FAST-VAL:
Case Study of North Vietnamese Army
Mortar Attack on U.S. Marine Infantry
Company and Battalion Command Post at
Hill 256 near the Ben Hai River

S. H. Miller

A Report prepared for
UNIVERSITY STATES AIR FORCE PROJECT RAND
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PREFACE

The Forward Air Strike Evaluation Model, Phase II (FAST-VAL II), was developed at Rand to measure the influence of close air support upon the outcome of ground engagements of regimental size or smaller. This two-sided simulation model measures the contribution of artillery, mortars, and small arms as well as air-delivered weapons upon the outcome of a fire fight. This research is intended to assist the Air Force in selecting weapons, vehicles, and operational techniques for close-air-support mission.

This report describes one of a series of case studies* used to compare the results of FAST-VAL simulations of small-unit (company-size) actions in Vietnam with actual combat results. Data for this series of case studies came from interviews with fire-fight participants and from official records. The interviews with military personnel were conducted in Okinawa and Vietnam during March and April 1969 under joint Air Force-Marine Corps sponsorship.

These comparisons are the basis for the critical evaluation of the FAST-VAL model and its parameters presented in R-810-PR, FAST VAL: Summary Report on the Comparison of Model with Combat Results (Infantry Fire-Fight Outcomes and Effectiveness of Small Arms, Bombs, Artillery, and Mortar Rounds).

This report describes a 4- to 6-minute North Vietnamese Army 82mm mortar attack against U.S. Marine Corps units and compares the results of FAST-VAL simulations of the attack with the combat results.

* * * * * * * * * *

We gratefully acknowledge the assistance and cooperation of the U.S. Marine Corps in providing us information that made this study possible. The results and conclusions we have drawn, however, should not be interpreted as reflecting the official opinion or policy of the U.S. Marine Corps.

* A bibliography of related FAST-VAL reports appears on the following pages.
BIBLIOGRAPHY OF RELATED FAST-VAL REPORTS


R-817-PR  Harris, K., and S. G. Spring, FAST-VAL Expected Casualties from Small-Arms Fire (U), The Rand Corporation, November 1971 (Confidential).


R-821-PR  Weaver, K. K., and S. G. Spring, FAST-VAL: Case Study of an Attack by a Marine Platoon on an NVA Company Near Kim (1) South of Da Nang (U), The Rand Corporation, November 1971 (Secret).

R-822-PR  Lind, J. R., S. G. Spring, and K. Harris, FAST-VAL: Case Study of a Series of Mortar Attacks on a Marine Infantry Company at LZ Margo, 16 and 17 September 1968 (U), The Rand Corporation, November 1971 (Secret).


SUMMARY

The Rand FAST-VAL II simulation model computes casualties inflicted in ground combat by small arms, mortars, artillery, and air ordnance; evaluates casualty-related effects on the performance of ground units; and appraises outcomes of military ground actions. This report presents a case study to evaluate the model's computation of casualties caused by mortars.

The text describes a 4- to 6-minute North Vietnamese Army (NVA) attack by 82mm mortar tubes on Bravo Company and the Command Post of the U.S. Marine 1st Battalion 9th Regiment (1/9) on 17 September 1968 near the Ben Hai River. The mortar attack was not followed by a ground attack. This was one of a series of encounters between elements of the NVA 320th Division and the U.S. 3d Marine Division during August and September 1968. Casualty figures resulting from the mortar attack are available and are compared directly with casualties computed by the model.

In early August 1968 the NVA 320th Division, deployed south of the Ben Hai River, prepared to launch an offensive into South Vietnam and westward along the trails north of Route 9 between Cam Ho and the rockpile. The U.S. 3d Marine Division engaged elements of the NVA 320th from mid-August into September. By mid-September, the 320th Division was employing "delaying tactics" (limited-objectives attacks, small-unit ambushes, harassing, mortar fire) in its attempt to escape north.

The two companies and the battalion Command Post of the 1st Battalion 9th Marine Regiment were inserted into the DMZ just south (1 kilometer) of the Ben Hai River on 17 September. Their landing zone (Hill 256) was "prepped" by fixed-wing aircraft prior to insertion. They had been briefed to expect enemy activity, so foxholes were immediately constructed. During the afternoon, small groups of NVA troops were sighted and engaged with small arms. U.S. artillery was called in on an underwater foot bridge spanning the river. The light contacts persisted until about 1800 hours and kept 1/9 from moving off Hill 256 that same day as originally planned.
At about 1915 hours, the NVA fired between 15 and 65 82mm mortar rounds at Hill 256 from positions about 2 km to the north. There were three casualties—2 Marines WIA and one correspondent.

At the time of the mortar attack, friendly aircraft were bombing and artillery was delivering white and phosphorous shells against enemy troops crossing the river. The first mortar rounds were about 300 meters off the position so that "everyone had a chance to get down." The computed casualties as a function of rounds received are shown in the upper portion of Fig. S1. The reported casualties, three, lie outside the 95th percentile line * when all troops are crouched in foxholes for the range of interview reported mortar rounds received.

A series of simulations were made to examine the troop posture assumptions that would cause the reported casualties to be within the 95th percentile curve * for the entire range of reported rounds (15-65). The lower portion of Fig. S1 illustrates two acceptable posture assumptions. The fit would be reasonable when about 8 percent (15 troops) were prone or 15 percent (29 troops) were standing in foxholes observing while the remaining troops were crouched in foxholes.

The moderate fraction of troops less protected appears a reasonable assumption according to the experience of other officers in other engagements; however, the interviews with two participating officers in this attack indicate that all troops were crouched in foxholes. The statistical test * indicates that the FAST-VAL computed casualties should be rejected as an acceptable representation of reported casualties when all troops are crouched in foxholes.

* See Appendix D.
Fig. S1--U.S. casualties versus NVA 82mm mortar rounds received (Hill 256 case - simulation of mortar attack)
ACKNOWLEDGMENTS

The assistance and suggestions of J. Lind, K. Harris, W. Barrett and S. Spring are gratefully acknowledged. We also acknowledge the cooperation of Major Charles Sirotniak and First Lieutenant V. J. Forte, USMC who participated in this attack and whose observations made it possible to simulate the actual attack closely.
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## GLOSSARY

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<thead>
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<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AO</td>
<td>Aerial Observer</td>
</tr>
<tr>
<td>BA</td>
<td>Basic Allowance</td>
</tr>
<tr>
<td>Battalion Three</td>
<td>Battalion Operations Officer</td>
</tr>
<tr>
<td>Charlie</td>
<td>Company C</td>
</tr>
<tr>
<td>COC Bunker</td>
<td>Combat Operations Center Bunker</td>
</tr>
<tr>
<td>CP</td>
<td>Command Post</td>
</tr>
<tr>
<td>Delta, Delphus</td>
<td>Company D</td>
</tr>
<tr>
<td>DMZ</td>
<td>Demilitarized Zone</td>
</tr>
<tr>
<td>FAC</td>
<td>Forward Air Controller</td>
</tr>
<tr>
<td>FO</td>
<td>Forward Observer</td>
</tr>
<tr>
<td>G2</td>
<td>Intelligence</td>
</tr>
<tr>
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<td>High Explosive</td>
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<td>IP</td>
<td>Impact Point</td>
</tr>
<tr>
<td>KIA</td>
<td>Killed in Action</td>
</tr>
<tr>
<td>LZ</td>
<td>Landing Zone</td>
</tr>
<tr>
<td>NVA</td>
<td>North Vietnamese Army</td>
</tr>
<tr>
<td>OP</td>
<td>Outpost or Observation Post</td>
</tr>
<tr>
<td>ROT</td>
<td>Round on Target</td>
</tr>
<tr>
<td>61, 62</td>
<td>Code Name for one of the forward observers</td>
</tr>
<tr>
<td>VT</td>
<td>Variable Time</td>
</tr>
<tr>
<td>WIA</td>
<td>Wounded in Action</td>
</tr>
<tr>
<td>Willy Peter</td>
<td>White Phosphorous</td>
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I. INTRODUCTION

A major mission of the U.S. Air Force is close support of ground forces in battle. This is a complex mission, conducted in concert with ground units, generally under ground-force rules and directed toward augmenting ground weapon systems. Rand's objective in the FAST-VAL project has been to provide an analytic aid to the selection of tactics, techniques, vehicles, and munitions for this mission.

The FAST-VAL model has been used to examine in detail interaction of men and weapons on the battlefield. In the earlier phases of this study, hypothetical combat situation scenarios were used. Highly detailed, confirmed descriptions of actual engagements of small units--our area of current primary interest--were not available. The situation changed in the spring of 1967. While the first battle of Khe Sanh, South Vietnam, was being fought in April and May of that year, the U.S. Marine Corps recorded the details of the action in depth and, at Rand's request, made the records available for use in Rand tactical studies.

Both the firing records of the artillery batteries supporting the Marine infantrymen and a fine-grained after-action report prepared by the Marine infantry regiment involved in the fighting were provided. In addition to providing records, the Marine Corps allowed Rand to interview key participants in the Khe Sanh fight. Most significantly, members of the study group were able several times to interview the infantry company commander in that part of the battle of prime interest to the analysis. The application of artillery was discussed with both the forward observer and the commander of the artillery units delivering the supporting fires. The Combat Activities (COACT) File of the Joint Chiefs of Staff provided data on the sorties flown and the air-delivered munitions used during the battle.

A FAST-VAL II simulation was made of one portion of this first battle for Khe Sanh. The simulation results in terms of casualties suffered by the Marines, were quite similar to those given in the after-action report and described in the interviews. Additionally, unit reaction to casualties bore close resemblance to the reaction implied
by the model. These results suggested quite strongly that the FAST-VAL methods of evaluating weapons effects and their influence on unit performance and battle outcome are realistic and that the FAST-VAL methodology warranted additional case study examination.

