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QUANTIFYING THE VALUE OF RECONNAISSANCE USING LANCHESTERIAN TYPE EQUATIONS

By

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QUANTIFYING THE VALUE OF RECONNAISSANCE USING LANCHESTERIAN TYPE EQUATIONS

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Submitted in partial fulfillment
of the requirements for the degree

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ABSTRACT

This paper presents a method to quantify the value of reconnaissance for both direct and indirect fire weapons for the defense-in-sector battle scenario. The Lanchester area fire model and the Helmbold equations were modified to allow the lethality of the defending blue force to be increased as they gained more combat intelligence about the attacking red force, thus modeling intelligence as a true combat multiplier. By adjustments made to parameters in the model, the lethality of blue direct and indirect fire weapons could be adjusted based on the quantity and quality of their intelligence assets. With information from a computer database, and the COMAN model, maximum likelihood attrition rate estimates were calculated for both red and blue forces for ten heavy defensive battles conducted at the Army's National Training Center. In each battle, the red force attrition rate was fitted to a curve which represented a percentage of blue's full potential, represented here by the square law. Using this model in a combat simulation, and with some preliminary work with comparable systems, one could implement a change in blue's intelligence assets and then provide a quantitative measure of the effect that this had on the outcome of a battle.

EXECUTIVE SUMMARY

Due to its nature, reconnaissance has been evaluated primarily in a qualitative sense in the past. However, the ability to quantify this value and directly apply this information to modeling our warfighting capabilities has not been accomplished. Without this measure, it is impossible for models to accurately weigh the costs and benefits of reconnaissance systems.

For a unit in battle, it is common knowledge that the proper use of intelligence assets will serve as a combat multiplier. However, current models generally have shortcomings when portraying the quantitative effect that they have on the outcome of the battle. The methods presented in this paper effectively translate *enemy information* into a weighting factor on the unit's ability to attrite the enemy. Two models are needed: an area fire model which is used for the indirect fire weapons such as artillery and mortars, and an aimed fire model which is used for the direct fire weapons such as tanks and missiles.

Lanchester equations have long been used to model force-on-force attrition under many different scenarios. Also the problem of assessing the value of the information gained from reconnaissance is not new. However, most models are somewhat tentative and incomplete by their own admission. The attempt in this thesis is to construct and validate a model which can be implemented throughout the modeling community.

Two different equations are used to model area and aimed fire. However, the intuitive argument behind both equations is the same; blue's weapons become more lethal as the blue force gains more knowledge about red's course of action (COA). In the area fire model, as blue gains information regarding red's COA, they can effectively reduce the area covered by their indirect fire weapons and improve specification of their target lists. A decrease in the area occupied by the red force results in increased effectiveness throughout the fire support battlefield operating system and hence, an increase in the lethality of their indirect fire weapons. The Lanchester linear law is used to model this where the ratio of the lethal area of a round to the area of the target is used explicitly.

The ratio is continually updated until the close battle commences, at which time red's attrition rate from blue's indirect fire weapons becomes fixed.

In the aimed fire model, the rate at which blue attrits red is bounded above and below by the square and the linear law Lanchester equations, respectively. As blue's perception of red's course of action approaches the ground truth, the blue force becomes more lethal. This is accomplished through use of a modified Helmbold equation by increasing what is known as the Weiss parameter. Similarly, if blue's perception deviates from ground truth, the Weiss parameter decreases. Ultimately the battle will be fought with blue attriting the red force at some percentage of their total potential, represented by the square law.

A positive correlation was shown to exist between the performance evaluation of a unit's use of intelligence information on the battlefield and the rate at which it attrited the red force. This was done with a nonparametric rank correlation technique and the use a subjective scoring of the performance narrative along with the attrition rate estimate obtained from the actual National Training Center defensive battle data. This result further emphasizes the need for combat simulations to quantitatively account for the use of intelligence assets in their attrition models.

The aimed fire model was applied to ten defensive battles conducted at the Army's National Training Center (NTC), and a Weiss parameter value was obtained for each of the battles, which represents a quantitative measure of effectiveness for each battle.

Further research was discussed to include extending the model to the heterogeneous case. Also discussed was the use of these attrition models in the Future Theater Level Model (FTLM). The FTLM is a new simulation which is in need of an attrition model, and would be well served to exploit the strengths of the equations presented in this study.

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This thesis would not have been possible without the initial guidance and support of numerous individuals in the Department of Systems Engineering, United States Military Academy, particularly to Colonel James Kays, Lieutenant Colonel James Armstrong and Dr. Donald Barr who are responsible for the original problem statement and who assisted tremendously in the preliminary research effort. Thanks also to Captain Mark Tillman who spent many hours assisting with the initial modeling concepts and mathematics.

I. INTRODUCTION

The goal of this thesis is to provide an analytical tool which quantitatively demonstrates the value of reconnaissance as a function of time. Additionally, this thesis will provide recommendations for further development of the model.

Considering the current emphasis on reduced spending and the downsizing of the military forces, it is necessary to focus on the most efficient use of our resources. Additionally the transition from the Cold War Era into a multi-polar world and a contingency force military structure demands that we maximize the combat effectiveness of our military forces. Now, more than ever it is critical to gain quick victory by rapidly massing fires instead of troops and engaging the enemy at the maximum effective range of our weapon systems. The information collected through reconnaissance missions helps us to accomplish this and continues to serve as an important combat multiplier for commanders.

For a unit in battle, it is common knowledge that the proper use of intelligence assets will serve as a combat multiplier. However, current models generally have had shortcomings when portraying the quantitative effect they have on the outcome of the battle. The methods presented in this paper effectively translate *enemy information* into a weighting factor on the unit's ability to attrite the enemy. Two models are needed: an area fire model which is used for the indirect fire weapons such as artillery and mortars, and an aimed fire model which is used for the direct fire weapons such as tanks and missiles. Once the model development has been discussed, the data which were gathered from ten battles conducted at the Army's National Training Center (NTC) will be described. Finally, these data are used to show how the units can be rated according to the magnitude of what is referred to as the Weiss parameter. This is a number which can be interpreted as the percentage of the unit's full potential to attrite the enemy.

Lanchester equations have long been used to model force-on-force attrition under many different scenarios [Refs. 1 and 2]. Also, the problem of assessing the value of the information gained from reconnaissance is not new [Refs. 3 and 4]. However, most models are somewhat tentative and incomplete by their own admission. The attempt in this thesis is to construct and validate a model which can be implemented throughout the modeling community.

Due to its nature, reconnaissance has been evaluated primarily in a qualitative sense in the past. However, the ability to quantify this value and directly apply this information to modeling our warfighting capabilities has not been fully realized. Without this measure, it is impossible for models to accurately weigh the costs and benefits of reconnaissance systems.

In Chapter II, some of the traditional Lanchester equations are presented and then modified to reflect the use of intelligence as a combat multiplier. These are presented along with intuitive arguments as to why these modifications satisfy military judgment. Also discussed are the basic battlefield scenarios for the area and aimed fire models for use throughout the thesis.

Chapter III describes the data which were acquired from the Army Research Institute, at the Presidio of Monterey (ARI-POM), from 10 defensive battles fought at the National Training Center (NTC) at Fort Irwin, California. Also described are the selection criteria used in choosing these ten battles. These data forms include numerous database tables. Additionally the form and structure of the database provided by the ARI-POM, and how it was manipulated and cleaned for the purpose of this thesis are discussed. These data forms include numerous database tables as well as the narrative take home package (THP). The final discussion in this chapter describes how this information was reorganized into a consolidated data table which will be used and expanded in the analysis.

The analysis of the data is presented in Chapter IV, where the method and calculations which produced the COMAN model maximum likelihood estimate (MLE) of various attrition rates from the NTC data are described. Also the battles are ranked according to two measures of effectiveness (MOEs), and a positive correlation is shown to exist between how well a unit uses its intelligence assets and the rate at which it actually attritted the red force. Finally a method is described which quantitatively measures the effectiveness of the use of reconnaissance and the processing of intelligence information using the NTC battle data with the modified Helmbold equations.

The final chapter contains the conclusions of the study and several suggestions for further research. The discussion outlines possible extensions of the models, opportunities to employ these results and a summary of the ongoing research.

II. THE LANCHESTER MODELS

In this chapter some of the traditional Lanchester equations are presented and then modified to reflect the use of intelligence as a combat multiplier. These are presented along with intuitive arguments as to why these modifications make sense. The resulting equations will be applied in Chapter IV, *Analysis*. Also discussed are the basic battlefield scenarios for the area and aimed fire models for use throughout the thesis.

A. GENERAL

The traditional Lanchester equations can be written as the

$$\text{linear law:} \qquad \frac{dR}{dt} = -\alpha_B RB, \tag{1}$$

and the

$$\text{square law:} \qquad \frac{dR}{dt} = -\beta_B B, \tag{2}$$

where R and B are the respective red and blue force sizes, α_B represents blue's ability to attrit red with area fire, and β_B represents blue's ability to attrit red with aimed fire.

Now it can be shown that the square law is closely related to the linear law. In fact, the two attrition rate coefficients can be written in terms of one another. Consider representing the square law attrition rate coefficient as

$$\beta_B = r_B \times P_{ssk}, \tag{3}$$

where r_B is the firing rate of blue's weapons and P_{ssk} is the probability of a kill per round fired. In the area fire case, assuming r_B to be a constant, the expected number of kills per round can be thought of as

$$P_{ssk} = A_L \times \frac{R}{a_{tgt}} = \frac{A_L}{a_{tgt}} \times R, \tag{4}$$

where A_L is the lethal area of one round, R is the number of red targets, and a_{tgt} is the area occupied by the red force. In words it can be written as

$$P_{ssk} = (\text{lethal area of round}) \times (\text{target density}). \tag{5}$$

Equations (2), (3), and (4) above provide the following expression for the attrition rate [Ref. 5];

$$\frac{dR}{dt} = r_B \frac{A_L}{a_{tgt}} RB. \tag{6}$$

Equation (6) is another way of expressing the linear law since it depends on R. The initial statement regarding the similarities in the two attrition rate coefficients can easily be shown since

$$\alpha_B = r_B \frac{A_L}{a_{tgt}}, \tag{7}$$

and

$$\beta_B = r_B \frac{A_L}{a_{tgt}} R = \alpha_B R. \tag{8}$$

B. AREA FIRE

The Lanchester Linear Law is the foundation for the equation used here. The idea is to reward the blue force for the information it has gained by increasing the rate at which it attrits the red force. The more intelligence blue gathers regarding red's probable courses of action (COA), the more lethal blue's area fire weapons become. This increase is determined by the ratio $\frac{A_L}{a_{tgt}}$.

Consider the following scenario which is depicted in Figure 1. The blue force defends against red who will attack along some combination of five available avenues of approach (AOA), each of which has similar physical characteristics and is five square kilometers in size. At time, t_0, the blue force has no information regarding red's COA.

Therefore he assesses the use of each AOA to be equally likely during the attack. This means the blue indirect fire assets are divided equally to cover each of the five AOAs. Blue's reconnaissance objective is to determine how much of red's strength will come down each AOA, as well as the force composition. Suppose for now that r_B is a constant, and use the initial conditions shown in Table 1.

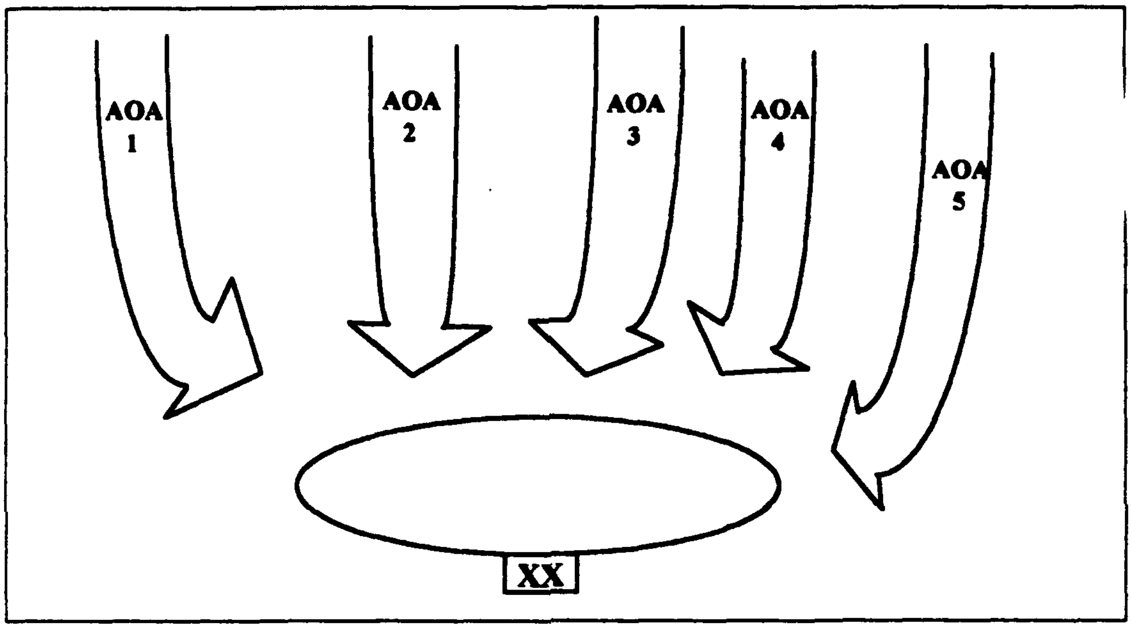

Figure 1. First Area Fire Scenario

TABLE 1. EXAMPLE PARAMETERS FOR THE AREA FIRE MODEL

Parameter Value	Units
$R = 1250$	elements
$B = 24$	area fire weapons
$A_L = 0.00785$	square kilometers
$a_{tgt} = 25$	square kilometers
$r_B = 4$	rounds per weapon per minute

This yields the following attrition rate for the red forces at time t_0,

$$\frac{dR}{dt} = -4\left(\frac{0.00785}{25}\right)(1250)(24) = -37.7\frac{\text{kills}}{\text{minute}}. \tag{9}$$

In this simple example we can extract the values for the attrition rate coefficients as

$$\alpha_B = 4\left(\frac{0.00785}{25}\right) = 0.00126, \tag{10}$$

and

$$\beta_B = 4\left(\frac{0.00785}{25}\right)(1250) = 1.57. \tag{11}$$

Now suppose the blue force has gained some information regarding red's current activity and location. Based on this information he reevaluates the enemy's probable COA. Suppose further that blue determines that the force will use only AOAs 1, 2 and 3 as shown in Figure 2. It follows that he will allocate his indirect fire assets according to these same proportions. Blue has in effect reduced the area of his target. This will result in a higher attrition rate against red for blue's area fire weapons, which is calculated as

$$\frac{dR}{dt} = -4\left(\frac{.00785}{15}\right)(1250)(24) = -62.8\frac{\text{kills}}{\text{minute}}. \tag{12}$$

Blue will continue to update the probable enemy COAs and reallocate his area fire assets. Provided that blue's intelligence was accurate and that his analysis was correct, he will ultimately attrit the red forces with area fire at a higher rate than if he had not used his reconnaissance assets. The graph in Figure 3 below shows the effect of reducing a_{tgt}, while all other parameters are held constant. Each line represents a change in the total area occupied by the red forces. The attrition rate of the blue forces is held constant at the arbitrary value of 3 percent.

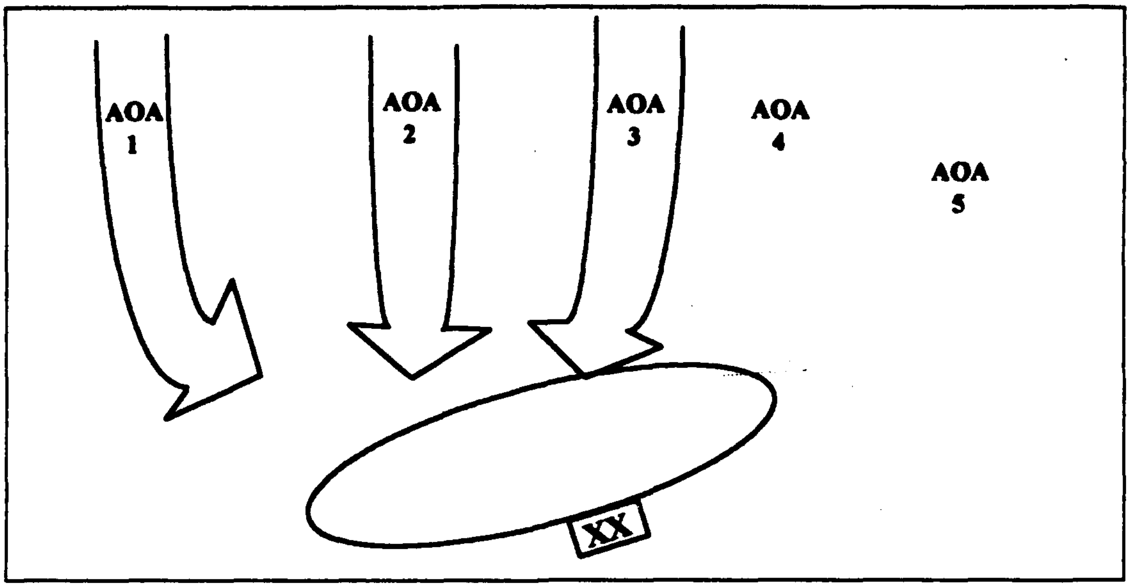

Figure 2. Second Area Fire Scenario

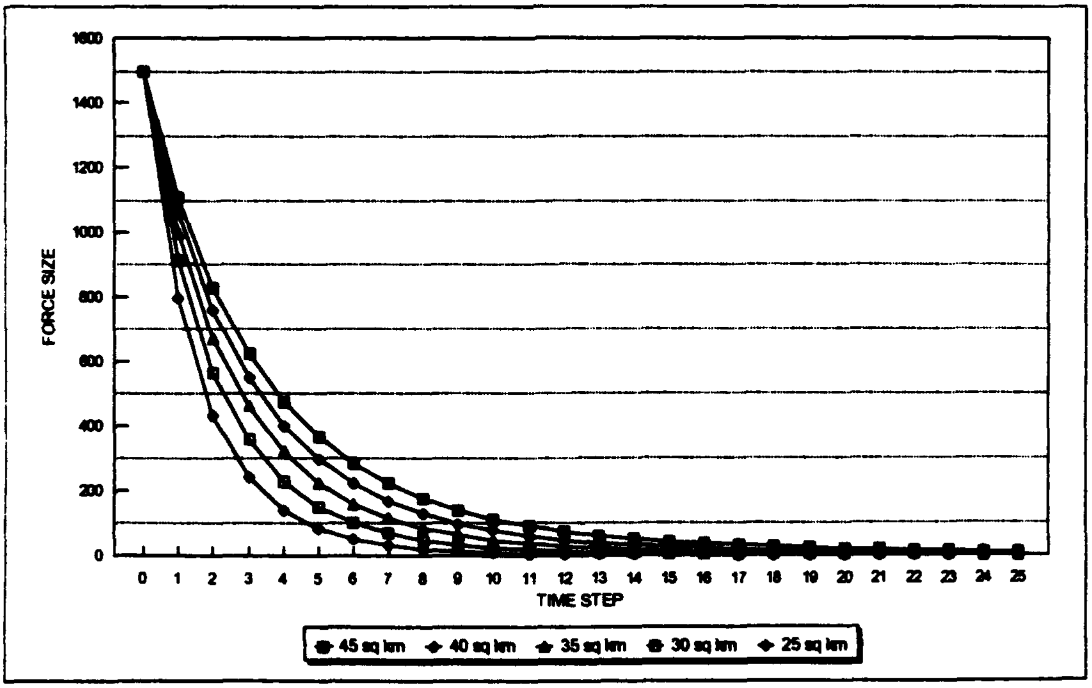

Figure 3. Effect Of a_{tgt} On Enemy Force Size

C. AIMED FIRE

Lanchester's square law is the basis for the equation used in this section, but here it is not related to the *area* of the AOAs, but instead, the *number* of AOAs. However, the key aspect of this model is similar to the area model in that the blue force gains information through reconnaissance efforts and applies this knowledge to increase his combat effectiveness. The aimed fire model does require a slightly different approach. The Helmbold modification of Lanchester's square law serves as a starting point to model the situation. The Helmbold equation is written as

$$\frac{dR}{dt} = -\beta_B \left(\frac{R}{B}\right)^{1-\omega} B, \tag{13}$$

where β_B is the rate at which blue attrits red using aimed fire, and ω is referred to as the Weiss parameter. Here, as before, both B and R are force strengths as a function of time.

Traditionally Helmbold's equations have been used to account for inefficiencies of scale for a larger force when the initial force sizes are grossly unequal [Ref. 5]. In Equation (13) above, the force ratio term is less than one, and the term $\left(\frac{R}{B}\right)^{1-\omega}$ can be interpreted as a weighting factor on the red attrition rate. Helmbold argued that a force which greatly outnumbered its opponents could not bring all its weapons to bear against the enemy. Note that when the Weiss parameter, ω, is equal to one, the Helmbold equation is the same as the square law. However, for values less than one, only a percentage of the square law attrition rate is applied. In effect, the intelligence contribution *offsets* the Weiss parameter.

The analogy here is that since the blue force is defending in such a manner that it can not bring direct fire from all its weapons to bear on the attacking red forces, the inefficiencies are the same as those described in the traditional Helmbold scenario. In other words, some of blue's direct fire weapons will not be used effectively in attriting red. Recall that the square law assumes that every blue firer can engage every red target, and this can be modeled with the Weiss parameter equal to one. It is necessary to make one change to the traditional Helmbold equation, since the force ratio term must be less than one. Thus, for the case of blue defending against a larger red force, the equation now is written as

$$\frac{dR}{dt} = -\beta_B \left(\frac{B}{R}\right)^{1-\omega} B. \tag{14}$$

Note the consistencies with the original Helmbold equation. When $\omega = 1$ it reduces to the square law, and for values $0 \le \omega < 1$, a percentage of the full attrition rate results.

It can be argued that there are other factors which can weigh heavily in determining success on the battlefield, (such as command and control, morale, timeliness and execution of the order) and therefore may have some influence on the magnitude of ω. However, in this study it is hypothesized that the differences in ω are primarily due to levels of intelligence. In Chapter IV Equation (14) will be used for curve fitting actual attrition data from NTC battles. In this curve fitting, even though $\omega = 1$ represents blue's highest aspirations, it is understood that this level of attrition is virtually impossible to achieve for two reasons. First, in order to have a Weiss parameter equal to one, the unit would have to have perfect intelligence, as well as perfect command and control, and perfect execution, etc. Secondly, the square law assumes that *all* blue weapons are able to mass fires on all red targets.

Also, the lower bound of $\omega = 0$ can only be considered a *soft* bound. Two battles are fit to a curve with negative Weiss parameter values. Even though the classical interpretation of Equation (13) does not hold for these cases, the result still serves as a relative measure, used to compare the attrition rates in these NTC battles.

Next consider how information gained by blue regarding red's COA can be used to increase the lethality of its own direct fire weapons. Consider the following simplified scenario. Blue defends with 50 tanks covering five AOAs. Initially, blue has no information about how red will allocate his forces along these AOAs. With no knowledge, and assuming all AOAs have identical physical characteristics, he will allocate 20% of his direct fire assets to cover each of the five AOAs. If the battle were to be fought under these conditions, blue would attrit red at a rate very close to the lower bound for this situation.

Next suppose that blue has acquired some useful information from a recon element and has adequate time to reposition his direct fire weapons so that larger portions are bringing fire to bear on the attacking red forces. Emphasis is placed on the *timeliness* of the information that blue gathers. This suggests that there is some key time period in the battle at which ω will be fixed, say for example 2-6 hours before the close battle begins. This time varies depending on the actual characteristics of the battle. The blue commander can also adapt to delayed information by the method in which he employs his reserve and how long he has had to prepare supplementary fighting positions.

If blue has perfect information regarding his opponent, and has had adequate time to prepare his defense, then he would use his direct fire weapons in the most effective manner possible. In this case the magnitude of the Weiss parameter would increase. Consider the initial conditions shown in Table 2.

TABLE 2. EXAMPLE PARAMETER VALUES FOR DIRECT FIRE MODEL

Parameter Value	Units
$R = 150$	vehicles
$B = 50$	direct fire weapons
$\beta_B = 0.05$	red attrition rate from blue direct fire weapons
0.08	fixed attrition rate for blue

Figure 4 shows the effects of changing the Weiss parameter on the attrition rate of the opponent.

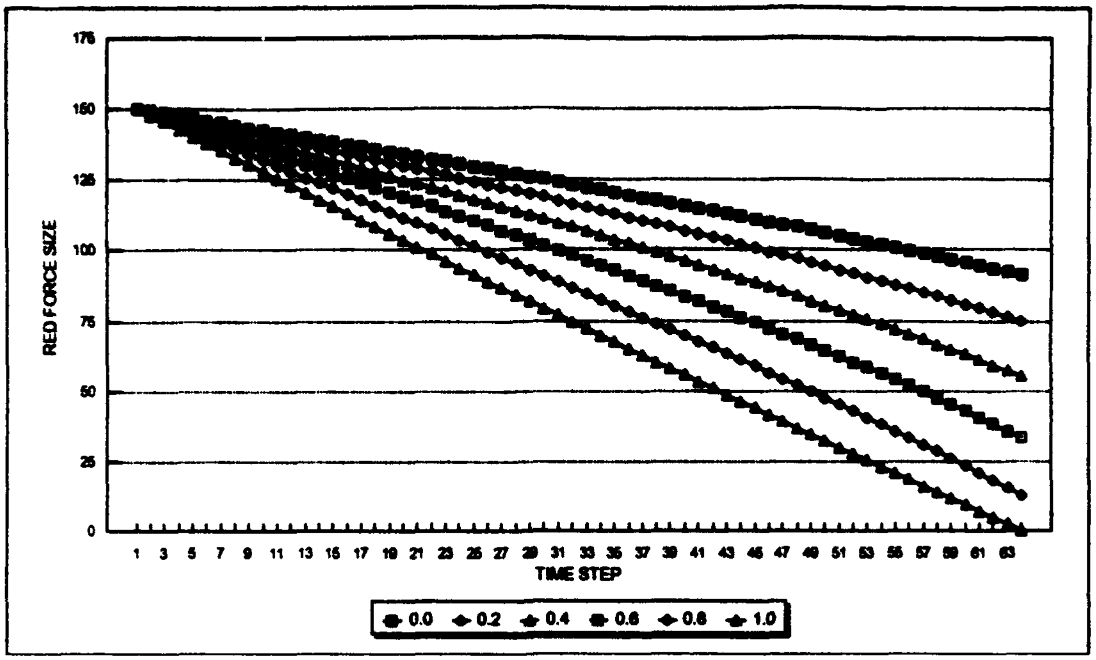

Figure 4. Effects On Red's Attrition Rate For Varying Weiss Parameter Values.

III. DATA

Data were acquired from the Army Research Institute, at the Presidio of Monterey (ARI-POM), from 10 defensive battles fought at the National Training Center (NTC) at Fort Irwin, California. This section describes the selection criteria used in choosing these ten battles. These database forms include numerous database tables. Additionally the form and structure of the data provided by the ARI-POM, and how it was manipulated and cleaned for the purpose of this thesis are discussed. These data forms include numerous database tables as well as the narrative take home package (THP). The final discussion describes how this information was reorganized into a consolidated data table which will be used and expanded in Chapter IV, *Analysis*.

A. SOURCES

1. The National Training Center (NTC)

The mission of the NTC is to provide highly realistic and intensified combined arms and services training for battalion task forces based in the continental United States and squadrons in a mid- to high-intensity combat environment. Since 1981 heavy brigades, with or without light elements, have been going to the NTC to train for 14 days and nights on tactical missions with force-on-force Multiple Integrated Laser Engagement System (MILES) engagements against an opposing force (OPFOR) employing Warsaw Pact tactics. The NTC schedules twelve rotations each year. On the average, a rotation consists of nine force-on-force and four live-fire exercises for each of the two battalion task forces.

The NTC's 1,000 square miles is considered to be some of the harshest terrain in the U.S. Simulated combat situations constantly arise demanding rapid assessments, timely decision making, and effective employment of artillery, air defense, engineers, aviation, and combat service support units. No other training presents in combination the scope, scale, and intensity of effort that is captured at the NTC. Its instrumented, one-of-a-kind battlefield provides instant feedback and heightens learning at all levels. [Ref. 6]

2. The Army Research Institute, Presidio of Monterey (ARI-POM)

The ARI-POM is designated to be the Army's repository for data collected at the NTC as well as the other Combat Training Centers; the Combat Maneuver Training Center (CMTC) and the Joint Readiness Training Center (JRTC). The ARI-POM Archive is one of the prime sources of Army unit performance data in existence. Initial development of the CTC Archive began in 1985 with a limited set of NTC materials. During the spring of 1990, the CTC Archive was expanded to include a wider variety of paper, video, audio, and digitized data types from the JRTC and the CMTC. [Ref. 7]

B. BATTLE SELECTION CRITERIA

The goal of the battle selection criteria was to represent the population of rotations at NTC through a sampling of NTC battles with similar characteristics. In order to accomplish this, many battles were considered in order to find those with similar characteristics. Listed below are the selection criteria for the NTC battles.

