

## 12. Randomized Impact Evaluation

---

Randomization works in the ideal scenario where individuals or households are assigned to treatment randomly, eliminating selection bias. In an attempt to obtain an estimate of the impact of a certain program, comparing the same treated individuals over time does not provide a consistent estimate of the program's impact, because other factors besides the program may affect outcomes. However, comparing the outcome of the treated individuals with that of a similar control group can provide an estimate of the program's impact. This comparison works well with randomization because the assignment of individuals or groups to the treatment and comparison groups is random. An unbiased estimate of the impact of the program in the sample will be obtained when the design and implementation of the randomized evaluation are appropriate. This exercise demonstrates randomized impact estimation with different scenarios. In this chapter, the randomization impact evaluation is demonstrated from top down—that is, from program placement to program participation.

### Impacts of Program Placement in Villages

Assume that microcredit programs are randomly assigned to villages,<sup>1</sup> and further assume no differences between treated and control villages. You want to ascertain the impact of program placement on household's per capita total annual expenditures.

For this exercise, use the 1998 household data `hh_98.dta`. The following commands open the data set and create the log form of two variables—outcome (“`exptot`”) and household's land before joining the microcredit program (“`hhland`,” which is changed to acre from decimal by dividing by 100).

```
use ..\data\hh_98;
gen lexptot=ln(1+exptot);
gen lnland=ln(1+hhland/100);
```

Then a dummy variable is created for microcredit program placement in villages. Two program placement variables are created: one for male programs and the other for female programs.

```
gen vill=thanaid*10+villid;
egen progvillm=max(dmmfd), by(vill);
egen progvillf=max(dfmfd), by(vill);
```

First, use the simplest method to calculate average treatment effect of village program placement. It is done by using the Stata “ttest” command, which compares the outcome between treated and control villages. The following command shows the effects of female program placement in the village:

```
ttest lexptot, by(progwillf);
```

The result shows that the difference of outcomes between treated and control villages is significant. That is, female program placement in villages improves per capita expenditure.<sup>2</sup>

Two-sample t-test with equal variances

```
-----+-----
      Group |      Obs      Mean   Std. Err.   Std. Dev.   [95% Conf.   Interval]
-----+-----
          0 |         67   8.328525   .0644093   .5272125    8.199927    8.457122
          1 |        1062   8.458371   .0157201   .5122923    8.427525    8.489217
-----+-----
combined |       1129   8.450665   .0152934   .5138679    8.420659    8.480672
-----+-----
      diff |           - .1298466   .0646421           - .2566789   - .0030142
-----+-----
```

Degrees of freedom: 1127

Ho: mean(0) - mean(1) = diff = 0

Ha: diff < 0	Ha: diff != 0	Ha: diff > 0
t = -2.0087	t = -2.0087	t = -2.0087
P < t = 0.0224	P >  t  = 0.0448	P > t = 0.9776

Alternately, you can run the simplest equation that regresses per capita expenditure against the village program dummy:

```
reg lexptot progwillf;
```

The result gives the same effect (0.130), which is significant.

```
-----+-----
Source |      SS      df      MS      Number of obs = 1129
-----+-----
Model | 1.06259118      1 1.06259118      F( 1, 1127) = 4.03
Residual | 296.797338 1127 .263351676      Prob > F = 0.0448
-----+-----
Total | 297.85993 1128 .264060221      R-squared = 0.0036
                                           Adj R-squared = 0.0027
                                           Root MSE = .51318
-----+-----
lexptot |      Coef.   Std. Err.      t    P>|t|   [95% Conf. Interval]
-----+-----
progwillf | .1298466   .0646421      2.01  0.045   .0030142   .2566789
_cons | 8.328525   .0626947    132.84  0.000   8.205513   8.451536
```

The preceding regression estimates the overall impact of the village programs on the per capita expenditure of households. It may be different from the impact on the expenditure after holding other factors constant—that is, specifying the model adjusted for covariates that affect the outcomes of interest. Now, regress the same outcome (log of per capita household expenditures) against the village program dummy plus other factors that may influence the expenditure:

```
reg lexptot progvillf sexhead agehead educhead lnland vaccess pcirr rice
wheat milk oil egg [pw=weight];
```

