Using Discrete Stochasticity for the Analyzation of Veist Stinger

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**Abstract:**

After the introduction of the weapon Taipan-FR4 into the video game Destiny 2, it quickly became realized that it had two interesting attributes, or perks, that quickly sprang it to a community favorite, those being Veist Stinger, which has a 10% chance on any damage from any bullet to fully reload the gun from reserves, or the ammunition that one has in their inventory, and Triple Tap, which allows one to gain an extra bullet to their magazine not from one’s inventory after three quick precision shots. Hence, because the weapon can have 3 different magazine sizes of 5, 6 or 7, we hypnotized that having the maximum number of shots in the magazine, 7, would give a person the best chance to proc, a term meaning that random chance occurred, Veist Stinger. In order to test this, we created a discrete stochastic model that would simulate each magazine size and their ability to proc Veist Stinger in tangent to Triple Tap over the course of 100,000 simulation to see if they were significantly different from one another by using T-Tests. First, we assumed perfect accuracy and then compared that to 85% accuracy. We found that not only was 7 the best magazine size to use for this random chance regardless of accuracy, but also that any increase in the magazine size was significantly different from the previous, meaning that not only is 7 the best for proc chance, but any increase to magazine size is a benefit in context to the chance for Veist Stinger to occur.

**Introduction:**

On August 23rd, 2022, the game Destiny 2 would enter its 18th season and make a quest for players to obtain the Linear Fusion Rifle Taipan-FR4. It then came to light that this LFR had a perk, or attribute, combination of Veist Stinger, Triple Tap, and Firing Line. Veist Stinger is a perk that has a 10% chance to allow the weapon to fully reload from reserves, or the ammunition one has in their inventory, on any bullet fired by the gun, and Triple Tap gives the player a bullet in their magazine after 3 quick precision shots (headshot, critical shots, weak spot shots, etc.), but this bullet is not taken from reserves and is instead simply given to the player. For our purposes, we will not be focusing on Firing Line, as it does not impact the random chance of Veist Stinger, but we felt it important to mention since its addition to the gun is one of the reasons why it was so popular on release because it increases player damage output. The interesting interaction, however, is between Veist Stinger and Triple Tap, for one can have the possibility to never have to reload should Veist Stinger proc, or occur, enough times, but the issue is that Veist Stinger goes on cooldown, meaning the chance for it to proc goes from 10% to 0%, for 7 seconds after it procs. Despite this, Triple Tap allows weapons to exceed the number of shots the magazine would typically allow. For instance, 5 in the magazine can shoot seven times because of Triple Tap, and this is important because this additional time spent shooting can act as a buffer to allow Veist Stinger to come off of cooldown, meaning that it can be activated again.

Because the weapon has a choice of a magazine size of 5, 6, or 7, we wished to test whether or not having the maximum magazine size, 7, would be the best way for players to not have to reload their weapon because of Veist Stinger during a damage phase, and we opted to test this hypothesis by creating a discrete, stochastic model that would simulate shooting each magazine size and then analyze which size had the best chance for Veist Stinger to occur multiple times. However, it is important to discuss which assumptions we utilized when creating our model.

**Assumptions:**

To understand how magazine sizes affect the total number of Triple Taps and Veist Stinger procs, we had to create a stochastic simulation. In general, our stochastic simulations keep track of triple taps for every shot as well as shots taken. The first stochastic simulation we constructed is a discrete model that assumes there is a 0% chance the user can miss and that every shot is a critical shot. Note that assuming the user is hitting critical shots 100% of the time is not entirely unrealistic, especially given the fact that either major bosses in Destiny 2 have large hitboxes or a gun named Divinity increases the boss’s critical hitbox, which makes it difficult to miss. We recognized that the only way a user can miss in our model is to miss entirely. So, for the second stochastic simulation, the user has an 85% chance to hit the shot, and every shot is still critical. We also assumed that for every bullet fired there is a 10% chance that it can fully reload the gun based on reserves (Veist Stinger). If Veist Stinger is activated, then there is a seven-second cooldown where it cannot be activated during this time. Furthermore, we assume that every time step is one second. Some batteries, the name of the magazines on LFRs, affect how long it can take to charge a shot, but in our testing, it took about a second to fire no matter what the battery. This was one of the major assumptions we made, as it would be difficult to capture the exact time step of a shot based on gameplay footage. Based on the time step, the cooldown for Veist Stinger was assumed to be 7 shots. Remember for these models we assume that a user is playing with a Taipan-FR4 and has options of magazine sizes 5, 6, and 7 available to them, where a magazine of size 5 has 15 reserves, size 6 has 14 reserves, and size 7 has 13 reserves. This is less of an assumption and more of a fact in Destiny 2: if the user is wielding a Linear Fusion Rifle, then these are the only possible magazine sizes and reserves. Perhaps the biggest assumption we made for these models is that every shot is continuous and uninterrupted, which is possible, albeit very difficult in practice as there are usually a variety of enemies attacking at once.

