



# D&D.Sci

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# D&D.Sci

You are studying to become an Adventurer. You're excited to begin your Great Quest, but also anxious: over a third of the graduates from your program fail to accomplish their Great Quests. And if you're being brutally honest with yourself, your odds are probably worse than that, since your stats – while about average for the general population – are pretty lousy by the standards of Adventurer College.

STR: 6/20

CON: 14/20

DEX: 13/20

INT: 13/20

WIS: 12/20

CHA: 4/20

On the eve of your graduation, you're visited by a mysterious fairy offering to add a total of ten extra points to whichever attributes you most want to improve. Following the college's standard mysterious fairy protocol, you humbly request a week for research and contemplation before deciding how best to use this one-in-a-lifetime opportunity. (Your low Charisma ensures you come off as simultaneously entitled and disinterested when saying this, but she agrees regardless.)

The college Archivist provides you [a complete but anonymised record](#) of the stats of everyone who graduated last year, and whether they succeeded at their Great Quests. (The record-keeping is magically perfect, and as Great Quests never take more than a year there are no incomplete Great Quests to account for.) The rest is up to you. Where will you allocate those ten points?

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I'll be posting an interactive letting you test your decision, along with a complete explanation of the dataset, sometime next Saturday. I'm giving you a week, but the task shouldn't take more than a few hours; use Excel, R, Python, random guessing, or whatever other tools you think are appropriate. Let me know in the comments if you have any questions about the scenario.

ETA: If you want to investigate this collaboratively with other lesswrongers (or just share your conclusions without waiting a week), feel free to do so in the comments; however, please use spoiler tags when sharing inferences, so people intending to fly solo can look for clarifications without being spoiled.

# D&D.Sci Evaluation and Ruleset

This is a followup to [the D&D.Sci post](#) I made a week ago; if you haven't already read it, you should do so now before spoiling yourself.

[Here](#) is the web interactive I built to let you test your solution; below is a complete explanation of the rules used to generate the dataset. You'll probably want to test your answer before reading any further.

(Unless you'd prefer to enter your answer, then read through the rules with a slowly growing sense of vindication and/or concern before clicking "Begin Quest!"; or unless you'd like to completely ignore the spirit of the exercise and use the rules to improve your solution. I'm not the boss of you.)

## Ruleset

### Generation and Selection

An applicant for Adventurer College gets their stats by rolling two ten-sided dice for each stat and then adding them.

Not everyone who applies gets in. Only those with >60 total points are allowed entry; you, with your 62 points, barely made the cut. Of course, you only get the records for those who were accepted; this produces small but non-negligible selection effects.

### Advantage and Disadvantage

On graduation, an Adventurer will inevitably find themselves in a party of 3-6 loyal friends who help each other with their Great Quests. Your chances of success are determined by how well you can contribute to a team like that (your Advantage), and how much you get in their way (your Disadvantage). These quantities are calculated as follows:

- Everyone starts with 1 Advantage and 1 Disadvantage.
- You can ignore the Dexterity score; in this world, it's useless for everything Adventurers do except qualifying for Adventurer College.
- Having unusually high stats allows you to help take skill checks for your team. For every non-Dexterity skill you have above 12 points, add 2 Advantage for every point it exceeds 12 by. (For example, if you had 15 Charisma, that would give you  $(15-12)*2=6$  extra Advantage.)
- Having unusually low stats means you cause trouble for your team. For every non-Dexterity skill you have below 8 points, add 3 Disadvantage for every point under 8. (For example, if you had 5 Charisma, that would give you  $(8-5)*3=9$ extra Disadvantage.)
- If your Strength is greater than your Constitution, you'll end up committed to physical tasks you don't have the stamina to see through: that's +2 Disadvantage.
- For similar reasons, if your Intelligence is greater than your Wisdom, that's also +2 Disadvantage.

- Being able to out-talk the local Vizier (who has Charisma 16) is very useful. Adventurers with >16 Charisma get an additional +5 Advantage.

## Success and Failure

Your odds of success are the ratio between your Advantage and your Disadvantage. That is:

$$P(\text{Success}) = \text{Advantage} / (\text{Advantage} + \text{Disadvantage})$$

As Advantage and Disadvantage are both always >0, there is always a chance of success or failure.

## Strategy

With the above in mind, the optimal strategy given your starting position is as follows:

- Get STR and CHA to 8.
- Get WIS above INT.
- Put your remaining skill points into WIS and/or CON and/or INT, while keeping WIS above INT.

## Closing Thoughts

You may have several objections to this scenario. Relevant selection effects were only vaguely alluded to, and the dataset contains phenomena – the discontinuity at CHA>16, and the STR-CON interaction – irrelevant to your situation. To this, I can only plead realism: most datasets in the real world are much messier, have much more dubious relevance to your goals, and contain distortions about which the GM provides no hints at all.

You may also object to the use of random elements in scoring. Even with perfect allocation, you can't get above a 93.75% chance of success: it is not only possible, but plausible, to do everything right and still lose. Meanwhile, refusing the fairy's offer leaves you a 25% chance of success, deliberately allocating points badly leaves you about one chance in three, and most random allocations still give better-than-even odds. I plead realism here too, but I can see why it might bother some people; as a compromise, I provide probability-of-success alongside success/failure, in case you'd prefer to keep score that way.

Finally, you may object to the ways that the challenge was unfair *in your favour*. If you didn't account for selection effects, you may have correctly avoided boosting DEX because you thought it was actively harmful instead of merely useless. If you didn't look for interactions, you may have dodged the WIS<INT penalty just because WIS seemed like a better place to put points than INT. And I'm pretty sure even the three people who submitted optimal answers on the last post (good job simon, seed, and Ericf) didn't find them by using the right link function, just because the linkage I set up between predictors and response was so arbitrary and idiosyncratic.

Here, I not only excuse but congratulate myself. The main benefit of exercises like this over Kaggle analyses – aside from Fate's unwillingness to show up the following week

and explain the algorithm it used to choose who would survive the sinking of the Titanic – is that making real-fake-world decisions based on real-fake-world data trains the ability to **make mistakes that don't hurt you**.

(If you have any *other* objections, please let me know. I very much want feedback so I can make the next challenge better.)

# D&D.Sci II: The Sorceror's Personal Shopper

The day's task shows up in an envelope, and not in glowing purple letters emblazoned across the inside of your eyelids, which is usually a good sign. The owl that brought it looks on with equanimity as you read its master's message:

*Hello,*

*I hearde that you do odde jobs for Wizards. I neede 120 mana for a ritual but cannot leave my Tower righte now. Go to the caravans in towne and buy enough magic items that I can gette that much by sacrificing them.*

*My Owle has a pouch. It is biggere inside than oute. Putte the things in it ande she will carrye them back.*

*Enclosed is my ~~Thermæ~~ ~~Tharmæ~~ Magic Sensing Device. It usually lies but is probably bettere than guessinge. Returne it when you are done. Enclosed is also a [list](#) of 836 itemse I sacrificed and what coloure they glowed and how muche mana I gotte and what the ~~Thau~~ Lying Box said when I pointede it at them. I like lists.*

*The pouch contains 200 gold pieces. You may keepe what coins are lefte over. If I do notte gette at leaste 120 mana from the things you sende me, you shalle owe me 200 gold pieces.*

*Goodbye,*

*Wakalix the Wizard*

*PS: If you do not accepte the jobbe, I bid you sende the Owle and the gold back before sundown, that I may finde another to charge with it.*

Your spirits lift with every line. Clear objectives, payment in advance, acknowledgement that you have the right to refuse the task, no threats of involuntary transformation, no random tangents about world domination or beard care, handwriting legible, capitalization not entirely random . . . this is one of the *good* clients. And if you make clever enough use of the list he provided, you suspect you could end up taking home a decent fraction of that 200gp once this day's work is done. With a song in your heart, you depart for the travelling caravans and their magic items.

The selection of artefacts that greets you is as follows:

Item name	Glow color	Thaumometer reading	Price
Longsword of Wounding +2	Red	14	66gp
Warhammer of Justice +1	Yellow	5	41gp
Hammer of Capability	Blue	35	35gp
Pendant of Truth	Red	40	38gp
Ring of Joy +5	Blue	29	32gp
Warhammer of Flame +2	Yellow	48	65gp

Battleaxe of Glory	Blue	7	23gp
Plough of Plenty	Yellow	12	35gp
Saw of Capability +1	Green	16	35gp
Amulet of Wounding +2	Green	50	35gp
Pendant of Hope	Blue	77	34gp
Pendant of Joy +4	Green	42	39gp

Will you accept Wakalix's errand? If so, what will you buy?

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I'll be posting an interactive letting you test your decision, along with an explanation of how I generated the dataset, sometime this Sunday. I'm giving you a week, but the task shouldn't take more than a few hours; use Excel, R, Python, tarot readings, or whatever other tools you think are appropriate. Let me know in the comments if you have any questions about the scenario.

If you want to investigate this collaboratively and/or call your decisions in advance, feel free to do so in the comments; however, please use spoiler tags when sharing inferences/strategies/decisions, so people intending to fly solo can look for clarifications without being spoiled.



# D&D.Sci II Evaluation and Ruleset

This is a followup to [the D&D.Sci post](#) I made earlier this week; if you haven't already read it, you should do so now before spoiling yourself.

[Here](#) is the web interactive I built to let you test your solution; below is a complete explanation of the rules used to generate the dataset. You'll probably want to test your answer before reading any further.

(The generation process is more complex than last time, so I'm leaving some extremely minor and irrelevant details out: feel free to dig through my [code](#) for the full story if this bothers you.)

## Ruleset

### Item Types

A magic item is either a Weapon (Sword, Longsword, Warhammer, Battleaxe), Tool (Plough, Saw, Hammer, Axe), or Trinket (Ring, Pendant, Amulet).

### Abstractions

Every item has an abstraction (Wrath, Prosperity, etc.) assigned to it. Weapons are randomly assigned Weaponish abstractions, Tools are randomly assigned Toolish abstractions, and Trinkets are randomly assigned Weaponish or Toolish or Trinketish abstractions. These abstractions have no effect on other features, and are only relevant to this exercise insofar as they make the demarcation of item types more obviously meaningful.

### Modifiers

Weapons are assigned modifiers (+1, +2, etc.) explaining how much more damage the enchantment lets them inflict. This is both easily testable and tightly-regulated in-universe: warriors can just swing their new Battleaxe of Wrath +2 at a training dummy and confirm it does 2 extra damage. This is potentially relevant to us because the amount of extra damage is equal to  $\text{mana}/10$  rounded down.

Non-Weapon items are also sometimes assigned modifiers; this is a marketing tactic performed ad-hoc by salesmen with shaky or nonexistent justification, and provides no actual information.

### Color and Mana

Enchanting an item randomly assigns it a color, and then randomly assigns it an amount of mana via a process based on that color:

- Red-enchanted items have  $1d4*1d4*1d6$  mana.

- Blue-enchanted items have  $1d6*1d10$  mana.
- Yellow-enchanted items have  $17+1d4$  mana.
- Green-enchanted items have  $2*1d20$  mana.

The mean amount of mana for each color is near 20, but the variance varies a lot.

## The Thaumometer

Wakalix did not read the instructions which came with his Thaumometer, and does not realize it needs to be calibrated based on the size and color of an item. Unfortunately, your lack of magical ability prevents you from adjusting it yourself.

It is currently optimized for Weapons and Tools which glow blue: its readings will only be off by one when applied to them.

When applied to Trinkets which glow blue, it will consistently overestimate the amount of mana present by 22, then be off by one from that position; for example, a Ring which glows blue and has a reading of 52 will have either 29 or 31 mana.

For a non-blue Weapon or Tool, it will roll  $1d6*1d10$  and report the result, completely disregarding the amount of mana present. For a Trinket, it will add 22 to this figure before reporting.

## Purchase History

On a given day, the caravans (the only local source of magic items) will have 4-5 randomly-generated Weapons, 2-3 randomly-generated Tools, and 5-6 randomly-generated Trinkets. The value of Weapons is affected by their mana content via their modifiers; the value of other item types is completely uncorrelated with mana, since mana level for Trinkets and Tools is both difficult to detect and irrelevant for most customers.

Since before he started his list, Wakalix's strategy when buying items for sacrifice has been to trust in his wizardly intuition and buy whatever two items he feels are best while disregarding cost; for the last 418 shopping trips, he has purchased two items almost completely at random. His only limitation is that these two items will not share a noun, abstraction, or modifier (he believes this lowers his chances of coming home with two low-mana items); selection effects produced thus are irrelevant enough to neglect.

(If you're wondering why I included selection effects that didn't affect the outcome, it's because creating a dataset entirely without selection effects would cause me to turn to ash and blow away in the wind.)

## Sacrificing

When sacrificing an item, Wakalix always harvests all of its mana, can always tell exactly how much mana that is, and will always honestly report it. He's very reliable like that.

## Strategy

Using the Thaumometer, you can deduce the amount of mana every blue-glowing object has to a tolerance of  $\pm 1$ . You can also make use of the fact that yellow-glowing objects never have less than 18 mana. Using this information, you can guarantee  $>120$  total mana by buying the Pendant of Hope, the Hammer of Capability, the Plough of Plenty, and the Warhammer of Justice  $+1$ , leaving you with 55gp profit.

(It is possible to do better than this by guessing randomly and being lucky. But given the information provided, and given that you're trying to max your character's EV and not your chances of topping the leaderboard, the above solution is optimal.)

## Reflections

This challenge was intended primarily as a horrible, unfair trap for those inclined to approach problems by throwing conventional ML algorithms at relevant datasets without doing manual data exploration. My condolences to everyone who got caught out, and my apologies to those who didn't: I'll endeavour to make future tricks harder to dodge.

