Mathematics lessons for Grade 6

Lessons in this section

Using these lesson plans

These sample lessons for Grade 6 are suitable for use with a whole class. The lessons are single examples to illustrate different teaching and learning activities. They are not intended to be taught as a sequence. They are drawn from different topics and points in the teaching year to show spread rather than sequence.

The objectives for the lessons are drawn from the standards for Grade 6. Occasionally, a standard from an earlier grade is revised. The relevant standards are shown in the lesson plans.

The lessons are organised in three parts: a starter to introduce the lesson, a main activity, and a final phase to help students to reflect on the lesson and consolidate their learning. Before the starter, you should outline the purpose of the lesson, drawing out for students what they will learn and how this builds on previous work. In the final part of the lesson, you will need to establish the key learning points, what students need to remember and what they will go on to learn next. There is no expectation that students should copy out the key learning points in their exercise books.

The lesson plans do not include homework tasks because the lessons are single examples taken out of sequence. You will need to provide this, since homework is an important part of a lesson.

Each lesson plan has enough material to support about 45 minutes of teaching. You may need to supplement the activities with simpler or more challenging tasks if the students in your class have a range of attainment. You could choose from activities in textbooks or from your own resources. If you wish, different tasks can be given to different groups of students, according to their needs.

There may be too much material in the lesson plan for 45 minutes, since this will depend on the class. In this case, you could designate one of the activities in the lesson as homework, or carry it forward to the next lesson. Be selective about which activity to cut – it does not have to be the last one merely because it comes at the end.

Answers to questions are provided to help you to correct students' responses and give feedback. Sometimes, alternative answers are possible that are equally correct.

6.1 Ratio and proportion

Objectives

- Use simple ratios to show the relative sizes of two quantities.
- Solve simple problems involving ratios or direct proportion.

Starter

Vocabulary

proportion
ratio
fraction
percentage
in every
for every

Resources

Interlocking cubes

Count together in multiples of 5 to 50.

Use 6 blue and 4 yellow interlocking cubes to make a stick like this.

Hold up the stick and tell the class that you have made a pattern where, for every 3 blue cubes, there are 2 yellow cubes. Ask:

Q What colour would the next cube in the pattern be? What colour would the 15th cube be? How do you know?

Q What colour would the 31st cube be? (blue) **How do you know?**

Establish that the cubes are grouped in fives, and that the first cube in every five will be blue. Draw this table on the board.

Blue cubes	Yellow cubes	Total cubes
3	2	5

Rearrange the stick of cubes to look like this.

Q What proportion of the stick is blue?

Explain that *proportion* means the same as 'fraction' or 'percentage'. Establish that $\frac{6}{10}$ or $\frac{3}{5}$ of the stick is blue.

Q In a stick of 10 cubes, how many are blue? (6) **How many are yellow?** (4)

Say that the pattern could also be described as 'for every 6 blue cubes, there are 4 yellow cubes' or 'for every 4 yellow cubes there are 6 blue cubes'. Add 6, 4 and 10 to the table.

Q If the stick had 9 blue cubes, how many yellow cubes would there be?

Establish that 3 more blue and 2 more yellow cubes would be needed, and add 9, 6 and 15 to the table.

Q If the stick had 18 blue cubes, how many yellow cubes would there be? How do you know?

Discuss students' responses and add 18, 12 and 30 to the table.

Q If the stick had 60 blue cubes, how many yellow cubes would there be? How do you know?

Discuss students' responses and add 60, 40 and 100 to the table.

Point to all the numbers in the first column.

Q What are all these numbers? (multiples of 3)

Establish that the numbers in the second column are all multiples of 2. Explain that the *ratio* of blue cubes to yellow cubes is 3 to 2, and is written as 3 : 2. A ratio can be simplified in the same way as a fraction, by dividing each side by the same number. For example, a ratio of 5 : 10 is equivalent to a ratio of 1 : 2.

Main activity

Vocabulary

problem
recipe

Resources

OHTs 6.1a and 6.1b

Show **OHT 6.1a**, a recipe for Samaka Harra for two people.

Q What is the ratio of butter to fish in the recipe?

Establish that for every 25 g of butter 250 g of fish are needed. The ratio of butter to fish is 25 : 250, or 1 : 10.

Q What is the first part of the problem asking us to do?