1. Digitized Data

Not all data from the NTC rotations on file at ARI-POM have been digitized. However, digitized data were essential for this thesis, in order to rapidly and accurately manipulate the large volume of data required for analysis, and to exploit the power of the personal computer along with several software packages.

2. Mission: Defense in Sector

This type of mission is most appropriate for this thesis. Gaining enemy intelligence is most critical in a defense mission. In an offensive mission, one usually has a good understanding of the adversary, his location, equipment, etc.

3. Unit Type: Armor, Mechanized or Cavalry

These unit types were chosen to add consistency to the data. Heavy units tend to defend using similar tactics and have nearly the same equipment, differing only in the proportion of tanks and APCs. In fact, at the battalion task force level, elements can be nearly identical, and serve well for the purposes of this thesis.

4. Similar Terrain

Although it was not possible to select battles fought on exactly the same terrain, the preference was for the battles occurring within a certain area of NTC which offers similar major terrain features, such as defendable terrain and similar avenues of approach, to add consistency to the data.

5. Recent NTC Rotation

With the changes in equipment, tactics and with the evolving state of NTC itself, only rotations which occurred within the past five years were candidates for selection.

C. TAKE HOME PACKAGES (THPs)

1. Description

This narrative feedback to units emphasizes a review of unit performance. For rotations after November 1987, the reporting was within the framework of the battlefield operating systems (BOS). THPs from earlier rotations contained the same information, but were organized by mission [Ref. 8]. The documents, written by the officer and non-commissioned officer (NCO) Observer/Controllers (O/Cs), are primarily narrative with some battle statistics gathered from the Core Instrumentation Subsystem (CIS).

2. Contents/Data Elements

The THPs available on floppy disk contained four main sections; Section I - General Summary; Section II - Mission Statements and Commander's Intent; Section III - BOS/Lessons Learned; Section IV - Statistical Analysis [Ref. 8]. Within each section, the mission segments were discussed as they occurred chronologically. Each document is typically 200-250 pages in length.

Sections of particular interest for this thesis are the O/C comments on the Intelligence and Fire Support BOSs for the particular defense-in-sector battles, and the consolidated comments made at the end of the rotation regarding unit trends for these same two BOSs.

D. DATA TABLES

1. The Player Status Initialization Table (PSIT)

The PSIT describes the list of vehicles at the beginning of the defense-in-sector mission. It includes all red and blue players as well as O/Cs [Ref. 8]. The original table included nine fields; however, only the three listed in Table 3 were used. The PSIT was used primarily to identify the side and weapon type, given a particular Logical Player Number (LPN). Figure 5 shows a few typical lines from a PSIT as received from the ARI-POM.

TABLE 3. FIELDS USED FROM PSIT

FIELD NAME	FIELD DESCRIPTION
LPN	Logical player number, (unique to each vehicle, all sides)
SIDE	Either B(lue), R(ed) or O(bserver)
PTYPE	Player type code, which is cross referenced in another table

pid	lpn	side	inst	acitive	ptype	org	track	pstat
H01	32	O	I		0	3	TOC	T	1
H02	33	O	I		0	1	TOC	T	1
H03	34	O	I		0	3	TOC	T	1
H05	35	O	I		0	3	TOC	T	1
H06	36	O	I		0	3	TOC	T	1

Figure 5. An Extract From The PSIT Printout

2. The Player/Vehicle/Weapon Code Table (PVWT)

The PVWT defines a unique code for each weapon system on the battlefield. The code allows correlation of MILES codes, vehicle types, and weapons. The PVWT is static, and does not change from rotation to rotation [Ref. 8]. The fields used from this table are listed in Table 4. Figure 6 shows the first few lines from the PVWT printout from the ARI-POM.

TABLE 4. FIELDS USED FROM PVWT

FIELD NAME	FIELD DESCRIPTION
PTYPE	Player type code
WEAPON	Description of unique weapon system

side	ptype	vehicle	miles	weapon	ammo
B	0	Undefined	0	Unknown	0
B	1	M60 A1/A3 Tank	12	105mm main gun	0
B	1	Abrams	16	120mm main gun	0
B	1	M60 A1/A3 Tank	27	Coax	0
B	1	M60 A1/A3 Tank	28	105mm (miss)	0
B	1	M60 A1/A3 Tank	23	Coax (miss)	0
B	2	APC	24	M2 Machine Gun	0
B	2	APC	29	M2 (miss)	0
B	3	APC	7	TOW	0

Figure 6. An Extract From The PVWT Printout

3. The Pairing Events Table (PET)

The PET is considered by ARI-POM to be the heart of the NTC research database. This is the table that describes the direct fire assessments on a play-by-play basis. The pairing table maintains a time-ordered record of legitimate pairing events [Ref. 8]. In a few cases the PET provided information regarding the firer, but not in enough pairings to be of use in this thesis. The fields used from the PET are listed in Table 5. Figure 7 shows some sample data extracted from the PET.

TABLE 5. FIELDS USED FROM THE PET

FIELD NAME	FIELD DESCRIPTION
TIME	Date and time of pairing
TLPN	Logical player number of the target
RESULT	N(ear miss), H(it) or K(ill)

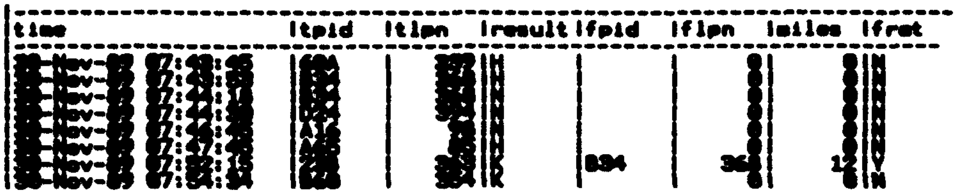
time	tpid	tlpn	result	fpid	flpn	miles	frat
[illegible]	[illegible]	[illegible]	[illegible]	834	36	1	[illegible]

Figure 7. An Extract From The PET Printout

When a vehicle is hit during a battle at NTC, an algorithm is invoked to calculate the probability of a kill, given a hit. It takes into account the weapon and the target types. Therefore the only lines of concern in the PET are those which represent a kill. Hence, all *Near miss* and *Hit* pairings were deleted under the assumption that the NTC kills are accurately assessed. The PET also showed some cases where one vehicle was *Killed* more than one time. This is accurate as far as the battle play is concerned, since in real combat vehicles have been found to have been hit numerous times. But for the required attrition calculations, we are only interested in distinct first time kills. Therefore, pairings which represented a multiple kill on the same LPN were deleted.

4. The Player State Update Table (PSUT)

This table tracks changes to all the players' states throughout the duration of the mission [Ref. 8]. The critical field subject to update is the Player Status Code (PSTAT). There are many PSTATs, but the only ones of concern here are; (1) operational; and (2) combat loss. The critical fields in this table are described in Table 6. Some example lines from the PSUT printout are shown in Figure 8.

TABLE 6. FIELDS USED FROM THE PSUT

FIELD NAME	FIELD DESCRIPTION
TIME	Date and time of update
LPN	Logical player number, (unique to each vehicle, all sides)
PSTAT	Player Status Code, 1 - operational, 2 - combat loss

time	pid	lpn	side	inst	ptype	org	pstat
[illegible]-Feb-[illegible] [illegible]:11:25	DMT	356	B	1	2	CP/D/D/2-[illegible]	1
[illegible]-Feb-[illegible] [illegible]:11:27	DEV	[illegible]	B	1	2	CST/2-[illegible]	[illegible]
[illegible]-Feb-[illegible] [illegible]:12:27	21H	4	[illegible]	1	2	No unit	[illegible]
[illegible]-Feb-[illegible] [illegible]:12:41	[illegible]	128	O	1	3	[illegible]/3-001	2
[illegible]-Feb-[illegible] [illegible]:13:40	218	15	[illegible]	1	2	No unit	[illegible]
[illegible]-Feb-[illegible] [illegible]:13:42	117	42	O	1	3	1/1-001	2
[illegible]-Feb-[illegible] [illegible]:14:49	216	67	O	1	3	1/2-001	1

Figure 8. An Extract From The PSUT Printout

5. The Indirect Fire Casualty Table (IFCT)

The IFCT portrays indirect fire casualties similarly to PET for the direct fire casualties. However, none of the ten battles considered had a complete IFCT. No other tabled data in the ARI-POM NTC database offer a complete picture of the indirect fire battle.

E. REORGANIZATION OF DATA

Each of the ten battles that were selected according to the criteria listed above had their own set of tables. These tables were combined into one summarizing table which provided all the data necessary to estimate the attrition rates for each battle. The ARI-POM tables were combined using a three dimensional spreadsheet which provided easy cross-referencing. The Consolidated Data Table (CDT) is described in Table 7. A few rows of the CDT are shown as an example in Figure 9.

TABLE 7. FIELDS FROM THE CDT

FIELD NAME	FIELD DESCRIPTION
TIME	Time of pairing
TLPN	Logical player number of the target
RESULT	N(ear miss), H(it), or K(ill)
GAME TIME	Time origin set to time of first shot of battle
KILL	Running count of the total kills
VEHICLE TYPE	Describes the side, (B or R), and vehicle, (Tank, APC or Other)

TIME	Target LNP	RESULT	Game Time	Kill	VEHICLE TYPE
06:35:00	N/A	N/A	00:00:00	N/A	N/A
06:36:00	148	K	00:01:00	1	R-OTHER
06:06:20	369	K	00:00:32	2	B-TANK
06:46:58	326	K	00:11:58	3	B-APC
07:13:13	35	K	00:38:13	4	R-APC
07:13:16	66	K	00:38:16	5	R-APC
07:14:16	42	K	00:39:16	6	R-APC
07:17:56	370	K	00:42:56	7	B-TANK

Figure 9. An Extract From The CDT Printout

The CDT contains all the information required to calculate the Combat Analysis Model (COMAN) maximum likelihood estimates (MLE) of attrition. These fields and the method in which the CDT was expanded to produce these estimates are explained in Chapter IV.

IV. ANALYSIS

This chapter describes the method and calculations which produced the COMAN model maximum likelihood estimate (MLE) of various attrition rates from the NTC data. The interested reader can find the mathematics behind the COMAN model briefly explained in reference 9; reference 10 contains the complete derivation and a more complete discussion of the model, and reference 11 provides some interesting applications of an extended COMAN model.

Also in this chapter, the battles are ranked according to two measures of effectiveness (MOEs), and a positive correlation is shown to exists between how well a unit uses its intelligence assets and their relative worth during the battle. Finally, a method is described which quantitatively measures the effectiveness of the use of reconnaissance and the processing of intelligence information using the NTC battle data with the modified Helmbold equations.

A. COMAN MODEL MLE AND RELATIVE WORTH

1. COMAN Model

a. Methodology

To estimate the direct fire attrition rates from the data obtained from the ARI-POM database, the Combat Analysis (COMAN) Model was used. The mathematical equation for the rate at which blue attrits red using direct fire weapons is

$$\hat{\beta}_B = \frac{C_T^R}{\sum_{k=1}^{K} B_{k-1}(t_k - t_{k-1})}. \qquad (15)$$

where C_T^R is the number of red casualties at time T, (the end of the battle); K is the total number of casualties to both sides; B_{k-1} is the number of blue firers after the $(k-1)$st casualty; and $(t_k - t_{k-1})$ is the time in minutes between the kth and the $(k-1)$st casualties. Similarly the rate at which red attrits blue can be written as

$$\hat{\beta}_R = \frac{C_T^B}{\sum_{k=1}^{K} R_{k-1}(t_k - t_{k-1})}. \tag{16}$$

The units of these equations are

$$\hat{\beta}_B = \frac{\text{Total number of Red casualties}}{\text{Total number of Blue firer minutes}}, \tag{17}$$

and

$$\hat{\beta}_R = \frac{\text{Total number of Blue casualties}}{\text{Total number of Red firer minutes}}. \tag{18}$$

In order to use a spreadsheet to calculate $\hat{\beta}_B$ and $\hat{\beta}_R$, the following columns were added to the CDT described in Chapter III.

TABLE 8. COMBINED DATA TABLE DESCRIPTION

FIELD NAME	FIELD DESCRIPTION
COUNT B-APC	The total number of blue APCs still operational
COUNT B-TANK	The total number of blue tanks still operational
COUNT R-APC	The total number of red APCs still operational
COUNT R-TANK	The total number of red tanks still operational
ALL BLUE	The total number of blue APCs and tanks still operational
ALL RED	The total number of red APCs and tanks still operational
Tk	Number of minutes until the *k*th kill
Bk	Number of blue firers at the time of the *k*th kill
Rk	Number of red firers at the time of the *k*th kill
T(k)-T(k-1)	Number of minutes between the *k*th and *k-1*st kill
Bk[T(k)-T(k-1)]	Number of blue firer minutes between the *k*th and *k-1*st kill
Rk[T(k)-T(k-1)]	Number of red firer minutes between the *k*th and *k-1*st kill

An extract from the CDT showing the new columns is shown in Figure 10. A sample calculation of the COMAN MLE of the red's attrition rate for both tanks and APCs illustrates the procedure. Cell I1 is the initial number of tanks and APCs for red. The value in cell I52 is the number of red tanks and APCs at the end of the battle. The difference in these two cells is the total number of red casualties. The value in cell K53 is the sum of cells K2 through K52, and represents the total number of blue firer minutes. For this example, according to Equation (17), the COMAN MLE for the attrition rate of red tanks and APCs is, $\frac{153-132}{9,376} = 0.00224$. There are six different attrition rate estimates which can be calculated in this manner; red tanks and APCs combined, red tanks, red APCs, blue tanks and APCs combined, blue tanks, and blue APCs. The consolidated data table (CDT) for each battle is contained in Appendix A.

	A	B	C	D	E	F	G	H	I	J	K	L
	COUNT B-APC	COUNT B-TANK	COUNT R-APC	COUNT R-TANK	ALL BLUE	ALL RED	Tk	Bk	Rk	T(K)-T(K-1)	Bk[T(K)-T(K-1)]	Rk[T(K)-T(K-1)]
1	47	30	98	55	77	153	0	77	153	N/A	N/A	N/A
2	47	30	98	55	77	153	1	77	153	1	77	153
3	47	29	98	55	76	153	9	76	153	8	570	1,148
4	46	29	98	55	75	153	12	75	153	4	263	536
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
50	43	25	82	51	65	133	105	68	133	1	54	106
51	43	25	81	51	68	132	107	68	132	2	102	198
52	43	25	81	51	68	132	130	68	132	23	1,557	3,023
53											9,376	18,452

Figure 10. Example Of The Additional Fields In The CDT.

b. Rank Using the COMAN MLE

There are numerous possible methods for ranking the ten battles using the data available in the ARI-POM database; the highest attrition rate, the fewest friendly casualties, or the most enemy casualties, are just a few. If the enemy attrition rate is used to rank the battles, an erroneous conclusion may result. For example, Table 9 shows that Armor battle #4 has the highest attrition rate against red, with the COMAN MLE being 0.00611. Armor battle #5 has a relatively low MLE of 0.00123. However, in battle #5, there were ten more red casualties and three fewer blue casualties than in battle #4. The COMAN MLE is a function of both red casualties, *and* blue firer-minutes. In this example, battle #5 lasted over 8 1/2 hours longer than did battle #4. Using enemy attrition rate shows only that in battle #5 the casualties occurred at a slower rate. If it were possible to select battles of nearly equal length, this MOE would be adequate. However, that is not a viable choice for this analysis, since large differences exists for the battle lengths.

2. Relative Worth

One MOE which is often used, and serves our purpose better, is commonly referred to as *relative worth*, defined as the ratio of the attrition rate of the blue force to the attrition rate of the red force. A relative worth greater than one means that blue is attriting red faster than red is attriting blue. Most importantly, this MOE is not a function of the length of the battle. The last column in Table 9, relative worth, is defined as

$$\frac{\frac{\text{TOTAL RED CASUALTIES}}{\text{BLUE FIRER MINUTES}}}{\frac{\text{TOTAL BLUE CASUALTIES}}{\text{RED FIRER MINUTES}}} = \frac{\text{RED ATTRITION ESTIMATE}}{\text{BLUE ATTRITION ESTIMATE}} = \text{RELATIVE WORTH}. \quad (19)$$

Table 9 shows the actual figures for this MOE, as well as other battle summary statistics, ranked according to relative worth.

TABLE 9. BATTLE SUMMARY FIGURES

BATTLE	LENGTH IN MINUTES	RED CASUALTIES	BLUE CASUALTIES	RED FIRERS	BLUE FIRERS	RED ATTRITION RATE	BLUE ATTRITION RATE	RELATIVE WORTH
3	90	35	8	196	74	0.00584	0.0005	11.680
5	638	55	18	190	80	0.00123	0.00016	7.688
9	711	19	11	198	53	0.00058	0.00008	7.250
10	440	26	16	198	54	0.00123	0.00019	6.474
4	117	45	21	202	75	0.00611	0.001	6.110
1	130	21	9	153	77	0.0024	0.00049	4.898
7	132	31	18	196	79	0.00385	0.00079	4.873
8	572	23	18	190	83	0.00056	0.00017	3.294
2	206	22	14	153	84	0.00214	0.00077	2.779
6	235	5	7	196	58	0.00041	0.00015	2.733

B. UNIT PERFORMANCE

1. General

One of the key postulates in this thesis is that the better a unit utilizes the Intelligence BOS, the more effective they will be in attriting the enemy. Thus far, the COMAN MLE has been used as an indicator of the blue force's ability to attrite the enemy. Also available for analysis is the narrative THP which describes in detail how the unit performed in each of the BOSs according the O/Cs at the NTC. The attempt here is to devise a scoring system which allows the ten battles to be ranked from the best to worst according to their THP evaluation of the Intelligence BOS. This ranking can be compared to the ranking using the COMAN MLE and the correlation can be measured. If a positive correlation exists between these two ranking methods, then it would reinforce the original postulate that intelligence gathering, analysis, and dissemination impacts on a unit's ability to kill the enemy.

2. Methodology and Ranking

Besides the ARI-POM mission database tables, the other source of data for the battles is the Take Home Packet. Included in this narrative, written primarily by the officer and non-commissioned officer O/Cs at the NTC, is the unit's performance evaluation regarding each of the battlefield operating systems. Since there does not currently exist any actual *performance scores* for a unit by either the NTC or the ARI-POM, a scoring system was devised which was used to rank the battles according to the unit's performance evaluation, concentrating solely on the Intelligence BOS. The attempt here is to assign a *score* to each unit regarding its efficient use of reconnaissance assets within the Intelligence BOS. In order to obtain a value for this measure based on the written evaluation, it is more appropriate to score each paragraph in the narrative as opposed to each sentence, since ideally, the paragraph contains a complete thought and cannot be taken out of context. The main difficulty was devising a scoring system which would produce consistent results from judge to judge. There is inherently a large amount of subjectivity to scoring a written paragraph. Therefore a scoring algorithm was devised to remove as much of the subjectivity as possible, without loosing information, or even worse, biasing the scores of the judges. Each paragraph within the intelligence section of the written evaluation was placed into one of five categories by each judge.

- Highly Positive: a paragraph which contains high praise for the units performance regarding important aspects of the Intelligence BOS. An example of a highly positive paragraph would contain sentences like, *"The template developed by the S2 did an excellent job of identifying MCs and avenues of approach."*

- Positive: a paragraph which praises the units performance, but to a lesser degree than the above category, or it may contain a caveat. An example of a positive paragraph may contain phrases like, *"Recon and counter-recon operations were generally, but not always executed in a timely manner."*

- Neutral: if the paragraph does not address any pertinent topics, or the positive comments are equally balanced with the negative comments.

- Negative: a paragraph which contains criticisms regarding the Intelligence BOS. An example would be, *"Light discipline of the recon platoon could use some improvement."*

- Highly Negative: a paragraph which contains heavy criticism, regarding important aspects of the Intelligence BOS. The paragraph may be one or two very critical sentences, or it may contain numerous sentences which criticize to a slightly lesser degree. An example of a very critical sentence contained in a highly negative paragraph would be, *"During both night operations, the platoon was unable to detect the mounted recon before it penetrated the task force zone."*

These five categories are shown in Figure 11, along with the symbols used by the judges and the associated values used for the scoring.

	Highly Positive	Positive	Neutral	Negative	Highly Negative
Judge's Rating	++	+	O	-	- -
Associated Score	3	1	0	-1	-3

Figure 11. Scoring System For Narrative Evaluation

Appendix C contains additional instructions to the judge to ensure he understands the purpose and definitions of the categories. These instructions include guidelines, precautions, and a flow chart which explains the process step by step. This was done to ensure that all the judges were assessing the same MOE. An example of how a typical battle was scored is shown in Appendix D. Three separate judges were asked to score all ten battles using this system, and produced remarkably consistent results. Table 8 shows their results as well as the ranking according to the battle's relative worth (Equation 19).

TABLE 10. RANKING OF BATTLES ACCORDING TO THE THPs AND RELATIVE WORTH

	RANK				
BATTLE	JUDGE 1	JUDGE 2	JUDGE 3	AVERAGE	REL. WORTH
1	10	8.5	8	8.83	6
2	6	5	6.5	5.83	9
3	1	1	1	1.00	1
4	6	10	10	8.67	5
5	6	6	4	5.33	2
6	8	8.5	6.5	7.67	10
7	9	7	9	8.33	7
8	2	3	3	2.67	8
9	4	4	2	3.33	3
10	3	2	5	3.33	4

The Spearman's coefficient of rank correlation, which measures the degree of correspondence between rankings instead of between actual variate values, was used to test these two ranked lists. The recommended formula [Ref. 12] for calculating this coefficient, because the ranked lists contain ties, is written as

$$R = \frac{\sum_{i=1}^{n} \left(X_i - \bar{X}\right)\left(Y_i - \bar{Y}\right)}{\left[\sum_{i=1}^{n} \left(X_i - \bar{X}\right)^2 \sum_{i=1}^{n} \left(Y_i - \bar{Y}\right)^2\right]^{1/2}}, \qquad (20)$$

where X_i and Y_i are the ith elements in the two lists, and n is the number of elements in each list. The data from the last two columns in Table 10 above, produces the Spearman's coefficient, $R = 0.49$. It is encouraging that R is positive, yet due to all the other factors which contribute to unit success, it is not extremely large. This correlation between the performance of the unit on the battlefield and their level of proficiency in using their reconnaissance and intelligence assets shows that intelligence is, in fact, a combat multiplier and should be accounted for in modeling combat attrition.

C. APPLYING THE LANCHESTERIAN TYPE EQUATIONS TO THE NTC BATTLES

The COMAN model provides an estimate of the average attrition rate of the red force for each of the ten NTC battles. A modified Helmbold equation having one parameter which can be varied to model different levels of intelligence is also used. In Figure 12, the modified Helmbold equation is plotted with three different Weiss parameter values for Battle #10. It is relatively straightforward to see that in this battle, the red attrition rate could be represented using the modified Helmbold equation with a Weiss parameter of approximately 0.50.

As discussed in Chapter II, there are many factors which influence whether or not a unit is successful in battle. Therefore it is possible for a unit to have perfect intelligence regarding its enemy and attrit him at a rate less than the perfect square law due to command and control, morale, execution, etc. This phenomenon may be present in Battle #10, shown in Figure 12, which is the battle where the COMAN MLE was fit to the curve with the highest parameter value, $\omega = 0.5$, and yet is still quite far from the square law.

Examining Battle #10 more closely raises an interesting point. It appears that it would make a great difference in the Weiss parameter value if the start of the battle was chosen differently. In fact the COMAN estimate of β_B more than doubles if the start of the battle is moved forward about five hours. However, Figure 13 shows that in this case the Weiss parameter fit of 0.48 is nearly the same. What has occurred in this example is the smaller blue force size has offset the effect of the increased attrition coefficient. Figure 14 shows a plot of the blue force size over the course of the entire battle. Notice that blue suffered about 10 percent casualties, (nearly half of its total casualties for the battle) during the first five hours of the fighting, while red lost only about 2 percent. The decrease in the force size, B, and necessarily the force ratio component, $\frac{B}{R}$, offset the increase in the magnitude of the attrition coefficient, β_B, resulting in effectively no change in the modified Helmbold equation, which was introduced before

