- Methods of calculating the length of Category :

Through the classified data the length of cotton plants in the recurring distribution table (table 4) it can be calculate the length of category at one of the following methods : -

Table 4:Recurring distribution table for lengths of cotton plant stating the real limits and categories centers .

Respectively	Classes	Real class limits	Class centers (y_i)	Recurring (f_i)
1	31 - 40	30.50 – 40.50	35.50	1
2	41 - 50	40.50 – 50.50	45.50	2
3	51 - 60	50.50 – 60.50	50.50	5
4	61 - 70	60.50 – 70.50	65.50	15
5	71 - 80	70.50 – 80.50	75.50	25
6	81 - 90	80.50 – 90.50	85.50	20
7	91 – 100	90.50 – 100.50	95.50	12
Total				80

For example, fourth category = (61-70). Minimum limit of fourth class = 61 The upper limit of fourth class = 70.

The length of the fourth category can be calculated from the recurring distribution table above by one of the following methods : -

1. **First method :**When the limits of categories are integers, the length of Category = upper limit - lower limit +1 = 70 - 61 +1 = 10 .

2. **Second method:** Length of class = real upper limit - real lower limit = 70.50 - 61.50 = 10 .

3. **Third method**: length of class is difference between the upper and lower limits for two consecutive classes = 71 - 61 = 10 . and 80 - 70 = 10 .

4. **Fourth method:** length of class is difference between the real maximum limits and real lower limits for two consecutive classes = 70.50 - 60.50 = 10 . and 80.50 - 70.50 = 10 .

5. **Fifth method:** length of class is difference between two consecutive centers = 75.50 - 65.50 = 10.

- Real limits: The account of real-border for any category in one of the following methods :

1. **The first method:** the real minimum for any class = center that category - half the length of that category.

As for the real minimum of fourth category = fourth category center – half length of the fourth category. = 65.50 – 1/2 × (10) = 65.50 - 5 = 65.50 .

2.The real upper limit for any category = category center + half the length of that category. So the real upper limit for fourth class = 65.50 + 1/2 (10) = 65.50 +5 = 70.50 .

The second method: the real minimum for any category = (minimum limit for that category + upper limit of the previous category) / 2 .

The real minimum for the fourth class = (minimum of fourth category + upper limit of the previous category) / 2 = (61 + 60) / 2 = 121 / 2 = 60.50.

Real upper limit for any category = (upper limit for that category + Minimum class that followed) / 2.

The real maximum of fourth class = (upper limit for fourth class + Minimum class that followed) / 2 = (70 + 71) / 2 = 141/2 = 70.50 .

If the categories limits are integers :

Real minimum for any category = minimum that category - 0.50 .

Real upper limit for any category = upper limit of that category + 0.50 .

- Category Center: It can be calculated in one of two ways :

1.The first method : Category center = (minimum + maximum) / 2 .

Fourth category center = (60.50 + 70.50) / 2 = 131/2 = 65.50 .

Frequency of fourth Class = 15 . there are 15 value of variable values in the range (61-70) .

- General steps to create a frequency distribution tables are:

(A). extracting the variable range. Where the term = higher value - less valuable.

(**B). Test and determine the number of categories number.**there are a number of ways, including

Sturges method. As the number of categories=1+(3.3×log of the vocabulary number).

Yule method. As the number of categories = (2.5 × root of the vocabulary number to four strength).

And each of the advantages and disadvantages of the two methods will not use any of them but we will choose for the number of categories that choice not less than five and not more than fifteen of categories, depending on the nature of the data , the number of vocabulary and extent of change in them.

(**C) Find the category length** it must not be length of the class less than the (extent of change) / number of categories, nearest to bigger whole number .

Category length = extent of change / number of categories = 64/7 = 9 × 1/7 .

(**D) writing of categories class limits** it must write categories limits should be all variable values between the minimum for the first category and the upper limit of the latter category, and it is

advisable to start writing the minimum of first category of less single or smaller value and ends upper limit for the last class of the largest value of single or more little .

E-find the number of iterations for each category and class frequency is by recording the original values, and after the other in its own category in the form of signals or signs first and then translate them into numbers like 1111 = 4 and so on .

- Relative frequency distribution :

It is a table was showing the relative importance of each category and calculates the relative frequency for each category in the following methods :

The relative frequency of any category: replicate of that class / total number of iterations.

So the relative frequency of fourth class = replicate of fourth category / total number of occurrences .

The relative frequency of the fourth category = $f_i / \Sigma f_i$. = 15/80 = 0.1875.

The centennial repetition = relative frequency × 100 .

So the centennial repetition of the fourth class = relative frequency of fourth class × 100.

Centennial repetition of the fourth class = 0.1875 × 100 = 18.75% .

