



Data Warehouse Implementation of Video Game Sales



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Introduction

A Data Warehouse is an integral part of every organization helping them to take business decisions by accumulating data from heterogeneous sources. Video gaming industry has made rapid strides in the market by generating a revenue of \$91 billion in the year 2016 according to the gameindustry.biz (2016). With the introduction of gaming consoles, high definition games, online gaming, high-performance graphic cards etc., video game industry has been revolutionized. Because of these advancements, a large amount of data is generated by online forums and social media.

This project has data from 3 diverse sources, first source has the sales data of video games, second source has the ratings of video games and the third source is extracted by twitter sentiment analysis. The motive behind my selection of these data sources is to combine these data and analyze them to determine which platform and publisher is a major player in the video game market and which game has the highest sales. Analyzing these data will help the video game companies to develop products and games based on users' liking.

Data Sources

Below are the links to my sources of data:

Source 1: The first source contains data about various video games, publishers, platforms and their sales in North America, Europe, Japan, Others and Global. This structured data was scraped from a website using web scraper. Below is the link for the website:

URL: <http://www.vgchartz.com/gamedb/>

Source 2: The second structured data source is taken from a Reddit blog which contains the ratings of different video games which is scraped from *ign* website. Below is the link:

URL:

https://www.reddit.com/r/datasets/comments/2awdgx/i_made_this_dataset_of_all_of_igns_game_reviews/

IGN website URL: <http://ie.ign.com/games/reviews>

Source 3: Third source of unstructured data is Twitter, I have extracted tweets on different video game publishers and performed sentiment analysis on those tweets to get the general opinion of users over the publishers.

Architecture and Implementation

I have employed Ralph Kimball's bottom-up approach dimensional modeling to implement the data warehouse because of its following advantages over Inmon approach:

1. It is easier to start with something small and gradually build on it, in this project I have taken the sales data and ratings, in future additional functionalities can be added to the warehouse.
2. Dimension tables must be loaded before loading the facts table.
3. The warehouse is data driven aimed at increasing the revenue of the video game industry.
4. Building the data warehouse and generating reports is quicker.
5. The dimensions serve as means to answer various business queries.

By separating the data into dimension and fact tables, Only the changing data is kept in the fact table so that updating the warehouse becomes easy. (Kimball, 1998)

Dimensional Model of video game sales data warehouse

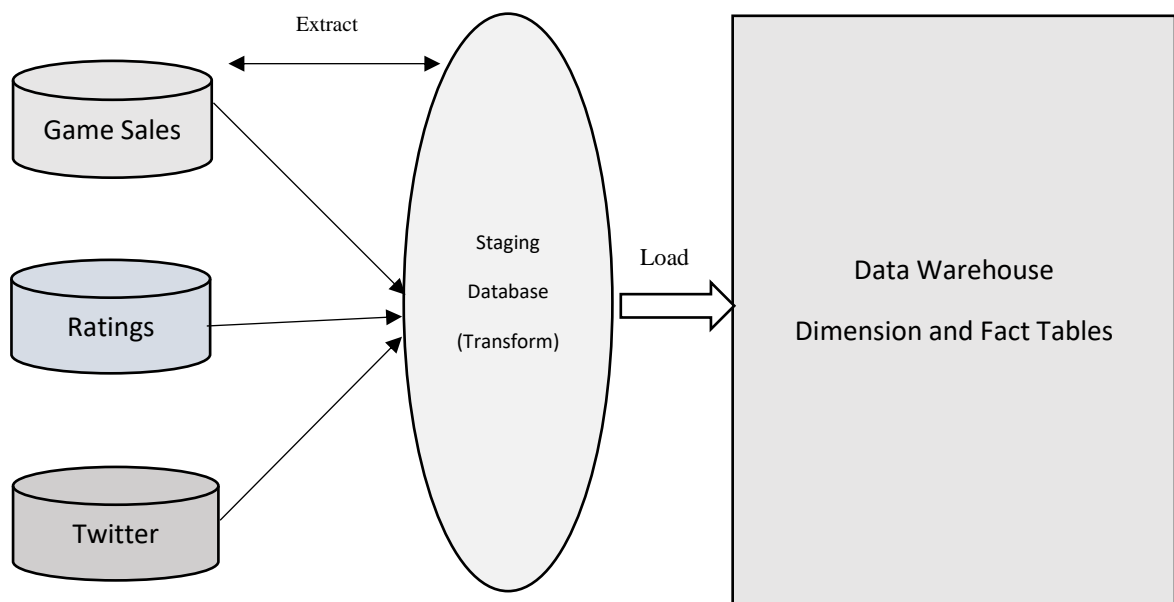


Figure-1

Schema design

I have used star schema to implement my data warehouse because of the following reasons:

- It is simple and straightforward to implement.
- Query execution is faster as all the dimension tables are directly connected to the fact table.
- Easier to navigate through data as less joins are required.

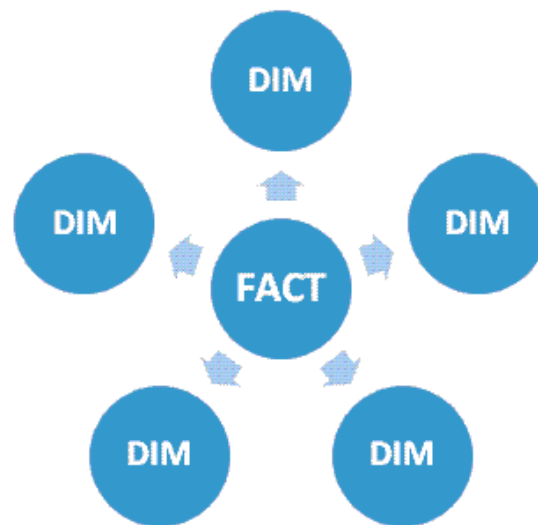


Figure - 2

The schema contains 4 dimension tables and one fact table as shown below:

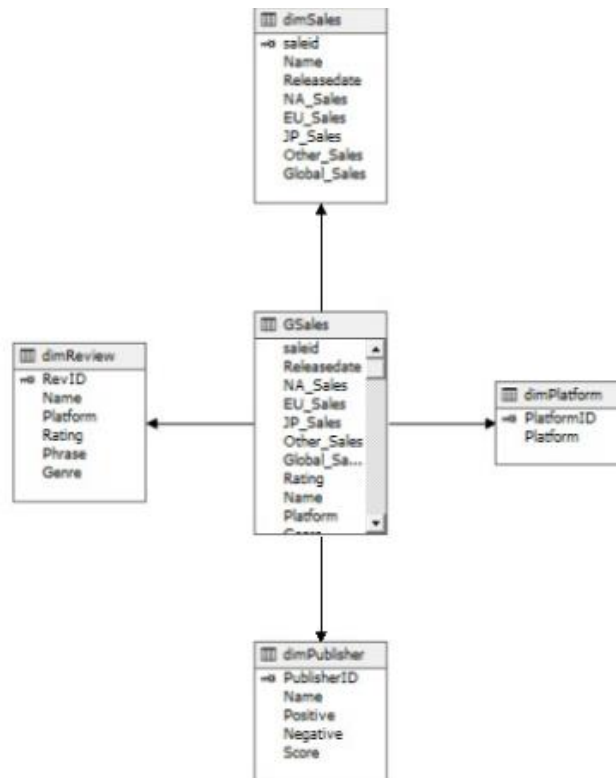


Figure – 3

Description of dimension and fact tables:

I have chosen the following dimension to normalize the data to reduce the redundancy as much as possible.

dimSales:

This dimension contains the actual sales data of games for Europe, North America, Japan, Others and global sales. These values are utilized to populate the fact table.

dimReview:

This dimension contains the reviews of games between 2015 and 2016 along with their publishers and genre.

dimPublisher:

This dimension consists of selected game publishers, number of positive tweets, number of negative tweets and corresponding rating of the video game publishers.

dimPlatform:

This dimension consists of video game platforms, their sale of hardware, software and tie-ratio.

GSales:

This fact table consists of video game sales in Europe, North America, Japan, Global and Others along with their release dates. Having all the numeric data in a fact table makes it easier to analyze the data and fetch reports. Any changes to data can be directly made to fact table as it is directly linked to the dimension tables. This justifies the reason behind the selection of star schema.

Deploying a cube is mainly done upon a fact table hence it becomes necessary to represent the key data in the fact table. They form the base to run the BI queries and develop insights on the data.

Extracting, Transforming and Loading Process

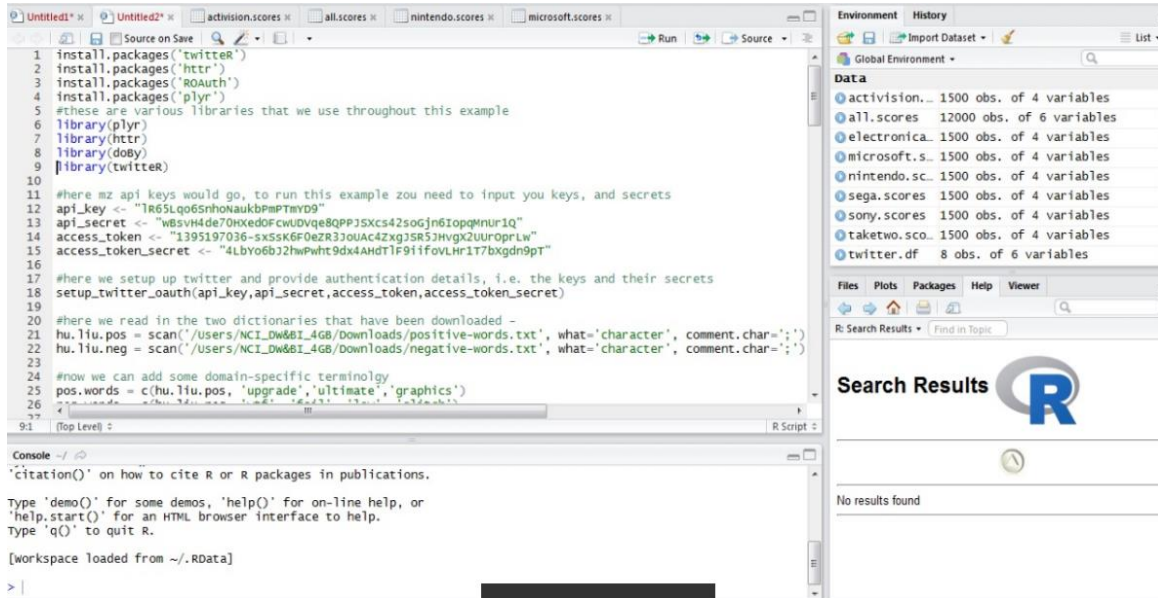
All the 3 sources of data extracted are in excel file format, Initial cleaning was done in excel using filter operation to extract the games only between the year 2015 and 2016 as it was my prime focus. As there were no missing values in the filtered data no further cleaning was required.

The entire process of extracting data from excel files into staging database, populating dimension tables from staging tables, populating fact table from dimension tables, processing dimensions and fact table to process the cube is automated.

Software used: RStudio, Microsoft SQL Server Management Studio, Microsoft Visual Studio.

Extraction

Links to structured data sources has already been mentioned above, the third source which is extracted from Twitter is implemented by R code using RStudio. Below is the screenshot of the code:



The screenshot shows the RStudio interface. The source editor contains R code for installing packages, setting up Twitter authentication, and reading sentiment dictionaries. The environment pane on the right lists several data frames: activation.scores (1500 obs, 4 variables), all.scores (12000 obs, 6 variables), electronica.s (1500 obs, 4 variables), microsoft.s (1500 obs, 4 variables), nintendo.sc (1500 obs, 4 variables), sega.scores (1500 obs, 4 variables), sony.scores (1500 obs, 4 variables), taketwo.sco (1500 obs, 4 variables), and twitter.df (8 obs, 6 variables). The console shows the workspace loaded from ~/.RData.

```
1 install.packages('twitter')
2 install.packages('httr')
3 install.packages('ROAuth')
4 install.packages('plyr')
5 #these are various libraries that we use throughout this example
6 library(plyr)
7 library(httr)
8 library(doby)
9 library(twitter)
10
11 #here m2 api keys would go, to run this example you need to input you keys, and secrets
12 api_key <- "IR65Lq065nh0naukbPmPTmYD9"
13 api_secret <- "wBsvH4de70HxedeFcuDvqe8QPPJ5Xcs42sogjN6IopqMnuriQ"
14 access_token <- "1395197036-sx55K6F0eZr3J0uAc42xg3SR5JHvgx2UuOpRLw"
15 access_token_secret <- "4Lby06bJ2hwPwht9dx4AHd7LF9iifovLHr1T7bxgdn9pt"
16
17 #here we setup up twitter and provide authentication details, i.e. the keys and their secrets
18 setup_twitter_oauth(api_key,api_secret,access_token,access_token_secret)
19
20 #here we read in the two dictionaries that have been downloaded -
21 hu.liu.pos = scan("/Users/NCI_DW&I_4GB/Downloads/positive-words.txt", what='character', comment.char=';')
22 hu.liu.neg = scan("/Users/NCI_DW&I_4GB/Downloads/negative-words.txt", what='character', comment.char=';')
23
24 #now we can add some domain-specific terminology
25 pos.words = c(hu.liu.pos, 'upgrade','ultimate','graphics')
