2017

AP CollegeBoard

AP Research Academic Paper

Sample Student Responses and Scoring Commentary

Inside:

- ☑ Sample B
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AP® RESEARCH 2017 SCORING GUIDELINES
Performance Task Rubric: Academic Paper

Content Area	Performance Levels		
1 Understand and Analyze Context	The paper identifies a broad topic of inquiry and/or a purpose. 2	The paper identifies a focused topic of inquiry and describes the purpose. 4	The paper explains the topic, purpose, and focus of the inquiry and why further investigation of the topic is needed by connecting it to the larger discipline, field, and/or scholarly community. 6
2 Understand and Analyze Argument	The paper identifies or cites previous scholarly works and/or summarizes a single perspective on the student's topic of inquiry. 2	The paper summarizes, individually, previous scholarly works representing multiple perspectives about the student's topic of inquiry. 4	The paper explains the relationships among multiple scholarly works representing multiple perspectives, describing the connection to the student's topic of inquiry. 6
3 Evaluate Sources and Evidence	The paper uses sources/evidence that are unsubstantiated as relevant and/or credible for the purpose of the inquiry. 2	The paper uses credible and relevant sources/evidence suited to the purpose of the inquiry. 4	The paper explains the relevance and significance of the used sources/cited evidence by connecting them to the student's topic of inquiry. 6
4 Research Design	The paper presents a summary of the approach, method, or process, but the summary is oversimplified. 3	The paper describes in detail a replicable approach, method, or process. 5	The paper provides a logical rationale for the research design by explaining the alignment between the chosen approach, method, or process and the research question/project goal. 7
5 Establish Argument	The paper presents an understanding, argument, or conclusion, but it is simplistic or inconsistent, and/or it provides unsupported or illogical links between the evidence and the claim(s). 3	The paper presents a new understanding, argument, or conclusion that the paper justifies by explaining the links between evidence and claims derived from the student's research. 5	The paper presents a new understanding, argument, or conclusion that acknowledges and explains the limitations and implications in context. 7
6 Select and Use Evidence	Evidence is presented, but it is insufficient or sometimes inconsistent in supporting the paper's conclusion or understanding. 2	The paper supports its conclusion by compiling relevant and sufficient evidence generated by the student's research. 4	The paper demonstrates an effective argument through interpretation and synthesis of the evidence generated by the student's research, while describing its relevance and significance. 6
7 Engage Audience	Organizational and design elements are present, but sometimes distract from communication or are superfluous. 1	Organizational and design elements convey the paper's message. 2	Organizational and design elements engage the audience, effectively emphasize the paper's message and demonstrate the credibility of the writer. 3
8 Apply Conventions	The paper cites and attributes the work of others, but does so inconsistently and/or incorrectly. 2	The paper consistently and accurately cites and attributes the work of others. 4	The paper effectively integrates the knowledge and ideas of others and consistently distinguishes between the student's voice and that of others. 6
9 Apply Conventions	The paper's use of grammar, style and mechanics convey the student's ideas; however, errors interfere with communication. 1	The paper's word choice and syntax adheres to established conventions of grammar, usage and mechanics. There may be some errors, but they do not interfere with the author's meaning. 2	The paper's word choice and syntax enhances communication through variety, emphasis, and precision. 3

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Performance Task Rubric: Academic Paper

NOTE: To receive the highest performance level presumes that the student also achieved the preceding performance levels in that row.

ADDITIONAL SCORES: In addition to the scores represented on the rubric, readers can also assign scores of **0** (zero).

- A score of **0** is assigned to a single row of the rubric when the paper displays a below-minimum level of quality as identified in that row of the rubric.

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AP® RESEARCH
2017 SCORING COMMENTARY

Academic Paper

Overview

This performance task was intended to assess students' ability to conduct scholarly and responsible research and articulate an evidence-based argument that clearly communicates the conclusion, solution, or answer to their stated research question. More specifically, this performance task was intended to assess students' ability to:

- Generate a focused research question that is situated within or connected to a larger scholarly context or community;
- Explore relationships between and among multiple works representing multiple perspectives within the scholarly literature related to the topic of inquiry;
- Articulate what approach, method, or process they have chosen to use to address their research question, why they have chosen that approach to answering their question, and how they employed it;
- Develop and present their own argument, conclusion, or new understanding while acknowledging its limitations and discussing implications;
- Support their conclusion through the compilation, use, and synthesis of relevant and significant evidence generated by their research;
- Use organizational and design elements to effectively convey the paper's message;
- Consistently and accurately cite, attribute, and integrate the knowledge and work of others, while distinguishing between the student's voice and that of others;
- Generate a paper in which word choice and syntax enhance communication by adhering to established conventions of grammar, usage, and mechanics.

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Music Chemistry

The Formula of K-Pop

Word Count: 4,314

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I. ABSTRACT:

South Korean pop music, or K-Pop, is a rapidly growing sector of the music industry, and has experienced increased economic success and international exposure over the last few years. Although a variety of possible causes have been postulated for this heightened popularity, this study aims to quantitatively analyze one aspect of K-Pop in particular - the music itself. Utilizing a novel method involving musical correlational analytics, this research will anatomize successful K-Pop songs released between 2014 and 2016 and parse existing databases for records of those songs. These two sets of information will then be compared with each other and evaluated for meaningful correspondence. The results of this evaluation potentially hold revelations of how a K-Pop song's content and commercial success are linked, leading to large-scale implications in terms of how K-Pop music producers choose to develop their songs. Beyond these industry-specific ramifications, however, this study also adopts a methodology that can be applied to analyze other styles of music.

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II. INTRODUCTION

Music has traditionally been perceived as a creative art form, delivered through the medium of sound. Its forms and elements vary vastly across societies and cultures, and its origins can be drawn back to prehistoric eras. The development and structure of music is amazingly complex, with different pitches, rhythms, timbres and dynamics all contributing to the effect a musical piece can have on a listener. It is this complexity that has influenced the analysis and study of music, causing researchers to utilize qualitative methods in examining music. This approach, although fairly effective at exploring musical qualities that attract a listener's interest and emotion, inherently introduces an aspect of bias.

Due to advances in technology, however, a new realm of quantitative investigation has been unlocked, and this research plans to use a novel method involving musical correlational analytics. This research seeks to use this method to discover potential relationships and connections between the quantitatively measured aspects of a song and its popularity within an audience, particularly pertaining to the music industry of South Korea. In this study, songs will be anatomized and organized through analytics software that provides measurements for pre-defined values. Existing databases will be parsed for information concerning each song's success, and the two datasets will be compared for correlations between them. Based off of existing trends in the current musical world, it is predicted that the most successful songs will possess higher levels of energy with consistent beat patterns, and that those trends will be present in the datasets when analyzed. This new quantitative analysis presents implications for song producers in South Korea, as well as researchers seeking to investigate other music industries using this easily replicable research methodology.

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III. LITERATURE REVIEW

For the purpose of this study, the South Korean pop music industry was selected for analysis due to a variety of attributes it possesses. First of all, Korean pop music, or K-Pop, encompasses a large variety of musical styles. According to Timothy N. Laurie, a researcher of Cultural Studies at the University of Technology Sydney, K-Pop incorporates elements from global hip-hop, smooth R&B, Hi-NRG, Japanese pop, and Cantonese pop.[1] Not only are songs pertaining to these styles present within K-Pop, hybrids and blends between these different styles have developed as well, introducing even more variation. This diversity means that analysis of the Korean music industry, which will be performed within this research, offers insights and conclusions about other musical genres and industries. Additionally, the large variety of styles signifies K-Pop as an independent, comprehensive musical environment, allowing it to serve as a microcosm for other music industries and audiences in general.

Beyond the assortment of different musical styles present in K-Pop, another attribute it possesses makes it extremely attractive as a subject for this research. This attribute is the relative size of the industry as a whole, and the number of songs released every year. Of all the songs released in South Korea every year, approximately 60 songs can be considered to achieve a moderate level of success, both domestically and internationally. These moderately successful songs were selected because of an easily defined and implemented criterion that will be further discussed in the Methodology portion, **Section IV.** Considering the 3 year time span covered in this study, the number of songs to be analyzed is reasonable given the scope and resource limitations of this research. The size of the K-Pop industry was an important consideration when

[1] Laurie, Timothy N. *Toward a Gendered Aesthetics of K-Pop*. Edited by Henry Johnson and Ian Chapman. London & New York: Routledge, 2016.

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selecting the focus of this study, as it allows the research to adequately analyze a number of songs over an appropriate time period.

An important contribution to the growing size of this industry can be found in Hallyu, or the Korean wave. Hallyu, a neologism for the 'flow of Korea,' refers to "a surge in the international visibility of Korean culture" originating within East Asia during the 1990s, and more recently expanding to the United States, Latin America, the Middle East, and parts of Europe.[2] Generally, Hallyu is composed of multiple aspects of Korean culture, including fashion, music, television programs, cosmetics, and games. The musical portion, K-Pop, has played a key role in Hallyu's continuing success, and the relationship between the two has been mutually beneficial.[3] One of Hallyu's premier examples is Gangnam Style, a song released in 2012 by K-Pop artist PSY. Although the song itself is a phenomenon that deserves separate examination, its significance to this study can be found in the interest it generated in the Korean music industry. In the year following the release of the song, views of Korean artists on YouTube tripled, from around 2.2 billion to 7 billion views.[4] It also holds a variety of accolades, from being the first song to reach 1 billion views on YouTube, to being recognized by the United Nations as an "international sensation."[5] Hallyu and K-Pop comprise a feedback loop, with each contributing to the development of the other, and discoveries concerning either one of them presenting

[2] Ravina, Mark. "Conceptualizing the Korean Wave ." *Southeast Review of Asian Studies* 31 (2009): 3-9. Accessed February 15, 2017.
[3] Kim, Sang Yeob. "Investigation on the Management Status of K-Pop Revenue Model and Finding Ways for Improvement." *International Journal of Trade, Economics and Finance*, 2012, 343-46. doi:10.7763/ijtef.2012.v3.224.
[4] "K-Pop's Profile Expands Exponentially, All Thanks to Psy." Billboard. Accessed February 15, 2017. http://www.billboard.com/biz/articles/news/digital-and-mobile/1685153/k-pops-profile-expands-exponentially-all-thanks-to-psy.
[5] "From Korean Pop music to Skydiving to Earth – Not-your-typical diplomatic meetings for UN Secretary-General." UN News Center. October 24, 2012. Accessed February 15, 2017. http://www.un.org/apps/news/story.asp?NewsID=43373&Cr=secretary-general&Cr1=#.WKSAR_nyvIV.

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valuable insights into the expansion of the other. As such, the investigation of K-Pop can lead to additional discoveries about the spread of Hallyu.

Even with K-Pop's rising popularity, certain aspects of the music industry itself limit the rate at which this advancement can occur. The K-Pop industry is extremely structured, and is organized into record labels, music production houses, event management companies, and various merchandise providers. This detailed format involves a trainee system, where potential artists are recruited at a young age and live in a regulated environment, developing their skills in singing and dancing.[6] This meticulous setup is restrictive towards individuals who wish to create their own music, independent from the industry's companies and established infrastructure, meaning that virtually all artists within the K-Pop scene are affiliated with a label that developed and promoted them. As such, even though Hallyu's rising prominence has increased interest and curiosity towards K-Pop, South Korea's relatively structured music industry limits the proliferation of new music. These two factors, in tandem, have contributed to an industry with a healthy, controlled rate of growth and a promising future, and that has an appropriate size for this study to focus on.

With Hallyu and K-Pop's current reputation, various academic sources have sought to investigate the driving causes behind its appeal, especially internationally. Dal-yong Jin and Woong-jae Ryoo's essay explored the incorporation of English lyrics in K-Pop songs as a form of cultural hybridization that helped develop a transnational appeal. They wished to understand K-Pop as a cultural phenomenon by analyzing the progression of the lyrical content under the context of unfolding globalization.[7] Their research, although valuable, utilized a more traditional,

[6] Kim, Yoon-mi. *K-Pop: A New Force in Pop Music*. Seoul: Korean Culture and Information Service, 2011.
[7] Jin, Dal Yong, and Woong Jae Ryoo. "Critical Interpretation of Hybrid K-Pop: The Global-Local Paradigm of English Mixing in Lyrics." *Popular Music and Society* 37, no. 2 (2012): 113-31. doi:10.1080/03007766.2012.731721.

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qualitative approach and served to bolster an understanding of the lyrical foundation found in K-pop. They discussed how the presence of English within the lyrics was vital to K-pop's international expansion, by offering familiar sections in each song to non-Korean listeners.

In another study, by Yew Chee Chew, 5 separate factors were identified as the main causes of K-Pop's popularity. One of them was a production factor, which relates to the incorporation of music and lyrics from imported Western and Japanese music producers. This one was intimately connected with Jin and Ryoo's work, especially the facet of fusing cultural aspects of other countries and how it contributes to driving K-pop's global appeal. The other factors were performance, idol characteristics, training, and Korean culture.[8] Chew's study weighed each of these factors evenly, whereas Jin and Ryoo focused on the lyrical aspect as the most significant contributors. This study intends to focus on the musical aspect of K-Pop, similar to the production factor identified in Chew's work, but instead of a qualitative analysis of the lyrics and music of K-Pop, this research utilizes a quantitative approach.

This research intends to find a numerical correlation between the musical qualities of songs and their success. Inspiration for this choice of methodology was drawn largely from a data visualization project titled "Visualizing a Hit," performed by Shaun Ellis and Tom Engelhardt.[9] Within their project, they used the Echo Nest API, a music analytics software, to examine and scrutinize popular American songs released between 1960 and 2010. Echo Nest was recently acquired by Spotify, but its fundamental programs and algorithms remain the same. Essentially, a set of characteristics of the K-Pop industry establish it as a suitable subject for this

[8] Chew, Yee Chee. "The Five Success Factors of K-pop Music: An Exploratory Study on How The Factors Affect Fans' Satisfaction."
[9] "Visualizing a Hit - InfoVis Final Project." Google Sites. Accessed February 20, 2017. https://sites.google.com/site/visualizingahit/home.

