Problem Set 1

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### Part 1: Labor Market Discrimination

The data set assignment1race.dta contains data from Bertrand and Mullainathan, 2004. “Are Emily and Greg More Employable than Lakisha and Jamal? Evidence on Racial Discrimination in the Labor Market from a Large Randomized Experiment,” September 2004, American Economic Review. Variable definitions and a more detailed description can be found in their paper. Open up the dataset and dig around - take some means, do some tabulations, get to know the data. Then get started with the questions below.

Load the dataset and create the indicator variable for college attendance.

. // this is the stata code   
. use assignment1race, clear  
  
. gen college = 1 if education == 4  
(1,366 missing values generated)  
  
. replace college = 0 if college == .  
(1,366 real changes made)  
  
. label variable college "indicator for college attendance (education >= 4)"

In order to test for equal variance, we can use the sdtest command. The function tests the null hypothesis of equal variance. The results are not significant for college, yearsexp, or linc, meaning we **reject** the null hypothesis. This means that in our t-tests below we can use the unequal command.

1. Test for observable differences between treatment and control baseline characteristics

. // this is the stata code used to produce these statistics  
. foreach var in college yearsexp linc {  
 2. display "`var'"  
 3. ttest `var', by(race) unequal  
 4. }  
college  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 b │ 2,435 .7227926 .009073 .4477117 .7050011 .7405841  
 w │ 2,435 .7162218 .009138 .4509231 .6983026 .7341409  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 4,870 .7195072 .0064381 .4492861 .7068856 .7321288  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ .0065708 .0128772 -.0186743 .031816  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(b) - mean(w) t = 0.5103  
H0: diff = 0 Satterthwaite's degrees of freedom = 4867.75  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.6951 Pr(|T| > |t|) = 0.6099 Pr(T > t) = 0.3049  
yearsexp  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 b │ 2,435 7.829569 .101544 5.010764 7.630447 8.02869  
 w │ 2,435 7.856263 .1029315 5.079228 7.65442 8.058105  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 4,870 7.842916 .0722875 5.044612 7.7012 7.984632  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -.026694 .1445894 -.3101545 .2567664  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(b) - mean(w) t = -0.1846  
H0: diff = 0 Satterthwaite's degrees of freedom = 4867.1  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.4268 Pr(|T| > |t|) = 0.8535 Pr(T > t) = 0.5732  
linc  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 b │ 2,394 9.547022 .0113012 .552953 9.524861 9.569183  
 w │ 2,390 9.554592 .0114816 .5613069 9.532077 9.577107  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 4,784 9.550804 .0080544 .5570967 9.535014 9.566594  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -.0075703 .0161104 -.0391541 .0240135  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(b) - mean(w) t = -0.4699  
H0: diff = 0 Satterthwaite's degrees of freedom = 4780.67  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.3192 Pr(|T| > |t|) = 0.6384 Pr(T > t) = 0.6808

1. Test for differences in baseline characteristics for subgroups

. // this is the code used to produce these statistics  
. foreach var in college yearsexp linc {  
 2. display "`var'"  
 3. ttest `var' if military == 1, by(race)  
 4. }  
college  
  
Two-sample t test with equal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 b │ 248 .7137097 .0287618 .4529408 .6570601 .7703593  
 w │ 225 .7866667 .0273716 .4105745 .7327278 .8406055  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 473 .7484144 .019973 .4343837 .7091674 .7876613  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -.072957 .0398943 -.1513499 .0054359  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(b) - mean(w) t = -1.8288  
H0: diff = 0 Degrees of freedom = 471  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.0340 Pr(|T| > |t|) = 0.0681 Pr(T > t) = 0.9660  
yearsexp  
  
Two-sample t test with equal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 b │ 248 4.225806 .2114705 3.330241 3.809291 4.642322  
 w │ 225 4.066667 .2162083 3.243125 3.640604 4.492729  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 473 4.150106 .1511169 3.286575 3.853161 4.447051  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ .1591398 .302824 -.4359134 .7541929  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(b) - mean(w) t = 0.5255  
H0: diff = 0 Degrees of freedom = 471  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.7003 Pr(|T| > |t|) = 0.5995 Pr(T > t) = 0.2997  
linc  
  
Two-sample t test with equal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 b │ 246 9.511905 .0332293 .5211811 9.446454 9.577357  
 w │ 223 9.616433 .0359372 .5366568 9.545611 9.687255  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 469 9.561606 .0245012 .5306088 9.51346 9.609752  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -.1045279 .0488752 -.2005705 -.0084852  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(b) - mean(w) t = -2.1387  
H0: diff = 0 Degrees of freedom = 467  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.0165 Pr(|T| > |t|) = 0.0330 Pr(T > t) = 0.9835

1. Discussion of balance of baseline characteristics

It looks like the randomization worked out overall. The t-statistics for college attendance, years of experience, and log of income allow us to reject the null hypothesis that the difference in means does not equal zero. In other words, the characteristics of the white name resumes and the Black name resumes are statistically similar enough.  
The randomization did not work as well for the military experience subgroup. The subgroup with military experience showed a statistically significant difference between white and Black resumes in the log income of the applicants zip code.  
There were some differences that were large but not statistically significant. In the military subgroup, the college variable mean difference was -.072957, where in the overall group the difference was much smaller (.0065708).  
In the paper they mentioned that higher quality resumes were assigned some military experience, and that because of the random assignment of addresses to resumes, they are able to use the difference in incomes to test for any effect neighborhood income might have on callbacks.

