Moneyball on Broadway: A Statistical and Economic Exploration of How to Succeed on Broadway without Really Trying

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Abstract

Commercial theatre is an industry that spans both the entertainment sector and the finance/investment sector, and is thus intuitively a profitable entity. However, today the industry lacks the necessary tools to ensure consistent success, and is consequentially perceived as a risky, unorthodox investment. This study strives to explore and discover which variables of a financially successful play and musical influence higher weekly ticket grosses, thus giving future producers insights to carry as they invest in their next Broadway show. Utilizing data analysis techniques and the principles of econometrics, my results suggested that there are certain variables of a play and differing variables of a musical that positively influence their weekly grosses and may be manipulated by the producer. While causation is not proven, the correlation and magnitude of impact are impressive enough for further exploration and attention from investors and producers seeking to create a profitable show.

Keywords: Broadway, Success, Analysis

1. Introduction:

In 2012, Broadway grossed $1.158 billion with an attendance of over 12 million people.[1] These prosperous numbers are popularly attributed to Broadway's trend of producing mainstream musicals and plays with more celebrities, more corporate sponsors, and more expensive budgets than ever before.[2] However, while the yearly grosses for Broadway have increased each year for the past several years, these increases can be attributed to a mixture of mega-musicals continuing to post high sales and ever-increasing ticket prices, which are increasing at least in part due to the rise in the costs associated with Broadway theatre.[3] In the past decade, the increasing costs of producing on Broadway have inhibited many producers from doing more daring work, as producers strove to make Broadway shows safe for popular consumption in order to make the show profitable.[4] From 2010 – 2011, total direct expenditures of shows, which includes production costs (such as building the set, purchasing the rights to produce the play or musical, hiring various production members and companies) and operating costs (such as the weekly salaries, advertising costs, and theater rent), have increased by $130.7 million (adjusted for inflation), bringing the total fiscal year direct expenditures to over $1 billion.[5] As a result of these higher costs, Broadway experiences the "economic dilemma of the performing arts", which states that one cannot increase productivity in the arts, beyond the limits set today, because of the strict resources around theatres, such as the number of seats and number of performances per week.[6] This means that for Broadway producers to stay ahead of the increasing production and operating costs, which increase with inflation, Broadway tickets must increase at or above the rate of this inflation, in order to maintain or increase profit.[7] This economic dilemma is why we see ticket prices skyrocketing with each year and with no end in sight. Yet, despite increasing ticket prices to outpace the increasing costs, there is still a low rate at which shows recoup their initial investments.

Since 1960, only 20 to 25 percent of all Broadway productions have turned a profit.[8] For an industry that invest, on average $2 - $15 million (or, in extreme cases, $75 million for spectacles like *Spider-Man: Turn Off The Dark*), this rate of return is paltry.[9] What Broadway needs is Bill James. In 1977, Bill James began writing *The Bill James Baseball Abstract*, a self-published book that dissected and identified the shortcomings of baseball statistics while presenting new insights into how one should analyze the game, developing new measurements and determinants for success.[10] Other forms of the entertainment industry, from sports to movies to music, have analyzed the determinants of success in their respective fields. Yet Broadway has been left by the wayside in this trend toward statistical analysis. While there have been a few studies including Simonoff and Ma – 2001, Reddy, Swaminathan, and Motley – 1998, and Loney – 1990, these studies just scratch the surface of deeper statistical analysis. For example, Simonoff and Ma use the longevity of a production as their definition of success, yet there are countless examples of long-running shows that never turn a profit.[11] The other two studies are based on old data (Loney from 1988-1989 and Reddy, Swaminathan, and Motely from 1980-1982), making these studies inconclusive for today's climate.[12][13]

