Hostage Survival Probability Model

The Justice Academy (justiceacademy.org) and the National Tactical Officers Association (ntoa.org) have joined forces to coordinate and conduct a national study regarding hostage survival rates in order to determine the contributive factors associated with such special operations situations. The Hostage Survival Probability Model project will endeavor to isolate, quantify, and prioritize discriminant variables that influence the outcome of such situations and then assemble the contributive factors into primary, secondary, and tertiary levels of influence in order to create a survivability equation that can be applied to future hostage situations. Predicated on the findings of the national study of past cases that have occurred, it is the goal of the research team to use the collected information to create a predictive algorithm that can be used by hostage negotiators and special operations units to minimize the risk factors associated with direct enforcement actions and enhance the likelihood of a positive outcome of the hostage situation, based on historical analysis. If anyone has a burning interest to participate in this study please let me know. As the study progresses the research team will be issuing updates and information that will allow agencies to participate in the data collection phase of the project and upon completion of the research project a final report will be issued to every agency in the country, along with instructions regarding how to access the Hostage Survivability Model.

Discriminant Analysis is a powerful mathematical tool that is perfect for this type of study. It essentially allows us to create two groups of outcomes (Hostage Killed or not killed) and then we can compare the individual predictive power of each variable and the collective power of all variables we include for analysis. The final outcome looks like a terrible multivariate calculus equation, but they really are quite simple to apply. We can also create a computer algorithm that takes the math out of it and focuses the results on the hostage situation, so all you have to do is enter the values for the current situation and stand by for "what - if" questions from the commander. The product of this study should also provide you with an ability to arrive at a scene, recon the situation, and then use the equation to provide a baseline assessment. In other words, as it stands presently, there is a 70% chance that the hostage will be killed. What do we have to do to lessen that likelihood and regain control over the situation to ease tension, lower the probability of the hostage being killed, and resolve the event with a minimum of force.

The resultant formula will look something like this:

$$Z = a + bX1 \;\; bX2 \;\; bX3 \text{ etc (in one horizontal direction),}$$

followed by another similar equation going vertically, for each X factor,

and then a series of perpendicular equations. for each axis.

Essentially, the equation becomes a Rubic's Cube and if we apply just the right amount of leverage on each variable, the outcome will be positive. It's an oversimplification, but that's the best way that I know how to explain it.

The purpose is to identify major, minor, and subtle level factors. Think of it as Dominos and you get a pretty fair idea of how it works. Each X factor represents a value from the current scene (such as suspect has killed a hostage already or not). The [b] values are standards that were derived from the study we will conduct. They never change unless we update the study and include new cases. The [a] part of the equation is also a static value that never changes. When applied in the field you won't see a + b symbols, but numerical values like Z = 235 + .7890X1 + .435X2 etc... where the X values you'll enter represent the current situation scores, based on your recon of the scene (such as subject is coherent 1, or not 2).

Then, all you have to do is change the value of one of the X's in any direction and you get a probability estimate [Z] which you can use to decide your next action. The idea would be to escalate the intensity of the scenario based on the least probable level of risk to the hostage, even though sometimes situations demand aggression. We all know that, but for those situations where time is on our side, this predictive model can be used to determine a course of action that mitigates as much risk as possible, until we run out of choices.

Essentially, this study and the eventual model it derives can be used by departments throughout the nation. It is not a replacement for intuition, experience, or decisive action, but it will help lessen probable outcomes of harm to the hostage, based on an statistical probability, predicated on an analysis of as many cases as we had available to us to analyze.

Keep in mind that not everyone, in fact few, have the experience you have in such situations and they need our help in providing a tool that will help them resolve the rare occasion when they found themselves faced with such a serious situation. This study is designed to bring together the wisdom, experience, and insights of those who face these situations many times every year and to make that knowledge available to every department and agency in the country.

