

Unit – 3 Introduction to Cost Estimation**Part – A****1. Classify the allowances considered in cost estimation (AU N/D '17)**

- Relaxation Allowance
 - Fatigue allowance
 - Personal need allowance
- Process allowance
- Interference allowance
- Contingency allowance
- Special allowance

2. What do you meant by cost accounting? (AU N/D '16) (AU N/D '15) (AU N/D '13) (AU N/D '12) (AU M/J '13)

Costing may be defined as a system of accounts which systematically and accurately records every expenditure in order to determine the cost of a product after knowing the different expenses incurred in various department.

3. Define overhead cost. (AU N/D '16) (AU N/D '14) (AU M/J '12)

Overhead is the sum of indirect labour cost, indirect material cost and other expenses including service which cannot be conveniently charged to specific cost unit. These can be further classified as

- Production expenses/Factory expenses.
- Administrative expenses.
- Selling expenses.
- Distribution expenses.

4. Distinguish between cost estimation and cost accounting (AU N/D '15) (AU A/M '17) (AU N/D '17)

S.No	Point of comparison	Cost estimating	Cost accounting
1.	Type of cost	It gives an expected cost of the product based on the calculations by means of standard formulae or certain established rules.	It gives actual cost of the product cost based on the data collected from the different expenditures actually done

5. List the types of estimates (AU N/D '15)

- Guesstimates
- Budgetary
- Using Past History
- Estimating in Some Detail
- Estimating in Complete Detail
- Parametric Estimating
- Project Estimating

6. What are the sources of for cost estimation? (AU N/D '15)

- Cost of design.
- Cost of drafting.

- Cost of research and development.
- Cost of raw materials.
- Cost of labour.
- Cost of inspection.
- Cost of tools, jigs and fixtures.
- Overhead cost.

7. Brief about the procedure to calculate material cost (AU N/D '15)

- Study the drawing carefully and break up the component into simple geometrical shapes. (Cubes, prisms, cylinders, etc.)
- Add the necessary machining allowances on all sides which are to be machined.
- Determine the volume of each part by applying the formulae of mensuration.
- Add the volumes of all the simple components to get total volume of the product.
- Multiply the total volume of the product by the density of the material to get the weight of the material.
- Find out the cost of the material by multiplying the cost per unit weight to the total weight of the material.

8. Define: Under estimate (AU N/D '14)

The estimated cost is below the actual cost of product, then the firm will face huge financial loss which may cause utter failure or closure of the firm. This estimation is called under estimate.

9. Define: Contingency Allowance (AU N/D '14)

Contingency Allowance: This is a small allowance of time which may be included in the standard time to meet unforeseen items of work, or delays (e.g. waiting for raw materials, tools). Contingency allowance is 5% (maximum) or Normal Time.

10. What is meant by conceptual cost estimating? (AU N/D '14)

In the conceptual design stage, the geometry of parts and materials has not been specified, unless they dictate essential product functions. In the conceptual design stage, the costs associated with a change in the design are low. In the conceptual design stage, the incurred costs are only 5 to 7% of the total cost whereas the committed costs are 75 to 85% of the total cost.

The accuracy of the conceptual cost estimate depends on the accuracy of the data base. The accuracy of conceptual cost estimating is approximately – 30% to + 50%. Accuracy in conceptual cost estimating is important since at the conceptual design stage only significant cost savings can occur.

11. List the elements of prime cost (AU N/D '13)

Prime cost = Direct material cost + Direct labour cost + Direct expenses

12. What is the need to include allowances in cost estimation? (AU N/D '13)

A worker cannot work for 8 hours continuously without rest. Also efficiency decreases as the time passes due to fatigue etc. He also requires for tool sharpening, checking measurements and personal calls. All these allowances come under this category. These allowances generally consumes 15 to 20% of total time.

13. Give the methods of costing. (AU N/D '13)

- Process costing.
- Job costing.

- Batch costing.
- Hybrid costing systems.

14. List the various elements of cost. (AU M/J '16) (AU A/M '18)

- Material cost,
- Labour cost and
- Other expenses

15. What shall be the effect of overestimate (AU M/J '16)

If a job is over estimated, i.e the estimated cost is much more than the actual cost of the product, then the firm will not be able to compete with its competitors who estimated the price correctly and losses the order to its competitors.

16. Mention any two functions of estimating. (AU M/J '16) (AU M/J '13) (AU M/J '12)

- To calculate the cost of new material needed to manufacture a product.
- To find the cost of parts to be purchased from outside vendors.
- To find the cost of equipment, machinery, tools, jigs and fixtures etc. required to be purchased to make the product.
- To calculate the direct and indirect labour cost associated with the manufacture of the product, based upon work study.
- To calculate various overhead charges associated with the product.
- To decide about the profit to be charged, taking into consideration other manufacturers of same product in the market.
- To calculate the selling price of the product.
- To maintain records of previous estimating activities of the company for future references.
- To decide the most economical method of making the product.
- To submit cost estimates with the competent authority for further action.

17. Differentiate direct and indirect overheads. (AU M/J '16)

Direct expenses: Direct expenses include all that expenditure which can be directly allocated and charged to a particular job. The direct expenses include cost of special jigs or fixtures, patterns, tooling made for job, or cost of research and development work done for that specific job.

Indirect expenses: Except direct expenses, all other indirect expenditure incurred by the manufacturer is called indirect expenses. The indirect expenses are also called overhead expenses or on-cost.

The indirect expenses are further classified as:

- (i) Factory expenses.
- (ii) Administrative expenses.
- (iii) Selling and distribution expenses.

18. What is meant by direct material? Give example. (AU M/J '13) (AU M/J '12)

It is the cost of those materials which are directly used for the manufacture of the product and become a part of the finished product. This expenditure can be directly allocated and charged to the manufacture of a specific product or job and includes the scrap and waste that has been cut away from original bar or casting.

19. What is meant by direct labour cost? (AU M/J '13) (AU M/J '12)

Direct labourer is one who actually works and processes the materials to convert it into the final shape. The cost associated with direct labour is called direct labour cost. The direct labour cost can be identified and allocated to the manufacture of a specific product. Examples of the direct labour are the workers operating lathes, milling machines or welders, or assemblers in assembly shop. The direct labour cost may be allocated to a product or job on the basis of time spent by a worker on a job.

20. What is fatigue allowance? (AU M/J '13)

The efficiency of the worker decreases due to fatigue (or) working at a stretch and also due to working conditions such as poor lighting, heating (or) ventilation. The efficiency is also affected by the psychology of the worker. It may be due to domestic worries, job securities etc. For normal work, the allowance for fatigue is about 5% of the total time. This allowance can be increased depending upon the type and nature of work and working conditions.

21. What do you meant by realistic estimate? (AU M/J '12) (AU N/D '12) (AU M/J '13)

Both over-estimate and under-estimate may prove to be dangerous and harmful for a concern. Assume that on the basis of an estimate, the concern has to fill up a tender enquiry. The overestimate means the concern will quote a higher rate and thus will not get the job or contract. In case of an under-estimate, the concern will get the contract but it will not be able to complete the work within that small quoted amount and hence will suffer heavy losses. This emphasizes the importance of making realistic estimates. Realistic estimates are very essential for the survival and growth of a concern.

Part – B**1. Discuss various methods of costing in detail. (8 marks) (AU N/D '16) (AU M/J '12) (AU M/J '16) (AU M/J '13)****Methods of Costing**

- (a) Process costing.
- (b) Job costing.
- (c) Batch costing.
- (d) Hybrid costing systems.

(a) Process costing

This method is employed when a standard product is being made which involves a number of distinct processes performed in a definite sequence.