Q How shall we begin to tackle it?

Ask students to discuss these questions in pairs, then take their suggestions. Establish that a good way to start would be to halve the recipe to make enough for one person. Ask the pairs to do this, then write it up on the board.

Q How much fish would be needed for 3 people?

Establish that 125 g × 3 would be needed for 3 people.

Q What fraction of 1 kg is 375 g? (three eighths of a kilogram) **How can we write this as a decimal?** (0.375 kg)

Q How much tomato would be needed for 3 people? (600 g) **What is 600 grams in kilograms?** (0.6 kg)

Q How much butter would be needed for 3 people? (37.5 g)

Read though the second part of the problem.

Q How many grams is 2 kg? (2000 grams)

Q How many grams of tomatoes are needed for 1 person? (200 g)

Q How many people would need 2000 grams of tomatoes?

Record on the board: 200 g → 1 person
2000 g → ? people

Q What operation do we need to do to find the answer? (2000 ÷ 200)

Q Does the answer of 10 people seem appropriate?

Q How much butter would be needed for 10 people? What operation do we need to do? (multiply 25 g by 5)

Q How much fish would be needed for 10 people? What operation do we need to do? (multiply 250 g by 5)

Q What is 1250 g in kilograms? (1.25 kg)

Show **OHT 6.1b**, a recipe for mango ice cream. Ask:

Q What is the ratio of sugar to mangoes?

Establish that both amounts must be in the same units, and that the ratio is 250 : 1000 or 1 : 4.

Ask students to work in pairs to tackle the problem. Establish that one way to start might be to halve the recipe to make enough for four people.

Collect and discuss solutions, inviting students to the board to explain their methods. Stress what they need to do to show their working.

Other tasks

If necessary, choose further related activities, selecting from available textbooks or your own materials.

Consolidation

Resources

OHTs 6.1c and 6.1d

Show **OHT 6.1c**. Discuss the ratios and proportions illustrated.

Show **OHT 6.1d** and complete the table.

Summary for students

- Ratio is a way of comparing two quantities. For example, the ratio of a 2 cm rod to a 3 cm rod is 2 : 3.
- A proportion is similar to a fraction or percentage. If 1 in every 4 beads in a necklace is red, then the proportion of red beads is ¼ or 25%.
- 2 for every 3 mean that there are 5 units being shared out, and the fractional parts are ⅖ and ⅗. The ratio of these two parts is 2 : 3.
- 2 in every 3 mean that there are 3 units being divided up, and the fractional parts are ⅔ and ⅓. The ratio of these two parts is 2 : 1.
- When changing a recipe, work out the quantities for one person, then increase the quantities by multiplying by the number of people involved.

6.2 Simple patterns and sequences

Objectives

- Given a rule, generate a simple sequence:
  - find a term from the previous term, given a rule such as ‘add 6’;
  - find a term given its position in the sequence.

Starter

Vocabulary

multiplication fact
division fact

Resources

Counting stick

Using a counting stick, count forwards from 0 in steps of 4 to 40.

Repeat, but stopping at intervals, e.g. 24.

Q What multiplication facts involving 4 and 24 can you tell me?

Collect and record $6 \times 4 = 24$ and $4 \times 6 = 24$.

Q Now what two division facts can you tell me?

Collect and record $24 \div 4 = 6$ and $24 \div 6 = 4$.

Count in steps of 5 and 6 and collect associated multiplication and division facts.

Main activity

Vocabulary

sequence
pattern
multiple
efficient
square number

Resources

Copies of Resource 6.2, one per student
Interlocking cubes
Empty box
Calculators

Show students an empty box. Explain that it once held interlocking cubes. Say that when the cubes in the box were used to make towers of 4 cubes, there was 1 cube left over.

Q How many cubes could there have been in the box?

Make a tower of 4 cubes and show the 1 cube left over.

Write on the board: $1 \times 4 + 1 = 4 + 1 = 5$ cubes.

Say that there were more than 5 cubes in the box.

Make two towers of 4 cubes and show the 1 cube left over.

Q How many cubes do I have now?

Collect answers and, on the board, record: $4 + 4 + 1 = 9$ cubes

Q How else can we record this?