Usually calculated centennial repetition as a percentage (%) and that the sum of the relative frequency of all categories should equal one and centennial repetition is equal to 100 as an essential prerequisite .

- Cumulative distributions :

The cumulative distribution that the distribution schedule normal iterative, which has already been explained shows the distribution of variable values of various categories, but in some cases there may be a need to know the number of values or a vocabulary of less or greater than a certain value and the tables that contain information is called repetitive tables.There are two types of these tables :

1. **Less than cumulative distribution table.**It gives us a number of vocabulary that it value at less than the minimum for certain class and it is symbolize the cumulative frequency for any Class is fi and upper cumulative frequency distribution table is consists of two columns: the first column that writes the boundaries of categories (table 5) and the second column which it writes upper cumulative frequency as the following :

Repetition of pre-first category = $F_0 = 0$. Repetition of first category (f_1) = F_1 and repetition of second category = $f_0 + f_1 + f_2 = F_2$ and repetition of third category = $f_1 + f_2 + f_3 = F_3$. Thus, so that the upper cumulative repetition of latter category = $Fn = \Sigma f_i$.

Table 4.Recurring distribution table for lengths of cotton plant .

Respectively	Classes	Recurring (f_i)	Relative repetition	Centennial Repletion
1	31 - 40	1	0.0125	1.25%
2	41 - 50	2	0.025	2.50%
3	51 - 60	5	0.0625	6.25%
4	61 - 70	15	0.1875	18.75%
5	71 - 80	25	0.3125	31.25%
6	81 - 90	20	0.25	25%
7	91 – 100	12	0.15	15%
Total		80	1.00	100%

This is sometimes were expressed Less than or more than cumulative repetition is form of repetition of relative or Centennial .

In this case, the relative cumulative repetition to any category = cumulative repetition of that class / total number of iterations $(f_i / \Sigma f_i)$.

As about for percentile cumulaive repetition = relative cumulative repetition × 100 .

Relative repetition = $f_i / \Sigma f_i$.

Centennial repetition = $f_i / \Sigma f_i \times 100$.

Relative cumulative repetition = $f_i / \Sigma f_i$.

Centennial cumulative repetition = $fi / \Sigma fi \times 100$.

Table 5. Upper cumulative repetition distribution that showed lengths of cotton plants .

Limits of categories	Upper cumulative repetition	Upper relative cumulative repetition	Upper centennial cumulative repetition
Less than 31	0	0.00	0%
Less than 41	1	0.0043	0.43%
Less than 51	3	0.0129	1.29%
Less than 61	8	0.0346	3.46%
Less than 71	23	0.0996	9.96%
Less than 81	48	0.2078	20.78%
Less than 91	68	0.2944	29.44%
Less than 101	80	0.3464	34.64
Sum	231	1.00	100%

2.More than cumulative distribution.

Repetition of first category = F1 = Σf_i .

Repetition of second category = F2 = total iterations - the repetition of the first category .

$F_2 = \Sigma f_i - f_1 = F_1 - f_1$.

Repetition of third category = $F_3 = \Sigma f_i - f_1 - f_2 = F_2 - f_1$.

Table 6.Lower cumulative repetition distribution for lengths of cotton plants .

Limits of categories	lower cumulative repetition	Lower relative cumulative repetition	Lower centennial cumulative repetition
Over than 31	80	0.1956	19.56%
Over than 41	79	0.1932	19.32%
Over than 51	77	0.1883	18.83%
Over than 61	72	0.1760	17.60%
Over than 71	57	0.1394	13.94%
Over than 81	32	0.0782	7.82%
Over than 91	12	0.0293	2.93%
Over than 101	0	0.00	0%
Sum	409	1.00	100%

Solved examples:

Example 1: The following table shows the frequency distribution of monthly salaries (Iraqi Dinar) for the number of staff (65) employees were working in one of the businesses company .

Table 7. Frequency distribution of monthly salaries (Iraqi dinars) of 65 staff were working at one of the commercial companies.

Wage categories	Frequency (number of employees)
50 - 59	8
60 - 69	10
70 - 79	16
80 - 89	14
90 - 99	10
100 - 109	5
110 - 119	2
Total	65

Find the following :

(A): Minimum of sixth category? Solution = 100.

(B) Minimum of fourth category? Solution = 89.

(C): Fifth Category center? Solution = (minimum + maximum) / 2 = (90 + 99) / 2 = (189) / 2 = 94.50 .

(D) Length of the fifth category? Solution = (maximum - minimum) +1 = (99 - 90) +1 = (9) + 1 = 10 .

(E): The real minimum for the fifth category? Solution / real minimum for the fifth category = five category Center - (0.50) × (length of fifth category).

