

Inventory Sampling (MM-IM-PI)



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Inventory Sampling (MM-IM-PI)

Purpose

This component reduces the time and cost of a physical inventory considerably by counting only the stock of individual materials and carrying out an extrapolation to arrive at an estimated count result for all units of stock managed in the R/3 System (stock management units).

The more materials a company has, the more costly it is to carry out a physical inventory by counting all stocks. The principle of extrapolation during sample taking is also used in quality inspection in the R/3 System: only one particular sample is inspected. The result is then applied to the entire quantity.

To infer the counts for all stock management units by extrapolating the count results for individual units, the following prerequisites must be fulfilled:

- The size of the stock management units included in the physical inventory must be large enough.
- The selection of stock management units to be counted must be "representative".

Statistical procedures are used for carrying out inventory sampling:

- A sample to be counted is randomly selected from the stock management units subject to physical inventory. The size of the sample depends on the degree of probability (probable degree of confidence) with which the extrapolated value inferred from individual counts is expected to be valid for all stock management units included in inventory sampling.
- On the basis of the posted count results, the system carries out an extrapolation for all the stock management units included in the physical inventory.
- The inventory sampling is considered successful, if there is only a small deviation between the extrapolated value and the book value and a high probability that the extrapolation result contains only a minor error.

If an inventory sampling is successful, it is assumed that the estimated deviations from the book inventory balances are so small that they can be neglected. As in the case of a "standard" physical inventory, only the stock of the elements actually counted is adjusted. The stock of the remaining stock management units remains unchanged.

If an inventory sampling is not successful, a complete physical inventory must be carried out for the stock management units not counted.

Integration

Inventory sampling can be carried out in the areas of Inventory Management and Warehouse Management. The steps required to carry out an inventory sampling are the same in both areas. The only difference is the selection of the objects included in the physical inventory:

- Inventory Management
The physical inventory is carried out through selection of the materials by plant, storage location, material type, and stock type.
- In Warehouse Management:

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The physical inventory is carried out through selection of the storage bins by warehouse number and storage type.

Features

As with a “standard” physical inventory, there are two methods of carrying out an inventory sampling:

- Periodic inventory sampling

In this procedure, the count is carried out on a key date. During the physical inventory, movements in the warehouse as well as changes to the book inventory balances are not allowed.

- Continuous inventory sampling

In this procedure, stock is counted over an extended period of time. In this case, inventory sampling data is updated from time to time to correspond to the latest book inventory balances. Changes to the book inventory balances are thus reflected in the calculations performed in inventory sampling.

In the R/3 System, there is no difference between the two methods of inventory sampling, neither in the steps used to carry out the inventory sampling nor in the calculations performed by the system. However, during periodic inventory sampling, you must ensure that the book values will not be changed during the process of inventory sampling.

Procedure of extrapolation

The extrapolation can be based on different mathematical procedures. The R/3 System supports the procedure of mean-value estimation.

How to Carry Out an Inventory Sampling

Purpose

You can carry out the inventory sampling procedure in either Inventory Management or Warehouse Management. The process flow is also independent of the inventory sampling procedure.

Process Flow

Preparation Phase

1. Creating an inventory sampling

You have to set up the inventory sampling in the system before you can start it. In this process, you have to define several basic parameters, such as:

- Which currency is to be used for the inventory sampling
- The area in which the inventory sampling is to be carried out (Inventory Management or Warehouse Management)
- The deviations up to which an inventory sampling is still considered successful

When you create an inventory sampling, it is assigned a number that uniquely identifies it. Any further steps are carried out as changes to this inventory sampling created.

2. Allocating the stock management levels

You must specify which stock management units are to be included in the inventory sampling. You do so by allocating certain quantities of stock management units, the so-called stock management levels, to the inventory sampling, rather than assigning individual stock management units to the inventory sampling.

3. Forming the stock population

The stock population is the total of all stock management units of an inventory sampling. When forming the stock population, the following actions are carried out automatically:

- Breakdown of the stock population into complete-count area and sampling area
You can preset that counting of particular stock management units is mandatory; for example, if the material exceeds a certain price or if no book inventory balance exists for the stock management unit. The total of these elements is called complete-count area. All stock management units of the complete-count area must be counted. The stock management units that do not necessarily have to be counted form the sampling area.
- Classification
The elements of the sampling area are divided into individual classes. Elements of approximately the same value belong to the same class. The generation of classes is necessary for stratification.

4. Generating a stratification

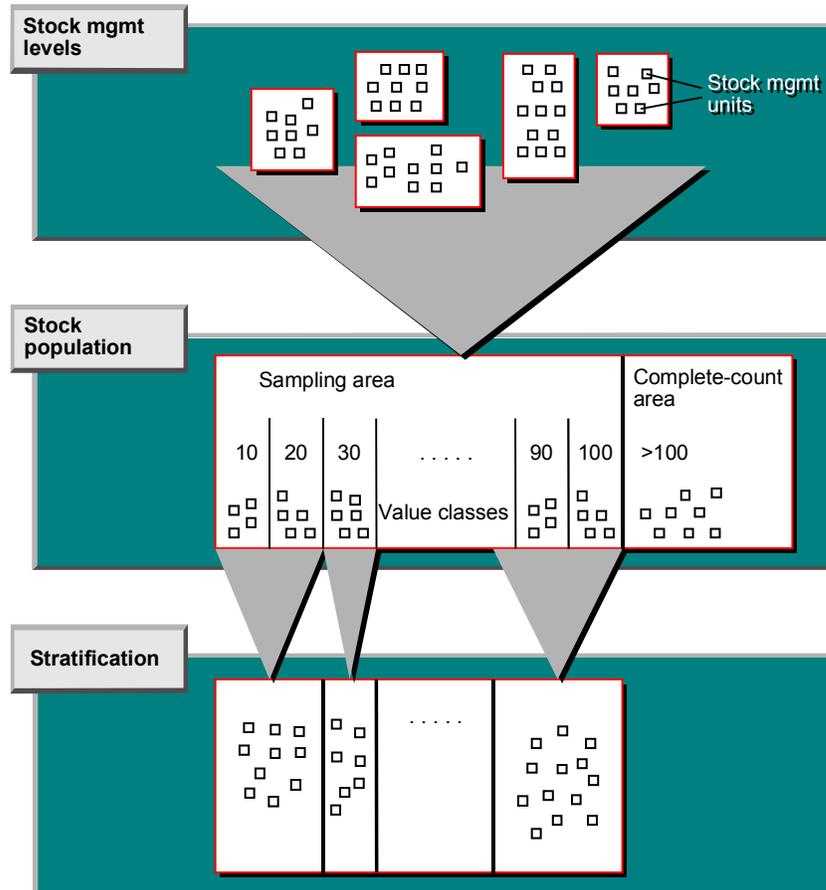
To reduce the number of stock management units to be counted to a minimum, the sampling area is divided into individual strata. The stratification is generated using classification. Consequently, the value dispersion in a stratum is considerably smaller than in the entire

How to Carry Out an Inventory Sampling

sampling area. With a small value dispersion, only relatively few elements must be selected to obtain a representative result. This has the advantage that considerably fewer elements must be counted than would be necessary if the random selection was performed for the entire sampling area. Therefore, the random selection is carried out separately for each stratum.

The process of stratification completes the preparatory phase.

The following graphic shows an overview of the preparatory phase of inventory sampling.



Active Phase

The following steps are required in the active phase:

1. Generating the random selection

In the process of random selection, the system determines the stock management units to be counted for each stratum.

2. Creating physical inventory documents

Physical inventory documents must be created for the stock management units to be counted. These documents are required both for all stock management units drawn during random selection and for all stock management units that were allocated to the complete-count area when the stock population was formed. The physical inventory document is the basis of the physical inventory.

How to Carry Out an Inventory Sampling

3. Update

During the update process, the system performs the following two actions first:

- It reads any count results.
- It reads any changed book inventory balances and book values.

The system also checks whether the elements selected are representative for the sampling area. If not, the system suggests subsequent random selection. This is carried out among the elements in the sampling area if the inventory sampling is not yet sufficiently representative and among the elements in the complete-count area if, for example, a material exceeded the upper value limit (compare the parameters to differentiate between the sampling area and the complete-count area - usually only occurs with continuous inventory sampling).

The relative inventory sampling error determines when an inventory sampling is representative. If the error is below the maximum value defined in the parameters (usually 1 %), the inventory sampling is said to be representative. If the error exceeds the maximum value, the system suggests subsequent random selection.

The inventory sampling error is calculated in terms of two approaches:

- a precise approach for the sampling area
- an approximation approach for the total area (sampling area plus complete-count area)

In the planning phase and in carrying out the update, the system always uses the precise approach - i.e. the inventory sampling can only be extrapolated if the relative inventory sampling error in relation to the sampling area is $\leq 1\%$. When this is the case, the inventory sampling is said to be fully representative. As long as errors continue to exceed this limit, the system continues to propose further subsequent random selections in the sampling area.

In consultation with your accountant, you can use the approximation approach as a basis for the final extrapolation. But you can only do so if the relative statistical error based on the sampling area and the complete-count area is $\leq 1\%$. The advantage is that only a smaller sample has to be counted (less counting effort being required), as the relative inventory sampling error is distributed between the sampling area and the complete-count area (which produces no inventory sampling error). The errors are displayed in the list of extrapolation results.

Subsequent random selection elements in the complete-count area must usually always be subject to complete physical inventory, as they are part of the complete-count area.

