~~10~~ 20 minutes on marginal models

Marginal Models / Population Average Models / Generalized Estimating Equations / Robust Standard Errors / Clustered Data

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Population Ave Model / Marginal Models

- Motivation for thinking about these approaches:
  - Not really been adopted in British Sociology

- Population average models/Marginal Modelling/GEE approaches are developing rapidly. They might be useful for estimating a policy or ‘social group’ differences

- Population average models are becoming more popular (Pickles – preference in USA in public health)

- Is a model that accounts for clustering between individual observations adequate?

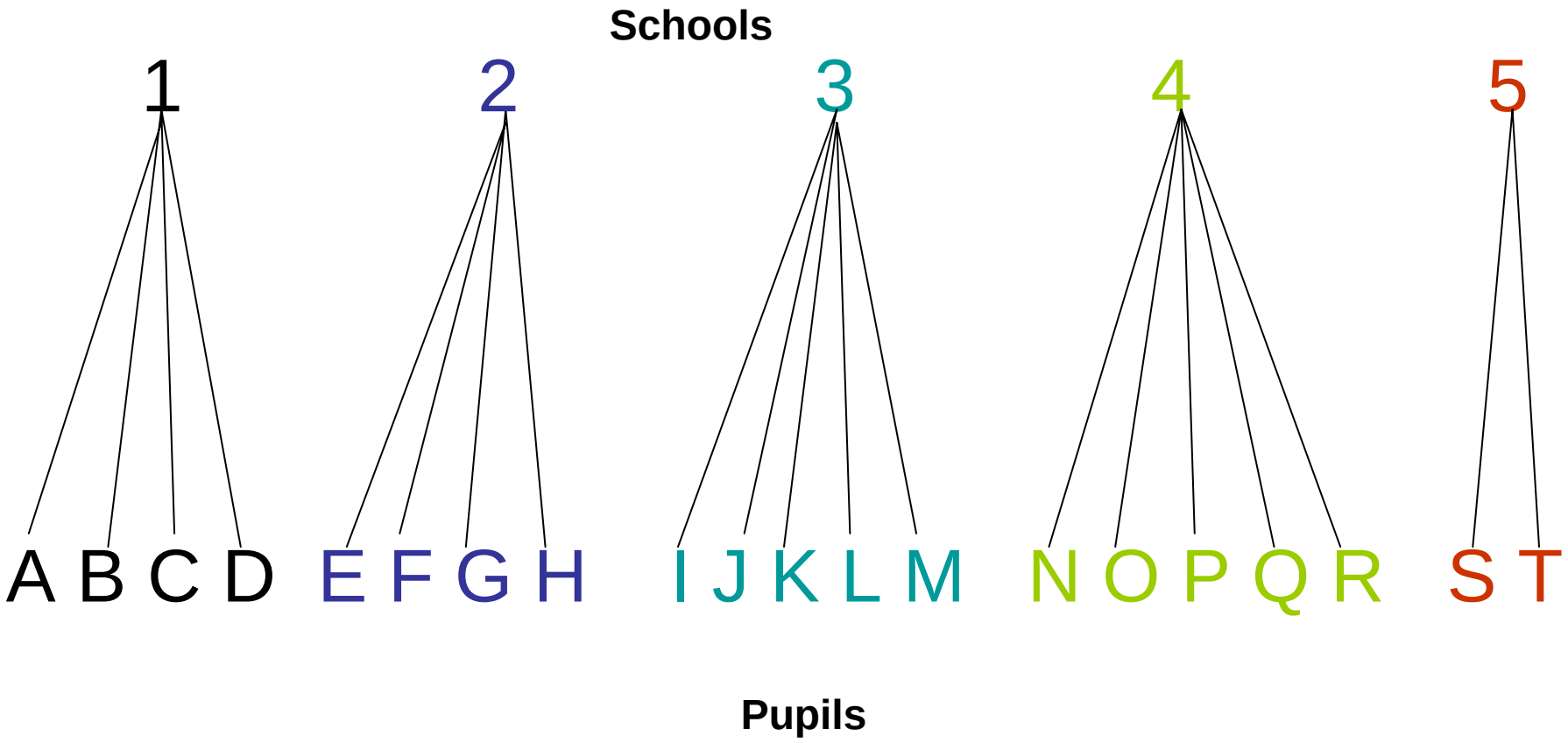
Simple pop. average model:

regress y x1, cluster(id)

