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Mathematical study of Kargil War and Indo-China war

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Abstract—

Nations want the people to support the war in times of conflict. The loss of innocent lives is an inevitable part of war .The focus of the paper is to mathematically understand and fit in the war of Kargil between India and Pakistan and to understand how the whole war could be understood. This study would help us to understand the war mathematically and to implement the same if there is war like situation between the rising tensions between India and China

I. Introduction

We all know how important Army is to any country. For India it has even higher importance. The basic role of the Army is to safeguard the territorial integrity of the nation against external aggression. External aggression can arrive in various ways. As was cleverly mentioned in [1]. " The borders that are aligned over the highest mountain ranges across turbulent water channels, through rolling fields, over shifting sand dune, amidst dense jungles, a long stretches that remain disputed, a mass of imponderables emanate that is unique in many ways. The Army has to constantly prepare itself for these multifaceted diverse challenges. Demands on the Army have increased manifold with near continuous deployment of its forces in counter-insurgency operations in Jammu and Kashmir and in the North East". The weightage of an army in any war like situations is very prominent. One such important war which is fought by India, The Kargil war. Kargil war was an armed conflict between India and Pakistan which took place in Kargil being a district of Kashmir between May 1999 and July 1999. The sparks of the war were the infiltrators from the Pakistani sides crossing the Line of Control. They are various important giveaways of why India won did and what it learned. India won due to various technologically improved weapons as compared to those of Pakistani's. But there were more learnings from the war than the winnings. India learnt the difference between Tactics and strategy and how to be at

war in High altitudes [2]. Recently similar events have happened, but this time on the Line of Actual Control (LAC). But this time no infiltration has happened from China, but there has been killing happening. This level of escalation has happened due to border issues pertaining to MacDonald (M-M) Line confusion [3]. As can be seen that there has been emergency military procurement from Indian side as well placing of hefty number of army's on either side of LAC, tensions are eventually rising [4]. Although the situations look worse on the LAC front, but there is a continuous approach from government as well from Military itself to easy off the tensions. Looking at the situations the study done here is of sheer importance.

II. Methodology and Mathematical Interpretation

In this paper as mentioned we wanted to find a mathematical understanding of the war in general. To understand this better we have used the Lanchester's Combat Model [5]. We have taken the strength of two fighting forces be as $x(t)$ and $y(t)$ which are engaged in combat. To quantify the strengths of the two forces, we take M and N be the individual strengths of the combating forces encompassing physical strengths, types of arms etc. As from the proposed Lanchester's Combat Model, the reduction of strengths of each force is proportional to the effective fighting strength of the opposite force as depicted in equation (1).

$$\frac{dx}{dt} = -ayN, \frac{dy}{dt} = -axM, a \text{ being a proportionality constant} \qquad (1)$$

We have this relation (equation (1)) with respect to a third variable being time. Since we are more interested in interdependence between the two combating force. Hence the equation can be simplified as,

$$\frac{dx}{yN} = \frac{dy}{xM} \text{ or, } Mx^2 - Ny^2 = Constant \qquad (2)$$

One important point needs to be kept in mind here is that we have not assumed that the proportional reduction of strengths in the two forces being same as there can be enormous factors which might be different between the two combating force.

III. Results

To understand the Lanchester's Combat Model, we have first listed the difference in strength of the two forces at war during Kargil. We have tabled the same in table. 1 with reference from [6] [7]. This will help us to gauge the strength between the two sides of the Kargil war. Table .1 can be helpful to extract the parameters M and N for the equation (2).

	India	Pakistan
Strength	30000	5000
Arms	130- mm M-46 field guns, 105-mm Indian Field Guns (IFG), Bofors FH-77B 155-mm howitzer,	No Bofors
Air Power	MiG-21, MiG-23 and MiG-27s, Mirage 2000, Mi-17 helicopters, HAL Cheetah helicopters	F-16s

Table. 1 Strengths difference between India and China

Normalization of the data in table .1 is necessary to make necessary fit for the Lanchester Combat Model. This normalization is done in table .2 where the strength between the forces is normal normalization, while other factors of Arms and Air power are normalized based on various factors such as the strength of arms at such high altitude of Kargil as well as the strength of Bofors is known to all [6].

