

Smoothing a time series plot using moving medians

Thursday, 23 January 2020 8:17 pm

★ By the end of the lesson I would hope that you have an understanding and be able to apply to questions the following concepts:

- Understand why we are smoothing data.
- Understand what it means to be a median (medium/middle point)
- Understand what it means to smooth using moving medians
- Apply the concepts to smooth and then describe the trends for a time-series plot

RECAP:

In the previous lesson we looked at the ideas behind three- and five-mean smoothing.

We also looked at the ideas of two- and four-mean smoothing with centering.

We do this to try and remove the effects of **random fluctuations** and to allow us to see if there are any trends in the data.

We must remember that in all the work we are doing for this topic, we will have to describe the data and interpret the results.

RECAP: Medians and finding the middle

We need to remember that **median** means **middle**.

When we are trying to find the middle value we **must make sure that the values are placed in order first**. Or we must look for the middle value in the list.

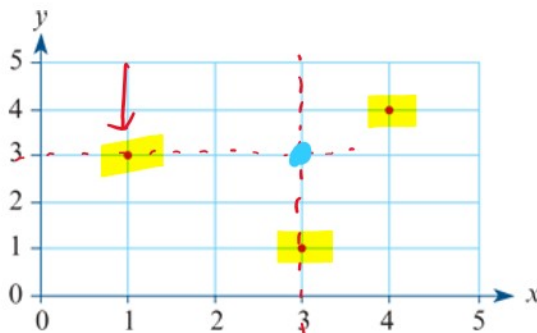
This can be applied to time-series plots.

TRICKS, TRICKS AND MORE TRICKS

When we are taking the moving medians for data we need to ensure we apply the process to both the x - and y -values.

Using a very simple example from the Cambridge Further Maths Units 3 and 4 textbook.

Let's find the moving median for the following **three** points.
This would be called three-median smoothing.



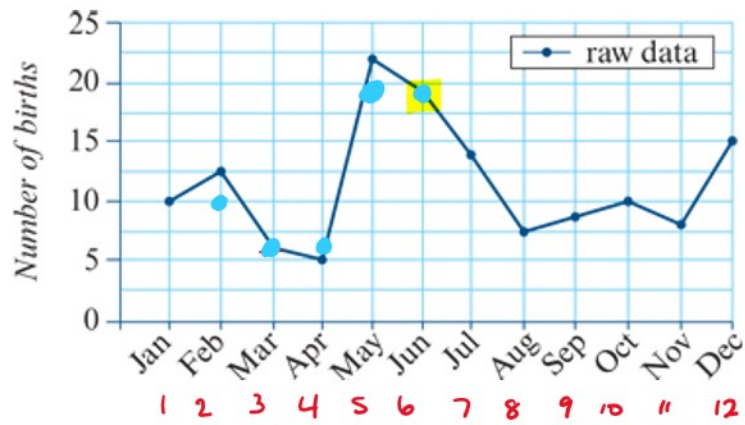
We can be asked to do three-median smoothing, five-median smoothing etc.
The process is the same!

Example

The following example has been taken (with permission) from the Cambridge Further Mathematics Units 3 and 4 Textbook

Construct a three-median smoothed plot of the time series plot shown opposite.

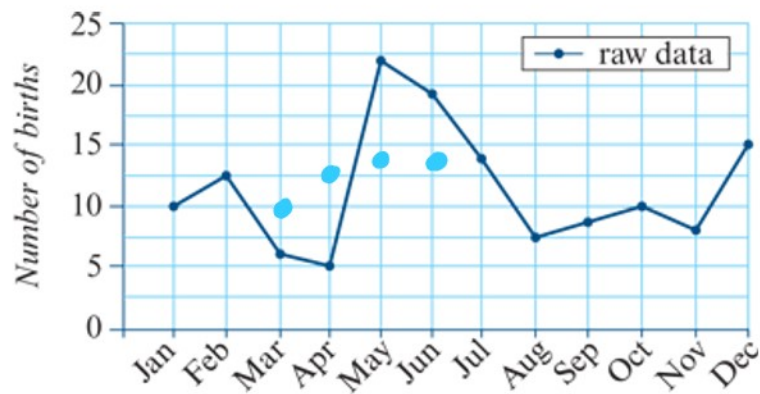
Note: When median smoothing graphically you smooth directly onto the time series plot.



