Example: Prediction

EE363
Stanford University

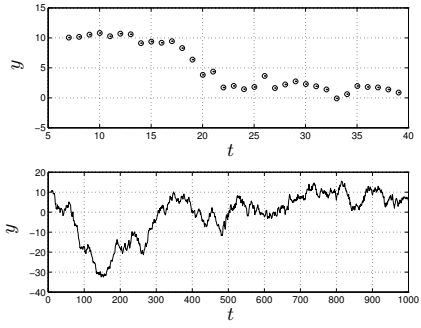
Estimation / prediction

random time-series y modeled as

$$x(t+1) = Ax(t) + Bw(t), \quad y(t) = Cx(t) + Dv(t)$$

where w and v are white noises (details later)

specific example, with $x(t) \in \mathbb{R}^{10}$ and scalar $y(t)$:

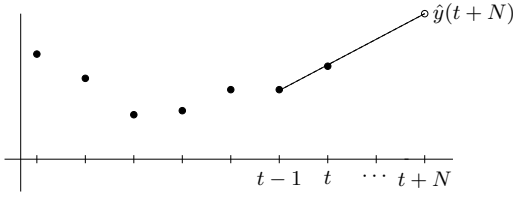


Problem

problem: predict $y(t+N)$ based on $y(t),\ y(t-1), \ldots$
(which obviously has many practical uses . . .)

simple method: predict $y(t+N)$ by *linear extrapolation* through $y(t)$ and $y(t-1)$:

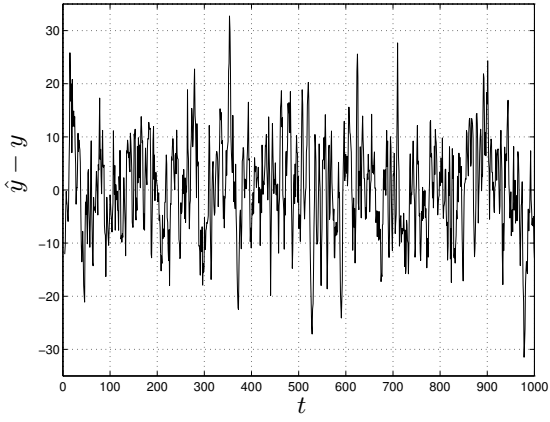
$$\hat{y}(t+1) = y(t) + N(y(t) - y(t-1))$$



Performance of linear extrapolation

how well does it do? (with $N = 4$)

RMS prediction error is 9.03 (RMS y is 11.11)
$i.e.$, 81% RMS prediction error



Better approach

in this course we'll study the **optimal** predictor
(which happens to be a linear system . . .)

prediction error with optimal predictor (same scale):

optimal RMS prediction error is 2.17
$i.e.$, 20% RMS prediction error