

**Assessing the Production Revenues and  
Forecasting Models of Lexington Children's  
Theatre Productions,  
1998- 2004 and 2008 – 2014**

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## **Executive Summary**

This paper assesses the accuracy of the ticket sales and revenue forecasting model used by Lexington Children's Theatre, a Central Kentucky Performing Arts non-profit.

Research suggests that if bias is present in the models, it could be a result of the Optimism Bias, which is a tendency for humans to predict favorable outcomes. Recent data seems to suggest that humans may also act pessimistically with forecasts if the endgame would work in their favor.

"The Lexington Children's Theatre provided data for 108 productions over a twelve-year span from 1998 – 2014. Using a series of regression models, I found that the organization's model was highly accurate in regards to predicting overall revenues earned by specific productions, but faced some level of bias when predicting the number of seats filled. It appears that this bias comes from an overestimation on the number of seats the Summer Musical would sell. I also found that the cost of a ticket, type and placement of a production do not statistically influence the percent capacity sold of a production, suggesting that some other subjective values are present when a patron decides to purchase a ticket.

## **Introduction**

This research is focused on Lexington Children’s Theatre, a non-profit performing arts organization based in Lexington, KY dedicated to creating “imaginative and compelling theatre for young people and families.” Staff at the organization expressed curiosity at the statistical accuracy of the forecasting model used to predict the revenue and seats sold of the organization’s public performances, wondering if there were any improvements that needed to be made or further variables to be fixed. Looking at data from 1998 – 2014 (with 4 years of data missing) The aim of this research was to fulfill the organization’s request. Using regression models to analyze data provided by the organization, this paper sought to assess the overall accuracy of the forecasting model in terms of total revenue earned per production and seats sold. Furthermore, I also attempted to determine which factors, if any, that Lexington Children’s Theatre controlled had any influence on the percent of capacity of seats sold.

Why does the accuracy of forecasting models matter? In competitive markets, the ability to accurately forecast revenues is imperative for an organization’s continued success.

Projected revenues allow the staff to determine budgets and spending capacity, as well as the ability to grow or cut back financially. Should the organization over or underestimate the revenues expected for the coming year, the resulting fallout could be dangerous or

costly, harming not only the finances of the theatre but also its overall perception by the public.

Percent of capacity of seats sold, though not necessarily vital to an organization's financial success, exists as an important factor in upholding overall mission. In the case of Lexington Children's Theatre, this mission is creating "imaginative and compelling theatre for young people and families." Even if a production raises enough revenue to keep the theatre open and running, it may not be meeting the overall mission of providing theatre for young people and families if said young people and families are not necessarily filling the most seats possible.

#### *History of Lexington Children's Theatre*

Established in 1938 with the assistance of the American Association of University Women and the local Junior League, Lexington Children's Theatre was created as a small community arts theatre with a stated purpose to "present educational entertainment for children and to provide the opportunity for creative expression." The organization was originally run and supported through the work of volunteers and did not employ a full-time executive director until 1971. Also in that year, the organization began development of a full program of classes and the creation of a professional adult tour company, marking the transition from a small community arts program to a professional theatre company (Lexington Children's Theatre, 2013).

Current Executive Director, Larry Snipes, was hired as Producing Director in 1979, bringing the staff total to one full time and one part-time employee. Also in that year, Lexington Children's Theatre began its first productions in Lexington Opera House. In the 1998-1999 season, the theater marked its 60<sup>th</sup> anniversary by moving into its first permanent home, located in the heart of downtown Lexington, Kentucky (Lexington Children's Theatre, 2013).

As of 2014, Lexington Children's Theatre exists as Lexington's only professional theatre company, employing over 100 employees with an operating budget of over \$1 million.

#### *Revenues of Lexington Children's Theatre*

Figure 1, below, shows the revenue earned from productions compared to the overall total revenue produced by Lexington Children's Theatre over a five-year span of the years 2008 – 2012. During this span, both production revenue and total revenue have experienced increases in dollars received. Interestingly, though total revenue decreased in 2012, production revenue increased, suggesting that other figures accounted for the total decline.

