Weight of Statistical Evidence

Detection and Correction of Publication Bias

Servan Grüninger

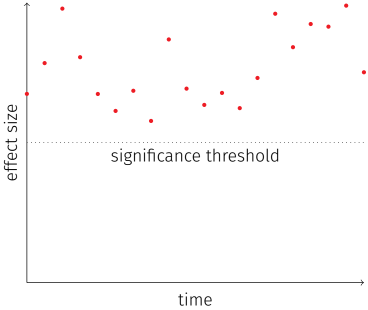
Zurich, November 29th 2019

EBPhD Admission Interview

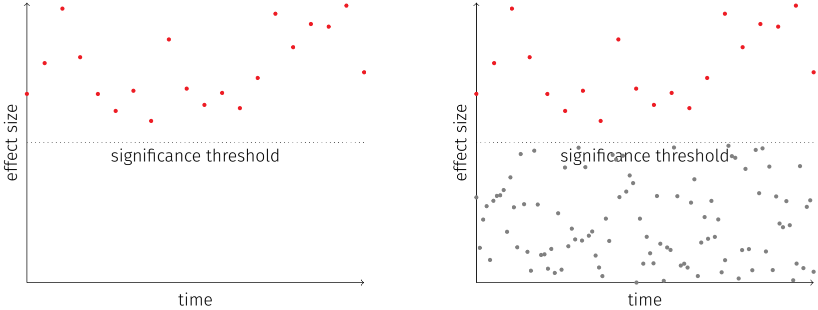
The Woozle effect

Pooh and Piglet tracking down the elusive Woozle (Image: Ernest H. Shepard)

The Woozle effect—why care?



The Woozle effect—why care?



Part 1: Making evidence comparable

Transform statistic S_n into
$V_n = h_n(S_n)$ so that:

Part 1: Making evidence comparable

Transform statistic S_n into $V_n = h_n(S_n)$ so that:

$E_1 :$ $V_n = h_n(S_n)$ monotonically increasing in S_n;

Part 1: Making evidence comparable

Transform statistic S_n into $V_n = h_n(S_n)$ so that:

E_1 : $V_n = h_n(S_n)$ monotonically increasing in S_n;

E_2 : $V_n \sim \mathcal{N}(\tau, 1)$;

Part 1: Making evidence comparable

Transform statistic S_n into $V_n = h_n(S_n)$ so that:

$E_1: \ V_n = h_n(S_n)$ monotonically increasing in S_n;

$E_2: \ V_n \sim \mathcal{N}(\tau, 1)$;

$E_3: \ \mathrm{Var}[V_n] = 1$;

Part 1: Making evidence comparable

Transform statistic S_n into $V_n = h_n(S_n)$ so that:

E_1 : $V_n = h_n(S_n)$ monotonically increasing in S_n;

E_2 : $V_n \sim \mathcal{N}(\tau, 1)$;

E_3 : $\mathrm{Var}[V_n] = 1$;

E_4 : $\mathrm{E}_\mu[V_n] = \tau(\mu)$ monotonically increasing in μ from $\tau(0) = 0$.

Transform statistic S_n into $V_n = h_n(S_n)$ so that:

E_1 : $V_n = h_n(S_n)$ monotonically increasing in S_n;

E_2 : $V_n \sim \mathcal{N}(\tau, 1)$;

E_3 : $\mathrm{Var}[V_n] = 1$;

E_4 : $\mathrm{E}_\mu[V_n] = \tau(\mu)$ monotonically increasing in μ from $\tau(0) = 0$.

Student's t-statistic as example:

$$T_n = \frac{\sqrt{n}(\hat{\mu} - \mu_0)}{\hat{\sigma}} \overset{H_0}{\sim} t(\nu = n-1)$$

Part 1: Making evidence comparable

Transform statistic S_n into $V_n = h_n(S_n)$ so that:

$E_1:$ $V_n = h_n(S_n)$ monotonically increasing in S_n;

$E_2:$ $V_n \sim \mathcal{N}(\tau, 1)$;

$E_3:$ $\mathrm{Var}[V_n] = 1$;

$E_4:$ $\mathrm{E}_\mu[V_n] = \tau(\mu)$ monotonically increasing in μ from $\tau(0) = 0$.

Student's t-statistic as example:

$$T_n = \frac{\sqrt{n}(\hat{\mu} - \mu_0)}{\hat{\sigma}} \overset{H_0}{\sim} t(\nu = n-1)$$

For small n, transformation needed:

Part 1: Making evidence comparable

Transform statistic S_n into $V_n = h_n(S_n)$ so that:

E_1 : $V_n = h_n(S_n)$ monotonically increasing in S_n;

E_2 : $V_n \sim \mathcal{N}(\tau, 1)$;

E_3 : $\mathrm{Var}[V_n] = 1$;

E_4 : $\mathrm{E}_\mu[V_n] = \tau(\mu)$ monotonically increasing in μ from $\tau(0) = 0$.