Congratulations to gjm and GuySrinivasan for producing my intended solution. Congratulations also to everyone who produced my intended solution plus some safety margin, to everyone who came up with a solution that made them a profit, and to everyone who chose to send the owl back when they couldn't find a solution they thought was worth gambling on.

(I really mean that last one, by the way. Making the best choice you can even if it seems boring or counter-intuitive is an important life skill; and also, the fact that people were willing to do this increases the variety of themes I can use in future games.)

I have some mixed feelings about how puzzle-ish this challenge turned out: ideally, I want challenges to have a smoother – or at least more natural – incentive gradient for figuring things out, but I couldn't find a good way of doing that with this concept. Feedback on this point would be greatly appreciated, as would feedback about anything else about the challenge.

## Scheduling

Week-long delays between posting a challenge and posting its solution don't seem optimal; most of the action in the comments section happens in the first few days after I post, and I don't want to leave people waiting for most of a week after coming to a final conclusion (or worse, leave anyone nerdsniped for an entire  $\sim 168$  hours). At the same time, I want to ensure everyone has a chance to investigate before I reveal the ruleset, and I want to be able to clear up questions about the premise while people are still playing. I think the best way to balance this is to hold challenges over shorter periods of time, and call these well in advance: to that end, **I hereby commit to posting the next challenge at 7pm UTC on Friday the 5<sup>th</sup> of March, and resolve it at 11pm UTC the following Sunday.**

(My much more tentative long-term plan is to post a challenge on the first Friday of every month for the rest of this year. We'll see how that goes.)

# D&D.Sci April 2021: Voyages of the Gray Swan

You were prepared for gratitude, a commendation from the Admiral, your own department, parades in your name. You were also prepared to hear that your 'list of helpful suggestions for ensuring supply ships survive random encounters' was an impudent insult to the collective intellect of High Command, and receive a public execution for your trouble. What you weren't prepared for was what happened: being allocated a modest stipend, assigned to a vessel, and told that if you're so clever you should implement your plans personally.

You have 100gp to spend, and your options are as follows:

Intervention	Cost
Coating the underside of the ship in shark repellent would ensure that no journey would feature shark attacks; however, Vaarsuvius' Law ("every trip between plot-relevant locations will have exactly one random encounter") means something <i>else</i> would attack instead.	40gp
You've given up trying to understand what it is about woodwork that makes its practitioners so good at fighting Crabmonsters, but your findings are undeniable: arming the ship's carpenters would halve the damage done by Crabmonster attacks.	20gp
Offering tribute to the Merpeople would ensure they won't attack the ship, similar to the effect of shark repellent.	45gp
There's enough space in the lower decks to add up to twenty more oars, so when fleeing is the best option, the entire crew can work together to escape. Each extra oar would decrease the damage done by Krakens and Demon Whales by 2%.	1gp/oar
You wouldn't think these ships could fit more artillery, but clever ergonomics allow you to add up to three more cannons. Your studies suggest each cannon would reduce the damage suffered in Nessie and Pirate attacks by 10%.	10gp/cannon
Arming the Crow's Nest with state-of-the-art rifles would give lookouts a 70% chance of ensuring a given Harpy attack does no damage.	35gp
Giving the deck crew novelty foam swords to wield alongside their standard-issue cutlasses would improve their effectiveness when fighting Water Elementals, reducing the damage these creatures do by 60%.	15gp

You're completely confident in the effectiveness of your ideas, but much less confident that you know which combination would make the best use of your limited budget. To

investigate this angle, you've procured [a record](#) of random encounters encountered by the ships travelling your assigned route; unfortunately, it's missing some important information for the ships that sank, due to everyone who could fill in those details being dead.

As you board the *Gray Swan* (why *do* they give these ships such charmingly unique names when they're all built and operated identically?), it occurs to you that this might have been intended as an execution after all. The dataset suggests that without any of your clever plans, the survival rate for a journey along your route is a little below 90%, and the *Gray Swan* is scheduled to make ten trips – five northbound voyages, five southbound – in quick succession. Hopefully this indicates nothing more than your superiors wanting to test your interventions *very very* thoroughly.

Your top priority is to save your skin. Secondary priorities are minimizing total damage taken and spending as little gold as possible, to impress High Command and return to their good graces.

What will you do?

(Notes:

- As a passenger, you'll be kept away from any fights, but the *Gray Swan* has no lifeboats; keeping the ship from sinking is necessary and sufficient to ensure your survival.
- Ships are fully repaired every time they make port.
- Interventions stack such that two 10% reductions are equivalent to one 20% reduction.
- Interventions apply such that a 10% reduction to an attack that would do 80% damage does 72% damage instead.
- Each journey takes a month; it is currently Month 5, Year 1406.)

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# D&D.Sci April 2021 Evaluation and Ruleset

This is a followup to [the D&D.Sci post](#) I made last week; if you haven't already read it, you should do so now before spoiling yourself.

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## Ruleset

(Note: to make writing this easier, I'm using standard D&D dice notation, in which "3+4d8" means "roll four eight-sided dice, sum the results, then add three".)

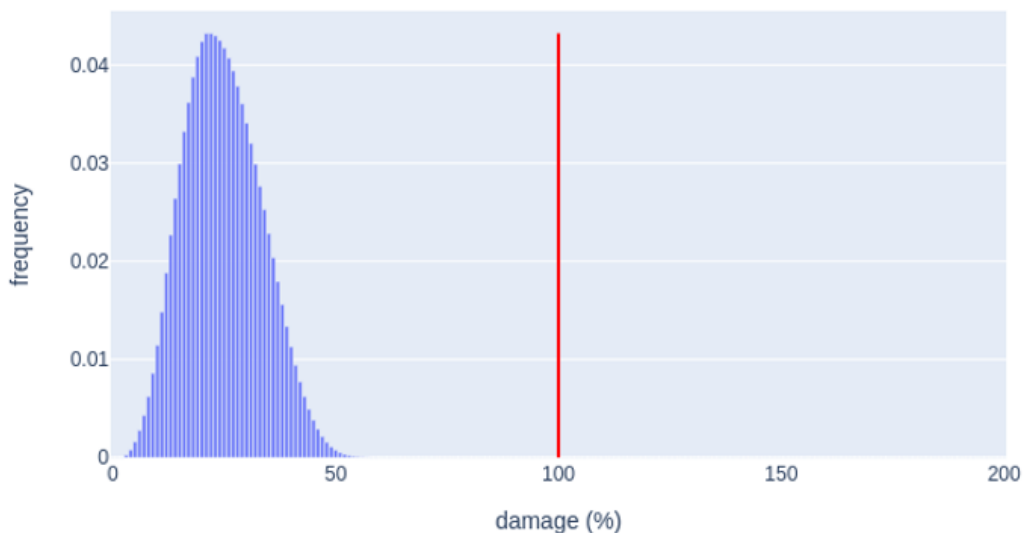
## Enemies

### Sharks

Sharks are 1/6 of encounters.

They attack in groups of  $2+1d4$ , each of which does  $1d10$  points of damage.

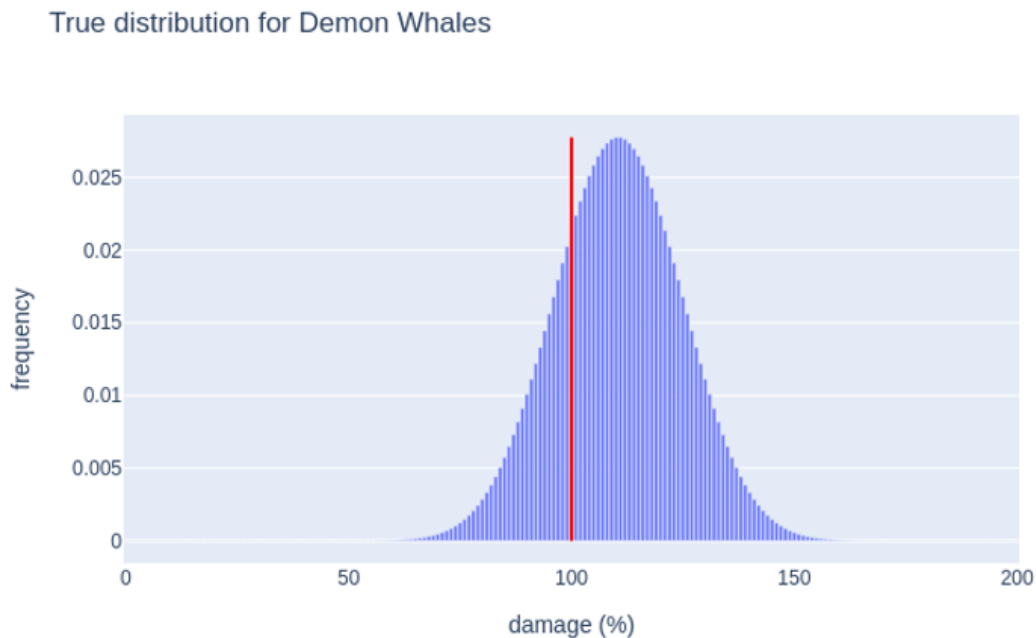
True distribution for sharks



### Demon Whales

Demon Whales are 1/14 of encounters. (If that fraction seems high, you're failing to account for all the sunk ships that couldn't report encountering them.)

An attack from a Demon Whale does 17d12 points of damage.



A Demon Whale encounter has a ~78% fatality rate

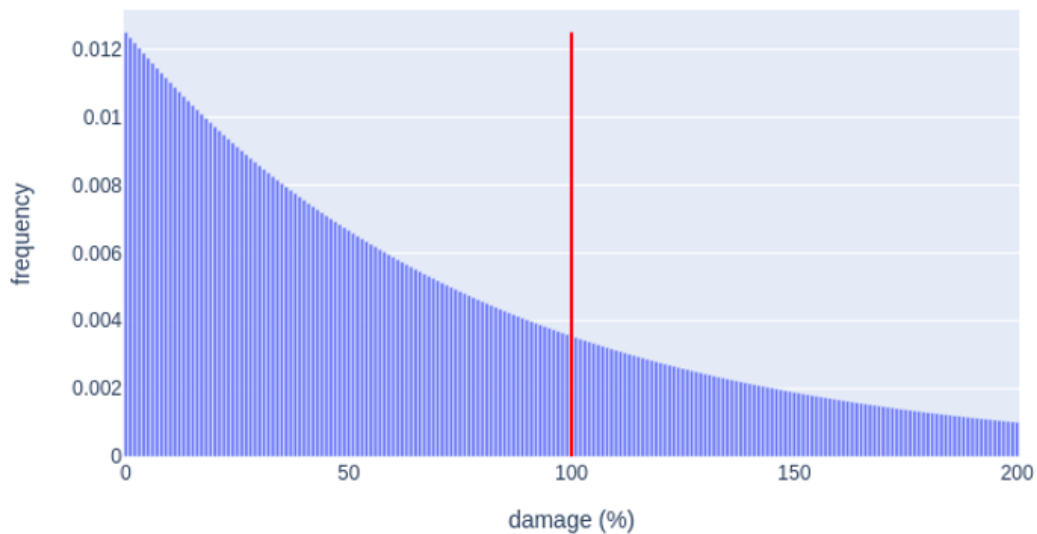
## Crabmonsters

Crabmonsters are 1/14 of encounters.

A Crabmonster repeatedly rolls 1d80 as it tears through the ship, adding a point of damage with each roll, until it rolls a 1 (that is, encounters someone or something that stops it).



True distribution for Crabmonsters



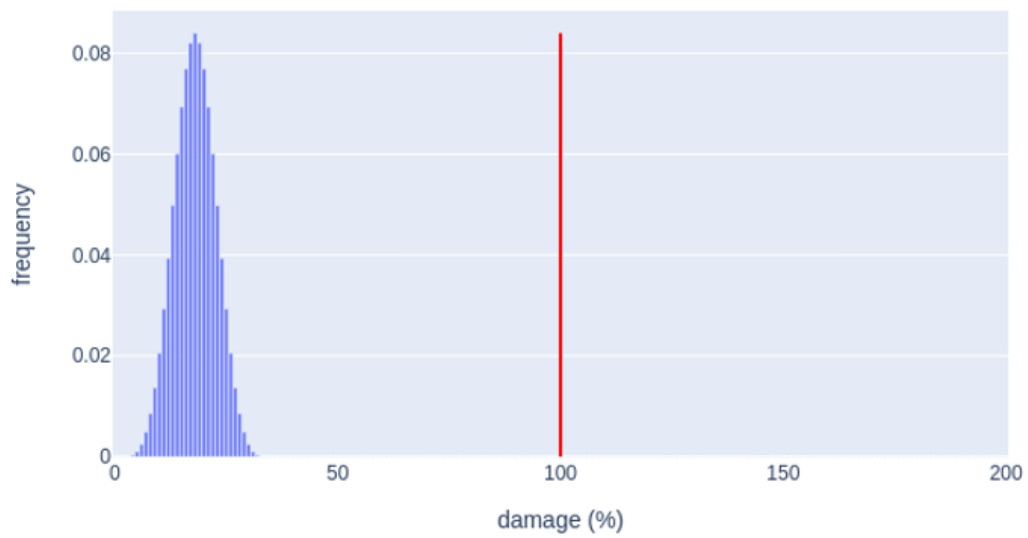
~8% of Crabmonster encounters do >200% damage; a Crabmonster encounter has a ~28% fatality rate

## Pirates

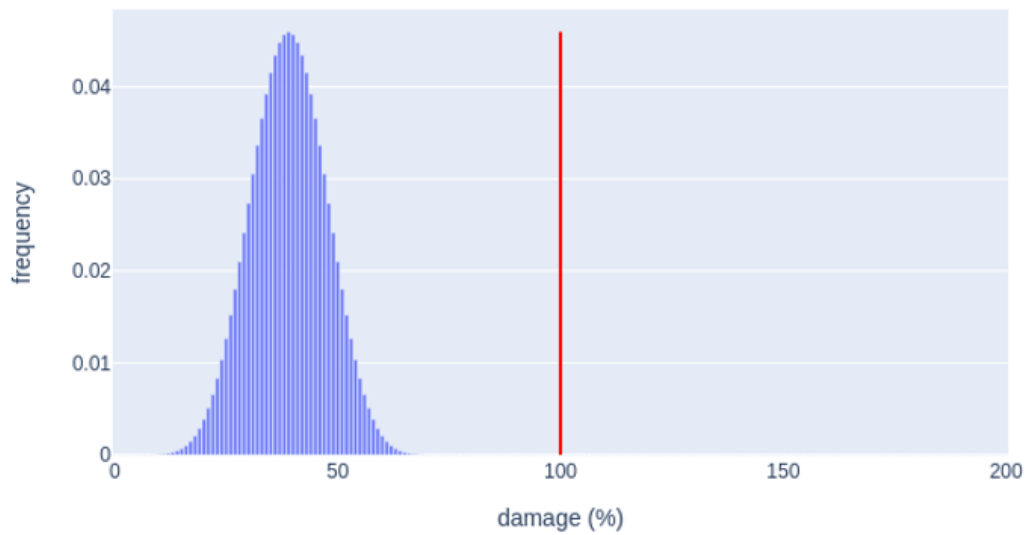
Though the Navy's records don't bother to distinguish, Pirates come in two categories: Brigands (local criminals who had the poor fortune to cross paths with Naval supply ships while flying the black flag, and/or to mistake them for civilian cargo ships) and Privateers (agents of an enemy government, harassing your Navy's fleet using hit-and-run tactics). Brigands are 1/6 of random encounters during your voyages, Privateers 1/21.

