Exploding 6's Explained

Overall, Firestorm Armada is a great game. The models are fantastic, the rules are generally straight-forward, and the units and factions are fairly balanced. However, there are some issues with the game which deter gamers from trying it out. The most common complaint from this group is the Exploding 6 mechanic. Generally gamers think this creates way too much variability and luck within the game (gambling with the Random Number Generator) while happily playing games with more luck than they realize. This is my attempt to explain why Exploding 6's is a solid mechanic.

First, I'm going to make some assumptions about you, the reader. I'm going to assume:

1. You've played games with a known percentage chance of success/failure for a given action.
2. You've played at least one D&D type game, which uses 3d6 to generate stats.
3. You've played Warhammer or Warhammer 40,000.

If you don't fit one of these three, that's ok. I'm writing specifically for you too, and will briefly explain these system's mechanics so you can understand what I'm saying.

Known Percentages

One of my favorite games is X-Com: Enemy Unknown. It's a fantastic tactical combat game where you control 4-6 soldiers fighting aliens invading earth. The heart of the game is maneuver and firepower; you move, you shoot. Good positioning brings success, and bad positioning gets you killed, even late-game. Anytime you look to shoot something, the game will calculate a percentage chance to land a hit, based on a variety of factors. Generally, anything with less than a 70% chance to hit is not a shot worth taking; you're better off saving your ammo and finding a better position to fire next turn, or shooting something else. But you wouldn't know you should hold your fire unless the game told you this percentage.

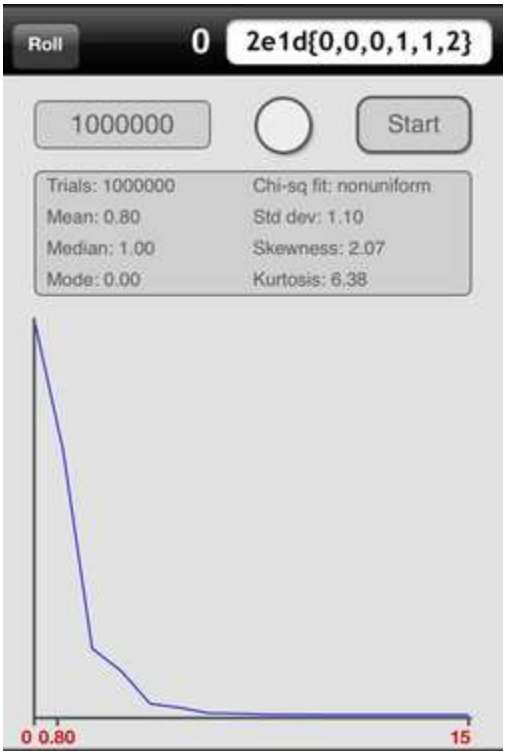
In FSA, the same principles apply; you move, you shoot. Positioning is very important, as it dictates what weapons you can fire, and how effective they will be against the target. However, the damage system and Exploding 6's make it almost impossible for a person to calculate the damage percentages. But just because it's difficult doesn't mean you can't figure it out. As a rule of thumb, you can multiply the number of Attack dice you're rolling by .8 to generate the statistical Mean, or average. For example, 10AD will, on average, generate 8 Hits... Even with Exploding 6's and each 6 counting as 2 Hits.

Warning! Optional Mathematical Proof (which I probably messed up)

I don't know how to write the statistics formula for Exploding 6's, but we can brute force it. For a given dice roll, three results are 0 Hits, two results are 1 Hit, and one result is 2 Hits. This means the base average is (0+0+0+1+1+2=4; 4/6=) 2/3 hits per roll, or .666 hits per roll. However, one result also generates another dice roll, which raises the total:

*Explosion 1: 1/6*2/3= 2/24, or .08333 more hits*
*Explosion 2: 1/36*2/3=2/108, or .0185 more hits*
*Explosion 3: 1/216*2/3=2/648, or .0031 more hits*

*Explosion 4 is 1/1,296*2/3, or .0005, which is close enough to zero to ignore. So if we add all three Explosions to .666, we get .771. Apparently, that one in a million chance of rolling eight to nine 6's in a row, and thus generating 16-18 hits from one dice, really pulls the average up. But why guess when I can use a computer? Using the using the free App 'RPG Roller':*

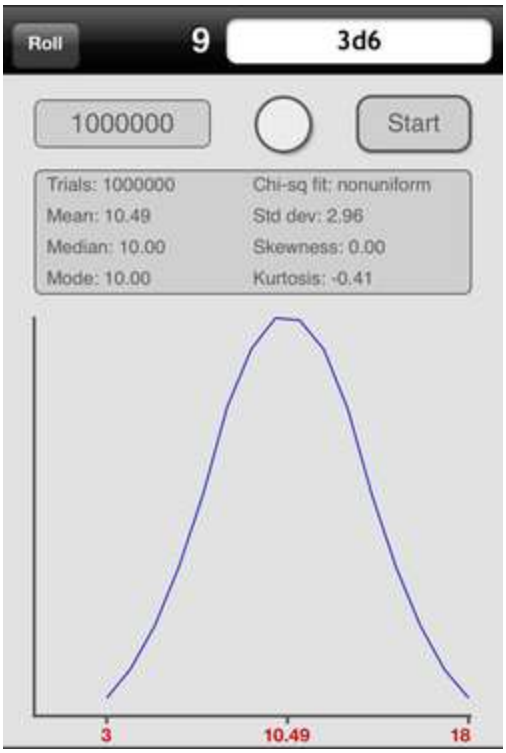


The computer says the Mean, or average result, from rolling one Exploding 6 one million times is 0.80. Why should I argue? Also, the highest result it achieved was 15 hits from one die.