- In oil refining, chemical manufacture, paper making, flour milling, and cement manufacturing etc., this method is used.
- The object i.e., record and trace costs for each distinct stage.
- While costing, the by-products of each process should be considered.
- This method indicates the cost of a product at different stages as it passes through various processes.

- The total time spent and materials used on each process, as well as services such as power, light and heating are all charged. For this purpose cost sheet may be employed.

The process cost sheet is a summary of all operations for the month. The current operating charges are entered on the sheet showing

1. The transfer cost from the previous operation.
2. The costs incurred by each operation showing materials, labour and overhead in separate columns.

This separation of transfer cost and conversion cost is extremely important for the charges incurred by a department are its measures of efficiency.

The sheet can be used as a basis for:

1. Closing entries at the end of each month.
2. Operating statements, without need to look up the ledger accounts.

Within the cost ledger an account is kept for each process. The direct material, direct labour and factory overhead costs are transferred from the process cost sheet. There are debited to the process account, and then any completed units are credited to cover the transfer to the next process. The balance on the account represents the work-in-progress at the end of the period, which, of course, becomes the opening balance for the next period.

(b) Job costing or order costing

- Job costing is concerned with finding the cost of each individual job or contract. Examples are to be found in general (job order) engineering industries, ship building, building contracts, etc.
- The main features of the system is that each job has to be planned and costed separately.
- Overhead costs may be absorbed on jobs on the basis of actual costs incurred or on predetermined costs.
- The process of determining in advance what a job or order will cost is known as estimating.

It involves consideration of the following factors for each job/order:

1. Materials requirements and prices to arrive at the direct material cost.
2. Labour hours and rates to determine labour costs.
3. Overhead costs.
4. Percentage added to total cost to cover profit.

A record of above costs per unit time is kept in separate cost sheets.

(c) Batch costing

Batch costing is a form of job costing. Instead of costing each component separately, each batch of components are taken together and treated as a job.

Thus, for example, if 100 units of a component, say a reflector are to be manufactured, then the costing would be as far a single job. The unit price would be ascertained by dividing the cost by 100.

Besides maintaining job cost sheets it may also be necessary to keep summary sheets on which the cost of each component can be transferred and the cost of the finished product can be calculated. This applies in general engineering where many hundreds of components may go towards making the finished machine or other product.

(d) Hybrid costing systems

- Many costing systems do not fall nearly into the category of either job costing or process costing. Often systems use some features of both main costing systems.
- Many engineering companies use batch costing, which treats each batch of components as a job and then finds the average cost of a single unit.
- Another variation is multiple costing, used when many different finished products are made. Many components are made which are subsequently assembled into the completed article, which may be bicycles, cars, etc. Costs have to be ascertained for operations, processes, units and jobs, building together until the total cost is found.
- Different names may be used to describe either process costing or job costing. Thus, for example, unit costing is the name given to one system where there is a natural unit, such as sack of flour, a barrel of beer etc.
- In unit costing method, the expenses on various items are charged per unit quantity or production.
- Operation costing is a variation of unit costing, and is used when production is carried out on a large scale, popularly known as mass production.
- Operation costing is the term applied to describe the system used to find the cost of performing a utility service such as transport, gas, water or electricity.
- In this method, the cost per unit is found on the basis of operating expenses incurred on various items of expenditure.
- Unit costing, operation costing and operating costing are variations of process costing.
- Contract or terminal costing is the name given to job costing employed by builders and constructional engineers.
- All these methods ascertain the actual cost.

2. Explain the procedure followed for estimating the cost of an individual product. (8 marks) (AU N/D '16) (AU N/D '14) (AU N/D '13) (AU M/J '12)

The basic steps in the cost estimation of any product are given below:

- Make thorough study of cost estimation request to understand it fully.
- Make an analysis of the product and prepare a bill of materials.
- Make separate lists of parts to be purchased from the market and parts to be manufactured in plant.

- Determine the cost of parts to be purchased from outside.
- Estimate the material cost for the parts/components to be manufactured in plant.
- Make manufacturing process plan for the parts to be manufactured in plant.
- Estimate the machining time for each operation listed in the manufacturing process plan.
- Multiply each operation time by the labour wage rate and add them up to find direct labour cost.
- Add the estimate of step 4, 5, and 8 to get prime cost of component.
- Apply overhead costs to get the total cost of the component.

3. Discuss the objectives of the cost estimation (10 marks) (AU N/D '15)

The main purpose or objectives of estimating are

- To establish the selling price of a product.
- To ascertain whether a proposed product can be manufactured and marketed profitably.
- To determine how much must be invested in equipment.
- To find whether parts or assemblies can be more cheaply fabricated or purchased from outside (make or buy decision).
- To determine the most economical process, tooling or material for making a product.
- To establish a standard of performance at the start of project.
- For feasibility studies on possible new products.
- To assist in long term financial planning.
- To prepare production budget.
- To help in responding to tender enquiries.
- To evaluate alternate designs of a product.
- To set a standard estimate of costs.
- To initiate programs of cost reduction that result in economics due to the use of new materials, which produce lower scrap losses and which create savings due to revisions in methods of tooling and processing, and
- To control actual operating costs by incorporating these estimates into the general plan of cost accounting.

4. Describe the classification and elements of cost. (16 marks) (AU N/D '15) (AU M/J '13)

Elements of cost

For the purpose of calculations, the total cost of the product is divided into the following:

(A) Material cost, (B) Labour cost, (C) Other expenses.

(A) Material Cost

Material cost consists of the cost of materials which are used in the manufacture of product. It is divided into the following

(a) Direct material cost: It is the cost of those materials which are directly used for the manufacture of the product and become a part of the finished product. This expenditure

can be directly allocated and charged to the manufacture of a specific product or job and includes the scrap and waste that has been cut away from original bar or casting. The procedure for calculating the direct material cost is as follows:

- (i) From the product drawing, make a list of all the components required to make the final product.
- (ii) Calculate the volume of each component from the drawing dimensions after adding machining allowances, where ever necessary.
- (iii) The volume of component multiplied by the density of material used gives the weight of the material per component.
- (iv) Add process rejection and other allowances like cutting allowance to get the gross weight per component.
- (v) Multiply the gross weight by the cost of material per unit weight to get the cost of raw material per component.
- (vi) The cost of raw material for all the components is, similarly, calculated and added up which gives the cost of direct material for the product.

(b) Indirect material cost: In addition to direct materials a number of other materials are necessary to help in the conversion of direct materials into final shape. Though these materials are consumed in the production, they don't become a part of the finished product and their cost cannot be directly booked to the manufacture of a specific product. Such materials are called indirect materials. The indirect materials include oils, general tools, grease, sand papers, coolants, cotton waste etc. The cost associated with indirect materials is called indirect material cost.

In some cases certain direct materials like nails, screws, glue, putty etc., are used in such small quantity that it is not considered worthwhile to identify and charge them as direct materials. In such cases these materials are also charged as indirect materials.

Depending upon the product manufactured, the same may be direct materials for one concern and indirect materials for others.

(B) Labour Cost

It is the expenditure made on the salaries, wages, overtime, bonuses, etc. of the employees of the enterprise. It can be classified as :

(a) Direct labour cost: Direct labourer is one who actually works and processes the materials to convert it into the final shape. The cost associated with direct labour is called direct labour cost. The direct labour cost can be identified and allocated to the manufacture of a specific product. Examples of the direct labour are the workers operating lathes, milling machines or welders, or assemblers in assembly shop. The direct labour cost may be allocated to a product or job on the basis of time spent by a worker on a job.