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This code fetches last 1500 tweets for each of the twitter handle of game publisher and outputs the score, I exported the output to an excel file.

Staging, Transforming and Processing

The steps of incorporating the data sources into staging tables, populating dimension tables from staging tables, populating fact table from dimension tables and finally processing the dimensions and cube is done in a single go. Below is the sequence of steps that I followed in SSIS.

1. Populating staging tables from raw data sources

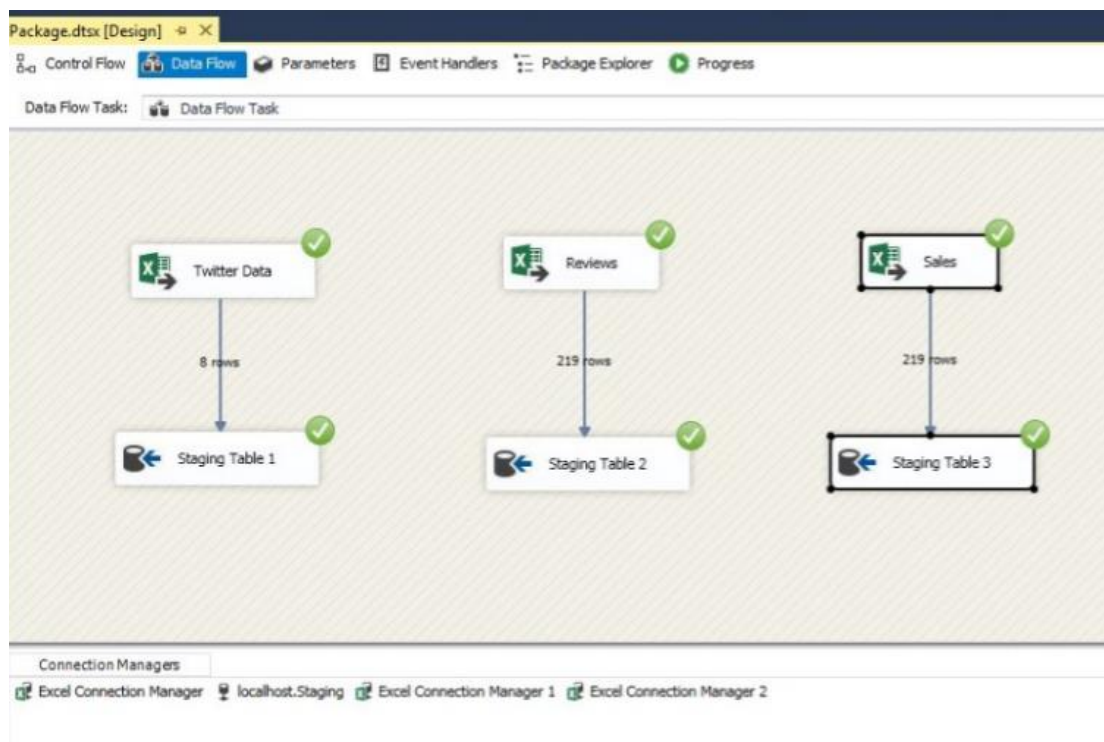


Figure – 6

In this step, I have pulled 3 sources of data which are in the form of excel files into staging tables which form the base for further transformation.

2. Populating dimension tables

This step involves creating and populating dimension tables by selecting only required columns from staging tables. As the data sources obtained did not have missing data, cleaning of data was not required.



Figure - 7

Above diagram depicts the loading of dimension tables from staging tables. It follows bulk loading approach where in the tables are truncated before accumulating the new data.

3. Loading the fact table

Once the dimension tables are loaded, look-up transformation is utilized to connect to dimension tables by matching the attributes and acquiring their primary keys eventually to populate the fact table.

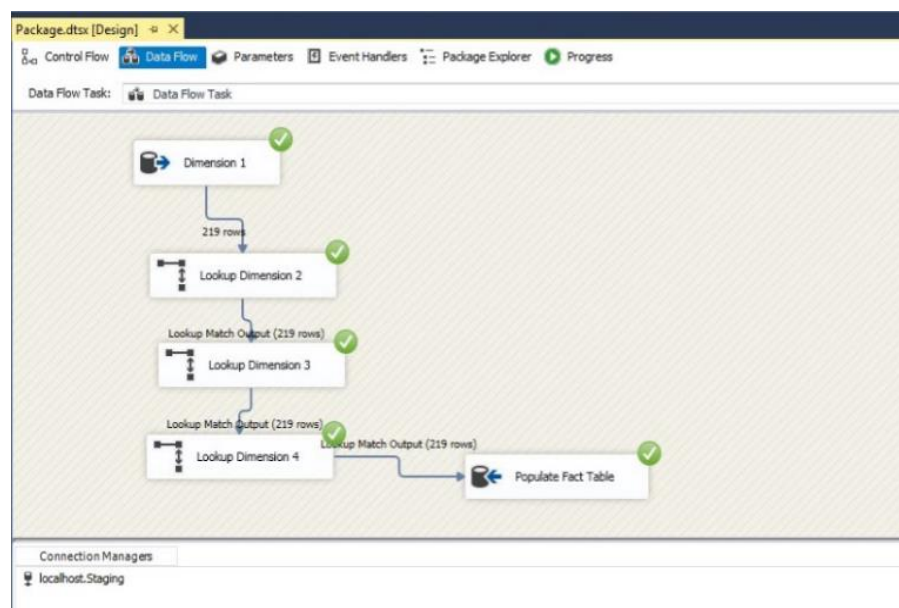


Figure – 8

4. Processing the dimensions and the cube

The last step in integration services project is processing the dimension tables and the fact table to process the cube. The overall design of the ETL control flow is shown below:

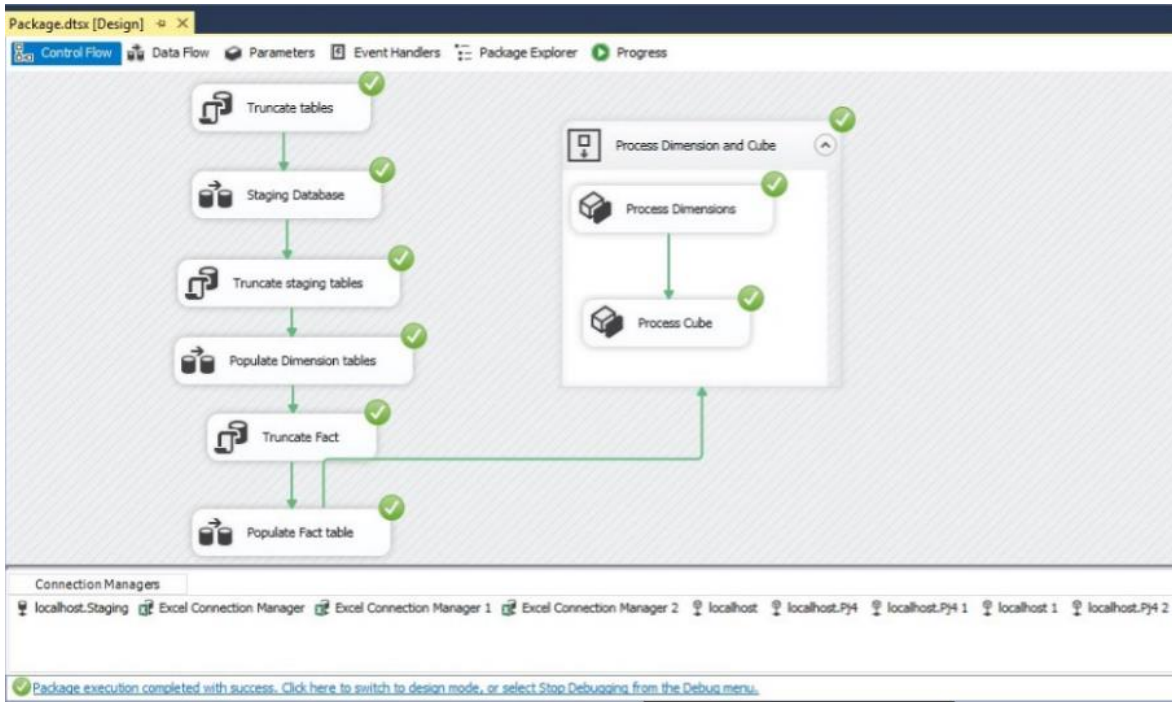


Figure – 9

All the above steps are performed with Microsoft Visual Studio Integration Services Project.