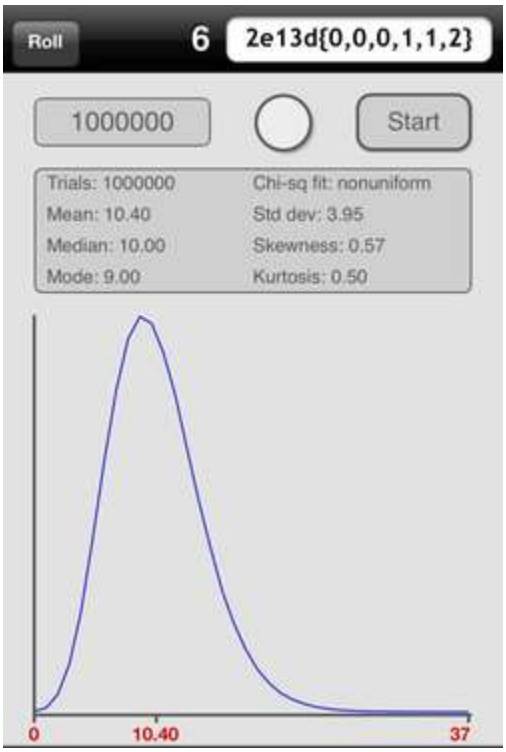
Knowing the average for a given roll is useful, but not exactly the same as knowing the percentage. I don't know how to make this calculation (too many variables, and I've forgotten Statistics) but I can show you one way to find out.

D&D and Dice Curves

Way back in the day, when D&D first came out, you created a character, including a stat-line for their abilities. The game used a simple system; roll 3d6, and that was your ability score. This meant the possible range was 3-18, and had a mean score of 10.5... So a 10 or 11 was an average score, and were essentially identical and average in the game. We can look at a graph showing the odds for rolling any given stat, and see a bell curve, like this:



We can do the same thing for FSA. 13AD has almost the same Mean as the 3d6 stat roll (13x.8=10.4) so we'll use it as a comparison. This is what the 13AD stat curve looks like:



In many ways, both graphs are similar. The odds of rolling a 10 or 11 are almost the same (25% vs 19.6%) and the odds drop as you move away from the Mean fairly quickly. Even the extreme values are close, in regards to percent.

(Warning! Boring pseudo-statistics: For 3d6, the odds of getting a 4 or less is 1.4%; for 13AD, the odds of getting 3 or less successes is 1.7%. For 3d6, the odds of getting a 17 or higher is 1.4%, for 13AD, the odds of getting an 18 or higher is about... 4.6%. (I don't know how to actually calculate this, I simply added the percentage chance for each value starting at 18, until the odds were less than 0.01% at 25 hits, and added .1% to guess the rest.))

There are some fundamental differences. First, the 3d6 curve is completely symmetrical, while the 13AD graph is skewed. It's actually more likely to obtain a value below the Mean than above the Mean. (The Mode, i.e. most common result, is 9, not 10 or 11) Second, the possible values for 13AD range from 0 to infinity. While there is a chance for these extreme results to happen, they're practically negligible. (The odds of rolling a 2 or less, or 20+, is less than 1% for each).

The important thing to remember when looking at these results is to keep in mind how damage works in FSA. Each model has a DR/CR value, as well as Hull Points. If your hit total meets the DR value, you do 1 point of damage; if your hit total meets the CR value, you do 2 points of damage; if your hit total meets 2x CR value, you do 4 points of damage. For Cruisers, which usually have 4HP, that's all the results which matter. It doesn't matter if you land 3x or 30x Criticals, it's still destroyed.
(Yes, each Critical Hit could result in a 1/36 Reactor Explosion, but let's leave the Critical Hit Chart for another article.)

So let's fire 13AD at some targets and see what happens.