(b) Indirect labour cost: Indirect labourer is one who is not directly employed in the manufacturing of the product but his services are used in some indirect manner. The

indirect labour includes supervisors, inspectors, foreman, storekeeper, gatekeeper, maintenance staff, crane driver etc. The cost associated with indirect labour is called indirect labour cost. The indirect labour costs cannot be identified with a particular job or product but are charged on the total number of products made during a particular period in a plant.

To make the concept of direct and indirect labour cost clear, consider an operator working on a drilling machine. The operator in this case is direct labour whereas the man supervising the job, inspector and store man supplying the material are indirect labour.

(C) Other Expenses

In addition to the material cost and labour cost, several other expenses such as rent of building, depreciation of plant and machinery, cost of packing materials, transport and distribution expenses, wages and salaries of administrative staff and executives are also incurred by the manufacturer. All this expenditure including the indirect material cost and indirect labour cost is called other expenses. We can say that except direct material and direct labour costs all other expenditure incurred by the manufacturer is known as “Other Expenses”. Expenses are further classified as:

(a) Direct expenses: Direct expenses include all that expenditure which can be directly allocated and charged to a particular job. The direct expenses include cost of special jigs or fixtures, patterns, tooling made for job, or cost of research and development work done for that specific job.

(b) Indirect expenses: Except direct expenses, all other indirect expenditure incurred by the manufacturer is called indirect expenses. The indirect expenses are also called overhead expenses or on-cost.

The indirect expenses are further classified as:

- Factory expenses.
- Administrative expenses.
- Selling and distribution expenses.

(i) Factory expenses: Factory expenses comprise of the indirect expenses incurred from the receipt of the order to the completion of production. In addition to indirect material and indirect labour cost it includes rent of factory building, licence fee, electricity and telephone bills of factory, insurance charges etc. Factory expenses are also called “Works expenses”, or “Factory or Works overhead”.

(ii) Administrative expenses: Administrative expenses or office expenses include the expenditure incurred on control and administration of the factory. It includes the salaries of office and administrative staff, rent of office building, postage and telephone charges, water and electricity charges for office, Director’s fee, legal and audit charges etc. Administrative expenses are also known as ‘Administrative overheads’.

(c) Selling and distribution expenses: This is the expenditure incurred on Sales Department for selling the product, *i.e.*, wages, salaries, commission and travelling

allowances of salesmen and officers in Sales Department, cost of advertisement, packing, delivery and distribution expenses, rent of warehouses etc.

5. Discuss various types of estimates (10 marks) (AU N/D '15) (AU M/J '13)

Types of Estimate

Estimates can be developed in a variety of different ways depending upon the use of the estimates and the amount of detail provided to the estimator. Every estimator should understand every estimating method and when to apply each, because no one estimating method will solve all estimating problems.

Guesstimates

Guesstimate is a slang term used to describe an estimate that lacks detail. This type of estimate relies on the estimator's experience and judgment. There are many reasons why some estimates are developed using this method. One example can be found in the tool and die industry. Usually, the tool and die estimator is estimating tool cost without any tool or die drawings. The estimator typically works from a piece part drawing and must visualize what the tool or die looks like. Some estimators develop some level of detail in their estimate. Material cost, for example, is usually priced out in some detail, and this brings greater accuracy to the estimator by reducing error. If the material part of the estimate has an estimating error of plus or minus 5 per cent and the remainder of the estimate has an estimating error of plus or minus 10 per cent, the overall error is reduced.

Budgetary

The budgetary estimate can also be a guesstimate but is used for a different purpose. The budgetary estimate is used for planning the cost of a piece part, assembly, or project. This type of estimate is typically on the high side because the estimator understands that a low estimate could create real problems.

Using Past History

Using past history is a very popular way of developing estimates for new work. Some companies go to great lengths to ensure that estimates are developed in the same way actual cost is conducted. This provides a way past history in developing new estimates. New advancements in group technology now provide a way for the microcomputer to assist in this effort.

Estimating in Some Detail

Some estimators vary the amount of detail in an estimate depending on the risk and dollar amount of the estimate. This is true in most contract shops. This level of detail might be at the operation level where operation 10 might be a turning operation and the estimator would estimate the setup time at 0.5 hours and the run time at 5.00 minutes. The material part of the estimate is usually calculated out in detail to reduce estimating error.

Estimating in Complete Detail

When the risk of being wrong is high or the dollar amount of the estimate is high, the estimator will develop the estimate in as much detail as possible. Detailed estimates for machinery operations, for example, would include calculations for

speeds, feeds, cutting times, load and unload times and even machine manipulations factors. These time values are calculated as standard time and adjusted with an efficiency factor to predict actual performance.

Parametric Estimating

Parametric estimating is an estimating method developed and used by trade associations. New housing constructions can be estimated on the basis of cost per square. There would be different figures for wood construction as compared with brick and for single strong construction as compared with multilevel construction. Some heat-beating companies price work on a cost per pound basis and have different cost curves for different heat-treating methods.

Project Estimating

Project estimating is by far the most complex of all estimating tasks. This is especially true if the project is a lengthy one. A good example of project estimating is the time and cost of developing a new missile. The project might take 5 years and cost millions of dollars. The actual manufacturing cost of the missile might be a fraction of the total cost. Major projects of this nature will have a PERT network to keep track of the many complexities of the project. A team of people with a project leader is usually required to develop a project estimate.

6. Explain the data requirements for cost estimation (6 marks) (AU N/D '15) (AU N/D '14) (AU M/J '12) (AU M/J '16) (AU M/J '13)

1. Man-hour cost (Labour rate) *i.e.*, hourly cost of skilled, semi-skilled and unskilled labours of the company.
2. Machine-hour cost for different types of equipment and machinery available in the company.
3. Material cost in respect of commercially available materials in the market :
 - Cost in Rs. per kg for different categories of materials like ferrous, non-ferrous, special steel etc., for rods of different diameters and for different thicknesses in respect of flats/sheet metals.
4. Scarp rates *i.e.*, scarp values of different materials in Rs. per kg.
5. In respect of welding operations, information such as electrode cost, gas cost, flux cost, power cost, etc.
6. Set-up time for different processes.
7. % allowances to be added for computing standard time, relaxation allowance, process allowance, special allowance as % of normal time as per the policy of the management.
8. Standard time for different types of jobs, if available.
9. Overhead charges in terms of % direct labour cost or overhead rate in Rs. per hr.
10. Life in years permitted for various types of equipment and machines available in the plant for calculation of depreciation, for cost recovery and for calculation of machine—hour rate.
11. Data base of cost calculations carried out by the company in respect of earlier products or jobs (Historical cost data).
12. Cost data of products available in the market similar to the ones manufactured by the company.

13. Budget estimates prepared by the company for new projects/products.
14. Journals or Data sheets of Professional Associations dealing with Costs and Accounting.

7. Describe different methods of estimates (10 marks) (AU N/D '15) (AU M/J '16)

Methods of Estimates

Computer Estimating

Computer estimating has become very popular in recent years primarily because of the advent of the microcomputer. Early efforts of computer estimating date back to the early 1970s but were cumbersome to use because they were on a mainframe and were card-driven. No less than 15 U.S. companies now offer estimating software for a microcomputer. Because the computer estimating industry is new, there are no real standards for estimating programs. Some programs are nothing more than a way to organize the calculations of an estimate, while others calculate all the details of the estimate.

Advantages and disadvantages

Shown below are some of the major advantages of computer cost estimating.

Accuracy versus consistency

Computer estimates are very consistent, provided they calculate the detail of an estimate. Because these estimates are consistent, they can be made to be accurate. Through the use of consistent efficiency factors or learning curves, estimates can be adjusted up or down. This is one of the chief advantages of computer cost estimating.

