Adventures in Bayesian Structural Time Series

Part 1: Introduction

Andrew Bates, Josh Gloyd, Tyler Tucker

The Adventure

- Structural time series

The Adventure

- Structural time series
- Bayesian approach to structural time series

The Adventure

- Structural time series
- Bayesian approach to structural time series
- Implementation via `bsts` in `R`

Useful Resources

- Predicting the Present with Bayesian Structural Time Series
  Steven L. Scott and Hal Varian

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- An Introduction to State Space Time Series Analysis
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- `bsts` documentation

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- `bsts` documentation
- Adventures in BSTS GitHub

SAN DIEGO STATE UNIVERSITY

- Stochastic process indexed by time $\{X_t,\ t \in \mathbb{T}\}$

$$E[X_t] = \mu$$

$$Cov(X_t, X_{t+k}) = \gamma(k)$$

Time Series Review

- Stochastic process indexed by time $\{X_t,\ t \in \mathbb{T}\}$
- (weak) Stationarity

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$$E[X_t] = \mu$$

$$Cov(X_t, X_{t+k}) = \gamma(k)$$

- Not i.i.d.

ARMA Models

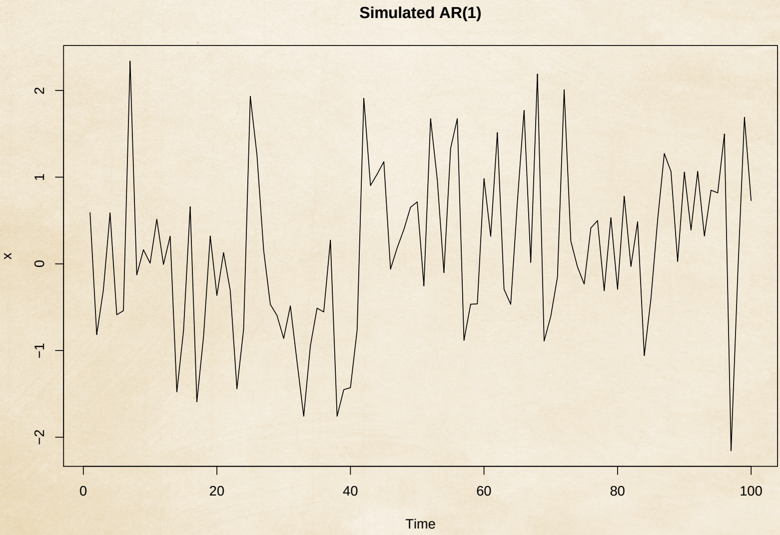
AR(1)

$$X_t = \phi X_{t-1} + e_t$$

e_t i.i.d. $(0, \sigma^2)$

$$|\phi| < 1$$

AR(1)



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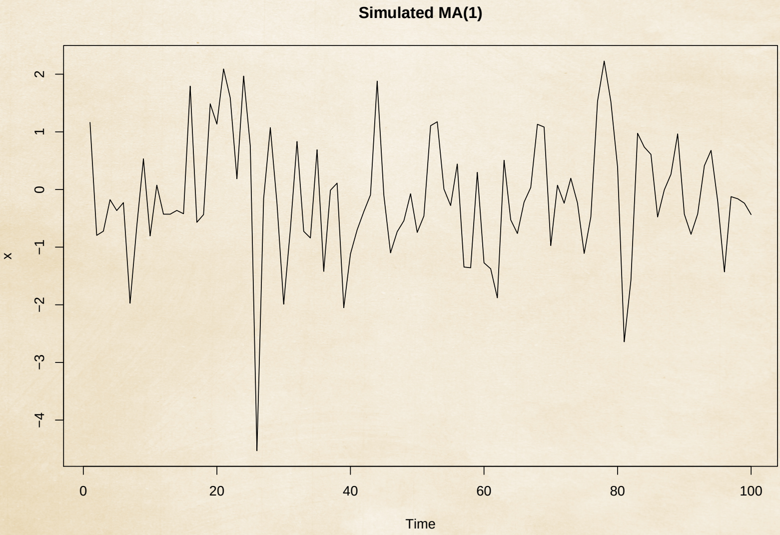
MA(1)

$$X_t = \theta e_{t-1} + e_t$$

e_t i.i.d. $(0, \sigma^2)$

MA(1)

Simulated MA(1)



ARMA Models

ARMA(p,q)

$$\phi(B)X_t = \theta(B)e_t$$

$$\phi(B)X_t = X_t - \phi_1 X_{t-1} - \cdots - \phi_p X_{t-p}$$

$$\theta(B)e_t = e_t + \theta_1 e_{t-1} + \cdots + \theta_q e_{t-q}$$

Your quest. . .