1. Test for differences in outcomes between treatment and control groups

. // this is the stata code used to produce these statistics   
. ttest call, by(race)  
  
Two-sample t test with equal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 b │ 2,435 .0644764 .0049781 .2456501 .0547145 .0742382  
 w │ 2,435 .0965092 .0059853 .295349 .0847724 .1082461  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 4,870 .0804928 .0038988 .2720826 .0728493 .0881363  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -.0320329 .007785 -.0472949 -.0167708  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(b) - mean(w) t = -4.1147  
H0: diff = 0 Degrees of freedom = 4868  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 1.0000  
  
. ttest call if military == 1, by(race)  
  
Two-sample t test with equal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 b │ 248 .0403226 .0125167 .1971125 .0156696 .0649756  
 w │ 225 .0888889 .0190145 .2852178 .0514187 .1263591  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 473 .0634249 .0112184 .2439838 .0413808 .0854691  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -.0485663 .0223756 -.0925346 -.004598  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(b) - mean(w) t = -2.1705  
H0: diff = 0 Degrees of freedom = 471  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.0152 Pr(|T| > |t|) = 0.0305 Pr(T > t) = 0.9848

1. Discussion

In the overall group, the callback rate was 3.5 percentage points higher for the white names than for the African American sounding names. This difference was very statistically significant, which indicates that it is unlikely we would see a difference this large in the callback rate purely by chance.  
In the military subgroup, the difference was still significant, but less so, we can still claim that the mean difference in callback rates is significantly different in the resumes assigned white names and military experience, as compared to the resumes assigned African American names with military experience.  
In terms of conclusions, the results make a strong causal case for the assignment of white names to resumes and the difference produced by assigning African American names to the same resumes, in terms of its affect on the callback rate. This is because there is balance along all of the other variables and we can be relatively certain that the randomization “worked”. There is less strong evidence for the same claim in the military subgroup, in part because of the lack of balance between the two groups along some of the other characteristics, such as zip code income.

### Part 2: College Scholarships in Michigan

The state of Michigan is considering implementing a new college scholarship program for high-achieving students from economically disadvantaged backgrounds. To qualify for the scholarship, students must have a 4.0 grade point average in high school, and have family income below $65,000. A generous donor has agreed to fund the scholarship program, which would provide $20,000 scholarships to graduating high school students to attend a public college or university in the state of Michigan. The state can only afford to award 500 of these scholarships in a given year, but there are 2,000 students who meet the criteria (grade point average, family income, intentions to attend a public institution in Michigan).

Below are three evaluation designs that have been proposed to allocate the scholarships and test whether the scholarship program increases college enrollment rates. For each, briefly (a few sentences) describe one or more concerns the design raises from an identification strategy perspective.

1. The state would offer scholarships to the 500 poorest students who meet the achievement criteria set out by the scholarship program. Researchers would then compare the college-going rates of the 500 students who were offered the scholarship to the 1,500 students who were not.

This method of evaluation would have biased results. It is likely that the poorest students are measurably different from the other 1,500 students who were not offered the scholarship. The students would likely all come from lower-income families. The method of assignment would make it difficult to attribute college-going rates solely to the treatment (scholarship).

1. The state would open an application system requiring students to verify their income, submit their high school transcripts, and write a 2-page personal statement on what a college degree means to them. Students must also pay a $25 fee to process their applications. The first 500 students who complete applications for the scholarship are offered the scholarship. Researchers would then compare the college-going rates of those first 500 students, to the 1,500 students in the state who met the criteria, but who were not one of the first 500 students to submit an application.

This method would also produce biased results. It’s possible that some students would not be able to pay the $25 application fee, even if they met the other academic criteria, excluding the lowest income students. In addition, because the scholarship will only accept the first 500 students, it is likely that those students are different in terms of other unobservables, such as motivation or some other characteristic that manifests itself in them being more ready to apply quickly. This could even be biased by differential rates of internet access and speed, creating unbalanced samples. This would make it difficult to claim a causal effect.

1. The state would assign each of the 2,000 students a random number between 1 and 2,000 and draw 500 numbers out of a hat. Students whose number was drawn from the hat will receive the scholarship. Researchers would then compare the college-going rates of the students who were offered the scholarship to the students who were not.

This procedure is the most methodologically sound. The random assignment of the numbers would ensure that all of the students who met the criteria would be similar across most characteristics, and selection into treatment (scholarship) would not be affected by other factors, such as motivation or internet access to the application. This method would allow the strongest claim to isolating the causal effect of the treatment.

### Part 3: Charter Schools

“What is the effect of charter school status on student achievement?”

