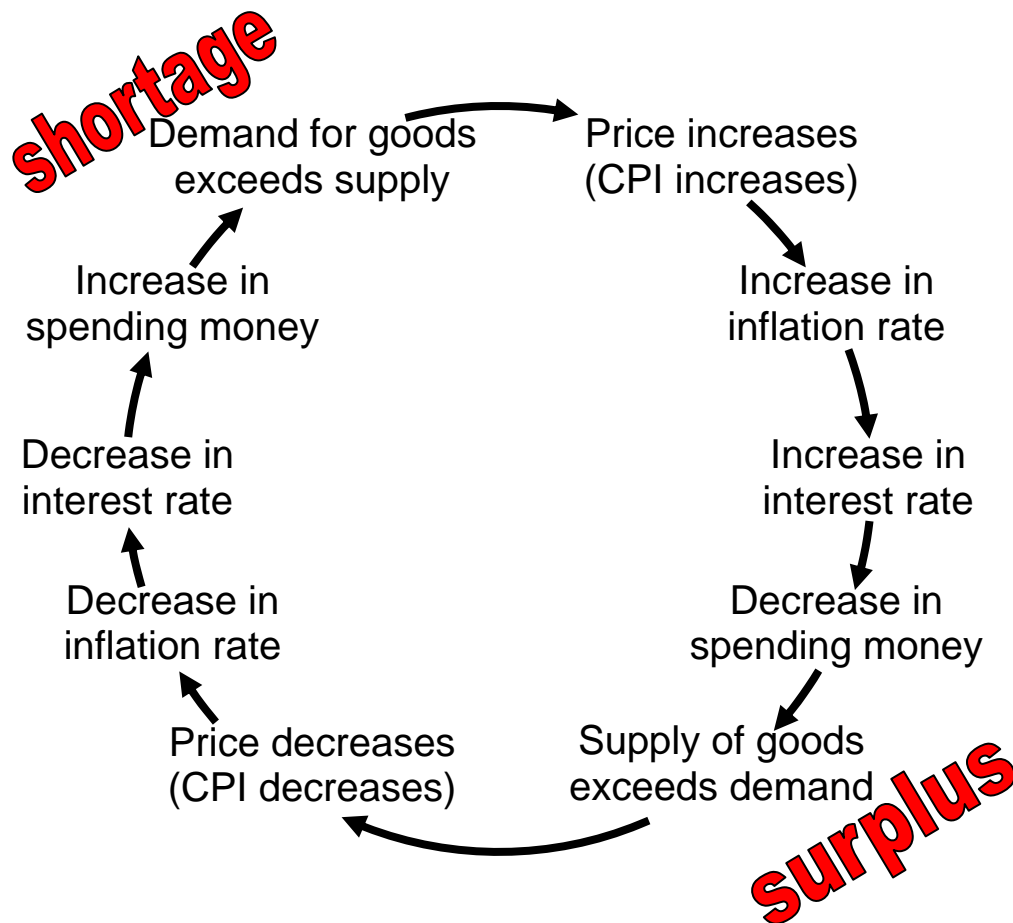


The impact of Interest Rates and Inflation

The Grade 12 Subject Statement for Mathematical Literacy expects that we deal with the impact of among other things the effects of taxation, inflation and changing interest rates (Assessment Standard 12.1.3) in the lives of individuals.

In this series of activities we hope to make sense of these concepts and, in particular, to assist participants in coming to a deeper understanding of how inflation and changing interest rates impact on their day to day lives.

The diagram below (although rather simplified) shows the relationship between inflation and interest rates.



