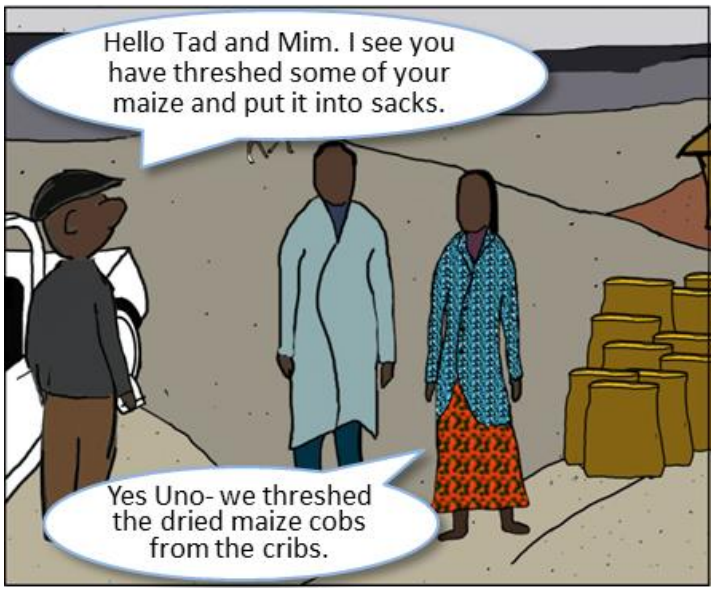
Improving Numeracy (Quantitative Literacy) in Rural Communities in Karamoja (INIK)

Field Numeracy - Uno How's Farm Visits™

Module 4



Using farm products

Numeracy linked Farm Visits 13-16

Improving Numeracy (Quantitative Literacy) in Rural Communities in Karamoja (INIK)

Cost Reimbursement Grant – Award Number 999001173

Field Numeracy - Uno How's Farm Visits™

Module 4

Field Visits 13-16

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Introduction

Uno How's Farm Visits is a custom-built series of farm numeracy classes, based on farm visits undertaken by a virtual extension agent called *"Uno How"*.

Module 4 – Using Farm Products

This module continues the series of 12 farm visits from "Uno How", following on from Modules 1, 2 and 3 (outlined below and available as a separate booklets).

Visit 13 – What do we do with the harvest?
Visit 14 – Estimating losses
Visit 15 – Selling the product
Visit 16 – Decision making

The visits are represented by a series of visual graphics which introduce the topic. Each topic is then followed by an explanation with illustrations, examples and exercises (the answers to which are given at the end of this booklet).

Module 1 – Calculating Area

Visit 1 – Measuring your fields
Visit 2 – Calculating the area of your fields
Visit 3 – Calculating the area of irregular fields
Visit 4 – Estimating the area of your farm

Module 2 - Estimating Seed Inputs, Fertiliser and Spray requirements

Visit 5 – Amount of seed required
Visit 6 – Cost of seed required
Visit 7 – Estimating the amount of fertiliser
Visit 8 – Amount of spray required

Module 3 - Estimating crop production and storage requirements

Visit 9 – Estimating the number of cobs or heads in the field
Visit 10 – Estimating the amount of crop in store
Visit 11 – Estimating grain production in the field
Visit 12 – Estimating storage requirements – revision

Modules 1, 2, 3 and 4 can be accessed and downloaded at:
http://www.agritechtalk.org/Uno How Introduction.html

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Uno How's Farm Visits…

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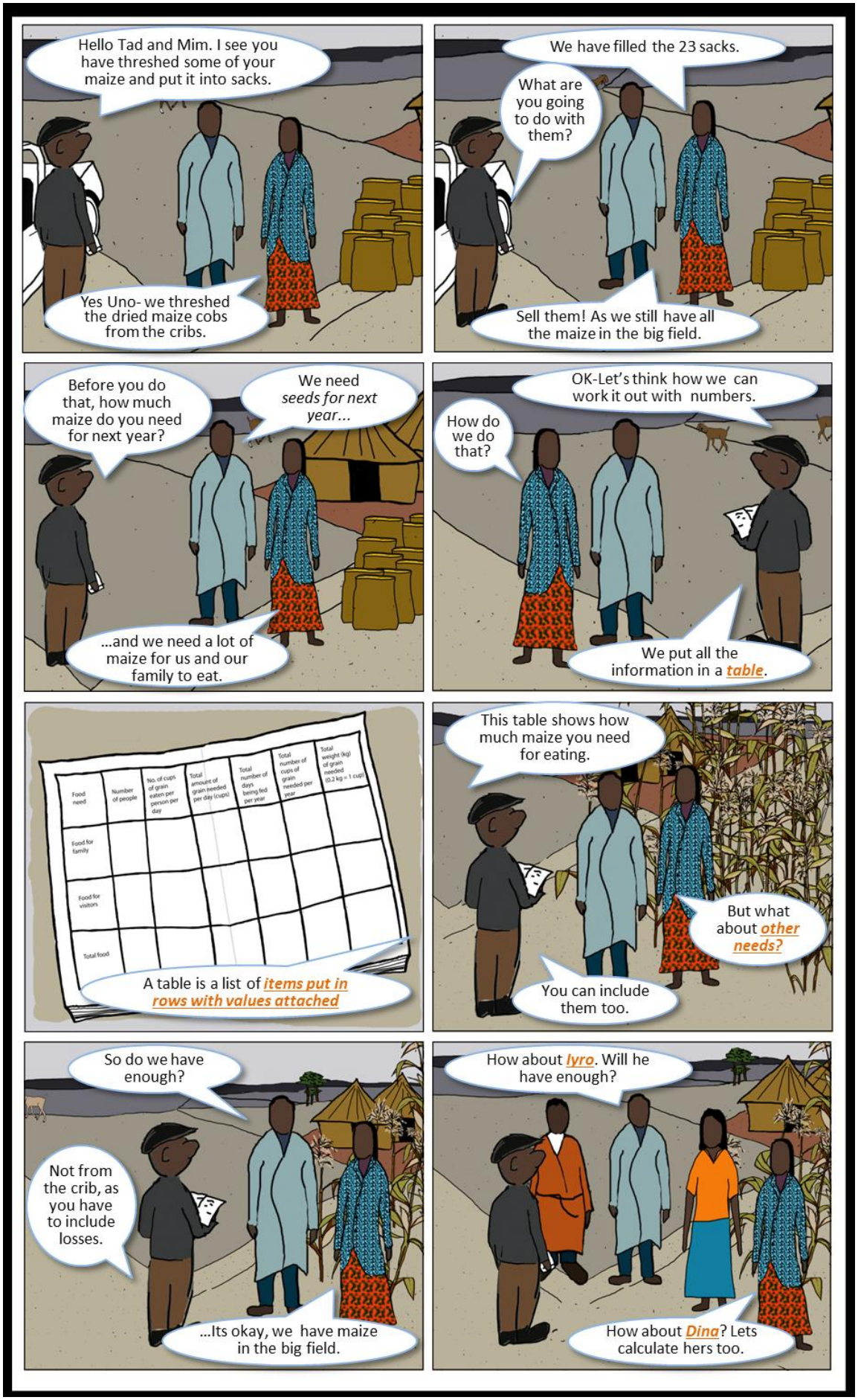
Uno How's Farm Visit 13… What do we do with the harvest?



Completed Visit 13 – Continue to Visit 14

Uno How's Farm Visit 13

What do we do with the harvest?

Using tables to help you plan

Tad and Mim dried the maize cobs from their small field in their two cribs; shelled them; and put the grain into sacks. What do they do next?

Tad and Mim are deciding what to do with the maize harvested from their small field. Mim says she wants to sell some of it.

They have shelled 1150 kg (1.15 tonnes) of maize grain from the dried cobs, which has filled 23 x 50 kg sacks (in Module 3, they **estimated** that they would have 1.14 tonnes of grain from the cobs).

Tad and Mim need maize grain to eat, to feed to their chickens, and to use as seeds.

They decide to work out how much grain they **need** for the coming year and to compare their need with their production, to see if they have a **surplus** (more grain than they need, which would mean that Mim could sell some of it) or a **deficit** (not enough grain to supply their needs)**.**

Uno helps them work this out by making **tables** in an exercise book.

Putting information into a table helps organise information in a logical fashion.

A table allows you to carry out calculations (adding, subtracting, multiplying or dividing), while keeping track of the values you have used and the answers you get.

At the end of the calculations the answers shown in the table can be compared, helping you make good decisions about how to manage your resources.

Uno starts by helping Tad and Mim make a table that will help them work out how much maize grain they need as **food** for their household in the coming year.

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Uno How's Farm Visit 13

What do we do with the harvest?

Making a table to see how much maize grain is needed

Uno prepares a **two-way table.** This is the most commonly used table and is made up of **columns** and **rows,** which enable values to be grouped together, like-with-like.

The first **column** of a two-way table normally lists the **main items** that are to be investigated - in this case maize grain to be used as food for the family; or maize grain as food for visitors. Pictures, symbols or colour codes can be used instead of written words.

The top **row** of a two-way table normally lists the **different types of information** that will be used in the calculations for each item - for example, number of people, number of days and so on.

Uno writes down the different food uses for the maize grain in the first column of the table (**Table 1a**).

Then, in the top row, he writes down the information needed to calculate how much maize grain Tad and Mim need for food in the coming year.

Table 1a: Tad and Mim's maize grain needs for food next year

Food Need	Number of people	Average number of cups of grain eaten per person per day	Total amount of maize grain needed/day in cups	Total number of days being fed per year	Total number of cups of grain needed/year	Total weight of grain needed (kg) (0.2 kg/cup)
Food for family						
Food for visitors						
Total food						

Tad and Mim need to be able to estimate some values, so that the calculations can be carried out:

- They need to estimate **how many** people will be eating maize grain: There are 5 people in Tad and Mim's family (Tad, Mim plus 3 children). They also have 10 other family members who come to stay with them from time to time.
- They need to estimate **how much** each person eats per day: Tad and Mim estimate that each person usually eats an average of two cups of maize grain per day, which will then be cooked.
- They need to estimate **how often** maize will be eaten by them and their visitors over the coming year: They estimate that their family will eat maize every day over the coming year, but that they will only have visitors for ten days in total.

They enter this information into the relevant columns of the table (**Table 1b**). Each column has been given a letter which will help explain how calculations are made in the next step.

Table 1b: Tad and Mim's maize grain needs for food next year (Table incomplete)

	A	B	C	D	E	F
Food Need	**Number of people**	**Average number of cups of grain eaten per person per day**	**Total amount of maize grain needed/day in cups**	**Total number of days being fed per year**	**Total number of cups of grain needed/year**	**Total weight of grain needed (kg) (0.2 kg/cup)**
Food for family	5	2		365		
Food for visitors	10	2		10		
Total food						

Uno now shows them how to use this information to fill in the rest of the table.

They work out:

- **The total amount of maize grain needed in cups, for family or visitors, each day** – which is the number of people *times* the average number of cups of grain each person eats per day: A x B = C.

- **The total number of cups of grain needed for family or visitors each year** – which is the amount of maize grain needed per day in cups *times* the total number of days they need to be fed each year: C x D = E.

- **The total weight of grain needed for family or visitors each year** – which is the total number of cups of grain needed each year *times* the weight of one cup of grain, which is 200 grams, or 0.2 kilograms: E x 0.2 kg = F.

- Finally, the weights of grain needed for family and visitors for the year are *added* together, to find the **total weight of grain needed**.

They carry out these calculations and put the answers in the table (**Table 1c**):

Table 1c: Tad and Mim's maize grain needs for food next year (Table completed)

	A	B	C	D	E	F
Food Need	**Number of people**	**Average number of cups of grain eaten per person per day**	**Total amount of maize grain needed/day in cups *(A x B)***	**Total number of days being fed per year**	**Total number of cups of grain needed/year *(C x D)***	**Total weight of grain needed (kg) (0.2 kg/cup) *(E x 0.2 kg)***
Food for family	5	2	10	365	3650	**730**
Food for visitors	10	2	20	10	200	**40**
Total food						**770**

The total amount of maize needed for eating by Tad and Mim's household is, therefore, estimated at 730 kg + 40 kg = **770 kg** for a year.

Quick Test 1 – Using tables

1 A family wants to find out how much grain they need as food for the year. Put the following information into a table and calculate their total grain food need for the year.

The family has 8 people. They eat an average of 3 cups of grain per person per day (0.2 kg/cup). They estimate that they will have 6 visitors, staying for about 20 days a year.

2 A family wants to find out how much grain they need for the year for food. Put the following information into a table and calculate their total grain food need for the year.

The family has 12 people. They eat an average of 1 cup of grain per person per day (0.2 kg/cup). They estimate these they will have 5 friends staying for about 40 days in the year. They also have 2 relatives who come and stay for 30 days a year.

Note down the answers and check them with the answers at the end of this booklet.

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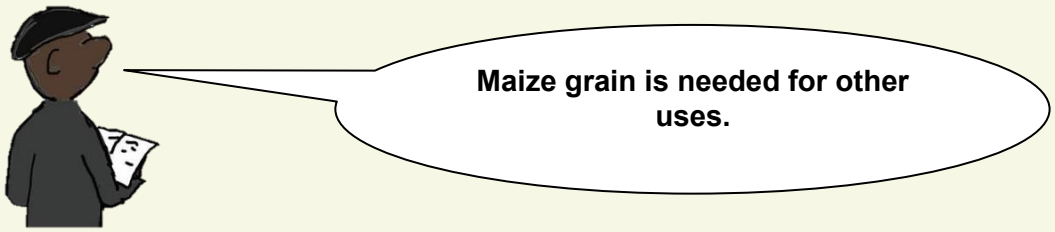
Uno How's Farm Visit 13

What do we do with the harvest?

Working out other needs for the year



In working out **Tad and Mim's total maize grain needs**, the **other uses** that must be considered are:

- The maize grain that they feed to their chickens every day, for the next year.
- The seeds they will sow in their fields.
- The seeds they need to pay back to their neighbour Iyro for a loan he made to them the previous year.

Maize needed for chickens

Using **Table 2** (as they did in Table 1), they work out how much grain they need to feed their chickens from the following information:

- The number of chickens (Column A).
- How much grain they give to each chicken each day of the year (Column B).
- The total amount of maize grain needed/day in cups: Multiply A x B (Column C).
- For how long they will feed the chickens. They plan to keep the chickens for the whole year (Column D).
- The total number of cups of grain needed/year: Multiply C x D (Column E).
- The total weight of grain needed: E x 0.2 (Column F).

Table 2: Maize grain needs for Tad and Mim's chickens

	A	B	C	D	E	F
Need	**Number of chickens**	**Average number of cups of grain eaten per chicken per day**	**Total amount of maize grain needed/day in cups *(A x B)***	**Days being fed per year**	**Total number of cups of grain needed/year *(C X D)***	**Total weight of grain needed (kg) (0.2 kg/cup) *(E x 0.2 kg)***
Feed for chickens	10	0.5	5	365	1825	**365**

Seed needs

Tad and Mim use **Table 3** to work out how much grain they will need to keep as seed for their large field the following season.

The use the following information:

- How many hectares of land they have to sow.
- How much seed they will sow per hectare.
- How many times they will sow maize in that field over the coming year.

They also need **to add in the amount of seed (in kg)** that they will use to pay back Iyro, for a loan he made to them the previous year.

Table 3: Tad and Mim's maize grain needs for seed next year

Need	Number of hectares (Field 2)	Seed needed kg per hectare	Total amount of seed needed in kg	Number of Sowings per year	Grain in kg rounded up
Seed to sow	1.23	12	14.76	1	**15**
Seed to pay back Iyro					**15**
TOTAL					**30**

Total needs

In **Table 4**, Uno brings all the needs together into a simple table, and adds them up together:

Table 4: Tad and Mim's total maize grain needs next year

Needs for 1 year	Source of value	Maize grain kg
Maize for food	From Table 1	**770**
Maize for chicken feed	From Table 2	**365**
Maize for seed	From Table 3	**30**
TOTAL		**1165**

The total amount of maize grain needed as food for the family, chickens and as seed is **1165 kg.**

Tad and Mim's household needs 1165 kg, or 1.17 tonnes, of maize in the coming year.

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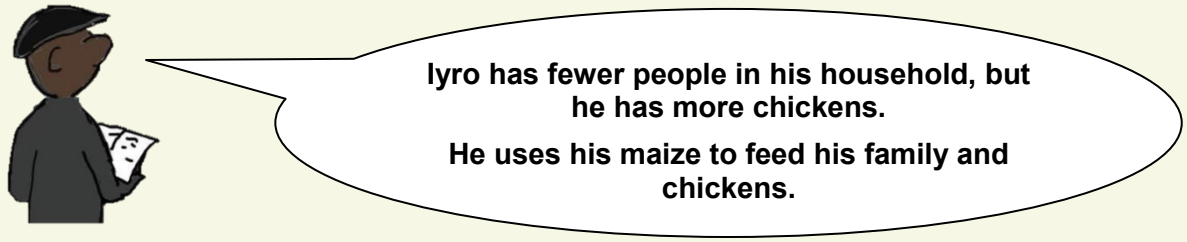
Uno How's Farm Visit 13

What do we do with the harvest?

Calculating Iyro's needs



Iyro asks Uno to help him work out his maize grain needs. He uses his maize to feed his family and chickens.

Here are Iyro's tables for maize use for the coming year. In the first table (**Table 5**), Uno has combined Iyro's maize food and chicken feed needs:

Table 5: Iyro's maize grain needs for food and chicken feed next year

Need	Number of people/ chickens	Average number of cups of grain eaten per person/ chicken per day	Total amount of maize grain needed/day in cups	Days being fed per year	Total number of cups of grain needed /year	Total weight of grain needed (rounded up to whole kg) (0.2 kg/cup)
Food for family	3	2.5	7.5	365	2738	**548**
Food for visitors	2	2.5	5	180	900	**180**
Feed for chickens	30	0.3	9	365	3285	**657**
TOTAL						**1385**

Iyro applies a much heavier sowing rate than Tad and Mim, so he uses more seed for his maize plot:

Table 6: Iyro's seed needs for the coming year

Need	Number of hectares	Seed needed kg per hectare	Total amount of seed needed in kg	Number of Sowings per year	Grain in kg rounded up
Seed to sow	0.5	25	12.5	1	**13**

Uno now groups all Iyro's maize needs together in **Table 7**:

Table 7: Iyro's total maize grain needs for the coming year

Needs for 1 year	Source of value	Maize grain kg
Maize for food/chicken feed	From Table 5	**1385**
Maize for seed	From Table 6	**13**
TOTAL		**1398**

Iyro's household needs 1398 kg (rounded up) of maize in the coming year.

Quick Test 2 – Using tables in more detail

1 A farmer wants to find out how much grain her family needs for the year. As well as eating the grain themselves, her family also has visitors. They also use some maize grain as seed and as food for their chickens. Put the following information into a table and calculate her family's total grain need for the year.

Her family has 6 people. They eat an average of 2½ cups of grain per person per day (0.2 kg/cup). They estimate they will have 4 visitors staying for about 15 days in the coming year. They keep 20 chickens and feed them ¼ of a cup each every day. They want to keep 18 kg of grain as seed.

2 A farmer wants to find out how much grain his family needs for the year. As well as eating the grain themselves, his family also has visitors. They also use some maize grain as seed and as food for their chickens. Put the following information into a table and calculate his family's total grain need for the year.

His family has 10 people but half-way through the year 4 of their children will be going away to stay with a relative for 3 months. They eat an average of 2 cups of grain per person per day (0.2 kg/cup). They estimate they will have 10 visitors staying for about 7 days in the coming year. They keep 12 chickens and feed them 1/3 of a cup of grain each every day. They want to keep 24 kg of grain as seed.

Note down the answers and check them with the answers at the end of this booklet.

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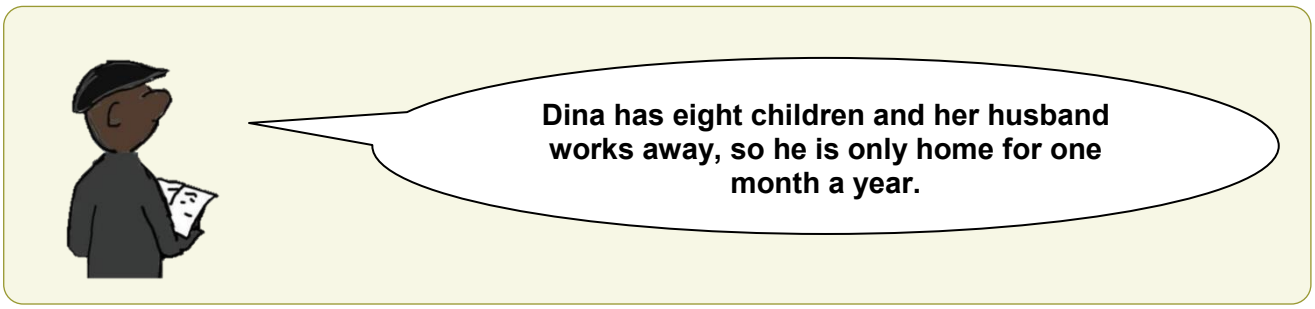
Uno How's Farm Visit 13

What do we do with the harvest?