1. What is an ideal experiment that would answer the causal question above?  
   For an ideal experiment, I would take the entire public school student population in Michigan, and then randomly assign a portion of the students to attend a charter school for a year. Then I could compare the achievement scores of the children in charter schools to achievement and outcomes from children in traditional public schools. If an experiment were designed in this way, we could be assured that the randomization was such that across all other variables the groups of children were similar. Then we could isolate the treatment as the only thing affecting outcomes.
2. Using the summary statistics below, test whether the average proficiency rate in math is different for charters vs. traditional public schools.

Table 1. Summary Statistics

|  | Mean | SD | Number of Schools |
| --- | --- | --- | --- |
| Charter | 0.282 | 0.177 | 177 |
| Traditional Public Schools | 0.430 | 0.183 | 1,877 |
| Difference | 0.148 |  |  |

To run a t-test, we need to calculate the standard error of the difference of means:

Which we can then use to calculate the observed test statistic:

The absolute value of the test statistic exceeds the critical value of 1.95 to establish 95% statistical significance, so we can reject the null hypothesis that the two means are the same.

1. Explore data and test for observable differences in other characteristics between districts with different grade spans.
   1. How many schools are in the data set?

Using the bcode variable, there are 2,054 unique schools in the dataset.  
b. What fraction of observations are charter schools?

177/2,054 are charter schools.  
c. Create a crosstab of school type and urbanicity: tab urbanicity charter, missing

. // this is the stata code used to create this table  
. use mich\_charters\_2014, clear  
  
. tab urbanicity charter, missing  
  
 Derived │  
4-Category │  
Urbanicity │  
 (from │  
 ulocale │ Charter School (EEM,  
 variable │ CCD)  
 in CCD) │ No Yes │ Total  
───────────┼──────────────────────┼──────────  
 City │ 291 86 │ 377   
 Suburb │ 832 69 │ 901   
 Town │ 184 6 │ 190   
 Rural │ 570 16 │ 586   
───────────┼──────────────────────┼──────────  
 Total │ 1,877 177 │ 2,054

d. Create a table that compares the student demographics and financial expenditures in charters and traditional public schools similar to what you created in Part I above. Use the variables: `enroll`, `per\_fl`, `per\_as`, `per\_hi`, `per\_bl`, `per\_wh`, `pp\_curr\_opp\_exp`.

Note: pasted output created in Stata.

. // this is the stata code used to create these statistics   
. use mich\_charters\_2014, clear  
  
. estpost ttest enroll per\_fl per\_as per\_hi per\_bl per\_wh pp\_curr\_opp\_exp, by(charter) unequal   
  
 │ e(b) e(count) e(se) e(t) e(df\_t) e(p\_l) e(p) e(p\_u) e(N\_1) e(mu\_1) e(N\_2)   
─────────────+─────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────  
 enroll │ -6.474456 2054 17.72718 -.3652276 200.5975 .3576631 .7153263 .6423369 1877 436.7176 177   
 per\_fl │ -.240336 2054 .0217067 -11.07198 201.1655 7.40e-23 1.48e-22 1 1877 .4407209 177   
 per\_as │ -.0092406 2054 .008123 -1.137581 186.1382 .1283788 .2567577 .8716212 1877 .0281777 177   
 per\_hi │ -.0057525 2054 .0117715 -.4886797 193.8918 .3128104 .6256208 .6871896 1877 .0709033 177   
 per\_bl │ -.4051156 2054 .0304445 -13.30668 187.9968 3.36e-29 6.71e-29 1 1877 .1353942 177   
 per\_wh │ .4191902 2054 .0257851 16.25704 198.3097 1 2.50e-38 1.25e-38 1877 .7237855 177   
pp\_curr\_op~p │ 1605.8 2054 146.736 10.94346 196.5246 1 4.52e-22 2.26e-22 1877 6933.128 177   
  
 │ e(mu\_2)   
─────────────+───────────  
 enroll │ 443.1921   
 per\_fl │ .681057   
 per\_as │ .0374183   
 per\_hi │ .0766558   
 per\_bl │ .5405098   
 per\_wh │ .3045953   
pp\_curr\_op~p │ 5327.328   
  
. esttab ., noobs cells("mu\_1(star fmt(3)) mu\_2(star fmt(3)) b(star fmt(3)) se(fmt(3)) t(fmt(3))") star(\* 0.1 \*\* .05 \*\*\* 0.01) collabels("P  
> ublic" "Charter" "Difference" "Std. Error" "t-stat")  
  
──────────────────────────────────────────────────────────────────────────────────────  
 (1)   
   
 Public Charter Difference Std. Error t-stat  
──────────────────────────────────────────────────────────────────────────────────────  
enroll 436.718 443.192 -6.474 17.727 -0.365  
per\_fl 0.441\*\*\* 0.681\*\*\* -0.240\*\*\* 0.022 -11.072  
per\_as 0.028 0.037 -0.009 0.008 -1.138  
per\_hi 0.071 0.077 -0.006 0.012 -0.489  
per\_bl 0.135\*\*\* 0.541\*\*\* -0.405\*\*\* 0.030 -13.307  
per\_wh 0.724\*\*\* 0.305\*\*\* 0.419\*\*\* 0.026 16.257  
pp\_curr\_op~p 6933.128\*\*\* 5327.328\*\*\* 1605.800\*\*\* 146.736 10.943  
──────────────────────────────────────────────────────────────────────────────────────

e. Create a table that compares the teacher characteristics in charters and traditional public schools. Use the variables: `pct\_teach\_yr1`, `median\_experience`, `pct\_competitive`, `pct\_new\_to\_school`.

