The Board Game Renaissance: What Makes A Great Board Game

By Sam Beardsley

CONTEXT

As of 2017, the worldwide tabletop gaming industry had a market size of **$7.2B**

which is expected to increase **40%** by 2023

and, by 2025, the US market alone is predicted be **$5B**

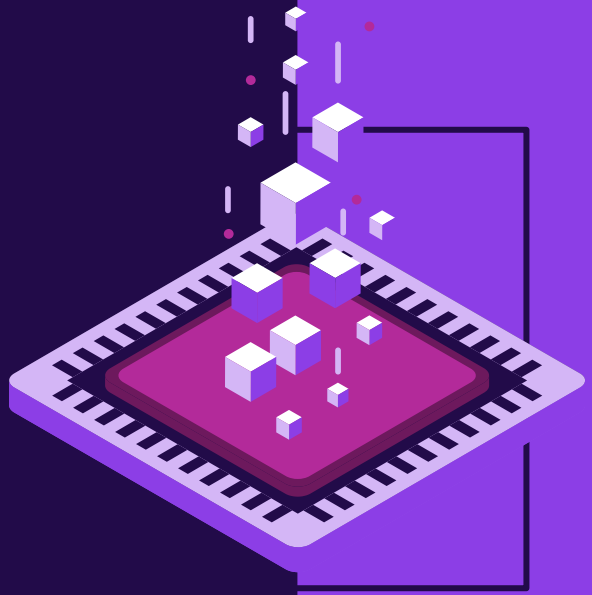
Can we predict the perceived quality of a game?

THE DATA

19,019 games scraped from BoardGameGeek.com including...

- Numerical features:
  - Ratings, Age, Weight, Min/Max Players, Min/Max Playtime

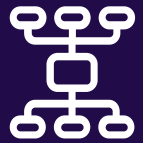
- Categorical features:
  - Category: a classification for the thematic type of board game (n=83)
  - Mechanic: an element or type of gameplay (n=186)
  - Family: an attempt to group a game into a broader set of descriptors (n=2,748)



WHAT AFFECTS GAME RATING?

Weight

- Weight represents the complexity of a game
- Games with a higher weight tend to rank higher
- Weight is the largest contributing factor to our model



Mechanics

- Mechanics define an element or type of gameplay
- Allowing for player choice and agency is important for success

Domain Expertise

- Fun is subjective
- A game can fail even with the right attributes
- The models misclassifications can help guide us

WHO CARES?