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research, which intends to utilize a quantitative method. In the next section, this methodology will be further clarified and defined.

IV. METHODOLOGY

The first step in carrying out the research was to select which songs would be reviewed and examined. Hundreds of songs are released each year in South Korea, and it was not feasible to analyze them all, given the time constraints of this project. As such, songs were chosen if they attained a moderate level of success, defined by if a song managed to win a music show. This definition was selected as it provides the most concise and effective formula for choosing an appropriate number of songs. Music shows are weekly television broadcasts, where artists perform and receive scores based off different factors, as shown below in **Figure 1**.

Music Show	**System Used**
The Show	Pre-score: Total 70% [Album sales + Digital sales + SNS (Korea) (35%) + Tudou music video views + pay vote items (China) (35%)]. Live voting *(for nominees only)*: Total 30% [Text votes (Korea) (15%) + Tudou votes (China) (15%)]
Show Champion	Digital sales (streaming + downloads) (50%), Online voting (MelOn) (15%), Physical sales (Hanteo) (20%), Ranking from professional judges (MBC Music) (15%)[10]
M Countdown	Digital music sales score (50%), Album sales volume score (15%), Social media score (15%), Popularity score (10%), Broadcast score (10%), Live broadcast real time voting score (10%)[11]

[10] "신동・김신영, MBC뮤직 `쇼 챔피언` 진행". Digital Times (in Korean). Accessed March 06, 2017. http://www.dt.co.kr/contents.html?article_no=2012020602019954604007

[11] "Weekly KPOP Music Chart & K-POP Star Chart | M COUNTDOWN." Mwave. Accessed March 06, 2017. http://mwave.interest.me/mcountdown/vote/mcdChart.

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Music Bank	Digital music charts (65%), Album sales (5%), Number of times broadcast on KBS TV only (20%), Viewer's choice charts (10%)[12]
Inkigayo	Digital single sales (55%), SNS (YouTube Views) (35%), Album sales (5%), Advance viewer votes (5%) (for 1st place candidates only)[13]

Figure 1: Factors Accounted for in Music Show Scoring

The winners of the 5 largest shows, *The Show*, *Show Champion*, *M Countdown*, *Music Bank*, and *Inkigayo*, between 2014 and 2016 were tabulated, along with their number of wins. This amounted to a total of 192 songs spanning the 3 year period.

For the next step of analysis performed in this study, the Echo Nest/Spotify API was used.[14] **Figure 2** below outlines the values that the API can return, the range of possible values, and their meanings, in terms of the musical qualities they represent.

Value	**Range**	**Meaning**
Acousticness	0.0 ~ 1.0	Measure of if a song is acoustic (not having electronic amplification).
Danceability	0.0 ~ 1.0	Measure of how suitable a song is for dancing, based on tempo, rhythm stability, beat strength, and overall regularity.
Energy	0.0 ~ 1.0	Measure of intensity and activity, based on dynamic range, perceived loudness, timbre, onset rate, and general entropy.
Instrumentalness	0.0 ~ 1.0	Measure of if a song is instrumental (sound generated solely by instruments without vocals).
Key	0 ~ 11	The key the track is in

[12] "[Oh!쎈 초점] '뮤직뱅크' 해외 팬만 중요? 시청자 의견에 귀 닫았나". Chosun (in Korean). Accessed March 06, 2017. http://news.chosun.com/site/data/html_dir/2015/04/10/2015041003723.html

[13] 인기가요 차트 공지사항 [Inkigayo Methodology] (in Korean). Seoul Broadcasting System. Accessed March 06, 2017. http://program.sbs.co.kr/builder/verticalEndpage.do?pgm_id=00000010182&pgm_mnu_id=22962&pgm_build_id=48&pageIdx=1&bbsCd=ct_gayo3&searchCondition=title&searchKeyword=&contNo=90000010

[14] "Get Audio Features for a Track." Spotify Developer. Accessed March 06, 2017. https://developer.spotify.com/web-api/get-audio-features/.

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Liveness	0.0 ~ 1.0	Measure of if a song was performed live.
Loudness	-60 ~ 0	Measure of the overall loudness of a song in decibels, averaged across the whole song. Loudness represents the primary psychological correlate of a song's amplitude.
Mode	0 ~ 1	Measure of if a track is major or minor.
Speechiness	0.0 ~ 1.0	Measure of presence of spoken words in the song.
Tempo	0.0 ~ 250.0	Overall estimated tempo of a song in beats per minute.
Valence	0.0 ~ 1.0	Measure of the musical positiveness conveyed by a song.

Figure 2: Spotify API Values and Meanings[15]

Simply from examining the meaning column of **Figure 2**, a few values can be eliminated from the method's analysis. The first one is instrumentalness, as there are no pertaining K-Pop songs that are purely instrumental, so the value would result in 0.0 or close to 0.0 for most songs. Additionally, liveness is an unnecessary value, as once again, each K-Pop song was recorded in a studio, instead of being a live performance, leading to 0.0 or near 0.0 outcomes. From there, each of the songs was input into the Spotify API engine. Unfortunately, 23 of the songs were not available on the Spotify database as of the time of this study, meaning that it was impossible to perform analysis on them with the API. This cut the number of usable songs down to 169.

After each of the remaining songs was analyzed, the values returned by the API were recorded in a spreadsheet and then transferred into a local database using the PostgreSQL relational database management system. This placement would permit convenient analysis and comparison in the future.

In addition to the values and qualities of the songs themselves, additional information about each song's success was recorded. The number of music show wins, music video views,

[15] Ibid.

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digital downloads, and streams were recorded for each song from the Gaon Music Chart, a chart that tabulates the popularity of songs and is compiled by the Korea Music Content Industry Association.[16] Unfortunately, data could not be recovered for some of the songs in terms of both downloads and streams. For downloads, there were still enough songs to perform legitimate analysis on them, but the amount of streaming data was far too miniscule, and therefore streaming was excluded as a measurement of a song's success. However, since the data on the number of music show wins and music video views was more comprehensive, those two factors were considered to be more representative of the overall patterns.

Once the data compilation was completed and transferred into the database, the next step was to compare and analyze the resulting information. Each of the song qualities taken from the Spotify API was plotted against each of the measures of success on a simple scatter graph. PostgreSQL's inner join and grouping functions proved invaluable in this aspect, allowing for data to be taken from different tables and compared with each other. Excel spreadsheet software was them used to create parabolic trend lines that fit the graphs, and those lines were then used to deduct patterns and general sequences that could be seen in the data. These graphs allowed for viable comparisons between the different quantities the API measured for each song and how successful each song was, which were further analyzed for additional conclusions and implications. In essence, the methodology performed in this study compared the fundamental qualities of songs with their success within the market, which, as described in **Section III**, provides an effective quantitative analysis of music.

[16] "국내 대표 음악 차트 가온차트!" Chart. Accessed March 08, 2017. http://gaonchart.co.kr/.

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V. RESULTS/DATA ANALYSIS

As stated in the methodology section, **Section IV**, constraints of the Spotify API limited the number of songs analyzed to 169. Even so, the quantity of data is too large to reasonably display within this section. As such, the data will be included at the end of this paper. **Appendix A** contains information about the songs' music show wins, **Appendix B** contains data on the number of music video views and downloads, **Appendix C** contains the results of the API analysis, and **Appendix D** is a list of the songs that were excluded due to their lack of availability in the Spotify database.

The first results presented are of the mode and key from the API, as both of them had well-defined, whole number ranges for the values. The mode represents if a song is in a major or minor key, with 1 representing major and 0 representing minor. **Figure 3** shows the average success of songs within each mode.

Mode:	**Average MV Views (Million)**	**Average Music Show Wins**
Major (1)	23.7	3.13
Minor (0)	36.3	3.61

Figure 3: Average Success based on Mode

As seen in **Figure 3**, songs with minor keys enjoyed more success than major songs, with, on average, 12.6 million more music video views, and 0.48 more music show wins.

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The musical keys and the statistics are represented in **Figure 4.**

Key:	**Average MV Views (Million)**	**Average Music Show Wins**
C (0)	41.0	3.55
C♯/D♭ (1)	26.7	2.38
D (2)	32.6	2.44
D♯/E♭ (3)	6.3	1.57
E (4)	21.9	3.71
F (5)	22.9	3.94
F♯/G♭ (6)	64.7	4.23
G (7)	21.5	3.89
G♯/A♭ (8)	16.1	4.08
A (9)	11.6	2.58
A♯/B♭ (10)	35.6	3.00
B (11)	34.2	3.62
Average:	**27.9**	**3.25**

Figure 4: Average Success based on Key

Most of the keys enjoyed moderate success, with a few notable differences. In particular, the keys of C and F♯/G♭ enjoyed a larger number of music views, with 13.1 and 36.8 million more than the average, respectively. F♯/G♭ had similar success on music shows, averaging 0.98 more wins on average. D♯/E♭ performed exceptionally poorly in terms of both MV views and wins, having 21.6 million less views and 1.68 less wins than the average. The keys D, E, F, G, G♯/A♭ , and A♯/B♭ had internally varying results, simultaneously performing both above and below average in the two categories. This can most likely be attributed to the low value of wins D♯/E♭ songs had, which significantly dropped the overall average number of show wins.

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Different musical keys inherently instigate varying reactions, and this information describes which keys generate higher levels of popularity.

Beyond the Mode and Key that the API returned, data concerning all of the other values was also graphed. **Figures 5 to 12** are the other graphs of the values and measures of success. One important observation that needs to be discussed prior to the analysis of the graphs and data is the existence of a R^2 value for each trend line. This R^2 value is a statistical measure of how close the data fits the trend line. As will be seen from most of the graphs, the association between the data points and the trend lines is not very exact, meaning that the R^2 values are fairly small and precise predictions can not be made about the data values. This is expected, due to the large variability of values within the songs, which leads to a larger prediction interval for each value. However, lower R^2 values are not inherently bad, and important conclusions can still be drawn from this information, and are discussed in this section.[17]

[17] Frost, Jim. "Regression Analysis: How Do I Interpret R-squared and Assess the Goodness-of-Fit?" Minitab. May 30, 1970. Accessed March 13, 2017. http://blog.minitab.com/blog/adventures-in-statistics-2/regression-analysis-how-do-i-interpret-r-squared-and-assess-the-goodness-of-fit.

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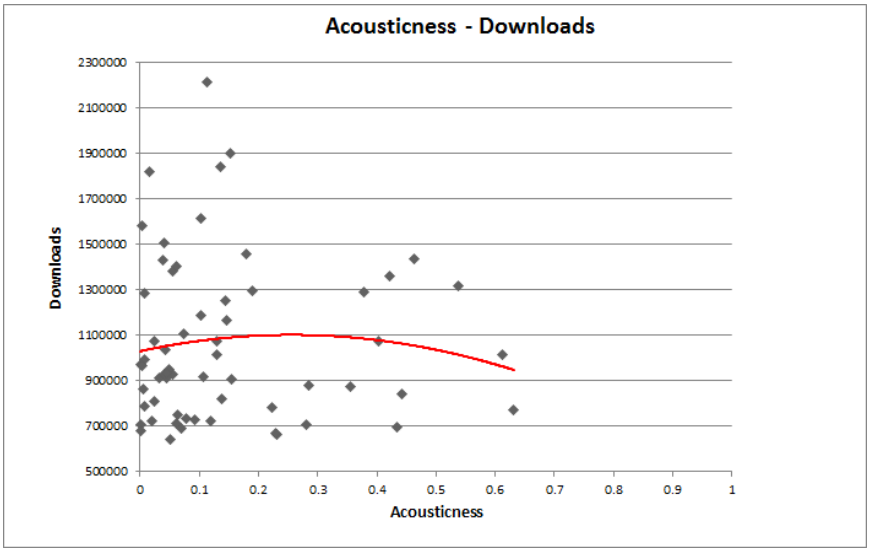


The data points are shown in dark grey, and the line represents the trend line of best fit that matches the data.

