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Fat Chance That

by Phil Johnston

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Roll dem bones. Anything but snake eyes. He rolled a natural 20?!
Wargamers probably have a closer relationship with dice than with anything else in the hobby certainly more than with those metal figures, since your favorite units may not be used in any given game, while dice always are. Of course, it starts getting dangerous when your relationship with dice is closer than your relationship with your spouse.

Dice give us a sense of doing something, interacting with the game, competing with our opponents. I know some players who judge the quality (or realism) of a game by how often they have to roll dice. Players who aren't pitching those little polyhedrons onto the table feel left out. Players even drag around bags of their favorite dice. (I've got two dice, much scarred and with their corners cracked and rounded. One's blue, the other white, and I use them only when Im playing a Napoleonic game and I'm French.)

What's it all mean?
Despite this intimate relationship with dice and their central role in our games, little time or thought is given them. Why do we use them? What kinds of mathematical probabilities do different types of die rolls give us? Do these bear any relationship to real warfare? The answers to these questions should not be the interest solely of the mathe-magicians among us, since we spend so much time with them and are so routinely frustrated and irritated by the little blobs of plastic.

Dice are important, not only for psychological reasons. They, more than anything else in a wargame, reflect what wargamers are willing to relinquish as the province of chance. In an earlier column we saw that chance is one of the four critical elements that Clauswitz identifies as defining the environment of war the others being physical danger, exertion and uncertainty. (I still cant get over how few games or simulations of war I know of make a thorough or consistent attempt to incorporate these at least uncertainty and chance though to the master of military analysis they are the fundamental characteristics to be examined. Its like building an HO railroad set without trains or tracks. What's the point?)

However, while almost all games use dice, they do not all give chance the same latitude for influencing events. For some, dice is kind of a sop we throw to chance, a couple of die rolls that don't really dramatically alter the outcome of the event, just modify it a little. The Irish Brigade really stomps their opponents into the dust or just tap dances on their heads.

Traditional U.K.-style wargame rules tend to limit chance to this kind of minor role two average dice the results of which might act as a mild modifier to fire, morale, etc., but not anything likely to radically alter the expected outcome. American and some U.K. rules tend to place a much greater burden on the dice. As usual, there are exceptions to this general analysis.

This reflects not only wargame style. It also represents a fundamental difference in design philosophy and in views of how warfare occurs. The former philosophy is largely deterministic: if the circumstances are favorable (my unit's morale, weapons, advantage of position, etc., are superior) I should win. The die roll results indicated just how big the win is. The other approach is probabilistic: if the circumstances are right, I increase my odds of winning, but I could roll badly and see my units flee in panic.

I would argue that the probabilistic approach more closely reflects chance in war. Even if everything I can control is to my advantage, that which I can't control may produce disaster. The odds may be small, but the unexpected could happen. (This normally happens to me when I play, and this usually takes the form of me rolling a series of natural 2s or 3s on 2D10 when even an 6 or 7 would enable me to win. Actually, it happens so consistently that it is no longer unexpected it's almost part of the house rules in our wargame group.)

Rolling right along

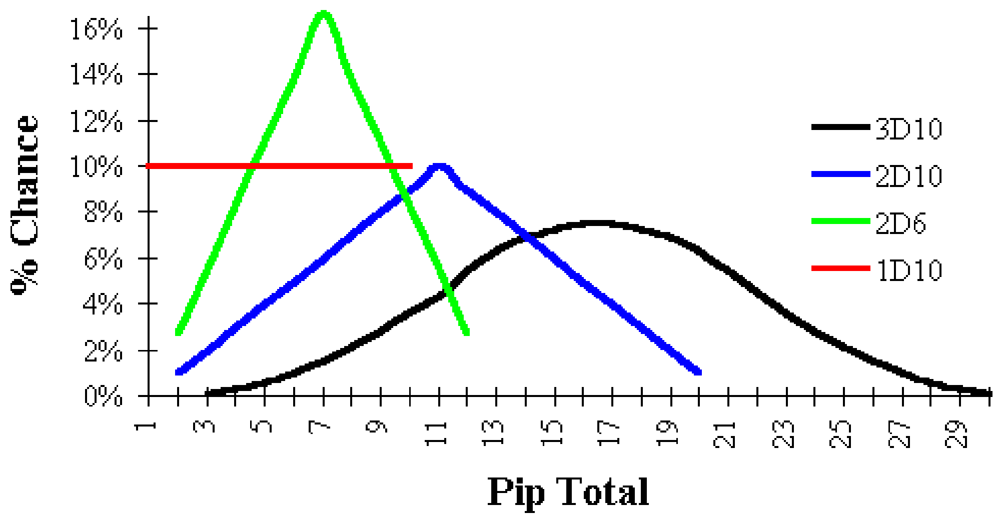
So, we've talked a lot about chance. So what? Okay, here comes the really important stuff. We're going to look at different kinds of die rolls and how they reflect or don't reflect a realistic set of battlefield outcomes. In particular, we'll look at rolls of one, two and three dice. I have to give credit to my friend Les Benoodt, a much better mathe-magician than I and the person who provided a lot of the statistical proof of what follows. I also recommend "The Cartoon Guide to Statistics" as an excellent and understandable source for this kind of discussion. It's been my primary text for this piece.