Data Structures

- Clustering is part of the substantive story
  - e.g. orthodox hierarchical (or multi-level) situation, pupils nested in schools
- Clustering as nuisance
  - e.g. geography is noise

Orthodox Hierarchical Data Structure



Data Example

An extract of data from The Institute of Education Class Size Project

n = 4873

schools = 172 (pupils mean=28;min=1; max=88);

y = Post reception class literacy score;

mean=.0200968;

95% c.i. *-.0081184, .048312*

min=-2.801403;

max=2.691811

Data Example

X Vars

Pre-school literacy score *(different test to y var)*

mean=.0229606;

95% c.i. -.0044204, .0503417

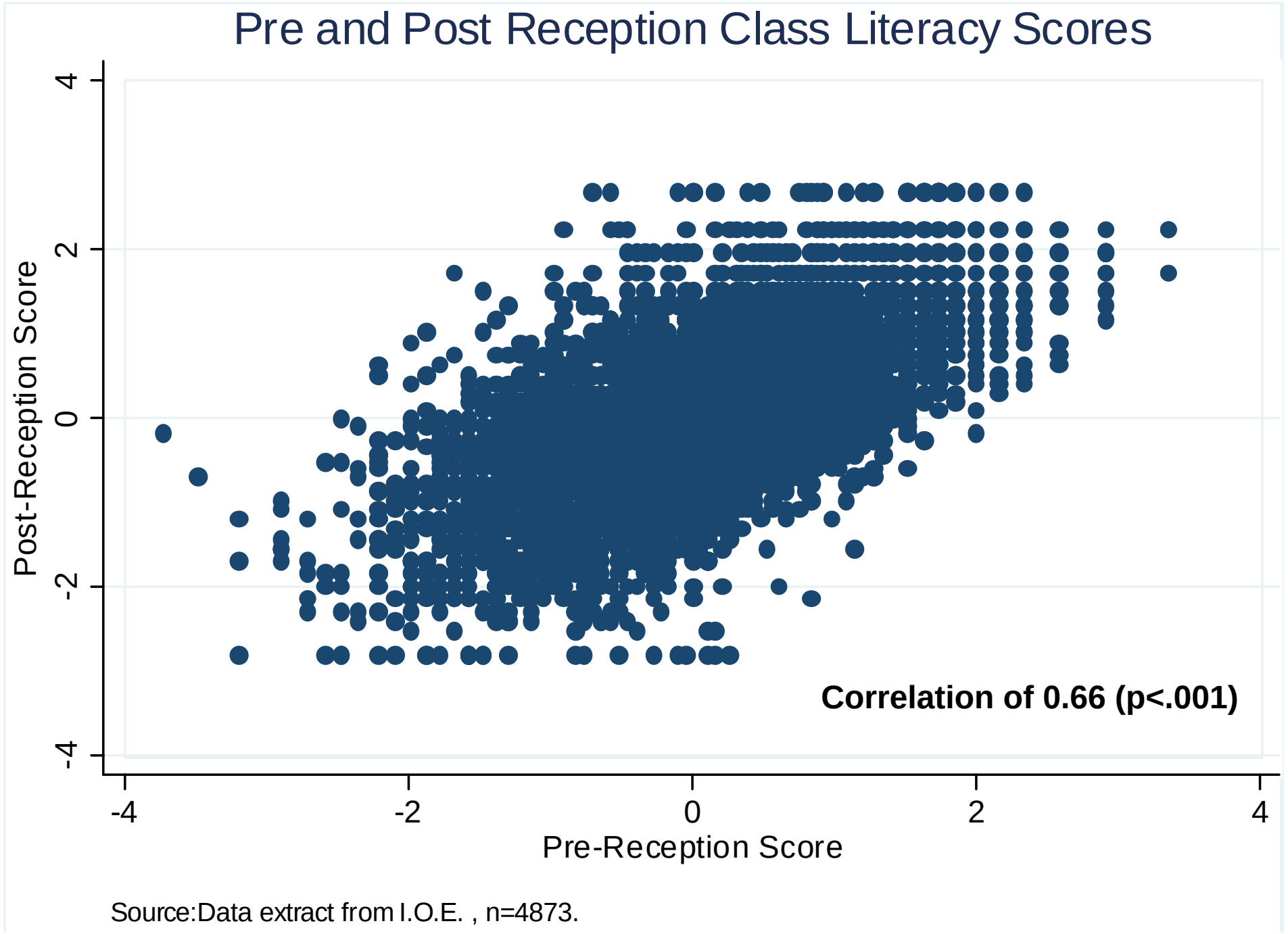
min= -.733834;