Publishers

Established Developers

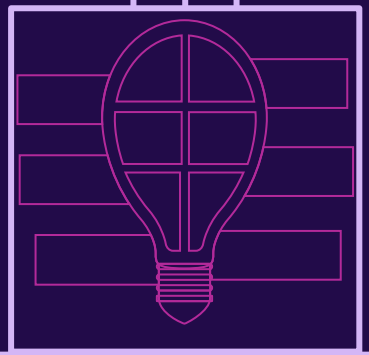
Start Ups & Crowd Funders

Consumer Endpoints

Big Box Stores

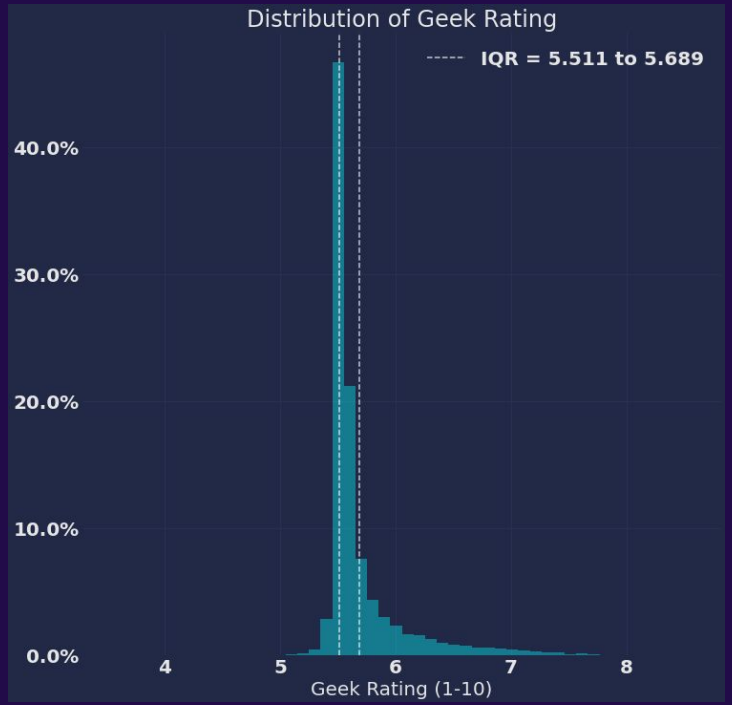
Local Establishments

- Mom & Pop Stores
- Board Game Cafes



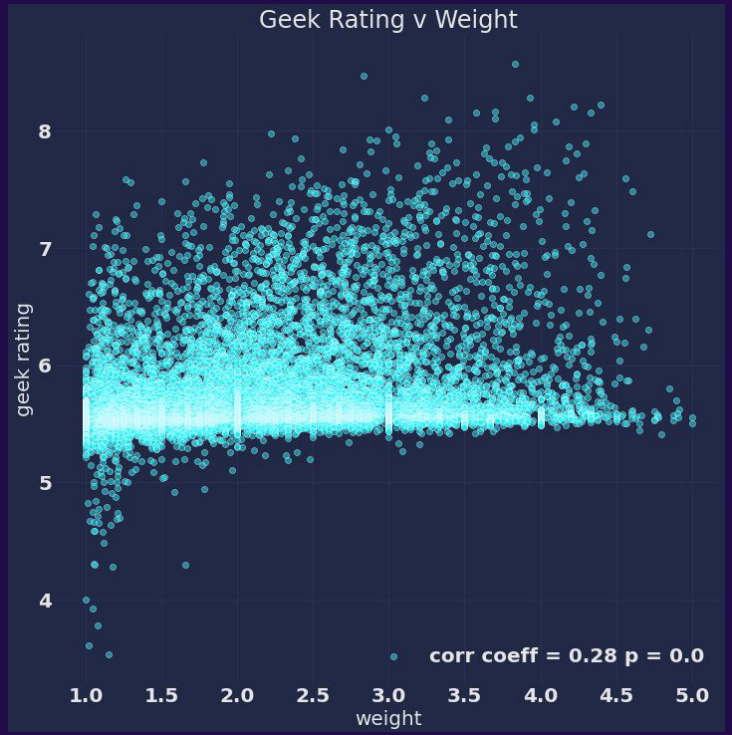
EXPLORATORY DATA ANALYSIS

GEEK RATING



- Games are ranked by users on a 10 point scale
- BGG applies Bayesian averaging to the raw ranking to prevent small numbers of users from skewing the ranking
- Geek Rating determines a games absolute rank
- A game must have 30 user rankings before a Geek Rating is given
- There are only 14 games with a Geek Rating > 8 (0.0074%), and 374 with a Geek Rating > 7 (1.966%)

WEIGHT



- Weight is a user generated number between 1 and 5 representing the complexity of a game
- The mean of weight is 2.04
- 75% of all games have a weight below 2.56
- There is a positive correlation between weight and Geek Rating with a 0.28 correlation coefficient and a p-value < 0.001

WHAT ARE MECHANICS?

Mechanics describe how players interact with game rules and other formal properties such as goals, player actions and strategies and game states.

- The interactions of game mechanics determine:
  - the complexity
  - the level of player interaction
  - game balance

5 WORST RATED MECHANICS (n games > 5)

	Count	Average Geek Rating
Rock-Paper-Scissors	151	5.615
Pattern Recognition	488	5.598
Zone of Control	115	5.597
Singing	47	5.542
Roll / Spin and Move	1,250	5.523

* see appendix for descriptions of these mechanics

5 BEST RATED MECHANICS (n games > 5)

	Count	Average Geek Rating
Turn Order: Pass Order	7	7.633
Automatic Resource Growth	10	7.309
Turn Order: Role Order	6	7.149
Action Drafting	18	7.142
Force Commitment	7	7.103

