Week 1

Business Forecasting

"Forecasting is an attempt to foresee the future by examining the past, present and trends"

Forecasting involves the prediction of future events or future outcomes of key variables.

- Accurate prediction of events or outcomes can reduce uncertainty and help in decision planning processes.

The more available information about the future reduces the uncertainty and risk of future ventures and operations.

Examples

- Short term:
  - Weather forecasts
  - Traffic predictions
- Medium term:
  - Investment returns
  - Economic growth
  - Interest rates
- Long term:
  - Global warming impacts
  - Expected average temperature in 30 years
  - Rainfall in Australia

Use of Forecasting

There is a **lag time** between identification of problem, opportunity and actualising

- Could be due to contracts, physical processes, verification, fing
- We need to identify problems, opportunities, threats before they happen

It is about being proactive not reactive.

Forecasting Methods

Most forecasting methods involve extending the experiences of the past into the future. Typically assume the conditions of the past will be like the conditions of the future. Forecast models will not perform optimally when conditions change.

Forecasting Tasks

Forecasting tasks can be categorised based on the business environment, the time/length (short-term/long-term) of the forecast.

Different types of forecasting tasks in a business environment;

- **Economic forecasts** – address business cycle (inflation rate, money supply)
- **Technological forecasts** – predict technological change and new product sales
- **Demand forecasts** – predict existing product sales

Key performance indicators – sales, market shares, profits, share price, demand; may involve prediction of environmental indicators such as economic growth, interest rates, inflation, exchange rate. This will often lead to secondary forecasts of costs, resource use, that are important for business operations.

Forecasting tasks can also be categorised by time horizon:

- **Short-term forecasts**
    - Operational forecasts of demand, inputs needed, costs, cashflow
    - Up to 1 year; usually less than 3 months
    - Job scheduling, worker assignments
- **Medium-term forecasts**
    - Mix of operational and strategic forecasts of demand, inputs, costs, market and environmental conditions and technology
    - 3 months to 3 years
    - Sales and production planning, budgeting
- **Long-term forecasts**
    - Mostly strategic forecasts involving environment and market conditions, technological advances
    - 3+ years
    - New product planning, facility location

Different functions/departments of an organisation have different forecasting requirements. These tasks differ in their **horizon, importance, quantities to be forecast**. the marketing department might need a prediction of sales while the finance department may need a prediction of the inflation rate or percentage of people retiring in any year.

The types of forecasting methods for each department will vary depending on their nature and requirements. More simplistic methods can be used for the finance department whereas marketing department forecast model may be more complex.

Forecasting and Decision Making

A forecast provides advice to planners and decision makers as to what will happen under an assumed set of circumstances. Often organisations need to make decisions regarding operations, strategy or corporate direction. Forecasts are typically integral for these decisions.

Example: “What type of new product should be launched?”
Requires forecasts on;

- Future market conditions and demands, technological innovations, costs, prices, competitor’s plan, labour, legislation, etc.
- Most forecasting required for decision-making is handled judgementally in an intuitive fashion, often without separating the task of forecasting from that of decision making.

Forecasting and Planning

Forecasting is not the same as planning.

Forecasting is concerned with determining what the future will look like, rather than what it should look like (planning). The forecast is not an end product but rather an input to the planning model. It can be a target or objective that a plan is then developed to achieve the goal.

Planning and Budgets

Plans include many components; predictions, forecasts, strategic issues, current performance, current directions, budgets. Planning for the organisation is done on many levels:

- Corporate – the direction of the firm and its activities
- SBU or departmental – required to plan and budget within the corporate plan

Budgets: predicted accounting of projected firms actions

- Often budgets based on predictions and/or forecasts
- Budgets can sometimes determine forecasts – expenses based on percentage of sales budget-promotion, salesforce
- Provide benchmarks of key performance indicators – used to evaluate strategies, compare performance

Forecasting for Organisation and Management

Organizational Unit	Short Term (< 3 months)	Medium Term (3 months to 2 years)	Long Term (> 2 years)
Marketing & sales	Sales of each product type, by geographic area; price; competition	Total sales, product categories, price, general economic condition	Total sales, major product categories, new product introduction, saturation, change of customer preferences
Production	Demand of each product, demand for material, plant loading, scheduling, inventory level	Costs, demand for materials, inventory level, leading time for purchasing of materials and equipment	Capacity expansion; new technology; long-term contracts for securing key resources;
Finance and accounting	Sales revenue, production costs, cash in- & out-flow, short-time borrowing	Budget allocation, cash flow, financial market (interest rate etc)	Total sales, investment selections, capital expenditure, cash flows,
HR		Staffing, labour market,	Labour market
Top management		Demand, costs and other expenses, cash position, general economic conditions, control objectives	Social and economic trends, organization objectives, introduction of new technology & products,

Week 2

Qualitative and Quantitative Forecasting

Most forecast variables that are measured quantitatively (sales, costs, exchange rates)

The distinction between qualitative and quantitative is how the prediction is derived.

