

CIND820: Project Design

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1 Abstract

Video game sales are influenced by multiple factors, including platform, genre, consumer and reviews, and publisher reputation [1]. While prior studies identify these as important factors of determining sales, many of these studies examine them individually rather than analyzing them in tandem [2]. In addition, earlier predictive modeling attempts relied on linear regression techniques which often did not fully capture the non-linear relationships among the determining factors [3]. To combat that, this proposed study will instead be using predictive analytics with nonlinear regression modeling to evaluate how platform, genre, reviews, and reputation affect global video game sales. The dataset that will be used in this proposed study is a historical dataset obtained from Kaggle which contains platform, genre, publisher, review scores, and regional sales data from 1983 to 2012 [4].

2 Literature Review

Research on video game sales has progressed from descriptive analyses of market characteristics to more advanced empirical and data-driven approaches that examine how multiple factors interact to influence commercial success. Prior studies identify a range of determinants, including platform choice, genre, consumer and critic reviews, corporate reputation, branding strategies, and predictive modeling techniques. Collectively, this literature provides a strong foundation for applying data analytics methods to forecast sales performance in the video game industry.

2.1 Factors that Affect Video Game Sales

2.1.1 Video Game Characteristics

Video game characteristic factors include design characteristics such as genre, themes, and non-design characteristics that could influence consumer preferences. A study on U.S sales data relates genre as a major factor of sales performance, with certain genres

more likely to have high sales than others [1]. Release timing and the current market also influence demand. Launching a game during a time of high competition or unfavorable market conditions can limit its potential sales [1]. Another study documents industry trends indicating a bias for franchise titles, specific themes, and unique gameplay [5]. Collectively, these studies indicate that video game sales are largely determined by video game characteristics which appeal to specific audiences.

2.1.2 Reputation

Reputation factors include game reviews, company reputation, and franchise recognition. All of these are major factors of video game sales. Consumer and critic reviews function as a form of quality control that reduce the amount of misinformation before purchasing [6]. It is important to note that a study showed that consumer reviews exert a stronger influence on sales for less popular games, indicating that reputation is more important when franchise familiarity is low [7]. Furthermore, another study shows that user and critic reviews affect sales in a nonlinear way which depends on how extreme the reviews are. Company and franchise reputation are also key determining factors in video game sales since publisher reputation significantly increases the chances at commercial success. Evidence was found that strong company reputation enhances video game sales, especially when reinforced through strategic branding and collaboration [8]. Together, these studies show that stronger a reputation is associated with higher video game sales.

2.1.3 Platform

Platform factors refer to the influence the gaming platform has on video game releases. Previous research shows that sales for the same title can differ a lot across platforms due to differences in their audiences [9][10]. The sales differences among platforms shows that platform choice is an important decision for developers and publishers. This pattern is also seen on the global market, with the most popular platform choice differencing depending on geography [10]. Platform competition also involves the choice between expanding the current audience or securing exclusive franchises, which can affect sales by

changing platform/company reputation and user access [11]. These factors highlight the role of platform selection in determining commercial success.

2.2 Predictive Modeling and Historical Methods

Previous research shows the importance of preparing and combining data before making predictions. It was shown that predictive accuracy improves when different types of data are properly processed beforehand [6]. While the study was in the healthcare field, the same logic can be applied to video game sales prediction. The main ideas include: handling missing values, normalizing variables, and analyzing multiple characteristics simultaneously [6]. Proper preprocessing ensures that the data is ready for meaningful analysis and reliable modeling.

On top of preprocessing, analysis of past industry data also plays an important role in predictive modeling. It has been shown that studying historical patterns helps identify relationships between factors, in this case: platform, genre, and sales performance [5]. This supports the selection of determining factors for regression models. As a result, exploratory data analysis helps connect historical data to known prediction methods [5].

Predictive analytic techniques like regression, are useful in prior research that models video game sales. By comparing linear and nonlinear regression models, it was found that nonlinear approaches consistently outperformed linear models in predicting sales [12]. This previous research shows that video game sales depend on complex relationships between factors. Making simple linear model less reliable than a regression model [12].

Regression remains one of the most common methods for predicting video game sales. Previous studies show that regression models can estimate potential sales and measure how important different factors are. In addition, model performance is evaluated with numerical metrics to ensure predictions are applicable to new data [12]. All these studies support a proposed methodology of data preprocessing, analysis, regression modeling, and performance evaluation.

2.3 Research Gaps

Despite the existing research on video game sales, several gaps remain in the literature. The first gap exists because many studies examine determining factors individually and separately rather than together [2]. Prior work frequently concentrates on specific factors like the ones mentioned previously. These works do not account for their combined impact on video game sales [2]. As a result, the combined impact among major factors of video game sales remain insufficiently explored.

The second gap exists because earlier work often relies on traditional statistical techniques such as linear regression. This may not accurately account for nonlinear effects between determining factors [12][3]. For example, studies found that user and critic reviews affect sales in nonlinear ways and that nonlinear regression outperforms linear models for complex factors [12][3]. Due to the fact that these effects are rarely accounted for in predictive models, a nonlinear model that incorporates all major factors in a nonlinear model has not been fully explored.

