Time Series Analysis

Lecture 4

Mixed Autoregressive Moving Average (ARMA) Models

Autoregressive Integrated Moving Average (ARIMA) Models

Seasonal ARIMA (SARIMA) Models

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ARIMA Model: Simulation

ARIMA: Algebraic Manipulation Before Simulation

- Following the approach in the last few lectures, we simulate an ARIMA model and examine its patterns exhibited in a time series plot, ACF, and PACF.
- The simulated model acts as a "true" model, so we can estimate the model and examine how close the parameter estimates are to the "true" model parameters.
- Consider a model taken from an example in (CM2009) section 7.2.4 on page 140:

$$y_t = 0.5y_{t-1} + y_{t-1} - 0.5y_{t-2} + \omega_t + 0.3\omega_{t-1}$$

$$y_t - y_{t-1} = 0.5(y_{t-1} - y_{t-2}) + \omega_t + 0.3\omega_{t-1}$$

$$(y_t - y_{t-1}) - 0.5(y_{t-1} - y_{t-2}) = \omega_t + 0.3\omega_{t-1}$$

$$\nabla y_t - 0.5 \nabla y_{t-1} = \omega_t + 0.3\omega_{t-1}$$

ARIMA: Algebraic Manipulation Before Simulation

- The equation can be rearranged and factored as an ARIMA(1,1,1) model:

$$(1 - 0.5B) \nabla y_t = (1 + 0.3B)\omega_t$$

$$\nabla y_t = 0.5 \nabla y_{t-1} + \omega_t + 0.3\omega_{t-1}$$

- Note that after the first difference, the model becomes a stationary ARMA(1,1) model.

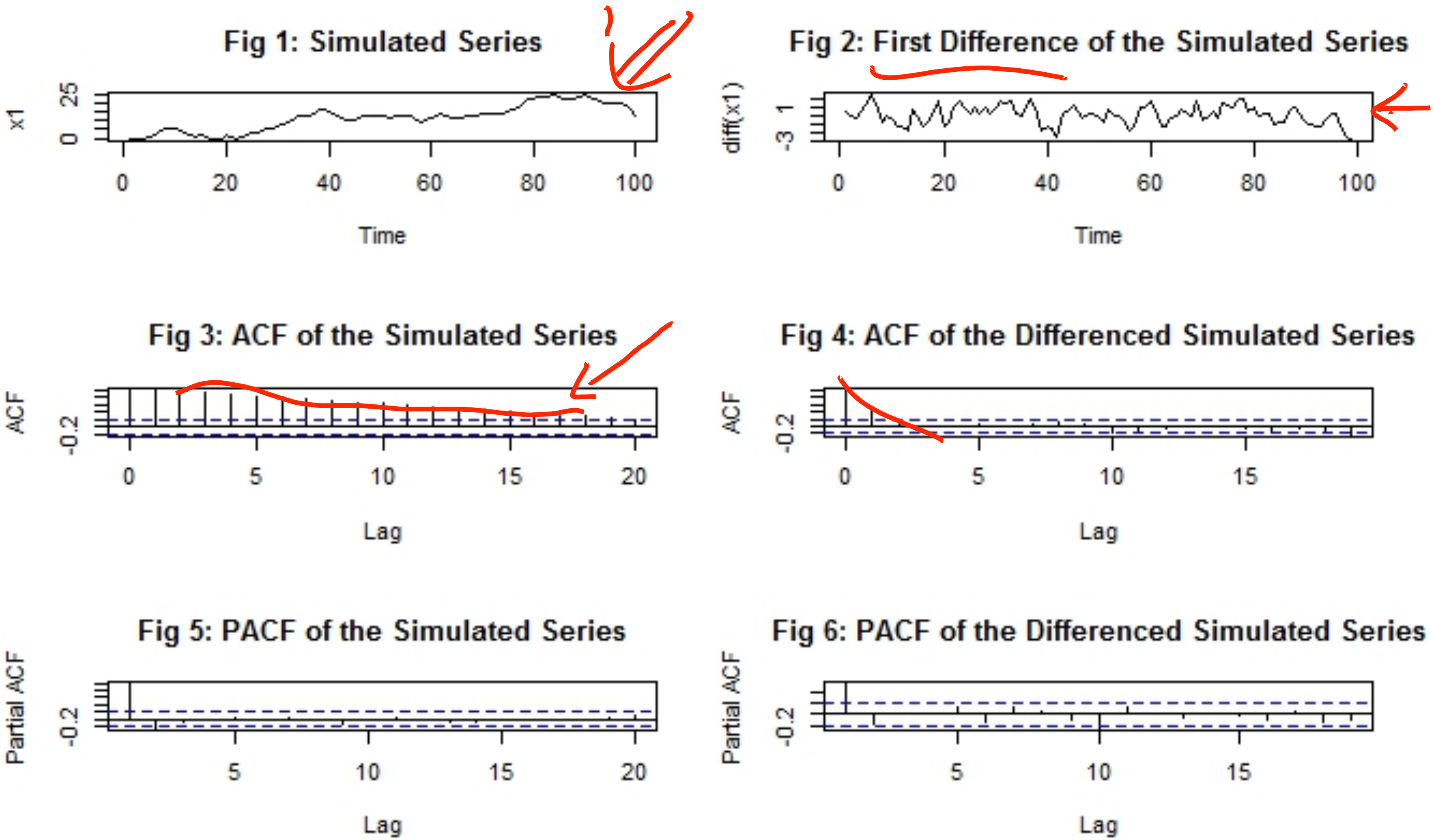
Simulated Data

```
set.seed(898)
x1 <- w <- rnorm(100)
for (i in 3:100) x1[i] <- 0.5*x1[i-1] + x1[i-1] - 0.5*x1[i-2] + w[i] + 0.3*w[i-1]
```

Basic structure and descriptive statistics of the data

```
> str(x1)
 num [1:100] -0.579 -0.0823 0.0254 -0.1728 0.254 ...
> summary(x1)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
   -0.9     5.0    12.5    11.5    15.9    24.3
```

Data Visualization



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