Lecture 7: Publication Bias

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University of Canterbury

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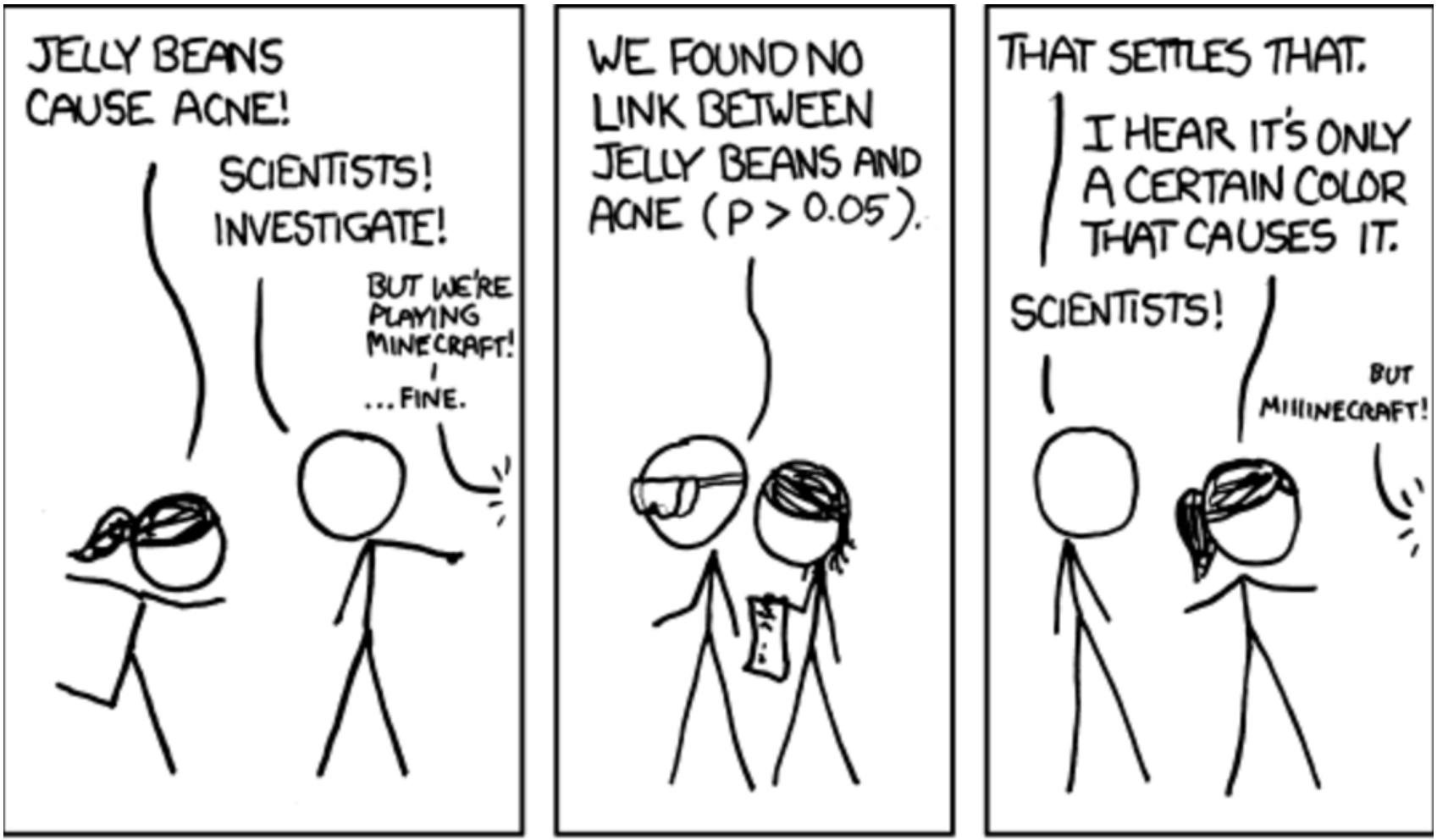
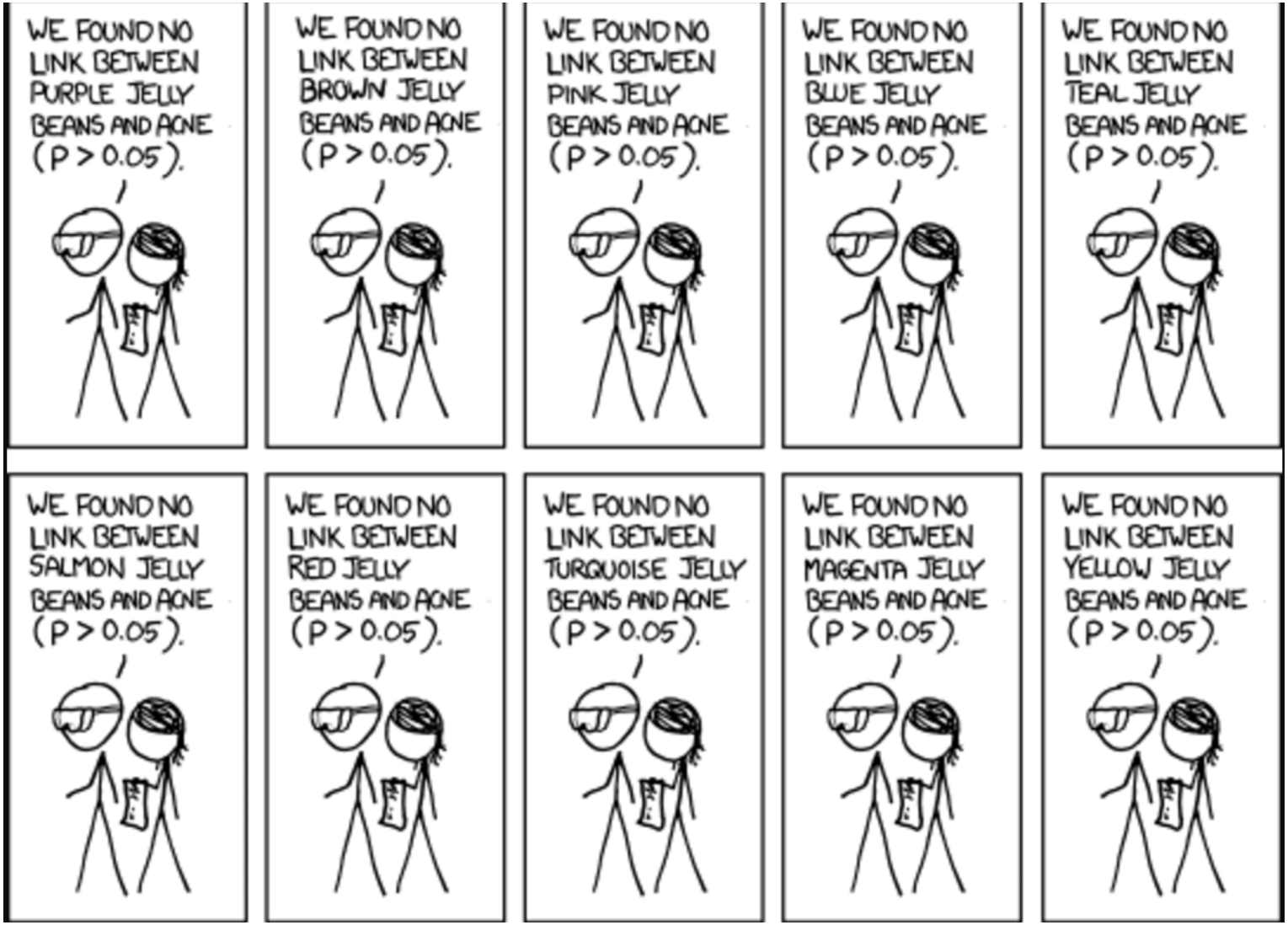
Intuition


JELLY BEANS CAUSE ACNE!
SCIENTISTS! INVESTIGATE!
BUT WE'RE PLAYING MINECRAFT!
...FINE.
WE FOUND NO LINK BETWEEN JELLY BEANS AND ACNE (P > 0.05).
THAT SETTLES THAT.
I HEAR IT'S ONLY A CERTAIN COLOR THAT CAUSES IT.
SCIENTISTS!
BUT MIIIINECRAFT!