. // this is the stata code used to create these statistics  
. use mich\_charters\_2014, clear  
  
. estpost ttest pct\_teach\_yr1 median\_experience pct\_competitive pct\_new\_to\_school, by(charter) unequal   
  
 │ e(b) e(count) e(se) e(t) e(df\_t) e(p\_l) e(p) e(p\_u) e(N\_1) e(mu\_1) e(N\_2)   
─────────────+─────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────  
pct\_teach\_~1 │ -.0714924 2054 .0059614 -11.99248 181.0469 4.57e-25 9.15e-25 1 1877 .0193197 177   
median\_exp~e │ 6.549449 2054 .1937636 33.80124 242.9905 1 7.89e-94 3.95e-94 1877 11.14593 177   
pct\_compet~e │ .0023727 2054 .0044303 .5355552 222.7043 .7035998 .5928004 .2964002 1877 .0445731 177   
pct\_new\_to~l │ -.1415233 2054 .0125163 -11.30711 187.359 3.11e-23 6.21e-23 1 1877 .1146763 177   
  
 │ e(mu\_2)   
─────────────+───────────  
pct\_teach\_~1 │ .0908121   
median\_exp~e │ 4.596483   
pct\_compet~e │ .0422005   
pct\_new\_to~l │ .2561996   
  
. esttab ., noobs cells("mu\_1(star fmt(3)) mu\_2(star fmt(3)) b(star fmt(3)) se(fmt(3)) t(fmt(3))") star(\* 0.1 \*\* .05 \*\*\* 0.01) collabels("P  
> ublic School" "Charter" "Difference" "Std. Error" "t-stat")  
  
──────────────────────────────────────────────────────────────────────────────────────  
 (1)   
   
 Public Sch~l Charter Difference Std. Error t-stat  
──────────────────────────────────────────────────────────────────────────────────────  
pct\_teach\_~1 0.019\*\*\* 0.091\*\*\* -0.071\*\*\* 0.006 -11.992  
median\_exp~e 11.146\*\*\* 4.596\*\*\* 6.549\*\*\* 0.194 33.801  
pct\_compet~e 0.045 0.042 0.002 0.004 0.536  
pct\_new\_to~l 0.115\*\*\* 0.256\*\*\* -0.142\*\*\* 0.013 -11.307  
──────────────────────────────────────────────────────────────────────────────────────

1. Discussion:

From the descriptive statistics produced, we cannot conclude that charter schools increase academic achievement. In particular it’s difficult to claim anything causally from this testing, because there are imbalances across the treatment groups. As shown by table 3c, there are significant differences between charter and public schools in terms of their urbanicity. There are relatively more charter schools in city settings, where public schools are more concentrated in suburban areas.  
In table 3d, we can see that along various characteristics, there are significant differences in the samples, along almost all of the variables included. Charter schools and public schools differ in a statistically significant way in their total enrollments, percent of free lunch students, percent of Black students, percent of white students, and finally in the amoutn of per-pupil expenditures. These imbalances make it difficult to establish causality, because instead of attributing any difference in outcomes to the treatment itself (charter status), we may be confounded in our estimates because of the baseline differences in the sample.  
In table 3e, the differences across charter schools and public schools continue. The only characteristic where we cannot reject the null hypothesis is in the percent of instructors who graduated from competitive colleges. In all of the other metrics – percent of year 1 teachers, median experience level of the teachers, and percent new to school, the charter and public school teacher populations differ in a statistically significant way. These baseline differences across the sample confound any causal claim that we can make about the effectiveness of the treatment (charter school status).

### Part 4: Random Assignment

#### Step 1: Randomly Assign Observations to treatment and control

Assigning 177 schools to “random charter” group.

. use mich\_charters\_2014, clear  
  
. set seed 1492  
  
. gen index = uniform()  
  
. sort index  
  
. gen random\_charter = (\_n <= 177)

#### Step 2: Test for differences between treatment and control

1. Current operating expenditures per student

. // stata code to run ttest  
. ttest pp\_curr\_opp\_exp, by(random\_charter) unequal  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 6788.652 35.35157 1531.584 6719.32 6857.985  
 1 │ 177 6859.428 153.0216 2035.821 6557.435 7161.421  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 6794.751 34.88199 1580.889 6726.343 6863.159  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -70.77575 157.0521 -380.5122 238.9607  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = -0.4507  
H0: diff = 0 Satterthwaite's degrees of freedom = 195.236  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.3264 Pr(|T| > |t|) = 0.6527 Pr(T > t) = 0.6736