A fight with Brigands does 4d8 points of damage; a fight with Privateers does 6d12.

True distribution for Brigands



True distribution for Privateers



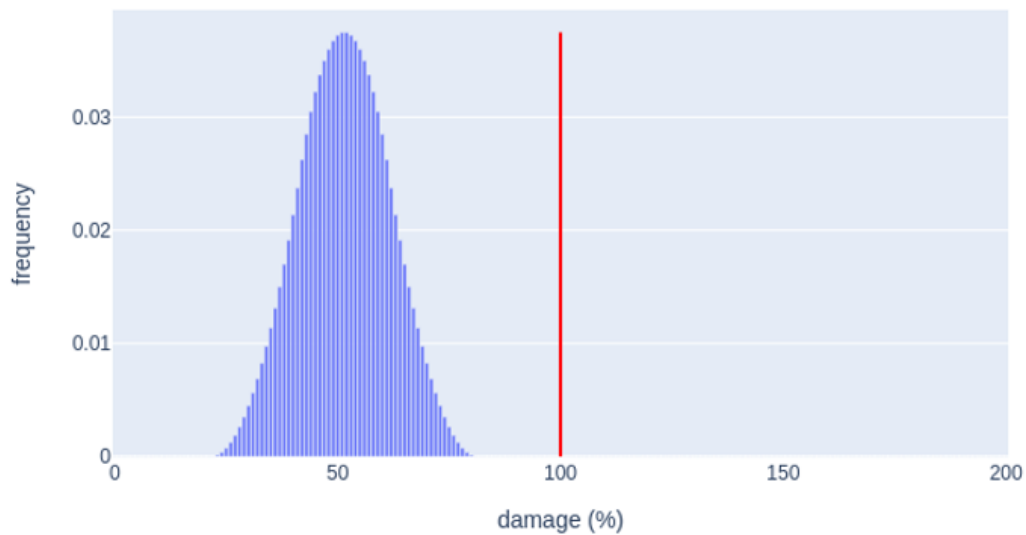
## Merpeople

Surface-dwellers are unaware of the intricacies of underwater society, and record both Atlantean Merfolk (1/14 of encounters) and Alexandrian Merfolk (2/21 of encounters) as

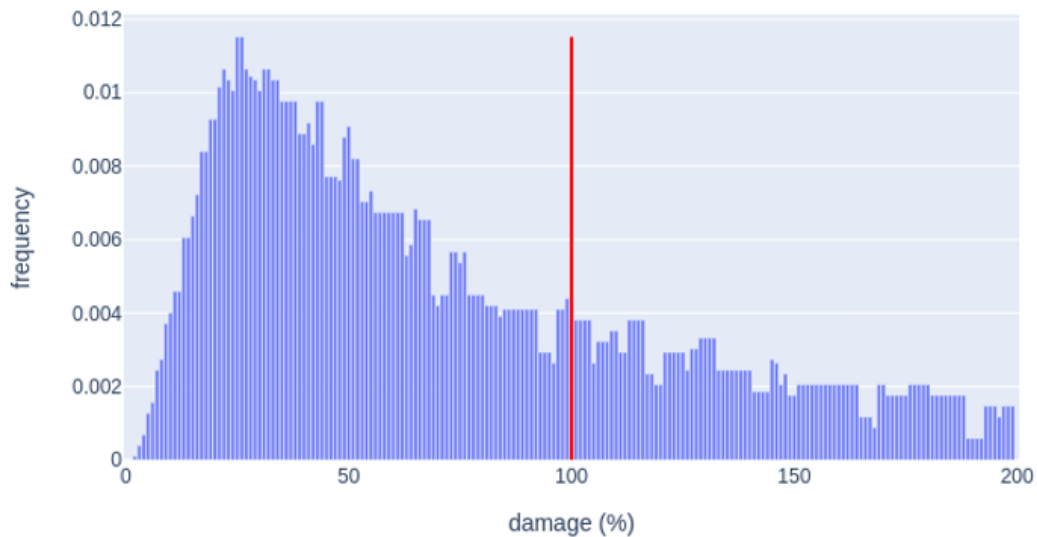
“Merpeople”. Fortunately, the two city-states are close enough politically that befriending one will cause them both to allow you free passage.

Atlanteans do  $20+3d20$  damage; Alexandrians do  $1d8*1d8*1d8+1d20$  damage.

True distribution for Atlanteans



True distribution for Alexandrians

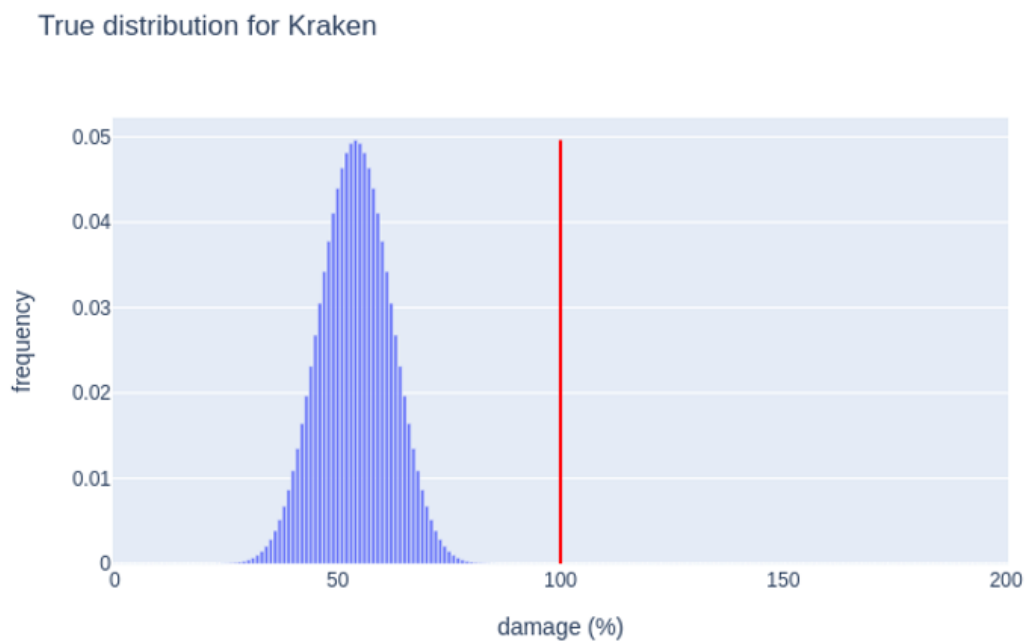


~14% of Alexandrian attacks do >200% damage; an Alexandrian attack has a ~37% fatality rate

## Kraken

Kraken are 2/21 of encounters.

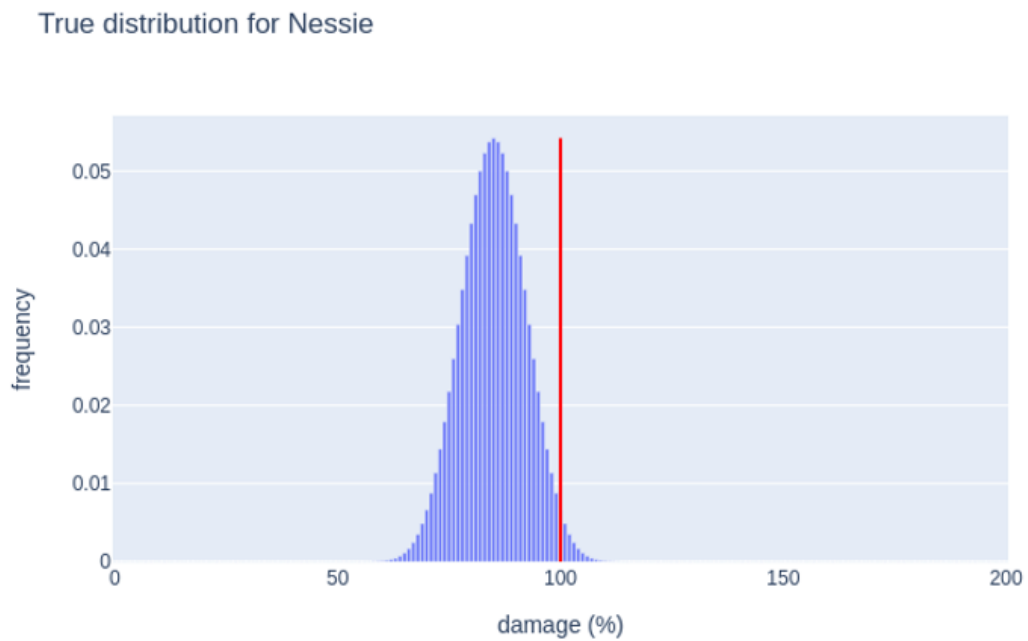
They do 12d8 points of damage.



## Nessie

Nessie is 1/21 of encounters.

She does 40+10d8 points of damage.

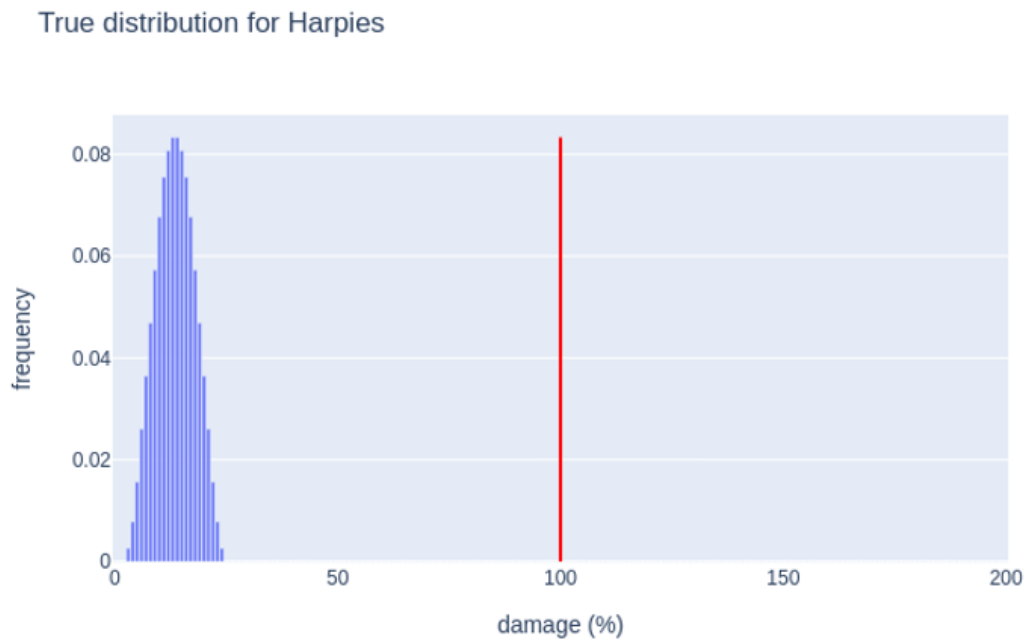


An encounter with Nessie has a ~2% fatality rate

## Harpies

Harpies are 1/14 of encounters.

They do  $1d4+1d8+1d12$  points of damage.

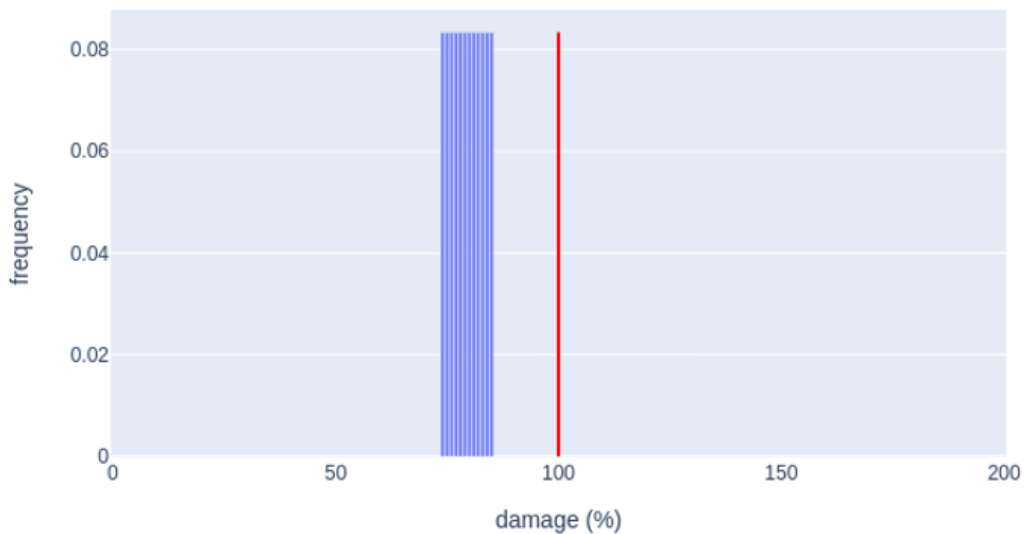


## Water Elementals

Water Elementals are 2/21 of encounters.