**Models:**

After establishing these assumptions, we constructed the simulations using Python. Each simulation had 100,000 trials and would stop once the magazine would reach 0 bullets, as we do not want to take manual reloads into account as we only care about continuous shots. Both simulations kept track of total shots, the number of Veist Stinger procs, the number of Triple Taps, and the number of bullets in the magazine for each trial. Simulation 2 also kept track of the miss counter and the total number of hits for each trial. Since Simulation 2 accounts for randomness in missing or hitting the shot, we also added code to account for two consecutive misses. If there were two consecutive misses, then the Triple Tap counter would reset, as the Triple Tap counter only allows for one miss to keep the counter going. In our models, Veist Stinger occurs when a random number is equal to or less than 0.1. Furthermore, this random number is selected from a uniform distribution from 0 to 1. When Veist Stinger is activated, the magazine is refilled from the reserves. If there is enough ammo in the reserves to completely refill the magazine it will instantly do so, if not then the remaining bullets left in the reserves will be instantaneously placed in the magazine. After the magazine receives the bullets from Veist Stinger, Veist Stinger deactivates for 7 seconds, which again in our model is 7 shots. During this time, Triple Tap is only possible, and no number is drawn for Veist Stinger. If there are still bullets left after these 7 shots, then Veist Stinger is possible again and the model resumes as normal. For every 3 shots, Triple Tap adds a bullet from “thin air”, which is not from the reserves. Note Triple Tap can also have an interaction effect with Veist Stinger which can be captured in the following diagram:

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Figure 1: Diagram of gameplay footage that explains interaction effect between Vesit Stinger and Triple Tap.

Figure 1 is a diagram of the video game footage that we generated. In this example, a red arrow means that Veist Stinger was activated, a blue arrow means that Triple Tap was activated, the green numbers are bullets that are shot, the brown numbers are bullets that were not shot but help depict how Veist Stinger works, and the black brackets represent the cooldown of Veist Stinger. The black numbers underneath the cooldown count how many shots were taken in between. Notice how one of the cooldowns is only 6 shots, this because an enemy ran in front of the screen, and the player stopped shooting for a second. This shows that our model isn’t perfect in the real world as users may not shoot a shot every second, and they may not shoot continuous shots. In general, this diagram displays how Veist Stinger takes precedence over Triple Tap when they interact. Furthermore, this diagram helped lay out the foundation of our model building since we had a concrete example to work off of.

**Analysis:**

To analyze the results of these 100,000 trials, we looked at violin and density plots. A violin plot is a combination of a density plot and boxplot. The violin plot becomes helpful when you have multiple categories or groups that you are analyzing and want to compare. In this case, we want to compare magazine sizes 5, 6, and 7 over the 100,000 for each simulation. We also want to understand the general distribution of these magazine sizes and how they differ over the 100,000 trials, this can be done by looking at a density plot of each variable: total shots, Veist Stinger, and Triple Tap.

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Figure 3: Simulation 1 density plot of Veist Stinger with each magazine size.

Figure 2: Simulation 1 density plot of Veist Stinger with each magazine size.

