Large Screens or More Shows: Multiplex Configuration in the Era of Digital Cinema

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Abstract

Movie exhibitors currently face two forces vying for the limited footprint of their properties. Recent advances in IMAX® technology have enabled exhibitors to satisfy consumers’ long-standing desire for increasingly larger screens. On the other hand, digital technology has reduced the cost of playing the same movie on multiple screens, thereby creating an incentive for screen expansion to increase the number of show times for a given movie. Increasing the screens also has the added benefit of allowing the exhibitor to expand the number of unique movies screened at a given time. The goal of this paper is to evaluate consumers’ relative valuations of the large screens vs. more shows tradeoff in determining space allocations. We use a new data set on movie showings in India at the movie-chain-market-week level to estimate an aggregate discrete-choice demand model providing measures of customer preferences for the number of movie showings and screen size. India provides a valuable setting to study this question because the densely populated cities face substantial space constraints and regional heterogeneity in tastes and languages suggest the option of more shows may be more important in some cities than others. Our findings generally indicate that while adding more shows is beneficial, the additional expenses associated with building more screens as opposed to larger screens is not justified by the increased demand in some markets.
1 Introduction

An anecdote from the earliest days of cinema is “the bigger the image, the greater the impact on the viewer”.\(^1\) All else equal this is likely true, but as we’ve seen screen sizes shrink in the multiplex era, it is clear that customers are willing to tradeoff other factors afforded by multiple small screens such as a greater variety of movies or greater time flexibility in when a movie is shown. The digital era may further this screen proliferation by reducing the costs of launching a movie on a given screen. Additional screens may imply even smaller screens. We consider theaters’ configuration tradeoffs between a few large screens vs. many small screens in India where recent economic growth is fueling a push toward new theater construction and use of digital technology.

The Indian market is insightful to study for three main reasons. First, entrants of new theaters are space constrained by the densely populated cities and therefore cannot afford to build many large screens within a multiplex. Second, there is substantial regional heterogeneity in the breadth of movies watched by the local population suggesting variable preferences for variety. Finally, India is unique in empirically analyzing screen size because customers there are well-versed with the screen size a movie will play in before buying the tickets. Exhibitors often list the screens in which movies will play (see Figure 1 for the choices that come up before a consumer finalizes her theater booking. The movie Terminator Salvation is available in two auditoria - Sathyam and Seasons.) This allows our identification to exploit screen size differences within a theater in addition to the more salient screen size differences across theaters.

\(^1\)Quoted from http://www.imax.com.au/visitor_info/
Figure 1: A consumer can choose both the screen and showtime before booking the movie.

To analyze the data and evaluate this tradeoff, we use a demand model similar to that of Davis (2006), who considers whether theater scale choices are optimal. A fundamental difference between our approaches is that he treats the number of screens in a “descriptive” sense by assuming they enter the consumer’s utility directly. However, we believe that a consumer’s utility is driven by the shows of a movie that a screen can deliver and not directly by the screens of a chain. Specifically, in regions where customers demand a greater variety of movies, or more showings for a given movie, additional screens will deliver more value than other areas. We therefore measure the marginal effect of an additional screen by conducting a counterfactual in which an additional screen is either used to screen an additional movie or to provide more shows of a theater’s existing movies.

Our results indicate that the impact of adding one more show is much higher than the impact of increasing screen size. This justifies to some extent the recent shift to multiplexes in India. However, we show that the extent of the increased demand is market-specific. We evaluate, for a multiplex planning to enter a market, whether having more small screens is more profitable than having fewer large screens. We find that in some markets the additional expenses associated with building more screens is not justified by the increase in demand.

These findings contribute to the literature in a variety of ways. Our focus on factors determining screen counts in theaters adds to a growing empirical literature on the movie industry that has covered topics ranging from organizational issues such as movie financing.
decisions (e.g. Goettler and Leslie, 2005) and contracting (e.g. Gil, 2009) to operational issues such as release and run-length (e.g. Einav, 2007 and Ainslie, Dreze and Zufriden, 2005), pricing (Gil and Hartmann, 2009), and finally post-box office distribution (Mortimer, 2007 and Mortimer 2008). Our analyses also effectively determines the “shelf space” to be allocated in theaters as described by Elberse and Eliashberg (2003). To date this literature has primarily focused on allocating products within this space (e.g. Eliashberg et.al. 2006).

