One Step Forecasting Model

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Abstract

In this research investigation, the author has presented two models of One Step Forecasting.

Theory

Given,

$$Y_n = \{y_1, y_2, y_3, ..., y_{n-1}, y_n\}$$

$$Y_{(k+1),n} = \{y_k, y_{k+1}, y_{k+2}, ..., y_{n-1}, y_n\}$$

$$Y_{1,(n-k)} = \{y_1, y_2, y_3, ..., y_{n-k-1}, y_{n-k}\}$$

$${}^{j}Y_{1,(n-k)} = j^{th}\ arrangement\ of\ \ elements\ of\ \ Y_{1,(n-k)}\ among\ the\ (n-k)!\ arrangements$$

$$\hat{Y}_{(k+1),n} = \frac{\{y_k, y_{k+1}, y_{k+2}, ..., y_{n-1}, y_n\}}{\left\{\sum_{i=k}^{n} y_i^2\right\}^{1/2}}$$

$$\hat{Y}_{1,(n-k)} = \frac{\{y_1, y_2, y_3, ..., y_{n-k-1}, y_{n-k}\}}{\left\{\sum_{i=1}^{n-k} y_i^2\right\}^{1/2}}$$

$${}^{j}\hat{Y}_{1,(n-k)} = \frac{{}^{j}Y_{1,(n-k)}}{\left\{\sum_{j=1}^{n-k} y_j^2\right\}^{1/2}}$$

$$Co\sin eSimilarity\left(\hat{Y}_{(k+1),n},\ {}^{j}\hat{Y}_{1,(n-k)}\right) = Dot\,\mathrm{Pr}oduct\left(\hat{Y}_{(k+1),n},\ {}^{j}\hat{Y}_{1,(n-k)}\right)$$

Model 1

$$y_{n+1} = \sum_{k=0}^{n-1} (\alpha_{n-k})(y_{n-k})$$

Case 1:

$$\alpha_{n-k} = \frac{Cosin\, eSimilarity\left(\hat{Y}_{(k+1),n}, \hat{Y}_{1,(n-k)}\right)}{\left\{\sum_{k=0}^{n-1} \left\{Cosin\, eSimilarity\left(\hat{Y}_{(k+1),n}, \hat{Y}_{1,(n-k)}\right)\right\}^2\right\}^{1/2}}$$

Case 2 :

$$\alpha_{n-k} = \frac{Cosin\, eSimilarity\left(\hat{Y}_{(k+1),n}, \hat{Y}_{1,(n-k)}\right)}{\sum_{k=0}^{n-1} \left\{Cosin\, eSimilarity\left(\hat{Y}_{(k+1),n}, \hat{Y}_{1,(n-k)}\right)\right\}}$$

Model 2

$$y_{n+1} = \sum_{k=0}^{n-1} (\breve{\breve{\alpha}}_{n-k})(y_{n-k})$$

Case 1:

$${}^{j}\alpha_{n-k} = \frac{Cosin\, eSimilarity\left({}^{j}\hat{Y}_{(k+1),n}, {}^{j}\hat{Y}_{1,(n-k)}\right)}{\left\{\sum_{k=0}^{n-1} \left\{Cosin\, eSimilarity\left({}^{j}\hat{Y}_{(k+1),n}, {}^{j}\hat{Y}_{1,(n-k)}\right)\right\}^2\right\}^{1/2}}$$

Case 2:

$${}^{j}\alpha_{n-k} = \frac{Cosin\, eSimilarity\left({}^{j}\hat{Y}_{(k+1),n}, {}^{j}\hat{Y}_{1,(n-k)}\right)}{\sum_{k=0}^{n-1} \left\{Cosin\, eSimilarity\left({}^{j}\hat{Y}_{(k+1),n}, {}^{j}\hat{Y}_{1,(n-k)}\right)\right\}}$$

Case 1:

$$\breve{\alpha}_{n-k} = \sum_{j=1}^{(n-k)!} \left\{ \frac{{}^{j}\alpha_{n-k}}{\sum_{j=1}^{(n-k)!} {}^{j}\alpha_{n-k}} \right\} {}^{j}\alpha_{n-k}$$ **Self-Weighted Mean**

Case 2:

$$\breve{\alpha}_{n-k} = \sum_{j=1}^{(n-k)!} \left\{ \frac{{}^{j}\alpha_{n-k}}{\left\{ \sum_{j=1}^{(n-k)!} \left\{ {}^{j}\alpha_{n-k} \right\}^{2} \right\}^{1/2}} \right\} {}^{j}\alpha_{n-k} \qquad \text{Normalized Weight}$$

Case 1:

$$\breve{\breve{\alpha}}_{n-k} = \left\{ \frac{\breve{\alpha}_{n-k}}{\sum_{k=0}^{n-1} \breve{\alpha}_{n-k}} \right\}$$

Case 2:

$$\breve{\breve{\alpha}}_{n-k} = \frac{\breve{\alpha}_{n-k}}{\left\{ \sum_{k=0}^{n-1} \left\{ \breve{\alpha}_{n-k} \right\}^{2} \right\}^{1/2}}$$

Note:

CosineSimilarity of only two different numbers can be taken as

1. Zero, i.e., 0
2. The Smaller Number among the two Numbers

Normalized CosineSimilarity of only two different numbers can be taken as

3. Zero, i.e., 0
4. Ratio of the Smaller Number by the Larger Number

Results

Model 1

For Model 1, when the first 8 Primes Numbers, i.e., $Y_n = \{2,3,5,7,11,13,17,19\}$ were taken to predict the next Number, a result of 22.8606 was found. The next Prime Number being 23, the Error % was (23-22.8606)

$$Error\ \% = \left\{ \frac{(23 - 22.8606)}{23} \right\} \times 100 = 0.606087\%$$

References

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