**Industrial engineering** is a branch of [engineering](http://www.answers.com/topic/engineering) dealing with the optimization of complex processes or systems. It is concerned with the development, improvement, implementation and evaluation of integrated systems of people, money, knowledge, information, equipment, energy, materials, analysis and synthesis, as well as the mathematical, physical and social sciences together with the principles and methods of engineering design to specify, predict, and evaluate the results to be obtained from such systems or processes. Its underlying concepts overlap considerably with certain business-oriented disciplines such as Operations Management, but the engineering side tends to emphasize extensive *mathematical* proficiency and usage of quantitative methods.

A branch of engineering dealing with the design, development, and implementation of integrated systems of humans, machines, and information resources to provide products and services. Industrial engineering encompasses specialized knowledge and skills in the physical, social, engineering, and management sciences, such as human and cognitive sciences, computer systems and information technologies, manufacturing processes, operations research, production, and automation.

**Process Charts**

The charting of work flows, working processes, systems and procedures is a useful way of recording the essential features of a work situation for subsequent analysis.

Process Charts are one of the simpler forms of workflow charting and are still in regular usage but are less common than they once were. This is unfortunate since it was the ubiquitous nature of the process chart that made it a common "language" between different groups of people and across different industries.

A variety of process charts has been designed to meet the needs of a particular level or stage of analysis; they can be used at a detailed level (recording activity at a specific work station or workplace), but also at the wider system, process or procedure level.

The different kinds of process chart share a common core set of symbols, though some have additional symbols for specific and specialized process steps. The common symbols (of which there are only five) were first promulgated by the American Society of Mechanical Engineers and have become known as the ASME symbols.

|  |  |  |
| --- | --- | --- |
| Symbols | |  | | --- | | **OPERATION:** a main step, where the part, material or product is usually modified or changed  **INSPECTION:** indicates a check for quality or quantity  **TRANSPORT:** the movement of workers, materials or equipment  **STORAGE:** controlled storage in which material is received into or issued from a store, or an item is retained for reference purposes  **DELAY or TEMPORARY STORAGE:** indicates a delay in the process, or an object laid aside until required | |

**Flowchart**

These symbols are simply linked together in a vertical chart representing the key stages in a process; it is usual to place a commentary in adjoining column recording contextual/environmental information. e.g. against a Transport symbol would be recorded, start of journey, end of journey, distance and mode of transport.

The simplest form of process chart is known as an **outline process chart** and records an overview or outline of a process. Only those steps of a process that can be represented by the ASME symbols of operation and inspection are recorded. An outline process chart is often a useful first step to identify key areas of concern before recording (part of) the process in more detail.

In a "full" process chart, where all symbols are used, it is common to chart the process from the "viewpoint" of the material being processed, the worker carrying out the work or, less commonly, a piece of equipment. Thus, the same symbols can be used in different ways. As a simple example, a piece of equipment can be represented on an equipment-type flow process chart as a delay because it is not in use; while a material-type flow process chart of the same process would show the material being transported to the next work station, and a man-type chart could show the operator involved in another operation on another machine.

The chart to be used may be determined by the purpose of the investigation or by the relative costs involved in the process - a highly capital-intensive process may focus more attention on the equipment being used.

Process charts may also be used at a more micro level of analysis. An example is the two-handed process chart which records the motions performed by both hands during a task. The sequence of motion of each hand is charted using the same symbols as before. There are slight changes to the meaning of the symbols, however. The delay symbol is used to indicate that the hand is waiting to carry out its next task. The storage symbol is used to indicate that the hand is holding on to a piece of material or a document. Two-handed process charts are usually drawn on a pre-formatted diagram. Their use has generally been superseded by the analyses involved in the use of low level [pre-determined motion time’s systems](http://www.ims-productivity.com/page.cfm/content/Predetermined-motion-time-systems-PMTS/).