Adjusting for other covariates, one still finds no significant impacts of program placement on the outcome variable:

```
Regression with robust standard errors          Number of obs =   1129
                                                F( 12, 1116) =   20.16
                                                Prob > F       =   0.0000
                                                R-squared     =   0.2450
                                                Root MSE     =   .46179
```

lexptot	Robust		t	P> t	[95% Conf. Interval]	
	Coef.	Std. Err.				
<b>progvillf</b>	<b>-.0455621</b>	<b>.1046759</b>	<b>-0.44</b>	<b>0.663</b>	<b>-.2509458</b>	<b>.1598217</b>
sexhead	-.0373236	.0643335	-0.58	0.562	-.1635519	.0889047
agehead	.0030636	.0012859	2.38	0.017	.0005405	.0055867
educhead	.0486414	.0057184	8.51	0.000	.0374214	.0598614
lnland	.1912535	.0389079	4.92	0.000	.1149127	.2675943
vaccess	-.0358233	.0498939	-0.72	0.473	-.1337197	.0620731
pcirr	.1189407	.0608352	1.96	0.051	-.0004236	.238305
rice	.0069748	.0110718	0.63	0.529	-.0147491	.0286987
wheat	-.029278	.0196866	-1.49	0.137	-.0679049	.009349
milk	.0141328	.0072647	1.95	0.052	-.0001211	.0283867
oil	.0083345	.0038694	2.15	0.031	.0007424	.0159265
egg	.1115221	.0612063	1.82	0.069	-.0085702	.2316145
_cons	7.609248	.2642438	28.80	0.000	7.090777	8.127718

### Impacts of Program Participation

Even though microcredit program assignment is random across villages, the participation may not be. Only those households that have fewer than 50 decimals of land can participate in microcredit programs (so-called target groups).

As before, start with the simplest method to calculate average treatment effect of program participation for females. It is done by using the Stata “ttest” command, which compares the outcome between treated and control villages:

```
ttest lexptot, by(dfmfd);
```

The result shows that the difference of outcomes between participants and nonparticipants is insignificant.

Two-sample t-test with equal variances

```

-----
      Group |      Obs      Mean      Std. Err.  Std. Dev. [95% Conf.  Interval]
-----+-----
          0 |      534  8.447977   .023202   .5361619  8.402398   8.493555
          1 |      595  8.453079   .0202292   .4934441  8.413349   8.492808
-----+-----
combined |     1129  8.450665   .0152934   .5138679  8.420659   8.480672
-----+-----
      diff |           -.005102 .0306448           -.0652292 .0550253
-----
    
```

Degrees of freedom: 1127

Ho: mean(0) - mean(1) = diff = 0

```

      Ha: diff < 0           Ha: diff != 0           Ha: diff > 0
      t = -0.1665           t = -0.1665           t = -0.1665
      P < t = 0.4339       P > |t| = 0.8678       P > t = 0.5661
    
```

Again, alternately you can run the simple regression model—outcome against female participation:

```
reg lexptot dfmfd;
```

The regression illustrates that the effect of female participation in microcredit programs is not different from zero.

```

-----+-----
Source |      SS      df      MS          Number of obs =    1129
-----+-----          F(1, 1127) =      0.03
Model | .007325582      1 .007325582      Prob > F = 0.8678
Residual | 297.852604    1127 .264288025      R-squared = 0.0000
-----+-----          Adj R-squared = -0.0009
Total | 297.85993    1128 .264060221      Root MSE = .51409
-----+-----
lexptot |  Coef.      Std. Err.      t      P>|t|      [95% Conf.  Interval]
-----+-----
      dfmfd |  .005102 .0306448      0.17 0.868      -.0550253 .0652292
      _cons |  8.447977   .0222468    379.74  0.000      8.404327   8.491626
-----+-----
    
```

Now, similarly to the regression of village program placement, include other household- and village-level covariates in the female participation equation:

```
reg lexptot dfmfd sexhead agehead educhead lnland vaccess pcirr rice wheat
milk oil egg [pw=weight];
```

Female participation impact to household expenditure has now changed from insignificant to significant (10 percent level).

```
Regression with robust standard errors      Number of obs =   1129
                                           F( 12, 1116) =  19.72
                                           Prob > F      =  0.0000
                                           R-squared    =  0.2478
                                           Root MSE    =  .46093
```