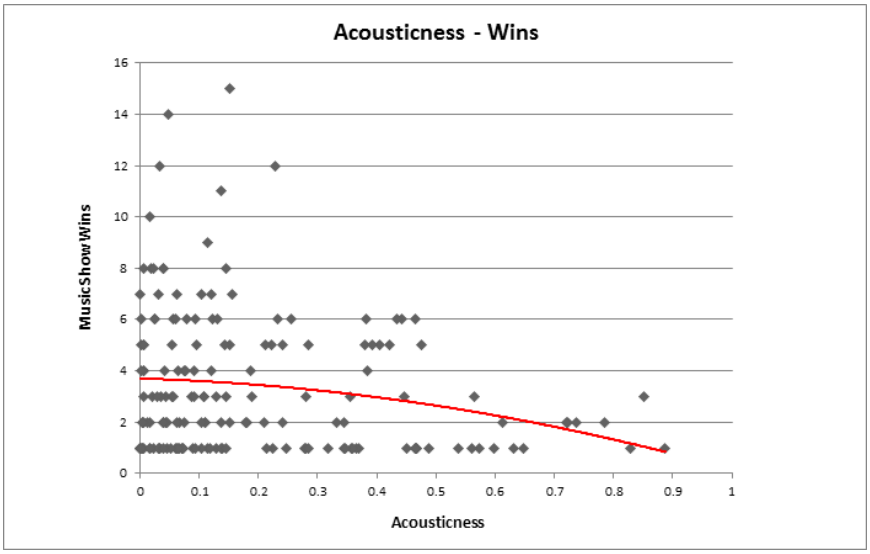
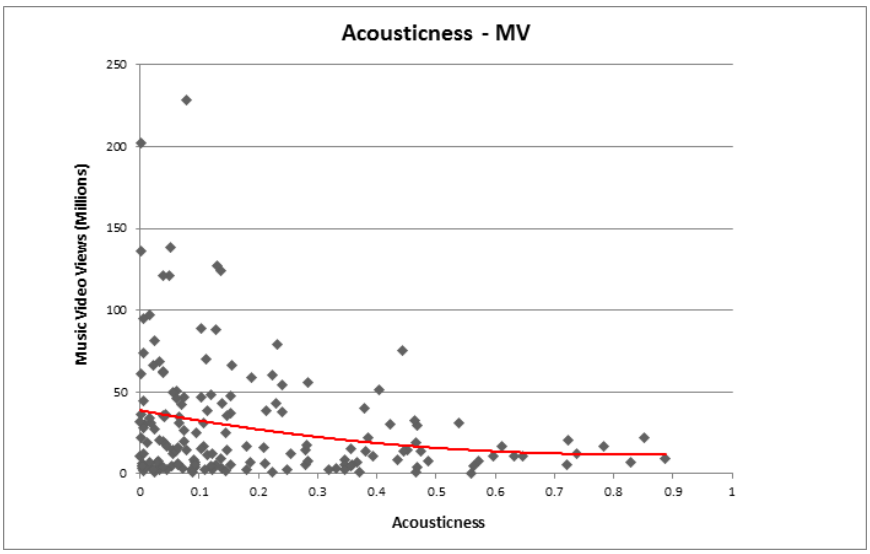


Figure 5: Acousticness Graphs



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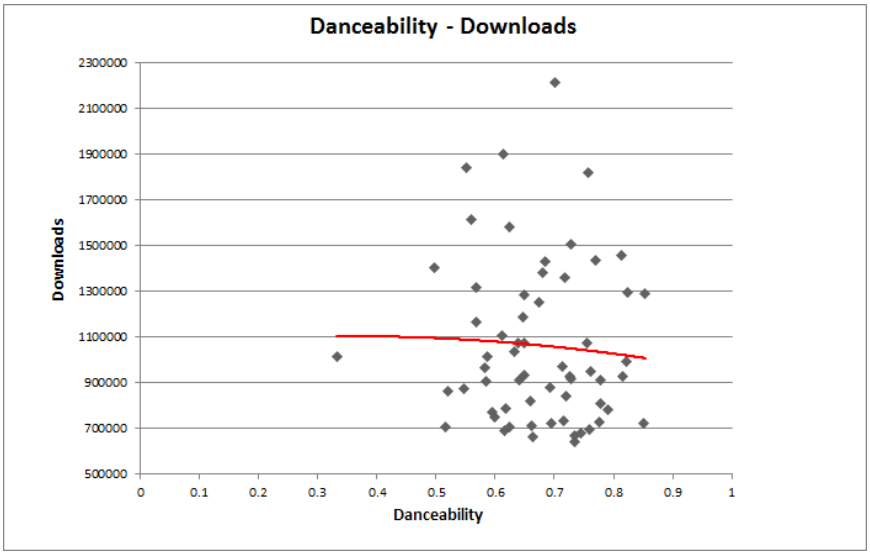

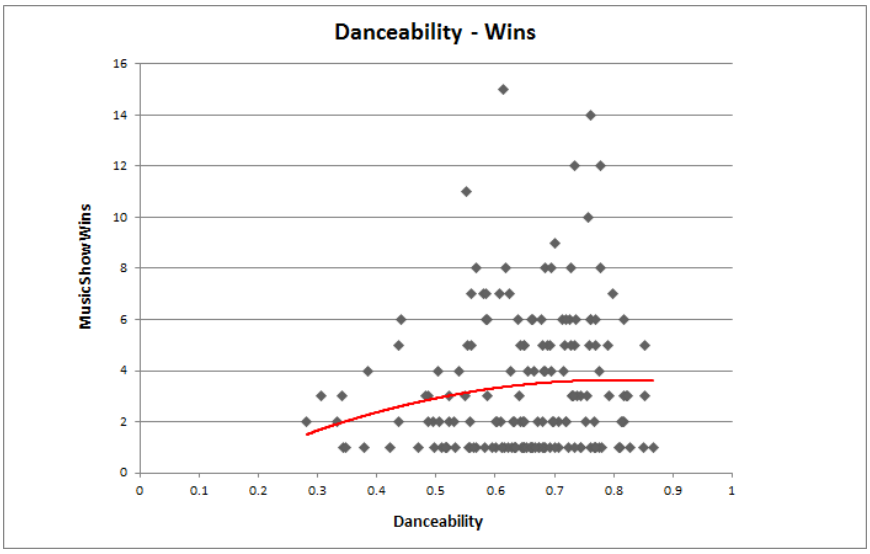

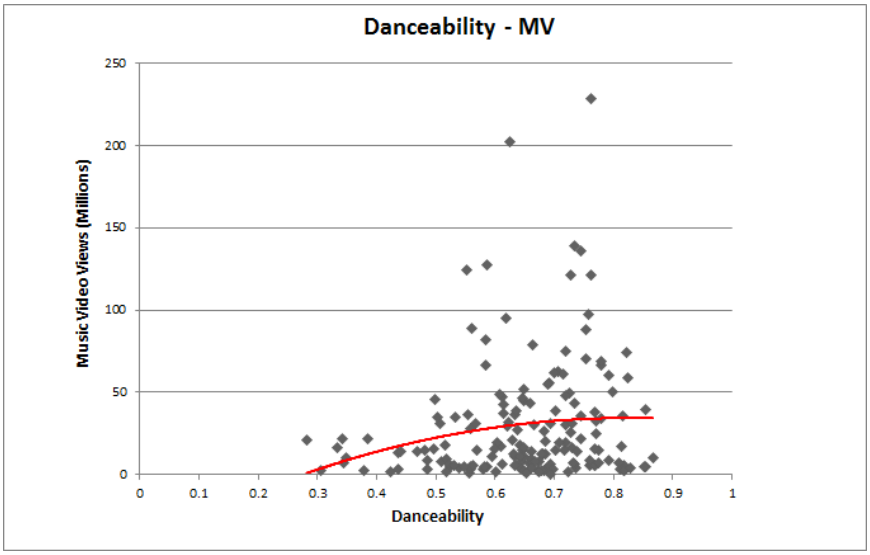

Figure 6: Danceability Graphs

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For the graphs of the acousticness data in **Figure 5**, it appears that the songs with lower acousticness perform better, with a song's success in terms of all three categories (Downloads, MV Views, Show Wins) being inversely proportional with the acousticness. Recall that acousticness measures the absence of electronic amplification, and this trend can likely be explained by a general rise in the presence of electronic and EDM (Electronic Dance Music) influences in K-Pop. Although there are a few acoustic songs that are moderately successful, as they needed to have won a music show to qualify in the data set, acoustic songs generally do not achieve the same levels of success as electronic sound oriented songs. As such, it should be noted that lower levels of acousticness are generally conducive to better financial and popular performance.

For danceability, the graphs in **Figure 6** of MV Views and Show Wins show an upward trend that plateaus after a value of around 0.6. Danceability measures how suitable a song is for dancing, based on tempo, rhythm stability, beat strength, and overall regularity, and a pattern like this can most likely be attributed to a shift of interest towards faster-paced and dance-oriented songs, drawing again on the influence of EDM in K-Pop. The Download graph's fairly straight line is probably due to some outliers, because of the previously mentioned smaller amount of data for that particular comparison. As these regular, constant songs enjoy additional success, it can also be noted that the marginal benefit of higher danceability values decreases, and that the difference in success between songs with values of 0.65 and 0.85 is minimal. As such, songs should generally try to adhere to higher levels of danceability, with a stable rhythm, and regular, strong beats.

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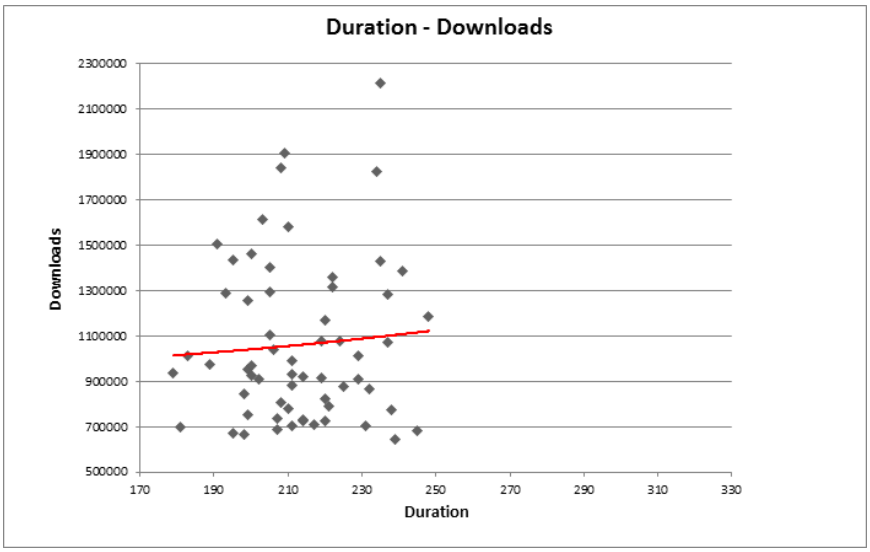

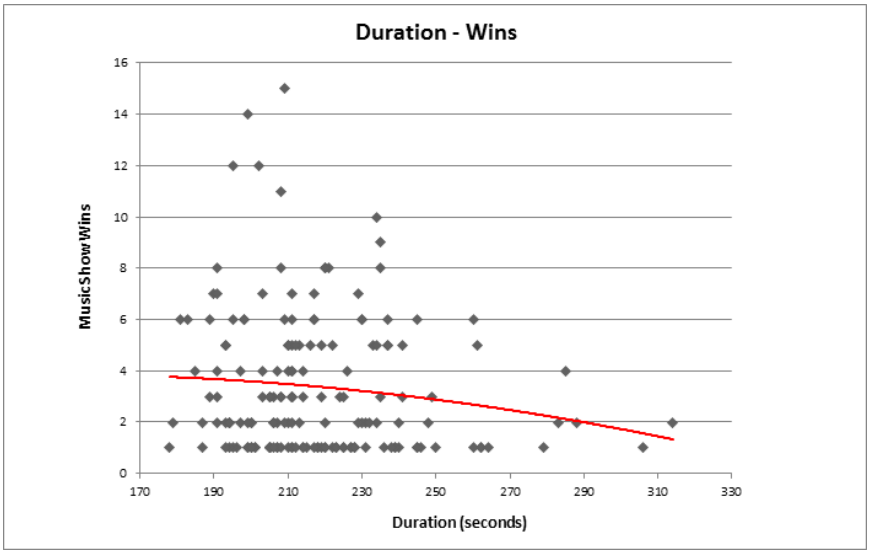

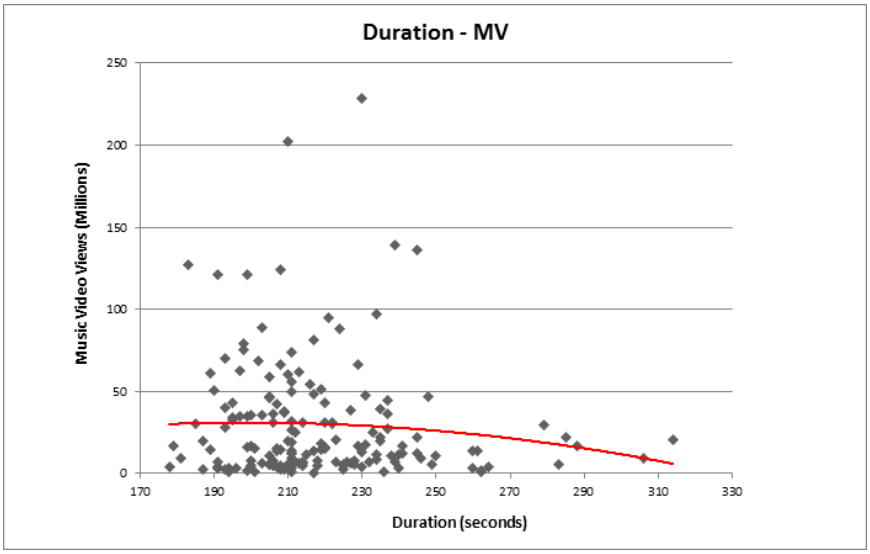

Figure 7: Duration Graphs

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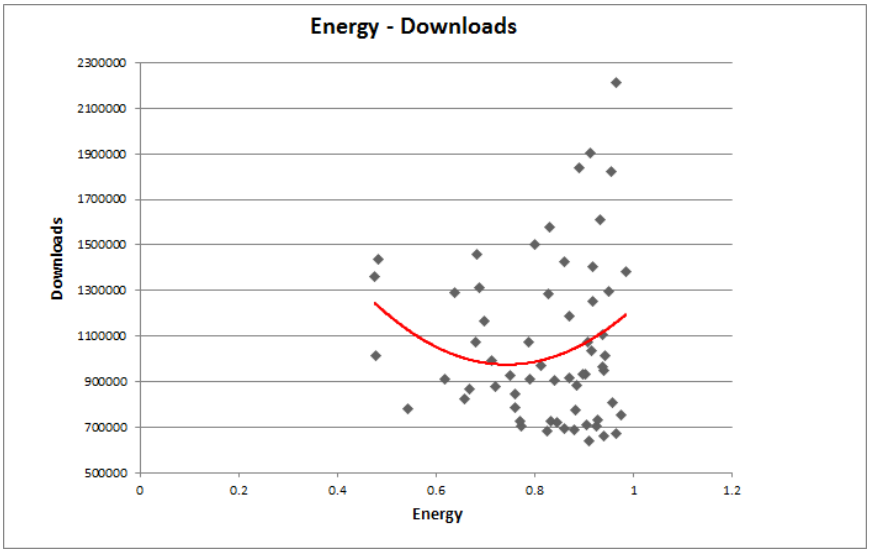