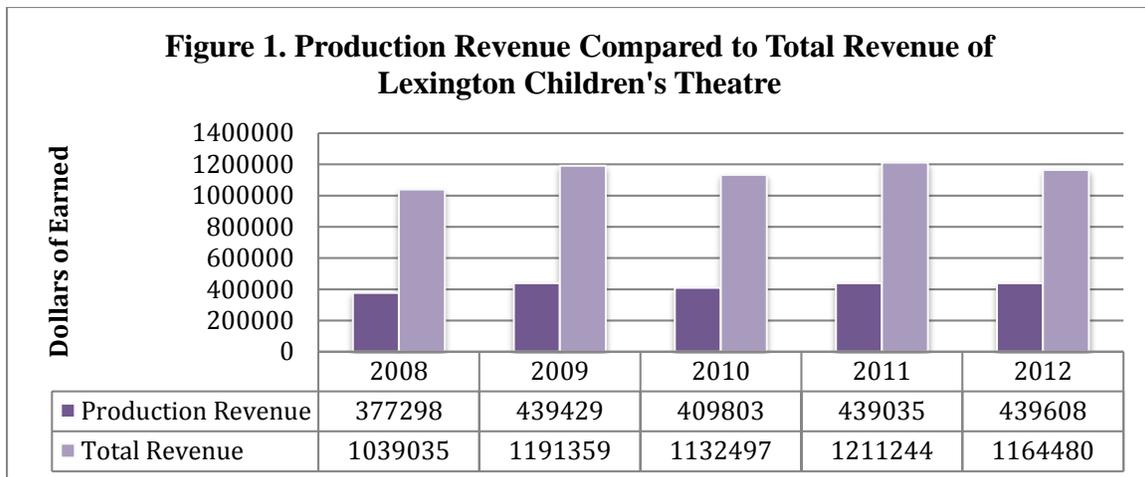


Figure 1 also indicates that production revenue comprises around one-third of total revenue received by the organization. Information pulled from IRS 990 forms indicates that the other two-thirds of revenue derive from education revenue, contributions, grants, and interest earned. This number is important because it shows the significance of accurate forecasts for production revenue.

With this information in mind, it is imperative to ask if the current forecasting model employed by Lexington Children's Theatre is accurate in regards to predicting revenue earned and overall tickets sold.

### **Literature Review**

Much research has been conducted attempting to understand the intricacies of forecasting, whether it be sales, events, or general life occurrences. Literature suggests that humans exhibit a natural tendency to allow bias in the projections, leading to

decreased accuracy in the forecasts. To remedy that, frameworks are being created to help downplay the subjectivity using quantitative analysis

The most bias present in projections is called the “Optimism Bias.” The definition of the Optimism Bias reflects its name – when trying to predict events, humans have the tendency to overestimate the likelihood of positive outcomes while underestimating the likelihood of negative outcomes. (Sharot, 2011). This psychological phenomenon is present in most groups, with the one exception: those suffering from depression (Sharot, 2011). This suggests that optimism is a common thread among the human experience, but also may be damaging if forecasters allow their personal biases to infect a prediction in a field where accuracy is imperative to an organization’s continued existence.

Hans Christian Müller from the Heinrich Heine Universität Düsseldorf studies this type of bias in his paper, *Forecast Errors in Undisclosed Management Sales Forecasts: The Disappearance of the Overoptimism Bias*. Analyzing internal sales reports of 6,234 German firms, Müller attempted to discover the level at which optimism affected the accuracy of their forecasts. Surprisingly, Müller did not find the Optimism Bias present in the results. Instead, his results displayed the opposite. The firms participating in Müller’s study tended to act overly pessimistic in their sales forecasts (Müller 2013). He attributes this to the possibility that the potential of overestimating the outcomes may yield more negative consequences that understating the overall yield.

Of course, Müller also concedes that his study is one of the first to show a Pessimism Bias. This study was conducted in 2011 when the world economy was still suffering a

slight decline. With global economy experiencing an upswing, could it be that firms may begin to act optimistic about their forecasts? Furthermore, though the Optimism Bias appears to be an underlying factor in human perception, one must ask if the level of optimism varies by country or culture. Would similar American firms from 2011 show a predilection for pessimistic forecasts as compared to the German counterparts featured in Müller's study?

