The Economy of Animal Crossing

Analyzing the Creation of Game Economics

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***Abstract*— The objective of this project is to analyze the economies developed in life simulator video games. First we'll analyze Animal Crossing, a game developed by a large company who's developed in game economy has been very similar since it's first iteration in 2001. Then we'll compare our analysis to Stardew Valley's economy, a game initially created by a single developer and later a small team. Both of these games' economies seem similar on the surface but after looking into how their economies were developed show how different they really are.**

I. INTRODUCTION

Animal Crossing: New Horizons is a video game created by Nintendo that released in March of 2020, and is the latest iteration in it's series that began in 2001. It is a social simulation game in which the player moves to a remote island and has to pay off their house to the local storekeep, Tom Nook. It was a massively popular game in which players participated in the simulated economy of the game, and we'd like to analyze that economy to figure out how it was balanced. Similarly, Stardew Valley is a social simulation game in which the player moves to a farm left to them by their late grandfather. In order to keep the farm alive and to aide the town, the player needs to forage for things to sell or donate to the community center.

As students who enjoy playing games along with making them in our spare time, we'd like to analyze an important aspect of game making, which is balancing the difficulty to make it fun and enjoyable to play. In Animal Crossing there are a myriad of items the player is able to sell, which the player can forage or craft. For example, there are fruit trees, Vegetables, Bugs, and Fish that many players rely on to make money in the game. Similarly, Stardew Valley is a game in which the player can do a wide range of things to be able to make money and succeed in the game. Some players focus on only the farming, the foraging, or the fishing and the game doesn't force the player to do all three, but lets them decide how they want to make money. The most similar systems of making money between the games are fishing, growing fruits and vegetables, and interestingly flowers. Foraging is much the same too, but because of the wide variety of items in both games, it's hard to make as many 1:1 comparisons. So to focus our project, we'll be focusing on comparing the Fishing, growing fruits and veggies, and the flowers.

II. THE DATA

To analyze Animal Crossing: New Horizons (ACNH), we'll be using a data set from Kaggle, a website designed for the ML and AI community and is well known as a trusted source. This data set details every aspect of items and NPCs (non-player character) in animal crossing. For example, for each fish it lists where to catch it, the size, conditions to catch it in, how much in game currency you can sell it for, and also where it can be sold. It details out each aspect of every item in this very way. We'll need to organize and clean the data for what will be useful for comparisons in this project so that we can more easily analyze the data.

For Stardew Valley, there did not seem to be any data sets available for us to use. Therefore, we instead pursued web-scraping of the fan-made "Wiki" to build our own data set for analysis. The process was roughly as follows:

1) Scrape the listings of all fish, veggies, and fruits to get the names of them
2) Use these names to generate the direct URLs for these items and scrape those as well
3) Break down the info cards for these items to retrieve key pieces of information
4) Clean the data so that it can be compared against ACNH
5) Organize the data into CSV files

While most of this process was straightforward, there were a few outlier items whose information was muddled or otherwise displayed differently from similar items. This meant extra effort had to go into covering edge cases on the web-scraping script to make sure the right data was gathered

every time, as well as extra effort in the data cleaning and organization process to make sure all of the entries were correct. Ultimately, the biggest challenge was translating concepts from ACNH to apply to Stardew Valley, as the games are of course not exactly the same as one another. This need to translate concepts is what drove us to compare the three categories we chose.

Fish were chosen for comparison as they had the largest number of immediately similar traits between the two games, with fairly minimal processing necessary. First, we had to try to liken fishing locations in Stardew Valley to ones in ACNH. Then, we had to translate from Stardew Valley's simple four-season system to ACNH's more complex 12-month system with hemispheres. Finally, we had to transform the names of fish to be similar between the two datasets (i.e., both datasets will have "catfish" rather than one deviating with "Catfish" or "cat fish").

For the fruits and veggies, the primary motive was to be able to compare colors. In ACNH, the color of an item can often influence its price, and we were interested to discover if that held true for Stardew Valley. For this, we had to first get the sell price for each fruit or vegetable. Then, we needed to determine from the scraped data what color it was, and transform any strange colors into more common ones (e.g., "dark brown" should just be "brown"). Finally, we had to make the same transformation as we did for the fish - normalize the names.