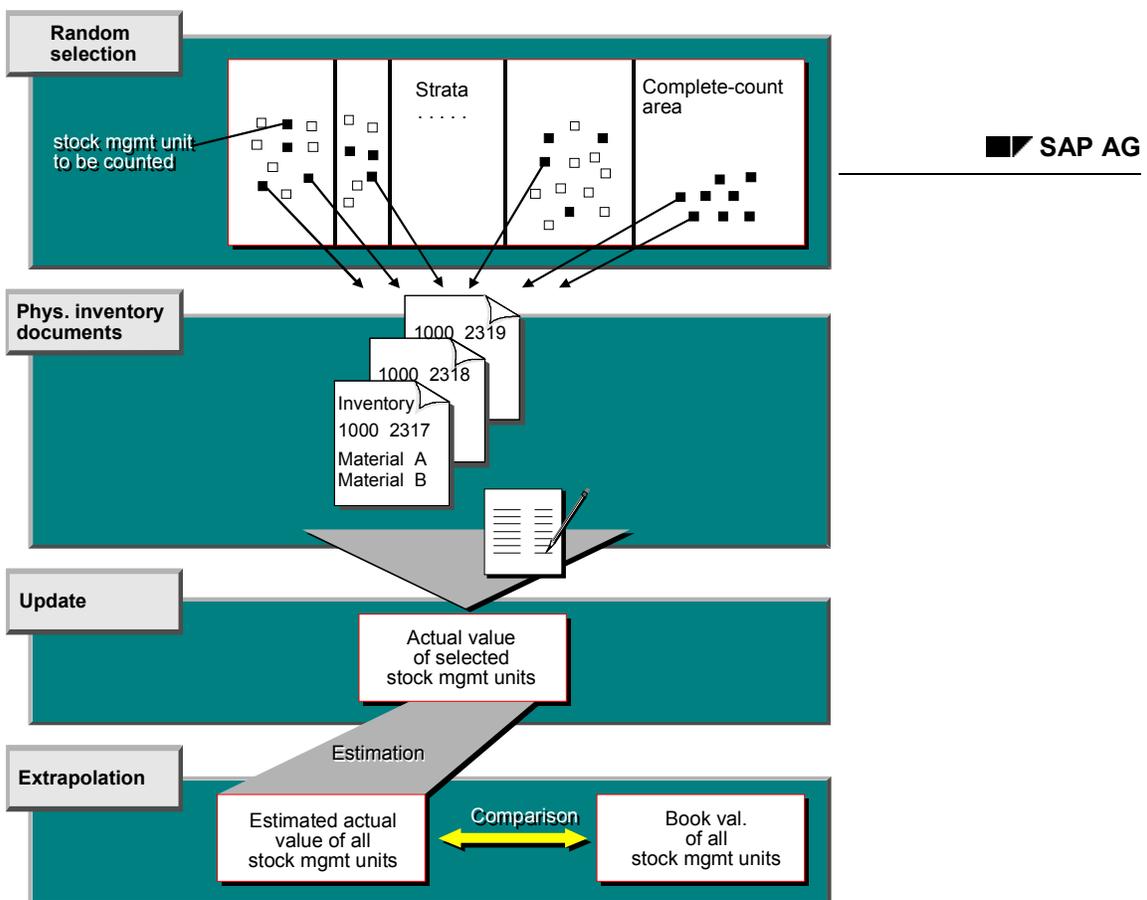
For inventory sampling elements that have not yet been subject to physical inventory when the update is carried out, the current book value is used as an approximation for the result of the physical inventory. This enables you to check at any time whether the current sample is large enough to obtain a representative estimate of the sampling area.

Only inventory sampling elements that have been subject to complete physical inventory are used to calculate the relative inventory sampling error.

4. Extrapolation

During the extrapolation process, the system estimates the physical inventory value of the sampling area on the basis of the latest counting results. An average physical inventory value per item is calculated in every stratum and multiplied by the number of items in each stratum. The total of the stratum values determined in this way gives the estimate for the sampling area.

An inventory sampling is said to have been *successful*, if the total physical inventory value (estimate for the sampling area plus the actual value for the complete-count area) deviates from the book inventory value by no more than 2 % (in the standard system). An inventory sampling is



said to have been *conditionally successful*, if the total area (sampling area plus complete-count area) was used as the basis for evaluating the relative statistical error (see above).

The following graphic shows an overview of the individual steps within the active phase.

Creating an Inventory Sampling

1. Choose *Physical inventory* → *Special procedures* → *Inventory sampling* → *R/3 System*.
2. Maintain the settings on the initial screen, including:
 - a) In which area (Inventory Management or Warehouse Management) is this inventory sampling carried out?
 - b) Which inventory sampling profile is used for this inventory sampling? The inventory sampling profile contains various data: the currency in which the calculations are performed and various parameters which the system proposes as default values during inventory sampling. In Customizing for Inventory Management, you define inventory profiles in the step *Physical Inventory* → *Inventory Sampling* → *Create Inventory Sampling Profiles*. In the inventory sampling profile, you can define a percentage upper value limit in addition to an absolute value after you enter an upper price limit for the upper value limit. This ensures that you adhere to the 80/20 rule in the case of optimum stratification.
3. To go to the parameter screen, choose *Goto* → *Parameters*.

Check the parameters on the parameter screen. The following parameters are of particular importance, because you can only change them when creating the inventory sampling:

 - a) Inventory sampling method
 - b) Extrapolation procedure
 - c) Probable degree of certainty
 - d) Relative statistical error
 - e) Relative deviation between book and actual value



(The extrapolation procedure parameter cannot be changed because only the mean-value estimation procedure is used.)

The inventory sampling profiles should be set so that changes will not be necessary.

The remaining parameters can be changed even after creation of the inventory sampling. The individual parameters are described in detail in the section dealing with the relevant operation/transaction.

4. Save the inventory sampling.

Editing and Changing an Inventory Sampling

Editing and Changing an Inventory Sampling

Use

The procedure of inventory sampling includes the following steps:

- Allocating the stock management levels
- Forming the stock population
- Generating the stratification
- Generating the random selection
- Carrying out the update
- Performing the extrapolation

You must perform these steps in this sequence by changing an existing inventory sampling. It is also possible to include more than one step in a single change session.

After the stock management levels have been assigned, you can carry out all the other stages of the inventory preparation simultaneously; once the stock management levels have been assigned, you can carry out collective processing for the procedures *Form stock population*, *Generate stratification* and *Generate random selection*.

The individual processing steps are explained in detail in the following sections. Each processing step is dealt with separately. Therefore, the inventory sampling is saved after each step. If you want to include several steps in a change, do not save the data until completion of the last step.

Stock Management Units

Use

A stock management unit is part of a material stock that cannot be further subdivided and for which a separate book inventory balance exists. The physical inventory is carried out on the basis of the stock management units. Each stock management unit of a material will be counted separately, and any inventory differences are posted per stock management unit.

In the example below, material A exists in plant 0001 with storage locations 0001 and 0002, and in plant 0002 with storage location 0007. For this material, there are the following stock management units:

Material	Plant	Storage location	Stock type
A	0001	0001	Warehouse
A	0001	0001	Quality inspection
A	0001	0002	Warehouse
A	0001	0002	Quality inspection
A	0002	0007	Warehouse
A	0002	0007	Quality inspection

As shown in the above table, the stock of material A consists of 6 stock management units. You have to define which stock management units are to be included in the physical inventory. In inventory sampling, you do not allocate individual stock management units but stock management levels.

Assigning and Changing Stock Management Levels

Assigning and Changing Stock Management Levels

Use

A stock management level is the total of all stock management units that have the following common characteristics:

- in Inventory Management
 - Plant
 - Storage location
 - Mat. type
 - Stock type
- in Warehouse Management
 - Warehouse number
 - Storage type

Various stock management levels are allocated to each inventory sampling. All stock management units belonging to these levels will be covered by the inventory sampling, with the exception of those stock management units for which a physical inventory has already been active.

The following example shows a possible allocation of stock management levels to an inventory sampling.

Plant	Storage location	Mat. type	Stock type
0001	0001	RAW	Warehouse and quality inspection
0001	0002	RAW	Warehouse and quality inspection
0001	0001	SEMI	Warehouse
0002	0003	SEMI	Warehouse
0002	0003	RAW	Warehouse
0002	0004	SEMI	Quality inspection

In plant 0001, an inventory sampling with this allocation includes the stocks of raw materials in storage locations 0001 and 0002 and the semi-finished products in storage location 0001 as well as the stock in quality inspection for the raw materials in storage locations 0001 and 0002. In plant 0002, the stocks of raw materials and semi-finished products in storage location 0003 as well as the stock in quality inspection for the semi-finished products in storage location 0004 are also included in this inventory sampling.

Prerequisites

Through Customizing for Inventory Management, you can define the stock management levels for which inventory sampling is allowed. For a list of all possible stock management levels, choose *Physical inventory* → *Inventory sampling* → *Define stock management levels*.

The stock management levels that are to be selectable for inventory sampling must be selected in the column *InvSampl. allow.* (inventory sampling allowed).

Assigning and Changing Stock Management Levels

Since usually several stock management levels are allocated to an inventory sampling, you can group together stock management levels that "belong together". When carrying out the inventory sampling, you can then select the stock management levels simply via the group number. Belonging to a group does not mean that there are any restrictions for the allocation of stock management levels. You can still allocate individual stock management levels from the same group as well as stock management levels from different groups to an inventory sampling.

