



Dr. Blosa Science

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### Sub math: Moving averages

$$\text{Average} = \frac{\text{sum of value}}{\text{number of value}}$$

Moving averages are a series of averages of values

Order of moving averages is number of values required to form an average.

### Calculation of moving averages

- (a) Moving total is the sum of n values, the first moving average is written against the (n-1)<sup>th</sup> value.
- (b) First moving averages =  $\frac{\text{sum of first } n \text{ values}}{\text{order } n}$
- (c) Second moving averages =  $\frac{\text{sum of next } n \text{ values, excluding the first value}}{\text{order } n}$
- (d) Third moving averages =  $\frac{\text{sum of next } n \text{ values, excluding the first two value}}{\text{order } n}$
- (e) This process continues up to last value of the data

### Example 1

The table below shows the enrollment of students in an institution over a period of 5 years.

Year	2003	2004	2005	2006	2007
Number of students	145	182	170	155	213

Calculate

- (a) three-year moving averages. (03marks)

### Solution

- first three-year moving total = 145 + 182 + 170 = 497
- First three-year moving average =  $\frac{145+182+170}{3} = 165.7$
- Second three-year moving total = 182+170+155 = 507
- Second three-year moving averages =  $\frac{507}{3} = 169.0$
- Third three-year moving total = 170+155+213 = 538
- Third three-year moving averages =  $\frac{538}{3} = 179.3$

The values are filled in the table as shown below

Year	Tax	Moving totals	
2003	145		
2004	182	497	165.7
2005	170	507	169.0
2006	155	538	179.3
2007	213		
2008	x		

(b) number of students enrolled in 2008, given that the fourth moving average is 203. (02 marks)

Let the number enrolled in 2008 be

$$\text{Fourth three-year moving averages} = \frac{155+213+x}{3} = 203$$

$$\Rightarrow 368 + x = 203 \times 3$$

$$x = 609 - 368 = 241$$

### Example 2

The table below shows quarterly sales of cars for the year 2000, 2001 and 2002 by a company.

YEAR	QUARTER			
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>
2000	390	310	280	355
2001	420	320	305	410
2002	400	350	315	425

(a) Calculate a four point moving average for the data. (06marks)

$$\text{First four point moving total} = 390+310+280+355 = 1335$$

$$\text{First four point moving average} = \frac{1335}{4} = 333.75$$

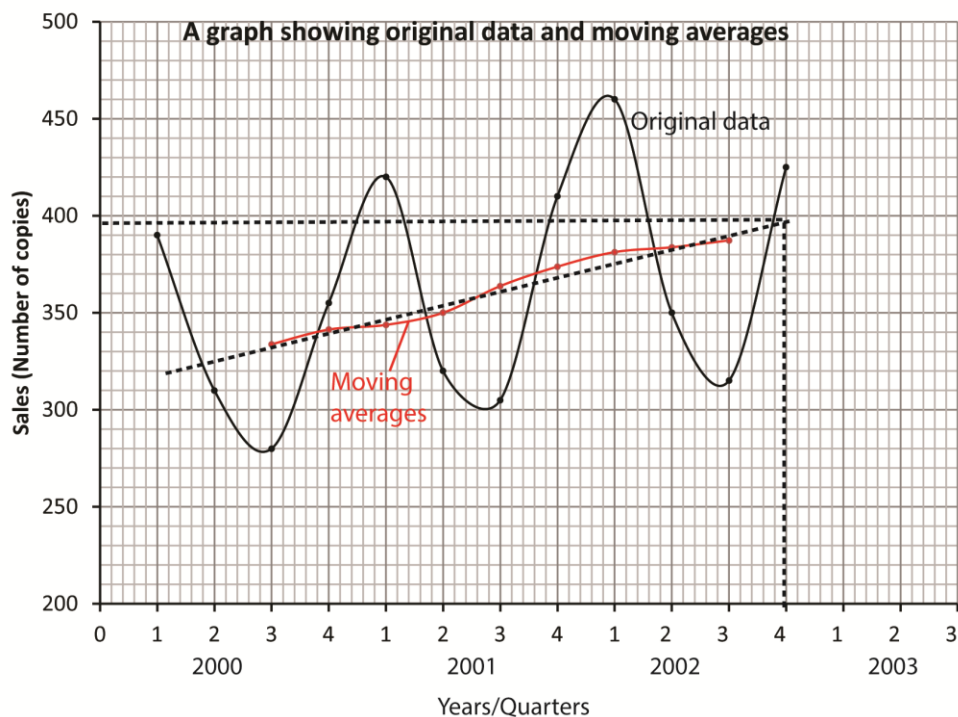
$$\text{Second four point moving total} = 310+280+355+420 = 1365$$

$$\text{Second four point moving average} = \frac{1365}{4} = 341.35$$

The calculations are carried on, the values filled into the table as shown below

Year	Quarter	Sales	Moving totals	Moving averages
2000	1	390		
	2	310		
	3	280	1335	333.75
	4	355	1365	341.35
2001	1	420	1375	343.75
	2	320	1400	350
	3	305	1455	363.75
	4	410	1495	373.75
2002	1	460	1525	381.25
	2	350	1535	383.75
	3	315	1550	387.3
	4	425		
2003	1	x		