max= 3.355553;

Boys (52%)

Term of entry [Spring/Summer] (22%)

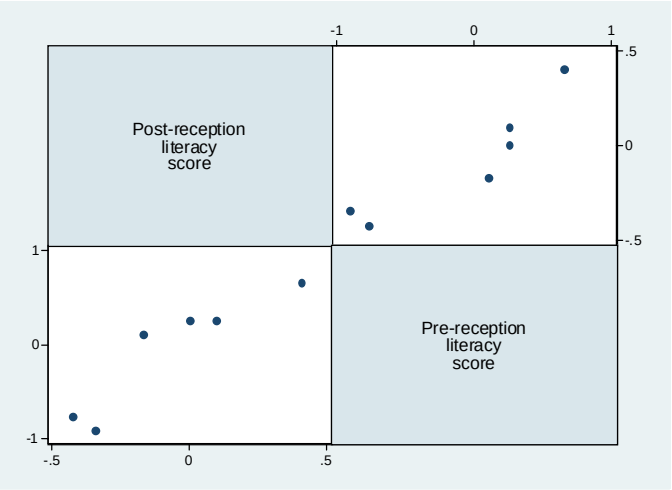
Free school meals (17%)



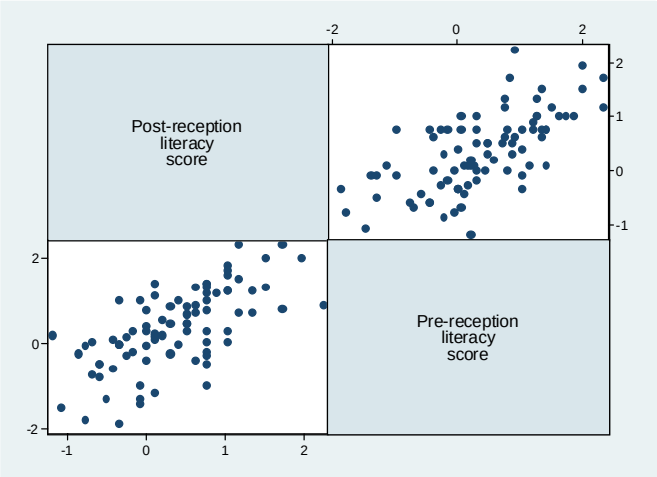
Source:Data extract from I.O.E. , n=4873.