Record under the first statement: $2 \times 4 + 1 = 8 + 1 = 9$ cubes

Say that there were more than 9 cubes in the box. With the students, collect other possibilities for the number of cubes in the box and record them as shown below:

$1 \times 4 + 1 = 4 + 1 = 5$

$2 \times 4 + 1 = 8 + 1 = 9$

$3 \times 4 + 1 = 12 + 1 = 13$

$4 \times 4 + 1 = 16 + 1 = 17$

$5 \times 4 + 1 = 20 + 1 = 21$

Q Can you see a pattern for the number of cubes?

Share suggestions.

Q Can you describe the pattern in words?

Ask students to write a sentence that describes the pattern. Discuss the students' sentences and agree that the pattern is the 4 times table plus 1. Say that the number of cubes in the box was between 35 and 40. With the students, recite the 4 times table and add 1 to generate numbers in the sequence. Stop at 41. Establish that the number of cubes in the box was 37.

Say that, in another box of cubes, when you made towers of 5 cubes there were 3 left over, and when you made towers of 6 there was 1 left over.

Q How many cubes were there in the box?

Discuss the problem.

Q What multiplication tables should we use?

Establish that they are the 5 and 6 times tables.

Start the sequences with the students, recording on the board:

$1 \times 5 + 3 = \ \ 5 + 3 = \ \ 8$ $\qquad$ $1 \times 6 + 1 = \ \ 6 + 1 = \ \ 7$

$2 \times 5 + 3 = 10 + 3 = 13$ $\qquad$ $2 \times 6 + 1 = 12 + 1 = 13$

Agree that 13 cubes is a possible answer.

Say that there were over 40 cubes in the box. Ask students to continue the sequences to find the number of cubes in the box.

Collect students' solutions and correct any errors or misunderstandings. Agree that the answer is 43 cubes. Emphasise how listing sequences like this is a useful strategy for solving these types of problems.

Give out **Resource 6.2**, and calculators.

Ask students to read the first problem.

Q Do you recognise the problem? What strategies can you use to solve it?

Establish the problem is the same kind of problem as the cubes and towers.

Discuss students' strategies and ask them to solve the problem, recording their work in the 'Show your method' box on the resource sheet.

Collect students' answers and correct any errors or misunderstandings.

Q What did you write in the box?

Share contributions and the students' writing.

Q Where did you start your sequences?

Establish that the students need not have started at:

$1 \times 5 + 3 = \ \ 8$ $\qquad$ $1 \times 4 + 3 = \ \ 7$

$2 \times 5 + 3 = 13$ $\qquad$ $2 \times 4 + 3 = 11$

Q What other information is given?

Point out that Bader made over 55 sweets.

Q Where could we have started?

Discuss suggestions. Agree that starting at 10 × 5 and 10 × 4 would be sensible. With the students, extend the sequences, recording on the board:

10 × 5 + 3 = 50 + 3 = 53	10 × 4 + 3 = 40 + 3 = 43
11 × 5 + 3 = 55 + 3 = 58	11 × 4 + 3 = 44 + 3 = 47
12 × 5 + 3 = 60 + 3 = 63	12 × 4 + 3 = 48 + 3 = 51
13 × 5 + 3 = 65 + 3 = 68	13 × 4 + 3 = 52 + 3 = 55
	14 × 4 + 3 = 56 + 3 = 59
	15 × 4 + 3 = 60 + 3 = 63
	16 × 4 + 3 = 64 + 3 = 67

Q Which multiple of 5 is close to 55?

Establish that 55 is a multiple of 5.

Q Which multiple of 4 is close to 55?

Establish that 52 is a multiple of 4.

On the lists on the board, underline 11 × 5 and 13 × 4. Say that to save writing and to be more efficient we could have started with these calculations to form the sequences.

Q What would we have written in the 'Show your method' box?

Discuss students' suggestions. Emphasise that they should write down all their calculations in this box to help them to answer the problem and get the marks.

Other tasks

If necessary, choose further related activities, selecting from available textbooks or your own materials.

Consolidation

Ask students to read the second question on **Resource 6.2**.

Q Is this problem similar to the others?

Establish that it is, and confirm the sequences that represent the number of cards. Ask the students to solve the problem, recording their calculations in the 'Show your method' box. Remind them that 21 is not a square number. Establish that 81 is a square number.

Summary for students

- Writing out the sequence can help you to see the pattern.
- Use all the information you are given to help you to decide where you might start the sequence.
- Similar problems may be described in different ways – always read the question carefully and compare it with problems you have done before.