To facilitate further investigations, the Air Force entered into a joint agreement with the Marine Corps that enabled members of the FAST-VAL study group to visit South Vietnam and the Pacific theater to interview military personnel with recent battle experience and to gather data on artillery battery fire and air munition deliveries. In March and April 1969, 23 Marine Corps officers were interviewed in Okinawa and South Vietnam on 16 different combat actions, and 3 U.S. Army officers were interviewed on 3 engagements.

The scenario for the case study described here was taken from official Marine records, and from two taped interviews made separately with one Marine company commander and one Marine platoon leader who took part in the action. The object of the study is to compare casualties as computed by the FAST-VAL model with actual casualties. The action concerns an NVA 82mm mortar attack against one Marine infantry company and its battalion Command Post (CP). A second Marine infantry company was inserted into a landing zone with these units, but only the CP and one company appear to have been targets of the NVA mortars.

Section II describes the tactical situation as we interpret it from the interviews, the official records, and a chronicle of the 320th NVA Division offensive and the 3d U.S. Marine counteroffensive, which appeared in the March 1969 Marine Corps Gazette.

Section III describes the attack as simulated by FAST-VAL, including the assumptions and planning factors or parameters used to make the simulations.

Section IV presents the results of the simulations, analyzes the NVA attack, and outlines our findings and conclusions.
II. THE TACTICAL SITUATION

In early August 1968, the NVA 320th Division, deployed south of the Ben Hai River, prepared to launch an offensive into South Vietnam and westward along the trails north of Route 9 between Cam Ho and the Rockpile. (1) Unless otherwise specified, all data hereunder were acquired from the appendices.

The 3d U.S. Marine Division commanded by Major General R. C. Davis engaged elements of the NVA 320th during the remainder of August and into September 1968. By the middle of September, it appeared that the enemy was using "delaying tactics (very limited-objective attacks, small-unit ambushes, employing claymore mines, and harassing mortar fire)"(1) which indicated that it was attempting to escape north. Accordingly two battalions, 1st Battalion, 6th Marine Regiment (1/4), and 1st Battalion, 9th Marine Regiment (1/9), were ordered into the DMZ with the objective of trapping as many scattered NVA units as possible. Three B-52 strikes were flown 16 September, and six more bombing missions on 17 September, on which date 1/4 and 1/9 were inserted into the DMZ just south of the Ben Hai River. Six more missions were flown after their insertion (see Fig. 1 and Appendix C).

Battalion 1/9 planned to push south and west immediately. Company A (Alfa), Company B (Bravo), and the 1st Battalion CP landed in the vicinity (see Fig. 1) of Hill 256 (map coordinate XD907676), with Alfa and Bravo Companies arriving early in the morning of September 17. Alfa's strength was 145; Bravo's was 140, plus or minus 10. They had been briefed to expect enemy activity, so most troops immediately dug 1- or 2-man foxholes deep enough to permit all occupants to crouch below ground level. Also, many small foxholes and one large foxhole, 4 feet by 5 feet (a combat operation's center (COC) bunker) were dug for the CP. The foxholes were sometimes reinforced at the forward edge with logs or sandbags, but were not covered. Some 50 CP personnel arrived about noon 17 September.

Alfa Company positioned one platoon forward as an outpost. This was withdrawn to the company perimeter during the evening.
Fig. 1—Nearby air strikes on September 17, 1968, subsequent to helicopter insertion of USMC 1st Battalion 9th Regiment in DMZ

The situation map drawn by the Alfa Company commander appears as Fig. 2 and a similar map drawn by the leader of 1st Platoon, Bravo Company, appears as Fig. 3. Both maps show Alfa to the east, Bravo to the west, and the CP in between. Based on these situation maps and data contained in the interviews with the Alfa Company and 1st Platoon Bravo Commanders (Appendix A), a detailed situation map, Fig. 4, was drawn.

There had been no previous fighting on and about Hill 256 in the area where Alfa, Bravo, and the CP were positioned on September 17. Prior to landing, the area was prepared by air attack for troop insertion, with the result that except for a few craters, some napalm burn, and trees knocked down, it was virgin territory. There was little cover on the ridge except for an 8- to 15-foot scrub growth of elephant grass that had been burned over with napalm. The elephant grass in the nearby hills served as cover for the NVA, who could be heard moving about in it. On Hill 256 itself, there was no cover—no brush,
NOTE: Estimated position of NVA mortars - XD917692. See Figure 1.

KEY: ○ Machine gun  □ Foxhole  ▲ Outpost

Unit Identification:  □ Battalion Hqtrs  ▲ Company Hqtrs

- Number immediately right of block identifies regiment.
- Number immediately left of block identifies battalion.
- Letter on left identifies company.

Fig. 2--Situation map as drawn by Maj Sirotniak
Fig. 3--Situation map as drawn by Lt Forte
NOTE: NVA mortars estimated to be located 6,000 ft from battalion CP. See Figure 1.

KEY:  
- 60mm mortars
- Machine guns
- Rifle squads
- Command Post

Unit Identification: (Infantry)
- Battalion Hqtrs
- Company Hqtrs
- Platoon Hqtrs
- Mortar Section

- Number immediately right of block identifies regiment.
- Number immediately left of block identifies battalion.
- Letter on left identifies company.
- Number preceding this letter identifies platoon.

Fig. 4--Situation map used in FAST-VAL simulation
no trees—just a grassy knoll. There was heavy foliage and brush in some areas, with heavy jungle and thick foliage on the far bank of the river.

The weather was fair. At 1800 hours, 17 September 1968, there were 0.2 cumulonimbus with bases at 3500 feet; 0.1 altocumulus with bases at 8000 feet; and 0.4 cirrus. Visibility was 7 miles. Temperature at 1500 hours was 96°F; at 1800 hours, 87°F. Relative humidity at 1800 hours was 72 percent. There was zero precipitation in the previous 24 hours. The season was the beginning of the transition from the SW to the NE monsoons.

Shortly after noon, small groups of NVA troops were sighted and engaged with small arms. Snipers fired on the enemy, and artillery was called in on an underwater footbridge (Fig. 3) across the Ben Hai River. NVA troops departing the area in haste used a small steel cable or rope handrail above the water. Observers reported excellent artillery effects on NVA troop occupants trying to cross the bridge, and on either side of the bridge: "25 NVA KIA (killed in action) were later confirmed." Snipers also reported success in felling NVA. This "light contact" with the enemy persisted through the day until about 1800 hours and kept 1/9 from moving off Hill 256 the first day, September 17, as originally planned.

At about 1915 hours on September 17, the NVA fired 82mm mortar tubes in an attack lasting not more than 5 or 6 minutes. The enemy mortar attack started at dusk, which was reported to be a favorite time for the NVA. The first round landed approximately 300 meters away from the Marine position. The mortar rounds were then walked in to the point at the crest of Hill 256, where Alfa and Bravo Companies were tied in at the north, through the Bravo line, through the battalion CP, and then down in the valley and out of Bravo's area. It thus appears that the rounds came in from the north, proceeding in a southerly direction and then veering north and east to follow the general location of Bravo Company and the battalion CP. Alfa Company was not hit.

* See "Command Chronology for 17 September," Appendix B.
The Command Chronology reports that the battalion CP received 15 NVA mortar rounds. Both officers interviewed agreed that there were more than 15 enemy mortar rounds. In fact, the leader of 1st Platoon, Bravo Company, estimated that "They shot about 65 at us...."

The Alpha Company Commander's estimate of casualties is: "No one was really hurt badly except for a newspaper correspondent, who stuck his head up. I remember seven. Maybe all of them were not medevacs, but I remember seven people being hit." Other casualty reports have conflicting information and are presented in Appendix E; our analysis of the casualty reports indicate that there were five casualties, three of whom were air-evacuated on the night of September 17.

The Alpha Company Commander estimated that two NVA mortar tubes used in the attack were located somewhere in a circle of radius 150 to 250 meters, with its center at map coordinate XD917692. The 1st Platoon leader estimated that the tubes were somewhere in a circle of radius 50 meters, with its center at XD913698. The Command Chronology reports that the mortar rounds were 82mm. According to the interviews, although the sound of the first enemy mortars may have been mixed in with bombing by friendly aircraft or the delivery of white phosphorus shells by friendly artillery against the enemy, all subsequent rounds could be identified by the "pop" of the tubes as they fired. The sound provided adequate warning, so that "everyone had a chance to get down." It is likely that the NVA had a very good idea of their aiming points. In answer to the question, "They had you spotted?," the Alpha Company Commander answered, "Sure, they couldn't help it. We stayed there all day, running around as well."

The mortar attack against the Marines was not accompanied by a ground attack. There were no further mortar attacks against these elements of 1/9 for the balance of September 17.

Thus, the effects of a known fire program on an objective can be determined quite accurately and compared to the FAST-VAL model's computations for a simulated attack.

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*See Appendix A.
III. SIMULATION OF THE MORTAR ATTACK

This section compares FAST-VAL estimated casualties with the actual casualties recorded in official reports. The comparison involves only the mortar attacks on Bravo Company and the Command Post. Alfa Company was not hit.

POSTURE

The body position assumed by riflemen and weapon crewmen in actual combat—e.g., lying prone, standing in open foxholes, crouched in open foxholes, or fighting from covered foxholes or bunkers—affects their vulnerability to incoming mortar fire. The FAST-VAL simulation model recognizes the relationship and provides an input for troop posture so that it may be considered in computing casualties.

Both U.S. Marine officers interviewed indicated that most troops had dug foxholes deep enough to permit them to crouch below ground level.

Troops caught away from foxholes at the beginning of the NVA mortar attack could hear the "pop" of mortar rounds leaving the tube, and could take some sort of cover or lie prone.

Uncertainty surrounds the exact number of troops who, during this attack, were (1) crouched in foxholes with all parts of their bodies below ground level; (2) standing in foxholes observing the action, with part of their bodies above ground level; and (3) prone on the ground.