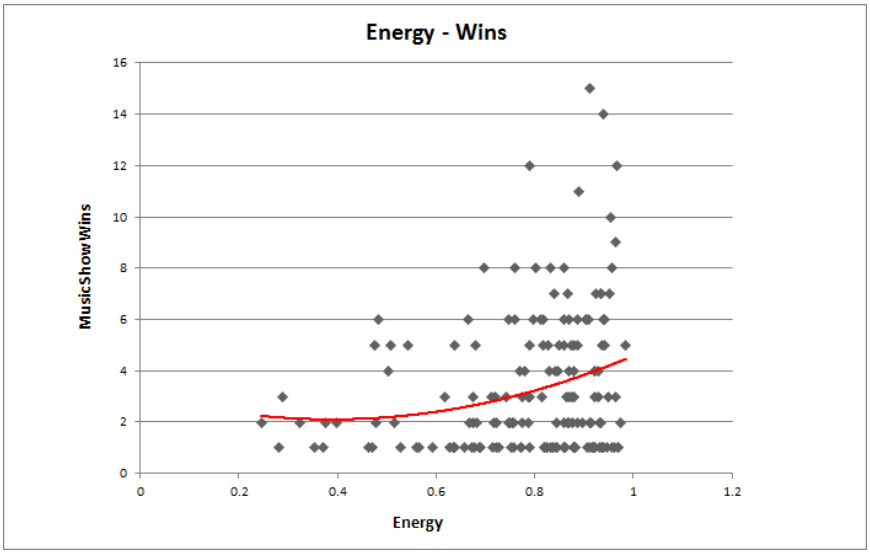

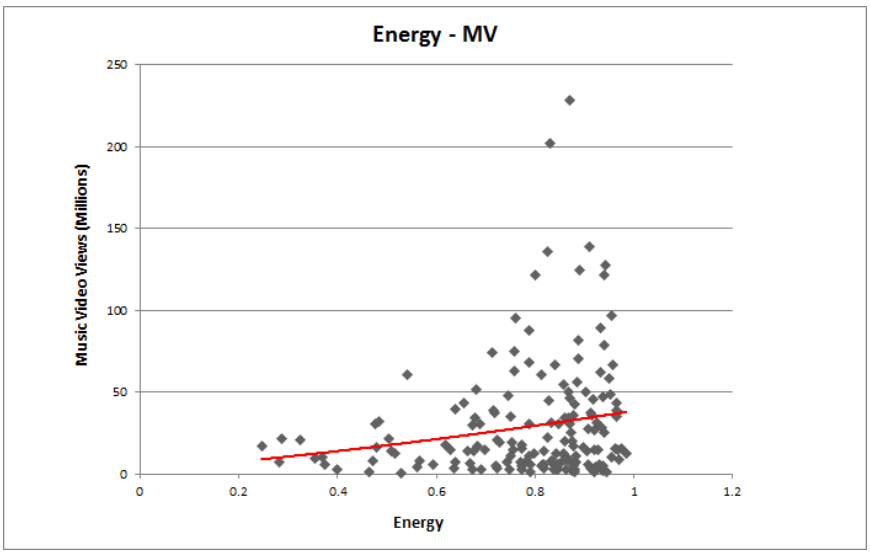

Figure 8: Energy Graphs

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A similar contrast can be found between the Download graph and the MV Views/Show Wins graphs in **Figure 7,** which represents the duration of songs. For this analysis, the results taken from the MV Views/Show Wins will be used, due to the more consistent and reliable amount of data. The trend line for both of these graphs are concave downward and inversely proportional to the length of the songs, meaning that as the length of a song increases, its success decreases exponentially. This hints at an audience that favors shorter songs with a length below 240 seconds, or 4 minutes.

For energy, there exists a nearly linear direct relationship between the value of energy and success in the MV graph. Recall that energy is a measure of intensity and activity in a song, based on dynamic range, perceived loudness, timbre, onset rate, and general entropy. In **Figure 8,** the Download graph shows a higher value of success for lower energy songs as well, but, once again, this may be attributed to variation in the smaller dataset. In the other two graphs, the positive trend is easy to observe, and more energetic songs generally perform better. This relationship reveals another facet of the music's audience, and their preference for more intense and energetic songs.

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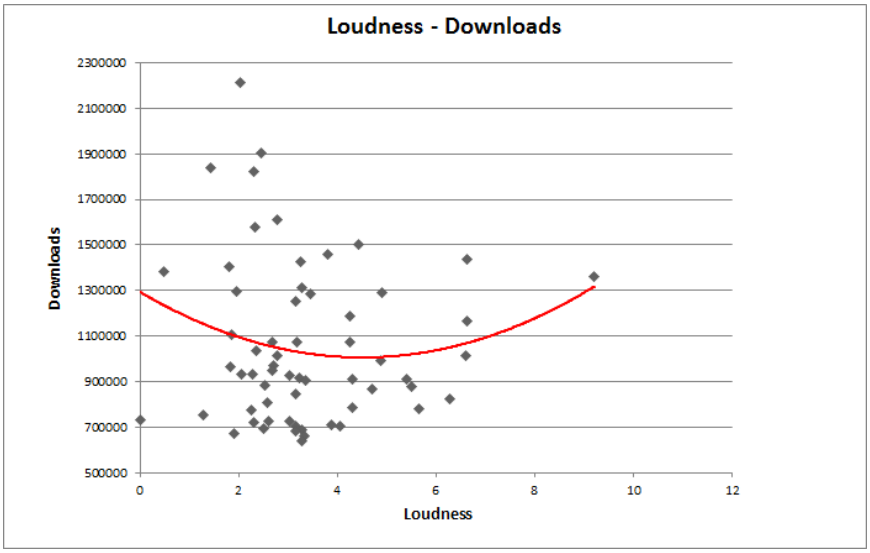

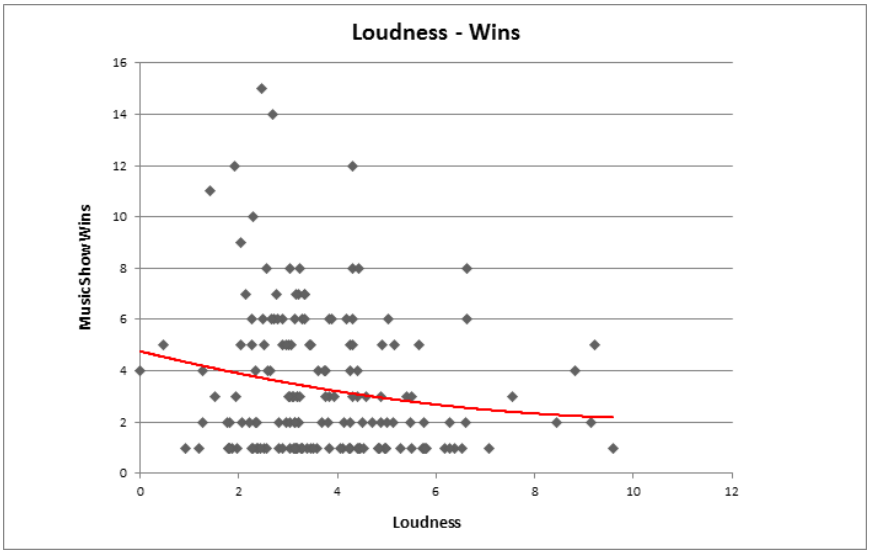

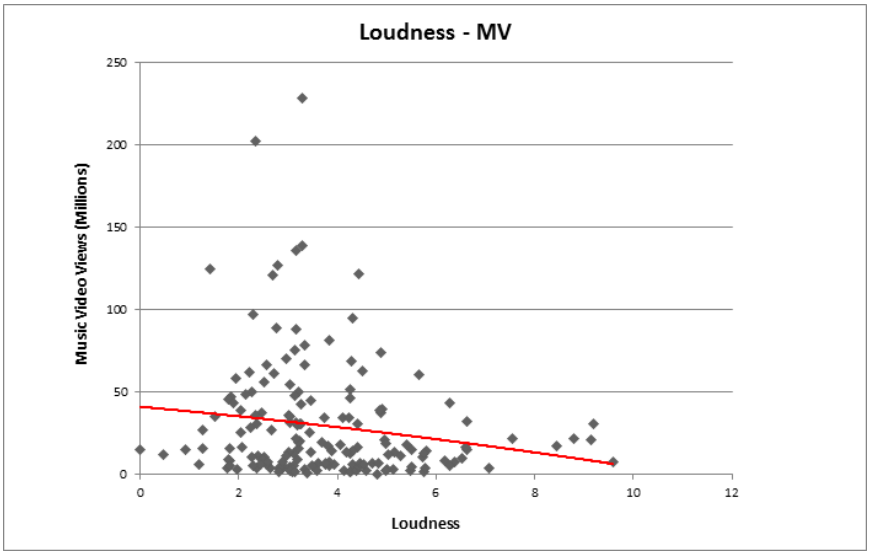

Figure 9: Loudness Graphs

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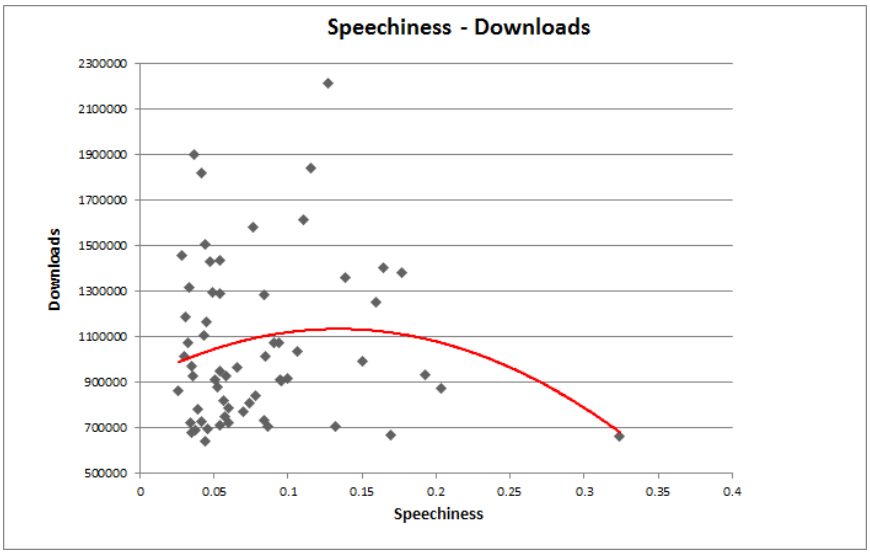

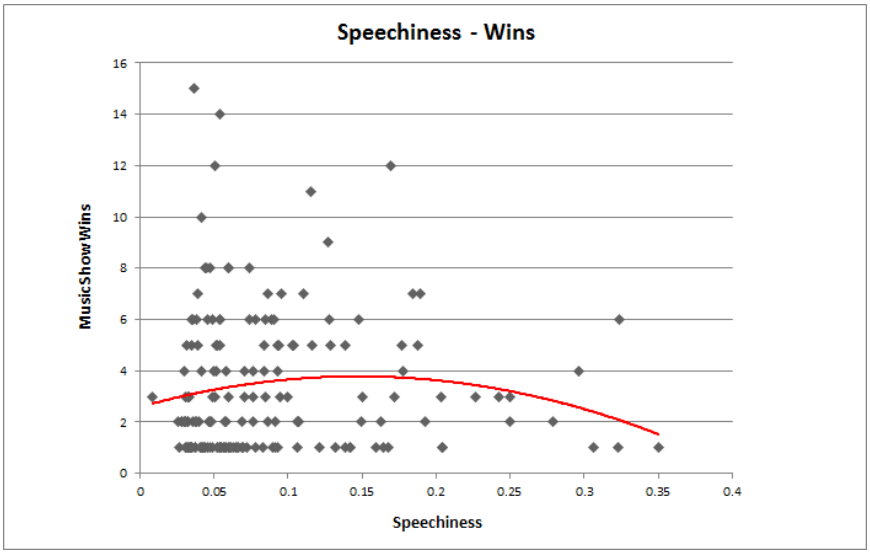

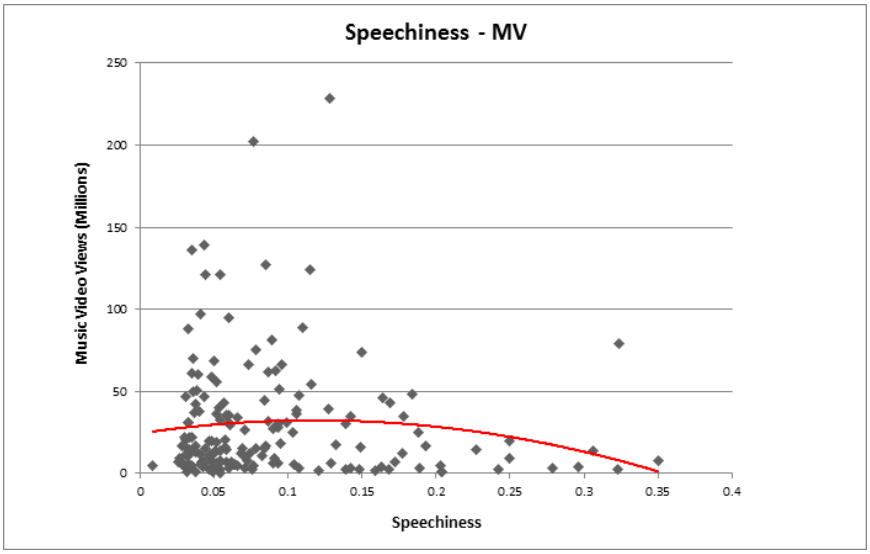

Figure 10: Speechiness Graphs

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In the scales for the loudness graphs in **Figure 9**, the absolute value of the loudness values was taken for ease of comprehension. The Download chart most likely shows contrasting results for aforementioned reasons, but the MV Views and Show Wins diagrams show a negatively sloped line for the data. Due to the absolute value performed on the data, the smaller magnitude values represent louder songs, while larger values represent quieter songs. As expected, louder songs performed better generally, and this can be correlated with the results from the energy graphs, of consumers preferring more intense, dynamic songs.