Lacking a timely analysis of Broadway productions, most of Broadway investing is done with little information, "without a real market of buyers and sellers of investments to evaluate and set the appropriate price for the investment given its level of risk".[14] As with investments in other new businesses, "the Broadway investor is placing a bet on the entrepreneur – the producer – as an individual of experience, resilience, taste, and character".[15] Experience and character are helpful, but it doesn't guarantee understanding. For this reason, in addition to those described above, this study strives to fill in a small part of this large gap in data analysis. As "economic models are conceptual frameworks that aid in the understanding, description, and/or prediction of human behavior", this exploratory regression analysis strives to provide producers new insights into achieving the only success that matters on Broadway – making a profit.[16] Using data to analyze entertainment is by no means an effort to replace artistry or restrict creativity, but to help alleviate a portion of the risk involved in investing $2 - $15 million on sometimes only 16 weeks of business. For Broadway theatre to survive despite the increasing costs of production, risk needs to be alleviated and data is the only objective source to help guide Broadway producers towards safer investing.

2. Methodology:

To begin assessing the factors that influence a production's ability to achieve recoupment, one must analyze plays and musicals with complete data sets, which exclude all currently running musicals and plays. In a previous study, it was demonstrated that there is a huge differentiation between musicals and plays, including the number of performances, size of cast, initial capital raised, and size of theatre, therefore, plays and musicals were separated in this analysis.[17] In determining the dependent variable, since recoupment was a rarity and confidential in some cases, a production's median weekly gross was chosen to analyze. This median weekly gross is from the first preview performance thru to the week the show announced its recoupment or until the show closed without announcing recoupment. This is to ensure the study identifies which variables help lead to recoupment, as grosses are vastly different and fluctuate greatly post-recoupment for a number of reasons, such as recasting, greater discount tickets, and additional advertising efforts. Granted, without some confidential information including weekly operating costs, the usage of median weekly gross as the dependent variable is inherently flawed because the larger the weekly gross does not necessarily mean the production recoups its initial investment at a faster rate. It depends on how well costs are managed, how much the production spends on advertising per week, how royalties and leasing contracts are structured, how much money is spent on rehearsals or out-of-town tryouts prior to Broadway, and many other variables that affect the rate of return.[18] However, based on the available data for this study, the median weekly gross was identified as the best option to be used as the dependent variable in a regression analysis. With a sample size of 141 plays and 103 musicals, spanning from the end of 2001 to the beginning of 2012, it was found that higher median weekly grosses did correlate with self-identified recouped productions, which confirmed the belief that median weekly gross was the best next option for a dependent variable. Lastly, the median weekly gross, instead of the average weekly gross, was selected to ensure the statistic is robust and more acutely accurate to the production's normal weekly gross, while an average weekly gross is greatly affected by extreme outliers, such as an extremely high week affected by Christmas or an extremely low week affected by harsh weather.[19] All data for this study was collected from public Broadway sales reports from BroadwayWorld.com, archival information from PlaybillVault.com, and other various websites including IMDb.com, Broadway.com, and Playbill.com.

2.1. Variables Selected For Analysis

Once the method was chosen, the samples were collected, and the dependent variable was chosen, Broadway sales analysts Janette Roush and Trevor Sponseller of aka, a Broadway advertising agency, and Broadway general managers, Tamar Haimes and David Richards of Richards/Climan, Inc., were enlisted to aid in identifying variables for analysis. The majority of variables identified are ones of which a producer can control or at least react to. The initial list of variables included an array of differing variables, including whether a production was an original or revival, the size of the production's initial investment, the number of days on public sale before preview performances, the number of seats in the theater, and the size of the cast, including understudies. From the initial list of fifteen variables, data was collected for each variable and adjusted for inflation using the US Bureau of Labor Inflation Calculator when necessary, but not all variables were kept for the regression analysis because of issues in multicollinearity, incomplete data sets, and inconclusive significance. Table 1 features the final list of variables used for the regression analysis, after being tested for multicollinearity, explored through scatter plots and residual plots, and assessed for heteroskedasticity. At this point, the data was ready for modeling and Minitab was utilized to check for modeling accuracy, using the best subset group test, stepwise regression modeling, and by further testing the data's significance in nonlinear models.