The figures above represent the 100,000 trials for Simulation 1 for the number of times Veist Stinger was activated in each trial for each magazine size. The density plot shows that as you increase the magazine size, there are more times Veist Stinger activates. For example, the orange distribution is when there are 5 bullets in the magazine, and it has two large peaks at 0 and 1 times for Veist Stinger, whereas the dark blue line is the magazine size of 7, and it has its largest peak at 1 and larger peaks at 2 and 3 compared to the other distributions. Similarly, when analyzing the violin plot magazine of size 5 doesn’t have any values above 1, indicating that for magazine of 5 none of the 100,000 trials had Veist Stinger proc more than once. We can also see that the green line that represents magazine size of 6 has a line that goes to 3, but the distribution around the 3 value is almost as thin as a line, indicating that there are a few trials where this occurred. When looking at the dark blue line, which is the magazine size of 7, it also goes out to 3, but there is a larger distribution around 3. Thus, the magazine size of 7 has more trials that had 3 Veist Stinger activated than the other magazine sizes. Both these two plots convey similar information and back up the claim that as the magazine size increases so does the amount of times Veist Stinger is activated, which is what we hypothesized.

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Figure 5: Simulation 1 violin plot of Triple Tap with each magazine size.

Figure 4: Simulation 1 density plot of Triple Tap with each magazine size.

The figures above represent the 100,000 trials for Simulation 1 for the number of times Triple Tap was activated in each trial for each magazine size. As expected, both plots that as the magazine size increases, so does the number of Triple Taps. In the density plot, the dark blue distribution, that represents a magazine size of 7, starts at 3 Triple Taps and continues to decrease until 9 Triple Taps. Around 8 Triple Taps the other distributions becomes almost invisible to the human eye, where there is still a somewhat strong presence for magazine 7. Furthermore, magazine size of 6 and 5 both have their largest respective peak at 2 Triple Taps, whereas magazine size of 7 has its largest peak at 3 and appears to be more evenly distributed across all the values. This is similar in the violin plot where magazine size of 5 doesn’t go beyond 4 Triple Taps, magazine size of 6 has a select few values at 8 and 9, but the magazine size of 7 still has a visible frequency at 8 and 9 compared to the other magazine sizes. Thus, as the magazine size increases so does the number of Triple Taps, which is what we anticipated.   
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Figure 7: Simulation 1 violin plot of total shots with each magazine size.

Figure 6: Simulation 1 density plot of total shots with each magazine size.

The figures above represent the 100,000 trials for Simulation 1 for the total number of shots in each trial for each magazine size. As the magazine size increases so does the number of total shots, this follows our initial intuition. Magazine size of 5 has a peak at 7 shots, which occurs when there are 2 Triple Taps and 0 Veist Stinger activations. Magazine size of 6 has a peak at 8 shots, which occurs when there are 2 Triple Taps and 0 Veist Stinger activations. Lastly, magazine size of 7 has a peak at 10 shots, which occurs when there are 3 Triple Taps and 0 Veist Stinger. One can think of each peak as a worst-case scenario for each magazine size for Simulation 1. Like the other plots prior, magazine size of 7 hits higher values more often than the other magazine sizes, this can be seen via the tail of the distribution in both plots. Therefore, as the magazine size increases, so does the number of total shots.

When comparing Simulation 1 variables to Simulation 2 variables, they are almost identical. The median of each variable differs roughly from a .0003 between each simulation, and the standard deviation for each distribution differs by .001 between each simulation. Below are the Veist Stinger graphs from Simulation 1 and Simulation 2 side by side, which demonstrates how close these distributions are, even when there is a chance of missing.

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Figure 2: Simulation 1 density plot of Veist Stinger with each magazine size.

Figure 8: Simulation 2 density plot of Veist Stinger with each magazine size.

Furthermore, because of the stochastic randomness added in Simulation 2 for hitting or missing a shot, we also kept track of hits during each trial. So, the below two plots are a density and violin plot of each magazine size and the number of hits each trial.

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Figure 9: Simulation 2 density plot of hits with each magazine size.

Figure 10: Simulation 2 violin plot of hits with each magazine size.

As the magazine size increases, so does the amount of hits. Conversely, as the magazine size increases, the number of misses decreases. This coincides with the other analysis and plots. It also makes sense that it would follow a similar pattern to total shots as hits are subset of total shots.

