



School of Civil Engineering

CE615 – Statistical and Econometric Methods II

Assignment #3

Three-Stage Least Squares (3SLS)

As in assignment #1, a survey of 206 people was conducted on the campus of Purdue University in the Fall of 2007. One of the key questions of the survey was to find out how fast people drove on interstate highways with speed limits of 55 mph, 65 mph and 70 mph.

As opposed to the seemingly unrelated regression approach used in assignment #1, your task is to try various three-stage least squares forms of this equation system. For a demonstration of the modeling approach, the following equation system is presented as in the example on subsequent pages:

$$\begin{aligned}Speed_{70} &= \lambda_{70-65}Speed_{65} + \beta_{70}Z + \alpha_{70}X + \varepsilon_{70} \\Speed_{65} &= \lambda_{65-70}Speed_{70} + \lambda_{65-55}Speed_{55} + \beta_{65}Z + \alpha_{65}X + \varepsilon_{65} \\Speed_{55} &= \lambda_{55-65}Speed_{65} + \beta_{55}Z + \alpha_{55}X + \varepsilon_{55}\end{aligned}$$

In these equations, $Speed_{70}$, $Speed_{65}$ and $Speed_{55}$ are the number of miles per hour respondents normally drive above the speed limit (with little traffic) for 70, 65, and 55 mph speed limits, respectively. These variables can take on positive values if respondents normally drive above the speed limit and negative values if they normally drive below it. Also in these equations, Z is a vector of driver and driver-household characteristics, X is a vector of vector of driver preferences and opinions, β 's, α 's, are vectors of estimable parameters, λ 's are scalars, and ε 's are disturbance terms. Include:

1. The results of your best model specification.
2. A discussion of the logical process that led you to the selection of your final specification (the theory behind the inclusion of your selected variables). Include t -statistics and justify the signs of your variables.
3. A brief comparison to your SURE results of assignment #1.

PURDUE

UNIVERSITY

A graduate class at Purdue University is undertaking a survey in an attempt to gain a better understanding of public opinions on a wide variety of subjects. We appreciate your time in completing this survey -- your responses will be strictly confidential.

Section A: Your Opinions and Preferences

- ① 1. On an interstate with a 70mph speed limit and little traffic, about how fast do you normally drive? _____ mph
- ② 2. On an interstate with a 65mph speed limit and little traffic, about how fast do you normally drive? _____ mph
- ③ 3. On an interstate with a 55mph speed limit and little traffic, about how fast do you normally drive? _____ mph
- ④ 4. About how many miles per year do you drive? _____ miles/yr
- ⑤ 5. How many vehicle accidents have you had (while driving) in the last 5 years? _____ years
- ⑥ 6. When braking quickly to avoid a collision do you usually?
1 Brake and steer 2 Brake only 3 Not sure/Depends on situation
- ⑦ 7. Do you have:
1 An engineering background 2 No engineering background
- ⑧ 8. When putting on socks and shoes do you normally:
1 Put both socks on then both shoes 2 One sock, one shoe 3 Not sure/Varies
- ⑨ 9. When waking up in the morning, what leg reaches the floor first from bed:
1 Right 2 Left 3 Both legs at the same time 4 Not sure/Varies
- ⑩ 10. Do you prefer to but online or in a store? 1 Online 2 Store 3 No preference
- ⑪ 11. Do you think Britney Spears should get full custody of her kids? 1 Yes 2 No 3 Don't care
- ⑫ 12. Do you prefer an automatic or manual transmission in your vehicle?
1 Automatic 2 Manual 3 No preference
- ⑬ 13. Do you sometimes smoke cigarettes? 1 Yes 2 No
- ⑭ 14. Do you prefer to text or talk on a cell phone? 1 Text 2 Talk 3 No preference
- ⑮ 15. At Purdue (West Lafayette), what is your favorite season?
1 Spring 2 Summer 3 Fall 4 Winter
- ⑯ 16. During severe winter weather (snow) do you use your car or bus? 1 Car 2 Bus 3 Not sure/Varies
- ⑰ 17. In money matters (investments, gambling, etc) do you consider yourself?
1 Conservative 2 Moderate 3 Risky 4 Don't know
- ⑱ 18. What is the first thing you drink in the morning?
1 Water 2 Juice 3 Milk 4 Soft drink 5 Coffee 6 Energy drink 7 Other
- ⑲ 19. Do you normally skip breakfast? 1 Yes 2 No

