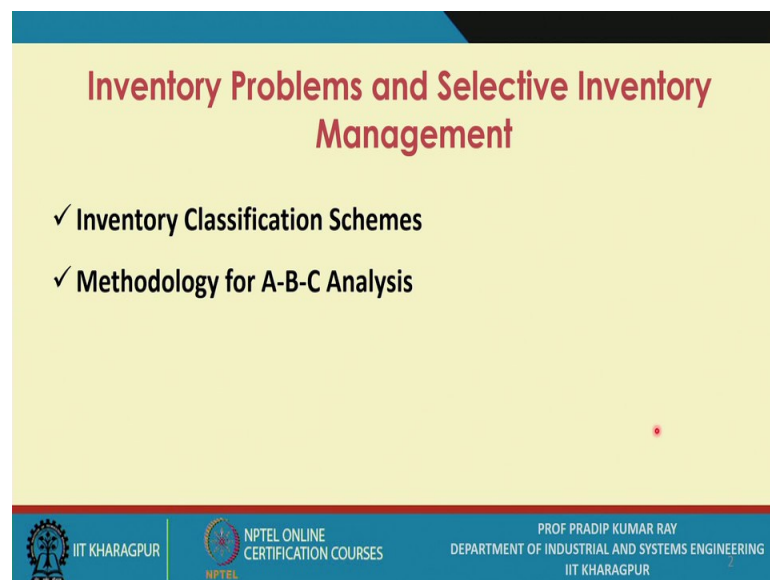


Management of Inventory Systems
Prof. Pradip Kumar Ray
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Lecture - 07
Inventory Problems and Selective Inventory Management (Contd.)

So, during this, these lecture sessions; that is the second lecture sessions, I will be discussing inventory classification schemes.

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There are the different types of the classification schemes that we will discuss one by one and one important; say, the classification scheme is A B C analysis,. So, what is the methodology you adopt for carrying out A B C analysis, that also we will discuss.

So, mainly, we will be focusing inventory classification schemes and the second one is, in this particular lecture sessions, I will elaborate, I will discuss the A B C analysis.

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Classification Schemes

- There are altogether six classification schemes for items in Selective Inventory Management.
- An organization may opt for one or more of these schemes depending on the priorities of the perspectives to be considered.
- Rational judgement and assessment of current problems related to inventory control plays an important role in selection of appropriate number of classification schemes in a given situation.

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Now, what we have mentioned? If you refer to my previous lecture sessions, you come across important point called the importance of an item. So, importance of an item can be explained from, say 6 different perspectives and against each perspective you need to propose a classification schemes.

So, how many classification schemes? You have usually in almost all situations, there are 6 classifications schemes altogether you can adopt for the inventory items in selective inventory management ok. And for each scheme, you have a purpose and the one purpose is common to all the schemes; that is, I need to have the most perfect and the best inventory control systems for the most important items. So, that is the uniform rule. I repeat that, I must have the best inventory control systems or the most perfect inventory control systems for the most important items, ok.

So, this is this is your objective; that is one single purpose. So, you must be very careful in proposing a particular classification schemes and any if such scheme is to be developed explicitly as well as most perfectly, an organisation may opt for one or more of these schemes. So, it is most unlikely that a company is following all the six classifications scheme routinely or blindly. In majority of the cases, we will find that 3

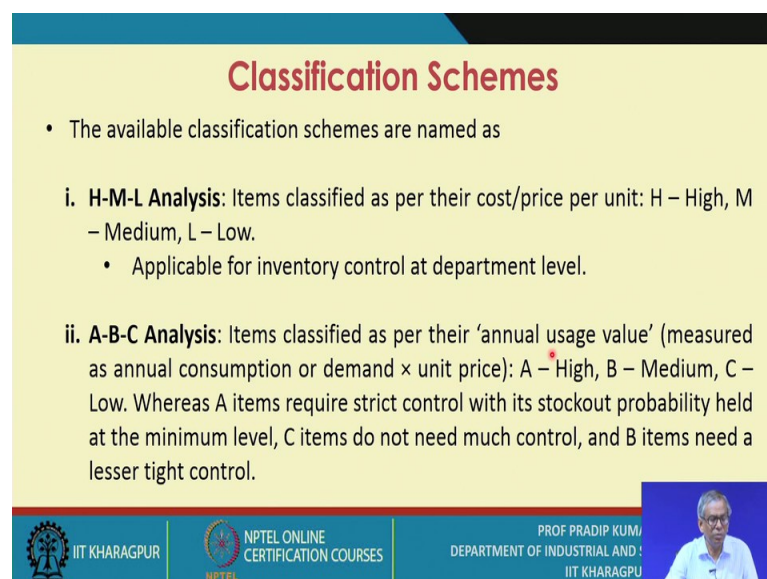
maximum the schemes classification schemes are used and other 3 may not be considered important in a given situation, right.

