

WORLD OF WARCRAFT ECONOMY

Syed Aqhib, Jose Barajas,
Hyungkyu Lim, Abhishek Sarvepalli

World of Warcraft

- Massively multiplayer online role playing game (MMO RPG)
- Almost 6 million subscribers
- Players interact with the simulated environment as well as other players:

Player/environment interactions:

Quests, gathering resources, battling NPCs, world exploring

Player/player interactions:

Social, “Battling”, running through dungeons, and trading



Motivation

- World of Warcraft has been used in the past to gain insights on epidemics
- Could the same extend to, the already hard to predict, markets in real life?
- **Can inferences in the World of Warcraft market shed some light on the real world market?**

“Blood plague”
incident in the news



The screenshot shows a news website interface. At the top, there's a navigation bar with links for NEWS, ARTS & LIFE, MUSIC, SHOWS & PODCASTS, and a SEARCH icon. Below this, a video player is featured with a large play button and a '+ QUEUE' button. The video title is "'Virtual' Virus Sheds Light on Real-World Behavior" under the category "SCIENCE". It was published on October 5, 2005, at 12:00 AM ET, and is from "Heard on All Things Considered" by Laura Sydell. Below the video player, a text snippet reads: "A recent outbreak of a 'plague' in a popular online game has scientists considering how the virtual world may provide clues to what people would do in real-world".

Below the video player, there's a section for "One-Minute World News" with a "Last Updated" timestamp of Tuesday, 21 August 2007, 00:04 GMT 01:04 UK. The main headline is "Virtual game is a 'disease model'", with a sub-headline: "An outbreak of a deadly disease in a virtual world can offer insights into real life epidemics, scientists suggest." A small image shows a virtual game environment. The text continues: "The 'corrupted blood' disease spread rapidly within the popular online World of Warcraft game, killing off thousands of players in an uncontrolled plague." and "The infection raged, wreaking social chaos, despite quarantine measures." It also mentions: "The experience provides essential clues to how people behave in such crises, Lancet Infectious Diseases reports." and "In the game, there was a real diversity of response from the players to the threat of infection, similar to those seen in real".

To the right of the "One-Minute World News" section, there's a link to "THE LANCET Infectious Diseases" journal, Volume 7, Issue 9, September 2007, Pages 625-629. Below this, a section titled "Summary" discusses the importance of simulation models in applied epidemiology and mentions a recent incident in the virtual world of online gaming.

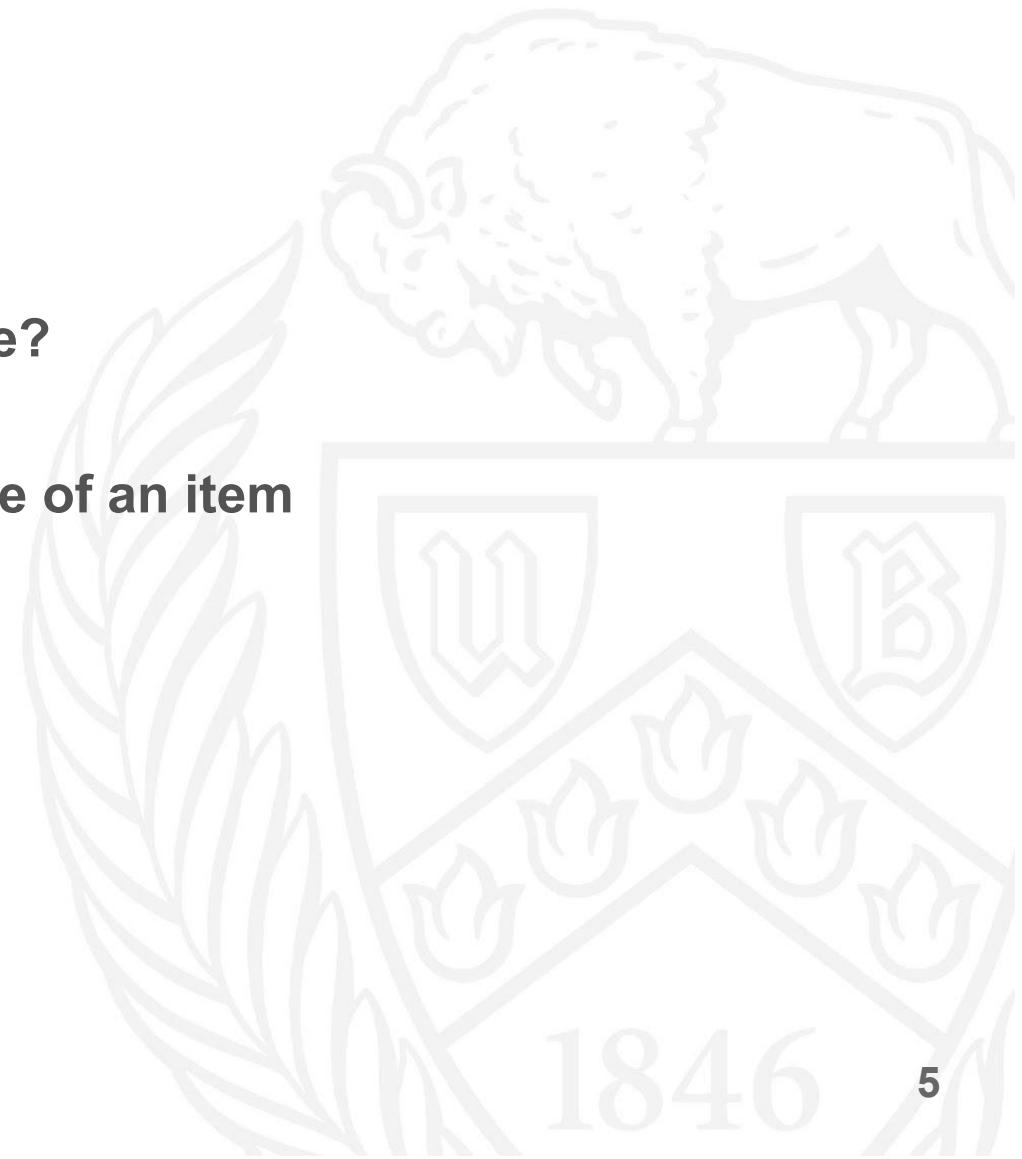
World of Warcraft Economy

- Currency
 - Obtained by questing, selling items to vendors, and trading with players
- Resources
 - Herbs, cloth, ore/metal, leather, gems
 - Used to craft items
 - Parallels raw materials in the real world
- Items
- Player interactions
 - One on one trade
 - Auction house



Potential Economic Considerations

- **Market inference/prediction**
 - **What features contribute the most to item price?**
 - **What type of items are volatile in price?**
 - **Can we accurately predict the the average price of an item overtime?**
- **Currency inflation/ arbitrage**
 - What factors impact the in game currency?
 - Can we predict inflation?



Data Collection from



- TradeSkillMaster (TSM) is an addon suite designed to help both players new to gold making as well as experienced auction house players streamline their gold-making processes.
- Holds all historical pricing data of every item that can be sold on the auction house (TSM pulls data from the auction house every hour for every server in the game).
- Only select data is made available to players in game through addon.