Intuition


WE FOUND NO LINK BETWEEN PURPLE JELLY BEANS AND ACNE (P > 0.05).
WE FOUND NO LINK BETWEEN BROWN JELLY BEANS AND ACNE (P > 0.05).
WE FOUND NO LINK BETWEEN PINK JELLY BEANS AND ACNE (P > 0.05).
WE FOUND NO LINK BETWEEN BLUE JELLY BEANS AND ACNE (P > 0.05).
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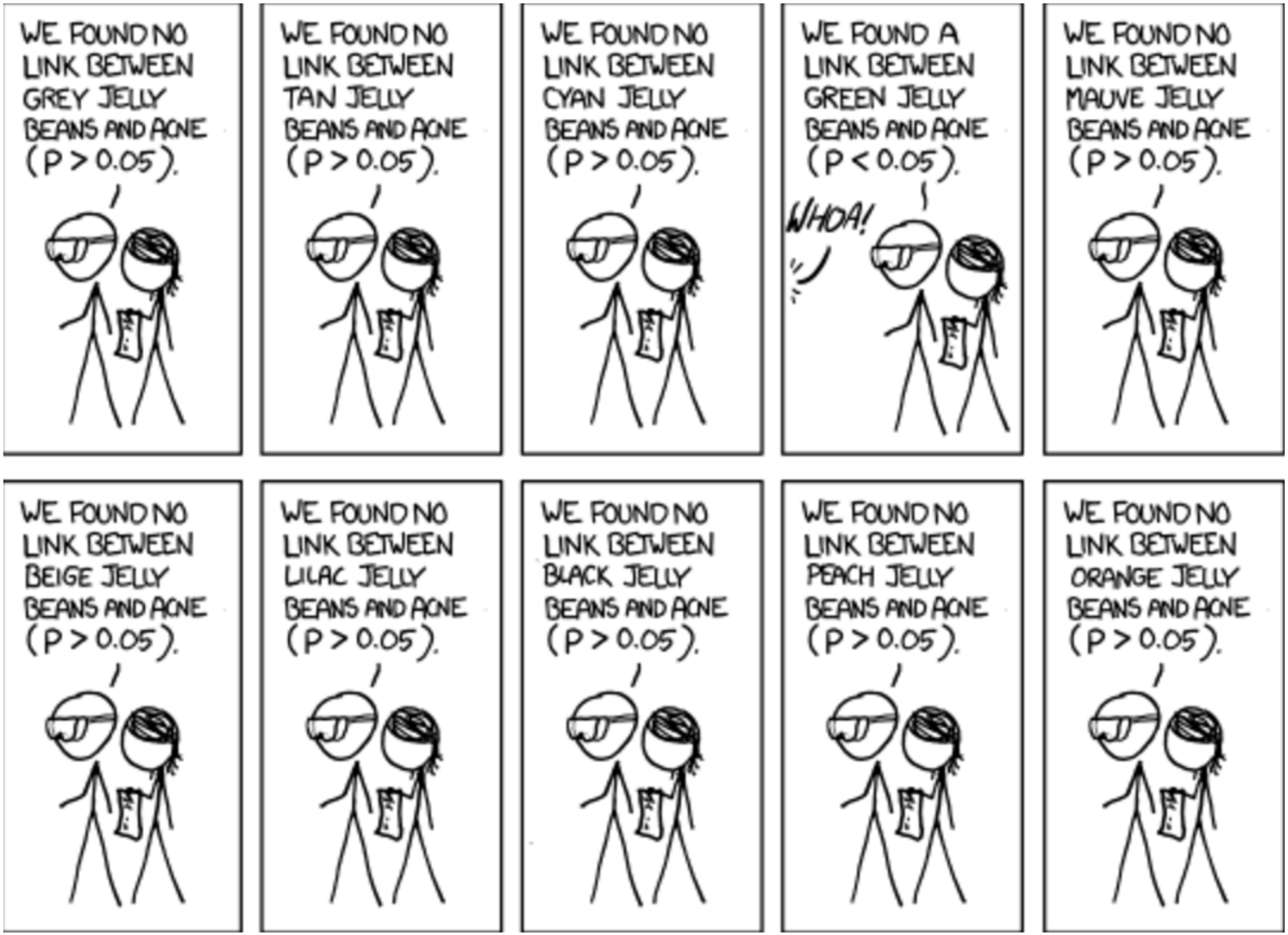
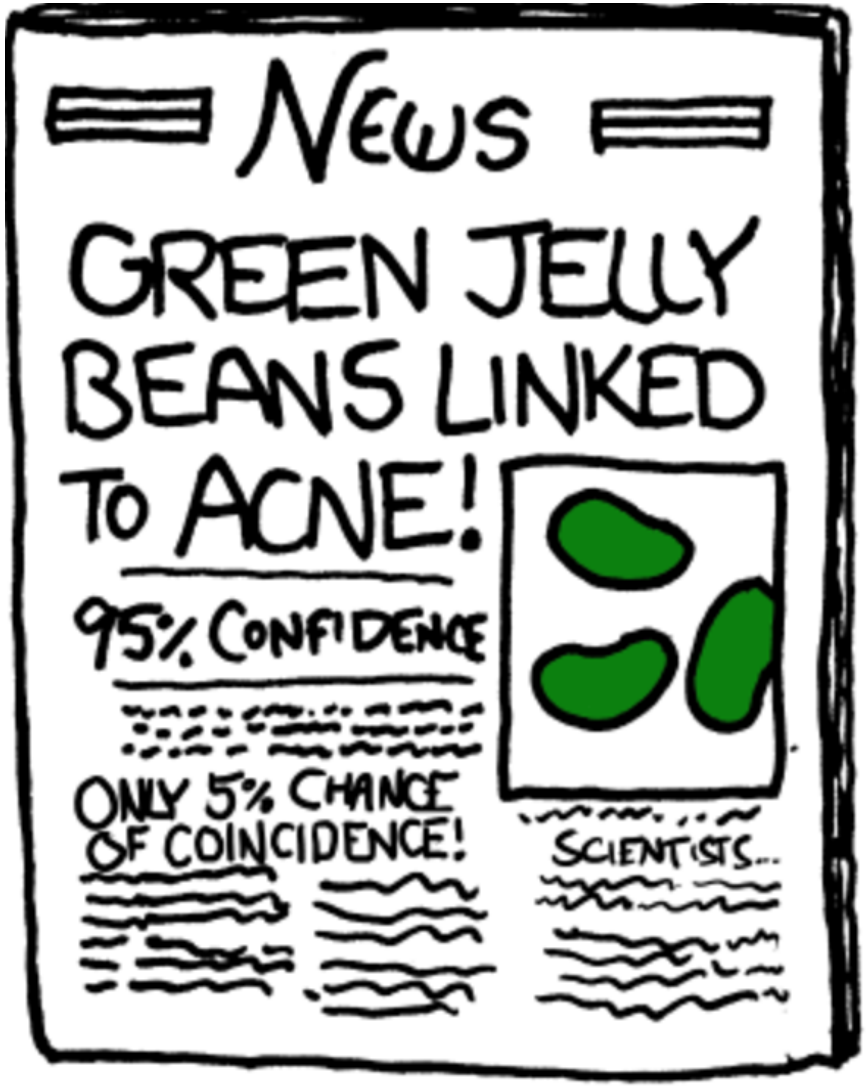
WE FOUND NO LINK BETWEEN RED JELLY BEANS AND ACNE (P > 0.05).
WE FOUND NO LINK BETWEEN TURQUOISE JELLY BEANS AND ACNE (P > 0.05).
WE FOUND NO LINK BETWEEN MAGENTA JELLY BEANS AND ACNE (P > 0.05).
WE FOUND NO LINK BETWEEN YELLOW JELLY BEANS AND ACNE (P > 0.05).