Generally, the configuration defining which stock management levels can be allocated to an inventory sampling, is carried out once before the first inventory sampling. For example, if your company sets up new plants, storage locations, or material types (IM) or new warehouse numbers and storage types (WM), and you want inventory sampling to be allowed for them, you have to change the configuration.

Procedure

After you have created an inventory sampling, you must allocate the stock management levels to this inventory sampling. You can change any allocation defined until you have carried out the random selection.

Allocating Stock Management Levels

1. From the physical inventory menu, choose *Inventory sampling* → *Change*.
2. Enter the number of the inventory sampling and the year. To go to the inventory sampling header screen, choose *Continue*.
3. Select *Transaction* → *Stock mgmt levels* → *Selectable*.

You obtain a list of all stock management levels for which inventory sampling is possible.
4. In this list, select the desired stock management levels. Here, you have the following select options:
 - Selecting an individual stock management level:

Place the cursor on the relevant item and choose *Edit* → *Selections* → *Select* from the menu.
 - Selecting a block of stock management levels:

Place the cursor on the first item of the desired block and choose *Edit* → *Selections* → *Select block* from the menu. Then place the cursor on the last item of the block and again choose *Edit* → *Selections* → *Select block* from the menu.
 - Selecting all stock management levels of a group:

Via the presetting option in the Customizing system, you can combine various stock management levels in a group. To select the stock management levels of a group, choose *Edit* → *Selections* → *Select group* from the menu. The system displays a window where you enter the relevant group number. Then choose *Continue*.
5. Copy (adopt) the selected stock management levels.

The system returns to the header screen where it issues a message confirming that the stock management levels have been adopted.
6. Save the change you made to the inventory sampling.

The system returns to the initial screen.

Assigning and Changing Stock Management Levels

Changing Existing Allocation

Changing an existing allocation is similar to the initial allocation of stock management levels to an inventory sampling. However, the system displays additional warning messages and information messages. To change the allocation, proceed as follows:

1. From the physical inventory menu, choose *Inventory sampling* → *Change*.
2. Enter the number of the inventory sampling and the year. To go to the inventory sampling header screen, choose *Continue*.
3. You have two options now:

You can cancel existing allocations. To do this, select *Transaction* → *Stock mgmt levels* → *Allocated* from the menu. The system displays a list of allocated stock management levels. In this list, deselect the stock management levels not required. Copy (adopt) all other selected stock management levels.

You can make new allocations. To do this, select *Transaction* → *Stock mgmt levels* → *Selectable* from the menu. The system displays a list of all stock management levels that can be selected but are not allocated to this inventory sampling. Select and copy the required lines.

4. Save the change you made to the inventory sampling.

The system returns to the initial screen.

You cannot change the allocation after you have performed the random selection. However, note that it may be necessary to adjust the stock population and the stratification accordingly. In this case, the system deletes the present stock population and stratification, so that you have to regenerate them.

Stock Population

Definition

The stock population is the total of all stock management units included in an inventory sampling. These stock management units are uniquely defined through the allocation of the stock management levels to a given inventory sampling. As a result, the stock population is also defined when you allocate stock management levels.

Use

The stock management levels do not contain any information on the stock management units. Therefore, the stock population must be formed in a separate step after allocation of the stock management levels. (The stock population can be changed until you have carried out the random selection.)

When forming the stock population, the system determines whether a physical inventory is currently active for each stock management unit of the allocated stock management levels. If inventory is being taken for the stock management unit, it will not be included in the stock population. If you want a stock management unit for which a physical inventory is currently active to be included in the stock population, you must first complete the corresponding physical inventory. That is, you either post any inventory differences or delete the physical inventory document. Afterwards, you regenerate the stock population.

Structure

The stock population is divided into

- Sampling area
- Complete-count area

Sampling Area and Complete Count Area

Sampling Area and Complete Count Area

The sampling area is part of the stock population. It contains all of the stock management units which will be subject to random selection, a process in which the system selects the stock management units (elements) to be counted. For the remaining stock management units of the stock population, a complete inventory count is necessary. These stock management units thus form the complete-count area.

There are five parameters that determine whether a stock management unit will be assigned to the complete-count area:

- If the deletion indicator is set in the master record for the stock management unit
- If the book inventory balance of the stock management unit is zero
- If the stock management unit has an ABC indicator
- If the price of the material exceeds a certain limit
- If the value of the stock management unit (material price x quantity) exceeds a certain limit

You set these criteria before generating the stock population. When generating the stock population, the system automatically divides the stock population into the sampling area and complete-count area.



If you have defined in the material master record that a material is a critical part, the material is always adopted to the complete count area.

Classification

The sampling area of an inventory sampling usually contains a large number of stock management units with extremely differing values. The larger the value range between the smallest value and the largest value within the sampling area, the more stock management units must be counted, in order to obtain statistically correct results.

To reduce the number of elements to be counted, the system divides the sampling area into classes, with each class containing elements of "approximately" the same value. Later, the system uses this classification as the basis for generating strata (stratification). For each stratum, the random selection and extrapolation is carried out separately.

Consequently, a class is the quantity of stock management units (in the sampling area) whose values lie within a certain interval. These intervals (possibly with the exception of the last one) are of equal size, but generally contain a variable number of stock management units.

The classification of the sampling area is carried out automatically when the stock population is formed. The parameters set during creation of the inventory sampling are used as the basis for the classification. The system attempts to generate 1000 classes. It calculates the class interval on the basis of the upper value limit specified, as follows:

class interval = upper value limit / 1000 (the result is rounded up to the nearest integer).

On the basis of the class interval, the system then generates classes until the upper value limit is reached. Due to the rounding up process, usually less than 1000 classes are generated. The last class ends with the upper value limit.



upper value limit: **12430**

class interval: 12430 :1000 = 12,43 --> **13**

Classification

Class	From	To
1	0,01	13
2	13,01	26
3	26,01	39
...
923	11986,01	11999
...
956	12415,01	12428
957	12428,01	12430

The upper value limit determines that stock management units with a value exceeding this limit are allocated to the complete-count area. For this reason, the system generates only 957 classes. If the classes just below class 957 contain only few elements, it may be useful to specify a smaller upper value limit, in order to obtain a smaller class interval. For example, if classes 924

Classification

to 957 contain only few elements, the upper value limit can be set to 11999. In that case, the elements as from class 924 and beyond would then be moved to the complete-count area. However, through a finer classification a more favorable stratification may be possible that requires less counting.

Simulation of Upper Price Limits and Upper Value Limits**Simulation of Upper Price Limits and Upper Value Limits**

The division of the stock population also depends on the upper price and value limits which are set on the parameter screen. If you change these upper limits, the number of the stock management units for which a complete inventory count is required may also change.

When forming the stock population, you can simulate the number of stock management units to be counted for various upper price and value limits. The system then calculates how many elements would move to the complete-count area as a result of the changed limits and would therefore have to be additionally counted.

Forming the Stock Population

Forming the Stock Population

To form the stock population, proceed as follows:

1. From the Physical Inventory menu, select *Inventory sampling* → *Change*.
The initial screen appears.
2. Enter the number of the inventory sampling and the year. Then press ENTER. The inventory sampling header screen is displayed.
3. Press the *Parameters* button to display the parameter screen. Check the parameters set on this screen.

The following fields are important for generating the stock population:

- a. Consider delete indicator
- b. Consider zero stock balances
- c. Consider ABC indicator
- d. Upper price limit for sampling area
- e. Upper value limit for sampling area

If required, you can make changes to the parameters. To return to the header screen, press F3.

4. Select *Transaction* → *Stock population* from the menu. Since forming the stock population is usually a time-consuming process, the system prompts you to specify whether you want to form a stock population (or if a stock population has already been formed, overwrite the existing one). If you confirm this message by selecting *Yes*, the stock population will be formed.

In this window, the following information is displayed:

- a. Stock population
The system displays of how many elements the stock population consists.
- b. Basic population before simulation
The system determines the maximum price and the maximum value from the elements of the stock population. Since none of the elements of the stock population exceeds these maximum limits, all elements of the stock population are initially assigned to the sampling area.
- c. Basic population after simulation
In the fields *Upper price limit* and *Upper value limit*, the system either proposes the upper price (or value) limit specified on the parameter screen, or it proposes the maximum price (or value) determined, depending on which of these two alternatives is the smaller value. The limits shown in these fields result in a new division of the stock population into sampling and complete-count areas. You can change the specifications in the *Upper price limit* and *Upper value limit* fields and then press ENTER. On the basis of these new values entered, the system will re-calculate the division of the stock population into sampling and complete-count areas.
- d. Additional counting

Forming the Stock Population

The data contained in this block of information indicates how many additional elements must be counted as a result of the upper price limit and how many as a result of the upper value limit.

Also, the total number of additional elements to be counted is displayed. The total number of additional elements to be counted only indicates how many elements have moved from the sampling area to the complete-count area due to the new price and value limits.

The system does not consider that the new upper price and value limits lead to a lower value dispersion in the sampling area, so that fewer elements to be counted have to be selected from this area. Therefore, the system may indicate here that additional counting is required, although the total number of stock management units to be counted is reduced.

5. In this window, you can change now the upper price and value limits and start the simulation process by pressing ENTER. As a result, the new basic population and the additional number of elements to be counted may change.
6. After entering the desired upper price and value limits, choose F5=Copy. Both limits are recorded in the parameters.

The system returns to the header screen where it issues the message

The stock population has been formed

In addition, the system will enter the current date and your user ID in the *Stock population* field under *Trans/ev* (transactions/events).

