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Future of India in Asian Games: A Prediction Based on Markov Chains

Gulab Singh Bura[1]* Himanshi Sharma[2] Manika Agarwal[3] Parul[4]

[1,2,3,4] Department of Mathematics and Statistics, Banasthali Vidyapith, Rajasthan, India

Abstract – Markov Chains methods are principally used for analysis and prediction. It comes out as the primary and most powerful technique to predict the long-term behavior of the performance of India in Asian Games. This paper borrows transition matrix as a forecasting instrument for determining the performance of India in future. The data for this study have been obtained from the medal table of Asian Games from social source. We have dene various Markov chains on the basis of data and obtained the transition probability matrix for all the cases. Also we have obtained the stationary distribution of the above mentioned Markov Chains.

Keywords – Asian Games, Stochastic Process, Markov Chain, Stationary Distribution

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1. INTRODUCTION

The Asian games are a continental event in which multiple sports are held at an interval of four years. The Asian games Federation is the regulating body of the Asian games since the First Asian game until 1978. Since 1982, Olympic council of Asia organizes the Asian games. After the Olympic games, Asian games are the second largest multi-sport event. India has participated in the Asian Games, since their inception in 1951 and is a member of the South Asian Zone of the Olympic Council of Asia. In 1951 and 1982, New Delhi has hosted the Asian games. India has always ranked among the top 10 countries of the medal table except in the 1990.

2. LITERATURE REVIEW

Markov chain model has been extensively used by many authors in various fields such as chemistry, physics, economics, queuing theory, finance, and health sciences etc. Goulionis and Koutsiumaris [4] have used Markov decision model for the treatment of early Prostate Cancer. Dharmaraja1 et.al.[2] have used Markov model to determine the mean time with Catastrophe. Cong and Tsokos [1] have used Markov Modeling for Breast Cancer. Doubleday and Julius [3] have applied Markov Chains to Stocks Trend. Murthy et. al.[6], have used a Markov Chain model to determine the behaviour of different company share prices. Joseph and Ndanguza [7], have forecast the Rainfall in Gasabo District using Markov Chain properties. Sharma and Adlakha[8], have studied gene express in using Markov Chain model. So, Markov chain have been used in various areas but first time we have used it for predication the performance of India in Asian Games.

3. OBJECTIVE

The objective of this paper is to develop Markov Chains for estimations and predication of the performance of India in Asian Games.

4. SOURCE OF DATA

For this study we collect the secondary data from the social websites of Asian Games.

5. ANALYSIS

Markov Chains are named after Russian mathematician Andrey Markov. Markov chain is a Markov process having either discrete state space or discrete index set. It is a stochastic process in which the future state is depends only on the present state not on the past.

Mathematically,

$$P(X_{n+1}=j/X_n=i,X_{n-1}=i_1,X_{n-2}=i_2,\ldots,X_0=i_n)=P(X_{n+1}=j/X_n=i) \quad (1)$$

for every sequence $i_1, i_2, \ldots, i_n$ of elements of S and every $n \succeq 0$. The transition probability

$$P_{ij} = P(X_{n+1} = j/X_n = i) \quad (2)$$

is defined as the probability that whenever the chain in state i it moves to state j in one step. A transition probability matrix P consisting of all the transition probabilities between stages in a matrix form is given by:

$$P = \begin{bmatrix} p_{11} & p_{12} & . & . & . & . & . & p_{1s} \\ p_{21} & p_{22} & . & . & . & . & . & p_{2s} \\ . & . & . & . & . & . & . & . \\ . & . & . & . & . & . & . & . \\ . & . & . & . & . & . & . & . \\ p_{s1} & p_{s2} & & . & . & . & . & p_{ss} \end{bmatrix}$$

Let F and P be the transition frequency and probability matrix for various Markov chains defined as follows:

1:) X_n: represents the rank of India at n^{th} Asian games.

Here, the states are decrement in rank denoted by -1, constancy in rank denoted by 0 and increment in rank denoted by +1

2:) X_n: represents the position of India in overall medals telly at n^{th} Asian games.

Here, the states are decrement in no. of medal denoted by -1, constancy in no. of medal denoted by 0 and increment in no. of medal denoted by +1

3:) X_n: represents number of time India ranked among top 5 countries at n^{th} Asian games.