Illustration of Four Schools

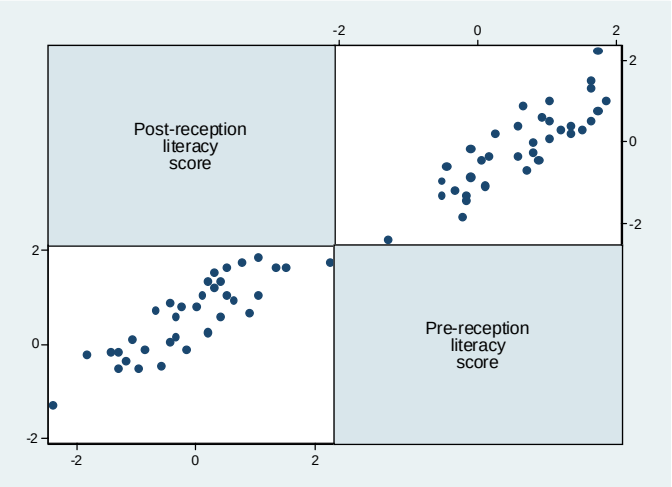
School 62



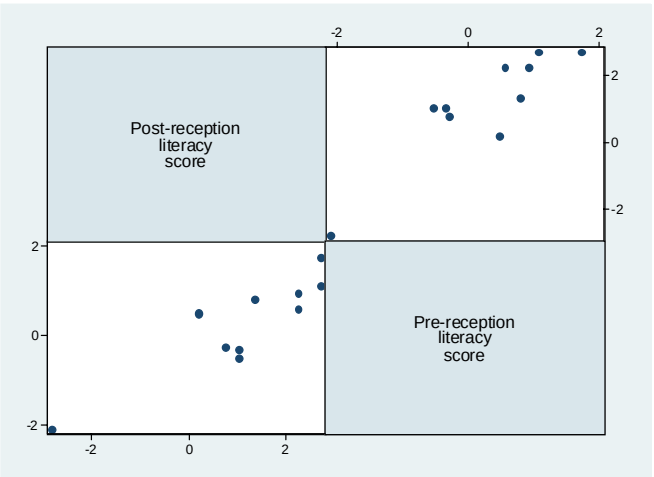
School 88



School 146



School 153



	(1)		(2)	
	Regression		Cluster	
Pre-reception literacy score	0.6704	***	0.6704	***
	(0.011)		(0.022)	
Eligible for free school meals	-0.1099	***	-0.1099	**
	(0.028)		(0.050)	
Boys	-0.0861	***	-0.0861	***
	(0.021)		(0.021)	
Term of school entry (Spr/Summer)	-0.5764	***	-0.5764	***
	(0.025)		(0.056)	
Constant	0.1965	***	0.1965	***
	(0.017)		(0.045)	
Observations	4873		4873	

Standard errors in parentheses
* p<.10, ** p<.05, *** p<.01

	(1)		(2)		(3)	
	Regression		Cluster		Svy	
Pre-reception literacy score	0.6704	***	0.6704	***	0.6704	***
	(0.011)		(0.022)		(0.022)	
Eligible for free school meals	-0.1099	***	-0.1099	**	-0.1099	**
	(0.028)		(0.050)		(0.050)	
Boys	-0.0861	***	-0.0861	***	-0.0861	***
	(0.021)		(0.021)		(0.021)	
Term of school entry (Spr/Summer)	-0.5764	***	-0.5764	***	-0.5764	***
	(0.025)		(0.056)		(0.056)	
Constant	0.1965	***	0.1965	***	0.1965	***
	(0.017)		(0.045)		(0.045)	
Observations	4873		4873		4873	

Standard errors in parentheses
* p<.10, ** p<.05, *** p<.01

	(1)		(2)		(3)	
	cluster		xtreg pa		xtgee	
Pre-reception literacy score	0.6704	***	0.7229	***	0.7229	***
	(0.022)		(0.010)		(0.010)	
Eligible for free school meals	-0.1099	**	-0.0844	***	-0.0844	***
	(0.050)		(0.027)		(0.027)	
Boys	-0.0861	***	-0.0538	***	-0.0538	***
	(0.021)		(0.018)		(0.018)	
Term of school entry (Spr/Summer)	-0.5764	***	-0.5376	***	-0.5376	***
	(0.056)		(0.029)		(0.029)	
Constant	0.1965	***	0.2099	***	0.2099	***
	(0.045)		(0.034)		(0.034)	
Observations	4873		4873		4873	