Calculating Dina's needs



Another neighbour, Dina, has the most mouths to feed and the smallest farm; just one field of 0.8 ha. Because she doesn't use fertiliser, her yield of maize (which is 1.4 tonnes per hectare) is lower than Tad and Mim's. Her production is 1.12 tonnes. Her maize requirements are shown in Table 8.

Table 8: Dina's maize grain needs for food and chicken feed next year

Need	Number of people/ chickens	Average number of cups of grain eaten per person/ chicken per day	Total amount of maize grain needed/ day in cups	Days being fed per year	Total number of cups of grain needed/year	Total weight of grain needed (rounded up to whole kg) (0.2 kg/cup)
Food for family	9	1.5	13.5	365	4928	**986**
Food for husband when home	1	1.5	1.5	30	45	**9**
Feed for chickens	2	0.3	0.6	365	219	**44**
TOTAL						**1039**

Dina uses the same sowing rate as Tad and Mim at 12 kg/ha. Her seed requirements are shown in Table 9.

Table 9: Dina's seed needs for the coming year

Need	Number of hectares	Seed needed kg per hectare	Total amount of seed needed in kg	Number of Sowings per year	Grain in kg rounded up
Seed to sow	0.8	12	9.6	1	**10**

By adding the weight of maize grain required as seed to the amount needed for food, Uno calculates the amount that should be available for Dina's household in the coming year, shown in Table 10:

Table 10: Dina's total maize grain needs for the coming year

Needs for 1 year	Source of value	Maize grain kg
Maize for food/chicken feed	From Table 8	**1039**
Maize for seed	From Table 9	**10**
TOTAL		**1049**

Dina's household needs 1049 kg of maize grain for the coming year.

Uno has helped Tad and Mim, as well as Iyro and Dina, estimate their maize grain **needs** for the coming year. Now he will help them work out their maize grain **production**. These production figures can then be compared with their needs, to see if they have a **surplus** or a **deficit**.

Quick Test 3 – Using tables to calculate changes

1 A farmer wants to find out how much grain her family needs for the year. As well as eating the grain themselves, her family also has visitors. They use some maize grain as seed; and as food for their chickens. They have promised to give a relative some seed. They also want to set aside some grain to give as a gift to a friend. Finally, they want to take some grain to be ground at the mill. Put the following information into a table and calculate the family's total grain need for the year.

The family has 7 people. They eat an average of 2 large cups of grain per person per day (0.3 kg/cup). They estimate they will have 4 visitors staying for about 12 days in the coming year. They keep 24 chickens and feed them ¼ of a cup each every day. They want to sow 1.5 ha at a sowing rate of 10 kg per ha. They want to set aside 2 sacks of grain (each weighing 50 kg) as a gift to a friend; and finally, want to take 5 sacks of grain to be ground at the mill.

Two of the visitors have asked if they can stay for an extra 40 days. What would the effect of this be on the family's total grain need for the year? They have 3000 kg of grain in store in total. Will this be enough?

Note down the answers and check them with the answers at the end of this booklet.

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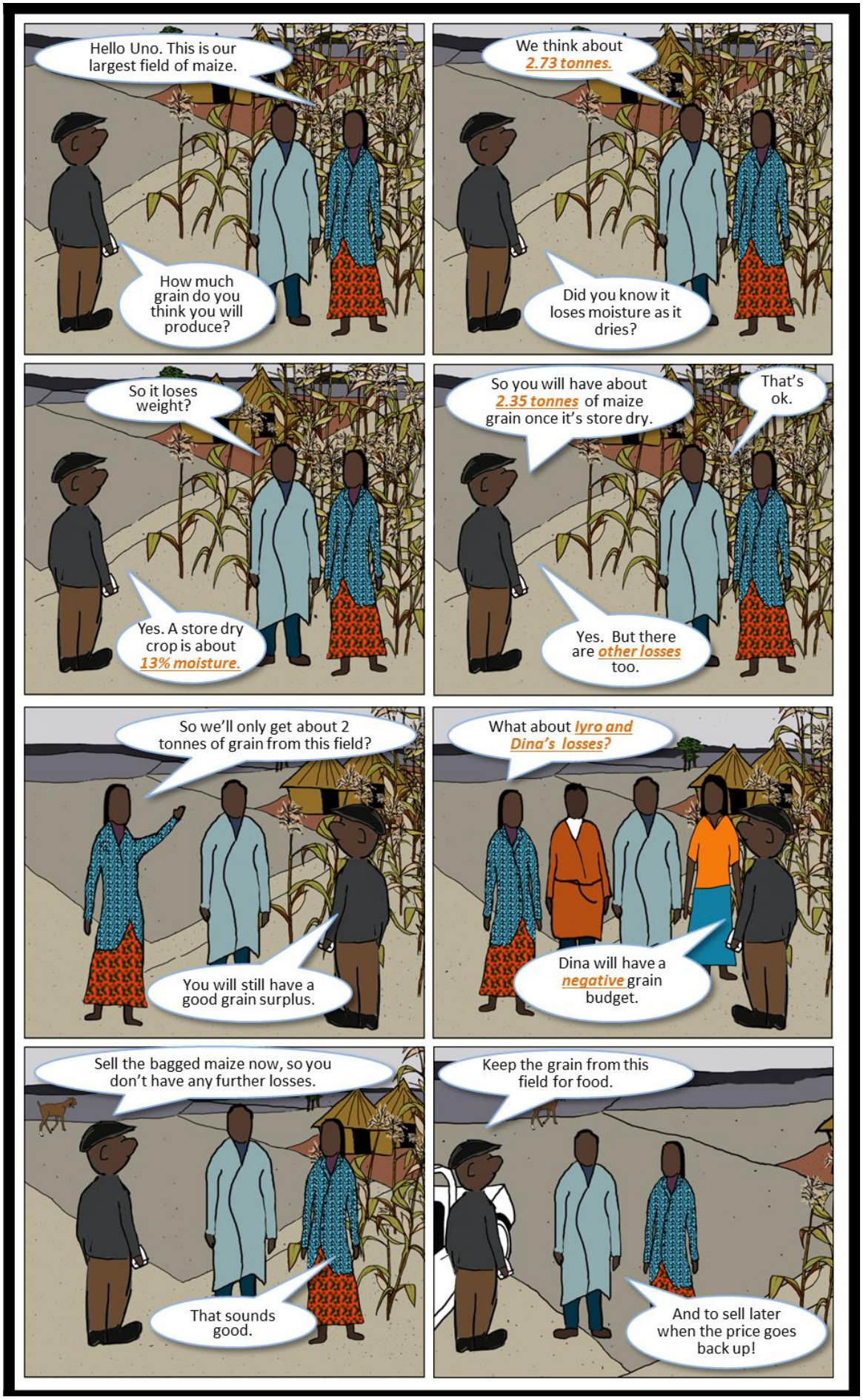
Uno How's Farm Visit 14… Estimating losses



Completed Visit 14 – Continue to Visit 15

Uno How's Farm Visit 14

Estimating losses

Rapid estimates of production of crops drying in the field

Returning to Tad and Mim – they have 1150 kg (1.15 tonnes) of maize grain shelled from the cobs that were stored in their cribs.

However, they have not yet harvested their bigger, 1.23 ha field.

In Module 3 (Visit 9), Tad and Mim estimated the **number of cobs** in their largest field. Now they want to estimate the **weight of grain** they will get from this field.

They notice that the maize crop in this field looks very similar to a maize crop in one of Iyro's fields which is also nearly ready for harvest.

This means that the grain **yield** (production of grain per unit area, in kg/m^2 or tonnes/ha) of the two fields will be similar.

Uno has already measured and sampled this maize field of Iyro's. It is 0.7 ha in area and has an estimated production of 1550 kg.

Therefore, the difference in **production** between the two fields will depend mainly on their different sizes (areas).

They need to know how many times larger their big field is than that of Iyro's maize field. To work this out they divide the area of their big field by that of Iyro's field:

Area Big Field ÷ Area Iyro's Field = 1.23 ÷ 0.7 = 1.76

So, Tad and Mim's big field is **1.76 times** larger than that of Iyro's maize field.

Assuming that the yield of the two fields is similar, their big field will therefore produce approximately 1.76 times more grain:

So, their estimated production of grain from their large field is:

1.76 x 1550 kg = **2728 kg** or approximately **2.73 tonnes.**

What is the yield of their field in tonnes per ha?

1.23 ha is estimated to produce 2.73 tonnes.

1 hectare is 1 ÷ 1.23 = 0.813 of the area of his field.

0.813 x 2.73 tonnes = 2.22

The estimated yield = 2.22 tonnes per hectare.

Experience shows that, once you become familiar with the “look” of your local fields and have experience in estimating their yields, you can start to make an approximate estimation of yield “by eye”.

Manuals called **PETs (Pictorial Evaluation Tools),** comprising images of real fields (from-a-distance and in close-up) displayed in a series of galleries along with their yields, can help provide quick guides to such “visual” estimates of yield, and greatly improve their accuracy. They are designed to help the user gain confidence in making rapid yield estimates.

The example below shows three samples of maize from PET Uganda, one from a productive field, producing 5.85 tonnes per hectare (t/ha); one from a less productive field, producing 3.42 t/ha; and finally a poor field producing only 0.32 t/ha.

Quick Test 4 – Rapid estimates of grain drying in field

1 A farmer has a sorghum field which measures 0.5 ha. His neighbour has just harvested her sorghum field of 1.25 ha and she tells him that it produced 1.9 tonnes.

If the two fields had a very similar yield, estimate how much sorghum grain his field would produce. What is their yield in tonnes per hectare?

2 A farmer has a maize field which measures 3 acres. His neighbour has just harvested his maize field of 0.75 ha and tells him that it produced 2.1 tonnes.

If the two fields had a very similar yield, estimate how much maize grain his field would produce. What is their yield in tonnes per hectare?

Note down the answers and check them with the answers at the end of this booklet.

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Uno How's Farm Visit 14

Estimating losses

Moisture Content and Dry matter

Judging by eye, Tad and Mim have estimated that they have 2.73 tonnes of maize standing in the field, where it is drying.

Cereals that are stored too wet are very likely to rot in store, so they must be dried first.

The crop in Tad and Mim's larger field is still drying in the field. As the maize grains slowly dry they lose water by evaporation. This causes the grains to shrink and lose weight.

This means that the weight of grain Tad and Mim have estimated before drying will be higher than the actual weight of grain available after the crop has dried.

Therefore, they need to adjust this estimate to take account of this weight loss. They can do this if they know the **moisture content** of the grain before and after drying:

Moisture content is the amount of moisture held in the grain crop. It is often expressed as a percentage.

The amount of solids in the grain is the **dry matter content**, which is also usually expressed as a percentage**.** Together, dry matter and moisture make up the entire weight of the crop.

Therefore it is always true that:

% Moisture Content + % Dry Matter Content = 100%

As a crop dries and loses water, its **moisture content percentage** falls over time. The **dry matter percentage** therefore rises, even though its **dry matter content** (weight) remains the same.

For example, if a maize crop has a maize grain moisture content of 25%, the grains contain: 100% - 25% = 75% dry matter.

This means that 1 tonne (1000 kg) of the grain, standing in the field would contain:
25% x 1000 kg = 250 kg of water **and** 75% x 1000 = 750 kg of dry matter.

If sunshine evaporated **all** this moisture off, the remaining grain would have a dry matter content of 100% but (because 250 kg of water had evaporated away) would now weigh only 750 kg.

In reality, crops are *rarely* dried to the point of zero moisture in the fields. **A grain crop is normally considered good for storage when its moisture content is about 13%.** At this stage, it feels very hard-to-bite and will **snap**, rather than be bitten in half.

Calculating Moisture Content Percentage of a grain harvest.

The moisture content percentage of a crop, whether still on the cob in the field; or as grain in a heap, yard or warehouse, can be estimated by:

- Taking a small sample of the cobs/grain.
- Threshing (if required).
- Weighing the grain sample.
- Drying it slowly.
- Reweighing.
- Drying and reweighing again (repeatedly if necessary) until the **weight remains the same**. This means the sample is **completely dry** (at this point the moisture content is 0% and the dry matter content is 100%).
- Finally, subtracting the weight of the dried sample from the initial grain weight gives the moisture content of the sample.

This sample's moisture content divided by its starting weight x 100% provides an estimate of the percentage moisture content of the whole crop:

% Moisture Content = (Starting Sample Weight – Final Sample Weight) ÷ Starting Sample Weight x 100

Let's show this using an example:

- A 200 g sample of maize grain is taken from a 1 tonne heap.
- The sample is dried and weighed (a few times) until it has a constant weight of 150 g.
- It has lost 200 g - 150 g = 50 g of water.
- The % moisture content of the grain in the heap at the time of sampling is therefore estimated to be: 50/200 x 100% = 25%.

Quick Test 5 – Calculating moisture content

1 A 500 g sample of millet is dried to a constant weight of 400 g.

What was its moisture content percentage at the time of sampling?

2 A 350 g sample of maize is dried to a constant weight of 275 g.

What was its moisture content percentage at the time of sampling?

3 An 850 g sample of sorghum is dried to a constant weight of 700 g.

What was its moisture content percentage at the time of sampling?

Note down the answers and check them with the answers at the end of this booklet.

Estimate crop weight after drying

If we know the starting weight of a grain crop, and its approximate moisture content before and after drying, we can **estimate the weight of grain after drying**.

Tad and Mim have an estimated 2.73 tonnes of maize grain in their field. Uno samples the field – its moisture content is 25%. He estimates that, after drying, its moisture content will be 13%.

After drying, the **dry matter weight** of the field will be the same (this will be 75% x 2.73 tonnes = 2.05 tonnes), but its **dry matter percentage** will now be 87% (100% - 13%).

To work out the new weight of the crop we need to use the numbers we know to calculate what we do not know.

To do that we arrange the numbers in **a simple equation.**

An equation is a mathematical statement that consists of two expressions with equal value.

We will return to Tad and Mim's calculation in the next unit when we have learnt more about **equations.**

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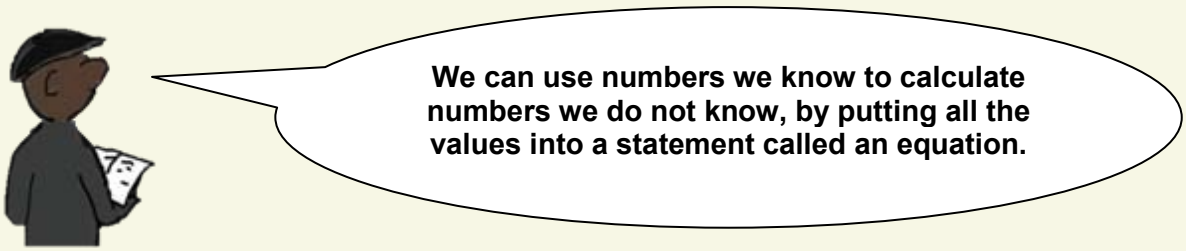
Uno How's Farm Visit 14

Estimating losses

Calculating unknown values using equations



A mathematical equation always has two sides, separated by the **=** sign. This means that both sides have the same value. Let's start with a very simple equation:

10 - 2 = 5 + 3

As you can see, both sides of the equation are different, but both are equal to 8.

In the equation above only numbers are shown. When some numbers are unknown, letters are used to represent the unknown number. Knowing that both sides are equal helps us calculate the unknown number. We call this **solving** an equation.

Rule 1: In all equations the two sides will always have the same value.

Solving an equation that includes addition or subtraction:

Let's use an example to demonstrate how to solve a simple equation that includes addition or subtraction. Tad goes to the market and buys a hoe and a watering can.

The market stallholder tells him the total he must pay is $30.

Tad knows that the watering can costs $7.

Tad could use an **equation** to work out the cost of the hoe.

Remember that in equations, letters are used to represent unknown numbers. Let **x** represent the cost of the hoe. Therefore:

$$x + \$7 = \$30$$

If we **solve** the equation (work out what **x** is), we will work out the cost of the hoe.

We do this by **rearranging** this equation. We need to rearrange the equation, so that **x** is on its own on one side.

Remember that, with **all** equations, the value on one side must always equal the other side. This means that if we add, subtract, multiply or divide one side of the equation, **we must do the same to the other**.

Rule 2: Whatever is done to one side of the equation must be done to the other.

Method 1:

To have the **x** on its own on one side, we **subtract** $7 from the left side of the equation.

As we have to do the same thing to both sides, we must also subtract $7 from the right side:

$$\begin{array}{rcl} x + \$7 & = & \$30 \\ - \$7 & & - \$7 \\ \hline x + \$0 & = & \$23 \end{array}$$

$$x = \$23$$

The hoe costs **$23**

Method 2:

Or, if we **move** the $7 across to the other side of the equation and **change its sign** in one step, this is the same as subtracting $7 from both sides.

$$x + \$7 = \$30$$

$$x = \$30 - \$7$$

$$x = \$23$$

Rule 3a: Equations can be solved by carrying out the opposite action: Equations which include addition can be solved by subtraction, or the other way round (this is made easier by moving the number to the other side of the equation and changing its sign).

Solving an equation that includes multiplication or division:

Uno buys 4 bags of seed. He is charged $24 for them. What is the cost of one bag of seed?

Let's call the unknown price of one bag of seed **y**.

$$4 \times y = \$24$$

Note that in equations, we do not need to write in the multiplication sign before the letter.

$$4\,y = \$24$$

This simple equation includes only multiplication. We can solve it by carrying out the opposite action, which is division.

Dividing both sides of the equation by 4 will provide the value of **y** (because 4y divided by 4 is y):

$$\frac{4\,y}{4} = \frac{\$24}{4}$$

$$\frac{\cancel{4}\,y}{\cancel{4}} = \frac{\$24}{4}$$

$$y = \$24 \div 4 = \$6$$

The price of one bag of seed is $6

Rule 3b: Equations can be solved by carrying out the opposite action: Equations which include multiplication can be solved by division, or the other way round.

Equations with addition/subtraction and multiplication/division

The examples we have provided so far were very easy – we didn't really need to write out an equation to work the answers out.

Equations are generally used for more complicated calculations and involve more than one of these processes.

Let's look at an example:

Uno buys 3 bags of fertiliser and pays for them with a $50 note. He receives $23 change. What was the price of one bag of fertiliser (z)?

Let's split this problem up:

The total cost of fertiliser was 3 x **z**, which can be written as 3**z**.

We know that the cash he gave to the stall holder **equals** the total cost of the fertiliser **plus** the change he received:

$$3z + \$23 = \$50$$

$$3z = \$50 - \$23 = \$27$$

Now we know that 3 bags of fertiliser costs $27. Lets solve this part of the equation:

$$3z = \$27$$

We can solve this simple equation by carrying out the opposite action – that is, by dividing both sides by 3:

$$\frac{3z}{3} = \frac{\$27}{3}$$

$$z = \$27 \div 3 = 9$$

The price of one bag of fertiliser is $9.

Quick Test 6 – Equations

1 A farmer has a 500 g bag of seed. After sowing some of the seed, she has 275 g left.

Write a simple equation to show how the amount of seed she has used (call this "**a**") can be calculated. Solve this equation (that is, find the value of **a**).

2 A farmer buys 4 goats for a total of $256.

Write a simple equation to show how the price of one goat (call this "**b**") can be calculated. Solve this equation (that is, find the value of **b**).

3 A famer buys 6 bags of flour for her family. She gives $30 to the shop keeper and receives $3 change.

Write a simple equation to show how the price of a bag of flour (call this "**c**") can be calculated. Solve this equation (that is, find the value of **c**).

