   0.0565  0.955   -.060586       .06418
            Robust |    -           -     0.4316  0.666   -.066468      .104003
--------------------------------------------------------------------------------
(est4 stored)

.         // Fake cutpoints above 0
.         forvalues j=60(10)90 {
  2.            _eststo: rdrobust difdemsharenext difdemshare if difdemshare>0,
> ///
>               c(`d`j'') kernel(triangular)
  3.            }
Mass points detected in the running variable.

Sharp RD estimates using local polynomial regression.
```

```
 Cutoff c = .2104068398475647 | Left of cRight of c   Number of obs =       3818
-------------------+----------------------            BW type       =      mserd
     Number of obs |      1194        2624            Kernel        = Triangular
Eff. Number of obs |       461         448            VCE method    =         NN
    Order est. (p) |         1           1
    Order bias (q) |         2           2
       BW est. (h) |     0.089       0.089
       BW bias (b) |     0.137       0.137
         rho (h/b) |     0.650       0.650
        Unique obs |      1120        2089

Outcome: difdemsharenext. Running variable: difdemshare.
--------------------------------------------------------------------------------
            Method |   Coef.    Std. Err.    z     P>|z|    [95% Conf. Interval]
-------------------+------------------------------------------------------------
      Conventional | -.02271     .02556   -0.8886  0.374   -.072808      .027384
            Robust |     -          -     -0.9146  0.360   -.087555      .031841
--------------------------------------------------------------------------------
Estimates adjusted for mass points in the running variable.
(est5 stored)
Mass points detected in the running variable.

Sharp RD estimates using local polynomial regression.

 Cutoff c = .3394892513751984 | Left of cRight of c   Number of obs =       3818
-------------------+----------------------            BW type       =      mserd
     Number of obs |      1851        1967            Kernel        = Triangular
Eff. Number of obs |       694         595            VCE method    =         NN
    Order est. (p) |         1           1
    Order bias (q) |         2           2
       BW est. (h) |     0.137       0.137
       BW bias (b) |     0.217       0.217
         rho (h/b) |     0.629       0.629
        Unique obs |      1774        1435

Outcome: difdemsharenext. Running variable: difdemshare.
--------------------------------------------------------------------------------
            Method |   Coef.    Std. Err.    z     P>|z|    [95% Conf. Interval]
-------------------+------------------------------------------------------------
      Conventional | -.01984       .019   -1.0442  0.296   -.057076      .017398
            Robust |     -          -     -1.0709  0.284    -.06783      .019896
--------------------------------------------------------------------------------
Estimates adjusted for mass points in the running variable.
(est6 stored)
Mass points detected in the running variable.

Sharp RD estimates using local polynomial regression.

 Cutoff c = .4901444613933563 | Left of cRight of c   Number of obs =       3818
-------------------+----------------------            BW type       =      mserd
     Number of obs |      2506        1312            Kernel        = Triangular
Eff. Number of obs |       640         369            VCE method    =         NN
    Order est. (p) |         1           1
    Order bias (q) |         2           2
       BW est. (h) |     0.146       0.146
       BW bias (b) |     0.235       0.235
         rho (h/b) |     0.622       0.622
        Unique obs |      2421         788

Outcome: difdemsharenext. Running variable: difdemshare.
--------------------------------------------------------------------------------
            Method |   Coef.    Std. Err.    z     P>|z|    [95% Conf. Interval]
-------------------+------------------------------------------------------------
      Conventional |   .0527     .02108    2.4996  0.012    .011377       .09402
            Robust |     -          -      2.4058  0.016    .010871      .106447
--------------------------------------------------------------------------------
Estimates adjusted for mass points in the running variable.
(est7 stored)
Mass points detected in the running variable.