6.3 Constructing triangles

Objectives

- Use the labelling conventions for angles, lines and geometric figures.
- Identify equal sides or find unknown angles in geometric figures.
- Use ruler and protractor to construct a triangle:
  - given two angles and the included side;
  - given two sides and the included angle.

Starter

Vocabulary

triangle
isosceles
diagonal
perimeter
pentagon
regular
vertex
vertices

Resources

OHT 6.3a
Copies of Resource 6.3b

Show **OHT 6.3a**. Trace round the perimeter of the pentagon and ask:

Q What is the name of this shape?

Tell the class that the shape is a *regular pentagon*, and that 'regular' means that all the sides are the same length, and all the angles are equal. Write *regular pentagon* on the board. Say that an equilateral triangle is regular, and so is a square.

Explain that each corner or vertex of the pentagon is labelled by a letter, and that the pentagon is the shape ABCDE. Trace round one of the triangles in the pentagon, such as triangle ABG.

Q What would we call this triangle using the letters?

Explain that ABG, BGA or GAB represent the same triangle.

Q How many different triangles can you see in the pentagon?

Give each student a copy of **Resource 6.3b**. Get students to work in pairs and to record different triangles by drawing them and labelling the vertices of the triangle on the diagram. Stress that the triangles can be different sizes and shapes. Allow the pairs several minutes to discover as many as possible of the 11 different triangles, then bring the class together. Refer to triangle ABE on **OHT 6.3a**.

Q What kind of triangle is triangle ABE? (isosceles) **Can you explain why?**

Establish that triangle ABE must be isosceles because two of its sides are equal, since they are also sides of the regular pentagon.

Q Which two angles must be equal? (angle ABE and angle BEA)

Q Are any other triangles that you found isosceles?

Ask students to respond using the letter labels. Ask them to justify their conclusion by identifying which sides and which angles are equal.

Main activity

Vocabulary

construct

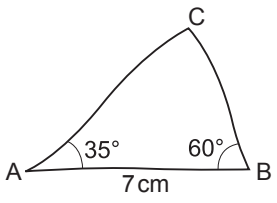
Resources

Blank OHTs
Transparent ruler and protractor for the OHP
Copies of Resources 6.3c and 6.3d

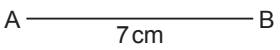
Show the class how to construct a triangle, given two angles and the included side. Write on the board:

Construct triangle ABC.
AB = 7 cm angle A = 35° angle B = 60°

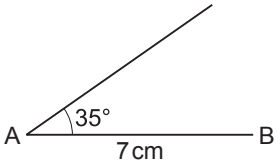
Start by sketching the triangle on a blank OHT.



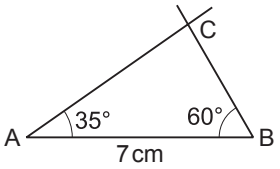
Use a ruler to draw a line AB 7 cm long.



Use a protractor to draw an angle of 35° at A.



Use a protractor to draw an angle of 60° at B. Label point C.

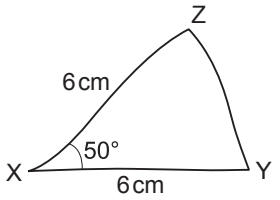


Give students **Resource 6.3c**. Ask them to use their rulers and protractors to construct the two triangles.

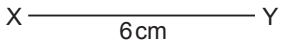
Write on the board:

Construct triangle XYZ.
XY = 6 cm XZ = 6 cm angle X = 50°

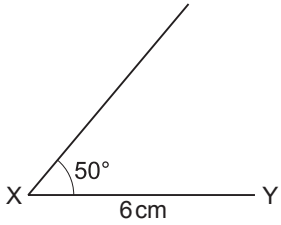
Start by sketching the triangle on a blank OHT.



Use a ruler to draw a line XY 6 cm long.

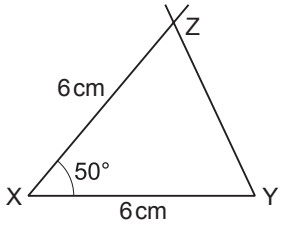


Use a protractor to draw an angle of 50° at X.



Measure from X a distance of 6 cm and mark it on the line. Label this point Z.