One reason the Optimism Bias (or pessimism) occurs is because humans tend to view each venture as unique, when in reality they are more closely related to previous events (Flyvbjerg, 2006). The belief is that forecasters do not consider similar and previous distributions when creating their forecast, so much so that this issue has become a major problem in forecast projections. "The analysts should therefore make every effort to frame the forecasting problem so as to facilitate utilizing all the distributional information that is available," Kahneman and Tversky write in their research. (Kahneman & Tversky, 1979, p. 316). This type of advice is called taking an "outside view" and is one proposed solution to the optimism bias. By looking at outside and similar factors, forecasters can help remove themselves from internal biases.

Researchers have been attempting to develop frameworks to offset bias, though it seems to always be present on some level, whether from the forecaster's perspective or that of the patron. Daniel S. Putler from the Saunderson School of Business at the University of British Columbia proposed one such design for creating a framework which performing arts organizations could use to forecast ticket sales. In his study, conducted in collaboration with firm Strategy Solutions, Putler studied the history of a university

theatre department, analyzing the sales, production reviews, and characteristics of 31 different productions leading to 343 performances. The established framework allowed the university in question to do the following: model demand for events that consist of more than a single performance, account for the influence of promotional effort on ticket sales, and account for sellouts of some performances (Putler, 2003).

In order to characterize the marketability of the productions to determine audience preferences to achieve the framework, Putler assigned parameters to assess appeal and give statistical weight to certain productions. Examples of the descriptors used to define the parameters included “Difficult,” “Boring,” “Familiarity.” By name alone, these parameters reflect a certain level of bias in the coding (Putler, 2003). Furthermore, the paper suggested a difficulty in defining the level of controversy surrounding certain shows, leading to some level of uncertainty. This suggests that when assessing the utility of a production to the general public, a certain level of subjectivity will inevitably be present.

It is with this information in mind that I approached the analysis of Lexington Children’s Theatre’s forecasting model.

## **Research Design**

Data was gathered from Lexington Children's Theatre from two distinct periods 1998 – 2004 and 2008 – 2014. The data from this period was divided into production seasons, a period which begins in the fall of one year and concludes in the spring of the following year and is comprised of 8-10 unique productions. The model of the season was based around the school year, as Lexington Children's Theatre receives a large percentage of its revenue from school field trips. Due to gaps in collecting and storing data, information is missing from the 2004/2005 – 2007/2008 years. Overall, twelve separate seasons were represented by the data.

Due to changes in the collection and archiving of data, information is formatted differently between the 1998 – 2004 years as compared to the 2008 – 2014 years. Even so, many variables remain consistent.

Variables Present in the 1998 – 2004 data:

- Potential Capacity (Total Number of Possible Tickets Sold)
- Percent of Capacity Filled
- Number of Tickets Sold
- Ticket Price
- Revenue
- Name of Production

Variables Present in the 2008 – 2014 data:

- Potential Capacity (Total Number of Possible Tickets Sold)
- Percent of Capacity Filled
- Number of Tickets Sold
- Revenue
- Ticket Price
- Projected Number of Tickets Sold
- Projected Revenue
- Name of Production

The variables concerning revenue and ticket price were nominal values, reflecting the cost of the dollar as it relates to the year in which it was collected. In order to create consistency and accuracy in the data, I converted the nominal dollar amounts into real values. In order to do so, I used the CPI index of the December of each year (mid-season) to calculate the real fixed values of the data into 2013 dollar amounts.

Each season is comprised of 8 – 11 distinct productions. Ticket prices vary depending on production. In order to control for apparently underlying influences, I coded whether or not a production was the seasonal Christmas production or a Summer Family Musical production. I did this because the Christmas production is located in a separate venue from the rest of the productions, has higher ticket prices, with the cast being comprised of community members as opposed to the professional company. Though the Summer Family Musical is still held in the Lexington Children's Theatre performance venue, it

features characteristics similar to the Christmas productions. To code these variables, I created separate dummy variables.

With the exception of the Christmas productions, which are hosted in the Lexington Opera House, every other production is held in at Lexington Children’s Theatre. The Lexington Children’s Theatre house holds 300 people per performance. Total potential capacity per production was determined by the number of performances multiplied by the total number of seats in in the house. Percent capacity filled during the production was determined by dividing the number of seats sold by the total capacity for a production.