Initial Variable Identification

As a result of some research and experience, I have assembled a short list of potential variables that might be worth a look, but then again I am guessing (or hypothesizing, if you prefer)... I can't lay them out in a three dimensional array because of the limitations of this venue, so I'll list the sub-variables underneath each major factor. I have no idea at this point if they matter to the outcome, what order they come in, whether one is really a sub-variable or not, or the predictive power of any of these factors. Essentially I'm just spit balling to get discussions moving but these seem, from the literature, to be reasonable things to look at as we begin. I am very sure there are a hundred more in each direction and that is what our discussions will focus on. Remember, there needs to be a theoretical basis for including variables, but it could be that something holds a significant degree of predictive power and we just haven't yet figured out what the theoretical support for it is, (yet). That doesn't mean we don't look at it in the study. You'll also note that some variables are controllable while others are beyond our control. That becomes a very important consideration. If those variables that we do not control align to predetermine a negative outcome at the time we arrive, what changes do we have to make to those factors that we do control to change the probability estimate of the hostage's survival. This controllable versus non-controllable factor consideration is important and we need to be mindful of it, as it constitutes the essence of tactical operation effectiveness.

Major Variables Include the Following.
See Hostage Array.pdf and HSPM Quantification strategy for sub-variable listing.

X1 - Subject Survival Disposition

X2 - Mental Illness and State

X3 - Degree of Cognitive Impairment

X4 - Motivation of the Subject

X5 - Situational Violence Level

X6 - Hostage Health Status

X7 - Demographic Profile

X8 - Number of Hostages

X9 - Familiarity of the Players

Hypotheses

There are, in scientific studies, always two hypothesis statements for each variable. The first is the Null Hypothesis which is always expressed as a negative statement such as, there is NO correlation or statistically significant difference between those instances where a hostage was killed and those where no such outcome was realized, based on the level of cognitive impairment of the offender at the time of the incident.

The Research Hypothesis would say just the opposite. There is a statistically significant difference in the frequency of hostage situations that end with the hostage being killed versus those situations where the hostage lives, based on the level of cognitive impairment of the subject.

The rule in such scientific studies is to ALWAYS embrace the Null Hypothesis until it is proven untrue by the results of the statistical analysis beyond the .05 or .01 level. That means at the 95% or 99% level of certainty which is a computation common to such forms of statistical analyses. The good news is that's my part of the study and you don't have to concern yourself with it. Such high level analytical certainty keeps us from embracing incorrect assumptions, such as the world is flat therefore everything orbits around the earth; therefore we (humans) must be important.

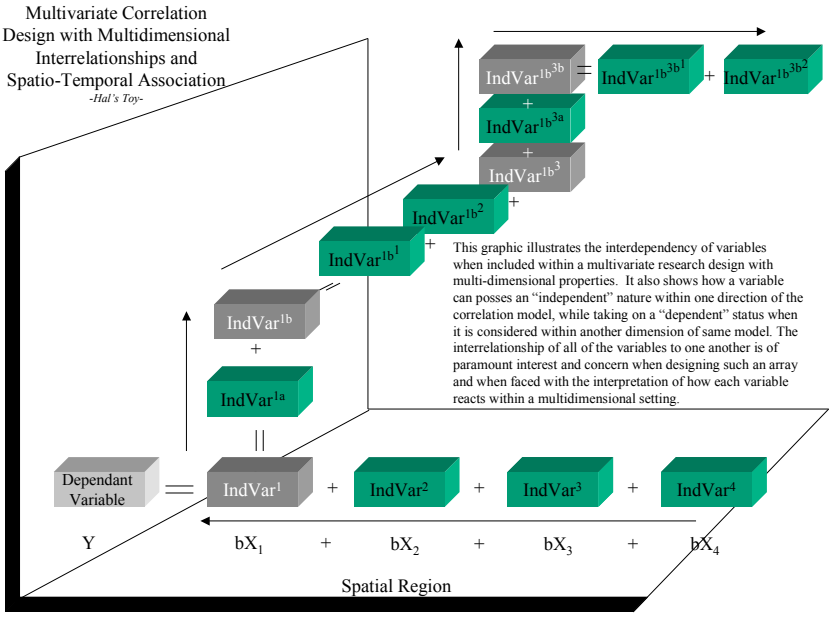
So for this study we presume nothing to be true, until we develop a hypothesis that is derived from the theory (if we can find some frame of reference) and then we prove that in the vast majority of cases the outcome was influenced (partially) by that variable or not.