Data Collection from



TRADESKILLMASTER

- Challenges:
 - Only way of getting the required data - API calls, limited to 50,000 per user per day.
- Workaround
 - Use 100 accounts to make a total of 5,000,000 API calls per day, to get a total of 56,541,829 records over 11 days.

default

Show/Hide | List Operations | Expand Operations

GET

/item/{itemId}

Stats for a specific item

GET

/item/region/{region}

Stats for every item for a specific region

GET

/item/{region}/{realm}

Stats for every item for a specific realm

GET

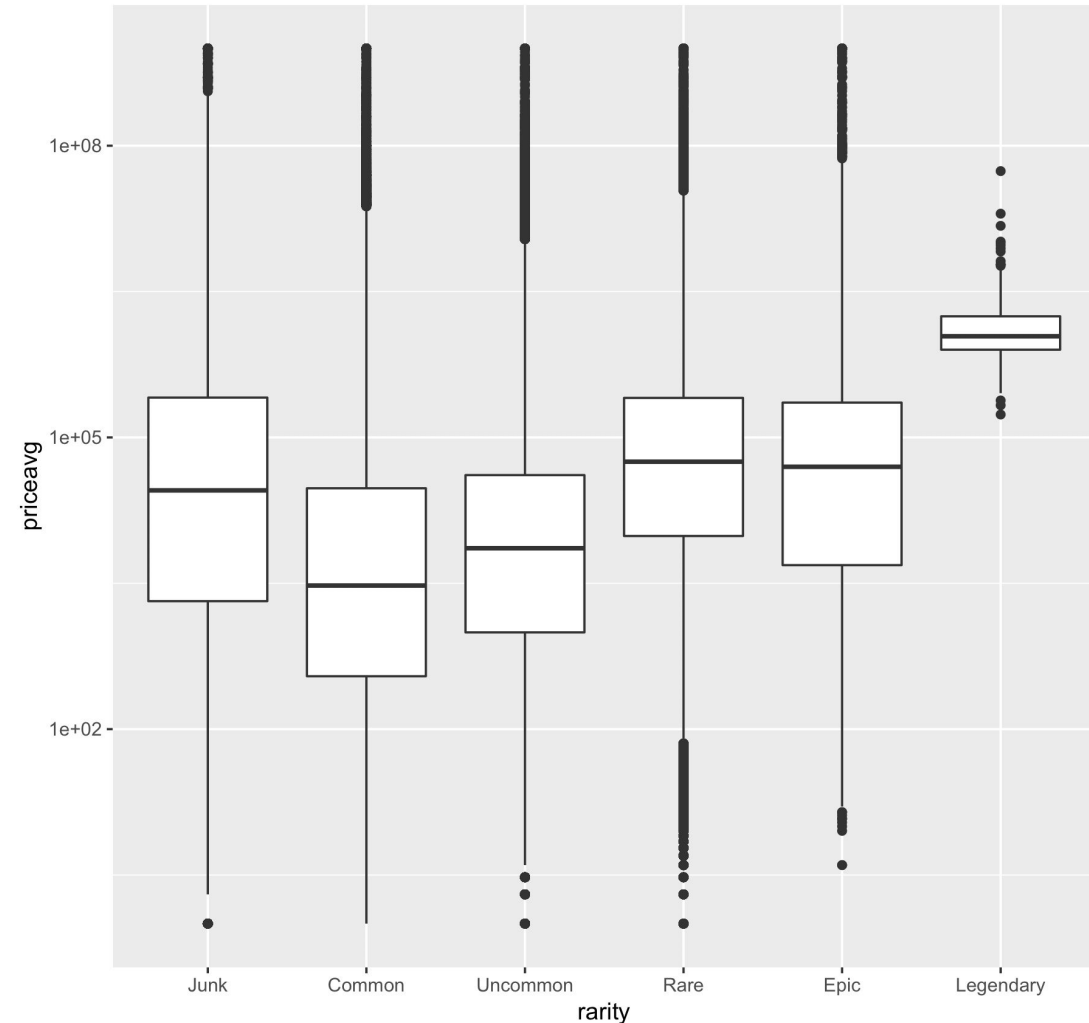
/item/{region}/{realm}/{itemId}

Item stats for a specific realm

EDA - Box Plots

- Junk items on average cost the most
- As rarity increases so does average price (with the exception of junk items)
- Legendary items - the most rare and hard to obtain items - has the lowest spread

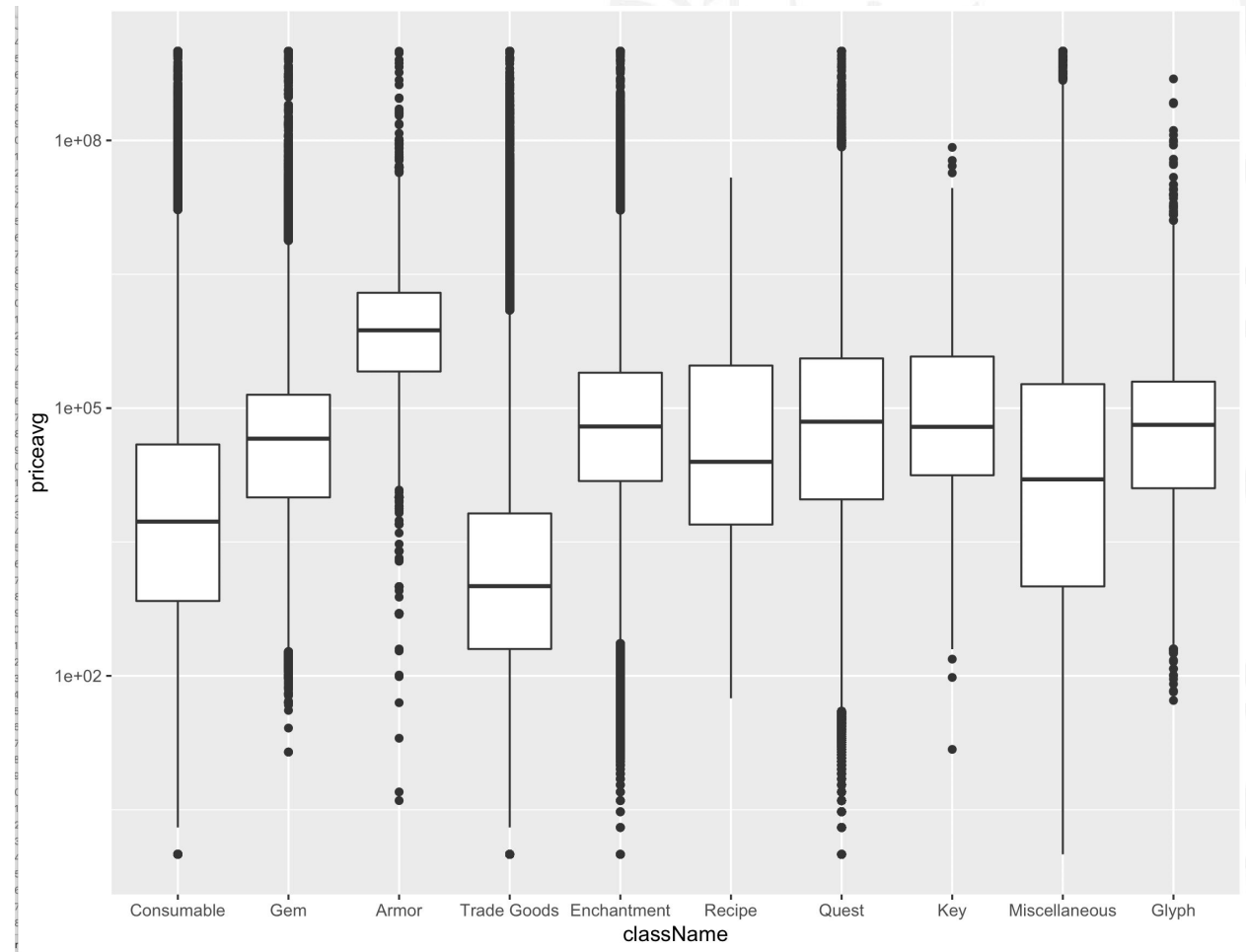
Average Price vs Item Rarity



EDA - Box Plots

- Trade goods - which are abundant in the world and used as raw materials - were on average the lowest priced item.
- Armor - which requires certain skills and luck to obtain - were on average the highest priced item.