The Navy has countered the powerful but predictable attacks of Water Elementals down to an art; there are well-known methods for ensuring they only *almost* destroy a given ship. They do  $73+1d12$  points of damage.

True distribution for Water Elementals



## Direction

Direction is irrelevant from perspectives both practical (you have no control over how many trips you take each way) and epistemic (direction happens to have no effect on outcomes).

## Time effects

Time has almost no effect. The one exception is that Privateers used to be much more common (and other encounters therefore slightly less common) before 4/1401; this is when your nation's main rival changed tactics and stopped hiring mercenaries to attack supply ships.

## Sinking Risk by Enemy

In the absence of interventions, ~50% of shipwrecks are caused by Demon Whales, ~18% by Crabmonsters, ~31% by Merpeople, ~1% by Nessie, and 0% by other threats.

## Strategy

If attempting to optimize odds of survival, your best choices are to buy all oars, arm carpenters, tribute the Merpeople, and buy one extra cannon; congratulations to simon, GuySrinivasan and Measure for reaching this conclusion.

However, since Pirates never sink ships and Nessie is pretty bad at it, you may wish to take the money you'd spend on the cannon and either hold onto it (to impress the Navy's accountants) or spend it on foam swords (to impress the Navy's dockworkers).

# Reflections

All else equal, there's a little extra uncertainty when predicting quantities instead of categories: "is that sudden peak at 14% noise, or a clue to the generating function?", etc. However, the *main* reason this challenge was so much more speculative than its predecessors is that the most important information – details of attacks that did 100%+ damage – was censored by the mechanics of the world. In the absence of hard evidence, small errors in inference compound, priors pick up the slack, and considerations like "what genres apply here?" or "is the scenario designer enough of a troll to have Demon Whale damage arbitrarily cap out at 99%?" take on a significance they wouldn't otherwise.

This is both good and bad. Good because the personal touch adds intrigue to what would otherwise just be data-wrangling; bad because every unit of effort spent psychoanalyzing the GM is a unit of effort not spent on getting better at data-wrangling or on psychoanalyzing reality's GM (i.e. studying Math and Science). I enthusiastically solicit feedback on this point, as well as on every other point.

# Scheduling

The next D&D.Sci challenge should be ready sometime earlyish next month, but nebulous and open-ended work commitments mean I can't promise anything.



# D&D.Sci May 2021: Monster Carcass Auction

You are an apprentice to Carver, the most successful butcher in your tiny, snow-swept village. Today, for the first time since you joined her, she is sending you to buy carcasses at the daily Auction.

(The ([first-price, sealed-bid](#)) Monster Carcass Auction began as a collective effort by local shopkeepers to divert Adventurers from trying to sell them random corpses, but has since become an integral part of the village economy, as well as the population's main protein source.)

Carver thinks you should trust your instincts and bid however feels right. It's an approach that's served her well thus far – the [record](#) you've been compiling of her bids and subsequent sales attests to that, among other things – but you suspect a more data-driven approach would work better. And if you do well enough on this expedition, that might suffice to prove it to her.

You make sure to arrive at the very end of the event, like your boss always does; this means you'll lose any tie-breakers – matching bids are resolved in favour of whoever bid first – but also means your rivals will have already put in their bids, so none of them will be able to change their bidding strategy to account for Carver's absence.

The lots available are as follows:

Lot	Species	Days Since Death
#1	Yeti	0
#2	Snow Serpent	2
#3	Snow Serpent	1
#4	Winter Wolf	1
#5	Yeti	5
#6	Winter Wolf	1
#7	Snow Serpent	1
#8	Snow Serpent	5
#9	Winter Wolf	3
#10	Winter Wolf	7
#11	Winter Wolf	8
#12	Snow Serpent	8
#13	Winter Wolf	2

(As usual, this is all the information given to bidders; the original organizers took the term 'blind auction' a little too literally, and by the time anyone realized, the practice of hiding almost everything about the lots had become a tradition.)

You and your employer are risk-neutral, and don't care how much or little time and effort you spend butchering. You brought 400 silver pieces. How much will you bid for each lot?

#### Notes:

- Payments are collected in lot order; if you're unable to pay your bid by the time a given lot comes up, you lose your claim to that lot but incur no penalty.
  - Your records are in no particular order, but the glacial pace of life in your village suggests there are no time trends to account for.
- 

I'll be posting an interactive letting you test your decision, along with an explanation of how I generated the dataset, sometime next Friday. I'm giving you a week, but the task shouldn't take more than a few hours; use Excel, R, Python, Ouija boards, or whatever other tools you think are appropriate. Let me know in the comments if you have any questions about the scenario.

If you want to investigate collaboratively and/or call your decisions in advance, feel free to do so in the comments; however, please use spoiler tags or rot13 when sharing inferences/strategies/decisions, so people intending to fly solo can look for clarifications without being spoiled.

# D&D.Sci May 2021 Evaluation and Ruleset

This is a followup to [the D&D.Sci post](#) I made last week; if you haven't already read it, you should do so now before spoiling yourself.

[Here](#) is the web interactive I built to let you evaluate your solution; below is an explanation of the rules used to generate the dataset. You'll probably want to test your answer before reading any further.

---

## Ruleset

(Note: to make writing this easier, I'm using standard D&D dice notation, in which "4d8+3" means "roll four eight-sided dice, sum the results, then add three".)

## Species

The carcasses brought back by adventurers are 2/13 Yetis, 5/13 Snow Serpents, and 6/13 Winter Wolves.

## Days Since Death

The days since each creature's death is modelled by rolling two d12s, taking the lowest result, and subtracting 1.

(For the rest of this post, let "[DSD]" stand in for "Days Since Death".)

## Butchery

Carver takes a "collect anything the local alchemists might pay for, then carve out all the technically-edible meat you can still access" approach to her vocation.

The amount Carver gains from a Yeti carcass is given by  $72 + 1d6 - [DSD]d6$ , the amount from a Snow Serpent is  $20 + 2d6$  (she can't prepare snakemeat, so all the profit comes from non-degrading components like scales and fangs; ergo, no time effects), and the amount from a Winter Wolf is  $25 - 2*[DSD] + 4d6$ .

## Bidders

There are three bidders at a given auction: Alistair, Betty, and - except for today's auction, where you take her place - your employer Carver.

## Carver the Butcher

Carver bids  $32 - 2*[DSD] + 2d20$  on Yeti carcasses,  $7 + 2d10$  on Snow Serpent carcasses, and  $31 - 3*[DSD] + 2d8$  on Winter Wolf carcasses.

## Alistair the Butcher

Alistair has a different business model to Carver, focusing on extracting the highest quality cuts and selling them to rich clients; as such, his utility sharply decreases with time since death.

He is very predictable, bidding  $55-6 \times [\text{DSD}]$  for Yetis,  $60-20 \times [\text{DSD}]$  for Snow Serpents, and  $50-12 \times [\text{DSD}]$  for Winter Wolves.

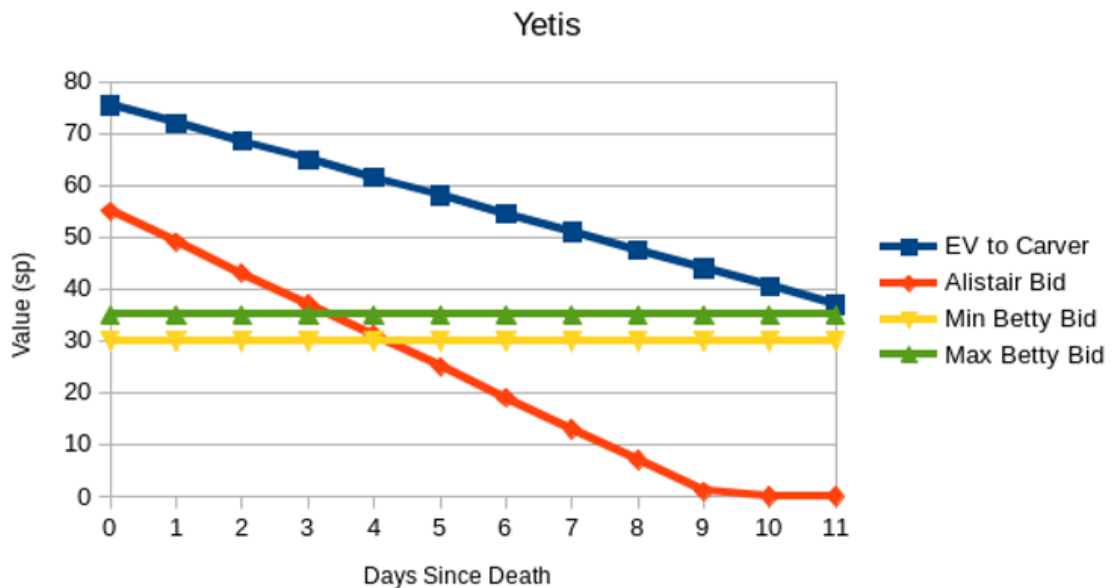
## Betty the Necromancer

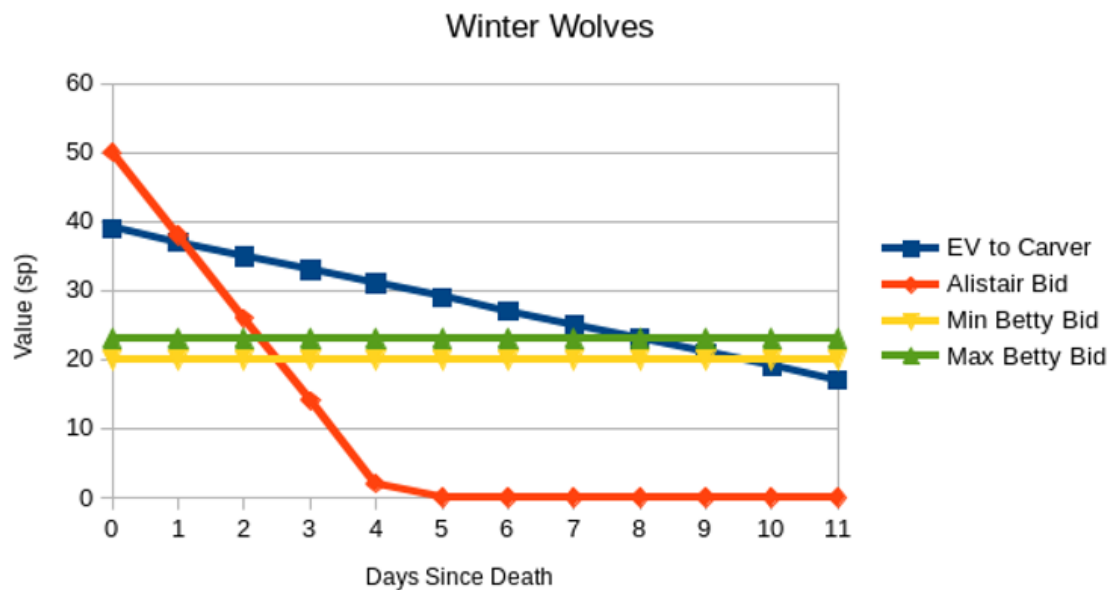
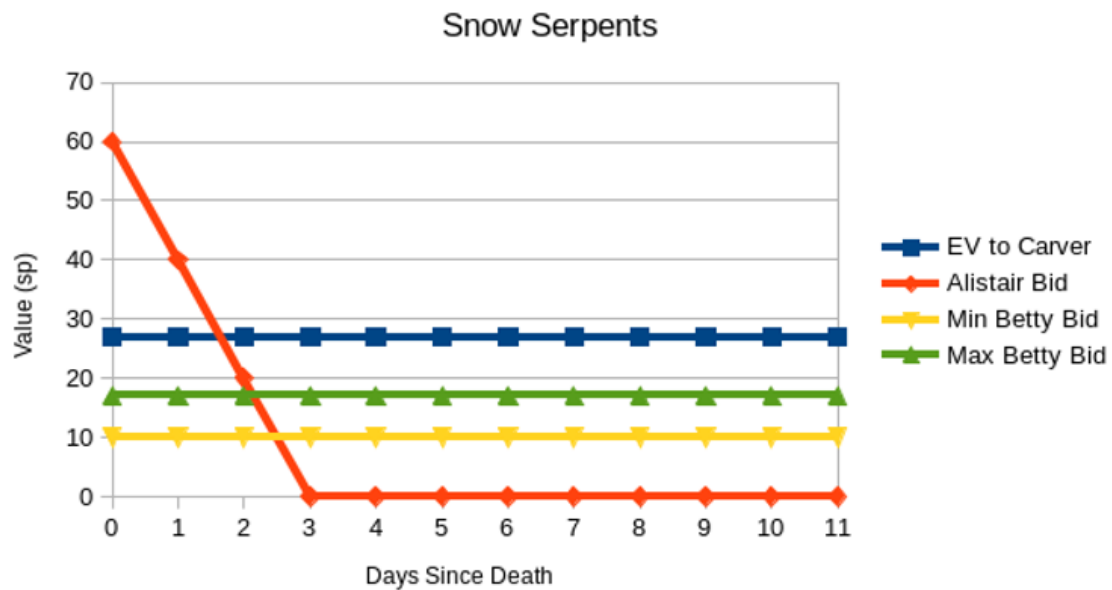
Betty doesn't care how long something's been dead, so long as no-one's interfered with the body.