It is also useful to consider our analysis in the context of retail configuration more generally. From an empirical analysis perspective, it is typically challenging to address retail configuration because we often do not observe enough variation in configuration to infer effects. Our approach focuses inference on valuations of variable product attributes (e.g. product variety and number of showings), but analyzes the effects of configuration (e.g. screen counts) by focusing on how it relates to these attributes. Application of this approach to traditional retail would allow researchers to measure store size effects by how they alter product variety instead of inserting store size directly into customer utility.\(^2\)

The rest of the paper is organized as follows. The next section outlines the data. Section 3 defines the empirical model and identification. Section 4 provides the model estimates. Section 5 conducts counterfactual analyses to demonstrate the relative tradeoffs of shows vs. screen size and section 6 concludes.

2 Data

We use a data set on movie showings in India at the movie-chain-market-week level. Variation in screen size as well as number of shows, necessary to answer our question, is present in our data set. The dataset consists of admits, net collections, shows, occupancy and spans 14 markets, 7 chains, 44 weeks (March 2007 – February 2008) and nearly 600 unique movies. While each chain has only one multiplex in a market, the number of competing chains in

\(^2\) Draganska and Jain (2005) first studied product line length, whereas Draganska et.al. (2009) extends this literature to allow each variety of a product to constitute a different demand alternative within an entry framework.
Each market ranges from two to four.

Unlike the US, prices of showings in India vary across markets, chains, movies and time. Weekly price of each movie showing in a chain-market was calculated by dividing the net collections by the total admits.

We use the number of seats as a proxy for screen size, i.e., a larger number of seats implies a larger screen size for the movie being screened. Figure 2, which shows the seat layout plan of two auditoria in the same chain, justifies use of this proxy. Screen 4 is a larger screen and the auditorium has 230 seats. Screen 2 is a smaller screen in an auditorium with 188 seats.

Source: http://in.bookmyshow.com

Figure 2: Screen size correlates with number of seats

The number of seats for each movie showing was inferred from the occupancy data as shown in Equation 1.
\[ \text{seats}_{jct} = \frac{\text{admits}_{jct}}{\text{occupancy}_{jct} \times \text{shows}_{jct}} \]  

Here \( j \) indexes movies, \( c \) theater-chains, \( l \) locations and \( t \) the week of the showing. Note that when a movie plays on more than one screen, the above calculation gives the average screen size the movie played in.

Markets were determined mainly by how theaters classified themselves. For example, \textit{PVR - Aurangabad} would belong to the market \textit{Aurangabad}. \textit{Adlabs - Goregaon, Mumbai} and \textit{Adlabs - Mulund, Mumbai} would be treated as belonging to two distinct markets \textit{Goregaon} and \textit{Mulund}. Market shares were computed as admits divided by the population of the market. The number of screens specific to a chain in a market was obtained from the chain website.

Movies were classified based on the language of screening. India being a culturally diverse nation, regional movies form a significant portion of the movies being screened. Movies were classified into English (official language), Hindi (national language) and regional (local language of the market). Movies screened in different languages e.g. ‘The Fantastic Four’ and ‘The Fantastic Four (Hindi)’ are treated as different movies. This is appropriate as they typically cater to different types of audiences.

Table 1 lists some of the descriptive statistics of the data.

<table>
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<th>Mean</th>
<th>Median</th>
<th>Std. Dev</th>
</tr>
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<tr>
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<td>93</td>
<td>37</td>
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<tr>
<td>Screens</td>
<td>5.16</td>
<td>5</td>
<td>2.37</td>
</tr>
<tr>
<td>Shows (per week)</td>
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<td>14</td>
<td>16</td>
</tr>
<tr>
<td>Seats</td>
<td>265</td>
<td>255</td>
<td>111</td>
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<tr>
<td>Hindi dummy</td>
<td>0.57</td>
<td>1</td>
<td>0.49</td>
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<tr>
<td>English dummy</td>
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<td>0.46</td>
</tr>
<tr>
<td>Observations</td>
<td>9062</td>
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</tr>
</tbody>
</table>

Table 1: Descriptive Statistics
Movies were also distinguished based on their week since release. This weekly distinction among movies is made to capture any demand dampening effects that might be present the further the movie is from its week of release. Moreover any word-of-mouth effects will be picked up by these movie-week fixed effects. Using movie-week fixed-effects rather than movie fixed effects alone will help capture any such patterns in the data that might be missed by not having a dynamic demand specification. A dynamic demand specification would be particularly challenging in this aggregate data analysis. One might be inclined to let the available market shrink over time, but this could not for instance account for customers that want to see the movie multiple times. The potential for word-of-mouth could also greatly complicate the analysis. However, neither of these factors are critical pieces of the analysis because we are not concerned with movie-specific factors.

