

Lyles, Robert H.; Weiss, Paul; Waller, Lance A.

Calibrated Bayesian credible intervals for binomial proportions. (English) Zbl 07194274
J. Stat. Comput. Simulation 90, No. 1, 75-89 (2020).

Summary: Drawbacks of traditional approximate and exact confidence intervals for binomial proportions are well recognized. Alternatives include an interval based on inverting the score test, adaptations of exact testing, and Bayesian credible intervals. We propose an approach that calls for selecting an optimal value κ between 0 and 0.5 based on stipulated coverage criteria over a grid of regions comprising the parameter space. One then bases lower and upper limits of a credible interval on Beta $(\kappa, 1 - \kappa)$ and Beta $(1 - \kappa, \kappa)$ priors, respectively. The result tends toward a Jeffreys prior-based interval if the goal is to constrain average overall coverage at $\leq 1 - \alpha$ across the full parameter space, and toward the Clopper-Pearson interval if the goal is to constrain region-specific lower and upper lack of coverage rates $\leq \alpha/2$ as region widths approach zero. We suggest an intermediate target that demonstrably improves region-specific coverage balance when compared with existing methods.

MSC:

62 Statistics

Keywords:













approximate inference; confidence interval; exact inference; lower bound; upper bound

Software:



SAS; SAS/STAT

Full Text: [DOI](#)

References:

- [1] Clopper CJ, Pearson ES. The use of confidence or fiducial limits illustrated in the case of the binomial. *Biometrika*. 1934;26:404-413. doi: 10.1093/biomet/26.4.404[Crossref], [Web of Science , [Google Scholar] · Zbl 60.1175.02
- [2] Agresti A, Coull BA. Approximate is better than 'exact' for interval estimation of binomial proportions. *Am Stat*. 1998;52:119-126. [Taylor & Francis Online], [Web of Science , [Google Scholar]
- [3] Wilson EB. Probable inference, the law of succession and statistical inference. *J Am Stat Assoc*. 1927;22:209-212. doi: 10.1080/01621459.1927.10502953[Taylor & Francis Online], [Web of Science , [Google Scholar]
- [4] Vollset SE. Confidence intervals for a binomial proportion. *Stat Med*. 1993;12:809-824. doi: 10.1002/sim.4780120902[Crossref], [PubMed], [Web of Science , [Google Scholar]
- [5] Agresti A, Min Y. On small-sample confidence intervals for parameters in discrete distributions. *Biometrics*. 2001;57:963-971. doi: 10.1111/j.0006-341X.2001.00963.x[Crossref], [PubMed], [Web of Science , [Google Scholar] · Zbl 1209.62041
- [6] Brown LD, Cai TT, DasGupta A. Interval estimation for a binomial proportion. *Stat Sci*. 2001;16:101-133. [Crossref], [Web of Science , [Google Scholar] · Zbl 1059.62533
- [7] Thulin M. The cost of using exact confidence intervals for a binomial proportion. *Electron J Stat*. 2014;8:817-840. doi: 10.1214/14-EJS909[Crossref], [Web of Science , [Google Scholar] · Zbl 1348.62092
- [8] Sterne TE. Some remarks on confidence or fiducial limits. *Biometrika*. 1954;41:275-278. [Crossref], [Web of Science , [Google Scholar] · Zbl 0055.12807
- [9] Crow EL. Confidence intervals for a proportion. *Biometrika*. 1956;43:423-435. doi: 10.1093/biomet/43.3-4.423[Crossref], [Web of Science , [Google Scholar] · Zbl 0074.14001
- [10] Blyth CR, Still HA. Binomial confidence intervals. *J Am Stat Assoc*. 1983;78:108-116. doi: 10.1080/01621459.1983.10477938[Taylor & Francis Online], [Web of Science , [Google Scholar] · Zbl 0503.62028
- [11] Casella G. Refining binomial confidence intervals. *Can J Stat*. 1986;14:113-129. doi: 10.2307/3314658[Crossref], [Web of Science , [Google Scholar] · Zbl 0592.62029
- [12] Blaker H. Confidence curves and improved exact confidence intervals for discrete distributions. *Can J Stat*. 2000;28:783-798. doi: 10.2307/3315916[Crossref], [Web of Science , [Google Scholar] · Zbl 0966.62016
- [13] Carlin BP, Louis TA. Bayesian methods for data analysis. 3rd ed. Boca Raton (FL): Chapman & Hall/CRC; 2009. [Google

Scholar] · [Zbl 1165.62003](#)

- [14] Brown LD, Cai TT, DasGupta A. Confidence intervals for a binomial proportion and asymptotic expansions. *Ann Stat.* 2002;30:160-201. doi: 10.1214/aos/1015362189 [Crossref], [Web of Science , [Google Scholar] · [Zbl 1012.62026](#)
- [15] Agresti A, Caffo B. Simple and effective confidence intervals for proportions and differences of proportions result from adding two successes and two failures. *Am Stat.* 2000;54:280-288. [Taylor & Francis Online], [Web of Science , [Google Scholar] · [Zbl 1250.62016](#)
- [16] SAS Institute Inc. SAS/STAT[®]14.1 user's guide: high-performance procedures. Cary (NC): SAS Institute Inc.; 2015. [Google Scholar]

This reference list is based on information provided by the publisher or from digital mathematics libraries. Its items are heuristically matched to zbMATH identifiers and may contain data conversion errors. It attempts to reflect the references listed in the original paper as accurately as possible without claiming the completeness or perfect precision of the matching.