So, an organisation may opt for one or more of this schemes depending on the priorities of the perspectives to be considered. So, you must have a priority listing and as for this priority list, you go for developing this classification schemes rational judgement. The next point you must remember that, this schemes many of this schemes cannot be determine explicitly through objective analysis.

So, you have to apply in many cases based on your knowledge based on your expertise it use the; you need to use your say subjective judgement in defining the importance of an item, ok. If all majority of the cases, there are may not be explicit objective analysis.

So, the rational judgement and assessment of current problems related to inventory control plays an important role in selection of appropriate number of classification schemes in a given situation. So, this point you please keep in mind that the rational judgement and assessment of current problems, ok. So, this is a must particularly when you deal with an inventory control system, ok. So, this we apply; later on we will come to know.

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Classification Schemes

- The available classification schemes are named as
 - i. **H-M-L Analysis:** Items classified as per their cost/price per unit: H – High, M – Medium, L – Low.
 - Applicable for inventory control at department level.
 - ii. **A-B-C Analysis:** Items classified as per their 'annual usage value' (measured as annual consumption or demand $\times$ unit price): A – High, B – Medium, C – Low. Whereas A items require strict control with its stockout probability held at the minimum level, C items do not need much control, and B items need a lesser tight control.

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Now, there are the 6 ways you can define the importance of an item. So, available classification schemes are named as so, first the these classifications schemes are to be known by their names or by their titles. The first one is known as H M L analysis; H stands for a high unit price, M stands for medium unit price and L stands for low unit price of an item. So, H M L analysis; whenever you mention, that means, you are referring to the unit price of an item and you have classified them under 3 categories.

So, the items classified as per their cost or price per unit. If it is an internal, say supply case; obviously, you know against each item you have the unit production cost. So, that value you get and then for different such items; you have different values of unit production cost. So, you say that among all these items which are being produced within the company self-supply case, I will say or I will judge an item by its unit production cost and the item which is having the maximum unit production cost will get the maximum importance. So, that item is referred to as H item.

So, this is for the internal supply case; self-supply case. For the outside supply case, what you do ? You get this item from an outside supplier. So, you have raised the purchase order and the in the purchase order and unit price is mentioned and the unit price you have negotiated and ultimately that is the agreed upon unit price.

So, if you find foreign item, these unit purchase price is very high or very low. So, you say the item is classified as H or item is classified as L is it ok. So, a H stands for high M stands for medium and L stands for low. So, this system is applicable for inventory control at the department level; not at the operations level at the department level; that means, at the department level you get these items from the stores, ok.

So, of the first, suppose it is an outside supply case. So, it is supplied to the stores and then by placing the requisition from, so, production department, you get the item supplied from the stores. So, obviously, at the department level; that means, when you get this item from the production purpose, you had aware of that that this item may be very high price item or low price item. So, if it is an highly priced item or high priced items, so you get maximum importance those items, is it.

So, applicable for inventory control at the department level. now, next important analysis is referred to A B C analysis this is very very common. It is you know when you make a survey of say varieties of manufacturing organisations or for that matter any say so, any any organisations what you may come across that almost in all cases, all this companies, they have been using A B C analysis. Whether they have been using the other the classification schemes, that you may not know. But one thing you must you will be aware or you or you know in with in with certainty that, A B C analysis in all likelihood is being used.

And many times, what happens that in the name of A B C analysis actually the company may be performing H M L analysis. So, this is point to be noted at this stage, is it ok. When you just say it is an A B C analysis, but when it actually start proving that what kind of proving the systems, you may come across that this is not an A B C analysis; actually it is an H M L analysis.

So, what is A B C analysis items classified as per their annual usage value; that means, if the annual usage value is considered very high the item is considered to be A class item. If the if the annual usage value for an item is considered not that high, it is at the medium level. So, that item is referred to as B class items and similarly, you compute annual usage value for an item and you say comparatively; obviously, relatively that that annual usage value for that item is at is not that high or not that you know say at the medium level. But it is at the low level; relatively speaking, then, you brand this item as a C class item ok.

