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FUTURREG Futures Workshop

Futures Toolkit: Trend analysis

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FUTURREG
Futures for Regional Development

Trend analysis



- Quantitative trend analysis
 - mainly based on statistical data
- Qualitative trend analysis
 - concerned with social, institutional, organisational, political etc. patterns

Quantitative Trend Analysis



Two main goals of quantitative trend analysis:

- Identify the nature of a phenomenon represented by the sequence of observations, and
- Forecast that is to say “predict” future values of a time series variable

Trend identification



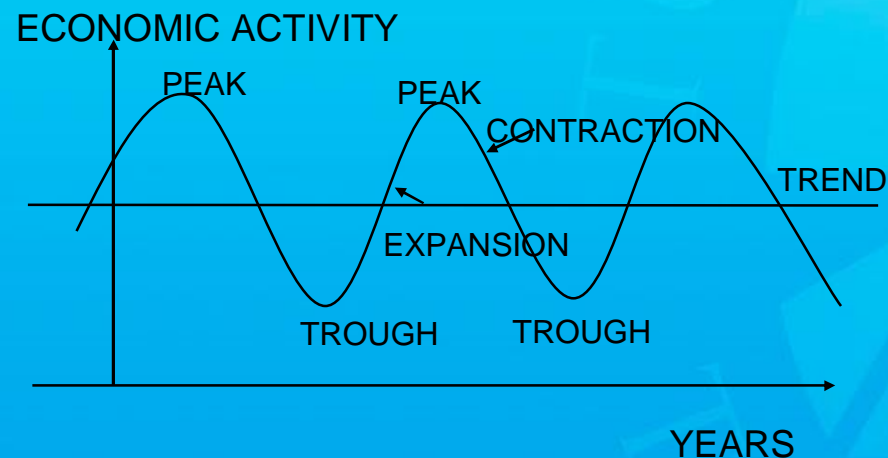
What is a trend?

- ▶ an inclination in a particular direction
- ▶ a tendency or
- ▶ a general direction.

- linear (e.g. continuous arithmetical increase) 

- exponential increase (J-curve) 

- cyclical (e.g. seasonal, discontinuous)



Trend identification



- The study of historical data is called Exploratory data analysis
- There are no "automatic" techniques to identify trend curves in time series data
- Smoothing is applied if the time series data contain considerable error
 - Smoothing always involves averaging of data such that the nonsystematic components of individual observations cancel each other out.
- The most common mathematical models involve various forms of weighted smoothing methods
- The decomposition technique mathematically separates the historical data into trend, seasonal and random components

A trend analysis can detect Trends of various type



Period Trends

- short-term trend: phenomena of limited durability
(accidental)
- long-term trend: phenomena of long durability
(fundamental)

Composite Trends

- S curves or logistic curves (e.g. initial invariance, then exponential growth and eventual flattening;
- envelope curves (big S curve riding on a series of small S's) curves, e.g. phenomena that pile up on top of each other)

Expected results of exploratory trend analysis



- The overall pattern of change in an indicator over time
- Comparing one time period to another
- Comparing one geographic area to another
- Comparing one industrial sector, line of business, population group etc. to another
- Making future projections