1. Percent free lunch

. // stata code to run ttest  
. ttest per\_fl, by(random\_charter) unequal  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 .4605943 .0058684 .2542434 .4490851 .4721035  
 1 │ 177 .4703096 .0173562 .2309087 .4360566 .5045625  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 .4614315 .0055665 .2522799 .4505149 .4723481  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -.0097153 .0183214 -.0458248 .0263942  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = -0.5303  
H0: diff = 0 Satterthwaite's degrees of freedom = 218.274  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.2982 Pr(|T| > |t|) = 0.5965 Pr(T > t) = 0.7018

c. Median teacher experience

. // stata code to run ttest  
. ttest median\_experience, by(random\_charter) unequal  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 10.57083 .0842587 3.650455 10.40558 10.73608  
 1 │ 177 10.69514 .2989882 3.977779 10.10508 11.2852  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 10.58154 .081175 3.67894 10.42235 10.74074  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -.1243088 .310634 -.7367569 .4881393  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = -0.4002  
H0: diff = 0 Satterthwaite's degrees of freedom = 204.944  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.3447 Pr(|T| > |t|) = 0.6894 Pr(T > t) = 0.6553

#### Step 3: Re-randomize and test for differences between newly defined treatment and control

. // stata code to rerandomize   
. //gen index=.   
. //gen random\_charters=.   
.   
. local i=1   
  
. while `i' <= 10 {   
 2. replace index= uniform()   
 3. sort index   
 4. replace random\_charter=(\_n<=177)   
 5.   
. display `i'  
 6. tab random\_charter, m  
 7. ttest pp\_curr\_opp\_exp, by (random\_charter) unequal   
 8. ttest per\_fl, by(random\_charter) unequal  
 9. ttest median\_experience, by(random\_charter) unequal  
 10. local i =`i' + 1   
 11. }   
(2,054 real changes made)  
(318 real changes made)  
1  
  
random\_char │  
 ter │ Freq. Percent Cum.  
────────────┼───────────────────────────────────  
 0 │ 1,877 91.38 91.38  
 1 │ 177 8.62 100.00  
────────────┼───────────────────────────────────  
 Total │ 2,054 100.00  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 6782.613 36.72156 1590.938 6710.594 6854.633  
 1 │ 177 6923.47 110.3524 1468.143 6705.686 7141.254  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 6794.751 34.88199 1580.889 6726.343 6863.159  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -140.8568 116.3018 -370.0833 88.36968  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = -1.2111  
H0: diff = 0 Satterthwaite's degrees of freedom = 216.887  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.1136 Pr(|T| > |t|) = 0.2272 Pr(T > t) = 0.8864  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 .4640526 .0058274 .2524672 .4526238 .4754814  
 1 │ 177 .4336361 .0187383 .2492963 .3966555 .4706167  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 .4614315 .0055665 .2522799 .4505149 .4723481  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ .0304164 .0196235 -.0082662 .0690991  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = 1.5500  
H0: diff = 0 Satterthwaite's degrees of freedom = 211.504  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.9387 Pr(|T| > |t|) = 0.1226 Pr(T > t) = 0.0613  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 10.59058 .0853477 3.697632 10.42319 10.75796  
 1 │ 177 10.48578 .2618025 3.483056 9.969101 11.00245  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 10.58154 .081175 3.67894 10.42235 10.74074  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ .1047986 .275363 -.4379557 .6475529  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = 0.3806  
H0: diff = 0 Satterthwaite's degrees of freedom = 215.169  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.6481 Pr(|T| > |t|) = 0.7039 Pr(T > t) = 0.3519  
(2,054 real changes made)  
(328 real changes made)  
2  
  
random\_char │  
 ter │ Freq. Percent Cum.  
────────────┼───────────────────────────────────  
 0 │ 1,877 91.38 91.38  
 1 │ 177 8.62 100.00  
────────────┼───────────────────────────────────  
 Total │ 2,054 100.00  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 6803.631 36.61655 1586.389 6731.817 6875.444  
 1 │ 177 6700.588 114.4378 1522.496 6474.741 6926.435  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 6794.751 34.88199 1580.889 6726.343 6863.159  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ 103.0424 120.1532 -133.7949 339.8797  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = 0.8576  
H0: diff = 0 Satterthwaite's degrees of freedom = 213.672  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.8040 Pr(|T| > |t|) = 0.3921 Pr(T > t) = 0.1960  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 .460811 .005823 .2522776 .4493908 .4722313  
 1 │ 177 .468011 .0190111 .2529256 .4304921 .50553  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 .4614315 .0055665 .2522799 .4505149 .4723481  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -.0072 .0198828 -.0463951 .0319951  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = -0.3621  
H0: diff = 0 Satterthwaite's degrees of freedom = 210.399  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.3588 Pr(|T| > |t|) = 0.7176 Pr(T > t) = 0.6412  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 10.62503 .0847203 3.670454 10.45887 10.79118  
 1 │ 177 10.12045 .2816651 3.74731 9.564576 10.67633  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 10.58154 .081175 3.67894 10.42235 10.74074  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ .5045733 .2941305 -.0752675 1.084414  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = 1.7155  
H0: diff = 0 Satterthwaite's degrees of freedom = 209.126  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.9561 Pr(|T| > |t|) = 0.0877 Pr(T > t) = 0.0439  
(2,054 real changes made)  
(314 real changes made)  
3  
  
