

Psychometric meta-analysis

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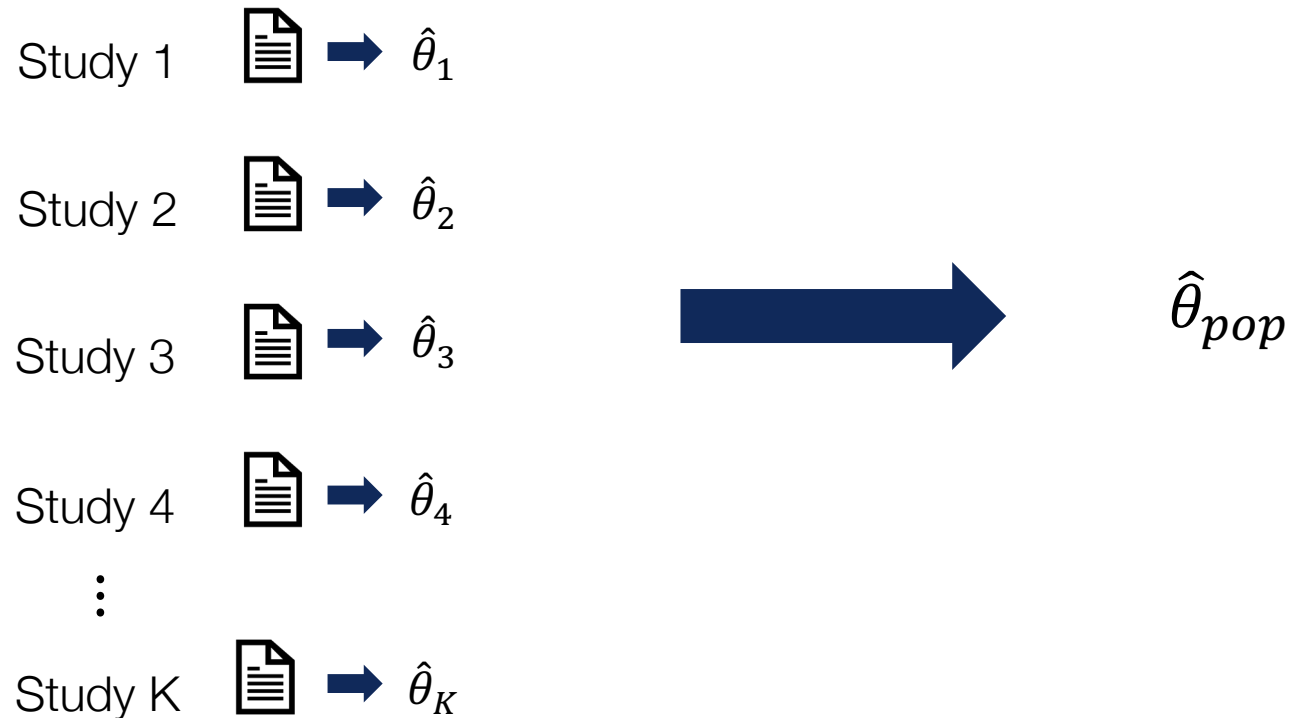
October 14, 2026

Outline

- Meta-analysis
- Example: Meta-analysis of correlations
- Psychometric meta-analysis
 - Small-study bias
 - Artificial dichotomization
 - Measurement error
 - Range restriction
- Example: Psychometric meta-analysis

Meta-analysis

- The goal of meta-analysis is to pool effect sizes across studies to summarize the overall evidence regarding a phenomenon of interest.



Meta-analysis of correlations

- . webuse adherence, clear
- . meta esize rho n, correlation
- . meta summarize, subgroup(design)
- . meta forestplot
- . meta galbraith
- . meta regress i.(design quality) meanage

Psychometric meta-analysis

- Psychometric meta-analysis corrects correlations and their associated standard errors for
 - Small-study bias
 - Artificial dichotomization
 - Measurement error
 - Range restriction
- By eliminating the distorting effects of these statistical artifacts, we can obtain more accurate estimates of the mean correlation and the between-study variance (Schmidt and Hunter, 2015).

Introducing meta psycorr

- The meta psycorr command was added as part of the StataNow 19 release on January 28, 2026.

```
.meta psycorr rho n, options
```

- It is completely integrated into Stata's meta suite, including support for plots and subgroup analysis.

A simple dataset

```
. clear

. set obs 1000
Number of observations (_N) was 0, now 1,000.

. matrix input R = (1,.5,.2\ .5,1,.3\ .2,.3,1)

. drawnorm x y z, corr(R) seed(12345)

. correlate x y z
(obs=1,000)
```

	x	y	z
x	1.0000		
y	0.4938	1.0000	
z	0.2422	0.3132	1.0000

Small-study bias

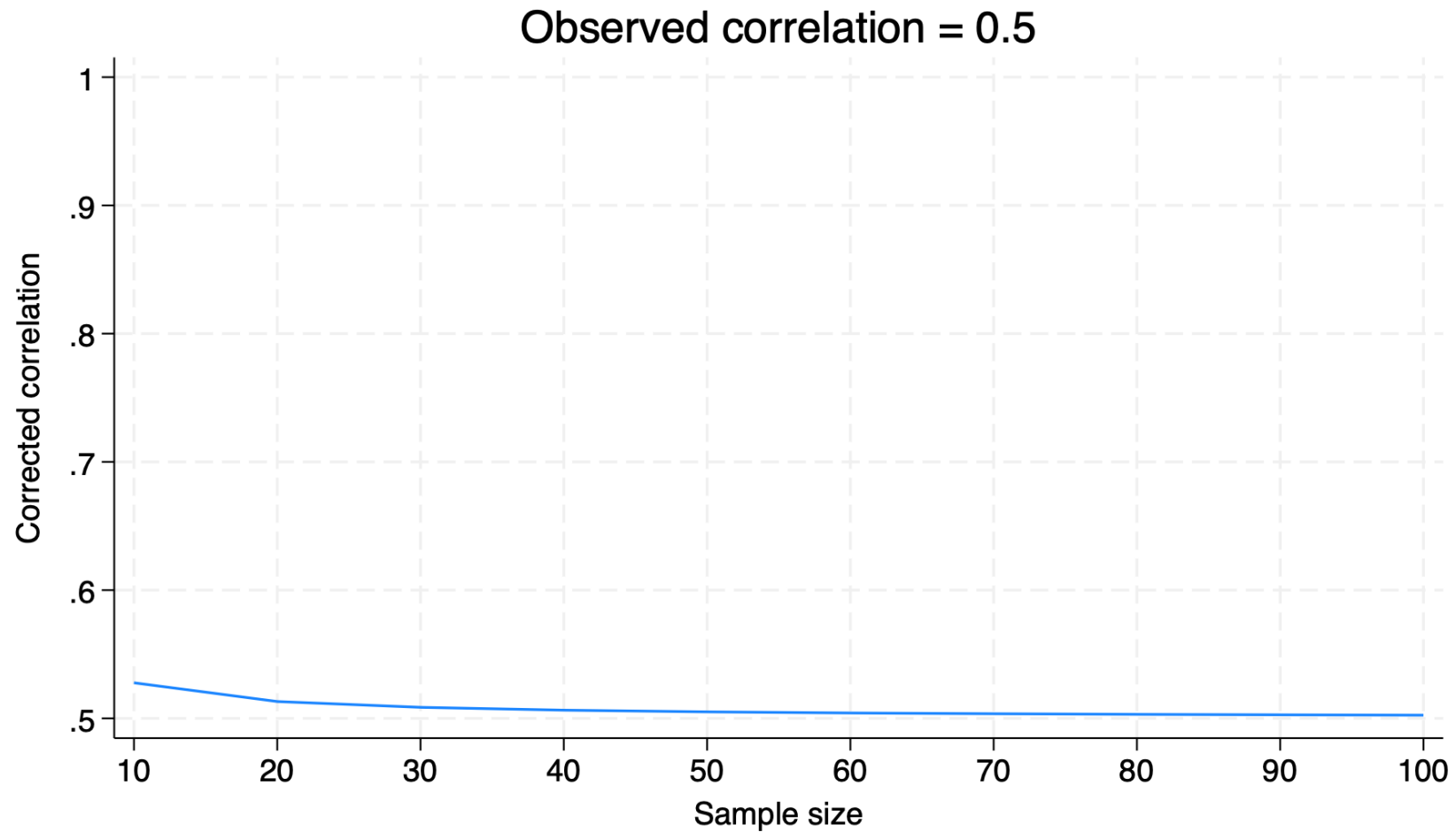
- Sample correlation typically exhibits a small negative bias, which is practically negligible for studies with sample sizes of 20 or more (Schmidt, Le, and Oh 2019, 320).
- The attenuation factor of small-study bias and the corresponding corrected correlation are given by