Intuition


WE FOUND NO LINK BETWEEN GREY JELLY BEANS AND ACNE (P > 0.05).
WE FOUND NO LINK BETWEEN TAN JELLY BEANS AND ACNE (P > 0.05).
WE FOUND NO LINK BETWEEN CYAN JELLY BEANS AND ACNE (P > 0.05).
WE FOUND A LINK BETWEEN GREEN JELLY BEANS AND ACNE (P < 0.05).
WHOA!
WE FOUND NO LINK BETWEEN MAUVE JELLY BEANS AND ACNE (P > 0.05).
WE FOUND NO LINK BETWEEN BEIGE JELLY BEANS AND ACNE (P > 0.05).
WE FOUND NO LINK BETWEEN LILAC JELLY BEANS AND ACNE (P > 0.05).
WE FOUND NO LINK BETWEEN BLACK JELLY BEANS AND ACNE (P > 0.05).
WE FOUND NO LINK BETWEEN PEACH JELLY BEANS AND ACNE (P > 0.05).
WE FOUND NO LINK BETWEEN ORANGE JELLY BEANS AND ACNE (P > 0.05).

Intuition


NEWS
GREEN JELLY BEANS LINKED TO ACNE!
95% CONFIDENCE
ONLY 5% CHANCE OF COINCIDENCE!
SCIENTISTS...

Paxil scandal

- **Background:**
  - Paxil (paroxetine): Antidepressant approved for adolescents, developed by GlaxoSmithKline (GSK).
  - Study 329 (1998-2001): Clinical trial funded by GSK to test Paxil's safety and efficacy in adolescents.

- **What Happened?**
  - Published study claimed Paxil was *"well-tolerated and effective."*
  - Internal documents later revealed:
    - Negative results (e.g., increased suicidal ideation) were downplayed.
    - Positive outcomes were selectively reported.

Paxil scandal

- **Discovery of Bias:**
  - Legal proceedings in 2012 forced disclosure of internal data.
  - Independent reanalysis of Study 329 showed:
    - No significant benefit over placebo.
    - Serious safety concerns (e.g., suicidal ideation).

- **Key Lessons:**
  - Publication bias can harm patients and public trust.
  - Highlights the need for:
    - Transparency in research data.
    - Independent replication and reanalysis.

No bias, no correlation (?)

Researchers estimate

$$Earnings_j = \gamma Beauty_j + w_j.$$

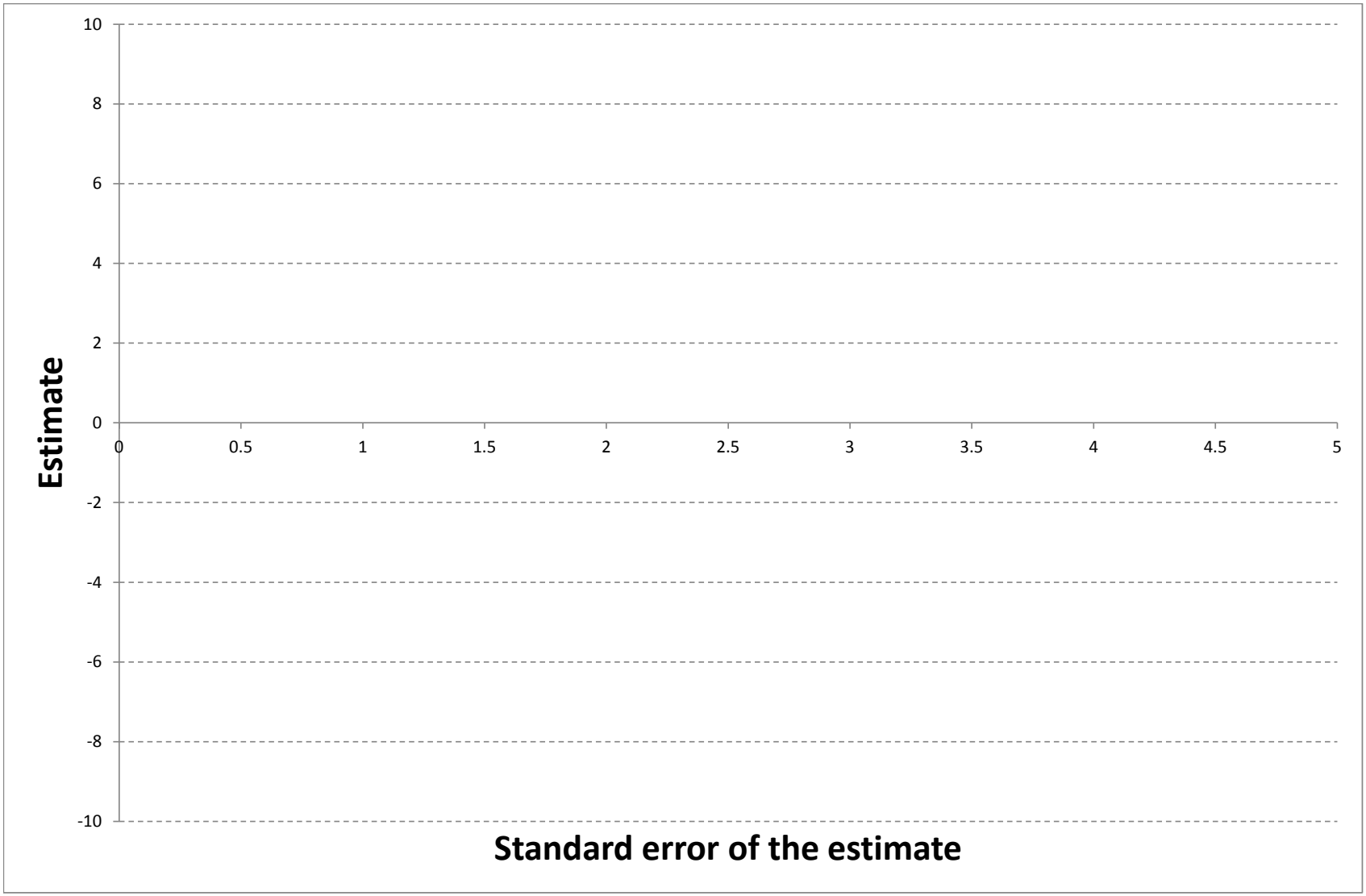
They assume that $\widehat{\gamma}/SE_{\widehat{\gamma}}$ has a t-distribution.

$\rightarrow$ estimates should not be correlated with standard errors (Card & Krueger, 1995)

Types of publication bias

Type I: Selection for the "correct sign."
Type II: Selection for statistical significance.