By using Microsoft SQL Server Management Studio, I created the database to store my staging tables as well as dimension and fact tables.

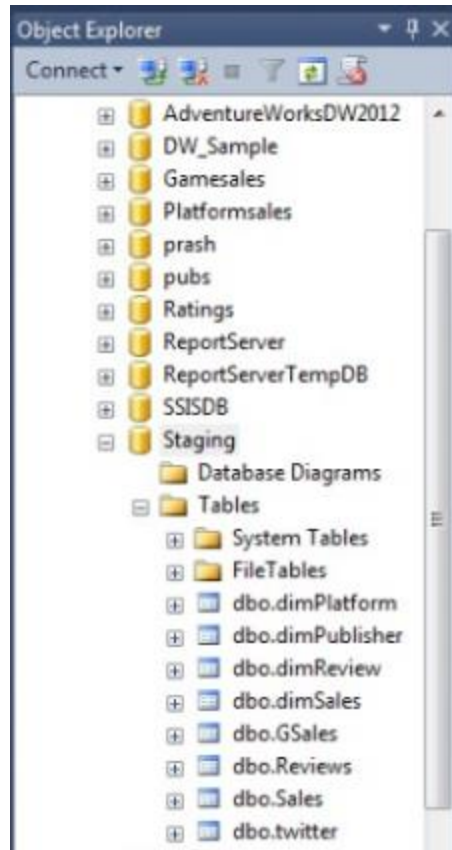


Figure - 10

Next set of steps involve creating dimensions and cube using Analysis Services Multidimensional and Data Mining Project.

Once the project is created, data source views, dimensions, and finally a cube is created by utilizing dimension and fact tables. Also, I have directly generated the time dimension directly on the server and have linked to the fact table as I found it to be easier than creating a separate dimension table for date.

The following diagram shows the result of performing the above steps.

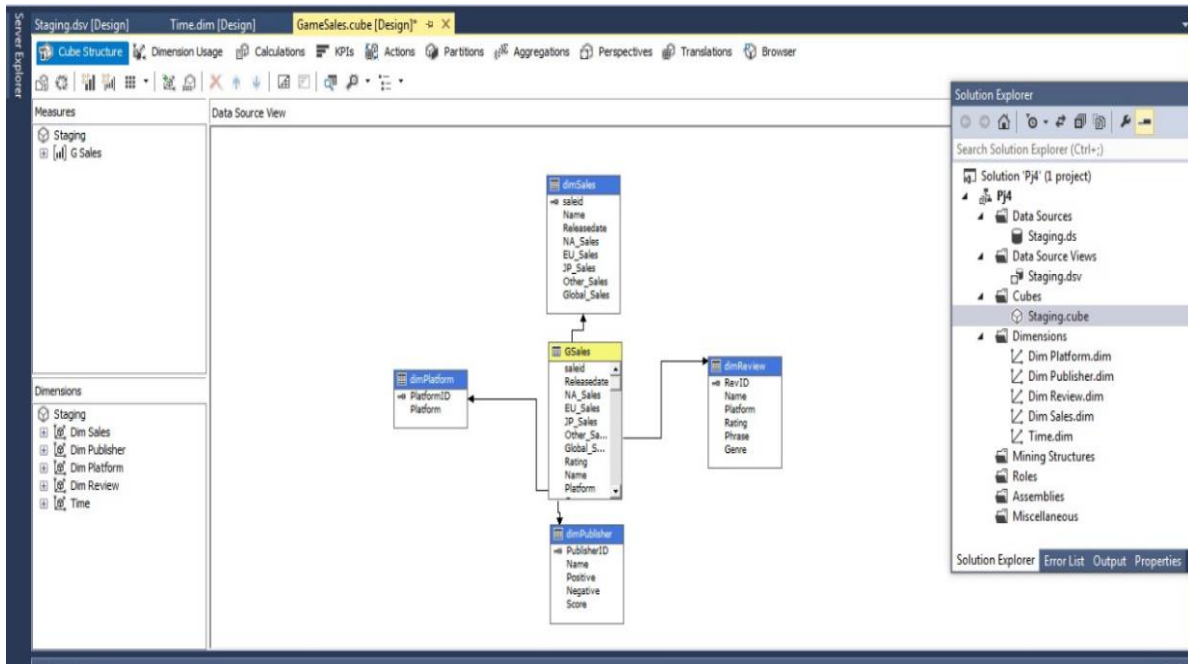


Figure – 11

Once the cube is deployed successfully we can browse the cube to retrieve multidimensional data

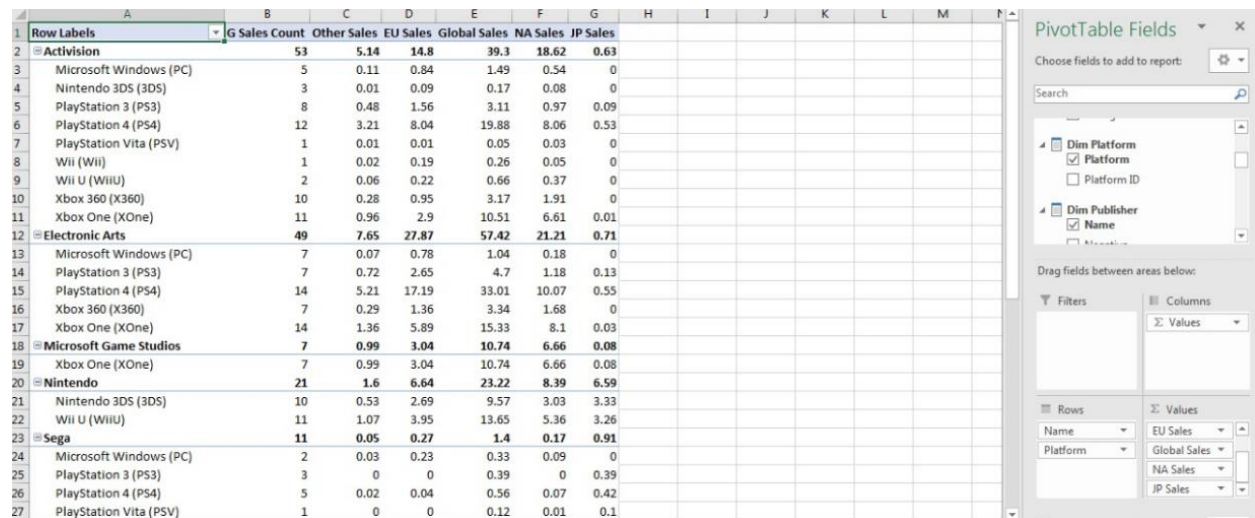
The screenshot shows the SSDT interface for 'Staging.cube [Design]' in 'Browser' view. The central pane displays a table with columns: Platform, EU Sales, Global Sales, JP Sales, NA Sales. The left pane shows the 'Measures' list with 'NA Sales', 'Other Sales', and 'Rating'. The right pane shows the 'Solution Explorer' with the project structure and a 'Deployment Progress' window indicating 'Deployment Completed Successfully'.

Platform	EU Sales	Global Sales	JP Sales	NA Sales
Microsoft Windows (PC)	3.51	5.79	0	1.86
Nintendo 3DS (3DS)	2.78	9.74	3.33	3.11
PlayStation 3 (PS3)	4.83	10.47	0.64	3.36
PlayStation 4 (PS4)	39.53	88.9	2.62	32.56
PlayStation Vita (PSV)	0.1	0.37	0.11	0.09
Wii (Wii)	0.78	1.46	0	0.57
Wii U (WiiU)	4.43	14.97	3.26	6.07
Xbox 360 (X360)	2.75	8.51	0	4.95
Xbox One (XOne)	14.72	47.36	0.12	28.23

Figure – 12

Note that Step 4 of Integration Services project can be implemented only after performing this step. The idea is to automate the process as much as possible when the data warehouse must be repopulated.