We now provide preliminary evidence that consumers might value large screens and more shows. A preliminary cut at the data shows that the number of admits increases with increasing screen size (Figure 3) and increasing number of shows (Figure 4). However, there is a potential endogeneity issue here. Chains may screen good movies in larger screens and as demand is likely to be high for good movies, we might wrongly infer that larger screens lead to higher demand if we do not instrument and account for this endogeneity bias. Similarly, good movies may have more shows resulting in an endogeneity bias for shows. Thus, to account for these effects we need instrumental variables. We describe these in the context of our structural demand model in Section 3.
As stated in the introduction, a unique feature of the Indian market is that there is
substantial regional heterogeneity in the variety of movies demanded. For example, cities like Market 4 and Market 6\(^3\) which are more cosmopolitan in their population have regional (non-Hindi, non-English) language movies that are more predominant than in other areas. We compute the concentration ratio for each market to determine which markets are more likely to be diverse. The average concentration ratio for each market was computed by averaging \(HHI_t\) across all weeks where

\[
HHI_t = \sum_{j=1}^{J_l} \left( \frac{\text{admits}_j}{\sum_j \text{admits}_j} \right)^2
\]

\(J_l\) is the number of movies playing in market \(l\) in week \(t\).

Values closer to 0 indicate that there are more movies and that each movie has an equal share in the market, while values closer to 1 indicate that the market is dominated by a few movies. Figure 5 below reveals that the average concentration ratio of movies in the more cosmopolitan markets, Markets 4 and 6, is substantially lower than in other, less diverse cities. We therefore expect that a larger number of screens might be valued disproportionally more in these cities because of the value associated with a greater variety of movies.

\(^3\)The market and chain names are suppressed for confidentiality.
3 Model

A consumer is assumed to make a choice of which movie to watch from all movies playing in her market in that week. The choice set as well as the number of choices in the set changes from one week to another. Consumers are influenced in their decisions by the movie, language of the movie (English, Hindi or regional), price, the chain the movie is playing in, the week since the movie was first released, the number of shows of the movie at the chain and the screen size (as proxied by the number of seats) of the particular auditorium the movie is being screened at.

A nested logit demand model is specified with consumer’s indirect utility specified by the following equation

$$U_{ijclt} = \alpha_{jl} + \alpha_c + \alpha_{l,lang} + \beta_{price} + \beta_{shows} \ln (shows_{jclt}) + \beta_{size} \ln (seats_{jclt}) + \varepsilon_{ijclt} \quad (3)$$
where

\( j \in \{1, \ldots, J_{lt}\} \) denotes the movies available in location \( l \) in week \( t \). Note that a movie playing in one chain is considered as a different choice compared to the same movie playing in another chain.

\( c \in \{1, \ldots, C_{lt}\} \) denotes the chains in that location (i.e. market). The time subscript allows for new chains to enter the market (observed in the data).

\( l \in \{1, \ldots, L\} \) denotes the market and

\( t \in \{1, \ldots, T\} \) denotes the week.

Movie-week fixed effects are included in the utility specification. These can be identified as we observe movies across time, chains and locations. As mentioned previously, this weekly distinction among movies is made to help tease out any patterns in the data that might be missed by not having a dynamic demand specification (e.g. demand dampening, word-of-mouth effects).

The choices are partitioned into 2 groups with group 1 consisting of the set of all movies playing in that location that week and group 2 consisting of the outside alternative (see Figure 6).

Following the nested logit formulation, we assume the joint distribution of \( \varepsilon \) in each market-week as
\[ F(\varepsilon_0, \varepsilon_1, \varepsilon_2, \ldots, \varepsilon_J) = \exp \left( -\exp(-\varepsilon_0) - \left[ \sum_{j=1}^{J} \exp(-\rho^{-1}\varepsilon_j) \right]^{\rho} \right) \]  

(4)

As a result we obtain the following system of equations

\[ \ln(s_{jclt}) - \ln(s_{0lt}) = \alpha_{jt} + \alpha_c + \alpha_l + \alpha_{l,lang} + \beta_{price} \ln(\text{shows}_{jclt}) + \beta_{size} \ln(\text{seats}_{jclt}) \]

\[ + (1 - \rho) \ln\left( \frac{s_{jclt}}{1-s_{0lt}} \right) \]  

(5)

The standard logit model is obtained when the nesting parameter \( \rho \) is 1. When the nesting parameter is 0 there is no substitution between the outside option and the movies nest.