Simulation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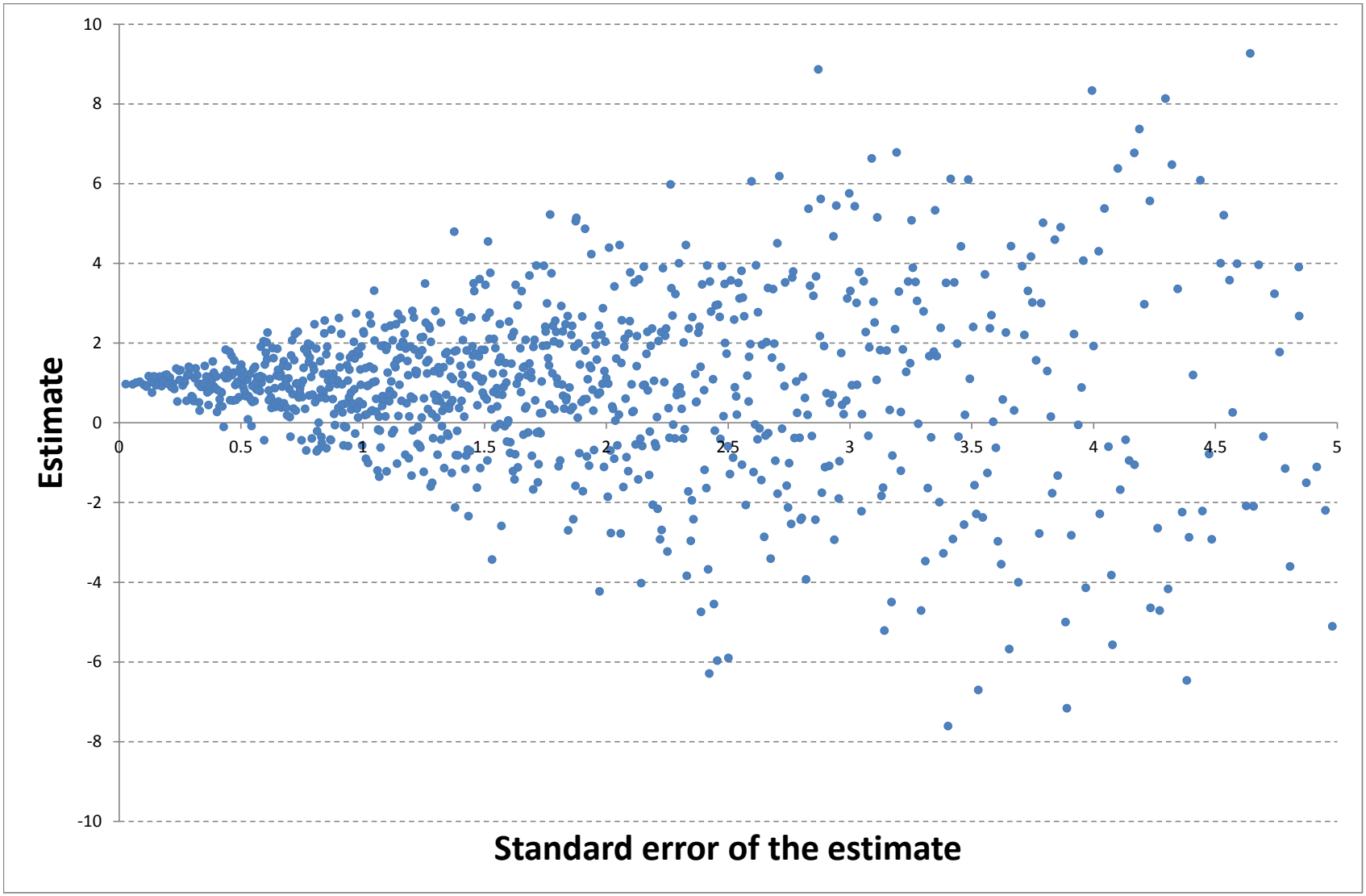
Estimate
Standard error of the estimate