Example

The following example has been taken (with permission) from the Cambridge Further Mathematics Units 3 and 4 Textbook

Construct a five-median smoothed plot of the time series plot shown opposite.



VCAA Exam Question on this concept 2017 Paper 2

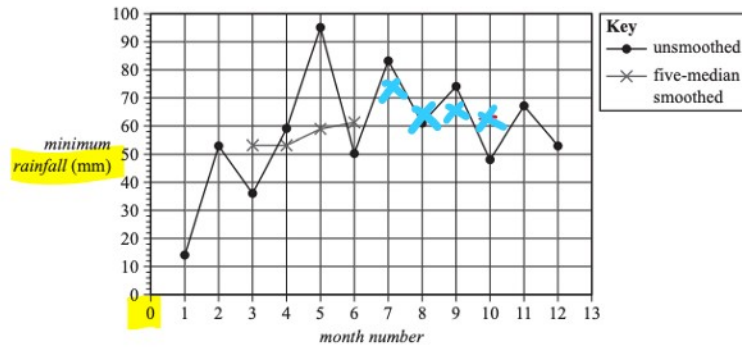
Question 4 (4 marks)

The time series plot below shows the *minimum rainfall* recorded at the weather station each month plotted against the *month number* (1 = January, 2 = February, and so on).

Rainfall is recorded in millimetres.

The data was collected over a period of one year.

against the *month number* (1 = January, 2 = February, and so on).
Rainfall is recorded in millimetres.
The data was collected over a period of one year.



- a. Five-median smoothing has been used to smooth the time series plot above.
The first four smoothed points are shown as crosses (x).

Complete the five-median smoothing by marking smoothed values with crosses (x) on the **time series plot above**.

2 marks

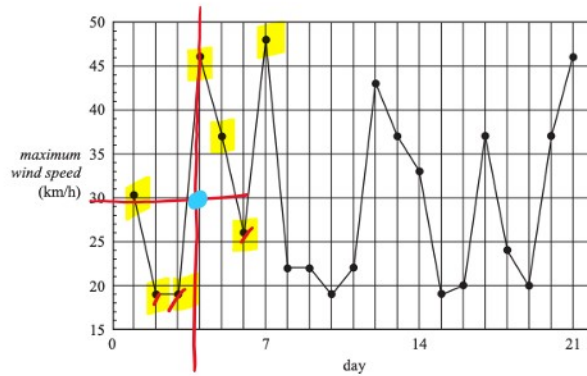
(Answer on the time series plot above.)



VCAA Exam Question on this concept 2017 Paper 1

Use the following information to answer Questions 13–15.

The wind speed at a city location is measured throughout the day.
The time series plot below shows the daily *maximum wind speed*, in kilometres per hour, over a three-week period.



Question 14

The seven-median smoothed *maximum wind speed*, in kilometres per hour, for day 4 is closest to

- A. 22
B. 26
C. 27
D. 30
E. 32



VCAA Exam Question on this concept 2019 Paper 1

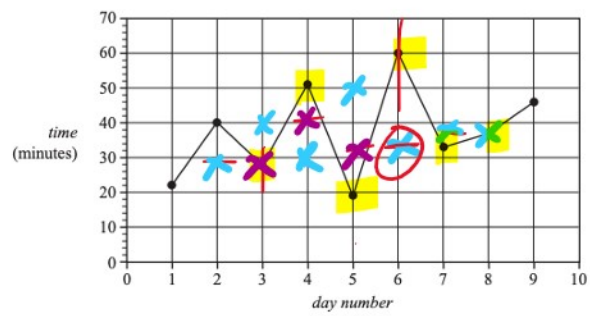
Use the following information to answer Questions 13 and 14.

The *time*, in minutes, that Liv ran each day was recorded for nine days.
These times are shown in the table below.

Day number	1	2	3	4	5	6	7	8	9
Time (minutes)	22	40	28	51	19	60	33	37	46

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Time (minutes)	22	40	28	51	19	60	33	37	46

The time series plot below was generated from this data.



Question 13

Both three-median smoothing and five-median smoothing are being considered for this data.

Both of these methods result in the same smoothed value on *day number*

- A. 3
- B. 4
- C. 5
- D. 6**
- E. 7