**Endogeneity**

Endogeneity can bias the estimates of seats and shows, the main variables of interest, if not accounted for appropriately. Good movies will have more shows; these movies will also have high demand. This endogeneity will lead to an upward bias in the estimate for shows. We instrument for this endogeneity by exploiting cross-theater variation in the number of screens at each location. The total number of screens is a good instrument because

1. It is pre-determined i.e., theaters cannot adjust the total number of screens in response to demand shocks.

2. It is correlated with the number of shows of a movie at a theater. Specifically, a chain with more screens can have more showings.

Secondly, good movies may also be screened in larger screens. This will lead to an upward bias in the estimate for screen size. A good instrument is a function of the total seats since the seating capacity is fixed for a given theater-chain. We use an instrument defined in (6), that in addition distinguishes between the kinds of seating-capacity present in a given chain. This
instrument distinguishes, for example between two theaters with the same seating capacity of 200, one with one 50-seat screen and one 150-seat screen and another with two 100-seat screens.

\[ \sum_{i=1}^{N} \left( \frac{seats_i}{\sum_i seats_i} \right)^2 \]  \hspace{2cm} (6)

The time-invariant seating capacity by screen for each chain is not directly available from the data. These were inferred by backing out the average number of seats using Equation 1 and plotting the histogram of seats for each chain in a market by week and inferring the time-invariant number of seats from the distribution knowing the number of screens in that chain. For example a distribution as shown in Figure 7 for a 4-screen theater would imply the existence of about 3280-seat auditoria and one 410-seat auditorium.

![Figure 7: Histogram of seats for chain 7 in market 13 for 1 week](image)

Apart from accounting for endogeneity biases in seats and shows, we also have to account for endogeneity that arises from the nesting parameter in Equation 5. A good instrument is one that is unrelated to the share of the movie relative to the outside good but is correlated with the share within the movie nest. Valid instruments include the total number of Hindi
(and English) movies playing in that market-week other than the movie under consideration. Einav (2007) uses the total number of movies playing other than the movie under consideration as an instrument and argues that including week- and movie- fixed effects will remove any endogeneity associated with the fact that more movies may be associated with high-demand weeks and that fewer movies may be released along with a high-quality movie respectively. We use all three instruments discussed above to account for endogeneity of the nesting parameter.

4 Results

Table 2 presents the estimates of the model before and after accounting for the endogeneity bias. As can be seen by the reduction in the magnitude of the shows and seats coefficients, the direction of the endogeneity correction is correct. The time, market and movie-week fixed effects are not reported. The coefficients for price, shows and seats coefficients have the right sign and are statistically significant.

Table 2 also presents the first-stage regression results showing the validity of the instruments. The number of screens in a chain was the instrument for shows. The significant positive coefficient indicates that screens and shows are positively correlated, i.e. a chain with more screens has more shows. The instrument for screen size is such that it takes on large values when a chain has a few large auditoria but many small auditoria. The negative coefficient indicates that such chains are more likely to screen movies in smaller auditoria with smaller screens. The instrument for the nesting parameter takes on larger values when there are fewer competing movies playing in the market. A positive coefficient indicates that the inside-nest share of the movie is higher when there are fewer competing movies playing.

\footnote{We do not include the nesting parameter in the before estimation as without instrumenting for the nest, this parameter - which is highly correlated with the dependant variable - explains most of the variation in the data.}

\footnote{For brevity, we present only the relevant instrument estimate for each endogenous variable.}
We now measure the effect of shows and screen size on demand. Figure 8 compares the original demand for a movie in Chain 3 in one of the markets to the demand arising from a) adding 1 more show to the existing showings holding screen size fixed and b) increasing screen size by adding 100 more seats holding the number of movie showings fixed. It can be seen from this figure that more shows impacts demand more than larger screens.
Our estimates indicate a nesting parameter significantly different from 1 suggesting that the nested logit model fits the data better than the standard logit model.