**Results:**

From the previous analysis, we see that regardless of the variable or metric used, the magazine size of 7 appears to yield the best results. Even with a chance of randomness for missing or hitting a shot, magazine size of 7 had the best results. As mentioned prior, every magazine size in each metric looked drastically different from each other. Also, we stated that Simulation 1 and Simulation 2 created almost identical results. To empirically test this intuition, we used a t-test. We found that each magazine size for each feature was statistically different from each other, regardless of the combination and simulation. For instance, the p-value for a t-test between Veist Stinger Magazine size of 7 and Magazine size of 6 was less than .05 (the standard alpha for 95% confidence interval), so we can reject the null hypothesis and conclude that the distributions are statistically different from each other. We also ran t-test to see if the variables were similar across Simulation 1 and Simulation 2. We found that each variable was not statistically different across simulations, which backs our analysis when looking at the summary statistics of each distribution for each simulation. Thus, our initial analysis was correct and magazine size of 7 does appear to be the best magazine option to activate Veist Stinger and Triple Tap.

**Conclusions:**

To reiterate, our model shows that our initial hypothesis that 7 in the magazine would be the best size when trying to maximize the procs of Veist Stinger is true, but it is important to note that our T-Test showed that each magazine size was significantly different from one another. This means that not only is 7 the best for this condition, but also that any increase to magazine size is a benefit to the overall proc chance of Veist Stinger. To us, this makes sense because it would mean that there are more shots to act as a buffer to the cool down of Veist Stinger. Additionally, it is important to note that, at least within our model, 5 is the worst mag to pick if one wishes to proc Veist Stinger more often, as there is either not enough time or just enough time for Veist Stinger to go off cooldown, for 5 in the mag only allows 7 shots, which equates to 7 seconds in our model, if there is perfect accuracy, and this becomes substantially worse once we account for missing. However, this leads us to some of the limitations of our model.

While a one second time step is a decent assumption for how long it takes for one to shoot a shot of an LFR, it is important to note that it is impossible to truly model the pace at which one takes shots in Destiny. When doing damage, one will normally prioritize being accurate rather than simply taking the shot for speed, and this means that there can be some shots that take longer than others, resulting in more time for Veist Stinger to come off cooldown. For instance, in our model it was impossible for Veist Stinger to proc four times, for if you need 7 shots for the cooldown of seven seconds, then this would mean you would need to shoot 28 times for Veist Stinger to proc four times, and this is the maximum number of shots one can take, meaning it would be impossible in our model. However, there were multiple videos online of people proccing Veist Stinger four times, but this was possible because of their differing pacing. However, one could note that while this possibility might never come up, having more shots that are paced differently would still impact the chance of Veist Stinger occurring multiple times.

The last thing of note is the nuance of our conclusion, as it can be interpreted that 7 in the magazine is the best overall, but this is not true when one considers how damage phases, that being the time one is given to do damage to a boss, can differ. For instance, Oryx gives around a 25 second timer to do damage, so it is worth it to try and maximize the amount of shots one can take because time permits it, which would be called sustain damage, but bosses like Atraks-1 give around 5 seconds to do damage, so it is important to get as much damage out as is possible, which would be called burst damage, meaning that 5 in the mag with the Liquid Coil battery, which increases the time between shots but gives a 2% increase to damage, would be the better magazine. Hence, while 7 is the best choice when trying to maximize multiple Veist Stinger procs, it might not be the best in all situations, and it will instead come down to player preference.

**References:**

(2017). Destiny 2 (v.6.3.0.1) [PC]. Bungie

Light.gg. (n.d.). Light.gg. Destiny 2 Database, God Rolls, Collection Manager, and Leaderboards. Retrieved December 14, 2022, from <https://www.light.gg/>

Swalesy. (2022, May 16). Veist Stinger &amp; Reed's regret... it's complicated | destiny 2 - witch queen. YouTube. Retrieved December 14, 2022, from <https://www.youtube.com/watch?v=4GSGUYd0ohk&amp;t=85s>

To say how each of these were used, the first is simply the game that we used to base our model on, and it is important as it allowed us to create Figure 1 in order to better understand what we were working with. Second, light.gg acts as a data base for most things Destiny 2 has in its background information, and this allowed us to better understand how long it would take one to shoot a shots since we could see how each of the batteries affected the charge time of the LFR. Lastly, the video linked is where we got the value of 10% for Veist Stinger to occur.

