why do you want to study this topic, what does existing scholarship say about this topic and what gaps are you hoping to fill, and what research questions are you hoping to answer.

military operation analysis

operations research

mathematics of armed conflict

Ph.D. Research Proposal Summary

Force Ratios and Relative Combat Power

Gurkan Yesilyurt

**CHAPTER 1: Introduction**

My intention is to work on relative combat power. I will collect information for the designated area wars and I will analyze these big data by the Python programming language which I gathered expertise after my military service, and I will try to reach meaningful conclusions whether our traditional belief of relative combat power 1/3 in order to plan attack operations is right or wrong based on scientific hypothesis testing. These results will be presented by Tableau, another powerful data visualization tool.

Overview of study

Explanation of project background

Briefly focus on primary issues

Why worth to attention

Present: research statement forms of hypothesis, goal statement or project statement

Rs:

* capture both essence and limitations of study
* follwed by clarification on the expected outcomes

Introduction: In the proposal introduction you should provide the following:

Research Questions: Explain the question/problem that the project intends to address to put the project in the proper context. You should develop a thesis statements that concisely sums up the question

Research approach: Explain in general the type of approach you will take and why

Significance: Explain why it is important to address the particular

Objectives: Briefly relate what you hope to accomplish through your research project

**CHAPTER 2**: **Literature Review**

+ Theory about this topic starts with Sun Tzu. He emphasizes “capturing enemy’s army intact rather than destroying”. According to him; “acme of the skill” is not winning 100 victories in 100 battle but to subdue the enemy without fighting.By this way the troops are not worn out. He terms this as the “art of offensive strategy”.

+ From this point Sun Tzu advises force ratios as; when the force ratio is 10:1 surround, 5:1 attack, 2:1 divide, 1:1 engage or elude, if force ratio is less then enemy, capable of withdraw**[[1]](#footnote-1)**.

+ **Clausewitz[[2]](#footnote-2)** refers to force ratio as “superiority of numbers” and he refers this as a most common element in victory. He specifies that it is not force ratio but strategy with deciding; time, place, and the forces of the engagement has considerable influence on engagement’s outcome.

+ Clausewitz emphasizes that if purpose and circumstances of the engagement, and the fighting value of the troops is disregarded, then distinguishing factor in battle will be the “number of troops”. In this understanding he points that “numbers” will determine victory. He further adds that when taking into consideration of circumstances, “superior numbers” may actually be contributing very “little”.

+ After this generalization, Clausewitz further goes and asserts that if superiority reach the point where it is overwhelming, superiority of numbers will be the most important factor in the outcome of an engagement, so long as it is great enough to counterbalance all other contributing circumstances. As a result of this assertion, he points out as a “first principle of strategy”: bringing as many troops as possible at the decisive point.

+ Clausewitz’s methodology on building this theory is “historical examples” (Napoleon and Frederick). He concludes that even the most talented general will find it very difficult to defeat an opponent twice his strength. He says that “when we observe that the skill of the greatest commanders may be counterbalanced by a two-to-one ratio in the fighting forces, in ordinary cases, a significant superiority in numbers (it does not have to be more than double) will suffice to assure victory, however adverse the other circumstances”.

+ **Lanchester** introduced totally new concept on subject with the N-Square Law[[3]](#footnote-3). He asserts that “the direct numerical comparison of the forces engaging in conflict is almost universal”. He further goes and asserts that “counting the pieces as of value, and to deny the more extended application of mathematical theory, is illogical and unintelligent.”

+His formulation is based on this phrase: the number of men knocked out per unit time will be directly proportional to the numerical strength of the opposing force and efficiency of weapon system and fighting value of the units (training, morale).

**+ From N-square law** he defines **the fighting strength of a force**: it is proportional to the square of its numerical strength multiplied by the fighting value of its individual units (N\*r²=M\*b²).

+ Where the component units differ among themselves, as in the case of a fleet that is not homogeneous, the measure of the total of fighting strength of a force will be the ***square of the sum of the square roots of the strengths of its individual units.***

+ Thus, he made conclusion of divided forces: sum of squares of two portions of the divided forces are for all values equal to the square of the other (not divided) force.