In order to account for the time of year, I coded each production of the season in relation to its placement in the season. The first production was coded with “1,” the second production as “2,” and so one. This led to the discovery that the Christmas productions tended to always be the third production of each season in all years. The Summer Family Musical marked the beginning of the season in the 2008 – 2014 data.

With the extra coding data complete, I could finally compose a time series of the Lexington Children’s Theatre dataset to then provide time-series regression analyses of the forecasting models for revenue earned and seats sold.. The regressions were built around the following model:

$$y = 1x + 0 + \Sigma$$

As indicated with the above formula, the slope of the equation is 1 with a constant of zero. If a forecast is accurate, the coefficient and constant will reflect the above

forecasting model. Why is this the case? A constant of more than zero would suggest that there are external factors at play – biases – that were otherwise not accounted for with X, the forecast. An accurate forecast (X) would naturally equate to the real event (y), therefore any other constant would imply that the forecast had a certain bias or expectation not otherwise warranted. Estimates not statistically significantly different from a constant of 0 and a slope of 1 would be consistent with unbiased predictions. This model is unusual in testing the constant.

Two separate regression analyses were conducted. The first was to measure the accuracy of the projected seats sold when compared to the real seats sold. The second regression accounts for the estimation of accuracy in regards to projected vs. real revenues. Both regressions controlled for year and type of production. Finally, I ran a test to determine the influencing factors in predicting the overall percent capacity filled for the productions. This test will control and check for any influencing factors including ticket price, placement in season, and type of production (Christmas, Summer Family Musical).

### **Analysis**

An initial analysis of the data provided valuable information for progressing forward in understanding the parameters of the forecasting model and the data with which it works. Table 1, below, displays the initial summary statistics of the data. The data accounted for 108 observations (108), with 60 of those productions occurring during the 2008 – 2014 period. This suggests that the number of shows per season had increased over the years, a point reflected in the data.

**Table 1. Summary Statistics of Lexington Children's Theatre Data**

Variable	Mean	Std. Dev.	Min.	Max.	Observations
<b>Ticket Price</b>	\$11.47	2.740646	8	19.5	108
<b>Seats Sold</b>	846.32	576.9531	159	3007	108
<b>Proportion Capacity</b>	.74	.3401998	.22	2.33	108
<b>Revenue</b>	8745.03	8220.13	1326	41074.5	108
<b>Projected Revenue</b>	10776.85	7825.719	1950	33744	60
<b>Projected Seats</b>	769.82	520.0484	150	2220	60

The average number of dollars earned per production amounted to \$8745.03. Telling in the analysis is the fact that the minimum revenue earned for a production was \$1326, whereas the maximum was \$41074.50. This is a difference of \$39, 749, indicating serious skew. This observation is reflected by a standard deviation of \$822.13.

Another telling observation resides in the data for percent capacity. The average percent capacity filled for the theatre production was 74%. The maximum observation for percent capacity was 2.33%. A closer look at the data indicated that 18 productions one possible explanation for the disparity in percent capacity to total capacity could be that the theatre added performances of certain shows that they did not originally project. For example, the production, Pinkalicious, had a total potential capacity of 900, meaning three performances of the show were scheduled. However, since it sold 2101 tickets, the

implication would be that a fourth show was added after the original season forecasting, most likely a result of its popularity.