A **flowchart** is a type of [diagram](http://en.wikipedia.org/wiki/Diagram) that represents an [algorithm](http://en.wikipedia.org/wiki/Algorithm) or [process](http://en.wikipedia.org/wiki/Process), showing the steps as boxes of various kinds, and their order by connecting these with arrows. This diagrammatic [representation](http://en.wikipedia.org/wiki/Knowledge_representation_and_reasoning) can give a step-by-step solution to a given [problem](http://en.wikipedia.org/wiki/Problem_solving). Process operations are represented in these boxes, and arrows connecting them represent flow of control. [Data](http://en.wikipedia.org/wiki/Data) flows are not typically represented in a flowchart, in contrast with [data flow diagrams](http://en.wikipedia.org/wiki/Data_flow_diagram); rather, they are implied by the sequencing of operations. Flowcharts are used in analyzing, designing, documenting or managing a process or program in various fields

**A Note on Flowchart Symbols**

**Different flow chart symbols have different meanings. The most common flow chart symbols are:**

* **Terminator: An oval flow chart shape indicating the start or end of the process.**
* **Process: A rectangular flow chart shape indicating a normal process flow step.**
* **Decision: A diamond flow chart shape indication a branch in the process flow.**
* **Connector: A small, labeled, circular flow chart shape used to indicate a jump in the process flow.**
* **Data: A parallelogram that indicates data input or output (I/O) for a process.**
* **Document: used to indicate a document or report (see image in sample flow chart below).**

**Direct Time Study / Stop Watch Study : Meaning and Definition**

Times study is concerned with the determination of the amount of time required to perform a unit of work. It consists of process of observing and recording the time required to perform each element of an operation so as to determine the reasonable time in which the work should be completed.

**According to ILO,** “Time study is a work measurement techniques for recording the times and rates of working for the elements of a specified job carried out under specified conditions and for analyzing the data so as to obtain the time necessary for carrying out the job at a defined level of performance.”

**Use of Time Study:**

The utility of the time study comes in:

         Determining the work content and thereby setting wages and incentive

         Arriving at cost standards per unit of output for the various jobs used for cost control and budgeting for deciding on sales price.

         Comparing the work efficiency of different operators

         Arriving at job schedules for production planning purposes

         Manpower planning

         Aiding in the method study

         Product design by providing basic data on costs of alternative materials and methods required to manufacture the product.

**Work Measurement : Meaning and Definition**

Work measurement goes hand in hand with method design. Whereas the method design are directed towards the study of the components of a single or multiple operation of a system. It is a technique by which the actual time consumed in performing an operation is computed and ultimately serves as suitable time standard. It is the study of work content of a job so as to lay down a fair days work. It seeks provide a quantitative assessment of the human work in a specified job and to establish the proper time for the effective performance of that job.

Work measurement has been defined as the application of techniques designed to determine the time required by or defined level of performance to do a specified job. The time is called standard or allowed time.

***According to British Standard Institute***, “The application of techniques designed to establish the time for a qualified worker to carry out a specified job at a defined level of performance.”

Qualified worker is a representative average of those workers. Who are fully trained and able satisfactorily to perform any and all phases of work involved, in accordance with the requirement of the job under consideration?

Normal pace is the effective rate of performance of conscientious, self paced, qualified worker when working neither fast nor slow and giving due considerations to physical, mental or visual requirements of the specific job. Specific job is in the best possible method of a job under consideration.

**Motion Study: Meaning and Definition**

Motion study is formal engineering analysis of motions perform to accomplish work. The motion or movements of limbs of a worker play a major part in the fabrication or the manufacture of the products. By carefully observing a worker while he is doing an operation, a number of movements made by him which appear to be unnecessary and unproductive can be identified and eliminated.

**According to Alford and Beatty,** “Motion study consist of dividing work into the most fundamental elements possible; studying these elements separately and in relation to one another and from these studied elements, when timed, building methods of least waste.”

“Analysis of an operation when carried out in terms of individual motions of a worker is known as motion analysis.”

Motion study techniques for methods analysis are an important contribution of the Gilbert to industrial management.

The purpose of motion study is to design as improved method which eliminates unnecessary motions and employs human efforts more productively. In doing so the principles of motion economy proves to be very helpful.

**Application of Method Study**

Method study can be applied to any field of work, but the most important areas where it pays rich dividends are:

·         Improved layout of office, working areas or factory

·         Improved design of plant and equipment

·         Improved use of material, plant, equipment, and manpower

·         Most effective handling of material

·         Improved flow of work

·         Standardization of methods and procedures

·         Improved safety standards

·         Better working conditions

·         Improved achievement with less effort

·         Productive and effective utilization of human effort

·         Economy of expenditure

**Method Study - Meaning and Definition**

Work methods analysis or method study is a scientific technique of observing, recording and critically examining the present method of perfo0rming a task or job or operation with the aim of improving the present method and developing a new and cheaper method. It is also known as methods improvement or work improvement. It encompasses the study of work processes, working conditions and equipments and tools used to carry out the job.

**According to British Standard Institute,** “Method study may be understood as the systematic recording and critical examination of existing and proposed ways of doing work, as a means of developing and applying easier and more effective method and reducing costs”.