Quantitative – the prediction is derived using some algorithm or mathematical technique based on quantitative data

Qualitative – the prediction is based primarily on judgement or opinion.

Time Series and Causal

Time series – methods which rely on the past measurements of the variable of interest and no other variables (moving average, exponential smoothing, decomposition, extrapolation)

Causal methods – where the prediction of the target series or variable is linked to other variables or time series (regression, correlation and leading indicator methods)

Sources of Data

Internal – sources that come from within the organisation (sales data, employment records, customer profiles and spending)

External - data that is sourced from outside the organisation (ABS data, other government agencies, internet, trade organisations, commercial data agencies)

Types of Data

Cross-sectional

Measurements on a variable that are at one point in time but spread across a population (tourism expenditure across age groups, production across sectors of the economy).

Time Series

A sequence of measurements on a variable taken over specified successive intervals of time (monthly interest rates, sales/week, tourist arrivals per annum)

1. Evaluation of the time series for historical patterns
2. Matching observed pattern to a relevant algorithm
3. Projection of algorithm into the future for forecasts

There are various patterns that are typically associated with time series. These patterns can usually be ascribed to various components of time series. The systematic components are typically due to explainable factors.

The forecaster needs to understand the components of the time series to match the appropriate forecast method or algorithm.

Components of a Time Series

Level

Indicates the underlying value of the series on the vertical axis for a given period. The level of the time series may be constant over time or may change with the influence of other components.

If the level remains relatively constant over time series, a horizontal data pattern is observed.

Trend

Tendency for the underlying level of the time series to systematically increase or decrease from period to period. The trend needs not be consistent over the entire time series or linear. Trends are usually caused by population changes, technology changes, market expansions, etc.

Seasonal

Systematic and repeatable fluctuations in the time series that usually occur within a well-defined period (yearly, weekly). Fluctuations typically repeat themselves in future iterations of the set period. Occurs due to weather or institutional reasons (holidays, special celebrations or accounting periods)

Cycle

Similar to seasonal fluctuations but the cycle period is not as regular as seasonality. This makes the cyclical component difficult to predict. It is usually subjectively assessed. Generally, the economic cycle will influence the cyclical behaviour of the series.

Random (the only non-systematic component)

Not able to be predicted with any accuracy. Typically, the random component incorporates effects on the times series that cannot be explained by the variables that influence the systematic components. Includes one-off effects such as introduction of GST, cataclysmic events or difficult to observe and quantify effects such as confidence and security.

The extent of the random component will determine maximum level of forecast accuracy achievable.

Exploring Data Patterns – Correlation

When a variable is measured over time, observations in different time periods are frequently related or correlated. Correlation in the context of time series is called autocorrelation.

Autocorrelation coefficients measure association between a time series and its lagged values.

Autocorrelation coefficients are useful in identifying patterns and hence components of time series.

Autocorrelation

There will be an autocorrelation coefficient for each of *p* nominated lags (r1, r2, r3…rp).

r_1 is the autocorrelation (sample) between y_t and y_{t-1}. r_2 is the autocorrelation between y_t and y_{t-2}

r_p is the autocorrelation between y_t and y_{t-p}

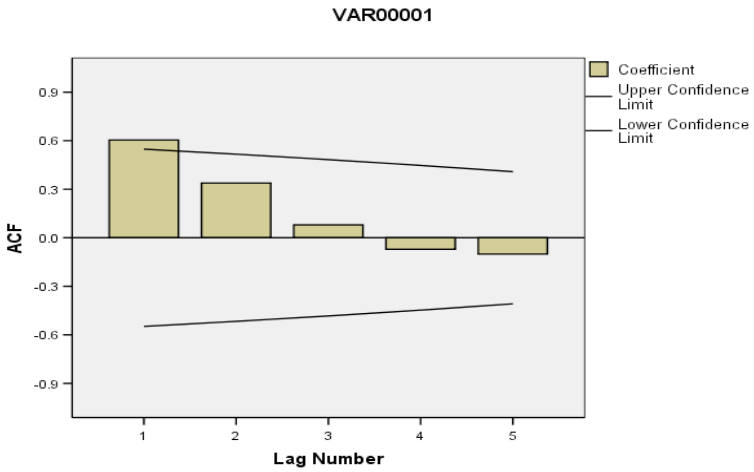
Typically, the autocorrelations up to order *p* are shown graphically on a correlogram.

Included in the correlogram are statistical limits that determine if the ***sample autocorrelation*** (r_p) indicates a ***population autocorrelation*** (ρ_p) different from zero.