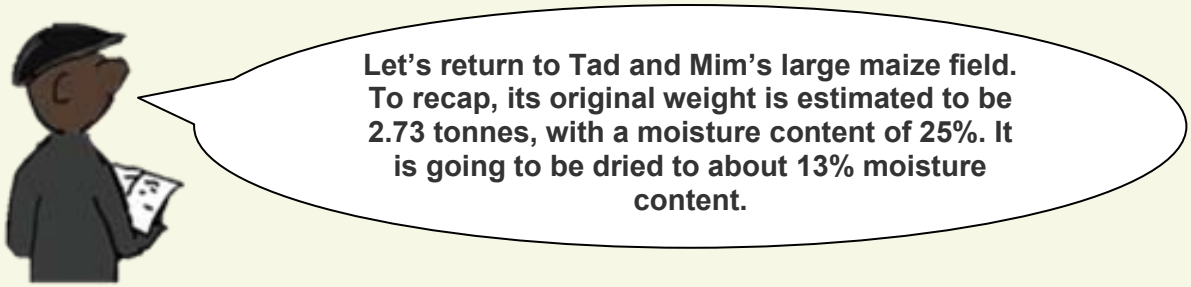
4 A famer buys 22 empty sacks. He gives $25 to the shop keeper and receives $1.90 change.

Write a simple equation to show how the price of a sack (call this "**d**") can be calculated. Solve this equation (that is, find the value of **d**).

5 A farmer has a maize field of 1.5 ha. His neighbour had a very similar looking field of 1.25 ha, which gave a production of 2.6 tonnes.

Write a simple equation to show how the production of his field (call this "**e**") can be calculated. Solve this equation (that is, find the value of **e**).

Note down the answers and check them with the answers at the end of this booklet



Equation to solve the weight of a grain after drying

Method 1

Original weight of Tad and Mims maize is estimated to be 2.73 tonnes.
Moisture content = 25%. Dry matter content = 75%.

Tad and Mim want to know how much weight will be lost from the maize when its dries in the field, so they can estimate the final weight of maize grain that they will harvest.

Let's call the weight of the dry maize **w**.

Its dry matter weight is 75% x 2.73 tonnes = 2.05 tonnes. This will not change.

After drying to 13% moisture content, 87% (100% - 13%) of the total weight of the grain will equal 2.05 tonnes:

$$87\% \times w = 2.05 \text{ tonnes}$$

or

$$87/100 \times w = 2.05 \text{ tonnes}$$

or

$$0.87 \times w = 2.05 \text{ tonnes}$$

So

$$0.87w = 2.05 \text{ tonnes}$$

We can solve this multiplication equation by carrying out the opposite action – that is, by dividing both sides by 0.87:

$$w = 2.05 / 0.87$$

$$w = 2.36 \text{ tonnes}$$

There is estimated to be 2.36 tonnes of maize grain in the field after drying.

To summarise, the equation we used was:

$$\textbf{Final weight (w)} = \textbf{Dry matter Weight} \div \frac{\textbf{Final dry matter \%}}{\textbf{100}}$$

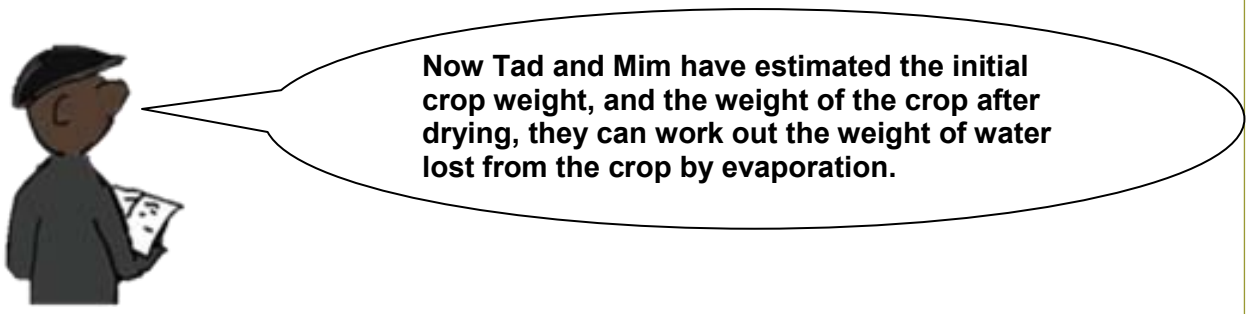
Method 2:

Once again, the answer can be found using another method. Here is another equation to find the same answer – this one is based on the changing % of dry matter.

$$\textbf{Final weight (w)} = \frac{\textbf{Starting dry matter \%}}{\textbf{Final dry matter \%}} \times \textbf{Initial weight of heap}$$

Using the above example, **w** = 75 / 87 x 2.73 tonnes = 0.862 x 2.73 tonnes = **2.35 tonnes of maize grain estimated to be in the large field after drying**.

(Note: This is slightly less than the answer using Method 1 due to rounding off)



They want to know the weight lost from moisture

The initial weight was estimated to be 2.73 tonnes. The final weight is estimated to be 2.35 tonnes, so the water loss is estimated to be 2.73 – 2.35 = 0.38 tonnes, or 380 kg.

They estimate that they have **lost 380 kg** due to the evaporation of the moisture.

Total grain production

Tad and Mim can now add the production of maize grain from their two fields to estimate their total production:

Total Production = Field 1 production + Field 2 Production

1.15 tonnes + 2.35 tonnes = 3.5 tonnes total.

But, they have not considered the **loss of grain in storage**.

Quick Test 7 – Calculating weight of grain after drying.

1 A farmer has maize drying in his field which he has estimated weighs 3 tonnes. It has a moisture content of 25%. He wishes to leave the grain to dry to 13% moisture content.

How many tonnes will be left in the field when it is at 13% moisture content?

2 A farmer has sorghum drying in his field which he has estimated weighs 5 tonnes. It has a moisture content of 30%. He wishes to leave the grain to dry to 13% moisture content.

How many tonnes will be left in the field when it is at 13% moisture content?

3 A farmer has millet drying in his field which he has estimated weighs 8 tonnes. It has a moisture content of 40%. He wishes to leave the grain to dry to 13% moisture content.

How many tonnes will be left in the field when it is at 13% moisture content?

4 A farmer has maize drying in his field which he has estimated weighs 2 tonnes. It has a moisture content of 50%. He wishes to leave the grain to dry to a13% moisture content.

How many tonnes will be left in the field when it is at 13% moisture content?

Note down the answers and check them with the answers at the end of this booklet.

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Uno How's Farm Visit 14

Estimating losses

Losses other than moisture

As Tad and Mim know, crop losses also occur in store. These are called post-harvest losses and they vary according to time in store; the quality of the crop; and the storage conditions.

Cereals, as we saw earlier, are generally harvested when their moisture content is low, which makes them less prone to rotting and better for storage than many other crops, such as cassava tubers or potatoes. But, from the moment of harvest, even grain crops are at risk of loss to scattering and splitting; insect pests; birds, rodents and disease attack.

The African Postharvest Losses Information System (**APHLIS** www.aphlis.net) has estimated that losses between harvest and sale in the market are often in the range of **10% to 20%**, for air-dry grain of all types.

Although some pests are able to feed on whole, healthy and well-stored maize grains; others can only attack broken grain; moist grain; pest damaged grain; or processed grains like flour. This means that careful handling and proper storage of all grain crops types is needed, if farmers are to ensure a supply of food for themselves and their families until the next harvest.

Careful storage of crops can also allow the farmer to sell when prices are high.

What does this mean for Tad and Mim?

Tad and Mim have estimated the amount of grain they have produced – but now they need to estimate the losses that are likely to happen from when the grain is harvested, to when it is being used or sold.

According to APHLIS the percentages of crop losses that occur, from harvest to market, are generally:

- 30% of the loss occurs at harvesting and infield treatment.
- 40% of the loss occurs during storage at the farm and market (short duration storage).
- 20% of the loss in transport from the field to the homestead/farm.
- 10% of the loss during transport to market.

The 1.15 tonnes of maize grain harvested from Tad and Mim's **smaller** field (Field 1) has already been put into sacks (23 x 50 kg sacks). Any losses they can expect to happen now will be due to pests and diseases, rather than spillage. Because they plan to sell/use this grain soon, these losses should be very small.

The **larger** field (Field 2), with its estimated 2.35 tonnes of grain, has not yet been harvested - so a lot more of this is likely to be lost. Based on the harvesting, threshing, handling and storage methods they have planned for this grain, Uno tells them they can expect to lose 20% over the coming year.

They work out the weight of these grain losses as follows:-

Field 2 losses: 20% x 2.35 tonnes = 20/100 x 2.35 = 0.47 tonnes

Therefore, of their estimated 1.15 + 2.35 = 3.5 tonnes of maize grain, they can expect to lose 0.47 tonnes.

Tad and Mim's maize grain budget

In visit 13, Tad and Mim estimated they will **need** 1.17 tonnes of maize.

They expect to **lose** 0.47 tonnes of grain during storage.

Therefore, their household **maize grain budget** for the coming year is 1.17 + 0.47 tonnes = 1.64 tonnes.

As their total grain supply is 3.5 tonnes, they estimate that they have a SURPLUS of:
3.5 – 1.64 = 1.86 tonnes of maize grain.

Tad and Mim have worked out that they have a surplus of 1.86 tonnes of maize grain. Mim is very pleased because this means that they will have plenty of spare grain to sell.

They need to think carefully about **when** to sell this grain.

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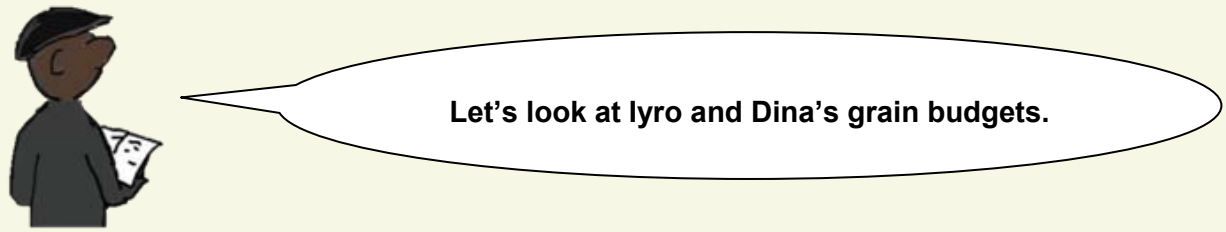
Uno How's Farm Visit 14

Estimating losses

Iyro and Dina's losses



Iyro's maize grain budget

In Visit 11, Iyro estimated he had 2.05 tonnes of maize grain in store. Because Iyro's grain silo is better built than Tad and Mim's, Uno estimates that he may lose 12% of this grain in the coming months. In Visit 13 he estimated that he needed a total of 1.40 tonnes of maize for the year.

The loss is 12/100 x 2.05 = 0.25 tonnes.

Iyro's total **maize grain budget** for the coming year is, therefore:

1.40 + 0.25 tonnes = 1.65 tonnes.

However he has 2.05 tonnes of maize grain.

Therefore, he has a SURPLUS of 2.05 – 1.65 = 0.4 tonnes of maize.

Dina's maize grain budget

In Visit 13, Dina estimated that her maize grain requirement is 1.05 tonnes for the coming year.

She produced an estimated 1.12 tonnes of maize grain this year (0.8 ha x 1.4 tonnes/hectare), which is now stored in a simple shelter.

Based on her poor store, Uno advises Dina that she may lose 20% of her crop to pests and diseases, leading to a loss of 20/100 x 1.12 = 0.22 tonnes of maize grain.

Dina's household maize grain budget is 1.05 + 0.22 tonnes = 1.27 tonnes.

Her maize grain production is 1.12 tonnes.

Therefore, because she has produced less than her maize grain budget, she estimates that she has a DEFICIT of 1.12 – 1.27 = – 0.15 tonnes.

We know that Dina has a deficit because she needs more than she produces. We also know because the calculation produced a **negative number**, shown by the **–** sign in front of the 0.15 tonnes.

Quick Test 8 – Calculating Grain Budgets

1 A farmer has estimated he needs 5 tonnes of grain over the coming year.

He has produced 7.5 tonnes of grain and is storing it in sacks in an old store.
Uno advises him he may lose 20% of his crop to pests and disease.

Calculate the farmer's grain budget. Will he have a surplus or deficit of grain?

2 A farmer has estimated that she needs 8 tonnes of grain over the coming year.

Over the previous year she has had a good harvest and produced 14.5 tonnes of grain. This is to be stored and Uno estimates that up to 20% of the grain may be lost to pests during storage because of pests and disease.

Calculate her grain budget. Will she have a surplus or deficit of grain?

3 A farmer estimates that over the coming year he will require 12 tonnes of grain.

He has produced 13 tonnes of grain. Although he does have a fairly good store he will still lose around 10% of this because of disease and pests.

Calculate the farmer's grain budget. Will there be a surplus or deficit of grain?

4 A farmer has estimated that she will need 7 tonnes of grain and has produced 9.35 tonnes.

This grain must be stored for a long period of time and it is estimated that there will be losses of around 15% because of pests and disease.

Calculate the farmer's grain budget. Will she have a surplus of grain or a deficit of grain?

Note down the answers and check them with the answers at the end of this booklet.

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Uno How's Farm Visit 14

Estimating losses

Negative numbers

In Visit 13, Dina estimated that her maize grain requirement was greater than her production. She estimated a deficit of – 0.15 tonnes, shown by the minus (–) sign.

Negative numbers were previously introduced in Visit 1 (Module 1). The examples shown at the time were *height below sea level* (zero metres) and *temperatures below freezing point of water* (zero degrees Celsius).

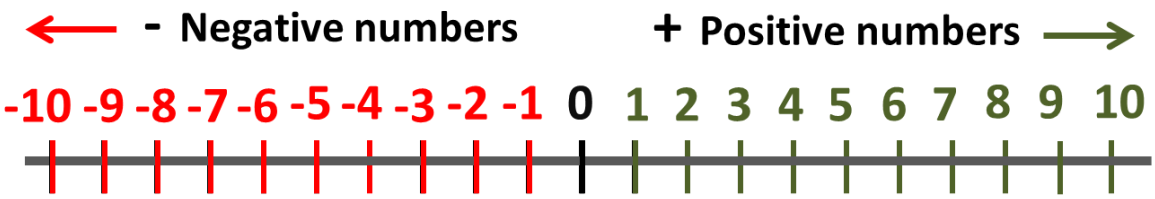
Negative values are often found in calculations relating to planning and budgeting for farming as a business.

In Dina's instance, it was her household maize budget that produced a negative value. It may equally have been her household expenditure, if she had spent more than her income. A negative number would also be used to represent a debt.

In order to understand and use negative numbers correctly, you must recognise some rules that always apply.

- Positive numbers are bigger than zero, negative numbers are less than zero.
- In graphs and figures, negative numbers increase in the opposite direction to positive numbers.
- Negative numbers are shown by the **–** sign. Positive numbers are shown by the **+** sign. Note that any number **without** a sign in front is positive.

The **number line** below shows the pattern of change of positive and negative numbers, starting from zero:



In Module 1, we learned about adding and subtracting numbers which were all greater than zero. They were all positive.

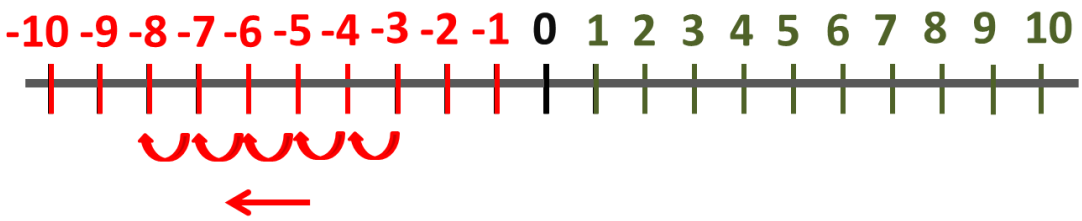
Sometimes we need to add or subtract negative numbers. We can use the number line to help us. When using a number line, count to the **right when adding** and to the **left when taking away**.

For example, a farmer owed a friend $3. Because this $3 is a **debt** (that is, money he owes) it is written as the negative number -$3.

If he then borrowed another $5 from his friend, this debt would be represented by the sum:

-$3 - $5 = - $8

We can use the number line to show this. Starting at -3, count another 5 places to the left (because the debt is getting bigger). The answer is -$8.

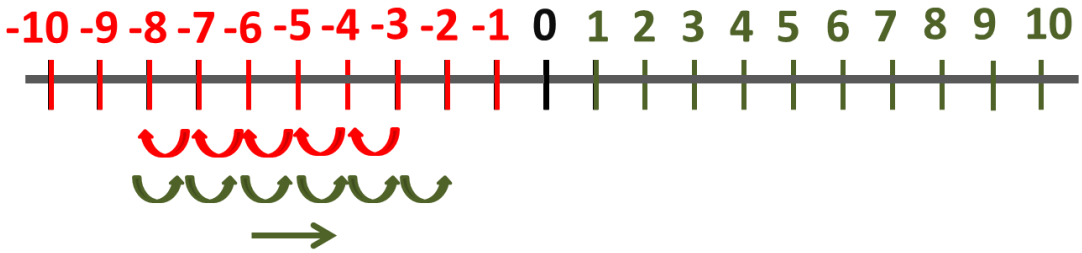


So, as the debt gets bigger, the negative number also gets bigger.

If he then paid $6 of this money back, his current debt would be represented by the sum:

-$8 + $6 = -$2

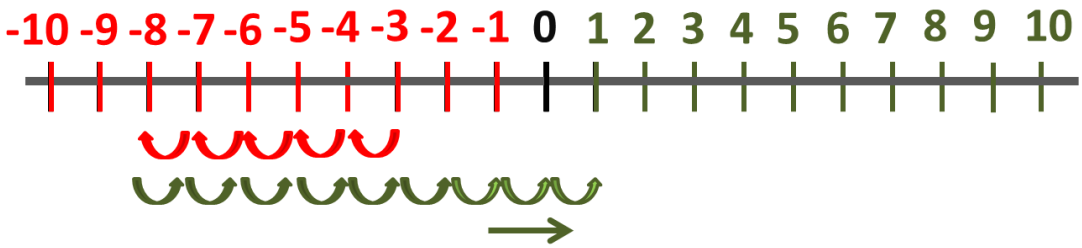
We can use the number line again to show this. Starting at -8, count 6 places to the right (because the debt is being reduced). The answer is -$2.



If his friend then gave him $3, this would be represented by the sum:

-$2 + $3 = +$1 which can be written as -$2 + $3 = $1

Again, we can use the number line to show this. Starting at -2, count 3 places to the right (because the debt is being reduced). The answer is +$1. Because this is a positive number he is no longer in debt. He is $1 in credit.



Quick Test 9 – Negative numbers

1 A farmer borrowed $10 from a neighbour. She paid back $3 each month for 3 months.

How much does she owe at the end of this period?

2 A farmer borrowed $5 from a friend. He paid $2 back a week later.
The following week he borrowed $8.

How much does he owe at the end of this period?

3 A farmer borrowed $16 from a neighbour. He then borrowed another $10.
The following month he paid his neighbour back $30.

How much is he in credit/debit at the end of this period?

4 A farmer borrowed $8 from a friend. He paid $4 of it back the following week.
The week after that he borrowed $6. Later that month he paid back $7.

How much is he in credit/debit at the end of this period?

Note down the answers and check them with the answers at the end of this booklet.