Sharp RD estimates using local polynomial regression.
```

```
 Cutoff c = .8602508306503296 | Left of cRight of c   Number of obs =       3818
-------------------+----------------------            BW type       =      mserd
     Number of obs |      3162         656            Kernel        = Triangular
Eff. Number of obs |        28          28            VCE method    =         NN
    Order est. (p) |         1           1
    Order bias (q) |         2           2
       BW est. (h) |     0.031       0.031
       BW bias (b) |     0.062       0.062
         rho (h/b) |     0.507       0.507
        Unique obs |      3061         148

Outcome: difdemsharenext. Running variable: difdemshare.
--------------------------------------------------------------------------------
            Method |   Coef.    Std. Err.    z     P>|z|    [95% Conf. Interval]
-------------------+------------------------------------------------------------
      Conventional |  .11619      .1397   0.8317   0.406    -.15763          .39
            Robust |     -          -     0.8132   0.416   -.174881      .422924
--------------------------------------------------------------------------------
Estimates adjusted for mass points in the running variable.
(est8 stored)

.
.         qui esttab _all using "Table6.tex", se(3) b(3) tex replace

.         graph close _all

.
.
. // *******
. // (2)
. // *******
. // ***********************************************************************
. // Illustration of not-centering running variable - using in-class exercise
. // 3 (Carruthers example)
. // ***********************************************************************
.
.         clear

.         set seed 195423

.         set obs 10000
Number of observations (_N) was 0, now 10,000.

.         gen id=_n

.         gen trueability = 50 + 4*rnormal()

.         gen grade3test  = trueability + rnormal()

.         replace grade3test = round(grade3test, 0.25)
(10,000 real changes made)

.
. //      students at or above 56 are eligible for G&T. Create a "gap" variable
. //          centered at 56
.
.         gen above56 = (grade3test>=56)

.         gen gap = grade3test-56

.
. //      assuming perfect compliance, everyone above 56 is treated (inGT) and
. //          everyone below is not
```

```
.
.         gen inGT = above56

.
. //      create a grade 4 outcome variable
.
.         gen grade4test = round(trueability + 5 + rnormal() + (3*inGT), 0.25)

.
. //  RD model where grade3test centered at 0 (gap)
.
.         reg grade4test c.gap##i.inGT

      Source |       SS           df       MS      Number of obs   =    10,000
-------------+----------------------------------   F(3, 9996)      =  32218.65
       Model |  187161.733         3  62387.2445   Prob > F        =    0.0000
    Residual |  19355.9606     9,996   1.9363706   R-squared       =    0.9063
-------------+----------------------------------   Adj R-squared   =    0.9062
       Total |  206517.694     9,999  20.6538348   Root MSE        =    1.3915

------------------------------------------------------------------------------
  grade4test | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
         gap |    .939221   .0040802   230.19   0.000     .9312229    .9472191
      1.inGT |    3.02236   .0798731    37.84   0.000     2.865792    3.178927
             |
  inGT#c.gap |
          1  |   .0046223   .0313781     0.15   0.883    -.0568851    .0661296
             |
       _cons |   60.61455   .0306168  1979.78   0.000     60.55453    60.67456
------------------------------------------------------------------------------

.
. //  RD model using non-centered grade 3 test
.
.         reg grade4test c.grade3test##i.inGT

      Source |       SS           df       MS      Number of obs   =    10,000
-------------+----------------------------------   F(3, 9996)      =  32218.65
       Model |  187161.733         3  62387.2445   Prob > F        =    0.0000
    Residual |  19355.9606     9,996   1.9363706   R-squared       =    0.9063
-------------+----------------------------------   Adj R-squared   =    0.9062
       Total |  206517.694     9,999  20.6538348   Root MSE        =    1.3915

------------------------------------------------------------------------------
  grade4test | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
  grade3test |    .939221   .0040802   230.19   0.000     .9312229    .9472191
      1.inGT |   2.763511   1.808055     1.53   0.126    -.7806416    6.307664
             |
        inGT#|
c.grade3test |
          1  |   .0046223   .0313781     0.15   0.883    -.0568851    .0661296
             |
       _cons |   8.018173   .2020343    39.69   0.000     7.622145    8.414201
------------------------------------------------------------------------------

.
.
.         capture log close
```