She bids  $29+1d6$  on Yetis,  $9+1d8$  on Snow Serpents, and  $19+1d4$  on Winter Wolves.

## Strategy

The relevant factors are summarized in these graphs.





In almost all cases where rivals aren't making bids greater than the Expected Value of the lot to Carver, the EV-maximizing choice is to bid the lowest amount that would guarantee winning the lot. The one exception is with lot #11, where it's possible to eke out a tiny amount of extra EV by bidding 21 or 22 silver pieces.

## Reflections

I aimed to make this entry as straightforward and approachable as I could. From the, uh, *comprehensiveness* with which it was solved, I think it's fair to say I succeeded. Congratulations to simon and GuySrinivasan for reaching perfect answers; and then, between them, managing to deduce my entire generation process.

The main problem with this scenario from my point of view is that I once again ended up making a puzzle when I was aiming for a challenge. It's premised on some Weird Crap (distorting effects of selection bias, auctions against rival agents) but the fact it needs a 'proper' solution obligates the Weird Crap to impose itself with a reliability it would never possess in real life (Carver acts implausibly randomly to limit the effect of selection bias, opposing bidders are wind-up toys who don't know anything you don't), and so players develop abilities optimized for synthetic problems.

I'm mad about this, but only a little. While my game failed to live up to my standards of quote-unquote-'realism', it succeeded at its primary objectives: being playable, giving players an excuse to practice technical skills, and setting things up for the Bonus Round (which I'm pleased to report is *absolutely* not a puzzle).

## Scheduling

Oh yeah, there's a Bonus Round. It's all written up and ready, but I'm delaying it slightly so I can have it both be a week long and end on a weekend; I plan to run it starting next Monday and conclude it the Monday after, unless I get hit by a truck or someone in the comments gives me a reason to use a different time window. Watch this space.

# D&D.Sci(-Fi) June 2021: The Duel with Earwax

It is dark in the submarine, and Maria isn't ready.

Maria isn't ready at *all*. Maria is in her usual post-battle fugue, disoriented, dissociated, checked-out, can't come to the phone right now. Sending her to fight in this condition would be both homicide and suicide; also, your boss wouldn't let you.

Janelle, the backup pilot, is ready. That is, she's physically/psychologically/pneumatologically prepared to go toe-to-toe with a soul-eating monstrosity, throw Beta Resonance at it, and almost certainly die. But in the sense of having a >5% chance to successfully protect herself and her colleagues from the aforementioned soul consumption, Janelle is not ready.

There are four other viable volunteers: Amir, Corazon, Flint, and Will. None of these pseudo-under-understudies have so much as a double-digit number of missions under their belt, and none of them have ever faced an adversary half as strong as the one you're dealing with. In other words, they're not ready either.

You are Ratio Tile, a scientist working at the Sphere, a deep-sea research facility dedicated to studying mysterious – and frequently aggressive – accumulations of soul energy called heteropneums. *You* are ready. Or, at least, you'd better be.

Three hours ago, ace pilot Maria N. returned from heading off a possible attack, exorcising the offending heteropneum so swiftly and thoroughly that your superiors saw fit to posthumously assign it the official designation "Toast". Two hours ago, while Maria was still catatonic, a heteropneum previously considered benign (amplitude: 3.2 kCept, designation: "Earwax") teleported onto the Sphere, flooding half of the base and injuring 21% of active personnel before dispersing. Sixteen minutes ago, sensor readings indicated that Earwax is reforming. Your communications are down, and there is no time to evacuate.

Dr. Cept was incapacitated in Earwax's first attack. Cecelia is on her annual visit to the surface, visiting friends and family, unaware of her colleagues' peril. In their absence, the decision of which pilot to send and which type of Resonance they should use falls to you and you alone.

Your boss seems to think that you can use Soul Coherence Theory to choose the pilot/Resonance combination most likely to produce >3.2 kCept of Effective Field Strength and therefore save everyone. Unfortunately, Soul Coherence Theory straightforwardly predicts that you're almost certainly all going to die; though it also rules out such observed phenomena as Pseudo-Refraction, heteropneums with amplitudes over 4.92 kCept (no, Cept, the instruments are *not* 'potentially unreliable'), and – topically – heteropneums vanishing and reappearing the way Earwax did. So instead, you're going to look at [the data for all fights thus far](#) with fresh eyes, treating this as a pure analysis problem.

There is one other relevant factor. (Really, Ratio? You're pulling this *now*?) When a pilot overwhelms a heteropneum by generating an Effective Field Strength of more than double its amplitude, you get readings of much greater precision, and can use Branch-Loop Analysis to determine how much EFS *would* have been generated if the

pilot had used a different Resonance. Earwax is exhibiting previously unseen behaviours and abilities; if you can not only defeat but dominate it, you just *know* that data will help you construct an alternative to Soul Coherence Theory. And this isn't (just) your (boundless, inappropriate, potentially lethal) curiosity talking: figuring out how this creature works could be key to protecting the Sphere against future attacks.

You are Ratio Tile. You have five possible pilots, seven known Resonances, one functioning submarine, and one chance. You are ready. Who will you send, and how will you have them fight?

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Notes:

- This challenge is fanfiction of Nostalgebraist's [Floornight](#), but having read it is unlikely to help you achieve your desired outcome.
  - The change in genre is matched by some changes in my approach to data generation. I will not be telling you what they are.
  - Your instruments have limited precision, but unerring accuracy. For example, since they say Earwax has an amplitude of 3.2 kCept, you can be 100% sure the true value is between 3.15 and 3.25 kCept; and since they say Janelle (would have) generated 2.02 kCept of amplitude from Alpha Resonance in her most recent fight, you can be 100% sure the true value is between 2.015 and 2.025 kCept.
- 

I'll be posting an interactive letting you test your decision, along with an explanation of how I generated the dataset, sometime next Tuesday. I'm giving you a week, but the task shouldn't take more than a few hours; use Excel, R, Python, the Summer Diary, or whatever other tools you think are appropriate. Let me know in the comments if you have any questions about the scenario.

If you want to investigate collaboratively and/or call your decisions in advance, feel free to do so in the comments; however, please use spoiler tags or rot13 when sharing inferences/strategies/decisions, so people intending to fly solo can look for clarifications without being spoiled. Please also spoiler or rot13 any Floornight plot points.



# D&D.Sci(-Fi) June 2021 Evaluation and Ruleset

This is a followup to [the D&D.Sci post](#) I made last week; if you haven't already read it, you should do so now before spoiling yourself.

[Here](#) is the web interactive I built to let you evaluate your solution; below is an explanation of the rules used to generate the dataset. You'll probably want to test your answer before reading any further.

---

## Ruleset

This challenge runs mostly on Poisson distributions; the rest of this post will abbreviate "Take the result of a Poisson process with  $\lambda=X$ " as "Po(X)".

## Heteropneums

There are two types of heteropneum. The most common is the garden-variety heteropneum, which exists as a natural consequence of the way soul energy clusters. This type has a randomly-generated amplitude which is always a multiple of 0.142 kCept. (You can infer that Earwax must not be of this kind because no amplitude which would round to 3.2 kCept is a multiple of 0.142 kCept.)

There are also a much smaller number of [Teeming] heteropneums, which exist because the [Teeming] hivemind does. These appear at times and with intensities not determined by the rules of this world (in other words, decided arbitrarily by the GM). Nicholas, Neville, Jasper, Athena, Endeavour, Spindle, Divisor, Desk, Pencil, Duchess, Economy, Sirocco, Constellation, Harbinger, Minimalist, Spackle, Tourniquet, Painting, Toast, and most importantly Earwax are [Teeming] heteropneums; all others are not.

## Who Fights What

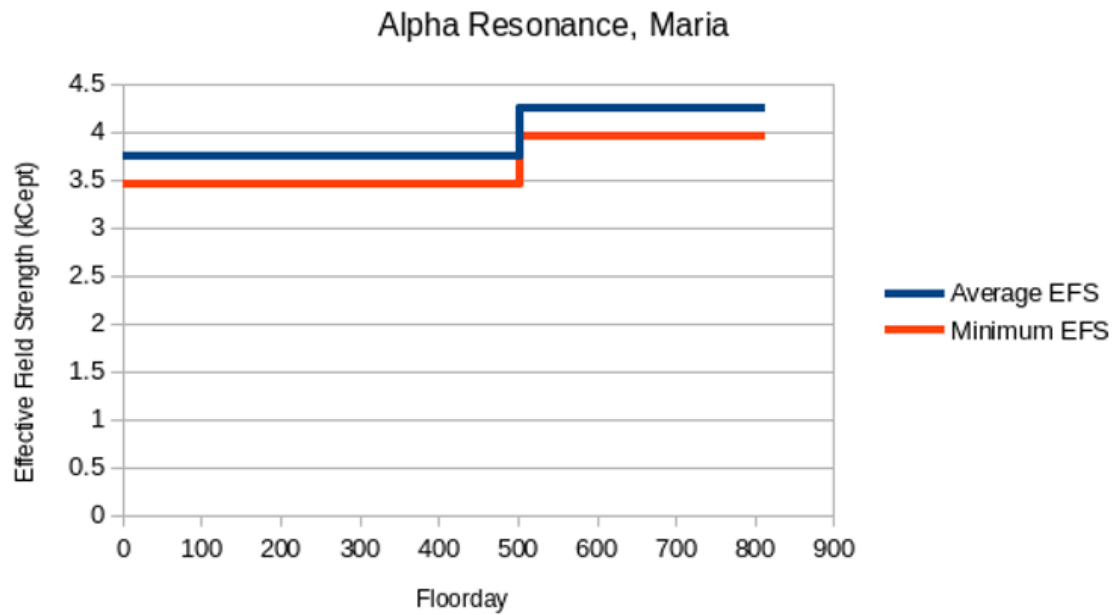
Heteropneums with amplitudes of  $>2.5$  kCept are handled by Maria. Heteropneums in the 1.2-2.5 kCept range are split evenly between Maria and Janelle. Weaker heteropneums are allocated unevenly between all viable pilots.

## Fighting (as Maria)

Let  $A$  be the amplitude of the heteropneum Maria is facing, in kCept.

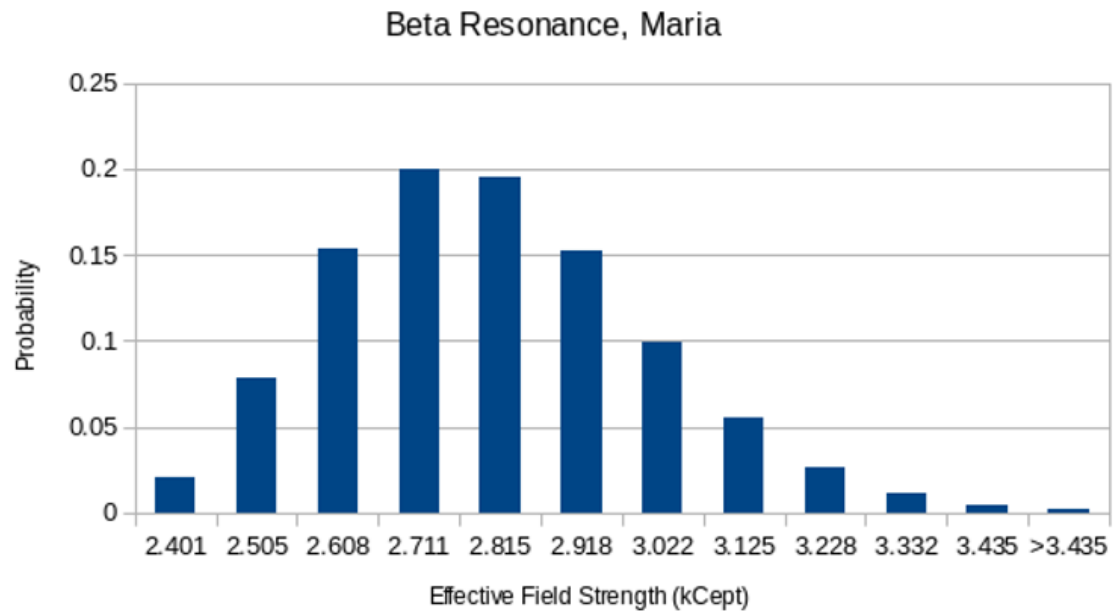
### Alpha

Alpha Resonance lets Maria create  $3.4444 + 0.0285 \cdot \text{Po}(10.2)$  kCept of Effective Field Strength. On Floorday 502, a breakthrough was made which allowed the Sphere's submarines to better utilize this form of Resonance; this adds an extra 0.5111 kCept.