All of the graphs in the speechiness section, **Figure 10**, show a similar pattern of a concave-downward parabola with a maximum value found around 0.15. This occurrence, of a maximum found in the center of the data set, demonstrate that the two extremes of high or low speechiness do not perform as well as a more moderate level of speechiness, which measured the presence of spoken words in the song. In turn, this demonstrates the appeal of songs with a balance between spoken words and musical aspects, where a proportional amount of each is required to achieve optimal levels of performance and success.

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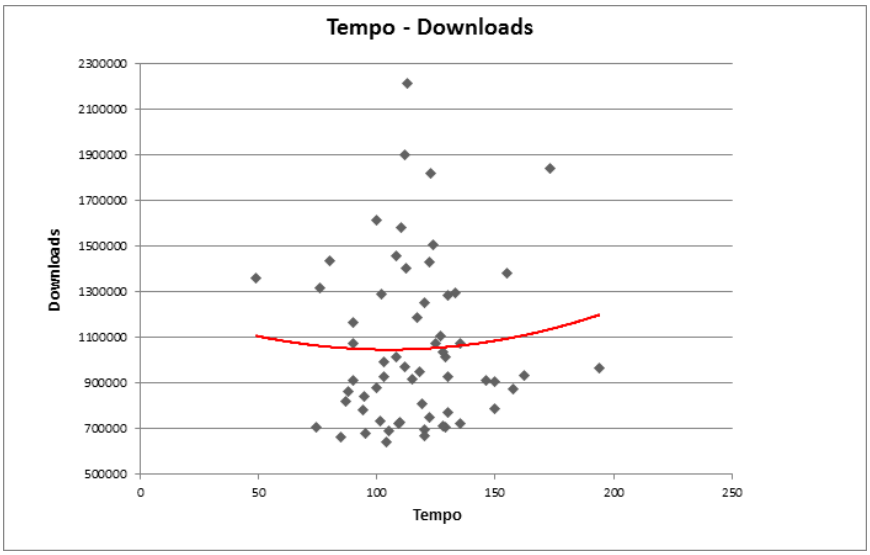

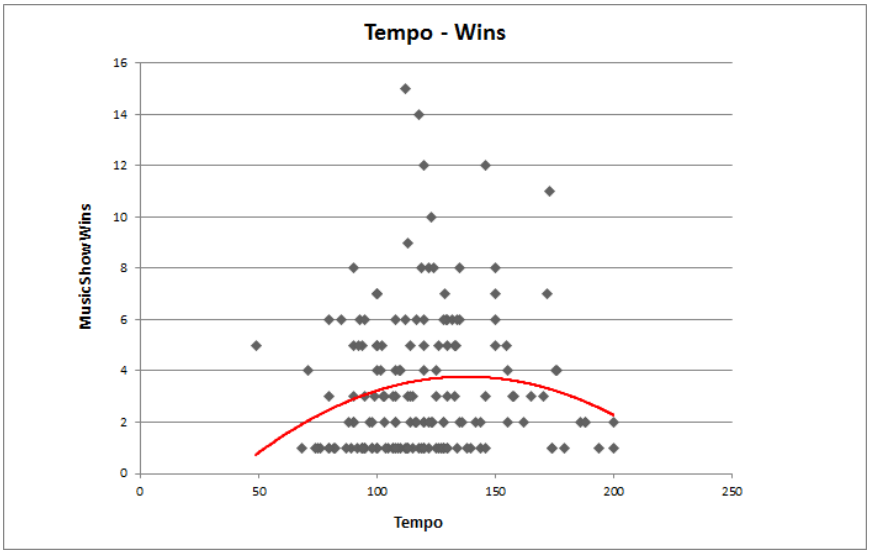

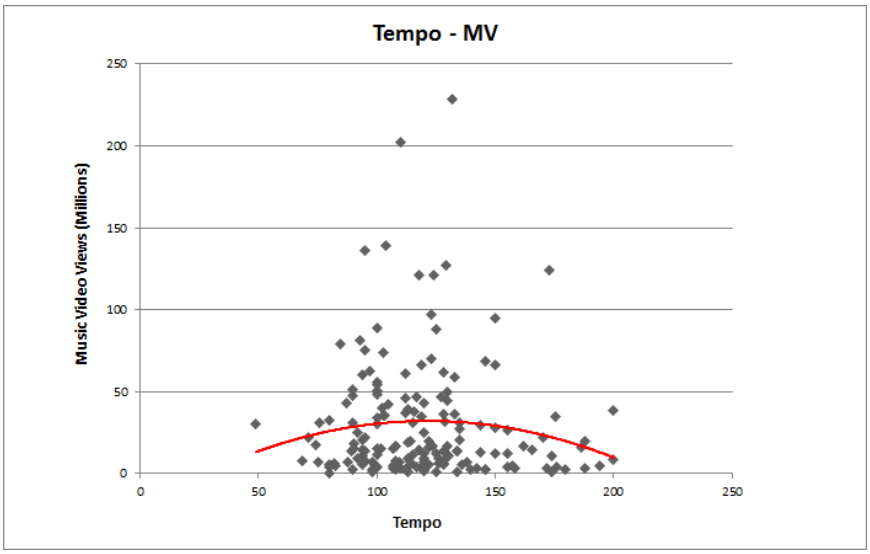

Figure 11: Tempo Graphs

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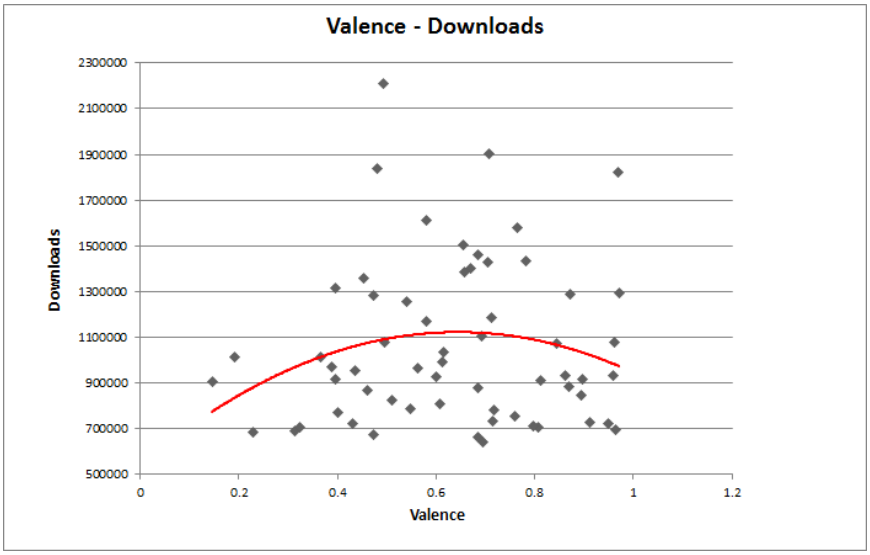

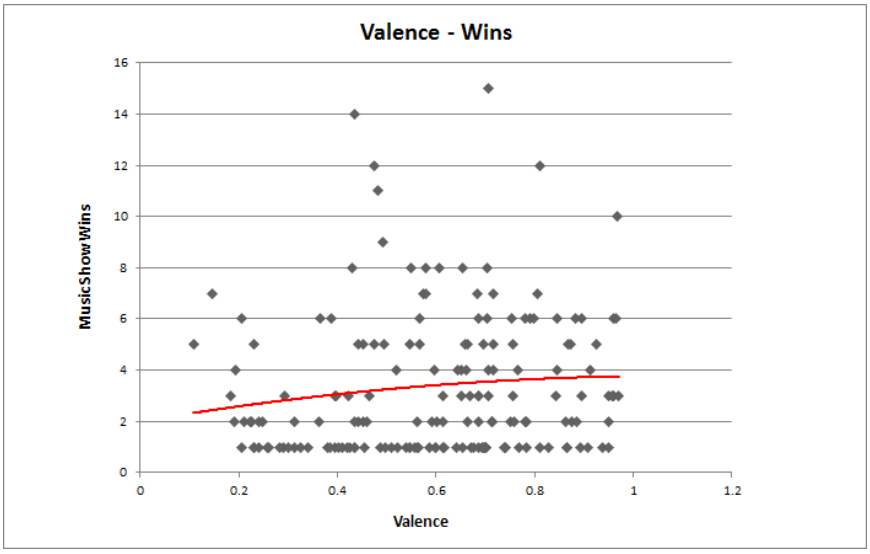

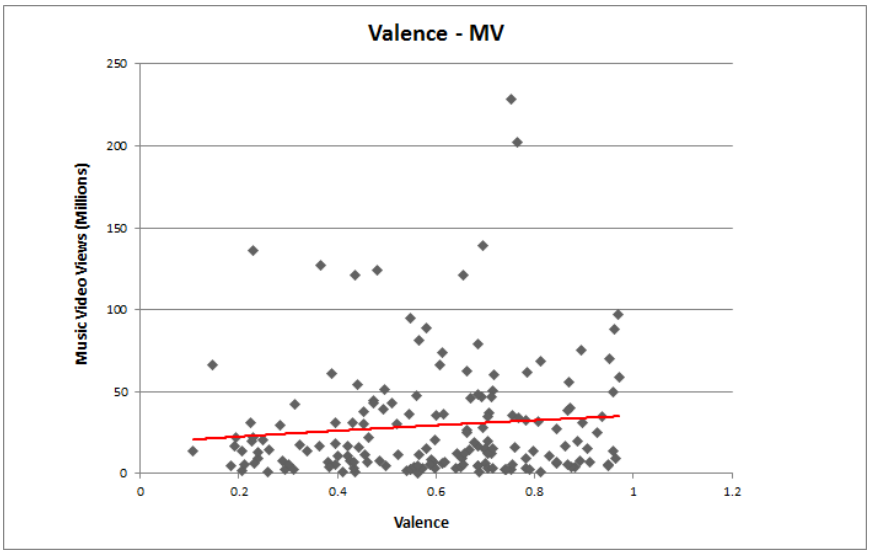

Figure 12: Valence Graphs

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With the exception of the first graph in **Figure 11**, the Tempo-Downloads graph, the other tempo charts display a similar trend as can be seen in speechiness. The parabola in this case has a maximum around 125 beats per minute, effectively illustrating the appeal of intermediate speeds in songs. Songs that exceed or fall below this mark significantly enjoy a similarly poorer reception, having less music video views and winning less music show wins. This value highlights a preference for songs for moderate tempos.

Finally, the valence graphs, which display the general positivity of songs, show a positive correlation between the API values and measures of success. Even the Downloads graph, with its exceptions and less-reliable dataset, possesses an upward-trending line. This pattern perhaps hints at an underlying inclination of the audience towards more upbeat, optimistic sounds, and can be clearly identified in the sequences in **Figure 12.**

VI. CONCLUSION

To summarize, the data shows that in general, successful K-Pop songs are in minor keys, not in D♯/E♭, less acoustic, more danceable, shorter than 4 minutes, highly energetic, loud, intense, and positive, with moderate tempos and an even balance between the use of vocals and music. This conclusion closely matches the initial predictions made prior to performing the methodology, with additional detail, especially pertaining to the durations and tempos of the songs. The potential implications and consequences of this derived conclusion will be discussed in the following section.

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VII. DISCUSSION

This section aims to primarily discuss this research's limitations and implications, as well as potential future directions. The most apparent issue arose with the analysis' dependence on the Spotify API and database. As elaborated in **Section IV**, the segment on the methodology, 23 of the songs were not available on the database and were unable to be examined, cutting down the number of songs available for use. Furthermore, the data storage mechanism of the Gaon chart downloads and streams database meant that data could not be gathered on a large portion of the songs in the desired dataset. As such, outliers had an immense impact on the diagrams involving the number of downloads, skewing the lines that tried to fit the data as a whole. The amount of data on streaming was far too small to be considered significant, and was not even utilized as a part of the analysis. The incompleteness of information concerning the song qualities and the measures of the songs' success presented a substantial limitation in the analysis of the K-Pop genre.

There also exist certain limitations with the K-Pop industry's applicability to specific genres of music. Although K-Pop possesses qualities attractive to this research, as established in **Section III**, the literature review, it is still fundamentally based on pop music. It draws on a variety of aforementioned musical styles, such as hip-hop, R&B, EDM and jazz, but fundamentally, all of these genres share tremendous similarities with popular music around the world, from Europe to the Americas. The results from this research can perhaps be related to those similar markets, but for more niche musical styles, like metal with its own myriad subcategories, to folk and punk, additional research would be necessary in order to generate findings for those respective categories.

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The methodology utilized in the study holds its own potential. As was seen with the R^2 values in **Section VI**, precise predictions can not be made about individual songs due to the large spectrum of values that different tracks can have. However, broader patterns and trends can be discovered, and those still hold value for potential songwriters and producers. As such, this method of quantative music analysis can be further implemented for other markets and genres, even if they share similarities with K-Pop. This is mainly because even though the music may seem similar, the audience's tastes in music could differ, so region- and market-specific analysis is still recommended for optimal results.