$$a_{bias} = \frac{2n - 2}{2n - 1}$$

$$\rho_{corrected} = \frac{\rho}{a_{bias}}$$

```
. meta psycorr rho n, small
```

Small-study bias



Artificial dichotomization

- Dichotomization of a continuous variable results in a correlation that is lower than the correlation originally observed when both variables were treated as continuous.

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 - In addition, some studies may report t tests rather than correlation coefficients. We can convert t statistics to correlation coefficients by

$$r = \frac{t}{\sqrt{t^2 + df}}$$

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 - In addition, some studies may report t tests rather than correlation coefficients. We can convert t statistics to correlation coefficients by

$$r = \frac{t}{\sqrt{t^2 + df}}$$

- **Example:** You would like to know the correlation between score on a skills test and job performance, but job performance was only measured in two categories: satisfactory and unsatisfactory.

Artificial dichotomization

```
. egen x_dich = cut(x), group(2)
```

```
. correlate x* y  
(obs=1,000)
```

	x	x_dich	y
x	1.0000		
x_dich	0.7889	1.0000	
y	0.4938	0.3852	1.0000



Artificial dichotomization

```
. egen x_dich = cut(x), group(2)
```

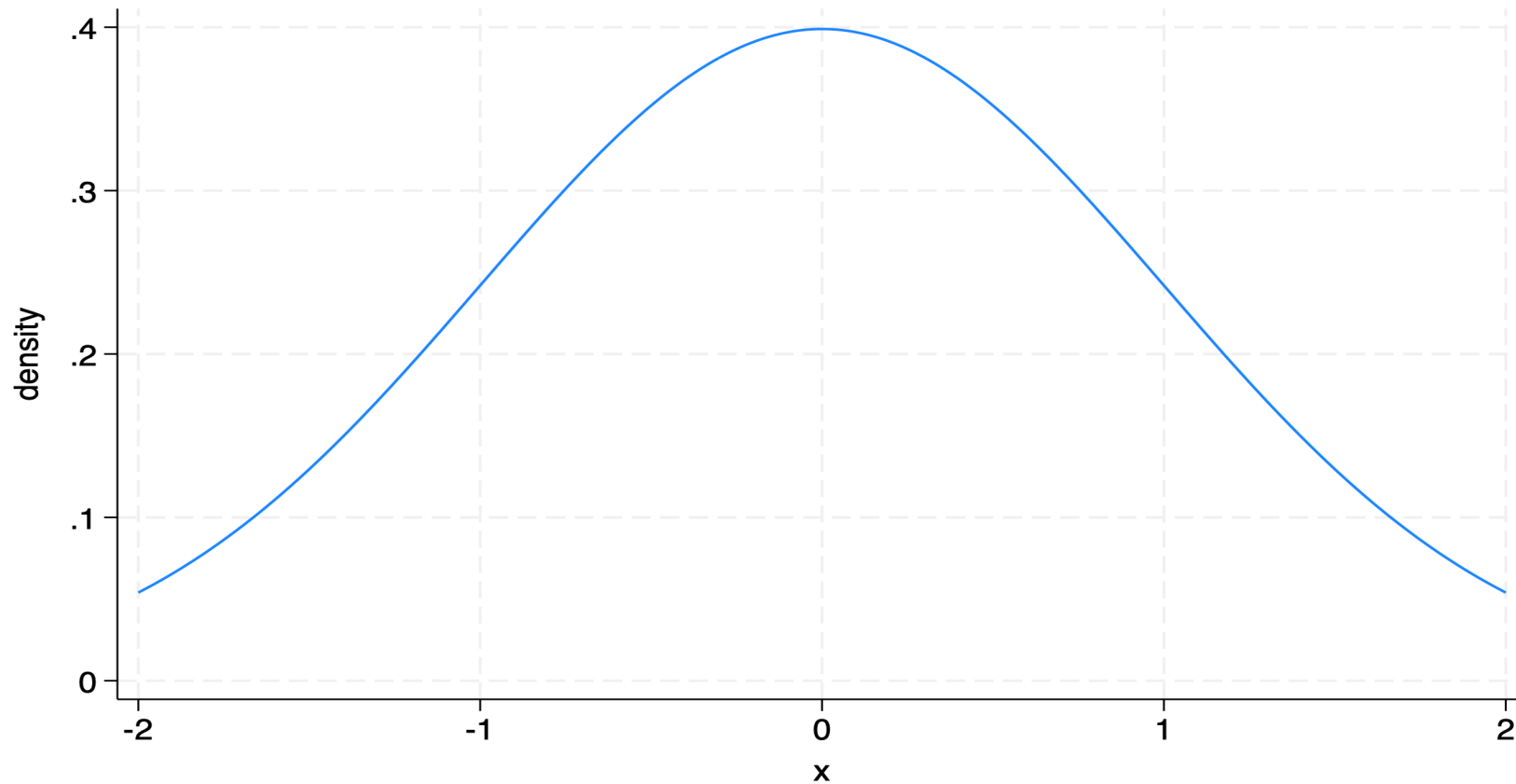
```
. correlate x* y  
(obs=1,000)
```

	x	x_dich	y
x	1.0000		
x_dich	0.7889	1.0000	
y	0.4938	0.3852	1.0000

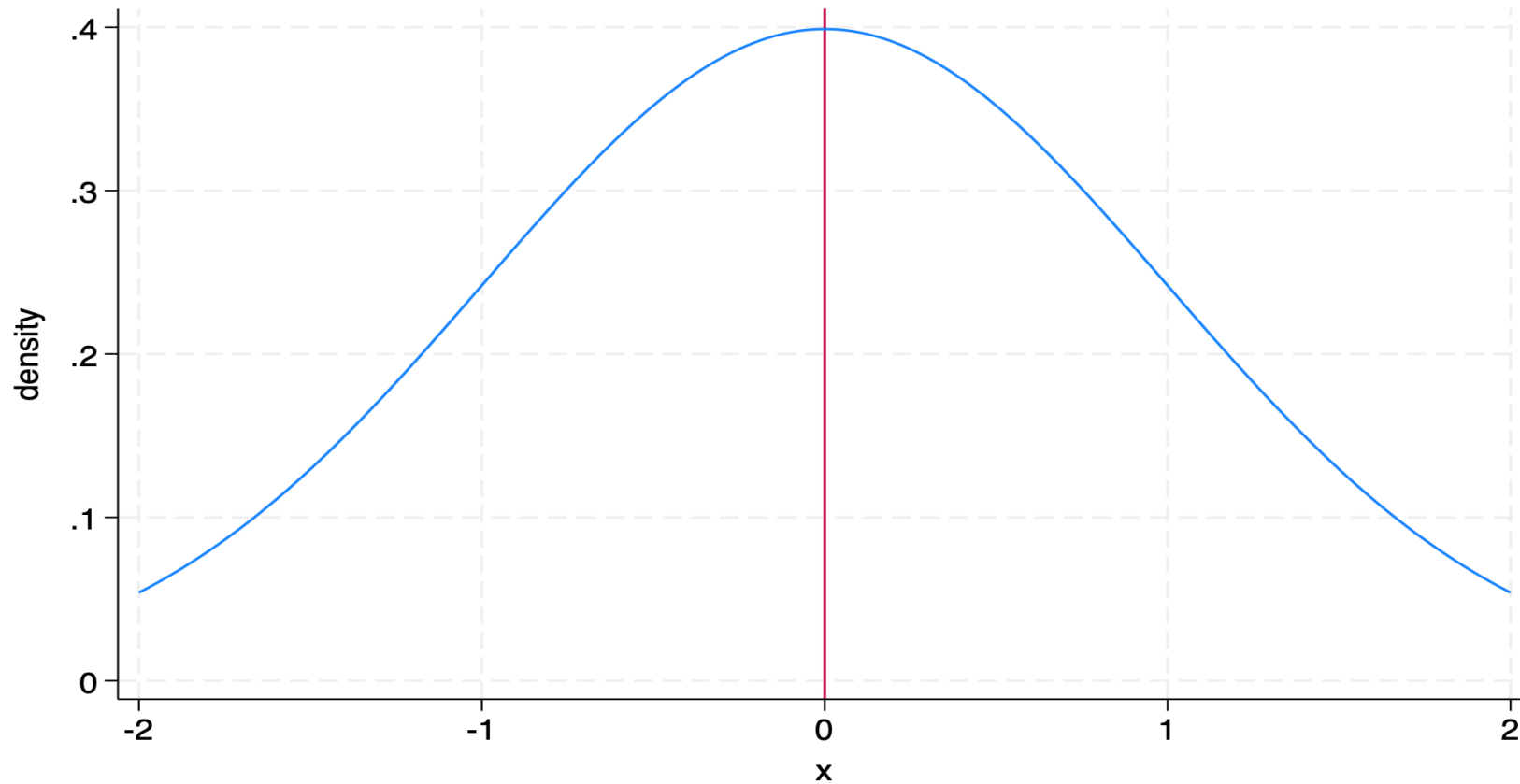
```
. summarize x_dich
```

Variable	Obs	Mean	Std. dev.	Min	Max
x_dich	1,000	.5	.5002502	0	1

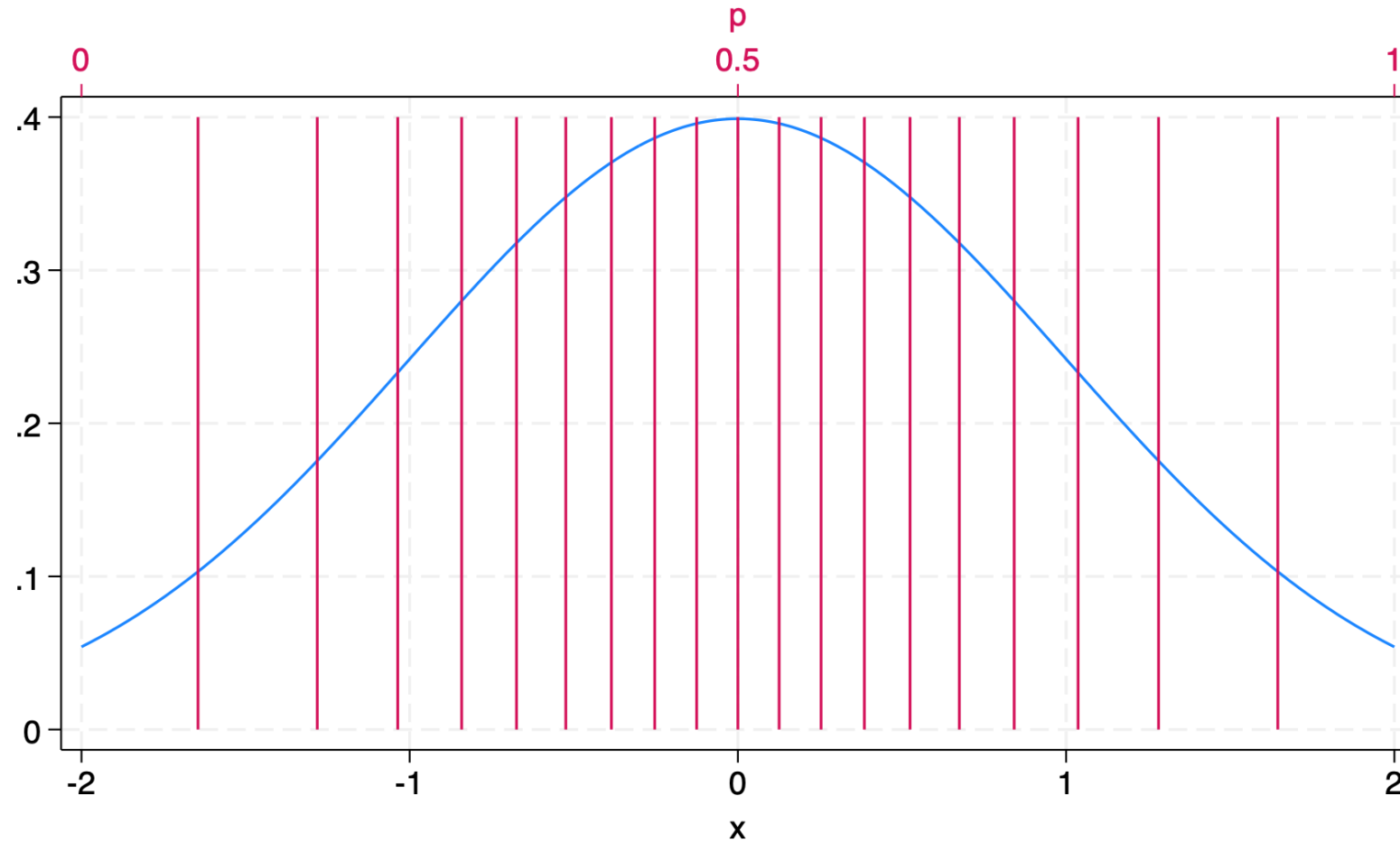
Artificial dichotomization



Artificial dichotomization



Artificial dichotomization



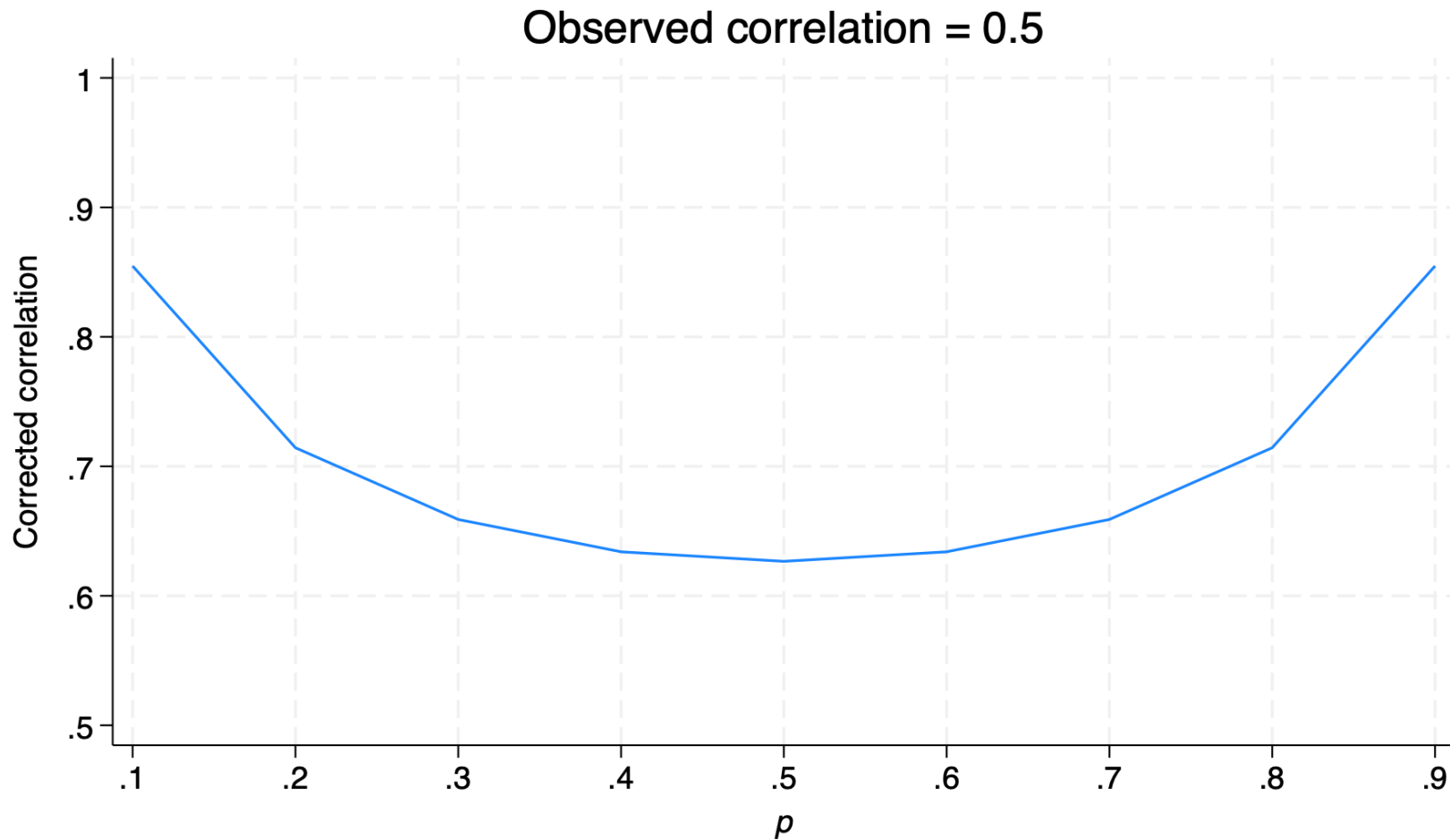