random\_char │  
 ter │ Freq. Percent Cum.  
────────────┼───────────────────────────────────  
 0 │ 1,877 91.38 91.38  
 1 │ 177 8.62 100.00  
────────────┼───────────────────────────────────  
 Total │ 2,054 100.00  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 6785.735 35.72595 1547.804 6715.669 6855.802  
 1 │ 177 6890.359 142.7478 1899.135 6608.642 7172.077  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 6794.751 34.88199 1580.889 6726.343 6863.159  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -104.6237 147.1505 -394.8011 185.5536  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = -0.7110  
H0: diff = 0 Satterthwaite's degrees of freedom = 198.666  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.2390 Pr(|T| > |t|) = 0.4779 Pr(T > t) = 0.7610  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 .458828 .0057883 .2507758 .4474758 .4701803  
 1 │ 177 .4890399 .020061 .2668947 .4494488 .528631  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 .4614315 .0055665 .2522799 .4505149 .4723481  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -.0302119 .0208794 -.0713761 .0109524  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = -1.4470  
H0: diff = 0 Satterthwaite's degrees of freedom = 206.391  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.0747 Pr(|T| > |t|) = 0.1494 Pr(T > t) = 0.9253  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 10.5629 .0843831 3.655843 10.39741 10.7284  
 1 │ 177 10.77924 .294721 3.921007 10.1976 11.36088  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 10.58154 .081175 3.67894 10.42235 10.74074  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -.216335 .3065631 -.8207401 .3880701  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = -0.7057  
H0: diff = 0 Satterthwaite's degrees of freedom = 205.909  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.2406 Pr(|T| > |t|) = 0.4812 Pr(T > t) = 0.7594  
(2,054 real changes made)  
(316 real changes made)  
4  
  
random\_char │  
 ter │ Freq. Percent Cum.  
────────────┼───────────────────────────────────  
 0 │ 1,877 91.38 91.38  
 1 │ 177 8.62 100.00  
────────────┼───────────────────────────────────  
 Total │ 2,054 100.00  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 6807.878 36.74127 1591.792 6735.82 6879.936  
 1 │ 177 6655.548 109.5285 1457.181 6439.39 6871.706  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 6794.751 34.88199 1580.889 6726.343 6863.159  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ 152.3302 115.5266 -75.36433 380.0248  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = 1.3186  
H0: diff = 0 Satterthwaite's degrees of freedom = 217.579  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.9057 Pr(|T| > |t|) = 0.1887 Pr(T > t) = 0.0943  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 .4655492 .0058492 .2534141 .4540775 .4770209  
 1 │ 177 .4177648 .0177545 .2362083 .3827257 .4528039  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 .4614315 .0055665 .2522799 .4505149 .4723481  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ .0477844 .0186932 .01094 .0846288  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = 2.5562  
H0: diff = 0 Satterthwaite's degrees of freedom = 216.04  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.9944 Pr(|T| > |t|) = 0.0113 Pr(T > t) = 0.0056  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 10.61587 .0859279 3.722773 10.44735 10.7844  
 1 │ 177 10.21753 .23778 3.163457 9.748261 10.6868  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 10.58154 .081175 3.67894 10.42235 10.74074  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ .3983428 .2528298 -.0998791 .8965647  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = 1.5755  
H0: diff = 0 Satterthwaite's degrees of freedom = 224.611  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.9417 Pr(|T| > |t|) = 0.1165 Pr(T > t) = 0.0583  
(2,054 real changes made)  
(336 real changes made)  
5  
  
random\_char │  
 ter │ Freq. Percent Cum.  
────────────┼───────────────────────────────────  
 0 │ 1,877 91.38 91.38  
 1 │ 177 8.62 100.00  
────────────┼───────────────────────────────────  
 Total │ 2,054 100.00  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 6784.441 37.03774 1604.636 6711.801 6857.08  
 1 │ 177 6904.087 97.82759 1301.511 6711.021 7097.153  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 6794.751 34.88199 1580.889 6726.343 6863.159  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -119.6459 104.6042 -325.7525 86.46082  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = -1.1438  
H0: diff = 0 Satterthwaite's degrees of freedom = 229.629  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.1269 Pr(|T| > |t|) = 0.2539 Pr(T > t) = 0.8731  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 .4629748 .0058294 .2525569 .4515419 .4744076  
 1 │ 177 .4450656 .0187492 .2494423 .4080633 .4820679  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 .4614315 .0055665 .2522799 .4505149 .4723481  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ .0179092 .0196346 -.0207954 .0566137  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = 0.9121  
H0: diff = 0 Satterthwaite's degrees of freedom = 211.487  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.8186 Pr(|T| > |t|) = 0.3627 Pr(T > t) = 0.1814  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 10.54677 .0854125 3.70044 10.37926 10.71428  
 1 │ 177 10.95031 .2578787 3.430853 10.44138 11.45924  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 10.58154 .081175 3.67894 10.42235 10.74074  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -.4035406 .2716555 -.9389689 .1318876  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = -1.4855  
H0: diff = 0 Satterthwaite's degrees of freedom = 216.488  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.0694 Pr(|T| > |t|) = 0.1389 Pr(T > t) = 0.9306  
(2,054 real changes made)  
(324 real changes made)  
6  
  