Table 1. variables compiled and analyzed

Original or Revival Production	Number of days of on sale before previews	Size of Cast (including understudies)
Based on a Movie Prior To Play	Month tickets went on sale	Celebrity Cast Rating
Based on a Recording Artist	Capitalization	Ticket Distance
Theatre size	GDP Annual Growth Rate	

2.2. Variables Created

From the initial list of variables, two variables were created for differing reasons. Ticket distance was created to solve a multicollinearity issue and Celebrity Cast Rating was created in order to measure quantitatively the popularity of a celebrity on Broadway, giving producers an insight into whether casting popular celebrities conclusively affects a production's weekly grosses. These variables both proved to be significant for plays and musicals, so extrapolation of these variables is warranted.

2.2.1. ticket distance

In order to correct the correlation between the average ticket price paid and the percentage of potential gross, a new variable, Ticket Distance, was created. This variable calculated the distance to which tickets were discounted on average from the full price. The first step towards calculating this new variable begins with the equation (1) for the Percentage of Potential Gross, which is then manipulated to solve for Full Ticket Price.

$$\text{Percentage of Potential Gross} = \frac{(\text{Average Ticket Price Paid} *(\text{Percentage of Capacity Filled} * \text{Theater Size}))}{(\textbf{Full Ticket Price} * (100\% * \text{Theater Size})} \qquad (1)$$

$$\text{Full Ticket Price} - \text{Average Ticket Price Paid} = \textbf{Ticket Distance} \qquad (2)$$

This new variable, Ticket Distance, calculates to the best ability using only public data the magnitude to which tickets are discounted from the original full ticket price.

2.2.2. celebrity cast rating

In order to create this variable, Niloy Sanyal, Director of Strategic Marketing at GE, with experience working for NBC in the same context, was interviewed on how NBC selected celebrities for a commercial or pilot. Sanyal

identified how social media websites like Facebook and Twitter were used to assess the celebrity's online popularity among key audiences.[20] In addition, NBC used the Internet Movie Database (IMDb) to see where the celebrity is ranked on their Star Meter.[21] This IMDb Star Meter is a weekly ranking of all actors and directors with at least one professional film credit and their popularity for that week, based on page views of each celebrity's IMDb page, articles written that week about the celebrity, movies opening featuring him or her, and any new projects announced involving the celebrity.[22] This Star Meter presented an opportunity to assess a celebrity's past popularity, as it has weekly data going back as far as twenty years ago with an ability to collect and compile these rankings.

From this, a two-year average IMDb Star Ranking was compiled for every celebrity in each cast, with a celebrity being defined as an actor listed above the title. Rankings collected began from two years prior to the first performance of their respective Broadway production, which captures how popular the celebrity was prior to the production, giving the producer an idea of the celebrity's status before casting. After compiling this, each Star Ranking was manipulated by an equation (2) in an effort to not only create a correct numerical rating, but also to reward celebrities closer to being ranked number one and to punish those ranked lower. Table 2 exemplifies how the new Star Rating worked to achieve this weighted rewarded.

$$\text{New Star Rating} = 10 \,/\, \text{Average IMDb Star Ranking} \tag{2}$$

Table 2. new star rating examples

Celebrity	Phillip Seymour Hoffman	Lisa Edmond
Average IMDb Star Ranking	582	14,028
New Star Rating (equation 2)	0.017	0.000713

Hoffman's New Star Rating is much better than Edmond's because is it much closer to one, rewarding him for having an average IMDb Star Ranking closer to one. Note that ten is used as the numerator because of the large range of rankings, from 51 - 63,693, making the numbers more manageable in size. In addition, since no celebrity had an average IMDb Star Ranking closer to one than 51, ten was used as a numerator to ensure the new ratings were not extremely minute as they would be with one as the numerator. Once this New Star Rating was calculated, these new ratings are added together with other celebrity cast members per cast to get the final Celebrity Cast Rating. The potential errors of this new variable include the accuracy of using IMDb Star Meter is an assessment of popularity and the assumed linearity of this rating system.

3. Results:

Plays and Musicals returned differing significant variables as expected, but did share a few significant variables with different coefficients. To some effect, the results seem logical, but the true insights are within the meaning of the coefficients per variable and the insignificance of certain variables, which differ from current popular beliefs.