Average Price vs Item Type

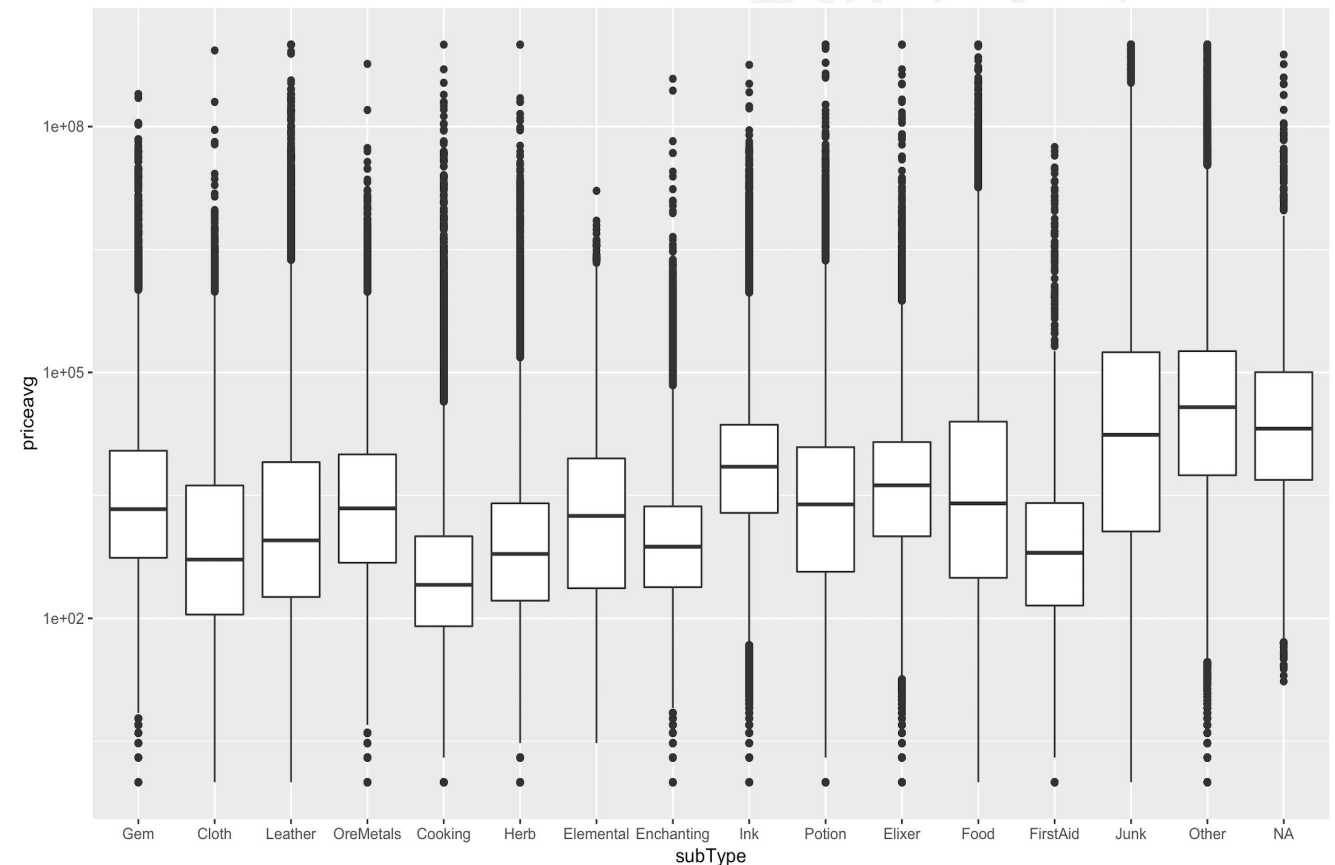


EDA - Box Plots

The maximum value of the average of price goes to Ink which is under the trade goods class

The minimum value of the average of price goes to cooking which is under the trade goods class

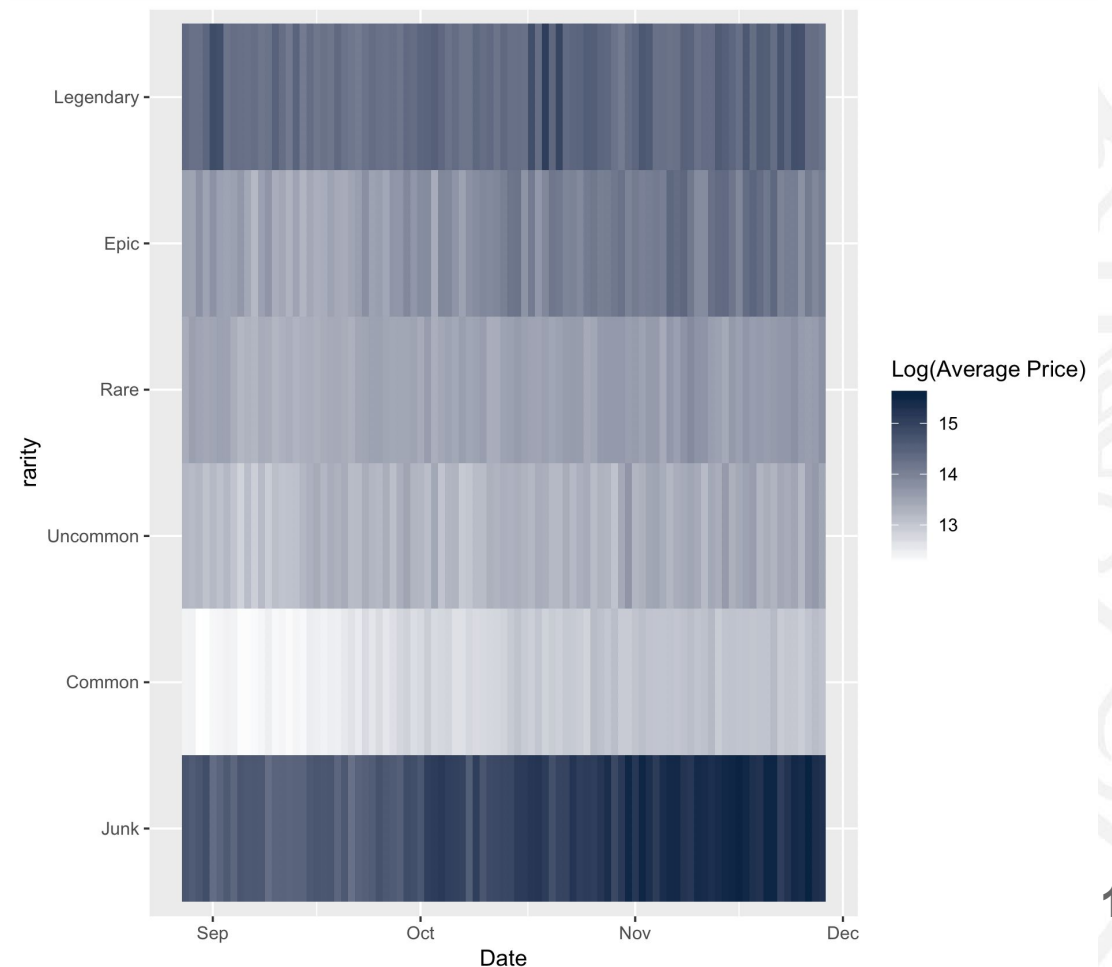
Average Price vs Sub type of class



EDA - Heat Maps

- Again, with the exception of Junk items, the average price increases as rarity increases
- Temporally, we can note a slight increase in price over time inflation?