Simulation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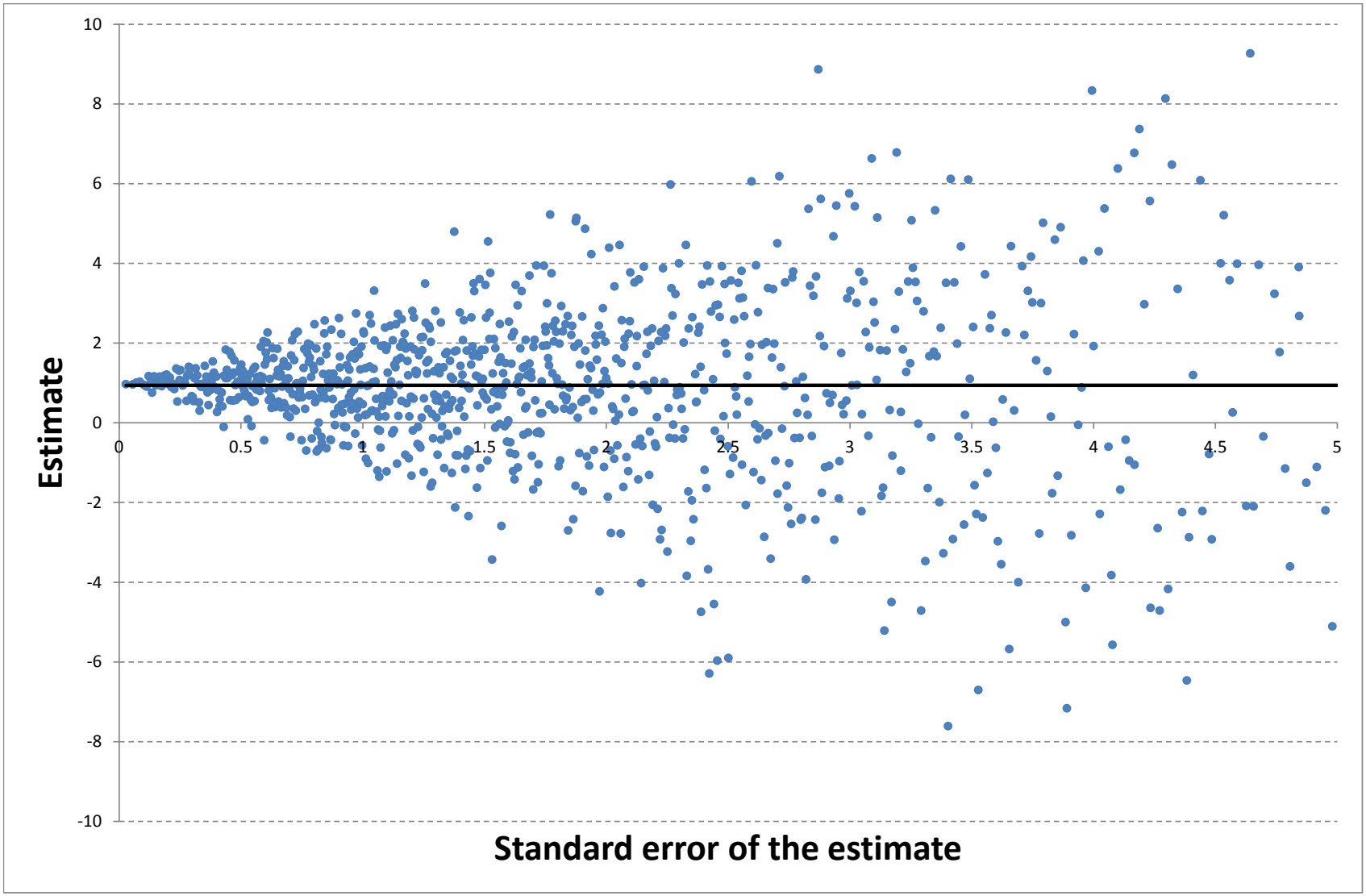
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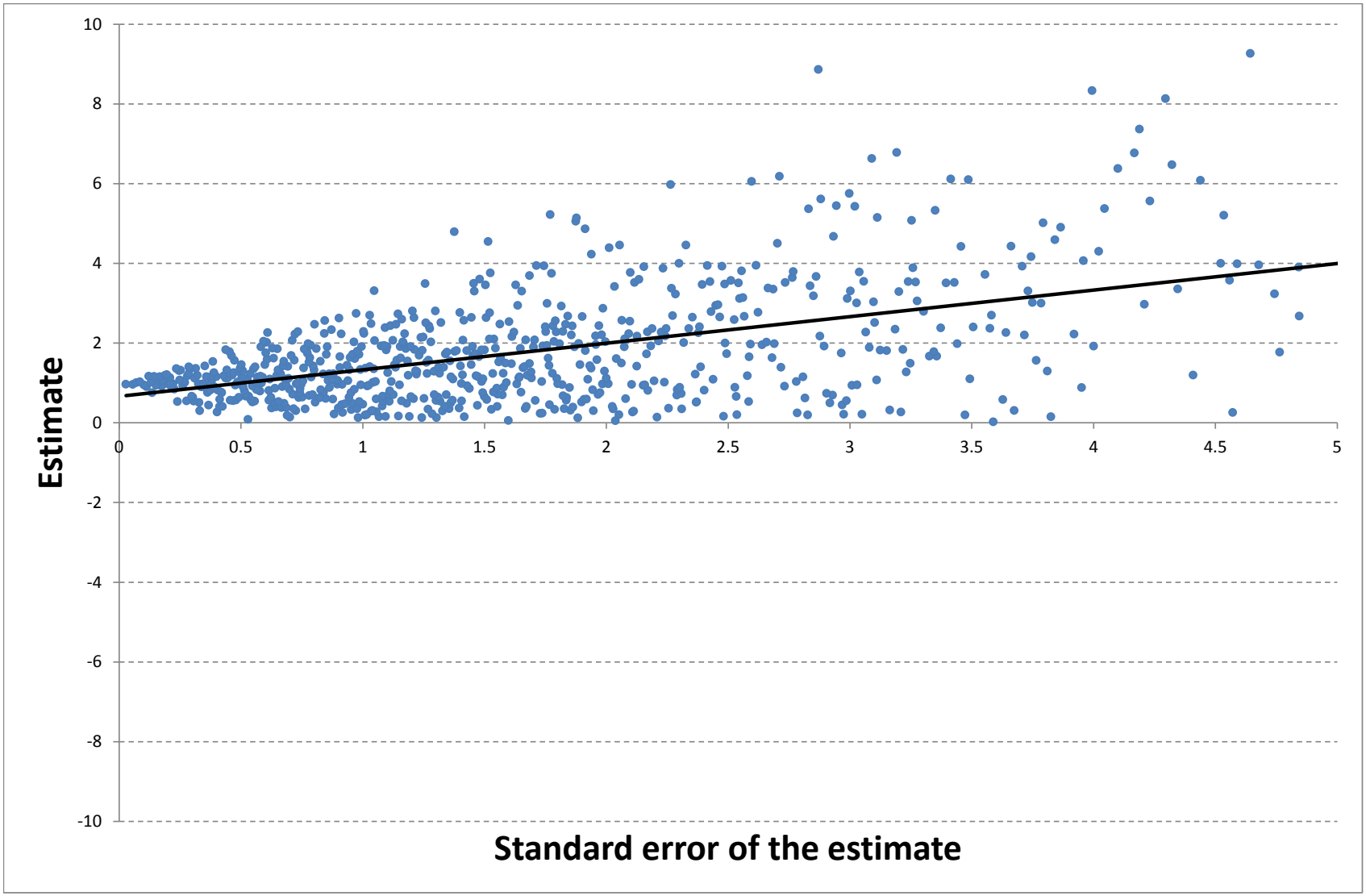
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