Abstract

Title: **Evidence for significant correlation between autocorrelated Emergency Department measures**
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Background: Assessing levels of crowding in Emergency Departments (EDs) is challenging problem and ongoing area of research. Strong evidence of linear association between a new scale and an established measure encourages further investigations of the new scale. Measures of crowding are time-series data, and display strong autocorrelation. This invalidates the OLS estimation of regression coefficients, which are commonly used to evaluate and assess the significance of the Pearson correlation coefficient (PCC).
Motivating Example: An editorial in the Journal of Emergency Medicine examines the difficulties faced by one pilot study. No evidence of linear association was found, and the authors point out earlier work may be invalid.
What this work offers: An `R` function is presented that uses simulation to model the effects of autocorrelation. Given an observed PCC ρ_0 between two series of known length and estimated autocorrelations, the function evaluates the probability of observing a PCC, $\tilde{\rho}$, such that $|\tilde{\rho}| \geq \rho_0$ under the null hypothesis that the two series are uncorrelated. This provides a two-sided hypothesis test. A confidence interval for the PCC is not supplied.
Interesting properties of the correlation coefficient are explored by simulation and the effects of autocorrelation are represented graphically.
Why this is helpful: The function is easily used, and may also be applied to earlier work. The pilot study above is examined in detail. Limited data from discrete observation sets make specifying a useful linear model difficult, loss of power from attempts to remove the autocorrelation is also demonstrated.
Main Conclusions: Strong evidence of linear association was found. However, the correlation coefficient is a one-dimensional summary of complex data, and of limited value. Designing a pilot study with time-series data, autocorrelation should be considered, noting discontinuities between small observation sets will be problematic in analysis. Explicitly stating the extent of autocorrelation is a recommended practice.