- (b) (i) Plot a four – point moving average for the data on the same axes. (06marks)



- (ii) Comment on the trend of the sales of the cars. (01 mark)

There is a general increase in the sale of cars with the years

- (iii) Use your graph to estimate the number of cars sold in the first quarter of 2003. (02marks)

The estimated 10<sup>th</sup> moving average = 395 cars

Let the number of cars sold in the 1<sup>st</sup> quarter of 2003 be x

$$\frac{x+425+315+350}{4} = 395$$

$$x + 1,115 = 395 \times 4 = 1580$$

$$x = 490$$

### Example 3

The table below shows the 3-month moving averages for the quantity of good (in tonnes) manufactured by a certain company from January to August of 2019.

Month	February	March	April	May	June	July
3-month Moving Average (tonnes)	15	17.5	19	20	21.5	22.5

(a) Find the moving totals. (03marks)

#### Solution

Month	Tax	Moving totals	
Jan			
February		45	15
March		52.5	17.5
April		57	19
May		60	20
June		64.5	21.5
July		67.5	22.5

(b) If 20 tonnes and 10 tonnes of goods were manufactured in February and March respectively, calculate the quantity that was manufactured in January. (02 marks)

#### Solution

Let the quantity manufactured in January be x

$$x + 20 + 10 = 45$$

$$x + 30 = 45$$

$$x = 15$$

**Example 5**

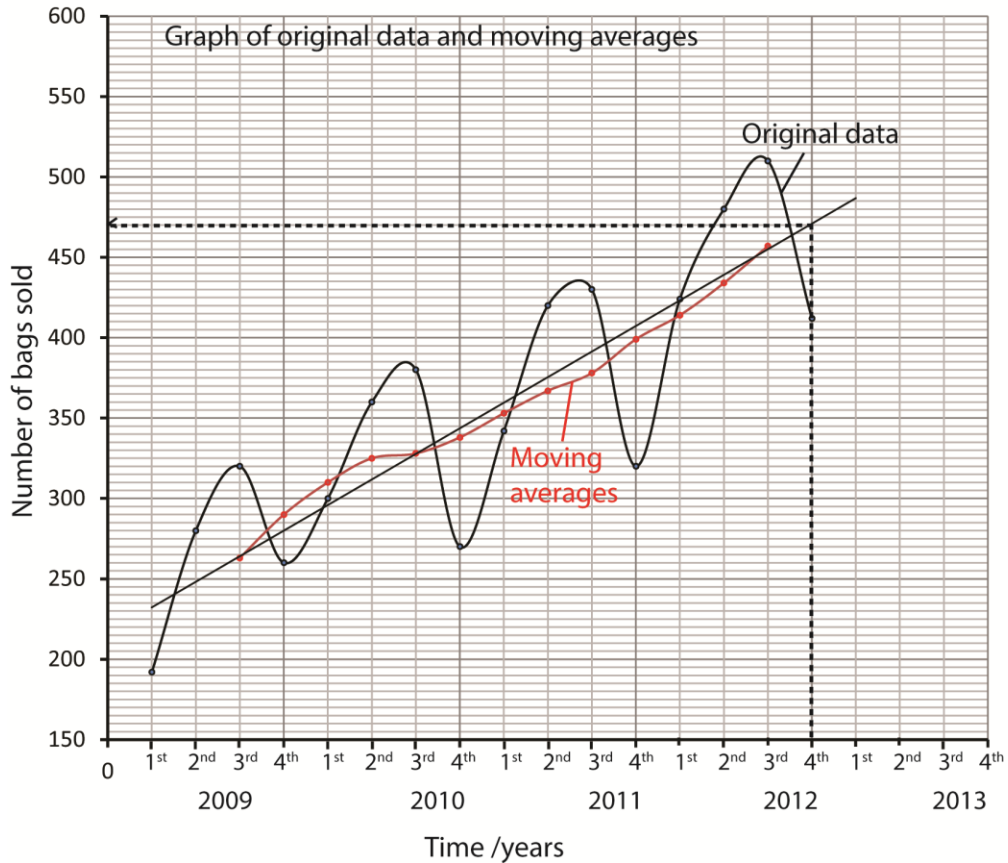
The table shows the number of bags of sugar sold by a certain wholesale shop from the year 2009 to 2020