As mentioned before, the movie-week fixed effects help us identify patterns that may exist in the data induced by word-of-mouth externalities, demand-dampening dynamic effects etc. Figure 9 shows some relevant interesting patterns that are captured by introducing these movie-week fixed effects. Figure 9 plots, for the movie *Namesake*, the fixed-effects over time since the week of release. As can be seen, demand decreases as the time since release increases. The figure also plots these fixed-effects for the movie *Blood Diamond* which exhibits demand-dampening effects during the first month of its release, but then picks up demand again. This coincides with the Oscar nominations announcements which were released on Jan 23rd 2007, about a month after *Blood Diamond*’s release. This demand spike could correspond to new customers or returning customers who want to watch the movie again both responding to the Oscar nominations announcement.
5 Counterfactuals

As was seen in the Results section the impact of adding one more show is much higher than the impact of increasing screen size. This justifies to some extent the recent shift towards multiplexes in India. However, the extent of the increased demand arising from more screens can vary across markets. In some markets the additional expenses associated with building more screens may not be justified by the increase in demand. We investigate these aspects in the counterfactuals in this section.

5.1 Building a new Multiplex: Market Heterogeneity

In this section we compute the demand that arises from building a 5-screen multiplex in two markets - Market 4 and Market 5. We conduct the counterfactual as follows: In both markets we add the same chain (Chain 6) to the existing set of chains in the market. For comparison purposes, we assume that the chain screens the same set of movies in both markets. As can be seen from Figure 10 the demand in Market 5 is much lower than the demand in Market 4. Based on this computation, Chain 6 might decide to enter Market 4.
5.2 Break-even Analysis: Large Screen or More Shows

We now return to the question posed initially which was the motivation behind estimating the structural model: are large screens or more screens and hence more shows more valuable to a consumer?

We answer this question by computing the number of years it would take for the new multiplex (Chain 6) to break-even in Market 4 and Market 5 under different configurations of screen size. We assume for this analysis that it costs $500,000 to build an additional auditorium. This cost includes the cost of digital projection systems, sound, lighting, seats and construction. The real estate is held fixed at a seating capacity of 4000. As mentioned in the introduction, the theater-developer needs to decide whether to build a few large screens or many small screens.

We show that in Market 5 it takes longer to break-even compared to Market 4 (this also follows from Section 5.1). In Market 5 break-even periods decrease as the chain moves from
a 1-plex to a 5-plex. However, as screen counts get larger, and subsequently screen sizes get smaller, the break-even periods start increasing. As can be seen in Figure 11, Chain 6 is better off entering with a 5-screen multiplex in Market 5 while Market 4 can support a larger number of smaller screens.

![Figure 11: Simulated Demand for a new multiplex under different screen configurations in Markets 5 and 4](image)

### 5.3 Marginal impact of an additional screen - more variety or more showings?

In this section we evaluate the impact an additional screen would have on existing multiplexes in a market. On the one hand, an additional screen may enable a theater to show a movie it otherwise would not be able to. This allows the theater to have an additional product offering that might enable it to capture more market share. On the other hand, the theater could also use the screen to create more showings for a given set of movies. This provides consumers with more flexibility in show times and essentially raises the utility of seeing a movie at that theater.

Figure 12 plots the additional admits arising from using an additional screen to screen 1) more showings of its existing movies and 2) a new movie\(^6\) which the chain is not currently

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\(^6\)The additional screen essentially provides 5 additional showings per day. While we considered distributing them evenly or giving them all to a new movie, other possibilities include 5 new movies with one showing each, or 1 showing of one new movie and 4 incremental showings of other movies. While a theater may wish to use our model to explore all such possibilities, there is negligible value with considerable potential confusion if we tried to illustrate all possibilities in this paper.
screening. While we do not test for a pattern in this process, it appears that when a theater has very few screens, it is likely already screening one or more of the best movies and an additional screen can enable more shows such that it can better compete for the top few movies. Once screen counts become larger, a theater competes by diversifying its selection of movies. But, this process can only continue as long as there are viable movies in the market to add. We see in Figure 12 that the 11-plex may be running out of additional viable movies and therefore only benefits by increasing the utility of existing movies through more show times.

This counterfactual depicts the value of modeling how the number of screens in a multiplex affects demand which requires a structural derivation of the ways in which an additional screen affects consumer choice.

![Chart](chart.png)

Figure 12: Option value of an additional screen in Markets 5 and 4

6 Conclusion

A demand model providing measures of customer preferences for the number of movie showings and screen size was estimated using a new data set on movie showings in India at the movie-chain-market-week level. The trade-off between large screens and more shows was viewed in the context of the digital era. Digital technology reduces the costs of additional screenings for a given movie, because a digital copy of a movie can be more easily played on multiple screens at the same time. Whether this can help increase revenues depends on how
much customers value the additional showings.