Ultimately, although this study's use of software to gather and organize data offered a promising method for quantitatively analyzing music, it is still a fairly novel development and requires supplementary improvement. The author invites individuals well-versed in statistical analysis and data manipulation to further implement and expand the presented methodology. However, this research suggests that the use of this type of quantitative analysis can provide useful insights into a variety of music markets and industries. The specific findings offered in this paper hold promise for the K-Pop industry in terms of crafting successful songs, but additional analysis is still recommended to be performed for other music markets and audiences.

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IX. APPENDIX A

Music Show Wins:

Song Name	Artist	Number of Wins
Lonely Night	Gary	1
Dream	Suzy & Baekhyun	5
Rough	GFriend	15
Rain	Taeyeon	1
You're The Best	Mamamoo	8
Breathe	Lee Hi	2
One of These Nights	Red Velvet	5
A Few Years Later	Block B	1
What the Spring??	10cm	1
Toy	Block B	3
Hopefully Sky	Jung Eun-ji	2
Cheer Up	Twice	11
L.I.E.	EXID	4
Monster	EXO	8
Why	Taeyeon	1
Whistle	Blackpink	3
Lotto	EXO	7
Russian Roulette	Red Velvet	6

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Hard Carry	Got7	4
1 of 1	SHINee	4
Blood Sweat and Tears	BTS	6
Very Very Very	I.O.I.	3
Playing With Fire	Blackpink	2
Bermuda Triangle	Zico	1
Star	Heize	1
Fxxk It	Big Bang	2
Sing For You	EXO	3
Run	BTS	5
Warning Sign	Teen Top	2
Press Your Number	Taemin	4
Remember That	BTOB	3
You're So Fine	CNBlue	6
Dynamite	VIXX	5
Starlight	Taeyeon	1
Ribbon	Beast	2
Whatta Man	I.O.I.	5
Making a New Ending for This Story	Han Dong-geun	1
A Lie	B1A4	3
Boom Boom	Seventeen	3
Last Dance	Big Bang	1
For Life	EXO	1
Daddy	Psy	6
Dumb & Dumber	iKon	3
Sentimental	Winner	1
Don't Forget	Crush	1
Pretty U	Seventeen	2
I Just Wanna Dance	Tiffany	2
Good Luck	AOA	2
She Is	Jonghyun	2
Fantasy	VIXX	3
Flower Way	Kim Se-jeong	1
Pain	SS301	1
Feel So Good	B.A.P.	1
Take Me Now	FTIsland	1

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The Closer	VIXX	1
Hey Mama!	EXO-CBX	1
Skydive	B.A.P.	1
Decalcomanie	Mamamoo	1
Good Boy	G-Dragon & Taeyang	1
Up & Down	EXID	6
Deja-Boo	Jonghyun	6
Fire	Mad Clown	3
One Fine Day	Jung Yong-hwa	3
Pretty	Infinite H	4
Crazy	4Minute	6
Sniper	Shinhwa	7
Ice Cream Cake	Red Velvet	5
Call Me Baby	EXO	14
Ah Yeah	EXID	5
Loser	Big Bang	8
View	SHINee	8
Bang Bang Bang	Big Bang	4
Love Me Right	EXO	8
Shake It	Sistar	5
Sober	Big Bang	2
Party	SNSD	6
Gotta Go To Work	Beast	1
YeY	Beast	4
Let's Not Fall In Love	Big Bang	3
Lion Heart	SNSD	12
Dumb Dumb	Red Velvet	5
My Type	iKon	2
I	Taeyeon	10
Twenty Three	IU	2
Boys and Girls	Zico	1
Apology	iKon	1
Hot Pink	EXID	2
Lovekiller	Niel	1
Growing Pains	Super Junior D & E	1
Pray	FTIsland	3

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I Need U	BTS	5
Bad	Infinite	5
Remember	Apink	3
Married to the Music	SHINee	2
Cinderella	CNBlue	5
4 Walls	f(x)	5
Chained Up	VIXX	3
Young Wild and Free	B.A.P.	2
Insensible	Lee Hong-gi	2
Zutter	G-Dragon & T.O.P.	1
Lean on Me	Soyou & Kwon Jeong-yeol	1
Rhythm Ta	iKon	1
Jam	Dynamic Duo	2
I Am a Woman Too	Minah	1
Heart Attack	AOA	2
Sweet Girl	B1A4	1
Mind Your Own Business	Ailee	1
Way Back Home	BTOB	1
Playground	U-Kiss	1
Bounce	Boyfriend	1
The Answer	Kim Sung-kyu	1
EOEO	Uniq	1
Cupid	Kara	1
Ah-Ah	Teen Top	1
Beautiful Liar	VIXX LR	1
I'm Fine	Kim Dong-wan	1
Friday	IU	2
Something	Girl's Day	5
Something	TVXQ	6
Lonely	B1A4	6
Miniskirt	AOA	1
1004 (Angel)	B.A.P.	3
Some	Soyou & Junggigo	9
Mr. Mr.	SNSD	7
Come Back Home	2NE1	3
Whatcha Doin' Today	4Minute	2

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Playground	U-Kiss	1
Bounce	Boyfriend	1
The Answer	Kim Sung-kyu	1
EOEO	Uniq	1
Cupid	Kara	1
Ah-Ah	Teen Top	1
Beautiful Liar	VIXX LR	1
I'm Fine	Kim Dong-wan	1
Friday	IU	2
Something	Girl's Day	5
Something	TVXQ	6
Lonely	B1A4	6
Miniskirt	AOA	1
1004 (Angel)	B.A.P.	3
Some	Soyou & Junggigo	9
Mr. Mr.	SNSD	7
Come Back Home	2NE1	3
Whatcha Doin' Today	4Minute	2
Wild Flower	Park Hyo-shin	1
Mr. Chu	Apink	5
200%	Akdong Musician	6
Not Spring Love or Cherry Blossoms	HIGH4 & IU	1
Overdose	EXO	6
Eternity	VIXX	2
Eyes Nose Lips	Taeyang	7
Good Luck	Beast	7
Red Light	f(x)	4
Darling	Girl's Day	2
Touch My Body	Sistar	8
Empty	Winner	6
I Swear	Sistar	4
Mamacita	Super Junior	7
Holler	SNSD - TTS	4
How I Am	Kim Dong-ryul	2
Sogyeokdong	IU	1
Error	VIXX	5

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12:30	Beast	6
Miss Me or Diss Me	MC Mong	1
I'm Different	Hi Suhyun	1
LUV	Apink	12
La Song	Rain	1
Can't Stop	CNBlue	2
Last Romeo	Infinite	6
You You You	Fly to the Sky	1
Solo Day	B1A4	3
Danger	Taemin	1
Missing	Teen Top	2
At Gwanghwamun	Kyuhyun	4
30 Sexy	Rain	1
Day 1	K.Will	2
H.E.R	Block B	2
Home	Roy Kim	1
No Make Up	Gaeko	1
Happen Ending	Epik High	3
Without You	Mad Clown & Hyolyn	1
Red	Hyuna	2
Mamma Mia	KARA	1
Like a Cat	AOA	1
Witch	Boyfriend	1
Rewind	Zhou Mi	1
Erase	Hyolyn & Jooyoung	1

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X. APPENDIX B

Music Video Views and Downloads:

Song Name	Artist	Views (Million)	Downloads
Lonely Night	Gary	12.5	**1009082**
Dream	Suzy & Baekhyun	30.4	**1360267**
Rough	GFriend	37.3	**1903126**
Rain	Taeyeon	30.8	**1315393**
You're The Best	Mamamoo	20	**1428938**
Breathe	Lee Hi	17	
One of These Nights	Red Velvet	13.7	
A Few Years Later	Block B	8	
What the Spring??	10cm	10.6	
Toy	Block B	18.1	**913927**
Hopefully Sky	Jung Eun-ji	15.8	
Cheer Up	Twice	124.5	**1839566**
L.I.E.	EXID	26.8	
Monster	EXO	95.2	**789078**
Why	Taeyeon	42.6	**689209**
Whistle	Blackpink	74	**991628**
Lotto	EXO	50.3	
Russian Roulette	Red Velvet	49.9	**930907**
Hard Carry	Got7	30.6	
1 of 1	SHINee	6.4	
Blood Sweat and Tears	BTS	81.6	
Very Very Very	I.O.I.	35.3	
Playing With Fire	Blackpink	62.9	
Bermuda Triangle	Zico	13.9	
Star	Heize	7.7	
Fxxk It	Big Bang	47.9	
Sing For You	EXO	21.8	
Run	BTS	36.2	
Warning Sign	Teen Top	2.7	
Press Your Number	Taemin	7	
Remember That	BTOB	5.2	
You're So Fine	CNBlue	3.8	
Dynamite	VIXX	5.5	
Starlight	Taeyeon	20.8	
Ribbon	Beast	8.4	
Whatta Man	I.O.I.	28.3	

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Making a New Ending for This Story	Han Dong-geun	1.3	
A Lie	B1A4	2.3	
Boom Boom	Seventeen	4.8	
Last Dance	Big Bang	29.7	
For Life	EXO	9.5	
Daddy	Psy	228.6	
Dumb & Dumber	iKon	16.7	
Sentimental	Winner	14.7	
Don't Forget	Crush	14.5	
Pretty U	Seventeen	4.2	
I Just Wanna Dance	Tiffany	19.5	
Good Luck	AOA	19.7	
She Is	Jonghyun	3.2	
Fantasy	VIXX	5	
Flower Way	Kim Se-jeong	7.3	
Pain	SS301	1.4	
Feel So Good	B.A.P.	3	
Take Me Now	FTIsland	1.7	
The Closer	VIXX	2.6	
Hey Mama!	EXO-CBX	34.6	
Skydive	B.A.P.	1.4	
Decalcomanie	Mamamoo	11.3	
Good Boy	G-Dragon & Taeyang	136	
Up & Down	EXID	61	**971632**
Deja-Boo	Jonghyun	2.5	
Fire	Mad Clown	9	
One Fine Day	Jung Yong-hwa	5.9	
Pretty	Infinite H	4.1	
Crazy	4Minute	78.9	**664249**
Sniper	Shinhwa	3.1	
Ice Cream Cake	Red Velvet	56.1	**881597**
Call Me Baby	EXO	121.2	**951930**
Ah Yeah	EXID	51.6	**1076447**
Loser	Big Bang	121.5	**1505163**
View	SHINee	31.1	**724659**
Bang Bang Bang	Big Bang	202.2	**1581284**

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Love Me Right	EXO	66.4	**808257**
Shake It	Sistar	44.8	**1283400**
Sober	Big Bang	70.3	
Party	SNSD	75.2	**843843**
Gotta Go To Work	Beast	6	
YeY	Beast	12.6	
Let's Not Fall In Love	Big Bang	88.1	**1076447**
Lion Heart	SNSD	68.5	**911721**
Dumb Dumb	Red Velvet	60.4	**780846**
My Type	iKon	30.9	
I	Taeyeon	97	**1822590**
Twenty Three	IU	35.4	**926631**
Boys and Girls	Zico	17.9	**705567**
Apology	iKon	15.6	
Hot Pink	EXID	37.7	
Lovekiller	Niel	1.4	
Growing Pains	Super Junior D & E	10.6	
Pray	FTIsland	3	
I Need U	BTS	54.7	
Bad	Infinite	25.2	
Remember	Apink	30.9	**918259**
Married to the Music	SHINee	12.6	
Cinderella	CNBlue	6.3	
4 Walls	f(x)	25.3	
Chained Up	VIXX	14.6	
Young Wild and Free	B.A.P.	3.1	
Insensible	Lee Hong-gi	2.5	
Zutter	G-Dragon & T.O.P.	43.1	**823317**
Lean on Me	Soyou & Kwon Jeong-ye	6	
Rhythm Ta	iKon	34.1	
Jam	Dynamic Duo	3.5	
I Am a Woman Too	Minah	9.1	
Heart Attack	AOA	46.6	**1187652**
Sweet Girl	B1A4	3.5	
Mind Your Own Business	Ailee	11.2	
Way Back Home	BTOB	2.6	

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Playground	U-Kiss	1.2	
Bounce	Boyfriend	4.9	
The Answer	Kim Sung-kyu	2.5	
EOEO	Uniq	5.9	
Cupid	Kara	7.7	
Ah-Ah	Teen Top	7	
Beautiful Liar	VIXX LR	4.2	
I'm Fine	Kim Dong-wan	0.2	
Friday	IU	17.1	**1460219**
Something	Girl's Day	12.2	**1383961**
Something	TVXQ	12.4	
Lonely	B1A4	9	**695394**
Miniskirt	AOA	47.1	**1104681**
1004 (Angel)	B.A.P.	13.8	
Some	Soyou & Junggigo	39	**2212895**
Mr. Mr.	SNSD	66.5	**906962**
Come Back Home	2NE1	58.6	**1294905**
Whatcha Doin' Today	4Minute	20.9	
Wild Flower	Park Hyo-shin	5.5	
Mr. Chu	Apink	39.8	**1290794**
200%	Akdong Musician	32.3	**1436302**
Not Spring Love or Cherry Blossoms	HIGH4 & IU	45.8	**1403026**
Overdose	EXO	127.3	**1014053**
Eternity	VIXX	12.7	
Eyes Nose Lips	Taeyang	89	**1613109**
Good Luck	Beast	31.7	**705909**
Red Light	f(x)	34.6	
Darling	Girl's Day	36.2	**1036598**
Touch My Body	Sistar	15	**1168060**
Empty	Winner	27.3	**1073498**
I Swear	Sistar	15	**733268**
Mamacita	Super Junior	48.5	
Holler	SNSD - TTS	21.9	
How I Am	Kim Dong-ryul	6.7	**866782**
Sogyeokdong	IU	5.8	
Error	VIXX	11.2	