Artificial dichotomization

- When a proportion p of the observations is assigned to one of the two levels of the binary variable, the attenuation factor of dichotomization and corresponding corrected correlation are given by

$$a_{dich} = \frac{\phi\{\Phi^{-1}(p)\}}{\sqrt{p(1-p)}} \quad \rho_{corrected} = \frac{\rho}{a_{dich}}$$

```
. meta psycorr rho n, xdich(px) ydich(py)
```

Artificial dichotomization

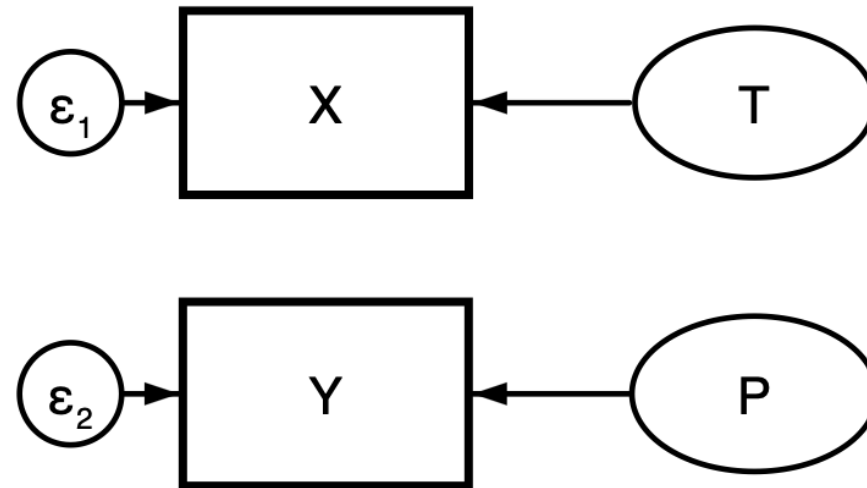


Measurement error

- Measurement error commonly occurs when using tests or assessments to measure constructs.
- If constructs are not measured perfectly, then the correlation coefficient is attenuated.

Measurement error

- **Example:** Job performance is not perfectly measured. The score (X) is a combination of their true performance (T) and measurement error (ε_1).