+ Example of this is an army of 50K giving battle in turn to two armies of 40K and 30K respectively, equally well armed; then the strengths are equal, since 50K²=40K²+30K². But if divided force fight in one part then the army of 50K will be overwhelmed.

**+ With** assumption of “machine-gun is 16 times effective than rifle”, he analyzes the number of men armed with machine-gun necessary to replace a battalion (1000 men strong) in the field. From n-square law he says 250 men needed (**16\*r²=1\*1000²).**

+ If two armies are successively brought into action their aggregate fighting strength of will be hypotenuse of a right-angle triangle.

+ The **n-square law** tells us at once the price or penalty that must be paid if elementary principles are outraged by the division of battle fleet into two or more isolated detachments. If battle fleet separated into 2 equal parts, increase would require to be fixed at approximately %40 percent – that is to say, in relation of 1 to √2; more generally the solution is given by a right-angled triangle.

+ **Nelson’s Tactical Scheme at Battle of Trafalgar (p.65-66):** Nelson planned to envelop the half of -23 ships- combined fleet with 32 ships. This, according to n² law would give him superiority of fighting strength of almost exactly 2 to 1[[4]](#footnote-4). He forced combined fleet to fight in two groups thus, inflicted √2 times their force in the beginning of fight. Thus, we are led to appreciate the commanding importance of a correct tactical scheme. If old-time method of attack had been adopted, British could not avert defeat.

+By the early 1960's, Soviet applied operations research theory to the problems of operational and tactical decision-making. One such application was the correlation of forces and means (COFM) [[5]](#footnote-5). The Soviet Dictionary of Military Terms defines correlation of forces and means as “an objective indicator of combat might/power of opposing sides which makes it possible to determine the degree of superiority of one side over another. This is determined by means of comparing the quantitative and qualitative characteristics of subunits, units, and formations and the armaments of one's own troops (forces) and those of the enemy.

+ Later Dupuy US Army Colonel and military historian developed Quantified Judgment Method, where the outcome of a battle is predicted using a fairly complicated multiplicative-additive formula in which various factors relating to the strength and firepower of the fighting parties as well as the circumstances are taken into account. Dupuy and his associates adjusted the parameters of his model by using known statistical facts of several recorded battles.

+ Depuy defined an equation in which he assesses combat power. In this equation Combat Power is defined as multiplication of Force Strength (number and types of weapons plus personnel), Operational Environmental Factor and Quality of Troops[[6]](#footnote-6) (P = S x OE x Q).

+ In the literature there some researches which focus on use of quantitative decision aids[[7]](#footnote-7). Smith points out that there are two schools of thought—moral (man is the decisive power on the

battlefield) and quantitative (many battlefield phenomena are quantifiable either with deterministic, probabilistic or heuristic models)—and these are not competitors rather complimentary. The main requirement for the decision maker and leader is to keep them in balance. His final advice is the maximum use of quantitative methods together with intuition and experience.

+ After analyzing 660 battles of CDB90FT data set which covers the period of Netherlands War of Independence in 1600 and Israel-Lebanon War in 1982 Yigit concludes that even though it is more probabilistic than other battle outcome predictors, the force ratio is a valid estimator of battle outcome. His final conclusion is like that: “despite some slight differences among probability of winning values corresponding to specific force ratio values of the data set, the general trend remains applicable for the overall analysis of the campaigns, emphasizing that the P (attacker wins given force ratio) value increases as the force ratio value increases[[8]](#footnote-8).

+ Coban, analyzed the same but updated data set of CDB90G with classification trees**[[9]](#footnote-9)**. He pre-selected three variables namely Objective, Relative and terrain and weather variables. Force ratio together with, tank, artillery, cavalry ratio is analyzed in Objective Variables.

+ Coban concludes that the descriptive statistics reveal that the objective variables are not highly correlated with victory. Prediction with only Objective variables yielded high misclassification rates. So, he states that “Objective variables alone are not sufficient to classify battle outcomes”. However, he finds that some of the relative variables, such as leadership, have a strong relationship with the battle outcome. He tried second model with both Objective and Relative variables. The result classification models have relatively low misclassification rates.