$$\frac{dR}{dt} = -\beta_B \left(\frac{B}{R}\right)^{1-\omega} B. \tag{21}$$

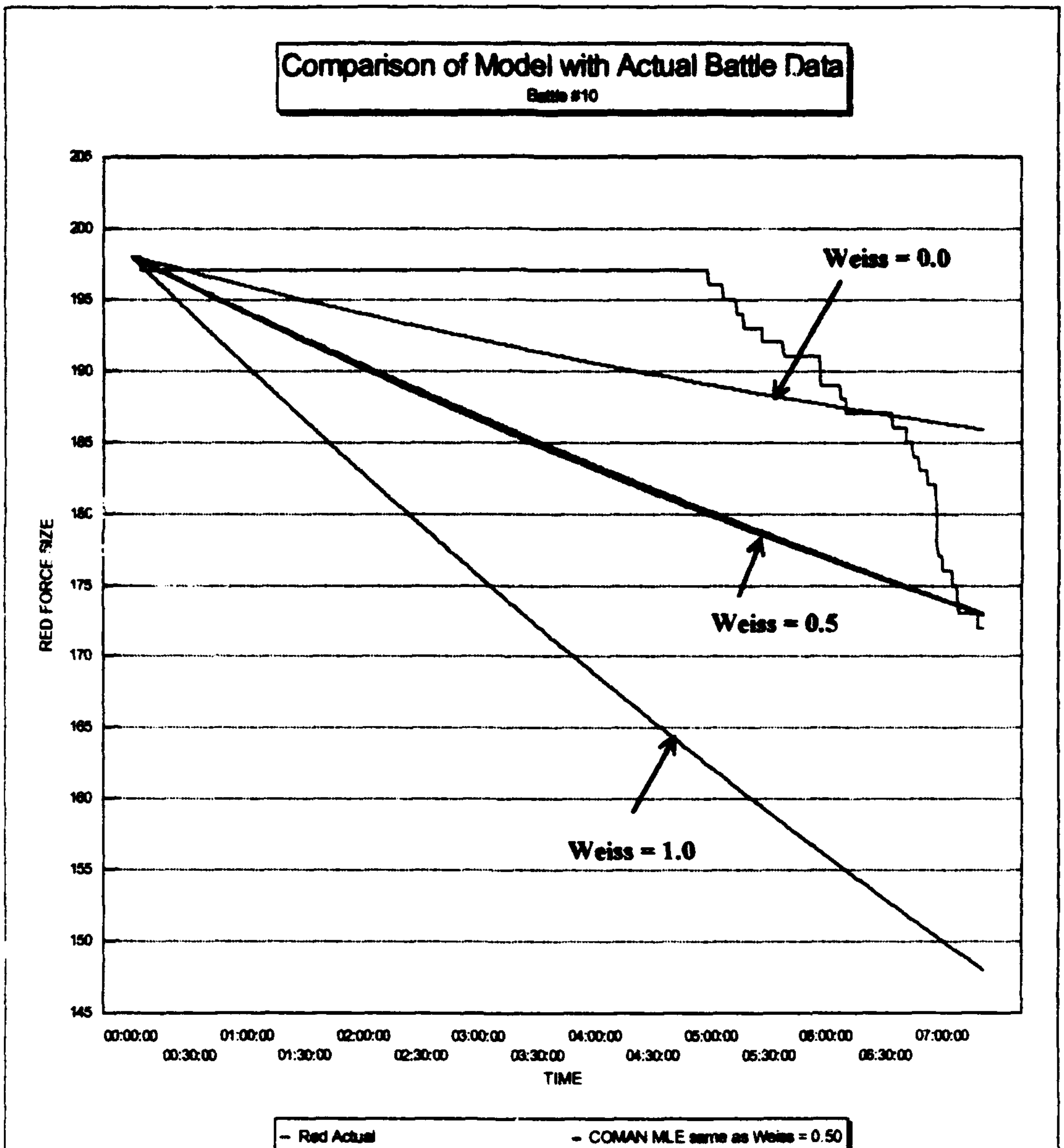

Figure 12. Coman Estimate And Modified Helmbold Equations Of Battle #10

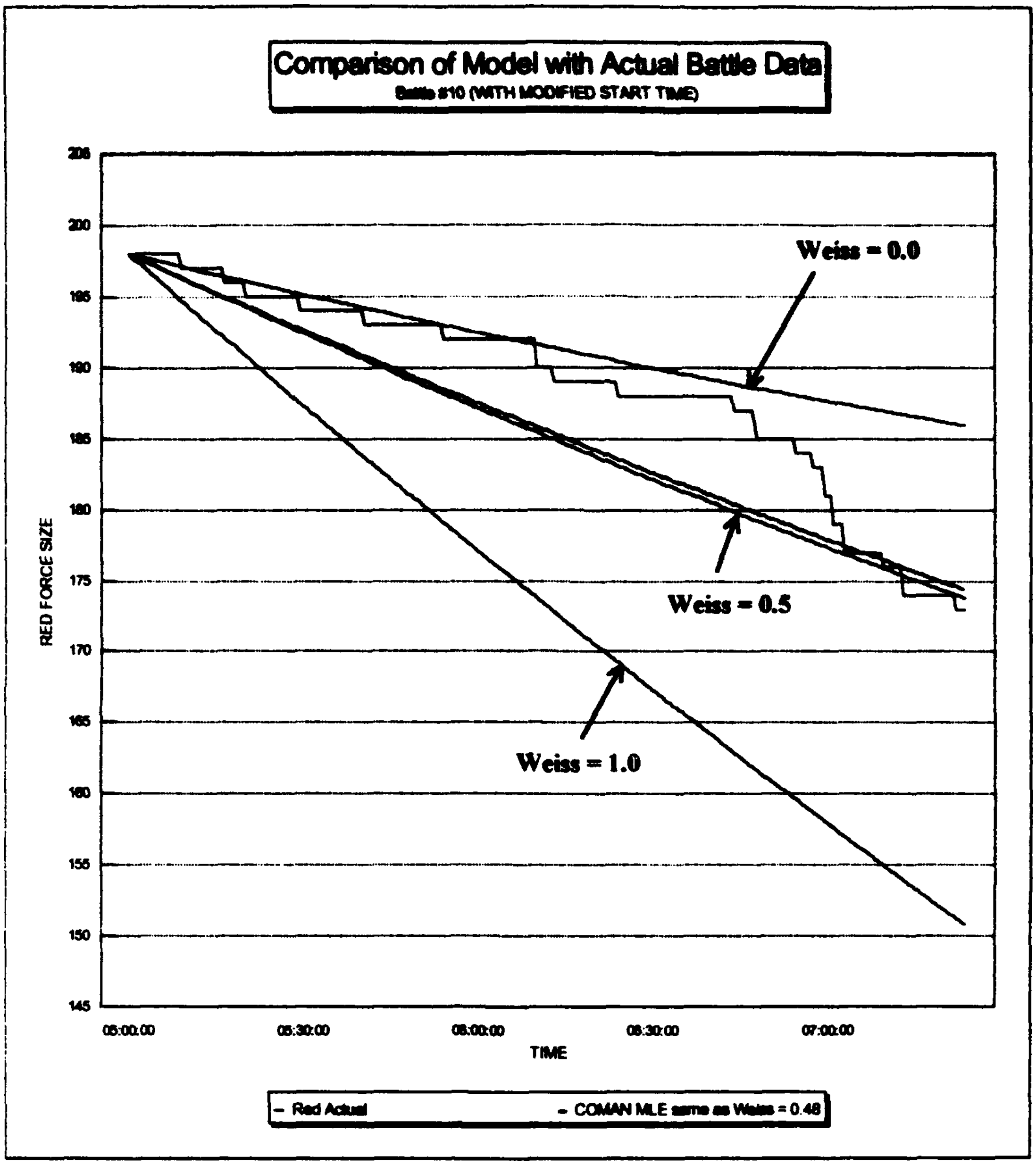

Figure 13. Battle #10 With The Modified Start Time

Battle #10 depicts realistically what often occurs in battle. As an attacking force approaches its opponent, the weapons with the greatest effective range are employed first. In this case, blue suffered substantial casualties in the long range battle, but did much better in the subsequent fighting at closer ranges. The battlefield can essentially be divided into range bands which correspond to the weapons systems with various effective ranges. In fact, the original work conducted by Clark used this approach in calculating separate attrition estimates for each range band [Ref. 9]. However, the data available for this thesis did not provide the necessary information to incorporate this level of detail.

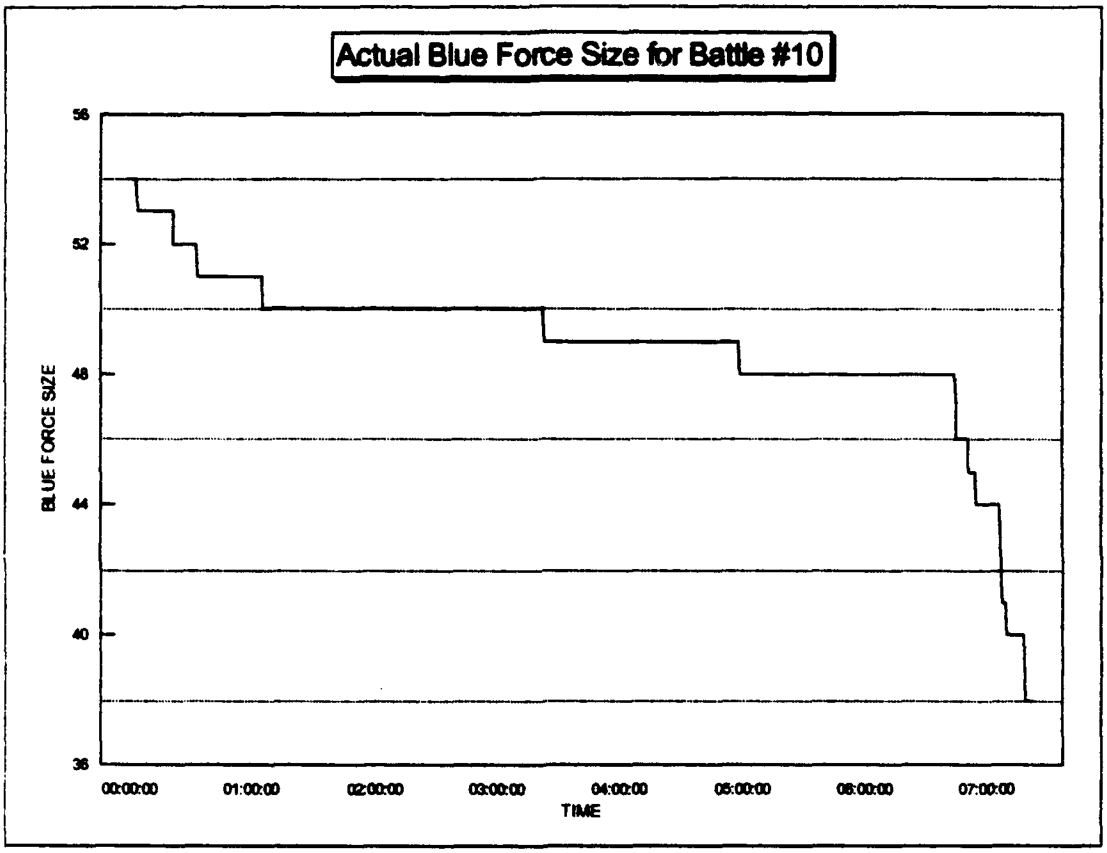

Figure 14. Blue Force Size For Battle #10

The lower bound of $\omega = 0$ can only be considered a *soft* bound. Two of the NTC battles are fit to a curve with negative Weiss parameter values. Even though the classical interpretation of Helmbold's formulations do not hold for these cases, the result still serves as a relative measure used to compare the attrition rates in these NTC battles. Battle #2 is an example of a negative value, where the COMAN MLE is fit to the curve,

$\omega = -0.13$, as shown in Figure 15. The graphs for all ten battles are contained in Appendix E. Table 11 shows all ten battle with the associated Weiss parameter value.

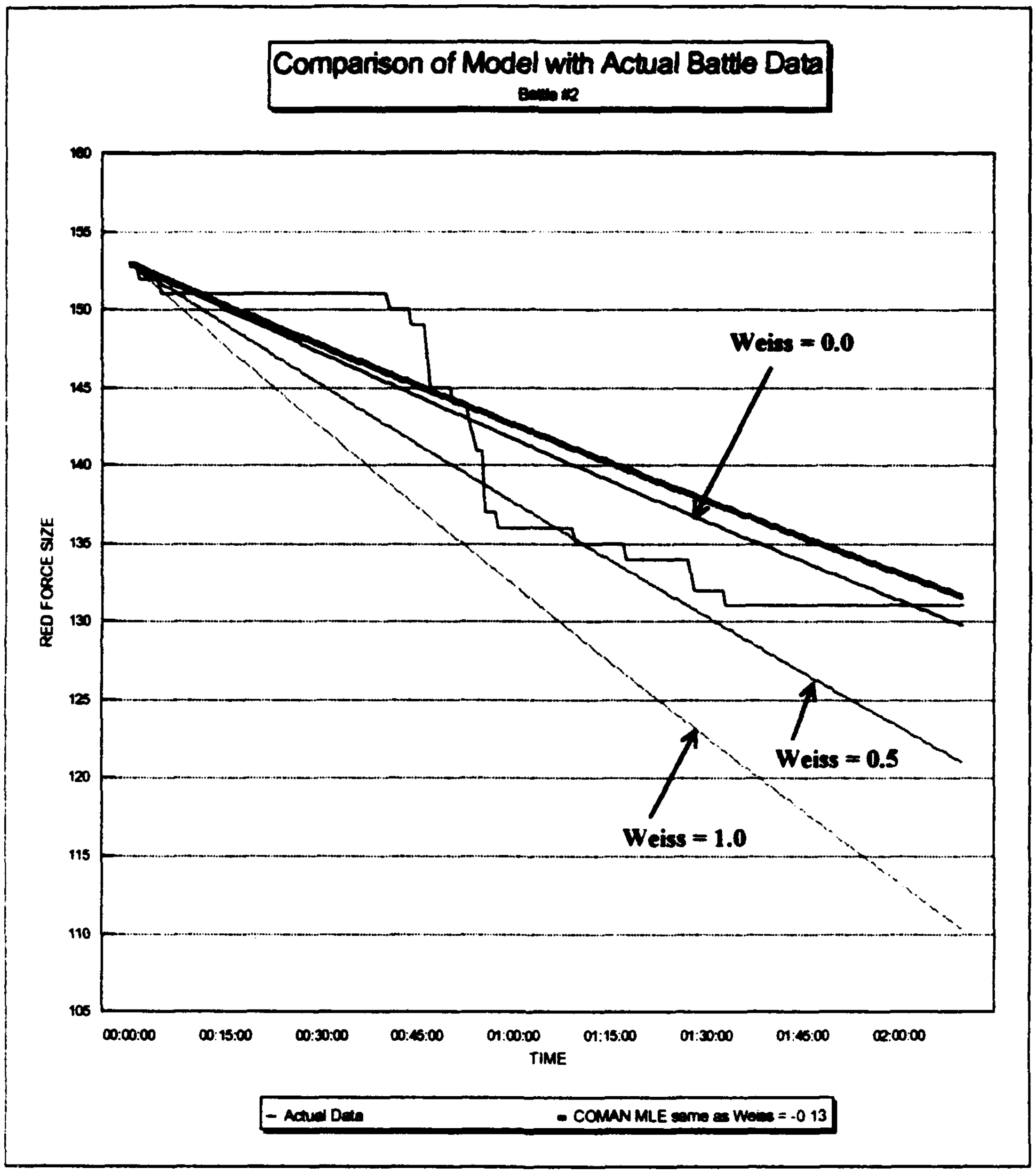

Figure 15. Coman Estimate And Modified Helmbold Equations Of Battle #2

TABLE 11. WEISS PARAMETER FOR EACH NTC BATTLE

BATTLE NUMBER	WEISS PARAMETER
1	-0.12
2	-0.13
3	0.27
4	0.31
5	0.16
6	0.45
7	0.26
8	0.20
9	0.49
10	0.50

V. CONCLUSIONS AND RECOMMENDED FURTHER RESEARCH

A. CONCLUSIONS

Through the modified Helmbold equations a quantitative measure of the value of reconnaissance can be obtained. Simulations can be run to determine the benefits of new systems, tactics and force structures. Prior to the close battle, periodic updates of $\frac{A_L}{a_\omega}$ and ω can be calculated. Through these updates, the lethality of the defending force's indirect and direct fire weapons increases accordingly. The parameters become fixed at some given point and the battle is fought.

B. RECOMMENDED FURTHER RESEARCH

Possibly the most appropriate model for these equations is the Future Theater Level Model (FTLM), since it uniquely incorporates perceptions into the battle simulation. FTLM is a symbolic model characterized by its aggregated, stochastic, information-intensive, and dynamic nature [Ref. 13]. However, it may be necessary to restructure portions of the FTLM in order to simulate combat at the small unit level. Along with this is the requirement to incorporate the modified Helmbold equations presented in this study into the FTLM program code. The most natural approach would be to associate the magnitude of the Weiss parameter to how close the unit's perception regarding its enemy's COA is to the ground truth. Currently the Naval Postgraduate School is pursuing these topics for upcoming theses.

Further studies could help to better identify the upper and lower bounds on the Weiss parameter. As was stated, the upper bound lies somewhere below one, and it is possible using real data to obtain parameter values less than zero for the lower bound.

Additional research to obtain attrition rates for the heterogeneous case could also be very useful. However, the data required to facilitate this research may be difficult to obtain.

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APPENDIX A

CONSOLIDATED DATA TABLES (CDTS)

This appendix contains the CDTs for the ten defensivc battles conducted at NTC. Below is a description of the column headings for quick reference.

Column	Heading	Description
1	Time	Time of the actual battle
2	Target LPN	Target logical player number, (unique to each vehicle)
3	Result	All the pairings in this table are (K)ills
4	Game Time	Duration of the battle
5	Kill	Running total of how many vehicles for both sides are killed
6	Vehicle Type	Denotes the side, (B)lue or (R)ed, and TANK, APC or OTHER
7	Count B-APC	Current number of mission capable blue APCs
8	Count B-Tank	Current number of mission capable blue tanks
9	Count R-APC	Current number of mission capable red APCs
10	Count R-Tank	Current number of mission capable red tanks
11	All Blue	Current number of mission capable blue vehicles
12	All Red	Current number of mission capable red vehicles
13	Tk	Game time (in minutes) of the *kth* kill
14	Bk	Total number of blue vehicles at the time of the *kth* kill
15	Rk	Total number of red vehicles at the time of the *kth* kill
16	T(k)-T(k-1)	Time (in minutes) between the *(k-1)st* and the *kth* kill
17	Bk[T(k)-T(k-1)]	Accumulated blue firer minutes between the *(k-1)st* and *kth* kill
18	Rk[T(k)-T(k-1)]	Accumulated red firer minutes between the *(k-1)st* and *kth* kill
19	Tk	Game time (in minutes) of the *kth* kill
20	Bk(APC)	Total number of blue APCs at the time of the *kth* kill
21	Rk(APC)	Total number of red APCs at the time of the *kth* kill
22	T(k)-T(k-1)	Time (in minutes) between the *(k-1)st* and the *kth* kill
23	Bk[T(k)-T(k-1)]	Accumulated blue APC firer minutes between the *(k-1)st* and *kth* kill
24	Rk[T(k)-T(k-1)]	Accumulated red APC firer minutes between the *(k-1)st* and *kth* kill
25	Tk	Game time (in minutes) of the *kth* kill
26	Bk(Tank)	Total number of blue tanks at the time of the *kth* kill
27	Rk(Tank)	Total number of red tanks at the time of the *kth* kill
28	T(k)-T(k-1)	Time (in minutes) between the *(k-1)st* and the *kth* kill
29	Bk[T(k)-T(k-1)]	Accumulated blue tank firer minutes between the *(k-1)st* and *kth* kill
30	Rk[T(k)-T(k-1)]	Accumulated red tank firer minutes between the *(k-1)st* and *kth* kill

At the bottom of each table is the total for columns 17, 18, 21, 22, 27, and 28, which represent the total firer minutes for the battle for the associated side and vehicle.

Battle 1

TIME	Target LFN	RESULT	Game Time	KB	VEHICLE TYPE	COUNT B-APC	COUNT B-TANK	COUNT R-APC	COUNT R-TANK	ALL BLUE	ALL RED	Tk	Bk	Rk	T(K)-T(K-1)	Bk[T(K)-T(K-1)]	Rk[T(K)-T(K-1)]	Bk(APC)	Rk(APC)	T(K)-T(K-1)	Bk[T(K)-T(K-1)]	Rk[T(K)-T(K-1)]	Bk(TANK)	Rk(TANK)	T(K)-T(K-1)	Bk[T(K)-T(K-1)]	Rk[T(K)-T(K-1)]
06:38:00	N/A	N/A	00:00:00	N/A	N/A	47	30	98	56	77	163	0	77	163	N/A	N/A	N/A	47	98	N/A	N/A	N/A	30	56	N/A	N/A	N/A
06:39:00	148	K	00:01:00	1	R-OTHER	47	30	98	56	77	163	1	77	163	1	77	163	47	98	1	47	98	30	56	1	30	56
06:48:32	388	K	00:10:32	2	B-TANK	47	29	98	56	76	163	9	76	163	8	670	1140	47	98	8	363	735	29	56	8	218	413
06:49:00	388	K	00:11:00	3	B-APC	46	29	98	56	75	163	12	75	163	4	283	636	46	98	4	161	343	29	56	4	102	193
07:10:13	35	K	00:32:13	4	R-APC	46	29	97	55	75	162	38	75	162	26	1966	3982	46	97	26	1206	2541	29	55	26	780	1441
07:12:16	68	K	00:34:16	5	R-APC	46	29	96	55	75	161	38	75	161	0	8	15	46	96	0	5	10	29	55	0	3	6
07:14:16	42	K	00:36:16	6	R-APC	46	29	95	55	75	160	39	75	160	1	75	160	46	95	1	46	96	29	55	1	29	56
07:17:06	370	K	00:39:06	7	B-TANK	46	28	95	55	74	160	43	74	160	4	274	566	46	95	4	170	362	28	55	4	104	204
07:28:11	180	K	00:50:11	8	R-APC	46	28	94	55	74	149	50	74	149	7	533	1073	46	94	7	331	677	28	55	7	202	386
07:29:12	184	K	00:51:12	9	R-APC	46	28	93	55	74	148	51	74	148	1	74	148	46	93	1	46	93	28	55	1	29	56
07:29:51	387	K	00:51:51	10	B-APC	45	28	93	55	73	148	54	73	148	3	197	400	45	93	3	122	251	28	55	3	78	149
07:31:10	147	K	00:53:10	11	R-OTHER	45	28	93	55	73	148	56	73	148	2	176	366	45	93	2	108	223	28	55	2	67	132
07:31:53	171	K	00:53:53	12	R-TANK	45	28	93	54	73	147	57	73	147	1	44	88	45	93	1	27	56	28	54	1	17	32
07:35:02	170	K	00:57:02	13	R-TANK	45	28	93	53	73	146	57	73	146	0	15	29	45	93	0	9	19	28	53	0	6	11
07:35:21	41	K	00:57:21	14	R-APC	45	28	92	53	73	145	57	73	145	0	22	44	45	92	0	14	28	28	53	0	8	16
07:36:04	48	K	00:58:04	15	R-APC	45	28	91	53	73	144	59	73	144	2	124	246	45	91	2	77	166	28	53	2	48	80
07:36:40	282	K	00:58:40	16	B-OTHER	45	28	91	53	73	144	60	73	144	1	58	116	45	91	1	36	73	28	53	1	22	42
07:38:48	101	K	01:00:48	17	R-TANK	45	28	91	52	73	143	61	73	143	1	58	114	45	91	1	38	73	28	52	1	22	42
07:40:20	37	K	01:02:20	18	R-APC	45	28	90	52	73	142	63	73	142	2	130	270	45	90	2	86	171	28	52	2	53	99
07:40:52	39	K	01:02:52	19	R-APC	45	28	89	52	73	141	64	73	141	1	96	183	45	89	1	59	116	28	52	1	38	68
07:42:10	38	K	01:04:10	20	R-APC	45	28	88	52	73	140	64	73	140	1	37	70	45	88	1	23	44	28	52	1	14	28
07:46:40	170	K	01:08:40	21	R-TANK	45	28	88	51	73	139	66	73	139	2	110	200	45	88	2	68	132	28	51	2	42	77
07:49:46	140	K	01:11:46	22	R-APC	45	28	87	51	73	138	72	73	138	6	431	814	45	87	6	280	513	28	51	6	166	301
07:52:16	46	K	01:14:16	23	R-APC	45	28	86	51	73	137	74	73	137	2	176	329	45	86	2	108	208	28	51	2	67	122
07:56:47	80	K	01:18:47	24	R-APC	45	28	85	51	73	136	79	73	136	5	336	636	45	85	5	207	391	28	51	5	129	236
07:57:41	284	K	01:19:41	25	B-TANK	45	27	85	51	72	136	80	72	136	1	66	122	45	85	1	41	77	27	51	1	24	46
08:02:20	301	K	01:24:20	26	B-APC	44	27	85	51	71	136	86	71	136	6	341	663	44	85	6	211	408	27	51	6	130	246
08:06:44	180	K	01:28:44	27	R-APC	44	27	84	51	71	135	91	71	135	6	447	851	44	84	6	277	529	27	51	6	170	321
08:08:00	385	K	01:30:00	28	B-TANK	44	26	84	51	70	135	91	70	135	0	7	14	44	84	0	4	8	26	51	0	3	6
08:13:25	88	K	01:35:25	29	R-APC	44	26	83	51	70	134	99	70	134	8	532	1016	44	83	8	334	631	26	51	8	198	388
08:19:34	371	K	01:41:34	30	B-TANK	44	25	83	51	69	134	102	69	134	3	214	416	44	83	3	136	257	25	51	3	78	158
08:22:30	382	K	01:44:30	31	B-APC	43	25	83	51	68	134	105	68	134	3	204	402	43	83	3	129	240	25	51	3	75	153
08:26:17	98	K	01:48:17	32	R-APC	43	25	82	51	68	133	106	68	133	1	54	108	43	82	1	34	68	25	51	1	20	41
08:27:40	91	K	01:49:40	33	R-APC	43	25	81	51	68	132	107	68	132	2	102	188	43	81	2	66	122	25	51	2	38	77
08:44:41	282	N	02:06:41	34	B-OTHER	43	25	81	51	68	132	130	68	132	23	1567	3023	43	81	23	985	1865	25	51	23	573	1160
																9376	10462				5822	11606				3863	6857

Battle 2

TIME	Target LPN	RESULT	GAME TIME	KILL	VEHICLETYPE	COUNT B-APC	COUNT B-TANK	COUNT R-APC	COUNT R-TANK	ALL BLUE	ALL RED	Tk	Bk	Rk	T(K)-T(K-1)	Bk(T(K)-T(K-1))	Rk(T(K)-T(K-1))	Tk	Bk	Rk	T(K)-T(K-1)	Bk(T(K)-T(K-1))	Rk(T(K)-T(K-1))	Tk	Bk	Rk	T(K)-T(K-1)	Bk(T(K)-T(K-1))	Rk(T(K)-T(K-1))
[illegible]	217	N	00:00:00	N/A	N/A	40	36	97	36	84	183	0	84	183	N/A	N/A	N/A	0	40	97	N/A	N/A	N/A	0	36	56	N/A	N/A	N/A
[illegible]	35	K	00:01:11	1	R-APC	40	36	[illegible]	[illegible]	84	162	1	84	162	1	101	182	1	40	[illegible]	1	50	115	1	35	56	1	42	67
[illegible]	182	K	[illegible]	2	R-TANK	40	35	[illegible]	56	84	161	5	84	161	4	311	560	5	40	[illegible]	4	181	366	5	35	55	4	130	204
[illegible]	66	K	[illegible]	3	R-APC	40	35	[illegible]	56	84	160	40	84	160	36	2040	5205	40	40	[illegible]	36	1720	3336	40	35	55	36	1229	1931
[illegible]	35	K	00:40:47	4	R-APC	40	35	94	55	84	149	44	84	149	4	319	[illegible]	44	40	94	4	166	367	44	35	55	4	133	209
[illegible]	35	K	[illegible]	5	R-APC	40	35	93	55	84	148	46	84	148	2	202	364	46	40	93	2	116	223	46	35	55	2	84	132
[illegible]	100	K	[illegible]	6	R-TANK	40	35	93	54	84	147	46	84	147	0	0	0	46	40	93	0	0	0	46	35	54	0	0	0
[illegible]	300	K	[illegible]	7	B-APC	40	35	93	54	83	147	46	83	147	0	17	29	46	40	93	0	10	19	46	35	54	0	7	11
[illegible]	290	K	[illegible]	8	R-TANK	40	36	93	53	83	146	47	83	146	0	8	15	47	40	93	0	5	9	47	36	53	0	4	5
[illegible]	79	K	[illegible]	9	R-APC	40	36	92	53	83	145	47	83	145	0	17	29	47	40	92	0	10	18	47	36	53	0	7	11
[illegible]	100	K	[illegible]	10	R-TANK	40	36	92	52	83	144	50	83	144	4	291	504	50	40	92	4	166	322	50	36	52	4	123	182
[illegible]	147	K	[illegible]	11	R-OTHER	40	36	92	52	83	144	52	83	144	2	174	302	52	40	92	2	101	193	52	36	52	2	74	109
[illegible]	41	K	[illegible]	12	R-A[illegible]	40	36	91	52	83	143	53	83	143	1	42	72	53	40	91	1	24	46	53	36	52	1	18	28
[illegible]	289	K	[illegible]	13	R-T[illegible]	40	36	91	51	83	142	53	83	142	0	17	29	53	40	91	0	10	18	53	35	51	0	7	10
[illegible]	354	K	[illegible]	14	B-TANK	40	34	91	51	82	142	53	82	142	0	33	57	53	40	91	0	19	38	53	34	51	0	14	20
[illegible]	100	K	[illegible]	15	R-APC	40	34	90	51	82	141	54	82	141	0	16	29	54	40	90	0	10	18	54	34	51	0	7	10
[illegible]	372	K	[illegible]	16	B-TANK	40	33	90	51	81	141	56	81	141	1	88	156	56	40	90	1	53	98	56	33	51	1	38	56
[illegible]	80	K	[illegible]	17	R-APC	40	33	89	51	81	140	56	81	140	0	32	56	56	40	89	0	19	38	56	33	51	0	13	20
[illegible]	40	K	[illegible]	18	R-APC	40	33	88	51	81	139	56	81	139	0	16	29	56	40	88	0	10	18	56	33	51	0	7	10
[illegible]	60	K	[illegible]	19	R-APC	40	33	87	51	81	138	56	81	138	0	8	14	56	40	87	0	5	9	56	33	51	0	3	5
[illegible]	85	K	[illegible]	20	R-APC	40	33	86	51	81	137	56	81	137	0	8	14	56	40	86	0	5	9	56	33	51	0	3	5
[illegible]	280	K	[illegible]	21	R-TANK	40	33	86	50	81	136	57	81	136	2	164	268	57	40	86	2	91	163	57	33	50	2	63	96
[illegible]	285	K	[illegible]	22	B-TANK	40	32	86	50	80	136	62	80	136	5	400	680	62	40	86	5	240	430	62	32	50	5	100	250
[illegible]	291	K	[illegible]	23	B-OTHER	40	32	86	50	80	136	63	80	136	0	16	27	63	40	86	0	10	17	63	32	50	0	6	10
[illegible]	282	K	[illegible]	24	B-APC	47	32	86	50	79	136	68	79	136	5	419	721	68	47	86	6	249	468	68	32	50	5	170	286
[illegible]	211	K	[illegible]	25	R-TANK	47	32	86	49	79	135	69	79	135	1	86	162	69	47	86	1	56	103	69	32	49	1	30	50
[illegible]	379	K	[illegible]	26	B-TANK	47	31	86	49	78	135	75	78	135	6	488	810	75	47	86	6	282	516	75	31	49	6	188	294
[illegible]	217	K	01:17:00	27	R-TANK	47	31	86	48	78	134	77	78	134	2	164	281	77	47	86	2	90	181	77	31	48	2	65	101
[illegible]	80	K	01:27:10	28	R-APC	47	31	85	48	78	133	87	78	133	10	798	1367	87	47	85	10	479	887	87	31	48	10	316	490
[illegible]	60	K	[illegible]	29	R-APC	47	31	84	48	78	132	88	78	132	1	39	65	88	47	84	1	24	42	88	31	48	1	16	24
[illegible]	107	K	[illegible]	30	R-TANK	47	31	84	47	78	131	93	78	131	5	367	616	93	47	84	5	221	395	93	31	47	5	146	221
[illegible]	300	K	[illegible]	31	B-APC	46	31	84	47	77	131	94	77	131	1	92	157	94	46	84	1	55	101	94	31	47	1	37	58
[illegible]	371	K	[illegible]	32	B-TANK	46	30	84	47	76	131	95	76	131	1	84	144	95	46	84	1	51	92	95	30	47	1	33	52
[illegible]	300	K	[illegible]	33	B-APC	45	30	84	47	75	131	96	75	131	1	90	167	96	45	84	1	54	101	96	30	47	1	36	56
[illegible]	284	K	01:42:10	34	B-TANK	45	29	84	47	74	131	102	74	131	6	488	825	102	45	84	6	284	529	102	29	47	6	183	296
[illegible]	373	K	01:42:31	35	B-TANK	45	28	84	47	73	131	103	73	131	0	16	28	103	46	84	0	9	17	103	28	47	0	6	9
[illegible]	382	K	[illegible]	36	B-TANK	45	27	84	47	72	131	110	72	131	8	547	[illegible]	110	45	84	8	342	638	110	27	47	8	205	367
[illegible]	261	K	[illegible]	37	R-OTHER	45	27	84	47	72	131	111	72	131	1	89	105	111	45	84	1	36	67	111	27	47	1	22	38
[illegible]	375	K	01:57:19	38	B-TANK	45	26	84	47	71	131	117	71	131	6	464	836	117	46	84	6	288	530	117	26	47	6	188	301
[illegible]	380	K	02:10:19	39	B-TANK	45	25	84	47	70	131	130	70	131	13	910	1703	130	46	84	13	585	1082	130	25	47	13	326	611
																10281	16188					6164	11580					4116	6809