Join ZY.



Give students **Resource 6.3d**. Ask them to use their rulers and protractors to construct the two triangles.

Other tasks

If necessary, choose further related activities, selecting from available textbooks or your own materials.

Consolidation

Resources

Seven sticks or straws of equal length to place on the OHP

Place six of the seven sticks on the projector. Invite a student to the projector to make a triangle using all six sticks (with sides 2, 2, 2).

Q What type of triangle has been made? (equilateral)

Q What is its perimeter? (6 units or sticks)

Q Is it possible to make a triangle from the six sticks with one side 3 units long?

Allow the student to experiment and to discover that it is impossible: the sum of the two shorter sides of a triangle must always be greater than the longest side, otherwise the two shorter sides would not meet.

Add one more stick. Invite a different student to make a triangle using all seven sticks (e.g. with sides 3, 3, 1). Ask another student to make a different triangle (e.g. 3, 2, 2). Point out that the perimeter of each triangle is 7 units long.

Q Is it possible to make a triangle from the seven sticks with one side 4 units long?

If students do not realise immediately that it would be impossible, allow a student to experiment. Stress again that the sum of the two shorter sides must be greater than the longest side.

Tell the class to work in pairs. Ask them to investigate the different triangles that they could make with a perimeter of 11 units. After a few minutes, gather the results, writing a list of the lengths of the sides on the board:

5, 5, 1
5, 4, 2
5, 3, 3
4, 4, 3

Check with the class that in each case the sum of the two shorter sides is greater than the longest side.

Summary for students

- The vertices of a 2-D shape can be labelled with letters. You can use the letters to refer to sides and angles of the shape.
- You can use a ruler and protractor to construct a triangle, given two sides and the included angle, or two angles and the included side.
- The sum of the two shorter sides of a triangle must be greater than the longest side.

6.4 Bar charts and frequency tables

Objectives

- Collect data to answer a question and represent them in a frequency table or bar chart.
- Use ICT to generate graphs, charts and tables, including bar charts.
- Read and interpret graphs and charts, including bar charts.

Starter

Vocabulary

statistics
data
frequency
survey

Say that this lesson is about tables and charts and how to read and understand them.

Q What kind of tables of information have you seen, in school or out of school? (for example, the school timetable, a timetable of travel information, a table of weather data, a table of football results)

Say that tables of *statistics* contain a lot of numbers or measurements: for example, measurements of length, area, height, weight or capacity. Sometimes we count things like the number of people or the number of times an event happens. In each case, the numerical information is called *data*.

Say that you will collect some information very quickly. Ask 12 different students what their favourite musical instrument is. (Alternatively, choose favourite pastime or favourite fruit, or anything where the choice is reasonably limited.) Write the words randomly on the board:

guitar guitar drums drums drums guitar guitar

violin flute flute harp piano

Q How many different instruments did our group of students choose?

Q Which instrument is the most popular among them?

Say that it is not easy to extract information when it is jumbled up. It is much easier when the information is organised in a table. Construct this table, basing yours on the data you have collected from the class.

Instrument	Frequency
drums	3
violin	1
guitar	4
flute	2
harp	1
piano	1
TOTAL	12

Explain that the word *frequency* means 'how many' or 'how often'. The table tells you how many students chose each instrument. It is called a *frequency table*.

Say that it is now easy to see what fraction of the students chose each instrument, especially as the frequency table shows the total number of students in your *survey*.

Q What fraction of the total chose the guitar? What fraction chose drums?

Main activity

Vocabulary

bar chart
horizontal axis
vertical axis
label
title
scale
spreadsheet

Resources

OHT 6.4a
Copies of Resource 6.4b
Computer with data projector and spreadsheet
Rulers for students

Show **OHT 6.4a**. Say that Samir has a collection of 12 video games. They cost from QR 40 to QR 70 each. At the top of the OHT the costs of the 12 games are shown at random. They have then been tidied up into a table. Point out that the bars on the bar chart represent the frequency of each cost.

Q Which cost appears most often in the data?