random\_char │  
 ter │ Freq. Percent Cum.  
────────────┼───────────────────────────────────  
 0 │ 1,877 91.38 91.38  
 1 │ 177 8.62 100.00  
────────────┼───────────────────────────────────  
 Total │ 2,054 100.00  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 6809.569 36.95946 1601.245 6737.083 6882.055  
 1 │ 177 6637.612 100.7261 1340.074 6438.825 6836.398  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 6794.751 34.88199 1580.889 6726.343 6863.159  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ 171.9579 107.2928 -39.46339 383.3792  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = 1.6027  
H0: diff = 0 Satterthwaite's degrees of freedom = 226.198  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.9448 Pr(|T| > |t|) = 0.1104 Pr(T > t) = 0.0552  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 .4589205 .0058183 .2520744 .4475095 .4703315  
 1 │ 177 .4880594 .0190645 .2536361 .4504351 .5256838  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 .4614315 .0055665 .2522799 .4505149 .4723481  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -.029139 .0199325 -.0684323 .0101544  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = -1.4619  
H0: diff = 0 Satterthwaite's degrees of freedom = 210.142  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.0726 Pr(|T| > |t|) = 0.1453 Pr(T > t) = 0.9274  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 10.54517 .0851328 3.688325 10.3782 10.71213  
 1 │ 177 10.96732 .2679782 3.565218 10.43845 11.49618  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 10.58154 .081175 3.67894 10.42235 10.74074  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -.4221499 .2811759 -.976392 .1320922  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = -1.5014  
H0: diff = 0 Satterthwaite's degrees of freedom = 213.114  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.0674 Pr(|T| > |t|) = 0.1347 Pr(T > t) = 0.9326  
(2,054 real changes made)  
(334 real changes made)  
7  
  
random\_char │  
 ter │ Freq. Percent Cum.  
────────────┼───────────────────────────────────  
 0 │ 1,877 91.38 91.38  
 1 │ 177 8.62 100.00  
────────────┼───────────────────────────────────  
 Total │ 2,054 100.00  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 6776.429 35.54335 1539.893 6706.72 6846.138  
 1 │ 177 6989.049 147.2076 1958.469 6698.53 7279.568  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 6794.751 34.88199 1580.889 6726.343 6863.159  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -212.6199 151.4378 -511.2666 86.0268  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = -1.4040  
H0: diff = 0 Satterthwaite's degrees of freedom = 197.056  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.0809 Pr(|T| > |t|) = 0.1619 Pr(T > t) = 0.9191  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 .4646716 .0058145 .2519088 .4532681 .4760751  
 1 │ 177 .4270717 .0191193 .2543653 .3893392 .4648043  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 .4614315 .0055665 .2522799 .4505149 .4723481  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ .0375999 .0199839 -.0017949 .0769946  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = 1.8815  
H0: diff = 0 Satterthwaite's degrees of freedom = 209.892  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.9694 Pr(|T| > |t|) = 0.0613 Pr(T > t) = 0.0306  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 10.60293 .0841786 3.646986 10.43784 10.76802  
 1 │ 177 10.35476 .3011294 4.006266 9.760471 10.94905  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 10.58154 .081175 3.67894 10.42235 10.74074  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ .2481703 .3126738 -.3683081 .8646487  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = 0.7937  
H0: diff = 0 Satterthwaite's degrees of freedom = 204.464  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.7859 Pr(|T| > |t|) = 0.4283 Pr(T > t) = 0.2141  
(2,054 real changes made)  
(320 real changes made)  
8  
  
random\_char │  
 ter │ Freq. Percent Cum.  
────────────┼───────────────────────────────────  
 0 │ 1,877 91.38 91.38  
 1 │ 177 8.62 100.00  
────────────┼───────────────────────────────────  
 Total │ 2,054 100.00  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 6787.463 36.45008 1579.176 6715.977 6858.95  
 1 │ 177 6872.034 120.37 1601.419 6634.48 7109.589  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 6794.751 34.88199 1580.889 6726.343 6863.159  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -84.57067 125.7679 -332.5028 163.3614  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = -0.6724  
H0: diff = 0 Satterthwaite's degrees of freedom = 209.592  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.2510 Pr(|T| > |t|) = 0.5020 Pr(T > t) = 0.7490  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 .4600992 .0058668 .254175 .4485931 .4716053  
 1 │ 177 .4755596 .0173948 .2314226 .4412304 .5098888  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 .4614315 .0055665 .2522799 .4505149 .4723481  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -.0154604 .0183575 -.0516413 .0207205  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = -0.8422  
H0: diff = 0 Satterthwaite's degrees of freedom = 218.054  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.2003 Pr(|T| > |t|) = 0.4006 Pr(T > t) = 0.7997  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 10.58583 .0847673 3.67249 10.41958 10.75208  
 1 │ 177 10.5361 .2823896 3.756949 9.978796 11.09341  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 10.58154 .081175 3.67894 10.42235 10.74074  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ .0497281 .2948379 -.5315094 .6309656  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = 0.1687  
H0: diff = 0 Satterthwaite's degrees of freedom = 208.988  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.5669 Pr(|T| > |t|) = 0.8662 Pr(T > t) = 0.4331  
(2,054 real changes made)  
(322 real changes made)  
9  
  