Standard errors in parentheses
* p<.10, ** p<.05, *** p<.01

	(1)		(2)		(3)	
	Regression		xtgee		Random effects	
Pre-reception literacy score	0.6704	***	0.7229	***	0.7238	***
	(0.011)		(0.010)		(0.010)	
Eligible for free school meals	-0.1099	***	-0.0844	***	-0.0833	***
	(0.028)		(0.027)		(0.026)	
Boys	-0.0861	***	-0.0538	***	-0.0533	***
	(0.021)		(0.018)		(0.017)	
Term of school entry (Spr/Summer)	-0.5764	***	-0.5376	***	-0.5358	***
	(0.025)		(0.029)		(0.029)	
Constant	0.1965	***	0.2099	***	0.2097	***
	(0.017)		(0.034)		(0.036)	
Observations	4873		4873		4873	

Standard errors in parentheses
* p<.10, ** p<.05, *** p<.01

xt Regression Approach

Fixed or Random effects estimators

- Fierce debate
  - F.E. β will tend be consistent
  - R.E. standard errors will be efficient but β may not be consistent
  - R.E. assumes no correlation between observed X variables and unobserved characteristics

xt Regression Approach

Fixed or Random effects

– Economists tend towards F.E.
(attractive property of consistent β)

– With continuous Y – little problem, fit both F.E. and R.E. models and then Hausman test $\beta_{f.e.} / \beta_{r.e.}$

(don't be surprised if it points towards F.E. model)

(Steve Pudney's suggestion)

	(1) Fixed effects (b)		(2) Random Effects (B)	
Pre-reception literacy score	0.7285	***	0.7238	***
	(0.010)		(0.010)	
Eligible for free school meals	-0.0774	***	-0.0833	***
	(0.026)		(0.026)	
Boys	-0.0511	***	-0.0533	***
	(0.017)		(0.017)	
Term of school entry (Spr/Summer)	-0.5252	***	-0.5358	***
	(0.030)		(0.029)	
Constant	0.1602	***	0.2097	***
	(0.015)		(0.036)	
Observations	4873		4873	

Standard errors in parentheses
•p<.10, ** p<.05, *** p<.01

Hausman Test: Ho: difference in coefficients not systematic

chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 26.49
Prob>chi2 = 0.0000

xt Regression Approach

Fixed or Random effects estimators

- Preference for Random Effects (RE) models in some areas (e.g. education studies)

- Frequent criticism – A key assumption in RE models is than random effects are uncorrelated with the observed variables in the model

- In practice this assumption goes untested and could potentially result in biased estimates (see Halaby 2004 *Ann. Rev. Sociology 30)*

Comparing Models

- Pre-reception lit score difference between regression β and
  - xtgee β -.0525
  - f.e. β -.0581
  - r.e. β -.0534

Remember that

y = Post reception class literacy score;

min=-2.801403; max=2.691811

Conclusion

- Clustering is sometimes part of the substantive story
  - e.g. orthodox hierarchical (or multi-level) situation, pupils nested in schools

- Explicitly modelling hierarchical structure may be desirable
  - Ironically, in this example even with ‘highly’ clustered data (rho=.34) we would tell a similar story which ever model we used (strength of coefficient, signs & significance)

Conclusion

- Population average models/Marginal Modelling/GEE might be useful for estimating a policy or ‘social group’ differences

  – Is the ‘average’ effect for a group the substantively more interesting or more important for informing policy or practice

Conclusion

- Some estimators (xtprobit) don’t have F.E. equivalents (xtlogit F.E. is not equivalent to R.E.)

- Here population average approaches might be attractive since a key assumption in RE models is than random effects are uncorrelated with the observed variables in the model and this can’t be formally tested