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A continuous time version and a generalization of a Markov-recapture model for trapping experiments

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Abstract

Wileyto et al. [E.P. Wileyto, W.J. Ewens, M.A. Mullen, Markov-recapture population estimates: a tool for improving interpretation of trapping experiments, Ecology 75 (1994) 1109] propose a four-state discrete time Markov process, which describes the structure of a marking-capture experiment as a method of population estimation. They propose this method primarily for estimation of closed insect populations. Their method provides a mark-recapture estimate from a single trap observation by allowing subjects to mark themselves. The estimate of the unknown population size is based on the assumption of a closed population and a simple Markov model in which the rates of marking, capture, and recapture are assumed to be equal. Using the one step transition probability matrix of their model, we illustrate how to go from an embedded discrete time Markov process to a continuous time Markov process assuming exponentially distributed holding times. We also compute the transition probabilities after time t for the continuous time case and compare the limiting behavior of the continuous and discrete time processes. Finally, we generalize their model by relaxing the assumption of equal per capita rates for marking, capture, and recapture. Other questions about how their results change when using a continuous time Markov process are examined.

Author keywords

Capture-recapture experiment; Discrete and continuous time Markov process; Maximum likelihood estimation; Multinomial distribution; Population size estimation; Transition probability matrix; Uniformization

Indexed Keywords

Engineering controlled terms: Continuous time systems; Estimation; Experiments; Population statistics; Probability

Engineering uncontrolled terms: (e ,3e) process; Continuous-time (CT); Discrete time (DT);

Elsevier (CO); holding times; insect populations; Limiting behavior; markov modelling; Per capita; population sizes; Transition probability (TP); transition probability matrices

Engineering main heading: Markov processes

GEOBASE Subject Index: experimental study; mark-recapture method; Markov chain; modeling; population distribution; population estimation; population size; trapping

EMTREE medical terms: article; insect; mathematical model; maximum likelihood method; population dynamics; population size; probability; time

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