III. FISH

- We theorized that each fish as the size increased the price would gradually increase for both games
- Big jump from L to L w/fin, but not as big a jump for M to M w/fin
  - M w/fin and Long are the rarest, yet are average in overall price
- XL to XXL is the biggest jump from one (non-fin) size to the next
- Generally, there is a small increase in bells per size growth, with the exception of L-> L w/fin and XL->XXL
- The outliers tended to be worth a lot more bells above the the average for the size

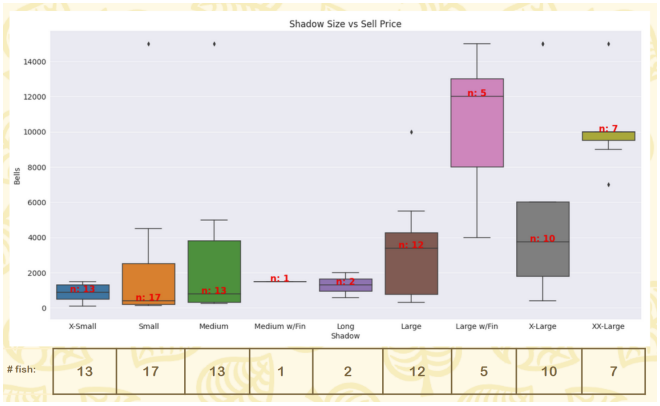

Fig. 1. Enter Caption

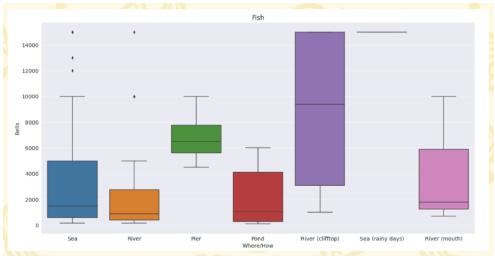

Fig. 2. Enter Caption

- We theorized that location wouldn't be a big indicator of sell price of fish in both games
- For the most part we were correct, except in the case of the pier and the clifftop river.
- The clifftop river needs to be 'unlocked' through getting a ladder
- In previous games, this location didn't have different fish, but New Horizons added 4 fish, with two of them being 15,000 bells
- Surprising how on average, the sea, river, and pond are similar, but the pier is much better
  - None of these locations needs unlocking
- How fish prices/rarity work in SDV
- Fish location is generally not an indicator of how much a fish is worth, unlike in ACNH
  - Except for the mines
- Rarity is more determining of price
- Each level of quality is more and more rare
  - The Mines is the only location with special rare fish
- As spawn rates decrease the price increases
- There are 4 fish in the Mines:
  - Ghostfish - 45 g (floor 20 & 60)
  - Stonefish - 300 g (floor 20)
  - Ice Pip - 500 g (floor 60)

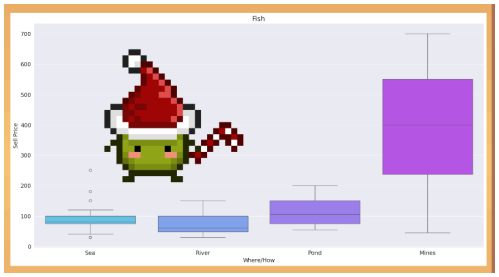

Fig. 3. Enter Caption

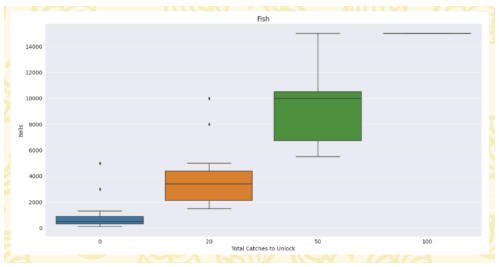

Fig. 4. Enter Caption

∗ Lava Eel - 700 g (floor 100)

Conclusion:

- **Price variety in ACNH comes from different kinds of fish and where they are, while in SDV there are fewer kinds of fish and their price variation comes from their quality**
- **In ACNH, as you catch more fish, you unlock more expensive fish**
- **In SDV you catch more expensive fish as you play since as you increase your gear and level up, you can handle more 'difficult' fish and you can sell the fish for better prices**
- **Generally, as you level up or unlock more the player is usually able to catch slightly more expensive fish, except in the cases of an exceptionally more expensive fish being unlocked**

IV. FRUITS & VEGGIES

- We theorized that for animal crossing, the fruit isn't very important
- Only 5 real fruits exist and are all sold for the same price
  - Each island comes with fruit trees at the start
- For the purposes of comparison, we looked at anything that could be 'harvested' from a tree
  - Nothing that can be harvested from a tree is worth a lot, and is a way to distribute certain items
- Ornaments and eggs are special holiday items
- Other items aren't incredibly rare or helpful in progressing the game in a big way

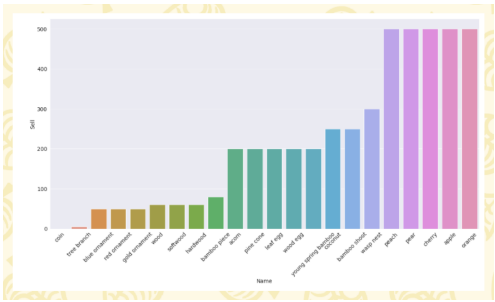

Fig. 5. Enter Caption

- We theorized that fruits would have an exponential growth for seed price to fruit sell price
- Fruits are gained from farming or foraging
- Interesting how very expensive seeds don't always yield expensive fruit
  - All of the fruits worth more than 200 are sold for less than 500
  - Some seeds you only need to buy once and they keep producing fruit, others you need new sees per harvest
- Interesting how the colors on average increase gradually, with yellow being the highest average price
- The more expensive a seed, the more time it seems to need to grow
  - Trees need more time, but are faster when regrowing fruit