7. Save this change you made to the inventory sampling by pressing F11.

The system returns to the initial screen.

Displaying the Options

Displaying the Options

Displaying the Stock Population

To display the stock population, select *Goto* → *List* → *Stock population* → *Total*. The list of the stock management units that form the stock population is displayed.

This list contains all stock management units that are covered by this inventory sampling, according to the stock management levels allocated. The stock management units that must be fully counted are recorded in the *CCA* (complete-count area) column. The adjacent columns indicate whether a delete indicator (*Del*), zero stock balance (*Zer*), or ABC indicator (*ABC*) exists for the given stock management unit. If none of the three columns *Del*, *Zer*, or *ABC* contains an indicator for the stock management unit, but the *CCA* column does, this means that the price and value of the stock management unit in question exceeds the upper price and value limits.

After completion of the random selection (carried out later), the stock management units drawn in the random selection process will contain an indicator in the *Ran* column. After completion of the update, the *Cnt* (counted) and *Pos* (posted) columns will contain an indicator for those stock management units for which the count results have been entered and any inventory differences posted.

Displaying the Sampling Area

To display the sampling area, select *Goto* → *List* → *Stock population* → *Sampling area*. You obtain a list containing the elements of the sampling area. This list corresponds to the list of the stock population.

Displaying the Complete-Count Area

To display the complete-count area, select *Goto* → *List* → *Stock population* → *Complete-count area*. You obtain a list containing the elements of the complete-count area. This list corresponds to the list of the stock population.

Displaying Elements Blocked Due To Active Physical Inventory

To display all stock management units which cannot be included in the stock population because they are currently subject to physical inventory, select *Goto* → *List* → *Stock population* → *Phys. invent. active*. You obtain a list of the stock management units in question.

Displaying the Classification

If you want to know how many elements are contained in the classes generated, you can display a corresponding list. Here, you have the option to either display all classes or only those which contain stock management units (elements).

To display the classification, either select *Goto* → *List* → *Classification* → *All classes* or *Goto* → *List* → *Classification* → *Only classes w.stock*. You obtain a list of the relevant classes.

Displaying the Lorenz Curve

The Lorenz curve is a graphic showing the value distribution of the stock management units. In particular, it shows how many (as percentage) of the stock management units represent how much (as percentage) of the total value.

Displaying the Options

The Lorenz curve can be displayed for the entire stock population, for the sampling area, or for the complete-count area.

You can display the Lorenz curve from various screens:

- From the inventory sampling header screen, select one of the following, depending on the object for which you want to display the Lorenz curve:
Goto → Lorenz curve → Stock population,... → Sampling area or... → Complete count area.
- To display the Lorenz curve from within one of the list screens, simply press the *Lorenz curve* button.

Strata

Strata

Use

The sampling area of an inventory sampling usually contains a large number of stock management units with very different values. The larger the value range between the smallest value and the largest value within the sampling area, the more stock management units must be counted in order to obtain statistically correct results.

To reduce the number of elements to be counted, the random selection and extrapolation are carried out for individual strata. The stratification is performed on the basis of the classification. Individual consecutive classes are grouped together to form various strata.



Optimum stratification is the only guarantee of a successful inventory sampling.

During stratification, the system issues a warning message (*M7 641*) if the last stratum of the sampling area is going to be a complete-count stratum and subsequent random selection would thereby not be possible. The message long text explains what you have to do to prevent this.

Features

Two parameters are predefined (on the parameter screen) for stratification:

- A variation interval
This interval defines within which limits the optimum stratification is expected to lie.
- The minimum sample size
The minimum sample size defines the minimum number of elements to be counted per stratum, provided that a stratum contains at least that number of elements.

During the stratification process, the system determines the following:

- The stratification for each number of strata within the variation interval
 - The number of elements to be counted per stratum
 - The optimum stratification of the generated stratifications

If the optimum stratification lies on a limit of the variation interval, you should move the variation interval beyond this limit. This is explained in the following example:

Example 1

The optimum stratification of an inventory sampling is expected to contain between 5 and 10 strata. However, the actual number of strata of the optimum stratification would be 12. 5 and 10 strata are entered as the variation limits. When generating the stratification, the system determines an optimum stratification of 10 strata. Only after you have changed the variation limits (for example, to an interval between 10 and 15), can the system set (in a new stratification process) the optimum stratification to 12.

Calculating a Stratification

The system uses the Dalenius-Hodges procedure to calculate the stratification. For this purpose, the following information is important:

- How many elements are contained in a class?
- How many strata are to be generated?

For this calculation, the system proceeds as follows:

It determines the number of elements per class, and then calculates the square root of each number determined. Afterwards, it adds the square roots together. The quotient obtained by dividing this total by the number of strata results in the target figure for the stratum limit.

The square roots of the individual classes are now added together in succession until the total equals or exceeds the target figure. All classes including the class that reached the target figure are combined to form the first stratum. From the next class onwards, the square roots are again added together until the target figure is reached. This is how the second stratum is obtained. This process is repeated until all strata have been generated. The following example shows these calculations.

Example 2

For an inventory sampling, the upper value limit is \$500 and the class interval is 50 (for the purposes of simplicity, the class interval has been set to 50 in this example). When carrying out an inventory sampling with the upper value limit of 500, the class interval would automatically be set to 1. Refer to [Classification \[Page 19\]](#). The table below shows how the stock management units are distributed among the individual classes.

Class number	Value	Number of elements	Square root of no. of elements
1	\$0 - 50	3600	60
2	\$50.01 - 100	2500	50
3	100.01 -150	^ 1936	43
4	150.01 -200	961	31
5	200.01 -250	786	28
6	250.01 -300	625	25
7	300.01 -350	441	21
8	350,01 -400	361	19
9	400.01 -450	144	13
10	450.01 -500	^ 100	10
10 Classes		11454	300

The system now calculates the individual stratifications, using various numbers of strata within the variation interval as a basis.

The target figure of the three strata is $300/3 = 100$. The totals of the square roots are 60, 110, 153, and so on. As 110 is the first total to exceed the target figure, the classes 1 and 2 are grouped in the first stratum. The square roots of the third class are then totaled. The totals are 43, 74, 102, 127, and so on. As 102 is the first total to reach the target figure, classes 3,4, and 5 form the second stratum. Classes 6 to 10 form the third stratum.

The following table shows how the stratification is calculated for 3 to 6 strata.

Strata

Class	Square roots	Number of strata (3)	4	5	6
1	60	60	60	60	60
2	50	110	110	50	50
3	43	43	43	93	43
4	31	74	74	31	74
5	28	102	102	59	28
6	25	25	25	84	53
7	21	46	46	21	21
8	19	65	65	40	40
9	13	78	78	53	53
10	10	88	10	63	10
	300	300:3	300:4	300:5	300:6
	Target fig.	=100	=75	=60	=50

For example, using three strata as a basis, classes 1 and 2 would form the first stratum, classes 3, 4, 5 the second stratum and classes 6 to 10 the third stratum.

It is possible that fewer strata are actually generated than the number of strata used as the basis would suggest. This case is shown in the above table with 5 strata used as the basis.

The following table shows which classes form a stratum as well as the value range and the number of elements in each stratum.

Number of Strata:	3	4	5	6
1. Stratum				
Classes	1,2	1,2	1	1
Value range	100	100	50	50
No.of elements	6100	6100	3600	3600
2. Stratum				
Classes	3,4,5	3,4,5	2,3	2
Value range	150	150	100	50
No.of elements	3683	3683	4436	2500
3. Stratum				
Classes	6 - 10	6 - 9	4,5,6	3,4
Value range	250	200	150	100
No.of elements	1671	1571	2372	2897
4. Stratum				
Classes	----	10	7 - 10	5,6

Value range	----	50	200	100
No.of elements	----	100	1046	1411
5. Stratum				
Classes	----	----	----	7,8,9
Value range	----	----	----	150
No.of elements	----	----	----	946
6. Stratum				
Classes	----	----	----	10
Value range	----	----	----	50
No.of elements	----	----	----	100

The above table shows the following: with a small number of strata, there is a wide range of values within each stratum. This means that many stock management units would have to be counted to obtain statistically correct results for a given stratum. As the number of strata increases, the value range in each stratum will become narrower. That is, strata will be generated which contain elements with values that only vary slightly.

Optimum Stratification

The system calculates the stratification for each number of strata within the variation interval. The following applies for the stratifications:

- If there is only a small number of strata, they will have wide value ranges. This means that many elements must be counted.
- If there is a large number of strata, each stratum will contain relatively few elements with a narrow value range. Therefore, all elements of a stratum may have to be counted if the minimum sample size has been set accordingly.

Among the stratifications generated, there is one which requires relatively few stock management units to be counted in total. This particular stratification is called the optimum stratification of the inventory sampling.

The optimum stratification may well include strata that contain fewer elements than the minimum sample size specified. For these strata, all elements must then be counted.



The optimum stratification is the most favorable stratification of all stratifications generated by the system according to the variation interval. If the number of strata of the optimum stratification equals the lower or upper variation limit of the variation interval, there may be an even better stratification outside the variation interval. Therefore, it may be useful to re-adjust the variation interval (by specifying different variation limits on the parameter screen) and carry out a new stratification (see example 1 earlier in this section).

Strata

Activities

How Do I Get Optimum Stratification?

You can control how many elements the system chooses for each stratum by choosing *Goto* → *List* → *Stratification* → *Optimum variant*.

