

dwarftough, September 27, 2025. How probable is extreme (un)luck?

After a game you often see chatlines like "I was soo unlucky, -20% inflicted" or "he was too lucky, +10% over the whole game" and so on, and so on. Luck in Wesnoth is a never-ending source of emotional comments. And at some point, the question arose in my head: How much luck/unluck is really too much?

In this article I'll consider the most obvious metric of luck in Wesnoth (with Standard RNG): percentages of inflicted/taken **strikes** in the "Statistics" menu. I will use a simple model to get reasonable estimates on the probabilities and luck ranges: each real game is a lot more complex but these numbers should at least give you some idea of how it can go.

The article will consist of several parts: basic model and results, discussion and some extra info, and detailed calculations that give the results.

1 Probable luck ranges for units on 50% defense

That would be our simplified model: suppose we have only units fighting on 50% defense (for example, Orcish Grunts on hills). We want to estimate which percents in the stats window (for **strikes**) we'll see with the probability of, let say, 95%.

We also suppose, for simplicity of calculation, that the number of strikes n is enough large.

With this in mind, let's see the results.

For units on 50% defense the percentage statistics on strikes will be in range $\pm \frac{200}{\sqrt{n}}\%$ with roughly 95.44% probability.

200 and 95% are easy to remember numbers, but there isn't anything magical about 95%: a similar formula can be derived for other probabilities. For 98% the formula is $\pm \frac{233}{\sqrt{n}}\%$, for 99% it's $\pm \frac{257}{\sqrt{n}}\%$. Below is the table with some precalculated results for different probabilities and numbers of strikes n .

n strikes	Range 95.44%	Range 98%	Range 99%
36	$\pm 33.3\%$	$\pm 38.8\%$	$\pm 42.8\%$
49	$\pm 28.6\%$	$\pm 33.3\%$	$\pm 36.7\%$
64	$\pm 25\%$	$\pm 29.1\%$	$\pm 32.1\%$
81	$\pm 22.2\%$	$\pm 25.9\%$	$\pm 28.6\%$
100	$\pm 20\%$	$\pm 23.3\%$	$\pm 25.7\%$
225	$\pm 13.3\%$	$\pm 15.5\%$	$\pm 17.1\%$
400	$\pm 10\%$	$\pm 11.65\%$	$\pm 12.85\%$

This formula gives more precise results with a larger n . $n = 36$ seems like a good starting value. For smaller n it's easier to get ranges with precise calculations.

n strikes	Range	Probability
6	$\pm 66.6\%$ (1-5 strikes)	96.8%
10	$\pm 60.0\%$ (2-8 strikes)	97.9%
20	$\pm 40.0\%$ (6-14 strikes)	95.9%

For $n = 20$ the formula gives $\pm 44.7\%$, so we see that the error is already pretty small for any practical consideration.

2 Discussion and considerations

What are some brief conclusions we can derive from these results and what do I have to say about this?

1. The possible percentage range gets narrower when n rises, but at a slower pace

As you can see from the table, $\pm 20\%$ strikes luck range is achieved (with 95% probability) only at $n = 100$ strikes (which is a long enough game). And $\pm 10\%$ is reached only at $n = 400$ strikes (that's an excruciatingly long game)

Don't forget that it's the range that occurs with 95% probability, here goes the second conclusion (let's take $n = 100$ for example)

2. For $n = 100$ roughly 1 of 20 games will face more than 20% stats, roughly 1 of 50 games will face more than 23.3%, roughly 1 of 100 games will face more than 25.7%

As small as it may seem, 1% isn't that small probability and such games will appear once in a while. And this 25.7% range is calculated for long enough games ($n = 100$), if the game is shorter, the range may be bigger than that.

3 What about non-50% defenses?

As it's shown in "Calculations" chapter, the general case formula for the range of percents in the Statistics window with a probability α with a chance-to-hit p is $\pm \frac{z}{\sqrt{n}} \sqrt{\frac{1-p}{p}} \times 100\%$ where $z = \Phi^{-1}(\frac{\alpha}{2})$. It's basically the same formula with an additional $\sqrt{\frac{1-p}{p}}$ factor. For $p = 0.5$ it's 1. For a higher unit defense $p < 0.5$, so this factor is bigger than 1: the probable percentages range is larger. For a lower unit defense $p > 0.5$ and the factor is less than 1. The extreme case is $p = 1$, which means 0% defense (always hits), for this one the probable (and only possible) value in the Statistics window is exactly 0%.

4 Calculations

This section describes the exact calculations I did to get the results above.

First of all, strikes in Wesnoth during a round of attack have the binomial distribution, which is a distribution of a series of n independent trials with fixed probability of success p . We shall note it as $Bi(n, p)$

Let's call our number of successes (hits) m . There is a theorem (De Moivre-Laplace) that with larger n $m = Bi(n, p)$ is approximated by the normally distributed value $N(np, \sqrt{np(1-p)})$. Alternatively it can be written that $\frac{m-np}{\sqrt{np(1-p)}}$ is approximated by $N(0, 1)$.

Suppose we have some probability α . Then for the normal distribution $P\left(\left|\frac{m-np}{\sqrt{np(1-p)}}\right| < z\right) = 2\Phi(z) = \alpha$ where $\Phi(z) = \int_0^z \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}} dx$.

So for $z = \Phi^{-1}(\frac{\alpha}{2})$ the following inequality holds with α probability :

$$\left|\frac{m-np}{\sqrt{np(1-p)}}\right| < z.$$

$$\left|\frac{m-np}{\sqrt{np(1-p)}}\right| < z \Rightarrow |m-np| < z\sqrt{np(1-p)}$$

Percents in the Wesnoth Statistics windows are calculated as $\frac{observed - expected}{expected} \times 100\%$. For us $observed = m$, $expected = np$, so

$$|m-np| < z\sqrt{np(1-p)} \Rightarrow \left|\frac{m-np}{np}\right| < \frac{z}{\sqrt{n}} \sqrt{\frac{1-p}{p}}$$

So the general formula for the percents range that we observe with probability α after n strikes with the hit chance p is $\pm \frac{z}{\sqrt{n}} \sqrt{\frac{1-p}{p}} \times 100\%$ where $z = \Phi^{-1}(\frac{\alpha}{2})$.

$z = 2$ for $\alpha \approx 0.9544$. For 50% defense with have $p = 0.5$ and the resulting formula is $\pm \frac{200}{\sqrt{n}}\%$.