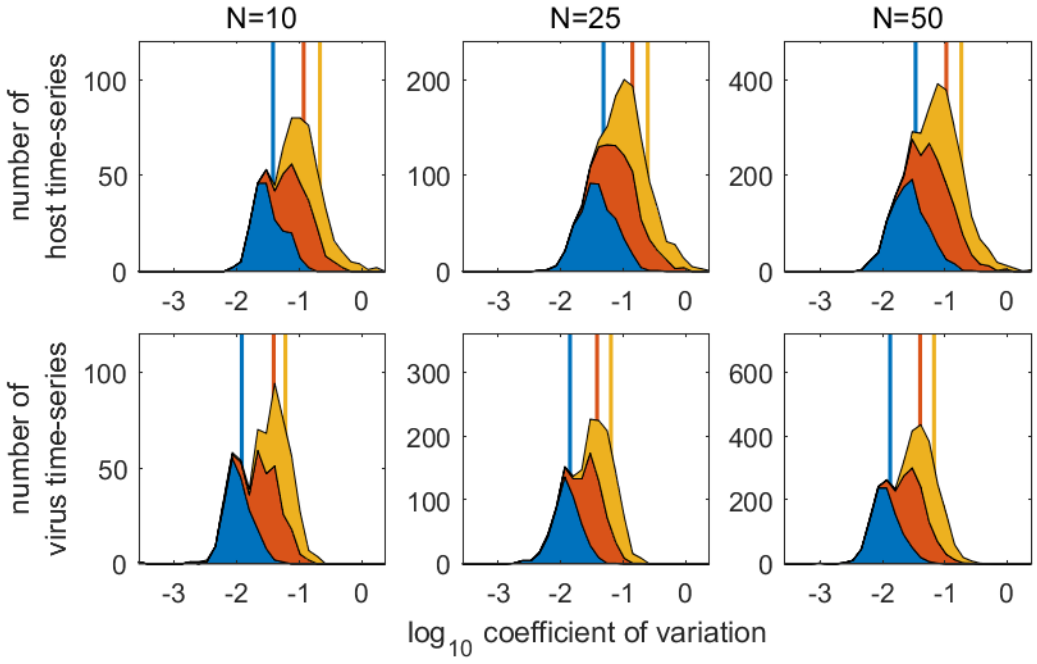

FIG S1

Distributions of coefficients of variation for each simulated host time series (top row) and virus time series (bottom row) for the ensemble of communities over three network sizes (N = 10, 25, 50 with 20 communities for each N). The coefficient of variation (CV) for an individual time series is CV = σ/μ where σ is the standard deviation and μ is the mean of the time series from t = 0 h to t = 200 h (the sample duration used in the main text). The colors correspond to time series with different initial condition perturbation amounts (δ = 0.1 [blue], 0.3 [orange], 0.5 [yellow]); the three distributions are plotted cumulatively here. Solid vertical lines correspond to distribution means. For both hosts and viruses, CV scales with δ but does not scale with N. The mean CVs for host time series for δ = 0.1, 0.3, 0.5 (averaged across network sizes) are 0.04 ($10^{-1.40}$), 0.12 ($10^{-0.92}$), and 0.22 ($10^{-0.67}$), respectively. For virus time series, they are 0.01 ($10^{-1.88}$), 0.04 ($10^{-1.41}$), and 0.06 ($10^{-1.20}$). Notably, increasing δ (and thus CV) did not improve AUC for any of the correlation-based inference methods (Fig. S4, S5, and S6).

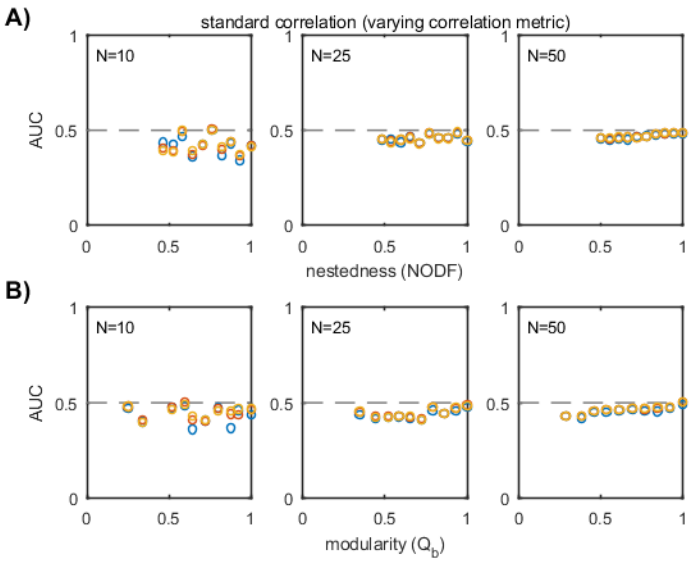

FIG S2

AUC values for standard correlation of various types (Pearson correlation [blue], Spearman correlation [orange], and Kendall correlation [yellow]) for the ensemble of nested (A) and modular (B) communities over three network sizes N = 10, 25, 50. The dashed lines mark AUC = 1/2 and imply that the predicted network did no better than random guessing. This figure corresponds to Fig. 3 in the main manuscript.