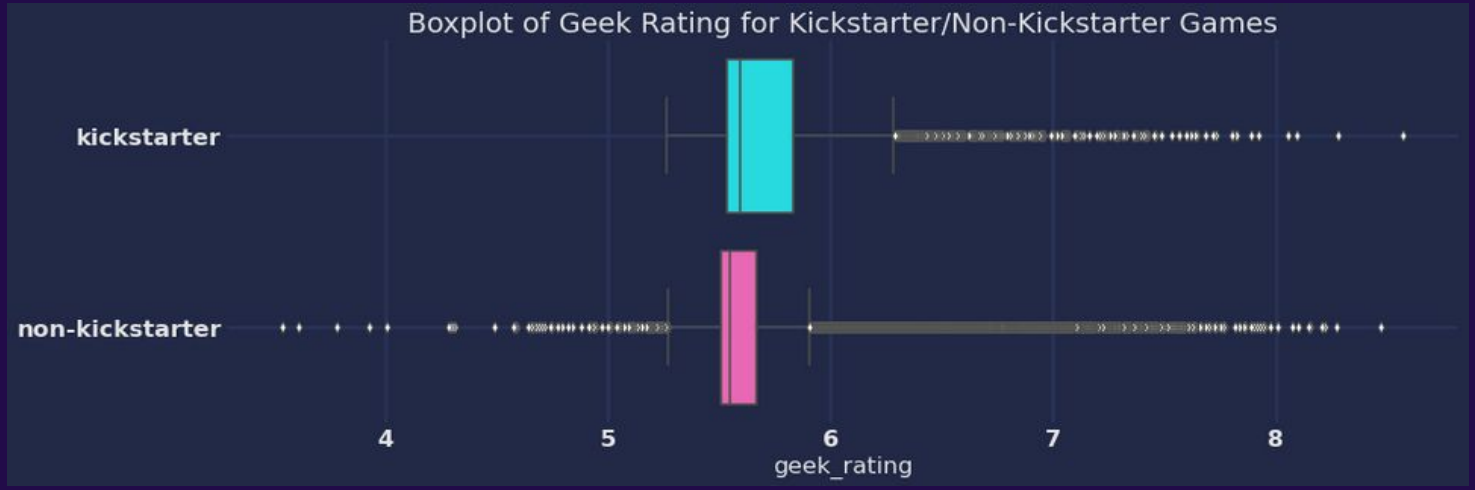
* see appendix for descriptions of these mechanics

MECHANICS: KEY TAKEAWAYS

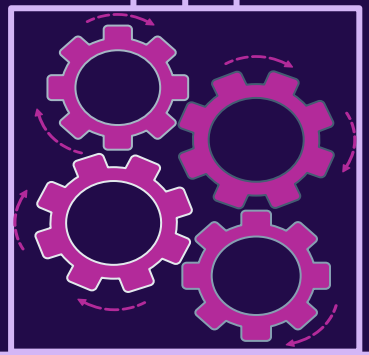
1. Mechanics that involve chance are not well received

2. Mechanics that allow strategy and player choice are

KICKSTARTER



- 13% (2,502) of the games are in the Kickstarter family
- Kickstarter games have a mean Geek Rating of 5.78 while non-Kickstarter games have a mean Geek Rating of 5.68
- A t-test determined that this is statistically significant with a p-value < 0.001 i.e. the difference in mean Geek Rating is not up to chance



FEATURE ENGINEERING & PREPROCESSING

FEATURE ENGINEERING & PREPROCESSING

01

Dummy variables created for each category and mechanic label which generated 269 features. Games missing labels were assigned “None”.

02

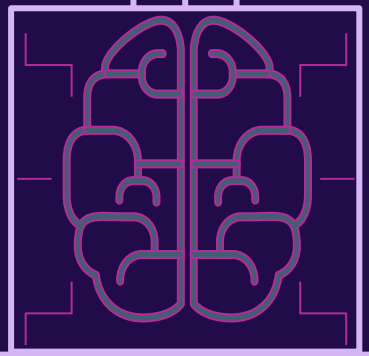
Missing values for numerical features were imputed with KNearestNeighbors and scaled to a range between 0 and 1.

03

Binary column created to indicate if a game was Kickstarter or not. Family label was dropped due to high cardinality.

04

Created a target variable indicating if a game is in the Top 1,000.

