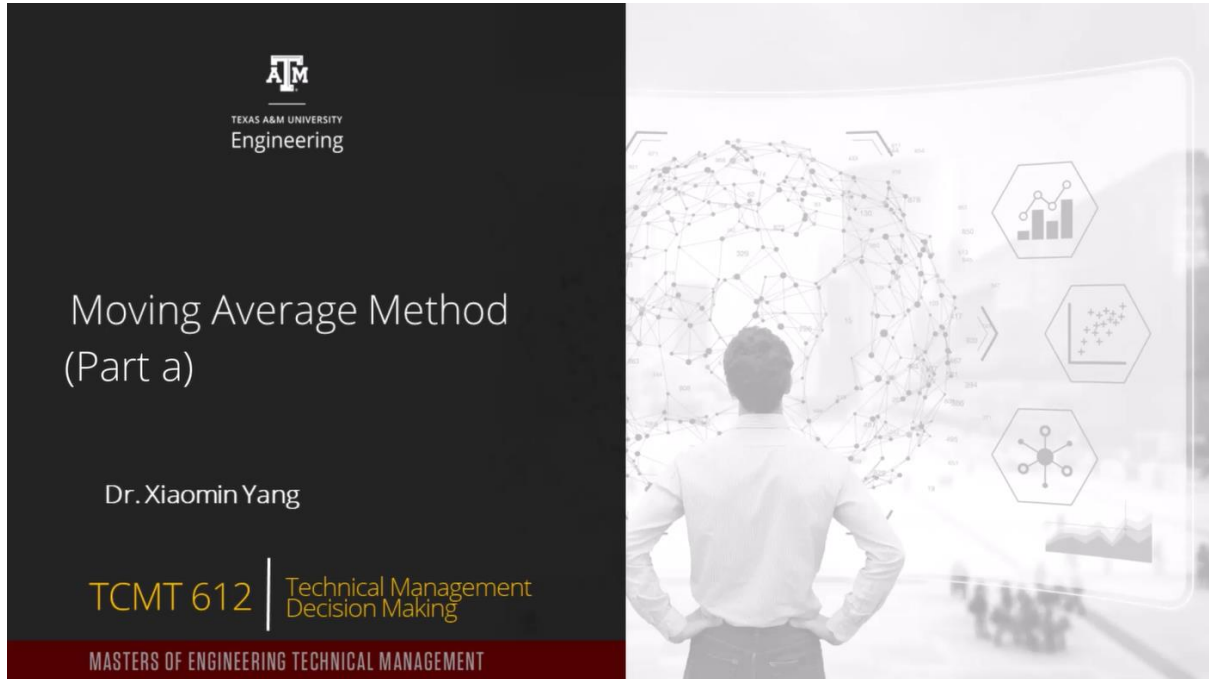


M6L4a. Moving Average Method

Slide #1



The slide cover is divided into two main sections. The left section is a dark grey rectangle containing the Texas A&M University Engineering logo at the top, followed by the title 'Moving Average Method (Part a)' in white, the name 'Dr. Xiaomin Yang' in white, and the course information 'TCMT 612 | Technical Management Decision Making' in yellow and white. At the bottom of this section is a red banner with the text 'MASTERS OF ENGINEERING TECHNICAL MANAGEMENT' in white. The right section is a light grey image showing a person from behind, looking at a large digital display. The display shows a complex network diagram on the left and several hexagonal icons on the right, each containing a different data visualization (bar chart, line graph, network diagram, and area chart).

ATM
TEXAS A&M UNIVERSITY
Engineering

Moving Average Method
(Part a)

Dr. Xiaomin Yang

TCMT 612 | Technical Management
Decision Making

MASTERS OF ENGINEERING TECHNICAL MANAGEMENT

Now, let us talk about the moving average method.

Slide #2

Moving Average Method

Monthly sale of OCT
retina diagnostic
equipment

Sale numbers fluctuate
dramatically

Growing trend is obvious

How to smooth the sale
curve to make a
projection of future sale?



Businesses often are interested in forecasting future values of a set of data over time, such as historical sale.

In constructing business plans, most companies make some attempt to forecast the expected level of sales, cost, profit, inventory, back orders, customer count, and so on.

These types of forecasts are often required inputs in the decision-making models.

For example, we have the historical data of the monthly sales of the OCT machine.

We can forecast the future sales with quantitative methods, and then we can use the forecasted sale number to plan our production and inventory management.

Techniques that analyze the historical data to predict the future are sometimes referred to as time series interpolation methods.

The moving average technique is probably the most common time series exploration method to use and understand.

Before explaining the moving average method, let us first look at the pattern of historical sale data of the OCT machine.

First, the sale numbers fluctuated dramatically.

Many factors contribute to the monthly sales and therefore it will require tremendous resources to build a sophisticated economic model, which takes into account the effects of these economic factors to forecast future sales.

Second, the growing trend is obvious.

From the practical perspective, if our forecasting method can roughly predict the future sales in the next several months, the company will be able to optimize its production, inventory, and so on to maximize profits.

So, from the practical perspective, we do not need to build a sophisticated economic model to accurately describe what factors contribute to the sale fluctuation.

If we can have a simple model to forecast the sale numbers in the next months and quarters, we will be able to make data-driven decisions with the forecasted data.