So, what you need to do? You need to measure the annual usage value. So, what is this annual usage value? This is very very simple; that means you get this data. What is this expected annual consumption? So, there is these consumption or the demand may very is it, ok. So, you get these the data easily from your information system and for a given item you get this data that is the annual consumption in physical units or the demand and for each unit you know what is this unit price or the unit production cost.

So, if you multiply these 2, you will get the annual usage value. So, there are 3 types of the items. Under this classification scheme, A is a high class item; I say high, A is an item

which is considered having high annual usage value B is a medium class item having annual usage value at the medium level and the C class items are having so, the low level of annual usage value. Whereas, A items require strict control. This point to be noted the strict control with the stock out probability held at the minimum level, ok.

So, what will happen that if you lose control on it is stock out occurrences. So, so even the A class items; that means, which is regularly used. That is why, it is consumption amount or the demand level is very high. So, it may affect the production systems of the performance significantly in a negative way ok. So, as you know, the there is the close relationship between the inventory control systems on the production control systems. So, many a time the inventory control system is discussed or is analysed with reference to the production systems and production control.

So,; obviously, you know if you if you lose control on A class items, it might directly affect the efficiency as well as the production rate of the production systems or manufacturing systems as a whole C items do not need much control ok. You exclude them from say right now or say the maybe one a may be for the next 1 year or the 2 years, you continue the existing systems ok. You do not need to bother about the C class item at this point in time. Whereas, for the B class items, you may need tight control, but not that strict control you required you need lesser tight control, ok. So, this is the basis.

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Classification Schemes

iii. **V-E-D Analysis:** Items classified as per their criticality to a production process: V - Vital (without which production process stops), E – Essential (without which efficiency of production process is significantly affected), and D – Desirable (without which there may not be immediate loss of production).

- Applicable for inventory control of spare parts.

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So, next important analysis the classification scheme we refer to an majority of the cases that is the V E D analysis. Now, in the V E D analysis items are classified as per their criticality; that means, this point to be noted within quote that the criticality; that means, these item is considered very very critical to a production process. So, the criticality this term is to be defined in clear and explicit term.

Now, there are 3 types of items you come across as per this analysis called V E D analysis. First one is the V class items. V means vital. How do you define the vital? That means, here is the condition you which means that without which; that means, if this particular item is not available, or it is not it is not available in acceptable condition it is suppose it gets damaged what will happen; that means, the whole productions process stops or enter you know or the plant shuts down the suppose the main transformer to the power line of a plant stops functioning what will happen; that means, entire production plant stops producing.

So; obviously, the transform is considered to be very very vital, is it ok. So, you need to identify such items from the list of items inventory items and among them as vital. This is the definition. Now, the next category is E type. What is E? We use a term call essential. What is essential? Essential means that item; that means, if this item is not

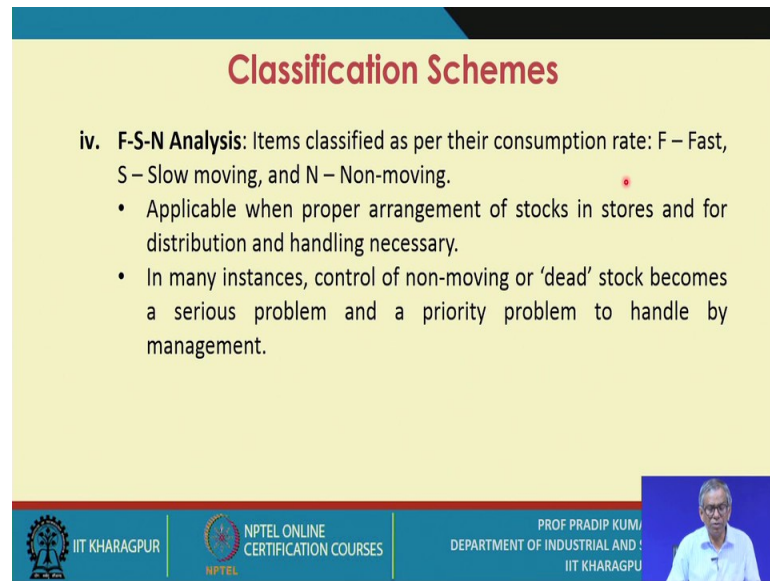
available; that means, what will happen efficiency of production process is significantly affected you can run the machine, but with lesser the spindle speed; getting my point?.

So, for the time being and it just cannot continue forever may be you one day or the next one day or one week you may run the system, is it ok, ah? But with the lesser production rate, but that also you cannot continue with this condition for the longer period of time. That could be you know sever damage to the systems and if it fails, then there could be you know irreparable damage. So, the risk is very very high. So, this items. So, you need to identify and there refer to essential. So, this is the definition.