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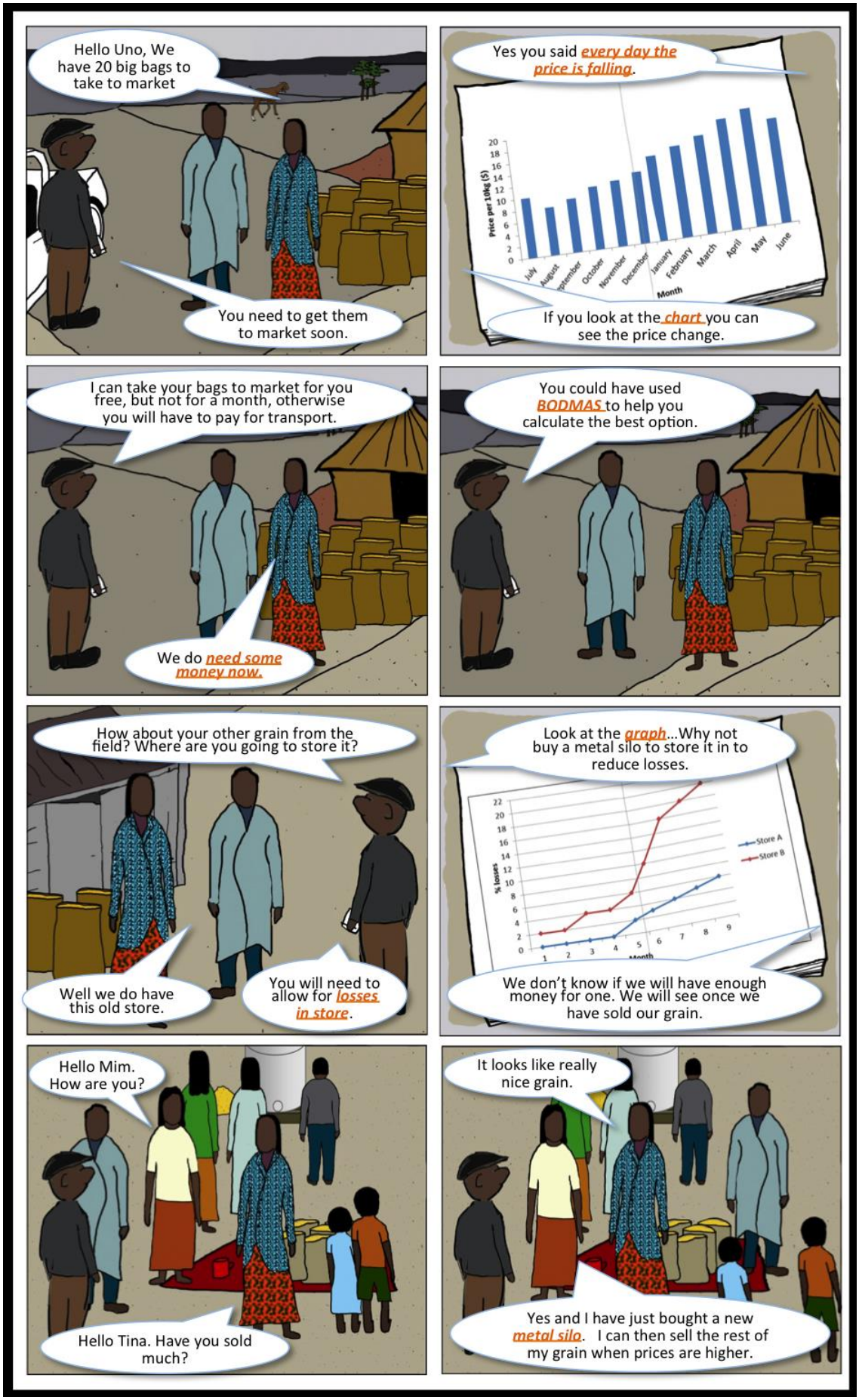
Uno How's Farm Visit 15… Selling the product



Completed Visit 15 – Continue to Visit 16

Uno How's Farm Visit 15

Selling the product

When to sell

Tad and Mim have much more maize than they need, as they have had a good year of rain and few pests.

Prices of goods are constantly changing and are generally determined by how much is available on the market (the **supply**) and how much is required by the customers (the **demand**).

As a very simple rule, when the **supply** of a product goes up, its price will go down; and when **demand** for it goes up, its price goes up.

Because agricultural production is seasonal, the supply to the market is variable and so prices tend to move up and down with the time of year. At harvest, crop prices tend to fall sharply, because there is more produce available (supply has gone up).

It is now July. The harvest has started. Uno tells Tad and Mim that the price is falling every day, because the number of sellers is going up each day. Because the farming households have their own fields, the number of buyers is also coming down.

As time passes, supplies on the market will start to decrease. Demand will increase, as households use up their grain supplies. So, prices will start to increase again.

Look at the example below:

July → **Much later in the year**

$85 per 100 kg sack	$70 per 100 kg sack	$100 per 100 kg sack	$200 per 100 kg sack
12 sellers at the market	*15 sellers at the market*	*8 sellers at the market*	*1 seller at the market*

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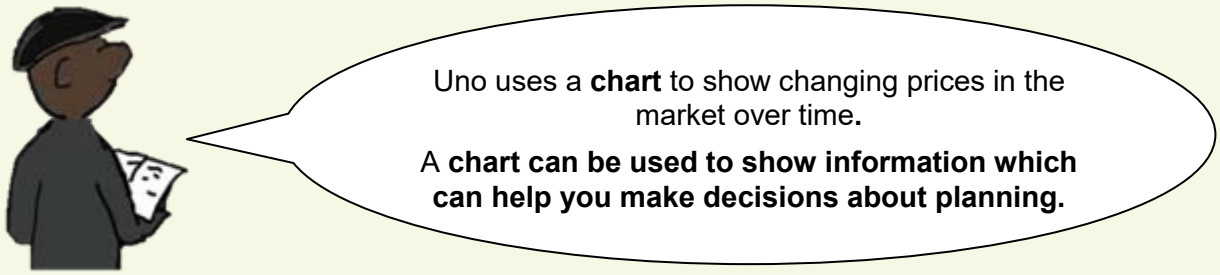
Uno How's Farm Visit 15

Selling the product

Charts



Extension services record market prices in most local markets. They work out the **average selling** price for each month and put this information into tables.

Uno shows Tad and Mim a table (**Table 11**) that shows the **average selling price** for maize on their market the year before:

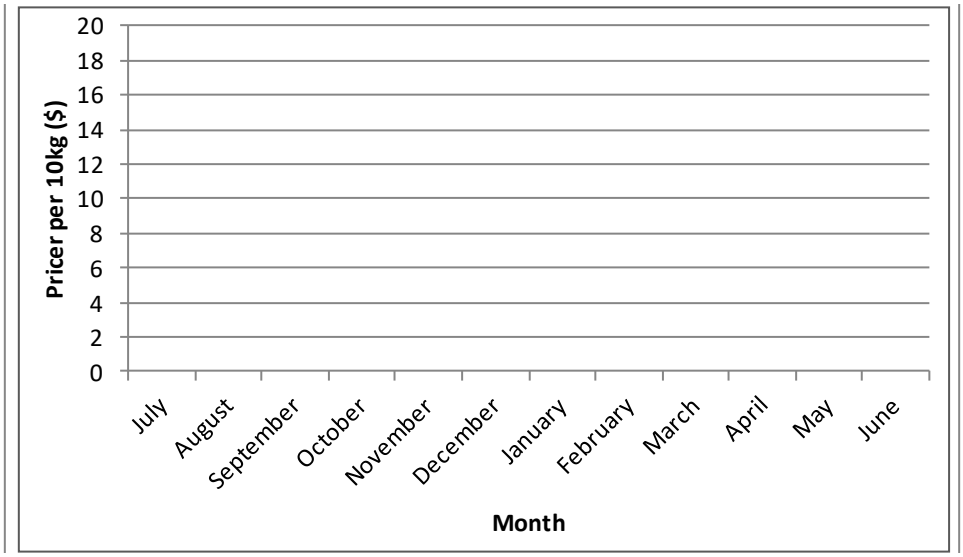
Table 11: Last year's average selling price per month, per 10 kg bag of maize grain

Month	Average selling in per 10 kg bag in $
July	10
August	8
September	9
October	10.50
November	11
December	12
January	13
February	14
March	15
April	17
May	18
June	16

Uno decides to put these figures into a **chart**. Charts are often used to present information as a picture, so that it is easier to understand. The type of chart he draws is called a **bar chart:**

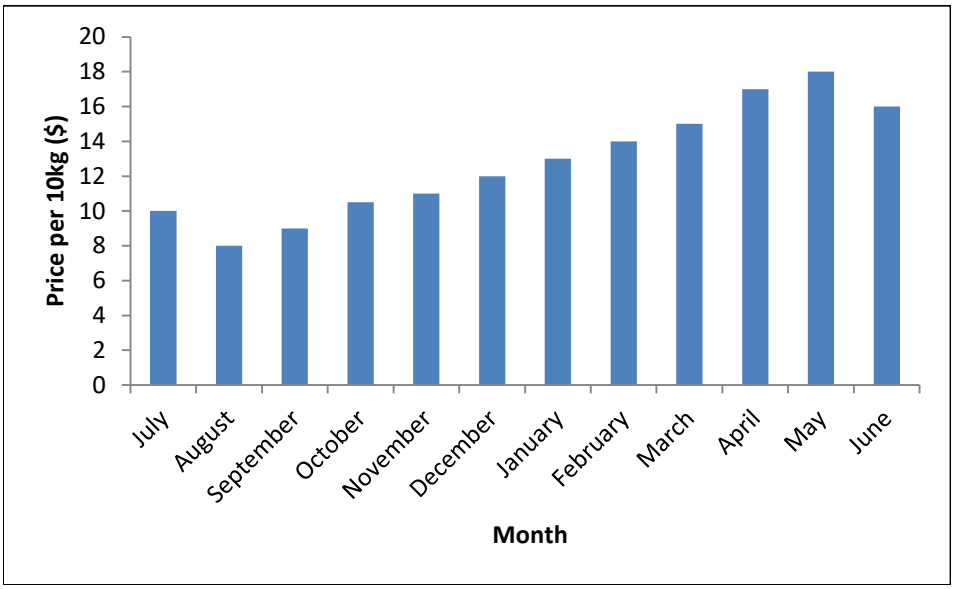
- **Time** is shown in months along the bottom (horizontal **axis**, also called the **x-axis**) of the graph. The months are shown in equally spaced intervals and move along from left to right.
- **Price** is shown going up the left (vertical **axis**, also called the **y-axis**) of the graph.

Figure 1a: Empty bar chart that will show the average prices of maize grain



Uno starts with July. The price of a 10 kg bag of maize grain was $10. He draws in a bar upwards from July that reaches the $10 line. He moves across to August and draws a bar to $8, and so on.... drawing bars for all 12 months.

Figure 1b: Completed bar chart showing average price ($) for 10 kg of maize grain



Looking at the bar chart (and assuming that prices will follow a similar pattern this year to last year), Tad and Mim can see that they would probably earn most income from their maize if they were able to sell it much later (for example, in May), when supply is low and prices are at their highest. However, it is not always possible to sell produce when market prices are at their highest.

Tad and Mim want to sell some of their grain very soon because:

- They urgently need some money to cover some household bills.
- They have a very poor and small storage area – they would not be able to store their grain for several months without big losses.

The grain from their large field (Field 2) is not yet ready for sale. But the grain from Field 1 is in 23 x 50 kg sacks, so can be easily transported to the market. They decide to take 20 of their 50 kg sacks to market to sell now, and to keep back 3 to use themselves.

Quick Test 10 – Bar Charts

1 Put the following information for the average price ($) of 10 kg of sorghum into a bar chart:

July $16; August $12; September $13; October $15; November $20; December $21; January $22; February $23; March $25; April $27; May $29; June $25

In what month is the price the highest? When is it the lowest?

2 Put the following information for the average price ($) of millet (per 10 kg) into a bar chart:

July $10; August $10; September $15; October $17; November $19; December $22; January $24; February $25; March $26; April $23; May $18; June $15

Which two months show the highest prices?

3 Put the following information for the average price ($) of finger millet (per 10 kg) into a bar chart.

July $12; August $12; September $15; October $13; November $17; December $18; January $20; February $19; March $22; April $20; May $21; June $23

Which months show the lowest prices? Which months would be best for the farmer to sell his grain?

Note down the answers and check them with the answers at the end of this booklet.

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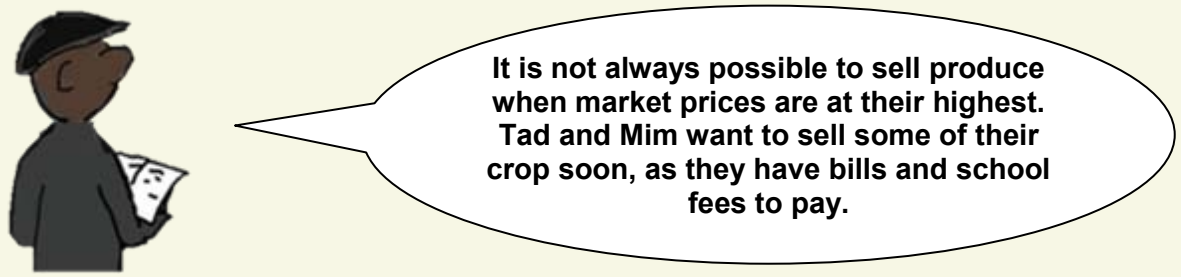
Uno How's Farm Visit 15

Selling the product

When and how much to sell



Having decided to sell 20 sacks of grain, Tad and Mim have a choice to make:

Option 1
Uno says he can transport the 20 sacks to market for them at no charge, but they will have to wait until next month, when prices will probably have fallen to $8 per 10 kg.

Option 2
They can pay a trader to transport their 20 sacks to market this week. The cost of transport is $11 a sack. Looking at the bar chart shows them they can expect a selling price of $10 per 10 kg.

Uno is going to help Tad and Mim write equations to help them work out the **revenue** (the money a business brings in when selling its goods) and the **costs** for each option. They can then work out which option will earn them more money.

Looking at Option 1:

Let's recap – Tad and Mim have 20 sacks to sell. The selling price next month is expected to be $8 per 10 kg bag. This means they could expect to have a **revenue** of $40 from a 50 kg sack.

Revenue = 20 sacks x $40 = $800

There is no transport cost as Uno will take them to market free of charge. **So the money they they will take home = $800.**

Looking at Option 2:

Tad and Mim have 20 sacks to sell. The selling price at the moment is $10 per 10 kg bag. This means they could expect to have a revenue of $50 from a 50 kg sack.

Transport would cost $11 a bag.

Revenue = 20 sacks x $50 each = 20 x 50 = $1000

Transport costs = 20 sacks x $11 = $220

So the money they will take home = $1000 - $220 = $780

If Tad and Mim take advantage of Uno's offer of help (Option 1) they will therefore bring home $800 - $780 = $20 more.

Also, because they will load the bags themselves and will check the load at regular intervals, they won't expect to lose any grain on this journey. When transported on public transport, harvests are at greater risk from losses through leakage, damage and theft.

Another example of calculating and comparing possible incomes.

Tad and Mim have a friend who has 25 sacks (50 kg each) of millet to sell.

At market millet is currently selling for $12 per 10 kg. Each 50 kg sack is, therefore, selling for $60. Transport costs to market are currently $10 per 50 kg sack.

He knows someone who can take the sacks to market in two weeks time for only $5 per 50 kg sack. At this time, the price of millet is set to decrease to $9 per 10 kg. Each sack would therefore be expected to sell for $45.

Calculate the advantage of each option. With which option would make him better off?

Option 1: Selling the millet now, with higher transport costs:

Revenue = 25 sacks x $60 each = $1500 **Cost of transport** = 25 sacks x $10 each= $250

The money they will take home from the sale of the 25 sacks of millet = $1500 - $250 = **$1250**

Option 2: Selling in two weeks, with lower transport costs:

Revenue = 25 sacks x $45 each = $1125 **Cost of transport** = 25 sacks x $5 each = $125

The money will take home from the sale of the 25 sacks of millet = $1125 - $125 = **$1000**

Option 1 gives more money to take home. Tad and Mim's friend would be better of selling the millet now and paying more for transport.

Quick Test 11 – Deciding when and how to sell

1 A farmer has 10 sacks of sorghum to sell. Each sack weighs 20 kg and currently sells for $30 each. Transport to market currently costs $5 a sack.

However, a neighbour can transport the sacks to market for free in three weeks' time, when they will probably only be worth $20 each.

Calculate the money he will take home from each option. Would he be better off selling them now, or selling them later?

Quick Test 11 cont… – Deciding when and how to sell

2 A farmer has 20 sacks of maize to sell. Each sack weighs 20 kg. The current selling price of maize on the market is $11 per 10 kg. Transport to market currently costs $3 per 20 kg sack.

A neighbour can transport the sacks to market for free in a week's time, when 10 kg of maize will probably sell for $10.

Calculate the money she will take home from each option. Would she be better off selling them now, or selling them later?

3 A farmer has 30 sacks of sorghum to sell. Each sack weighs 40 kg and currently sells for $60 each. The cost of transport to the market is currently $10 per 40 kg sack.

If they are taken to the market in two weeks, the cost of transport decreases to only $4 per 40 kg sack. By this time the price of sorghum will probably decrease to about $45 per 40 kg sack.

Calculate the money the farmer will take home from each of these two options. Which one would make the farmer better off?

Note down the answers and check them with the answers at the end of this booklet.

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Uno How's Farm Visit 15

Selling the product

Using BODMAS

In the above example, Tad and Mim worked out profit by writing down three separate sums. Uno explains that they could have carried out these calculations in fewer steps if they used "BODMAS"

The use of brackets in calculations is the first step in a sequence explained by the acronym **BODMAS**. The word BODMAS explains the right order to carry calculations out. The letters stand for:

- **B**rackets - Work out the parts of the calculation that are in brackets first.
- **O**rder - Next work out the parts that are "ordered" (for example squared numbers).
- **D**ivision or **M**ultiplication - Next work out the parts that are either divided **or** multiplied.
- **A**ddition or **S**ubtraction - Finally, work out the parts that are either added **or** subtracted.

Knowing when and where to use brackets is a very important step in solving many mathematical calculations!

Tad and Mim worked out the best option for selling their maize by writing down three separate sums:

1. They calculated the revenue from the 20 sacks.
2. They calculated the cost of transporting the 20 sacks.
3. They subtracted the transport costs from the income to work out the take-home income.

Uno explains that this calculation could have been written out as one sum, but that brackets must be written in, to make sure it is carried out in the correct way:

Take home income = (no. of sacks x price of sack at market) – (no. of sacks x transport/sack)

Let's look at Option 2 again. They have 20 sacks, which will sell for $50 each. Transport is $11 a sack.

Take-home income = (20 x 50) – (20 x 11) **= 1000 – 220 = $780**

The **brackets** keep the first and second parts of the equation separate, which stops the numbers from becoming confused. If brackets had **not** been used, then the answer **could** have been worked out incorrectly. Let's look at Option 2 again, without the brackets:

Take-home income = 20 x 50 – 20 x 11 = 1000 – 20 x 11 = 980 x 11 = £10780

or 20 x 30 x 11 = 600 x 11 = $6600

Notice that both these answers are incorrect!

By drawing in the brackets, Uno could make sure that the calculation was carried out in the correct order – that is, by working out the revenue, then working out the cost and finally subtracting these to work out the take-home income.

Let's try another example:

Tad and Mim buy 10 kg of seed at $25 and 20 kg of fertiliser at $30 from a merchant. How much would they have to pay in total?

Tad and Mim buy 10 kg of seed at $25 and 20 kg of fertiliser at $30

Putting numbers into brackets allows Tad to recognise the correct order:

They buy **10 kg of seed at $25**. This sum will go inside the **first set of brackets**.

They buy **20 kg of fertiliser at $30**. This sum will go inside the **second set of brackets**.

(10 kg x $25) + (20 kg x $30)

Do the calculations inside each bracket first.

(10 x 25) + (20 x 30) = 250 + 600

Then the final calculation

250 + 600 = $850

Note that if we did not use brackets, we may have got the **wrong** answer:

Total Cost = 10 kg x $25 + 20 kg x $30

Without brackets this **could** be worked out as:

10 x 25 + 20 x 30 = 250 + 20 x 30 = 270 x 30 = 8100

8100 is the wrong answer! Note that this is the answer provided by a simple calculator when the sum is typed in without bracket.

Let's look at another example of using **BODMAS.**

You have 2 boxes of 80 oranges to share out to 30 girls and 10 boys. How many oranges will they have each?

By following **BODMAS**, we can use brackets to work out the total number of oranges and the total number of children separately. Once we have worked these two answers out, we can divide them to find our final answer:

(2 x 80) ÷ (30 + 10) = **160 ÷ 40** = 4 oranges each.

More complicated equations using BODMAS

We have learned what BODMAS stands for, and therefore the order of calculations. Here are some examples:

Calculation	Order of completion "BODMAS"	Answer
3 x (7 - 5) =	Three farmers have 7 sacks. Each farmer sells 5 sacks. How many sacks do they have left in total? **The subtraction goes into brackets. This calculation is worked out first.**	3 x 2 = 6
$20 + 4^2$	A farmer had a vegetable bed measuring 20 m^2. He had another square bed measuring 4m along each side. What is the total area of the two beds? **The "order" (that is the squared number) is calculated first, then the addition.**	20 + 16 = 36
3 x 10 ÷ 2 =	A farmer sold 3 chickens for $10 each and divided the money he earned between his two children. How much did they get each? **Multiplication and division have the same level of order so complete from left to right**. This means that in your equation, if you do not need brackets, you can work through the equation from left to right.	30 ÷ 2 = 15
6 - 2 + 5 =	A farmer bought 6 sacks of grain, gave 2 to his neighbour, but then bought another 5. How many sacks of grain does he have? **Addition and subtraction have the same level of order so complete from left to right**. This means that in your equation, if you do not need brackets, you can work through the equation from left to right.	4 + 5 = 9
30 - 2 x 5 =	A farmer has $30. He buys 2 hoes for $5 each. How much does he have left? **Complete the multiplication first, followed by the subtraction (brackets can help make the sum easier to understand but will not change the answer if BODMAS is applied).**	30 - 10 = 20

More examples using BODMAS

1. A farmer sells chickens for $5 each. He sells 2 to one neighbour and 1 to another friend. How many dollars has he made?

