

KAIST Summer Session 2018

Module 2. Causal Inference with STATA

Replication (1) Randomized Experiment

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Let's Replicate the Work of Bloom et al. (2015)

The Quarterly Journal of Economics (2015), 165–218. doi:10.1093/qje/qju032.
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DOES WORKING FROM HOME WORK? EVIDENCE FROM A CHINESE EXPERIMENT*

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A rising share of employees now regularly engage in working from home (WFH), but there are concerns this can lead to “shirking from home.” We report the results of a WFH experiment at Ctrip, a 16,000-employee, NASDAQ-listed Chinese travel agency. Call center employees who volunteered to WFH were randomly assigned either to work from home or in the office for nine months. Home working led to a 13% performance increase, of which 9% was from working more minutes per shift (fewer breaks and sick days) and 4% from more calls per minute (attributed to a quieter and more convenient working environment). Home workers also reported improved work satisfaction, and their attrition rate halved, but their promotion rate conditional on performance fell. Due to the success of the experiment, Ctrip rolled out the option to WFH to the whole firm and allowed the experimental employees to reselect between the home and office. Interestingly, over half of them switched, which led to the gains from WFH almost doubling to 22%. This highlights the benefits of learning and selection effects when adopting modern management practices like WFH. *JEL* Codes: D24, L23, L84, M11, M54, O31.

Bloom, N., Liang, J., Roberts, J. and Ying, Z.J., 2015. Does Working from Home Work? Evidence from a Chinese Experiment. *Quarterly Journal of Economics*, 130(1), pp.165-218.

Let's Replicate the Work of Bloom et al. (2015)

- Research question:

Does working from home really increase employee productivity?

- Bloom et al. (2015) conduct a randomized field experiment on the working from home (WFH) at Ctrip, Chinese travel agency.

- Through lottery, call center employees who volunteered to WFH were randomly assigned either to work from home or in the office.



Treatment groups were determined by a lottery



Working at home



Working at home



Working at home

Bloom, N., Liang, J., Roberts, J. and Ying, Z.J., 2015. Does Working from Home Work? Evidence from a Chinese Experiment. *Quarterly Journal of Economics*, 130(1), pp.165-218.

(1) Designing the Final Data Structure First

- Model specification (p. 186)
 - Difference-in-differences (DID) with fixed effects

Between treatment
and control groups

Between prior and during
experimental period

$$Employee\ Performance_{i,t} = \alpha Treat_i \times Experiment_t + \beta_t + \gamma_i + \epsilon_{i,t}$$

where $Treat_i$ is a dummy variable that equals 1 if an individual belongs to the treatment group defined by having an even-numbered birthday; $Experiment_t$ is a dummy variable that equals 1 for the experimental period December 6 to August 14; and $Employee\ Performance_{i,t}$ is one of the key measures of work performance.

- Final panel structure (long panel)

Individual (i)	Time (t)	Dependent var.	Independent var.	...
1	1			
1	2			
1	3			
2	1			
2	2			

(2) Random Assignment of Treatment/Control Groups

- Data collection procedure
 - “Of the 994 employees in the airfare and hotel booking departments, 503 volunteered for the experiment.”
 - “The treatment and control groups were then determined from this (eligible) group of 249 employees through a public lottery.”
- You can get the personnel data (*Personnel Data.xlsx*)

personid	volunteer	treatment	age	tenure	grosswage	children	bedroom	commute	men	married	high_educ
3224	0	0	30	113	3.82	no	no	40	1	0	0
3906	1	1	33	96	2.74	yes	yes	180	0	1	0
4118	0	0	31	94	3.46	yes	no	180	0	1	1
4122	0	1	30	94	4.10	no	no	180	0	0	0
4164	1	0	28	25	7.25	no	yes	65	0	1	1
4252	0	0	29	94	4.06	no	no	140	0	0	1
4448	1	0	35	92	4.27	yes	yes	100	0	1	0
4942	1	1	27	82	5.30	no	yes	160	0	1	0
4944	0	0	25	82	4.48	no	yes	180	0	0	1

(2) Random Assignment of Treatment/Control Groups

- [STATA Practice] Balance check / t-test

	Balance	
	Std-diff	Var-ratio
age	.4670971	1.419163
tenure	.0842273	1.052389
grosswage	.1018474	.6391224
_child	.1320702	1.390025
_bed	1.072657	.1094537
commute	.3691064	1.05527
men	.3718246	1.190454
married	.2261744	1.421783
high_educ	.0995287	.9497115

You need to set the directory where your files are located.