**Appendix:**

Graphical user interface

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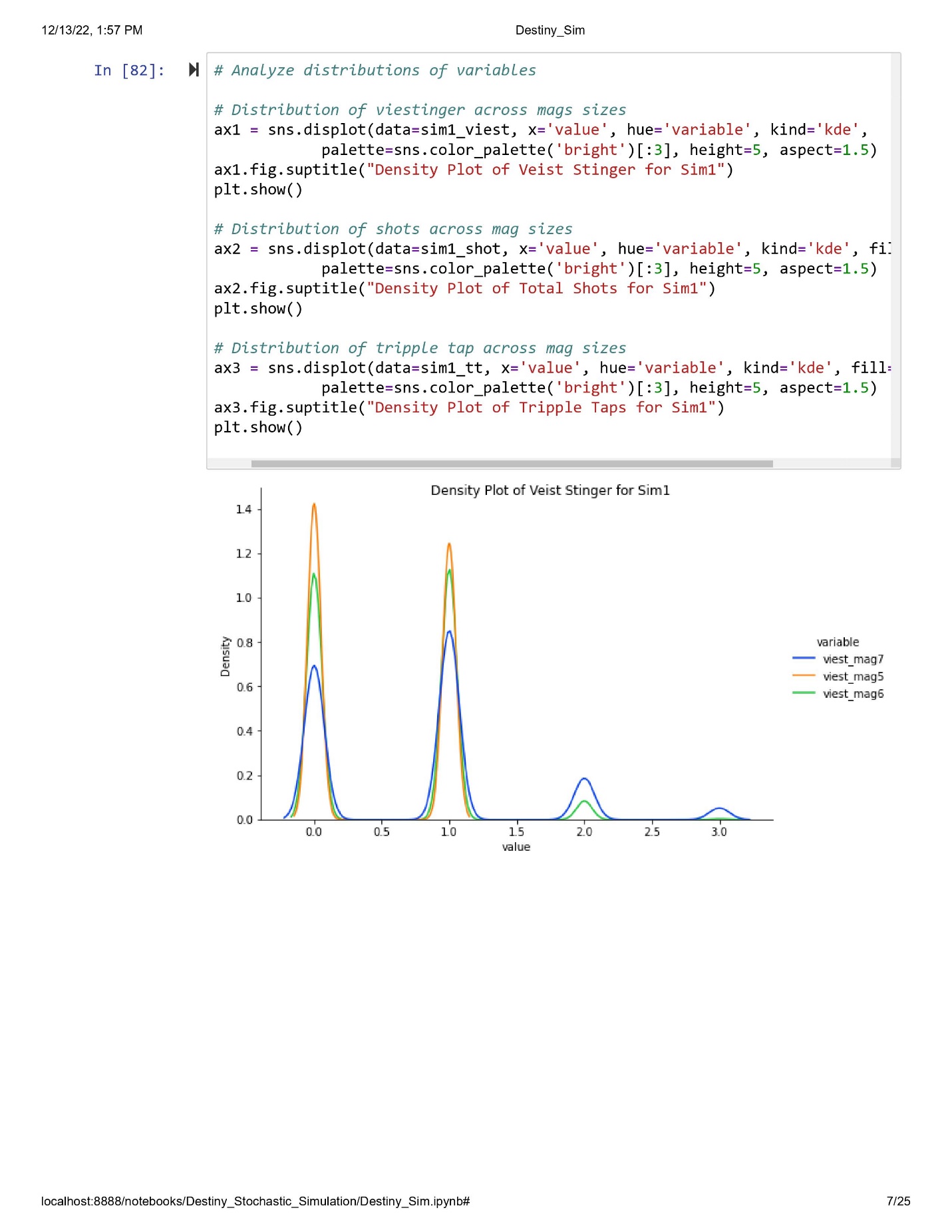
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