(Please Turn Over)

Section A: Continued

20. What drives your decision to accept a job offer?
1 Compensation 2 Career progression opportunities 3 Job location 4 Not sure
21. When showering, do you normally use: 1 Body wash 2 Bar soap 3 Unsure
22. While driving and using your cell phone, do you:
1 Use a headset 2 Use one hand on the phone - one hand on wheel 3 Other
4 Do not use phone while driving
23. When your car is the first in line at a traffic signal (dry road) and the light turns green do you normally:
1 accelerate briskly 2 accelerate moderately 3 accelerate slowly
24. What is the fastest that you (as a driver) have ever driven on an interstate, rural or urban road?
1 less than 70mph 2 70-79mph 3 80-89mph 4 90-99mph 5 100-109mph
6 110-119 mph 7 120-129mph 8 130-139mph 9 more than 140mph
-

Section B: Additional Questions About Yourself

25. Are you? 1 Female 2 Male
26. Are you? 1 Married 2 Single 3 Separated 4 Divorced 5 Other
27. What is your age? _____
28. Are you currently?
1 Not affiliated with Purdue 2 Purdue undergraduate 3 Purdue graduate
4 Purdue faculty 5 Purdue staff (other than RA/TA/faculty)
29. What is your highest completed level of education?
1 Some high school 2 High school diploma 3 Technical college degree (A.A.)
4 College degree 5 Post graduate degree
30. Please indicate your Race/Ethnicity
1 African American 2 American Indian 3 Asian 4 Caucasian
5 Hispanic/White 6 Hispanic/Non-white 7 Other 8 I would rather not answer
31. What is the approximate annual household income of the household you consider home?
1 no income 2 under \$10,000 3 \$10,000-\$19,999 4 \$20,000-\$29,999
5 \$30,000-\$39,999 6 \$40,000-\$49,999 7 \$50,000-\$74,999 8 \$75,000-\$100,000 9 Over \$100,000
32. Including yourself, how many people live in the household you consider home? _____
33. How many children, in the household you consider home, are under age 6? _____
34. How many children, in the household you consider home, are aged 6 to 16? _____
35. How many people living, in the household you consider home, work outside the home? _____
36. How many licensed and operable motor vehicles does your "home" household have? _____
37. Are you a licensed driver? 1 Yes 2 No
- 37a. If you are licensed to drive, how many years have you had a license? _____ years
38. Did you lie about your response to any of the previous questions on this survey? 1 Yes 2 No
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40 STUDENT ID (Thank you)

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--> RESET
--> read;nvar=40;nobs=206;file=D:\old_drive_d\new_laptop\CE697N\class-07.txt$
--> skip
--> create;ageL=x27-x38$
--> create;if(ageL>17)late=1$
--> create;if(x25=2)male=1$
--> create;if(x26=1)married=1$
--> create;if(x23=1)brisk=1$
--> create;mo70=x1-70$
--> create;mo65=x2-65$
--> create;mo55=x3-55$
--> dstat;rhs=mo70,mo65,mo55$

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Descriptive Statistics

All results based on nonmissing observations.

Variable	Mean	Std.Dev.	Minimum	Maximum	Cases
MO70	.545365854D+01	.706820401D+02	-.300000000D+02	.200000000D+02	205
MO65	.569024390D+01	.707054116D+02	-.250000000D+02	.250000000D+02	205
MO55	.624757282D+01	.766950686D+01	-.400000000D+02	.250000000D+02	206

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--> reject;x1=-999$
--> reject;x2=-999$
--> reject;x3=-999$
--> reject;x27=-999$
--> reject;x38=-999$
--> reject;x25=-999$
--> reject;x37=2$
--> 3sls;lhs=mo70,mo65,mo55
;eq1=one,mo65,x27,x32,late,brisk,x24
;eq2=one,mo70,mo55,male,x27,x32,late,brisk,x24
;eq3=one,mo65,x33,late,brisk,x24
;Inst= male,married,late,brisk,x4,x5,x24,x27,x28,x29,x31,x32,x34,x35,x37
;maxit=1$
Iteration 0, 3SLS = 1.000000
Iteration 1, 3SLS = 4.265239