Options	India (Weightage)	Pak (Weightage)
Strength (Normalize)	0.85	0.15
Arms	1	0
Air Power	0.9	0.1

Table. 2 Normalized data

From table.2 we can attain the individual strengths of India and Pakistan during the war of 1999. We get $x(t)$ and $y(t)$ as India and Pakistan respectively and $M = 2.75$ and $N = 0.25$. We get the equation as :

$$2.75x^2 - 0.25y^2 = 1 \text{ ,} (Constant = 1)$$

$$\frac{x^2}{0.6030^2} - \frac{y^2}{2^2} = 1 \qquad\qquad (3)$$

As we can see the equation (3) can be plotted and we get figure 1. After analyzing we note that
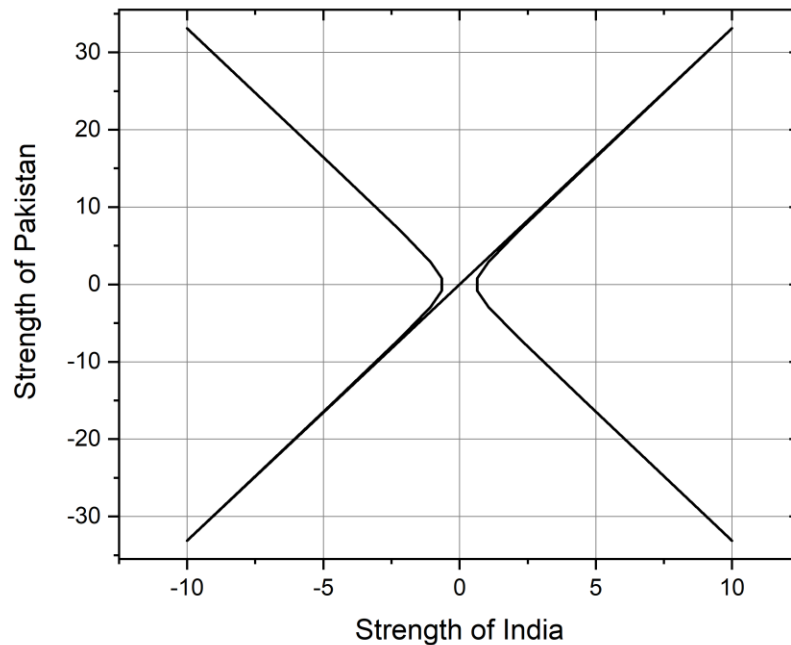

Figure .1 Plotting of equation (3)

From the figure .1 we understand that if we make an asymptote and calculate the slope we 3.3 which is very large indicating that India won the war based on the sheer strength. This can also

be stated that the slope of an asymptote is $\frac{b}{a}$ ($\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$) can be re written as $\sqrt{\frac{M}{N}}$. Hence it can be said that India won Kargil due to its superiority.

Regulating the very same study on the recent Indo-China tension risings on LAC. Although war is never expected, but let's say India goes to war with China, let's do a similar strength check between the Indian forces and Chinese force deployed on LAC front. Table .3 depicts the same [8][9][10][11][12].

	India	China
Strength	60000	52000
Arms	130- mm M-46 field guns, 105-mm Indian Field Guns (IFG), Bofors FH-77B 155-mm howitzer, 155mm	No bofors
Air Power	C-17 Globemaster III, C-130J, Sukhoi-30MKI, Jaguar, Mirage 2000, Apache, Chinook	J-20
Missiles	NIRBHAY, BRAHMOS, AKASH, AAD Shoulder fired missiles	HONGQI-9(HQ-9), SAM, HQ-2,HQ-16, V-750, S-400
Tanks	T-90, T-72, BMP-2	Type-15

Table .3 Strength difference between India and China

This table.3 can be normalized and we attain table.4. Normalization of the data in table .3 is necessary to make necessary fit for the Lanchester Combat Model. For few items such as the J-20 of China which is a 5th generation aircraft has edge over India's air power. Similarly in terms of missiles China has ballistic missiles having range upto 2000kms.