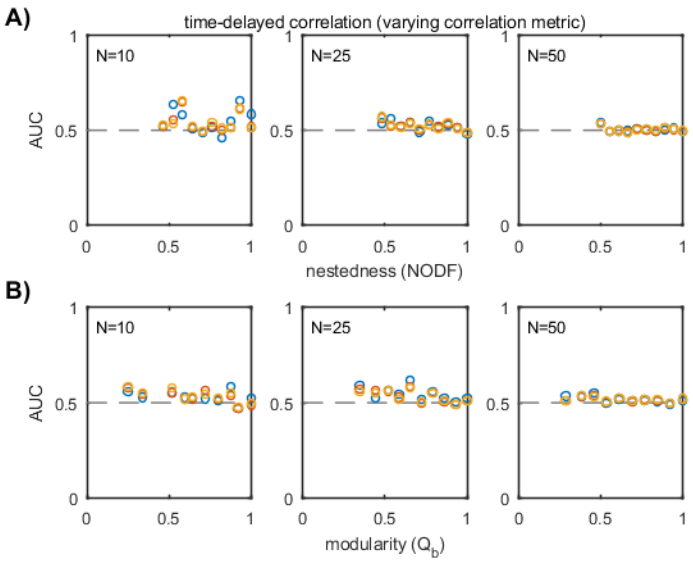

FIG S3

AUC values for time-delayed correlation of various types (Pearson correlation [blue], Spearman correlation [orange], and Kendall correlation [yellow]) for the ensemble of nested (A) and modular (B) communities over three network sizes N = 10, 25, 50. The dashed lines mark AUC = 1/2 and imply that the predicted network did no better than random guessing. This figure corresponds to Fig. 4 in the main manuscript.

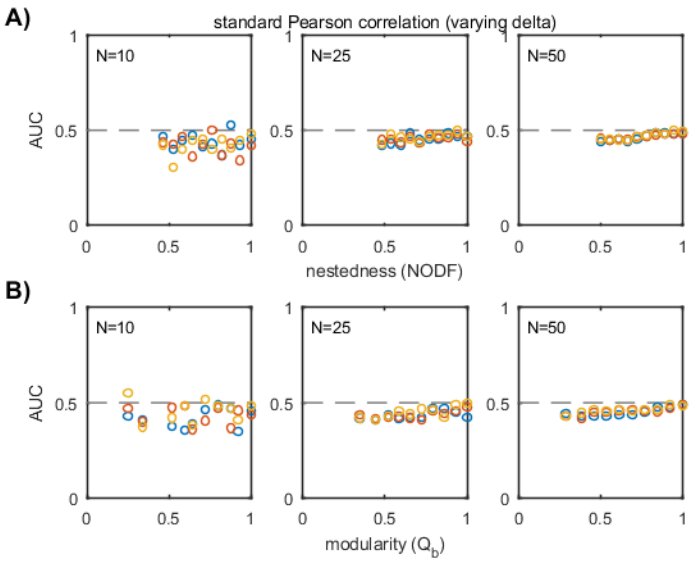

FIG S4

AUC values for standard Pearson correlation with different δ values (δ = 0.1 [blue], 0.3 [orange], and 0.5 [yellow]) for the ensemble of nested (A) and modular (B) communities over three network sizes *N* = 10, 25, 50. The dashed lines mark AUC = 1/2 and imply that the predicted network did no better than random guessing. This figure corresponds to Fig. 3 in the main manuscript.