There should always be at least 30 elements in each stratum, as only then does the selection meet the standard statistical distribution. Extrapolation for sample-based physical inventory is based on a mean value estimate. A prerequisite for this is that the mean values of possible samples per stratum form a standard distribution. This is probably the case when there are 30 or more elements. The system therefore expects an entry of 30 or more elements.

For optimum stratification, in the random selection you should choose a maximum of 25% to 30% of the stock management units per stratum in the last few strata (especially in the last stratum).



If there are 100 elements in the last stratum, a maximum of 25 to 30 elements should be proposed for counting.

In the above table of **classes, value range, and number of elements per stratum**, there are 100 elements in the last sampling stratum. Of these 100 elements, a maximum of 25 to 30 elements should be proposed for counting.

If this criterion has not been fulfilled, you should reduce the upper value limit of the sampling area by choosing *Goto* → *Parameter*. You then have to form a new stock population and carry out a new stratification. The system re-forms the strata with reference to the new upper value limit.

You should not start [Random Selection \[Page 34\]](#) until the criterion for optimum stratification is fulfilled.

Displaying the Options

The options for displaying the strata depend on whether you have saved the inventory sampling after completing the stratification:

- Before saving, you can
 - display all variants of stratification
 - display the optimum variant of stratification
- After saving, you can only display the optimum stratification since any other stratifications will not be stored.

Displaying All Stratification Variants

To display all stratification variants generated, select *Goto* → *List* → *Stratification* → *All variants*.

The list of the stratification variants is displayed.

This list contains all variants (or variations) of stratification. The columns *Total*, *Select.*, *SMUs to cnt*, and *CCA* have the following meaning:

- The *Total* column displays the number of elements contained in the stratum. The total of these elements represents the size of the sampling area for the given stratification variant.
- The *Select.* (selection) column specifies how many elements must be selected for statistical reasons without taking the minimum sample size per stratum specified on the parameter screen into account.
- The *SMUs to cnt* (stock management units to count) column takes the minimum sample size per stratum into account, as follows:
 - If the number in the *Total* column is smaller than the minimum sample size, the system enters this number in the *SMUs to cnt* column.
 - If the number in the *Total* column is larger than the minimum sample size, the system enters either the value from the *Select.* column or the minimum sample size from the parameter screen in the *SMUs to cnt* column, depending on which value is greater.
- The *CCA* (complete-count area) column shows for which strata a complete inventory count must be carried out. Here, the system uses two different indicators to indicate for which reason a complete inventory count is required:
 - An **X** in the *CCA* column indicates that all elements of the given stratum must be counted for statistical reasons (value in *Select.* column corresponds to value in *Total* column)
 - An **!** in the *CCA* column indicates that all elements of the given stratum must be counted due to the minimum sample size specified on the parameter screen.

In this list, the optimum variant is highlighted accordingly.

Displaying the Optimum Stratification Variant

To display the optimum stratification variant, select *Goto* → *List* → *Stratification* → *Optimum variant*.

Displaying the Options

The system displays the optimum stratification variant.

Generating a Stratification

To carry out the stratification, proceed as follows:

1. From the Physical Inventory menu, select *Inventory sampling* → *Change*. The initial screen appears.
2. Enter the number of the inventory sampling and the year. Then press ENTER. The inventory sampling header screen is displayed.
3. Press F20 to display the parameter screen. Check the parameters set on this screen.

For generating the stratification, the following fields are relevant:

- a. Lower number of strata for variation
- b. Upper number of strata for variation
- c. Minimum sample size per stratum

If you make any changes to the parameters, save them by pressing F11. To return to the header screen, press F17.

4. Select *Transaction* → *Stratification*. Since the process of stratification can be very time-consuming, the system first prompts you to specify whether you want to carry out the stratification. If you select *Yes* in the window displayed, the system generates the stratification and issues the message:

Stratification has been completed

In addition, the system will enter the current date and your user ID in the *Stratification* field under *Trans/ev* (transactions/events).

5. Save this change you made to the inventory sampling by pressing F11. The system returns to the initial screen.

The system only saves the optimum stratification since any other stratifications generated will not be needed for further processing.

Random Selection

Random Selection

Use

In the random selection process, the system draws the elements to count for each stratum.

Please note that the system performs the random selection on the basis of the transactions previously performed. Therefore, the stock management units, stock population, and stratification can no longer be changed.

However, when performing the random selection, the system does not automatically create the physical inventory documents. Therefore, at this point, you still have the option of deciding whether or not to carry out the physical inventory.

The random selection is carried out with the aid of random numbers, which are generated in the system using an internal random number generator. The random number generator uses the linear congruence method and meets the latest research standards in this area.

Activities

Generating the Random Selection

Enter the number of the inventory sampling and the year by choosing *Inventory Sampling* → *Change*. To go to the inventory sampling header screen, choose *Continue*. Choose *Transaction* → *Random selection*.

Since all previous transactions cannot be changed after the random selection has been generated, the system prompts you to specify whether you want to carry out the random selection. If you select *Yes*, the system will carry out the following actions:

- It selects the stock management units to be counted
- It creates a session for the physical inventory documents (also refer to the section *Physical Inventory*)
- It saves the random selection

The system displays a list of the stock management units to be counted and issues the message *Random selection executed - Inventory sampling saved*.

The header of the list contains the name of the session created.

Inspecting the Random Selection

After you have created a session, you should check whether the random selection is representative of all the layers. To do this, update the inventory sampling (refer to [Update \[Page 39\]](#)). If the system finds that a subsequent random selection is required for the sampling area, although the book inventory balances and values have not changed, it could be due to the following:

- In some strata, the random selection does not correspond to the statistical standard split.
- For the parameters, the upper value limit you have chosen for the sampling area is too high.
- In the lowest stratum, there are many materials with a stock value of zero although, in the random selection for this stratum, a disproportionately high number of materials with a value greater than zero were chosen.

Random Selection

As the system has not yet created any physical inventory documents for the current inventory sampling, you can decide at this point whether you want to carry out a subsequent random selection or cancel and delete this inventory sampling before you have processed the session.

If the subsequent random selection is very high due to the criteria above, it is advisable to cancel and delete the current inventory sampling. You cannot delete an inventory sampling that you have created, just the elements in the stock population. When a user deletes an inventory sampling, he or she enters a comment in the header data and in the stock management units. This is stored in the system.

When creating a new inventory sampling, you can prevent a subsequent random selection by choosing an upper value limit that corresponds to the criteria for optimal stratification (see [Strata \[Page 26\]](#)).

Carrying out a Plausibility Check

With the plausibility check, you can run checks before the inventory sampling count. These give you an idea of how much work will be required and how successful the inventory sampling will be. During the check, the system equals the fictitious count values for the sampling elements with the current book values. It therefore assumes that the count would not have resulted in any inventory differences.

The plausibility check gives you an idea of the quality of the random selection that has been carried out and thereby of the probable success of the inventory sampling. At the same time, the system provides you with an approximate overview of the expected subsequent random selections. If the results of the plausibility check are not satisfactory, you can carry out a new random selection.

Displaying the Options

Displaying the Options

To check which stock management units have been drawn by the system, you can create a list of these stock management units. In addition, the stock management units drawn are marked with an X in the *Ran* column both in the list of the stock population and in the list of the sampling area.

Displaying the Random Selection

To display a list of the stock management units to be counted, select *Goto* → *List* → *Random selection*.

Physical Inventory

After completion of the random selection, the actual physical inventory is carried out by counting the stock of the stock management units (elements) selected. These include the selected elements of the sampling area and all elements of the complete-count area. The physical inventory includes three steps:

- Creating physical inventory documents
- Entering count results
- Posting inventory differences

The physical inventory document is the basis of the physical inventory, because it contains the materials to be counted. The printout of the physical inventory document is used to write down the counting results. When these counting results are entered in the system, this is considered a change to the physical inventory document. The same applies when inventory differences are posted.

Creating Physical Inventory Documents

The physical inventory documents for an inventory sampling are created through batch input. This process includes two steps:

- creating a session which contains the stock management units to be counted (is carried out automatically when generating the random selection).
- processing the session (carried out by your system administrator). During this process, the relevant physical inventory documents are created.

To set default values for the creation of sessions, your system administrator can use the Customizing system of Inventory Management/Physical Inventory. To do this, select *Transactions* → *Physical inventory* → *BTCI default values* from the Configuration menu.

- These default values specify the maximum number of items contained in a physical inventory document
 - To prevent the system from creating a physical inventory document for each individual stock management unit, you should combine a maximum of 20 stock management units of a storage unit in a single document, for example.
- whether the documents will cause a block due to physical inventory
 - To avoid short-term inconsistencies between the book inventory balance and actual stock, you should block the physical inventory document. This means that postings for the material will not be possible until the counting result has been entered for the corresponding item.

Creating a Session

The session containing the stock management units to be counted is created automatically by the system when generating the random selection. If errors occur during processing of the session, you must manually create a new session. To do this, proceed as follows:

1. From the Physical Inventory menu, select *Inventory sampling* → *Change*. The initial screen appears.

Physical Inventory

2. Enter the number of the inventory sampling and the year. Then press ENTER. The inventory sampling header screen is displayed.
3. Select *Sessions* → *Create phys.inv.docs* from the menu. Since generating a session is usually a time-consuming process, the system prompts you to specify whether you want to create the session. If you select *Yes*, the system displays the list of stock management units to be counted.

The system issues a message confirming that a session with the number nn has been created.