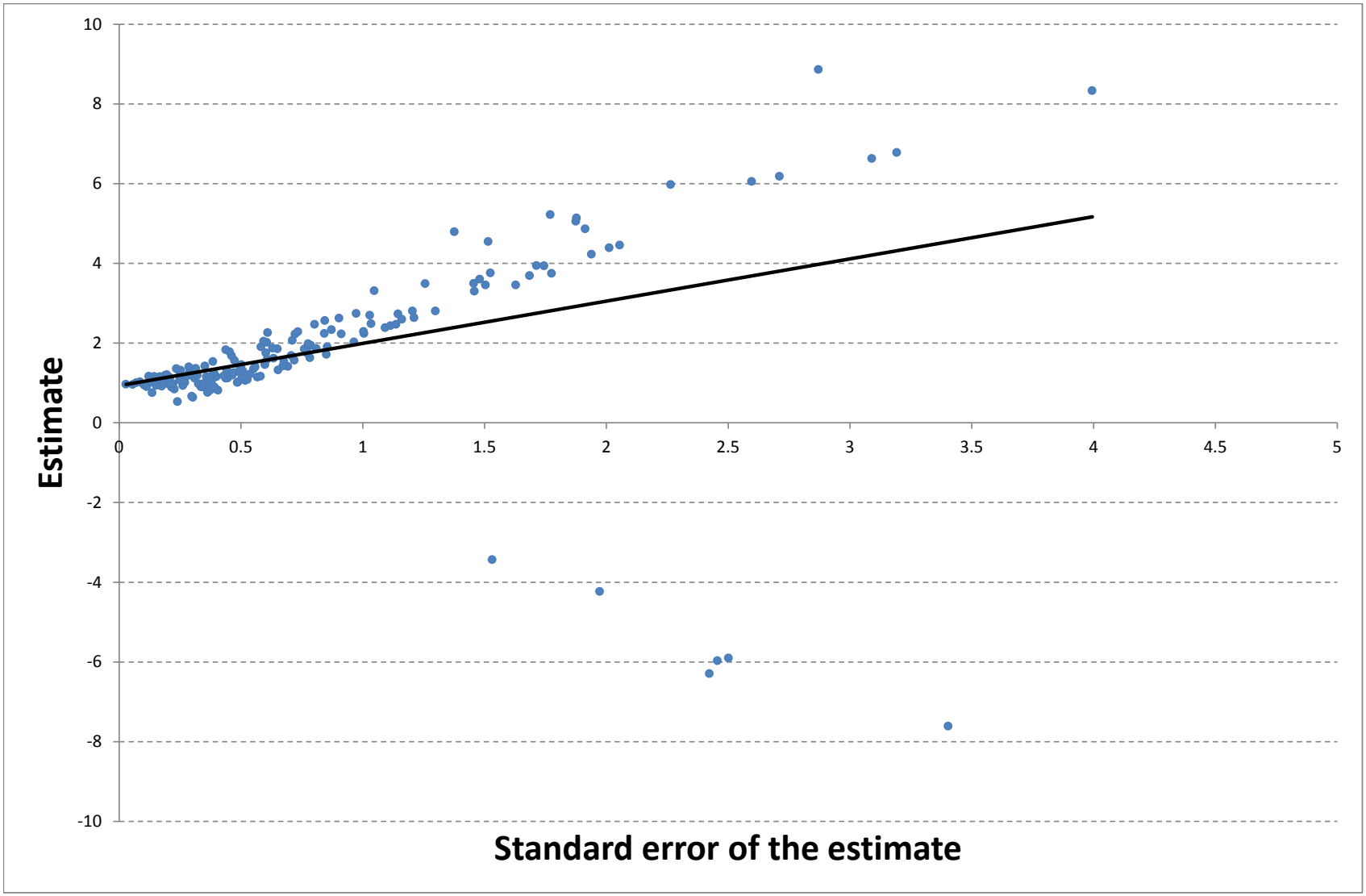
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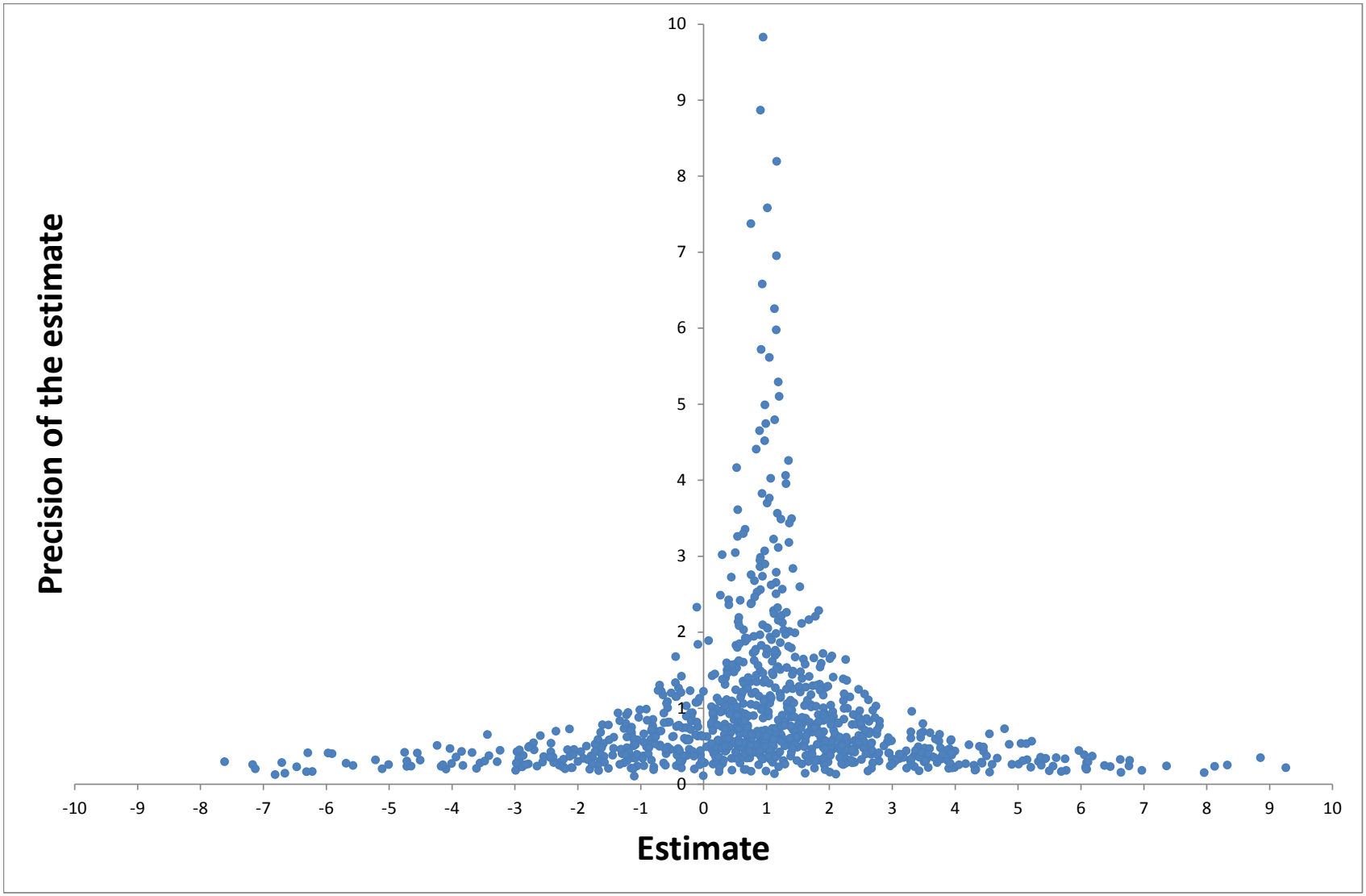
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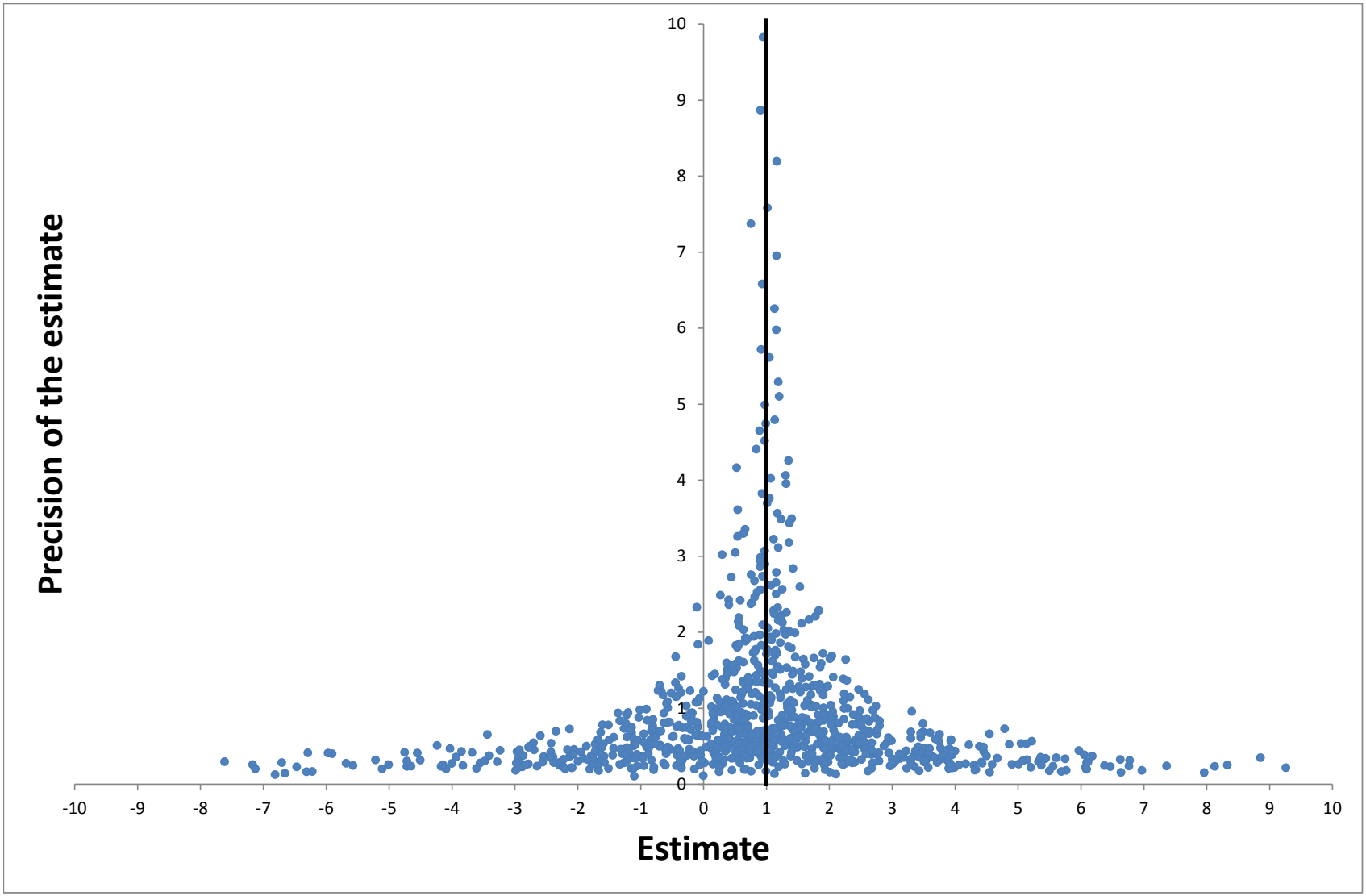
Estimate