This project will examine how platform, genre, reviews, and reputation together affect sales using nonlinear models. By combining exploratory analysis with predictive modeling, it aims to apply theoretical research to practical decisions in the video game industry.

3 Data Description

The raw dataset used in this study contains historical information on video game titles with the variables and descriptions from Kaggle [4]:

- Rank - The rank of the video game based on global sales volume. (Numerical)
- Game Title - The name of the video game. (String)
- Platform - The platform on which the game is available, such as PC, PS4, Xbox One, etc. (Categorical)
- Year - The year in which the game was released. (Date)

- Genre - The genre of the game, such as action, adventure, racing, etc. (Categorical)
- Publisher - The company that published the game. (String)
- North America - The number of units sold in North America, in millions. (Numerical)
- Europe - The number of units sold in Europe, in millions. (Numerical)
- Japan - The number of units sold in Japan, in millions. (Numerical)
- Rest of World - The number of units sold in the rest of the world, excluding North America, Europe, and Japan, in millions. (Numerical)
- Global - The total number of units sold worldwide, in millions. (Numerical)
- Review - The review score of the game, on a scale of 1 to 10. (Numerical)

Descriptive statistics was calculated to summarize the main characteristics of the dataset using Python. The functions *shape*, *dtypes*, *isnull*, and *describe* were used to calculate basic information about the dataset.

			Year	Genre	Publisher	North America	Europe
	count	1878.000000	1907	1905	1907.000000	1907.000000	
index	int64						
Rank	int64						
Game Title	object						
Platform	object						
Year	float64						
Genre	object						
Publisher	object						
North America	float64						
Europe	float64						
Japan	float64						
Rest of World	float64						
Global	float64						
Review	float64						
dtype: object							
	index	Rank	Game Title	Platform \	Japan	Rest of World	Global
count	1907.0000	1907.0000	1907	1907	907.000000	1907.000000	1907.000000
unique	Nan	Nan			Nan	Nan	Nan
top	Nan	Nan	LEGO Batman: The Videogame	PS2	Nan	Nan	Nan
freq	Nan	Nan			6	372	0.317493
mean	953.0000	954.0000			NaN	NaN	NaN
std	550.6478	550.6478			NaN	NaN	NaN
min	0.0000	1.0000			NaN	NaN	NaN
25%	476.5000	477.5000			NaN	NaN	0.020000
50%	953.0000	954.0000			NaN	NaN	0.130000
75%	1429.5000	1430.5000			NaN	NaN	1.530000
max	1906.0000	1907.0000			NaN	NaN	81.000000
							Review
							index
							Rank
							Game Title
							Platform
							Year
							Genre
							Publisher
							North America
							Europe
							Japan
							Rest of World
							Global
							Review
							dtype: int64

Figure 1: Raw Data Characteristics

The data preprocessing steps and results are taken are as follows:

- Remove columns that contain a missing "Year" value

- Convert year from float64 to int64
 - Convert object data types to string
 - Round the float64 columns to 2 decimal places

Figure 2: Cleaned Data Set

Even with the preprocessing steps taken the dataset still has a few constraints. Firstly, the data set only covers video games from 1983 to 2012 which leaves out games before the release of the Nintendo Entertainment System and the more modern/recent releases. Secondly, the sales counts are grouped in only 4 categories which may hide important details related to geographic region. Finally, this dataset relies on historical review score data which might not capture a direct relationship between how good a game is and how well it sells due to controversies causing a review bombing of a game.

4 Project Approach and Visualization

This project uses predictive analytics to examine historical video game data to predict global sales. To achieve an accurate prediction, proper data preparation steps such as handling missing values and improving data quality is required [6]. It is also important to get an outlook on the dataset and an understanding of general data patterns before

modeling by performing exploratory analysis. This highlights which factors are could be important for regression modeling and shows how platform, genre, and sales are related [5].

Following preprocessing and exploratory analysis, regression techniques are applied to estimate global sales and to measure the importance of different factors. Model performance will be evaluated using quantitative metrics to ensure predictions generalize to future data rather than applying only to the historical data the model was built on [12]. These steps of preprocessing, descriptive statistics, exploratory data analysis, factor selection, regression modeling, and model evaluation forms the entire methodology of which sales predictions will be made.

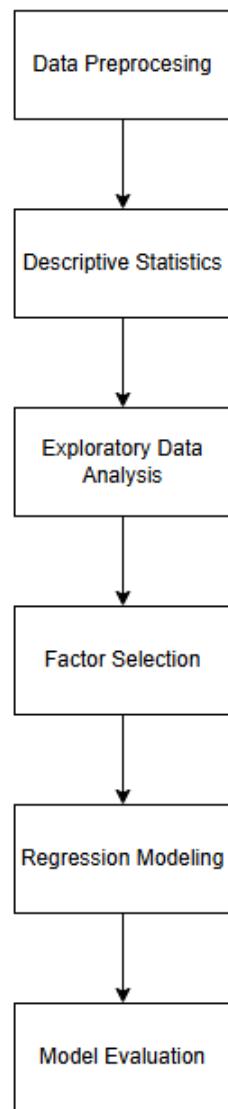


Figure 3: Data Approach Visualization

5 GitHub Repo

<https://github.com/eddie-li-git/CIND820>

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