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	393	22.87023	.1555682	3.08402	22.56438	23.17608
1	110	24.45455	.3502975	3.673951	23.76027	25.14882
combined	503	23.2167	.1464464	3.28445	22.92898	23.50442
diff		-1.584316	.3832881		-2.341476	-.8271572
diff = mean(0) - mean(1)						t = -4.1335
Ho: diff = 0						Satterthwaite's degrees of freedom = 154.564
Ha: diff < 0						Pr(T < t) = 0.0000
Ha: diff != 0						Pr(T > t) = 0.0001
Ha: diff > 0						Pr(T > t) = 1.0000

```
cd "E:\Desktop\"
```

```
use "E:\Desktop\STATA_Lab1\Personnel Data.dta"
```

```
encode children, gen(_child)
```

```
replace _child = _child-1
```

```
encode bedroom , gen(_bed)
```

```
replace _bed = _bed-1
```

```
tabstat age tenure grosswage _child _bed commute men married high_educ, by(volunteer)
```

```
ssc install covbal
```

```
covbal volunteer age tenure grosswage _child _bed commute men married high_educ, abs
```

```
covbal treatment age tenure grosswage _child _bed commute men married high_educ if volunteer==1, abs
```

```
ttest age if volunteer==1, by(treatment) unequal
```

```
ttest tenure if volunteer==1, by(treatment) unequal
```

(2) Random Assignment of Treatment/Control Groups

- [STATA Practice] Balance check / t-test

TABLE I
WFH VOLUNTEERS

Dependent variable: volunteer to work from home	(1)	(2)	(3)	(4)	(5)	(6)	(7)	Sample mean
Children	0.123** (0.056)		0.054 (0.083)	0.075 (0.083)	0.081 (0.083)		0.084 (0.084)	0.08
Married ^a		0.095** (0.044)	0.012 (0.065)	0.054 (0.066)	0.052 (0.066)		0.057 (0.068)	0.15
Daily commute (minutes ^a)			0.062** (0.030)	0.062** (0.031)	0.071** (0.032)		0.072** (0.0032)	80.6
Own bedroom			0.095*** (0.035)	0.088** (0.035)	0.089** (0.036)		0.089** (0.037)	0.60
Tertiary education and above				-0.080** (0.033)	-0.088*** (0.033)		-0.086** (0.034)	0.42
Tenure (months ^a)				-0.268*** (0.080)	-0.415*** (0.110)		-0.401*** (0.117)	25.0
Gross wage (¥1,000)					0.048** (0.024)	-0.019 (0.017)	0.048** (0.024)	2.86
Age							-0.002 (0.007)	23.2
Male							0.010 (0.036)	0.32
Number of employees	994	994	994	994	994	994	994	994

^aThe coefficients and standard errors have both been multiplied by 100 for scaling purposes.

dprobit volunteer _child, robust

dprobit volunteer married, robust

dprobit volunteer _child married commute
_bed, robust

dprobit volunteer _child married commute
_bed high_educ tenure, robust

dprobit volunteer _child married commute
_bed high_educ tenure grosswage, robust

dprobit volunteer grosswage, robust

dprobit volunteer _child married commute
_bed high_educ tenure grosswage age men,
robust

sum volunteer _child married commute _bed
high_educ tenure grosswage age men

(3) Measuring the Subjects' Performance

- To evaluate the performance during the experiment, you should collect the employees performance before and during the experimental period.
 - Performance data (*Performance Data_Wide.xlsx*) – This has a wide panel structure.