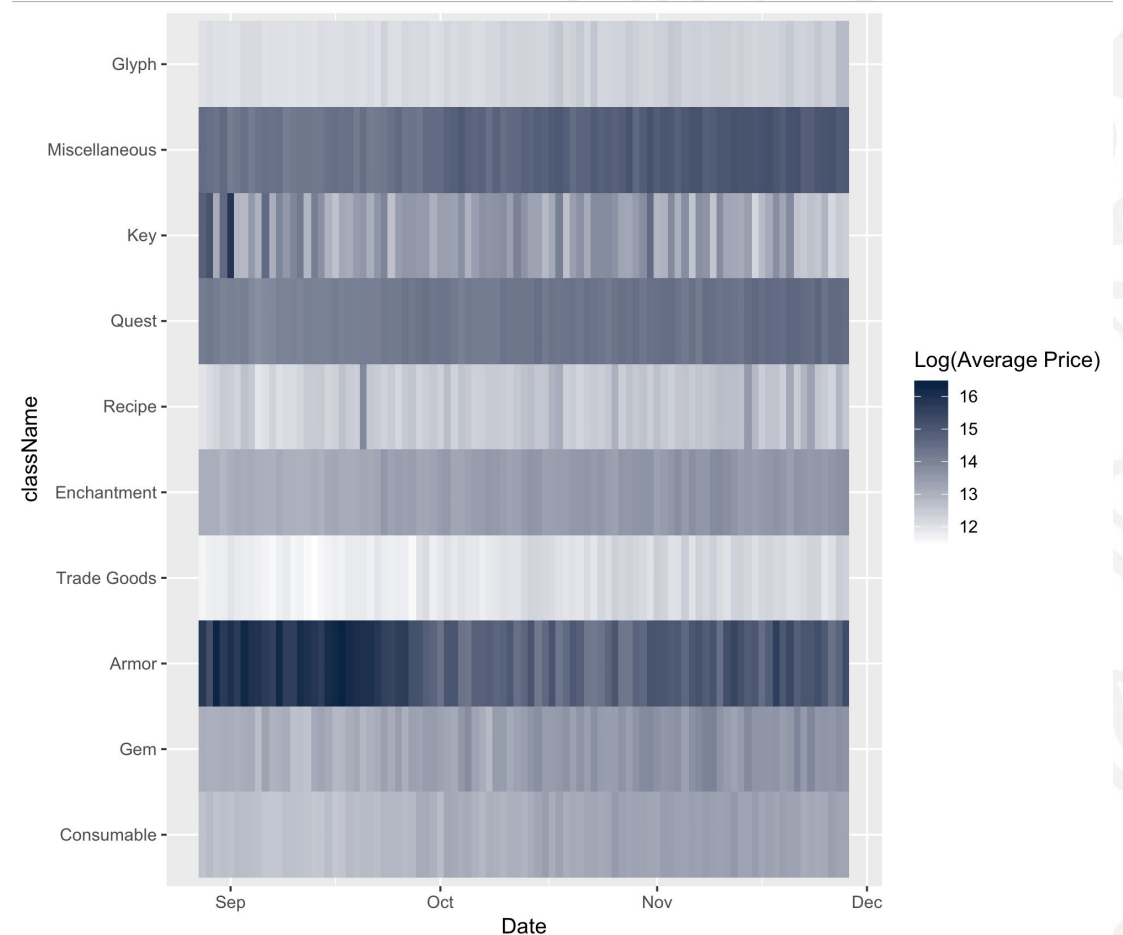
Average Price vs Item Sub Type



EDA - Heat Maps

- Armor overall sells for a higher amount
- There is a spike in armor prices around August and september