Real minimum of fifth class = 94.5 - (0.50) × (length fifth category) = 94.5 - (0.50) × (10) = 89.50 .

Or other method the real minimum for the fifth class = (minimum for the fifth + upper limit for the fourth class) / 2 = (90 + 89) 2 = 179/2 = 89.50.

(F): frequency of third category? Solution = 16.

(G) The relative frequency of the third category? Solution = Relative frequency of third category = recurrence of third category / total number of iterations .

Relative frequency of third category = 16/65 = 0.246 .

(H): Centennial frequency of the third category? Solution = Centennial frequency of third category = (recurrence of third category / total number of iterations) × 100 = (16/65) × 100 = 24.60% .

Example (2): Complete the frequency distribution table :

Categories	Categories center	real limits	Frequency	Relative repetition	Centennial repetition
	4		2		
	9		5		
	14		10		
	19		25		
	24		8		
Total			50		

Solution :

Category length = the difference between two categories center consecutive = 9 - 4 = 5.

Minimum real limit of the first category = First Category center - (1/2) (length category) = 4 - (1/2) × (5) = 1.50.

Upper real limit of the real first category = First Category Center + (1/2) (length category) = 4 + (1/2) × (5) = 6.50.

Then add the length of the class on the real minimum for the first class to produce real minimum for second category and so as then add the length to the upper real category limit for the first class to produce real upper limit for the second category and so on .

The lower limit for the first category is the nearest integer real minimum which is equal to (2) the addition a half to real minimum, while the upper limit is raised half of the upper real limit. So the first category are (2-6) then add the length of the class to both the minimum and maximum limits to find other categories .

The relative frequency of any category = repeat Category / Total duplicates.

The relative frequency for the first category = repeat the first category / total iterations = 2/50 = 0.04.

Centennial repetition = relative frequency × 100.

Centennial repetition for first category = relative frequency for the first category × 100 = 0.40 × 100 = 4% .

Example (2): Complete the frequency distribution table :

Categories	Categories center	real limits	Frequency	Relative frequency	Repetition centennial
2 - 6	4	1.50 – 6.50	2	0.04	4
7 - 11	9	6.50 – 11.50	5	0.10	10
12 - 16	14	11.50 – 16.50	10	0.20	20
17 - 21	19	16.50 – 21.50	25	0.50	50
22 - 26	24	21.50 – 25.50	8	0.16	16
Total	70	57.50 – 82.50	50	1.00	100

Example (3): Suppose that the number of vocabulary phenomenon are 150, including it lower value is 5.10, and the highest value equal to 7.36 .

find the following :

(A): The Limits of categories .

(B): Categories centers .

(C): The real categories limits .

Solution:

(A): Range = highest value - minimum value = 7.36 - 5.10 = 2.26. Assume that selected number of the appropriate categories are = 8.

Category length = range / number of categories = 2.26 / 8 = 0.28 nearest to 0.30 .

Including the lowest value of the vocabulary = 5.10.

So we start the minimum of the first category is equal to 5.10.

The upper limit of the first category = equal to the minimum for the first category is added to the length category length - 0.01 = 5.10 + 0.30 - 0.01 = 5.39 .

Then add the category length to minimum for the first category to find the minimum for the second category, as well as add the length of the class to the upper limit of the first category to find the upper limit for the second category.

(B): Category center = (minimum + maximum) / 2.

first category center = (minimum first class + upper limit of the first class) / 2 = (5.10 + 5.39) / 2 = first category center = 10.49 / 2 = 5.245 .

(C) The real boundaries of the categories are extracted in the following steps :

The real minimum of the first class = category center – (1/2) × (category length) .

The real minimum of the first class = first category center – (1/2) × (category length) =

The real minimum of the first class = 5.245 – (0.50) × (0.30) = 5.245 - 0.15 = 5.095 .

Real upper limit = Category Center + (1/2) × (category length) .

The real upper limit of the first category = First Category Center + 1/2 × (category length) =

The real upper limit of the first category = 5.245 + 0.50 × (0.30) = 5.245 + 0.15= 5.395 .

Then add category length to real minimum limit of first class to find real minimum limit for the second category, and so for the real upper border .

Table (9): categories limits, real-border groups and categories centers .

Categories limits	Real limits of categories	Categories centers
5.10 – 5.39	5.095 - 6.095	5.245
5.40 - 5.69	5.395 - 5.695	5.545
5.70 - 5.99	5.695 - 5.995	5.845
6.00 - 6.29	5.995 - 6.295	6.145
6.30 - 6.59	6.295 - 6.595	6.445
6.60 - 6.89	6.595 - 6.895	6.745
6.90 - 7.19	6.895 - 7.195	7.045
7.20 - 7.49	7.195 - 7.495	7.345