Battle 3

Time	Target LPN	Result	GAME TIME	KILL	VEHICLETYPE	COUNT B-APC	COUNT B-TANK	COUNT R-APC	COUNT R-TANK	ALL BLUE	ALL RED	Tk	Bk	Rk	T(K)-T(K-1)	Bk[T(K)-T(K-1)]	Rk[T(K)-T(K-1)]	Tk	Bk	Rk	T(K)-T(K-1)	Bk[T(K)-T(K-1)]	Rk[T(K)-T(K-1)]	Tk	Bk	Rk	T(K)-T(K-1)	Bk[T(K)-T(K-1)]	Rk[T(K)-T(K-1)]
[illegible]:42:18	110	N	00:00:00	0	R-APC	38	36	98	98	74	196	0	74	196	N/A	N/A	N/A	0	38	98	N/A	N/A	N/A	0	36	98	N/A	N/A	N/A
[illegible]:42:[illegible]	110	K	00:00:34	1	R-APC	38	36	97	98	74	195	0.6	74	195	1	44	117	1	38	97	1	23	68	1	36	98	1	22	59
[illegible]:54:54	31	K	00:12:38	1	R-APC	38	36	96	98	74	194	12.6	74	194	12	888	2328	13	38	96	12	456	1152	13	36	98	12	432	1176
[illegible]	114	K	00:14:02	1	R-APC	38	36	95	98	74	193	14	74	193	1	104	270	14	38	96	1	53	133	14	36	98	1	50	137
[illegible]:01:57	348	K	00:19:38	1	B-OTHER	38	36	95	98	74	193	19.7	74	193	6	422	1100	20	38	95	6	217	542	20	36	98	6	206	559
[illegible]:01:[illegible]	96	K	00:19:40	1	R-APC	38	36	94	98	74	192	19.7	74	192	0	0	0	20	38	94	0	0	0	20	36	98	0	0	0
[illegible]	210	K	00:19:48	1	R-TANK	38	36	94	97	74	191	19.8	74	191	0	7	19	20	38	94	0	4	9	20	36	97	0	4	10
[illegible]:04:04	101	K	00:21:48	1	R-APC	38	36	93	97	74	190	21.8	74	190	2	148	380	22	38	93	2	76	188	22	36	97	2	72	194
[illegible]:08:37	80	K	00:28:18	1	R-APC	38	36	92	97	74	189	28.3	74	189	5	333	861	28	38	92	5	171	414	28	36	97	5	162	437
[illegible]:10:57	228	K	00:28:38	1	R-TANK	38	36	92	96	74	188	28.7	74	188	2	178	451	29	38	92	2	91	221	29	36	96	2	86	230
[illegible]:11:[illegible]	33	K	00:29:38	1	R-APC	38	36	91	96	74	187	29.7	74	187	1	74	187	30	38	91	1	38	91	30	36	96	1	36	96
[illegible]:14:45	200	K	00:32:28	1	R-TANK	38	36	91	95	74	186	32.6	74	186	3	207	621	33	38	91	3	108	266	33	36	95	3	101	268
[illegible]:16:40	130	K	00:33:22	1	R-OTHER	38	36	91	95	74	186	33.4	74	186	1	67	167	33	38	91	1	34	82	33	36	95	1	32	86
[illegible]:16:[illegible]	227	K	00:34:32	1	R-TANK	38	36	91	94	74	185	34.6	74	185	1	88	222	35	38	91	1	46	109	35	36	94	1	43	113
[illegible]:17:[illegible]	96	K	00:34:46	1	R-APC	38	36	90	94	74	184	34.8	74	184	0	16	37	36	38	90	0	8	18	36	36	94	0	7	19
[illegible]:17:11	100	K	00:34:58	1	R-APC	38	36	89	94	74	183	34.9	74	183	0	7	18	36	38	89	0	4	9	36	36	94	0	4	9
[illegible]:17:17	348	K	00:34:59	1	B-TANK	38	35	89	94	73	183	35	73	183	0	7	18	36	38	89	0	4	9	35	35	94	0	4	9
[illegible]:17:40	302	K	00:36:28	1	B-TANK	38	34	89	94	72	183	36.6	72	183	1	38	92	38	38	88	1	19	46	38	34	94	1	17	47
[illegible]:19:18	220	K	00:37:00	1	R-TANK	38	34	89	93	72	182	37	72	182	2	108	273	37	38	88	2	57	134	37	34	93	2	51	140
[illegible]:22:37	380	K	00:40:18	1	B-OTHER	38	34	88	93	72	182	40.3	72	182	3	238	601	40	38	88	3	126	294	40	34	93	3	112	307
[illegible]:27:22	105	K	00:46:08	1	R-TANK	38	34	88	92	72	181	46.1	72	181	6	348	888	46	38	88	6	182	427	46	34	92	5	163	442
[illegible]:27:32	180	K	00:46:14	1	R-TANK	38	34	88	91	72	180	46.3	72	180	0	14	38	46	38	88	0	8	18	45	34	91	0	7	18
[illegible]	102	K	00:46:35	1	R-TANK	38	34	88	90	72	179	46.6	72	179	1	94	233	47	38	88	1	49	116	47	34	90	1	44	117
[illegible]:30:34	307	K	00:48:18	1	B-APC	37	34	88	90	71	179	48.3	71	179	2	121	304	48	37	88	2	63	161	48	34	90	2	58	153
[illegible]:31:16	42	K	00:48:57	1	R-APC	37	34	88	90	71	178	49	71	178	1	60	128	49	37	88	1	28	62	49	34	90	1	24	63
[illegible]:32:[illegible]	98	K	00:49:45	1	R-APC	37	34	87	90	71	177	49.8	71	177	1	67	142	50	37	87	1	30	70	50	34	90	1	27	72
[illegible]:32:28	97	K	00:50:08	1	R-APC	37	34	86	90	71	176	50.2	71	176	0	28	70	50	37	86	0	15	34	50	34	90	0	14	36
[illegible]:32:42	88	K	00:50:24	1	R-APC	37	34	85	90	71	175	50.4	71	175	0	14	36	50	37	85	0	7	17	50	34	90	0	7	18
[illegible]:33:12	88	K	00:50:54	1	R-APC	37	34	84	90	71	174	50.9	71	174	1	36	87	51	37	84	1	19	42	51	34	90	1	17	46
[illegible]:35:34	101	K	00:53:08	1	R-TANK	37	34	84	89	71	173	53.1	71	173	2	166	381	53	37	84	2	81	186	53	34	89	2	75	198
[illegible]:35:35	84	K	00:54:17	1	R-APC	37	34	83	89	71	172	54.3	71	172	1	86	208	54	37	83	1	44	100	54	34	89	1	41	107
[illegible]:35:57	105	K	00:54:38	1	R-TANK	37	34	83	88	71	171	54.7	71	171	0	28	68	55	37	83	0	15	33	55	34	88	0	14	36
[illegible]:37:47	147	K	00:56:28	1	R-APC	37	34	82	88	71	170	56.5	71	170	1	57	138	56	37	82	1	30	68	56	34	88	1	27	70
[illegible]:40:10	387	K	00:57:58	1	B-TANK	37	33	82	88	70	170	58	70	170	3	175	425	58	37	82	3	93	206	58	33	88	3	83	220
[illegible]:41:37	342	K	00:59:19	1	B-TANK	37	32	82	88	69	170	59.4	69	170	1	97	238	59	37	82	1	52	115	59	32	88	1	46	123
[illegible]:42:16	34	K	01:00:57	1	R-APC	37	32	81	88	69	169	61	69	169	2	110	270	61	37	81	2	59	130	61	32	88	2	51	141
[illegible]:42:42	35	K	01:01:24	1	R-APC	37	32	80	88	69	168	61.4	69	168	0	28	67	61	37	80	0	16	32	61	32	88	0	13	36
[illegible]	38	K	01:10:16	1	R-APC	37	32	79	88	69	167	70.3	69	167	9	614	1488	70	37	79	9	329	703	70	32	88	9	286	783
[illegible]:[illegible]:48	104	K	01:10:28	1	R-TANK	37	32	79	87	69	166	70.6	69	166	0	14	33	71	37	79	0	7	16	71	32	87	0	6	17
[illegible]:04:[illegible]	384	K	01:11:42	1	B-TANK	37	31	79	87	68	166	71.7	68	166	1	82	198	72	37	79	1	44	96	72	31	87	1	37	104
[illegible]:[illegible]:47	40	K	01:14:28	1	R-APC	37	31	78	87	68	165	74.6	68	165	3	190	482	75	37	78	3	104	218	75	31	87	3	87	244
[illegible]	243	K	01:14:48	1	R-OTHER	37	31	78	87	68	165	74.7	68	165	0	14	33	75	37	78	0	7	18	75	31	87	0	6	17
[illegible]:[illegible]:20	380	K	01:16:11	1	B-TANK	37	30	78	87	67	165	76.2	67	165	2	101	248	76	37	78	2	58	117	76	30	87	2	46	131
[illegible]:[illegible]:40	43	K	01:16:22	1	R-APC	37	30	77	87	67	164	76.4	67	164	0	13	33	76	37	77	0	7	16	76	30	87	0	6	17
[illegible]:[illegible]:22	67	K	01:17:04	1	R-APC	37	30	76	87	67	163	77.1	67	163	1	47	114	77	37	76	1	28	63	77	30	87	1	21	61
[illegible]	46	K	01:17:40	1	R-APC	37	30	75	87	67	162	77.7	67	162	1	40	97	78	37	75	1	22	46	78	30	87	1	18	52
07:[illegible]:10	340	K	01:18:06	1	B-TANK	37	29	75	87	66	162	78.1	66	162	0	28	68	78	37	75	0	15	30	78	29	87	0	12	36
07:11:17	37	K	01:29:00	1	R-APC	37	29	74	87	66	161	89	66	161	11	719	1756	89	37	74	11	403	807	89	29	87	11	316	948
07:11:[illegible]	380	N	01:29:41	0	B-TANK	37	29	74	87	66	161	89.7	66	161	1	46	113	90	37	74	1	28	62	90	29	87	1	20	61
																6373	16882					3386.5	7727.2					3007.6	8254.7

Battle 4

Time	Target LRN	Result	GAME TIME	KILL	VEHICLETYPE	COUNT B-APC	COUNT B-TANK	COUNT R-APC	COUNT R-TANK	ALL BLUE	ALL RED	Tt	Bt	Rt	T(tk)-T(tk-1)	Bt(T(tk)-T(tk-1))	Rt(T(tk)-T(tk-1))	Tt	Bt	Rt	T(tk)-T(tk-1)	Bt(T(tk)-T(tk-1))	Rt(T(tk)-T(tk-1))	Tt	Bt	Rt	T(tk)-T(tk-1)	Bt(T(tk)-T(tk-1))	Rt(T(tk)-T(tk-1))
07:30:10	300	H	00:00:00	0	B-TANK	33	42	101	101	75	202	0	75	202	N/A	N/A	N/A	0	33	101	N/A	N/A	N/A	0	42	101	N/A	N/A	N/A
07:30:17	80	K	00:02:07	1	R-APC	33	42	100	101	75	201	2.1	75	201	2	150	422	2	33	100	2	66	210	2	42	101	2	88	212
[illegible]	90	K	[illegible]	1	R-APC	33	42	99	101	75	200	9.1	75	200	7	525	1400	9	33	99	7	231	693	9	42	101	7	294	707
[illegible]	165	K	00:11:53	1	R-OTHER	33	42	99	101	75	200	11.6	75	200	3	210	600	12	33	99	3	92	277	12	42	101	3	118	283
[illegible]	300	K	00:12:16	1	B-TANK	33	41	99	101	74	200	12.3	74	200	0	30	80	12	33	99	0	13	40	12	41	101	0	16	40
[illegible]	300	K	00:13:07	1	B-APC	32	41	99	101	73	200	13.1	73	200	1	56	160	13	32	99	1	26	79	13	41	101	1	33	81
[illegible]	327	K	00:20:26	1	B-APC	31	41	99	101	72	200	20.4	72	200	7	506	1400	20	31	99	7	226	723	20	41	101	7	286	737
[illegible]	91	K	00:22:57	1	R-APC	31	41	98	101	72	199	23	72	199	3	167	517	23	31	98	3	81	256	23	41	101	3	107	263
[illegible]	305	K	00:34:03	1	B-APC	30	41	98	101	71	199	34.9	71	199	12	645	2300	35	30	98	12	357	1100	35	41	101	12	480	1202
[illegible]	74	K	00:35:46	1	R-APC	30	41	97	101	71	198	35.8	71	198	1	64	178	36	30	97	1	27	87	36	41	101	1	37	91
[illegible]	190	K	00:38:30	1	R-APC	30	41	96	101	71	197	38.4	71	197	3	185	512	38	30	96	3	78	250	38	41	101	3	107	263
[illegible]	290	K	00:38:40	1	R-TANK	30	41	96	100	71	196	38.7	71	196	0	21	59	39	30	96	0	9	29	39	41	100	0	12	30
[illegible]	192	K	00:39:11	1	R-APC	30	41	95	100	71	195	39.2	71	195	1	38	98	39	30	95	1	15	48	39	41	100	1	21	50
[illegible]	84	K	00:39:13	1	R-APC	30	41	94	100	71	194	39.2	71	194	0	0	0	39	30	94	0	0	0	39	41	100	0	0	0
[illegible]	165	K	00:39:34	1	R-APC	30	41	93	100	71	193	39.6	71	193	0	29	77	40	30	93	0	12	37	40	41	100	0	16	40
[illegible]	164	K	00:41:30	1	R-APC	30	41	92	100	71	192	41.6	71	192	2	142	384	42	30	92	2	60	184	42	41	100	2	82	200
[illegible]	340	K	00:47:32	1	R-OTHER	30	41	92	100	71	192	47.6	71	192	6	426	1152	48	30	92	6	180	552	48	41	100	6	246	600
[illegible]	210	K	00:48:30	1	R-TANK	30	41	92	99	71	191	48.7	71	191	1	78	210	49	30	92	1	33	101	49	41	99	1	45	100
[illegible]	213	K	[illegible]	1	R-TANK	30	41	92	98	71	190	49.1	71	190	0	28	76	49	30	92	0	12	37	49	41	98	0	16	39
[illegible]	65	K	00:49:40	1	R-APC	30	41	91	98	71	189	49.7	71	189	1	43	113	50	30	91	1	18	55	50	41	98	1	25	59
[illegible]	143	K	00:50:15	1	R-APC	30	41	90	98	71	188	50.3	71	188	1	43	113	50	30	90	1	18	54	50	41	98	1	26	59
[illegible]	83	K	00:51:14	1	R-APC	30	41	89	98	71	187	51.3	71	187	1	71	187	51	30	89	1	30	89	51	41	98	1	41	98
[illegible]	216	K	00:51:38	1	R-TANK	30	41	89	97	71	186	51.6	71	186	0	21	56	52	30	89	0	9	27	52	41	97	0	12	29
[illegible]	280	K	00:51:40	1	R-TANK	30	41	89	96	71	185	51.7	71	185	0	7	19	52	30	89	0	3	9	52	41	96	0	4	10
[illegible]	62	K	00:52:04	1	R-APC	30	41	88	96	71	184	52.1	71	184	0	28	74	52	30	88	0	12	35	52	41	96	0	16	38
[illegible]	93	K	00:52:22	1	R-APC	30	41	87	96	71	183	52.4	71	183	0	21	56	52	30	87	0	9	26	52	41	96	0	12	29
[illegible]	79	K	00:52:57	1	R-APC	30	41	86	96	71	182	53	71	182	1	43	109	53	30	86	1	18	52	53	41	96	1	25	58
[illegible]	377	K	00:53:03	1	B-TANK	30	40	86	96	70	182	53.1	70	182	0	7	18	53	30	86	0	3	9	53	40	96	0	4	10
[illegible]	380	K	00:53:30	1	B-TANK	30	39	86	96	69	182	53.7	69	182	1	41	109	54	30	86	1	18	52	54	39	96	1	23	58
[illegible]	169	K	00:53:47	1	R-TANK	30	39	86	95	69	181	53.8	69	181	0	7	18	54	30	86	0	3	9	54	39	95	0	4	10
[illegible]	376	K	00:54:20	1	B-TANK	30	38	86	95	68	181	54.5	68	181	1	40	127	55	30	86	1	21	60	55	38	95	1	27	67
[illegible]	290	K	00:55:40	1	R-TANK	30	38	86	94	68	180	55.9	68	180	1	66	252	56	30	86	1	42	120	56	38	94	1	53	132
[illegible]	29	K	00:56:06	1	R-APC	30	38	85	94	68	179	56.1	68	179	0	14	38	56	30	85	0	6	17	56	38	94	0	8	19
[illegible]	89	K	00:56:08	1	R-APC	30	38	84	94	68	178	56.2	68	178	0	7	18	56	30	84	0	3	8	56	38	94	0	4	9
[illegible]	87	K	00:56:47	1	R-APC	30	38	83	94	68	177	56.8	68	177	1	41	109	57	30	83	1	16	50	57	38	94	1	23	56
[illegible]	387	K	[illegible]	1	B-TANK	30	37	83	94	67	177	56.8	67	177	0	0	0	57	30	83	0	0	0	57	37	94	0	0	0
[illegible]	169	K	00:56:51	1	R-TANK	30	37	83	93	67	176	56.9	67	176	0	7	18	57	30	83	0	3	8	57	37	93	0	4	9
[illegible]	169	K	00:57:13	1	R-TANK	30	37	83	92	67	175	57.3	67	175	0	27	70	57	30	83	0	12	33	57	37	92	0	15	37
[illegible]	80	K	00:57:33	1	R-APC	30	37	82	92	67	174	57.6	67	174	0	20	52	58	30	82	0	9	25	58	37	92	0	11	26
[illegible]	389	K	00:58:27	1	B-TANK	30	36	82	92	66	174	58.5	66	174	1	59	157	59	30	82	1	27	74	59	36	92	1	32	83
[illegible]	384	K	00:59:37	1	B-TANK	30	35	82	92	65	174	59.7	65	174	1	78	209	60	30	82	1	36	98	60	35	92	1	42	110
[illegible]	378	K	01:01:03	1	B-TANK	30	34	82	92	64	174	61.1	64	174	1	90	244	61	30	82	1	42	115	61	34	92	1	48	129
[illegible]	374	K	01:01:41	1	B-TANK	30	33	82	92	63	174	61.7	63	174	1	38	104	62	30	82	1	18	49	62	33	92	1	20	56
[illegible]	165	K	01:02:49	1	R-TANK	30	33	82	91	63	173	62.8	63	173	1	69	190	63	30	82	1	33	90	63	33	91	1	38	100
[illegible]	308	K	[illegible]	1	B-APC	29	33	82	91	62	173	62.8	62	173	0	6	17	63	29	82	0	3	9	63	33	91	0	3	9
[illegible]	352	K	01:05:28	1	B-TANK	29	32	82	91	61	173	65.5	61	173	3	159	460	66	29	82	3	75	213	66	32	91	3	83	237
[illegible]	390	K	01:05:38	1	B-TANK	29	31	82	91	60	173	65.7	60	173	0	12	35	66	29	82	0	6	16	66	31	91	0	6	18
[illegible]	32	K	01:07:11	1	R-APC	29	31	81	91	60	172	67.2	60	172	2	90	258	67	29	81	2	44	122	67	31	91	2	47	137
[illegible]	38	K	01:08:47	1	R-APC	29	31	80	91	60	171	68.8	60	171	2	96	274	69	29	80	2	46	128	69	31	91	2	50	140
[illegible]	43	K	01:10:22	1	R-APC	29	31	79	91	60	170	70.4	60	170	2	96	272	70	29	79	2	46	126	70	31	91	2	50	140
[illegible]	212	K	01:14:34	1	R-TANK	29	31	79	90	60	169	74.6	60	169	4	252	710	75	29	79	4	122	332	75	31	90	4	130	378
[illegible]	44	K	01:17:17	1	R-APC	29	31	78	90	60	168	77.3	60	168	3	162	464	77	29	78	3	78	211	77	31	90	3	84	243
[illegible]	341	K	01:17:51	1	B-TANK	29	30	78	90	59	168	77.8	59	168	1	35	101	78	29	78	1	17	47	78	30	90	1	18	54
[illegible]	48	K	[illegible]	1	R-APC	29	30	77	90	59	167	79	59	167	1	66	184	79	29	77	1	32	88	79	30	90	1	33	99
[illegible]	270	K	01:19:01	1	B-TANK	29	29	77	90	58	167	79.1	58	167	0	6	17	79	29	77	0	3	8	79	29	90	0	3	9
[illegible]	167	K	01:19:21	1	R-TANK	29	29	77	89	58	166	79.4	58	166	0	17	50	79	29	77	0	9	23	79	29	89	0	9	27
[illegible]	169	K	01:19:52	1	R-TANK	29	29	77	88	58	165	79.9	58	165	1	29	83	80	29	77	1	15	39	80	29	88	1	15	44
[illegible]	169	K	01:20:12	1	R-APC	29	29	76	88	58	164	80.3	58	164	0	23	66	80	29	76	0	12	30	80	29	88	0	12	35
[illegible]	89	K	01:20:37	1	R-APC	29	29	75	88	58	163	80.7	58	163	0	23	66	81	29	75	0	12	30	81	29	88	0	12	35
[illegible]	280	K	[illegible]	1	R-TANK	29	29	75	87	58	162	80.9	58	162	0	12	32	81	29	75	0	6	15	81	29	87	0	6	17
[illegible]	380	K	01:20:57	1	B-TANK	29	28	75	87	57	162	81	57	162	0	6	16	81	29	75	0	3	8	81	28	87	0	3	9
[illegible]	92	K	01:22:23	1	R-APC	29	28	74	87	57	161	82.4	57	161	1	80	225	82	29	74	1	41	104	82	28	87	1	39	122
[illegible]	164	K	01:22:57	1	R-TANK	29	28	74	86	57	160	83	57	160	1	34	96	83	29	74	1	17	44	83	28	86	1	17	52
[illegible]	344	K	01:24:00	1	B-TANK	29	27	74	86	56	160	84.2	56	160	1	67	192	84	29	74	1	35	89	84	27	86	1	32	103
[illegible]	294	K	01:24:35	1	R-TANK	29	27	74	85	56	159	84.7	56	159	1	29	80	85	29	74	1	15	37	85	27	85	1	14	43
[illegible]	390	K	01:29:34	1	B-TANK	29	26	74	85	55	159	89.6	55	159	5	270	779	90	29	74	5	142	383	90	26	85	5	127	417
[illegible]	41	K	[illegible]	1	R-APC	29	26	73	85	55	158	89.9	55	158	0	17	47	90	29	73	0	9	22	90	26	85	0	8	26
[illegible]	333	K	01:43:49	1	B-APC	28	26	73	85	54	158	103.7	54	158	14	748	2180	104	28	73	14	388	1007	104	26	85	14	350	1173
[illegible]	72	K	01:53:43	1	R-APC	28	26	72	85	54	157	113.8	54	157	10	545	1580	114	28	72	10	283	727	114	26	85	10	263	858
[illegible]	169	N	01:57:10	0	R-APC	28	26	72	85	54	157	117.2	54	157	3	164	534	117	28	72	3	86	245	117	26	85	3	88	289
																7529	20867					3483	10008					4048	10850

