The effects of different specifications of standard deviations in the MXL model

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Operationalizing standard deviations

– Random parameter's distribution typically simulated in the following way:

$$B_i = m + s \cdot \varepsilon_i$$

  – ε_i – standard normal draws (mean = 0, s.d. = 1)
  – parameters:
    – m – mean
    – s – standard deviation

– This is the way it is operationalized in NLOGIT, STATA, Train's code etc.

– Issues:
  – s can be positive or negative (optimizer can go both ways)
  – Common suggestion – "just ignore the sign"
  – Draws are likely not ideally symmetric – positive or negative s can perform differently (fit better or worse)
    – … but it does not seem completely 'fair', as there more possible parameter values than it seems (additional 'flip signs of your draws' option for improving LL)

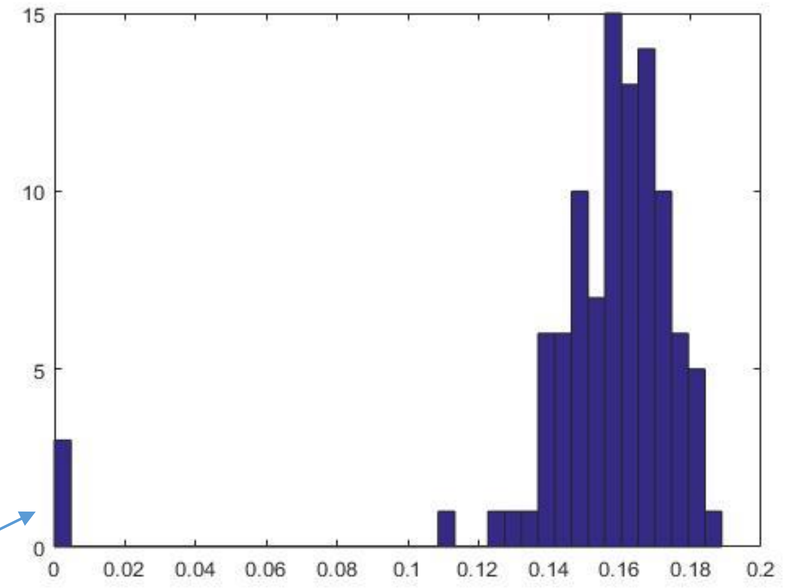
Estimates at the boundary of parameter space

- What if we need to test if s.d. = 0
  - Testing if the coefficient of s.d. = 0 is a restriction at the boundary of parameter space and hence not all tests may be equally suitable
    (McFadden, D., and Train, K., 2000. Mixed MNL Models for Discrete Response. Journal of Applied Econometrics, 15(5):447-470)
  - With linear specification of *s* – discontinuity at 0 (changing the sign for draws)

- Alternatives – more 'fair' and dealing with this problem?
  - $B_i = m + |s| \cdot \varepsilon_i$ – still 'at the boundary' problem
  - $B_i = m + \exp(s) \cdot \varepsilon_i$ – still 'at the boundary' problem
  - $B_i = m + s^2 \cdot \varepsilon_i$

Monte-Carlo comparison

- GDP: MXL, no correlations, different designs (OOD, MNL, MXL), number of choice tasks, number of respondents
- Interesting pattern for specifications with 'constrained' s.d. parameters:
  - s.d. generally recovered
  - But every once in a while s.d. = 0
  - This is not happening for linear specification of s.d. parameter!



Significant peak at 0

Monte-Carlo comparison

- Less 0 peaks if ‘enough’ draws are taken
  - How many draws required for no peaks to occur?

MXL	NP = 400, CT = 4	NP = 800, CT = 4	NP = 1200, CT = 4	NP = 400, CT = 8	NP = 800, CT = 8	NP = 1200, CT = 8	NP = 400, CT = 12	NP = 800, CT = 12	NP = 1200, CT = 12
PMC	2000	1000	200	1000	500	100	500	500	100
MLHS	5000	500	100	1000	200	200	200	200	100
RHS	1000	500	100	500	100	200	200	200	200
SOB	500	500	100	500	200	100	200	500	200

- So it is not the “**conventional wisdom to fix at least one parameter in estimation**” (Chiou, L., and Walker, J. L., 2007. Masking identification of discrete choice models under simulation methods. *Journal of Econometrics*, 141(2):683-703.), which actually does not seem true

Monte-Carlo comparison

– Do the 0 peaks happen for all s.d. specifications?

	s^2	*exp*(*s*)	constrained optimization	linear	full covariance
The share of identified 0 s.d.	10.8%	10.2%	10.7%	0.0%	0.0%

– Conclusions:
  - ?
  - For now, we reverted to using linear specification
    - Does not seem 'fair' to have the additional option to switch signs of your draws
    - But the results more similar to the 'full covariance' case