Here the states are, India not in top 5 denoted by 0 and India in top 5 denoted by 1

5.1 Frequency Matrix

Rank

$$F_1 = \begin{array}{c} \\ -1 \\ 0 \\ +1 \end{array} \begin{array}{c} \begin{matrix} -1 & 0 & +1 \end{matrix} \\ \begin{pmatrix} 1 & 1 & 5 \\ 3 & 0 & 0 \\ 4 & 1 & 1 \end{pmatrix} \end{array}$$

Overall Medals

$$F_2 = \begin{array}{c} \\ -1 \\ 0 \\ +1 \end{array} \begin{array}{c} \begin{matrix} -1 & 0 & +1 \end{matrix} \\ \begin{pmatrix} 2 & 1 & 2 \\ 1 & 0 & 2 \\ 3 & 1 & 4 \end{pmatrix} \end{array}$$

Top 5

$$F_3 = \begin{array}{c} \\ 0 \\ 1 \end{array} \begin{array}{c} \begin{matrix} 0 & 1 \end{matrix} \\ \begin{pmatrix} 8 & 2 \\ 3 & 4 \end{pmatrix} \end{array}$$

5.2 Transition Probability Matrix

The frequency matrix may be converted into probability matrix by using the formula.

$$P_{ij} = \frac{a_{ij}}{\sum_j a_{ij}} \qquad (3)$$

where,

i = rows,

j = columns

(i; j) = 1; 2; 3

We obtain the probability matrices from frequency matrices as follows:

Rank

$$P_1 = \begin{array}{c} \\ -1 \\ 0 \\ +1 \end{array} \begin{array}{c} \begin{matrix} -1 & 0 & +1 \end{matrix} \\ \begin{pmatrix} 0.14 & 0.14 & 0.71 \\ 1.0 & 0 & 0 \\ 0.66 & 0.16 & 0.16 \end{pmatrix} \end{array}$$

Overall Medals

$$P_2 = \begin{array}{c} \\ -1 \\ 0 \\ +1 \end{array} \begin{array}{c} \begin{matrix} -1 & 0 & +1 \end{matrix} \\ \begin{pmatrix} 0.4 & 0.2 & 0.4 \\ 0.3 & 0.0 & 0.6 \\ 0.4 & 0.1 & 0.5 \end{pmatrix} \end{array}$$

Top 5

$$P_3 = \begin{array}{c} \\ 0 \\ 1 \end{array} \begin{array}{c} \begin{matrix} 0 & 1 \end{matrix} \\ \begin{pmatrix} 0.81 & 0.18 \\ 0.42 & 0.57 \end{pmatrix} \end{array}$$

We also calculate the two step and three step transition probability matrices. These are as follows:

5.3 Two-step transition probabilities:

Rank

$$P_1^2 = \begin{array}{c} \\ -1 \\ 0 \\ +1 \end{array} \begin{array}{c} \begin{matrix} -1 & 0 & +1 \end{matrix} \\ \begin{pmatrix} 0.62 & 0.13 & 0.21 \\ 0.14 & 0.14 & 0.71 \\ 0.35 & 0.11 & 0.48 \end{pmatrix} \end{array}$$

Overall Medals

$$P_2^2 = \begin{array}{c} \\ -1 \\ 0 \\ +1 \end{array} \begin{array}{c} \begin{matrix} -1 & 0 & +1 \end{matrix} \\ \begin{pmatrix} 0.37 & 0.13 & 0.49 \\ 0.38 & 0.14 & 0.46 \\ 0.37 & 0.13 & 0.48 \end{pmatrix} \end{array}$$

Top 5

$$P_3^2 = \begin{array}{c} \\ 0 \\ 1 \end{array} \begin{array}{c} \begin{matrix} 0 & 1 \end{matrix} \\ \begin{pmatrix} 0.73 & 0.24 \\ 0.57 & 0.39 \end{pmatrix} \end{array}$$

From 2nd step transition probability matrices, we can conclude that In 17th Asian games there was decrement in the rank of India so, the probability that there will be increment in the rank of India in 18th Asian games is 21 percent, there will be no change is 13 percent and there will be decrement in the rank of India is 62 percent.

In 17th Asian games there was decrement in the overall medals won by India so, the probability that there will be increment in the overall medals won by India in 18th Asian games is 49 percent, there will be no change in the counts of medal is 13 percent and there will be decrement in the overall medals is 37 percent. In 17th Asian games Indian was not ranked among top 5 so, the probability that India will rank among top 5 in 18th Asian games is 24 percent and will not rank among top 5 is 73 percent. We compared our result from the results of 18th Asian games and we found that our results are true in great extent.