Battle 5

Time	Target LPN	Result	GAME TIME	KILL	VEHICLETYPE	COUNT B-APC	COUNT B-TANK	COUNT R-APC	COUNT R-TANK	ALL BLUE	ALL RED	Tt	Bt	Rt	TBO-TBK-1)	Bt(TBO-TBK-1)	Rt(TBO-TBK-1)	Tt	Bt	Rt	TBO-TBK-1)	Bt(TBO-TBK-1)	Rt(TBO-TBK-1)	Tt	Bt	Rt	TBO-TBK-1)	Bt(TBO-TBK-1)	Rt(TBO-TBK-1)
20:00:23	384	M	00:00:00	0	B TANK	48	32	96	96	80	[illegible]	0	80	[illegible]	N/A	N/A	N/A	0	48	96	N/A	N/A	N/A	0	32	96	N/A	N/A	N/A
20:00:30	384	K	00:00:07	0	B TANK	48	31	96	96	79	[illegible]	0	79	[illegible]	0	9	10	0	48	96	0	5	10	0	31	96	0	1	10
20:08:10	301	K	00:07:47	1	B APC	47	31	96	96	78	[illegible]	8	78	[illegible]	8	601	1403	8	47	96	8	382	732	8	31	96	8	210	732
20:32:20	382	K	00:32:00	2	B TANK	47	30	96	96	77	[illegible]	32	77	[illegible]	24	1071	4017	32	47	96	24	1142	2300	32	30	96	24	720	2300
21:40:22	387	K	01:38:00	3	B TANK	47	28	96	96	76	[illegible]	100	76	[illegible]	60	5100	17001	100	47	96	60	3101	6451	100	28	96	60	1000	6451
22:08:00	200	K	02:03:27	4	B TANK	47	28	96	96	75	[illegible]	124	75	[illegible]	24	1703	4406	124	47	96	24	1106	2233	124	28	96	24	668	2233
22:31:58	346	K	02:31:35	5	B TANK	47	27	96	96	74	[illegible]	212	74	[illegible]	88	6627	16760	212	47	96	88	4146	8370	212	27	96	88	2301	8370
[illegible]	67	K	[illegible]	6	R-OTHER	47	27	96	96	74	[illegible]	230	74	[illegible]	18	1330	3430	230	47	96	18	861	1720	230	27	96	18	400	1720
[illegible]	336	K	04:37:21	7	B TANK	47	28	96	96	73	[illegible]	278	73	[illegible]	48	3402	8603	278	47	96	48	2247	4632	278	28	96	48	1240	4532
[illegible]	118	K	[illegible]	8	R APC	47	28	94	96	73	[illegible]	398	73	[illegible]	120	8700	22750	398	47	94	120	5660	11310	398	28	96	120	3130	11430
[illegible]	[illegible]	K	[illegible]	9	R TANK	47	28	94	94	73	[illegible]	417	73	[illegible]	19	1304	3501	417	47	94	19	880	1785	417	28	94	19	407	1786
[illegible]	86	K	07:11:57	10	R APC	47	26	93	94	73	187	432	73	187	16	1110	2842	432	47	93	16	714	1414	432	26	94	16	386	1428
[illegible]	72	K	[illegible]	11	R OTHER	47	28	93	94	73	187	444	73	187	12	864	2180	444	47	93	12	560	1080	444	28	94	12	304	1100
[illegible]	340	K	[illegible]	12	B TANK	47	26	93	94	72	187	446	72	187	2	168	430	446	47	93	2	100	214	446	26	94	2	58	218
03:27:41	161	K	[illegible]	13	R TANK	47	26	93	93	72	186	448	72	186	1	101	280	448	47	93	1	68	130	448	26	93	1	36	130
[illegible]	[illegible]	K	07:28:01	14	R APC	47	25	92	93	72	185	448	72	185	1	60	130	448	47	92	1	33	64	448	25	93	1	10	65
[illegible]	[illegible]	K	07:41:01	15	R APC	47	25	91	93	72	184	461	72	184	13	936	2382	461	47	91	13	611	1183	461	25	93	13	325	1200
[illegible]	[illegible]	K	07:48:22	16	R APC	47	26	90	93	72	183	467	72	183	6	380	880	467	47	90	6	264	488	467	26	93	5	116	502
[illegible]	43	K	[illegible]	17	R APC	47	26	90	93	72	182	474	72	182	7	407	1268	474	47	90	7	324	614	474	26	93	7	173	642
[illegible]	341	K	[illegible]	18	B TANK	47	24	90	93	71	182	487	71	182	14	880	2512	487	47	90	14	840	1270	487	24	93	14	331	1283
[illegible]	[illegible]	K	08:08:17	19	R APC	47	24	88	93	71	181	488	71	181	2	168	388	488	47	88	2	103	184	488	24	93	2	53	286
[illegible]	[illegible]	K	[illegible]	20	R APC	47	24	87	93	71	180	510	71	180	20	1420	3880	510	47	87	20	880	1740	510	24	93	20	480	1880
[illegible]	[illegible]	K	[illegible]	21	R APC	47	24	88	93	71	178	516	71	178	6	428	1074	516	47	88	6	282	516	516	24	93	6	144	568
[illegible]	228	K	08:37:12	22	R TANK	47	24	88	92	71	178	518	71	178	2	136	330	518	47	88	2	88	103	518	24	92	2	46	175
[illegible]	[illegible]	K	08:37:45	23	R APC	47	24	86	92	71	177	518	71	177	1	43	108	518	47	86	1	28	51	518	24	92	1	14	56
[illegible]	221	K	[illegible]	24	R TANK	47	24	86	91	71	176	518	71	176	1	71	176	518	47	86	1	41	85	518	24	91	1	24	91
[illegible]	70	K	[illegible]	25	R OTHER	47	24	86	91	71	176	518	71	176	0	0	0	518	47	86	0	0	0	518	24	91	0	0	0
[illegible]	[illegible]	K	[illegible]	26	R APC	47	24	84	91	71	175	520	71	175	1	43	105	520	47	84	1	28	50	520	24	91	1	14	56
04:40:47	[illegible]	K	08:40:24	27	R APC	47	24	83	91	71	174	521	71	174	1	71	174	521	47	83	1	47	83	521	24	91	1	24	81
[illegible]	[illegible]	K	[illegible]	28	R APC	47	24	82	91	[illegible]	[illegible]	522	[illegible]	[illegible]	1	78	180	522	47	82	1	62	88	522	24	91	1	28	100
[illegible]	[illegible]	K	[illegible]	29	R APC	47	24	81	91	[illegible]	[illegible]	524	[illegible]	[illegible]	2	120	310	524	47	81	2	86	146	524	24	91	2	43	184
[illegible]	[illegible]	K	[illegible]	30	B TANK	47	23	81	91	[illegible]	[illegible]	524	[illegible]	[illegible]	1	42	103	524	47	81	1	28	40	524	23	91	1	14	56
[illegible]	[illegible]	K	[illegible]	31	B APC	48	23	81	91	[illegible]	[illegible]	525	[illegible]	[illegible]	1	86	130	525	48	81	1	37	65	525	23	91	1	18	73
[illegible]	[illegible]	K	[illegible]	32	R APC	48	23	80	91	[illegible]	[illegible]	527	[illegible]	[illegible]	2	117	201	527	48	80	2	78	138	527	23	91	2	38	156
[illegible]	[illegible]	K	[illegible]	33	R OTHER	48	23	80	91	[illegible]	[illegible]	527	[illegible]	[illegible]	1	35	88	527	48	80	1	23	49	527	23	91	1	12	46
[illegible]	[illegible]	K	[illegible]	34	B TANK	48	22	80	91	[illegible]	[illegible]	528	[illegible]	[illegible]	1	88	171	528	48	80	1	48	80	528	22	91	1	22	81
[illegible]	[illegible]	K	[illegible]	35	R APC	48	22	78	91	[illegible]	[illegible]	530	[illegible]	[illegible]	2	118	280	530	48	78	2	78	134	530	22	91	2	37	156
[illegible]	[illegible]	K	[illegible]	36	R APC	48	22	78	91	[illegible]	[illegible]	531	[illegible]	[illegible]	1	85	237	531	48	78	1	84	100	531	22	91	1	31	127
[illegible]	[illegible]	K	[illegible]	37	R APC	48	22	77	91	[illegible]	[illegible]	532	[illegible]	[illegible]	0	14	34	532	48	77	0	8	15	532	22	91	0	4	10
[illegible]	[illegible]	K	[illegible]	38	R APC	48	22	76	91	[illegible]	[illegible]	532	[illegible]	[illegible]	0	7	17	532	48	76	0	5	8	532	22	91	0	2	8
[illegible]	[illegible]	K	[illegible]	39	R TANK	48	22	76	90	[illegible]	[illegible]	534	[illegible]	[illegible]	3	177	432	534	48	76	3	120	180	534	22	90	3	57	234
[illegible]	[illegible]	K	[illegible]	40	R TANK	48	22	76	90	[illegible]	[illegible]	536	[illegible]	[illegible]	2	122	287	536	48	76	2	83	137	536	22	90	2	40	180
[illegible]	[illegible]	K	[illegible]	41	R APC	48	22	75	90	[illegible]	[illegible]	536	[illegible]	[illegible]	0	14	33	536	48	75	0	8	15	536	22	90	0	4	10
[illegible]	[illegible]	K	[illegible]	42	R APC	48	22	74	90	[illegible]	[illegible]	536	[illegible]	[illegible]	0	14	33	536	48	74	0	8	15	536	22	90	0	4	18
[illegible]	[illegible]	K	[illegible]	43	R APC	48	22	73	90	[illegible]	[illegible]	537	[illegible]	[illegible]	0	14	32	537	48	73	0	8	15	537	22	90	0	4	10
[illegible]	[illegible]	K	[illegible]	44	R TANK	48	22	73	90	[illegible]	[illegible]	537	[illegible]	[illegible]	0	7	10	537	48	73	0	5	7	537	22	90	0	2	8
[illegible]	[illegible]	K	[illegible]	45	R APC	48	22	72	88	[illegible]	[illegible]	537	[illegible]	[illegible]	1	41	88	537	48	72	1	28	43	537	22	88	1	13	53
[illegible]	[illegible]	K	[illegible]	46	R APC	48	22	71	88	[illegible]	[illegible]	538	[illegible]	[illegible]	1	82	101	538	48	71	1	66	85	538	22	88	1	28	100
[illegible]	[illegible]	K	[illegible]	47	R APC	48	22	70	88	[illegible]	[illegible]	538	[illegible]	[illegible]	0	14	32	538	48	70	0	8	14	538	22	88	0	4	10
[illegible]	[illegible]	K	[illegible]	48	R TANK	48	22	70	87	[illegible]	[illegible]	541	[illegible]	[illegible]	3	177	400	541	48	70	3	120	182	541	22	87	3	57	278
[illegible]	[illegible]	K	[illegible]	49	R APC	48	22	68	87	[illegible]	[illegible]	546	[illegible]	[illegible]	4	252	577	546	48	68	4	170	256	546	22	87	4	81	322
[illegible]	[illegible]	K	[illegible]	50	R TANK	48	22	68	86	[illegible]	[illegible]	546	[illegible]	[illegible]	1	40	100	546	48	68	1	32	40	546	22	86	1	15	60
[illegible]	[illegible]	K	[illegible]	51	R TANK	48	22	68	85	[illegible]	[illegible]	546	[illegible]	[illegible]	0	27	82	546	48	68	0	18	28	546	22	85	0	8	34
[illegible]	[illegible]	K	[illegible]	52	R TANK	48	22	68	84	[illegible]	[illegible]	547	[illegible]	[illegible]	0	27	81	547	48	68	0	18	28	547	22	84	0	8	34
[illegible]	[illegible]	K	[illegible]	53	R TANK	48	22	68	83	[illegible]	[illegible]	547	[illegible]	[illegible]	0	7	16	547	48	68	0	5	7	547	22	83	0	2	8
[illegible]	[illegible]	K	[illegible]	54	R TANK	48	22	68	82	[illegible]	[illegible]	547	[illegible]	[illegible]	0	14	30	547	48	68	0	8	14	547	22	82	0	4	10
[illegible]	[illegible]	K	[illegible]	55	R APC	48	22	68	82	[illegible]	[illegible]	548	[illegible]	[illegible]	1	61	136	548	48	68	1	41	61	548	22	82	1	20	74
[illegible]	[illegible]	K	[illegible]	56	R APC	48	22	67	82	[illegible]	[illegible]	548	[illegible]	[illegible]	0	14	30	548	48	67	0	8	13	548	22	82	0	4	16
[illegible]	[illegible]	K	[illegible]	57	R APC	48	22	66	82	[illegible]	[illegible]	548	[illegible]	[illegible]	0	0	0	548	48	66	0	0	0	548	22	82	0	0	0
[illegible]	[illegible]	K	[illegible]	58	R APC	48	22	65	82	[illegible]	[illegible]	548	[illegible]	[illegible]	1	41	88	548	48	65	1	28	30	548	22	82	1	13	40
[illegible]	[illegible]	K	[illegible]	59	R APC	48	22	64	82	[illegible]	[illegible]	548	[illegible]	[illegible]	0	20	44	548	48	64	0	14	18	548	22	82	0	7	25
[illegible]	[illegible]	K	[illegible]	60	R APC	48	22	63	82	[illegible]	[illegible]	548	[illegible]	[illegible]	0	14	20	548	48	63	0	8	11	548	22	82	0	4	16
[illegible]	[illegible]	K	[illegible]	61	R APC	46	22	62	82	[illegible]	[illegible]	548	[illegible]	[illegible]	0	14	20	548	46	62	0	8	12	548	22	82	0	4	10
[illegible]	[illegible]	K	[illegible]	62	R APC	48	22	61	82	[illegible]	[illegible]	562	[illegible]	[illegible]	12	843	1773	562	48	61	12	570	756	562	22	82	12	273	1017
[illegible]	[illegible]	K	[illegible]	63	R TANK	48	22	61	81	[illegible]	[illegible]	573	[illegible]	[illegible]	11	741	1548	573	48	61	11	501	886	573	22	81	11	240	883
[illegible]	[illegible]	K	[illegible]	64	B TANK	48	21	61	81	[illegible]	[illegible]	584	[illegible]	[illegible]	11	737	1607	584	48	61	11	606	671	584	21	81	11	231	881
[illegible]	[illegible]	K	[illegible]	65	B TANK	46	20	61	81	[illegible]	[illegible]	588	[illegible]	[illegible]	3	166	356	588	46	61	3	116	153	588	20	81	3	50	203
[illegible]	[illegible]	K	[illegible]	66	B TANK	48	19	61	81	[illegible]	[illegible]	589	[illegible]	[illegible]	4	220	487	589	48	61	4	161	214	589	19	81	4	67	284
[illegible]	[illegible]	K	[illegible]	67	R APC	48	19	60	81	[illegible]	[illegible]	590	[illegible]	[illegible]	1	40	80	590	48	60	1	32	42	590	19	81	1	11	57
[illegible]	[illegible]	K	[illegible]	68	B TANK	48	18	60	81	[illegible]	[illegible]	610	[illegible]	[illegible]	20	1704	2704	610	48	60	20	882	1176	610	18	81	20	363	1580
[illegible]	[illegible]	K	[illegible]	69	R APC	48	18	59	81	[illegible]	[illegible]	611	[illegible]	[illegible]	1	51	112	611	48	59	1	37	47	611	18	81	1	14	65
[illegible]	[illegible]	K	[illegible]	70	R APC	48	18	58	81	[illegible]	[illegible]	614	[illegible]	[illegible]	4	230	580	614	48	58	4	186	708	614	18	81	4	65	702
[illegible]	[illegible]	K	[illegible]	71	R APC	48	18	57	81	[illegible]	[illegible]	620	[illegible]	[illegible]	5	330	731	620	48	57	5	244	307	620	18	81	5	86	420
[illegible]	[illegible]	K	[illegible]	72	B APC	46	18	57	81	[illegible]	[illegible]	623	[illegible]	[illegible]	3	180	414	623	46	57	3	136	171	623	18	81	3	54	243
[illegible]	[illegible]	K	[illegible]	73	R APC	45	18	58	81	[illegible]	[illegible]	623	[illegible]	[illegible]	0	19	41	623	45	58	0	14	17	623	18	81	0	5	24
[illegible]	[illegible]	K	[illegible]	74	R TANK	45	18	56	80	[illegible]	[illegible]	632	[illegible]	[illegible]	0	564	1107	632	45	56	0	186	407	632	18	80	0	158	704
[illegible]	[illegible]	K	[illegible]	75	B APC	44	18	56	80	[illegible]	[illegible]	633	[illegible]	[illegible]	1	67	136	633	44	56	1	44	56	633	18	80	1	18	80
[illegible]	[illegible]	K	[illegible]	76	R TANK	44	18	56	78	[illegible]	[illegible]	633	[illegible]	[illegible]	1	50	108	633	44	56	1	35	45	633	18	78	1	14	63
[illegible]	[illegible]	K	[illegible]	77	B TANK	44	18	56	78	[illegible]	115	638	[illegible]	115	4	287	581	638	44	56	4	188	241	638	18	78	4	77	380
																48107	115100					28894	58156					18272	58844

Battle 6

Time	Target LPN	Result	GAME TIME	KILL	VEHICLETYPE	COUNT B-APC	COUNT B-TANK	COUNT R-APC	COUNT R-TANK	ALL BLUE	ALL RED
17:02:28	370	N	00:00:00	0	B-TANK	17	41	98	98	58	196
17:02:32	370	K	00:00:08	0	B-TANK	17	40	98	98	57	196
17:03:28	139	K	00:01:00	1	R-APC	17	40	97	98	57	195
17:07:32	384	K	00:05:08	2	B-TANK	17	39	97	98	56	195
17:16:16	388	K	00:12:52	3	B-TANK	17	38	97	98	55	195
17:38:33	339	K	00:36:07	4	B-OTHER	17	38	97	98	55	195
17:41:06	388	K	00:38:38	5	B-TANK	17	37	97	98	54	195
18:02:08	374	K	00:59:40	6	B-TANK	17	36	97	98	53	195
18:04:48	382	K	01:02:20	7	B-OTHER	17	36	97	98	53	195
18:12:28	388	K	01:10:00	8	B-TANK	17	35	97	98	52	195
18:29:21	316	K	01:26:56	9	B-OTHER	17	35	97	98	52	195
20:12:00	83	K	03:09:37	10	R-APC	17	35	96	98	52	194
20:13:52	122	K	03:11:28	11	R-APC	17	35	95	98	52	193
20:16:42	239	K	03:13:16	12	B-TANK	17	34	95	98	51	193
20:16:02	238	K	03:13:38	13	R-TANK	17	34	95	97	51	192
20:42:54	123	K	03:40:28	14	R-APC	17	34	94	97	51	191
20:57:04	388	H	03:54:38	15	B-TANK	17	34	94	97	51	191

Time	Tk	Bk	Rk	T(K)-T(K-1)	Bk[T(K)-T(K-1)]	Rk[T(K)-T(K-1)]
17:02:28	0	58	196	N/A	N/A	N/A
17:02:32	0	57	196	0	6	20
17:03:28	1	57	195	1	61	178
17:07:32	5	56	195	4	230	800
17:16:16	13	55	195	8	429	1521
17:38:33	36	55	195	23	1276	4524
17:41:06	39	54	195	3	140	507
18:02:08	60	53	195	21	1113	4095
18:04:48	62	53	195	3	143	527
18:12:28	70	52	195	8	395	1482
18:29:21	87	52	195	17	884	3316
20:12:00	190	52	194	103	5340	19924
20:13:52	192	52	193	2	99	367
20:16:42	193	51	193	2	92	347
20:16:02	194	51	192	0	15	58
20:42:54	221	51	191	27	1372	5138
20:57:04	236	51	191	14	724	2712
					12310	46611

Time	Tk	Bk	Rk	T(K)-T(K-1)	Bk[T(K)-T(K-1)]	Rk[T(K)-T(K-1)]
17:02:28	0	17	98	N/A	N/A	N/A
17:02:32	0	17	98	0	2	10
17:03:28	1	17	97	1	15	87
17:07:32	5	17	97	4	70	398
17:16:16	13	17	97	8	133	757
17:38:33	36	17	97	23	394	2250
17:41:06	39	17	97	3	44	252
18:02:08	60	17	97	21	357	2037
18:04:48	62	17	97	3	46	262
18:12:28	70	17	97	8	129	737
18:29:21	87	17	97	17	289	1649
20:12:00	190	17	96	103	1746	9860
20:13:52	192	17	95	2	32	181
20:16:42	193	17	95	2	31	171
20:16:02	194	17	95	0	5	29
20:42:54	221	17	94	27	457	2529
20:57:04	236	17	94	14	241	1336
					3992	22642

Time	Tk	Bk	Rk	T(K)-T(K-1)	Bk[T(K)-T(K-1)]	Rk[T(K)-T(K-1)]
17:02:28	0	41	98	N/A	N/A	N/A
17:02:32	0	40	98	0	4	10
17:03:28	1	40	98	1	36	88
17:07:32	5	39	98	4	160	402
17:16:16	13	38	98	8	296	764
17:38:33	36	38	98	23	882	2274
17:41:06	39	37	98	3	96	256
18:02:08	60	36	98	21	758	2058
18:04:48	62	36	98	3	97	265
18:12:28	70	35	98	8	266	745
18:29:21	87	35	98	17	595	1666
20:12:00	190	35	98	103	3596	10066
20:13:52	192	35	98	2	67	188
20:16:42	193	34	98	2	61	176
20:16:02	194	34	97	0	10	29
20:42:54	221	34	97	27	916	2609
20:57:04	236	34	97	14	483	1377
					8318	22989

Battle 7

Time	Target LPN	Result	GAME TIME	KILL	VEHICLETYPE	COUNT B-APC	COUNT B-TANK	COUNT R-APC	COUNT R-TANK	ALL BLUE	ALL RED	Tk	Bk	Rk	T(K)-T(K-1)	Bk(T(K)-T(K-1))	Rk(T(K)-T(K-1))	Tk	Bk	Rk	T(K)-T(K-1)	Bk(T(K)-T(K-1))	Rk(T(K)-T(K-1))	Tk	Bk	Rk	T(K)-T(K-1)	Bk(T(K)-T(K-1))	Rk(T(K)-T(K-1))
07:40:56	100	H	00:00:00	0	R-TANK	57	22	98	98	79	198	0	79	198	N/A	N/A	N/A	0	57	98	N/A	N/A	N/A	0	22	98	N/A	N/A	N/A
07:43:12	55	K	00:02:17	0	R-APC	57	22	97	98	79	196	2	79	196	2	182	449	2	57	97	2	131	223	2	22	98	2	51	226
07:44:34	70	K	00:03:38	1	R-APC	57	22	96	98	79	194	4	79	194	1	111	272	4	57	96	1	80	134	4	22	98	1	31	137
07:44:49	170	K	00:03:54	2	R-TANK	57	22	96	97	79	193	4	79	193	0	16	38	4	57	96	0	11	19	4	22	97	0	4	19
07:44:58	342	K	00:03:55	3	B-TANK	57	21	96	97	78	193	4	78	193	0	0	0	4	57	96	0	0	0	4	21	97	0	0	0
07:47:05	181	K	00:06:10	4	R-TANK	57	21	96	96	78	192	6	78	192	2	179	442	6	57	96	2	131	221	6	21	96	2	48	221
07:48:38	100	K	00:07:43	5	R-TANK	57	21	96	95	78	191	8	78	191	2	117	287	8	57	96	2	88	144	8	21	95	2	32	143
07:48:48	88	K	00:07:53	6	R-APC	57	21	95	95	78	190	8	78	190	0	16	38	8	57	95	0	11	19	8	21	95	0	4	19
07:49:09	240	K	00:08:14	7	B-OTHER	57	21	95	95	78	190	8	78	190	0	23	67	8	57	95	0	17	29	8	21	95	0	6	29
07:50:03	100	K	00:09:08	8	R-APC	57	21	94	95	78	189	9	78	189	1	70	170	9	57	94	1	51	85	9	21	95	1	19	86
07:51:16	288	K	00:10:21	9	B-OTHER	57	21	94	95	78	188	10	78	188	1	101	246	10	57	94	1	74	122	10	21	95	1	27	124
07:54:23	108	K	00:13:28	10	R-APC	57	21	93	95	78	188	13	78	188	3	234	564	13	57	93	3	171	279	13	21	95	3	63	286
07:57:19	164	K	00:16:24	11	R-OTHER	57	21	93	95	78	188	16	78	188	2	156	376	15	57	93	2	114	186	15	21	95	2	42	190
07:58:11	377	K	00:17:16	12	B-APC	56	21	93	95	77	188	17	77	188	2	148	357	17	56	93	2	108	177	17	21	95	2	40	181
07:59:00	102	K	00:18:05	13	R-TANK	56	21	93	94	77	187	18	77	187	1	82	150	18	56	93	1	46	74	18	21	94	1	17	76
07:59:05	100	K	00:18:10	14	R-TANK	56	21	93	93	77	186	18	77	186	0	8	19	18	56	93	0	6	9	18	21	93	0	2	9
07:59:50	41	K	00:18:55	15	R-APC	56	21	92	93	77	185	19	77	185	1	64	130	19	56	92	1	39	64	19	21	93	1	15	86
08:01:57	107	K	00:21:02	16	R-TANK	56	21	92	92	77	184	21	77	184	2	162	386	21	56	92	2	118	193	21	21	92	2	44	193
08:02:44	221	K	00:21:49	17	R-TANK	56	21	92	91	77	183	22	77	183	1	82	146	22	56	92	1	46	74	22	21	91	1	17	73
08:03:31	32	K	00:22:36	18	R-APC	56	21	91	91	77	182	23	77	182	1	82	146	23	56	91	1	46	73	23	21	91	1	17	73
08:04:16	222	K	00:23:21	19	R-TANK	56	21	91	90	77	181	23	77	181	1	82	146	23	56	91	1	46	73	23	21	90	1	17	72
08:06:13	33	K	00:25:18	20	R-APC	56	21	90	90	77	180	25	77	180	2	148	342	25	56	90	2	108	171	25	21	90	2	40	171
08:07:33	303	K	00:26:38	21	B-TANK	56	20	90	90	76	180	27	76	180	1	90	234	27	56	90	1	73	117	27	20	90	1	26	117
08:07:53	108	K	00:26:58	22	R-APC	56	20	89	90	76	179	27	76	179	0	30	72	27	56	89	0	22	36	27	20	90	0	8	36
08:08:05	376	K	00:27:10	23	B-APC	55	20	89	90	75	179	27	75	179	0	16	38	27	55	89	0	11	18	27	20	90	0	4	18
08:09:08	305	K	00:28:13	24	B-TANK	55	19	89	90	74	179	28	74	179	1	74	179	28	55	89	1	55	88	28	19	90	1	19	90
08:11:30	88	K	00:30:35	25	R-APC	55	19	88	90	74	178	31	74	178	2	178	427	31	55	88	2	132	211	31	19	90	2	48	216
08:11:44	90	K	00:30:49	26	R-APC	55	19	87	90	74	177	31	74	177	0	15	36	31	55	87	0	11	17	31	19	90	0	4	18
08:11:47	101	K	00:30:52	27	R-APC	55	19	86	90	74	176	31	74	176	0	7	18	31	55	86	0	6	9	31	19	90	0	2	9
08:11:52	100	K	00:30:57	28	R-APC	55	19	85	90	74	175	31	74	175	0	7	18	31	55	85	0	6	9	31	19	90	0	2	9
08:12:14	90	K	00:31:19	29	R-APC	55	19	84	90	74	174	31	74	174	0	22	52	31	55	84	0	17	25	31	19	90	0	6	27
08:12:54	224	K	00:31:59	30	R-TANK	55	19	84	89	74	173	32	74	173	1	52	121	32	55	84	1	39	59	32	19	89	1	13	62
08:13:38	304	K	00:32:43	31	B-APC	54	19	84	89	73	173	33	73	173	1	51	121	33	54	84	1	38	59	33	19	89	1	13	62
08:21:01	220	K	00:40:06	32	R-TANK	54	19	84	88	73	172	40	73	172	7	540	1273	40	54	84	7	400	622	40	19	88	7	141	661
08:21:12	297	K	00:40:17	33	B-APC	53	19	84	88	72	172	40	72	172	0	14	34	40	53	84	0	11	17	40	19	88	0	4	18
08:24:03	364	K	00:43:08	34	B-TANK	53	18	84	88	71	172	43	71	172	3	208	480	45	53	84	3	154	244	43	18	88	3	52	256
08:28:32	100	K	00:46:37	35	R-TANK	53	18	84	87	71	171	46	71	171	2	170	410	46	53	84	2	127	202	46	18	87	2	43	209
08:28:35	90	K	00:46:40	36	R-APC	53	18	83	87	71	170	46	71	170	0	7	17	46	53	83	0	5	8	46	18	87	0	2	9
08:31:33	300	K	00:49:38	37	B-TANK	53	17	83	87	70	170	51	70	170	6	360	850	51	53	83	5	265	415	51	17	87	5	86	435
08:31:38	210	K	00:49:43	38	R-TANK	53	17	83	86	70	169	51	70	169	0	0	0	51	53	83	0	0	0	51	17	86	0	0	0
08:32:15	288	K	00:51:20	39	B-APC	52	17	83	86	69	169	51	69	169	1	48	118	51	52	83	1	36	58	51	17	86	1	12	60
08:33:26	105	K	00:52:31	40	R-APC	52	17	82	86	69	168	53	69	168	1	83	202	53	52	82	1	62	98	53	17	86	1	20	103
08:33:28	300	H	00:52:33	41	B-TANK	52	17	82	86	69	168	53	69	168	0	0	0	53	52	82	0	0	0	53	17	86	0	0	0
08:35:54	388	K	00:55:00	41	B-APC	51	17	82	86	68	168	56	68	168	3	231	571	56	51	82	3	173	279	56	17	86	3	58	292
08:36:58	388	K	00:56:03	42	B-APC	50	17	82	86	67	168	56	67	168	0	7	17	56	50	82	0	5	8	56	17	86	0	2	9
08:39:14	341	K	00:58:19	43	B-TANK	50	16	82	86	66	168	58	66	168	2	152	388	58	50	82	2	115	180	58	16	86	2	37	198
08:39:25	455	K	00:58:30	44	B-APC	49	16	82	86	65	168	59	65	168	0	7	17	59	49	82	0	5	8	59	16	86	0	2	9
08:40:30	340	K	00:59:35	45	B-TANK	49	15	82	86	64	168	60	64	168	1	70	186	60	49	82	1	54	90	60	15	86	1	17	95
08:41:58	370	K	01:01:03	46	B-TANK	49	14	82	86	63	168	61	63	168	2	96	252	61	49	82	2	74	123	61	14	86	2	21	129
08:42:03	382	K	01:01:08	47	B-TANK	49	13	82	86	62	168	61	62	168	0	6	17	61	49	82	0	5	8	61	13	86	0	1	9
08:46:05	301	K	01:05:10	48	B-TANK	49	12	82	86	61	168	65	61	168	4	244	672	65	49	82	4	196	328	65	12	86	4	48	344
08:47:32	162	K	01:08:37	49	R-OTHER	49	12	82	86	61	168	67	61	168	2	92	252	67	49	82	2	74	123	67	12	86	2	18	129
08:53:24	288	K	01:12:29	50	R-TANK	49	12	82	85	61	167	73	61	167	6	364	900	73	49	82	6	294	476	73	12	85	6	70	493
08:53:36	247	K	01:12:41	51	B-OTHER	49	12	82	85	61	167	73	61	167	0	12	33	73	49	82	0	10	16	73	12	85	0	2	17
08:58:38	116	K	01:17:43	52	R-OTHER	49	12	82	85	61	167	78	61	167	5	311	852	78	49	82	5	260	418	78	12	85	5	61	434
09:09:35	274	K	01:28:40	53	B-OTHER	49	12	82	85	61	167	86	61	167	8	482	1319	86	49	82	8	387	648	86	12	85	8	96	672
09:09:09	170	K	01:28:14	54	R-TANK	49	12	82	84	61	166	88	61	166	3	156	432	88	49	82	3	127	213	88	12	84	3	31	218
09:42:51	38	K	02:01:56	55	R-APC	49	12	81	84	61	165	122	61	165	34	2066	5681	122	49	81	34	1851	2730	122	12	84	34	404	2831
09:53:04	83	H	02:12:09	56	R-APC	49	12	81	84	61	165	132	61	165	10	622	1883	132	49	81	10	500	826	132	12	84	10	122	867
																5836	22890					6810	11164					2025	11527

