




1 statConfR: An R Package for Static Models of 2 Decision Confidence and Metacognition

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7 Summary

8 We present the statConfR package for R, which allows researchers to conveniently fit and
9 compare nine different static models of decision confidence applicable to binary discrimination
10 tasks with confidence ratings: the signal detection rating model ([Green & Swets, 1966](#)), the
11 Gaussian noise model ([Maniscalco & Lau, 2016](#)), the independent Gaussian model ([Rausch
& Zehetleitner, 2017](#)), the weighted evidence and visibility model ([Rausch et al., 2018](#)), the
12 lognormal noise model ([Shekhar & Rahnev, 2021](#)), the lognormal weighted evidence and visibility
13 model ([Shekhar & Rahnev, 2023](#)), the independent truncated Gaussian model ([Rausch et al.,
2023](#)) based on the model specification used for the original meta- d' / d' method ([Maniscalco
& Lau, 2012](#); [Maniscalco & Lau, 2014](#)), and the independent truncated Gaussian model based
14 on the model specification of Hmetad ([Fleming, 2017](#)). In addition, the statConfR package
15 provides functions for estimating meta- d' / d' , the most widely-used measure of metacognitive
16 efficiency, allowing both [Maniscalco & Lau \(2012\)](#)'s and [Fleming \(2017\)](#)'s model specification.

19 Statement of need

21 Cognitive models of confidence are currently used implicitly and explicitly in a wide range of
22 research areas in the cognitive sciences: In perception research, confidence judgments can
23 be used to quantify perceptual sensitivity based on receiver operating characteristics ([Egan
et al., 1959](#)), a method based on the signal detection rating model ([Green & Swets, 1966](#);
24 [Hautus et al., 2021](#)). In metacognition research, the most popular measure of metacognitive
25 performance, the meta- d' / d' method ([Maniscalco & Lau, 2012](#); [Maniscalco & Lau, 2014](#)),
26 implicitly relies on the independent truncated Gaussian model ([Rausch et al., 2023](#)). Finally,
27 confidence models have become a flourishing research topic in their own right ([Boundy-Singer
et al., 2022](#); [Desender et al., 2021](#); [Guggenmos, 2022](#); [Hellmann et al., 2023, 2024](#); [Pereira
et al., 2021](#); [Rausch et al., 2018, 2020](#); [Shekhar & Rahnev, 2021, 2023](#)). However, too few
28 studies have empirically compared different confidence models ([Rausch et al., 2018, 2020,
2023](#); [Shekhar & Rahnev, 2021, 2023](#)), so there is still no consensus about the computational
29 principles underlying confidence judgments ([Rahnev et al., 2022](#)). This is problematic because
30 meta- d' / d' can be biased by discrimination sensitivity, discrimination criteria, and/or confidence
31 criteria if the generative model underlying the data is not the independent truncated Gaussian
32 model ([Rausch et al., 2023](#)). Likewise, receiver operating characteristics in rating experiments
33 are only appropriate measures of discrimination sensitivity if the assumptions of the signal
34 detection rating model are correct ([Green & Swets, 1966](#); [Hautus et al., 2021](#)).

35 At the time of writing, statConfR is the only available package for an open software that
36 allows researchers to fit a set of static models of decision confidence. The ReMeta toolbox
37 provides functions for MATLAB to also fit a variety of different confidence models ([Guggenmos,](#)

42 2022), but some important models such as the independent truncated Gaussian model are
43 missing. Previous studies modelling confidence have made their analysis scripts freely available
44 on the OSF website (Rausch et al., 2018, 2020, 2023; Shekhar & Rahnev, 2021, 2023), but
45 these analysis scripts are often tailored to specific experiments and require time and effort
46 to adapt to new experiments. In addition, the documentation of these scripts is not always
47 sufficient to be used without expert knowledge in cognitive modelling. Finally, the lognormal
48 noise model and the lognormal weighted evidence and visibility model were previously only
49 available implemented in MATLAB, so statConfR makes these confidence models available
50 to researchers who do not have access to MATLAB. The statConfR package also provides a
51 faithful implementation of meta- d'/d' , which has been originally implemented in MATLAB
52 (Maniscalco & Lau, 2012). Fleming provides MATLAB and R code for Hmetad, a Bayesian
53 hierarchical version of meta- d'/d' (Fleming, 2017), but notably the model specification used
54 for Hmetad is not the same as in meta- d'/d' (Rausch et al., 2023).

55 An important limitation of the models implemented in statConfR is that the dynamics of the
56 decision process are not taken into account. This is a problem because confidence judgments
57 are related to the dynamics of decision making (Hellmann et al., 2024; Pleskac & Busemeyer,
58 2010; Rahnev et al., 2020). However, most previously proposed dynamical models of confidence
59 do not include a parameter to represent metacognitive ability. There is one proposal for a
60 dynamical measure of metacognitive efficiency, the v -ratio (Desender et al., 2022), which is
61 based on two-stage signal detection theory (Pleskac & Busemeyer, 2010), but two-stage signal
62 detection theory has been outperformed by other models in a number of visual discrimination
63 tasks (Hellmann et al., 2023, 2024; Shekhar & Rahnev, 2023). Thus, the static confidence
64 models included in statConfR may still be useful for many researchers.

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