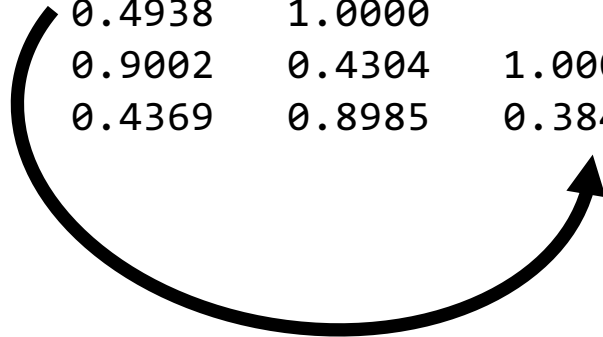
Measurement error

```
. generate x_me = x+rnormal(0,.5)
```

```
. generate y_me = y+rnormal(0,.5)
```

```
. correlate x y x_me y_me  
(obs=1,000)
```

	x	y	x_me	y_me
x	1.0000			
y	0.4938	1.0000		
x_me	0.9002	0.4304	1.0000	
y_me	0.4369	0.8985	0.3849	1.0000



Measurement error

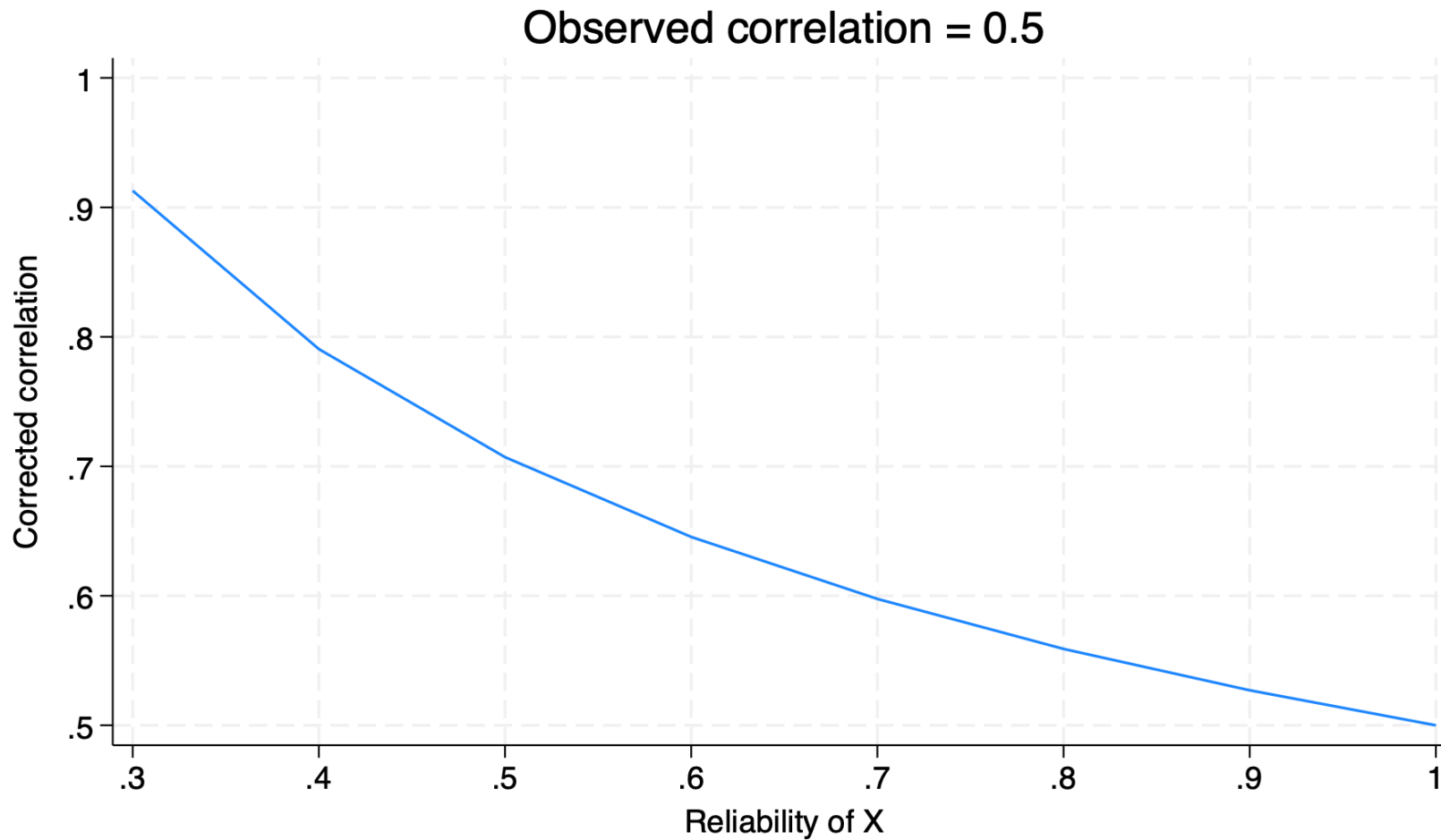
- The corrected correlation is given as

$$\rho_{TP} = \frac{\rho_{XY}}{\sqrt{r_{XX}r_{YY}}}$$

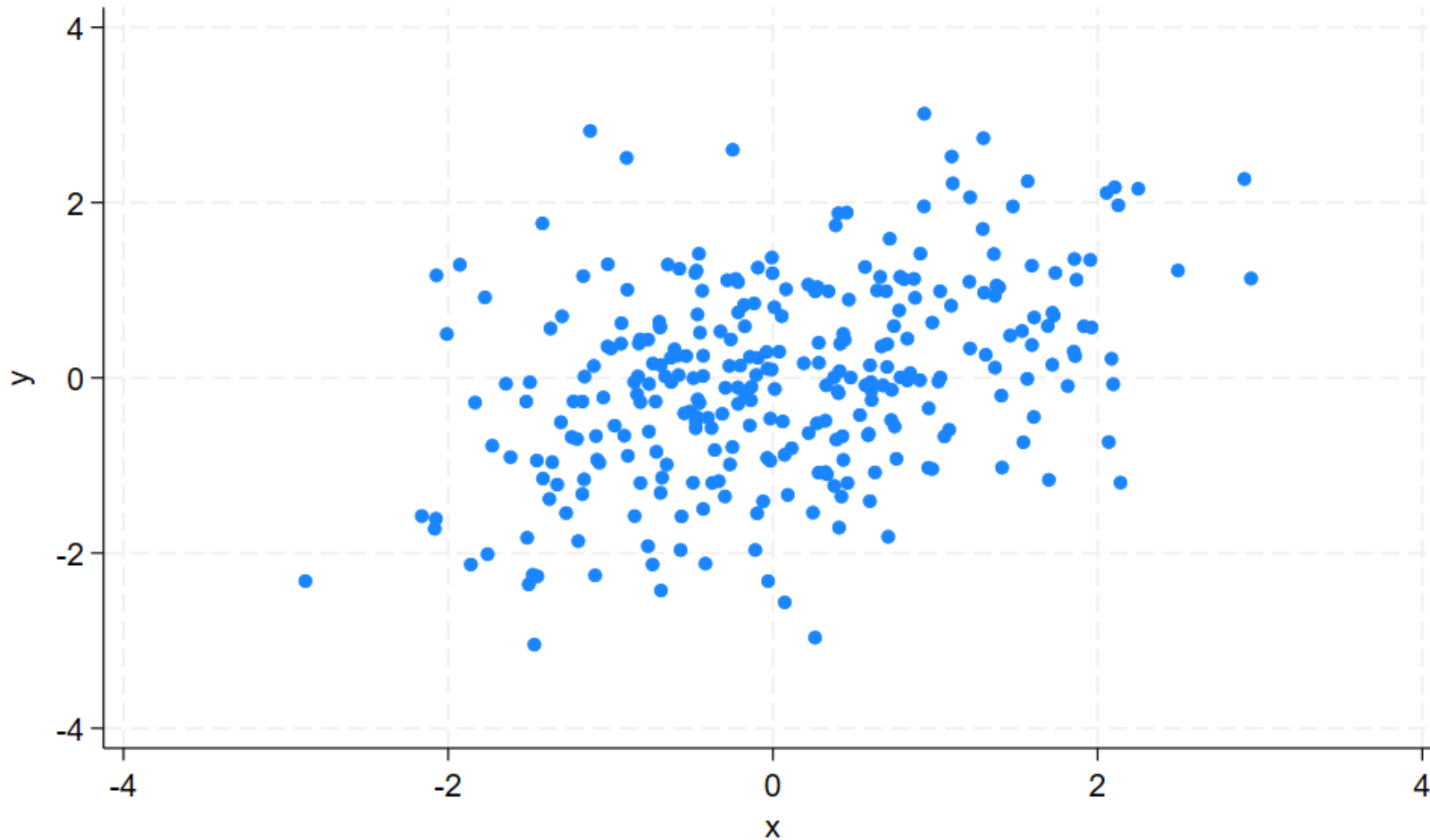
where r_{XX} and r_{YY} are their reliability estimates

```
. meta psycorr rho n, xreliability(rxx) yreliability(ryy)
```