person	performance201001	performance201002	performance201003	performance201004	performance201005	performance201006
4122	-1.1	0.4	1.0	1.5	-0.1	1.5
4448	-1.1	1.0	1.3	0.7	1.8	0.7
4942	-1.3	-0.4	-0.1	1.9	-1.7	0.6
5614	-0.9	-0.2	0.0	-0.2	0.3	0.2
6278	-3.0	-0.6	0.6	1.3	1.4	1.4
6362	-1.3	0.2	0.9	1.6	0.8	-0.1
7068	-0.6	-0.1	0.6	0.4	0.6	0.5
7720	-3.0	0.4	0.4	-0.1	0.9	-1.2
8522	-0.7	0.1	1.1	0.4	0.7	0.2

- Experiment compliance data (*Experiment Compliance.xlsx*)

personid	year_week	experimentperiod	homethatweek
28560	201001	0	0
26906	201001	0	0
31888	201001	0	0
16424	201001	0	0
6364	201001	0	0
12306	201001	0	0
7720	201001	0	0
29996	201001	0	0

(3) Measuring the Subjects' Performance

- [STATA Practice] Reshaping wide panel to long panel

person	performance201001	performance201002	performance201003
4122	-1.1	0.4	1.0
4448	-1.1	1.0	1.3
4942	-1.3	-0.4	-0.1
5614	-0.9	-0.2	0.0
6278	-3.0	-0.6	0.6
6362	-1.3	0.2	0.9
7068	-0.6	-0.1	0.6
7720	-3.0	0.4	0.4
8522	-0.7	0.1	1.1



personid	year_week	performance
3906	201110	2.717504978
3906	201111	-1.677693725
3906	201113	1.537805915
3906	201114	0.501472831
3906	201115	0.739051223
4122	201110	1.197689533
4122	201111	1.127737641
4122	201112	1.004186153
4122	201113	1.944447756
4122	201114	0.815326512
4122	201115	0.919193864

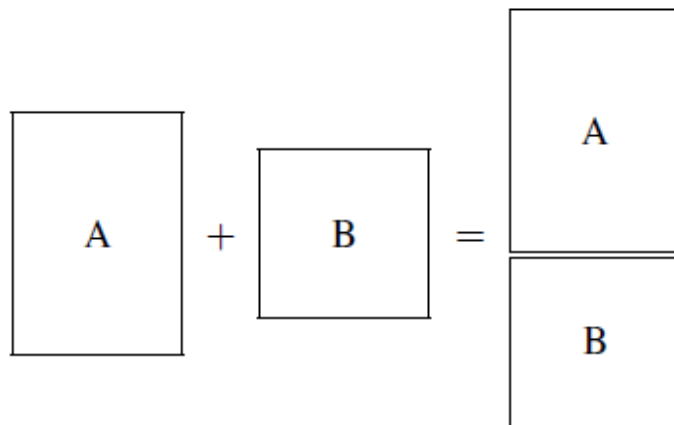
```
import excel "STATA_Lab1\Performance Data_Wide_Shanghai.xlsx", sheet("Sheet1") firstrow clear
```

```
reshape long performance phonecall phonecallraw logphonecall logcallpersec logcalllength logcall_dayworked  
logdaysworked , i(personid) j(year_week)
```

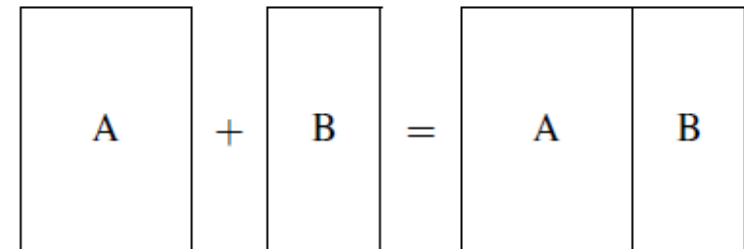
```
save "STATA_Lab1\Performance Data_Shanghai.dta"
```