Two series of simulations were run to show the influence of posture on the simulation results:

1. The first simulation in the initial series had all Bravo Company and CP personnel crouched in foxholes. In succeeding simulations of the series the ratio of personnel standing in foxholes to personnel crouched in foxholes was increased until, in the last simulation, all personnel of Bravo Company and the CP were standing in foxholes.
2. In the second series, part of the personnel were crouched in foxholes and part were lying prone on the ground away from foxholes. The ratio of the latter to the former was increased until the last simulation of the second series. Five simulations were run in each of the two series to show a relationship between posture and casualties:

<table>
<thead>
<tr>
<th>Simulation</th>
<th>Posture</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>100 percent in the lower posture</td>
</tr>
<tr>
<td>(2)</td>
<td>95 percent in the lower posture</td>
</tr>
<tr>
<td>(3)</td>
<td>80 percent in the lower posture</td>
</tr>
<tr>
<td>(4)</td>
<td>60 percent in the lower posture</td>
</tr>
<tr>
<td>(5)</td>
<td>100 percent in the upper posture</td>
</tr>
</tbody>
</table>

**NVA WEAPON FIRES**

Both officers interviewed were uncertain of the exact number of mortar rounds fired, but both believed that more were fired than the 15 rounds officially reported. When asked about the number, the Alfa Company Commander said, "I counted in excess of fifteen and they came fast," but did not say how many rounds were fired. The leader of the Bravo Company 1st platoon reported that there were about 65 rounds. To cover the general range, we made simulations with 20, 32, and 66 rounds for each posture in both series. Thus, 3x5x2 or 30 combinations of mortar rounds and posture were covered by the simulations.

**SIMULATION INPUTS**

The simulations require three basic types of inputs: weapon effects, location of targets, and aiming points of mortars. Each is examined in turn.

*There would be no casualties with zero rounds. This fact coupled with the results at 20, 32, and 66 rounds permits the calculation, using interpolation techniques, at all intermediate numbers of rounds fired, i.e., from 1 through 65 82mm mortar rounds fired.
Weapon Effects

In a FAST-VAL simulation, a deployed unit is defined by gridding the battlefield into squares 100 feet on a side using a rectangular coordinate system. The numbers of riflemen, support personnel, and equipment positioned in each square are associated with the coordinates of the center of the square. The probability that a man (or piece of equipment) will be disabled is computed taking into consideration many factors, e.g., type of weapon and its characteristics (fragment pattern, velocities, etc.), aiming error, relative location of target to aiming point, average presented area of target, vulnerability of target, etc. Men and equipment are assumed to be distributed about the center of each 100-foot square according to a Normal (Gaussian) distribution, as though each man is in a 100-foot square area with most of his area at the center of the square.

Tables 1, 2, and 3 show the casualty probabilities for a single 82mm mortar round against troops that are (1) prone, (2) standing in foxholes, and (3) crouched in foxholes, respectively. The tables provide the probability that a man located in a 100-foot square whose center is d feet downrange and c feet crossrange from the aiming point will become a casualty if one 82mm mortar is aimed at the point of origin (0,0). For example, a man crouched in his foxhole in the 100-foot square containing the aiming point has a probability of 0.00188 of being a casualty. A man standing in a foxhole in a 100-foot square whose center is 100-feet short and 200-feet right of the aiming point (when viewed from the mortar crew's position) has a probability of 0.00129 of being a casualty. A prone man in the 100-foot square 200-feet over and 100-feet left of the aiming point has a probability of 0.00208 of being a casualty. A casualty is defined in Ref. 4 as the "5-min assault" casualty standard. The lethal area for an 82mm mortar is also shown on Tables 1, 2, and 3 for each type of target.

A range of 6000 feet from mortars to target was used to calculate the target coverage functions shown in Tables 1, 2, and 3. This

* See p. 4 of Ref. 2.
### Table 1

**82MM MORTAR SINGLE-SHOT PROBABILITY OF CASUALTY TO TROOPS PRONE ON OPEN GROUND**

**Weapon Code 104001**  
**Lethal Area 2159 Sq Ft**

<table>
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<tr>
<th>Crossrange (ft)</th>
<th>0.0</th>
<th>100.0</th>
<th>200.0</th>
<th>300.0</th>
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<tr>
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<td>0.00002</td>
<td>0.00000</td>
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</table>

### Table 2

**82MM MORTAR SINGLE-SHOT PROBABILITY OF CASUALTY TO TROOPS STANDING IN FOXHOLES**

**Weapon Code 104002**  
**Lethal Area 1222.7 Sq Ft**

<table>
<thead>
<tr>
<th>Crossrange (ft)</th>
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<td>0.00003</td>
<td>0.00001</td>
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</table>
distance is between the range distances that result when the estimates of the position of the NVA mortar tubes provided separately by each of the two commanders are used. Unfortunately, the interviews were made at different places and times.

Table 4 lists some of the weapon parameters that were used to calculate the casualty probabilities. Target parameters used in calculating Tables 1 and 2 were obtained from Refs. 5 and 6. The probabilities computed in Table 3 for men crouched in foxholes are simply the probabilities of impacting within the foxhole or close enough to cave in a side.\(^{(7)}\). There is a minor inconsistency in the method of computing target parameters for prone troops versus troops
standing in foxholes. Table 1 assumes that the troops are lying prone in average terrain with irregular hillocks and hollows. Some troops in the hollows are shielded by the higher terrain between them and the path of the fragments. On the other hand, Table 2 assumes that the foxholes are in flat terrain. Therefore, the average body area presented by troops located away from the aiming point is slightly larger than if the shielding effect of average irregular terrain were considered.

Location of Targets

Based on the interviews, we assumed for the simulations that only Bravo Company with 145 personnel and the 1st Battalion CP with 48 personnel were targets of the mortar attack. Figure 5 shows the Bravo Company organization assumed for the simulation. Deployment of Bravo Company personnel and equipment of the CP in the simulation is shown in Fig. 6. FAST-VAL II uses a 100-foot grid system to deploy personnel and equipment. Map coordinate XD904673 is the initial point or origin for this study. Map coordinate XD904673 is also shown on Figs. 1 through 4 for cross-reference purposes. Figure 6 presents the target structure for those simulations which considered Bravo Company and CP personnel to be all in the "lower" posture or, conversely, all in the "upper" posture. In reading the deployment shown in the example (Fig. 6) the model sees these troops in a 100-foot square whose center is at coordinate (27,15). Troop distribution within the square is Gaussian.

Figures 7, 8, and 9 show personnel in "upper" and "lower" postures during the attack, when approximately 5 percent, 20 percent, and 40 percent, respectively, of all personnel were assumed to be in the "upper" posture.

Aiming Points

Figure 10 shows the FAST-VAL grid system and the aiming points used in the FAST-VAL simulations in firing 66, 32, or 20 mortar rounds. These follow the pattern described by the platoon commander: mortar rounds came from the north at the point where Alfa and Bravo Companies were tied in, proceeding south and then in a northeasterly direction fanning through Bravo up to the hill 450 meters east of Hill 256.

* See Appendix A.
Fig. 5--Assumed organization of Bravo Company
Fig. 6--Location of Bravo Company and CP personnel during simulated NVA mortar attack
Fig. 7—Location of Bravo Company and CP personnel during simulated NVA mortar attack
(Approximately 5 percent in upper posture)
Fig. 8—Location of Bravo Company and CP personnel during simulated NVA mortar attack (approximately 20 percent in upper posture)
Fig. 9--Location of Bravo Company and CP personnel during simulated NVA mortar attack (approximately 40 percent in upper posture)
Fig. 10--Location of aiming points
IV. ANALYSIS OF SIMULATION RESULTS

RECORDED CASUALTIES

Five casualties were reported as a result of the NVA mortar attack. Our objective is to compare the number of recorded casualties with the FAST-VAL computed casualties as part of a critical evaluation of the FAST-VAL model and its parameters. Before making the comparison, we discuss some of the factors considered in computing the FAST-VAL casualties.

UNCERTAIN FACTORS

In the previous section, we stated that uncertainty exists about the number (ratio) of men in each posture and the number of NVA mortar rounds fired.

Posture of Troops

Both U.S. Marine officers interviewed stated that most troops had dug and were crouched in foxholes during the attack. Although it is desirable to crouch in available foxholes during a mortar attack, not all troops always do so. Some commissioned officers, senior non-commissioned officers, and platoon, squad, and fire-team leaders may have been watching for enemy movements and actions during the attack. Others new to combat may have been exposed out of curiosity. For these reasons, and because of certain observations made by combat-seasoned officers, we considered it was possible that from 10 to 25 percent of Bravo Company and 1st Battalion CP personnel could have been standing, partially exposed, in open foxholes. In addition, based on observations of combat-experienced officers in groups this size, about 9 to 15 men could have been away from their foxholes and would have "hit the deck," i.e., thrown themselves prone on the ground, at the start of a surprise attack of this type. Later they would take

* See Appendix E.
shelter in a foxhole. As the midvalue between 9 and 15 is 12, then 12 men would be prone during half the attack, or for computational purposes, 6 men (or 3 percent of the initial strength of 193 men) were prone during the entire attack.

Based on these considerations, 10 to 25 percent of the Marines (midvalue at about 17 percent) could have been standing in foxholes, and an additional 3 percent could have been prone during the attack. A priori, if we did not have the interview data from the participating officers, we could expect that on the average, about 20 percent of an initial strength of 193 men would be in the "upper" (more exposed) posture during an attack of this type. The remainder would crouch in foxholes with their bodies below ground level.

Number of NVA Mortar Rounds Fired

As mentioned in Section III, the remarks of the two U.S. Marine Corps officers interviewed indicate that there were more rounds fired than the 15 reported in official records.* One interviewer estimated "about 65 rounds." We estimated for the simulations that the number of incoming rounds should range between 15 and 65, with a mid-value of 40.