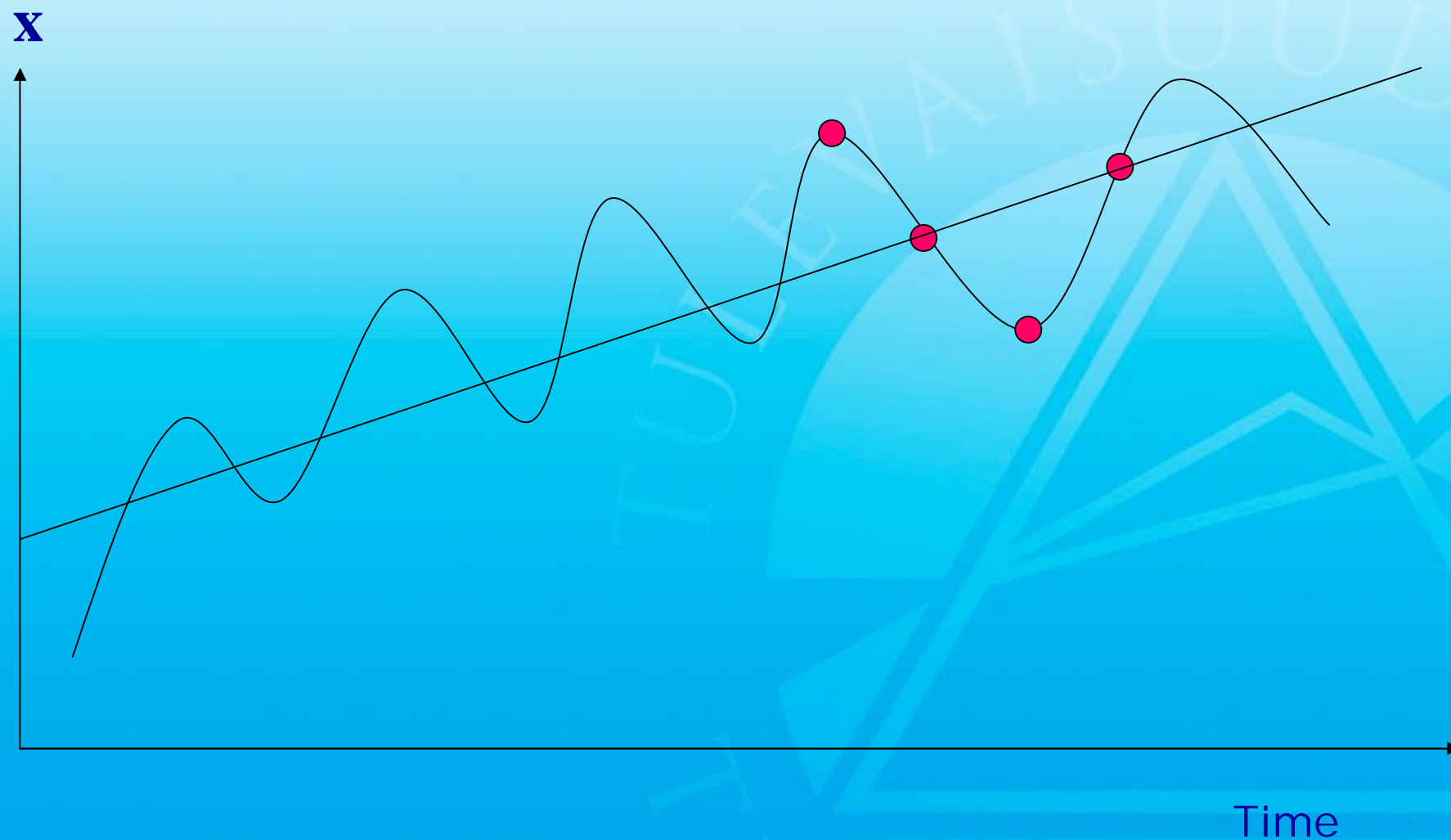
Trend extrapolation



- One of the most common forms of *forecasting*
- Is an anticipation based on the assumption that certain phenomena are likely to continue to manifest themselves in the future (persistence), sometimes with the same dynamic (direction, rate).
- Does not attempt to provide an explanation of the pattern observed in the past.
- The future is considered as a continuation of the past

Key task of extrapolation analysis:

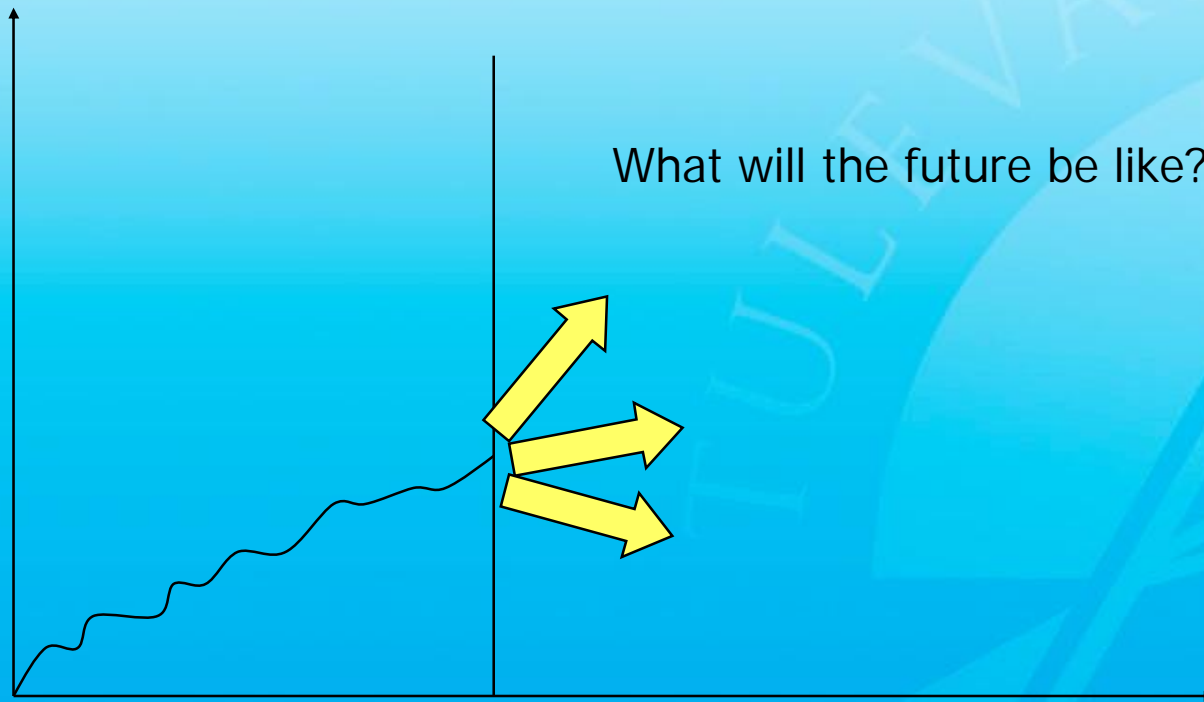
To find where we are now on the trend path



Positive approach of explorative forward trend scenario



Variabe



What will the future be like?