V. MACHINE LEARNING APPROACH

In addition to the manual analysis of the Animal Crossing: New Horizons economy, we applied various machine learning techniques to the dataset with the aim of uncovering insights that could inform a robust pricing policy. Tackling the challenge as a regression problem, we employed both linear and stochastic gradient descent models on the meticulously pre-processed dataset.

Despite our efforts, the outcomes from both models proved to be less than satisfactory. The r-squared scores, measuring the goodness of fit, fell well below 0.5 for both training and testing data subsets. This subpar performance may be attributed to the type of data being examined.

Notably, the dataset predominantly comprised textual rather than numeric values, potentially introducing complexity and unwarranted variance into the computation. This characteristic of the data may be a key contributor to the underwhelming results observed in our machine learning models. To combat this, it may have been necessary to encode the textual features into numeric values for better machine analysis.

VI. CONCLUSION

In conclusion, most games tend to price items based off of progression. From the data that we collected this is what make the largest impact on prices. We found that, in the games we looked at, superficial things like color did not have nearly any correlation to the price. Both games also dealt with some type of expected profit from putting time or money into an item. This is very expected and also related to progression. As you gain more money, you are able to get more money out of the items that you buy. So in all, we found that game developers do their best to price items based on what the player will expect at the time. If you spend a lot of time to get to a new area or unlock some new items and they cost less than the ones you got at the start, there will be some disappointment.

VII. RESPONSIBILITIES

Our approach was to gather all of the data first, as we needed to determine what was possible to compare. First, we looked at many games including Counter-Strike: Global Offensive, Skyrim, Team Fortress 2, Club Penguin, and Roblox. The goal was to find games that had data sets (or gather-able data) surrounding their economies and some aspects that lent themselves to comparison against ACNH. After much searching, we found that Stardew Valley seemed to be the only game that fit those requirements while remaining within the scope of our investigation. With this determined, the responsibilities of the group were divided as so.

Christian Graham Machine-Learning Methods NetID: cgraha37, ghid: cgraha37

1) Search for games that fit the goal of our project
2) Once games were found, set up a way to analyze the data using machine-learning methods
3) Work with Andrew Lay to build graphs for our findings
4) Participate in a goal pivot with Andrew Lay

Andrew Lay Team Lead and Data Visualization NetID: alay10, ghid: alay10

1) Search for games that fit the goal of our project
2) Once games were found, set up a framework for data visualization and determine what traits (if any) were comparable between items
3) Work with Christian Graham to build the graphs
4) Assist with organizing the final presentation

Imani Pelton Web-Scraping and Data Gathering NetID: ipelton, ghid: bepri

1) Search for games that fit the goal of our project
2) Once games were found, gather data on those games
3) Build the gathered data into a data set usable by Christian Graham and Andrew Lay
4) Assist with the final report

Laura Smith Presentation, Official Documents, and Data Visualization NetID: lsmit248, ghid: LSmith2174

1) Write the initial proposal
2) Search for games that fit the goal of our project
3) Once games were found, assist with determining what traits (if any) could be compared between two items
4) Create the presentation
5) Write the final report

VIII. TIMELINE

1) (9/28/23 - 10/12/23) Find data sets for the 5 games and determine their usability and if we should move forward with using each game. Begin the data cleaning and analysis of the Animal Crossing data.
2) (10/12/23 - 11/2/23) Finish analysis of Animal Crossing data and begin to compare it to the other games, each member is in charge of comparing the games they found data for, Andrew Lay will assist with Imani and Laura's games.

3) (11/2/23 - 11/16/23) Begin to compile together the data and assemble it visually through graphs and charts.
4) (11/16/23 - 11/30/23) Create the presentation and finalize conclusions and findings]
5) Practice presenting and iron out the creases until the presentation date.

IX. FUTURE WORKS

In the future it would be interesting to look into the economy of the other games that we planed to work on. I thin that looking at games like TF2 and CS:GO would be very interesting considering the fact that the items are priced with real money and sold by real people. With that we could likely look more into the psychology behind why some items are more expensive to more people just based off of the visuals of the item.

Another topic that we could have expanded more on could have been game balancing by looking at patches to the game. Game developers can spend a lot of time balancing the game but this doesn't always go correct so they may need to tone some parts down or make some parts more powerful. One thing that developers need to balance is item pricing. If we look at the items that needed a price change, we could find the reasoning behind the change and extrapolate that to why the other items are priced as they are.