RANGE OF FAST-VAL COMPUTED CASUALTIES

Table 5 shows the casualties computed by the FAST-VAL model for Bravo Company and the 1st Battalion CP, 9th Marine Regiment for 5 different ratios of men either prone or crouched in foxholes at the time they were hit by 20, 32, and 66 mortar rounds, respectively.

Table 6 presents similar data for 5 ratios of men, either standing in foxholes or crouched in foxholes, subjected to strikes by 20, 32, and 66 mortar rounds. These data are graphically displayed in Fig. 11.

* See Appendix B.
### Table 5
COMPUTED CASUALTIES FROM NVA MORTAR ATTACK ON 193 TROOPS LYING PRONE ON THE GROUND OR CROUCHED IN FOXHOLES

<table>
<thead>
<tr>
<th>Assumed Number of 82mm Mortar Rds Fired</th>
<th>Fraction Prone</th>
<th>Computed Casualties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Number</td>
</tr>
<tr>
<td>20</td>
<td>0.0</td>
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</tr>
<tr>
<td>20</td>
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<tr>
<td>20</td>
<td>0.197</td>
<td>3.0</td>
</tr>
<tr>
<td>20</td>
<td>0.435</td>
<td>6.0</td>
</tr>
<tr>
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<td>1.0</td>
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<tr>
<td>32</td>
<td>0.197</td>
<td>3.5</td>
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<tr>
<td>32</td>
<td>0.435</td>
<td>7.5</td>
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<tr>
<td>32</td>
<td>1.0</td>
<td>15.5</td>
</tr>
<tr>
<td>66</td>
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<td>1.0</td>
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<td>66</td>
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<td>2.8</td>
</tr>
<tr>
<td>66</td>
<td>0.197</td>
<td>7.3</td>
</tr>
<tr>
<td>66</td>
<td>0.435</td>
<td>15.0</td>
</tr>
<tr>
<td>66</td>
<td>1.0</td>
<td>31.1</td>
</tr>
</tbody>
</table>

$^a$ Percent of 193 Bravo Company and 1st Battalion CP personnel.

### Table 6
COMPUTED CASUALTIES FROM NVA MORTAR ATTACK ON 193 TROOPS STANDING IN FOXHOLES OR CROUCHED IN FOXHOLES

<table>
<thead>
<tr>
<th>Assumed Number of 82mm Mortar Rds Fired</th>
<th>Fraction Standing in Foxholes</th>
<th>Computed Casualties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Number</td>
</tr>
<tr>
<td>20</td>
<td>0.0</td>
<td>0.4</td>
</tr>
<tr>
<td>20</td>
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<tr>
<td>20</td>
<td>0.197</td>
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<tr>
<td>20</td>
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<tr>
<td>32</td>
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</tr>
<tr>
<td>66</td>
<td>1.0</td>
<td>18.3</td>
</tr>
</tbody>
</table>

$^a$ Percent of 193 Bravo Company and 1st Battalion CP personnel.
Fig. 11--Computed casualties as percentage of men in upper (more vulnerable) posture increases.
ESTIMATE OF COMPUTED CASUALTIES

Tables 5 and 6 or Fig. 11 permit 3-way interpolation for determining the number of expected casualties for any combination of troops allocated to each of the three postures: crouched in foxholes, standing in foxholes, and prone.

COMPARISON OF RECORDED AND COMPUTED CASUALTIES

There were 5 recorded casualties, of whom 2 Marines and 1 civilian correspondent were incapacitated sufficiently to be evacuated. The weapons effects used in these FAST-VAL simulations are based on the Ballistic Research Laboratories 5-min assault casualty criteria. Therefore, in our opinion, casualties not requiring evacuation probably are not hurt sufficiently to fall within the 5-min assault casualty criteria. We thus believe that the FAST-VAL computed casualties should be compared with the recorded, evacuated casualties.

Because a small difference between computed and recorded casualties may be significant for a large initial strength, we apply a rule-of-thumb statistical test (Appendix D) to determine whether the difference is significant for an initial strength of the 193 troops present.

FAST-VAL

The number of computed casualties depends on the number of mortar rounds received and the posture of men during the attack.

Based on the estimate of the two interviewed officers that all men were crouched in foxholes, the number of computed casualties, although close quantitatively to the number of reported casualties, is significantly lower according to the statistical test. This is shown in the upper portion of Fig. 12, where the 95th percentile value of computed casualties is below the 3 recorded evacuated casualties for values of from 15 to 65 mortar rounds received. Therefore, we must conclude that the FAST-VAL computed casualties do not agree closely with reported casualties—if in fact all troops were crouched in foxholes during the attack as indicated in the interviews.
Fig. 12—U.S. casualties versus NVA 82mm mortar rounds received (Hill 256 case - simulation of mortar attack)
Perhaps unknown to the two officers who provided the interview data, it may have been possible that as many as 8 percent or more were prone or 15 percent or more were standing in foxholes and the remainder were crouched in foxholes during the attack. Then, the statistical test, as indicated in the lower portion of Fig. 12, would lead us to accept the hypothesis that the FAST-VAL computed casualties agree closely with the reported casualties, since the 95th percentile value lies above the reported 3 casualties for all values of mortar rounds between 15 and 65. In fact, if we did not have the participating officers' interviews indicating that all troops were crouched in foxholes during the attack, we would have estimated that 13 to 28 percent, with midpoint at 20 percent, were standing in foxholes. For 20 percent standing in foxholes and the midvalue of 40 mortars received, the number of FAST-VAL computed casualties is 3, which agrees exactly with the number of reported casualties.

POSTURE VERSUS VULNERABILITY

Posture during a mortar attack is an important factor in determining vulnerability. Usually, the lethal area is used as a measure of the vulnerability of area personnel targets. The lethal areas for each of the postures computed for mortars of this type are listed in Tables 1, 2, and 3. These results indicate that if troops are uniformly distributed about the aiming point, the ratio of vulnerability will be 2159 (prone) to 1222 (standing in foxhole) to 56.6 (crouched in foxhole). These figures suggest that, on the average, a prone man is 38 times more vulnerable during a mortar attack than one crouched in a foxhole. Similarly, a man standing in a foxhole is approximately 21 times more vulnerable than one crouched in a foxhole.

Though the men were not uniformly distributed about each aiming point in this study, the importance of posture and its relationship to casualties is borne out. For example, in Table 5, the computed number of casualties for 66 mortar rounds is 1 if all troops are crouched in foxholes. If all troops are prone, 31.1 casualties are computed. In Table 6, the number of casualties computed (again
for 66 mortar rounds) is 18.3, if all troops are standing in foxholes, as compared to 1 casualty if all troops are crouched in foxholes throughout the attack.

CONCLUSION

- Although the FAST-VAL computed casualties seem to agree closely with the 3 reported casualties, a statistical comparison indicated that they differ significantly. This is based on the consideration that all 193 troops were crouched in foxholes during the attack, according to interviews recorded with two officers who participated in the attack.

- Interviews with other battle-experienced officers who did not participate in this particular attack indicate that it is customary for some (13 to 28 percent) officers and men not to crouch down in foxholes during an attack of this type. Also, simulations indicate that if, in fact, 8 percent (15 troops) were prone or 15 percent (29 troops) were standing in foxholes observing while the remaining troops were crouched in foxholes, then the statistical test would support the conclusion that the FAST-VAL computed casualties agreed closely with the 3 reported casualties.

- Although the moderate fraction of troops less protected appears a reasonable assumption, the interviews indicate that all troops were crouched in foxholes. Under these conditions, the statistical test indicates that the FAST-VAL computed casualties were significantly different from the reported casualties.
Appendix A

INTERVIEWS: MAJOR CHARLES SIROTNIAK
AND 1ST LIEUTENANT V. J. FORTE

This Appendix contains extracts from a transcription of taped interviews with two United States Marine Corps officers: Major Charles Sirotniak and 1st Lt. V. J. Forte who with their units located in the DMZ sustained an NVA mortar attack on September 17, 1968. Major Sirotniak was then the commander of "A" Company and Lt. Forte was the leader of First Platoon, "B" Company, 1st Battalion, 9th Marine Regiment. The first interview was taped by Jack Lind of The Rand Corporation ("A") and Major Sirotniak ("B") in March 1969 at Danang. The second interview was taped by Sid Spring of The Rand Corporation ("A") and Lieutenant Forte ("B") in Okinawa in March 1969.

The text of these interviews is assigned the overall classification of Confidential, Group 4, since it reveals detailed information concerning friendly combat casualties. In the interest of simplicity and clarity, no attempt has been made to classify each question and answer separately.
INTERVIEW 1: MAJOR CHARLES SIROTNIAK

A. Give us your name first so we get it on this recording.
B. Sirotniak, Charles (Major).
A. What day is it, 16 September?
B. Right.
A. O.K. Where was your CP and what did it look like?
B. Actually two companies, with the CP in the middle. Bravo was on the right, Alfa was on the left. The CP was just on the other side.
A. What was it, a bunker?
B. No, it was just a side of the hill that they dug in really fast that day. I have been out of my business so long that I have forgotten my symbols...
B. The CP in the middle was protected. The other two companies were in the process of crossing the stream. I was the company commander of Alpha company, with the (battalion) CP most of the time. This is Saturday evening.
A. How many people did you have in your company?
B. 145.
A. Did they have foxholes dug in? Were they covered?
B. No, they were two or three-man positions--just open holes dug.
A. O.K. So you would all get down below the surface, standing or horizontal, which?
B. Crouched.
A. Crouched, O.K. Do you happen to know what Bravo was?
B. Same thing.... Their strength was, I think, 5 less than ours.
A. O.K. It was in the order of 140, plus or minus 10 or 5, you say. Now, out in the CP what did it look like?