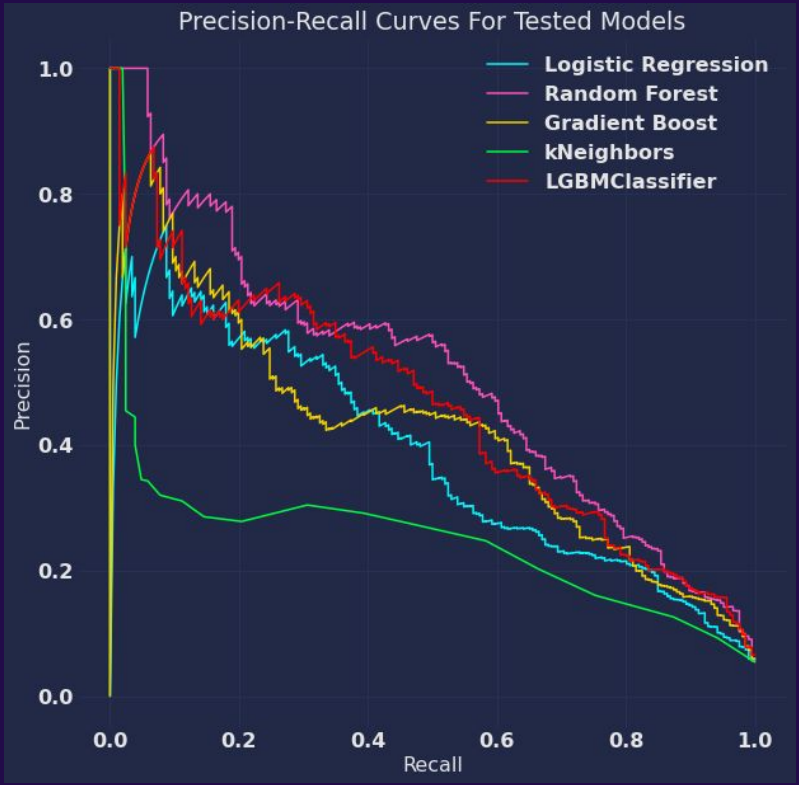


MODELING

GRID-SEARCH CROSS VALIDATION

Classifier	Parameter Grid	Best Parameters
Logistic Regression	penalty: L1, L2 C: 0.01, 0.1, 0.5, 1.0 max_iter: 100, 500, 1000, 2500, 5000	penalty: L2 C: 1.0 max_iter: 500
Random Forest	n_estimators: 50, 100, 250, 500, 1000 criterion: gini, entropy max_depth: 5, 25, 50, 100, None	n_estimators: 1000 criterion: entropy max_depth: 25
Gradient Boost	learning_rate: 1, 0.5, 0.25, 0.1, 0.05, 0.01 n_estimators: 5, 50, 100, 250, 500 max_depth: 3, 5, 10, 15, 20, 25	learning_rate: 0.05 max_depth: 5 n_estimators: 500
KNeightbors	n_neighbors: 5, 25, 50, 75, 100, 125, 150, 175, 200 weights: uniform, distance	n_neighbors: 100 weights: uniform
LGBM	boosting_type: gbdt, dart, goss n_estimators: 5, 50, 100, 250, 500 num_leaves: 10, 25, 50, 100 max_depth: -1, 5, 10, 15, 20, 25 learning_rate: 1, 0.5, 0.25, 0.1, 0.05, 0.01	boosting_type: dart n_estimators: 250 num_leaves: 50 max_depth: 25 learning_rate: 0.1

MODEL SELECTION

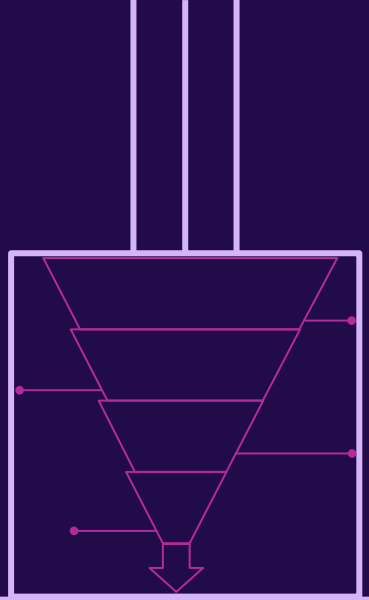


Model	Precision Recall AUC
Logistic Regression	0.3794
Random Forest	0.5084
Gradient Boost	0.4167
k-Neighbors	0.2510
LGBM Classifier	0.4564