random\_char │  
 ter │ Freq. Percent Cum.  
────────────┼───────────────────────────────────  
 0 │ 1,877 91.38 91.38  
 1 │ 177 8.62 100.00  
────────────┼───────────────────────────────────  
 Total │ 2,054 100.00  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 6784.516 36.6666 1588.557 6712.604 6856.427  
 1 │ 177 6903.295 112.5314 1497.133 6681.21 7125.379  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 6794.751 34.88199 1580.889 6726.343 6863.159  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -118.779 118.3544 -352.0617 114.5038  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = -1.0036  
H0: diff = 0 Satterthwaite's degrees of freedom = 215.127  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.1584 Pr(|T| > |t|) = 0.3167 Pr(T > t) = 0.8416  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 .4646253 .0058238 .2523102 .4532036 .476047  
 1 │ 177 .4275629 .0188033 .2501619 .3904539 .4646719  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 .4614315 .0055665 .2522799 .4505149 .4723481  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ .0370624 .0196845 -.0017409 .0758657  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = 1.8828  
H0: diff = 0 Satterthwaite's degrees of freedom = 211.203  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.9695 Pr(|T| > |t|) = 0.0611 Pr(T > t) = 0.0305  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 10.55745 .085127 3.68807 10.3905 10.72441  
 1 │ 177 10.83703 .2691554 3.58088 10.30585 11.36822  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 10.58154 .081175 3.67894 10.42235 10.74074  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -.2795818 .2822964 -.8360377 .276874  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = -0.9904  
H0: diff = 0 Satterthwaite's degrees of freedom = 212.772  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.1616 Pr(|T| > |t|) = 0.3231 Pr(T > t) = 0.8384  
(2,054 real changes made)  
(326 real changes made)  
10  
  
random\_char │  
 ter │ Freq. Percent Cum.  
────────────┼───────────────────────────────────  
 0 │ 1,877 91.38 91.38  
 1 │ 177 8.62 100.00  
────────────┼───────────────────────────────────  
 Total │ 2,054 100.00  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 6793.441 36.22167 1569.28 6722.402 6864.48  
 1 │ 177 6808.641 128.067 1703.82 6555.896 7061.385  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 6794.751 34.88199 1580.889 6726.343 6863.159  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -15.19924 133.0908 -277.6003 247.2018  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = -0.1142  
H0: diff = 0 Satterthwaite's degrees of freedom = 205.161  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.4546 Pr(|T| > |t|) = 0.9092 Pr(T > t) = 0.5454  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 .4629981 .0058464 .253291 .451532 .4744642  
 1 │ 177 .4448183 .0181417 .2413591 .4090151 .4806215  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 .4614315 .0055665 .2522799 .4505149 .4723481  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ .0181798 .0190604 -.0193902 .0557497  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = 0.9538  
H0: diff = 0 Satterthwaite's degrees of freedom = 214.238  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.8294 Pr(|T| > |t|) = 0.3413 Pr(T > t) = 0.1706  
  
Two-sample t test with unequal variances  
─────────┬────────────────────────────────────────────────────────────────────  
 Group │ Obs Mean Std. err. Std. dev. [95% conf. interval]  
─────────┼────────────────────────────────────────────────────────────────────  
 0 │ 1,877 10.56879 .0854025 3.700007 10.4013 10.73629  
 1 │ 177 10.71675 .2596651 3.454619 10.20429 11.22921  
─────────┼────────────────────────────────────────────────────────────────────  
Combined │ 2,054 10.58154 .081175 3.67894 10.42235 10.74074  
─────────┼────────────────────────────────────────────────────────────────────  
 diff │ -.1479568 .2733487 -.6867306 .390817  
─────────┴────────────────────────────────────────────────────────────────────  
 diff = mean(0) - mean(1) t = -0.5413  
H0: diff = 0 Satterthwaite's degrees of freedom = 215.899  
  
 Ha: diff < 0 Ha: diff != 0 Ha: diff > 0  
 Pr(T < t) = 0.2944 Pr(|T| > |t|) = 0.5889 Pr(T > t) = 0.7056  
  
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#### Step 4: Discussion

The code assigns random uniform variates across all of the observations. The uniform() function has apparently been [replaced](https://www.statalist.org/forums/forum/general-stata-discussion/general/1358352-randomizing-the-observations-in-your-dataset) by the runiform() function. The next command sorts by the new index, and assigns a 1 to the newly sorted observations based on whether or not the \_n row number/position is less than or equal to 177. In this way it randomly assigns schools to be coded as charter or non-charter schools.  
This method of randomization created comparable treatment and control groups, except in a couple of cases across the three variables from the exercises above. There were 2 instances in which the differences between random\_charter and public schools were statistically different (noted below). In those cases, it could be attributed to random chance.  
In certain cases the difference between the treatment and control group means for per pupil expenditures was large. In the first randomization, the difference was -207.0487, compared to a standard deviation of around 1585 for public schools and 1520 for charter schools. The difference of $200 on average could have an impact on the estimates.

**statistically significant variables**

median\_experience = 1

per\_fl = 1