+ Christian argues that force ratios are invalid and their continued use may develop unwanted mental constraints**[[10]](#footnote-10)**. Christian refers to Force Ratio as “heuristics” and he argues that force ratios are a derivative of Lanchester’s early work on concentration and attrition but do not account for technological developments and the multiple domains of warfare that make up the modern battlefield. He advises that US Army must differentiate force ratios from correlation of forces models. Force ratios should be abandoned as invalid heuristics. Correlation of forces models, with some effort, may provide utility to planners if they can be separated from force ratios and altered to present the results of its comparison in terms of anticipated effects and expenditures.

**Chapter 3 Research Objectives and Methodology**

Detailed account of how you intend to conduct your research.

Discuss equipment, tools, techniques and anything else that will be used in conducting project.

You won’t be expected to know precisely everything involved but you will need to demonstrate that you have given it serious thought.

U.S. Concepts Analysis Agency (CAA): updated version of the historical combat data set[[11]](#footnote-11)

**Chapter 4 Current Work & Initial Results**

**Chapter 5 Work Plan and Potential Implications**

outline of your proposed time frame with specific targets at certain intervals.

Make sure your proposed time frame fits within the programs schedule to complete a PhD.

This section isn’t always required or may be combined with the methodology section. Check with specific programs for their requirements.

**Chapter 6 Conclusion**

**References**

Bibliography: This is a page of all references that you have used, will use or think you might use in your research project including the literature review. The bibliography will be used to determine if you have a good background in the relevant literature and haven’t overlooked an important source. Use the citation style appropriate for your particular field.

CDB90-CAA Database of Battles, Version 1990

1. TZU, Sun. The Art of War, Translated and with an Introduction by Samuel B.Griffith, Oxford University Press, p.77-80. [↑](#footnote-ref-1)
2. Clausewitz, Carl Von. On War, Edited and Translated by Michael Howard and Peter Paret, Princeton University Press, Princeton, New Jersey, 1984, p. 194-195. [↑](#footnote-ref-2)
3. LANCHESTER, F.W. Aircraft in Warfare, London, 1916, p.39-66. [↑](#footnote-ref-3)
4. Though explanation is given like this: 23\*√2=32.5, means since combined fleet is divided, they need √2 plus force to make equation with the UK fleet. I make this deduction to reach 2/1 force equation: 32²=23²+23², thus in the first battle would be fight with 32²=23² this portion. Equals to 1024 vs 529. [↑](#footnote-ref-4)
5. WOMACK, James K., “Soviet Correlation of Forces and Means: Quantifying Modern Operations”, Master’s Thesis, US Army Command and General Staff College, Fort Leavenworth, KS, 1990. [↑](#footnote-ref-5)
6. Dupuy, T.N., Numbers, Predictions & War: The Use of History to Evaluate and Predict the Outcome of Armed Conflict, Hero Books, 1985. [↑](#footnote-ref-6)
7. SMITH, Kevin B., “The Calculus of War: The Role and Use of Quantitative Decision Aids at the Tactical Level of War”, Master’s Thesis, US Army Command and General Staff College, Fort Leavenworth, KS, 1993, p.193. [↑](#footnote-ref-7)
8. YIGIT, Faruk. “Finding the Important Factors in Battle Outcomes: A Statistical Exploration of Data From Major Battles”, Master’s Thesis, Monterey, California. Naval Postgraduate School, 2000, p.xii-xv. [↑](#footnote-ref-8)
9. COBAN, Muzaffer. “Predicting battle outcomes with classification trees”, Master’s Thesis, Monterey, California. Naval Postgraduate School, 2001, xvii. [↑](#footnote-ref-9)
10. CHRISTIAN Jashua T., “An Examination of Force Ratios”, Master’s Thesis, US Army, School of Advanced Military Studies, US Army Command and General Staff College, Fort Leavenworth, KS, 2019. [↑](#footnote-ref-10)
11. Requirements and Resources Directorate, “Combat History Analysis Study Effort (CHASE): Progress Report for the Period August 1984-June 1985,” U.S. Army Concepts Analysis Agency, 1986. [↑](#footnote-ref-11)