(3) Measuring the Subjects' Performance

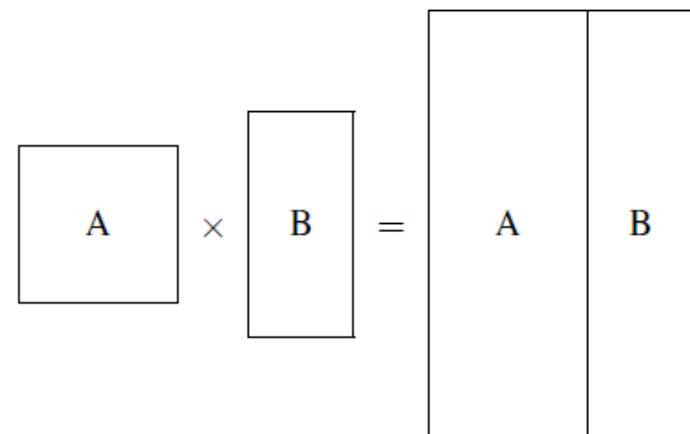
- [STATA Practice] Merging two datasets



Append



Merge



Join

(3) Measuring the Subjects' Performance

- [STATA Practice] Merging two datasets

Individual (i)	Time (t)	Performance Data		Personnel Data	
		Performance	...	Age	...

```

import excel "STATA_Lab1\Experiment Compliance.xlsx", sheet("Sheet1") firstrow clear
merge m:1 personid using "STATA_Lab1\Personnel Data.dta"
drop if _merge==2
drop _merge

merge 1:1 personid year_week using "STATA_Lab1\Performance Data_Shanghai.dta"
drop if _merge==2
drop _merge

save "STATA_Lab1\Final Panel.dta"

```

(4) Intention-to-Treat Effect (ITT)

- [STATA Practice] DID with fixed effects

TABLE II
THE PERFORMANCE IMPACT OF WFH

Dependent variable	(1) Overall performance Pre and during experiment z-score	(2) Overall performance During experiment z-score	(3) Phone calls Pre and during experiment z-score	(4) Phone calls Pre and during experiment log	(5) Phone calls per minute Pre and during experiment log	(6) Minutes on the phone Pre and during experiment log
<i>Experiment_t*Treatment_i</i>	0.232*** (0.063)		0.248*** (0.058)	0.120*** (0.025)	0.032** (0.001)	0.088*** (0.027)
<i>Treatment_i</i>		0.184** (0.086)				
Number of employees	249	249	134	134	134	134
Number of time periods	85	37	85	85	85	85
Individual fixed effects	Yes	No	Yes	Yes	Yes	Yes
Observations	17,806	7,476	9,426	9,426	9,426	9,426

```
use "STATA_Lab1\Final Panel.dta", clear
xtset personid year_week
```

```
reg performance c.experiment_period#c.treatment i.year_week if year_week~=201049 & volunteer==1, cluster(personid)
reg performance c.experiment_period#c.treatment age tenure men married high_educ i.year_week if year_week~=201049 &
volunteer==1, cluster(personid)
```

```
xtreg performance c.experiment_period#c.treatment age tenure men married high_educ i.year_week if year_week~=201049 &
volunteer==1, fe cluster(personid)
xtreg performance c.experiment_period#c.treatment i.year_week if year_week~=201049 & volunteer==1, fe cluster(personid)
reg performance c.experiment_period#c.treatment i.personid i.year_week if year_week~=201049 & volunteer==1, cluster(personid)
```

(5) Average Treatment Effect on the Treated (ATT)

- [STATA Practice] 2-stage least squares (2SLS) using IVs

- Variation from the treatment eventually received (in the first stage) is included in the second stage.

Online Appendix Table O.V: Robustness Check of Table 2 using IV regressions

Dependent Variable	Overall Performance Pre and during experiment	<u>First Stage</u>	
Period		Experiment _i *Treatment _i	0.856*** (0.005)
<u>Dependent Normalization</u>	<u>z-score</u>		
<u>Second Stage</u>			
Experiment _i *WFH _i	0.271*** (0.073)	Number of Employees	249
WFH _i		Number of Weeks	85
		Individual Fixed Effects	Yes
		Observations	17806

```

tab year_week, gen(dum_time)
gen experiment_treatment = c.experiment_period#c.treatment
gen experiment_home = c.experiment_period#c.homethatweek

ssc install xtivreg2
xtivreg2 performance (experiment_home = experiment_treatment) dum_time* if year_week~=201049 & volunteer==1, fe
cluster(personid) first