First, the number of chickens the farmer sells should be put into brackets:

$5 x (2 + 1) = $5 x 3 = $15

The farmer has made $15.

If we didn't use brackets, the multiplication would be carried out before the addition – that is, 5 x 2 + 1 = 11, which is incorrect.

2. A farmer buys 5 sacks for $2 each, and 2 smaller sacks for $1.50. How much does he spend?

This sum includes multiplications and an addition. Because (using BODMAS) the multiplications will be worked out separately first, brackets are not essential – but they do make the sum easier to understand:

(5 x $2) + (2 x $1.50) = $10 + $3 = $13

3. A farmer has $15. He buys 4 chickens for $3 each. How much money does he have left?

This sum includes a multiplication and subtraction. Because (using BODMAS) the multiplication will be worked out separately first, brackets are not essential – but they do make the sum easier to understand:

$15 – 4 x $3

Or as:

$15 – (4 x $3) = $15 – $12 = $3

The farmer has $3 left.

4. A farmer has 6 bags of maize and 14 bags of sorghum. He is sharing the sorghum equally with his brother but is keeping the maize for himself. How many bags of grain will he have for himself in total?

This sum includes a division and addition. Because (using BODMAS) the division will be worked out separately first, brackets can make the sum easier to understand – but they are not essential. The equation can be written as:

6 + 14 ÷ 2

Or as:

6 + (14 ÷ 2) = 6 + 7 = 13 sacks for himself in total.

5. A farmer has $12 from one sale and $4 from another. He shares this money equally with his mother. How much money will they each receive?

This sum involves addition and division. The addition part must be carried out first, in order to calculate the total amount of money the farmer earned. So, brackets must be used:

(12 + 4) ÷ 2 = 16 ÷ 2 = 8

They will each receive $8.

6. A farmer has only 10 kg of grain that he wishes to share equally between 5 visitors for 3 days. How much grain does each person get over the 3 days?

This sum involves division only, so brackets are not required. It can be written as:

10 ÷ 5 ÷ 3 = 0.66

They will each have 0.66 kg of grain.

7. A farmer has 3 boxes, each with 10 apples in. He has 5 bags, one for each customer. How many apples should he put in each bag so they each have an equal amount?

This sum involves multiplication and division which are at the same level within BODMAS, so brackets are not required. The equation can be written as:

3 x 10 ÷ 5 = 6

He should put 6 apples in each box.

8. A farmer sells 3 chickens for $6 each at the market. He then divided this money equally with his father. He then spent $1 on food on the way home. How much money does he have left?

The equation involves multiplication, division and subtraction. Because the subtraction is the last calculation in the sequence, brackets are not needed – but putting them in makes it easier to follow:

3 x 6 ÷ 2 – 1 = 18 ÷ 2 – 1 or as: (3 x 6 ÷ 2) – 1 = (18 ÷ 2) – 1 = $8 left.

9. A farmer sells 5 sacks of grain for $20 each at the market. He pays $15 market fees. He shares the remaining money equally with his sister when he gets home. How much money do they receive each?

The equation involves multiplication, subtraction and then division. It is like the above example but things happen in a different order, which means the sum needs to be done differently. We must write in brackets to make sure that the multiplication and subtraction are carried out first, and finally the division:

(5 x 20 – 15) ÷ 2 = $42.50 each

NOTE: If brackets were not used, the multiplication and divisions would be carried out first, so the wrong answer would result: 5 x 20 – 15 ÷ 2 = 100 – 7.5 = $92.50 = the wrong answer!

Using BODMAS with calculators and Excel

The use of brackets is especially important when using calculators and computer packages like Excel.

Let's look at Question 3 again: **A farmer has $15. He buys 4 chickens for $3 each. How much money does he have left?** As pointed out earlier, this sum includes a multiplication and subtraction. When working out the sum by hand, BODMAS dictates that the multiplication part will be worked out separately first, so brackets are not essential. However, if we type this sum directly into a **calculator**, we get the wrong answer – this is because the calculator does not "know" what is coming up next. When using a calculator, it is always best to put parts of the calculation that need working out separately into brackets:

$15 – (4 x $3) = $15 – $12 = $3

The farmer has $3 left.

The same is applied to calculations carried out on computer spreadsheets:

Let's try an example:

A trader is selling hoes at the market. He bought the hoes for $15 each and is selling them for $20 each. He wishes to calculate the profit he makes when he sells 10 hoes.

Profit = Revenue - Cost
Profit on one hoe = $20 - $15 = $5
Profit on 10 hoes = 10 x 5 = $50

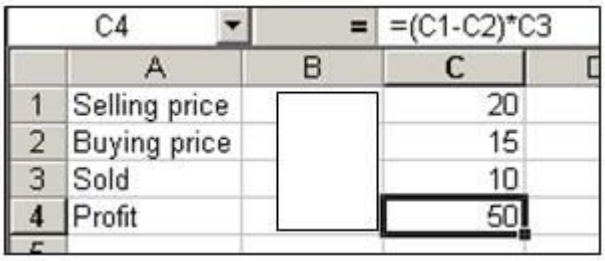
This can be written as ($20 - $15) x 10 = $5 x 10 = $50

In **C4** below, brackets have been used in the Excel equation, giving the right answer (*note that in Excel, the **x** sign is represented by a* *). **The brackets ensure that C2 is subtracted from C1 before the multiplication is carried out:**

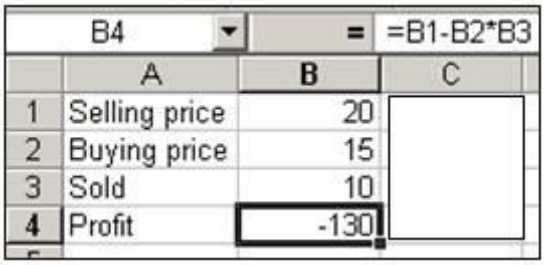
C4 = (C1 - C2) * C3

In the Excel calculation shown in **B4**, brackets were not used and the wrong answer is provided. This has happened because B2 has been multiplied by B3 before being taken away from B1. **Because there were no brackets, in B4 the actions were in the wrong order, giving a wrong answer.**

B4 = B1 – B2 * B3



C4	=	=(C1-C2)*C3
	A	B	C
1	Selling price		20
2	Buying price		15
3	Sold		10
4	Profit		50



B4	=	=B1-B2*B3
	A	B	C
1	Selling price	20	
2	Buying price	15	
3	Sold	10	
4	Profit	-130	

Quick Test 12 – Using BODMAS in calculations

1 A farmer buys 3 sacks of sorghum for $20; 2 sacks of millet for $10; and 1 sack of fertiliser for $5.

Write out a calculation using BODMAS to find out how much he spends in total.

2 A farmer buys 10 sacks of millet that cost $5 each, 4 sacks of sorghum that cost $7 each and 3 sacks of fertiliser for $8 each.

Write out a calculation using BODMAS to find out how much she spends in total.

3 A farmer has $23. He buys 3 sheep which cost $5.50 each.

Write the calculation using BODMAS and work out how much he will have left.

4 A farmer sells 6 goats for $40 each and a cow for $100. He then pays $30 market fees out of the money he earned.

Write out a calculation using BODMAS to find out how much he has remaining.

5 A farmer sells 4 sacks of grain for $24 each and 2 goats for $32 each. He then pays $34 market fees and buys 2 chickens for $5. When he returns home, he shares the money he has left equally between himself and his 2 siblings.

Write out a calculation using BODMAS to find out how much they each receive.

6 A farmer has 12 chickens and 10 sheep. After selling half of his sheep how many animals will he have left?

Write out a calculation using BODMAS to find out how many animals he will have left.

7 A farmer has 28 kg of grain. He wants to keep 4 kg of it and to share the remainder equally between his 40 chickens over 6 days. How much grain will he give each chicken per day?

Use BODMAS to work out the answer.

Note down the answers and check them with the answers at the end of this booklet.

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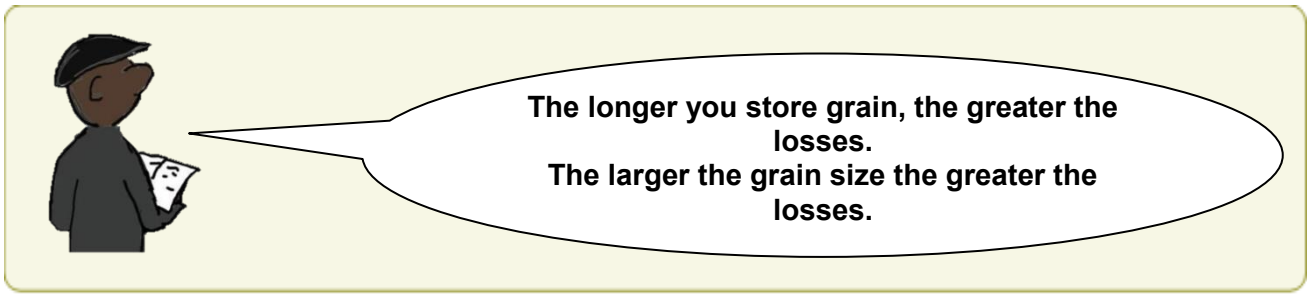
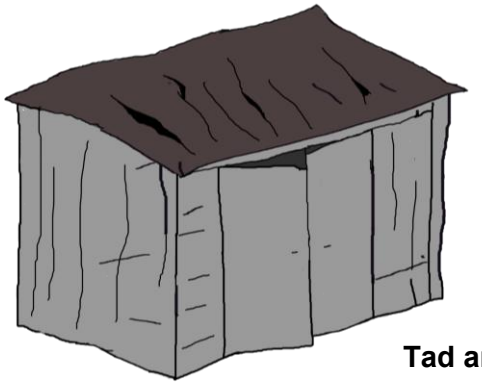
Uno How's Farm Visit 15

Selling the product

Losses from long-term storage



Tad and Mim are selling off nearly all of their bagged maize, but what about the grain that they will be threshing from their large field? Uno is worried that Tad and Mim do not have a good enough store to keep this threshed grain.



Tad and Mim's old store

Uno has already estimated that Tad and Mim may lose 20% of this grain and that 40% of this loss is likely to happen in storage. But of course, the actual amount of loss will largely depend upon how long the crop is in the store.

The longer a crop is in storage, the more is likely to be lost. A crop can be stored longer in a well-built store than it can in a poorly-built store.

Uno wants to show Tad and Mim the importance of a well-built store.

He shows them a table that shows grain losses in two stores that he once visited – one was well built (secure, dry but ventilated) and the other very poor (a simple shelter with a leaking roof).

Each store contained 50 sacks.

Table 12a shows the number of sacks spoiled each month (by moulds, rodents and insects), in each store:

Table 12a: Monthly losses out of 50 sacks, in a well-built and poorly built store.

Sacks and percentage lost in store (out of 50 in each store)				
Months in storage	Store A - Well-built		Store B - Very poorly built	
	Total number of sacks lost	Percentage lost	Total number of sacks lost	Percentage lost
1	0		1	
2	0		1	
3	0		2	
4	0		2	
5	1		3	
6	1.5		5	
7	2		8	
8	2.5		9	
9	3		10	

Uno helps Tad and Mim work out what these losses are as percentages.

Note: So far, Tad and Mim have worked out what the percentage of a value is (e.g. 10% of $200 is $20). **Now Uno is showing them how to find out what one value is as a percentage of another** (e.g. $20 is 10% of $200).

For each month, he does this by dividing the number of sacks lost by the total number of sacks put in the store (which is 50) and multiplying this by 100.

Percentage loss = sacks lost ÷ total sacks x 100.

For example, in the well-built store, 1 sack of grain (out of the 50) was lost after 5 months.

Percentage loss = 1/50 x 100% = 2% of the sacks lost.

Tad and Mim complete the table for the other months and both stores:

Table 12b: Monthly losses and percentages for 50 sacks, in a well-built and poorly built store.

Sacks and percentage lost in store (out of 50 in each store)				
Months in storage	Store A - Well-built		Store B- Very poorly built	
	Total number of sacks lost	Percentage lost	Total number of sacks lost	Percentage lost
1	0	0/50 x 100% = 0%	1	1/50 x 100% = 2%
2	0	0/50 x 100% = 0%	1	1/50 x 100% = 2%
3	0	0/50 x 100% = 0%	2	2/50 x 100% = 4%
4	0	0/50 x 100% = 0%	2	2/50 x 100% = 4%
5	1	1/50 x 100% = 2%	3	3/50 x 100% = 6%
6	1.5	1.5/50 x 100% = 3%	5	5/50 x 100% = 10%
7	2	2/50 x 100% = 4%	8	8/50 x 100% = 16%
8	2.5	2.5/50 x 100% = 5%	9	9/50 x 100% = 18%
9	3	3/50 x 100% = 6%	10	10/50 x 100% = 20%

Tad and Mim's store is very old, so Uno thinks they could face losses of up to 20%, if their grain is stored for several months.

They need to think very carefully about storage so they can minimize losses from the maize which they will harvest shortly from their big field.

Quick Test 13 – Calculating percentage losses in store

1 Calculate the percentage losses for Store A and Store B and complete the table. Note: there were 30 bags in both stores at the start.

Sacks and percentage lost in store (out of 30 in each store)				
Months in storage	Store A - Well-built		Store B- Very poorly built	
	Total number of sacks lost	Percentage lost	Total number of sacks lost	Percentage lost
1	0		2	
2	0		2	
3	0		3	
4	1		4	
5	2		6	
6	2		8	
7	3		10	
8	4		11	
9	5		14	

2 Calculate the percentage losses for Store A and Store B and complete the table: Note: there were 25 bags in both stores at the start.

Sacks and percentage lost in store (out of 25 in each store)				
Months in storage	Store A - Well-built		Store B- Very poorly built	
	Total number of sacks lost	Percentage lost	Total number of sacks lost	Percentage lost
1	0		2	
2	0		2.5	
3	0		3	
4	1		3	
5	1		4	
6	1.5		4	
7	2		7	
8	4		9	
9	6		12	

Note down the answers and check them with the answers at the end of this booklet.

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Uno How's Farm Visit 15

Selling the product

Losses in the field and in storage - Using graphs

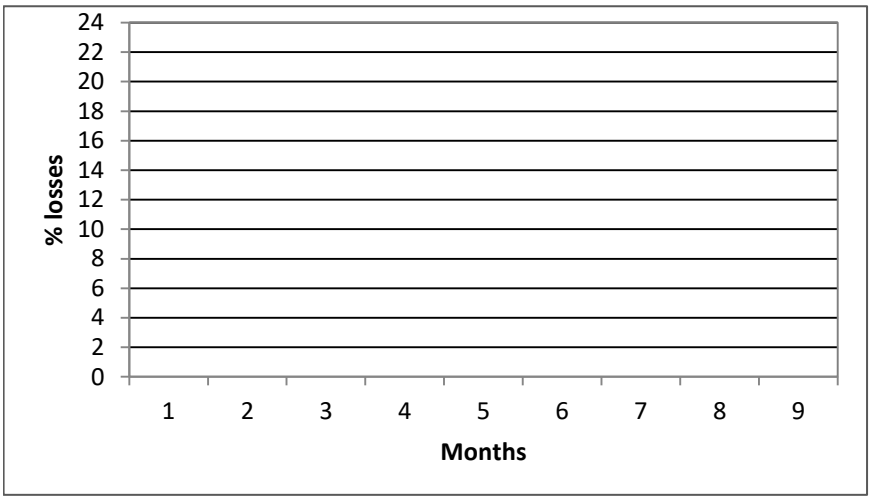
Although Tad and Mim can easily see that more grain is lost in the poor store, it is not so easy for them to see the pattern of loss with time.

Uno decides to put the figures into a **graph**. Like a chart, a graph displays information in a picture. Uno uses a **line graph**, which is a good way of displaying changes that occur **gradually** over time, making them easier to understand and compare in a single glance.

In the empty graph shown in **Figure 2a, time** is shown in months along the bottom line (horizontal or x axis). The months are equally spaced and increase from left to right.

The size of the loss is shown up the vertical axis (y-axis) of the graph. The losses are in equally spaced intervals of 2% and increase from bottom to top.

Figure 2a: Empty Graph for % losses for each month

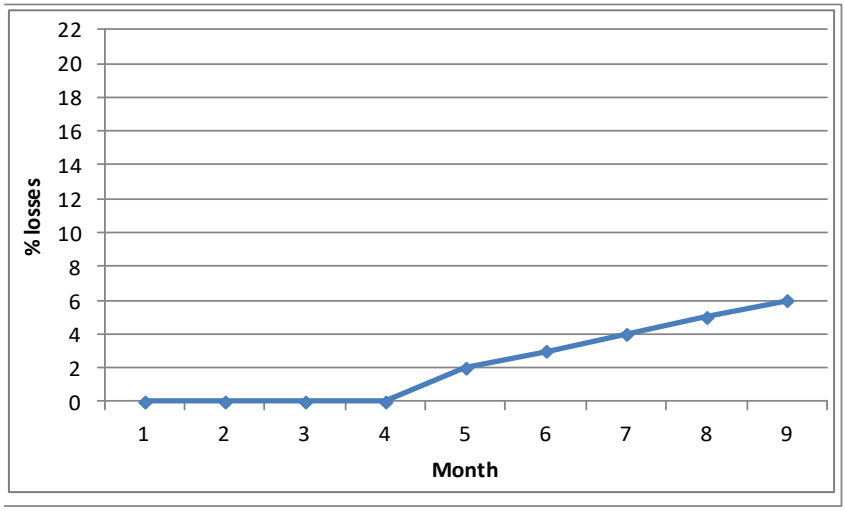


Because there are two stores, Uno's line graph will have two lines.

He starts by drawing the line for Store A, the well-built store: He moves along the horizontal axis of the graph until he gets to month 1. Looking at the table, the grain loss for month 1 for Store A is 0%. He therefore draws a dot where (generally invisible) lines drawn upwards from month 1, and across from 0% loss would meet. He continues doing this for all 9 months. So, for example, for month 5, he draws a dot where a line drawn upwards from month 5 would meet a line drawn across from 2%.

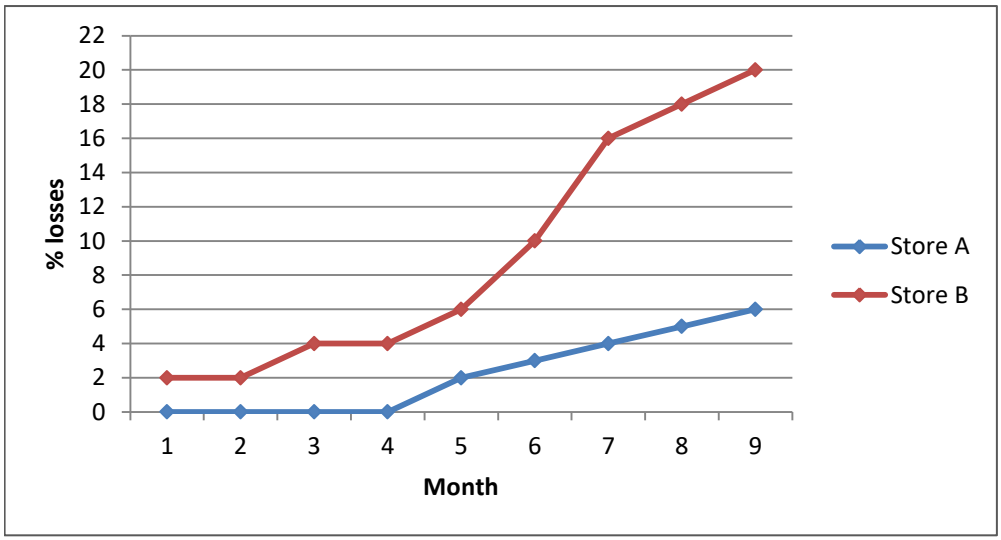
Finally, Uno joins up the dots with a line. The line graph in **Figure 1b** shows changes over time for Store A, the well-built store.

Figure 1b: % losses for each month in Store A



Uno repeats the same process for Store B, adding it to the same line graph, using a different colour. The result is a line graph that shows percentage grain losses over time for 2 stores, allowing comparison between them.

Figure 1c: % losses for each month in Store A and Store B



The line graph can be used to read one figure off from another.

For example, what is the % grain loss for each store after 8 months? Follow the (imaginary) line up from Month 8 to where it meets lines A and B. Move across from each point and read off the corresponding % loss value.

After 8 months, Store A has lost 5% of its grain, whereas Store B has lost 18%.