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12:30	Beast	14	**711240**
Miss Me or Diss Me	MC Mong	5.1	**723795**
I'm Different	Hi Suhyun	22.1	**682157**
LUV	Apink	43.3	**672195**
La Song	Rain	10.7	**773111**
Can't Stop	CNBlue	15.8	**753113**
Last Romeo	Infinite	13.8	
You You You	Fly to the Sky	1.8	**1254451**
Solo Day	B1A4	6.9	
Danger	Taemin	19.1	
Missing	Teen Top	5.5	
At Gwanghwamun	Kyuhyun	7.4	**728086**
30 Sexy	Rain	7.9	
Day 1	K.Will	16.6	**933619**
H.E.R	Block B	16.6	**1013651**
Home	Roy Kim	2.5	
No Make Up	Gaeko	3.8	
Happen Ending	Epik High	4.8	**876983**
Without You	Mad Clown & Hyolyn	5	**967646**
Red	Hyuna	61.9	
Mamma Mia	KARA	15.1	
Like a Cat	AOA	38.6	
Witch	Boyfriend	7	
Rewind	Zhou Mi	5.9	
Erase	Hyolyn & Jooyoung	7.5	

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XI. APPENDIX C

API Results:

Song Name	Artist	Danceability	Energy	Key	Loudness	Mode	Speechiness	Acousticness	Valence	Tempo	Duration
Lonely Night	Gary	0.559	0.743	10	-6.741	1	0.0695	0.171	0.506	149.63	217
Dream	Suzy & Baekhyun	0.718	0.476	4	-9.205	1	0.139	0.422	0.453	48.973	222
Rough	GFriend	0.613	0.912	8	-2.464	1	0.0366	0.152	0.707	112.005	209
Rain	Taeyeon	0.567	0.687	8	-3.269	1	0.0329	0.538	0.396	76.024	222
You're The Best	Mamamoo	0.684	0.86	5	-3.243	0	0.0471	0.0395	0.704	122.03	235
Breathe	Lee Hi	0.609	0.246	8	-8.449	1	0.0376	0.784	0.364	123.773	288
One of These Nights	Red Velvet	0.436	0.509	6	-5.161	0	0.0345	0.475	0.108	133.653	261
A Few Years Later	Block B	0.644	0.565	10	-6.174	1	0.35	0.487	0.487	95.024	228
What the Spring??	10cm	0.866	0.37	1	-5.739	1	0.0327	0.597	0.829	94.018	205
Toy	Block B	0.641	0.618	7	-5.397	1	0.0949	0.0441	0.396	90.107	219
Hopefully Sky	Jung Eun-ji	0.495	0.774	0	-3.214	0	0.149	0.209	0.443	186.165	220
Cheer Up	Twice	0.552	0.89	6	-1.425	1	0.115	0.136	0.481	172.97	208
L.I.E.	EXID	0.682	0.921	1	-1.261	1	0.0707	0.0742	0.662	155.054	211
Monster	EXO	0.618	0.76	6	-4.312	1	0.0596	0.0066	0.549	150	221
Why	Taeyeon	0.615	0.879	6	-3.275	0	0.0377	0.0702	0.313	105.026	207
Whistle	Blackpink	0.822	0.712	11	-4.877	1	0.15	0.00682	0.614	102.874	211
Lotto	EXO	0.798	0.867	11	-3.207	0	0.0386	0.0618	0.715	99.996	190
Russian Roulette	Red Velvet	0.726	0.903	7	-2.277	0	0.0357	0.055	0.96	129.986	211
Hard Carry	Got7	0.666	0.847	1	-4.412	1	0.0929	0.00685	0.52	99.999	185
1 of 1	SHINee	0.694	0.879	5	-3.765	0	0.0515	0.0635	0.845	108.045	203
Blood Sweat and Tears	BTS	0.585	0.887	0	-3.825	0	0.089	0.0244	0.566	92.971	217
Very Very Very	I.O.I.	0.745	0.965	7	-1.517	1	0.06	0.146	0.755	102.994	203
Playing With Fire	Blackpink	0.707	0.758	4	-4.511	0	0.0917	0.0399	0.663	97.037	197
Bermuda Triangle	Zico	0.469	0.819	3	-3.469	0	0.306	0.0592	0.34	89.013	207
Star	Heize	0.509	0.471	11	-6.374	0	0.0721	0.572	0.29	68.426	218
Fxxk It	Big Bang	0.72	0.746	0	-3.143	0	0.107	0.152	0.561	90.026	231
Sing For You	EXO	0.341	0.288	8	-7.544	1	0.0335	0.852	0.464	170.202	235
Run	BTS	0.554	0.878	11	-3.02	0	0.0513	0.00146	0.546	132.889	237
Warning Sign	Teen Top	0.672	0.845	3	-4.14	0	0.0463	0.18	0.752	98.043	194
Press Your Number	Taemin	0.656	0.78	10	-3.609	0	0.058	0.186	0.596	120.021	226
Remember That	BTOB	0.523	0.774	3	-3.831	1	0.0304	0.564	0.397	79.961	249
You're So Fine	CNBlue	0.737	0.818	8	-2.892	1	0.0492	0.0936	0.883	116.93	230
Dynamite	VIXX	0.759	0.816	6	-2.898	0	0.104	0.152	0.756	113.953	210
Starlight	Taeyeon	0.628	0.723	1	-4.962	0	0.0571	0.0329	0.599	93.958	223
Ribbon	Beast	0.486	0.867	0	-1.818	1	0.0475	0.345	0.591	199.982	234
Whatta Man	I.O.I.	0.559	0.936	6	-2.254	0	0.0931	0.0063	0.696	150.065	193
Making a New Ending for T	Han Dong-geun	0.556	0.464	3	-5.751	1	0.0374	0.37	0.259	134.1	262
A Lie	B1A4	0.305	0.875	7	-4.583	1	0.242	0.0862	0.293	145.973	208
Boom Boom	Seventeen	0.853	0.814	8	-3.047	1	0.0766	0.0347	0.686	108.111	206
Last Dance	Big Bang	0.621	0.673	1	-3.194	0	0.0606	0.467	0.283	143.889	279
For Life	EXO	0.517	0.353	3	-6.522	1	0.0268	0.887	0.24	91.736	246
Daddy	Psy	0.762	0.87	6	-3.287	0	0.128	0.0788	0.753	132.049	230
Dumb & Dumber	iKon	0.729	0.878	1	-4.402	1	0.085	0.108	0.422	129.96	241
Sentimental	Winner	0.775	0.756	7	-5.513	1	0.058	0.279	0.7	118.019	208
Don't Forget	Crush	0.646	0.628	5	-5.81	1	0.0337	0.451	0.262	93.897	219

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Pretty U	Seventeen	0.642	0.931	8	-2.82	1	0.163	0.0173	0.875	155.088	207
I Just Wanna Dance	Tiffany	0.72	0.754	5	-3.675	1	0.0481	0.0128	0.227	114.054	210
Good Luck	AOA	0.603	0.876	5	-3.217	0	0.25	0.0745	0.886	187.936	187
She Is	Jonghyun	0.697	0.723	0	-5.134	1	0.107	0.00353	0.781	119.966	191
Fantasy	VIXX	0.586	0.929	7	-3.107	0	0.00847	0.0533	0.184	106.938	208
Flower Way	Kim Se-jeong	0.344	0.281	1	-9.59	1	0.0545	0.828	0.381	74.998	239
Pain	SS301	0.724	0.79	5	-3.101	0	0.0314	0.465	0.687	124.975	211
Feel So Good	B.A.P.	0.811	0.845	10	-1.964	0	0.06	0.0458	0.641	110.031	196
Take Me Now	FTIsland	0.518	0.937	9	-4.268	0	0.121	0.00504	0.206	119.852	262
The Closer	VIXX	0.648	0.837	11	-3.598	0	0.139	0.0337	0.548	139.82	225
Hey Mama!	EXO-CBX	0.532	0.859	1	-4.106	1	0.142	0.0662	0.937	118.919	199
Skydive	B.A.P.	0.423	0.921	11	-2.816	0	0.204	0.0236	0.435	174.031	236
Decalcomanie	Mamamoo	0.648	0.859	10	-2.384	1	0.0472	0.114	0.523	115.436	215
Good Boy	G-Dragon & Taeyang	0.745	0.825	1	-3.162	0	0.0352	0.000875	0.23	95.001	245
Up & Down	EXID	0.714	0.812	7	-2.703	1	0.0351	0.00189	0.388	112.018	189
Deja-Boo	Jonghyun	0.818	0.748	5	-4.296	1	0.148	0.122	0.79	108.117	209
Fire	Mad Clown	0.792	0.864	9	-3.19	1	0.25	0.0914	0.652	113.061	211
Pretty	Infinite H	0.818	0.79	4	-3.931	0	0.0325	0.28	0.95	98.994	205
Crazy	4Minute	0.539	0.922	7	-2.643	1	0.296	0.00691	0.651	176.079	191
Sniper	Shinhwa	0.663	0.94	10	-3.337	0	0.324	0.232	0.685	84.851	198
Ice Cream Cake	Red Velvet	0.58	0.935	9	-3.348	1	0.189	0.0318	0.574	172.023	191
Call Me Baby	EXO	0.692	0.886	1	-2.519	1	0.0519	0.284	0.869	100.03	211
Ah Yeah	EXID	0.762	0.939	11	-2.688	0	0.054	0.0483	0.435	117.986	199
Loser	Big Bang	0.648	0.681	0	-4.251	0	0.0937	0.404	0.495	89.947	219
View	SHINee	0.728	0.801	6	-4.428	0	0.0439	0.04	0.655	123.953	191
Bang Bang Bang	Big Bang	0.694	0.832	5	-3.038	0	0.0598	0.0192	0.431	135.011	220
Love Me Right	EXO	0.625	0.83	0	-2.33	1	0.0764	0.00266	0.766	110.04	210
Shake It	Sistar	0.778	0.957	11	-2.57	0	0.0735	0.0234	0.607	118.997	208
Sober	Big Bang	0.649	0.827	5	-3.465	1	0.0838	0.00676	0.474	129.963	237
Party	SNSD	0.753	0.887	10	-2.975	0	0.0359	0.111	0.951	122.981	193
Gotta Go To Work	Beast	0.719	0.759	2	-3.144	1	0.0781	0.443	0.895	94.93	198
YeY	Beast	0.611	0.907	2	-1.189	0	0.0929	0.345	0.701	127.961	214
Let's Not Fall In Love	Big Bang	0.685	0.843	0	-4.258	1	0.0499	0.121	0.643	125.029	211
Lion Heart	SNSD	0.754	0.788	2	-3.175	1	0.0322	0.129	0.961	124.992	224
Dumb Dumb	Red Velvet	0.778	0.789	7	-4.297	0	0.0503	0.0334	0.811	145.99	202
My Type	iKon	0.791	0.542	5	-5.659	0	0.0388	0.223	0.717	93.98	210
I	Taeyeon	0.506	0.788	9	-2.372	1	0.0324	0.0666	0.224	89.993	206
Twenty Three	IU	0.757	0.955	5	-2.299	0	0.0412	0.0168	0.968	122.952	234
Boys and Girls	Zico	0.815	0.75	1	-3.029	1	0.0581	0.0399	0.601	103.037	200
Apology	iKon	0.515	0.773	6	-4.066	1	0.132	0.281	0.325	74.146	231

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Hot Pink	EXID	0.769	0.962	1	-1.812	1	0.0691	0.357	0.699	107.008	201
Lovekiller	Niel	0.768	0.718	2	-4.892	1	0.0402	0.241	0.453	115.979	209
Growing Pains	Super Junior D & E	0.601	0.879	6	-4.256	1	0.0491	0.224	0.41	112.972	201
Pray	FTIsland	0.348	0.956	9	-2.511	1	0.0826	0.000271	0.42	173.786	250
I Need U	BTS	0.486	0.88	5	-3.097	0	0.0706	0.0215	0.705	158.043	211
Bad	Infinite	0.689	0.858	0	-3.051	1	0.116	0.24	0.442	99.994	216
Remember	Apink	0.77	0.873	1	-3.444	1	0.103	0.144	0.663	120.007	233
Married to the Music	SHINee	0.729	0.869	10	-3.24	0	0.0994	0.107	0.896	114.995	214
Cinderella	CNBlue	0.68	0.858	0	-3.126	1	0.0686	0.00635	0.713	119.985	211
4 Walls	f(x)	0.735	0.849	4	-4.308	0	0.129	0.212	0.231	125.972	213
Chained Up	VIXX	0.728	0.941	9	-2.044	0	0.188	0.0955	0.926	92.073	212
Young Wild and Free	B.A.P.	0.482	0.921	11	-4.31	1	0.227	0.056	0.668	165.401	189
Insensible	Lee Hong-gi	0.437	0.674	7	-4.995	1	0.032	0.138	0.434	141.955	240
Zutter	G-Dragon & T.O.P.	0.817	0.399	10	-5.482	0	0.076	0.11	0.312	90.015	194
Lean on Me	Soyou & Kwon Jeon	0.659	0.657	10	-6.266	1	0.0568	0.139	0.51	87	220
Rhythm Ta	iKon	0.762	0.819	7	-4.459	1	0.0897	0.129	0.613	81.981	227
Jam	Dynamic Duo	0.779	0.677	10	-4.242	0	0.066	0.0156	0.768	99.967	195
I Am a Woman Too	Minah	0.558	0.912	1	-1.758	0	0.279	0.332	0.714	187.979	194
Heart Attack	AOA	0.661	0.97	0	-1.802	1	0.091	0.137	0.782	125.993	306
Sweet Girl	B1A4	0.647	0.87	0	-4.249	1	0.0305	0.103	0.713	116.969	248
Mind Your Own Business	Ailee	0.685	0.921	8	-2.357	0	0.142	0.073	0.598	106.95	260
Way Back Home	BTOB	0.633	0.751	7	-5.272	1	0.0411	0.647	0.455	129.885	240
Playground	U-Kiss	0.683	0.69	9	-4.396	0	0.0543	0.318	0.739	111.949	210
Bounce	Boyfriend	0.652	0.946	4	-3.385	0	0.204	0.0893	0.811	98.003	194
The Answer	Kim Sung-kyu	0.558	0.878	0	-4.427	1	0.0351	0.00452	0.497	82.48	218
EOEO	Uniq	0.679	0.862	9	-3.037	0	0.168	0.248	0.742	145.966	187
Cupid	Kara	0.768	0.845	6	-2.567	0	0.0644	0.00532	0.866	122.003	205
Ah-Ah	Teen Top	0.674	0.833	11	-3.824	1	0.0543	0.0314	0.426	128.031	200
Beautiful Liar	VIXX LR	0.664	0.882	7	-4.449	1	0.0544	0.366	0.434	137.972	223
I'm Fine	Kim Dong-wan	0.662	0.56	5	-7.076	1	0.0306	0.467	0.384	80.018	178
Friday	IU	0.693	0.529	9	-4.819	1	0.0539	0.56	0.563	80.026	217
Something	Girl's Day	0.813	0.683	6	-3.813	0	0.0285	0.179	0.685	107.95	200
Something	TVXQ	0.68	0.985	2	-0.47	0	0.177	0.0546	0.658	154.942	241
Lonely	B1A4	0.678	0.798	9	-5.04	1	0.074	0.255	0.704	150.037	245
Miniskirt	AOA	0.76	0.859	5	-2.501	1	0.046	0.434	0.964	119.987	181

