

# Forecasting CPU usage of Virtual Machines

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## I. INTRODUCTION

In this paper we forecast CPU usage by five different virtual machines by using different such as moving average (MA), weighted moving average (WMA), exponential smoothing (ES), and exponential smoothing with trend (EST). Along with these basic methods, we also test modified EST with weighted moving average for updating  $F_t$  and piecewise regression models.

To test the performance of the forecasting methods we used tracking signal ratio (TS). Tracking signal is the ratio of cumulative sum of forecasting signals to the mean absolute deviation. Which indicates the presence of bias in the results produced by the forecast model.

$$TS = \frac{\sum A_t - F_t}{MAD} \quad (1)$$

Where  $A_t$  is the actual value,  $F_t$  is predicted value and MAD is the mean absolute deviation.

$$MAD = \frac{\sum |A_t - F_t|}{n} \quad (2)$$

For a better forecasting model, TS should be not greater than 4 and not less than -4.

$$-4 < TS < +4 \quad (3)$$

If tracking signal value is out the limits, then the forecasting model should be re-evaluated. If the TS above 4, most of our predictions are above actual values and vice versa.

## II. FORECASTING TECHNIQUES

- A. *Moving Average (MA)*
- B. *Weighted Moving Average (WMA)*
- C. *Exponential Smoothing (ES)*
- D. *Exponential Smoothing with Trend (EST)*
- E. *Windowed Exponential Smoothing with Trend (WEST)*
- F. *Piecewise regression (PR)*

## III. RESULTS

- 1) Show the frequency data for all five VM's
- 2) For each forecasting method talk about the results
- 3) Finally select the most varying VM's and show all the different methods performance.

## IV. CONCLUSION

Talk about what we just wrote in this paper.

## REFERENCES

- [1] H. Kopka and P. W. Daly, *A Guide to L<sup>A</sup>T<sub>E</sub>X*, 3rd ed. Harlow, England: Addison-Wesley, 1999.