

Business Maths

Curriculum

- Introduction to Grouped Data
- Design of Grouped frequency table
- Construction of cumulative frequency tables
- Calculation of averages (Mean, median, Mode) from grouped frequency table
- Calculation of range and variance from grouped frequency table
- Calculation of mean deviation and standard deviation from grouped frequency table
- Introduction to statistical graph (bar chart, pie chart, Histogram)
- Cumulative frequency curve

MATERIALS NEEDED FOR THE SUBJECT

- **SCIENTIFIC CALCULATOR**
- **3 GRAPH BOOKLETs**

WEEK 1
Intro to Grouped Data (Revision)

Last term we have been able to study

- * the presentation of ungrouped data in frequency distribution tables
- * the presentation of grouped data in frequency distribution tables
- * the mean, median and mode of ungrouped data
- * the mean and median of grouped data

This term however we will extend our knowledge of grouped data by 'looking' at

- * the term cumulative frequency and its curve (OGIVE)
- * the histogram
- * the mode of grouped data by graphing the histogram

However first we will refresh our memory on the reason why data are grouped.

GROUPED DATA

In many practical cases, data to be considered are sometimes very large. example; the JAMB scores of candidates in Nigeria, the entrance test score of applicant into GISS, the mathematics exam score of the 400 SS1 students in GISS, the ages of students in GISS etc. When data is large, grouping them becomes necessary in order to obtain a concise but clear picture of the information contained in the data.

For example, the heights of 45 students in senior secondary of GISS is given in *cm* as

159 185 173 166 169 162 179 170 160
190 178 160 170 171 183 163 180 164
155 182 165 164 168 157 172 175 166
154 177 161 167 176 169 158 173 165
150 153 158 167 174 162 168 175 180

Using the class interval of 150 - 154, 155 - 159,... a frequency distribution table for the student heights can be tabulated as follows

Height	Frequency
150 - 154	3
155 - 159	5
160 - 164	8
165 - 169	10
170 - 174	7
175 - 179	6
180 - 184	3
185 - 189	2
190 - 194	1

Exercise W1

Tabulate the following data using a class interval of (i) 5 (ii) 10

1. 129 135 131 135 125 131 128
125 128 125 121 126 134 127
130 129 140 120 127 132 138
135 129 122 128 120 130 128
125 130 120 129 132 126 121
2. 34 50 46 38 44 54 31 52
50 51 49 50 54 30 50 40
40 48 35 36 55 50 56 36
51 56 54 61 76 77 76 77

3. 96 124 102 80 133 105 87 62 105 101
 108 136 110 54 105 117 103 76 93 122
 98 126 96 96 91 73 82 138 91 84
 110 88 97 69 94 117 99 114 88 60

4. 25 12 10 18 12 14 16 21 16 16
 18 17 11 14 13 18 19 17 13 20
 16 10 11 21 15 12 14 19 15 12
 21 14 18 20 21 13 13 16 10 14

WEEK 2

CONSTRUCTION OF HISTOGRAMS FROM GROUPED FREQUENCY TABLES

The histogram is a form of data presentation that uses bars/rectangles joined together (that is, there are no space between the bars).

Grouped frequency distribution tables are used to construct the histogram where the class boundaries are drawn against the frequency

Example 2.1

The Scores of 50 students in a maths test were given as follows

Scores	0-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40
Freq	7	3	12	8	10	5	3	2

Draw the histogram representing the data

Solution

First, we determined the class boundaries

Class Interval	Class Boundaries	Frequency
0 - 5	-0.5 - 5.5	7
6 - 10	5.5 - 10.5	3
11 - 15	10.5 - 15.5	3
16 - 20	15.5 - 20.5	12
21 - 25	20.5 - 25.5	10
26 - 30	25.5 - 30.5	5
31 - 35	30.5 - 35.5	3
36 - 40	35.5 - 40.5	2

The Histogram would be draw in class

Features of the Histogram

- * The height of each rectangle/bar corresponds to the frequency in the distribution
- * The rectangles have common boundaries. Hence the class boundaries of a grouped frequency distribution table is used.
- * The rectangles have equal width along the horizontal axis because the class intervals are equal

Note: The mode of a distribution can be determined with the histogram

Example 2.2

The following are heights of students in a certain Senior Secondary class.