Levels of details

Some computer estimating systems provide different levels of estimating cost. The level of detail selected by the user depends on the dollar risk. Many estimators produce an estimate in more detail because the computer can calculate speeds and feeds, for example, much faster than an estimator can a hand-held calculators.

Refinements

Some computer estimating systems provide many refinements that would be impossible for the estimator to do in any timely manner. One example is to adjust speeds and feeds for material hardness. Typically, the harder the material the more slowly a part will be turned or bored. Another refinement is the ability to calculate a feed state and adjust it based on the width of a form tool.

Source code

Some companies offer the source code uncompiled to their users. This is important because it affords the user the opportunity to customize the software. In addition, many companies have written their own software to do something that is not available on the market. If the source code is not compiled, the users can build upon a computer estimating system.

Disadvantages

The chief disadvantage of computer estimating is that no one estimating system can suit everyone's need. This is especially true if the source code is compiled and not customizable.

Another problem with computer estimating is that the estimator will, in all probability, have to change some estimating methods. Computer software for estimating cost is seldom written around one method of estimating.

Group Technology

Group technology is not new. It was invented by a Russian engineer over 30 years ago. Unfortunately the subject is not taught in many of our colleges and universities. Group technology (GT) is a coding system to describe something. Several proprietary systems are on the market. One such system, the MICAPP system, uses four code lengths, a 10-, 15-, 20-, 25- digit code. The code length selected is based on the complexity of the piece part or tool being described.

Use for group technology

Shown below are several uses for group technology along with several examples of use both internally and externally.

Cost estimating

GT can be used very efficiently in estimating cost. Assume a company manufactures shaft-type parts. Also assume there is a computer data base named SHAFT that contains 10-digit code followed by a part number, that is, code part number, and so on. When an estimator must estimate the cost of a new shaft, the process starts by developing a code that describes the characteristics of the part. The first digit in the code might be assigned the part length, while the second digit is assigned the largest diameter and so on. Next, the code is keyed in and the computer finds all the parts that meet the numeric descriptions and points out the part numbers. The best fit is selected to be modified into a new part. All the details of each description are retrieved. These include diameter, length of cut, number of surfaces, and the like. The estimator can alter these features and make the old part into a new one.

Actual performance

As the part is being produced, the estimated information is updated with actual performance and refined. This gives the estimator the ability to improve estimating accuracy, because the next time, the computer finds that part as one to be modified into a new one, the estimator is working with actual performance.

Parametric Estimating

Parametric estimating is the act of estimating cost or time by the application of mathematical formulas. These formulas can be as simple as multiples or as complex as regression models.

Parametric estimating, sometimes referred as statistical modeling, was first documented by the Rand Corporation in the early 1950's in an attempt to predict military hardware cost.

Use of parametric estimating

Many companies use some form of parametric estimating to develop sales forecasting. The four examples cited below will give the reader a good feel of how parametric estimating is used in a variety of different industries.

Construction industry

In developing a cost estimate for residential buildings, some cost estimators use a dollar value per square foot. The estimator constitutes curves based on different construction such as wood on brick buildings and single or multi-storey dwellings. These numbers can then be multiplied by the number of square feet in the building.

Some construction companies have refined this process to provide additional detail carpeting, for example, could have a separate multiplier.

Heat treating

Most commercial heat-treating companies price their work based on a cost per pound and heat treating method. Heat-treating costs are very difficult to define because many times more than one type of part is in the heat-treating furnace at the same time. It is difficult to think of a more effective way to estimate cost for this type of industry.

Statistical Estimating

The analysis of data through the use of statistical methods has been used for centuries. These data can be cost versus other information that leads to cost development. The practitioner must have a well-founded background in the use and application of statistical methods because an endless array of methods is available, several of which are described below.

Parametric estimating

Statistical estimating is another form of parametric estimating. The parametric methods made industry oriented whereas the methods discussed below are universal.

Regression analysis

They form most popular of regression analysis are simple regression, multiple regression, log-linear regression and curvilinear regression. Each math model is different and is designed for a specific use.

8. Explain the allowances in estimation (6 marks) (AU N/D '15) (AU M/J '12) (AU M/J '16)

Allowances in estimation

$$\text{Normal Time} = \text{Observed time} \times \text{Rating factor}$$

Observed time and rating factor are obtained during the time study of an operation or a job.

Various allowances are considered in estimating the standard time for a job. These allowances are always expressed as % of Normal Time and are added to Normal Time to compute the Standard Time.

$$\text{Standard Time} = \text{Normal Time} + \text{Allowances}$$

Standard Time is time required to complete one cycle of operation (usually expressed in minutes).

Standard Time for a job is the basis for determining the standard output of the operator in one day or shift.

Need for Allowances

Any operator will not be able to carry out his work throughout the day without any interruptions. The operator requires some time for his personal needs and rest, and hence such time should be included in standard time. There are different types of allowances, and they can be classified as follows :

1. Relaxation Allowance : This is also known as **Rest Allowance**. This allowance is given to enable the operator to recover from the physiological and psychological effects (Fatigue) of carrying out the specified work and to attend to personal needs.

Relaxation allowance consists of :

- (i) Fatigue allowance, and
(ii) Personal needs allowance.

(i) Fatigue allowance is intended to cater for the physiological and psychological effects of carrying out the work.

This time allowance is provided to enable to operator to overcome the effect of fatigue which occurs due to continuous doing of the work (monotony etc.).

Relaxation allowance (Fatigue allowance and Personal needs allowance put together) is commonly 5% to 10% (of normal time).

(ii) Personal needs allowance: This allowance is provided to enable the operator to attend to his personal needs (e.g. going to toilet, rest room, etc.).

2. Process Allowance: It is an allowance to compensate for enforced idleness of the worker.

During the process, it may be likely that the operator is forced to be idle due to certain reasons, such as:

- When the process is carried out on automatic machines, (the operator is idle after loading the job on the machine).
- When the operator is running more than one machine (as in the case of cellular manufacturing)

Process allowance varies from one manufacturing situation to another depending on factors such as hazardous working conditions, handling of heavy loads, strain involved, mental alertness required etc. Generally 5% of the normal time is provided towards process allowance.

Interference Allowance : This allowance is provided where in a cycle of operation, there are certain elements which are machine controlled. The operator cannot speed up those elemental operations.

This allowance is also provided when one worker is working on several machines.

4. Contingency Allowance : This is a small allowance of time which may be included in the standard time to meet unforeseen items of work, or delays (e.g. waiting for raw materials, tools). Contingency allowance is 5% (maximum) or Normal Time.

5. Special Allowances : These allowances are a policy matter of the management, e.g. when the job is newly introduced or when a new machine or new method is introduced, because worker takes some time to learn the new method or job; Special allowance is also provided depending on the working conditions such as noise, dust, etc.

Once the normal time is obtained, the standard time can be estimated or obtained by adding all the allowances to normal time.

$$\text{Standard time} = \text{Normal time} + \text{Allowances}$$

9. Write the difference between cost accounting and cost estimation (8 marks) (AU N/D '14) (AU N/D '13) (AU M/J '12) (AU M/J '13)

Points of comparison	Cost estimating	Cost accounting
1.Types of	It gives an expected cost of the	It gives actual cost of the product

cost	product based on the calculations by means of standard formula.	based on the data collected from the different expenditures actually done for a product.
2.Duration of process	It is generally carried out before actual production of a product Due to certain unexpected expenses coming to light at a later stage, estimates may be modified or revised.	It usually starts with the issue of order for production of a product and ends after the product is dispatched for sale. For sale commitments like free repair or replacement, the process continuous up to the expiry period of guarantee because the overhead expenses incurred in the above case will be included in the production cost.
3.Nature of quality	A qualified technical person or engineer having a thorough knowledge of the drawings and manufacturing process is required.	It can be done by a person qualified for accounts instead of a technical person. Thus, this work instead of being of technical nature is more of a clerical work

10. What are the methods used in conceptual cost estimation? Explain (8 marks) (AU N/D '14) (AU A/M '17)

There are different methods of estimates of cost. These are in addition to conventional method of estimating of cost such as calculating material cost, labour cost, factory expenses and overhead expenses and adding all these cost elements.

