Corrigendum to "Nonlinear Prediction, Chaos, and Noise"

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This corrigendum is to identify a minor error made in Elsner and Tsonis (1992). The error was recently brought to our attention by a colleague of the first author, J. Ahlquist, and concerns the reported prediction errors of the linear autoregressive (AR) models (Figs. 5, 7, and 9) used for comparison with a nonlinear model. A bug found in our computer program reveals that, after the first two predictions, we have underestimated the skill of the AR models. The examples chosen in Elsner and Tsonis contain significant autocorrelation that allow the AR models to perform satisfactorily. This might make the examples chosen in Elsner and Tsonis that show superiority of a nonlinear model less convincing.

Had we been aware of the error, we would have attempted further optimization of our model or would have included other nonlinear representations and/or chosen other examples, especially cases with no apparent autocorrelation. The error, however, as is demonstrated next, does not invalidate our conclusions.

Prediction skill between the corrected AR model and artificial neural network (ANN) and a nonlinear simplex model (Farmer and Sidorowich 1987) is compared on the logistic equation. The logistic equation is defined as

$$X_{t+1} = aX_t(1 - X_t),$$

and with $a = 3.8$, this equation represents a chaotic system. As clearly shown in Fig. 1, both nonlinear models outperform the AR model. The example is chosen to emphasize that there is more to the evolution of dynamical systems than autocorrelation (autocorrelation is negligible in the logistic equation) and that certain nonlinear models including ANNs are capable of short-term useful predictions by exploiting the nonlinear dynamics, even if it is chaotic.

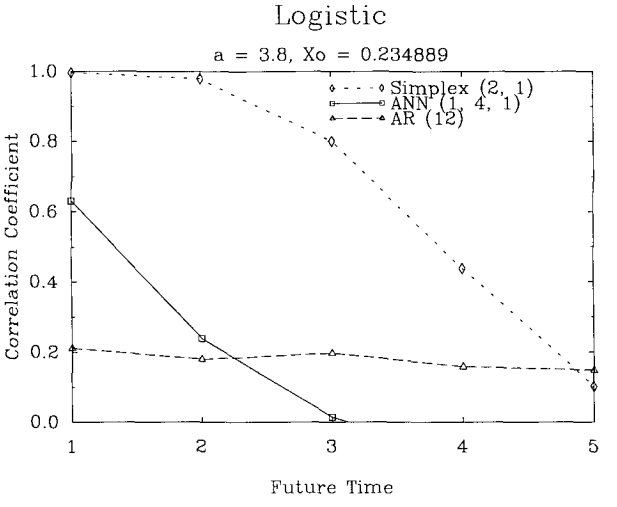

FIG. 1. Correlation coefficients between actual and predicted values as a function of future iterations of the logistic equation. The initial value used is X_0=0.234889. Comparisons are made between the two nonlinear models (ANN and Simplex) and the linear autoregressive (AR) model. For short-term predictions, both nonlinear models outperform the linear model. ANN (1, 4, 1) refers to a network with one input node, four hidden nodes, and one output node, and Simplex (2, 1) refers to a simplex model having an embedding dimension of 2 and a lag of 1. AR(12) refers to an autoregressive model of order 12.

References

Elsner, J. B., and A. A. Tsonis, 1992: Nonlinear prediction, chaos, and noise. *Bull Amer. Meteor. Soc.*, **73,** 49–60.

Farmer, J. D., and J. J. Sidorowich, 1987: Predicting chaotic time series. *Phys. Rev. Lett.*, **59,** 845–848.

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