Simulation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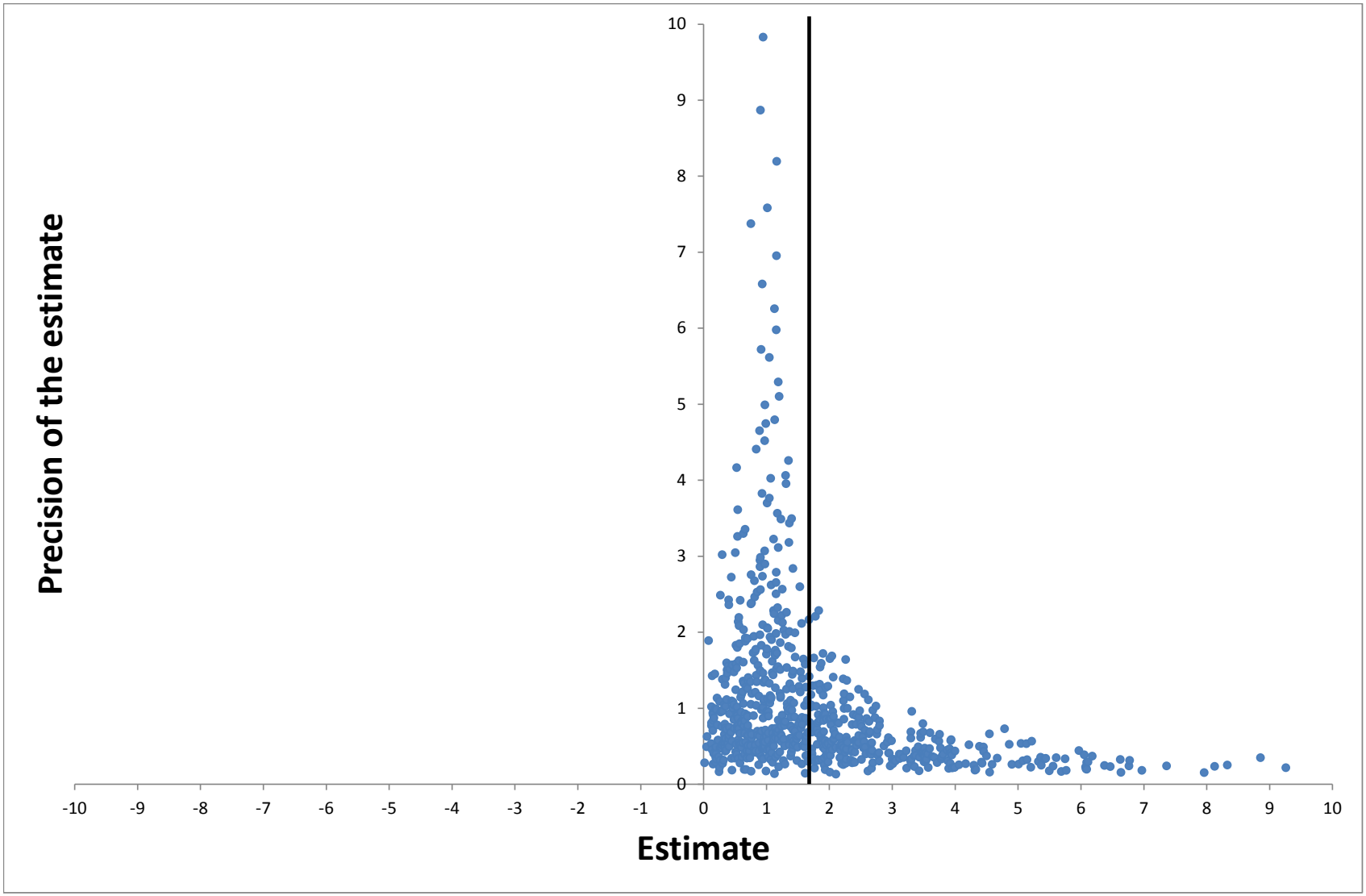
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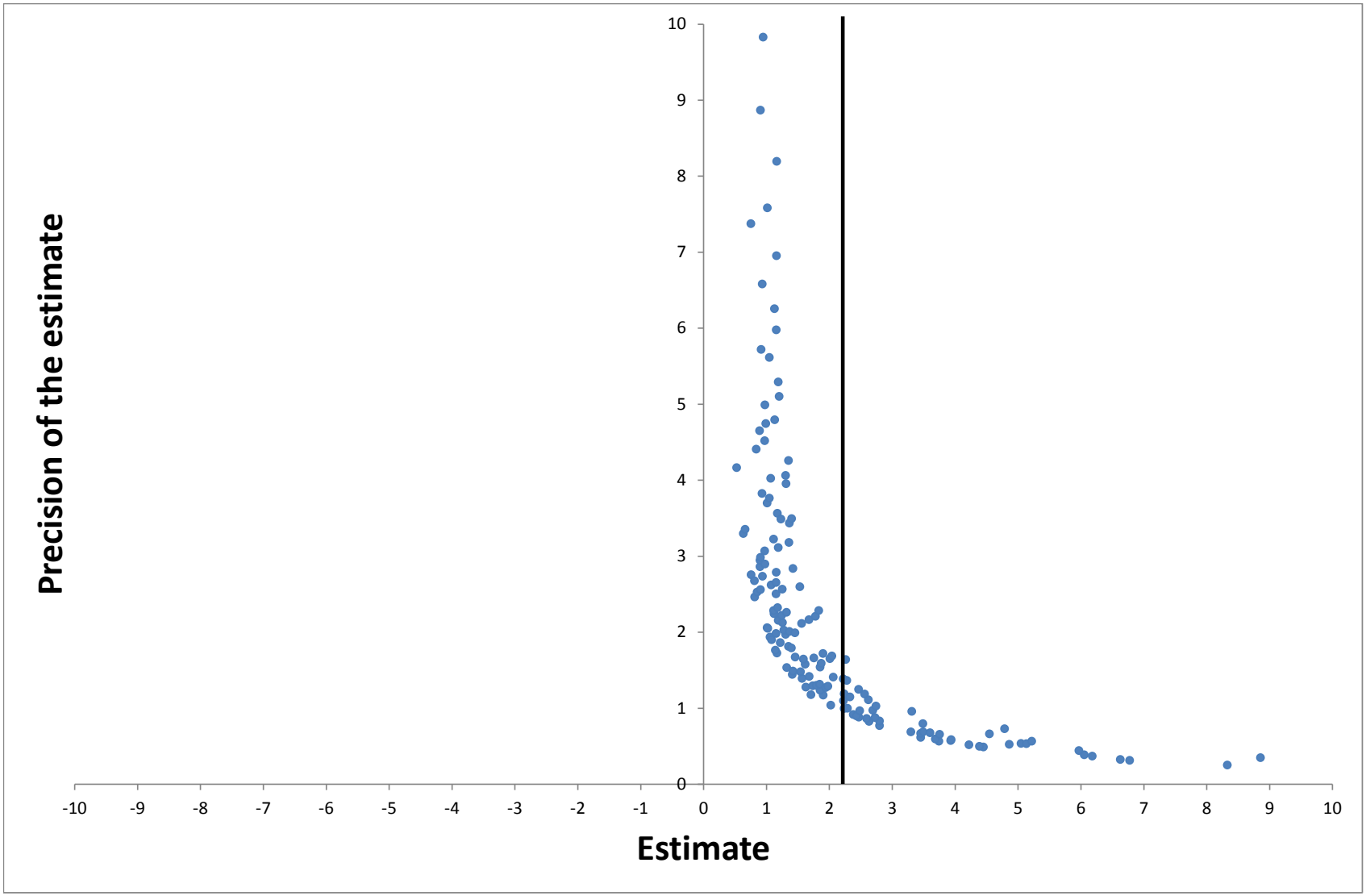
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Funnel asymmetry test