RANDOM FOREST TUNING

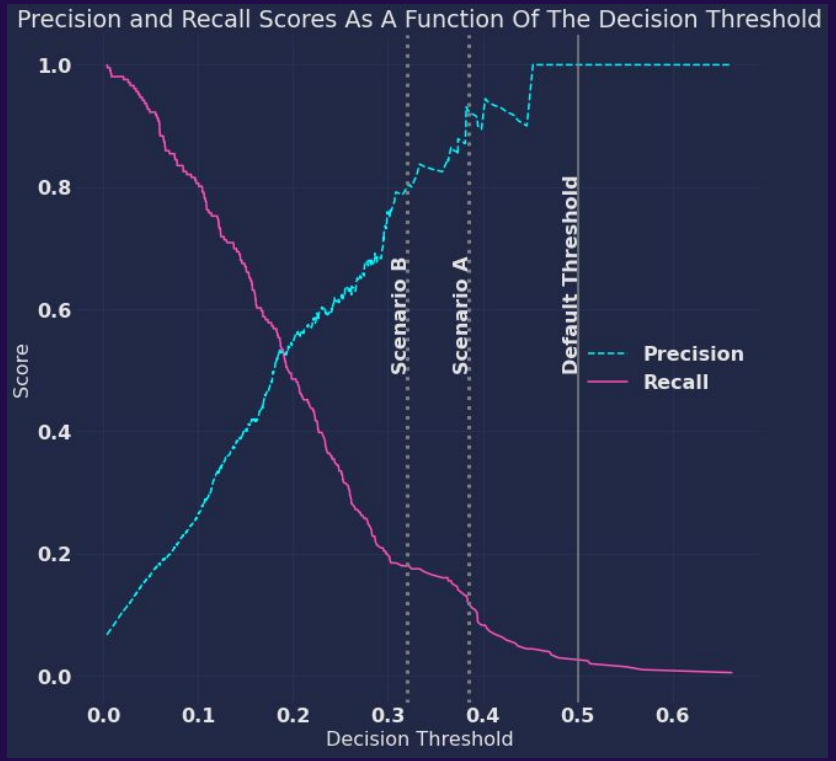
Model	Precision Recall AUC
Base Model	0.5084
Multiple Correspondence Analysis (100% Variance)	0.4008
Feature Selection (Drop Column Feature Importance)	0.5095
Oversampled Minority Class (10%)	0.4966
Oversampled Minority Class (100%)	0.4157
Feature Selection & Bayesian Hyperparameter Tuning*	0.5233

*Best Parameters: n_estimators = 1050, criterion = entropy, max_features = log2, min_samples_split = 19, min_samples_leaf = 1, bootstrap = True



MODEL EXPLORATION

DECISION THRESHOLDS

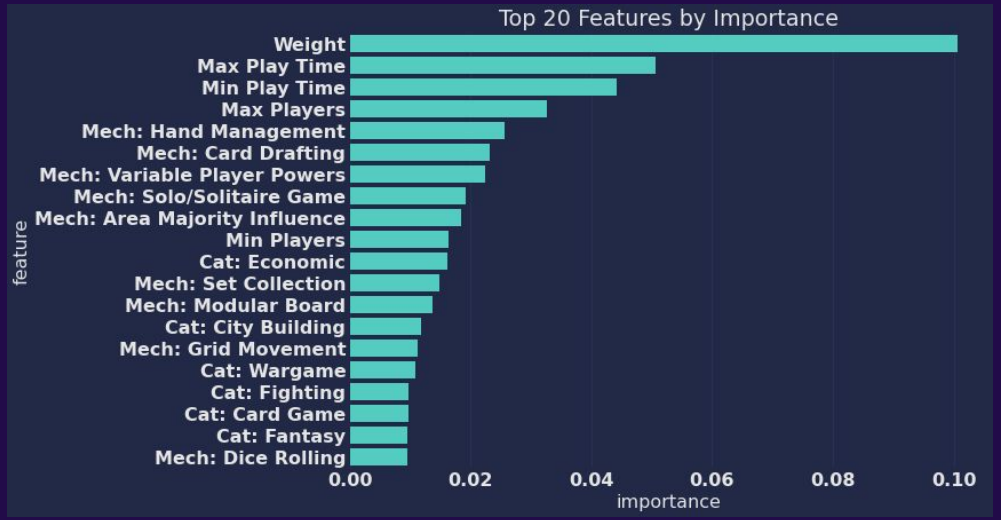


Scenario A: This publisher is new. Perhaps they are a startup or a hobbyist trying to break into the market with a Kickstarter campaign.