Tad and Mim decide that they need to buy a new store to try to reduce their grain losses. They decide to go and visit a trader they know who has a grain silo, to learn more.

Quick Test 14 – Using graphs

1 30 sacks of grain were placed in two stores, A and B. The table below shows how many sacks were lost from each store over 9 months.

	Month 1	**Month 2**	**Month 3**	**Month 4**	**Month 5**	**Month 6**	**Month 7**	**Month 8**	**Month 9**
Store A	0	1	1.5	2	3	5	6	9	12
Store B	0	0	0	1	2	2.5	2.5	3	3

Calculate the percentage losses for both stores over the 9 months. Plot these losses on a graph. Which of the stores was better?

2 50 sacks of grain were placed in three stores, A, B and C. The table below shows how many sacks were lost from each store over 9 months.

	Month 1	**Month 2**	**Month 3**	**Month 4**	**Month 5**	**Month 6**	**Month 7**	**Month 8**	**Month 9**
Store A	0	1	3	3	5.5	7	10	12	15.5
Store B	0	2	3.5	6	8	9	11.5	14	19
Store C	0	0	1	3	3	4	4.5	4.5	5

Calculate the percentage losses for the 3 stores over the 9 months. Plot these losses on a graph.

Note down the answers and check them with the answers at the end of this booklet.

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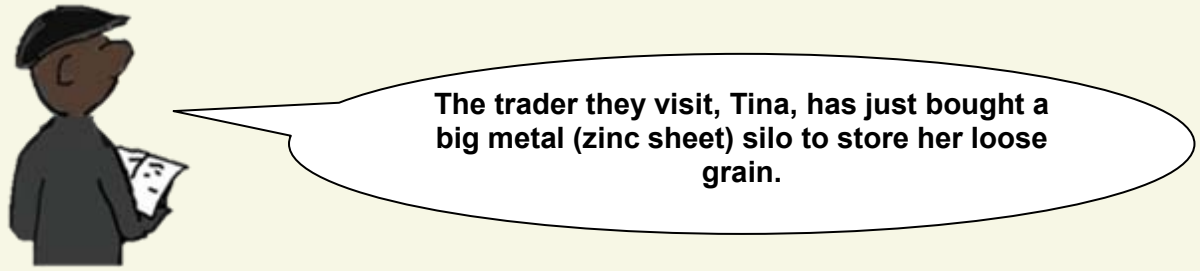
Uno How's Farm Visit 15

Selling the product

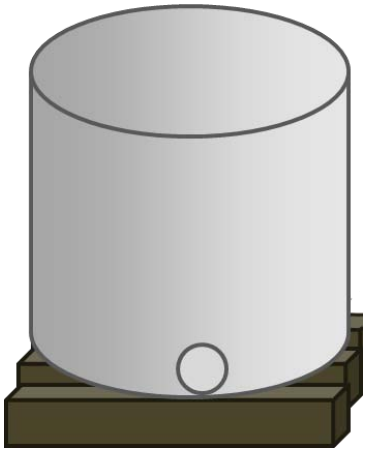
Using silos for storage



Tina has bought a metal (zinc sheet) cylinder shaped silo to store her loose grain. She has dried her grain to 13% moisture content after harvest, to protect the grain from insect and disease build up. This should allow her to store her grain until next year, when prices will be higher.

It is a very large silo – much bigger than one Tad and Mim would need.

Tina explains how Uno helped her calculate the size of silo she needed, based on the amount of grain she had to store, which was 20 tonnes.



As we learned in Module 3, maize grain has a density of 0.72 tonnes per cubic metre.

0.72 tonnes of maize grain needs a storage capacity of 1 m^3.

So a store for 20 tonnes would need to be 20 ÷ 0.72 = 27.8 times bigger.

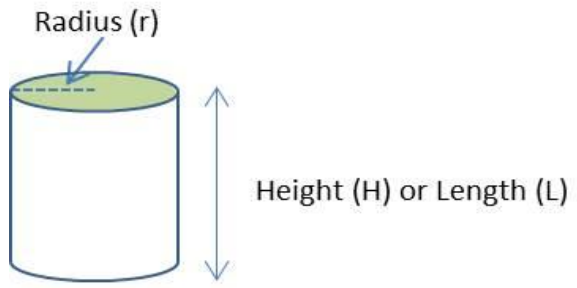
27.8 x 1 m^3 = 27.8 m^3 = 28 m^3 when rounded up.

Tina needed a silo with a storage capacity of 28 m^3.

But what should its dimensions be?

She did not want a silo with a radius bigger than 2 metres, or one that was too high.

Remember that in Visit 10 we noted that the volume (V) of a cylinder (or a tube) **= π r ^{2} h**.



Substituting the values they know, Uno showed Tina how to work out the height of the silo, if its radius was to be 2 metres and its volume 28 m^3.

Volume = π r ^{2} h

28 = 3.142 x 2^2 x h

28 = 3.142 x 4 x h

28 = 12.568 x h

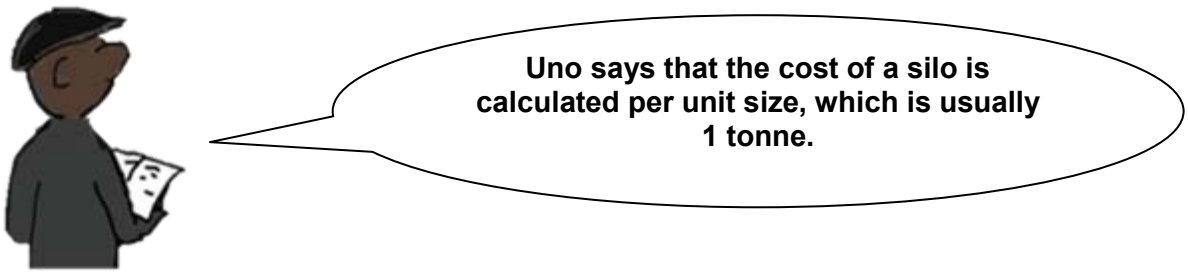
By dividing both sides by 12.568 we can solve this equation:

h = 28 ÷ 12.568

h = 2.23 metres.

The silo needed to be 2.23 m high if it was to have a radius of 2 m and be able to store 20 tonnes of maize grain.

Tad and Mim are very impressed with Tina's silo and would like to buy one for themselves – but they need to think carefully about what they can afford.



They are told that the guideline price for a grain silo is $210 per tonne.

Tina's silo cost $210 x 20 = $4200.

Quick Test 15 – Calculating sizes and costs of metal silos

1 A farmer wants to buy a silo for his millet. The bulk density factor for millet is 0.63 tonnes/ m^3. He needs to store 20 tonnes of millet.

He doesn't want a silo with a radius bigger than 1.5 metres.

How high will his silo be?

What will the cost of the silo be if the guideline price given to the farmer for a grain silo is $100 per tonne?

2 A farmer wants to buy a silo in order to store her shelled groundnuts. The bulk density factor for shelled groundnuts is 0.64 tonnes/m^3. She wants to be able to store 30 tonnes of shelled groundnuts.

The farmer doesn't want the silo to have a radius larger than 2 metres.

How high will her silo be?

What will the cost of the silo be if the guideline price given to the farmer for the silo is $175 per tonne?

3 A farmer wants to buy a silo to store 55 tonnes of maize. The bulk density factor for maize is 0.72 tonnes/m^3.

He doesn't want the radius of the silo to be larger than 2.5 metres.

How high will his silo be?

How much will this silo cost be if the guideline price that was given to the farmer is $130 per tonne?

4 A farmer wants to store 20 tonnes of sorghum. The bulk density factor for sorghum is 0.73 tonnes/m^3. The radius of the silo can be no more than 2 metres.

How high will her silo be?

What will the cost of the silo be if the guideline price that is given to the farmer for the silo is $110 per tonne?

Note down the answers and check them with the answers at the end of this booklet

Back to Uno How Farm Visit 15

Uno How's Farm Visit 16... Decision making

Uno How's Farm Visit 16

Decision Making

Home from the market – making decisions

Tad and Mim have $800. They have to pay bills before they decide what to do with the rest.

Having visited Tina, they think they would like to buy a grain silo, but they have school fees and other household bills to pay first. Also, Tad wants to buy some livestock. They are not sure if they can afford the silo.

Tad and Mim decide to start by working out the cost of the silo they would like to buy. They begin by working out the size and dimensions this would need to be, for the 2.35 tonnes of grain from their large field.

They know that 1 m^3 holds 0.72 tonnes of maize grain.

2.35 tonnes would need to have a capacity of 2.35 ÷ 0.72 x 1 m^3 = 3.26 m^3

They see a silo with a radius of 0.75 m and a height of 1.8 metres. Together, they work out its capacity:

Volume = $\pi r^2 h$

Volume = 3.142 x 0.75^2 x 1.8 = 3.18 m^3

This is just about right for the grain from their larger field.

Based on the cost guideline that Tina gave them, they estimate that this would cost approximately:

$210 x 2.35 tonnes = $494.

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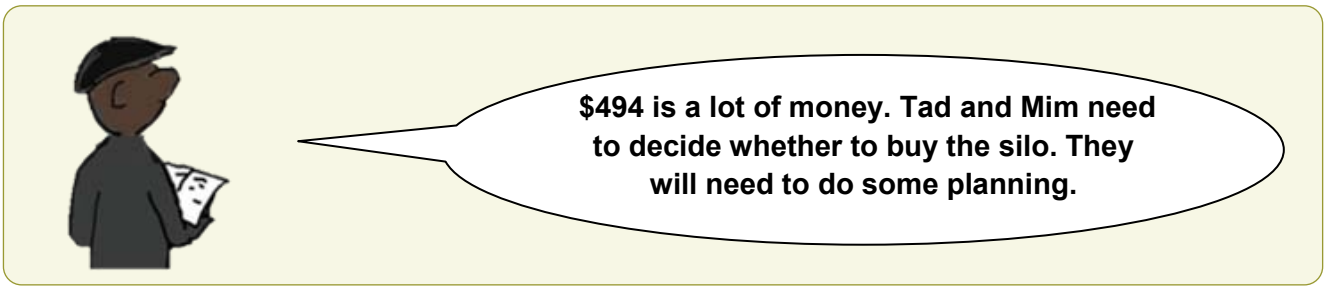
Uno How's Farm Visit 16

Decision making

Running a farm as a business



Earlier on, Tad and Mim sold 20 sacks of grain from their smaller field for $40 each, earning themselves $800. If they buy the silo now, they would be left with only **$800 - $494 = $306** for their household bills and other purchases. But they do know that they will have more grain to sell in the future.

Uno helps them bring together all the maize grain information they have gathered so far, so that they can estimate the amount they will have left to sell in the future, and how much this may earn them at different selling prices:

Table 13: Tad and Mim's maize grain summary table (in tonnes)

Prod'n Small Field (A)	Prod'n Large Field (B)	Total Prod'n (C = A + B)	Amount needed for food, seed etc. (D)	Expected Losses (E)*	Balance (F = D + E)	Already Sold (G)	Amount remaining for Future Sale (= C – F – G)
1.15	2.35	3.5	1.17	0.47	1.64	1.00	0.86

**NOTE: Their losses would probably be much lower than 0.47 tonnes if they had a new silo.*

If the **quality** of the maize remains **good**, and/or prices on the market hold well, they can expect to sell 0.86 tonnes for $1800 per tonne **= 0.86 x 1800 = $1548.** If they bought the silo, this could leave them with as much as **$1548 + $306 = $1854** to spend on other things over the coming months.

However, if the **quality** of the maize **deteriorates** and/or prices on the market drop, they can expect to sell 0.86 tonnes for as little as $300 per tonne **= 0.86 x 300 = $258.** But, if they bought the silo, this could leave them with as little as **$258 + $306 = $564** to spend on other things over the coming months.

Table 14: Tad and Mim's maize grain income ($)

Income from 1 tonne of maize grain already sold ($)	Future income from 0.86 tonnes if high quality: ($1800/t)	Future income from 0.86 tonnes if poor quality: ($300/t)
800	1548	258

They know how much they need for school fees and other bills now – but do not know what these prices will be in the future. They are also worried about what their costs of producing maize will be next year, as they can see the cost of inputs going up.

Although there are many things they can't **know** about the future, by collecting and recording as much information as they can about quantities, costs and prices, Tad and Mim can **plan** for the future.

They can make proper decisions about how to manage their farm, such as:

- What to grow?
- When to produce the crop?
- Whether to use inputs?
- Where to buy inputs?
- How much to pay?
- Where and when to sell their produce?

This means running the farm as a business – allowing themselves to make as much profit as possible. We will learn about profit, and how important it is to businesses, in the next lesson.

Back to Uno How Farm Visit 16

Uno How's Farm Visit 16

Decision making

Profit

Most households in rural areas run their farms on a subsistence basis – this is a very different approach to running a **farm as a business.** A business is a way of making money from selling goods or services.

It is very important to know whether any business you are running is making a **profit** or a **loss**.

The money a business brings in when selling its goods is called its **revenue** (also called **gross income** – the term "gross" means *without deductions*). The money spent on producing those goods is its **cost**. By taking away the total costs of production from the revenue (or gross income) we can see if a business has made a profit or a loss.

Profit (or Loss) = Revenue (or Gross Income) – Costs

- **If revenue is greater than costs, then a profit is made.**
- **If costs are greater than revenue, then a loss is made.**
- **If revenue and costs are the same, then the business has broken even.**

Profit is represented by **positive numbers**. **Loss** is represented by **negative numbers**.

The profit (or loss) a business makes after all costs have been deducted, but **before tax** is paid, is called its **Operating Profit** (or **Operating Loss**).

Taxes

A business generally needs to pay **taxes** on profits that it makes.

The profit (or loss) made **after all costs and taxes** have been deducted is **Net Profit** (or **Net Loss**).

Net Profit (or Net Loss) = Operating Profit – Taxes

NOTE: Net Profit is the same as Net Income.

In order to explain how a business approach to small-holder farming could work, Uno shows Tad and Mim an example of a simple business to help them get started with planning.

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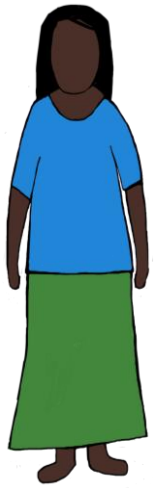
Uno How's Farm Visit 16

Decision making

Sheba's laundry - an example of a very simple business - costs

Sheba runs a business washing clothes/fabrics for others.



Sheba has a very simple business. She collects dirty sheets and blankets from local guest houses and washes them by hand in the river, then leaves them to dry in the sun on the rocks.

Sheba provides a service for which she is paid but, as her water is *free*, she has no inputs other than soap and her own labour.

Her **revenue** is the amount she earns for her services washing sheets and blankets.

Sheba's only cost is soap, which she buys from a friend.

Because the more clothes she washes, the more soap she uses, the soap is a **variable cost**.

Variable costs change with the level of output.

Water would also be a variable cost – the more clothes Sheba washes the more water she would use. But because Sheba gets her water free from the river, she does not need to include water as a cost.

She estimates that she normally spends $3 a day on soap, so her **variable costs are estimated to be $3 a day**.

Fixed costs (or overheads) are costs that do not vary with output - for example, the rent on a shop or a stall. No matter how few customers a shop may get, it would still have to pay the same rent.

Sheba does not have any fixed costs as she works outdoors.

Tad and Mim will have many more costs, as they have a farm. They will need to think carefully about all their variable and fixed costs.

Back to Uno How Farm Visit 16

Uno How's Farm Visit 16

Decision making

Calculating Sheba's profit

Sheba wants to calculate her profits:

Remember that:

Profit (or Loss) = Revenue (or Gross Income) – Costs

Sheba needs to know her **revenue**, as well as her **costs**, before she can work out her profit.

She charges $0.50 per item for washing sheets, and $1 for washing blankets.

She washes approximately 10 sheets and 4 blankets a day.

Her **gross income** (or **revenue**) per day is (10 x $0.50) + (4 x $1) = $5 + $4 = $9

She normally spends $3 a day on soap.

Therefore, her operating profit = $9 - $3 = $6.

Operating Profit = $6 per day

Sheba pays taxes on her profit.

The profit remaining after these have been paid is her **net profit**.

Net Profit = $6 – taxes

The net profit is the money Sheba keeps for herself to live on.

Quick Test 16 – Profit or Loss?

1 A beekeeper sells honey for $3 a jar. Her only cost is for the jars which are $0.50 each. She sells approximately 200 jars of honey a year.

Calculate her gross income (revenue) and her costs.

Does she make a profit for the year? Can she afford to pay herself $600 a year salary out of this profit?

2 A sewing business typically sews 700 pieces of clothing each year. It sells each item for $2.50

Its costs are for thread, needles and fabric. New thread costs $2 per reel. One reel is needed to make 50 pieces of clothing. It typically spends $25 on new needles each year and $200 on fabric.

It pays $550 a year as wages but has no other costs.

What is the size of the business's profit/loss?

3 A baker sells large loaves of bread for $0.60 and smaller loaves of bread for $0.30.

On average he sells 16 large loaves and 12 smaller loaves each day and his shop is open for 310 days a year.

The rent for his shop, his electricity and fuel costs come to $1700 a year. The baker employs part-time help, which costs $1.75 every day that the shop is open.

Work out if the baker made a profit in the year. If so, how much?

Note down the answers and check them with the answers at the end of this booklet

Back to Uno How Farm Visit 16

Uno How's Farm Visit 16

Decision making

Gross Margins

Sheba would like to increase her profit, but how?
She could increase her profits by either increasing her revenue **or** reducing her costs.

Increasing revenue and calculating Gross Margins

Sheba could increase her revenue either by washing more sheets and blankets, or by putting up the amount she charges for washing the sheets and blankets.

Increasing revenue - washing more sheets and blankets.
Assuming she could easily find more customers, Sheba could increase the amount she washes by:
a) Washing more items in the same time.
b) Working longer hours.
c) Hiring someone to help her.
d) Using a washing machine.

Table 15: Sheba's options for increasing profit by washing more sheets and blankets

	Merits	**Drawbacks**
Washing more sheets and blankets		
Washing more items in the same time	More revenue earned.	Poorer quality service – may lose trade.
Working longer hours	More revenue earned.	Tiredness and maybe not be sustainable – may lose trade.
Hiring someone to help her	More revenue earned.	Would have to pay for this labour. Would need to ensure that enough new customers were found to cover these extra costs.
Using a washing machine	More revenue earned.	Would have to borrow the money and would have to pay back this loan or share the profit afterwards. Would need to buy and have access to electricity. Would need to ensure that enough new customers were found to cover these extra costs.

Increasing revenue – raising the amount she charges for the washing.
Sheba would need to do some **market research** to see what other people are charging before she increased her prices.

Table 16: Sheba's options for increasing profit by increasing the amount she charges for the washing

	Merits	Drawbacks
Increasing the price of the washing	More revenue earned.	May lose trade due to higher prices, as people may go elsewhere.

Reducing her costs.
Sheba could use less soap powder or use a cheaper brand.

Table 17: Sheba's options for increasing profit by reducing her costs

	Merits	Drawbacks
Use less soap powder	Costs reduced	Quality of her work likely to be affected – may lose customers.
Use cheaper soap	Costs reduced	Quality of her work likely to be affected – may lose customers.

As well as looking at the merits and drawbacks **Sheba would need to consider the costs and revenue of each option**, to see what she can afford. She needs to think carefully before she makes any changes to her business.

Uno tells Sheba that she can calculate the effects that any changes would have on her business by calculating her **Gross Margin**.

The Gross Margin is the difference (margin) between how much she makes and how much she spends on inputs (her variable costs):

Gross margin = Gross Income – Variable Costs

Sheba's variable costs were calculated at $3 a day (her soap costs).
Her Gross Income (revenue) per day was calculated at $9 a day.

Gross margin per day = $9 - $3 = $6 per day

Note that because Sheba has no fixed costs, her Gross Margin is the same as her Operating Profit.

If Sheba changed any part of her business, she could recalculate her Gross Margin, to see if the change was going to have a positive or negative impact on the business. Gross Margins will be studied in more depth in the next module, Module 5.

