The Consistency of Biomedical Research and Social Dependency

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Introduction

Replication Crisis of Science?

- A recent survey conducted by *Nature* in 2016 suggests that 90% of respondents expressed their concern about the reproducibility crisis.
- Meta-analysis is one way of pooling results from different studies. But, the inclusion/exclusion of original studies can affect the conclusion. Then, how are the results from systematic reviews (in)sensitive in the field of biomedical research?

Data

The Cochrane Systematic Review:

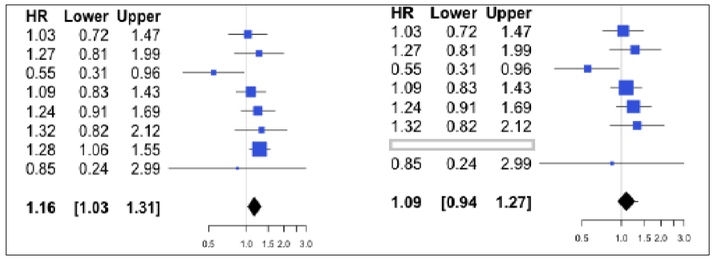
- Initial data: 4,543 review articles (i.e., articles with meta-analyses) Narrowed down to 1) biomedical claims supported by more than three trials but less than 100 trials with dichotomous dependent variables.
- Final data: 18,664 biomedical claims examined in 3,427 Cochrane reviews.

Authorship and Reference Overlaps

- The lists of publications written by authors of original research articles examined by Cochrane review are collected from the NCBI PubMed database, using PMID.
- The list of references of original research articles were also collected through the NCBI PubMed data.

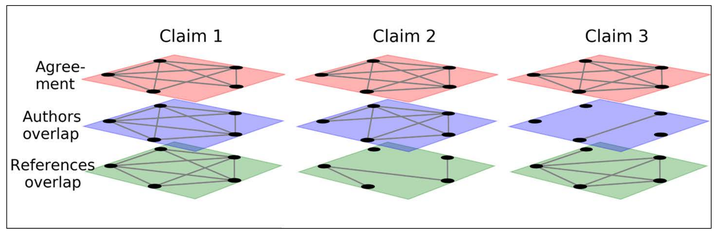
Measurements

r-value: Leave-One-Out Sensitivity Analysis for Meta-Analyses



- One study can change the result of meta analysis. The Left is significant while the right (when study 7 is excluded) is not.
- Using the Leave-one-out procedure, the *r*-value attempts to find a study that maximizes the *p*-value of a meta-analysis when it is excluded.

Social Dependency based on Overlaps



Edge weights: the Jaccard Coefficient

$$E(A_i, A_j) = \frac{|A_i \cap A_j|}{|A_i| + |A_j|\,|A_i \cap A_j|}$$

Dependency score: Network Density

$$Dep(Claim_i) = \frac{\sum E}{n(n-1)/2}$$

Results

- About **28.4%** of the 6,446 significant claims become sensitive to the LOOCV procedure.

	Logistic Regression
	From *p-value* < 0.05 to *r-value* ≥ 0.05
Num_of_Trials	-0.047***
	(0.003)
Authorship_Dep	**-1.824***
	(0.885)
Ref_Dep	-1.738
	(3.588)
Intercept	-0.253***
	(0.045)
Observations	6,446
Log Likelihood	-3,640.245
Note:	*p<0.05; **p<0.01; ***p<0.001

- The logistic regression suggest that the co-authorship overlap in original studies is positively associated with the stability of the meta-analysis.

Implication and Future Work

- The result suggests that a small change in terms of selecting of the original studies for a meta-analysis can affect the result.
- Authorship dependency seems to generate stability but it implies that insensitivity of meta-analyses does not guarantee the reliability of claims.
- A better data collection is definitely required.