## Beta

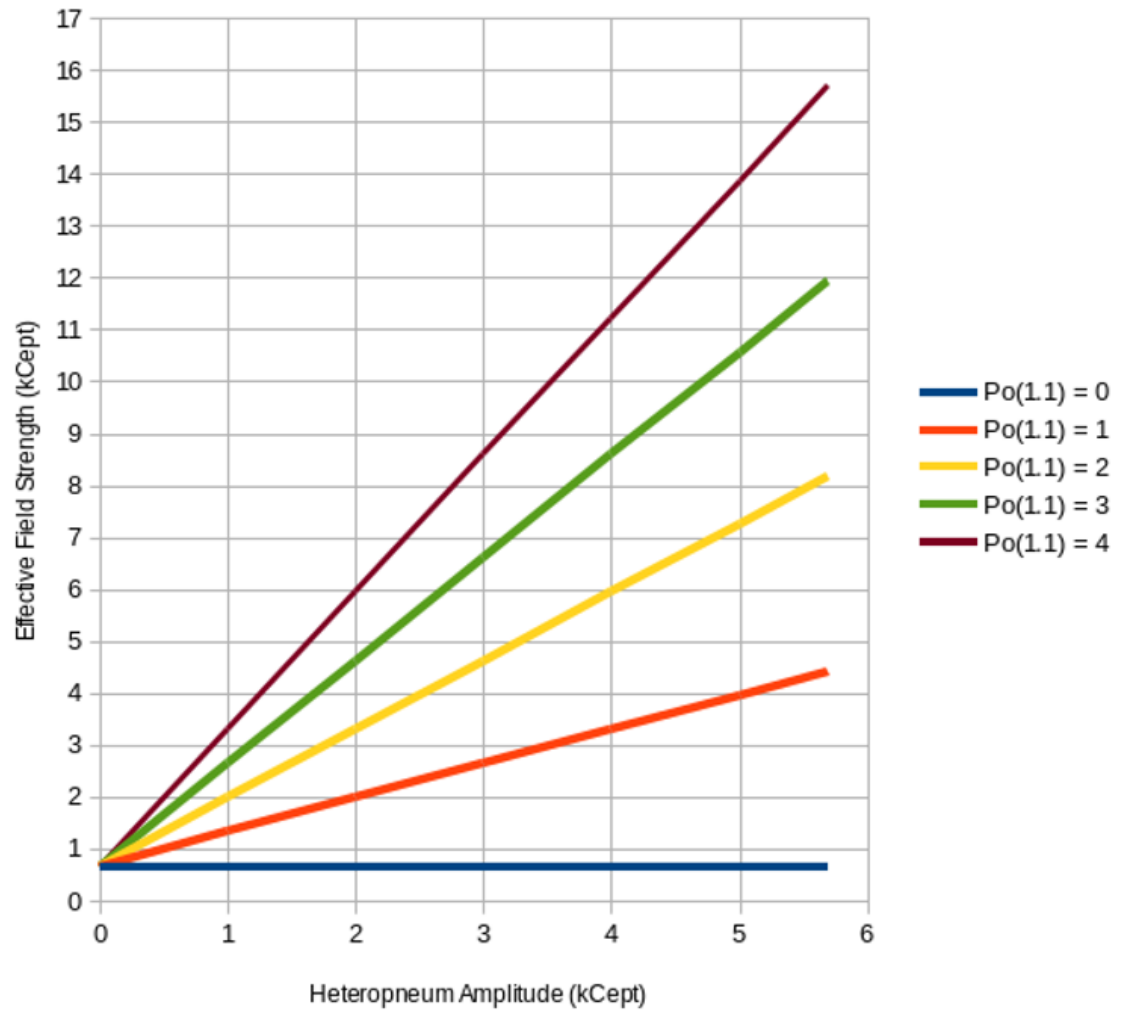
Beta Resonance lets Maria create  $2.4011 + 0.1034 \cdot \text{Po}(3.9)$  kCept of Effective Field Strength.

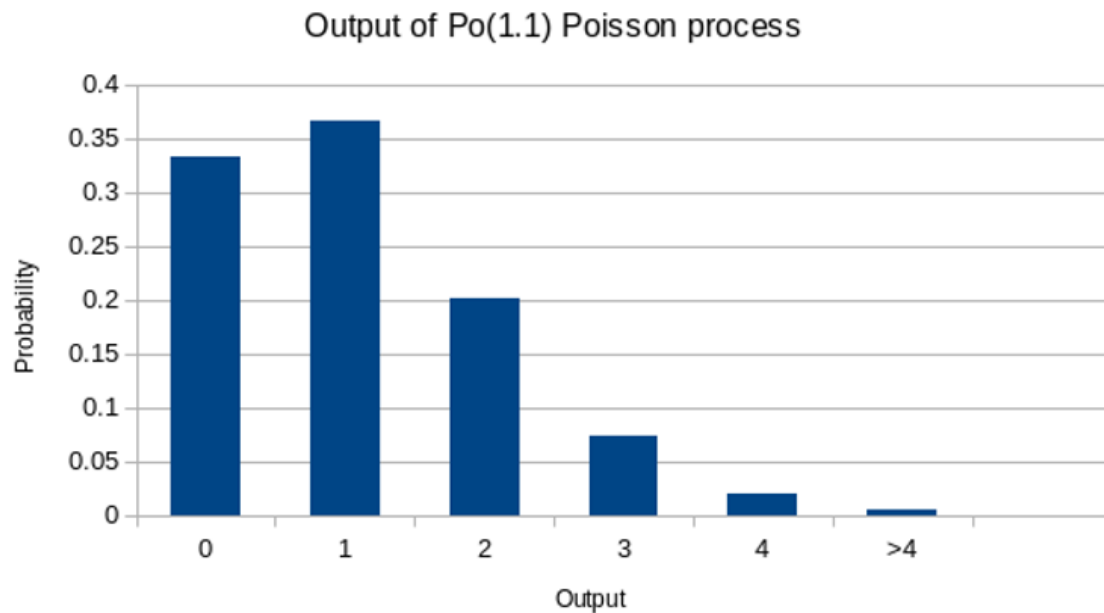


## Gamma

Gamma Resonance gets stronger as the enemy does. It lets Maria create  $0.6626 + A \cdot 0.66 \cdot \text{Po}(1.1)$  kCept of Effective Field Strength.

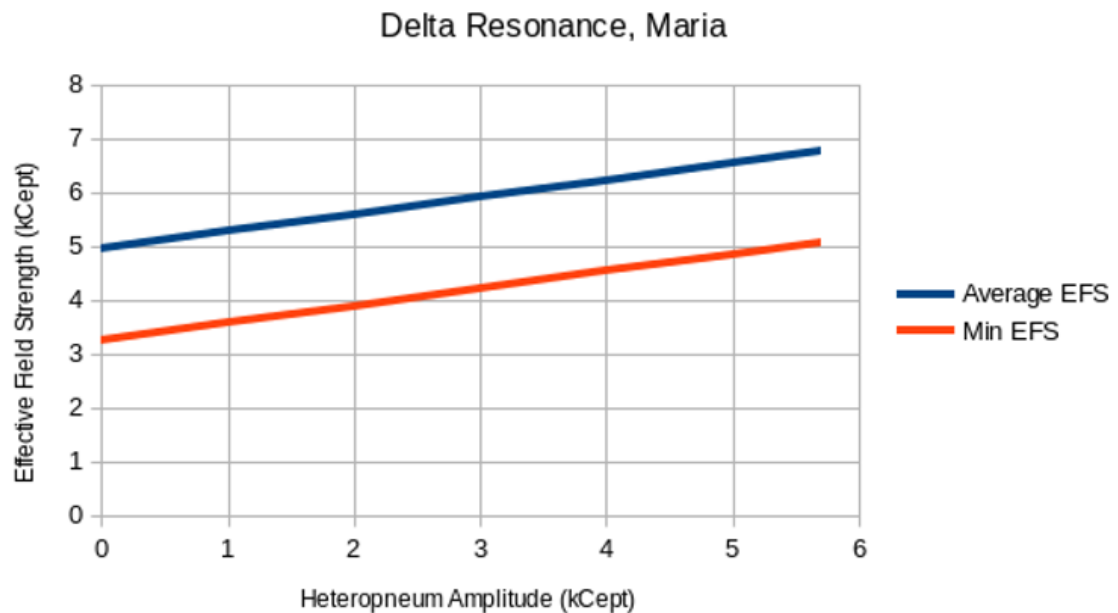
# Gamma Resonance, Maria





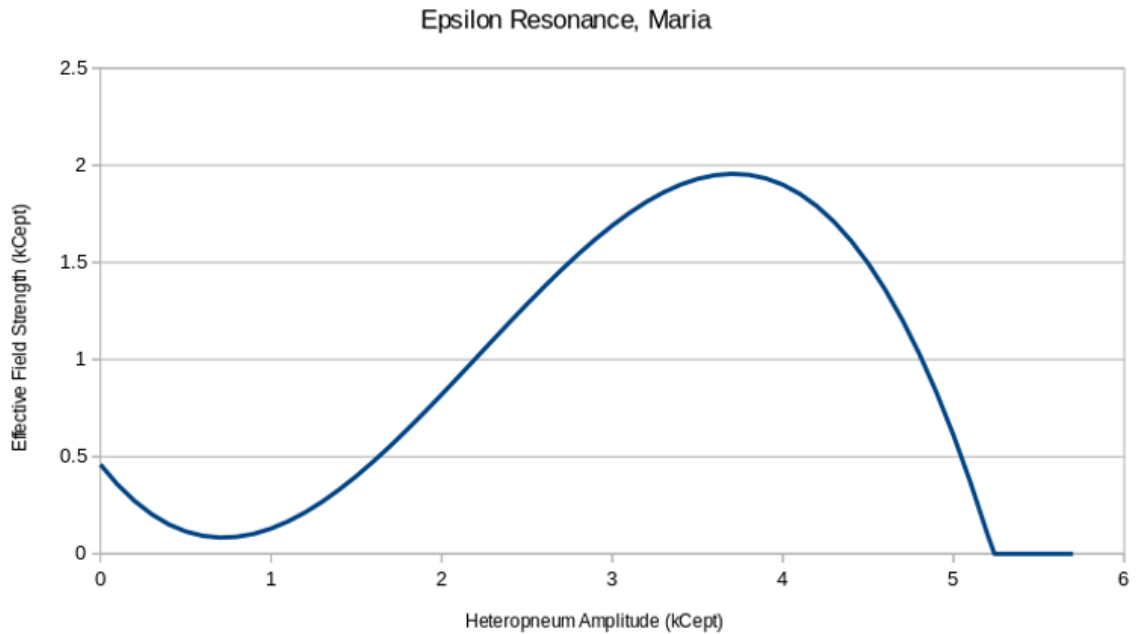
## Delta

Delta Resonance is Maria's preferred means of attacking. It lets her create  $A \cdot 0.32 + 3.253 + 0.0882 \cdot \text{Po}(19.2)$  kCept of Effective Field Strength.



## Epsilon

Epsilon Resonance has a complex but predictable effect. It lets Maria create  $0.46 - 1.12 \cdot A + 0.93 \cdot A^2 - 0.14 \cdot A^3$  kCept of Effective Field Strength.

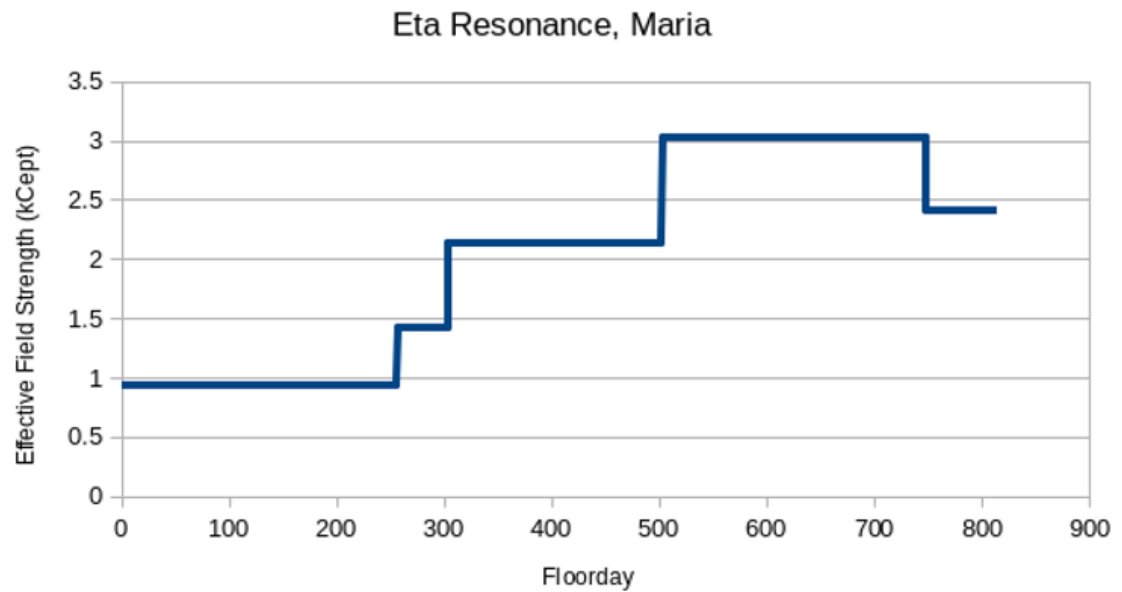


## Zeta

Zeta Resonance randomly fails and produces 0kCept 22% of the time. When it succeeds, it lets Maria create 2.1571 kCept of EFS against an ordinary heteropneum, or 7.5311 kCept against a [Teeming] heteropneum.

## Eta

Eta Resonance varies sharply and arbitrarily with time, as shown below.



## Fighting (as anyone else)

Every pilot/Resonance combination has a factor representing how well that pilot handles that resonance compared to Maria. The EFS they generate is always the EFS Maria would generate multiplied by that factor. All factors are tabulated below.

	Janelle	Amir	Corazon	Flint	Will
<b>Alpha</b>	0.48	0.50	0.59	0.42	0.23
<b>Beta</b>	0.98	0.72	0.11	0.32	0.55
<b>Gamma</b>	1.34	0.42	0.58	0.36	0.14
<b>Delta</b>	0.24	0.34	0.16	0.32	0.21
<b>Epsilon</b>	0.79	0.78	0.35	1.23	2.11
<b>Zeta</b>	0.43	0.41	0.92	0.39	0.12
<b>Eta</b>	0.45	0.23	0.12	1.08	0.95

## Strategy

Once you know everything about this system, the two dominant solutions are to have Will use Epsilon Resonance (100% chance to live), or have Corazon use Zeta Resonance (22% chance to die, 78% chance to live and replace Soul Coherence Theory). However, the small amount of data you were provided may not have been enough for you to confidently assess how reliably Zeta Resonance works on [Teeming] heteropneums, and/or you may have suspected that Earwax is unique enough that Zeta Resonance wouldn't treat it like other [Teeming]s; thus, you may have reasonably opted for having Janelle use Gamma Resonance (~33% chance to die, ~37% chance to live but keep SCT, ~30% chance to live and replace SCT). Ultimately, your choice depends on your values and your circumstantial reasoning.