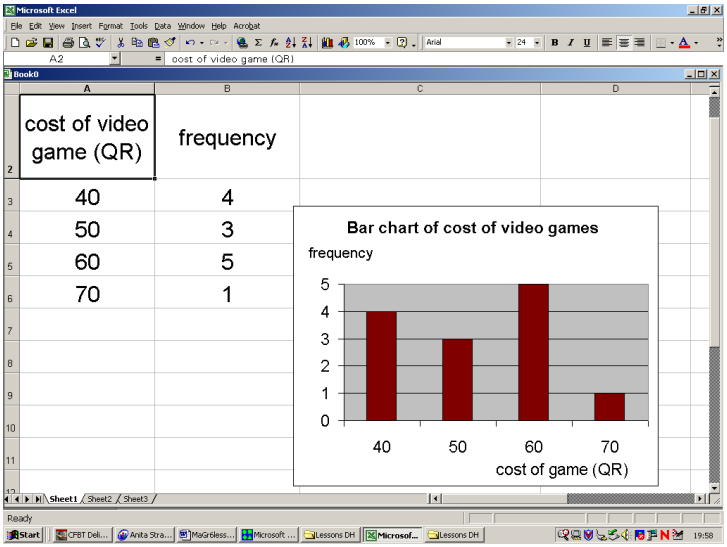
Q Which cost appears least often?

Q What fraction of all the games cost QR 60?

Q Which form of the data did you use to answer these questions: the jumbled data, the frequency table or the bar chart? (the graph is better for the first two questions and the table for the third)

Point out the features of the *bar chart*: the *horizontal axis*, the *vertical axis*, the *label* on each axis, and the *title* of the chart. Explain that the *scale* on the axis that shows the frequency has been chosen so that the maximum value of the data (in this case, the frequency of 5 for video games costing QR 60) will fit on the graph. Point out that each bar has its own label to show what it represents.

Before the lesson, prepare a simple spreadsheet based on the data. Show students how to use it to present different forms of bar charts.



Show the class that the bars may be horizontal or vertical but that each form represents the same data and gives the same information. Demonstrate how a change to one of the frequencies in the table produces a corresponding change to the height of the relevant bar. For example, change the number of video games costing QR 50 to 3, rather than 2, as in the illustration above.

Give out copies of **Resource 6.4b**.

Q What information does this bar chart show?

Discuss responses. Establish that the title and labels help to explain the meaning. Say that the data represents the colours of the cubes in a box.

Q How many red cubes are in the box? (25)

Q How many more red cubes than pink cubes are there? (20)

Q Estimate how many cubes there are altogether in the box. (about 93)

Q Estimate how many cubes are not pink. (about 88)

Refer to the frequency table below the bar chart. Say that this is another way of representing the same data. Remind students that *frequency* means 'how many'.

Q What do we need to add to the table so that it represents the same information as the bar chart? (the number of cubes of each colour)

Ask students to complete the table in pairs. Check answers by taking feedback.

Say that the second table gives information about another box of cubes.

Q How many brown cubes are in the box? (25)

Q How many more brown cubes than green cubes are there? (8)

Say that you want them to put the same information on a bar chart.

Q What will need to go on the horizontal axis? (the colours of the cubes)

Q How tall will the tallest bar be? (25 units)

Q How tall will the shortest bar be? (10 units)

Establish that the bars will range in height from 10 to 25.

Discuss how the vertical scale could be labelled: for example, if it were labelled in twos the highest division would be 10 – too small. If it were labelled in tens the highest division would be 50 – too big.

Ask students to work in pairs to agree their scale and to draw their bar chart, using their rulers to help. Remind them that they will need to estimate the height of some of the bars.

Other tasks

If necessary, choose further related activities, selecting from available textbooks or your own materials.

Consolidation

Resources

OHT 6.4c
calculators
mini-whiteboards

Show **OHT 6.4c**, a bar chart showing how many students went on a visit to Al Khor.

Discuss with the class how to use the graph to estimate the total number of Grade 7 and Grade students who went on the visit. Ask students to do the calculation mentally and to write the answer on their whiteboards.

Discuss what information is needed to work out the travel money collected from Grade 6 students and what kind of calculation to do. Remind students how to use their calculators to key in amounts of money and how to interpret the display.

Summary for students

- The bars of a bar chart show how many of each item there are. The axis for frequency will have a scale.
- A bar chart should have a title and each axis should be labelled.
- Each bar should have a label to show what it represents.
- A frequency table can contain the same information as in a bar chart.
- A frequency table should have a title.
- The total of the count should be included in a frequency table.