

# The basics of time series analysis

## Modeling Intensive Longitudinal Data

Ellen Hamaker



**Utrecht  
University**

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# What is a time series?

Characteristics of time series data:

- ▶  $N=1$
- ▶  $T$  is large (say  $>50$ )
- ▶ univariate or multivariate
- ▶ data are (often) autocorrelated
- ▶ multivariate data can be cross-correlated

# Examples of time series data

In **sociology**:

- ▶ quarterly unemployment numbers
- ▶ alcohol consumption per capita and criminal violence rates

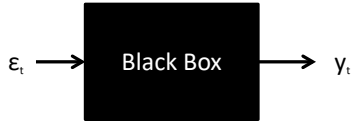
In **medical research**:

- ▶ antidepressants use
- ▶ 9/11 attacks and weekly psychiatric patient admissions

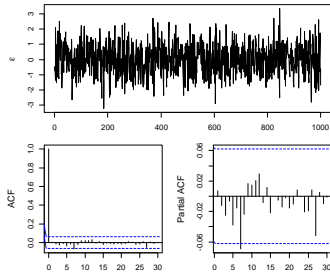
In **psychology**:

- ▶ network of symptoms in depressive patient
- ▶ feedback and academic performance

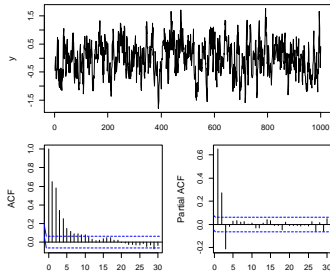
# From white noise to observed data (and back)



White noise in



Autocorrelated data out



# Fitting time series models

Evaluating time series models is tricky because

- ▶ the focus is not only on the variance, but also on the autocorrelation structure
- ▶ there is no saturated model (unlike in SEM)

When considering various time series models, we can focus on:

- ▶ the residuals (should be white noise sequence)
- ▶ forecasting (using cross-validation)
- ▶ model selection (with information criteria)
- ▶ model comparison for nested models (using log likelihood difference test)

To learn more about (the practice of) **forecasting with time series data**, see the book and software from Hyndman and Athanapoulos: <https://otexts.com/fpp3/>



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