In short the diagram suggests that a decrease in interest rates leads to an increase in disposable income or spending money because people will have to spend less money on (among other things) their monthly home loan repayments. Because many people experience an increase in spending capacity they start buying goods and services. This increase in the purchase of goods and services can lead to demand exceeding supply – in other words a shortage of good and services. Because there is a shortage of goods and service and at the same time a high demand there will typically be an increase in the prices of these goods and services. An increase in the price of goods and services leads to an increase in the Consumer Price Index (CPI) – see later – which in turn leads to an increase in inflation. Because an increase in inflation is undesirable, and because South Africa has adopted a policy of inflation targeting, the Governor of the Reserve Bank will increase interest rates. The increase in interest rates lead to people having less disposable income because they are paying more on (among other things) their monthly

home loan repayments. A decrease in disposable income results in a decline in spending and a surplus of goods and services. Because the people selling the goods and services would rather make less profit per item than to be stuck with the goods and services they will reduce the price. A reduction in price leads to a decrease in the CPI and hence inflation. To keep the economy stimulated the Governor may well lower interest rates again and the whole cycle starts again.

As already stated, this synopsis of the relationship between inflation and interest rates is a gross simplification. There are many other factors that influence inflation over which we have no control. For example a draught can lead to a shortage of maize which will push up the price of maize. An increase in the price of maize leads to an increase in the price of meat and dairy – because cows and chickens etc. eat maize as part of their diet and so we see an increase in the cost of living – and increase in inflation. For now it is enough that we have made the point that interest rates and inflation are related and in the remainder of this activity we will explore the effect of both on the lives of individuals.

Inflation

Definition: Inflation is a measure of the general increase in the cost of goods and services, or a measure of the decline in the purchasing power of money

As the definition suggests inflation measures the change in the cost of goods and services over time – it measures the “cost of living”.

Illustration: Say a particular basket of groceries cost R250 in June 2007. If we buy the *identical* basket of groceries a year later in June 2008 and it now costs R268 – R18 more. Then we can say one of two things – either we can say that the cost of the basket has increased or we can say that we can no longer buy in June 2008 the things that we could buy with R250 in June 2007 – the purchasing power of our money has declined. Inflation measures by how much the “basket” increases in value from one year to the next.

The calculation of inflation is a complex process. In South Africa this is done by Statistics South Africa (Stats SA). By completing the activities that follow you should develop a sense of how Stats SA determines what is known and the inflation rate. The purpose of these activities is only to give you a sense of the process.

To calculate inflation Stats SA monitors the price of a “basket” of goods and services from one month to the next. In simple terms they go out and buy these goods and services every single month. They buy some 1 500 items arranged into 40 different categories.

Having bought the goods and services they record their prices in a large data base. Because it is difficult to compare the trends in the prices of say cars that cost hundreds of thousands of Rand with bottles of peanut butter that cost less than R10,00, Stats SA introduces what is called an index for each item in their basket.

To determine the price index of an item in the basket, Stats SA randomly allocates an index of 100 to the item's price in one month – this month is then called the base month (the base month for most of the items in the Stats SA basket was sometime in 2000). By using the simple calculations illustrated below Stats SA then calculate the price-index for each item in their basket for all of the other months in their data base.

Activity 1: Determining an index for a productWorked example: Chicken food index

Let us assume that the price of a particular bag of chicken food is R45.95 in May. Rather than working with R45,95 let us say that the chicken food's price index is 100.

If the price in June of the same bag of food is now R48,65 we need to calculate the chicken food's index for June. We do this as follows:

$$\text{Chicken food index (June)} = \frac{48,65}{45,95} \times 100 = 105,87 \dots 106$$

If the price in July is R47,45 the chicken food's index for July is 103. This can be calculated in two ways:

$$\text{Chicken food index (July)} = \frac{47,45}{45,95} \times 100 = 103,26 \dots 103$$

$$\text{Chicken food index (July)} = \frac{47,45}{48,65} \times 106 = 103,38 \dots 103$$

Notice how we decided to let the index for May be 100 – this could have been for any month – however, we cannot change this once we have made the decision. If we now want to calculate the index for a month earlier than May – say February (when the price of the meal was R38,99) we use the same method:

$$\text{Chicken food index (February)} = \frac{38,99}{45,95} \times 100 = 84,85 \dots 85$$

Questions

1. Use the table of values below to determine the peanut butter index for each of the months in the table. Let the peanut butter index in February be 100.