What is D? D is desirable without which there may not be immediate loss of production you can manage or there could you know you are waiting for a substitute, is it ok? If the substitutes are may available. So, there are 3 types of items under this analysis first one is the V, vital. The second one is the E, that is the essential and the third one is the D, that is the desirable.

So, applicable this analysis is applicable for inventory control of the spare parts, ok. Maybe for even for the M R O items, you know what is an M R O items. So, the machinery spares usually you know even if it is less costly, but, but is supply or it is availabilities to be guaranty it. So, for the vital items you first check what it is existing inventory control policy and whether the; this policy needs change or not ok. So, this is the basis.

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Classification Schemes

iv. **F-S-N Analysis:** Items classified as per their consumption rate: F – Fast, S – Slow moving, and N – Non-moving.

- Applicable when proper arrangement of stocks in stores and for distribution and handling necessary.
- In many instances, control of non-moving or 'dead' stock becomes a serious problem and a priority problem to handle by management.

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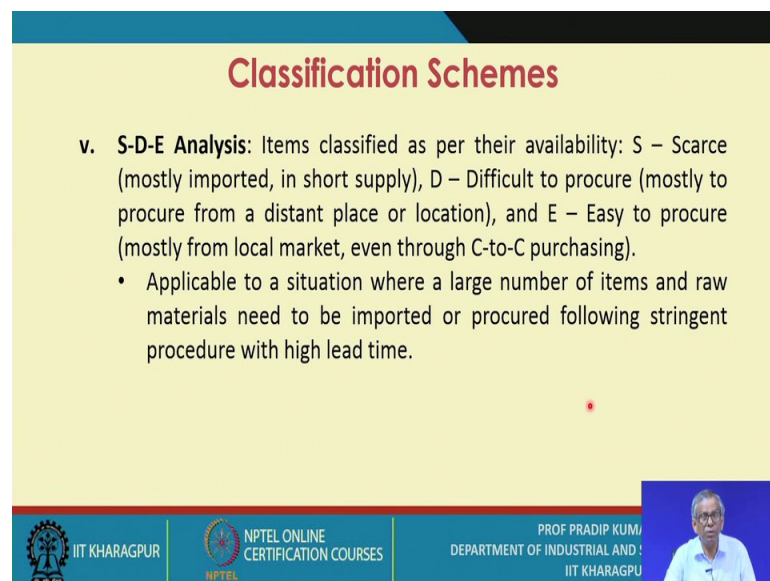
The next important classification scheme is F S N analysis. This analysis is also widely used, it is adopted throughout the industries items classified as per their consumption rate. So, if the consumption rate is very high that you have to define in a given situation which is considered to be very high may be say you say that if the consumption rate is 1000 units and more per hour is considered to be fast moving and that is your definition or so, suppose you that every hour the consumption rate for that item is around 100 units per hour.

So, that is considered to be slow moving and the non-moving; means, it is anybody's guess. Sometimes you know, the 5 units you are using, sometimes 10 units, sometimes no units at all. So, So, the ultimately, what happens that after you know a few time periods you may find that these items are not at all used. So, they are declared as non-moving items there could be many reasons of non-moving items. Later on, while we discuss the excess inventory model. So, we will specifically identify or specifically highlight the various kinds of the reasons or the situations where, this you may have the non-moving condition for the items.

Now, this analysis is applicable when proper arrangement of stocks in stores and for distribution and handling necessary. So, this is the point to be noted in many instances

control of non-moving or dead stock. So, there are refer to as a dead stock; this the dead stock may become a very serious problem and a priority problem to handled by management. So, in many cases, you will find I have already pointed out in the introductory the lecture sessions, I have already pointed out that in many organisations the materials management executive majority of ease or hard time is spent on controlling this dead stock, ok.

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The slide is titled "Classification Schemes" in red text. It contains a section labeled "v. S-D-E Analysis" which describes items classified by availability: S (Scarce, mostly imported, in short supply), D (Difficult to procure, mostly from a distant place or location), and E (Easy to procure, mostly from local market, even through C-to-C purchasing). A bullet point states it is applicable to situations where a large number of items and raw materials need to be imported or procured following stringent procedures with high lead times. The slide footer includes the IIT Kharagpur logo, NPTEL Online Certification Courses logo, and a video feed of Prof. Pradip Kumar, Department of Industrial and Manufacturing Engineering, IIT Kharagpur.