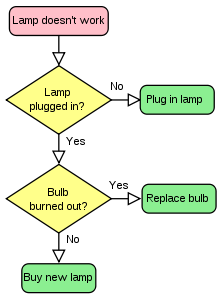
**Work Study - Meaning and Definition:**

One of the most important techniques, which are frequently employed by all management personnel, is work study. It introduces the most effective method of working. Work study has proved to be the most effective tool in the hands of management. Every industry is facing problems concerning the efficiency at all levels and so a systematic attempt is needed to eliminate unnecessary work and the make remaining work easier. Thus productivity would automatically be increased. It is therefore, necessary to have a constant effort to reduce the waste in every phase of production. So, that there is a surplus available for division to develop good life.

**According to the ILO,** work study is a term used to embrace the techniques of method study and work measurement, which are employed to ensure the best possible use of human and material resources in carrying out s specified activity.

**According to British Standards Institute,** “work study is a generic term for those techniques, particularly ‘method study’ and ‘work measurement’, which are used in the examination of human work in all its contexts and which lead systematically to the investigation of all factors which affect the efficiency and economy of the situation being renewed, in order to effect improvement.”

Thus, the work study of human works in all aspects in order to improve productivity. It is a systematic and analytical study of work process and work methods with the objective of increasing efficiency and reducing costs. Work study helps to reduce waste through standardization of qualitative and quantitative element of the job.

[](http://en.wikipedia.org/wiki/File:LampFlowchart.svg)

A simple flowchart representing a process for dealing with a non-functioning lamp.

**Gantt Chart**

The Gantt charts were developed by ***Henry L Gantt a***bout a century ago. Their purpose is to provide an immediate comparison between schedule and reality ( i.e. between planned work and actual progress of the work.) This is achieved simply by making on the chart the planned work and the actual progress of the work.

The Gantt chart is actually a modified bar chart in which horizontal bars are drawn for each activity in proportion to the time required for completing it. A cursor attached to the Gantt chart can be moved across the chart to compare between the actual progress and planned work till any particular date.

There are basically two types of Gantt Charts:

1.       Order / Activity progress chart

2.       Machine load chart.

In Gantt Chart, time in weeks or days is marked along the h0orizontal axis and the activities or orders are represented along the vertical axis. The amount of work planned or scheduled is marked by the firm lines or blank areas and the actual progress of the work by dotted lines or shaded areas.

**METHODS ENGINEERING**

There are many different reasons for constructing a new method. We identified four of

them:

* To define a brand new method to satisfy a set of situational requirements;
* To add alternative ways-of-working in a method to its original one;
* 3. To extend a method by a new functionality;
* 4. To select in a method only relevant functionalities

**Layout of Facilities -Meaning and Definition**

Layout refers to the arrangement of facilities. A plant layout refers to the arrangement of machinery. Equipment and other industrial facilities-such as receiving and shipping departments, tool rooms, maintenance rooms and employee amenities-for the purpose of achieving the quickest and smoothest production at the least cost.

Comparism between work-sampling and time-and-motion study

Two widely used techniques for collecting work activity information are work-sampling and time-and-motion. Both techniques are used frequently by industrial engineers. Each technique has strengths and weaknesses. The work-sampling technique collects data at intervals of time. For example, data might be collected by determining exactly what a worker is doing four times each hour. Sometimes the data are collected by observing the worker in action at the point in time selected for the observation. In other studies the workers use logs to self-report their activity. In some cases the intervals between observations are of fixed duration. In other cases the observations occur at randomly chosen moments in time. Typically, an inference is made about the portion of overall work time spent on an activity, based on the percent of observations that relate to that activity.

In contrast to the work-sampling method, the time-and-motion technique uses an observer to record exactly how much time is being devoted to each task. This is a much more labor-intensive method of data collection, because it requires a one-on-one observation. Observers must follow the subject continuously for extended periods of time.

Each activity and its duration must be recorded on a data collection instrument.