*This should be September 17, 1968, as per Appendix B and Ref. 1.
B. A conglomeration, as they usually do. They had square little holes and a big hole. By big, I mean four by five.... All open. It takes about four hours to dig one of these things. And the CP's (personnel) finally came in around 12 o'clock in the afternoon.... I had the 81 section (4 mortar tubes) in various holes and located throughout this area. But this was on the reverse slope of the hill with the enemy mainly in this direction (north).... Generally they were just plopped down within some brush over here.

A. O.K. Your patrol out here was in the same fashion?

B. It was an OP (observation post).... The platoon I had out there during the day. And they came in during the evening.

A. All right. Machine guns were in the same kind—everything was sort of just dug in; in other words, there hadn't been any fighting in this area before?

B. No. We had just come up to it and blown it away and naped it and knocked the trees down. There were a few craters there.... It was virgin territory. Just the way it looked at the time the mortaring occurred.

A. O.K. Now how many rounds do you think you took?

B. I counted in excess of 15 and they came fast.

A. Were they sort of spread all over here?

B. No, they were down here. This was about the time they ran.

A. Around in that area?

B. One or two came up here.

A. O.K. What did you do then? I know they said their air artillery came in after the mortars. You didn't get an attack or anything?

B. No, I did not get a ground attack.... Immediately, an azimuth was taken; and an azimuth was attempted to be taken from one of the locations.... And I heard that they estimated the tube—take a look at the little map.

A. Did the mortars cover the CP at all?

B. Yes.

A. Down here?

B. You mean the enemy mortars?
A. Yes.

A. O.K. Was the CP really down here? I just want to get this circle in here and include it.
B. Yes.

A. How many men were in the CP? Was it in the order of 10? 20?
B. No. It's more than that. Close to 50.
A. Close to 50? That is a little higher. Mortar rounds, 15? In excess of 15? Is that what you were saying?
B. Yes, in excess of 15.
A. O.K. Was this at night when this came in?
B. Dusk.... Their favorite time.
A. There was no attack following it?
B. No. No ground attack.
A. They just had you spotted.

B. Sure they couldn't help it. We stayed there all day. Running around as well. Our people were on this side of the slope with the snipers taking potshots at the NVA running across this road here. The road is not accurate with the map. The road is next to heavy foliage here. It is a very cleared area, within a contour line down here to a pretty steep brush here, over to the brush here, across a bridge. It shows as a ridge although it was a ravine. This is more of a ravine although it will show flat around here, although it was a ravine going up. We spotted them there and started shooting at them. And then one would try to run across. We hit or miss them. Then we started running arty into here. Blew this place apart, counted bodies floating down the stream.
A. O.K.
B. This was the area of arty.
A. Do you happen to remember...do you have any idea of what was in there? People? NVA types?
B. How many?
A. Yes. Just a guess.
B. We counted 15.
A. That was your KIA?
B. Right, this was run acrosses.
A. Oh. Run acrosss, O.K. Could you bring air in this mission too?

B. We called air in, but air came over here. The arty seems to have done a bang-up job here.

A. Same evening?

B. No, it was the next evening. No, I am sorry, air did come in that night, because an AO had spotted activity over here.

A. Something is labeled 248.

B. 248 is over in here, up in this draw.

A. That's pretty far away, isn't it? Could you observe up there? From your hill?

B. Yes. You couldn't see down. But you could see what the air was doing.

A. You mean this?

B. No, I mean over here.

A. On this. Did they catch you by surprise? Did everyone have a chance to get down?

B. Yes, everyone had a chance to get down. The first rounds were out. Usually outside.

A. O.K.

B. What we usually do is say, "Hey, it's coming 50 meters out."

A. You can hear the plop?

B. Yes, and you can hear him adjust his sight.

A. Do you know where he was firing from?

B. Yes. It was estimated that he was firing from within this area.

A. O.K.

B. The air was coming in where it's recorded, and also further up this area up here was a suspected mortar position. We spooked it the next night. As a secondary.

A. Did you return any mortar fire up to there?

B. No, not up to here either. We didn't have any artillery on that.

*Major Sirotniak estimated the NVA mortar positions as X097592. See map in body of text, p. 3.
A. O.K., now do you remember how many casualties? I just want your estimate here. It was mainly out of Bravo company and the CP.

B. Yes. Bravo and the CP. No one was really hurt badly except for a newspaper correspondent who stuck his head up. I remember seven. Maybe all of them were not medevacs, but I remember seven people being hit.

A. And nobody at Alfa got hit at all?
B. No.

A. Just the CP itself?
B. The CP and that portion of Bravo.

A. When you put out a position like that, where would you put your machine gun? This is just some added information for us. How would you have your people distributed?

B. We had six guns in the company. Primary consideration was given to the guns on both sides of the avenue of approach. If you have cover in the front, then it is an occasional ravine and there was one down over in this area which is a very good avenue of advance and another gun...

A. O.K. Were you in the CP?
B. No, I was over here. I was in line with the CP. I also had a little foxhole.

A. O.K. Believe it or not, you just gave us enough information to do this whole thing. There was no second attack? No mortars after that? They all came down very quickly?

B. No. There were two tubes in a matter of a minute.

A. Two tubes and that was it. O.K. Did it disrupt any of the operations at all? That's right, you only had a few casualties.

B. No, we took the medevacs out the next day. That evening as a matter of fact. There was a downed helicopter in the LZ.

A. Oh, did he have a phone in it?
B. Yes, right.

A. That's a good idea. You say it was a downed helicopter?
B. Right. They couldn't get it out during the day so they left it there. They just left it there. They took everything out of it and left the hull.
A. That's a good aiming position. O.K., now let me spin through these questions a little bit. This is such a neat type case. Oh boy. We haven't had one this clean. It's been a maneuver of lots of mortars coming in or outgoing. But we especially wanted to try to get a case like that, just to get at the effects of these mortars. And also the idea of the foxholes that you were crouching down in. Generally, there were 3-man foxholes, 2- or 3-man foxholes in the CP. I'm just trying to understand it. Out in the company, they tended not to be that big, did they? Or did they?

B. Two-man fighting positions usually. It would be a sleeping area for a man and a fighting position. The three would get in there if they had to. But they usually worked with two, two and a half people, and they would improvise with what they had available. Either logs and we carried sandbags with us, just to put two or three sandbags up in the front.

A. O.K. What was the terrain, you said there were trees, but what kind of trees? Was it fairly open?

B. Yes, it was a scrub growth with elephant grass. This is one of the few areas—it was an elephant grass knoll with some light scrub trees that they had burned off with napalm.

A. How high is the elephant grass?

B. It varies from 8 feet to 12 feet to 15 feet.

A. So people could move up these hills and you wouldn't know it.

B. Sure, you could hear them. We heard them too.

A. Did they snipe at you all night?

B. No, no.

A. O.K. Everybody got down by the time the incoming was due because you could hear it fired?

B. Well, you could usually hear it fired. And when it impacted outside.

A. You didn't fire any machine guns at all?

B. No, there was nothing to fire a machine gun at.

A. What kind of ammo were you carrying when you were there?

Was it a normal load?

B. No, it was a heavy load.
A. Heavy load? That's how many rounds of clips?

B. O.K. We had riflemen, O.K.? And you've got your machine gun, M79, and his BA is 7 magazines, with 18 per magazine. A company--riflemen in the company would carry 14 plus magazines. A gun usually runs around 1200 rounds. We had 1700 to 2000 rounds a gun. Plus two extra packs.

A. What are two extra packs?

B. 200 rounds.

A. Oh, O.K.

B. The M79, 70 rounds per 79. I don't remember what our BA was. But we had 70 rounds. Which is about 30 rounds more than I would normally carry because we were going in here on the concept that we are not going to get resupplied for four or five days. We are going out like a hunter kill or recon team.

A. I see. Pretty solid recon team. Isn't it? Did you have 81's?

B. Yes.

A. How many rounds did you have with that?

B. We had 30-31. I didn't have 81's out there myself.

A. No, I know you didn't, but later.

B. Besides, dark came.

A. Oh, excuse me.

B. They attacked a section called K.

A. All right. You didn't fire at anybody? There was no small arms fire?

B. Not during the mortar.

A. After you moved out, of course, I'm sure you--did you move some of your companies out to search around?

B. Across the Ben Hai?

A. I don't know.

B. No. This is North Vietnam, and this is South Vietnam.

A. Oh, O.K.

B. You need an act of Congress to go across there.

A. Oh, is this it?

B. Right.

A. This road here. The river, I guess.
B. The river, right.

A. Here is your DMZ. Who called in the artillery?

B. My FO called in artillery, you mean for mortar attack?

A. No, for your attack up here.

B. My FO did. He was a lance corporal.

A. Sounds like he did a good job.

B. He did, he always did a fine job for me.

A. When he called in, would he ask for a number of rounds or would he just ask for some artillery? I am just curious about how the action was done.

B. Yes. He asks for a type round. If he doesn't ask for the type round, he gets HE with a fuze quick. If he asked for VT, which he did ask for, he got VT--variable time that explodes over their heads--and some of it mixed. How many rounds? He'd request, and he got a message to the observer on duty, telling him how much was available to shoot for him. And when you have an active, open target, they'll give you every gun they possibly have. So you kind of have a battery going all the time of six guns. And munitions are in battery fives and battery sixes which is five rounds per gun.

A. You've got that much ammunition and that many rounds coming down here? Some of the other fights we worked at, they weren't getting that much fire. Oh, that's right, you were up pretty far north and they want to make sure you get a little help. We were talking to people down in Mead River and I don't think they were getting quite the help you were getting.