(You may also choose to sabotage the fight and kill everyone. But why would a Sphere scientist ever do something like that?)

## Reflections

This scenario was a puzzle; for once, I think that's justified. When dealing with a problem rooted in (Meta)Physics and (Xeno)Biology instead of Economics and Sociology, exact predictions become sensible goals and sophisticated modelling becomes a valid tactic. The fact that it had three intended solutions made me comfortable turning up the difficulty for this one: congratulations to everyone who found at least one answer, and particular congratulations to Simon for finding the two optimal ones.

This scenario was also fanfiction. It . . . probably shouldn't have been. I had hoped that using someone else's canon would let me borrow gravitas, cut down on exposition, and enable players' pre-existing attitudes towards the characters both motivate and bias them. This was undercut somewhat by the fact that - to my surprise - literally 0% of players seem to have read Floornight (in my defence, it was big on rationalist tumblr!). But the main problems were inherent to the idea: it's hard to write an introduction such that it works for both fans and non-fans, ~700 words of problem description just isn't enough for me to successfully cloud people's judgement, and the whole "solve this puzzle or your husbando gets it!" conceit seems tacky in hindsight (especially given I didn't invent the husbando in question). Next time I do a D&D.Sci challenge as fanfic, I'll pick a less obscure story; and next time I try to inflict Feels on you, I'll use both a better format and original characters.

Finally, this scenario was Sci-Fi, with capital letters and everything. No dungeons, no dragons, no questing heroes, and most importantly no dicerolls. I'm conflicted both about

whether Sci-Fi is less likely than Fantasy to alienate potential players, and about whether using 'grown-up' distributions that could conceivably show up in players' dayjobs is an improvement over my usual approach.

. . . this is typically the part where I say "Feedback on these points, and on all other points, is enthusiastically solicited", but it's possible Nostalgebraist might read this and I want him to think I'm cool. Therefore: I coolly solicit cool feedback on these cool points (in a cool sort of way).

## **Scheduling**

I've just started a new job. This shouldn't interfere with making July's challenge – especially since I've done all the conceptual work for it already – but unexpected delays are a lot more likely. Best guess: I'll post it towards the end of next month.

# D&D.Sci August 2021: The Oracle and the Monk

You are Oeis the Wise, professional Oracle. Your uncanny ability to predict how lists of whole numbers will continue – and *only* how lists of whole numbers will continue – creates infrequent but intense demand for your counsel: you usually leave your mountain home about once a month, whenever circumstances place a local noble or merchant lord in need of your services.

Today's customer is Morgan, a monk. (Morgan has no money, but his temple has frequently provided you with food and shelter while travelling to more lucrative clients, so you're fine doing this one for free.)

Morgan explains that he uses transcendental meditation to link himself to the substructure of the universe, observing the pulse and flicker of those lights which cast all we know as shadows. In his [notes](#), he records flows of mana as they rise and ebb, forming the rhythms that undergird reality.

You tell him that sounds cool and you hope it works out for him.

However, Morgan continues, a recent supernova of unusual intensity has disrupted the leylines of the world, creating the possibility of flux in realms which have previously known only stasis. In ten days – day 384 in his record – he will have a once-in-several-lifetimes chance to not merely channel these flows, but change them: he plans to invoke two mana types simultaneously, wielding them in a ritual that subtly but profoundly reshapes the world for the better. If he is to do this, he must begin the endeavour now; to determine which sources of power he should prepare to conjure on that fateful day, he zealously entreats your assistance.

You tell him that sounds cool and you hope it works out for him. (Living alone on a mountain has not done wonders for your conversational repertoire.)

Morgan concludes by saying that his priorities for day 384 are as follows:

- Firstly, the strongest of the two mana types he channels cannot be Void, Doom, or Spite. These may be used if you are certain they will be the weaker of the pair, but if they dominate, darkness will possess him and he will transform into an immortal demon, wreaking horror and bloodshed upon the world he sought to improve.
- Secondly, the ritual must work. For this to occur, the two mana types together must have a combined power of at least 70.
- Finally, as a strictly tertiary objective, increasing the total amount of mana channelled would allow him to increase the amount of good done; however, this is much less important than guaranteeing the ritual works at all.

From the dedication in his eyes, you perceive Morgan will not be persuaded from this path: all you can do is ensure he walks it as best he can. You are Oeis the Wise, and you have a title to uphold. What, in your ~~Oeisdom~~ Wisdom, will you advise him to do?

---

I'll be posting an interactive letting you test your decision, along with an explanation of how I generated the dataset, sometime ~~next Friday~~ on Monday the 23rd. I'm giving



you a week, but the task shouldn't take more than a few hours; use Excel, R, Python, Shivers, Inland Empire, Espirit de Corps, or whatever other tools you think are appropriate. Let me know in the comments if you have any questions about the scenario.

If you want to investigate collaboratively and/or call your decisions in advance, feel free to do so in the comments; however, please use spoiler tags or rot13 when sharing inferences/strategies/decisions, so people intending to fly solo can look for clarifications without being spoiled.

# D&D.Sci August 2021 Evaluation and Ruleset

This is a followup to [the D&D.Sci post](#) I made ten days ago; if you haven't already read it, you should do so now before spoiling yourself.

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## Ruleset

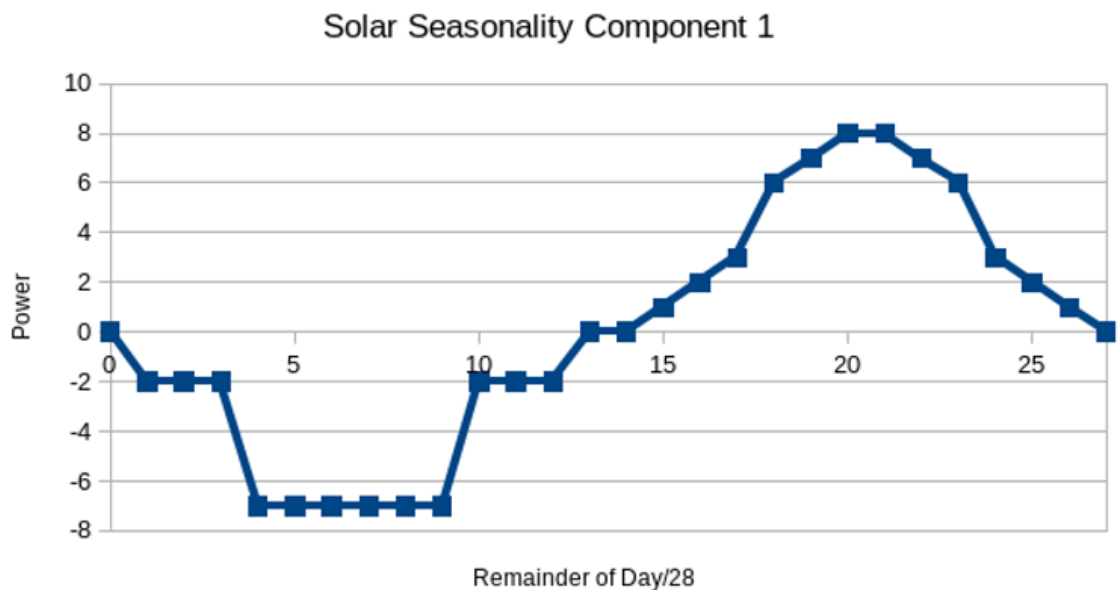
Below is a summary of how the dataset works; full generation code is available [here](#).

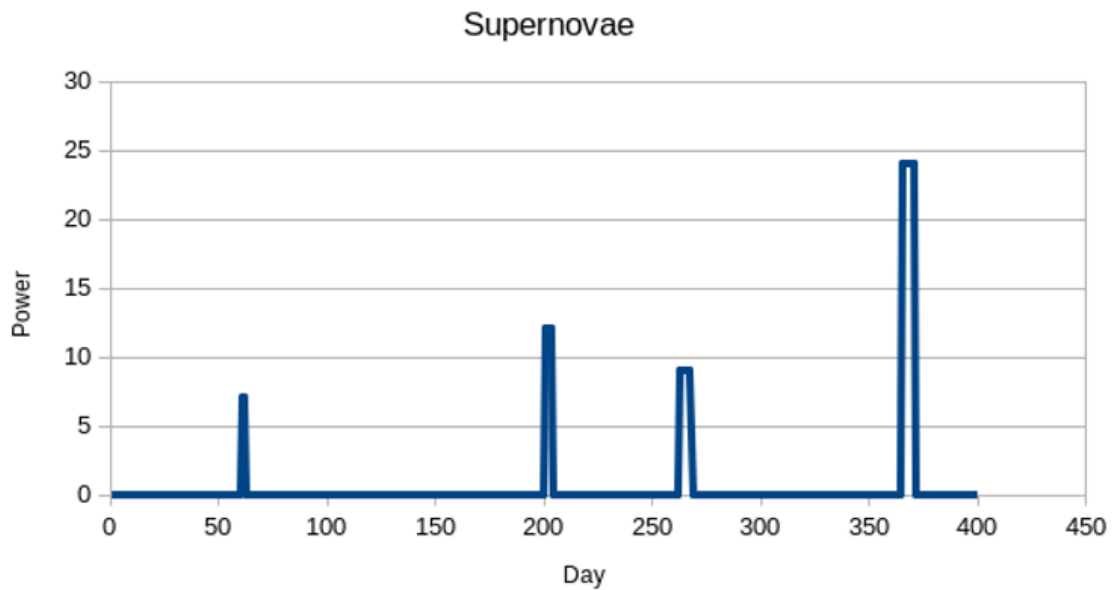
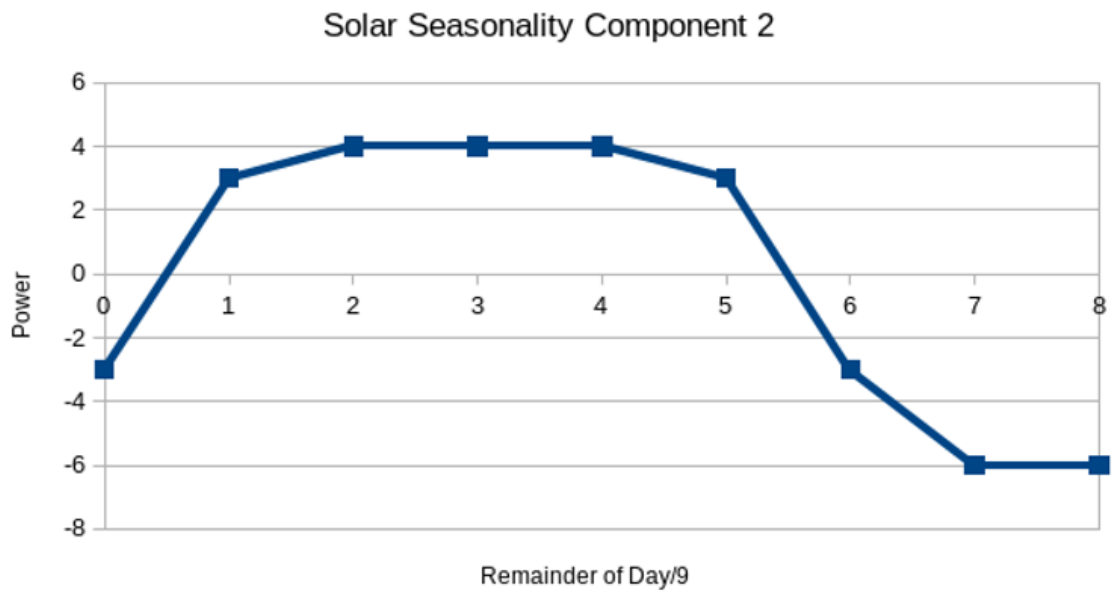
(Note: to make writing this easier, I'm using standard D&D dice notation, in which "4d8+3" means "roll four eight-sided dice, sum the results, then add three".)

## Mana types

### Solar

Solar is the strongest and most complicated mana type. It can be decomposed into an average (40), a small amount of random noise (+ 1d2 - 1d2), two seasonality components, and the effects of distant supernovae.





The power of Solar on Day 384 is  $45 + 1d^2 - 1d^2$

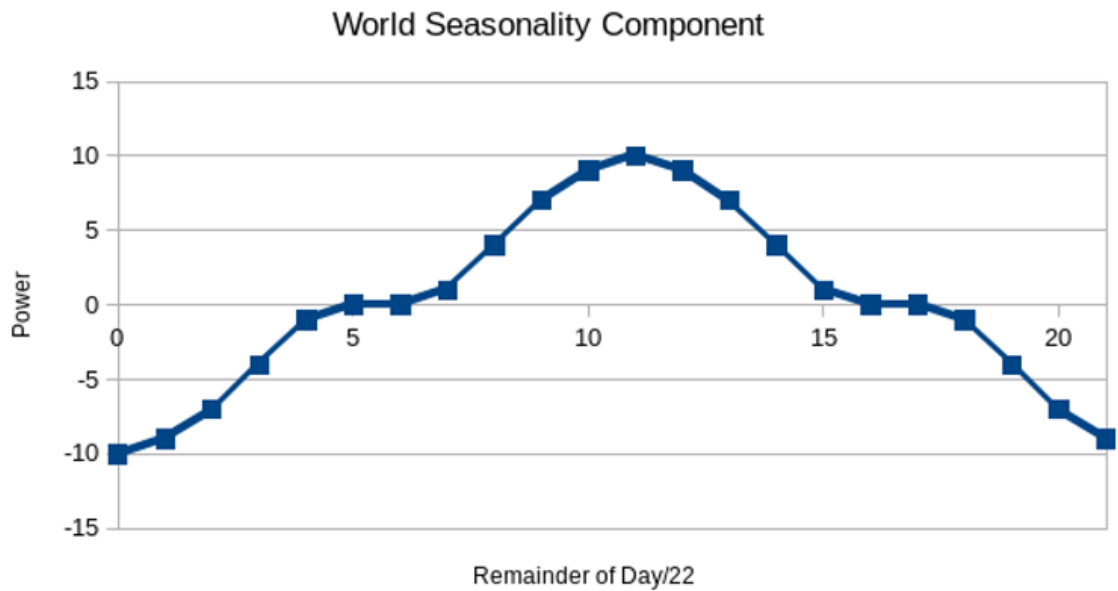
## Lunar

The moon reflects and inverts the effects of the sun, with a delay. It provides a power of 75 minus the amount of Solar power 14 days ago.