Processing a Session

Your system administrator will process the session by selecting *System* → *Services* → *Batch input* → *Edit* from the menu. During processing of the session, all physical inventory documents required for the given inventory sampling are created. These include physical inventory documents

- for all stock management units that were drawn
- for all stock management units in the complete-count area

Entering the Count

The counting results are recorded on the printed physical inventory documents. Afterwards, the count is entered in the system.

However, the count does not yet have an effect on the extrapolation of the inventory sampling, since the extrapolation is carried out on the basis of the adjusted book values.

Posting Inventory Differences

After the counting results have been entered in the system, the inventory differences must be posted. This also applies to items for which the difference between the book inventory balance and actual stock is zero.

On the basis of the differences posted, the extrapolation calculates the estimated value for all the elements in each stratum (refer to [Update \[Page 39\]](#) and [Extrapolation \[Page 43\]](#)).

Status of the Physical Inventory

For a given inventory sampling, you can display how much of the physical inventory has already been carried out.

After the update has been carried out, you can display the total number of stock management units to be counted, the number of stock management units already counted, and for how many stock management units the inventory differences have already been posted.

- When you select *Edit* → *Status*, the system displays a window which lists the above information both for the sampling area and the complete-count area.
- The extrapolation for an inventory sampling displays this information for each stratum and for the complete-count area (refer to [Update \[Page 39\]](#) and [Extrapolation \[Page 43\]](#)).

Update

Use

During an update, the system:

- Reads posted count results that have been added
- Determines changed book inventory balances and book values
- Determines whether subsequent random selection is required

Reading Added Count Results

In inventory sampling, any count entered or difference posted is recorded in the relevant physical inventory document. However, this information is not updated automatically in the inventory sampling concerned. This will only be done during the update process.

During the update, the system checks the physical inventory documents created for inventory sampling and uses any required information from these documents for extrapolation.

The value of stock management units that have already been counted, and for which differences have been posted, are no longer updated; the inventory differences that occur are extrapolated in the current sampling stratum. This prevents stratum changes resulting from current goods movements after the inventory differences are posted. In Customizing for Inventory Management, you can define whether counted and posted stock management units are to be updated by choosing *Physical Inventory -> Inventory Sampling -> Create Physical Inventory Profiles* and the *Update counted and posted stock management units* indicator.

Determining Changed Book Inventory Balances and Book Values

In inventory sampling, the system differentiates between three points in time:

- The **time of planning** - this is the time when the stock population is formed. The division of the stock population into complete-count area and sampling area, the classification, and the stratification are based on the data at the time of planning.
- The **time of physical inventory** - this is the time when the physical inventory count is entered and the difference posted.
- The **current time** - this is the time when the update is carried out. The extrapolation refers to the data at the current time.

If provided for in the physical inventory documents, a posting block for stock management units to be counted only exists in the period between creation of the physical inventory document and entry of the physical inventory count. Before and after this period, inventory postings are allowed. Throughout the inventory sampling, postings can be made without restriction for stock management units that need not be counted. Consequently, changes to the book inventory balances or book values are possible during inventory sampling. This is what is called continuous inventory sampling in the SAP System.

During the update, the system determines these changes and considers them for extrapolation.

The following table shows the stock balance and the value of a stock management unit at different points in time, for example.

		Book value	Actual value
--	--	-------------------	---------------------

Update

Time of planning		1200	
Increase in stock	+ 120		
Before the phys. inv.		1320	
Physical inventory count			1296
Inv. adjustm. postng	- 24	1296	
Increase in stock	+ 480		
Current		1776	

During the update, the system determines that the count has been entered and the inventory difference posted for the stock management unit.

To calculate the estimate, which is determined during extrapolation, the system stores the current book value of the stock management unit. In the above example, the current book value is 1776.

To find out to which stratum the stock management unit belongs, the system performs the following calculation: the current book value is increased by the inventory difference of 24. This means that the assignment of the stock management unit to a specific stratum is based on the value 1800. Therefore, the stock management unit may belong to another stratum (see the section below “Determining Whether Subsequent Random Selection Is Required”).



If you carry out inventory sampling on a particular date (periodic inventory sampling), deviations between book inventory quantities and values are neither allowed at the time of planning nor at the current time. You can only prevent such deviations by carrying out the individual transactions – from forming the stock population to the final update – in immediate succession to prevent any inventory postings in the meantime.

Determining Whether Subsequent Random Selection Is Required

In the case of continuous inventory sampling, the book inventory quantities and book values may be changed while the inventory sampling is being carried out. As a result, a stock management unit that belonged to a particular stratum at the time of planning may belong to another stratum at the current time. Stock management units can also be transferred between the sampling area and the complete-count area.

If a stock management unit moves to the complete-count area, it must be counted. The system will then propose a subsequent random selection for the complete-count area.

Switching elements to another stratum can also result in a subsequent random selection: as a result of “stratum changers”, the remaining elements that were selected for a stratum may no longer be representative of that stratum. In this case, further elements to be counted must be drawn for this stratum. The system performs this check for each stratum. If it determines that additional elements must be drawn, it proposes a subsequent random selection for the sampling area.



The stratum containing stock management units of a value between 120 to 150 consists of the materials A to F at the time of planning. During the random selection, the system draws the materials B, D, and E to be counted. The table below shows the stratum elements at the time of planning and at the current time.

Material	Value at time of planning	Random selection	Value at current time
A	120		120
B	140	X	(70)
C	125		125
D	125	X	130
E	150	X	(100)
F	130		130
From other strata:			
G	(100)		140
H	(400)		130

The stratification is based on the data that applied at the time of planning. At the time of the update, the system determines that the materials B and E no longer belong to this stratum. The materials G and H have been added to the stratum. Therefore, the stratum contains 6 elements, of which only one has originally been drawn to be counted. Since this single count does not guarantee that the results for the entire stratum are correct, the system proposes a subsequent random selection. In the subsequent random selection, the system will draw stock management units of the updated stratum that have not yet been counted (the updated stratum includes the elements A, C, F, G, and H).

Subsequent Random Selection

If, at the time of the update, the system determines that particular stock management units should be contained in the complete-count area due to the current stock values or that a selection made for a stratum is no longer representative, it proposes a subsequent random selection. In a subsequent random selection, the system will:

- Carry out a random selection in the strata for which no representative selection exists, using the elements not yet counted.
- Create a session for generating physical inventory documents for the following stock management units:
 - The new stock management units drawn
 - The stock management units that have been added to the complete-count area

In each update, you can decide whether or not to carry out the subsequent random selection suggested by the system. If, during the last update, the system recommended a subsequent random selection, you must start the random selection to allow for the final extrapolation.

It is recommended that you do not carry out a subsequent random selection until shortly before the final extrapolation, as during update the system may propose that you carry out a subsequent random selection, though this may no longer be required after the next update has been carried out. For example, this would be the case if goods receipts were posted for various stock management units before an update and corresponding goods issues prior to the next update. If you performed a subsequent random selection as a result of the first update, more stock management units would have to be counted than actually necessary.

Update

Activities

Carrying Out an Update

1. From the Physical Inventory menu, choose *Inventory sampling* → *Change*. The initial screen appears.
2. Enter the number of the inventory sampling and the year. Choose *Continue*. The inventory sampling header screen is displayed.
3. Choose *Transaction* → *Update*. Since carrying out an update is usually a time-consuming process, the system prompts you to specify whether you want to carry out an update. If you select *Yes*, the system updates the existing data.

(If the system suggests that you perform a subsequent random selection, continue with step 6.)

4. The system displays the following message:

Stratification has been completed

(This message will also appear if no changes were made in the physical inventory documents between the last and the current update.)

In addition, the system will enter the current date and your user ID in the *Update* field under *Trans/ev* (transactions/events).

5. Save the change you made to the inventory sampling. The system returns to the initial screen.
6. If the system determined that a subsequent random selection is necessary as a result of the update, it will prompt you to specify whether you want to carry out the subsequent random selection for the complete-count period and/or for the sampling period.

(If you decide not to carry out the subsequent random selection, continue with step 4.)

If you decide to carry out a subsequent random selection, the system generates a new random selection (in the case of subsequent random selection for the sampling area). It also creates a session for generating the physical inventory documents required for the new stock management units to be counted. The system displays a list of the additional stock management units to be counted and issues the message:

Random selection completed - Inventory sampling saved

Extrapolation

Use

Inventory sampling is based on the principle that the system extrapolates the counting results for the stock management units that have been drawn at random to arrive at an estimated value for all stock management units of the sampling area. The counting results for the complete-count area are also considered in the overall calculation. The system uses both results to calculate the estimate for the stock population as a whole.

Features

Types of Extrapolation

There are two types of extrapolation:

- An extrapolation is regarded as **provisional** if inventory differences have only been posted for some of the stock management units to be counted. You can perform as many extrapolations as you wish. Only the last one will be stored.



A provisional extrapolation can be assigned the status **Active (completion provisionally successful)** if the relative statistical error and the maximum allowed deviation between the book value and the estimated value are already under the defined limit, even although not all stock units chosen for counting have been counted and posted. In this case, the auditor has to decide whether the inventory sampling can be accepted at this stage. You can manually close an inventory sampling with the status **Active (provisionally successful)** if you have sufficient criteria for successfully completing the inventory sampling.

- An extrapolation is regarded as **final** once all inventory differences have been posted. This means all counting results have been taken into account in the calculation, and further subsequent random selection is not required. A final extrapolation can only be carried out once, since any new results cannot be added.