In the absence of publication bias the funnel should be symmetrical:

$$\text{estimate}_i = \underbrace{\beta}_{\text{true effect}} + \underbrace{\beta_0 SE_i}_{\text{publication bias}} + \mu_i.$$

The equation is heteroscedastic. Weighted least squares yield

$$t_i = \beta_0 + \beta \left(\frac{1}{SE_i} \right) + \vartheta_i.$$

This is call the funnel asymmetry test—precision effect test (FAT-PET).

Precision effect test with standard error (PEESE):

$$\text{estimate}_i = \underbrace{\beta}_{\text{true effect}} + \underbrace{\beta_0 SE_i^2}_{\text{publication bias}} + \mu_i.$$

The equation is heteroscedastic. Weighted least squares yield

$$t_i = \beta_0 SE_i + \beta \left(\frac{1}{SE_i} \right) + \vartheta_i.$$

WAAP (Ioannidis et al., 2017)

Weighted **A**verage of **A**dequately **P**owered (WAAP) estimates.

- Focus on studies with adequate statistical power to reduce the impact of selective reporting.
- Combines results only from studies with at least 80% power.

Issues:

- Simple and robust.
- Need to estimate the true effect first and then compute power.

Stem-based correction technique (Furukawa, 2019)

Stem-based method:

- A non-parametric estimator that exploits the variance-bias trade-off.
- Focuses on the most precise estimates, referred to as the "stem" of the funnel plot.

Key features:

- Robust to various publication selection processes.
- Does not rely on specific distributional assumptions.

Application:

- Filters studies with the highest precision (lowest standard errors) to estimate the true effect.
- Reduces influence from noisier, potentially biased studies in the broader funnel plot.

Endogenous kink model (Bom & Rachinger, 2019)

Overview:

- Fits a piecewise linear model with a kink determined by the data.
- Identifies where publication selection is less likely to occur.

Key features:

- Endogenously estimates the cutoff based on standard errors.
- Often reduces bias and improves efficiency compared to traditional methods.

Application:

- Highlights genuine effects by focusing on less selective segments of the data.
- Effective in meta-analyses with substantial heterogeneity in study precision.

Selection model (Andrews & Kasy, 2019)

Overview:

- Models the selection process explicitly to address publication bias.
- Assumes researchers are more likely to publish statistically significant results.

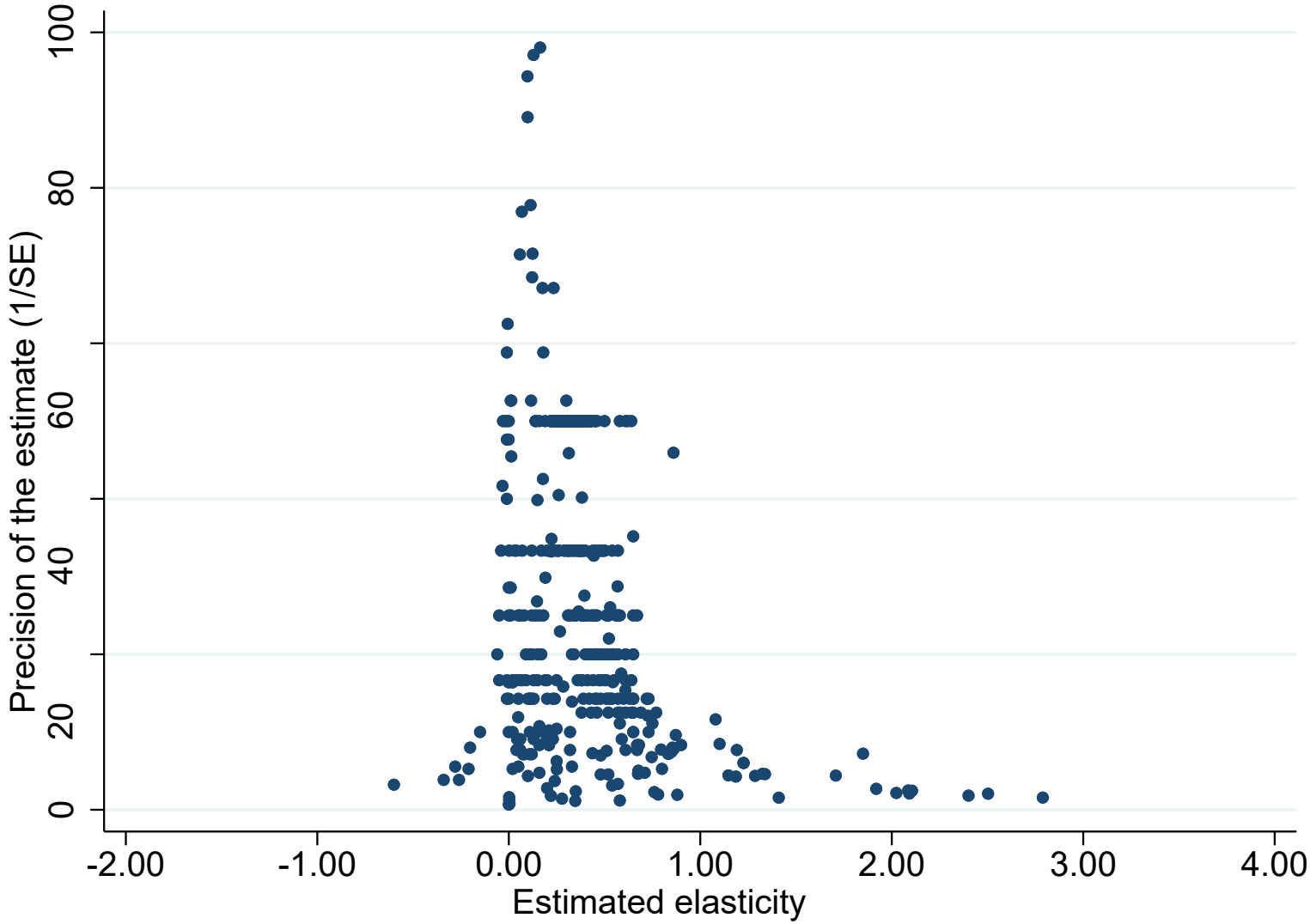
Key features:

- Uses the likelihood of publication as a function of statistical significance.
- Adjusts estimates to reflect the missing studies.

Comparison to funnel-based models:

- Selection models are more rigorous but require stronger assumptions about the publication process.
- Funnel methods are simpler and more robust to model misspecification.

Example: labor supply elasticity



Results vary: RoBMA?

Panel A: Linear tests					
	OLS	FE	Precision	Study	IV
Standard error	1.595***	0.788***	2.222***	2.106***	2.706
(*publication bias*)	(0.262)	(0.283)	(0.484)	(0.258)	(2.103)
	[0.93, 2.20]	-	[1.23, 3.31]	[1.53, 2.56]	-
Constant	0.301***	0.370***	0.247***	0.252***	0.130*
(*mean beyond bias*)	(0.044)	(0.026)	(0.065)	(0.109)	(0.066)
	[0.12, 0.42]	-	[0.11, 0.31]	[0.13, 0.38]	-
Observations	723	723	723	723	522
Studies	36	36	36	36	23
Panel B: Nonlinear tests					
	Ioannidis *et al.* (2017)	Andrews & Kasy (2019)	Bom & Rachinger (2019)	Furukawa (2021)	van Aert & van Assen (2021)
Effect beyond bias	0.260***	0.356***	0.207**	0.187*	0.374***
	(0.041)	(0.061)	(0.094)	(0.112)	(0.020)
Observations	723	723	723	723	723
Studies	36	36	36	36	36

Bias caused by preference for positive estimates