Student's t-statistic as example:

$$T_n = \frac{\sqrt{n}(\hat{\mu} - \mu_0)}{\hat{\sigma}} \overset{H_0}{\sim} t(\nu = n-1)$$

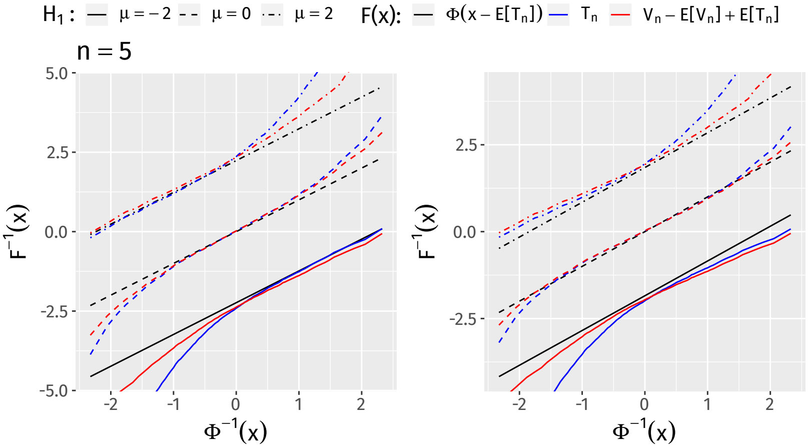
For small n, transformation needed:

$$V_n = h_n(T_n) = \sqrt{2n} \sinh^{-1}(T_n/\sqrt{2n})$$

Further improvement by finite sample correction:

$$V_n^* = \frac{n-1.7}{n-1}\sqrt{2n} \sinh^{-1}(T_n/\sqrt{2n})$$

Part 1: Make evidence comparable



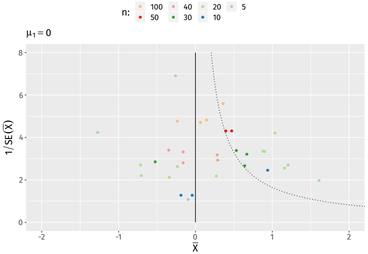
Part 2: Methods to detect publication bias

Several methods assessed

Part 2: Methods to detect publication bias

Several methods assessed

- The funnel plot



Part 2: Methods to detect publication bias

Several methods assessed

- The funnel plot
- File drawer calculation

Part 2: Methods to detect publication bias

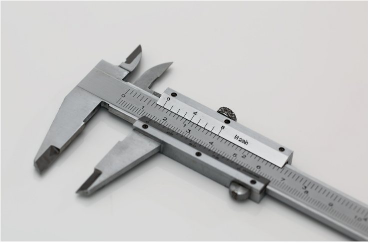
Several methods assessed

- The funnel plot
- File drawer calculation
- Expected vs. observed # of significant publications

Part 2: Methods to detect publication bias

Several methods assessed

- The funnel plot
- File drawer calculation
- Expected vs. observed # of significant publications
- The calliper test



Part 2: Methods to detect publication bias

Several methods assessed

- The funnel plot
- File drawer calculation
- Expected vs. observed # of significant publications
- The calliper test
- Rank correlation & Egger regression

Part 2: Methods to detect publication bias

Several methods assessed

- The funnel plot
- File drawer calculation
- Expected vs. observed # of significant publications
- The calliper test
- Rank correlation & Egger regression
- *p*-curve

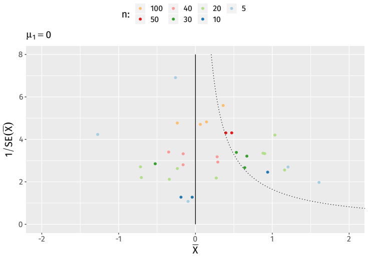
Part 3: Methods to correct publication bias

Several methods assessed

Part 3: Methods to correct publication bias

Several methods assessed

- Trim-and-fill



Part 3: Methods to correct publication bias

Several methods assessed

- Trim-and-fill
- Reweight by publication probability

Part 3: Methods to correct publication bias

Several methods assessed

- Trim-and-fill
- Reweight by publication probability
- *p*-curves for effect-size correction

Part 3: Methods to correct publication bias

Several methods assessed

- Trim-and-fill
- Reweight by publication probability
- *p*-curves for effect-size correction
- Maximise truncated likelihood

Coming Full Circle

Fighting publication bias is like hunting the Woozle—all too often it forces you to go in circles