Extrapolation Procedure

The extrapolation can be based on different mathematical procedures. The SAP System currently supports the **procedure of stratified mean-value estimation**.

Using the procedure of stratified mean-value estimation, the system calculates the following values on the basis of the sample elements posted:

- The estimated mean actual value per stratum
- The estimated mean actual value for the whole area

The following example shows the calculation according to the stratified mean-value estimation.



The extrapolation is to be performed for a given inventory sampling. The sampling area consists of two strata. The following table shows the stock situation of the individual strata and of the complete-count area.

Extrapolation

Stock Population of an Inventory Sampling

	Book value	Actual value
Stratum 1 Values from 100.01 to 150		
A	110	109
B	140	135
C	135	
D	125	122
E	150	150
F	120	
Total	780	516
Stratum 2 Values from 150.01 to 220		
G	201	
H	209	202
I	207	205
K	204	202
L	199	
Total	1020	609
Complete-count area Values over 220		
M	230	230
N	230	230
O	250	250
P	240	240
Total	950	950

In the first stratum, the actual value of the counted stock management units is a total of 516. The mean actual value is $516 : 4 = 129$. As the total stratum consists of 6 stock management units, the actual value is estimated at $129 * 6 = 774$. The adjusted book value of the stratum 771 is therefore $(= 516 + 135 + 120)$. Thus, there is a deviation of 3 between the adjusted book value and the estimated value.

When the same calculation is performed for stratum 2, the adjusted book value is 1009 $(= 609 + 201 + 199)$, and the estimated actual value is 1015 $(= 609 : 3 * 5)$.

The adjusted book value of the stock population is 2730 $(771 + 1009 + 950)$; the estimated actual value is 2739 $(774 + 1015 + 950)$. This results in a deviation of 9 between the adjusted book value and the estimated value. The relative deviation is 0.33 % $(9 / 2730 = 0.33 \%)$.

Status and Rating of the Inventory Sampling

An inventory sampling can have the following status:

- Newly created
- In preparation
- Active
- Stock units posted
- Completion successful
- Completion unsuccessful
- Active (completion provisionally successful)

The result of the final extrapolation determines whether an inventory sampling is rated as **successful** or **unsuccessful**. If the extrapolation is only preliminary, the inventory sampling can be rated as **provisionally successful**.

- If an inventory sampling is successful or provisionally successful, it can be assumed that the book inventory balances of all materials covered by the inventory sampling agree with the actual stocks.
- If an inventory sampling is unsuccessful, it must be assumed that the deviations between the book inventory balances and the actual stock are too large. For this reason, a complete physical inventory must be carried out for all elements that have not been counted.

Rating an inventory sampling as **(provisionally) successful** or **unsuccessful** depends on the following two criteria:

- How good is the estimate?
The system checks whether it can be assumed with a high degree of probability that the possible deviation between the estimated value and the actual value (unknown) is very small.
- How good are the book values?
The system checks whether the deviation between the estimated value and the book value is small.

Inventory Sampling Unsuccessful, but System does not Require Subsequent Random Selection

When an inventory sampling is updated, the system may not suggest that another subsequent random selection is carried out. Despite this, the relative statistical error is greater than that which was specified in the parameters at the beginning. When the extrapolation for the inventory sampling is final, the status is therefore **unsuccessful**. This constellation resulted because:

Due to a high variance, a complete count was carried out for the last inventory sampling stratum with the materials highest in value. Although this stratum is therefore part of the complete count area, the statistical error is assigned to the sampling area. As a result, the relative statistical error is greater than allowed. A subsequent random selection is not allowed, however, as all the materials in the last stratum have already been counted. You can only prevent this situation by choosing the optimum values for stratification and random selection very carefully.

Extrapolation

Specified Statistical Parameters

When creating an inventory sampling, you specify through the following parameters the maximum statistical deviations allowed for the inventory sampling to be considered successful.

- Probable degree of certainty
- Maximum allowed relative deviation between book and actual value
- Maximum allowed relative statistical error

The following example clearly shows the meaning of these parameters:



You have set the statistical parameters as follows:

Probable degree of certainty	95.00 %
Relative statistical error	1.00 %
Relative deviat. betw. book and actual value	2.00 %

An inventory sampling is considered successful:

- If, with 95 % probability, any possible deviation between the actual physical inventory value and the estimated physical inventory value is less than 1 %
and
- If the relative deviation between the adjusted book value and the estimated physical inventory value is less than 2 %

Activities

Performing an Extrapolation

How you perform an extrapolation does not depend on whether the extrapolation is provisional or final.

To perform the extrapolation, proceed as follows:

1. From the Physical Inventory menu, choose *Inventory sampling* → *Change*.
2. Enter the number of the inventory sampling and the year. Choose *Continue*. The inventory sampling header screen is displayed.
3. Choose *Transaction* → *Extrapolation*. The system carries out the extrapolation and issues the message

Provisional extrapolation has been carried out

or

Final extrapolation has been carried out

1. In addition, the system will enter the current date and your user ID in the *Extrapolation* field under *Trans/ev* (transactions/events).

During the final extrapolation, the status of the inventory sampling is changed to:

Completion successful

or

Completion unsuccessful

If the extrapolation is preliminary, the status of the inventory sampling changes depending on the relative statistical error with relation to the whole area to:

Completion provisionally successful

Save the changes you made to the inventory sampling.

Displaying the Result of an Extrapolation

To display the extrapolation result, choose *Goto* → *List* → *Extrapolation*. A list of the calculations performed by the system is displayed.

After the extrapolation results for the individual strata, the system displays the extrapolation result for the entire sampling area, followed by the extrapolation result for the complete-count area. At the end, the result includes the whole area with the relative deviation and the relative statistical error. In the example, the inventory sampling is successful, as the relative deviation and the relative statistical error are smaller than specified.

The final extrapolation completes the process of inventory sampling.

Interpreting the Results of an Extrapolation

Interpreting the Results of an Extrapolation

The result of an extrapolation consists of the following areas:

- Summary of the specified parameters
- Information on each of the individual sampling strata
- Result of extrapolation for the whole sampling area
- Information on the complete-count area
- Result of the extrapolation for the whole area

The following describes how the system determines the values for the individual sampling strata, the whole sampling area, and the result of the extrapolation for the whole area.



Note that:

You can only see the results of the inventory sampling if you have the complete printout of the extrapolation from the R/3 System. To print this, from the extrapolation display, choose *Goto* → *List* → *Print*.

The printed list contains the following pages:

- *Extrapolation for the inventory sampling XXXXXXXX XXXX*: contains a summary of the specified parameters
- *Inventory sampling stratum XX*: contains information on each sampling stratum
- *Extrapolation result for the whole sampling area*: contains information on the extrapolation result for the whole sampling area
- *Complete-count area*: contains information on the stock management units that have been completely counted
- *Extrapolation for the whole sampling area*: contains a summary of the individual results

Information on each of the Individual Sampling Strata

Weighted relative deviation per stratum

For each stratum, the system first calculates a *relative deviation*. This is calculated as follows:

$$\text{Relative Deviation per stratum} = \frac{\text{Inv. difference at estimated value per stratum}}{\text{Current book value per stratum}} * 100$$

As these details only concern one stratum at a time, these have to be linked with the whole sampling area. Weighting is used to do this. The following ratio applies for weighting:

Interpreting the Results of an Extrapolation

$$\text{Weighting} = \frac{\text{Value of individual stratum}}{\text{Total value of all strata}}$$

Statistical calculations for each sampling stratum show that:

The *weighted relative deviation per stratum* is calculated from:

$$\text{Relative deviation of stratum} * \frac{\text{Current book value of stratum}}{\text{Total of current book values of all strata}}$$

You can also work out the *weighted relative deviation* of a stratum directly from the results of the extrapolation:

$$\text{Weighted relative deviation of stratum} = \frac{\text{Inv. difference at estimated value per stratum}}{\text{Book value at time whole sampling area is updated}}$$

Weighted relative statistical error per stratum

For each stratum, the system first calculates a *relative statistical error*. Once the number of strata and the stratum limits have been defined, the sample size *n* has to be determined and allocated to the individual strata. In the R/3 System, the inventory sampling procedure is carried out according to the mathematical-statistical procedure of the Neyman allocation:

$$n_g = n_{ney} \geq \frac{t^2 * \left(\sum_{l=1}^L N_l * s_{X,l} \right)^2}{(e_r * X)^2 + t^2 * \sum_{l=1}^L N_l * s_{X,l}^2}$$

In this formula *e_r* stands for the relative error. To calculate this, the system re-forms the equation according to *e_r*. If it is defined that the maximum error is 1 %, = 1/100 is used in the formula for *e_r* (see also [Determining the Relative Statistical Error \[Page 52\]](#)).

If you want the weighting to affect the value of all strata as in the *weighted relative deviation* shown above:

the *weighted relative statistical error of the stratum* is calculated from:

Interpreting the Results of an Extrapolation

$$\text{Relative statistical error of stratum} * \frac{\text{Current book value of stratum}}{\text{Total of current book values for all strata}}$$



The *weighted relative statistical error* of each stratum and the *relative statistical error* of the whole sampling area can only be calculated in the system and not from the results of the extrapolation.

The *weighted relative deviation* and the *weighted relative statistical error* are thereby calculated using different mathematical procedures and do not directly affect one another.

Result of Extrapolation for the Whole Sampling Area

When the values are listed, you should pay attention to the following:

The Book Values

The *book value at the time of planning* for the whole sampling area is the total of the *book values at the time of planning* in the individual sampling strata.