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1004 (Angel)	B.A.P.	0.612	0.937	2	-1.855	1	0.0435	0.0733	0.693	126.983	205
Some	Soyou & Junggigo	0.738	0.676	11	-3.025	0	0.0507	0.446	0.958	95.04	211
Mr. Mr.	SNSD	0.701	0.964	4	-2.037	0	0.127	0.114	0.492	113.058	235
Come Back Home	2NE1	0.585	0.84	0	-3.349	0	0.0957	0.155	0.147	149.855	229
Whatcha Doin' Today	4Minute	0.823	0.949	11	-1.954	0	0.0487	0.189	0.971	133.025	205
Wild Flower	Park Hyo-shin	0.281	0.323	8	-9.145	1	0.031	0.722	0.249	134.824	314
Mr. Chu	Apink	0.769	0.837	2	-3.499	1	0.0631	0.359	0.587	120.005	205
200%	Akdong Musician	0.853	0.638	1	-4.911	1	0.0536	0.379	0.873	102.06	193
Not Spring Love or Cherry	HIGH4 & IU	0.77	0.484	7	-6.626	1	0.0538	0.464	0.781	79.988	195
Overdose	EXO	0.498	0.917	5	-1.797	0	0.164	0.0615	0.671	112.357	205
Eternity	VIXX	0.586	0.942	0	-2.791	0	0.0848	0.13	0.366	129.088	183
Eyes Nose Lips	Taeyang	0.631	0.516	0	-5.759	1	0.0378	0.738	0.24	143.777	230
Good Luck	Beast	0.56	0.933	10	-2.776	0	0.11	0.103	0.58	99.966	203
Red Light	f(x)	0.623	0.924	7	-3.162	1	0.0862	0.000457	0.806	128.947	211
Darling	Girl's Day	0.503	0.868	11	-3.727	0	0.178	0.0414	0.705	175.62	197
Touch My Body	Sistar	0.633	0.915	9	-2.347	1	0.106	0.0437	0.615	128.033	206
Empty	Winner	0.568	0.698	0	-6.618	1	0.0445	0.146	0.58	90.119	220
I Swear	Sistar	0.638	0.908	8	-2.67	1	0.0902	0.0242	0.845	134.955	237
Mamacita	Super Junior	0.716	0.928	7	-0.005	1	0.084	0.0777	0.715	101.564	207
Holler	SNSD - TTS	0.608	0.952	10	-2.144	0	0.184	0.12	0.684	100.025	217
How I Am	Kim Dong-ryul	0.385	0.504	7	-8.806	0	0.03	0.385	0.194	71.006	285
Sogyeokdong	IU	0.521	0.668	1	-4.714	1	0.0258	0.00465	0.461	87.919	232
Error	VIXX	0.563	0.931	5	-2.436	0	0.052	0.0636	0.301	128.019	225
12:30	Beast	0.642	0.789	1	-2.959	1	0.0312	0.393	0.566	100.007	234
Miss Me or Diss Me	MC Mong	0.662	0.904	8	-3.877	0	0.0539	0.0606	0.797	127.953	217
I'm Different	Hi Suhyun	0.851	0.845	2	-2.293	0	0.0342	0.119	0.949	108.998	214
Good Boy	G-Dragon x Taeyang	0.745	0.825	1	-3.162	0	0.0352	0.000875	0.23	95.001	245
LUV	Apink	0.735	0.911	6	-3.282	0	0.0437	0.0511	0.696	103.978	239
La Song	Rain	0.734	0.966	0	-1.905	1	0.169	0.229	0.474	119.975	195
Can't Stop	CNBlue	0.595	0.882	1	-2.256	1	0.0697	0.631	0.402	130.02	238
Last Romeo	Infinite	0.6	0.974	11	-1.277	0	0.0575	0.0632	0.759	122.057	199
You You You	Fly to the Sky	0.441	0.664	7	-4.178	1	0.0379	0.381	0.206	133.822	260
Solo Day	B1A4	0.674	0.918	0	-3.144	1	0.159	0.145	0.54	119.977	199
Danger	Taemin	0.732	0.743	1	-3.765	1	0.172	0.0295	0.844	114.051	191
Missing	Teen Top	0.708	0.728	0	-4.974	0	0.052	0.465	0.677	112.97	211
At Gwanghwamun	Kyuhyun	0.53	0.375	3	-6.268	1	0.0285	0.72	0.211	135.821	283
30 Sexy	Rain	0.775	0.77	8	-2.594	1	0.0413	0.0919	0.912	109.522	214
Day 1	K.Will	0.667	0.836	4	-2.894	1	0.0454	0.284	0.893	107.984	206
H.E.R	Block B	0.648	0.897	8	-2.057	1	0.193	0.0453	0.863	162.014	179
Home	Roy Kim	0.333	0.479	2	-6.592	1	0.0299	0.612	0.191	107.953	229
No Make Up	Gaeko	0.379	0.773	0	-4.992	1	0.323	0.346	0.547	179.334	193
Happen Ending	Epik High	0.828	0.636	11	-5.78	0	0.0427	0.0397	0.556	100.006	264
Without You	Mad Clown & Hyoly	0.548	0.72	5	-5.5	1	0.203	0.356	0.686	157.467	225
Red	Hyuna	0.582	0.938	9	-1.829	1	0.0658	0.00287	0.564	193.91	200
Mamma Mia	KARA	0.699	0.933	0	-2.21	1	0.0864	0.0398	0.784	128.108	213
Like a Cat	AOA	0.701	0.968	1	-0.913	1	0.078	0.103	0.908	100.009	220
Witch	Boyfriend	0.635	0.715	11	-4.848	0	0.106	0.213	0.866	199.971	227
Rewind	Zhou Mi	0.808	0.638	7	-4.834	1	0.0614	0.0164	0.617	97.942	212
Erase	Hyolyn & Jooyoung	0.634	0.593	3	-4.522	0	0.0406	0.0936	0.655	94.091	228

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XII. APPENDIX D

Songs not included:

Fly	Got7
Fire	BTS
So-So	Baek A-yeon
I Like That	Sistar
Why So Lonely	Wonder Girls
Navillera	GFriend
How's This?	Hyuna
The Eye	Infinite
TT	Twice
You From The Same Time	Naul
One Fine Day	Jung Yong-hwa
Love Equation	VIXX
Love Again	Im Chang-jung
Cry Again	Davichi
Shouldn't Have	Baek A-yeon
Just	Zion.T & Crush
My House	2 P M
If You Do	Got7
Full Moon	Sunmi
Don't Touch Me	Ailee
Three of Us	Toy
Singing Got Better	Ailee
Night and Day	Wheesung

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AP® RESEARCH
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Academic Paper

Sample: B
1 Understand and Analyze Context Score: 6
2 Understand and Analyze Argument Score: 6
3 Evaluate Sources and Evidence Score: 6
4 Research Design Score: 7
5 Establish Argument Score: 7
6 Select and Use Evidence Score: 6
7 Engage Audience Score: 3
8 Apply Conventions Score: 6
9 Apply Conventions Score: 3

HIGH SAMPLE RESPONSE

Music Chemistry

Content Area: Understand and Analyze Context — Row 1
The response earned 6 points for this row because the paper identifies a focused topic on page 4, paragraph 2: "This research seeks to use this method to discover potential relationships and connections between the quantitatively measured aspects of a song and its popularity within an audience, particularly pertaining to the music industry of South Korea". It also makes a connection to the larger field on page 8, paragraph 1: "This study intends to focus on the musical aspect of K-Pop, similar to the production factor identified in Chew's work, but instead of a qualitative analysis of the lyrics and music of K-Pop, this research utilizes a quantitative approach". This statement also serves as a useful transition to the paper's subsequent statement of method.

Content Area: Understand and Analyze Argument — Row 2
The response earned 6 points for this row because the paper presents multiple perspectives throughout the Literature Review section. These perspectives include the variety of musical styles within K-Pop, the size and importance of the South Korean music industry (and its relation to the international visibility of Korean culture), the highly structured nature of the Korean music industry, and the international appeal of K-pop songs. The relationship of the sources can be found on page 8, paragraph 2: "Chew's study weighed each of these factors evenly, whereas Jin and Ryoo focused on the lyrical aspect as the most significant contributors". This in turn opens up an avenue of original research by the student, who "...intends to find a numerical correlation between the musical qualities of songs and their success" (page 8, paragraph 2).

Content Area: Evaluate Sources and Evidence — Row 3
The response earned 6 points for this row because the paper explains how sources are relevant and credible on pages 7 and 8, noting that the research by Dal-yong Jin and Woong-jae Ryoo, "...although valuable, utilized a more traditional, qualitative approach and served to bolster an understanding of the lyrical foundation found in K-Pop". The paper connects the literature review sources to the student's topic of inquiry, explicitly on page 8, paragraph 1: "This study intends to focus on the musical aspect of K-Pop, similar to the production factor identified in Chew's work, but instead of a qualitative analysis of the lyrics and music of K-Pop, this research utilizes a quantitative approach".

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2017 SCORING COMMENTARY

Academic Paper

Content Area: Research Design — Row 4
The response earned 7 points for this row because the paper carefully lays out its method, adapting an existing "...data visualization project titled 'Visualizing a Hit', performed by Shaun Ellis and Tom Engelhardt" (page 8, paragraph 3) and utilizing Echo Nest API, a program since acquired by Spotify. Pages 9 to 12 of the paper carefully outline specific steps in the method while defending method choices throughout.

Content Area: Establish Argument — Row 5
The response earned 7 points for this row because the paper mounts a complex, logical argument carefully linking evidence derived from its original research. The paper's conclusion on page 27, paragraph 3 states that "...the data shows that in general, successful K-Pop songs are in minor keys,...less acoustic, more danceable, shorter than 4 minutes, highly energetic, loud, intense, and positive, with moderate tempos and an even balance between the use of vocals and music. This conclusion closely matches the initial predictions made prior to performing the methodology..." In addition the student usefully discusses both implications and limitations of the inquiry on pages 28 to 29. For example, it is suggested that this research might "...hold value for potential songwriters and producers" if "...broader patterns and trends" (page 29, paragraph 1) can be discerned from the data and used to produce original music.

Content Area: Select and Use Evidence — Row 6
The response earned 6 points for this row because the paper does an exceptional job of laying out its extensive original forms of evidence. These include indications of popularity of individual songs and the television programs which help to popularize them, the visualized musical characteristics of songs within the sample selection, and the number of downloads of music videos of K-Pop tunes. These are found in the paper's appendices and in the twelve separate figures included within the body of the text. This evidence is carefully interpreted within the body of the argument, and its relevance is consistently tied to both method and new understanding.

Content Area: Engage Audience — Row 7
The response earned 3 points for this row because the paper's organizational and design elements are of superior quality, consistently engaging the reader and underlining the student's credibility. The paper itself is organized carefully and divided into labeled sections which confidently lead the reader from the introduction and background literature through method and the various stages of argumentation. In addition, the paper's extensive use of visual materials, including tables, graphs, and charts, both in the body of the text and appendices, greatly enhance the impact of the argument, as these materials are well-labeled and carefully referenced.

Content Area: Apply Conventions — Row 8
The response earned 6 points for this row because there are no evident citation errors within the paper and the bibliography adheres to proper format. In addition, the student is able to use extensive data without surrendering authorial voice, as on page 21, paragraph 2: "In Figure 8, the Download graph shows a higher value of success for lower energy songs as well, but, once again, this may be attributed to variation in the smaller dataset. In the other two graphs, the positive trend is easy to observe, and more energetic songs generally perform better. This relationship reveals another facet of the music's audience, and their preference for more intense and energetic songs".

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Academic Paper

Content Area: Apply Conventions — Row 9
The response earned 3 points for this row because the paper is well written and uniformly strong throughout, and does an especially good job of setting its inquiry within a larger context, rationalizing its method, mounting a complex argument, and explaining its data to the non-expert reader.

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