The methods of estimates are :

1. Conceptual Cost Estimating

It is estimating during the conceptual design stage. In the conceptual design stage, the geometry of parts and materials have not been specified, unless they dictate essential product functions. In the conceptual design stage, the costs associated with a change in the design are low. In the conceptual design stage, the incurred costs are only 5 to 7% of the total cost whereas the committed costs are 75 to 85% of the total cost.

The accuracy of the conceptual cost estimate depends on the accuracy of the data base. The accuracy of conceptual cost estimating is approximately – 30% to + 50%. Accuracy in conceptual cost estimating is important since at the conceptual design stage only significant cost savings can occur.

Conceptual cost estimating methods include :

- (a) Expert opinion,
- (b) Analogy methods, and
- (c) Formula based methods.

(a) Conceptual Method Based on Expert Opinion

If back-up and/or historical cost data are not available, getting expert opinion is the only way for estimating cost.

The disadvantages of this method are

- i. The estimate is subjected to bias.
- ii. The estimate can't be quantified accurately.
- iii. The estimate may not reflect the complexity of the product or project.
- iv. Reliable data base for future estimates are not possible.

In spite of these disadvantages, the expert opinion is useful when historical data base is not available. It is also useful to verify cost estimate arrived at using other methods of conceptual estimating (like analogy methods and formula based methods).

(b) Conceptual Method Based on Analogy

Analogy estimating derives the cost of a new product based on past cost data of similar products. Cost adjustments are made depending on the differences between the new and previous product/system. Analogy estimating requires that the products be analogous or similar and products manufactured using similar facilities or technology. If the technology changes, the analogy estimating relationship has to be changed to reflect the changes in technology. Another limitation of this method is that analogy estimates often omit important details that makes cost considerably higher than the original cost estimates.

(c) Conceptual Method Based on Formula

There are formula based methods that are primarily used in the conceptual cost estimating. These are :

- (i) Factor method,
- (ii) Material cost method,
- (iii) Function method, and
- (iv) Cost-size relationship.

These methods are known as **Global cost estimation methods** and they generally use one of the above methods only.

(i) Factor method

This is the simplest method, but it can give reliable estimates if the data are kept up-to-date, taking into consideration factors such as inflation, and environmental issues which tend to increase the cost.

(ii) Material cost method

Material cost method is justified since the material cost is the largest cost item in the prime cost of many manufacturing companies.

According to this method :

Estimated cost of an item = $\frac{\text{material cost of the item being estimated}}{\text{material cost share of item being estimated (in \%)}}$

(iii) Function method

In function method more variables are used and the expressions are non-linear. The function is basically a mathematical expression with constants and variables that provides a mathematical function for the cost estimate. One expression is given below:

Cost of turbo fan engine development, (in Rs. Lakhs)

$$= 41.2 \times a^{0.74} \times b^{0.08}$$

where a = Maximum engine thrust, in kg

and b = No. of engines produced

11. Discuss about determination of material and labour cost. (8 marks) (AU N/D '13)

Determination of Material Cost

To calculate the material cost of the product the first step is to study drawing of the product and split it into simple standard geometrical shapes and to find the volume of the material in the product and then to find the weight. The volume is multiplied by density of the metal used in the product.

The exact procedure to find the material cost is like this:

1. Study the drawing carefully and break up the component into simple geometrical shapes. (Cubes, prisms, cylinders, etc.)
2. Add the necessary machining allowances on all sides which are to be machined.
3. Determine the volume of each part by applying the formulae of mensuration.
4. Add the volumes of all the simple components to get total volume of the product.
5. Multiply the total volume of the product by the density of the material to get the weight of the material.
6. Find out the cost of the material by multiplying the cost per unit weight to the total weight of the material.

12. Discuss in detail about the computation of price of a product using the ladder of cost with appropriate example. (16 marks) (AU N/D '13)

The elements of cost can be combined to give following types of cost:

				Profit (or) Loss	
			Selling + Distribution expenses		
		Administrative expenses	Office cost (or) production	Total (or) selling cost	Selling price (or) Market price
	Factory expenses	Factory cost (or)	(or) Manufacturing cost	(or)	Catalogue price
Direct material	Prime cost (or)	Works cost	(or)		
Direct labour	Direct cost				
Direct expense					

1. Prime cost: It consists of direct material cost, direct labour cost and direct expenses.

Prime cost = Direct material cost + Direct labour cost + Direct expenses.

Prime cost is also called as direct cost.

2. Factory cost: It consists of prime cost and factory expenses.

Factory cost = prime cost + factory expenses.

Factory cost is also named as works cost.

3. Office cost: It consists of factory cost and administrative expenses.

Office cost = Factory cost + Administrative expenses

It is also named as manufacturing cost (or) cost of production.

4. Total cost: It includes manufacturing cost and selling and distribution expenses.

Total cost = Manufacturing cost + selling and distribution expenses.

Selling price

If the profit is added in the total cost of the product, it is called selling price. The customers get the

articles by paying the price which is named as selling price.

Selling price = Total cost + Profit

= Total cost – Loss

Making price (or) catalogue price: Some percentage of discount allowed to the distributors of product is added into the selling price. The result obtained is called the market price (or) catalogue price (figure).

13. Explain the various methods used in an industry for allocation of overheads with an example. (16 marks) (AU M/J '16) (AU N/D '12)

After estimating the total on-cost, next step is the allocation of this on-cost over the production. To run the business in economical way, it is necessary to know, the variation of on-cost with the variation of production. Several methods are available for the allocation of on-cost. The choice of a particular method depends upon the nature of work, type of organisation and types of machine used, etc.

Following are the different methods of on-cost allocation:

- Percentage on direct material cost.
- Percentage on direct labour cost.
- Percentage on prime cost.
- Manhour method.
- Machine hour method.
- Combination of man hour and machine hour method.
- Unit of production method.
- Space rate method.

These methods for estimation the overheads are discussed below:

Percentage on Direct Material Cost

This method is based on the theory that the overhead expense is incurred in proportion to the value of the direct materials consumed. This method is simple, but does not allow for the usual situation where in some of the materials is fabricated without the use of much equipment whereas other material in the same plant requires extensive machinery, requiring considerably more labour, power, maintenance and floor space.

However, for the allocation of material expenses such as purchasing, storage and handling, this method is useful. This method is also useful when major part of the cost is of material line foundries and mines.

$$\text{Overhead rate} = \frac{\text{Total overhead expenses}}{\text{Total direct material cost}}$$

Percentage on Direct Labour Cost

In this method, allocation of on-cost depends upon the wages paid to the direct labour. This method is very reasonable and simple in calculation. Therefore, this method is very popular. It is the ratio of the total overhead to the direct labour cost for a particular period.

$$\text{Overhead rate} = \frac{\text{Total overhead for a period}}{\text{Total direct labour for that period}}$$

It is also called as labour burden rate. It is the ratio of the annual total overheads to the annual direct labour cost.

$$\text{Overhead cost} = \text{Overhead rate} \times \text{Direct labour cost/unit.}$$

This is very suitable where production is mainly carried out by hand. It may not be an accurate indicator where machines of greatly different capacity and sizes are operated. Also if two products take the same time but labour rate for both is different then this method will give less overhead cost where labour is cheap and high overhead cost where labour is costly. Therefore, this method increases the cost of a component which has already higher labour cost. Also, in many cases it gives very approximate results because sometimes overheads such as depreciation and taxes have very little relationship to labour costs.