Scenario B: In this scenario the game publisher is an established business with a successful track history and experienced game developers on staff.

Business Case	Threshold	Precision
Scenario A	0.385	0.92
Scenario B	0.320	0.80

FEATURE IMPORTANCE



- Weight provides the most information by a significant margin
- With the exception of City Building, these categories are within the top 10 categories by number of games having over 1,300 games each
  - City Building is in the top 10 categories by Geek Rating
- With the exception of Solo/Solitaire Game, these mechanics are in the top 20 mechanics by count with over 1,000 games each
  - Solo/Solitaire Game is a top mechanic by Geek Rating for those with > 50 games

MISCLASSIFICATIONS

False Positive - Uchronia (Rank 2,628)
Weight: 2.73
Categories: Ancient, Card Game, City Building, Prehistoric
Mechanics: Card Drafting, Follow, Hand Management, Set Collection, Take That, Variable Phase Order
Reimplementation of Glory to Rome (Rank 184)

4/10 - “I have been wanting to play this one for a while since I really like Glory to Rome. Personally I found this to be a far cry from GtR; in my opinion all of **the tension and interesting card synergies are missing.** The locations are all very lackluster and are just worth 1, 2 or 3 points with **very generic powers.** The worst part of the game is **how poorly the theme is tied into the game**. Dinosaurs, awesome... except none of the theme comes through with any of the cards. This game was a **major disappointment** and not something I would seek out to play again.” - user Papa NinJa

5/10 - “Fun game but that **component quality... Terrible cardstock**. Buildings were obviously intended to be tiles based on the graphic design. Now theyre misaligned cards. The **MSRP is way too high** for this kind of nonsense. Gameplay itself is ok though player count heavily impacts the power level of certain actions. 2p has a very different feeling from every other player count due to this **lack of scaling**.” - user Kamaitatchi

MISCLASSIFICATIONS

False Positive - Renegade (Rank 1,190)
Weight: 3.650
Category: Science Fiction
Mechanics: Action Points, Area Majority / Influence, Cooperative Game, Deck, Bag, and Pool Building, Dice Rolling, Hand Management, Hexagon Grid, Modular Board, Network and Route Building, Pick-up and Deliver, Point to Point Movement, Push Your Luck, Solo / Solitaire Game, Variable Player Powers

4/10 - "All the rules grit of Mage Knight (rank 24) with none of the payoff. It has really good ideas but theyre brought down by some **overly convoluted systems** and **poor conveyance**." - user bmarting

4/10 - "Im glad the designer has found success in this product, and that people seem to genuinely like it. But Im at a loss to understand why. I really tried to enjoy this game, but the more I prodded at the mechanics, the more **unbalanced** they seemed. For such a technical theme, its strange that this game is so **technically flawed**." - user decoseer

MISCLASSIFICATIONS

False Negative - KLASK (Rank 289)

Use magnets to push a ball into the goal, but beware of falling in yourself!

Weight: 1.05
Categories: Action / Dexterity & Real-time

8.5/10 - "Great foosball like fun with much more **strategic variance** than I typically expect in a dexterity game." - user neflight86

9/10 - "I HATE dexterity games. This should say enough about my rating." - user cuazzel

CONCLUSION

- The Random Forest Classifier is the best model with a 0.5233 precision-recall AUC score after feature selection and Bayesian hyperparameter tuning
- This model is useful for both publishers in game creation and small and large retailers for inventory management
- Great games...
  - Have a high weight
  - Have mechanics that allow for strategy and player agency
  - Are more than the sum of their features
    - But, misclassifications help guide us

THANKS!