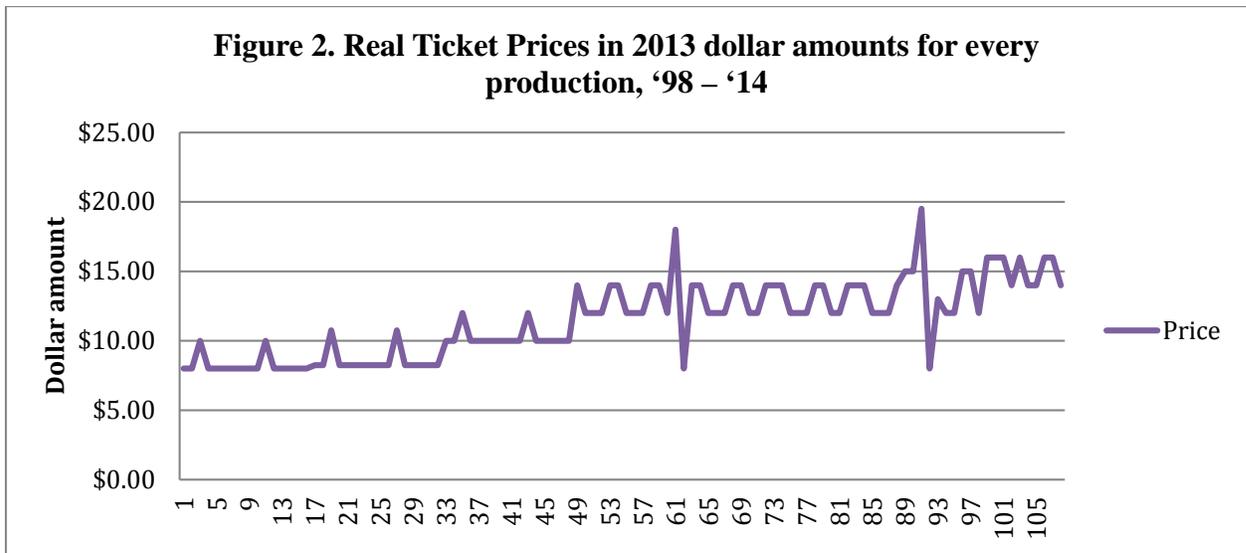


Figure 2, above, displays the trends in ticket prices in 2013 dollars for every production from 1998 – 2014.<sup>1</sup> Based on the graph, ticket prices for productions tended to gradually increase, corresponding with the growth of the organization over time. The peaks correspond to Christmas productions and Summer Family Musicals. The large drop-off between the high ticket prices suggests that the productions following the Christmas productions and Summer Family Musicals are significantly less expensive in price, implying that prices were either inflated for the two “special” performances or that the theatre exhibited higher expectations for the overall success of these productions. This is also reflected in the fact that Summer Family Musicals and Christmas productions tend to show higher predicted revenues and seats sold compared to regular season productions. Furthermore, these productions also show higher potential capacity, suggestion that more performances are scheduled per production. Since the Christmas production is also held

<sup>1</sup> Excluding 2004 – 2007 seasons

at the Lexington Opera House, a venue that holds almost triple the capacity of Lexington Children's Theatre, higher expectations may be warranted.

*Forecasting Seats Sold*

**Table 2. Regression Analysis of Projected Seats Sold**

<b>Actual Seats</b>	<b>Coef.</b>	<b>t</b>	<b>P&gt; t </b>	<b>95% Confidence (low)</b>	<b>95% Confidence (high)</b>
<b>Proj_Seats</b>	.953441	3.65	0.001	.43	1.47
<b>Constant</b>	132.62	1.26	0.28	-111.69	376.95

The model for projected seats sold appears to indicate a strong correlation between the forecasted ticket sales and the actual results. With the correlation coefficient being .95, the regression indicates a strong positive relationship. Building upon the a strong correlation is the R-squared result, .74, which suggests that 74% of total variation in results is explained by this model. However, upon closer look at the individual data, certain biases appear to be present in regards to the Summer Family Musical and other performances. This information is detailed in Table 3, below.

**Table 3. Differences between Predicted Number of Seats Sold and Actual Number of Seats Sold**

<b>Name of</b>	<b>Difference</b>	<b>Name of</b>	<b>Difference</b>
<b>Underestimated</b>	<b>Between Projected</b>	<b>Overestimated</b>	<b>Between Projected</b>
<b>Production</b>	<b>Seats and Actual</b>	<b>Production</b>	<b>Seats and Actual</b>
	<b>Seats</b>		<b>Seats</b>
<b>Pinkalicious</b>	-1138	Shrek*	733
<b>Junie B</b>	-1055	Honk!*	664
<b>BCPE</b>	-886	Wiley	562
<b>Pirates</b>	-520	Old Jake	508
<b>Jack</b>	-347	Seussical*	458

*\*Indicates Summer Family Musical*

As mentioned earlier in the analysis, the projection model faced slight biases when forecasting the number of seats that would actually be sold, particularly in regards to the Summer Family Musical productions. In this case, it appeared that the optimism bias was in full effect when applied to these productions. This optimism bias is further evidenced by the above table, which displays the differences between the predicted number of seats sold and the actual number of seats sold for the top five overestimated and underestimated productions. Of the top overestimated productions, 3/5 were Summer Family Musicals.