Classification Schemes

v. **S-D-E Analysis:** Items classified as per their availability: S – Scarce (mostly imported, in short supply), D – Difficult to procure (mostly to procure from a distant place or location), and E – Easy to procure (mostly from local market, even through C-to-C purchasing).

- Applicable to a situation where a large number of items and raw materials need to be imported or procured following stringent procedure with high lead time.

So, obviously, you must have an acceptable F S N analysis or a valid F S N analysis for the your items.

The next important classification scheme is S D E analysis. S stands for the scarce mostly imported items and so, and they may be in short supply and very very expensive to be imported from foreign countries these transport difficult to procure. That means, mostly to procure from a distance place or location. So, the logistics could be problem.

And, so, the lead time you may lose control on the lead time and in many cases. Suppose, this item is very very vital; that means, as per the V D E analysis, you say this is vital a spare is not that expensive, but then this item is to be important and so, to be imported

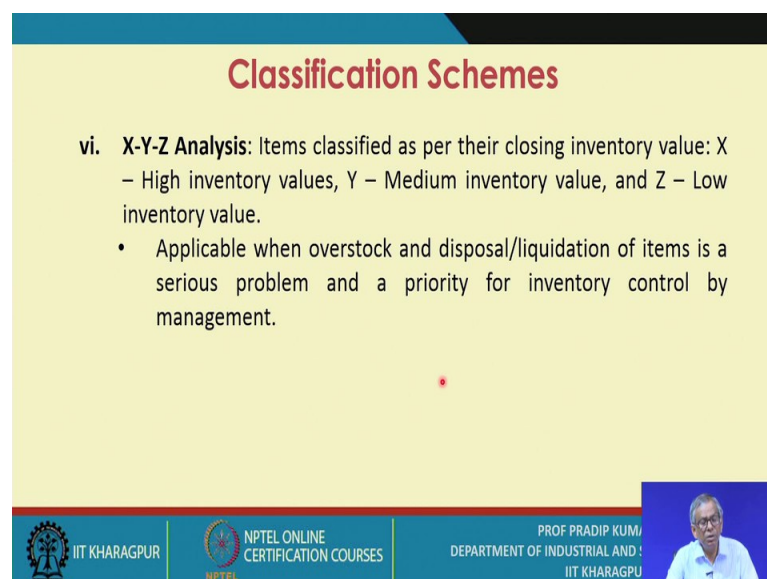
from a place which is a distant place and the lead time control of lead time is not guaranteed that is sort of situation you come across.

And the last category is the E category item; that means, you say those items are branded as easy to procure class mostly. From local market means, just even with a telephone call, you can get the item supplied to your workplace within hours even though C to C, through purchasing also even through C to C computer to computer purchasing.

Now, here one important aspect I should highlight that is if you adopt the J I T based manufacturing system. So if you adopt J I T based manufacturing systems. So, and particularly at the soft floor if you adopt the Kanban system; so, later on we will highlight, we will discuss these aspects in the later weeks you will find that is lead time of the supply can be substantially reduced, and what we will find that as the more supplies per unit of time are guaranteed are guaranteed.

So, you may have you know the inventory level becoming lower and the and you get them supplied through adopting simple procedures of purchasing applicable to a situation where a large number of items and raw materials need to be imported or procured following stringent procedure with high lead time ok, high lead time.

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Classification Schemes

vi. **X-Y-Z Analysis:** Items classified as per their closing inventory value: X – High inventory values, Y – Medium inventory value, and Z – Low inventory value.

- Applicable when overstock and disposal/liquidation of items is a serious problem and a priority for inventory control by management.

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Next one is the X Y Z analysis. So, this is also an important analysis. You carry out because, one of the objectives of the inventory control system is to reduce or minimise the overstock amount items classified as per their closing inventory value. So, X stands for high inventory values, Y stands for medium inventory values and Z stands for low inventory values. Later on, we will come to know the procedures used for valuation of inventory, is it ok.

So, at any point in time for a given item, if the inventory value is very high, it is referred to as X. If the value is considered medium, relatively speaking it is referred to as the Y class items and if it is considered low, then it is referred to as the Z class of items. So, this classification is applicable when overstock and disposal or liquidation of items. So, this is the point to be noted sometime you use the term called writing of.

So, disposal or liquidation of items is a serious problem ok. Mostly the non-value items non non moving items and non-value items. So, these 2 are very critical problems and many organisations and a priority for inventory control by management; that means, it becomes a priority.