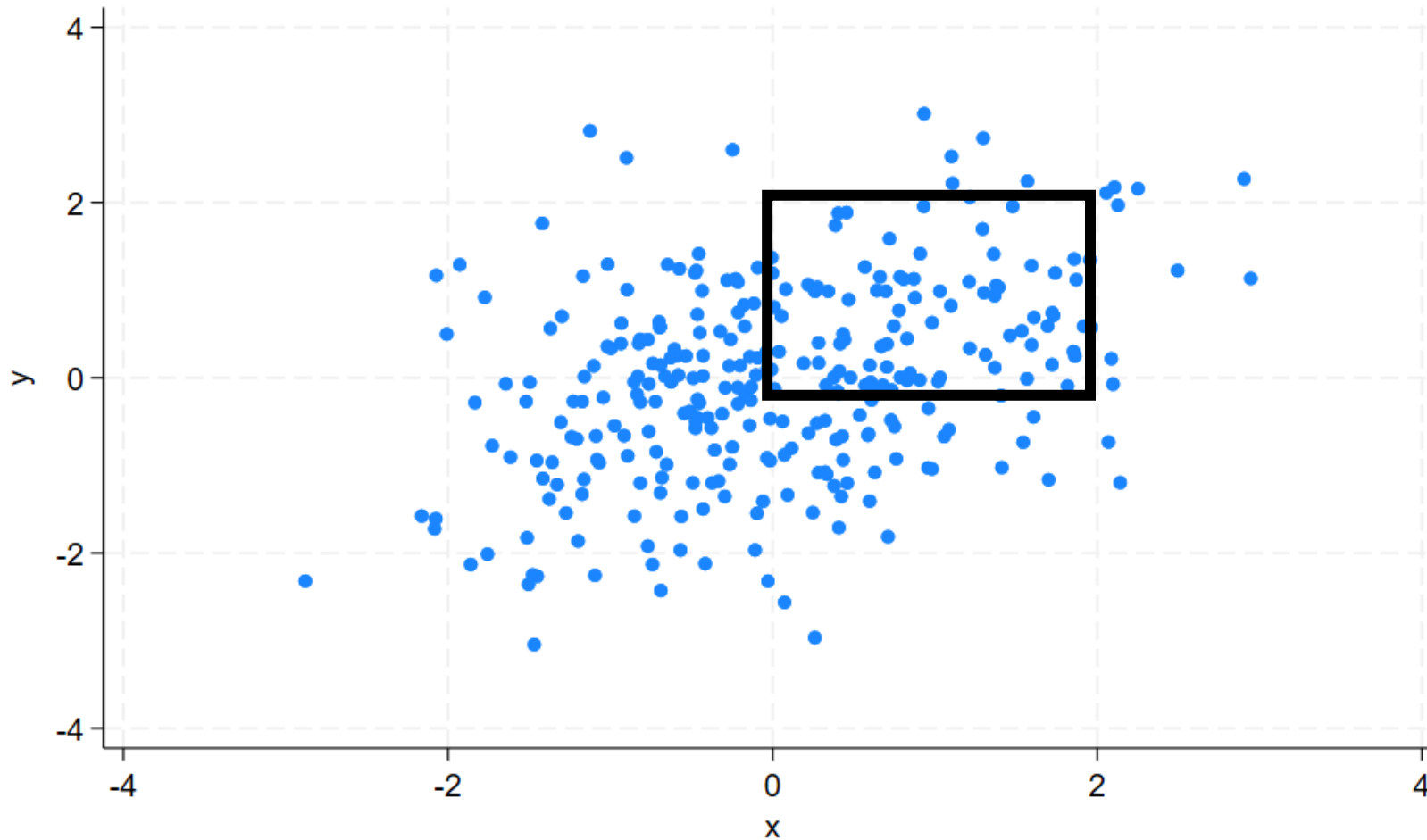
Measurement error



Range restriction



Range restriction



Range restriction

- Range restriction is a specific type of sample selection bias in which the variability of scores on one or more variables is artificially reduced because of the selection process.
 - How can we use our restricted (incumbent) sample to make inferences about the unrestricted (applicant) sample?

Range restriction

- Range restriction is a specific type of sample selection bias in which the variability of scores on one or more variables is artificially reduced because of the selection process.
 - How can we use our restricted (incumbent) sample to make inferences about the unrestricted (applicant) sample?
- **Example:** You would like to know the correlation between score on a skills test and job performance, but you only have job performance scores from the individuals that were hired.

Range restriction

- Range restriction can be direct or indirect.
 - **Direct:** The employer only uses the skills test to make hiring decisions. The restriction is directly on X.
 - **Indirect:** The employer uses the skills test, interview, and past experience to make hiring decisions. The restriction is correlated with X.

Range restriction

- Direct range restriction

```
. correlate x y if x<1  
(obs=840)
```

	x	y
x	1.0000	
y	0.3745	1.0000

- Indirect range restriction

```
. correlate x y if z<0  
(obs=484)
```

	x	y
x	1.0000	
y	0.4282	1.0000

Range restriction

- Without measurement error, the corrected correlation is given by

$$\rho_{XY,u} = h(u, \rho_{XY,r}) = \frac{\rho_{XY,r}}{u \sqrt{\left(\frac{1}{u^2} - 1\right) \rho_{XY,r}^2 + 1}}$$