Many games use 1D10 or 1D6, or 2D10 reading results as a percentage. Some use 2D10 or 2D6 reading the results as a sum. In many cases the hoped for result is a greater than kind of thing, like rolling a five or higher. In other instances, the results are broken into ranges, a 1-4 means you rout, a 5-8 means you stand there shaking and 9-12 means you run the other guys off the hill.

Big deal. Actually, yes it is. These three aspects of dice number of dice thrown, how you read results and whether effects are used as a range of outcomes are the most important mechanical aspects of wargame design. They also reflect how well the designer grasps the role chance plays on the battlefield.

Look at Figure A. It illustrates the possible outcomes of 1D10, 2D10 and 3D10 where the results are read as a sum. (You could use, 1D6, 2D6 and 3D6; the lines will simply be modified upward and the legs of the curves will move closer together.) The flat line shows that rolling a 1D10, you always have a 10 percent chance of rolling any given result. When you roll 2D10, that's a completely different set of probabilities. The 3D10 roll is actually a lot like 2D10, but with curves.

Figure A



Reading the results of a 1D10 or 2D10 as a percentage is a much more straightforward affair. Since, in effect, each die roll produces a separate result, the odds of rolling any particular result is always about 1 in 10x10, or 1 in 100. Translation: rolling dice to read as a percentage gives an undistorted set of probable outcomes if you are looking for a greater-than or less-than result or an exact numerical match, like a roulette wheel.

But, if your outcomes are given as ranges (2-5, 6-10, etc.), a single die and two dice give you radically different probability curves. This means someone always has an equal 10 percent chance or rolling a 2, 5 or 10 on 1D10, but has a one percent chance of rolling a 2 or 20 on 2D10, while the chances of rolling an 11 are 10 times greater. No fair.

This also means that rolling 1D20, instead of 2D10 is cheating, since the 1D20 line would look just like the 1D10 line, but with a constant five percent chance of rolling any number.

Hang on

Now, try to stay with me here, cause it's going to get both more complicated and more interesting, at least in terms of realism, playability and wargame design. Remember in an earlier column when we looked at how to promote both realism and playability by substituting a 2D10, read as a sum, for a series of single die rolls?

I'll recite that line of reasoning, for those who might have missed it. Rolling two or more dice gives you a bell curve of results, and that's what is needed to reflect complex interactions of minor events, such as those involved in large unit morale, close combat, etc. The bell curve tends to give average or normal results, but it allows for extremes at both ends. Thus, modifiers for the right circumstances (morale, weapons, position, etc.) tend to push the results toward the higher success end of the curve, and a more balanced set of circumstances tend to cause results to fall in the indecisive center of the curve.

By imbedding complex routines in a bell curve with modifiers, you can dramatically simplify rules without sacrificing reality, since the real world conditions are included but rendered transparent to the player. Thus, instead of having to follow a lengthy flow chart (rolling a die or dice each time for a greater than result) to determine each of the subsidiary events in close combat that affect the final outcome, you can imbed them in a single table and one die roll.