Battle 6

Time	Target LPN	Result	GAME TIME	KILL	VEHICLETYPE	COUNT B-APC	COUNT B-TANK	COUNT R-APC	COUNT R-TANK	ALL BLUE	ALL RED	Tk	Bk	Rk	T(K)-T(K-1)	Bk*[T(K)-T(K-1)]	Rk*[T(K)-T(K-1)]	Tk	Bk	Rk	T(K)-T(K-1)	Bk*[T(K)-T(K-1)]	Rk*[T(K)-T(K-1)]	Tk	Bk	Rk	T(K)-T(K-1)	Bk*[T(K)-T(K-1)]	Rk*[T(K)-T(K-1)]
22:43:38	370	K	00:00:00	1	B-APC	54	29	96	96	83	190	0	83	190	N/A	N/A	N/A	0	54	96	N/A	N/A	N/A	0	29	96	N/A	N/A	N/A
22:51:04	338	K	00:07:26	2	B-TANK	53	29	95	95	82	190	0	82	190	0	0	0	7	53	95	7	392	703	7	29	95	7	215	703
23:11:40	380	K	00:28:10	3	B-TANK	53	28	96	95	81	190	7	81	190	7	569	1406	28	53	96	21	1102	1976	28	28	95	21	582	1976
00:31:00	373	K	01:48:12	4	B-APC	53	27	96	96	80	190	28	80	190	21	1684	3962	108	53	96	80	4245	7610	108	27	96	80	2163	7610
02:00:34	46	K	03:19:08	5	R-APC	52	27	96	96	79	190	108	79	190	80	6328	15219	200	52	96	92	4774	8721	200	27	96	92	2479	8721
02:40:44	43	K	04:05:06	6	R-APC	52	27	94	96	79	189	200	79	189	92	7262	17360	246	52	94	46	2360	4249	246	27	96	46	1220	4294
02:48:00	44	K	04:05:21	7	R-APC	52	27	93	96	79	189	246	79	189	46	3671	8469	246	52	93	0	10	19	246	27	96	0	5	19
06:17:04	171	K	05:34:16	8	R-TANK	52	27	92	95	79	187	246	79	187	0	16	37	395	52	92	149	7748	13708	395	27	95	149	4023	14155
06:24:00	134	K	05:41:16	9	R-APC	52	27	92	94	79	186	395	79	186	149	11771	27714	402	52	92	7	364	644	402	27	94	7	189	658
06:04:06	381	K	07:20:27	10	B-APC	52	27	91	94	79	186	402	79	186	7	553	1296	441	52	91	39	2038	3587	441	27	94	39	1058	3686
06:11:02	380	K	07:28:14	11	B-APC	51	27	91	94	78	186	441	78	186	39	3068	7262	449	51	91	8	398	710	449	27	94	8	211	733
06:14:47	364	K	07:31:08	12	B-TANK	50	27	91	94	77	186	449	77	186	8	601	1443	451	50	91	3	145	264	451	27	94	3	78	273
06:16:43	382	K	07:33:06	13	B-APC	50	26	91	94	76	186	451	76	186	3	220	537	453	50	91	2	100	182	453	26	94	2	52	188
06:20:38	176	K	07:46:50	14	R-TANK	49	26	91	94	75	185	453	75	185	2	150	370	466	49	91	13	632	1174	466	26	94	13	335	1213
06:56:19	204	K	08:12:41	15	B-OTHER	49	26	91	93	76	184	466	76	184	13	988	2374	493	49	91	27	1308	2430	493	26	93	27	694	2483
07:01:34	167	K	08:17:08	16	R-APC	49	26	91	93	76	184	493	76	184	27	2003	4013	498	49	91	5	260	482	498	26	93	5	130	493
07:03:20	223	K	08:19:42	17	R-TANK	49	26	90	93	76	183	498	76	183	5	380	970	500	49	90	2	83	153	500	26	93	2	44	158
07:04:41	127	K	08:21:03	18	R-TANK	49	26	90	92	76	182	500	76	182	2	128	309	501	49	90	1	60	128	501	26	92	1	38	129
07:12:00	201	K	08:28:31	19	B-OTHER	49	26	90	91	76	181	501	76	181	1	105	263	509	49	90	7	383	666	509	26	91	7	192	673
07:16:16	208	K	08:34:40	20	B-OTHER	49	26	90	91	76	181	509	76	181	7	565	1330	516	49	90	6	304	558	516	26	91	6	161	564
07:20:16	180	K	08:38:40	21	R-APC	49	26	90	91	76	181	516	76	181	6	405	1122	517	49	90	2	98	180	517	26	91	2	52	182
07:22:38	209	K	08:38:00	22	R-TANK	49	26	89	91	76	180	517	76	180	2	150	380	517	49	89	0	15	27	517	26	91	0	8	27
07:25:44	349	K	08:42:08	23	B-TANK	49	26	89	90	76	179	517	76	179	0	23	54	522	49	89	5	250	454	522	26	90	5	133	469
07:27:23	304	K	08:43:46	24	B-APC	49	25	89	90	74	179	522	74	179	6	377	913	524	49	89	2	83	161	524	25	90	2	43	153
07:27:40	388	K	08:44:02	25	B-APC	48	25	89	90	73	179	524	73	179	2	124	304	524	48	89	0	14	27	524	25	90	0	8	27
07:32:10	47	K	08:48:32	26	R-OTHER	47	25	89	90	72	179	524	72	179	0	22	54	527	47	89	3	118	223	527	25	90	3	63	226
07:36:10	283	K	08:51:41	27	B-OTHER	47	25	89	90	72	179	527	72	179	3	180	448	532	47	89	5	240	454	532	25	90	5	128	459
07:36:37	230	K	08:52:00	28	CONTROLL	47	25	89	90	72	179	532	72	179	6	387	913	533	47	89	1	61	116	533	25	90	1	33	117
07:38:00	230	K	08:53:21	29	R-TANK	47	25	89	90	72	179	533	72	179	1	94	233	534	47	89	0	19	36	534	25	90	0	10	36
07:37:31	170	K	08:53:53	30	R-APC	47	25	89	89	72	178	534	72	178	0	29	71	534	47	89	1	24	46	534	25	89	1	13	46
07:39:42	227	K	08:56:04	31	R-TANK	47	25	89	89	72	177	534	72	177	1	38	89	536	47	89	2	103	194	536	25	89	2	56	196
07:41:46	341	K	08:58:07	32	B-TANK	47	25	88	88	72	176	536	72	176	2	168	387	538	47	88	2	99	186	539	25	88	2	53	186
07:46:27	66	K	09:01:40	33	R-OTHER	47	24	88	88	71	176	539	71	176	2	149	370	542	47	88	4	174	326	542	24	88	4	89	326
07:47:10	80	K	09:03:40	34	R-APC	47	24	88	88	71	176	542	71	176	4	283	651	544	47	88	2	86	158	544	24	88	2	43	158
07:47:21	334	K	09:03:43	35	B-TANK	47	24	87	88	71	175	544	71	175	2	128	315	544	47	87	0	5	9	544	24	88	0	2	9
07:47:39	348	K	09:03:52	36	B-TANK	47	23	87	88	70	175	544	70	175	0	7	18	544	47	87	0	5	9	544	23	88	0	2	9
07:47:50	387	K	09:04:12	37	B-APC	47	22	87	88	69	175	544	69	175	0	7	18	546	47	87	0	14	26	546	22	88	0	7	26
07:48:22	74	K	09:04:44	38	R-APC	46	22	87	88	68	175	546	68	175	0	20	53	546	46	87	1	28	52	546	22	88	1	13	53
07:48:00	386	K	09:06:16	39	B-APC	46	22	86	88	68	174	546	68	174	1	41	104	548	46	86	1	23	43	548	22	88	1	11	44
07:48:42	88	K	09:06:04	40	R-APC	46	22	86	88	67	174	546	67	174	1	34	87	548	46	86	1	38	69	548	22	88	1	18	70
07:50:14	306	K	09:06:36	41	B-TANK	46	22	85	88	67	173	546	67	173	1	54	138	547	46	85	1	27	51	547	22	88	1	13	53
07:50:46	110	K	09:07:07	42	R-APC	46	21	85	88	66	173	547	66	173	1	40	104	548	46	85	1	23	43	548	21	88	1	11	44
07:50:57	143	K	09:07:19	43	R-APC	46	21	84	88	66	172	548	66	172	1	33	86	548	46	84	0	9	17	548	21	88	0	4	18
07:50:22	160	K	09:14:44	44	R-TANK	46	21	83	88	65	171	548	65	171	0	13	34	555	46	83	7	333	614	555	21	88	7	156	651
08:02:42	132	K	09:19:04	45	R-APC	46	21	83	87	66	170	555	66	170	7	480	1250	559	46	83	4	194	367	559	21	87	4	90	374
08:04:40	113	K	09:21:10	46	R-APC	46	21	82	87	66	169	559	66	169	4	284	727	562	46	82	2	96	172	562	21	87	2	44	183
08:12:38	317	K	09:28:56	47	B-APC	46	21	81	87	66	168	562	66	168	2	139	363	569	46	81	8	361	632	569	21	87	8	164	679
08:16:01	183	K	09:31:23	48	R-TANK	44	21	81	87	66	168	569	66	168	8	607	1310	572	44	81	2	106	194	572	21	87	2	50	209
08:19:00	288	N	09:36:21	49	B-OTHER	44	21	81	86	65	167	572	65	167	2	156	401	577	44	81	5	220	406	577	21	86	5	106	430
																44324	108204					29634	53206					16294	54173

Battle 9

Time	Target LPN	Result	GAME TIME	KILL	VEHICLETYPE	COUNT B-APC	COUNT B-TANK	COUNT R-APC	COUNT R-TANK	ALL BLUE	ALL RED
22:23:32	380	K	00:00:00	1	B-TANK	13	40	99	99	53	198
22:23:51	387	K	00:00:19	2	B-TANK	13	39	99	99	52	198
22:45:10	383	K	00:21:38	3	B-TANK	13	38	99	99	51	198
01:37:02	387	K	03:13:30	4	B-OTHER	13	38	99	99	51	198
01:54:44	367	K	03:31:12	5	B-TANK	13	37	99	99	50	198
03:24:41	380	K	05:01:09	6	B-TANK	13	36	99	99	49	198
05:42:00	141	K	07:19:18	7	R-APC	13	36	98	99	49	197
05:47:30	238	K	07:24:08	8	R-TANK	13	36	98	98	49	196
06:28:00	208	K	08:04:28	9	R-APC	13	36	97	98	49	195
06:31:20	148	K	08:07:48	10	R-TANK	13	36	97	97	49	194
06:56:51	220	K	08:32:19	11	R-TANK	13	36	97	96	49	193
06:56:45	385	K	08:33:13	12	B-TANK	13	35	97	96	48	193
06:58:14	53	K	08:34:42	13	R-APC	13	35	96	96	48	192
07:01:52	310	K	08:38:20	14	B-OTHER	13	35	96	96	48	192
07:05:14	230	K	08:42:42	15	R-TANK	13	35	96	95	48	191
07:05:53	280	N	08:43:21	16	B-OTHER	13	35	96	95	48	191
07:46:05	221	K	09:22:33	16	R-APC	13	35	95	95	48	190
07:46:18	110	K	09:22:46	17	R-APC	13	35	94	95	48	189
08:16:11	348	K	09:52:39	18	B-TANK	13	34	94	95	47	189
08:22:23	178	K	09:58:51	19	R-OTHER	13	34	94	95	47	189
08:32:10	130	K	10:08:38	20	R-APC	13	34	93	95	47	188
08:47:44	228	K	10:24:12	21	R-TANK	13	34	93	94	47	187
08:47:57	211	K	10:24:25	22	R-TANK	13	34	93	93	47	186
08:48:33	104	K	10:25:01	23	R-TANK	13	34	93	92	47	185
09:02:41	358	K	10:39:09	24	B-APC	12	34	93	92	46	185
09:04:52	288	K	10:41:20	25	R-APC	12	34	92	92	46	184
09:10:43	383	K	10:47:11	26	B-TANK	12	33	92	92	45	184
09:12:02	91	K	10:48:30	27	R-APC	12	33	91	92	45	183
09:16:00	365	K	10:52:28	28	B-TANK	12	32	91	92	44	183
09:21:00	210	K	10:58:10	29	R-TANK	12	32	91	91	44	182
09:22:02	285	K	10:59:30	30	R-APC	12	32	90	91	44	181
09:22:04	280	K	10:59:22	31	R-APC	12	32	89	91	44	180
09:24:54	148	K	11:01:22	32	R-APC	12	32	88	91	44	179
09:38:20	373	K	11:14:48	33	B-OTHER	12	32	88	91	44	179
09:51:27	380	K	11:27:55	34	B-OTHER	12	32	88	91	44	179
09:55:57	388	K	11:32:25	35	B-OTHER	12	32	88	91	44	179
09:58:19	343	K	11:34:47	36	B-TANK	12	31	88	91	43	179
10:06:56	382	K	11:43:24	37	B-TANK	12	30	88	91	42	178
10:14:08	382	H	11:50:36	38	B-TANK	12	30	88	91	42	178

Time	Tk	Bk	Rk	T(K)-T(K-1)	Bk[T(K)-T(K-1)]	Rk[T(K)-T(K-1)]
22:23:32	0	53	198	N/A	N/A	N/A
22:23:51	0	52	198	0	16	69
22:45:10	22	51	198	21	1088	4217
01:37:02	194	51	198	172	8772	34088
01:54:44	211	50	198	18	886	3506
03:24:41	301	49	198	90	4410	17820
05:42:00	440	49	197	138	6777	27246
05:47:30	444	49	196	5	236	941
06:28:00	486	49	195	40	1980	7878
06:31:20	488	49	194	3	162	640
06:56:51	513	49	193	25	1201	4728
06:56:45	514	48	193	1	43	174
06:58:14	516	48	192	2	72	288
07:01:52	519	48	192	4	178	710
07:05:14	523	48	191	4	208	821
07:05:53	524	48	191	1	34	134
07:46:05	563	48	190	39	1882	7440
07:46:18	563	48	189	0	10	38
08:16:11	593	47	189	30	1406	5651
08:22:23	599	47	189	6	291	1172
08:32:10	609	47	188	10	461	1842
08:47:44	625	47	187	16	733	2917
08:47:57	625	47	186	0	9	37
08:48:33	626	47	185	1	28	111
09:02:41	640	46	185	14	663	2627
09:04:52	642	46	184	2	97	388
09:10:43	648	45	184	6	288	1088
09:12:02	650	45	183	2	104	421
09:16:00	653	44	183	3	132	540
09:21:00	659	44	182	6	265	1056
09:22:02	659	44	181	0	9	38
09:22:04	660	44	180	1	40	162
09:24:54	662	44	179	2	88	358
09:38:20	676	44	179	14	608	2434
09:51:27	688	44	179	13	572	2327
09:55:57	693	44	179	5	198	808
09:58:19	696	43	179	2	98	412
10:06:56	704	42	178	9	366	1567
10:14:08	711	42	178	7	302	1280
					34652	137938

Time	Tk	Bk	Rk	T(K)-T(K-1)	Bk[T(K)-T(K-1)]	Rk[T(K)-T(K-1)]	Tk	Bk	Rk	T(K)-T(K-1)	Bk[T(K)-T(K-1)]	Rk[T(K)-T(K-1)]
22:23:32	0	13	99	N/A	N/A	N/A	0	40	99	N/A	N/A	N/A
22:23:51	0	13	99	0	4	30	0	39	99	0	12	30
22:45:10	22	13	99	21	277	2109	22	38	99	21	809	2109
01:37:02	194	13	99	172	2236	17028	194	38	99	172	6536	17028
01:54:44	211	13	99	18	230	1762	211	37	99	18	665	1752
03:24:41	301	13	99	90	1170	8910	301	36	99	90	3240	8910
05:42:00	440	13	98	138	1798	13563	440	36	99	138	4979	13692
05:47:30	444	13	98	5	62	470	444	36	98	5	173	470
06:28:00	486	13	97	40	526	3919	486	36	98	40	1454	3989
06:31:20	488	13	97	3	43	320	488	36	97	3	119	320
06:56:51	513	13	97	25	319	2377	513	36	96	25	882	2362
06:56:45	514	13	97	1	12	87	514	35	96	1	32	96
06:58:14	516	13	96	2	20	144	516	35	96	2	53	144
07:01:52	519	13	96	4	48	366	519	35	96	4	130	366
07:05:14	523	13	96	4	56	413	523	35	95	4	151	409
07:05:53	524	13	96	1	9	67	524	35	95	1	26	97
07:46:05	563	13	95	39	510	3724	563	35	95	39	1372	3724
07:46:18	563	13	94	0	3	19	563	35	95	0	7	19
08:16:11	593	13	94	30	389	2811	593	34	95	30	1017	2841
08:22:23	599	13	94	6	81	563	599	34	95	6	211	569
08:32:10	609	13	93	10	127	911	609	34	95	10	333	931
08:47:44	625	13	93	16	203	1461	625	34	94	16	530	1488
08:47:57	625	13	93	0	3	19	625	34	93	0	7	19
08:48:33	626	13	93	1	8	56	626	34	92	1	20	55
09:02:41	640	12	93	14	170	1321	640	34	92	14	483	1306
09:04:52	642	12	92	2	25	193	642	34	92	2	71	193
09:10:43	648	12	92	6	71	543	648	33	92	6	196	543
09:12:02	650	12	91	2	28	209	650	33	92	2	78	212
09:16:00	653	12	91	3	38	273	653	32	92	3	96	276
09:21:00	659	12	91	6	70	528	659	32	91	6	186	528
09:22:02	659	12	90	0	2	18	659	32	91	0	6	18
09:22:04	660	12	89	1	11	80	660	32	91	1	29	82
09:24:54	662	12	88	2	24	178	662	32	91	2	64	182
09:38:20	676	12	88	14	163	1197	676	32	91	14	436	1238
09:51:27	688	12	88	13	156	1144	688	32	91	13	416	1183
09:55:57	693	12	88	5	64	396	693	32	91	5	144	410
09:58:19	696	12	88	2	28	202	696	31	91	2	71	209
10:06:56	704	12	88	9	104	788	704	30	91	9	261	792
10:14:08	711	12	88	7	86	634	711	30	91	7	216	666
					9160	68788					25494	69163

Battle 10

Time	Target LPN	Result	GAME TIME	KILL	VEHICLETYPE	COUNT B-APC	COUNT B-TANK	COUNT R-APC	COUNT R-TANK	ALL BLUE	ALL RED	Tk	Bk	Rk	T(tK)-T(K-1)	Bk[T(tK)-T(K-1)]	Rk[T(tK)-T(K-1)]	Tk	Bk	Rk	T(tK)-T(K-1)	Bk[T(tK)-T(K-1)]	Rk[T(tK)-T(K-1)]	Tk	Bk	Rk	T(tK)-T(K-1)	Bk[T(tK)-T(K-1)]	Rk[T(tK)-T(K-1)]
01:21:38	388	K	00:00:00	1	B-OTHER	13	41	99	99	54	198	0	54	198	N/A	N/A	N/A	0	13	99	N/A	N/A	N/A	0	41	99	N/A	N/A	N/A
01:25:01	347	K	00:03:23	2	B-TANK	13	40	99	99	53	198	0	53	198	0	0	0	3	13	99	3	44	337	3	40	99	3	136	337
01:25:48	48	K	00:04:10	3	R-APC	13	40	98	99	53	197	3	53	197	3	180	670	4	13	98	1	10	78	4	40	99	1	32	79
01:42:56	322	K	00:21:18	4	B-APC	12	40	98	99	52	197	4	52	197	1	42	160	21	12	98	17	206	1676	21	40	99	17	684	1693
01:47:54	48	K	00:26:16	5	R-OTHER	12	40	98	99	52	197	21	52	197	17	880	3330	25	12	98	4	48	392	25	40	99	4	160	396
01:54:30	389	K	00:32:52	6	B-TANK	12	39	98	99	51	197	25	51	197	4	204	788	33	12	98	8	91	745	33	39	99	8	296	752
02:26:41	343	K	01:05:03	7	B-TANK	12	38	98	99	50	197	33	50	197	8	380	1497	65	12	98	32	386	3150	65	38	99	32	1224	3168
04:43:51	382	K	03:22:13	8	B-TANK	12	37	98	99	49	197	65	49	197	32	1578	6343	202	12	98	137	1646	13446	202	37	99	137	5076	13683
04:44:15	179	K	03:22:37	9	R-OTHER	12	37	98	99	49	197	202	49	197	137	6723	27028	203	12	98	0	5	39	203	37	99	0	15	40
04:49:56	235	K	03:28:18	10	R-TANK	12	37	98	99	49	197	203	49	197	0	20	79	209	12	98	6	70	588	209	37	99	6	215	574
06:19:54	388	K	04:58:16	11	B-TANK	12	36	98	98	48	196	209	48	196	6	278	1137	299	12	98	90	1080	8820	299	36	98	90	3240	8820
06:27:16	138	K	05:05:38	12	R-APC	12	36	97	98	48	195	299	48	195	90	4320	17560	306	12	97	7	88	708	306	36	98	7	263	715
06:34:28	138	K	05:12:50	13	R-APC	12	36	96	98	48	194	306	48	194	7	350	1418	313	12	96	7	86	681	313	36	98	7	259	706
06:38:13	94	K	05:16:35	14	R-APC	12	36	95	98	48	193	313	48	193	7	348	1390	317	12	95	4	48	381	317	36	98	4	137	372
06:47:49	48	K	05:26:11	15	R-APC	12	36	94	98	48	192	317	48	192	4	182	730	326	12	94	10	115	902	326	36	98	10	346	941
06:58:39	220	K	05:37:01	16	R-APC	12	36	93	98	48	191	326	48	191	10	461	1834	337	12	93	11	130	1004	337	36	98	11	388	1058
07:12:21	191	K	05:50:43	17	R-TANK	12	36	93	98	48	191	337	48	191	11	518	2083	351	12	93	14	164	1274	351	36	98	14	493	1343
07:17:47	187	K	05:56:09	18	R-APC	12	36	92	97	48	189	351	48	189	14	658	2590	356	12	92	6	66	506	356	36	97	6	198	534
07:28:23	201	K	06:06:45	19	R-APC	12	36	91	97	48	188	356	48	188	6	264	1034	367	12	91	11	127	985	367	36	97	11	382	1026
07:31:21	382	K	06:09:43	20	B-OTHER	12	36	91	97	48	188	367	48	188	11	509	1993	370	12	91	3	36	273	370	36	97	3	108	291
07:31:37	88	K	06:09:59	21	R-APC	12	36	90	97	48	187	370	48	187	3	144	561	370	12	90	0	2	18	370	36	97	0	7	19
07:42:03	111	K	06:20:25	22	R-TANK	12	36	90	97	48	187	370	48	187	0	10	37	381	12	90	11	126	946	381	36	97	11	378	1019
07:55:22	132	K	06:33:44	23	R-TANK	12	36	90	96	48	186	381	48	186	11	504	1963	394	12	90	13	160	1197	394	36	96	13	479	1277
08:02:17	235	K	06:40:39	24	R-TANK	12	36	90	95	48	185	394	48	185	13	638	2461	401	12	90	7	83	621	401	36	95	7	248	656
08:05:52	340	K	06:44:14	25	B-TANK	12	35	90	94	47	184	401	47	184	7	324	1270	405	12	90	4	43	324	405	35	94	4	128	338
08:06:09	389	K	06:44:31	26	B-TANK	12	34	90	94	46	184	405	46	184	4	166	662	405	12	90	0	4	27	405	34	94	0	10	28
08:06:25	284	K	06:44:47	27	R-TANK	12	34	90	94	46	184	405	46	184	0	14	56	405	12	90	0	2	18	405	34	94	0	7	19
08:09:08	88	K	06:47:30	28	R-OTHER	12	34	90	93	46	183	405	46	183	0	9	37	408	12	90	3	34	262	408	34	93	3	96	280
08:12:33	384	K	06:50:55	29	B-TANK	12	33	90	93	45	183	408	45	183	3	150	612	411	12	90	3	41	308	411	33	93	3	112	316
08:13:11	123	K	06:51:33	30	R-APC	12	33	89	93	45	182	411	45	182	3	153	619	412	12	89	1	7	53	412	33	93	1	20	56
08:15:39	304	K	06:54:01	31	B-TANK	12	32	89	93	44	182	412	44	182	1	28	108	414	12	89	3	30	223	414	32	93	3	80	233
08:16:04	210	K	06:54:26	32	R-TANK	12	32	89	93	44	182	414	44	182	3	110	466	415	12	89	0	5	38	415	32	93	0	13	37
08:17:40	285	K	06:56:02	33	R-APC	12	32	88	92	44	180	415	44	180	0	16	72	416	12	88	2	19	141	416	32	92	2	51	147
08:17:47	211	K	06:56:09	34	R-TANK	12	32	88	92	44	180	416	44	180	2	70	288	416	12	88	0	1	9	416	32	92	0	3	9
08:18:25	289	K	06:56:47	35	R-APC	12	32	87	91	44	178	416	44	178	0	4	18	417	12	87	1	8	61	417	32	91	1	22	64
08:19:07	138	K	06:57:29	36	R-APC	12	32	86	91	44	177	417	44	177	1	31	124	418	12	86	1	8	60	418	32	91	1	22	64
08:21:10	188	K	06:59:32	37	R-APC	12	32	85	91	44	176	418	44	176	1	31	123	420	12	85	2	24	170	420	32	91	2	64	182
08:21:20	284	K	06:59:42	38	B-OTHER	12	32	85	91	44	176	420	44	176	2	88	362	420	12	85	0	2	17	420	32	91	0	6	18
08:26:34	83	K	07:04:56	39	R-APC	12	32	84	91	44	175	420	44	175	0	9	36	425	12	84	5	62	437	425	32	91	5	168	473
08:27:40	380	K	07:06:02	40	B-TANK	12	31	84	91	43	175	425	43	175	5	224	910	426	12	84	1	13	92	426	31	91	1	34	100
08:28:30	379	K	07:06:52	41	B-TANK	12	30	84	91	42	175	426	42	175	1	46	193	427	12	84	1	10	67	427	30	91	1	24	73
08:28:54	361	K	07:07:16	42	B-TANK	12	29	84	91	41	175	427	41	175	1	33	140	428	12	84	0	5	34	428	29	91	0	12	38
08:29:22	280	K	07:07:44	43	R-TANK	12	29	84	91	41	175	428	41	175	0	16	70	428	12	84	1	6	42	428	29	91	1	16	46
08:29:24	210	K	07:07:46	44	R-APC	12	29	83	90	41	173	428	41	173	1	21	87	428	12	83	0	0	0	428	29	90	0	0	0
08:30:56	380	K	07:09:18	45	B-TANK	12	28	83	90	40	173	428	40	173	0	0	0	430	12	83	2	19	133	430	28	90	2	46	144
08:35:48	85	K	07:14:10	46	R-TANK	12	28	83	90	40	173	430	40	173	2	64	277	434	12	83	5	56	388	434	28	90	5	134	432
08:39:46	385	K	07:18:08	47	B-TANK	12	27	83	89	39	172	434	39	172	5	187	828	438	12	83	4	48	332	438	27	89	4	108	358
08:40:03	368	K	07:18:25	48	B-TANK	12	26	83	89	38	172	438	38	172	4	152	688	438	12	83	0	4	26	438	26	89	0	8	27
08:41:00	147	K	07:19:22	49	R-OTHER	12	26	83	89	38	172	438	38	172	0	11	82	440	12	83	1	11	75	440	26	89	1	23	80
08:43:34	60	N	07:21:56	50	R-OTHER	12	26	83	89	38	172	440	38	172	1	34	156	442	12	83	3	31	216	442	26	89	3	68	231
																21106	84806					5311	42269					16033	43189

APPENDIX B

NTC BATTLE DATA SUMMARY

BATTLES STATISTICS

	Battle									
	1	2	3	4	5	6	7	8	9	10
Relative Worth	4.59	2.77	11.66	6.1	7.87	2.69	4.85	3.34	7.21	6.5
Battle Length (hh:mm:ss)	2:09:41	2:10:19	1:29:41	1:57:10	10:37:19	3:54:38	2:12:09	9:36:21	11:50:36	7:21:56

BLUE BATTLE DATA SUMMARY

Battle	Unit Type	Initial Tanks	Initial APCs	Initial Total	Tank Firer Minutes	APC Firer Minutes	Total Firer Minutes	Tanks Lost	APCs Lost	Total Lost	Tank attrit rate*	APC attrit rate*	Total attrit rate*
1	Armor	30	47	77	3,553	5,822	9,375	5	4	9	0.00729	0.000345	0.000488
2	Armor	35	49	84	4,116	6,164	10,280	10	4	14	0.001513	0.000345	0.00077
3	Armor	36	38	74	3,008	3,365	6,373	7	1	8	0.000848	0.000129	0.000501
4	Armor	42	33	75	4,046	3,483	7,529	16	5	21	0.00146	0.0005	0.001002
5	Armor	32	48	80	16,272	29,834	46,106	14	4	18	0.000238	0.000071	0.000156
6	Cav	41	17	58	8,318	3,992	12,310	7	0	7	0.000305	0	0.000154
7	Mech	22	57	79	2,025	6,810	8,835	10	8	18	0.000868	0.000717	0.000793
8	Mech	29	54	83	15,294	29,534	44,828	8	10	18	0.000148	0.000188	0.000169
9	Mech	40	13	53	25,494	9,159	34,653	10	1	11	0.000145	0.000015	0.00008
10	Mech	41	13	54	16,033	5,311	21,344	15	1	16	0.000347	0.000024	0.000189

RED BATTLE DATA SUMMARY

Battle	Unit Type	Initial Tanks	Initial APCs	Initial Total	Tank Firer Minutes	APC Firer Minutes	Total Firer Minutes	Tanks Lost	APCs Lost	Total Lost	Tank attrit rate*	APC attrit rate*	Total attrit rate*
1	MRR	55	98	153	6,857	11,595	18,452	4	17	21	0.001126	0.00292	0.00224
2	MRR	56	97	153	6,609	11,580	18,189	9	13	22	0.002186	0.002109	0.00214
3	MRR	98	98	196	8,255	7,727	15,982	11	24	35	0.004041	0.007428	0.00584
4	MRR	101	101	202	10,959	10,008	20,967	16	29	45	0.003954	0.008614	0.00611
5	MRR	95	95	190	58,944	56,156	115,100	16	39	55	0.001015	0.001341	0.001228
6	MRR	98	98	196	22,969	22,542	45,511	1	4	5	0.000124	0.001002	0.000414
7	MRR	98	98	196	11,527	11,164	22,691	14	17	31	0.006913	0.002937	0.003848
8	MRR	95	95	190	54,173	53,206	107,379	9	14	23	0.00059	0.000542	0.000564
9	MRR	99	99	198	69,153	68,786	137,939	8	11	19	0.000314	0.00131	0.000577
10	MRR	99	99	198	43,189	42,269	85,458	10	16	26	0.000623	0.003013	0.001228

* Attrition rate values are the COMAN MLE attrition rate estimate.