	Robust					
lexptot	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
<b>dfmfd</b>	<b>.0654911</b>	<b>.0348852</b>	<b>1.88</b>	<b>0.061</b>	<b>-.0029569</b>	<b>.133939</b>
sexhead	-.0331386	.0647884	-0.51	0.609	-.1602593	.0939822
agehead	.0031133	.001314	2.37	0.018	.000535	.0056915
educhead	.0493265	.0060583	8.14	0.000	.0374395	.0612134
lnland	.2058408	.0421675	4.88	0.000	.1231043	.2885774
vaccess	-.0295222	.0501813	-0.59	0.556	-.1279825	.0689381
pcirr	.1080647	.0610146	1.77	0.077	-.0116515	.2277809
rice	.0057045	.0112967	0.50	0.614	-.0164607	.0278696
wheat	-.0295285	.0195434	-1.51	0.131	-.0678744	.0088174
milk	.0136748	.0073334	1.86	0.062	-.0007139	.0280636
oil	.0079069	.0038484	2.05	0.040	.000356	.0154579
egg	.1129842	.0612986	1.84	0.066	-.0072893	.2332577
_cons	7.560953	.278078	27.19	0.000	7.015339	8.106568

### Capturing Both Program Placement and Participation

The previous two exercises showed in separate regressions the effects of program placement and program participation. However, these two effects can be combined in the same regression, which gives a more unbiased estimate.

```
reg lexptot dfmfd progvillf sexhead agehead educhead lnland vaccess pcirr
rice wheat milk oil egg [pw=weight];
```

The results show no significant effect of program placement but a positive significant effect (7.3 percent) of female program participants ( $t = 2.05$ ).

```
Regression with robust standard errors      Number of obs =   1129
                                           F( 13, 1115) =  18.34
                                           Prob > F      =  0.0000
                                           R-squared    =  0.2490
                                           Root MSE    =  .46079
```

	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
<b>dfmfd</b>	<b>.0737423</b>	<b>.0359919</b>	<b>2.05</b>	<b>0.041</b>	<b>.0031228</b>	<b>.1443618</b>
progvillf	-.0747142	.107158	-0.70	0.486	-.2849682	.1355397
sexhead	-.0377076	.0641847	-0.59	0.557	-.1636439	.0882288
agehead	.0030077	.0012831	2.34	0.019	.0004901	.0055254
educhead	.0499607	.0057753	8.65	0.000	.038629	.0612924
lnland	.2040906	.040482	5.04	0.000	.1246611	.2835201
vaccess	-.0348664	.0494669	-0.70	0.481	-.1319252	.0621924
pcirr	.1071558	.0609133	1.76	0.079	-.0123617	.2266734
rice	.0053896	.011106	0.49	0.628	-.0164013	.0271806
wheat	-.028722	.0196859	-1.46	0.145	-.0673476	.0099036
milk	.0137693	.0072876	1.89	0.059	-.0005297	.0280683
oil	.0077801	.0038339	2.03	0.043	.0002576	.0153025
egg	.1137676	.0614016	1.85	0.064	-.0067082	.2342433
_cons	7.64048	.2627948	29.07	0.000	7.124852	8.156108

## Impacts of Program Participation in Program Villages

Now, see if program participation matters for households living in program villages. Start with the simple model, and restrict the sample to program villages:

```
reg lexptot dfmfd if progvillf==1 [pw=weight];
```

The result shows that the impact of female participation in microcredit programs on household expenditure in program villages is in fact negative. Female participation lowers per capita expenditure of households in program villages by 7.0 percent.

Regression with robust standard errors	Number of obs	=	1062
	F(1, 1060)	=	3.57
	Prob > F	=	0.0590
	R-squared	=	0.0044
	Root MSE	=	.51788

	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
<b>dfmfd</b>	<b>-.0700156</b>	<b>.0370416</b>	<b>-1.89</b>	<b>0.059</b>	<b>-.1426987</b>	<b>.0026675</b>
_cons	8.519383	.0294207	289.57	0.000	8.461653	8.577112

Now regress the extended model (that is, including other variables that influence the total expenditures):

```
reg lexptot dfmfd sexhead agehead educhead lnland vaccess pcirr rice wheat
milk oil egg if progvillf==1 [pw=weight];
```

By keeping all other variables constant, you can see that female participation becomes positive and is significant at the 10 percent level.

```
Regression with robust standard errors      Number of obs = 1062
                                           F(12, 1049) = 18.69
                                           Prob > F = 0.0000
                                           R-squared = 0.2567
                                           Root MSE = .4498
```