January	February	March	April	May
R4,95	R4,65	R4,45	R4,78	R5,20

2. The table of values below shows the price of a particular basket of household cleaning products. Determine the household cleaning product index for each of the months in the table. Let the household cleaning product index in April be 100.

January	February	March	April	May
R43,95	R48,38	R52,62	R51,87	R54,65

Activity 2: Determining the price of a product knowing its price index

Worked example: Price of chicken food

Knowing the index and the price of a product in a given month allows us to calculate the cost of the product for another month if we know the index of the product for that month.

If the chicken food index for December is 111, use the information in the previous worked example to determine what you could expect to pay for the bag in December.

We can calculate the price in a number of ways:

$$\text{Chicken food price (December)} = \frac{111}{100} \times 45,95 = 51,0045 \dots \text{R}51,00$$

$$\text{Chicken food price (December)} = \frac{111}{103} \times 47,45 = 51,1354 \dots \text{R}51,14$$

The slight discrepancy arises because of the rounding in the earlier answer

1. Refer back to the values you determined in question 1 of activity 1. If the peanut butter index for August is 108, calculate what the jar of peanut butter will cost in August. Calculate the value in two different ways to “check” you answer.
2. Refer back to the values you determined in question 2 of activity 1. If the household cleaning product index for November is 117, calculate what the basket of household cleaning products cost in November. Calculate the value in two different ways to “check” you answer.

Stats SA publishes the historical price indices for a wide range of products over the last 30 years on its website (www.statsa.gov.za). The table below is extracted from that database. Use this information in the table to answer the questions that follow.

	1977	1987	1997	2003	2004	2005	2006	2007
Food	5,4	22,4	80,9	131,8	135,4	137,1	143,1	155,4
Alcoholic beverages	6,6	20,1	76	118,2	133,4	146,4	154,4	167
Clothing and footwear	12,4	37,6	95,9	100,8	97,2	94,4	89,4	79,7
Housing	12,3	44,3	92,4	123,6	109,5	113	114,2	124,7
Medical care and health expenses	4,5	16,4	70,5	136,1	149,8	159,3	169,3	178,7
Transport	6,4	25	80	116,4	116,7	121,1	131,8	137,7
Vehicles	4,6	21,1	82,2	119,4	119,1	117	116,2	115,2
Running costs	6,8	24,5	72,5	117,6	118,1	128,3	151,3	164,2
Public and hired transport	12,1	38,3	92,7	106,6	108,3	111	111,6	112,8

3. If a brand new car costs R120 000,00 in 2007 – use the *vehicles* index to calculate what that same car would have cost in: 2006; 2005; 2004; 2003 as well as 1997; 1987; and 1977

4. If a house costs R1 000 000,00 in 2007 – use the *housing* index to calculate what that same house would have cost in: 2006; 2005; 2004; 2003 as well as 1997; 1987; and 1977

Activity 3: Comparing the cost of living for two different people over time

The 1997 monthly household budgets of two different people with the same disposable income are shown in the table below.

	1997		2003		2006		2007	
	A	B	A	B	A	B	A	B
Food	470	1022						
Alcoholic beverages	60	955						
Clothing and footwear	1550	489						
Housing	1660	1203						
Medical care and health expenses	35	400						
Transport	490	197						
TOTAL	4265	4265						

1. Assume that both A and B continue to spend their money on exactly the same goods and services over time. Use the product indices from the Stats SA table to complete the table of value above.
2. Use the formula for percentage change (below) to calculate by what percentage the household expenditure of both A and B has changed over the following periods:
 - 1997 to 2007
 - 2003 to 2007
 - 2006 to 2007

$$\text{percentage change (\%)} = \frac{\text{new} - \text{original}}{\text{original}}$$

3. In light of the above calculations determine whose “cost of living” has increased the most over the period.

Inflation continued

Rather than being concerned with the increase in the cost of living for each and every individual South African – which is quite clearly impossible – Stats SA uses the information that it collects on the costs of the 1500 goods and services every month to calculate the cost of the “typical South African’s” basket of groceries.