Percentage on Prime Cost

This is a very simple method. So it has gained popularity. This method is suitable, where labour and material both play equal role. This method will give the same overhead cost for two products with equal prime cost, even though their labour and material costs will be different. This will be useful where only one type of product is being manufactured and when direct labour and direct materials costs are nearly equal.

$$\text{Overhead rate} = \frac{\text{Total overhead over a period}}{\text{Prime cost over a period}} \times 100$$

Then, overhead cost/unit = Overhead rate X Prime cost/unit.

Man-Hour Rate

This method is very similar to the percentage on direct labour cost method. The difference in the two methods is that in which the basis of allocation was the total direct labour cost, whereas in this basis of the total hours spent by the direct labour and not the wages paid to them. This is an important method over the direct labour cost method.

$$\text{Man-hour rate} = \frac{\text{Total overheads}}{\text{Total direct man hour spent}}$$

Unit Rate Method

This is also known as production unit basis method. In this, on-cost is allocated on the basis of unit of production. Unit of production is generally piece, kilogram, tonne, litres, metre, etc. This method is mostly used where only one type of production is carried out. This method cannot be used in factories, where different kinds of products are manufactured. Unit rate is the overheads for one unit. It can be calculated as the ratio of total overheads to the quantity of production during a particular period.

$$\text{Overhead/Unit} = \frac{\text{Total overheads}}{\text{Quantity of production}}$$

Space Rate Method

The amount of space occupied by a machine has a relationship to certain overhead expenses. For example, building expense, heat, light, ventilation and service equipment such as cranes and conveyors

Space rate/m² for a department is

$$\text{Rs.} = \frac{\text{Total overhead assigned to a department}}{\text{Total area of the production department in square metre}}$$

∴ Space charges to the individual machine for the defined period of time = Space rate × Total area with which the machine should be charged.

14. A factory has 15 lathes of same make and capacity and 5 shapers of same make and capacity. Lathes occupy 30 m² area while shapers occupy 15 m². During one calender year, factory expenses for this section area are as follows:

(i) Building rent and depreciation	Rs. 5000
(ii) Indirect labour and material	Rs. 15000
(iii) Insurance	Rs. 2000
(iv) Depreciation charges of lathes	Rs. 5000
(v) Depreciation charges of shapers	Rs. 3000
(vi) Power consumption for the lathes	Rs. 2000
(vii) Power consumption for the shapers	Rs. 1000

Find out the machine hour rate for lathes and shapers work for 25000 hours and 8000 hours respectively. (16 marks) (AU N/D '12) (AU A/M '18)

Solution

(a) Lathe section

Total overheads for the lathe section will be as follows:

(i) Building rent and depreciation (charged on the basis of floor area occupied)	= (5000 × 30) / (30 + 15)
	= Rs. 3333.33
(ii) Indirect labour and material	= (15000 × 30) / (30 + 15)
	= Rs. 10000
(iii) Insurance	= (2000 × 30) / (30 + 15)
	= Rs. 1333.33
(iv) Depreciation	= Rs. 5000
(v) Power	= Rs. 2000
∴ Total overheads	= Rs. 21666.66
∴ Machine hour rate for lathes	= 21666.66 / 25000
	= Rs. 0.87

(b) Shaper section

Total overhead for the shaper section will be as follows

(i) Building rent and depreciation	= (5000 × 15) / (30 + 15)
	= Rs. 1666.66
(ii) Indirect labour and material	= (15000 × 15) / (30 + 15)
	= Rs. 5000

(iii) Insurance	= (2000 × 15) / (30+15)
	= Rs. 666.66
(iv) Power consumption	= Rs. 1000.00
(v) Depreciation	= Rs. 3000.00
Total overheads	= Rs. 11332.32
∴ Machine hour rate for shapers	= 11332.32/ 8000
	= Rs. 1.42

15. Calculate prime cost, factory cost, production cost, total cost and selling price per item from the data given below for the year 2003-04.

Cost of raw material in stock as on 1-04-2003	Rs. 25,000
Raw material purchased	Rs. 40,000
Direct labour cost	Rs. 14,000
Direct expenses	Rs. 1,000
Factory/Works overhead	Rs. 9,750
Administrative expenditure	Rs. 6,500
Selling and distribution expenses	Rs. 3,250
No. of items produced	Rs. 650
Cost of raw material in stock as on 31-03-2004	Rs. 15,000

Net profit/item is 10 percent of total cost of the product.

(16 marks) (AU N/D '14)

Solution :

For 650 units produced during 2003-04

$$\begin{aligned}
 (i) \text{ Direct material used} &= \text{Stock of raw material on 1-04-2003} + \text{raw material purchased} - \text{stock of raw material on 31-03-2004} \\
 &= 25,000 + 40,000 - 15,000 \\
 &= \text{Rs. } 50,000
 \end{aligned}$$

$$(ii) \text{ Direct labour} = \text{Rs. } 14,000$$

$$(iii) \text{ Direct expenses} = \text{Rs. } 1,000$$

$$\begin{aligned}
 \text{Prime cost} &= 50,000 + 14,000 + 1,000 \\
 &= \text{Rs. } 65,000
 \end{aligned}$$

$$\begin{aligned}
 \text{Factory cost} &= \text{Prime cost} + \text{Factory expenses} \\
 &= 65,000 + 9,750 \\
 &= \text{Rs. } 74,750
 \end{aligned}$$

$$\begin{aligned}
 \text{Production cost} &= \text{Factory cost} + \text{Administrative expenses} \\
 &= 74,750 + 6,500 \\
 &= \text{Rs. } 81,250
 \end{aligned}$$

$$\begin{aligned}
 \text{Total cost} &= \text{Production cost} + \text{Selling expenses} \\
 &= 81,250 + 3,250 \\
 &= \text{Rs. } 84,500
 \end{aligned}$$

$$\begin{aligned}
 \text{Selling price} &= 84,500 + 10 \text{ percent of } 84,500 \\
 &= 84,500 \times 1.10 = \text{Rs. } 92,950
 \end{aligned}$$

$$\text{Prime cost/item} = \frac{65,000}{650} = \text{Rs. } 100$$

$$\text{Factory cost/item} = \frac{74,750}{650} = \text{Rs. } 115$$

$$\text{Production cost/item} = \frac{81,250}{650} = \text{Rs. } 125$$

$$\text{Total cost/item} = \frac{84,500}{650} = \text{Rs. } 130$$

$$\text{Selling price/item} = \frac{92,950}{650} = \text{Rs. } 143$$

16. From the following data for a sewing machine manufacturer, prepare a statement showing prime cost, Works/factory cost, production cost, total cost and profit.