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| Estimates for equation: MO70
| InstVar/GLS least squares regression Weighting variable = none
| Dep. var. = MO70 Mean= .2930704644E-01, S.D.= 6.794473367
| Model size: Observations = 194, Parameters = 7, Deg.Fr.= 187
| Residuals: Sum of squares= .1513390291D+04, Std.Dev.= 2.84482
| Fit: R-squared= .823785, Adjusted R-squared = .81813
| (Note: Not using OLS. R-squared is not bounded in [0,1]
| Model test: F[ 6, 187] = 145.70, Prob value = .00000
| Diagnostic: Log-L = -474.5363, Restricted(b=0) Log-L = -646.4980
| LogAmemiyaPrCrt.= 2.126, Akaike Info. Crt.= 4.964
| Durbin-Watson Stat.= 1.6674 Autocorrelation = .1663
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Variable	Coefficient	Standard Error	b/St.Er.	P[Z >z]	Mean of X
Constant	.9357775513E-01	1.3314688	.070	.9440	
MO65	.9987178509	.10897982	9.164	.0000	5.8118557
X27	-.2094563787E-01	.23643033E-01	-.886	.3757	31.505155
X32	-.2427929674E-02	.36452637E-02	-.666	.5054	-2.3350515
LATE	.9906262279	.52205245	1.898	.0578	.45360825
BRISK	.1836041345	.53704651	.342	.7324	.18556701
X24	.2136767481E-02	.20413085E-02	1.047	.2952	-11.185567

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| Estimates for equation: MO65
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InstVar/GLS least squares regression Weighting variable = none
 Dep. var. = MO65 Mean= .2995801892E-01, S.D.= 6.966010273
 Model size: Observations = 194, Parameters = 9, Deg.Fr.= 185
 Residuals: Sum of squares= .1337401960D+04, Std.Dev.= 2.68872
 Fit: R-squared= .850250, Adjusted R-squared = .84377
 (Note: Not using OLS. R-squared is not bounded in [0,1])
 Model test: F[8, 185] = 131.30, Prob value = .00000
 Diagnostic: Log-L = -462.5448, Restricted(b=0) Log-L = -651.3351
 LogAmemiyaPrCrt.= 2.023, Akaike Info. Crt.= 4.861
 Durbin-Watson Stat.= 2.1801 Autocorrelation = -.0900

Variable	Coefficient	Standard Error	b/St.Er.	P[Z >z]	Mean of X
Constant	-.8296691892	.66765470	-1.243	.2140	
MO70	.2777842042	.45350950E-01	6.125	.0000	5.6855670
MO55	.7426994196	.67160643E-01	11.059	.0000	6.6237113
MALE	.2363461971E-02	.97777625E-01	.024	.9807	.63402062
X27	.5839853626E-02	.81523688E-02	.716	.4738	31.505155
X32	.6710412874E-03	.12220426E-02	.549	.5829	-2.3350515
LATE	.9074106967E-01	.44248382	.205	.8375	.45360825
BRISK	-.4924242187	.51456769	-.957	.3386	.18556701
X24	.6083315358E-04	.16478103E-02	.037	.9706	-11.185567

Estimates for equation: MO55
 InstVar/GLS least squares regression Weighting variable = none
 Dep. var. = MO55 Mean= .3414284196E-01, S.D.= 6.920544966
 Model size: Observations = 194, Parameters = 6, Deg.Fr.= 188
 Residuals: Sum of squares= .2157779191D+04, Std.Dev.= 3.38785
 Fit: R-squared= .759113, Adjusted R-squared = .75271
 (Note: Not using OLS. R-squared is not bounded in [0,1])
 Model test: F[5, 188] = 118.49, Prob value = .00000
 Diagnostic: Log-L = -508.9448, Restricted(b=0) Log-L = -650.0647
 LogAmemiyaPrCrt.= 2.471, Akaike Info. Crt.= 5.309
 Durbin-Watson Stat.= 2.1196 Autocorrelation = -.0598

Variable	Coefficient	Standard Error	b/St.Er.	P[Z >z]	Mean of X
Constant	1.086507863	.74220368	1.464	.1432	
MO65	.9721758038	.93633218E-01	10.383	.0000	5.8118557
X33	-.1573534675E-01	.21143606	-.074	.9407	.22164948
LATE	-.4917392292	.54707789	-.899	.3687	.45360825
BRISK	.5946284565	.63250110	.940	.3472	.18556701
X24	-.8728622155E-03	.19871920E-02	-.439	.6605	-11.185567