Instead of publishing the price of the basket of groceries from month to month Stats SA once again calculates the index for the basket and publishes this instead – the index is called the consumer price index (CPI). You will hear this being reported from month to month in newspapers, on the radio and television.

Since inflation is defined as the a measure of the general increase in the cost of goods and services, or a measure of the decline in the purchasing power of money – Stats SA determines inflation by calculating the percentage change in the CPI. This percentage change – also referred to as the inflation rate – which is announced by Stats SA on a monthly basis measures the change in the CPI from a give month in one year to the corresponding month in the next year.

The table below lists the CPI for each month of the year over a 10 year period.

Year		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Ave.
1998	CPI	86,7	86,9	87,5	87,9	88,3	88,6	90,7	91,7	93,3	93,7	93,7	93,7	90,2
	%	5,7	5,3	5,4	5	5,1	5,2	6,6	7,6	9	9	9,3	9	6,9
1999	CPI	94,4	94,4	94,4	94,6	94,5	95	95,1	94,7	95,1	95,3	95,5	95,8	94,9
	%	8,9	8,6	7,9	7,6	7	7,2	4,9	3,3	1,9	1,7	1,9	2,2	5,2
2000	CPI	96,9	96,6	97,6	98,9	99,3	99,9	101	101	102	102	102	103	100
	%	2,6	2,3	3,4	4,5	5,1	5,2	6	6,9	6,9	7	7	7	5,4
2001	CPI	104	104	105	105	106	106	106	106	106	106	107	107	106
	%	7,1	7,8	7,4	6,5	6,4	6,3	5,3	4,6	4,4	4	4,3	4,6	5,7
2002	CPI	109	110	111	113	114	115	116	117	118	120	120	121	115
	%	5	5,9	6,2	7,4	7,8	8	9,6	10,4	11,2	13	12,9	12,4	9,2
2003	CPI	122	122	123	123	123	122	122	123	123	122	121	121	122
	%	11,6	10,3	10,2	8,8	7,8	6,7	5,2	5,1	3,7	1,5	0,4	0,3	5,8
2004	CPI	122	122	123	123	124	124	124	124	124	125	125	125	
	%													
2005	CPI	125	126	127	128	128	127	129	129	130	130	130	130	
	%													
2006	CPI	130	131	131	132	133	134	135	136	136	137	137	137	
	%													
2007	CPI	138	138	139	141	142	143	144	145	146	147	148	149	
	%													

Explanatory notes:

- The CPI in January 2002 was 109 and the CPI in January 2003 was 122 – using these values the year-on-year inflation from January 2002 to January 2003 has been calculated as follows:

$$\text{inflation (Jan}_{2002} \text{ to Jan}_{2003}) = \frac{122 - 109}{109} = 11,9\%$$

Note that this has been recorded as 11,6 in the table (under January 2003). The difference between 11,9 and 11,6 can be attributed to the fact that Stats SA works with many decimal places but does not repost these.

- The average of the CPI's for each of the twelve months in a year is recorded in the column average and is considered the representative CPI for the year – in other words the average CPI for 2003 was 122.
- The average inflation rate for the year is determined by calculating the percentage change in the average CPI from one year to the next.

By reading the information in the table you should realise that the year on year inflation can vary quite a bit from month to month and for this reason it is important to calculate an average for the year.