Both methodologies have advantages and limitations, some of which are functions of the type of observation done for each. Work-sampling studies that rely on self-reported logs are generally considered least reliable, since workers may not record activities in a timely fashion, and may not be totally frank concerning what activities were being done at the specified sampling times. Work-sampling approaches that use an observer or observers to record the activities of several workers are used most frequently if workers are in a circumscribed area-for example, nurses on a unit, factory workers on a floor, or pharmacists in a pharmacy. If workers are not in a circumscribed area-for example, residents traveling throughout the hospital-then the time-and-motion approach of one observer for each subject may be more feasible. Similarly, other data collection approaches such as the use of one-way mirrors and closed-circuit television are impractical for most observations of health care workers who move extensively around a large building such as a hospital or nursing home. If use of a videocassette recorder for continuous taping were feasible, such taping could be done for extended periods. One could then review the entire tape (equivalent to time-and-motion but less obtrusive) or choose random Sampling as desired. For example, this might be useful for analyses of time spent by some researchers or administrators. However, one would still have to decide whether someone should continuously watch the videotape, mirror, or television, or whether instead a sampling approach will be sufficient, requiring that the worker or videotape be watched only at specified time intervals. Thus, we come back to the choice between continuous observations versus work-sampling.

Although both time-and-motion and work-sampling methods are vulnerable to error because the workers may change their behavior upon being observed, the problem is more severe for continuous observation.

Work-sampling that uses one observer on a floor may allow the observer to blend in since he or she can usually be stationed at some distance from the worker being observed. On the other hand, time and- motion observers shadowing workers are much more obvious and are more likely to disrupt the normal routine. It is more difficult for the worker to forget that he or she is being observed.

However, the distance from the observer creates limitations in what can be observed. In work-sampling the observer needs to make quick judgments about behavior for a number of workers. This means that it may not be possible to make fine-grained distinctions about differing behaviors from a great distance. It may not be possible to distinguish between "professional interaction" and "personal conversation." With small distances between the observer and subject more subtle characterizations of behavior can be ascertained. For example, the observer must determine if a physician is taking a patient's medical history, or simply having a personal conversation not directly related to the patient's care. Work-sampling is usually less costly than continuous observation because fewer observations are made. Since continuous observation requires an observer for each subject, most studies using this methodology limit the number of subjects. On the other hand, work-sampling requires fewer observations but more subjects. Continuous observation yields a detailed description of the activities of a few workers, whereas work-sampling gives less detail, but for a larger sample of workers. The trade-off often is between depth and breadth.

**Work sampling**

**Work Sampling** is the statistical technique for determining the proportion of time spent by workers in various defined categories of activity (e.g. setting up a machine, assembling two parts, idle…etc). It is as important as all other statistical techniques because it permits quick analysis, recognition, and enhancement of job responsibilities, tasks, performance competencies, and organizational work flows. Other names used for it are 'activity sampling', 'occurrence sampling', and 'ratio delay study'.

In a work sampling study, a large number of [observations](http://en.wikipedia.org/wiki/Observation) are made of the workers over an extended period of time. For statistical accuracy, the observations must be taken at random times during the period of study, and the period must be representative of the types of activities performed by the subjects.

One important usage of the work sampling technique is the determination of the standard time for a manual [manufacturing](http://en.wikipedia.org/wiki/Manufacturing) task. Similar techniques for calculating the standard time are [time study](http://en.wikipedia.org/wiki/Time_and_motion_study), standard data, and [predetermined motion time systems](http://en.wikipedia.org/wiki/Predetermined_motion_time_system).

## Characteristics of work sampling study

The study of work sampling has some general characteristics related to the work condition. One of them is the sufficient time available to perform the study. A work sampling study usually requires a substantial period of time to complete. There must be enough time available (several weeks or more) to conduct the study. Another characteristic is multiple workers. Work sampling is commonly used to study the activities of multiple workers rather than one worker. The third characteristic is long cycle time. The job covered in the study has relatively a long cycle time. The last condition is the non-repetitive work cycles. The work is not highly repetitive. The jobs consist of various tasks rather than a single repetitive task. However, it must be possible to classify the work activities into a distinct number of categories.

## Steps in conducting a work sampling study

There are several recommended steps when starting to prepare a work sampling study[[1]](http://en.wikipedia.org/wiki/Work_sampling" \l "cite_note-Groover-0):

1. Define the manufacturing tasks for which the standard time is to be determined.
2. Define the task elements. These are the defined broken-down steps of the task that will be observed during the study. Since a worker is going to be observed, additional categories will likely be included as well, such as "idle", "waiting for work", and "absent".
3. Design the study. This includes designing the forms that will be used to record the observations, determining how many observations will be required, deciding on the number of days or shifts to be included in the study, scheduling the observations, and finally determining the number of observers needed.
4. Identify the observers who will do the [sampling](http://en.wikipedia.org/wiki/Sampling_%28statistics%29).
5. Star the study. All those who are affected by the study should be informed about it.
6. Make random visits to the plant and collect the observations.
7. After completing the study, analyze and present the results. This is done by preparing a report that summarizes and analyzes all data and making recommendations when required.

