A Damage Output Analysis of Dungeons and Dragons

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A. Project Overview

A1. Research Question or Organizational Need

This project will identify the rate of improvement for damage output as complexity is introduced into abilities and attacks within the Dungeons and Dragons ("D&D") game. Python will be utilized to identify the average damage output for each individual ability and attack, then to calculate the average increase in damage for each modifier; each individual modifier will be considered as an additional degree of complexity.

A2. Context and Background

D&D is an immensely popular game with a broad fanbase and years of fine-tuning. That said, one of the most significant barriers to entry is the ability to understand how to build a character; the process is complex and daunting for a newcomer. This project aims to identify the level of complexity needed to reach optimal damage output and help new players determine the best build path for creating a new character. Three archetypal characters will be utilized to make these analyses: The Barbarian as a melee fighter, the Ranger as a ranged archer, and the Warlock as a spell-caster.

A3. Summary of Published Works

The 5e Player's Handbook provides detailed information regarding the weapons, spells, abilities, and modifiers available to a D&D character (Wizards of the Coast 2014).

The Curse of Strahd adventure module is the standard entry-level campaign. This campaign is aimed at newer players and is built to have players no higher than level 10 (Wizards of the Coast, 2016).

The D&D Adventurers League is a compendium of data used to provide recommendations for character builds, specifically with a pre-defined consistent set of attribute values: 15, 14, 13, 12, 10, and 8 (Wizards of the Coast, 2023).

A3a. Relation of Published Works to Project

The 5e Player's Handbook will be utilized to guide the building of damage output and coding required to accurately depict the calculations for each modifier. The handbook will largely be

utilized to build out the initial data required for weapon and ability damage, limitations regarding when and how modifiers can be applied, and ensure accuracy of the analyses.

The Curse of Strahd Adventure Module is utilized to identify the capped "fight potential" of the analyzed characters. Though characters can reach as high as level 20 in some campaigns, reducing the level cap reduces the scope of data needed to provide entry-level players appropriate information. Additionally, the damage potential of a character is determined largely by the defensive ability of the monsters that they are fighting; this data will help further define how damage calculations should be made.

The Adventurers League Guides help identify some of the more ephemeral choices that a player can make when building their character, specifically with ability scores. Every character has 6 scores they can assign randomly, which will massively adjust how the character is played. By utilizing the standard set of values recommended in the Adventurers League, the damage calculations are more consistent across the different character classes.

A4. Summary of Data Analytics Solution

To provide the required statistical information, the baseline damage of each available weapon, spell, and ability will be gathered in a CSV file and imported into Python. This data will then be placed in a ranked order. Once the initial data is ranked, each modifier will be created as a Python class and the effects of the damage output will be measured, with each modifier acting as an additional layer of complexity. Once all possible layers of complexity have been added, a linear regression will be performed between the damage outputs and complexity levels to determine if there is a linear relationship between the two.

A5. Benefit to Organization and Decision-Making Process

This analysis will largely be for the benefit of new or beginning players. This information will help either provide a better understanding of the damage mechanics within D&D or ease the barrier of entry that is

character creation. Additionally, the data may be helpful to the game makers themselves, as the analysis can indicate if there is an appropriate and equitable damage curve between player archetypes.

B. Data Analytics Plan

B1. Goals, Objectives, and Deliverables

There are two major goals with this project:

1. Develop a ranking of weapons, abilities, spells, and modifiers as they pertain to the average damage output for each of the Barbarian, Ranger, and Warlock classes.
    a. Deliverables will be a descending list of damage rankings and corresponding bar chart to provide visual representation.
2. Identify the linear relationship between damage and complexity.
    a. Deliverable will be a scatterplot comparing the damage output at varying levels of complexity and a regression line to indicate if the relationship exists.

All deliverables will be presented in a PDF version of a Jupyter Notebook, as well as a final Project Report.

B2. Scope of Project

This project will include an analysis of the core weapons, abilities, spells, and modifiers available in the D&D 5e Player's Handbook. This analysis will be limited to level 10, the Barbarian, Ranger, and Warlock classes. The project will also follow the Adventurers League recommendations for player ability scores and monster challenge rating ("CR") to provide more consistent calculations between classes. This project will *not* include any analysis of non-damage related abilities, cross-class calculations, or take into account any role-playing-centric decisions.

B3. Standard Methodology

As there are no iterative deliverables, the project will follow a Waterfall methodology.

- Requirements: This phase will consist of gathering the high-level requirements of the data required to make the appropriate calculations.
- Design: This phase will consist of identifying the best tools and methods to utilize with the Python architecture to properly analyze the data.
- Implementation: This phase will be the actual data analysis utilizing Python and the data collected during requirements gathering.
- Verification: This phase will be the validation that the analysis methodology utilized is performing appropriately and to fine-tune any of the code that was developed.
- Maintenance: This phase will consist of final delivery of the data analysis with options for continual optimization or addition.

