NEPAL COLLEGE OF INFORMATION TECHNOLOGY

Balkumari, Lalitpur

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Lab 0.0: Forecasting NEPSE Trends Using Moving Averages:

An Analysis of SMA, WMA, and EMA

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Moving Averages in Technical Analysis: Theory and Application

Assumptions and Calculations Using Revised Formulas for SMA, WMA, and EMA

Key Assumptions:

1. **Simple Moving Average (SMA):**
   The SMA is calculated as the average of the values from the last four months:

$$\text{SMA}(t) = \frac{a + b + c + d}{4} \tag{1}$$

2. **Weighted Moving Average (WMA):**
   The WMA assigns more weight to recent data, using the formula:

$$\text{WMA}(t) = \frac{a \times 1 + b \times 2 + c \times 4 + d \times 8}{1 + 2 + 4 + 8} \tag{2}$$

3. **Exponential Moving Average (EMA):**
   Assume a smoothing factor $\alpha = 0.5$, meaning equal weight is given to the most recent actual value and the previous forecast.
   The EMA is calculated as:

$$\text{EMA}(t) = b + 0.5(a - b) \tag{3}$$

   Where:

   - a is the actual value,
   - b is the previous forecast.

Moving averages are essential tools for smoothing out price data and identifying trends in financial markets. This analysis explores three types of moving averages—Simple, Weighted, and Exponential—and demonstrates their practical application in forecasting stock values.

1 Theory of Moving Averages

1.1 Simple Moving Average (SMA)

The SMA is the most basic form of moving average, calculating the arithmetic mean of a selected range of prices over a specific period:

$$\text{SMA} = \frac{A_1 + A_2 + \ldots + A_n}{n} \tag{4}$$

Where A represents prices and n is the number of periods. The SMA gives equal weight to all data points in the calculation period. For example, in a 4-day SMA, each day's price contributes exactly 25% to the average.

1.2 Weighted Moving Average (WMA)

The WMA assigns different weights to data points, with greater emphasis on more recent values:

$$\text{WMA} = \frac{\text{Sum of weighted prices}}{\text{Sum of weights}} \tag{5}$$

A common formula uses linearly increasing weights:

$$\text{WMA} = \frac{P_1 \times 1 + P_2 \times 2 + P_3 \times 3 + P_4 \times 4}{1 + 2 + 3 + 4} \tag{6}$$

This makes WMA more responsive to recent price movements while still considering historical data.

1.3 Exponential Moving Average (EMA)

The EMA gives exponentially decreasing weights to older data points:

$$\text{EMA} = (\text{Close} - \text{Previous EMA}) \times \text{Smoothing factor} + \text{Previous EMA} \tag{7}$$

The smoothing factor (typically between 0 and 1) determines how quickly the EMA responds to price changes. Higher values make the EMA more sensitive to recent prices.

2 Practical Application in Excel

2.1 Data Analysis and Visualization

The Excel spreadsheet and chart demonstrate the application of these three moving average methods to stock index values across Nepali months. Each method produces different forecasted values based on its calculation approach.

2.2 Prediction Performance

The Excel analysis calculates forecasted values for each month using the three moving average methods. Looking at the chart:

- The actual index (blue line) shows significant volatility, particularly the spike in Bhadra month
- All three moving averages smooth out this volatility to different degrees
- The EMA (purple line) shows earlier responsiveness to price changes
- The WMA (green line) follows price movements more closely than SMA
- All three methods converge in the later months of the dataset

2.3 Mean Squared Error (MSE) Calculation

The Excel file calculates MSE for each method to quantify prediction accuracy:

- WMA: 7,058.35 (lowest error)
- SMA: 13,816.89 (medium error)
- EMA: 61,972.44 (highest error)

For this particular dataset, the WMA provided the most accurate forecasts, while the EMA had the highest error despite its theoretical advantages in responding to recent price movements.

2.4 Visualization Insights

The line graph visualization offers several insights:

1. All three moving averages effectively smoothed the major spike in the Kartik month, demonstrating their primary function of reducing data noise
2. The WMA line (green) follows the actual index more closely than the other methods in the middle periods, confirming its superior MSE score
3. The three forecast lines converge toward similar values in later months (Chaitra through Jestha), suggesting stabilization in the underlying data
4. The final predicted value for Jestha month is nearly identical across all three methods despite their different calculation approaches

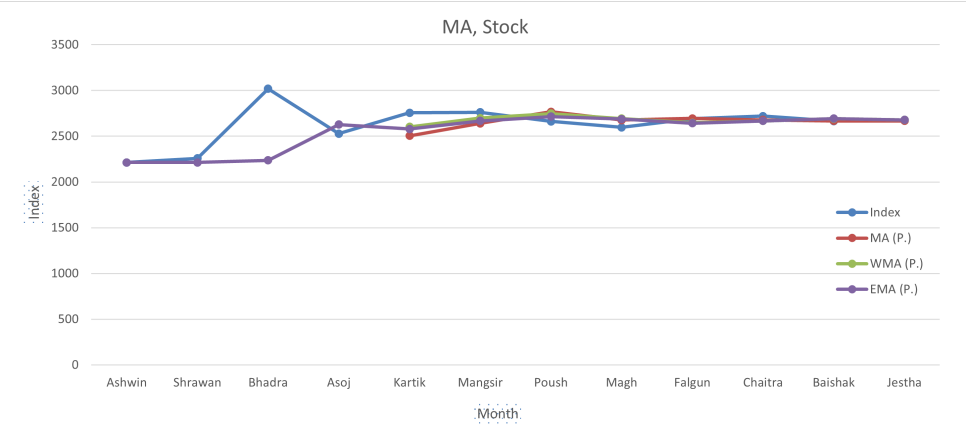

Figure 1: Comparison of SMA, WMA, and EMA forecasts against actual NEPSE index values

3 Forecast Accuracy Analysis

Table 1: Forecast Accuracy for NEPSE Index Using Moving Averages (SMA, WMA, EMA)

Month	Index	SMA			WMA			EMA		
		P.	Error	Error Sq.	P.	Error	Error Sq.	P.	Error	Error Sq.
Ashwin	2214							2214	0	0
Shrawan	2259							2214	45	2025
Bhadra	3019							2237	783	612306
Asoj	2529							2628	-99	9752
Kartik	2756	2505	251	62876	2603	153	23511	2578	178	31551
Mangsir	2762	2641	121	14702	2697	65	4173	2667	95	8989
Poush	2662	2767	-105	10920	2746	-84	7135	2715	-53	2766
Magh	2597	2677	-80	6440	2692	-95	9088	2688	-91	8335
Falgun	2691	2694	-3	11	2647	44	1942	2643	48	2338
Chaitra	2720	2678	42	1764	2667	53	2830	2667	53	2828
Baishak	2665	2668	-3	6	2692	-27	729	2693	-28	807
Jestha		2668			2679			2679		
Total				96718			49408			681697
MSE				13817			7058			61972

For source code and data files, visit: **Moving-Average-Forecasting**