	<i>Rs.</i>
Value of stock of material as on 1-04-2003	26,000
Material purchased	2,74,000
Wages to labour	1,20,000
Depreciation of plant and machinery	8,000
Depreciation of office equipment	2,000
Rent, taxes and insurance of factory	16,000
General administrative expenses	3,400
Water, power and telephone bills of factory	9,600
Water, lighting and telephone bills of office	2,500
Material transportation in factory	2,000
Insurance and rent of office building	2,000
Direct expenses	5,000
Commission and pay of salesman	10,500
Repair and maintenance of plant	1,000
Works Manager salary	30,000
Salary of office staff	60,000
Value of stock of material as on 31-03-2004	36,000
Sale of products	6,36,000
	(16 marks) (AU N/D '13)

Solution :

(i) Material cost = Opening stock value + Material purchases – Closing balance
 = 26,000 + 2,74,000 – 36,000
 = Rs. 2,64,000

Prime cost = Direct material cost + Direct labour cost + Direct expenses
 = 2,64,000 + 1,20,000 + 5,000
 = Rs. 3,89,000

(ii) Factory overheads are :

	<i>Rs.</i>
Rent, taxes and insurance of factory	16,000
Depreciation of plant and machinery	8,000
Water, power and telephone bill of factory	9,600
Material transportation in factory	2,000
Repair and maintenance of plant	1,000

Work Manager salary	30,000
Factory overheads or Factory cost	66,600

$$\begin{aligned}\text{Factory cost} &= \text{Prime cost} + \text{Factory expenses} \\ &= 3,89,000 + 66,600 \\ &= \text{Rs. } 4,55,600\end{aligned}$$

(iii) Administrative/office expenses are :

	<i>Rs.</i>
Depreciation of office equipment	2,000
General administrative expenses	3,400
Water, lighting and telephone bills of office	2,500
Rent, insurance and taxes on office building	2,000
Salary of office staff	60,000
Total	69,900

$$\begin{aligned}\text{Production cost} &= \text{Factory cost} + \text{Office expenses} \\ &= \text{Rs. } 4,55,600 + \text{Rs. } 69,900 \\ &= \text{Rs. } 5,25,500\end{aligned}$$

(iv) Selling overheads are :

$$\text{Commission and pay to salesmen} = \text{Rs. } 10,500$$

$$\begin{aligned}\text{Total cost} &= \text{Production cost} + \text{Selling expenses} \\ &= 5,25,500 + 10,500 \\ &= \text{Rs. } 5,36,000\end{aligned}$$

$$\begin{aligned}\text{(v) Profit} &= \text{Sales} - \text{Total cost} \\ &= 6,36,000 - 5,36,000 \\ &= \text{Rs. } 1,00,000\end{aligned}$$

17. In a manual operation, observed time for a cycle of operation is 0.5 minute and the rating factor as observed by the time study engineer is 125%. All allowances put together is 15% of N.T. (Normal Time). Estimate the Standard Time.

(8marks) (AU N/D '2014)

Solution :

$$\begin{aligned}\text{Observed time for a cycle} &= 0.5 \text{ min.} \\ \text{Rating factor} &= 125\% \\ \text{Normal time} &= \text{Observed time} \times \text{Rating factor} \\ &= 0.5 \times 1.25 \\ &= 0.625 \text{ min.} \\ \text{Allowances} &= 15\% \text{ of Normal Time} \\ \text{Standard Time} &= \text{Normal Time} + \text{Allowances} \\ &= 0.625 \text{ min.} + (0.15 \times 0.625) \text{ min.} \\ &= 0.625 \text{ min.} + 0.094 \text{ min.} \\ &= 0.719 \text{ min.} \\ &= 0.72 \text{ min.}\end{aligned}$$

18. In a manufacturing process, the observed time for 1 cycle of operation is 0.75 min. The rating factor is 110%. The following are the various allowances as % of normal time :

Personal allowance = 3%

Relaxation allowance = 10%

Delay allowance = 2%

Estimate the standard time. (8 marks) (AU N/D '2014)

Solution :

$$\begin{aligned} \text{Basic time or normal time} &= \text{Observed time} \times \text{Rating factor} \\ &= 0.75 \text{ min} \times 110\% \\ &= 0.75 \times 1.1 \\ &= 0.825 \text{ min.} \end{aligned}$$

$$\begin{aligned} \text{Standard time} &= \text{Normal time} + \text{All allowances} \\ &= \text{Normal time} + [3\% + 10\% + 2\%] \text{ of normal time} \\ &= 0.825 \text{ min.} + (0.15 \times 0.825) \text{ min.} \\ &= 0.825 \text{ min.} + 0.124 \text{ min.} \\ &= 0.949 \text{ min.} \\ &= 0.95 \text{ min.} \end{aligned}$$

Standard time is the basis for calculation of standard output (*i.e.*, no. of components produced) in 1 day or in 1 shift (of 8 hours). Incentive schemes are based on the standard output.

19. From the records of an oil mill, the following data are available,

(a) Raw materials

Opening stock = Rs. 1,40,000

Closing stock = Rs. 1,00,000

Total purchases during the year = Rs. 2,00,000

(b) Finished goods

Opening stock = Rs. 20,000

Closing stock = Rs. 30,000

Sales = Rs. 6,00,000

(c) Direct wages = Rs. 1,00,000

(d) Factory expenses = Rs. 1,00,000

(e) Non-manufacturing expenses = Rs. 85,500

Find out what price should be quoted for a product involving an expenditure of Rs. 35,000 in material and Rs. 45,000 wages. Factory expenses to labour cost is 100%. (16marks) (AU M/J '2012)

Solution

$$\begin{aligned} \text{Direct material cost} &= \text{Opening stock} + \text{Total purchases} - \text{Closing stock} \\ &= 1,40,000 + 2,00,000 - 1,00,000 \\ &= \text{Rs. 2,40,000} \end{aligned}$$

$$\text{Direct material cost} = \text{Rs. 2,40,000}$$

$$\text{Direct wages} = \text{Rs. 1,00,000}$$

$$\text{Factory expenses} = \text{Rs. 1,00,000}$$

$$\begin{aligned}\text{Factory cost} &= \text{Direct material} + \text{Direct labour} + \text{Factory overheads} \\ &= 2,40,000 + 1,00,000 + 1,00,000 \\ &= \text{Rs. } 4,40,000/\end{aligned}$$

$$\text{Non-manufacturing expenses} = \text{Rs. } 85,000$$

$$\begin{aligned}\text{Total cost} &= \text{Factory cost} + \text{Non-manufacturing expenses} \\ &= 4,40,000 + 85,000 \\ &= \text{Rs. } 5,25,000/\end{aligned}$$

$$\text{Factory expenses of direct labour cost} = 100\%$$

$$\text{Non-manufacturing expenses} = 85000/4,40,000 = 19.31\%$$

$$\begin{aligned}\text{Cost of finished goods} &= \text{Opening stock} + \text{cost of goods} - \text{Closing stock} \\ &= 20,000 + 5,25,000 - 30,000 \\ &= 5,15,000\end{aligned}$$

$$\text{Cost of finished goods} = \text{Rs. } 5,15,000/-$$

$$\text{Total sales} = \text{Rs. } 6,00,000$$

$$\text{Profit} = \text{Rs. } 6,00,000 - 5,15,000$$

$$\text{Profit to sales cost} = 85,000/5,15,000 = 16.5\%$$

The cost of the product to be quoted is listed down as follows:

$$\text{Direct material cost} = \text{Rs. } 35,000$$

$$\text{Direct labour cost} = \text{Rs. } 45,000$$

$$\begin{aligned}\text{Factory expenses} &= 100\% \text{ of wages} \\ &= \text{Rs. } 45,000\end{aligned}$$

$$\begin{aligned}\text{Factory cost} &= \text{Direct material cost} + \text{Labour cost} + \text{Factory expenses} \\ &= 35000 + 45000 + 45000 = 1,25,000\end{aligned}$$

$$\text{Factory cost} = \text{Rs. } 1,25,000$$

$$\begin{aligned}\text{Administrative and selling expenses} &= \text{Non-manufacturing expenses} \\ &= 19.31\% \text{ of factory cost} \\ &= \text{Rs. } 24,137.50\end{aligned}$$