YEAR	QUARTER			
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>
2009	192	280	320	260
2010	300	360	380	270
2011	342	420	430	320
2012	424	480	510	412

(a) Calculate the four-point averages for the data (06marks)

Year	Quarter	Bags sold	Moving Totals	Moving averages
2009	1 <sup>st</sup>	192		
	2 <sup>nd</sup>	280		
	3 <sup>rd</sup>	320	1052	263
	4 <sup>th</sup>	260	1160	290
2010	1 <sup>st</sup>	300	1240	310
	2 <sup>nd</sup>	360	1300	325
	3 <sup>rd</sup>	380	1310	328
	4 <sup>th</sup>	270	1352	338
2011	1 <sup>st</sup>	342	1412	353
	2 <sup>nd</sup>	420	1462	367
	3 <sup>rd</sup>	430	1512	378
	4 <sup>th</sup>	320	1594	399
2012	1 <sup>st</sup>	424	1654	414
	2 <sup>nd</sup>	480	1734	434
	3 <sup>rd</sup>	510	1826	457
	4 <sup>th</sup>	412		
2013	1 <sup>st</sup>	x		

(b) (i) On the same axes, plot the original data and the four-point moving averages. (05 marks)



- (ii) Comment on the trends of the number of bags of sugar sold over the four year period. (01 mark)

There is a general increase in the number of bags sold with increase in time

- (iii) Use your graph to estimate the number of bags to be sold in the first quarter of 2013. (03marks)

The estimates 14<sup>th</sup> moving average = 460

Let the number of bags sold in the first quarter of 2013 be x

$$\frac{x+480+510+412}{4} = 470$$

$$x = 1,880 - 1402 = 478$$

### Example 6

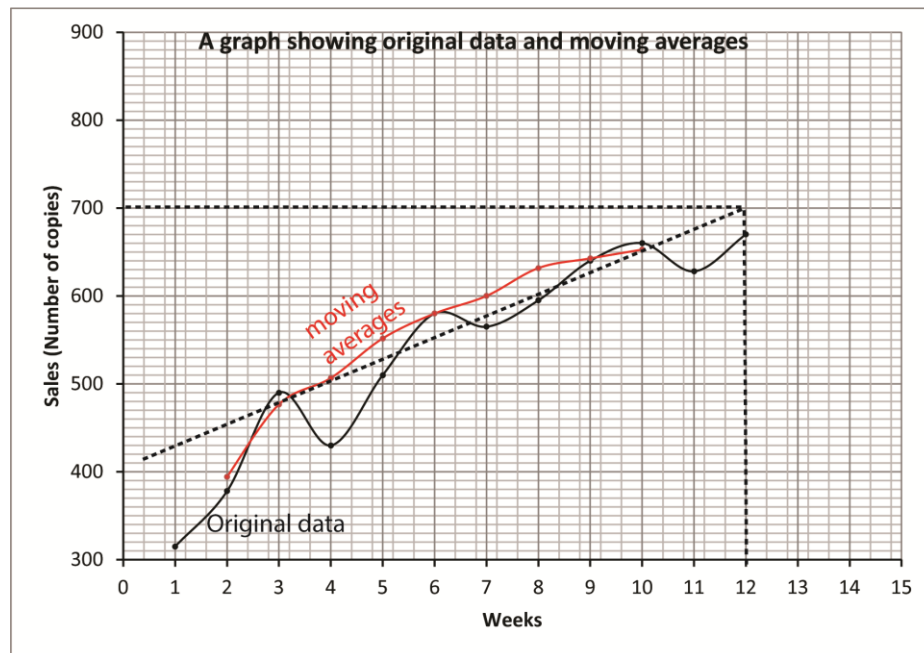
The table shows the sales in thousands of copies by a local Newspaper over a period of 12 weeks.

Week	1	2	3	4	5	6	7	8	9	10	11	12
Number of copies sold	135	378	490	430	510	580	565	595	640	660	628	670

(a) Calculate the 3-weeks moving averages for the copies sold. (06marks)

week	Number of copies	Moving totals	Moving averages
1	315		
2	378	1183	394.3
3	490	1298	476.7
3	430	1430	476.7
5	510	1520	506.7
6	580	1655	551.7
7	565	1740	580
8	595	1800	600
9	640	1895	631.7
10	660	1928	642.7
11	628	1958	652.7
12	670		
13	x		

(b) (i) On the same axes, plot the original data and the 3-weeks moving averages. (06marks)



(ii) Use your graphs to estimate the number of copies sold in the 13<sup>th</sup> week. (03marks)

From the graph the 11<sup>th</sup> moving average = 700

Let x be the number of copies sold in the 13<sup>th</sup> week

$$\frac{x+628+670}{3} = 720; \quad x = (700 \times 3) - (628 + 670) = 802$$

### Example 7

The table below shows the tax collection of a town council in millions of shillings for six consecutive months.