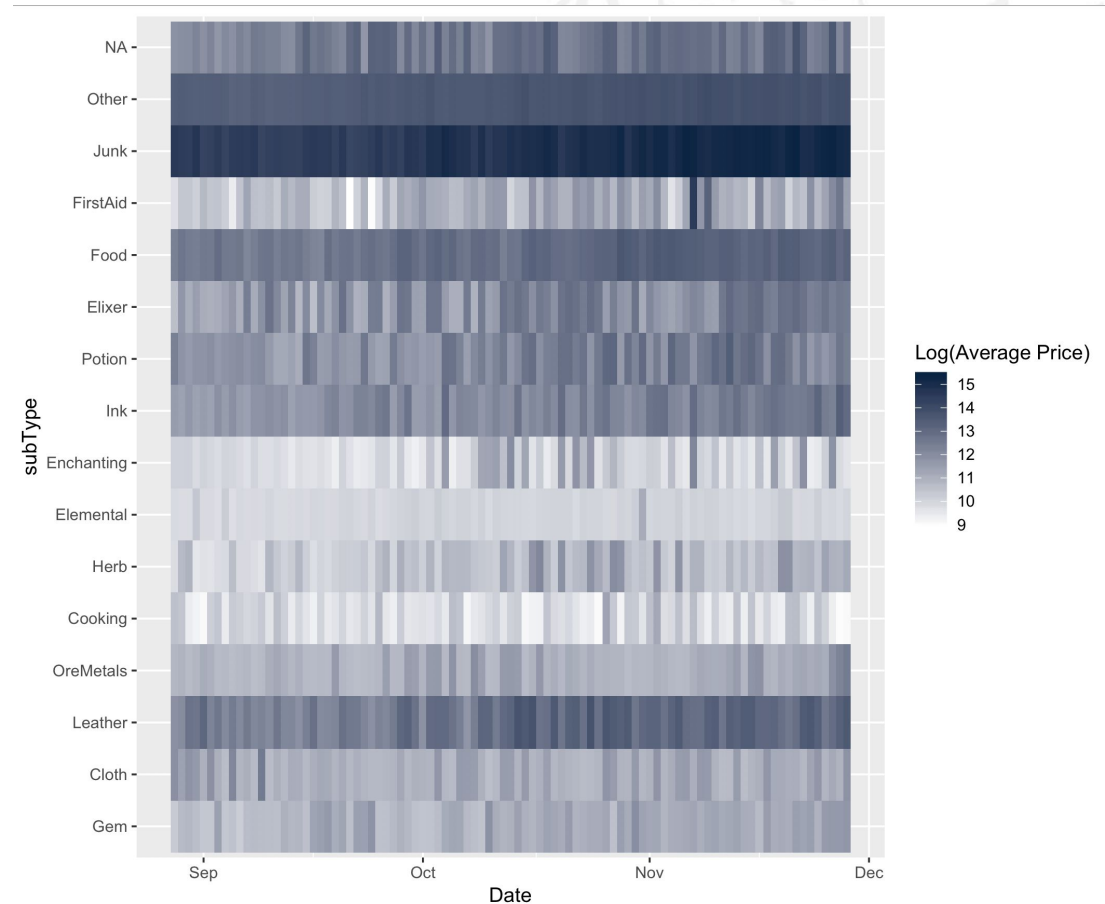
Average Price vs Item Type



EDA - Heat Maps

- “Heat” intensifies as color as time progresses

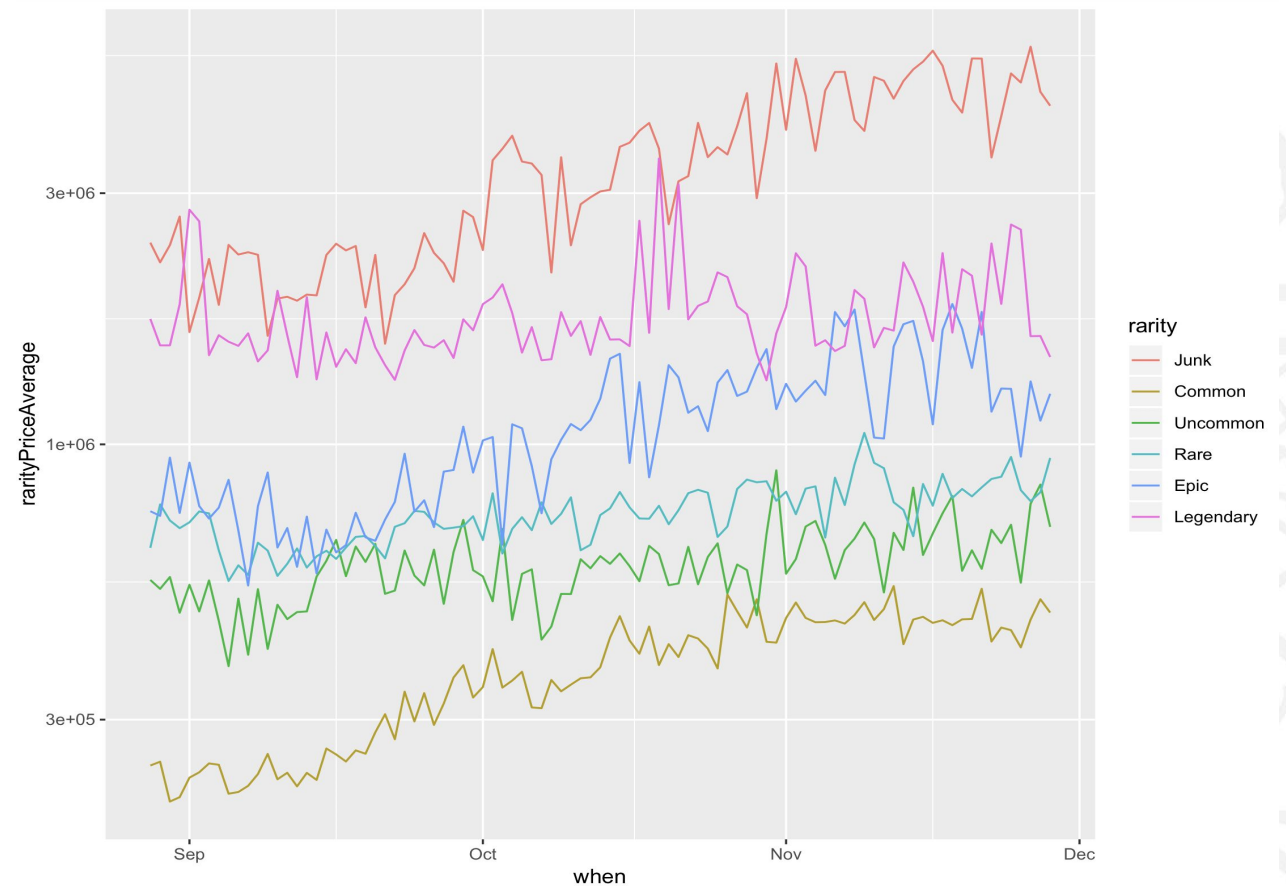
Average Price vs Sub Type



EDA - Time Series Plot

- All timelines, overall, increase as time increases
- As rarity increases so does the price

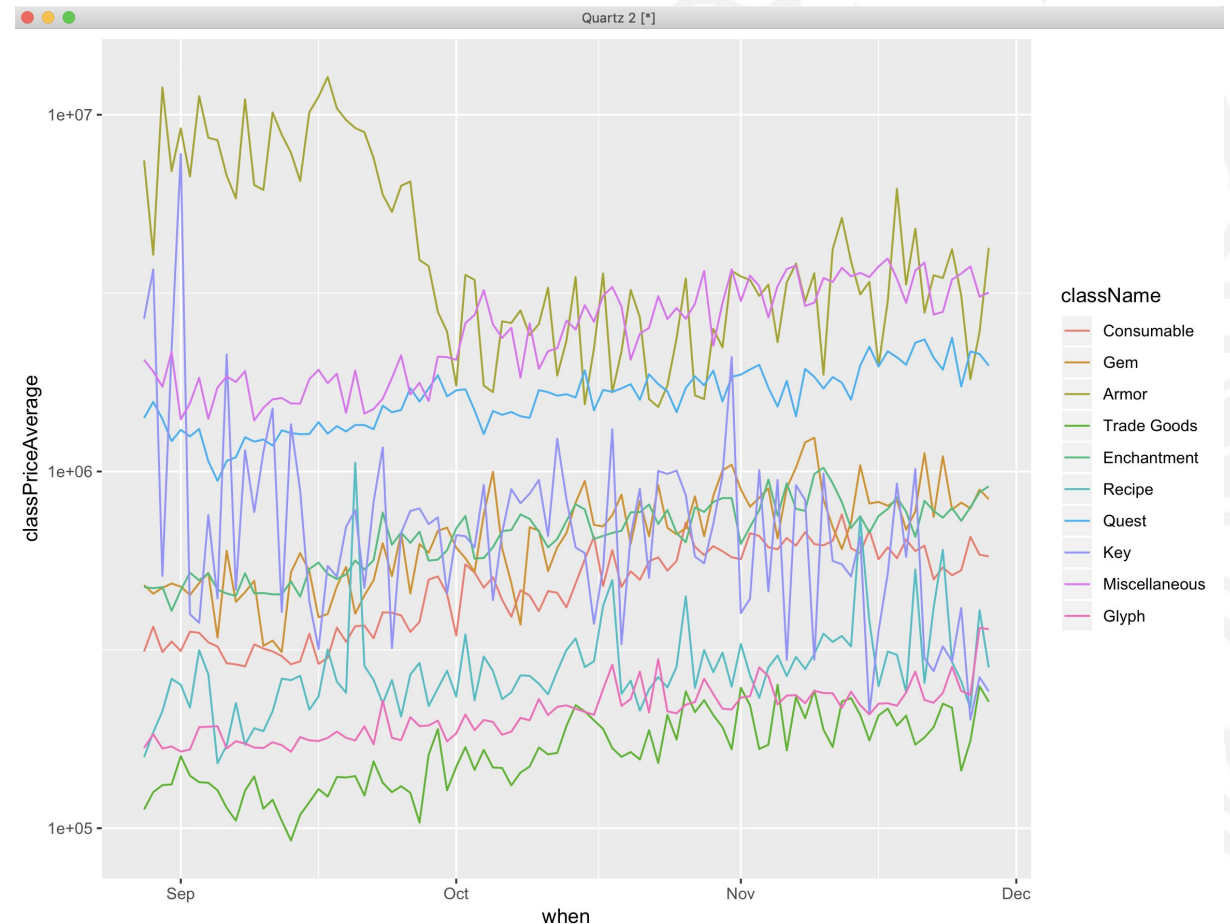
Average Price vs Time for Different Rarities



EDA - Time Series Plot

- Armor spikes in August and September, quickly falls off and plateaus
This spike coincides with the release of new content