We found that it can take an exhibitor longer breakeven periods to justify the increased demand that comes from additional showings. This is because additional showings implies smaller screen sizes for a fixed theater capacity and also because building more screens comes at an additional fixed cost. This analysis has important insights to theater-developers who wish to know if they should build a few large screens or many small screens holding seating capacity fixed. This trade-off analysis is crucial in determining the scale of entry especially because developers have a fixed area of land and want to maximize their profits given their fixed capacity.

We also showed that an additional screen can be used in various ways by exhibitors and the optimal use depends on the market and the existing set of movies being screened.

We have only looked at the demand side in this research and answered the question from the perspective of consumer preferences. We have taken the choice set in a market as exogenous. We do not account for the fact that in some markets for the same number of screens theaters prefer to show more variety of movies while in other markets theaters prefer to show fewer movies more times. Future work would benefit from endogenising the set of movies being screened by a chain and also from modeling that allows for the effects of capacity constraints and spillovers between movies. Data with detail at the time-of-show level would help us infer customer preferences better by controlling for the time of day.

References


Appendix: Counterfactual Computation

To compute the demand $s_{jclt}$ in our counterfactuals we make use of Equation 7

$$s_{jclt} = \frac{\exp\left(\frac{V_{jclt}}{\rho}\right)}{\left(\sum_{k \in \text{Group}2} \exp\left(\frac{V_{kclt}}{\rho}\right)^{1-\rho}\right) \left(1 + \left(\sum_{k \in \text{Group}2} \exp\left(\frac{V_{kclt}}{\rho}\right)^{\rho}\right)\right)^{\rho}}$$

(7)

$$V_{jclt} = \alpha_{jt} + \alpha_{c} + \alpha_{l} + \alpha_{l,\text{lang}} + \beta_{\text{price}} \ln(\text{shows}_{jclt}) + \beta_{\text{size}} \ln(\text{seats}_{jclt})$$

(8)

In the case of a new multiplex entry into a market, the number of shows and seats for each movie are computed using equations

$$\text{shows}_{jclt}^{\text{new}} = 5 \times \frac{\text{screens}_{cl}}{\sum_{k \in J_{clt}} k}$$

(9)

$$\text{seats}_{jclt}^{\text{new}} = \frac{\text{SeatingCapacity}_{cl}/J_{clt}}{\text{shows}_{jclt}^{\text{new}}}$$

(10)

where

- $\text{screens}_{cl}$ is the number of screens chain $c$ enters market $l$ with
- $\text{SeatingCapacity}_{cl}$ is the total (fixed) seating capacity of the chain
- $J_{clt}$ is the set of movies the chain screens in week $t$

In our last counterfactual we either use an additional screen to 1) distribute the resulting new showing slots uniformly across all existing movies of a chain or 2) to add a new movie to the set of existing movies being screened at the chain.

In case 1, the number of choices for a chain remains the same while the independent variable shows and seats change. The new shows and seats for the existing movies are computed as
\[
shows_{jclt}^{new} = shows_{jclt} + shows_{jclt}^{addn}
\]

\[
seats_{jclt}^{new} = \frac{seats_{jclt} \cdot shows_{jclt} + seats_{clt} \cdot shows_{jclt}^{addn}}{shows_{jclt}^{new}}
\]

where

\[
shows_{jclt}^{addn} = \frac{5 \times screens_{clt}^{addn}}{\sum_{k \in J_{clt}} k}
\]

\(screens_{clt}^{addn}\) is the number of additional screens added to chain \(c\)

\(seats_{clt}^{addn}\) is the seating capacity (per show) of the additional screens

\(J_{clt}\) is the set of movies being screened in chain \(c\), location \(l\) at time \(t\)

In case 2, the independent variable for the existing movies remains the same but the choice set for the chain under question increases by one due to the new movie added. The new movie is chosen as that movie which attracts the highest number of admits in the focal chain’s local competitors and is not being currently screened in the focal chain. The new movie’s characteristics (movie-week fixed effect, language) are known as it is playing in one of the competing chains in the same market. The price is assumed to be the same as the price of the movie in the competing chain. The variable shows and seats are chosen - typically shows is set at 5 if one screen is added and seats at 100 or 200.