APPENDIX C

INSTRUCTIONS TO SCORER OF THP NARRATIVE

Shown below are the instructions provided to the judges who scored the THPs.

1. **Use the flowchart on the following page as a guideline.**

2. **Example of what might be considered a *very positive comment* within a paragraph:**

"The template developed by the S2 did an excellent job of identifying MCs and avenues of approach."

3. **Example of what might be considered a *very negative comment* within a paragraph:**

"However the avenues of approach analysis were not continuous throughout the sector nor were the MCs through the Furlong and the Whale identified. The TF was aware of the dismounted avenues of approach, but these were not adequately analyzed."

4. **Look for key words and phrases that indicate the correct subject matter.**

(i.e. IPB, DST, R&S, Terrain Analysis, Tracking of enemy recon elements, Identification of enemy avenues of approach or MCs or COAs, etc.)

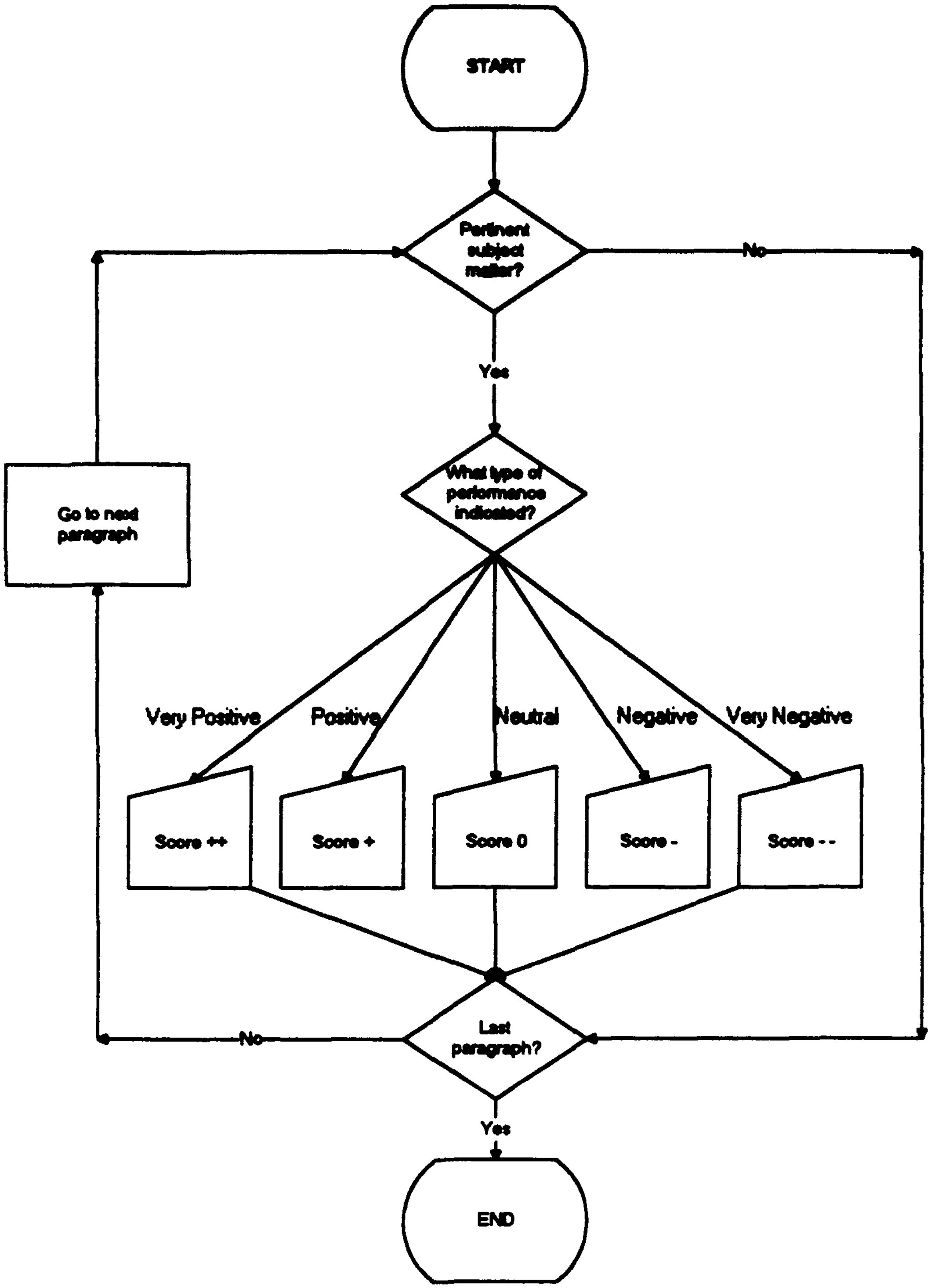
5. **Consider the relative time of the events being discussed in the narrative. Some have more impact than others.**

(i.e. early tracking of enemy recon elements is almost certainly more important to this analysis than events that occurred in the counter attack.)

6. **I realize that many paragraphs are not well written, and many are nothing more than stand alone sentences. Feel free to group them as you wish and score them collectively. I just ask that you draw arrows and braces so I know how you scored them.**

7. **Beware of *preaching* that can occur from the author of the THP narrative.**

8. **Note that the second portion of the THP narrative is consolidated comments from the entire rotation, NOT just the defense-in-sector mission segment.**


START
Pertinent subject matter?
No
Yes
What type of performance indicated?
Go to next paragraph
Very Positive
Positive
Neutral
Negative
Very Negative
Score ++
Score +
Score 0
Score -
Score - -
Last paragraph?
No
Yes
END

APPENDIX D

SAMPLE SCORING OF THP NARRATIVE

A sample battle THP narrative is shown here with the scores displayed in the text box to the right of each paragraph. There are two scored sections in each of the THPs. Any key statements within the sentence are shown in bold typeface. The first section comments on the BOSs, and the second discusses performance trends. Any references to the rotation number or unit designation have been removed or disguised.

INTELLIGENCE OPERATING SYSTEMS

1. MISSION: DEFENSE IN SECTOR DATE: DD MMM YY

a. SUMMARY OF EXECUTION

(1) THE S2

The staff synchronization by the battalion staff improved in regards to the development of the DST. The S2 still was not given adequate time to prepare IPB for the planning staff and was forced to provide cursory support. **He was able to fully develop the basic IPB products in time for distribution during the OPORD**. The staff developed a fairly complete DST, yet due to heavy attrition of the command and control elements at the preliminary stages of the battle, the identified decisions were not executed. **The template developed by the S2 did an excellent job of identifying MCs and avenues of approach**, with the exception of two dismounted routes in the southern AOs, and through the area known as John Wayne Pass, by which the OPFOR actually conducted dismounted operations. **Timelining the advancing enemy by the S2 was fairly accurate, with little error**.	**Paragraph Score: +**

The counter-reconnaissance plan developed by the S2 and S3 lacked the necessary synchronization to make it effective. This coordination also involves ensuring that all elements execute their tasks and are sufficiently resourced to conduct their mission, to include having adequate and operational night sights, operational radios, and graphics. Timely execution of assigned tasks are also critical, especially when it comes to a counter-reconnaissance mission. **When all of these shortfalls were combined (i.e., scouts executing security screen late and without proper night vision capabilities, and inadequate handoff between tracking and destruction assets), you will repeatedly have what occurred, successful penetration of the AO by enemy reconnaissance.**

Paragraph Score: -

The S2 was able to maintain a timely track of the counter- recon battle and made an estimate of the probable COAs by the enemy based upon the known reconnaissance effort. He also was able to maintain an accurate assessment of what elements had been destroyed and what remained. The TOC was destroyed during the early phase of the battle by enemy reconnaissance elements and the S2's track of the main battle ended prior to the enemy actually entering the task force's AO. Other intelligence concerns observed during the operation included the use of proper radio techniques on unsecure radio nets and establishment of local security for the TOC, both which dealt with OPSEC and counter-intelligence operations.

Paragraph Score: ++

(2) SCOUT PLATOON

(a) MISSION SUMMARY

The scout platoon was to occupy a stationary screen forward of the task force during a defense in sector.

Paragraph Score: 0

(b) PLAN

The platoon was to occupy three scout OPs, two on Furlong Ridge **and one in the** John **Wayne** Hills, **with** GSR **and** LRP teams **attached**. **The platoon was to conduct the operation during both** night **counter-recon operations and during the regimental main attack.**

Paragraph Score: 0

(c) PREPARE/EXECUTE

The **platoons preparation** prior to **each** mission has continued to improve, **particularly** in the **area** of PCC/PCI, **weapon** test fire, and OP/ **patrol preparation**; however, the platoon has yet to conduct any leader recon or rehearsals in conjunction with the OPORDs.

Paragraph Score: 0

The platoon did not occupy its screen until 040900 Mar 89; consequently, they did not participate in the first night counter-recon operation during the DRT insertion. The platoon's ability to detect the OPFOR recon on 5 Mar 89 was severely limited due to the lack of thermal devices (none on hand). **During the mission, the platoon was unable to track the regiment because it was attrited by friendly artillery, NBC, and OPFOR dismounts.**

Paragraph Score: -

INTELLIGENCE TRENDS

1. PERFORMANCE TRENDS:

Observations of Task Force 3-70, Armor's, intel operations covered the areas of planning, preparation, and execution of missions, administrative operations and recon/counter-recon planning and execution.

Paragraph Score: 0

The DST generally was developed after the formal planning session (war-gaming process) and was merely a reflection of the plan. This did not allow the staff to confirm or deny the capabilities and/or limitations of their assets to execute the plan and thus reduce the changes which might be made prior to production and distribution of the DST. Staff interaction by the S2 started out at an acceptable level. At the end of the training period, levels of coordination and synchronization between the S2 and the FSO, the staff engineer and the ALO as well as ADA officer had improved, especially in the development of the situation template. **Adjacent unit coordination was generally affected either by radio or by on the ground coordination at brigade, but this did not occur every mission. Consequently, the S2 did not always have knowledge of the adjacent units recon/counter-recon effort until his own plan had been finalized. The most serious problem observed involving the S2 in the planning process was the commander allowing him sufficient time to develop a preliminary IPB product to support the planning process. He frequently had to brief from the brigade product without the opportunity to refine the product for the task force's specific AO.**

Paragraph Score: -

The S2 was always abreast of the status of the recon/counter-recon effort, his situation template was up-to-date and he continually studied and analyzed his SITMAP for new observations and analysis to disseminate.

Paragraph Score: ++

Observations of intel operations during the execution phase of the mission involved the tracking of the battle in terms of friendly and enemy activities, analysis, and dissemination of SPOTREPs (to and from higher headquarters). The attempts to track the battle were progressive; however, available information did not always enhance the process and ultimately reduced the S2's ability to quickly analyze and evaluate the situation in reference to those COAs available to the OPFOR. Improving the quantity and quality of spot reporting, to include enemy BDA, would have greatly enhanced his efforts to conduct analysis.

Paragraph Score: 0

Recon and counter-recon operations were generally, but not always, executed in a timely manner. Planning for the missions always occurred early to allow the elements executing the plan more time for planning internally and for execution. Heavy reliance was placed upon establishing OPs for collection of information, and the scouts were seldom given route, zone, or area recon missions. When the scouts were given a mobile mission, it usually involved screening the task force's flank. OPs were generally limited in collection capabilities by communications equipment and visibility conditions, which can be affected by weather, terrain, or smoke operations. Survivability of OPs was limited by mobility and enemy direction finding efforts during the reporting process. **Overall, recon plans were generally executed successfully, but frequently failed to provide sufficient information for analysis.**

Paragraph Score: +

Finally, administrative operations during the training period were commendable. The journal improved and became a valuable tool in the tracking process. The SITMAP was constantly updated to show the latest intel. Operations maximized the use of resources and personnel. Graphics and annexes for the OPORD were always ready for distribution during the OPORD.

Paragraph Score: ++

Operations security needs emphasis and improvement across the task force. Light discipline, radio procedures and garbage and sanitation control all need improvement to ensure that the operational status of the task force is not compromised.

Paragraph Score: -

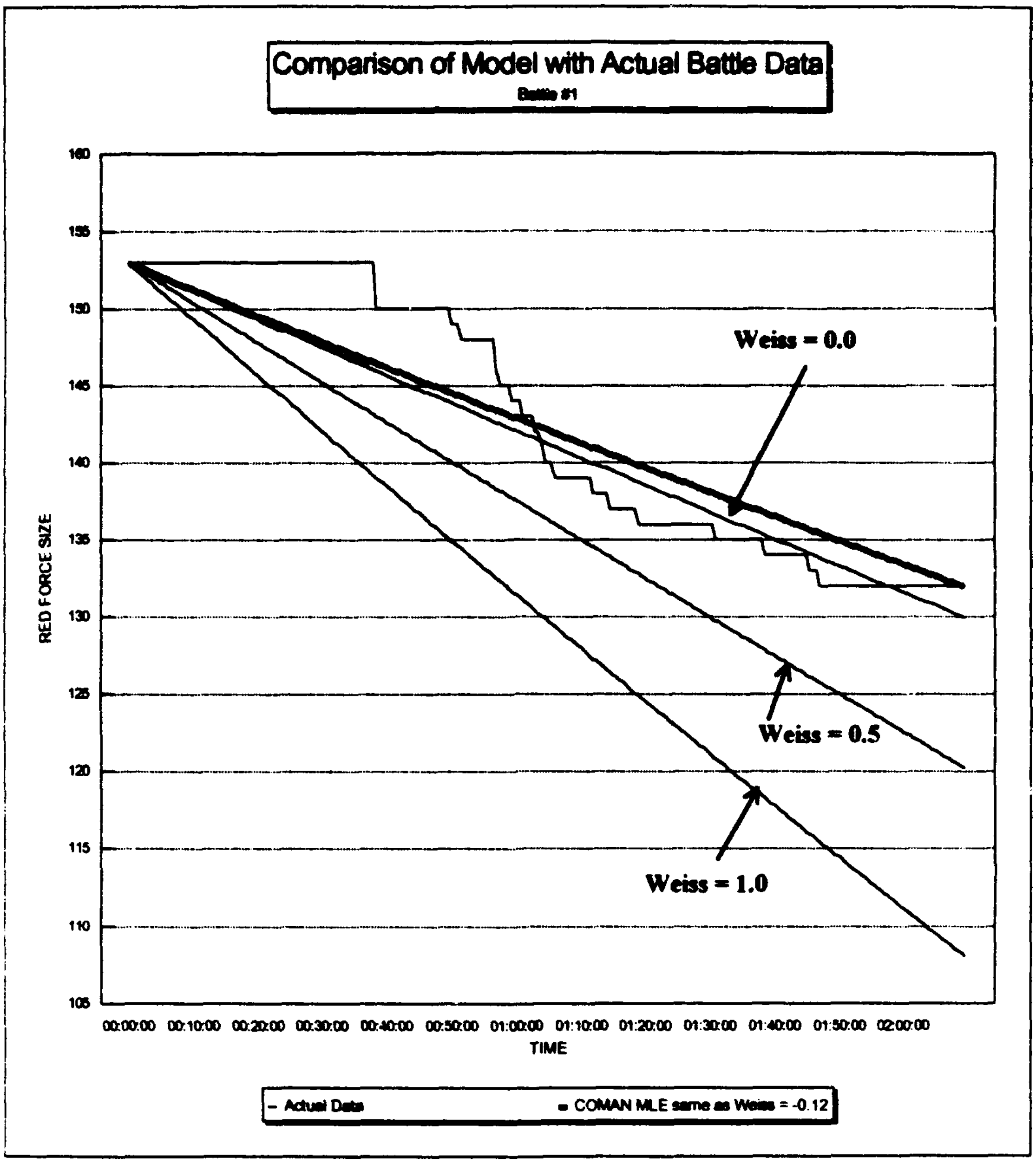
Score Tally

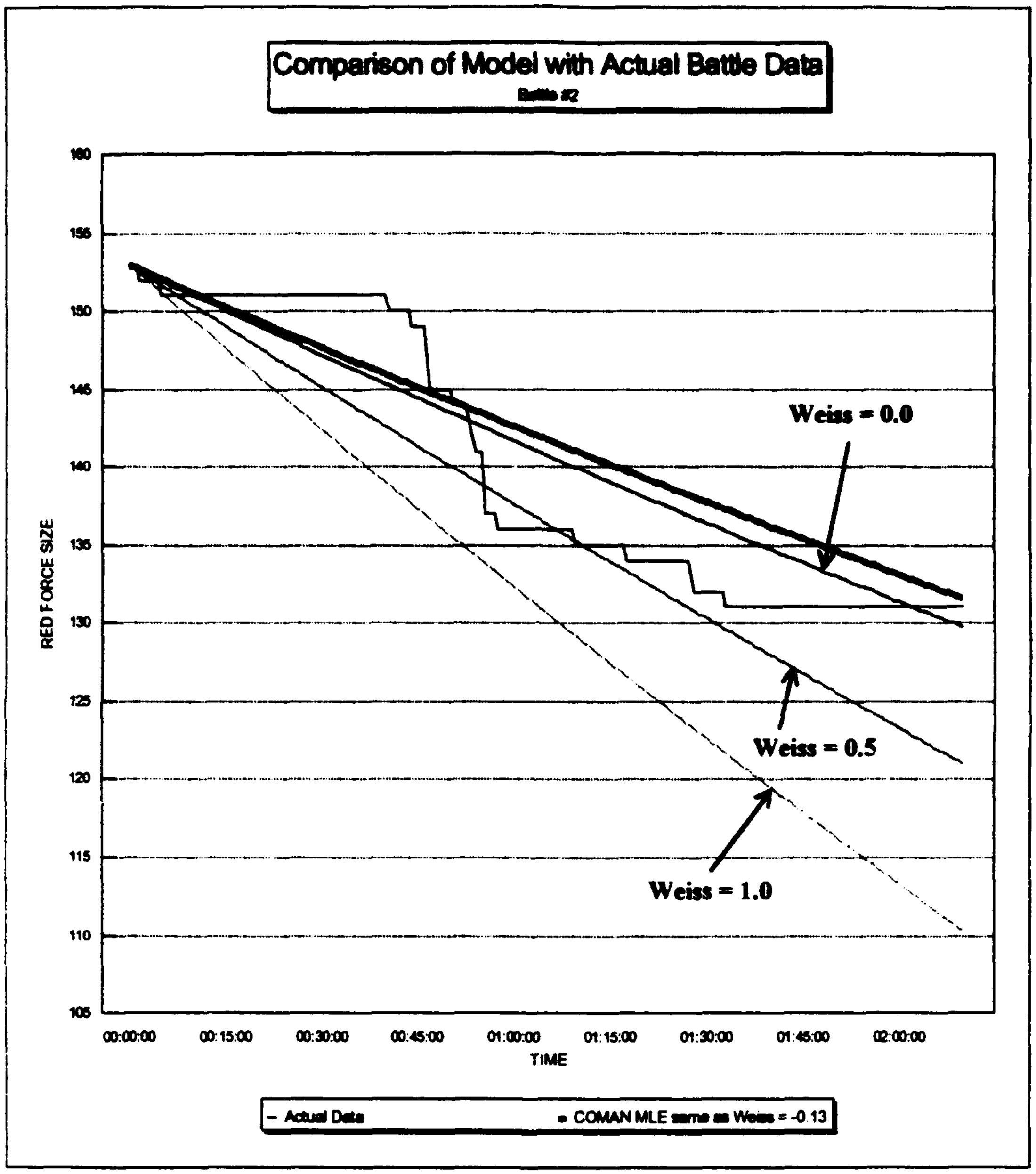
Total "++" paragraphs:	3 x 3 = 9
Total "+" paragraphs:	2 x 1 = 2
Total "0" paragraphs:	5 x 0 = 0
Total "-" paragraphs:	3 x (-1) = -3
Total "- -" paragraphs:	0 x (-3) = 0
Score for battle:	9 + 2 - 3 = 8

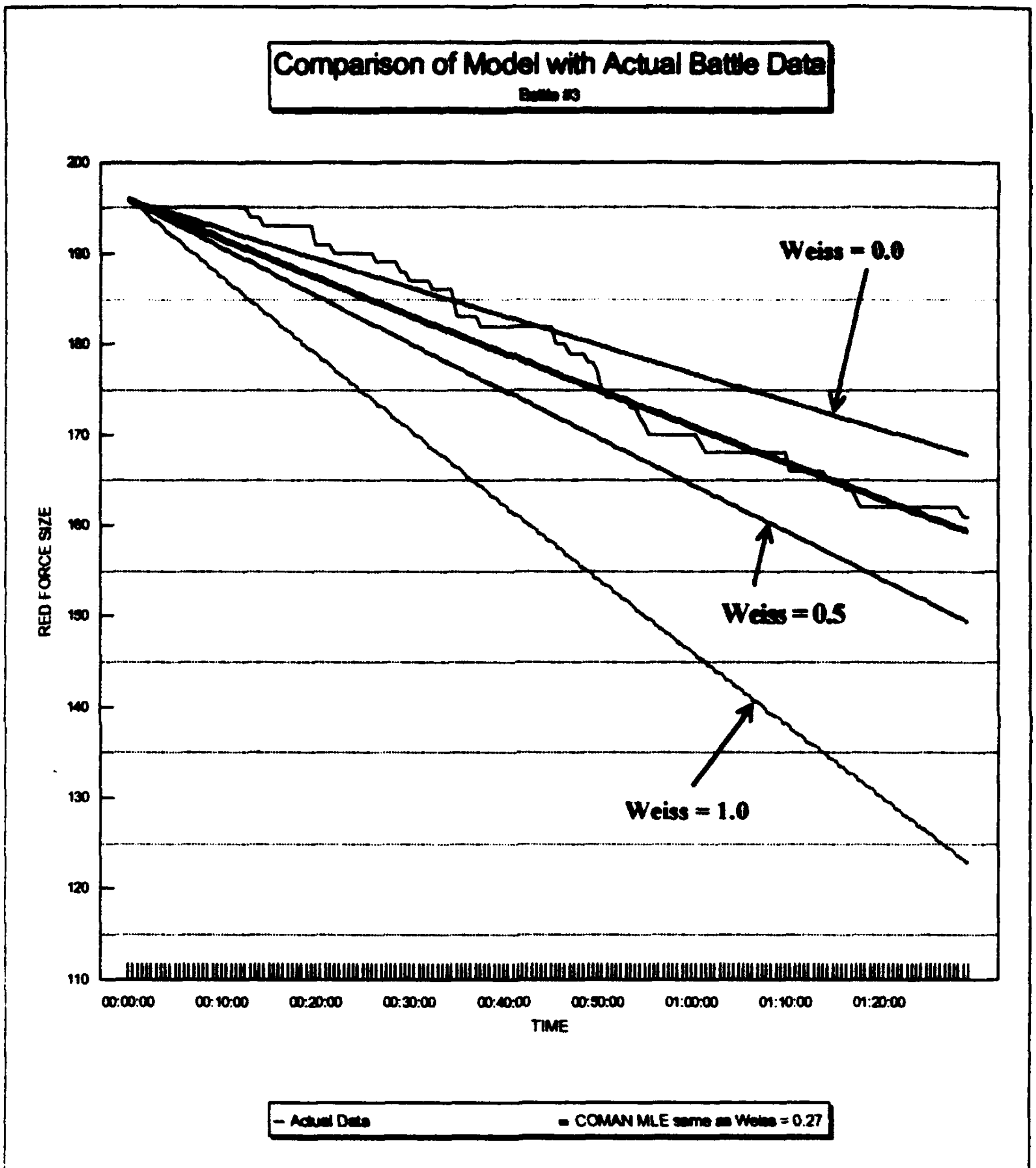
APPENDIX E

COMPARISON OF MODEL WITH ACTUAL BATTLE DATA

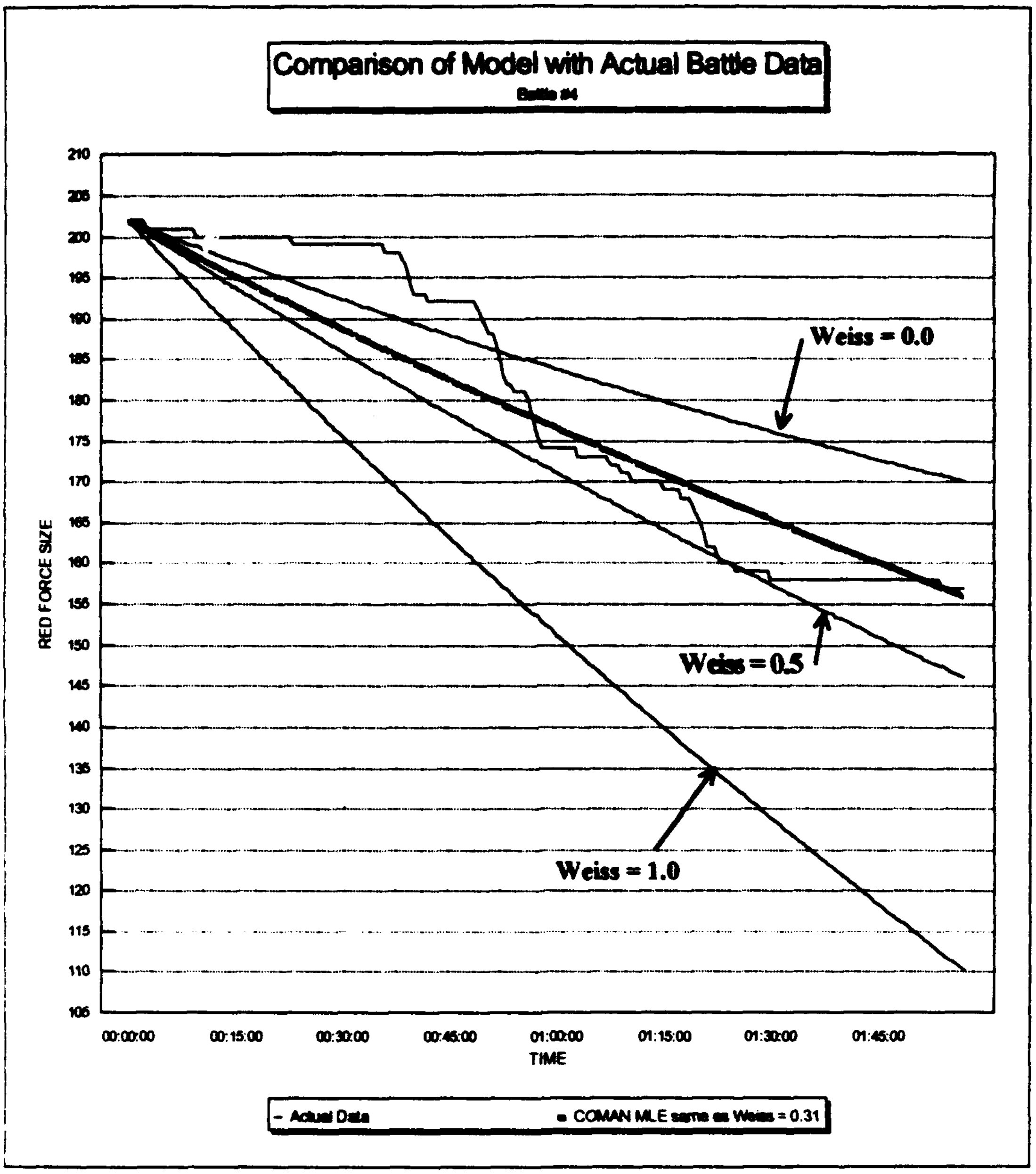
This appendix contains graphs for each of the ten NTC battles, which compare the COMAN maximum likelihood estimate of red's attrition rate to the modified Helmbold equation with the Weiss parameter set at 0.0, 0.5, and 1.0. A plot of the actual red force size for each battle is also included.