B. No. That's a different area. That's first division.

A. Well, sir. As a matter of fact you know you told me everything I want to know.

B. O.K., good.

A. Didn't take long. We were, I think, kind of apprehensive that we would even get a right man that could tell us about this. That's first, and secondly, it's a beautiful pure case from our viewpoint. Only one thing happened, a defensive position, some mortars came in, what are those affected? Kind of a very pure case. And we thank you.
INTERVIEW 2: 1st LIEUTENANT V. J. FORTE

A. This tape records an interview with 1st Lt V.J. Forte, U.S. Marine Corps. The interview covers the operation of his platoon, First Platoon, B Company, First Battalion, 9th Marine Regiment, on 17 September 1968.

B. On 16 September we were just waiting around for the liftoff for a DMZ OP. Everybody there was pretty well frightened. We had been told that we would only end up there 3 to 5 days because of political reasons, but it turned out we stayed there 24.

In the morning, liftoff of Alfa Company went in first on Hill 256, followed by Bravo, then the battalion CP, Charlie and Delta. Charlie and Delta landed and moved toward us and they were to move off to the next objective. Alfa and Bravo, along with the CP, stayed at 256 for the night. In the beginning when we landed, this had been sort of a big buildup. We got an intelligence report, I believe, that the enemy base camp was right on Hill 256, which was false. It was just a grassy hill. Also, an artillery battery within 500 meters of 256. So when we landed, everybody was pretty well shook up. We established our lines, tied in with Alfa Company, and we dug one-man holes.

The battalion CP came in. At this time we started to see small groups of NVAs trying to get across the Ben Hai River. The first one we saw was about 150 meters outside our lines in a draw. He was trying to work his way down through 256 to the Ben Hai River to get across. They had a bridge that was under water along the river and it had—the only way we saw it was they had a small steel cable or rope across the bridge to help with their hands as they crossed. What they were doing, I think, about 25 or 30 of them had been around through 256 during the time it was either arc lighted or arty and they looked kind of confused. Their clothes were all torn and none of them had weapons. They were trying to make their way across the river. Sad to say, but as soon as the battalion CP saw these people, they started opening up with small arms trying to hit people at a range of 900 meters with M-16.

One of the Alfa machine guns opened up and they killed one. I had a sniper with my platoon, and I had him shooting at the people at
900 meters. He fell three of them, and by this time he started to call artillery, right at that river crossing. It was one of the better artillery missions I have seen around. It landed right in the river, right on the bridge, right on both sides of the river crossing, covering them pretty good. Then they brought air in.

Now, this lasted until about 1800 at night. They were pretty sure they got a lot of NVAs that were trying to cross the river because there was no place else for them to go from there. The artillery was landing right at the river crossing, so was the air, and we didn't see them get up to try to run anymore.

Originally, we were supposed to move off 256 the first day, but the way the time schedule went, we never did make it. So the word came down that we would spend the night there with Alfa Company and the battalion CP. About 1830 that night, we heard the first tubes pop. Well, actually we didn't hear them because we had air working over the bottom of the valley, and after the air broke off, some morearty was coming in, and a Willy Peter round landed at the bottom of the valley right near the river. Then the NVA put all their first—now the records say only 15 rounds, but I think...just maybe 15 landed in the battalion CP—but I think they shot about 65 at us with a whole bunch of them starting off the northern side of the hill down toward the Ben Hai River. We were above where the first 10 or 15 landed, and there was a Willy Peter Round laying out there from our arty. So we weren't really too sure it was incoming mortar until we heard them starting to walk our way. They were about 300 meters off at first. By that time you can hear the tubes pop after that. Everybody got into their holes, and they walked their rounds up to 256, over to where Alfa Company was tied in with Bravo, which was just about at the crest and then down Bravo line through the battalion CP and then back down in the valley, and that was it. We just responded with our 62 which was our FO. He had a mission going; 61 had the same mission going, and I believe they brought more air in. We got azimuth fixes on the tube and they worked them over pretty good. I believe it was that night that the pilot, the air that they brought in, said they got one or two of the tubes.
The next night, when we got mortared, it was from a different spot, so I imagine we got those tubes that night.

A. Lt Forte has really covered the phase of the questionnaire normally called the Infantry employment so we will skip that, and we will concentrate on selected items in which he has some particular knowledge and experience.

The interview will now continue on item 40—enemy mortar fires.

B. The mortar fire started at, I'd say, between 1800 and 1830, and lasted approximately five or six minutes, and came in what you'd call two barrages, one was about 300 meters off from us, and the one [redacted] was right in this....Now as far as my platoon went, we took a total of about five rounds, they were walked around up the draw, traversed a little bit on the line, and I can remember one landing between my CP and the line, and one landing in back of my CP, and the rest of them kept on landing in back of my CP. They were walking them back toward the other hill. I believe it was an 82 mortar, and the rounds they were firing were all HE.

A. How many casualties did you take?

B. I didn't take any casualties.

A. You didn't take any casualties? Did any of the rounds land within your squad disposition?

B. Right. I'd say four or five of them landed in my platoon area, along the lines or just in back of the lines, but like I said before, we had heard so much about this area we were in, when we first got there everybody had dug one-man holes, instead of just playing around, getting ready to move out. Everybody was in their holes and everybody was down so there was no real danger.

A. The holes were really deep enough so they could get really down below the ground?

Lt Forte said that there was no cover on the hill, there was no brush, no trees, it was just a grassy knoll. Lt Forte, do you know what took out the NVA mortars?

B. I believe it was aircraft on their second pass. I guess it was 500 pound bombs. Later, on the next day, I heard our 1-4 man talking about how he had told the battalion he had seen the tubes and laid the bombs right on them.
A. Lt Forte, you were telling me about a bridge that NVA had across the river and they hit it with artillery. Do you want to go into it in detail?

B. All right, it was a footbridge that was under water, and what we could see of it, there was a metal cable or rope that led across the river, that was the only thing visible. And the way we saw it, we saw these people running, and they seemed to be making their way to one point in the river. They'd try to dash across there as fast as possible, one at a time. FO-62 got on them and gave a call to mission, but Alfa Company's FO-61 was already working on it, so we let them handle it. It was about, I believe, let's see....Initially it took about three minutes, I guess, before it was really up that thing. It took about three minutes for the first round to come in. We tried two Willy Peters and I believe they were, on ROT, short and to the left. He gave one adjustment; and I believe he used HE on adjustment and that landed in and called for a fire effect. And I'd say within about 7 or 8 minutes--oh--maybe 10 or 12, he had the bridge under fire, where that and fire for effect were landing at the normal disbursement, right on the bridge. The bridge took several direct hits, I know, but for some reason they didn't break the rope, or the cable, whatever it may be, until about the sixth or seventh fire for effect. And what the FO did was, he moved his fire effects around to different spots on the river where he thought they were crossing, and in covered areas on either side of the river. He could see there a long draw leading down to the bridge and he just moved his fire for effects to both sides of the river, up the draw a little bit, and up on the--I guess you'd call it a ridge line on the other side of the river. It had a road cut into it, and it was pretty good that day. The arty was right on target, and there was the feeling that everybody was together. There was no foul-up in waiting for a clearance. You knew that there wasn't anybody friendly at the Ben Hai River, so the clearance didn't take the usual hour.

A. Lt Forte, would you tell me how an infantryman gets artillery support?
B. Right, based upon myself, I've only called for artillery two times. I called direct to the battery, and both of those times when I was out with my platoon on patrol without an FO, called the company, told them that I had a fire mission, and they told me to go up on a 2-4 push and I didn't call. Most of the time, though, I've been fortunate, I've always had good FOs. In fact, the last operation I was on, I just pointed to an area and I told my FO, who was a corporal, get some rounds right there and a few minutes later he had them. I'd usually leave that up to the FO to call.

A. But you can, as I understand, you can describe the target in the area.

B. Right. But you usually say to the FO, we're getting mortar, let's get some counter mortar going. Look, there are some people out there and they're not friendly. The FO has enough on the ball, he knows whether he wants a battery or a platoon. He knows how many rounds of Willy Peter and when to switch from Willy Peter to HE. Usually, he'll lie a little to get the guns working faster. To the squad out there he'll say, "15 or 20 NVA." Or if the mortar sounds are outside the line, he'll say, "They are bracketing us," or, "They're walking the line." So you don't have to worry about the FO.

A. How about the...who normally describes the target. Do you describe the target to the FO?

B. Sometimes, if I see it, I'll describe it, or if...usually the target is of such a nature that nobody has to describe it. The FO will be working on the fire mission before he even asks you, and then he usually tells you, "Sir, I've got a fire mission out there--do you want it?" That's usually the way I've seen it work.

A. Lt Forte, how many men did you have when you were on hill 256--on your own mission?

B. We really had about a 9-man squad--9--or 10-man squads, that's including a 2-man machine gun team. It came down to about 33 to 34 people in a platoon.

A. You started on 54 and you're pressured.
B. The type of area we were in around hill 256. It was pretty hilly, and the area we had to go to the next morning was about 800 meters away up on another hill. Once you get off the slope of 256, it turned to high altitude grass with a lot of brush, came down to a small river where it was really wooded on the other side--heavy jungle--how can I put it--not that jungle type you imagine in movies, but just thick foliage. And our company's move was more or less what you call an Admin because the day before Charlie and Alfa had moved through the same area, and they had cut a path through this brush, but it was still so thick that it took us about 6 hours to move 800 meters. A lot of the time was taken up getting medevacs out. We had guys--it was steep in places--in other words, it was just like climbing cliffs, we had people falling. We had heat casualties from a lot of new troopers who, I don't know, something was the matter with the training, but every time, a new trooper was always hurt. Every time there's a new trooper, there's a fall-out. So this time we had five or six medevacs due to heat casualties, and that's what held us up for a long time waiting for the birds to get in. And also we had a battalion CP movement in back of us, and the 81--they took an awful long time to get up. If our company was patrolling this area, we wouldn't have all our gear on, we'd just have our fighting gear on, and we'd be able to move a lot more easily. We'd probably be moving by bounds with a platoon out in front, and the rest of the company behind with people on the flank. With a patrol in that area, I'd say we could move about 1000 meters in about 3 hours, and cover the area fairly well. Let's see, how fast could we advance in the attack on that area. Not fast at all. Well, we landed on top of 256, and if the next hill that we went to was occupied the only way we could have moved toward the attack was to just have it completely blown away and walk up there. But, there was no possible way we could maneuver toward the next piece of ground we went to. And, let's see, "Would incoming bombs and mortar rounds decrease the rate of advance?" I don't believe so. I've always moved through mortar, it might hold us up a little bit, but not that much. We always move right through it and carry the casualties with us.