## Determining the Number of Observations Needed In Work Sampling

After the work elements are defined, the number of observations for the desired accuracy at the desired confidence level must be determined. The formula used in this method is:

\sigma_P=\sqrt{\frac{pq}{n}}

n=\frac{pq}{\sigma_P}

σ*P* = standard error of proportion

*p* = percentage of idle time

*q* = percentage of working time

*n* = number of observations

**FORECAST**:

* A statement about the future value of a variable of interest such as demand.
* Forecasts affect decisions and activities throughout an organization
  + Accounting, finance Product / service design
  + Human resources Operations
  + Product / service design Marketing MIS

**Uses of Forecasts:**

Accounting - Cost/profit estimates

Finance - Cash flow and funding

Operations - Schedules, MRP, workloads

Marketing- Pricing, promotion, strategy

Product/service design - New products and services

**Common in all forecasts**

* Assumes causal system  
  past ==> future
* Forecasts rarely perfect because of randomness
* Forecasts more accurate for  
  groups vs. individuals
* Forecast accuracy decreases   
  as time horizon increases

# Forecasting Tools & Techniques

The science of sales and demand forecasting involves using certain tools and methodologies to achieve reliable results. Today, a number of highly efficient software programs crunch amazing amounts of data and turn that data into a forecast output. Most of these programs have high-initial costs and setup requirements. Basic tools such as a spreadsheet, combined with simple forecasting methods can adequately serve some companies.

## Spreadsheet

* + The [computer](http://www.ehow.com/computers/) spreadsheet serves as one of the most commonly used tools in forecasting. Savvy spreadsheet users learn to take full advantage of the spreadsheet's ability to perform complex calculations. Advanced spreadsheet users can import data directly from a company's inventory management and sales systems. Users can then perform historical demand analysis using these data to better understand trends and to form the historical database for projecting future sales. Most spreadsheets have built-in forecasting formulas. Although the formulas are simple, forecasters can use them for basic forecasting of non-critical materials or low-level selling products. A number of third-party companies make advanced add-ons for spreadsheets that turn them into full-featured forecasting tools.

## Moving average

* + Many companies use the moving average forecasting method. The moving average method is simple to use but does not provide or account for sales trends until after the trend occurs. The moving average uses a set number of periods to calculate usage for the next set number of periods. For example, a three-month moving average uses three periods of data to forecast the next three periods of data. Using the following historical sales data for January to March we can forecast the sales for April to June. January sales equal 35 units, February sales equal 30 units and March sales equal 36 units. The average of these three months of sales (34 units) becomes the forecast for April. In order to forecast the sales for May, we drop off the January sales figure and use the historical sales from February (30 units) and March (36 units) plus the forecasted sales for April (34 units). The average of these three months (33 units) becomes the forecast for May. Each month we "move" forward one month by dropping off the last month of data. This is why the method is called a "moving average."

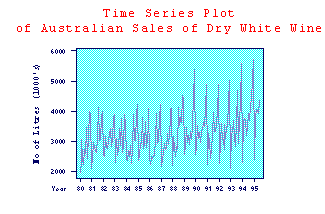
## Time series

* + The time series method remains the most commonly used method of forecasting. The time series uses historical sales data such as dollars, volume or some other information as the dependent series located along the vertical axis of a spreadsheet. Time serves as the independent variable located along the spreadsheet's horizontal axis. The time series methodology divides the dependent data into four categories---trend, cyclical, seasonal and irregular. After determining the baseline demand for a product, a time series chart helps identify the four categories of data. Forecasters use various statistical methods to analyze time series data to create future forecasts. These methods include Gompertz Curve, Box-Jenkins, Regression Analysis and Decomposition.

**Time Series**

A time series is a sequence of observations which are ordered in time (or space). If observations are made on some phenomenon throughout time, it is most sensible to display the data in the order in which they arose, particularly since successive observations will probably be dependent. Time series are best displayed in a scatter plot. The series value X is plotted on the vertical axis and time t on the horizontal axis. Time is called the independent variable (in this case however, something over which you have little control). There are two kinds of time series data:

1. Continuous, where we have an observation at every instant of time, e.g. lie detectors, electrocardiograms. We denote this using observation X at time t, X(t).
2. Discrete, where we have an observation at (usually regularly) spaced intervals. We denote this as Xt.