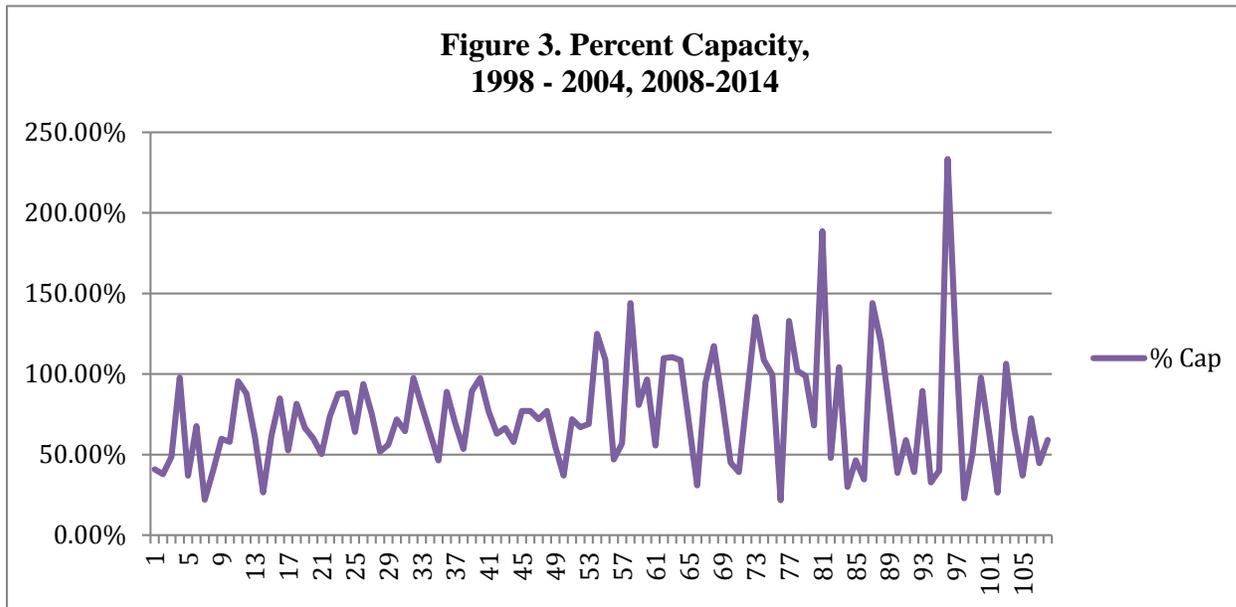
What is also worth discussing are the two plays that were most underestimated in terms of seats sold. *Pinkalicious* is a short musical inspired by the popular book series named after the titular character. In the production, *Pinkalicious* makes the mistake of eating too

many pink cupcakes, accidentally turning herself pink! The moral of the story is that she needs to learn to appreciate eating vegetables, food which can be delicious and healthy, and most importantly, do not turn little girls pink (Kann, 2006). The other most underestimated production was *Junie B. Jones*. *Junie B. Jones* is a play also inspired by a popular book series featuring a young female protagonist. Unlike *Pinkalicious*, however, Junie B. only faces the trials and tribulations of navigating kindergarten – no turning pink required (Gregory, 2011).

Both of these productions feature young female protagonists, with plots that can be described as somewhat “girly.” Could it be that the staff at Lexington Children’s Theatre approached the potential ticket sales with a pessimistic bias, thinking that the feminine nature of the productions might not appeal to half of the general population?

### *Capacity*

Attracting the general population to a production is imperative to the success of the show and continued growth of the theatre. Filling the seats as close to full capacity as possible also allows for the theatre to measure its performance in regards to fulfilling the mission. As indicated earlier in Table 1, the average percent capacity filled for the theatre during the period measured was 74%, meaning that the productions hosted by Lexington Children’s Theatre drew 74% of the maximum patrons possible.