5.4 Three step transition probabilities:

Rank

$$P_1^3 = \begin{array}{c} \\ -1 \\ 0 \\ +1 \end{array} \begin{array}{c} \begin{array}{ccc} -1 & 0 & +1 \end{array} \\ \begin{pmatrix} 0.34 & 0.11 & 0.47 \\ 0.63 & 0.13 & 0.21 \\ 0.47 & 0.12 & 0.32 \end{pmatrix} \end{array}$$

Overall medals

$$P_2^3 = \begin{array}{c} \\ -1 \\ 0 \\ +1 \end{array} \begin{array}{c} \begin{array}{ccc} -1 & 0 & +1 \end{array} \\ \begin{pmatrix} 0.37 & 0.13 & 0.48 \\ 0.33 & 0.12 & 0.43 \\ 0.37 & 0.13 & 0.48 \end{pmatrix} \end{array}$$

Top 5

$$P_3^3 = \begin{array}{c} \\ 0 \\ 1 \end{array} \begin{array}{c} \begin{array}{cc} 0 & 1 \end{array} \\ \begin{pmatrix} 0.69 & 0.26 \\ 0.63 & 0.32 \end{pmatrix} \end{array}$$

From 3rd step transition probability matrices, we can conclude that

1. As in 18th Asian Games there was no change in rank of India so, in 19th Asian games, 63 percent chances that there will decrement in rank of India, there will be no change is 13 percent and there will be increment in the rank of India is 21 percent.
2. As in 18th Asian Games there was increment in overall medals won by India so, in 19th Asian games, 48 percent chances that there will increment in the overall medals won by India, there will be no change is 13 percent and there will be decrement in the rank of India is 37 percent.
3. As in 18th Asian Games India was not ranked among top 5 so, in 19th Asian games, 69 percent chances that India will not rank among in top 5 and 26 percent chances that India will be in top 5.

6. STEADY STATE PROBABILITY MATRICES

Since all the transition probability matrix are irreducible and aperiodic in nature and hence all states are non-null recurrent. Therefore these matrix are ergodic in nature. So we have obtained their stationary (Steady state) distribution by using the formula

$$\Pi = \Pi P \qquad (4)$$

where $\Pi = [\Pi_{-1}\ \Pi_0\ \Pi_1]$ and P be the transition probability matrix. Therefore for first case

$$\Pi = [\Pi_{-1}\ \Pi_0\ \Pi_1] \begin{bmatrix} 0.14 & 0.14 & 0.71 \\ 1.00 & 0 & 0.67 \\ 0.66 & 0.16 & 0.16 \end{bmatrix} = [0.47\ 0.13\ 0.40]$$

For second case

$$\Pi = [\Pi_{-1}\ \Pi_0\ \Pi_1] \begin{bmatrix} 0.40 & 0.20 & 0.40 \\ 0.30 & 0.0 & 0.60 \\ 0.40 & 0.10 & 0.50 \end{bmatrix} = [0.21\ 0.21\ 0.58]$$

For Third case

$$\Pi = [\Pi_0\ \Pi_1] \begin{bmatrix} 0.82 & 0.18 \\ 0.42 & 0.58 \end{bmatrix} = [0.69\ 0.31]$$

7. CONCLUSION

In this paper, a Markov chain problem is developed to examine and predict the performance of India in Asian Games. This model will provide information, valuable for managers and ministries of the conducting body of India for Asian Games to improve process as well as for the policy makers at government agencies to supervise the effectiveness of existing Indian players. This model further demonstrates that, from the data collected and observed we came to conclude that in forthcoming Asian Games: 1. There is 47 percent chances that there will be decrement in the rank of India, 13 percent chances that there will be no change and there 40 percent chances that there will be increment in the rank of India. 2. There is 21 percent chances that there will decrement in the overall medals won by India , 21 percent chances that there will be no change and 58 percent chances that there will be increment in the overall medals won by India. 3. There is 69 percent chances that India will not ranked among top 5 and 31 percent chances that India will ranked among top 5.

We observe that in future the chances for the rank of India for increment or decrement is near about same, so it is a matter of concern for the ministry of sports that if they provide proper support and guidance then there are chances for Indian players to achieve great success in forthcoming Asian games. We also observe that for future Asian games, there is an increment in the overall medals won by India but the rank of India is decreases which means the medals won by India may be silver or bronze.

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Corresponding Author

Gulab Singh Bura*

Department of Mathematics and Statistics, Banasthali Vidyapith, Rajasthan, India

burastats@gmail.com