Autocorrelation example

Time	Y_t	Y_{t-1}	Y_{t-2}
1	123	-	-
2	130	123	-
3	125	130	123
4	138	125	130
5	145	138	125
6	142	145	138
7	146	142	145
8	147	146	142
9	157	147	146
10	160	157	147

Correlogram Example

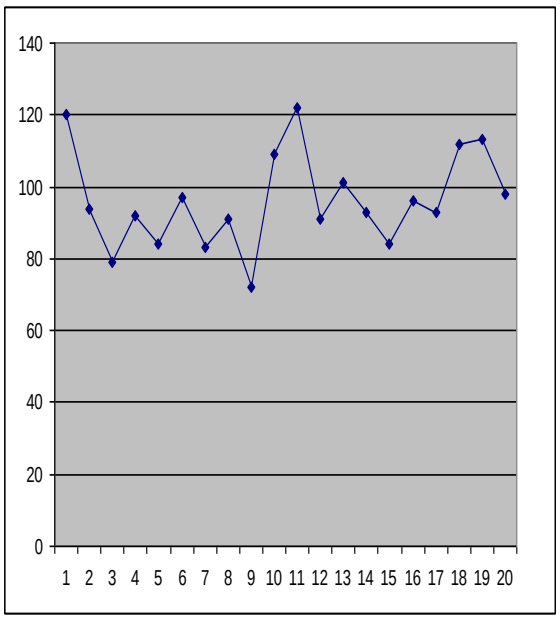


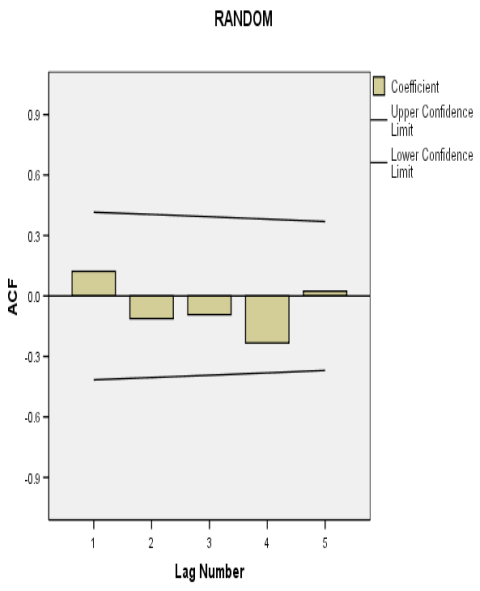
Using Correlograms

Correlograms help identify/confirm patterns in time series.

Random

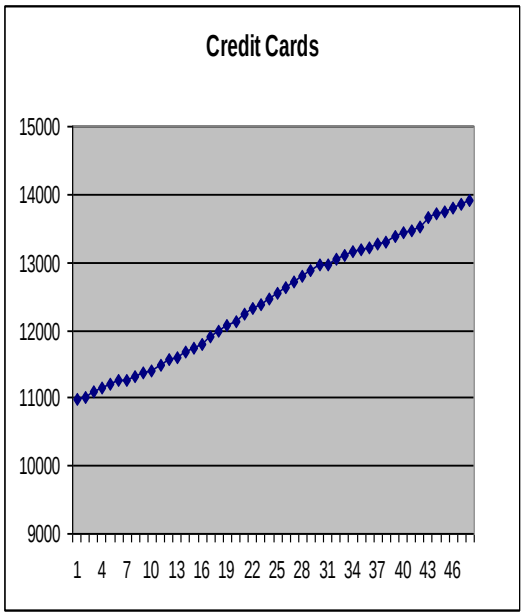
If the time series is random, sample autocorrelations should all be statistically insignificant.

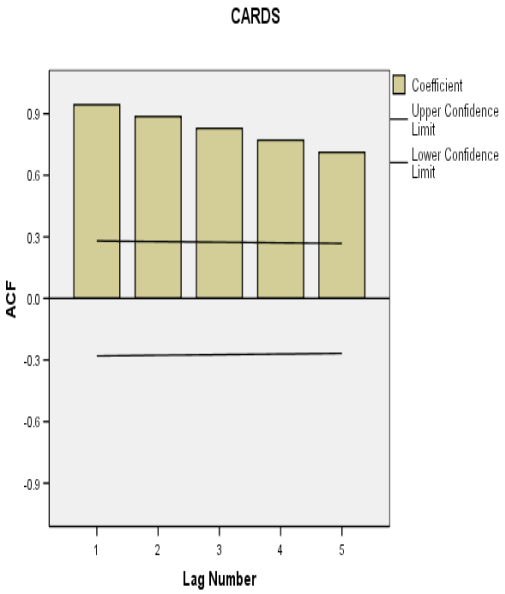




Trend

If the time series as a trend significant relationship between successive time series values, the autocorrelations will be large for the first few lags and then decline as *p* increases.





Seasonal

There will be a relationship between observations in the same period of the season. The autocorrelation related to the period of seasonality will be significant [e.g. quarterly data (r4) monthly data (r12)].