Options	India (Weightage)	China(Weightage)
Strength (Normalize)	0.535	0.464
Arms (Guns)	0.8	0.2
Air Power	0.35	0.65
Missiles	0.2	0.8
Tanks	0.25	0.75

Table .4 Normalized data

From table.4 we can attain the individual strengths of India and China during any war like situations in upcoming months. We get $x(t)$ and $y(t)$ as India and China respectively and $M = 2.135$ and $N = 2.864$. We get the equation as:

$$2.135x^2 - 2.864y^2 = 1 \text{ ,}(Constant = 1)$$

$$\frac{x^2}{0.6848^2} - \frac{y^2}{0.590^2} = 1 \qquad\qquad (4)$$

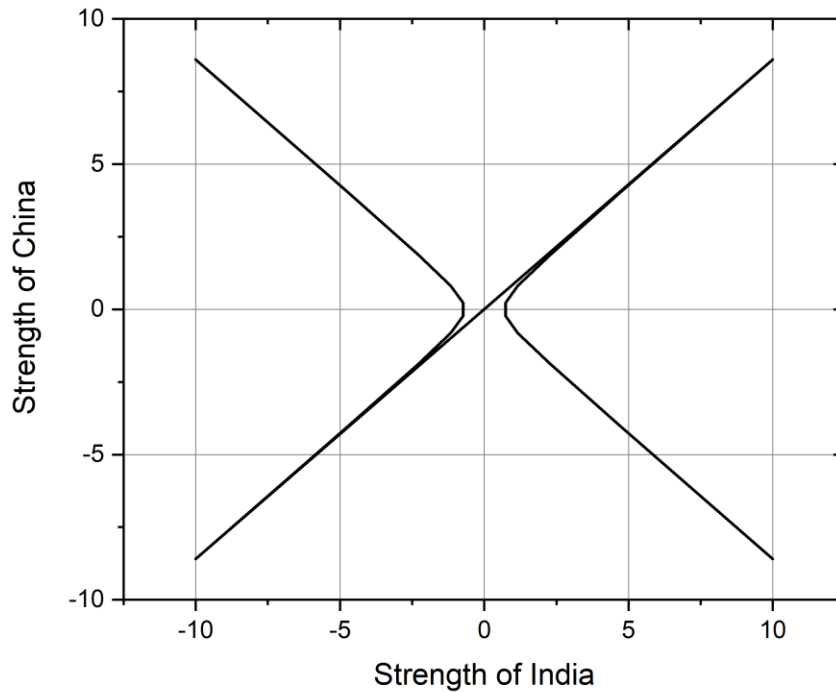As we can see the equation (4) can be plotted and we get figure 2. We attain a slope of 0.8

Figure .2 Plotting of equation (4)

Of the asymptote of the figure 2, which is in sync with the strengths of India and China. Well from the data and slope value of figure 2 we understand that it is less than 1 which means China has a higher edge compared to India in few aspects of technology.

IV.Conclusion

War has a catastrophic effect on the health and well being of nations. Nations should not support the modern warfare. Hence according to the study we can state that India is at a slighter disadvantage if India goes to war with China, hence if war occurs there would be huge repercussions.

V. Bibliography

1. http://www.spsmilitaryyearbook.com/

2.https://thewire.in/diplomacy/india-pakistan-kargil-war-lessons

3.https://www.deccanherald.com/national/india-china-conflict-a-timeline-of-key-events-862742.html

4. https://theprintmedia.in/2020/09/27/india-china-border-standoff-heavyweight-tanks-and-armoured-vehicles-deployed-in-eastern-ladakh/

5. https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=mathematical+modelling+by+j+n+kapoor&btnG=&oq=mathem#

6.https://core.ac.uk/reader/36694780

7. :https://defenceupdate.in/why-did-pakistans-f-16s-refuse-to-engage-the-iafs-mig-29s-during-the-kargil-war/

8. https://economictimes.indiatimes.com/

9.https://thewire.in/

10. https://www.financialexpress.com/

11. https://www.imrmedia.in/

12. https://www.dnaindia.com/