```

(6) Moderating Effects

- [STATA Practice] Generating interaction terms

TABLE III
WFH PRODUCTIVITY

Variables	(1) Minutes on the phone	(2) Minutes on the phone/days worked	(3) Days worked	(4) Minutes on the phone	(5) Minutes on the phone/days worked	(6) Days worked
$Experiment_i * Treatment_i$	0.088*** (0.027)	0.063*** (0.024)	0.025** (0.012)	0.069** (0.030)	0.049* (0.027)	0.021 (0.013)
$Experiment_i * Treatment_i * [total\ commute > 120\ min]_i$				0.069* (0.036)	0.055* (0.031)	0.014 (0.017)
Number of employees	134	134	134	134	134	134
Number of weeks	85	85	85	85	85	85
Observations	9,426	9,426	9,426	9,426	9,426	9,426

```
sum commute, detail
gen dum_commute120 = 0
replace dum_commute120=1 if commute>120
```

```
xtreg logcalllength c.experiment_period#c.treatment i.year_week if year_week~=201049 & volunteer==1 &
logphonecall~= . & phonecallraw>20, fe cluster(personid)
```

```
xtreg logcalllength c.experiment_period#c.treatment c.experiment_period#c.treatment#c.dum_commute120
i.year_week if year_week~=201049 & volunteer==1 & logphonecall~= . & phonecallraw>20, fe cluster(personid)
```

(7) Ruling out Alternative Explanation (Spillover)

- [STATA Practice] Appending two datasets

		Performance Data		Personnel Data			
		Individual (i)	Time (t)	Performance	...	Age	...
Shanghai	{						
Nantong	{						

```
append using "STATA_Lab1\Performance Data_Nantong.dta", generate(Nantong)
```

(7) Ruling out Alternative Explanation (Spillover)

- [STATA Practice] DID with fixed effects

TABLE IV
THE IMPACT OF WFH AGAINST NAN TONG AND NONEXPERIMENTAL EMPLOYEES

Variables	(1) Overall performance (z-score)	(2) Phone calls (z-score)	(3) Overall performance (z-score)	(4) Phone calls (z-score)
Comparison group	Nan Tong	Nan Tong	Nonexperiment	Nonexperiment
$Experiment_i * treatment_i$	0.194*** (0.047)	0.281*** (0.048)	0.302*** (0.060)	0.312*** (0.064)
$Experiment_i * control_i$	-0.035 (0.048)	-0.011 (0.043)	0.066 (0.061)	0.019 (0.061)
Observations	99,753	86,589	27,823	15,261

```

gen control=0
replace control=1 if treatment==0 & volunteer==1

gen Nantong_sample = 1
replace Nantong_sample = 0 if Nantong==0 & volunteer==0
xtreg performance c.experiment_period#c.treatment c.experiment_period#c.control i.year_week if
year_week~=201049 & Nantong_sample==1, fe cluster(personid)

xtreg performance c.experiment_period#c.treatment c.experiment_period#c.control i.year_week if
year_week~=201049 & Nantong==0, fe cluster(personid)