Trend line so far

Future

Time

Time horizon



- The further out we attempt to forecast, the less certain becomes the forecast and the fuzzier the result
- The curvilinear shape of the trend is more easily forecasted than the actual timing of curving transitions
- What is thought of as the "long-term" varies across different issues and actors
- Data to be analyzed should cover a period of at least twice the length of time to be forecasted; some futurists insist on three to four times the length of the projection



Examples of data that can be relevant in regional trend analysis:

- voting data, transportation data, public finance data, labour market data employment, healthcare data, financial data, educational data, economic history data, economic growth data, demographic data (age structure, population density, settlement data, mobility data), crime statistics and data, agricultural data, public sector investment data, consumption data, income data, energy data etc.

Data sources are local, state and federal agencies, Statistic centres, unions etc.



The users

- Treatment of data is mainly quantitative.
- Demands mathematical and computer program skills
- Most sophisticated quantitative methods require considerable expertise to apply

Trend forecasting software programmes

Number Cruncher Statistical System (NCSS): www.ncss.com/

SPSS: www.spss.com/index.htm

RATS: www.estima.com/index.shtml

EXCEL: <http://office.microsoft.com/en-gb/FX010858001033.aspx>

GAUSS: www.creative.net/Pages/List_ArtCat.asp?IDCategoria=C002

JMP Software: www.jmp.com/software/

Trend extrapolation methods



- Least squares trend
- Double exponential smoothing
- Holt's linear trend
- Other trend extrapolation methods

Exponential smoothing



LEAST SQUARES TREND

computes a straight-line trend equation through the data using standard least squares techniques in which the dependent variable is the time series and independent variable is the row (sequence number).

The forecasting equation is:

$$F_t = a + bt$$



DOUBLE EXPONENTIAL SMOOTHING

computes a trend equation through the data using a special weighting function that places the greatest emphasis on the most recent time periods. The forecasting equation changes from period to period. The forecasting algorithm makes use of the following formulas

$$F_t = a_t + b_t$$

$$a_t = X_t + (1 - \alpha)^2 e_t$$

$$b_t = b_{t-1} + \alpha^2 e_t$$

$$e_t = F_t - X_t$$

The smoothing constant α dictates the amount of smoothing that takes place. It ranges from zero to one.



Smoothing constants

To find the value of the smoothing constants objectively, we select one method of summarizing the amount of error in the forecasts. Methods are the mean square error (MSE), the mean absolute error (MAE) and the mean absolute percent error (MAPE).

The forecast error is the difference between the forecast of the current period made at the last period and the value of the series at the current period.

$$e_t = X_t - F_t$$

$$MSE = \frac{1}{n} \sum e_t^2$$

$$MAE = \frac{1}{n} \sum |e_t|$$

$$MAPE = \frac{100}{n} \sum \left| \frac{e_t}{X_t} \right|$$



Holt's linear trend

Computes an evolving trend equation through the data using a special weighting function that places the greatest emphasis on the most recent time periods. Instead of the global trend equation of the least squares trend algorithm, this technique uses a local trend equation. The trend equation is modified from period to period. The forecasting equation changes from period to period.

$$a_t = \alpha X_t + (1 - \alpha)(a_{t-1} + b_{t-1})$$

$$b_t = \beta(a_t - a_{t-1}) + (1 - \beta)b_{t-1}$$

Alfa and beta are smoothing constants which are each between zero and one.

Different methods analysing explorative trends



- Descriptive Statistics
- Cross Tabulation
- Frequency Tables
- Descriptive Tables



Trend extrapolation

Should be used when:

- Past information about the variable of concern is available
- The information can be quantified.
- Reasonable assumption can be made that the variable trend pattern of the past will continue into the future.

Because every trend is having also a counter-trend, it is important to identify what forces are driving a trend; then one can consider whether these are liable to persist, and to have the same effects.

A trend is more qualitative rather than quantitative.

Trend impact analysis (TIA)



- Trend Impact Analysis is developed by The Futures Group
- TIA combines statistical extrapolations with probabilities i.e. qualitative factors
- Permits “the integration of perceptions about future developments with an otherwise naive extrapolation”
- Produces several alternative futures.



Principal TIA steps

1. A basic trend identification is carried out e.g. a curve is fitted to historical data
1. The historical data trend is extrapolated (with a selected algorithm) e.g. the curve is projected to generate a forecast.
2. Possible future phenomena that, if they were to occur, could cause deviations from the extrapolation of historical data, are identified
3. The identified possible future phenomena are discussed and considered. Experts judge for each such event the probability of occurrence as a function of time and its expected impact on the future trend.

Qualitative changes may suddenly become quantitative ones



Kiitos, thank you, gracias, tack,
danke, grazie, dziękuje