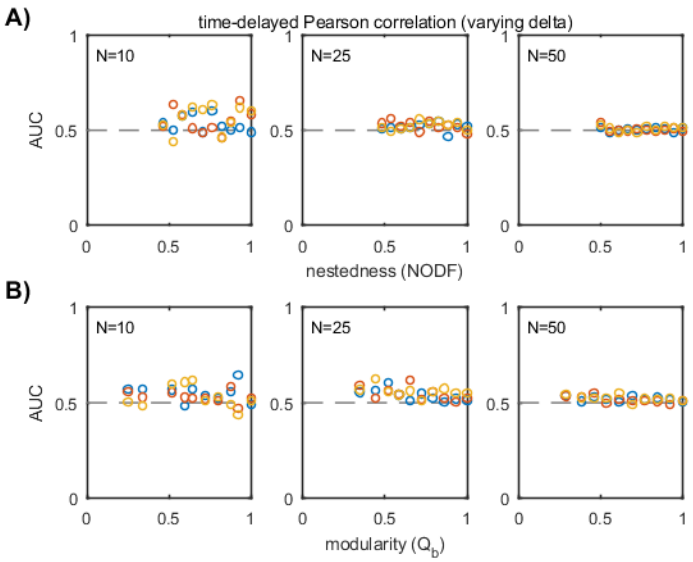

FIG S5

AUC values for time-delayed Pearson correlation with different δ values (δ = 0.1 [blue], 0.3 [orange], and 0.5 [yellow]) for the ensemble of nested (A) and modular communities (B) over three network sizes N = 10, 25, 50. The dashed lines mark AUC = 1/2 and imply that the predicted network did no better than random guessing. This figure corresponds to Fig. 4 in the main manuscript.

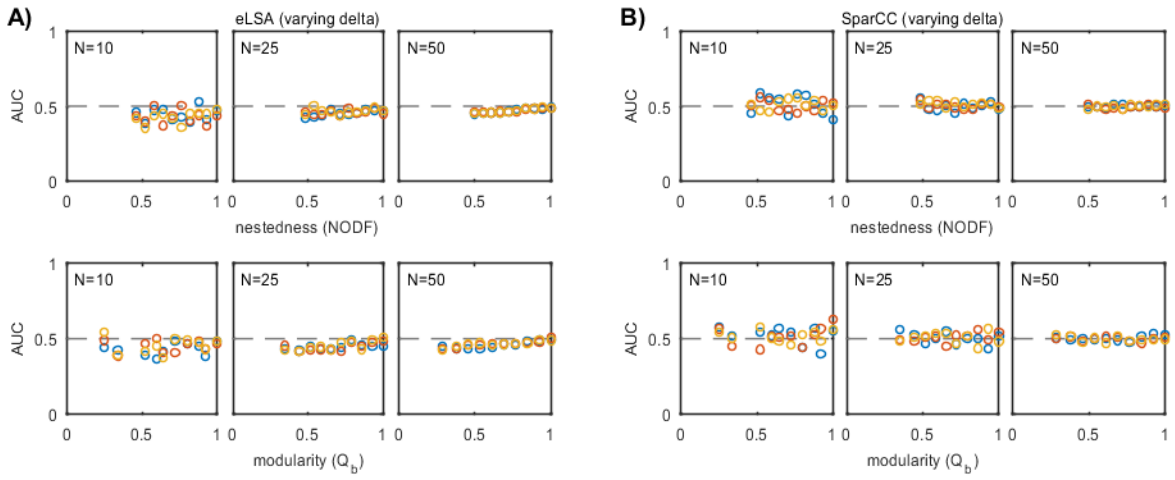

FIG S6

AUC values for eLSA and SparCC with different δ values (δ = 0.1 [blue], 0.3 [orange], and 0.5 [yellow]) for the ensemble of nested (A) and modular communities (B) over three network sizes N = 10, 25, 50. The dashed lines mark AUC = 1/2 and imply that the predicted network did no better than random guessing. This figure corresponds to Fig. 5 in the main manuscript.

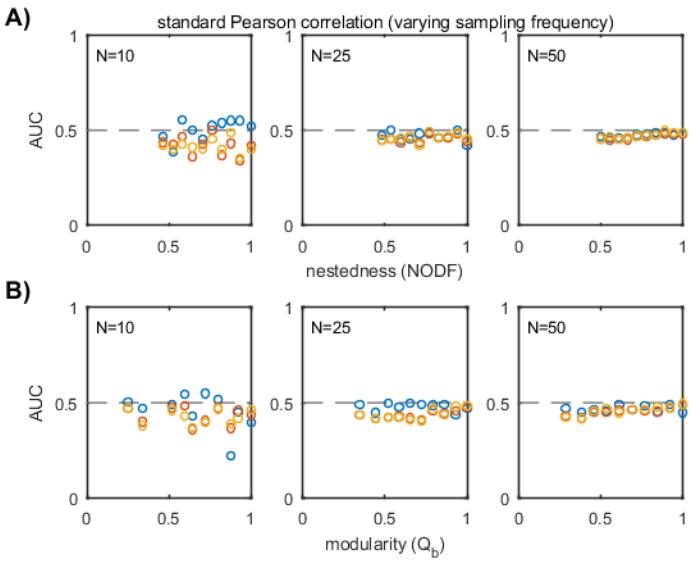

FIG S7

AUC values for standard Pearson correlation with different sample frequencies (0.5 h [blue], 2 h [orange], and 4 h [yellow]) for the ensemble of nested (A) and modular communities (B) over three network sizes N = 10, 25, 50. The dashed lines mark AUC = 1/2 and imply that the predicted network did no better than random guessing. This figure corresponds to Fig. 3 in the main manuscript.