The power of Lunar on Day 384 is 16, because the power of Solar on Day 370 was 59.

## Earth and Ocean

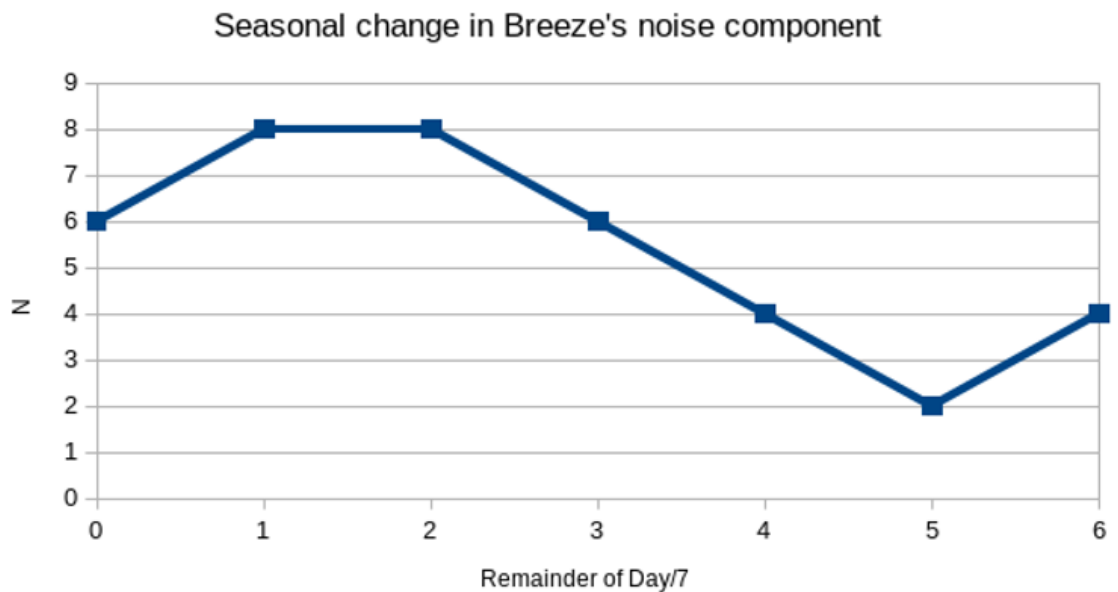
Earth and Ocean combine to create the World. World Mana can be decomposed into an average (68), some random noise (1d4 - 1d4), and a seasonality effect.



On a given day, Earth takes  $(15 + 1d80)\%$  of World Mana, rounded down; Ocean gets the rest. The combined power of Earth and Ocean on Day 384 is  $77 + 1d4 - 1d4$ .

## Breeze

The breeze varies, as does its variance. It is composed of an average (13), and some random noise which varies seasonally ( $1dN - 1dN$ , where N is given in the graph below).

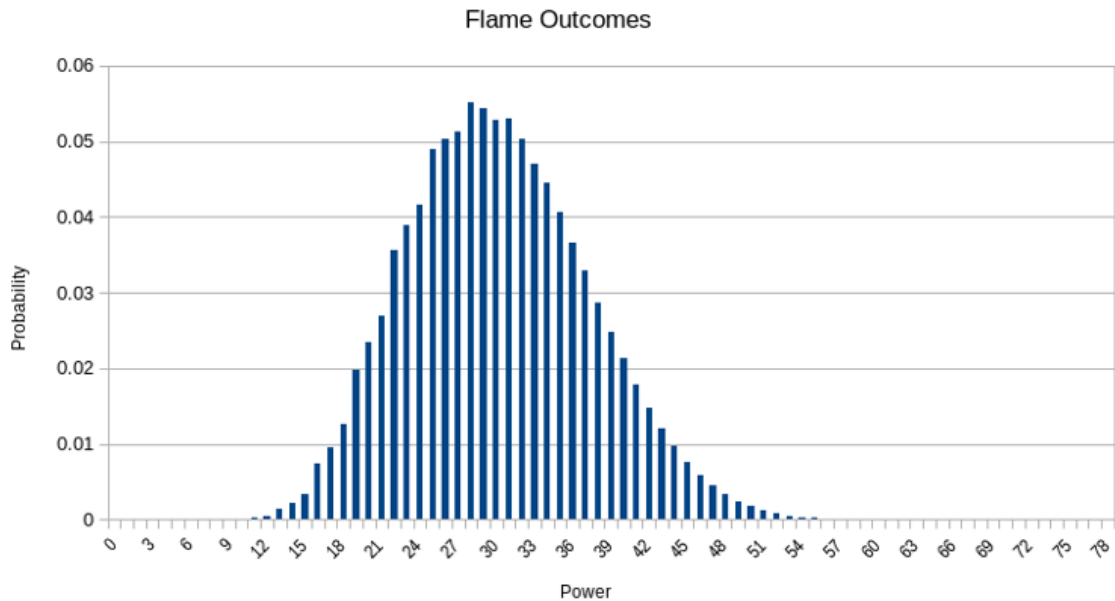


The power of Breeze on Day 384 is  $13 + 1d4 - 1d4$

**Flame**

Flame catches, sputters and starts, building and waning randomly. Today’s Flame mana is yesterday’s, minus 25% (rounded down), plus the lowest of two d20 rolls.

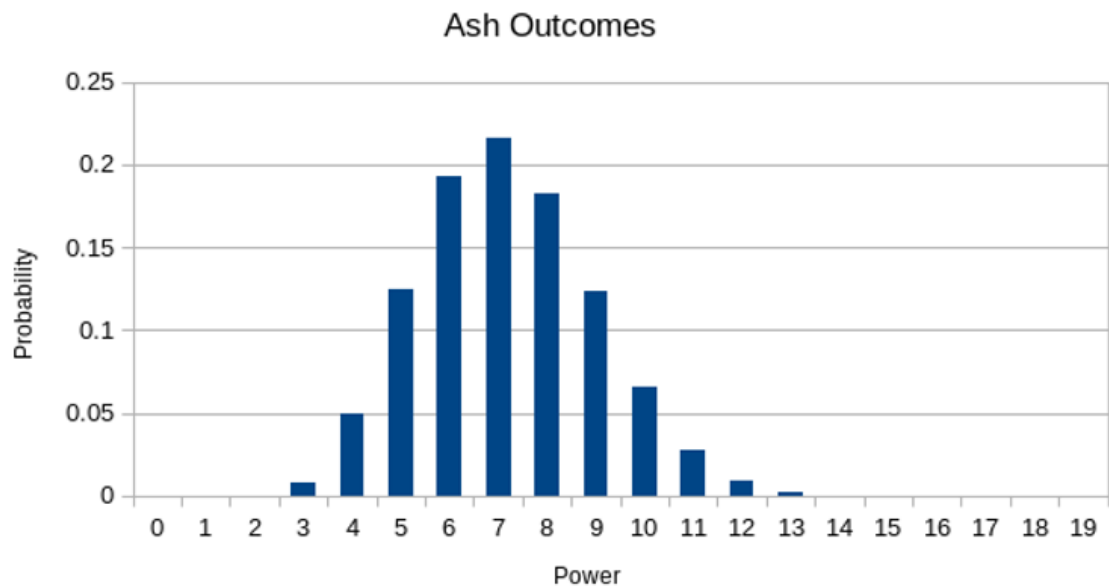
The spread of possibilities at Day 384 looks like this:



**Ash**

Ash is what remains when Flame is extinguished. Today’s Ash is the 25% removed from yesterday’s Flame.

The spread of possibilities at Day 384 looks like this:

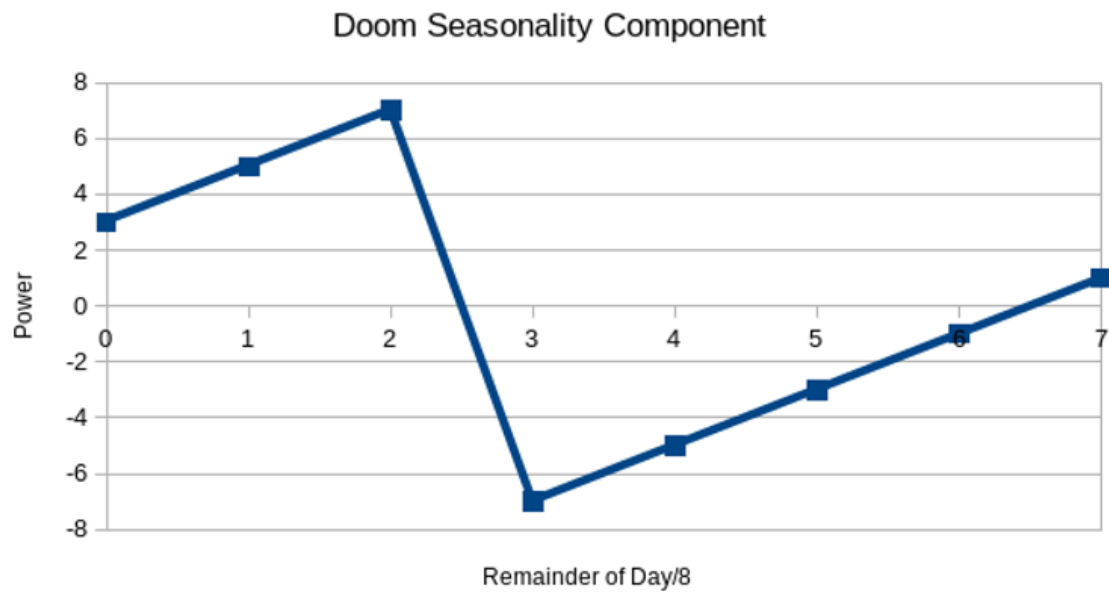


## Void

Void is timeless; all motion within it is random, and all apparent trends or correspondences are merely noise. The power of Void on Day 384 - and all other days - is  $24 + 1d8 - 1d8$ .

## Doom

Doom builds gradually, then diminishes sharply as it is fulfilled. On a typical day, it can be decomposed into a starting point (24), some random noise (1d6), and a jagged seasonality effect.



However, there have been four recorded days – 34, 91, 181 and 249 – where the die rolled an impossible value. There’s a 99% chance that this is due to natural disasters, to Morgan’s pure heart and optimism making him slightly unreliable at quantifying Doom flows, or to some other innocuous explanation . . . and a 1% chance that this is due to the demon lord Astaroth modifying Doom whenever he detects a mortal using it in a ritual. As such, the power of Doom on Day 384 has a 99% chance of being  $27+1d6$ , and a 1% chance of being one unit greater than whatever other mana flow Morgan channels.

(In my defense, I did literally call it ‘Doom’.)

## Spite

Spite lays dormant, then explodes briefly, only to become silent again. Its default power is 0; to this we add 13, 7, 18 and 6 at 4-, 5-, 7- and 14-day intervals respectively.

On Day 384, Spite is 0.

## Strategy

The only strategy which ensures Morgan’s success is using Earth and Ocean. However, you don’t have to share his priorities, and you had no way of knowing that there would be no supernova effect on Day 384. As such, taking an unknown risk to gain an unknown benefit in the form of Doom and Solar is also a not-strictly-dominated answer; for that matter, you could also prioritize best-case outcomes over guaranteed successes by suggesting Solar and Earth, or sabotage the ritual by advising him to use (to give one example) Lunar and Doom.

## Reflections

The premise for this challenge was specified by GuySrinivasan, as a prize for [winning an earlier game](#). He asked for a scenario about chronological effects: I built a system of autocorrelations, lagging and leading indicators, overlapping seasonalities, transient anomalies, and factors which turn out to actually just be random, all overshadowed by the potential for Black Swan events.

One thing I did not include was any overall time trends: Morgan and Oeis’ world is naturally one of stasis, cycles, and noise. Congratulations to everyone who successfully enabled them to change it, and particular congratulations to aphyer for reaching the intended solution within three hours (!) of the challenge being posted.

Using someone else’s premise was unexpectedly pleasant: there’s a lot of fun to be had working around arbitrary but lenient constraints, and I appreciated the guarantee that at least one player would appreciate the subject matter chosen. As such, I conclude this section by soliciting both feedback on this challenge and suggestions for what you’d like to see in future ones.

## Scheduling

. . . speaking of which, I’m sorry to say you’re unlikely to see much from me for a while. I’m about to begin an intense and protracted piece of contract-work, and I don’t know how much attention I’ll be able to spare for this hobby of mine. I hope to get the next entry done sometime in October, but it’s entirely possible this will be the last D&D.Sci challenge posted this year.

(If this state of affairs bothers you, you are warmly encouraged to amend it: all my work is public domain, and I never planned to be the sole custodian of this genre. I look forward to investigating whatever scenarios you find the time and inspiration to construct.)