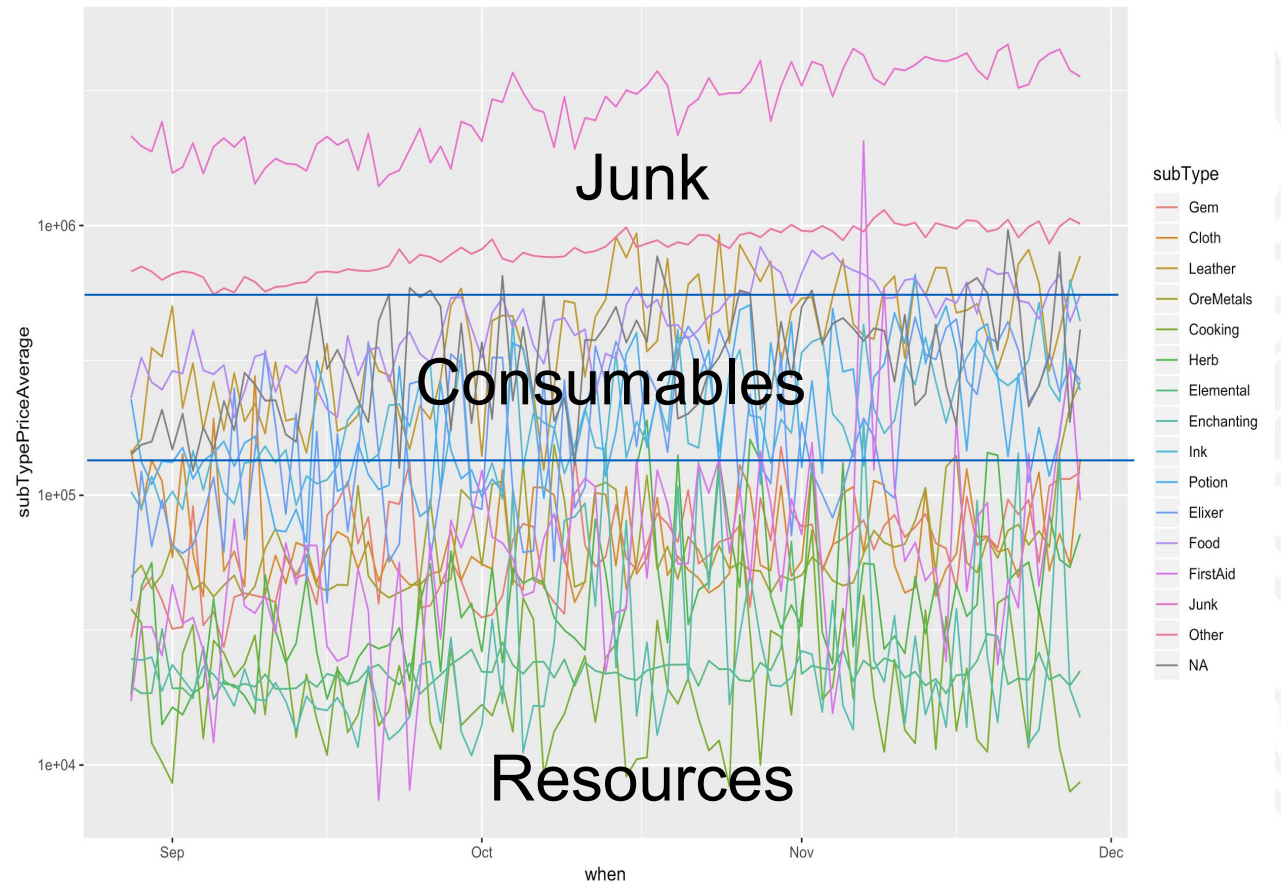
Average price of class of Item vs time



EDA - Time Series Plot

- Items classified as other show little variance over time
- color spread identifies different tiers