*Lieutenant Forte probably meant Charlie and Delta ("D") Companies.
A. Would you like to comment on your observations of a term they call "suppression"?

B. Well, O.K., you know it happens and I know why it happens, but in my opinion there is no way to estimate it or to be able to judge when and how.

A. Would you comment on what happens to riflemen and machine gunners or any other weapon crews when they are subjected to incoming artillery or why incoming rounds?

B. Well, they're basically--they go down for a while, but I don't think you can measure. It depends on the individual.

A. Would you take a look at 69 and give me your comments, if you would?

B. O.K. "How casualties affect the unit performance as a whole?" Initially when you have a few casualties, the performance goes down just a short time, and then it comes back up, to just about where it was before. People who are hit--the ones I've seen, they really don't stop that much over a dead person. They'll think about him later on, but not during the fight. The wounded are sort of relieved that they are wounded, because they think well this is it, and I'm going home now. And, there is that moment of confusion, where like somebody has to put down their rifle and pick up an M79 and then take the bags of M79 rounds and be told where to shoot. And, the same thing with the gun; the ammo humper is hit, and the gunner runs out of ammo, somebody has to run up with the ammo, and if the gun is hit, somebody's got to pick up the gun with enough G2 to pull the bolt back and start firing.

Yes, that's where it hurts, when you have to divert people to other jobs and make sure there is not gear strewn all over the area. The loss of a communicator puts some men out of contact with leaders. There's always somebody who'll pick up the radio. I don't know why, but everybody likes to carry the radio. We've lost a lot of radio men, and there is always somebody handing me a radio. If we did take 15 percent casualties, if we couldn't medevac the people right then, more, if not 10 percent more than half of the company we'd take up would take 4 to 6 people to carry at least one person, and there's a big problem of losing contact. You can assign one platoon to carry dead and wounded, or one
squad to pull the wounded people back from the front lines, so the corpsmen can work on them. But, when they get tired, and somebody takes their place they really have no where to go--there's no unit integrity left. All you have is people wandering around, and they're tired and out from carrying somebody. They lose their effectiveness all together, because, let's say there's no unit integrity--there's just bodies there. Four people from one squad will be carrying somebody and then four people from another squad take over, well by this time the squad has changed points and they are nowhere near a squad--they are just stumbling along the column with the rest of the group.

A. Will you take a look at question 70?
B. "At what level of casualties would a company be able to advance in an attack?" It depends. It would be a lot less than 20 or 30 percent. That they say here. Usually, if you're moving and there is another company moving with you, all the medevacs and casualties will be handled by the other company, and I'd say you could move somewhere close to 20 percent of the casualties--not all Ks and still go on. A lot of the wounded would be able to continue through that. I'd say most of the wounded over here do not require medevacs.

A. Regarding these casualties, you're either killed or wounded badly so you're out for at least five days?
B. O.K. I'd say, somewhere around 20 percent--meaning that overall 20 percent when you got to where you were going. You were taking 20-percent casualties every two or three minutes, but overall.

A. Would you take a crack at 71?
B. Right, but I have no idea what level of casualties you have to lose to stop acting as the company in defense. If you are in an actual attack, not moving along or anything, I think you can act as a company in attack, with greater than 50 percent of the company gone.

A. Do you want to try to answer 72?
B. O.K. In machine gun crews usually we travel 2- or 3-man machine gun crews. If a gunner gets hit, a gunner usually can take over with only a drop in the effective rate of fire until the gunner gets working or if one of the ammo humpers usually knows a lot about the gun, he can take over. But, if somebody has to use the
machine gun who is not a machine gunner, he basically knows what to do, but he just won't be able to fire it as well. I'd say as high as 60 percent of the machine gunners would be ineffective, because most of the rounds fired will be at least 10 feet off the ground.

A. Then do you have any comments on the use of the effectiveness of air?

B. Well, to use it with the ground is too much involved in coordination—who is firing what and where. The only thing you can really use effectively close to infantry is a napalm. The rest of the air ordinance is good if an Aerial AO has got a target; he can see it and he marks it and the fixed wing comes in and takes it away, and it is far enough away from you so it won't hit you when the air knows exactly where you are good. But, as far as the whole business of guys running up the hill with a jet 30 feet over their head strafing an area in front of them, it doesn't work at all.

A. Would you like to comment on your impressions of the relative effectiveness of mortars, artillery and air?

B. Well, I'll just start with mortars. I like 60 mortars because they are right with you and you can crawl them right up where we have 25 meters outside our own lines and use them really effectively. I have no faith in 81 mortar because it takes too long to get 81's both on target and to be able to use them. I don't think the round is that effective. Artillery is the same as 81's. You have to wait, if you can be in a position, you don't have to wait for clearance, you can fire what you want, when you want, and they'll let you bring the rounds close enough to your lines to do some good, then I really like arty. Air, I think, is wonderful when you have an area to be worked over with everything, with napalm bombs, strafing it with everything they've got. And also, air when it is used with an Aerial AO who can see definite targets, and he can mark it with marking round and bring fixed wings in, and destroy it. That really helped out a lot. That is something you don't see initially, because you are 700 or 800 meters away, but there isn't going to be anyone there when you get there. But I don't think air is that good used as a close supporting arm. I really don't think it was meant to be.
A. Do you want to comment on the way you mark targets for
the FAC?

B. Usually, if the Aerial AO sees them, he'll mark them with
his rounds, and we use our 60's using Willy Peter and mark from there,
and of course other times we'll mark our own position with smoke, but
mostly, we like to use air panels to mark our own, so we can pick them
up.

A. Well now, if you would give some of your recent exper-
ience with incoming mortar rounds in your unit, I'd be happy to hear it.

B. All right. In August when I first got here, well, two
squads in my platoon were going out to help one of my other squads, and
the second platoon in Bravo Company which had run into a really large
size enemy unit. To get to them we were just on a narrow ridge line,
and to get to them we had to walk straight down the ridge line, 10
meters either way a complete drop off. But 600 meters away from the
IP and about 200 meters from the people we were going to help
was a bald hill on top of the ridge line which was thoroughly registered
with enemy 60 mortars. We didn't notice as we moved out, they had not
used mortars on the people who first moved across. They let them get
through and they had machine guns turning them down and we came out to
help. My point came to the bald hill, we couldn't go around. We did
not know what was on the other side of us, in a short tree line, so we
sent one team right up over the top running as fast as they could. The
other team started to go around the left side of the hill as we were
moving in a westerly direction. We heard tubes pop and rounds were
landing right off the western slope of the hill—10 meters away from
where we were moving. The way we moved through was we sent people across
this bald hill in rushes, and every time we heard the tubes pop we timed
them. We knew we had something like 18 seconds to make it across the
hill. We would listen for a tube pop and then the guys would run and
usually we would make it right into the other tree line, get down and
get some cover—you know, down on the deck, and the mortar would always
land. We got only two or three people scratched from fragments. We
would listen for the pop, and pop four or five of them, and we knew we
had 18 or 20 seconds to make it across the hill. Coming back, we
stayed out there for a night, giving these people a lot of trouble, coming back the next day. They mortared us again in the same spot and we did the same thing. The only serious casualty we took was because one man, when he heard a tube pop, ran across the open area, and instead of hitting the deck by laying down, he got down on one knee—sort of like in a football position—and he caught a big piece of shrapnel in the arm and he was the only one that needed medevac, but everybody who got down as far as they could, all the worst they got out of it was a scratch. Also, instead of leaving the mortar where it was the next day, the day before they landed the ridge line register, they started to walk them with us. And the way we got out was to just move right through the mortar fire which never really did catch up to us.

A. How many tubes were firing?
B. I'd say two.

A. Two—how many men went across in each group?
B. Groups of two or three.

A. Do you know how close those rounds were landing—to your men as they went across?
B. What really helped us out was that rounds were landing maybe 10 meters away from us, but they were downhill from us. So as soon as we heard a tube pop, we moved across, hit the deck, the round would land and the shrapnel would have to come up hill at us, so that on their gun target if they had dropped 10 meters, maybe they would have inflicted some good casualties on us. Some heavy casualties on us. But that 10 meters, it was a pretty steep slope downhill, just about did it.

A. They came over from where your men had departed?
B. We were moving east to west, and they were firing north to south. So that was about it.

A. How close were they landing to your men when they were down in the edge of the woods?
B. They were back and they were 30 meters away. The first day they just left the rounds where they were, they thought they had a good spot for them and every round landed approximately in the same
spot. They didn't shift or traverse, or anything; they just left the rounds there. The only time you were in danger was when you were going across the bald hill.