The *book value at the time of update* for the whole sampling area is the total of the *book values at the time of update* in the individual sampling strata.

- The book value at the time of update can be different from the book value at the time of planning, for the following reasons:
 - Material postings were made while the inventory sampling took place (this is not allowed in the case of periodic inventory sampling)
 - The inventory differences have been posted
 - Active material ledger

Sampling Area

The *adjusted book value*, the *estimated value*, and the *inventory difference at the estimated value* for the whole sampling area is the total of the corresponding values from the individual sampling strata.

Therefore for the adjusted book value, the following applies:

- The adjusted book value of the inventory sampling is the total obtained by adding:
 - The actual value of the elements posted to
 - The book value (at the time of update) of the elements that have not been posted

The *relative deviation* and the *relative statistical error* are thereby calculated using different mathematical procedures and do not directly affect one another.

The *relative deviation* of the sampling area is calculated from the total of the *weighted relative deviations* of the individual sampling strata, for example

Interpreting the Results of an Extrapolation

$$0.5 + 0.5 + 0.5 = 1.5$$

But the *relative statistical error* of the sampling area is worked out mathematically, not equal to the total of the *weighted relative statistical error* of the individual sampling strata, for example,

$$\sqrt{0.5} + \sqrt{0.5} + \sqrt{0.5} \neq 1.5$$

Calculation of the Relative Deviation of the Sampling Area

From the values specified for the extrapolation for the sampling area, you can calculate the specified *relative deviation* using the following formula:

$$\text{Relative deviation of sampling area} = \frac{\text{Inventory difference at estimated value}}{\text{Book value at time of update}}$$

Result of the Extrapolation for the Whole Area

The result for the whole area is obtained by adding up the extrapolation results for the sampling area and for the complete-count area. At the end, the statistical data (*relative deviation* and *relative statistical error*), which is required to complete the inventory sampling successfully, is displayed.

Calculating the Relative Statistical Error

Calculating the Relative Statistical Error

Basics

This section describes how the system calculates the relative statistical error from the data that is collected during the inventory sampling procedure. The data the system works with is contained in table *XSSCH* (Strata for the inventory sampling). In the R/3 System, the inventory sampling procedure is carried out in the module pool *SAPMM07S*. The extrapolation is reproduced in the subroutine *MM07SFP5*. The entry "Line XXX" in the formulas specifies the program line in *MM07SFP5* in which the printout can be found.

If you display the data in table *XSSCH* for an inventory sampling procedure, with the help of the program coding you can trace all of the information in the extrapolation result. For further calculations, the system calculates the total of the individual strata in the temporary table *XSIMU*. The following applies:

$$XSIMU = \sum XSSCH$$

As already shown (refer to [Interpreting the Results of an Extrapolation \[Page 48\]](#)), the Neyman allocation is used as the basis for calculating the relative statistical error:

$$n_g = n_{ney} \geq \frac{t^2 \cdot \left(\sum_{l=1}^L N_l \cdot s_{X,l} \right)^2}{(e_r \cdot X)^2 + t^2 \cdot \sum_{l=1}^L N_l \cdot s_{X,l}^2}$$

In this formula, the symbols stand for the dimensions listed below. The name of the relevant table field in the program is listed in brackets after each dimension:

n_g = Number of sample elements (minimum sample size) (XSIMU-NGZZP)

t = Safety factor (see *line 513*)

N = Number of elements in the stock population ($\sum XSSCH$ -NGAKT)

L = Number of strata

l = Description for the individual stratum

s_X = Standard deviation of the book values of the population

$s_{X,l}$ = Standard deviation of the book values of the population in stratum l

$s_{X,l}^2$ = Variance of the book values of the population in stratum l

X = Book value of the elements of the population

e_r = Relative statistical error for all strata (XSIMU-RELSF)

Relative Statistical Error per Stratum

The relative statistical error for the total area is calculated from the individual values for the strata. When calculating the relative statistical error per stratum, the system carries out the steps

Calculating the Relative Statistical Error

below. In the first line, the general printout is specified, and in the second, the relevant printouts and field names in the program coding are specified.

Calculation of the Mean Value

See *line 544*.

$$\begin{aligned} \text{Mean value} &= \frac{\text{Actual value at time of count}}{\text{No. of stratum elements posted}} \\ &= \frac{\text{XSSCH-ISZZP}}{\text{XSSCH-NGZZP}} \end{aligned}$$

Calculation of the Estimated Inventory Value

See *line 547*.

Estimated inventory value = mean value * current no. of stratum elements

inventory value = mean value * XSSCH-NGAKT

Calculation of the Correction

See *line 556*.

$$\begin{aligned} \text{Correction} &= \sqrt{1 - \frac{\text{No. of stratum elements posted}}{\text{Current no. of stratum elements}}} \\ &= \text{SQRT} \left(1 - \frac{\text{XSSCH-NGZZP}}{\text{XSSCH-NGAKT}} \right) \end{aligned}$$

Calculation of the Deviation

See *line 563*.

Calculating the Relative Statistical Error

$$\begin{aligned} \text{Deviation} &= \text{safety} * \frac{\text{Mean value estimate of stand. dev. of act. values}}{\sqrt{\text{No. of posted stratum elements}}} * \text{Correction} \\ &= \text{Safety} * \frac{\text{XSSCH-SMZPP}}{\text{SQRT (XSSCH-NGZZP)}} * \text{Correction} \end{aligned}$$

Calculating the Relative Statistical Error

Relative statistical error = XSSCH-RELSF (*line 572 to line 574*)

$$\begin{aligned} \text{XSSCH-RELSF} &= 100 * \left(\frac{\text{Mean value} + \text{deviation}}{\text{Mean value}} - 1 \right) * \frac{\text{Current book values}}{\sum \text{Current book values over all strata}} \\ &= 100 * \left(\frac{\text{Mean value} + \text{deviation}}{\text{Mean value}} - 1 \right) * \frac{\text{XSSCH-BUAKT}}{\text{T_AKT-B_SPR}} \end{aligned}$$

Relative Statistical Error for all Strata

Once the system has calculated the relative statistical error of each of the strata, it calculates the relative statistical error for all the strata on the basis of this, as follows.

Calculating the Estimated Inventory Value

The estimated inventory value is derived from the total of the estimated inventory values of all the strata (*line 606*).

$$\text{Inventory value} = \text{XSIMU-ISTGS} = \sum \text{XSSCH-ISTGS} = \sum \text{Inventory value of all strata}$$

Determining the Partial Deviations

Help variants are defined to determine the partial deviations. See *line 596 to line 600*.

$$\text{Help1} = \sum (\text{XSSCH-NGAKT} * \text{XSSCH-SMZPP})$$

$$\text{Help2} = \sum (\text{XSSCH-NGAKT} * \text{XSSCH-SMZPP} * \text{XSSCH-SMZPP})$$

$$\text{Help3} = (\text{Hilf1} * \text{Hilf1}) - (\text{XSIMU-NGZZP} * \text{Hilf2})$$

The following applies:

XSSCH-NGAKT = Number of current stratum elements

XSSCH-SMZPP = Mean value estimate of standard deviation of actual values

XSIMU-NGZZP = Number of posted stratum elements

Calculating the Relative Statistical Error

Calculating the Relative Statistical Error

Relative statistical error = XSIMU-RELSF for all inventory sampling strata (line 620 to line 622):

$$\begin{aligned}
 \text{XSIMU-RELSF} &= \sqrt{\frac{(\text{Safety})^2 * \text{Help3}}{\sum \text{No. of posted stratum elements} * (\sum \text{Inventoryvalue})^2}} * 100 \\
 &= \sqrt{\frac{(\text{Safety})^2 * \text{Help3}}{\text{XSIMU - NGZZP} * (\text{XSIMU - ISTGS})^2}} * 100
 \end{aligned}$$

or in the extended format:

$$\begin{aligned}
 \text{XSIMU-RELSF} &= \\
 &\sqrt{\frac{(\text{Safety})^2 * [(\sum \text{XSSCH-NGAKT} * \text{XSSCH-SMZZP})^2 - \text{XSIMU-NGZZP} * \sum \text{XSSCH-NGAKT} * (\text{XSSCH-SMZZP})^2]}{(\text{XSIMU-NGZZP}) * (\text{XSIMU-ISTGS})^2}} * 100
 \end{aligned}$$

Relative Statistical Error over the Total Area

The inventory sampling error is weighted according to value distribution. The actual value at the time the complete-count stratum (XSSCH-ISZZP) is counted is the revised book value of the complete-count area. The estimated inventory value of the sampling stratum is reduced by the value of the completely counted sampling stratum.

The following applies:

loc_inventwert_ver = \sum XSSCH-ISTGS (total of the completely counted strata)

See line 633 to line 637.

$$\begin{aligned}
 \text{REL_FEHLER} &= \frac{\text{Sampling error for all strata}}{\text{Actual value at time complete-count stratum counted} + \sum \text{inv. value}} * \frac{\sum \text{Inv. value} - \sum \text{Inv. value of completely counted stratum}}{\text{XSSCH - ISZZP} + \sum \text{inv. value}} \\
 &= \text{XSIMU - RELSF} * \frac{\sum \text{Inv. value} - \sum \text{Inv. value of completely counted stratum}}{\text{XSSCH - ISZZP} + \sum \text{inv. value}}
 \end{aligned}$$

See line 647 to line 648.

Calculating the Relative Statistical Error