Average price of Sub-Type vs Time



EDA - Time Series Plot

- Increases over time

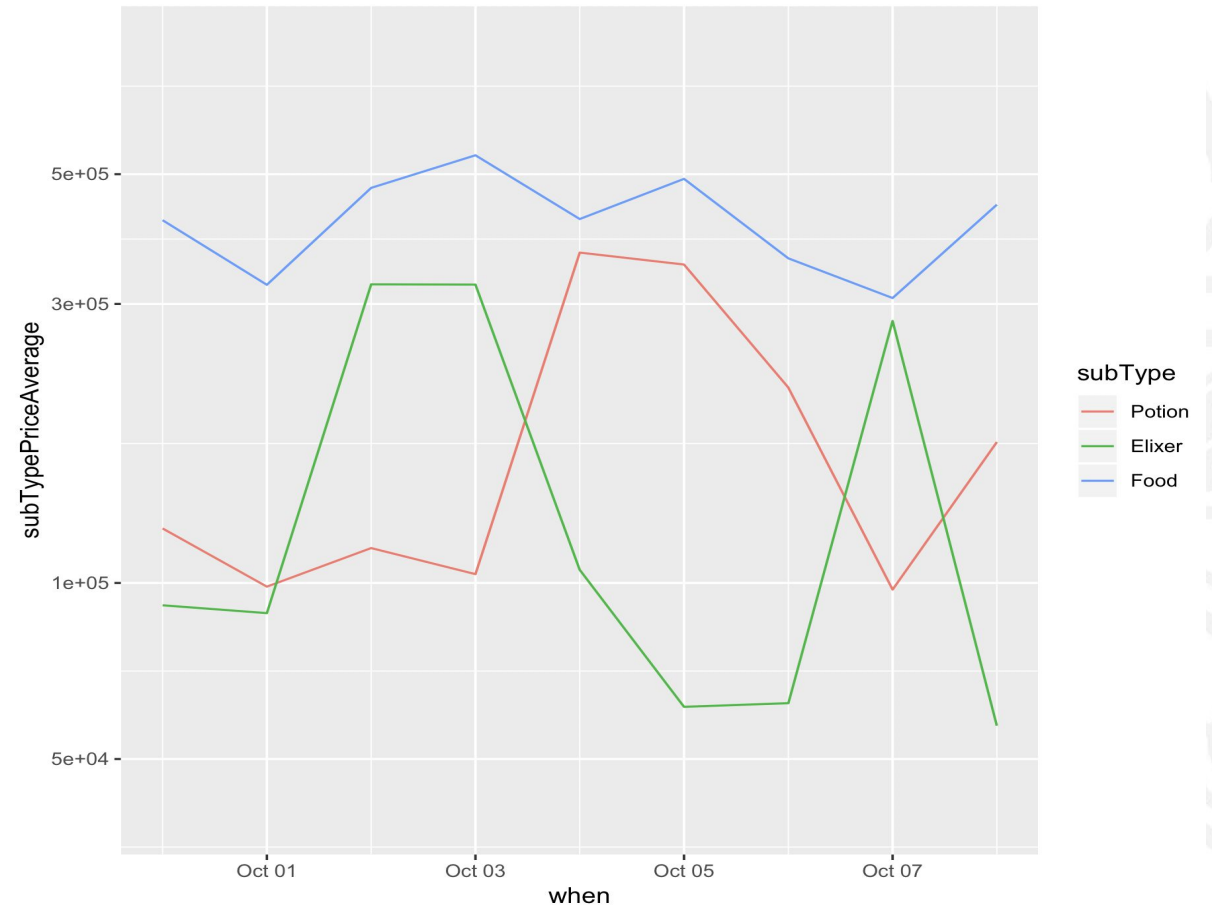
Average price of Consumables vs Time



EDA - Time Series Plot

- Spikes on Tuesday

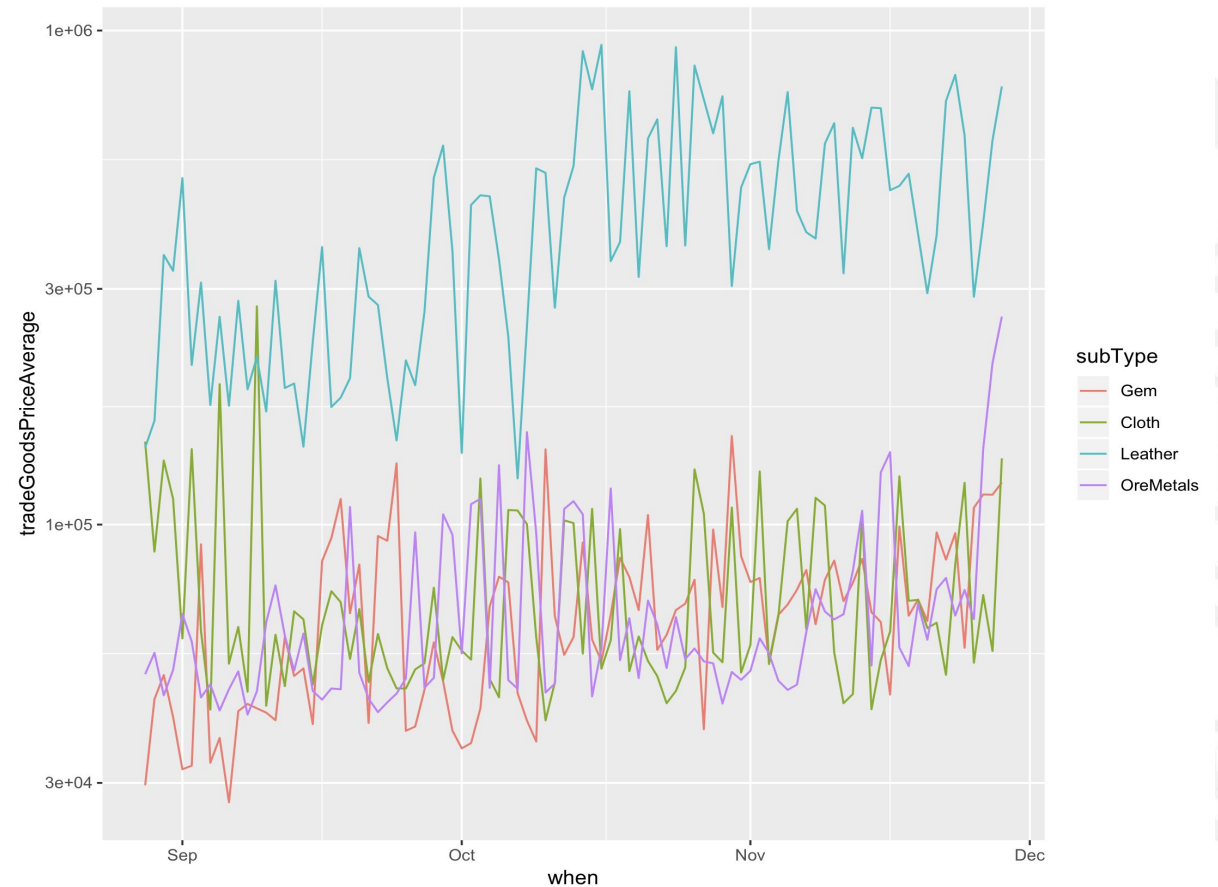
Average price of Consumables vs Time



EDA - Time Series Plot

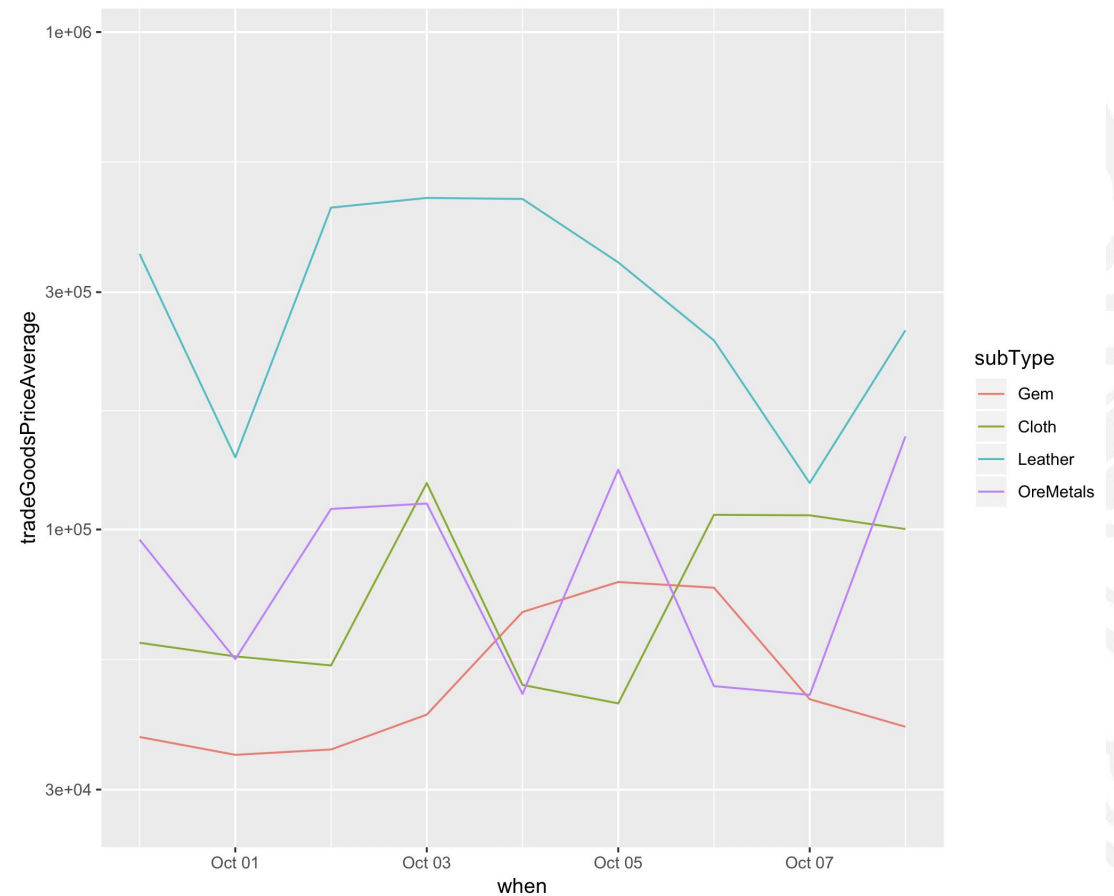
- Out of all resources, leather was consistently more expensive.
- Cloth and leather had small spikes in the beginning of september.