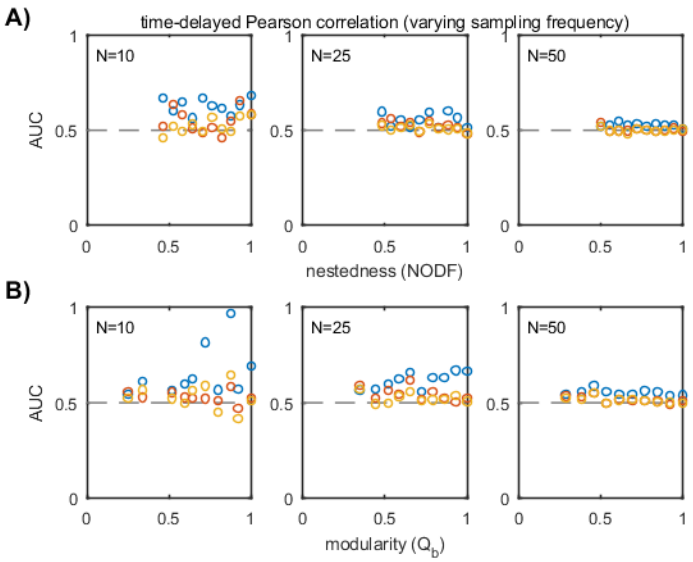

FIG S8

AUC values for time-delayed Pearson correlation with different sample frequencies (0.5 h [blue], 2 h [orange], and 4 h [yellow]) for the ensemble of nested (A) and modular (B) communities over three network sizes N = 10, 25, 50. The dashed lines mark AUC = 1/2 and imply that the predicted network did no better than random guessing. This figure corresponds to Fig. 4 in the main manuscript.

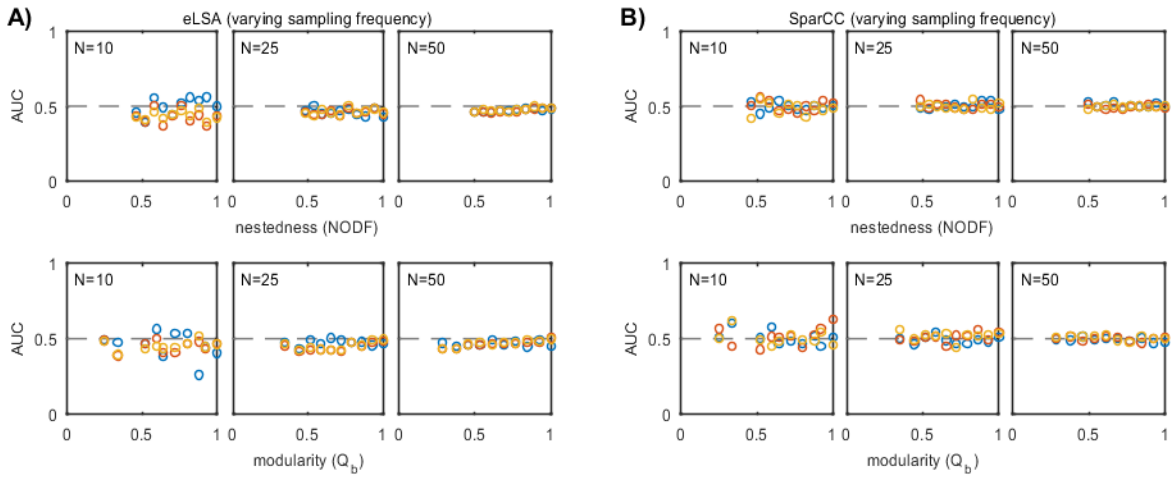

FIG S9

AUC values for eLSA and SparCC with different sample frequencies (0.5 h [blue], 2 h [orange], and 4 h [yellow]) for the ensemble of nested (A) and modular (B) communities over three network sizes *N* = 10, 25, 50. The dashed lines mark AUC = 1/2 and imply that the predicted network did no better than random guessing. This figure corresponds to Fig. 5 in the main manuscript.