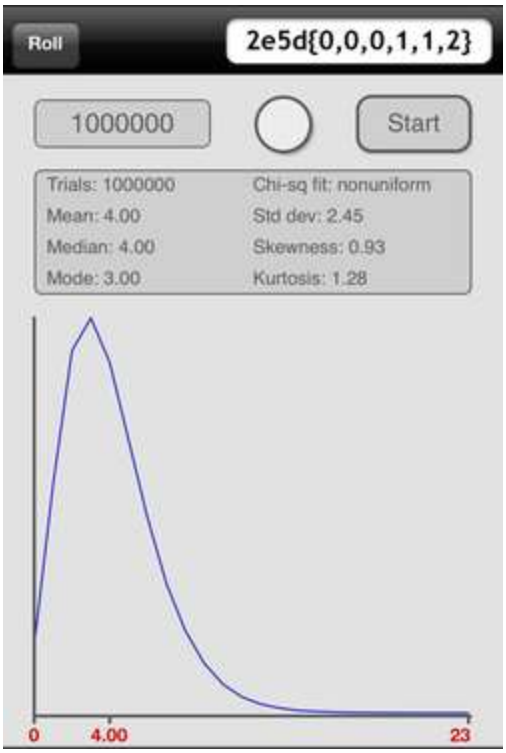
<u>13AD vs Dindrenzi Cruiser (DR/CR is 4/8)</u>

Miss: 1.8%
Hit: 22.6%
Critical Hit: 65.3%
Destroyed: 10.3%

<u>13AD vs Aquan Cruiser (DR/CR is 5/6, ignoring shields)</u>
Miss: 4.5%
Hit: 2.7%
Critical Hit: 55.4%
Destroyed: 35.5%

(Unfortunately, the dice rolling app cannot generate the chart displaying the impact of shields... But it can roll all the dice at once. Someday, I'll generate a few charts showing what Shields do to the percentages using time-consuming, brute force techniques... Or maybe a Statistician will show up and save the day for me. For now, Shields skew the curve to the left, as well as flatten it.)

Let's look at an AD value with a nearly equal chance to Damage or Miss the Dindrenzi Cruiser, and compare it to the Aquan Cruiser. The graph for 5AD looks like this:



5AD vs Dindrenzi Cruiser (DR/CR is 4/8)
Miss: 47%
Hit: 40%
Critical Hit: 13%
Destroyed: ~0.1%

5AD vs Aquan Cruiser (DR/CR is 5/6, ignoring shields)
Miss: 63%
Hit: 12%
Crit: 25%
Destroyed: ~0.1%

Essentially, the game mechanics produce a unique damage table for each offense/defense combination. Some old table top systems actually used a unique damage chart to obtain results; the FSA system is far more elegant. The only down side is this isn't apparent to the player, and it is too complicated for 98% of people to calculate on the fly.

Warhammer Damage Curves

Let's compare this to a system many of you are familiar with: Warhammer 40,000 (6th Edition, when I stopped playing.) In this system, when you shoot at vehicles, there is a three step process for each weapon fired:

1. Roll to Hit; if hit
2. Roll Weapon AP vs Target AV; if damage
3. Roll against a damage chart, dependent on what type of hit (typically glance or penetrate) you

obtained in Step 2

So, let's pretend we fire a Strength 10 weapon (strongest possible in the game) against an average vehicle target (AV 12) with a BS 4 unit (hits with a 3+ on a d6). Here are the odds for doing no damage, and outright destroying it.

(Warning! Lots of Math Hammer ahead!)

No Damage
1. 1/3 chance to miss; no damage, plus
2. 2/3 chance to hit, but
3. 1/6 chance no damage
Total: 44.44% chance no damage

Destroyed
1. 2/3 chance to hit
2a. 1/6 chance to glance
2b. 1/6 chance destroyed, plus
3a. 2/3 chance to penetrate
3b. 1/2 chance destroyed (2/3*1/6*1/6) + (2/3*2/3*1/2)=(2/108) + (4/18) =(2/108) + (24/108)=
Total: 24.1% destroyed

More importantly, the odds for doing no damage, and for landing a penetrating hit (50% penetrating hits destroy), is almost the same: 44% vs 45%. There's only an 11% chance for getting the 'middle' result. This also means there's a 31.5% chance to do something in between no damage and total destruction; a Hit (non-destroying Glance) or Crit (non-destroying Penetrate) in FSA terms. Here it is in the same format as before:

BS 4, Str 10 vs AV 12
Miss: 44.4%
Hit: 9.3%
Critical Hit: 22.2%
Destroyed: 24.1%

Now let's look at an average shooter (BS 3) firing an average anti-tank weapon (Str 8) at average tank armor (AV12).

BS 3, Str 8 vs AV 12
Miss: 75%
Hit: 6.9%
Critical Hit: 8.3%
Destroyed: 9.7%

This damage curve makes almost no sense from a game design standpoint, yet no one seems to complain about it. If I were to make a baseline scenario (avg vs avg), I'd make it so there's about a 50/50 chance to do damage, but a low chance to inflict significant damage. If 40K mechanics were translated directly to X-Com, positioning wouldn't matter, only volume of fire, and it'd be pretty boring to play... Unless you like gambling with the Random Number Generator, and hope to consistently roll higher than your opponent. If I wanted to do that, I'd just play Yahtzee, or maybe

Risk.

Hopefully this gives you a new way of looking at the main shooting mechanic in FSA; maybe you can utilize some of it when discussing the game with other gamers.

-Ryjak