*Examples*   
Economics - weekly share prices, monthly profits   
Meteorology - daily rainfall, wind speed, temperature   
Sociology - crime figures (number of arrests, etc), employment figures   
  


**Trend Component**

We want to increase our understanding of a time series by picking out its main features. One of these main features is the trend component. Descriptive techniques may be extended to forecast (predict) future values.

Trend is a long term movement in a time series. It is the underlying direction (an upward or downward tendency) and rate of change in a time series, when allowance has been made for the other components.

A simple way of detecting trend in seasonal data is to take averages over a certain period. If these averages change with time we can say that there is evidence of a trend in the series. There are also more formal tests to enable detection of trend in time series.

It can be helpful to model trend using straight lines, polynomials etc.

**Cyclical Component**

We want to increase our understanding of a time series by picking out its main features. One of these main features is the cyclical component. Descriptive techniques may be extended to forecast (predict) future values.

In weekly or monthly data, the cyclical component describes any regular fluctuations.

It is a non-seasonal component which varies in a recognizable cycle.

.**Seasonal Component**

We want to increase our understanding of a time series by picking out its main features. One of these main features is the seasonal component. Descriptive techniques may be extended to forecast (predict) future values.

In weekly or monthly data, the seasonal component, often referred to as seasonality, is the component of variation in a time series which is dependent on the time of year. It describes any regular fluctuations with a period of less than one year. For example, the costs of various types of fruits and vegetables, unemployment figures and average daily rainfall, all show marked seasonal variation.

We are interested in comparing the seasonal effects within the years, from year to year; removing seasonal effects so that the time series is easier to cope with; and, also interested in adjusting a series for seasonal effects using various models.

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**Irregular Component**

We want to increase our understanding of a time series by picking out its main features. One of these main features is the irregular component (or 'noise'). Descriptive techniques may be extended to forecast (predict) future values.

The irregular component is that left over when the other components of the series (trend, seasonal and cyclical) have been accounted for.

**Smoothing**

Smoothing techniques are used to reduce irregularities (random fluctuations) in time series data. They provide a clearer view of the true underlying behaviour of the series.

In some time series, seasonal variation is so strong it obscures any trends or cycles which are very important for the understanding of the process being observed. Smoothing can remove seasonality and makes long term fluctuations in the series stand out more clearly.

The most common type of smoothing technique is moving average smoothing although others do exist. Since the type of seasonality will vary from series to series, so must the type of smoothing.

**Exponential Smoothing**

Exponential smoothing is a smoothing technique used to reduce irregularities (random fluctuations) in time series data, thus providing a clearer view of the true underlying behavior of the series. It also provides an effective means of predicting future values of the time series (forecasting).

**Moving Average Smoothing**

A moving average is a form of average which has been adjusted to allow for seasonal or cyclical components of a time series. Moving average smoothing is a smoothing technique used to make the long term trends of a time series clearer.

When a variable, like the number of unemployed, or the cost of strawberries, is graphed against time, there are likely to be considerable seasonal or cyclical components in the variation. These may make it difficult to see the underlying trend. These components can be eliminated by taking a suitable moving average.

By reducing random fluctuations, moving average smoothing makes long term trends clearer.

**Running Medians Smoothing**

Running medians smoothing is a smoothing technique analogous to that used for moving averages. The purpose of the technique is the same, to make a trend clearer by reducing the effects of other fluctuations.

**Differencing**

Differencing is a popular and effective method of removing trend from a time series. This provides a clearer view of the true underlying behaviour of the series.

**Autocorrelation**

Autocorrelation is the correlation (relationship) between members of a time series of observations, such as weekly share prices or interest rates, and the same values at a fixed time interval later.

More technically, autocorrelation occurs when residual error terms from observations of the same variable at different times are correlated (related).

**Extrapolation**

Extrapolation is when the value of a variable is estimated at times which have not yet been observed. This estimate may be reasonably reliable for short times into the future, but for longer times, the estimate is liable to become less accurate.

*Example*   
Suppose Angela was 1.20m tall on January 1st 1975, and 1.40m tall on January 1st 1976. By extrapolation, it could be estimated that by January 1st 1977 she would have grown another 0.20m to be 1.60m tall. This however assumes that she continued to grow at the same rate. This must eventually become a false assumption, otherwise by January 1st 1980, she would be a giantess.