3.1. Regression Results For Plays

$$y = 390453 - 13583(\text{GDP Annual Growth Rate}) + 1191(\text{Number of Days on Sale prior to Previews})$$
$$+ 4055 \,(\text{Size of Cast}) + 2387110 \,(\text{Celebrity Cast Rating}) - 5653 \,(\text{Ticket Distance}) \tag{3}$$

Table 3. important statistics for plays regression variables

Predictor	Coefficient	Standard Deviation	T score	P statistic
Constant	390453	39107	9.98	0.000
GDP Annual Growth Rate	-13583	5471	-2.48	0.014
Number of Days on Sale prior to Previews	1190.6	436.8	2.73	0.007
Size of Cast	4055	1802	2.25	0.026
Celebrity Cast	2387110	328701	7.26	0.000
Ticket Distance	-5653.3	602.6	-9.38	0.000

S = 135457   R-Sq = 64.9%   R-Sq (adj) = 63.6%

In analyzing each significant variable, GDP Growth Rate, which is measured in full integers (a 1% increase in GDP was recorded as 1 and not 0.01), displays how Broadway grosses may be affected in an opposite manner than logically expected. According to this regression model, one could expect a Broadway play to lose $13,583 when the US experiences a 1% increase in GDP. This could be interpreted in multiple ways, as an audience member's reaction to a bad year or an example of a lagged effect, where the US GDP Growth Rate does not affect Broadway grosses until a year later when the full economic impact is felt.[23] This relationship could also suggest that tourists are more willing to travel to New York during negative growth years as traveling may be cheaper. This inverse relationship needs further exploration with different US economic variables for more accurate results. The number of days on sale prior to the first preview performance illustrates how $1,191 is added to the median weekly gross for each additional day on public sale. This can be interpreted as saying that the longer a play is able to build a brand, garner greater awareness, and accumulate word of mouth from advance sales, the higher the play's median weekly gross will be over the entire run of the production.

Size of Cast, as a significant variable, suggests that a show could expect an increase of $4,055 per additional cast member, but without confidential information about the costs associated with additional cast members, this result is partially flawed. The variable also could suggest more about production value than actual cast size, meaning that a production is perceived to be a bigger spectacle with more cast members.

Celebrity Cast Rating, which is reported in decimals, makes the coefficient difficult to interpret. Table 4 illustrates how a celebrity's individual star ranking affects a production's median weekly gross and Table 5 gives examples of current celebrities ranked using the IMDb star rankings.

Table 4. Celebrity Individual Star Rankings with Projected Grosses

Celebrity Ranking	Adjusted Ranking	Weekly Gross Generated
10	1	$2,387,110.00
100	0.1	$238,711.00
200	0.05	$119,355.50
500	0.02	$47,742.20
1000	0.01	$23,871.10
5000	0.002	$4,774.22

Table 5. Examples of Celebrity Individual Star Rankings

Top 100	101-500	501-1000
Scarlett Johansson	Denzel Washington	James Earl Jones
Julia Roberts	Katie Holmes	Phillip Seymour Hoffman
Hugh Jackman	Andrew Garfield	Patrick Stewart
Daniel Craig	Kevin Spacey	Terrence Howard

These rankings demonstrate not only how important the Star Rankings are but how arduous these rankings are in practice. Table 4 demonstrates the sudden drop-off in weekly gross generated as a celebrity is less popular. Without

confidential data on costs, there was no way to investigate the threshold where the expense of the celebrity exceeds the weekly gross generated from their popularity.