So, forget about the other classification schemes you may come across a situation where you are you start with X Y Z analysis, is it ok. Immediately you conclude that essentially.

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Classification Schemes

- Usually, in majority of the cases, A-B-C Analysis along with two more analyses, viz. V-E-D and F-S-N (or S-D-E) are routinely used.
- It is imperative that the exact method of analysis for each classification scheme is in place for which appropriate stepwise methodology with required databases is to be developed.
- A typical method for carrying out A-B-C Analysis will be discussed next.

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The company is facing problem in disposing of say non-moving items or so the dead stock usually majority of the cases A B C analysis along with 2 more analysis; either V E D and F S N or V E D and S D E are routinely used and as I already mentioned that A B C is very very common, it is imperative that the exact method of analysis for each classification scheme is in place for each appropriate stepwise methodology with required databases is to be developed.

So, this point is to be noted and now, I will just in the next 2 to 3 minutes of time, I will be just referring to a typical method which you may use for carrying out A B C analysis,.

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Methodology for A-B-C Analysis

- The methodology consists of a number of steps. These steps are as follows:

Step-1: Collect the list of n number of items and information on unit price (C_{u_i}) and annual consumption (S_i) for each item i .

Step-2: Determine annual usage value for each item. For item i , the annual usage value is $S_i C_{u_i}$.

Step-3: Rank the annual usage values of all the n number of items in descending order.

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So, what kind of methodology you use for carrying out A B C analysis? So, this methodology consists of a number of steps. So, what are the steps? In the first step, what you do collect the list of number n of items n . So, that you have to specify it could be 100, it could be 1000 or it could be 10000. It could be 1 100 1000. So, that you have to select what is the possible value of n collect the list of n number of items and information on unit price.

So, this information you can collect that is referred to a C_{u_i} and annual consumption S_i for each item i step 2 determine the annual usage value for each item, ok. So, you may refer to you are information systems the databases. So, what you get for item i ? The annual usage value is S_i in to C_{u_i} , is it ok. So, that is the annual usage value in monetary terms.

Then, what you do in step 3? You rank the annual usage values of all the n number of items in descending order.

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Methodology for A-B-C Analysis

Step-4: Express the annual usage value of each item as a proportion of total annual usage value of n number of items. For item i , the percentage is

$$S_i C_{u_i} / \sum_{i=1}^n S_i C_{u_i}$$

Step-5: Cumulate the proportion of annual usage value for all ranked items.

Step-6: Plot the cumulative proportion of annual usage value versus proportion of the items considered. On plotting, the nature of the curve is known.

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That means the first value comes first the next value comes next like this; so, these to be arranged in descending orders. Then in next 4, step 4 express the annual usage value of each item as a proportion of the total annual usage value of n number of items ok. For item i for example, the percentage is or the proportion is $S_i C_{u_i}$ divided by sigma of $S_i C_{u_i}$ varies from 1 to n. This is the total usage value for all the n number of items and so, this the proportion you will calculate.

Then in step 5, you accumulate the proportion of annual usage value for all ranked items, ok. And then in the step 6 plot the cumulative proportion of annual usage value versus proportion of the items considered on plotting the nature of the curve is known. So, this exercise you do.

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Methodology for A-B-C Analysis

Step-7: Decide on the proportion of A, B, and C class items and corresponding cumulative proportions of annual usage values. For example, it may be observed that 10% of the items contribute to 70% of the total usage value (A-items), next 20% of the items contribute to 20% of the total annual usage value (B-items), and the rest 70% of the items contribute to 10% of the total annual usage value (C-items).

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And the step 7 decide on the proportion of A, B and C class items; that means, when the curve is plotted now looking at the curve you decide that what is the proportion of A, what is the proportion of B and what is the proportion of C and the number of items classified as A or classified as B or classified as C. And; obviously, if the corresponding cumulative proportions of the annual usage values for all the class of items; that means, A B C will be known.

For example, it may be observed that the 10 percent of items contribute to 70 percent of the total usage value A items. Usually it happens; that means, these are considered to be the nontrivial or important items contributing substantially to the annual usage value ok. Total annual usage value 70 percent may be the case. These are referred to as A items.

Next 20 percent of the items contribute to 20 percent of the total annual usage value. This is just an example I am providing. So, in a typical case, these values might change that these are these items are considered to be B class items and the rest 70 percent of the items contribute to only 10 percent of the total annual usage value. So, they are referred to as so, C class items. So, later on, we will discuss with numerical examples A B C and other kinds of analysis.

Thank you.