**Table 4. Table 4. Regression Analysis on Percent Capacity**

	Coefficient	t	P> t
<b>Price</b>	.02	0.99	0.32
<b>Summer</b>	.12	0.93	0.35
<b>Christmas</b>	.03	0.25	0.80
<b>Constant</b>	.32	1.08	0.28

When controlling for real ticket price, placement in the season, or if the show was a Christmas or Summer Family Musical production, the analysis found no discernible trends. As indicated by the graph and table above, percent capacity by production varies wildly from show to show, having an incredibly weak correlation, if any at all. This implies that there are external factors that can influence the patronage of a production. These external factors could also relate back to the unexpected success of *Pinkalicious* and *Junie B. Jones*. What is it about these shows that led the theatre staff to so underestimate their attendance and how does it relate to the forecasting model?

Regardless of being a Summer Family Musical, Christmas Production, or ticket prices, patrons wish to visit certain productions more than others for factors that are not in the immediate control of the theatre. This analysis found no easily identified factors associated with the percent capacity. This could result from the difficulty of predicting artistic success, but further consultation with artists and identification of possible explanatory factors is indicated.

### *Forecasting Revenue Earned*

With the presence of slight bias found in the projection models for forecasting seats sold and the inability to note a discernable trend in predicting percent capacity filled, one may naturally assume that the model employed to predict revenues would also prove insufficient. This, however, is not the case. Table 5, below, reveals the results of the regression analysis for the data.

**Table 5. Regression Analysis of Revenue Earned**

	<b>Coef.</b>	<b>t</b>	<b>P&gt; t </b>	<b>95% Confidence (low)</b>	<b>95% Confidence (high)</b>
<b>Projected Sales</b>	.99	4.69	0.000	.56	1.41
<b>christmas</b>	3646.01	0.58	0.564	-8933.21	9584.7
<b>summer</b>	761.38	0.17	0.863	-8061.94	9584.7
<b>_cons</b>	20.14	0.02	0.988	-2635.07	2675.3

As indicated by the results, the coefficient is close to one, with the constant appearing not too far from zero. The r-squared value is also 80%, supporting the conclusion that the data are closely fitted to the regression line. Unlike with the seats sold, the theatre seems to not apply optimism or pessimism to the revenue forecast, suggesting they have a fairly accurate view of the finances of the organization but not completely of the patronage and why the patronage chooses the productions they do.

## Conclusion

Since the forecasting model employed by Lexington Children's Theatre predicts revenues to a statistically accurate measure, a new model does not need to be created or utilized.

Staff at the theatre does, however, need to rework their model in regards to predicting the number of seats sold for a production in order to overcome the presence of an optimism and pessimism bias.

To further build upon this study, researchers may choose to ascribe subjective characteristics to the productions in a manner similar to Putler's research with the university theatre department. As seen with the failure to properly estimate the seats sold for productions such as *Pinkalicious* and *Junie B. Jones* combined with the seeming inability to properly account for underlying factors in estimating the capacity of the venue filled, there are subjective factors about the show itself that are out of the control of theatre staff. *Pinkalicious* and *Junie B. Jones* were written about young girls learning valuable lessons about nutrition and growing up. One of the 2014 productions hosted by Lexington Children's Theatre, *And Then They Came for Me*, focused on the Holocaust, with emphasis on the life and friendship of Anne Frank. (Still, 2000) At what point does subject matter influence the overall success (ticket sales and revenue) of a production? This information could prove immensely useful when Lexington Children's Theatre begins to develop the list of plays produced in future seasons.

Further research could also delve into the environment surrounding Lexington Children's Theatre during the periods reflected in the data. The data provided by the organization covers a near 16-year span. During that period, the United States saw three different presidents and entered and began recovery of one of the worst recessions in a generation. How did that influence the financial success of the theatre? Also, considering Lexington Children's Theatre is located one block away from the Lexington Center, staff may find it useful to determine the impact of Lexington Center/Rupp Arena events on the ticket sales and revenue of corresponding production performance dates.

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