Comparison of Model with Actual Battle Data
Battle #1
160
155
150
145
140
135
130
125
120
115
110
105
RED FORCE SIZE
Weiss = 0.0
Weiss = 0.5
Weiss = 1.0
00:00:00 00:10:00 00:20:00 00:30:00 00:40:00 00:50:00 01:00:00 01:10:00 01:20:00 01:30:00 01:40:00 01:50:00 02:00:00
TIME
Actual Data
COMAN MLE same as Weiss = -0.12

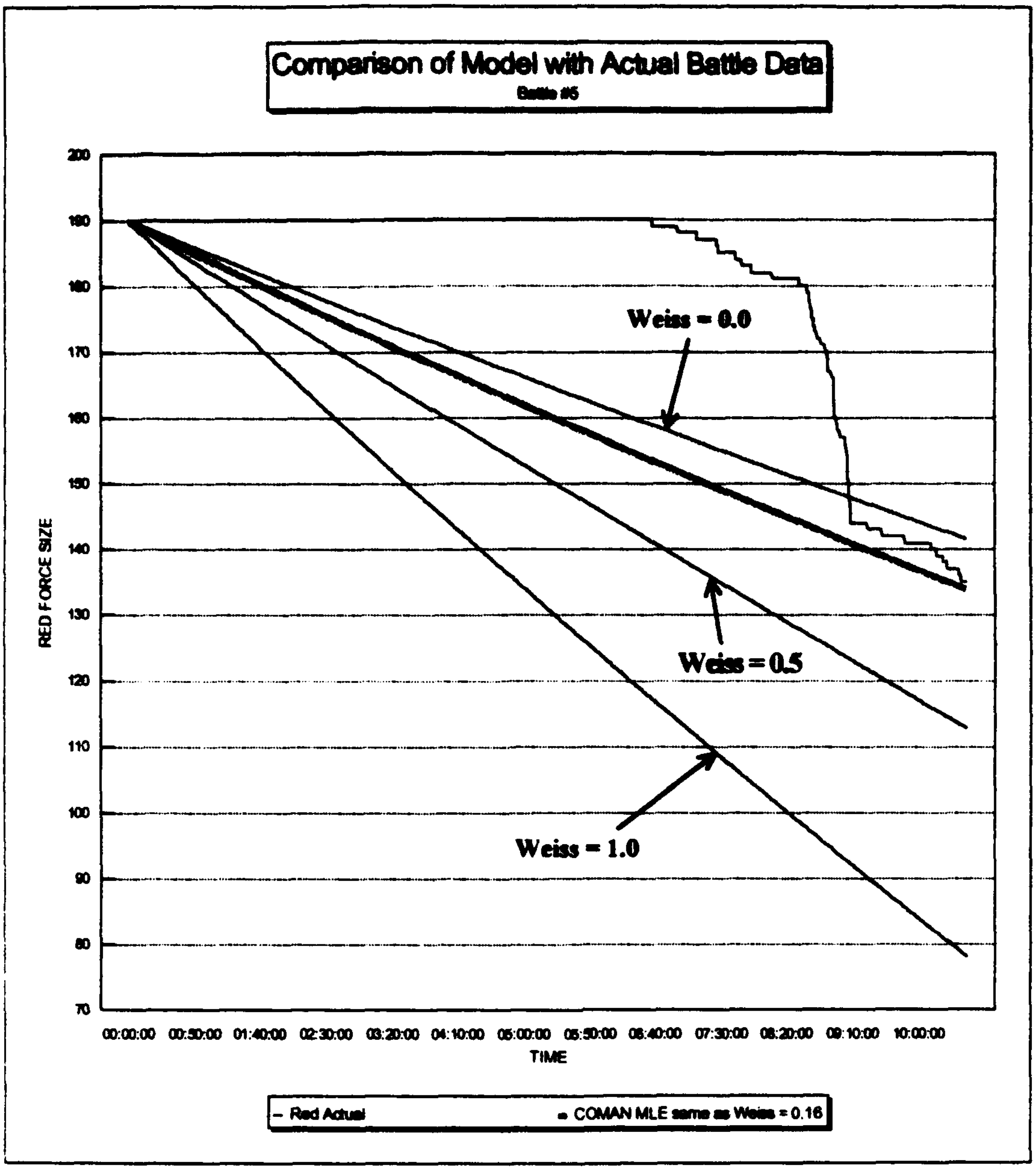

Comparison of Model with Actual Battle Data
Battle #2
RED FORCE SIZE
TIME
Weiss = 0.0
Weiss = 0.5
Weiss = 1.0
Actual Data
COMAN MLE same as Weiss = -0.13



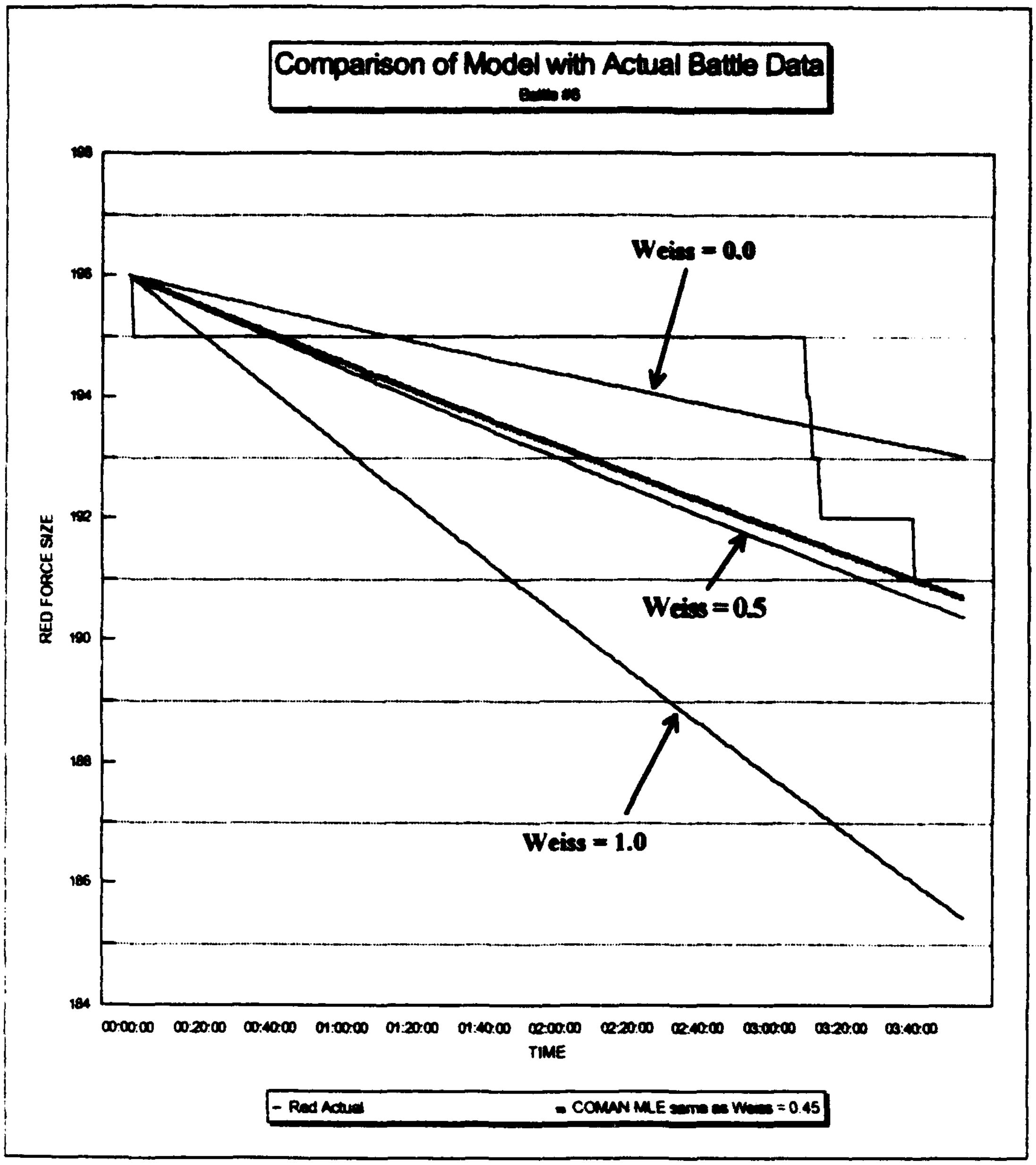
Comparison of Model with Actual Battle Data
Battle #3
200
190
180
170
160
150
140
130
120
110
RED FORCE SIZE
Weiss = 0.0
Weiss = 0.5
Weiss = 1.0
00:00:00
00:10:00
00:20:00
00:30:00
00:40:00
00:50:00
01:00:00
01:10:00
01:20:00
TIME
Actual Data
COMAN MLE same as Weiss = 0.27

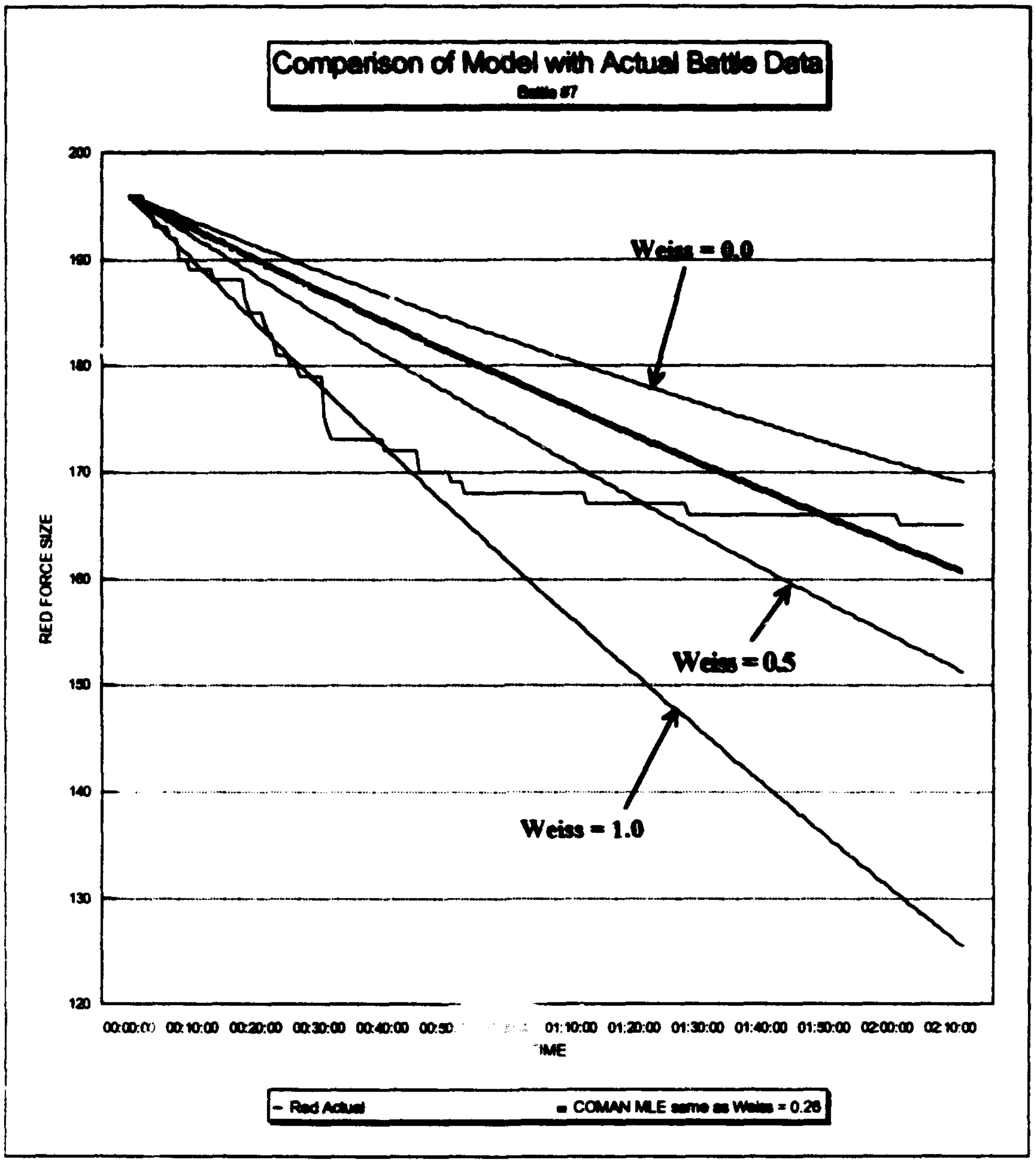


Comparison of Model with Actual Battle Data
Battle #4
210
205
200
195
190
185
180
175
170
165
160
155
150
145
140
135
130
125
120
115
110
105
RED FORCE SIZE
00:00:00
00:15:00
00:30:00
00:45:00
01:00:00
01:15:00
01:30:00
01:45:00
TIME
Weiss = 0.0
Weiss = 0.5
Weiss = 1.0
Actual Data
COMAN MLE same as Weiss = 0.31

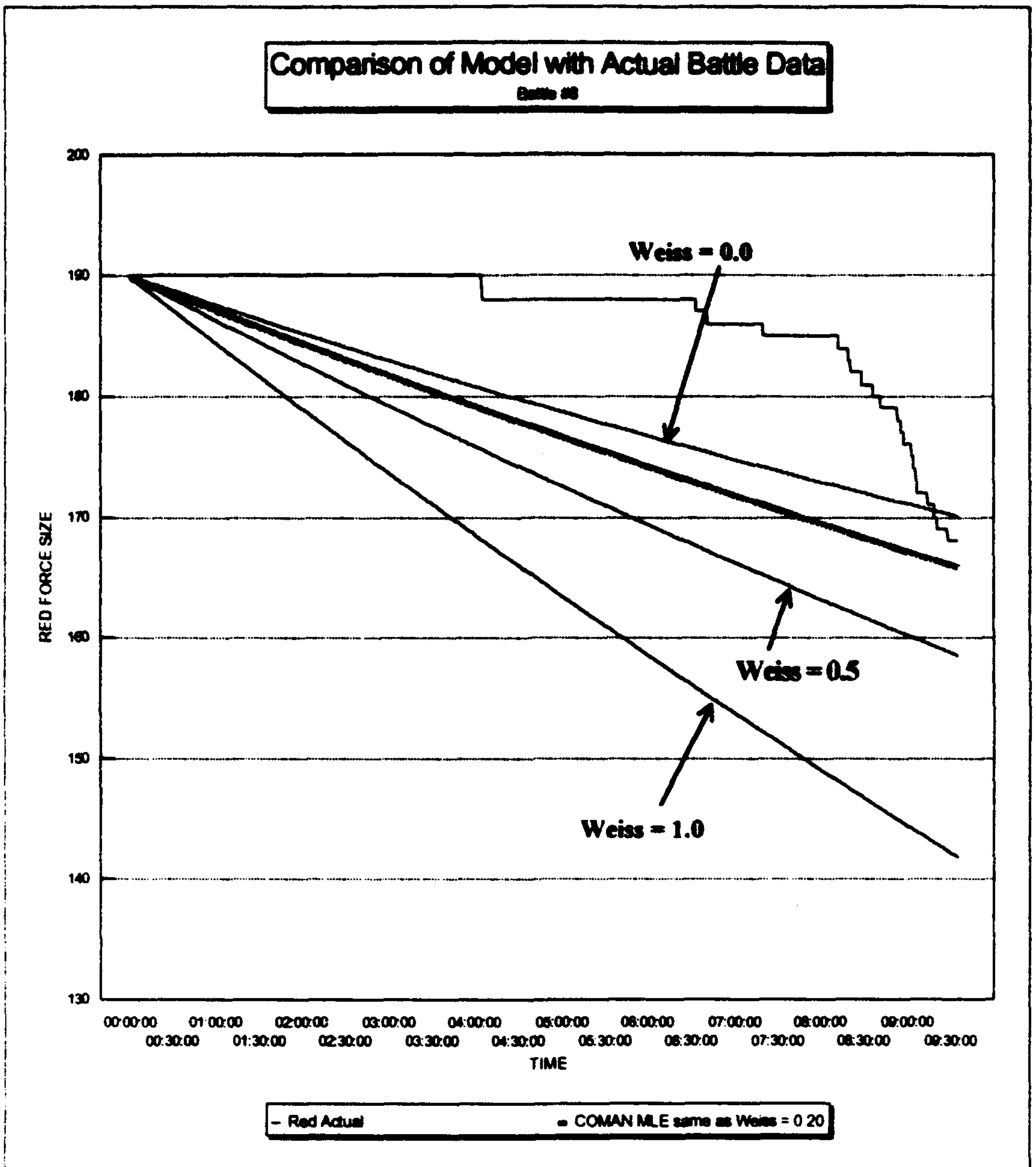


Comparison of Model with Actual Battle Data
Battle #5
200
190
180
170
160
150
140
130
120
110
100
90
80
70
RED FORCE SIZE
Weiss = 0.0
Weiss = 0.5
Weiss = 1.0
00:00:00
00:50:00
01:40:00
02:30:00
03:20:00
04:10:00
05:00:00
05:50:00
06:40:00
07:30:00
08:20:00
09:10:00
10:00:00
TIME
Red Actual
COMAN MLE same as Weiss = 0.16

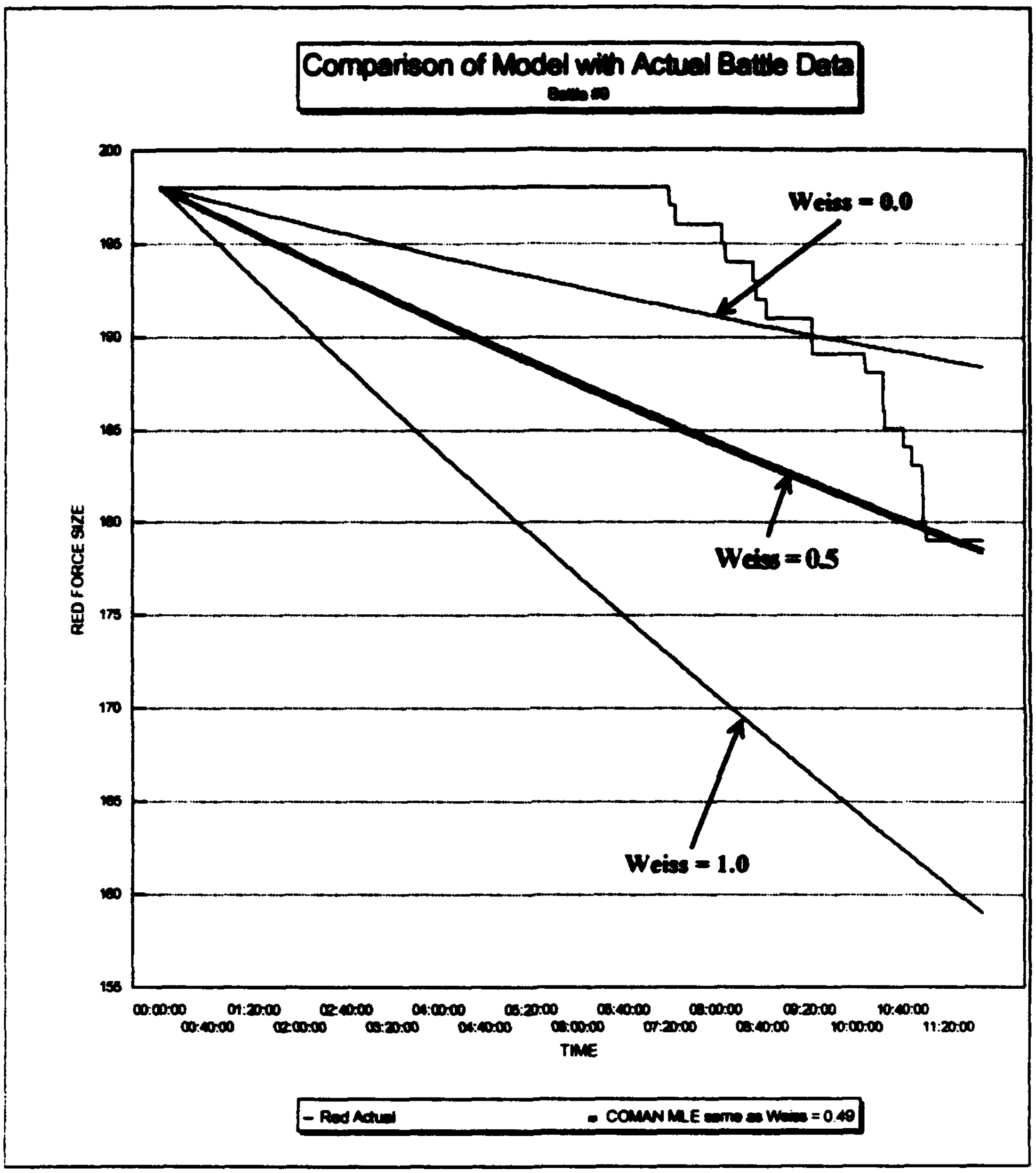

Comparison of Model with Actual Battle Data
Battle #6
198
196
194
192
190
188
186
184
RED FORCE SIZE
Weiss = 0.0
Weiss = 0.5
Weiss = 1.0
00:00:00
00:20:00
00:40:00
01:00:00
01:20:00
01:40:00
02:00:00
02:20:00
02:40:00
03:00:00
03:20:00
03:40:00
TIME
Red Actual
COMAN MLE same as Weiss = 0.45

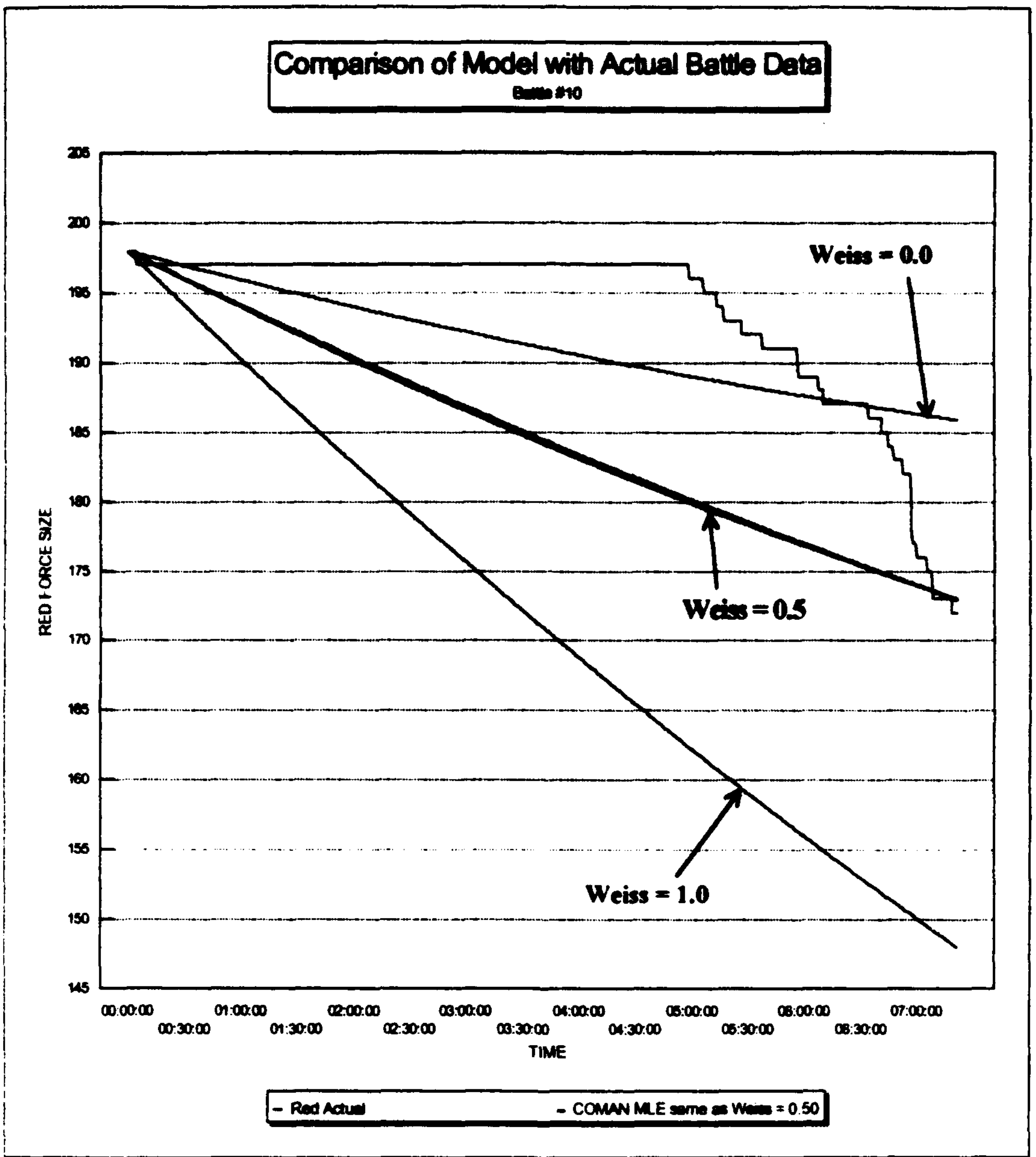


Comparison of Model with Actual Battle Data
Battle #7
200
190
180
170
160
150
140
130
120
RED FORCE SIZE
Weiss = 0.0
Weiss = 0.5
Weiss = 1.0
00:10:00
00:20:00
00:30:00
00:40:00
01:10:00
01:20:00
01:30:00
01:40:00
01:50:00
02:00:00
02:10:00
Red Actual
COMAN MLE same as Weiss = 0.26



Comparison of Model with Actual Battle Data
Battle #8
200
190
180
170
160
150
140
130
RED FORCE SIZE
Weiss = 0.0
Weiss = 0.5
Weiss = 1.0
00:00:00
01:00:00
02:00:00
03:00:00
04:00:00
05:00:00
06:00:00
07:00:00
08:00:00
09:00:00
00:30:00
01:30:00
02:30:00
03:30:00
04:30:00
05:30:00
06:30:00
07:30:00
08:30:00
09:30:00
TIME
Red Actual
COMAN MLE same as Weiss = 0.20


Comparison of Model with Actual Battle Data
200
195
190
185
180
175
170
165
160
155
RED FORCE SIZE
Weiss = 0.0
Weiss = 0.5
Weiss = 1.0
00:00:00
00:40:00
01:20:00
02:00:00
02:40:00
03:20:00
04:00:00
04:40:00
05:20:00
06:00:00
06:40:00
07:20:00
08:00:00
08:40:00
09:20:00
10:00:00
10:40:00
11:20:00
TIME
Red Actual
COMAN MLE same as Weiss = 0.49



Comparison of Model with Actual Battle Data
Battle #10
205
200
195
190
185
180
175
170
165
160
155
150
145
RED FORCE SIZE
00:00:00
00:30:00
01:00:00
01:30:00
02:00:00
02:30:00
03:00:00
03:30:00
04:00:00
04:30:00
05:00:00
05:30:00
06:00:00
06:30:00
07:00:00
TIME
Weiss = 0.0
Weiss = 0.5
Weiss = 1.0
Red Actual
COMAN MLE same as Weiss = 0.50

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