Take two hypothetical examples. In one, the player (a corps commander) moves his units into tactical combat range. He then selects the first unit to launch its assault. He rolls to see if they advance; he rolls to see whether they attack with enthusiasm or elan. The defending player (also a corps commander) rolls to see if the unit targeted by the attack stays or leaves. If it stays, he rolls to see at what range it fires. He then rolls to see how many casualties he inflicted. The attacking player now checks to see whether his unit is stopped by the fire or continues the charge. Assuming now that both attacker and defender don't break, the actual impact is resolved. The players move flanking stands around the enemy's unit, if possible, bonuses for additional ranks of figures are determined, and the die is rolled. Somebody stays; somebody doesn't. The entire procedure is repeated for each attacking unit. In most rules, this multi-step process is accomplished using a series
of greater than die rolls. Each event is distinct, and the player must roll a number or higher (sometimes lower) to achieve the desired result.

In example two, the attacking player simply advances each of his attacking units toward the enemy. Then, each defending unit fires, and the casualties are calculated this is done using the interaction of the unit's quality and a die roll, even a percentage die roll suffices. (Alternately, you may incorporate the defending unit's fire quality into the impact roll as a modifier.) The attacker and defender then total up their impact modifiers, and there's a die roll, 2D10 or 3D10 read as a sum and results given in ranges of outcomes. Casualties, mass, unit quality and enthusiasm, advantage of position, etc., are considered modifiers to this roll. As a result, somebody stays; somebody goes.

We need to look at these two alternative approaches in two ways. First, the multiple greater than die roll system requires multiple decisions and die rolls. This slows down the game and renders it less playable. It also gives the player much more involvement in close combat than his historic counterpart would have had. In the single roll, bell curve system the same range of results might occur, with the interaction of the same events and attributes, but with only one or two die rolls and virtually no player involvement at a level on the field very remote from his position as corps commander. The latter is quicker, more playable and more realistic.

But isn't this bell curve approach unrealistic and over simplistic? To answer that, I quote the famous Fuzzy Central Limit Theorem: Data that are influenced by many small and unrelated random effects are approximately normally distributed. (I'm not making this stuff up.) Translation: where many different causes are involved, the resulting probability appears as a bell curve. Stuff like peoples weights, ages of death, IQs, batting averages, etc., all are the result of many unrelated causes (genetics, personal habits, practice, education and so on). The result of any useful sampling of these data produces a bell curve.

Battlefield events are likewise the result of numerous and often unrelated causes things like training, elan, weapon type and condition, surprise, momentum, position relative to the enemy the list goes on and on. In other words, the battlefield is as subject to the Fuzzy Central Limit Theorem as any other arena.

Consider what goes into determining whether an assault succeeds of fails, whether a division is gripped by panic, the effects of attrition or strategic consumption. The effects are generated by numerous unrelated causes, and the chance of any particular outcome falls right on the bell curve. Positive modifiers push the probability toward the better end of the curve, negative modifiers have the opposite effect.

What's the chance that a three-pack-day smoker who never exercises and who has a family history of heart disease and diabetes will live to be 99. Probably about the same chance the Neapolitans, charged on the flank by Russian Guard cavalry and already down 50 percent in casualties, have of forming square and beating off the attack, routing their opponents. So, roll those dice and see what happens. Our smoker might die at 30, 40, 50, etc. or he might live to 99. The hapless Neapolitans might disintegrate and be hacked up, they might rout in a body, they might be overrun in place, the might form square but be broken, the Guard might balk, and so on.

All these reflect the range of results possible on that bell curve. The fact that they are Neapolitans, their casualties, being charged by cavalry, being charged by Guard class troops, being charged on the flank, are all modifiers which increase the likelihood of rolling a result down on the unpleasant end of the curve, but sometimes a natural 20 comes along, and the Neapolitans stand firm, form square and empty lots of Russian saddles.

Thus we see that the bell curve, produced by 2D10 or better yet 3D10 read as a sum with results given in ranges, is actually the most realistic model of probability that statistics and dice can generate. This, plus the improved playability from eliminating those multiple greater than rolls and the enhanced realism from shutting players out from decisions remote from their position as commander. That makes the 2D10 and 3D10 a tremendous tool for designing sophisticated, realistic and extremely playable wargame rules.