Activity 4: Working with CPI data

1. Calculate all of the missing values in the table.
2. Use the CPI data from the table to estimate the cost of a collection of goods and services in:
 - a. Dec '06 if the identical collection of goods and services cost R4 750 in Dec '07
 - b. Feb '06 if the identical collection of goods and services cost R4 750 in Feb '07
 - c. 2006 if the identical collection of goods and services cost R4 750 in 2007
 - d. Dec '02 if the identical collection of goods and services cost R4 750 in Dec '03
 - e. Feb '02 if the identical collection of goods and services cost R4 750 in Feb '02
 - f. 2002 if the identical collection of goods and services cost R4 750 in 2002
3. If a person earned R6 000 per month in 2000, calculate how much that person should earn in each of the years 2001 to 2007 so that the purchasing power of their salary remains unchanged.
4. If a person used to earn R5 000,00 per month in 1998 and in 2007 the same person earned R6 800 per month, calculate whether or not this person's salary has kept pace with the cost of living.
5. Calculate which of the following people's salary have:
 - not kept pace with inflation;
 - kept pace with inflation; and
 - increased by more than we would have expected in terms of inflation:
 - a. A: earned R5 000,00 per month in 1998 and earns R6800 per month in 2007
 - b. B: earned R6 000,00 per month in 2001 and earns R8750 per month in 2007
 - c. C: earned R7 000,00 per month in 2004 and earns R8120 per month in 2007

Interest rates

The link between inflation and interest rates was described in the early part of this handout.

Definition: Interest is the fee paid by a borrower to a lender for the use of borrowed money. The fee is usually expressed as an annual percentage of the amount borrowed and is known as the interest rate.

We now turn our attention to interest rates. When the Governor of the Reserve bank changes the interest rate – what really happens is that the Repo Rate (the rate at which the Reserve Bank loans money to commercial banks) is changed. In this relationship the commercial bank is the borrower and the Reserve Bank the lender. When the commercial bank loans money to an individual – the individual is the borrower and the commercial bank the lender. Because the commercial bank needs to make money as well it charges a greater interest rate to the individual than it is charged by the Reserve Bank.

In any loan arrangements there are four interrelated variables:

- The loan amount
- The interest rate
- The monthly repayment; and
- The period of the loan – the number of months it takes to repay the loan

Of interest to our discussion is how the interest rate and the monthly repayment are related. If we fix the loan amount and the period of the loan then we find that an increase in the interest rate will increase the monthly repayment while a decrease in the interest rate will lead to a decrease in the monthly repayment. This is well illustrated by referring to the table of bond repayment factors published by a commercial bank below:

Interest rate	Monthly repayment per R1000 borrowed					
	over 5 years	over 10 years	over 15 years	over 20 years	over 25 years	over 30 years
10%	21,25	13,22	10,75	9,65	9,09	8,78
11%	21,74	13,78	11,37	10,32	9,80	9,52
12%	22,24	14,35	12,00	11,01	10,53	10,29
13%	22,75	14,93	12,65	11,72	11,28	11,06
14%	23,27	15,53	13,32	12,44	12,04	11,85
15%	23,79	16,13	14,00	13,17	12,81	12,64

Activity 5: Calculating the impact of a change in interest rate on a monthly loan repayment

The table can be used to determine the monthly repayment on a loan as follows: For a home loan of R250 000 that is being paid of over a period of 20 years at an interest rate of 12% per annum, the monthly repayment is:

$$\text{monthly repayment} = \frac{\text{R}250\,000}{1\,000} \times 11,01 = \text{R } 2752,50$$

1. If a person is paying of a R250 000 loan over 20 years at an interest rate of 12% and the interest rate changes to 14%, calculate the change in their monthly repayment – i.e. the change in their monthly disposable income.
2. Calculate the change in monthly disposable income for each of the following people
 - a. A is repaying a R500 000 loan over 30 years and the interest rate changes from 10% to 13%
 - b. B is repaying a R500 000 loan over 15 years and the interest rate changes from 10% to 13%
 - c. C is repaying a R500 000 loan over 5 years and the interest rate changes from 10% to 13%
 - d. D is repaying a R1 000 000 loan over 10 years and the interest rate changes from 13% to 11%
 - e. E is repaying a R1 000 000 loan over 20 years and the interest rate changes from 13% to 11%
 - f. F is repaying a R1 000 000 loan over 25 years and the interest rate changes from 13% to 11%