B4. Timeline and Milestones

Present a table showing for each milestone its projected start and end dates, and its projected duration:

Milestone	**Projected Start Date**	**Projected End Date**	**Duration (days/hours)**
Gather all raw data	7/2/2023	7/5/2023	3
Investigate available Python code	7/6/2023	7/7/2023	1
Build Python code	7/8/2023	7/12/2023	5
Fine-tune Python code	7/13/2023	7/16/2023	4
Clean up Jupyter Notebook	7/17/2023	7/18/2023	2
Notebook Delivery	7/19/2023	7/20/2023	1

B5. Resources and Costs

Resource	Cost
D&D 5e Player’s Handbook	$60
Curse of Strahd Data	N/A

Adventurer's League Data	N/A
Anaconda Python Environment	N/A

B6. Criteria for Success

How will you measure the success and effectiveness of outcomes? Present at least 3 criteria for success, including how you will collect the data for each criterion and what constitutes success. Summarize your discussion in a table:

Criterion/Metric	Required Data	Cut Score for Success
Can a baseline be created and ranked?	Table presented in Jupyter Notebook	Successful if the damage output is measurable and can be ranked.
Can modifiers be measured and ranked?	Table presented in Jupyter Notebook	Successful if the effect on damage output is measurable and can be ranked.
Is there a correlation between damage output and complexity?	Graphs provided in Jupyter Notebooks	Successful if the damage output and complexity can be compared to provide an indicator of whether a linear relationship exists.

C. Design of Data Analytics Solution

C1. Hypothesis

Weapons, abilities, spells, and modifiers will have an identifiable ranking regarding damage output or relative effect on damage output. The correlation between damage output and complexity will be measurable as a strong linear relationship.

C2. Analytical Method

Data will be collected regarding weapons, abilities, and spells to create a baseline of complexity 0. Data

on modifiers will be collected and applied to each baseline, where each applied modifier adds an additional level of complexity. Once all modifier possibilities have been outlined, the average damage value of each will be calculated and ranked. The optimal modifier paths will be identified and provided as a ranking list, and compared using a linear regression model to identify if there is a strong or weak correlation between damage and complexity.

C2a. Justification of Analytical Method

The nature of the project is to identify if there is or is not a linear relationship; because we are comparing two points of data, the linear regression model is the best model to identify this.

C3. Tools and Environments of Solution

Data from the 5e player's handbook will be pulled manually and placed into an excel spreadsheet to be exported into a Jupyter Notebook as a CSV file. Once imported, the baseline data will be entered into a Data frame and modifiers will be built as Python classes.

C4. Methods and Metrics to Evaluate Statistical Significance

The baseline will be created by taking the relative likelihood of a hit being landed, referencing that with the average dice roll, and the relative chance of a critical hit. From here, the modifier Python classes will be used to calculate the relative damage increase, with a new class to run all potential calculations within a complexity level. Once the calculations are completed, a linear regression will be completed comparing the damage output and complexity levels. If there is a weak correlation coefficient of 0.59 or less, the hypothesis will be disproven.

C4a. Justification Of Methods and Metrics

Gathering a base average is the most consistent variable to identify damage output, as there will multiple encounters against multiple enemies during a campaign; having the average value will give a player the best estimate of a typical battle experience.

Building classes for the modifiers is preferable, as their interaction with the baseline varies significantly. The classes for complexity levels reduce the overall number of manual calculations that would need to be performed to gather all necessary data.

The scatterplot and correlation coefficient are going to be used, as they are the best graphing method to visually identify a linear model and best indicator of a strong relationship, respectively.

C5. Practical Significance

The overall data will help new or beginning D&D players build more efficient and effective characters. As a result, their associated campaigns will run smoother and provide more enjoyable playthrough, leading to a higher likelihood of repeat play and an expanded community.

C6. Visual Communication

For the rankings, a list containing the rankings and a bar graph to display the relative disparity in damage output will provide an easily readable and usable set of data. For the damage to complexity comparison, a scatterplot and line will be used to identify the data points and linearity.

D. Description of Datasets

D1. Source of Data

The data for weapons, spells, abilities, modifiers, and mechanics are all pulled from the D&D 5e Player's Handbook. Data regarding character limits is pulled from the D&D Curse of Strahd campaign. Data regarding character stat distribution and relative monster difficulty is pulled from the D&D Adventurer's League resource.

D2. Appropriateness of Dataset

As the analysis is based on damage from D&D sources, the 5e Player's Handbook is the most accurate place to gather the information required to build the dataset. The dataset itself will be hand-built. The data from the Curse of Strahd campaign and Adventurer's League will help provide an appropriate scope of data that will be relevant for beginning players.

D3. Data Collection Methods

Data is manually pulled from the source books and materials and imported into Python utilizing the Anaconda stack and Jupyter Notebooks. While baseline weapons and abilities are easily translatable to a CSV file, the various modifiers are not and will need to be built as Python classes.

D4. Data Quality

The use of baseline data will ensure that all base damage calculations are consistent and the utilization of Python classes will ensure that the complexity calculations are consistent, as well.

D5. Data Governance, Privacy and Security, Ethical, Legal, and Regulatory Compliance

All data utilized within this project is intellectual property owned by Wizards of the Coast. Public use of this data is covered and approved by the Open-Gaming License (OGL) or Creative Commons agreement that Wizards of the Coast has created with their community.

D5a. Precautions

The calculations and analysis will be saved in a Jupyter Notebook to allow ease of adjustment during the fine-tuning period. It will be important to ensure that the environment is consistently saved to prevent loss of progress.

E. Sources

Dungeons and Dragons Fifth Edition Player's Handbook. Wizards of the Coast, 2014.

The Curse of Strahd. Wizards of the Coast, 2016.

Wizards of the Coast. (2023). *Adventurers League: Organized Play: Dungeons & Dragons.* D&D Official | Dungeons & Dragons. https://dnd.wizards.com/adventurers-league