# Statistics Study Guide

1.  A time series is a collection of data recorded over a period of time, usually monthly, quarterly, or yearly.  Two examples of time series are a department store's sales by quarter since opening in 1962 and the annual production of sulfuric acid since 1970.   
0True 0False   
  
2.   Long-term forecasts are usually more than one year into the future.  Projections of 5, 10, 15 and 20 years are common.   
0True 0False   
  
3.   A statement of the long-term goals of management is considered necessary in order to have the raw materials, production facilities, and staff available to meet the estimated future.   
0True 0False   
  
4.  One component of a time series is the secular trend.  It is the smooth movement of a series over a short period of time, such as a few months or quarters.   
0True 0False   
  
5.  Episodic and residual variations can be projected into the future.   
0True 0False   
  
6.   The following linear trend equation was developed for annual sales from 1984 to 1990 with 1984 the base or zero year.  Y1  =  500  +  60X (in $ thousands).  The estimated sales for 1984 (in $ thousands) is:   
a. $   500   
b. $   560   
c. $1,040   
d. $1,100   
e. None of the above   
  
10.  The general equation for the logarithmic trend equation using the coded method is:  log of y1  =   
a. log a  +  log b  (X)   
b. log a  x  log b (X)   
c. a  x  b  (X)   
d. a + b  (X)   
e. None of the above   
  
11.  If the exports (in $ millions) for the period 1986 through 1990 were $878,  $892,  $864, $870 and 912, respectively, what are these values called?   
a. Moving average   
b. Linear trend equation   
c. Logarithmic trend equation   
d. Time series   
e. None of the above   
  
29. Given a linear time series trend, Y' = 5.2 + 3.1t, what is the forecast for 2002 if the time series started in 1995?   
a. 23.8   
b. 26.9   
c. 30.0   
d. 21.7   
e. 32.07

30. What is a disadvantage of the estimated method of determining a trend line equation?   
  
a. Provides quick approximations   
b. Is subject to human error   
c. Provides accurate forecasts   
d. Is too difficult to calculate   
e. None of the above   
  
31. A logarithmic trend equation should be used for forecasts when the time series is increasing by?   
  
a. Equal amounts   
b. Increasing percents   
c. Increasing amounts   
d. Increasing or decreasing percents   
e. None of the above   
  
32. In a seasonal index (4 seasons) the total of the quarterly means will be   
  
a. 4.0   
b. 1.0   
c. 100%   
d. a variable   
e. 5.0

Solution Summary

Multiple Choice questions on time series analysis. The questions are related to Moving average, Time series, Forecast and Trend.

If you're not satisfied with the answer you've downloaded, we'll give you another download free of charge.

