fitbit weight loss efficacy of drug treatment

Longitudinal Data and Time Series (April 4th, 2016)

Examples: atmospheric data, oceanic data, weather GDP, stock markets population → "space-time" bacteria cultures / other bio stuff.

Time Series: Measuring a single variable over points in time

Can be regularly or irregularly spaced time intervals:

Data structure:

one person/object: X_i — $T_1, T_2, \ldots, T_J$ — J time points — 1×J vector

$T_1, T_{1+h}, T_{1+2h}, T_{1+3h}$ → regularly spaced

several people/objects: n obs; J time points; n×J matrix

$$\begin{array}{c} \\ 1 \\ 2 \\ \vdots \\ n \end{array}\begin{bmatrix} T_1 & T_2 & \cdots & T_J \\ & X_{ij} = \text{value of person } i \text{ at time point } j & & \end{bmatrix}$$

$T_1, T_2, T_3, \ldots, T_J$ → irregularly spaced

Can have more than one variable:

one person/object: $T_1\ T_2\ \cdots\ T_J$; V_1, V_2

several people/objects: several n×J matrices → one for each variable.

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Analyzing and Comparing Time Series

What are we interested in seeing with time series?

increasing trend? decreasing trend?

seasonal trends (monthly data)

weekly trends (e.g. NYC bike)

variability over time

parallel (↑↑ or ↓↓) vs. opposite (↑↓ or ↓↑)

periodicity/patterns/cyclical trends/seasonal trends

What if we have multiple time series? How to compare?

sudden changes in reaction to events

Must be on the same Time scale

(points should "line up")

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check for differences in subgroups

Ex: HW 10: "all" vs. "males" vs. "females"

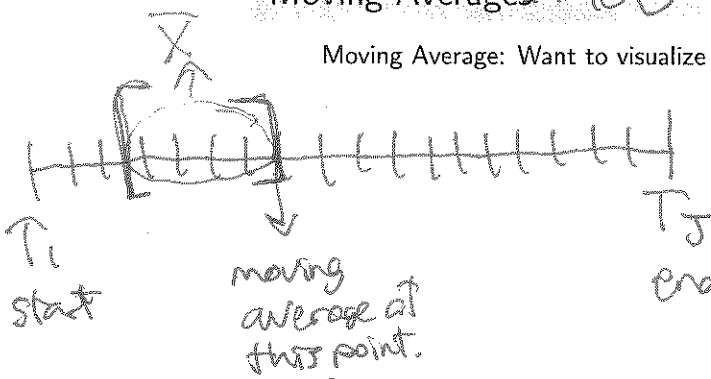
X mean(X[(k-ww):k])
↓ vector LyMA at k

not really a MA; ww=1 → just the orig. time series

Moving Averages Plots

parameter

Moving Average: Want to visualize how the trend changes over time.



[ ] = "window" ↑ "window width"

big ww → smooth MAs
small ww → jagged MAs
↳ high variability

Can downweight older observations in your moving window:

"weighted Moving average" → often useful in prediction

how do we weight the observations in the MA window?

↳ suppose ww = 3, set weight (importance of each obs

(e.g. 5, 2, 1/2) → 5/(5+2+1/2), 2/(5+2+1/2), (1/2)/(5+2+1/2)

↳ scale weights (importances) by their sum ⇒ wts sum to 1

Lags and Autocorrelation

Lags: Does one time point influence future time point(s)?

Lag 1: looking at time series vs. itself at previous time point

Lag 2: 2nd prev. time point

IaR:
X[1:(n-1)] vs X[2:n]
X[1:(n-2)] vs. X[3:n]

Autocorrelation: Correlation between a time series and a lagged version of itself

$$R(s,t) = \frac{E[(X_s - \mu_s)(X_t - \mu_t)]}{\sigma_s \sigma_t}$$

↳ two time points