Do you have any questions?
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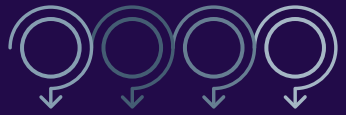

APPENDIX

5 BEST RATED MECHANICS
(COUNT > 50)

	Count	Average Geek Rating
End Game Bonuses	54	6.727
Race	59	6.364
Communication Limits	70	6.242
Traitor Game	64	6.219
Solo / Solitaire Game	420	6.164

DROPPED FEATURES

Numerical: age

Categories: Abstract Strategy, Action Dexterity, American Indian Wars, Aviation Flight, Deduction, Educational, Environmental, Expansion for Basegame, Farming, Game System, Murder Mystery, Mythology, Number, Party Game, Pike and Shot, Renaissance, Trains, Trivia, Video Game Theme, Word Game,

Mechanics: Prisoners Dilemma, Acting, Action Event, Action Points, Action Retrieval, Alliances, Auction Dutch Priority, Auction English, Auction Fixed Placement, Auction Once Around, Auction Sealed Bid, Auction Turn Order Until Pass, Automatic Resource Growth, Betting and Bluffing, Chaining, Chit Pull System, Connections, Contracts, Crayon Rail System, Die Icon Resolution, Different Dice Movement, Elapsed Real Time Ending, End Game Bonuses, Events, Induction, Legacy Game, Line of Sight, Lose a Turn, Map Reduction, Movement Points, Multiple Maps, Order Counters, Ownership, Race, Score and Reset Game, Simultaneous Action Selection, Singing, Static Capture, Stock Holding, Tech Trees Tech Tracks, Time Track, Track Movement, Worker Placement, None

DEFINITIONS

In **Rock-Paper-Scissors** there are three possible options, and they are cyclically superior (A beats B, B beats C, and C beats A). The name derives from the well-known childrens game where Scissors cuts Paper, Paper covers Rock, Rock crushes Scissors, but can refer to any game with non-transitive mechanisms.

Roll/Spin and Move is defined as "games where players roll dice or spin spinners and move playing pieces in accordance with the roll. This term is often used derogatorily to imply that there is no thought involved. Roll and move games like Backgammon, however, contain tactical elements."

Zone of Control games are where "spaces adjacent to a unit impact the ability of opposing units to move or attack. This is a very common mechanism in wargames."

Force Commitment is a mechanic where players choose how many and how to use their units in battle.

In games with the **Turn Order: Pass Order** mechanic , players can choose to take an action or pass their turn. This affects player order in subsequent rounds. While in T**urn Order: Role Order** games all players secretly and simultaneously make a decision on an action, role, or priority they wish, and this determines how the round is played.

Automatic Resource Growth increases your resources over time. This gives players options to consume their resources or save them to gain more. Likewise, **Action Drafting** is when "Players select from an assortment of Actions in a shared pool. The available Actions are limited in quantity, and once a player has chosen an Action it may not be chosen again." Both of these s add layers of strategy where players must make determinations between immediate or future pay offs.

Games designed to be or have an option with rules on how to play by yourself are under the **Solo / Solitaire Game** mechanic.

Traitor Games are team or cooperative games with a betrayal mechanic. The traitor or traitors are unknown by other players, and is given an alternative condition to win the game by subversion. This also ties in well with the mechanic **Communication Limits** which prevents players from disseminating certain information to other players. Restricting communication keeps players immersed in the game, limits overplanning and over communication, and allows for unique and surprising situations to arise.

The **Race** is any sort of game when a player wins by accomplishing a fixed goal.

End Game Bonuses work off of a system where players only gain the points at the end of the game.

TERMINOLOGY

Precision: the number of correctly identified positive results divided by the number of all positive results.

Recall: the number of correctly identified positive results divided by the number of all samples that should have been identified as positive.

Precision Recall AUC: A precision-recall curve (or PR Curve) is a plot of the precision (y-axis) and the recall (x-axis) for different probability thresholds. Precision Recall AUC summarizes the PR curve with a range of threshold values as a single score. The score (representing the area under the curve) can then be used as a point of comparison between different models on a binary classification problem where a score of 1.0 represents a model with perfect skill.

Decision (or Probability) Threshold: Classification algorithms calculate a probability that a data point is of a certain class. This threshold defaults to 0.5, but can be adjusted depending on use case.

T-test: A type of inferential statistic used to determine if there is a significant difference between the means of two groups.

P-value: The level of marginal significance within a statistical hypothesis test, representing the probability of the occurrence of a given event.