

Sequential Certification of Threshold Decisions in Rare-Event Risk Prediction

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Abstract

Rare clinical outcomes pose a difficulty deeper than ordinary class imbalance: a penalized logistic model can return finite, stable-looking coefficients before the data support a reliable threshold decision. We formulate the accrual question as decision-targeted sequential certification. On a pre-specified finite monitoring schedule and target set, asymptotic prediction bands are adjusted for simultaneous coverage, and certification is assessed only among profiles that might be referred, so that a large low-risk majority cannot trigger an uninformative stop. Under the working rare-event logistic model and stated regularity conditions, each certified decision is asymptotically model-conditionally correct with probability at least $1-\alpha$ over the schedule, and the effective information scales with the number of genuine events. Simulations and a US linked birth/infant-death application illustrate the gap between a model that is merely estimable and one whose decisions are certifiable: the whole-population rule stopped while more than half of referral-relevant profiles remained ambiguous, whereas the decision-targeted rule did not certify by the 300,000-birth horizon despite stable temporal validation. Regularization makes a rare-event model estimable but does not substitute for genuine rare-event information.

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