Ticket Distance in this model shows us that for each $1 increase in the distance between the full price and the price paid, the production's weekly gross decreases by $5,653. Productions that did recoup discounted an average $12 off each ticket while productions that did not recoup discounted an average $36 off each ticket. Therefore, it would seem to suggest that discounting is a negative strategy for increasing sales, yet this practice has increased in magnitude over time due to the changes in GDP Annual Growth Rate, as illustrated by Graph 1. It also suggests that demand on Broadway may have been lower than previously perceived when setting ticket prices, hence larger discounts.
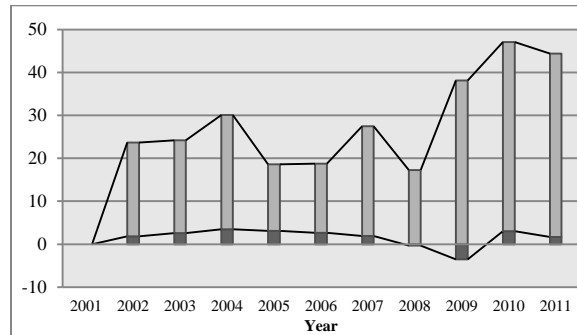
Graph 1. GDP annual growth rate versus play ticket distance from 2001-2012 as adjusted for inflation

This demonstrates how ticket distance fluctuates in reaction to the GDP annual growth rate, which explains the current trend of greater discounting as a reaction to the negative GDP growth rates in 2008 and 2009. It explains how, despite being a negative strategy, discounting is required by productions based on the economic climate, as well as a method to stimulate sales.

Variables that did not significantly affect the production's median weekly gross include whether a production was an original or a revival. This variable had no effect on sales and no correlation with recoupment, which suggests that audiences are not as concerned with familiarity of content, as much as they are concerned with who is in the cast and how much tickets will cost. This is important because it means producing a daring, original piece can be viable as long as the casting and ticketing are appropriate. This also combats the common rhetoric on Broadway that revivals are dominating because of their profitability.

Table 6 is a quality check on the regression equation, with a randomly selected sample comparing the production's real median weekly gross and the projected median weekly gross as found by the equation.

Table 6. random play sample – comparison of real and projected median weekly gross

Exit The King - 2009		
Real Median Weekly Gross	Projected Median Weekly Gross	Difference
$499,757.59	Y = 390453 - 13583 (-3.527) + 1191 (41) + 4055 (9) + 2387110 (0.0333) – 5653 (24.92) = **$462,236.12**	$499,757.59 - $462,236.12 = **$37,521.47**

3.2. Regression Results For Musicals

y = 206975 + 112732 (Based on a Movie) + 456 (Theater Size) + 4019170 (Celebrity Cast Rating) - 7789 (Ticket Distance) - 17206 (GDP Growth Rate)   (4)

Table 7. important statistics for musicals regression variables

Predictor	Coefficient	Standard Deviation	T score	P statistic
Constant	206975	77627	2.67	0.009
Based on a Movie	112732	36786	3.06	0.003
Theater Size	456.18	51.87	8.80	0.000
Celebrity Cast Rating	4019170	1257785	3.20	0.002
Ticket Distance	-7789	721.2	-10.80	0.000
GDP Annual Growth Rate	-17206	8077	-2.13	0.036

$$S = 162750 \quad \text{R-Sq} = 75.4\% \quad \text{R-Sq (adj)} = 74.1\%$$

The first significant variable is whether the musical was based on a movie. The coefficient in this equation states that a musical based on a movie could expect an increase of \$112,732 in the production's median weekly gross. While that is a large increase, this does not mean the musical will recoup, as from this study, only 23% of all the musicals based on a movie in the past 10 years recouped, which is on par with the rate of recoupment for plays and musicals as a whole. What this coefficient illustrates is that these musicals based on a movie have an advantage in their weekly grosses because of their already established brand; however, the costs associated with these musicals are higher than plays, which hurt their recoupment rate.[24]

Theater Size is not a surprise variable, especially for musicals, as musicals average theaters with 1,353 seats and plays average theaters with 1,038 seats. The regression equation illustrates that for each additional seat in a theater, a musical can expect a \$456 increase in median weekly gross, which comes out to \$57 increase per performance. However, without the costs associated with leasing Broadway theaters, one cannot determine whether this \$456 increase per seat is worth leasing a larger theater.