Once the cube is deployed, it can be exported to excel to browse the data:



Row Labels	G Sales Count	Other Sales	EU Sales	Global Sales	NA Sales	JP Sales
Activision	53	5.14	14.8	39.3	18.62	0.63
Microsoft Windows (PC)	5	0.11	0.84	1.49	0.54	0
Nintendo 3DS (3DS)	3	0.01	0.09	0.17	0.08	0
PlayStation 3 (PS3)	8	0.48	1.56	3.11	0.97	0.09
PlayStation 4 (PS4)	12	3.21	8.04	19.88	8.06	0.53
PlayStation Vita (PSV)	1	0.01	0.01	0.05	0.03	0
Wii (Wii)	1	0.02	0.19	0.26	0.05	0
Wii U (WiiU)	2	0.06	0.22	0.66	0.37	0
Xbox 360 (X360)	10	0.28	0.95	3.17	1.91	0
Xbox One (XOne)	11	0.96	2.9	10.51	6.61	0.01
Electronic Arts	49	7.65	27.87	57.42	21.21	0.71
Microsoft Windows (PC)	7	0.07	0.78	1.04	0.18	0
PlayStation 3 (PS3)	7	0.72	2.65	4.7	1.18	0.13
PlayStation 4 (PS4)	14	5.21	17.19	33.01	10.07	0.55
Xbox 360 (X360)	7	0.29	1.36	3.34	1.68	0
Xbox One (XOne)	14	1.36	5.89	15.33	8.1	0.03
Microsoft Game Studios	7	0.99	3.04	10.74	6.66	0.08
Xbox One (XOne)	7	0.99	3.04	10.74	6.66	0.08
Nintendo	21	1.6	6.64	23.22	8.39	6.59
Nintendo 3DS (3DS)	10	0.53	2.69	9.57	3.03	3.33
Wii U (WiiU)	11	1.07	3.95	13.65	5.36	3.26
Sega	11	0.05	0.27	1.4	0.17	0.91
Microsoft Windows (PC)	2	0.03	0.23	0.33	0.09	0
PlayStation 3 (PS3)	3	0	0	0.39	0	0.39
PlayStation 4 (PS4)	5	0.02	0.04	0.56	0.07	0.42
PlayStation Vita (PSV)	1	0	0	0.12	0.01	0.1

Figure - 13

Reporting and Visualization

I have chosen the Tableau software to generate reports and visualize the data as I found it easier to work with, the interface is user-friendliness, fast response time, drag and drop features etc., Cube can be directly imported and deployed in its interface.

Firstly, I set up the connection to my database and used drag and drop feature to build the schema for dimension and fact tables. Below screenshots the depict the sequence of steps I followed.