Average price of Resources vs Time



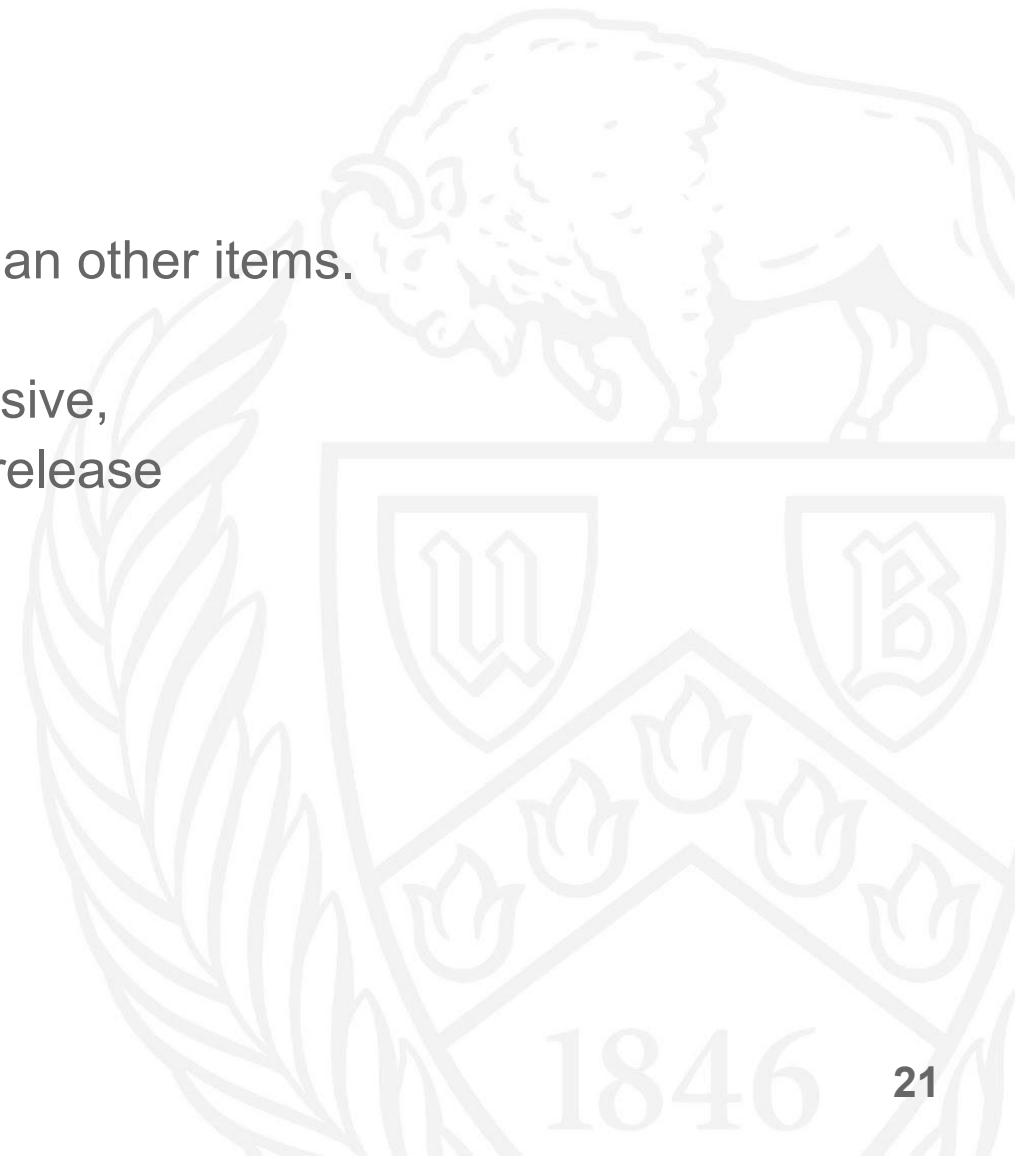
EDA : Time Series Plot

- Cloth, leather and ore/metals show similar patterns
- Cloth leather and ore/metals are also the materials that players use to craft armor (unlike gems).



EDA summary

- Overall, junk items are, on average more expensive than other items.
- Prices increase as rarity increases
- Items classified as armor are, on average more expensive,
- Spike in armor prices around the time of new content release
- overall increases in prices as time progresses



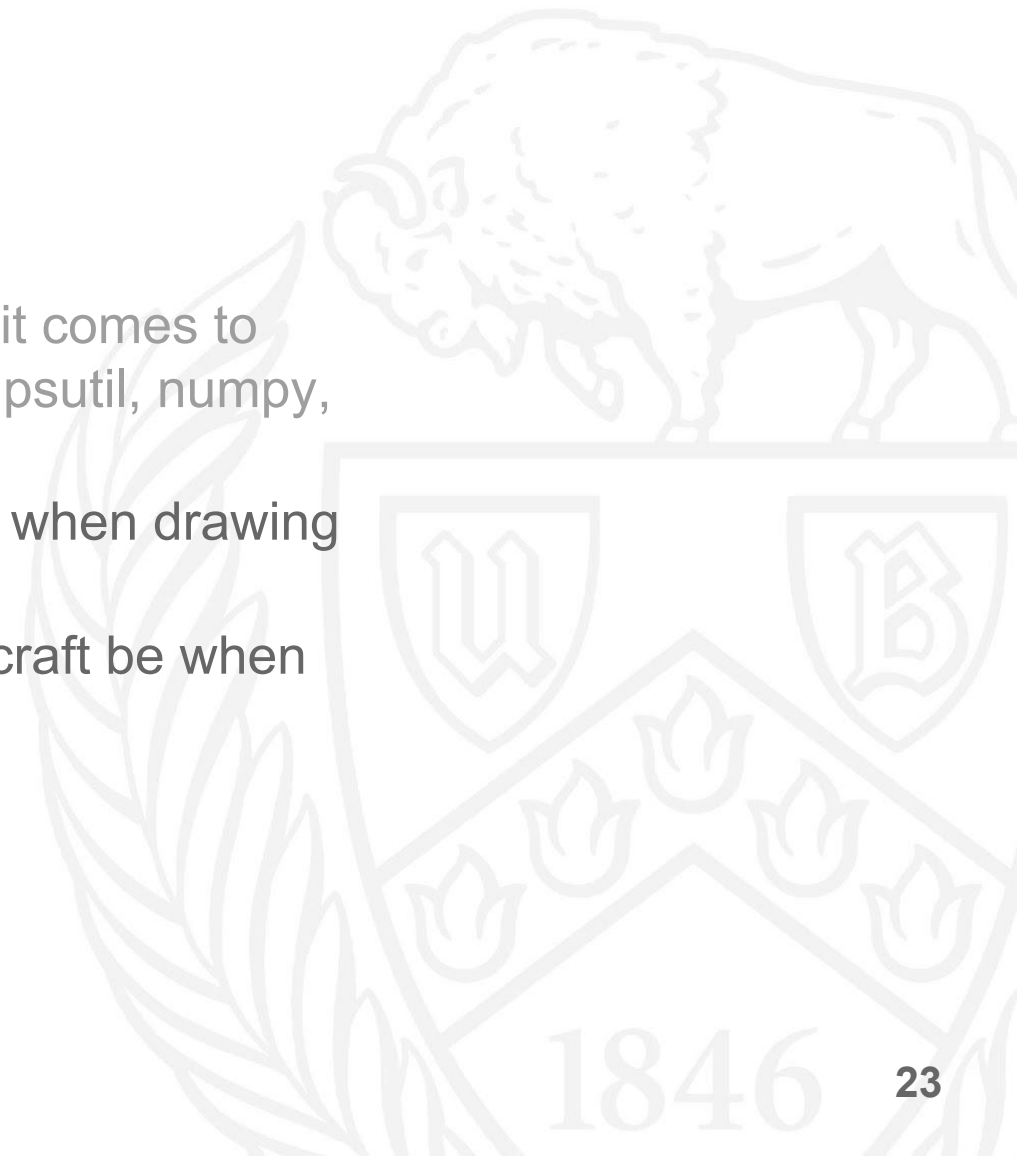
Modeling Challenges

- Memory issues in R when working with 5gb of data
consider using python - numpy/pandas/scikit
- Unreasonable computational times for modeling
consider prototyping with a smaller sample of the data
- Cross validation with ridge regression even with 1/5th of the samples
posed memory issues.



Future work

- Switch over to python
Python contains libraries that are optimized when it comes to dealing with large data sets. (i.e. multiprocessing, psutil, numpy, etc.)
- Identify which models can most appropriately be used when drawing parallels in real world application.
- Assess how accurate can analysis from World of Warcraft be when using it to compare real world features
What are the limitations?



Questions/Discussion