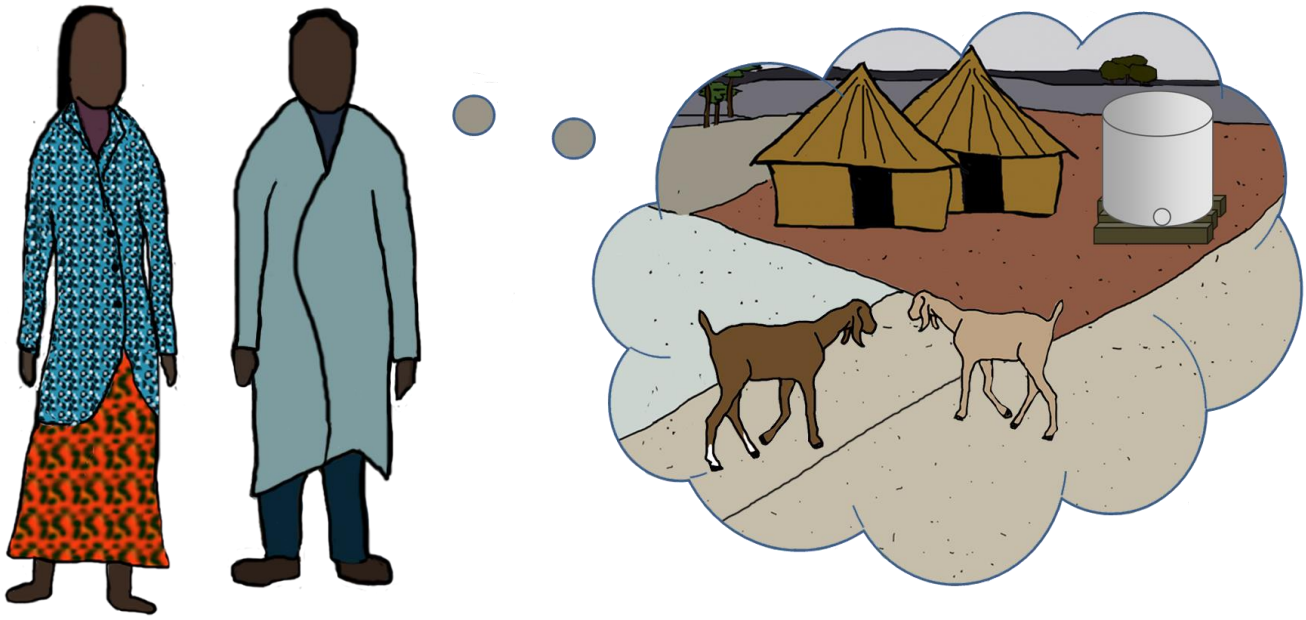
Talking to Uno and Sheba, Tad and Mim realise they need to carefully consider the merits and drawbacks of buying a silo.

They need to look at the cost of buying the silo, and compare this with the extra revenue they expect to earn if they do buy it.

They also need to consider their **cash flow** situation – that is, whether buying the silo now will leave them short of money for other bills in the near future.

If Tad and Mim buy the silo, their revenue from the sale of grain would probably increase, because they would have less post-harvest loss. However, their costs would also increase.

In the next visit, Visit 17, in Module 5, Uno is going to tell Tad and Mim about 2 other rural businesses, Sara, who runs a tea shop and Jon who is a blacksmith. By exploring how these businesses have developed, Tad and Mim can learn more about how to make better decisions – not only about whether or not to buy a silo, but also about how to run their whole farm and household.



You have now completed Module 4

Answers to Quick Tests

Quick Test 1 – Using tables

Answers

1. **Total grain food need for the year is 1824 kg.**
2. **Total grain food need for the year is 928 kg.**

Explanation

1

	A	B	C	D	E	F
Food Need	**Number of people**	**Average number of cups of grain eaten per person per day**	**Total amount of maize grain needed/day in cups *(A x B)***	**Total number of days being fed per year**	**Total number of cups of grain needed/year *(C x D)***	**Total weight of grain needed (kg) (0.2 kg/cup) *(E x 0.2 kg)***
Food for family	8	3	24	365	8760	**1752**
Food for visitors	6	3	18	20	360	**72**
Total food						**1824**

2

	A	B	C	D	E	F
Food Need	**Number of people**	**Average number of cups of grain eaten per person per day**	**Total amount of maize grain needed/day in cups *(A x B)***	**Total number of days being fed per year**	**Total number of cups of grain needed/year *(C x D)***	**Total weight of grain needed (kg) (0.2 kg/cup) *(E x 0.2 kg)***
Food for family	12	1	12	365	4380	**876**
Food for visitors	5	1	5	40	200	**40**
Food for relatives	2	1	2	30	60	**12**
Total food						**928**

Back

Quick Test 2 – Using tables in more detail

Answers

1. **Total grain food need for the year is 1508 kg.**
2. **Total grain food need for the year is 1660 kg.**

Explanation

1

Need	Number of people/ chickens	Average number of cups of grain eaten per person/ chicken per day	Total amount of maize grain needed/day in cups	Days being fed per year	Total number of cups of grain needed/year	Total weight of grain needed (rounded up to whole kg) (0.2 kg/cup)
Food for family	6	2.5	15	365	5475	**1095**
Food for visitors	4	2.5	10	15	150	**30**
Feed for chickens	20	0.25	5	365	1825	**365**
Grain as seed						**18**
TOTAL						**1508**

2

Need	Number of people/ chickens	Average number of cups of grain eaten per person/ chicken per day	Total amount of maize grain needed/day in cups	Days being fed per year	Total number of cups of grain needed/year	Total weight of grain needed (rounded up to whole kg) (0.2 kg/cup)
Food for family who is staying	6	2	12	365	4380	**876**
Food for family who is leaving	4	2	8	365 – 90 = 275	2200	**440**
Food for visitors	10	2	20	7	140	**28**
Feed for chickens	12	1/3	4	365	1460	**292**
Grain as seed						**24**
TOTAL						**1660**

Back

Quick Test 3 – Using tables to calculate changes

Answers

1. **Total grain food need for the year is 1855 kg.**

Explanation

1

Need	Number of people/ chickens	Average number of cups of grain eaten per person/ chicken per day	Total amount of maize grain needed/day in cups	Days being fed per year	Total number of cups of grain needed/year	Total weight of grain needed (rounded up to whole kg) (0.3 kg/cup)
Food for family	7	2	14	365	5110	**1533**
Food for visitors	4	2	8	12	96	**29**
Feed for chickens	24	0.25	6	365	2190	**657**
TOTAL						**2219**

Need	Number of hectares	kg per hectare/ kg per sack	Total amount of in kg	Number of Sowings per year	Grain in kg rounded up
Seed to sow	1.5	10	15	1	**15**
Gift grain	2	50	100	-	**100**
Grain for mill	5	50	250	-	**250**

Needs for 1 year	Maize grain kg
Maize for food/chicken feed	**2219**
Maize for seed	**15**
Maize for gift	**100**
Maize for mill	**250**
TOTAL without visitors staying longer	**2584**

Need	Number of people/ chickens	Average number of cups of grain eaten per person/ chicken per day	Total amount of maize grain needed/day in cups	Days being fed per year	Total number of cups of grain needed/year	Total weight of grain needed (rounded up to whole kg) (0.3 kg/cup)
Food for visitors staying longer	2	2	4	40	160	**48**

If two visitors stay an extra 40 days they estimate they will need an extra 48 kg.

TOTAL if visitors stay longer = 2584 + 48 = 2632 kg.

This is less than the 3000 kg they have in store, so they should have enough.

Back

Quick Test 4 – Rapid estimates of grain drying in field

Answers

1. **His field would produce 0.76 tonnes of sorghum. The estimated yield is 1.52 tonnes/ha.**
2. **His field would produce 3.36 tonnes of maize. The estimated yield is 2.80 tonnes/ha.**

Explanation

1 His field is 0.5 ÷ 1.25 = 0.4 times the area of the neighbour's larger field.

His neighbour's field produced 1.9 tonnes/ha.

So, estimated production from his field = 0.4 x 1.9 = **0.76 tonnes of sorghum**.

To calculate the yield in tonnes per ha:

1 hectare is 1 ÷ 0.5 = 2 times bigger than his field.

So, the estimated yield is 2 x 0.76 = **1.52 tonnes/ha**

2 Start by converting the area of his field to hectares = 3 x 0.405 = 1.2 ha (rounded down).

The neighbour's field is 0.75 ha and produced 2.1 tonnes.

The farmer's field is 1.2 ÷ 0.75 = 1.6 times bigger than the area of the neighbour's larger field.

So, estimated production from his field = 1.6 x 2.1 = **3.36 tonnes of maize**.

To calculate the yield in tonnes per ha:

1 hectare is 1 ÷ 1.2 = 0.83 of the area of his field.

So, the estimated yield 0.83 x 3.36 = **2.8 tonnes/ha**.

Back

Quick Test 5 – Calculating moisture content

Answers

1. **The moisture content percentage at the time of sampling is 20%.**
2. **The moisture content percentage at the time of sampling is 21%.**
3. **The moisture content percentage at the time of sampling is 18%.**

Explanation

1 The sample has lost 500 – 400 = 100 g of water.

The moisture content % is therefore estimated to be 100/500 x 100 = **20%.**

2. The sample has lost 350 – 275 = 75 g of water.

The moisture content % is therefore estimated to be 75/350 x 100 = **21%.**

3. The sample has lost 850 – 700 = 150 g of water.

The moisture content % is therefore estimated to be 150/850 x 100 = **18%.**

Back

Quick Test 6 – Equations

Answers

1. **She has used 225 g of seed.**
2. **The price of one goat is $64.**
3. **A bag of flour costs $4.50.**
4. **A sack costs $1.05.**
5. **The field has an estimated production of 3.12 tonnes.**

Explanation

1 The equation: **a** + 275 = 500

a = 500 - 275 = **225 g of seed**.

2 The equation: 4**b** = 256

b = 256/4 = **$64 each**.

3 The equation: 6**c** = 30 - 3

6**c** = 27

c = 27/6 = **$4.50 per bag**.

4 The equation: 22**d** = 25 – 1.9

22**d** = 23.1

d = 23.1/22 = **$1.05 per sack.**

5 The equation: **e** = 1.5/1.25 x 2.6

e = 1.2 x 2.6 = **3.12 tonnes estimated production**.

Back

Quick Test 7 – Calculating weight of grain after drying

Answers

1. **The final weight of the grain, with moisture content 13% is 2.59 tonnes.**
2. **The final weight of the grain, with moisture content 13% is 4.02 tonnes.**
3. **The final weight of the grain, with moisture content 13% is 5.52 tonnes.**
4. **The final weight of the grain, with moisture content 13% is 1.15 tonnes.**

Explanation

Using Method 2 Equation:

Final weight (w) = $\frac{\text{Starting dry matter \%}}{\text{Final dry matter \%}}$ x Initial weight of heap

1 The estimated weight of grain is 3 tonnes. The moisture content is 25%. The farmer wants to dry it to 13% and find the final weight.

Initial Weight = 3 tonnes.
Starting Dry matter % = 100 – 25 = 75%
Final Dry Matter % = 100 – 13 = 87%

Final weight = 75/87 x 3 = **2.59 tonnes.**

2 The estimated weight of grain is 5 tonnes. The moisture content is 30%. The farmer wants to dry it to 13% and find the final weight.

Initial Weight =5 tonnes.
Starting Dry Matter % = 100 – 30 = 70%
Final Dry Matter % = 100 – 13 = 87%

Final weight = 70/87 x 5 = **4.02 tonnes.**

3 The estimated weight of grain is 8 tonnes. The moisture content is 40%. The farmer wants to dry it to 13% and find the final weight.

Initial Weight =8 tonnes.
Starting Dry Matter % = 100 – 40 = 60%
Final Dry Matter % = 100 – 13 = 87%

Final weight = 60/87 x 8 = **5.52 tonnes.**

4 The estimated weight of grain is 2 tonnes. The moisture content is 50%. The farmer wants to dry it to 13% and find the final weight.

Inital Weight =2 tonnes.
Starting Dry Matter % = 100 – 50 = 50%
Final Dry Matter % = 100 – 13 = 87%

Final weight = 50/87 x 2 = **1.15 tonnes.**

Back

Quick Test 8 – Calculating grain budgets

Answers

1. **The farmer's grain budget for the year is 6.5 tonnes. He will have a surplus of 1 tonne.**
2. **The farmer's grain budget for the year is 10.9 tonnes. He will have a surplus of 3.6 tonnes.**
3. **The farmer's grain budget for the year is 13.3 tonnes. He will have a deficit of - 0.3 tonnes.**
4. **The farmer's grain budget for the year is 8.40 tonnes. He will have a surplus of 0.95 tonnes.**

Explanation

1 A farmer produces 7.5 tonnes with estimated loss of 20%.

Loss = 20/100 x 7.5 = 1.5 tonnes.

The farmer needs 5 tonnes of grain.

5 + 1.5 = 6.5 tonnes. **The farmer's grain budget for the year is 6.5 tonnes**.

The farmer produced 7.5 tonnes so will have a **surplus of 1 tonne** (7.5 – 6.5).

2 A farmer produces 14.5 tonnes of grain with an estimated loss of 20%.

Loss = 20/100 x 14.5 = 2.9 tonnes.

The farmer needs 8 tonnes of grain.

8 + 2.9 = 10.9 tonnes. **The farmer's grain budget for the year is 10.9 tonnes.**

The farmer produced 14.5 tonnes, so will have a **surplus of 3.6 tonnes** (14.5 – 10.9).

3 A farmer produces 13 tonnes of grain with an estimated loss of 10% in storage.

Loss = 10/100 x 13 = 1.3 tonnes.

The farmer needs 12 tonnes of grain.

12 + 1.3 = 13.3 tonnes. **The farmer's grain budget for the year is 13.3 tonnes.**

The farmer produced 13 tonnes of grain, so will have a **deficit of – 0.3 tonnes** (13 – 13.3).

The negative number means that there is a grain budget deficit. The farmer does not have all the grain that he needs meaning he will have to buy some grain to make up this deficit.

4 A farmer produces 9.35 tonnes of grain with an estimated loss of 15%.

Loss = 15/100 x 9.35 = 1.40 tonnes.

The farmer needs 7 tonnes of grain.

7 + 1.40 = 8.40 tonnes. **The farmer's grain budget for the year is 8.40 tonnes.**

The farmer produced 9.35 tonnes, so has a **surplus of 0.95 tonnes** (9.35 – 8.40).

Back

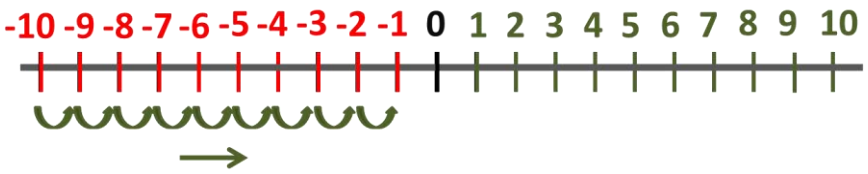
Quick Test 9 – Negative numbers

Answers

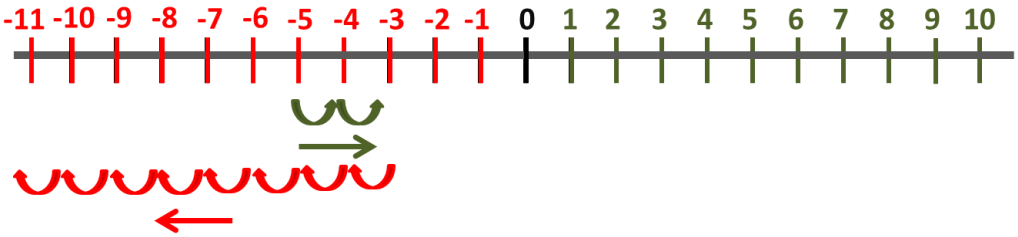
1. **She owes $1**
2. **He owes $11**
3. **He is $4 in credit**
4. **He is $3 in debt**

Explanation

1 Using the number line, start at -$10. Because she has paid money back she will be less in debt, so count 3 x 3 (= 9) places to the right. The answer is –$1.

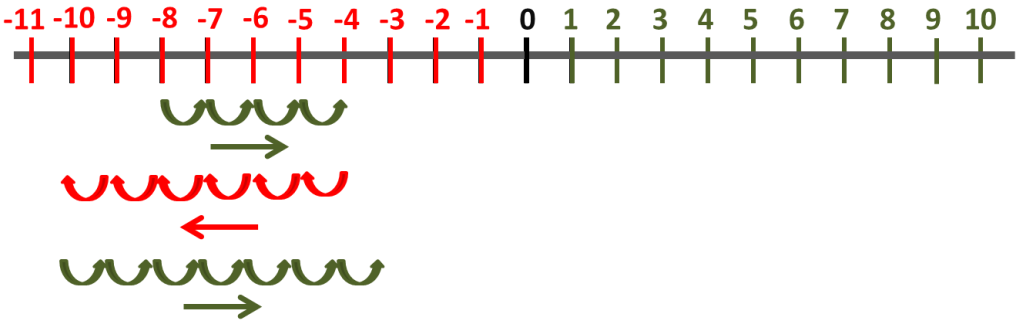


2 Using the number line, start at -$5. Because he then pays $2 back, count two places to the right = –$3. Because he then borrows $8 he will then be more in debt. Count eight places to the left. The answer is –$11.



3 The farmer is – $16 in debt at the start. Because he borrows another $10 this debt becomes –$26. He then pays back $30, which is $4 more (–$26 + $30) than the money he owed. He is now $4 in credit.

4 Using the number line, start at – $8. Because he then pays $4 back, count four places to the right = –$4. Because he then borrows $6 he will then be more in debt again. Count six places to the left, which is –$10. Finally, he pays back $7. Count seven places to the right. The answer is – $3, or $3 in debt.



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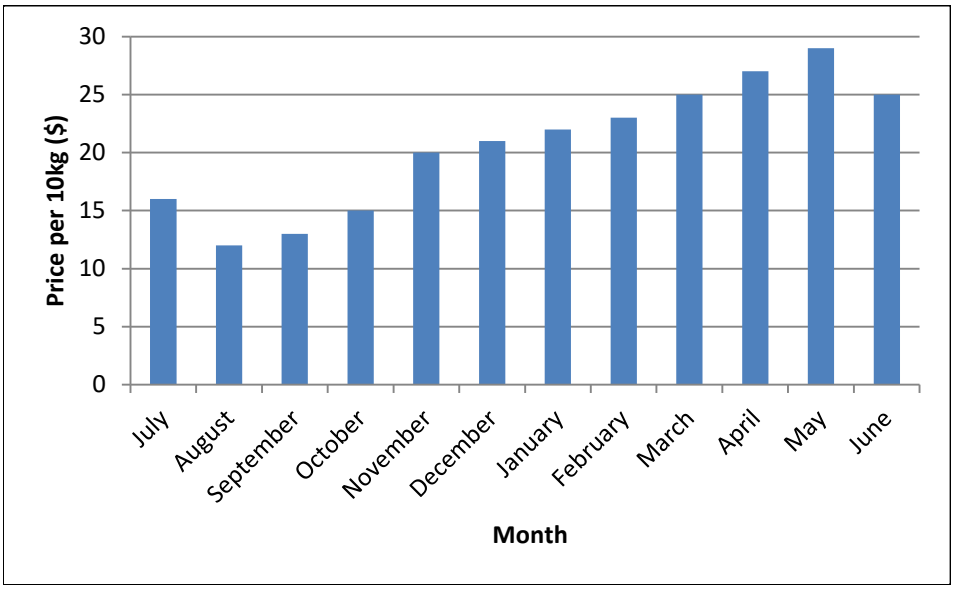
Quick Test 10 – Bar Charts

Answers

1. **The highest price for sorghum is in May ($29). The lowest price is in August ($12).**
2. **The highest price is in March ($26). February has the second highest price ($25).**
3. **The lowest price is in July and August ($12). The farmer would be best off selling his grain in March ($22) or June ($23).**

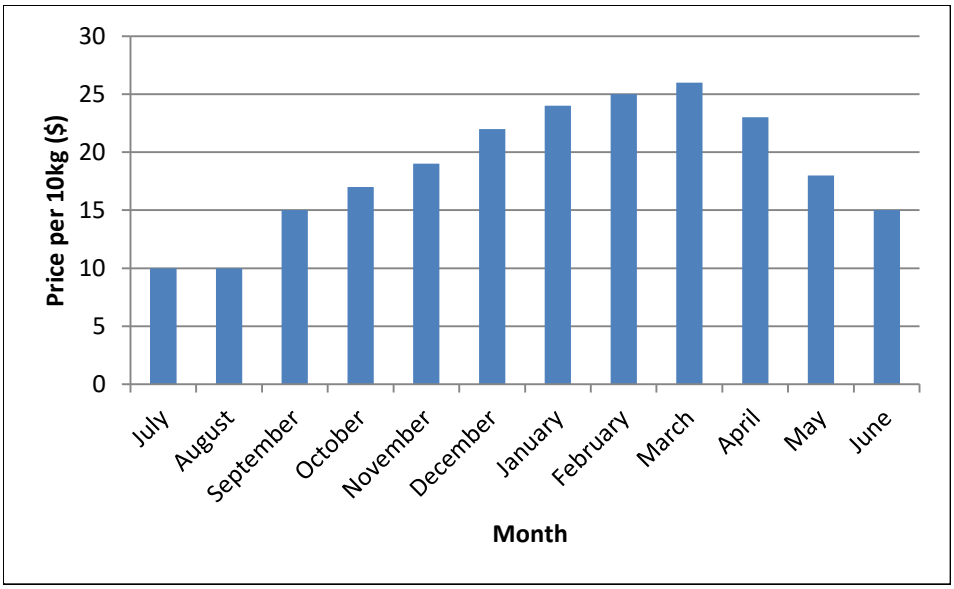
Explanation

1



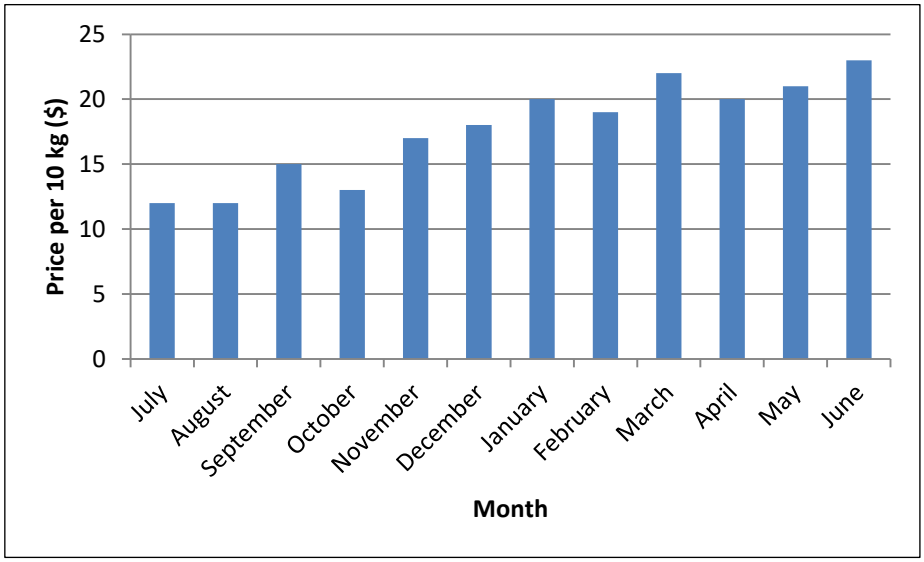
The vertical (left) axis shows the price per 10 kg ($) while the horizontal axis shows the months of the year. In this bar chart it is clear that the highest price for the sorghum is in May where it has a price of $29 per 10 kg. The lowest price is in August where it has a price of $12 per 10 kg. There is a clear trend where the price gets more and more expensive after August before peaking in May and then decreasing again.