Weight	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94
Frequency	3	5	8	10	7	6	3	2	1

- * Draw up a histogram to represent the information
- * Estimate the modal height

Features of Histogram and Bar Chart

1. There is no space between bars	1. There are spaces between bars
2. The width of each rectangle corresponds to its class width	2. The width of each rectangle has no fixed definite size, but are all equal
3. The heights of bars are proportional to its frequency	3. The height of bars are proportional to its frequency
4. Class boundaries are used	4. Single scores are used. There is nothing like class boundaries

Exercise W2

1. The following are scores of 80 students in a test

Class Interval	0 - 10	1 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80
Frequency	18	16	15	12	10	5	2	2

Draw up a histogram to represent this information

2. Consider the table below

Class Interval	50 - 54	55 - 59	60 - 64	65 - 69	70 - 74	75 - 79	80 - 84	85 - 89
Frequency	3	5	8	10	7	6	4	2

- (a) Draw a histogram of this distribution
- (b) Estimate the mode

3. Given the following distribution of test scores

Class interval	120-129	110-119	100-109	90-99	80-89	70-79	60-69	50-59	40-49	30-39	20-29
Frequency	2	8	12	24	36	42	37	21	10	7	1

- (a) Represent the information on a histogram
- (b) Estimate the mode

**WEEK THREE
CUMULATIVE FREQUENCY TABLES**

Cumulative frequency distribution is the successive addition of data which shows how many of the items in each class interval are less than or greater than the values in the next class

Example 3.1

The following distribution table shows the weights of students in a certain class as follows

kg	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
frequency	5	4	2	6	3	5	20	12	3

Construct a cumulative frequency distribution table

Solution

Weight(kg)	Frequency	Cumulative Frequency
20 - 24	5	5
25 - 29	4	5+4
30 - 34	2	5+4+2
35 - 39	6	5+4+2+6
40 - 44	3	5+4+2+6+3
45 - 49	5	5+4+2+6+3+5
50 - 54	20	5+4+2+6+3+5+20
55 - 59	12	5+4+2+6+3+5+20+12
60 - 64	3	5+4+2+6+3+5+20+12+3

Weight(kg)	Frequency	Cumulative Frequency
20 - 24	5	5
25 - 29	4	9
30 - 34	2	11
35 - 39	6	17
40 - 44	3	20
45 - 49	5	25
50 - 54	20	45
55 - 59	12	57
60 - 64	3	60

Exercises W3

1. The following are scores of 80 students in a test

Class Interval	0-10	1-20	21-30	31-40	41-50	51-60	61-70	71-80
Frequency	18	16	15	12	10	5	2	2

Construct the cumulative frequency table.

2. Consider the table below

Class Interval	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89
Frequency	3	5	8	10	7	6	4	2

Construct the cumulative frequency table

WEEK 4
CALCULATING THE MEAN, MEDIAN, MODE, RANGE, VARIANCE, STANDARD DEVIATION OF A GROUPED DATA (REVISION)

The following are scores of students in a certain mathematics test

Scores	Frequency
10 - 14	3
15 - 19	5
20 - 24	8
25 - 29	10
30 - 34	7
35 - 39	6
40 - 44	3
45 - 49	2
50 - 54	5
55 - 59	3
60 - 64	8
65 - 69	7
70 - 74	2
75 - 79	3

1. Determine
 - (a) Mean
 - (b) Median
 - (c) By constructing a histogram of the data, estimate the mode.
2. Find
 - (a) The range
 - (b) The variance
 - (c) The mean Deviation
 - (d) The standard Deviation

To be solved in class

Exercise W4

The number of child births recorded in 50 maternity centres of a local government in August 1993 are as follows

50 99 81 86 69 85 93 63 92 65
 77 74 76 71 90 74 81 94 67 75
 95 81 68 82 99 68 75 75 76 73
 79 74 80 69 74 62 74 80 79 68
 79 75 75 71 83 75 80 85 81 105

- Construct a frequency distribution table, using class intervals 45 - 54, 55 - 64, etc.
- Determine the mean, median of the distribution
- Determine the standard deviation of the distribution
- Draw a histogram for the distribution and use it to estimate the mode

WEEK FIVE

INTRODUCTION TO STATISTICAL GRAPHS

Statistical graphs are graphics/drawings used to visualize quantitative data.

One goal of statistics is to present data in a meaningful way. One effective tool to depict data is by the use of graphs.

They say a picture is worth a thousand words. The same thing could be said about a graph. Good graphs convey information quickly and easily to the user.

The most common graphs in statistics are

1. Bar Graph (Pareto Diagram)
2. Pie Chart (Circle graph)
3. Histogram
4. The cumulative frequency curve

Bar Chart

The bar chart is another way of presenting data. These are rectangular bars drawn in lengths proportional to the magnitude of the numbers they represent. For data to be presented in bar charts, suitable scales must be chosen. The choice of having either vertical or horizontal bar charts are optional. The bars are represented by equal widths. Sometimes the spaces may not be equal.