Slide #3

Moving Average Method

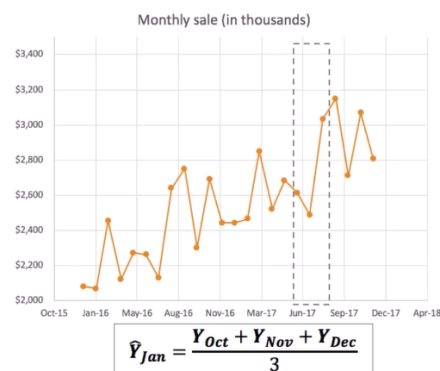
Method: Use the average sale of a period (e.g. 3 months or 6 months) to predict next month's sale

$$\hat{Y}_{t+1} = \frac{Y_t + Y_{t-1} + Y_{t-2} + \dots + Y_{t-k+1}}{K}$$

\hat{Y}_{t+1} : predicted value in month $t + 1$

Y_t : sale of month t

k : number of months in the average window



The underlying principle of the moving average method is to use the average sale of a period.

For example, three months or six months to predict next month's sale.

The equation is shown in this slide, where the value k in the equation determines how many previous data will be included in a moving average calculation.

No general methods exist for determining what value of k will be the best for a particular time series estimation, but k can be determined with empirical methods.

Microsoft Excel and other mathematical tools can be used to build the moving average method.

With the tool, it is very easy to test different k values and to determine which one gives us the most accurate forecast.

We will discuss how to use the Microsoft Excel Moving Average Forecasting tool to test different k values, or different moving average windows, to determine which window, which k value, gives us the most accurate forecasting results.

As shown in the equation on the right chart, if we choose 3 for k , then we will use the monthly sale in October, November, and December 2017 to forecast the sale in January 2018.

So we will use the sales in a three month window to forecast the sale in the next month.

The sales in January is the average monthly sales in the past three months.

That is why we call this method moving average.

We use the average sales of the previous three months to predict the sales in the next month.

Slide #4

Moving Average Method

	A	B	C	D	E	F	G
	Time	Monthly sale (in thousands)	Sale forecast: 2 month moving average	Sale forecast: 3 month moving average	Sale forecast: 4 month moving average		
2	Jan-16	\$ 2,080					
3	Feb-16	\$ 2,068					
4	Mar-16	\$ 2,465	\$ 2,074				
5	Apr-16	\$ 2,124	\$ 2,261	\$2,201			
6	May-16	\$ 2,272	\$ 2,289	\$2,215	\$ 2,182		
7	Jun-16	\$ 2,261	\$ 2,196	\$2,284	\$ 2,230		
8	Jul-16	\$ 2,130	\$ 2,267	\$2,219	\$ 2,278		
9	Aug-16	\$ 2,640	\$ 2,196	\$2,221	\$ 2,197		
10	Sep-16	\$ 2,750	\$ 2,385	\$2,344	\$ 2,326		
11	Oct-16	\$ 2,300	\$ 2,890	\$2,507	\$ 2,445		
12	Nov-16	\$ 2,891	\$ 2,525	\$2,563	\$ 2,455		
13	Dec-16	\$ 2,442	\$ 2,496	\$2,580	\$ 2,595		
14	Jan-17	\$ 2,442	\$ 2,561	\$2,619	\$ 2,546		
15	Feb-17	\$ 2,466	\$ 2,442	\$2,525	\$ 2,469		
16	Mar-17	\$ 2,850	\$ 2,454	\$2,450	\$ 2,510		
17	Apr-17	\$ 2,523	\$ 2,604	\$2,586	\$ 2,550		
18	May-17	\$ 2,684	\$ 2,686	\$2,613	\$ 2,570		
19	Jun-17	\$ 2,613	\$ 2,603	\$2,685	\$ 2,630		
20	Jul-17	\$ 2,487	\$ 2,649	\$2,607	\$ 2,667		
21	Aug-17	\$ 3,014	\$ 2,550	\$2,595	\$ 2,577		
22	Sep-17	\$ 3,148	\$ 2,760	\$2,711	\$ 2,704		
23	Oct-17	\$ 2,712	\$ 3,091	\$2,890	\$ 2,821		
24	Nov-17	\$ 3,067	\$ 2,936	\$2,895	\$ 2,845		
25	Dec-17	\$ 2,808	\$ 2,890	\$2,976	\$ 2,990		
26	Jan-18		\$ 2,938	\$2,862	\$ 2,934		
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We can evaluate the relative accuracy of three moving average forecasting functions by comparing the differences between forecast and actual values for three techniques shown in cells C28, D28, and E28.

The period used for the comparison is between May 2016 and December 2017, or rows 6 and 26.

The following formula calculates the square difference values.

The formula for cell C28 equals to SUMXMY2, the range of actual sales data in column B, and the corresponding forecasting data in column C, divided by the number of data points in the comparison window, which is described by the formula count C 6 to C26.

The SUMXMY2 function calculates the sum of square differences between corresponding values.

You can find the syntax of SUMXMY2 in the Excel, help the count function returns the number of values in a range.

We use the comparison to determine which average period returns the most accurate results.

In this specific case, a three-month moving average window gives us the most accurate estimation.

Because we want to forecast future observations, we might be interested in how well the forecasting function performed on the most recent data.

We can determine this by choosing different comparison windows also.

The choice of the comparison window depends on where the product is in its life cycle.

For a mature product, you may choose a broad window.

For a relatively new product, you may choose a narrow window in recent months.

In general, the choice of comparison window and the moving average period is empirical.

You can test different comparison windows and different k values, the moving average window, to determine which one gives you the best result.

Again, with the Microsoft Excel tool, it is very easy to test different moving average windows and different comparison windows.