Celebrity Cast Rating was significant again, but with a larger magnitude than with plays as the coefficient for the musicals regression is 4,019,170, a 1,632,060 increase from the plays' regression. This can be attributed to several different factors, including the rarity of celebrities in a musical, making the production a higher priced commodity, and the scale of musicals, which means that since musicals are in larger Broadway houses, the celebrity's financial impact is larger in magnitude. However, as noted previously, one would and should believe there is a profitability threshold for the ratio between the cost associated with a celebrity and the ranking of the celebrity, but, without information on costs available for analysis, this is still just speculation.

Ticket Distance was significant again as well and the difference between plays and musicals is comparable for the same reasons dictated above for the Celebrity Cast Rating. For Ticket Distance, as well as for GDP Annual Growth Rate, the only difference between plays and musicals regression is the coefficient's magnitude, which is attributed to the difference in production scale. Ticket discounting negatively affects the production's median weekly gross, but it is necessary for recoupment, as those musicals that did recoup on Broadway averaged an \$8.60 discount per ticket. This is a much smaller average discount than plays (\$12), which is most likely because of the higher costs the musical must cover, so discounting is a more difficult practice to justify. In addition, musicals that took longer to recoup their investment, which means taking longer than the average number of performances to recoup, discounted as much as \$25 per ticket, which suggests that discounting is necessary to sustain a show's sales level.

The variables that were found not to influence the median weekly grosses included whether the musical was an original or revival, whether the musical was based on a recording artist or not, the number of days on sale prior to the first performance, the size of the cast, and the month tickets went on sale. This highlights how audiences, when deciding on a musical to see, focus on their recognition of the musical or the content of the musical, in conjunction with the perceived spectacle or theatricality of the production. This harks back to the idea of branding for success on Broadway being a necessity in today's economic climate. Since musicals are longer running productions, the building of the brand happens not solely during presale, as it does for plays, but throughout the first year of performances. For musicals, the average number of performances prior to recoupment is 358 performances, with the median being 338, while plays average 100 performances prior to recoupment, with the median being 95. Musicals take over three times as long to turn a profit, mostly because of their larger initial investments, but also because of larger weekly costs to control and long-term ticket discounting. This longer recoupment time lends itself towards the idea of long-term brand management and dispersal of advertising and discounting efforts.

Table 7 is a quality check on the regression equation, with a randomly selected sample comparing the production's real median weekly gross and the projected median weekly gross as found by the equation.

Table 7. random musical sample – comparison of real and projected median weekly gross

Curtains – 2007		
Real Median Weekly Gross	Projected Median Weekly Gross	Difference
$734,358.74	Y = 206975 + 112732 (No = 0) + 456 (1437) + 4019170 (0.007) – 7789 ($21.11) – 17206 (1.907) = **$694,144.26**	$734,358.74 - $694,144.26 = **$40,214.48**

4. Conclusion:

One should not take these results as absolutes. Correlation does not mean causation. However, it does suggest a relationship that should be further explored, which is exactly what this study was intended for - to create a stepping stone for further exploration on variables influencing a show's rate of return. As with Bill James, he set out to explore and decipher greater trends and statistics within baseball that lead to the ultimate goal of scoring runs and winning. This study is just a step towards a similar idea and, with a larger sample size and more access to confidential information, including weekly costs and advertising costs, another step can be made towards smarter producing and smarter investing on Broadway. As the concept of cognitive dissonance states, a potential audience member needs to quantify the value of a ticket and convince him/herself that the price is warranted.[25] The results of this study showcase how we can quantify the variables of a Broadway show that lead to cognitive dissonance. The variables that highly influence a show's grosses (universally across plays and musicals) are the stars casted in the show and the magnitude a show discounts away from their full price ticket. The variables that influence a play are tied to a play being a limited engagement, variables such as the number of days on sale before previews. Such time sensitive variables aren't as influential on musicals, which rely more heavily on larger theaters and being based on a movie with a proven brand. Further exploration of these samples with more data on costs would give insights that are more accurate on exactly how to achieve this balance of brand management and cost mitigation, which would lead to smarter investing, better producing, better pieces of Broadway theater, and more money for everyone associated with the production. This is not a study of profiteering, but of sustainability, which is a distinction producers and investors need to comprehend for true change to occur.

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