Example

The allotment of time in minutes per week for some of the school subjects in SS1 class is

Subject	Minutes
English	80
Maths	120
Biology	160
Geography	120
Chemistry	120
Physics	140

Construct a bar chart to represent the above data.

(The students is to construct this)

Pie Chart

Data can be represented in circular form called the pie chart. The pie chart shows the relationship of the parts to the whole. In bar charts, we compared lengths of bars but in pie charts, areas of sectors are compared. Since it is a circular representation of data, the pie is divided into sectors. The area of each sector is proportional to the angle of the sector. Since a circle consists of 360° , the proportion that each part bears to the whole will be the corresponding proportion to 360° . This can be calculated.

Example

The allotment of time for subjects in SS1 are as follows:

Subject	English	Maths	Biology	Geography	Chemistry
Time allotted (in minutes)	80	120	160	120	120

Construct a Pie Chart to represent the information.

Solution

First the total time allotted is

$$80 + 120 + 160 + 120 + 120 = 600 \text{ minutes}$$

The angle of each sector is calculated as

$$\text{For English: } \frac{80}{600} \times \frac{360}{1} = 48^\circ$$

$$\text{Mathematics: } \frac{120}{600} \times \frac{360}{1} = 72^\circ$$

$$\text{Biology: } \frac{160}{600} \times \frac{360}{1} = 96^\circ$$

$$\text{Geography: } \frac{120}{600} \times \frac{360}{1} = 72^\circ$$

$$\text{Chemistry: } \frac{120}{600} \times \frac{360}{1} = 72^\circ$$

The next step is to construct a circle with parts corresponding to the angles calculated

(The student is expected to this)

WEEK SIX CUMULATIVE FREQUENCY CURVE (OGIVE)

This curve is obtained by plotting the cumulative frequencies against the upper limit of the class intervals

Example: Consider the data below

Weight(kg)	Frequency	Cumulative frequency
20 - 24	5	5
25 - 29	4	9
30 - 34	3	12
35 - 39	5	17
40 - 44	5	22
45 - 49	5	27
50 - 54	18	45
55 - 59	12	67
60 - 64	3	70

(The cumulative frequency curve will be drawn in class)

USES OF THE OGIVE

The Ogive or Cumulative Frequency Curve can be used to determine

- The Percentile: The percentile point is defined as a specific point in the distribution that has a given percentage of scores or cases less than or equal to it. For example, the 20th percentile (or centile) denoted by P_{20} or (or C_{20}) in a distribution is the point that has 20 percent of the scores or cases less than or equal to it.
- The Quartile
 - Lower Quartile is equivalent to the 25th percentile.
 - Upper Quartile is equivalent to the 75th percentile.
- The Median

MISCELLANEOUS EXERCISES

- The number of items produced by a company over a five-year period is given below

Year	1978	1979	1980	1981	1982
Number produced	4100	2500	1500	1800	9200

- Plot a bar chart for this information
- The table belows the frequency distribution of the marks of 800 candidates in an examination

marks (%)	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99
Frequency	10	40	80	140	170	130	100	70	40	20

- (a) Construct a cumulative frequency table
- (b) draw the ogive
- (c) Use the ogive to determine the 50th percentile
- (d) The candidates that scored less than 25% are to be withdrawn from the institution while those that score more than 75% are to be awarded scholarship. Estimate the number of candidates that will be retained, but who will not enjoy the award.

3. The table below shows the weekly profit in naira from a mini market

Weekly profit(N)	1-10	11-20	21-30	31-40	41-50	51-60
Frequency	6	6	12	11	10	5

- (a) Draw a cumulative frequency graph of the data
 - (b) From your graph, estimate (i) the mode (ii) the 80th percentile
 - (c) What is the modal weekly profit?
4. The table below shows the scores of 2000 candidates in an entrance examination into a private secondary school.

marks(%)	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90
No. of pupils	68	184	294	402	480	310	164	98

- (a) Prepare a cumulative frequency table and draw the cumulative frequency curve for the distribution
 - (b) Use your curve to estimate the cut-off mark, if 300 candidates are to be offered admission
5. The table below shows the number of eggs laid by chicken in a man's farm in a year

No of eggs per year	45-49	50-54	55-59	60-64	65-69	70-74
No. of eggs	10	36	64	52	28	10

- (a) Draw a cumulative frequency curve of the distribution
- (b) use your graph to find the interquartile range