Related Solutions

* [Underlying average of a time series](http://www.brainmass.com/homework-help/statistics/all-topics/58030) - When the underlying average of a time series is very stable and there is no trend, cyclical, or seasonal influences, a. A simple moving average forecast with n = 20 should outperform a simple movin ...
* [Forecasting the demand](http://www.brainmass.com/homework-help/statistics/all-topics/86964) - Forecasting Exercise Year Demand ( in 1000's ) 1 13 2 17 ...
* [Forecasting the demand](http://www.brainmass.com/homework-help/statistics/all-topics/85844) - Forecasting Exercise Year Demand ( in 1000's ) 1 13 2 17 3 ...
* [Weighted Moving Average Forecast and MAD in EXCEL](http://www.brainmass.com/homework-help/statistics/all-topics/280108) - The problem states that the manager of the Carpet City outlet needs to make an accurate forecast of the demand for Soft Shag carpet (it biggest seller). If the manager does not order enough carpet fro ...
* [time series](http://www.brainmass.com/homework-help/statistics/all-topics/11416) - Horace Mann, principal of Jones Public School, has decided to construct a time series model to obtain a 2- and a 3-period moving average to forecast student enrollments for next term. Which statement ...
* [Time Series Forecasting](http://www.brainmass.com/homework-help/statistics/all-topics/121133) - Summary Exercise In unit 1 the National Sales Perspectives data was used to predict retail pharmaceutical sales from non-retail. That data was collected over a 12 month period. Now we are going ...
* [Statistics moving average: forecast demand for product ZXT](http://www.brainmass.com/homework-help/statistics/all-topics/281422) - Recent past demand for product ZXT is given in the following table. Month Actual Demand February 20 March 22 April 33 May 35 June ...
* [Moving Average](http://www.brainmass.com/homework-help/statistics/all-topics/245015) - Twenty two years sales (in millions) data for a company is given below: Year Sales 1 1 2 2 3 3 4 4 5 5 6 4 7 3 8 2 9 3 10 4 11 5 12 6 13 5 14 4 15 3 16 4 17 5 18 6 19 7 20 6 21 5 ...
* [Moving Average Forecast for Closing Value of Stock](http://www.brainmass.com/homework-help/statistics/all-topics/303220) - The closing value of the AMEX Airline Index for each trading day during a 1-year period is given in the file P13\_17.xlsx. a. How well does the moving average method track this series when the span i ...
* [Time series data](http://www.brainmass.com/homework-help/statistics/all-topics/13011) - Horace Mann, principal of Jones Public School, has decided to construct a time series model to obtain a 2- and a 3-period moving average to forecast student enrollments for next term. Which statement ...
* [Forecast Accuracy Measure](http://www.brainmass.com/homework-help/statistics/all-topics/281168) - RAP Computer assembles personal computers from generic parts it purchases at a discount, and it sells the units via phone orders it receive from customers responding to the company's ad in trade journ ...
* [Time Series Line Chart for airline data.](http://www.brainmass.com/homework-help/statistics/all-topics/238606) - For this exercise, use Excel, MegaStat, or MINITAB to make an attractive, well-labeled time-series line chart. Adjust the Y-axis scale if necessary to show more detail (since Excel usually starts the ...
* [Moving Average](http://www.brainmass.com/homework-help/statistics/all-topics/42035) - I am trying to understand the following question: If the overall trend of the dependent variable is decreasing, will a k-period moving average be greater than a moving average obtained with k minu ...
* [Sales Data - Determine a 4-year moving average forecast for 2003](http://www.brainmass.com/homework-help/statistics/all-topics/195190) - 4. The following sales data are available for 1998-2003 inclusive: Year Demand 1998 7 1999 12 2000 14 2001 2 ...
* [Trend lines for yearly data](http://www.brainmass.com/homework-help/statistics/all-topics/228838) - A clothing manufacturer uses a trend line in the form of T= 38.7 + 1.16t to generate yearly forecasts of its total sales......
* [Ratio to moving average method](http://www.brainmass.com/homework-help/statistics/all-topics/228604) - An analysis wants to use the ratio to moving average to forecast a company's sales for the next few quarters....
* [Statistics](http://www.brainmass.com/homework-help/statistics/all-topics/120414) - The following time series data represent the yearly amounts spent on advertising (in millions of dollars) by a large toy company: 23.3, 21.7, 22.7, 25.5, 22.7, 25.9 This series of data begins in ...
* [Statistics Discussion: Common trend models; centered to moving average method](http://www.brainmass.com/homework-help/statistics/all-topics/278358) - DQ3: (a) Name two advantages and two disadvantages of each of the common trend models (linear, exponential, quadratic). Explain! (b) When would the exponential trend model be preferred to a ...
* [Seasonal indexes multiplicative model](http://www.brainmass.com/homework-help/statistics/all-topics/229028) - The quarterly number of permits granted for building houses in a large city is seasonal......
* [Calculation of moving average in Megastat](http://www.brainmass.com/homework-help/statistics/all-topics/236089) - A woman got a job at a starting salary of $35,000 a year. If she received an 8% raise on each additional year, how much would her salary be at the beginning of the tenth year? Use future-value method ...
* [Moving Average Forecast and Forecast Accuracy Measure: MAD, MAPD, Cumultive Error](http://www.brainmass.com/homework-help/statistics/all-topics/296449) - See attached file.
* [Linear Trend](http://www.brainmass.com/homework-help/statistics/all-topics/222177) - Fit a linear trend equation to the following data describing average hourly earnings of US production workers. What is the trend estimate for 2010? Year: 2001 2002 2003 2004 A ...
* [Moving Average Forecast, Weighted Moving Average Forecast, Cumulative Error and Comparison](http://www.brainmass.com/homework-help/statistics/all-topics/314059) - 1. The Fastgro Fertilizer Company distributes fertilizer to various lawn and garden shops. The company must base its quarterly production schedule on a forecast of how many tons of fertilizer will b ...
* [Develop an appropriate forecast model for the bookstore manager to use to forecast computer demand for tne next fall semester.](http://www.brainmass.com/homework-help/statistics/all-topics/167641) - Please read the case study attached. I am not sure how to develop a model? I can put the info into an excel sheet, but need help getting started. 1. Develop an appropriate forecast model for the ...
* [Forecast error for time series analysis](http://www.brainmass.com/homework-help/statistics/all-topics/223903) - Consider the following data that was fitted using a Linear Trend Period Actual Value Period number (or)Y (or)X Period 1 10 1 Period 2 11 ...