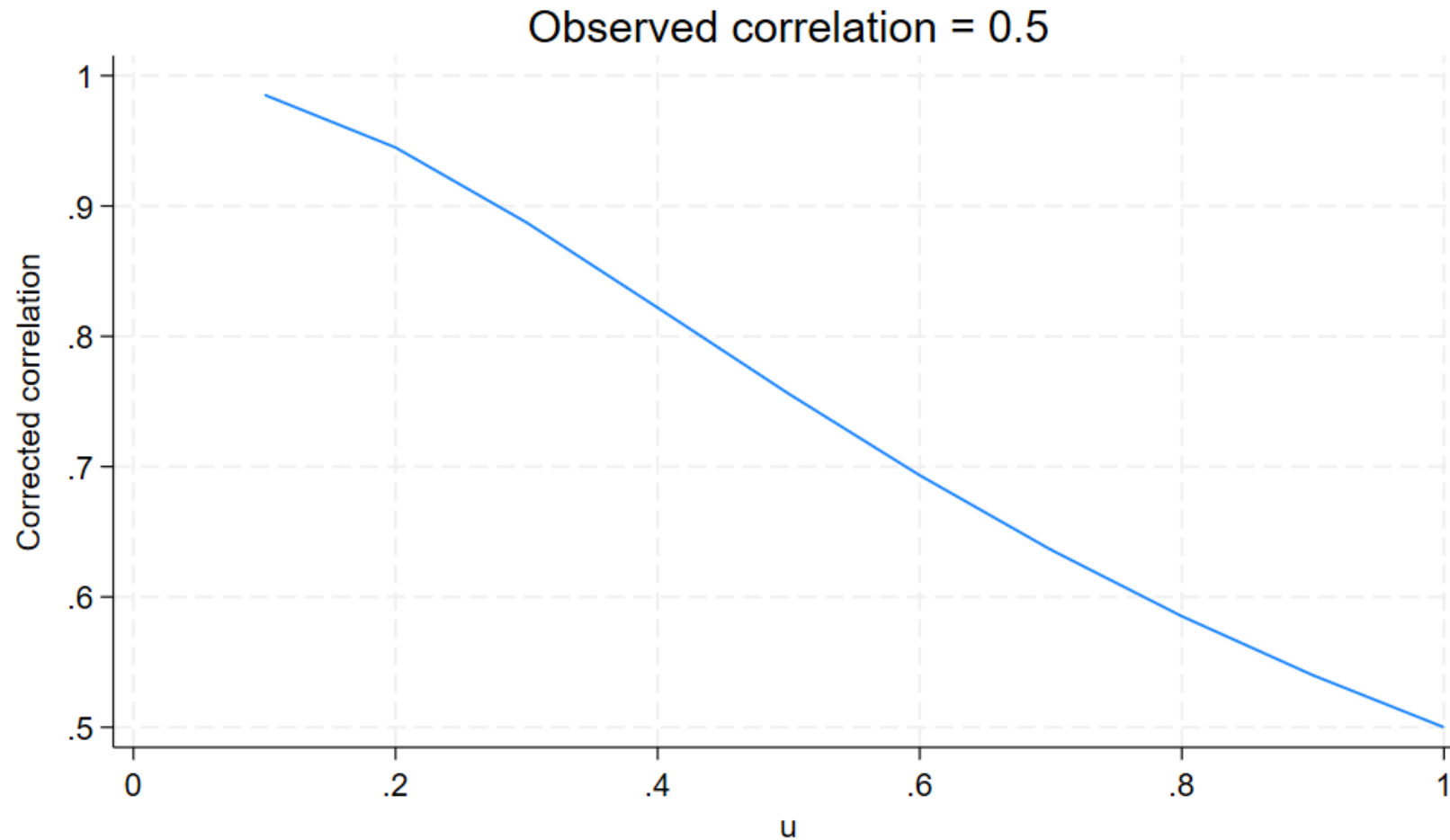
- u-ratios are calculated as

$$u = \frac{s_r}{s_u}$$

where s_r is the standard deviation in the restricted sample and s_u is the standard deviation in the unrestricted sample.

. meta psycorr rho n, xuratio(u) direct/indirect

Range restriction



Range restriction

- With measurement error:
 - **Direct:** Correct for range restriction then for measurement error

$$\rho_{TP,u} = \frac{h(u_X, \rho_{XP,r})}{\sqrt{r_{xx,u}}}$$

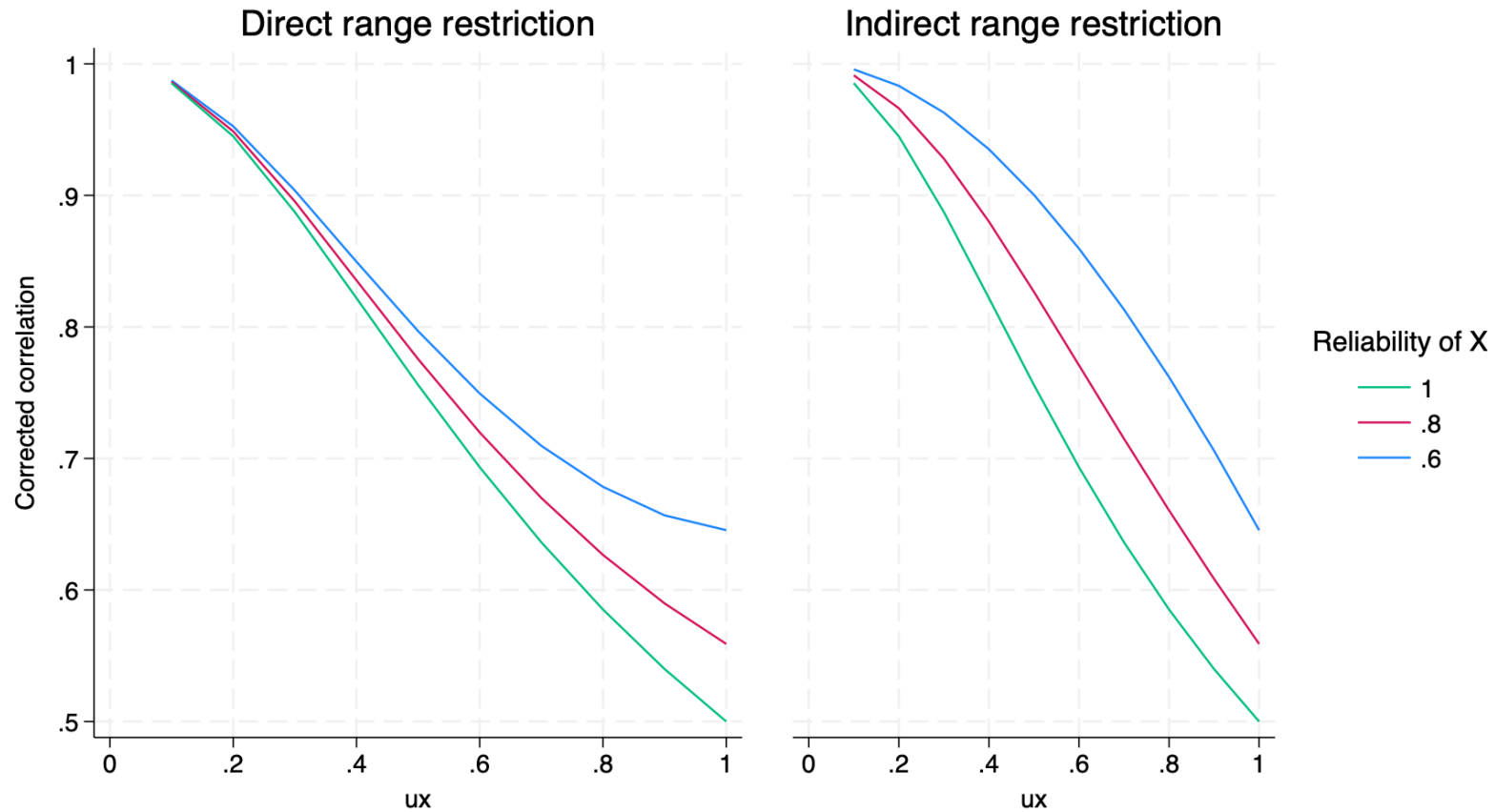
- **Indirect:** Correct for measurement error then for range restriction

$$\rho_{TP,u} = h(u_T, \rho_{TP,r})$$

. meta psycorr rho n, xreliability(rxx) yreliability(ryy)
xuratio(uX) yuratio(uY) direct/indirect