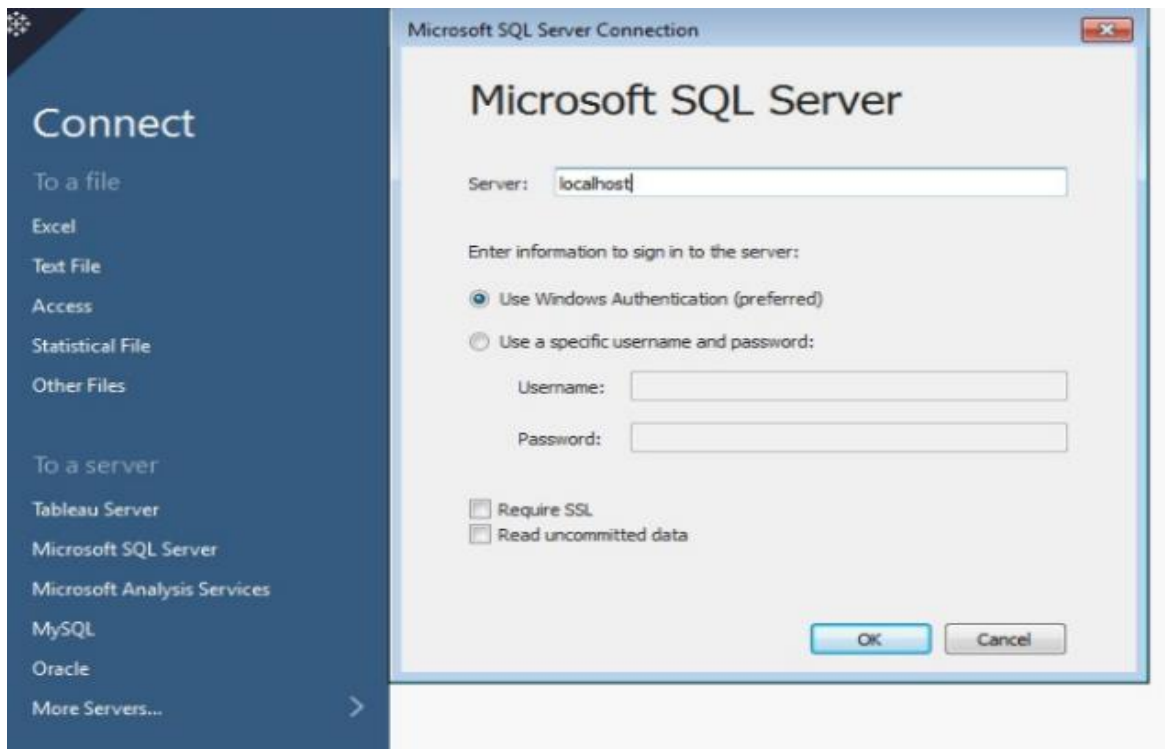


Figure – 14

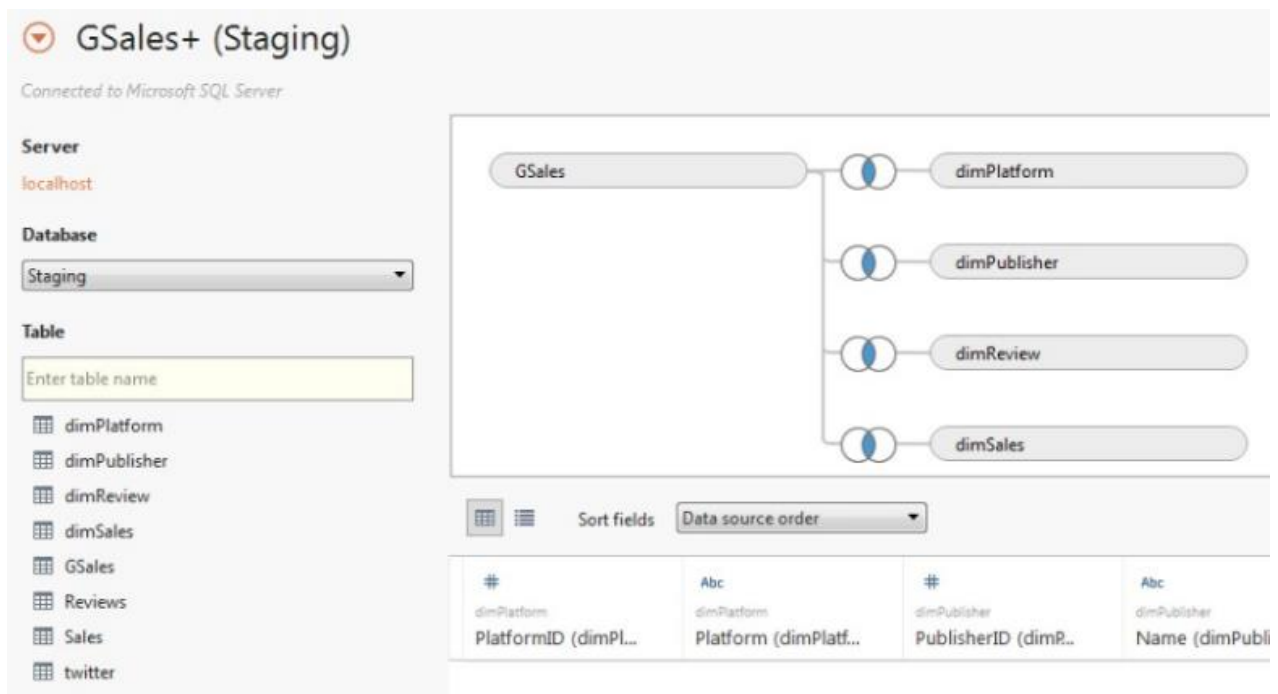


Figure – 15

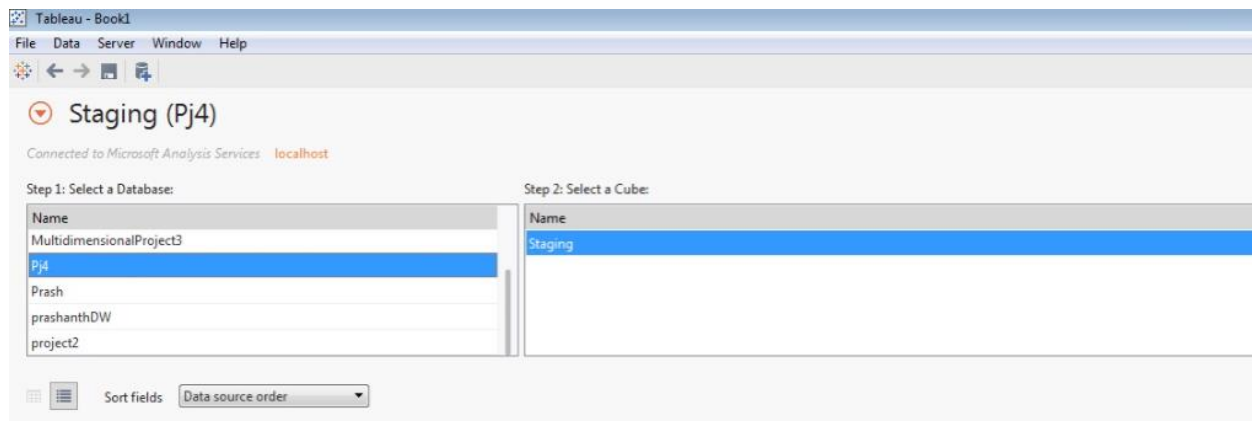


Figure – 16

Next, using the measures and dimensions I generated visualized the data and performed my business case studies. During the analysis, I found some meaningful insights which are described in the form of business intelligence queries below.

BI Query – 1: Which game publisher has the maximum sales and how is it related to the twitter sentiment score?

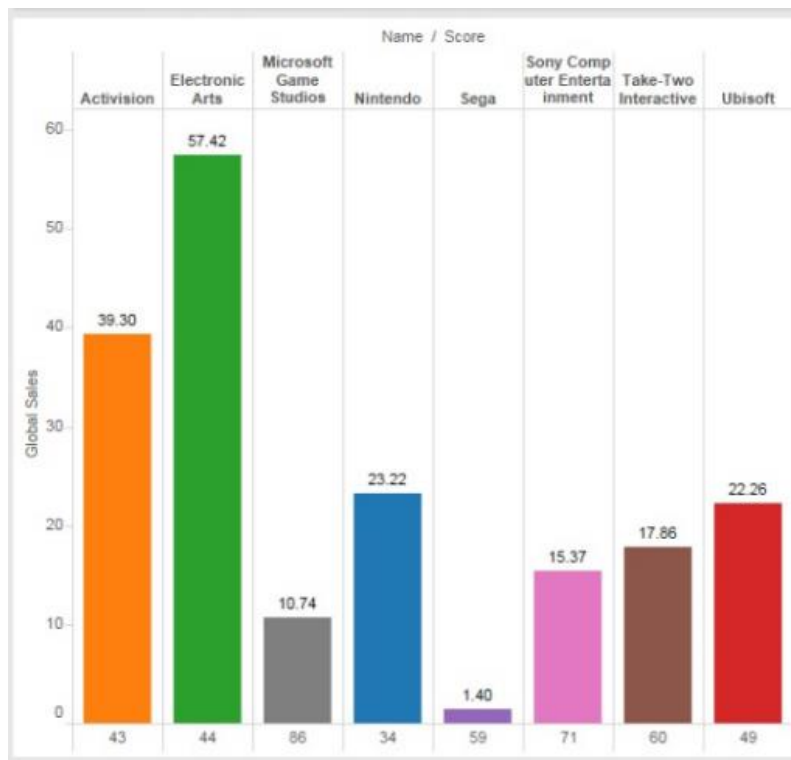


Figure – 17

From the graph above we can see that Electronic Arts has the maximum sales globally and is followed by Activision, However, the sentiment score of these publishers are 44 and 43 respectively indicating that sentiment analysis is not completely accurate. It is because the method rates the tweets by comparing them with a predefined list of words, they are not capable of parsing certain tweets which are sarcastic, ambiguous which might lead to incorrect analysis (Social Sentiment Analysis, 2014). Additionally, the scores are Obtained from the latest 1500 tweets adding to the disadvantage.

BI Query – 2: Which game has the maximum sales in Europe, Japan and North America? And what is its corresponding rating?

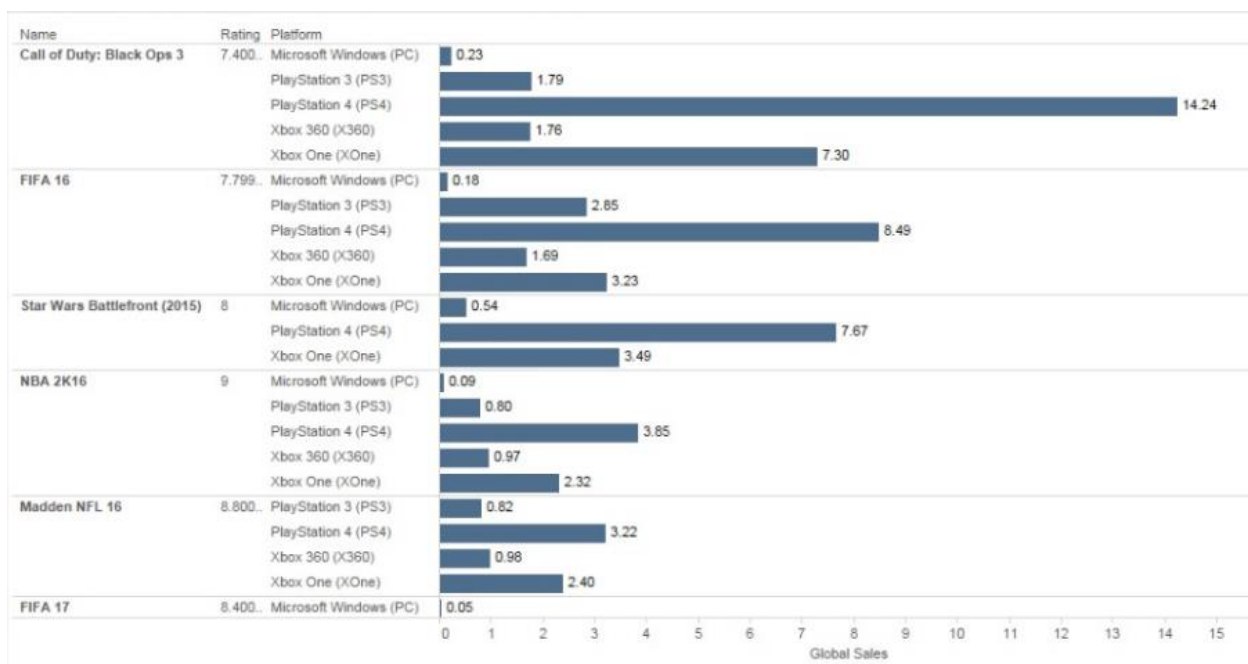


Figure – 18

From the analysis, it was evident that Call of Duty: Black Ops 3 had the most units sold globally with the platform PlayStation 4 although its rating is 7.4, Although it is a product of Activision, which stands second in the list of top publishers. The main reason is due to the success of its predecessors i.e. Call of Duty Black Ops and Call of Duty Black Ops II which had gained significant popularity after their release.

BI Query – 3:

Which Platform has the highest sales globally?



Figure – 19

As we can see from the above figure, PlayStation 4 dominates the other platforms in global sales, possibly due to its extended features like USB compatibility, standby mode, support for video applications, color coding in joysticks to provide rich gaming experience etc., (Prima Games, 2016).

BI Query – 4

Which Platform-Publisher pair has more sales globally?

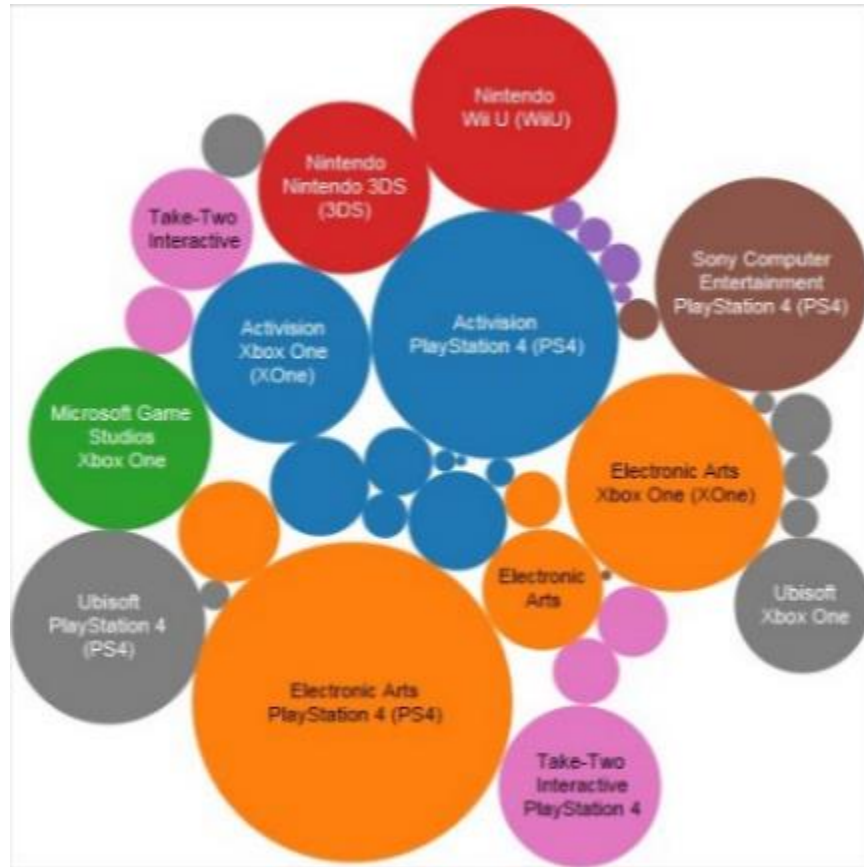


Figure – 20

As we can see that Electronic Arts – PlayStation 4 combination has the highest sales closely followed by Activision – PlayStation 4. This might be due to the better gaming experience provided by PS4 compared to other gaming consoles. As Sony is the manufacturer of the PlayStation and as well as games, they can focus more on the improvement of their consoles as they fetch more profit than the games.

BI Query – 5:

What genre of the game is popular? does it differ by the region?

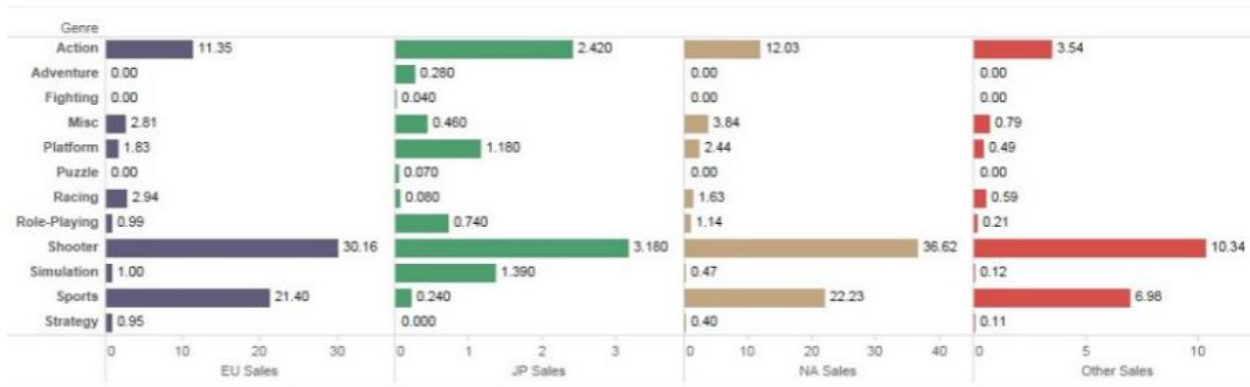


Figure – 21

This was an interesting outcome of my analysis, games of shooting genre have the highest sales in all the 4 regions. This is supported by facts that first person shooter games involve quick thinking, decision making and the adrenaline rush generated by playing keeps them in a condition of absolute presence by losing their identity (Mail Online, 2013). This directly explains BI query – 2 as Call of Duty is of shooting genre. This can encourage the video game developers to produce more shooting games.

These statistics are only limited to the games released between 2015 and 2016, However the warehouse can be expanded to incorporate additional functionalities such as sales information of gaming equipment, stock prices of game publishers, video game players and so on.

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