```


(8) Visualizing the Results

- [STATA Practice] Drawing the scatter plot

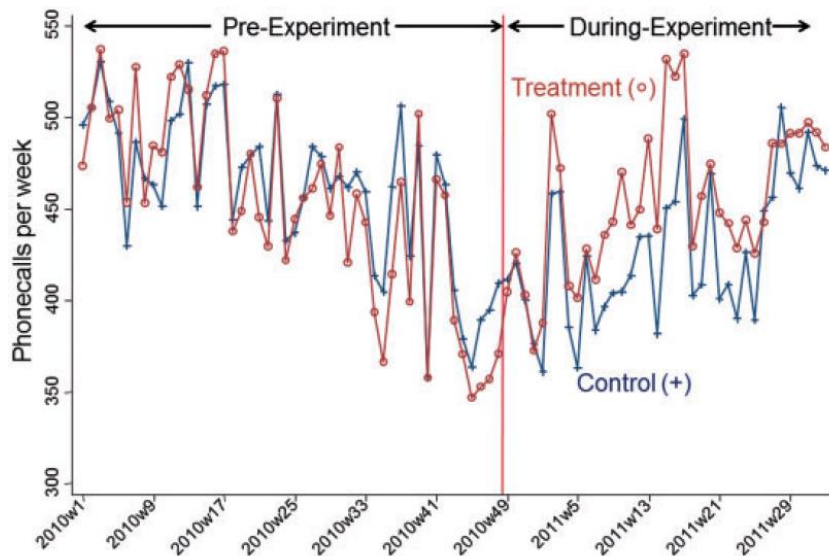


FIGURE VI

Performance of Treatment and Control Employees: Phone Calls

```
use "STATA_Lab1\Final Panel.dta", clear
keep if volunteer==1
collapse phonecallraw (min) date, by(treatment
year_week)
reshape wide phonecallraw date, i(year_week)
j(treatment)

tsset date1
gen wk = wofd(date1)
label var wk "Week"
local condition1 c(1 1) xline(2647.5)
tlabel(,format(%tw)) ms(+) scale(0.8)
local legend1 legend(order(1 "control" 2 "treatment"))
local xlabel xlabel(2600(8)2694, angle(forty_five))
```

```
drop if wk==2600
scatter phonecallraw0 phonecallraw1 wk, `condition1'
ytlabel(" ") ylabel(300(50)550, nogrid) xtitle(" ")
legend(off) graphregion(margin(medium) fcolor(white)
lcolor(none) lwidth(none) lpattern(blank) ifcolor(white)
ilcolor(white) ilwidth(vvvthin)) xlabel(2600(8)2680,
angle(forty_five))
```

(8) Visualizing the Results

- [STATA Practice] Drawing the histogram

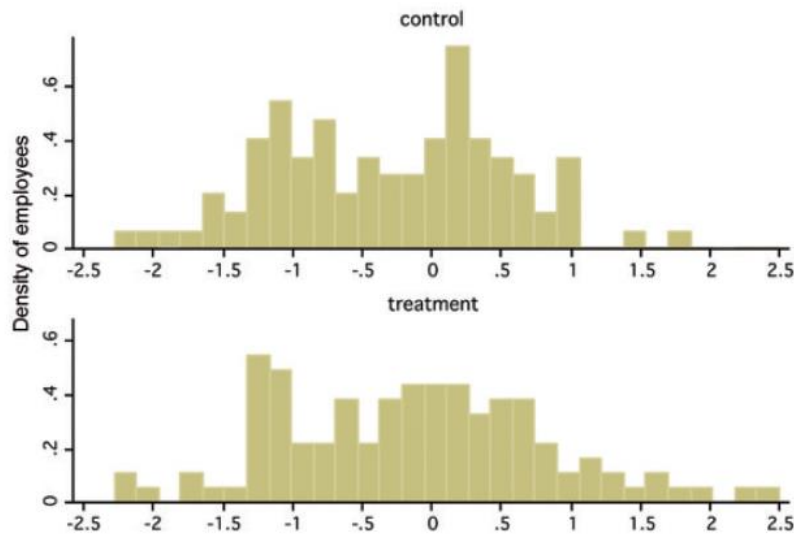


FIGURE VII

Cross-Sectional Performance Spread During the Experiment

```
use "STATA_Lab1\Final Panel.dta", clear
```

```
keep if volunteer==1
```

```
keep if year_week==201109
```

```
gen expgroup=0
```

```
replace expgroup=1 if volunteer==1 & treatment==1
```

```
replace expgroup=2 if volunteer==1 & treatment==0
```

```
label define expgroup 1 "treatment" 2 "control"
```

```
label val expgroup expgroup
```

```
histogram performance, bin(40) by(expgroup, col(1))
ylabel(0(0.2)0.6, nogrid) xlabel(-2.5(0.5)2.5) xtitle(" ")
yttitle(" ") legend(off) scale(0.8)
graphregion(fcolor(white) lcolor(none) ifcolor(white)
ilcolor(none))
```

End of Document