A. That's all there is.
Appendix B

EXTRACT FROM COMMAND CHRONOLOGY*

At 0900 on 17 September, the First Battalion, Ninth Marines conducted a heliborne assault into a landing zone just south of the Ben Haí River. The battalion's mission was to search out and destroy or capture the enemy and his supply caches. The lift was completed to LZ Pacific (XD907676) at 1200. At 1210 on September 17, Company A sighted 5 enemy troops at XD913683. Elements of Company A engaged the troops with small arms and an artillery mission was requested immediately. Forward observers reported that there was excellent coverage of the target area and 25 NVA KIA were later confirmed. Due to numerous elephant tracks and droppings, it was probable that the enemy had utilized these animals in this area. The tracks appeared to be one or two weeks old. At 1340, Company B sighted 4 enemy troops at XD910681 moving from west to east towards the Ben Haí River. Snipers fired upon the enemy and artillery was employed, killing the 4 NVA. At 1410 Company A observed 6 to 8 enemy at XD913683. Small arms and artillery were employed and 2 NVA KIA were confirmed. At 1410, a sniper attached to Company B took 3 NVA troops under fire at XD909684. One NVA KIA was confirmed. At 1450 on 17 September, elements of Company B observed enemy troops in a bomb crater at XD908689. Small arms were utilized with one NVA KIA confirmed. At 1500 several NVA were sighted to the north of the Ben Haí River. Four flights of fixed wing air support were run on the target. Three bunkers were destroyed and one secondary explosion was observed. Twenty-five NVA KIA were confirmed. At 1625 an aerial observer called a mission on 10-12 bunkers, buildings and a trail network at XD916656. A fixed wing mission was run resulting in 12 bunkers destroyed. At 1915 on 17 September, the Battalion CP located at XD918687 received 15 rounds of 82mm mortars. This resulted in 4 USMC KIA and one civilian reporter WIA. One flight of fixed wing and artillery were fired on XD918687. At 2345 one 82mm mortar round impacted at Company C's position. Three USMC KIA resulted.

Appendix C

AIR-STRIKE DATA

Table 7 shows the air strikes on September 17 near the USMC 1st Battalion, Ninth Regiment (1/9) subsequent to its helicopter insertion into the DMZ. These air-strike data were taken from a COACT run. A plot of the air strikes falling within the fifteen 1000-meter squares is shown as Fig. 1 in the text. None of the reported air strikes taken from the COACT run occurred at the time of the NVA attack. However, Lt Forte, the 1/9 Bravo 1st platoon leader, said that "we had air working over the bottom of the valley" at about 1830 hours local time, i.e., 1130 GMT, when he thought the NVA mortar attack occurred. No air strikes are reported for that time. Also, Lt Forte said "...the air that they brought in said that they got one or two of the tubes." However, none of the reported air-strike targets are near the feasible locations of the NVA tubes. Therefore, the COACT data may be incomplete.
### Table 7

NEARBY AIR STRIKES ON SEPTEMBER 17, 1968, SUBSEQUENT TO INSERTION OF 1/9 IN DMZ

(SOURCE: COACT RUN)

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<td>2</td>
<td>165300N1064800E</td>
<td>N/A</td>
<td>750LB NAP BLU-27 2.75IN ALR HE 500LB MK-82 SNAKEYE</td>
<td>4 114 6</td>
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Appendix D

RULE-OF-THUMB STATISTICAL TEST

A rule-of-thumb statistical test is applied to determine if the FAST-VAL computed casualties, \( C_f \), compare closely with the recorded casualties, \( C_r \), as follows:

1. Let \( N \) = initial strength, and

\[
p = \frac{C_f}{N^*}
\]

2. Compute the "normalized deviation,"

\[
\sqrt{ \frac{C_r - C_f}{(N \cdot p \cdot (1-p))^2} }
\]

3. If the "normalized deviation" is greater than 2, the comparison fails the test, and the FAST-VAL model and its parameters are suspect. Otherwise it passes.

Let

\[
x_i = \begin{cases} 
1 & \text{if the } i\text{th troop is a recorded casualty} \\
0 & \text{otherwise} 
\end{cases}
\]

\[
p = P_r(x_i = 1) \quad \text{probability that } x_i = 1
\]

\[
E(x_i) \triangleq \text{expected value of } x_i
\]

\[
E(x_i) = E(x_j) = p \quad \text{for } i, j \in N^*
\]

Therefore,

\[
E(C_r) = E(x_1 + x_2 + \ldots + x_N)
\]

\[
= E(x_1) + E(x_2) + \ldots + E(x_N)
\]

\[
= Np
\]

*The symbol \( \triangleq \) means "equals by definition."
\[
\text{Var} \left( C_r \right) \triangleq \text{variance of } C_r, \\
\text{Cov} \left( x_j, x_k \right) \triangleq \text{covariance of } (x_j, x_k), \\
\rho(x_j, x_k) \triangleq \text{correlation coefficient of } (x_j, x_k).
\]

If \( |\rho(x_j, x_k)| \neq 1 \) for all pairs of \((x_j, x_k)\) with \( j < k \), it can be shown* that the distribution of \( C_r \) converges to a normal distribution as \( N \) gets large. For our purposes \( N > 30 \) usually suffices.

Now,

\[
\text{Var} \left( C_r \right) = \sum_{k=1}^{N} \text{Var} \left( x_k \right) + 2 \sum_{j < k} \text{Cov} \left( x_j, x_k \right) \tag{**}
\]

\[
= Np(1-p) + 2p(1-p) \sum_{j < k} \rho(x_j, x_k)
\]

where \( j, k = 1, 2, \ldots, N \)

\( \sum_{j < k} \rho(x_j, x_k) \) is the sum over all pairs \((x_j, x_k)\) with \( j < k \)

and

\[
\text{Var} \left( x_k \right) = p(1-p)
\]

follows from the fact that \( x_k \) is a zero, one variable. We believe that

\[
\sum_{j < k} \rho(x_j, x_k) \geq 0
\]

and

\[
\text{Var} \left( C_r \right) \approx Np.(1-p) \cdot
\]

* The author wishes to thank J. Rolph of The Rand Corporation for his personal communication on this matter.

Therefore, if we use $\text{Var} (C_r) = Np(1-p)$, we will err on the conservative side in our rule-of-thumb statistical test. That is, we will consider that the computed casualties deviate further from the reported casualties than they actually do.

We define

$$E(x_i) = E(x_j) = p = C_f/N$$

Now

$$E(C_r) = Np = C_f$$

and

$$\frac{(C_r - C_f)/[\text{Var} (C_r)]^{1/2}}$$

is an asymptotically normal variable with mean = 0 and variance = 1.0.

Our hypothesis is that $C_r$ and $C_f$ differ only because of chance or random fluctuations of a Gaussian variable about its mean. We use a two-sided test in which each tail of the normal-distribution side contains 2.5 percent of the distribution. The critical value is approximately 2, and if

$$\frac{|C_r - C_f|/[\text{Var} (C_r)]^{1/2}} > 2$$

we reject the hypothesis. Otherwise we accept it.

The above version of the statistical test is a two-sided 5-percent test that is used when $N$ and $Np$ are sufficiently large, i.e., $N \geq 30$ and $Np \geq 5$.

For $N \geq 30$ and $Np < 5$, a one-sided 5-percent test is used as follows.

$x_i$ is treated as a binomial variable with probability

$$p = \frac{C_f}{N}$$

that the $i^{th}$ troop will be a recorded casualty.
The 95th percentile, value \( M \), is found by linear interpolation between \( M_s \) and \( M_s + 1 \) where
\[
P\left( \frac{\sum x_i}{n} \leq M_s \right) \leq 0.95 \leq P\left( \frac{\sum x_i}{n} \leq M_s + 1 \right)
\]
and \( M_s \) is an integer,
\[
M_s \leq M \leq M_s + 1
\]
For example, from Table 6 for 20 mortars
\[
C_r = 0.4
\]
\[
N = 193
\]
\[
p = 0.4/193 = 0.002
\]
\[
M_s = 1
\]
\[
M_s + 1 = 2
\]
\[
P\left( \frac{\sum x_i}{n} \leq M_s \right) = N!/(2!(N-2))p^s(1-p)^{N-s}
\]
\[
P\left( \frac{\sum x_i}{n} \leq 1 \right) = 0.9386
\]
\[
P\left( \frac{\sum x_i}{n} \leq 2 \right) = 0.9922
\]
and
\[
M = 1.26
\]
Since \( C_r \) takes on only integer values 0, 1, 2, 3, etc., it can be seen that the critical value, \( M \), will also cause this version of the rule-of-thumb statistical test to err on the conservative side. Since
M = \text{M}_8 \) occurs only when M is an integer (which should only occur rarely),
the rule-of-thumb statistical test critical value will reject the hypo-
thesis that \( C_r \) agrees closely with \( C_f \) more than 5 percent of the time,
when in fact they differ only due to chance fluctuations. In our ex-
ample, even though \( C_r \) and \( C_f \) are from the same population, the critical
value of 1.26 means that for all values of \( C_r \geq 2 \), the hypothesis will
not be accepted with a probability of \( 1 - 0.9386 = 0.0614 \) (instead of
0.05), when in fact they differ only due to chance.

- For \( N < 30 \), it is suggested that the rule-of-thumb statisti-
cal test does not apply and should not be used.
Appendix E

SUMMARY OF CASUALTY REPORTS*

In addition to the interview data, the following sources of casualty data were available: (1) command chronology, (2) unit diaries, (3) "point paper," and (4) III MAF SITREP. The reported casualties for 17 September 1968 in each are as follows:

1. Command Chronology
   "4 USMC KIA and 1 Civilian reporter WIA."

2. Unit Diaries
   "A" Company: 0 casualties
   "B" Company: 1 wounded in action
   H+S Company: 1 wounded in action, 2 wounded in action not evacuated
   Note: Civilians wounded are not reported in unit diaries.

3. Point Paper
   "0 KIA, 5 WIA"

4. III MAF SITREP
   "5 USMC WIA (MED EVAC)"

* The unit diary was considered as the most accurate report for this study. Thus, adding the wounded civilian reporter to the casualties reported in the unit diaries, we obtain 5 casualties, 3 of whom were evacuated.
REFERENCES


5. Harris, B. W., and K. A. Myers, Cover Functions for Prone and Standing Men Targets on Various Types of Terrain (U), Ballistic Research Laboratories, Report No. 1203, March 1959 (Confidential).