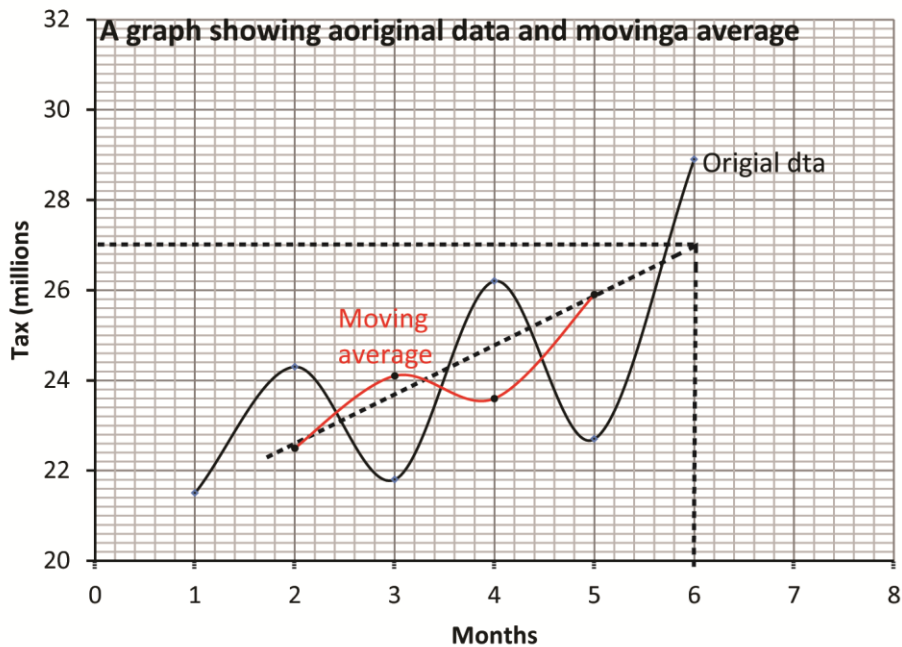
Month	Jan	Feb	Mar	Apr	May	June
Tax (in millions)	21.5	24.3	21.8	26.2	22.7	28.9

(a) Construct the 3-month moving average for the given data. (06marks)

#### Solution

Month	Tax	Moving totals	Moving average
Jan	21.5		
Feb	24.3	67.6	22.5
Mar	21.8	72.3	24.1
Apr	26.2	70.7	23.6
May	22.7	77.8	25.9
June	28.9		
x			

(b) Plot the 3-month moving averages and the original data on the same axes. (06 marks)



(c) Use your graph to estimate the town council's tax collection for the month of July. (03marks)

From the graph the moving average for June = 27 millions

If  $x$  are the sales for July

$$\text{Then } \frac{x+22.7+28.9}{3} = 27$$

$$x + 51 = 81$$

$$x = 30$$

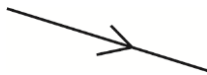
### Defining the trend of the moving averages

The trend of moving average is indicated by the line of the best fit. For the sake of uniformity, the line of the best fit is drawn through the first and last moving average.

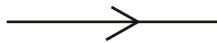
- (i) A line of the best fit sloping up from left to right shows a general increase in production, sales, performance etc.



- (ii) A line of the best fit sloping down from left to right shows a general decrease in production, sales, performance etc.



- (iii) A line of best fit that is horizontal (parallel to x-axis) shows constant production, performance, sales.



### Revision exercise

1. The table below shows the tax collection of a town council in millions of shillings for 8 consecutive months of a given year.

months	1	2	3	4	5	6	7	8
sales	60	45	52	40	45	42	35	48

- (a) Construct a four year moving average  
(b) Plot a graph of the moving averages together with the original data.  
(c) Comment on the trend of sales over 8month period. [general decline of sales over eight months]
2. The table below shows the termly marks scored in mathematics by a certain student in four years of secondary school.

Year	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>
1	36	50	54
2	40	45	60
3	39	46	70
4	49	50	x

- (a) Construct the 3-month moving average for the given data  
(b) On the same axes, plot the original data and the 3-month moving averages.  
(c) Use your graphs to estimate the mark x scored in term 3 year 4. [45%]
3. The sales of brand A in a supermarket for a period of five years are given in the table below

Year	1	2	3	4	5
sales	230	241	259	272	288

- (a) Construct the 3-month moving average for the given data  
(b) On the same axes, plot the original data and the 3-year moving averages.  
(c) Use your graphs to estimate the sales of the 6<sup>th</sup> year [45%]

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**Thanks**

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