$$\begin{aligned}\text{Total cost} &= 1,25,000 + 24137.50 \\ &= \text{Rs. } 1,49,137.50\end{aligned}$$

$$\text{Total cost} = \text{Rs. } 1,49,137.50$$

$$\begin{aligned}\text{Profit} &= 16.5\% \text{ total cost} \\ &= \text{Rs. } 24,607.68\end{aligned}$$

$$\text{Profit} = \text{Rs. } 24,607,68/-$$

$$\text{Quotation price} = 1,49,137.50 + 24,607.68 = 1,73,745.1875$$

$$\begin{aligned} \text{Quotation price} &= \text{Rs. } 1,73,745.1875/- \\ \text{Selling price} &= \text{Total cost} + \text{Profit} \\ &= 3410 + 682 = \text{Rs. } 4092/- \\ \text{Cost per unit} &= 4092 / \text{Number of units} \\ &= 4092 / 50 \\ &= \text{Rs. } 81.84 \\ \text{List price} &= \text{Selling price} + \text{Discount} \\ &= \text{Selling price} + 20\% \text{ list price} \end{aligned}$$

Let us assume 'list price' be ('x/-Rs.')

$$\text{Now, } x = 81.84 + (20x/100)$$

$$x = 81.84 + 0.2x$$

$$0.8x = 81.84$$

$$x = 102.30$$

$$\text{List price} = \text{Rs. } 102.30.$$

20. Calculate the selling price per unit from the following data :

Direct material cost	= Rs. 8,000
Direct labour cost	= 60 percent of direct material cost
Direct expenses	= 5 percent of direct labour cost
Factory expenses	= 120 percent of direct labour cost
Administrative expenses	= 80 percent direct labour cost
Sales & distribution expenses	= 10 percent of direct labour cost
Profit	= 8 percent of total cost
No. of pieces produced	= 200 (16 marks) (AU A/M '17) (AU N/D '17)

Solution :

$$\text{Direct material cost} = \text{Rs. } 8,000$$

$$\text{Direct labour cost} = 60 \text{ percent of direct material cost}$$

$$= \frac{60 \times 8,000}{100} = \text{Rs. } 4,800$$

$$\text{Direct expenses} = 5 \text{ percent of direct labour cost}$$

$$= \frac{4,800 \times 5}{100} = \text{Rs. } 240$$

$$\text{Prime cost} = 8,000 + 4,800 + 240$$

$$= \text{Rs. } 13,040$$

$$\text{Factory expenses} = 120 \text{ percent of direct labour cost}$$

$$= \frac{4,800 \times 120}{100} = \text{Rs. } 5,760$$

$$\text{Administration Expenses} = 80 \text{ percent of direct labour cost}$$

$$= \frac{4,800 \times 80}{100} = \text{Rs. } 3,840$$

$$\text{Sales and distribution expenses} = 10 \text{ percent of direct labour cost}$$

$$= \frac{10 \times 4,800}{100} = \text{Rs. } 480$$

$$\text{Total cost} = \text{Prime cost} + \text{Factory expenses} + \text{Office expenses} + \text{Sales and distribution expenses}$$

$$= 13,040 + 5,760 + 3,840 + 480$$

$$\begin{aligned}
 &= \text{Rs. } 23,120 \\
 \text{Profit} &= 8 \text{ percent of Total cost} \\
 &= \frac{23,120 \times 8}{100} = \text{Rs. } 1,849.60 \\
 &= \text{Rs. } 1,850 \text{ (say)}
 \end{aligned}$$

$$\begin{aligned}
 \text{Selling price} &= \text{Total cost} + \text{Profit} \\
 &= 23,120 + 1,850 \\
 &= \text{Rs. } 24,970
 \end{aligned}$$

$$\begin{aligned}
 \text{Selling price 1 unit} &= \frac{24,970}{200} = \text{Rs. } 124.85 \\
 &= \text{Rs. } 125
 \end{aligned}$$

21. Describe the various components of job estimate. (16 marks) (AU N/D '17)

Components of a cost estimate or job estimate

The total estimated cost of a product consists of the following cost components :

1. Cost of design.
2. Cost of drafting.
3. Cost of research and development.
4. Cost of raw materials.
5. Cost of labour.
6. Cost of inspection.
7. Cost of tools, jigs and fixtures.
8. Overhead cost.

1. Cost of Design

The cost of design of a component or product is estimated by ascertaining the expected time for the design of that component. This may be done on the basis of similar job previously manufactured but for new and complicated jobs the estimator has to consult the designer who gives the estimated time of design. The estimate design time multiplied by the salary of designer per unit time gives the estimated cost of design. If the design of the component is done by some outside agency, the total amount paid to outside agency gives the cost of design.

2. Cost of Drafting

Once the design of the component is complete, its drawings have to be prepared by draftsman. The expected time to be spent in drawing or drafting is estimated and is then multiplied by the standard drafting rate or by the salary of the draftsman per unit time to get estimated cost of drafting.

3. Cost of Research and Development Work

Before taking up the manufacturing of actual components/parts considerable time and money has to be spent on research and development. The research may be theoretical, experimental or developmental research. The cost of R and D can be estimated by considering various items of expenditure incurred during R and D work which include :

- (i) Cost of labour involved.
- (ii) Cost of material used.
- (iii) Cost of special equipment used or fabricated for the prototype.

- (iv) Depreciation, repair and maintenance cost of experimental set-up.
- (v) Cost of services of highly qualified and trained personnel needed for experimentation.
- (vi) Cost of preparing Test Reports, if any.

In some cases the cost of R and D may be estimated on the basis of research involved in similar products produced in the past.

4. Cost of Raw Material

The estimation of cost of materials used in production of a component/product consists of following steps:

- (i) A list of all the materials used in the manufacture of the product is made which includes the direct as well as indirect materials.
- (ii) The quantity (weight or volume) of all the material expected to be used in the manufacture of the product is estimated. The allowance for material wastage, spoilage and scarp are also added for each component/part.
- (iii) Cost of each material is estimated by multiplying the estimated quantity of each material with its estimated future price. The estimate of future price of a material is made keeping in view of present prices and general trends and variations.
- (iv) Estimated cost of all the materials is added to get the overall estimated material cost.

5. Cost of Labour

The cost of labour involved in the manufacture of a product is estimated by estimating the labour time needed to manufacture the product and multiplying it by cost of labour per hour. In order to estimate the labour time expected to be spent on a job, one must have thorough knowledge of the various operations to be performed, machines to be used, sequence of operations, tools to be used and labour rates. For this purpose, the estimator may consult engineers, supervisors or foremen from production or industrial engineering departments.

6. Cost of Inspection

A product being manufactured is inspected at various stages during its manufacture. It may be inspection of raw material or in-process inspection or inspection of finished goods. The cost of inspection equipment, gauges and consumable involved in the inspection and testing are taken into account while estimating the cost of the product.

7. Cost and Maintenance Charges of Tools, Jigs and Fixtures

Estimated cost of a product includes the estimated cost and maintenance charges for the tools, jigs, fixtures and dies required in the production. The cost of tools, jigs, fixtures etc., is estimated considering their present prices, market trend and the number of times a particular tool can be used during its life-time. The estimated cost divided by the number of jobs, it can make, gives the tool cost per unit produced.

8. Overhead Costs

Overhead or indirect costs are those which are not incurred specifically for any one order or product and these cannot be charged directly to a specific order or product. The overhead costs may be estimated by referring to the records of overhead costs in similar items produced in past. The overhead cost per unit varies considerably with the volume of production *i.e.* number of components produced.