	Robust					
lexptot	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
<b>dfmfd</b>	<b>.0670471</b>	<b>.0354779</b>	<b>1.89</b>	<b>0.059</b>	<b>-.0025687</b>	<b>.1366629</b>
sexhead	-.050392	.0656695	-0.77	0.443	-.1792505	.0784666
agehead	.0025747	.001273	2.02	0.043	.0000768	.0050727
educhead	.0542814	.0056875	9.54	0.000	.0431212	.0654416
lnland	.1641575	.0337974	4.86	0.000	.0978392	.2304758
vaccess	-.0389844	.0498359	-0.78	0.434	-.1367739	.0588051
pcirr	.1246202	.0592183	2.10	0.036	.0084203	.2408201
rice	.0006952	.0103092	0.07	0.946	-.0195338	.0209243
wheat	-.0299271	.0214161	-1.40	0.163	-.0719504	.0120963
milk	.0150224	.0068965	2.18	0.030	.0014899	.0285548
oil	.0076239	.0038719	1.97	0.049	.0000263	.0152215
egg	.105906	.0598634	1.77	0.077	-.0115597	.2233717
_cons	7.667193	.2737697	28.01	0.000	7.129995	8.204392

## Measuring Spillover Effects of Microcredit Program Placement

This exercise investigates whether program placement in villages has any impact on nonparticipants. This test is similar to what was done at the beginning, but it excludes program participants. Start with the simple model and restrict the sample to program villages:

```
reg lexptot progvillf if dfmfd==0 [pw=weight];
```

The result does not show any spillover effects.

```
Regression with robust standard errors      Number of obs = 534
                                           F(1, 532) = 0.00
                                           Prob > F = 0.9525
                                           R-squared = 0.0000
                                           Root MSE = .55686
```

```
-----
                |               Robust
lexptot |           Coef.  Std. Err.   t    P>|t|   [95% Conf. Interval]
-----+-----
progvillf | -.0074135  .1243228  -0.06  0.952  -.2516373  .2368103
   _cons | 8.526796   .1207848   70.59  0.000   8.289523   8.76407
-----
```

Next, run the extended model regression.

```
reg lexptot progvillf sexhead agehead educhead lnland vaccess pcirr rice
wheat milk oil egg if dfmfd==0 [pw=weight];
```

As can be seen from the output that follows, program placement in villages shows no spillover effect after other variables are controlled for:

```
Regression with robust standard errors           Number of obs =    534
                                                F(12, 521) = 17.48
                                                Prob > F = 0.0000
                                                R-squared = 0.3254
                                                Root MSE = .46217
```

```
-----
                |               Robust
lexptot |           Coef.  Std. Err.   t    P>|t|   [95% Conf. Interval]
-----+-----
progvillf | -.0667122  .1048541  -0.64  0.525  -.272701  .1392766
  sexhead | -.0308585   .0919099  -0.34  0.737  -.2114181  .1497011
  agehead | .0037746   .0017717   2.13  0.034  .0002941  .0072551
  educhead | .0529039   .0068929   7.68  0.000  .0393625  .0664453
  lnland   | .2384333   .0456964   5.22  0.000  .1486614  .3282053
  vaccess  | .0019065   .0678193   0.03  0.978  -.1313265  .1351394
  pcirr    | .0999683   .0876405   1.14  0.255  -.0722039  .2721405
  rice     | .0118292   .0171022   0.69  0.489  -.0217686  .045427
  wheat    | -.0111823  .0263048  -0.43  0.671  -.0628588  .0404942
  milk     | .0084113   .0096439   0.87  0.384  -.0105344  .027357
  oil      | .0077888   .0050891   1.53  0.127  -.0022089  .0177866
  egg      | .1374734   .0815795   1.69  0.093  -.0227918  .2977386
   _cons   | 7.347734   .3449001  21.30  0.000  6.670168  8.0253
-----
```

### Further Exercises

Do the same exercise using male participation (“dmmfd”). Discuss the results.

## Notes

1. In reality, such random assignment is not done. The assumption is made just to demonstrate the implementation of randomized impact evaluation.
2. Even though the difference is negative in the output, the impact is interpreted as positive. The negative sign simply means that outcome in program villages (“progvillf=1”) is more than that in nonprogram villages (“progvillf=0”), implying that the participation impact is in fact positive.