2



There is a clear trend where the price gets more and more expensive after August, peaking in March and then decreasing again.

3



There is a general upward trend from August onwards, with a dip in October. The lowest price is in July and August ($12). The farmer would be best off selling his grain in March ($22) or June ($23), when the prices are at their highest.

Back

Quick Test 11 – Deciding how and when to sell

Answers

1. **Option 1 – Sell sorghum now and pay for transport. The money from sale would be $250.**
   Option 2 – Wait three weeks and get free transport: The money from sale would be $200.
   He would be better off paying for transport and selling the sorghum now.
2. **Option 1 – Sell maize now and pay for transport. The money from sale would be $380.**
   Option 2 – Wait three weeks and get free transport: The money from sale would be $400.
   She would be better off waiting three weeks and getting free transport.
3. **Option 1 – Sell maize now and pay for higher transport costs. The money from sale would be $1500.**
   Option 2 – Wait two weeks and get cheaper transport: The money from sale would be $1230.
   He would be better off selling now and paying higher transport costs.

Explanation

1 Option 1 is to sell the sorghum now and pay for transport.

Revenue = 10 x 30 = $300 Cost of transport = 10 x 5 = $50

Money they will take home from the sale = $300 – $50 = **$250**

Option 2 is to wait three weeks and get free transport.

Revenue = 10 x 20 = $200 There is no cost for transport.

Money they will take home from the sale = **$200**

Option 1 will result in the highest money from sales.

2 Option 1 is to sell the maize now with transport costs.

Price of 20 kg sack = 11 x 2 = $22 per 20 kg sack.

Revenue = 20 x 22 = $440 Cost of transport = 20 x 3 = $60

Money they will take home from the sale = $440 - $60 = **$380**

Option 2 is to wait one week and get free transport.

Price of 20 kg sack = 10 x 2 = $20 per 20 kg sack.

Revenue = 20 x 20 = $400 There is no cost for transport

Money they will take home from the sale = $400 – 0 = **$400**

Option 2 will result in the highest money from sales.

3 Option 1 is to sell the sorghum now with higher costs.

Income = 30 x 60 = $1800 Cost of transport = 30 x 10 = $300

Money they will take home from the sale = $1800 - $300 = **$1500**

Option 2 is to wait two weeks and get cheaper transport.

Income = 30 x 45 = $1350 Cost of transport = 30 x 4 = $120

Money they will take home from the sale = $1350 – $120 = **$1230**

Option 1 will result in the highest money from sales.

Back

Quick Test 12 – Using BODMAS

Answers

1. **The farmer has spent $85.**
2. **The farmer has spent $102.**
3. **The farmer will have $6.50 left.**
4. **The farmer will have $310 left.**
5. **They will receive $38.67 each.**
6. **The farmer will have 17 animals left.**
7. **The farmer gives each chicken 0.1 kg of grain per day.**

Explanation

1 A farmer buys 3 sacks of sorghum for $20 each, 2 sacks of millet for $10 each and 1 sack of fertiliser for $5. Write out a calculation using BODMAS to find out how much he spends in total.

Brackets are not essential because BODMAS dictates that the multiplications will be done separately before the additions. But brackets do make it clearer to understand:
(3 x 20) + (2 x 10) + (1 x 5)

Add together the answers from the calculations in the brackets, to find out how much the farmer has spent:

60 + 20 + 5 = $85

The farmer has spent $85.

2 A farmer buys 10 sacks of millet that cost $5 each, 4 sacks of sorghum that cost $7 each and 3 sacks of fertiliser for $8 each. Write out a calculation using BODMAS to find out how much she spends in total.

Brackets are not essential because BODMAS dictates that the multiplications will be done separately before the additions. But brackets do make it clearer to understand:

(10 x 5) + (4 x 7) + (3 x 8)

Add together the answers from the calculations in the brackets, to find out how much the farmer has spent:

50 + 28 + 24 = $102

The farmer has spent $102.

3 A farmer has $23. He buys 3 sheep which cost $5.50 each. Write the calculation using BODMAS and work out how much he will have left.

BODMAS tells us that we complete the multiplication first, then subtract. Brackets are not required.

23 – 5.5 x 3

23 – 16.5 = $6.5

The farmer will have $6.50 left.

4 A farmer sells 6 goats for $40 each and a cow for $100. He then pays $30 market fees out of the money he earned. Write out a calculation using BODMAS to find out how much he has remaining.

BODMAS tells us that we complete the multiplication first, then the addition and subtraction. Brackets are not required.

6 x 40 + 100 - 30

240 + 100 – 30 = $310

The farmer will have $310 left.

5 A farmer sells 4 sacks of grain for $24 each and 2 goats for $32 each. He then pays $34 market fees and buys 2 chickens for $5 each. When he returns home, he shares the money he has left equally between himself and his 2 siblings.

We need to put all the transactions that took place before he shared out the money into one calculation – that is, into one set of brackets. If we don't then only the 5 would be divided by the 3, not the total!

(4 x 24 + 2 x 32 – 34 – 2 x 5) ÷ 3

Let's work out what is in brackets first. Because BODMAS dictates that the multiplications are carried out before the subtractions, adding in more brackets is not essential, but can make it easier to understand *NOTE: When carrying out more complicated calculations like this, it is common to have brackets inside brackets. Work out the answers to the inner bracket calculations first!*

(4 x 24) + (2 x 32) – 34 – (2 x 5) = 96 + 64 – 34 – 10 = $116

Now we have worked out what was in brackets at the start, we can divide this answer by the 3:

$116 ÷ 3 = $38.67

They will receive $38.67 each.

6 A farmer has 12 chickens and 10 sheep. After selling half of his sheep how many animals will he have left? Write out a calculation using BODMAS to find out how animals he will have left.

This sum does not need brackets because BODMAS dictates that the division is carried out first:

12 + 10 ÷ 2

12 + 5 = 17

The farmer will have 17 animals left.

7 A farmer has 28 kg of grain. He wants to keep 4 kg of this and to share the remainder equally between his 40 chickens over 6 days. How much grain will he give each chicken per day?

This sum needs brackets to ensure that the subtraction is carried out first:

(28 – 4) ÷ 40 ÷ 6

24 ÷ 40 ÷ 6

Next, the first division is carried out:

24 ÷ 40 = 0.6

Finally, the second division is carried out:
0.6 ÷ 6 = 0.1

The farmer gives each chicken 0.1 kg of grain per day.

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Quick Test 13 – Calculating percentage losses in store

Answers

1

Sacks and percentage lost in store (out of 30 in each store)				
Months in storage	**Store A - Well-built**		**Store B- Very poorly built**	
	Total number of sacks lost	**Percentage lost**	**Total number of sacks lost**	**Percentage lost**
1	0	0/30 x 100 = 0%	2	2/30 x 100 = 6.7%
2	0	0/30 x 100 = 0%	2	2/30 x 100 = 6.7%
3	0	0/30 x 100 = 0%	3	3/30 x 100 = 10%
4	1	1/30 x 100 = 3.3%	4	4/30 x 100 = 13.3%
5	2	2/30 x 100 = 6.7%	6	6/30 x 100 = 20%
6	2	2/30 x 100 = 6.7%	8	8/30 x 100 = 26.7%
7	3	3/30 x 100 = 10%	10	10/30 x 100 = 33.3%
8	4	4/30 x 100 = 13.3%	11	11/30 x 100 = 36.7%
9	5	5/30 x 100 = 16.7%	14	14/30 x 100 = 46.7%

2

Sacks and percentage lost in store (out of 25 in each store)				
Months in storage	Store A - Well-built		Store B- Very poorly built	
	Total number of sacks lost	Percentage lost	Total number of sacks lost	Percentage lost
1	0	0/25 x 100 = 0%	2	2/25 x 100 = 8%
2	0	0/25 x 100 = 0%	2.5	2.5/25 x 100 = 10%
3	0	0/25 x 100 = 0%	3	3/25 x 100 = 12%
4	1	1/25 x 100 = 4%	3	3/25 x 100 = 12%
5	1	1/25 x 100 = 4%	4	4/25 x 100 = 16%
6	1.5	1.5/25 x 100 = 6%	4	4/25 x 100 = 16%
7	2	2/25 x 100 = 8%	7	7/25 x 100 = 28%
8	4	4/25 x 100 = 16%	9	9/25 x 100 = 36%
9	6	6/25 x 100 = 24%	12	12/25 x 100 = 48%

Back

Quick Test 14 – Using graphs

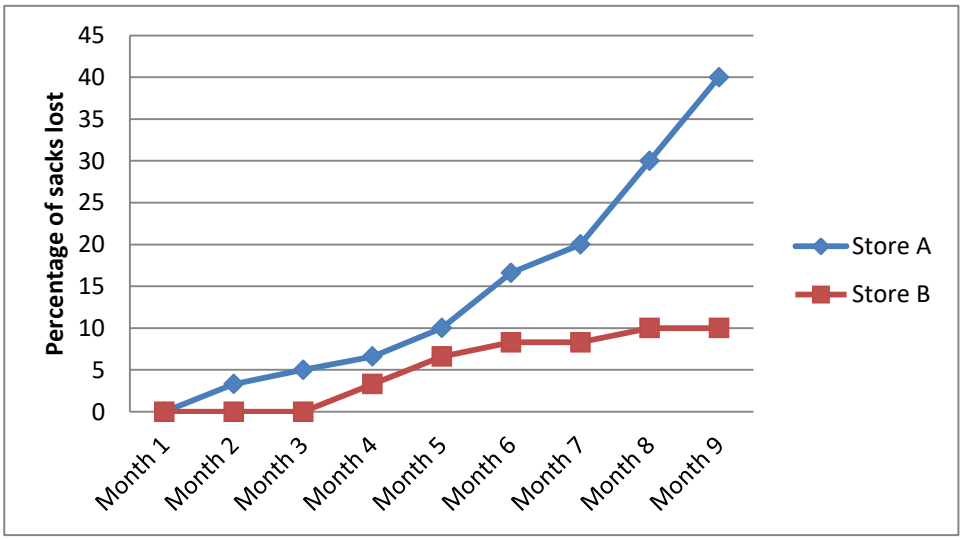
Answers

1. **Store B is significantly better than Store A, with lower losses in all months and just 10% being lost in Month 9, compared to 40% from Store B.**
2. **Store C has the lowest percentage losses. Stores B has the highest losses in all months.**

Explanation

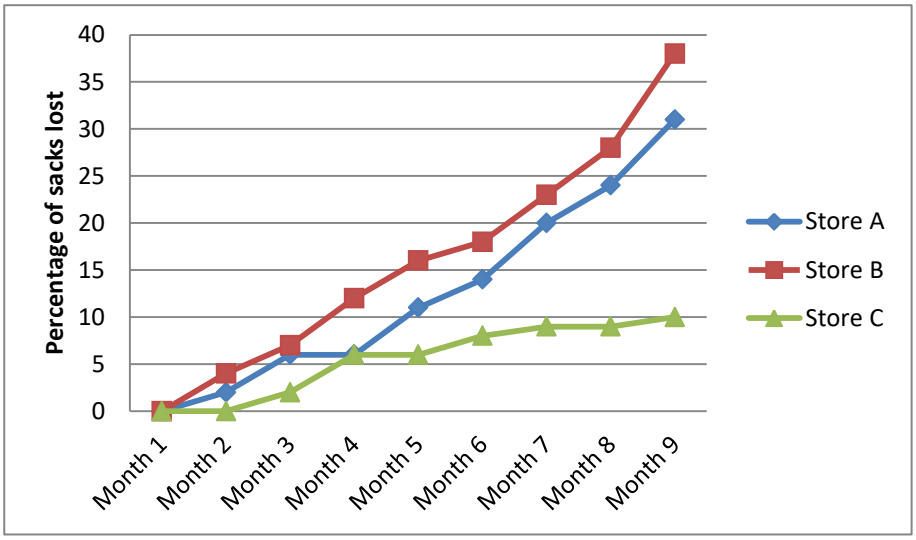
1

	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9
Store A	0/30 x 100 = 0%	1/30 x 100 = 3.3%	1.5/30 x 100 = 5%	2/30 x 100 = 6.6%	3/30 x 100 = 10%	5/30 x 100 = 16.6%	6/30 x 100 = 20%	9/30 x 100 = 30%	12/30 x 100 = 40%
Store B	0/30 x 100 = 0%	0/30 x 100 = 0%	0/30 x 100 = 0%	1/30 x 100 = 3.3%	2/30 x 100 = 6.6%	2.5/30 x 100 = 8.3%	2.5/30 x 100 = 8.3%	3/30 x 100 = 10%	3/30 x 100 = 10%



2

	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9
Store A	0/50 x 100 = 0%	1/50 x 100 = 2%	3/50 x 100 = 6%	3/50 x 100 = 6%	5.5/50 x 100 = 11%	7/50 x 100 = 14%	10/50 x 100 = 20%	12/50 x 100 = 24%	15.5/50 x 100 = 31%
Store B	0/50 x 100 = 0%	2/50 x 100 = 4%	3.5/50 x 100 = 7%	6/50 x 100 = 12%	8/50 x 100 = 16%	9/50 x 100 = 18%	11.5/50 x 100 = 23%	14/50 x 100 = 28%	19/50 x 100 = 38%
Store C	0/50 x 100 = 0%	0/50 x 100 = 0%	1/50 x 100 = 2%	3/50 x 100 = 6%	3/50 x 100 = 6%	4/50 x 100 = 8%	4.5/50 x 100 = 9%	4.5/50 x 100 = 9%	5/50 x 100 = 10%



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Quick Test 15 – Calculating sizes and costs of metal silos

Answers

1. **The height of the silo will be 4.53 m. The price of the silo is $2000.**
2. **The height of the silo will be 3.74 m. The price of the silo is $5250.**
3. **The height of the silo will be 3.92 m. The price of the silo is $7150.**
4. **The height of the silo will be 2.23 m. The price of the silo is $2200.**

Explanation

1 Millet has a density of 0.63 tonnes/m^3 and he wants to store 20 tonnes of millet, with the radius of the silo being a maximum of 1.5 metres.

In order to work out the height:

0.63 tonnes occupies 1m^3.
So 1 tonne occupies 1 ÷ 0.63 = 1.59 m^3.

20 tonnes therefore occupies 20 x 1.59 = 32 m^3 (rounded up).

OR, a shorter way to calculate this is: 20/0.63 = 32 m^3.

Volume of a cylinder = πr^2 x h

32 = 3.142 x 1.5^2 x h = 3.142 x 2.25 x h

32 = 7.0695 x h

h = 32 ÷ 7.0695 = 4.526 **Height of the silo = 4.53 m**

The guideline price given to the farmer = $100 per tonne.

Price of the silo = 20 x 100 = **$2000.**

2 Shelled groundnuts have a bulk density of 0.64 tonnes/m^3 and the farmer wants to store 30 tonnes of shelled groundnuts. The radius of the silo can be no larger than 2 metres.

In order to work out the height:

0.64 tonnes occupies 1 m^3.
So 1 tonne occupies 1 ÷ 0.64 = 1.56 m^3.

30 tonnes therefore occupies 30 x 1.56 = 47 m^3 (rounded up).

OR, a shorter way to calculate this is: 30/0.64 = 47 m^3.

Volume of a cylinder = πr^2 x h

47 = 3.142 x 2^2 x h = 3.142 x 4 x h

47 = 12.568

h = 47 ÷ 12.568 = 3.739 **Height of the silo = 3.74 m**

The guideline price that was given to the farmer was $175 per tonne.

Price of the silo = 175 x 30 = **$5250**

3 Maize has a bulk density factor of 0.72 tonnes/ m^3 and the farmer has 55 tonnes of maize to store. She decides that the radius of the silo can be no larger than 2.5 metres.

55 ÷ 0.72 = 76.388 = 77 m^3 (rounded up).

Volume of a cylinder = πr^2 x h

77 = 3.142 x 2.5^2 x h = 3.142 x 6.25 x h

77 = 19.638 x h

h = 77 ÷ 19.638 = 3.92 **Height of the silo = 3.92 m**

The guideline price that was given to the farmer was $130 per tonne.

Price of the silo = 130 x 55 = **$7150**

4 Sorghum has a bulk density factor of 0.73 tonnes/m^3 and there is 20 tonnes of sorghum to store. The radius of the silo can be no more than 2 metres.

20 ÷ 0.73 = 27.397 = 28 m^3 (rounded up)

Volume of a cylinder = πr^2 x h

$28 = 3.142 \times 2^2 \times h = 3.142 \times 4 \times h$

$28 = 12.568 \times h$

$h = 28 \div 12.568 = 2.227$ **Height of the silo = 2.23 m**

The guideline price was $110 x 20 = **$2200**

Back

Quick Test 16 – Profit or Loss?

Answers

1. **Revenue = $600. Cost = $100. Operating profit = $500**
   She cannot afford to pay herself $600 a year salary.
2. **Revenue = $1750. Costs = $803. Operating profit = $947**
3. **Revenue = $4092. Cost = $2242.50. Operating profit = $1849.50**

Explanation

1 Revenue = 200 x $3 = **$600**

Costs = 200 x $0.50 = $100

Operating Profit = $600 - $100 = **$500 profit.**

$600 is greater than the $500 operating profit so she cannot afford to pay herself a $600 salary.

2 Revenue = 700 x $2.50 = **$1750**

Costs:
Thread: Amount of reels needed = 700 ÷ 50 = 14 14 x $2 = $28
Needles = $25
Fabric = $200
Wages = $550
Total cost = $28 + $25 + $200 + $550 = $803

Operating Profit/Loss = $1750 - $803 = **$947 profit**.

3 Revenue per day = (16 x 0.60) + (12 x 0.30) = $9.60 + $3.60 = $13.20

Revenue per year = $13.20 x 310 = **$4092**

Costs:
Overheads = $1700
Wages = 1.75 x 310 = $542.50
Total cost = $ 1700 + $542.50 = **$2242.50**

Operating Profit/Loss = $4092 – $2242.50 = **$1849.50 profit**.

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