Range restriction

Observed correlation = 0.5



Range restriction

- Range restriction can be direct or indirect.
 - **Direct:** The employer only uses the skills test to make hiring decisions. The restriction is directly on X.
 - **Indirect:** The employer uses the skills test, interview, and past experience to make hiring decisions. The restriction is correlated with X.
- Range restriction can be univariate or bivariate.
 - **Univariate:** All applicants take the skills test. The only restriction is in job performance.
 - **Bivariate:** Only the applicants with limited past experience took the skills test. There is restriction in both the skills test and job performance.

Psychometric meta-analysis

- You can control for all or any combination of
 - Small-study bias
 - Artificial dichotomization
 - Measurement error
 - Range restriction
- . meta psycorr rho n, small xdich() ydich()
xreliability() yreliability()
xuratos() yuratos() direct/indirect

Psychometric meta-analysis

- By default, Stata assumes that that your reliability estimates are based on the restricted sample. If they are based on the unrestricted sample,

```
xreliability(rxx, unrestricted)
```

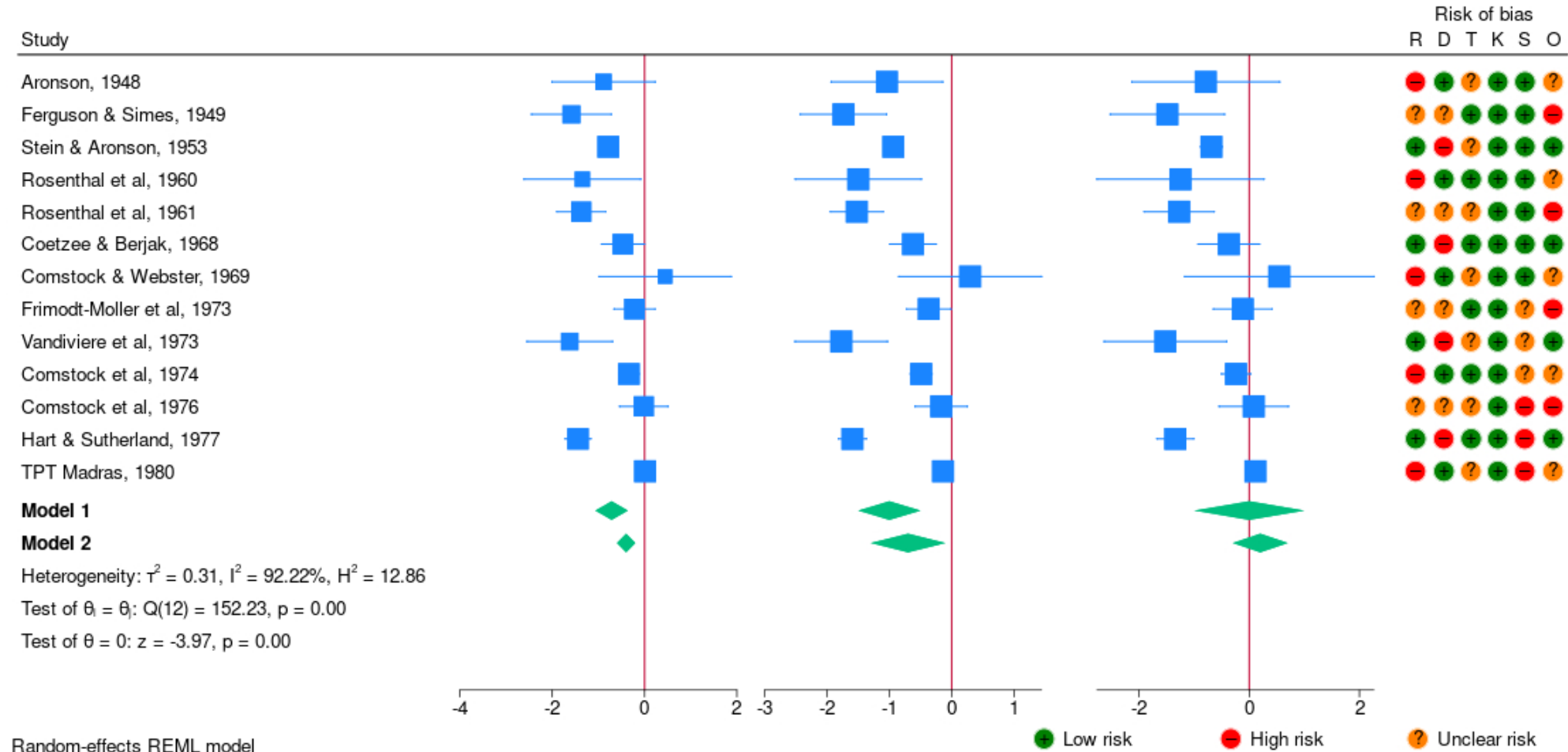
- By default, Stata assumes that your u-ratios are ratios of the observed data. If they are ratios of true scores,

```
xur ratios(ut, true)
```

Example

- . use <https://www.stata.com/exdata/metalemp.dta>
- . meta psycorr r N, xreliability(rxx) yreliability(ryy) small
studylabel(Authors) impute(bootstrap, rseed(12345))
- . meta summarize, subgroup(prov)
- . meta forestplot
- . meta galbraithplot
- . meta regress i.prov age

In the next StataNow update



References

- Schmidt, F. L., H. Le, and I.-S. Oh. 2019. “Correcting for the distorting effects of study artifacts in meta-analysis and second order meta-analysis”. In *The Handbook of Research Synthesis and Meta-Analysis*, edited by H. Cooper, L. V. Hedges, and J. C. Valentine, 315–338. 3rd ed. New York: Russell Sage Foundation. <https://doi.org/10.7758/9781610448864.18>.
- Schmidt, F. L., and J. E. Hunter. 2015. *Methods of Meta-Analysis: Correcting Error and Bias in Research Findings*. 3rd ed. Thousand Oaks, CA: Sage. <https://doi.org/10.4135/9781483398105>.
- Slemp, G. R., J. G. Field, R. M. Ryan, V. W. Former, A. Van den Broeck, and K. J. Lewis. 2024. Interpersonal supports for basic psychological needs and their relations with motivation, well-being, and performance: A meta-analysis. *Journal of Personality and Social Psychology* 127: 1012-1037. <https://doi.org/10.1037/pspi0000459>.

Thank you!



Feel free to email questions at tech-support@stata.com