

# Population Dynamics Virtual Seminar



**Alex Yuan**  
**Shou Lab - UCL**

28.01.22 - 4:00 pm GMT - 5:00 pm CET

## **A rigorous and general statistical test for correlations between time series**

Computing a correlation between a pair of time series is a routine task in disciplines from biology to climate science. How do we test whether an observed correlation is statistically significant (i.e. unlikely under the null hypothesis that the time series are independent)? This problem is made especially challenging by two factors: First, time series typically exhibit autocorrelation, which can induce spurious correlations and render standard statistical tests invalid. Second, researchers increasingly use nonlinear correlation statistics with no known analytical null distribution, thus rendering parametric tests infeasible. Several statistical tests attempt to address these two challenges, but none is perfect: Some are only guaranteed to control the false positive rate under restrictive requirements, while others simply lack clear conditions for exact validity. I will describe a correlation significance test that is exactly valid so long as one of the time series is stationary, which is the least restrictive requirement among known nonparametric tests. Using synthetic data, we verify that this test performs correctly even while other tests suffer false positive rates above the significance level. When applied to processes in climatology, microbiome science, and animal behavior, our test confirms previously detected dependence relationships and suggests new ones.