One caution however, we will undoubtedly see that X1 is responsible for (let's say) 15% of the outcome, and X2 for 5% of the outcome, etc. In other words some variables may be good discriminators, but possess only a relatively low level of power in determining the outcome. Our goal is to find as many variables as we can, in multiple directions, to increase the chance that we have accounted for as much of the variability in the outcome of all cases that we studied. If we get above 80% in combined or aggregate influence, then the predictive accuracy of the model will be

such that it can be applied with certainty to help guide the outcome of future hostage events. The more variables we include, the better our chances of finding controllable and non-controllable factors that may account for the outcome. We can always eliminate them if we discover that they afford little or no influence over the outcome of an event and are subsequently not worthy of including within a master predictive equation. This is also important if you consider that we need to avoid information collection overload at a hostage situation. In other words, becoming overwhelmed with data collection for variables that possess little or no discriminating power is counterproductive so, ideally, we need to isolate a sequence of variables that maintain a significant level of influence (historically) about which data can be collected at the scene (expediently). The rest is up to the tactical operators at the scene to use this information to their advantage.

IF, we are successful in identifying a collection of variables that indeed influence the outcome of most hostage situations, and IF we can arrange them in an equation with their predictive power identified and their relation identified (which I am certain we can do) THEN it will be possible to write a computer program (algorithm) that can be used at every hostage situation by command and tactical personnel to gauge the threat level to the hostage at the time of arrival and throughout the event. Essentially, the algorithm or program can reside on a iPad so there is no calculation required and all we have to do is plug in values for each variable based on the event. Then the program will wait for us to ask it "what happens to the probability that the hostage will be killed if we do X"? In other words, we can game the event before we take any actions. Based on the results of the game, we can decide whether to employ the tactic or not, or find a different approach to employ that has a lesser probability of the hostage being killed.

Multidimensional Theory



The research design strategy presented within the graphic above depicts just how complicated this process of multidirectional hypothesis formulation and spatial correlation modeling can become and also depicts the degree of comprehensiveness required in order for the research team to build in such multidimensional considerations. As can be observed, each variable, along with its defined hypothetical interrelation to all of the variables contained within the multidirectional correlation

matrix. After we have identified the perpendicular relationships that exist between multiple correlation equations and the interrelation that exists between perpendicular equations, we are free to further examine the controllable and non-controllable properties of each IndVar and use this recognition to experiment with the impact that subtle manipulations of each variable may have on the greater principle equation. This process of recognizing, identifying, measuring, and manipulating variables, in multiple directions, can be highly effective at disclosing the subtleties that exist between variables and at providing researchers with a tool for creating models and subsequent policies based on these models that maximize the degree of prerogative that exists in manipulating our universe. From the strategist's perspective, such research designs not only offer a comprehensive examination of phenomena, but also further provide for the ability to construct advanced equations that offer a highly refined degree of subtlety over potential courses of action to manipulate the environment. This approach can not only maximize effectiveness in achieving the desired results to control phenomena, but can also provide for the expanded consideration that minor adjustments in the values of the IndVars contained in the perpendicular equations will have upon the more principle aspects of the model.

Survey Strategy

It is important to standardize the data collection approach used in this study to assure accuracy and commonality in valuation of the factors under study. Toward this end, the quantification strategy will be shared with all participants that prescribe the method by which each case, and each specific variable associated with the data set for a specific case, should be valued. Data will be collected using an Internet based survey instrument that is prepared by the research team and made available for all participants. It is anticipated that each tactical operations team participating in the study will review their after-action reports to glean the values associated with each variable identified within the study. A determination of the value for each variable, for each case, will be made by the team leader and then entered into a spreadsheet, along with an identifying case number and Incident number that identifies the agency that handled the event. Completed surveys will be forwarded to the HSPM analysis team, via email, for inclusion within the master database. Once all data is collected, parsed, and validated, the DFA analysis will be conducted and the results interpreted.