

Final Project Proposal

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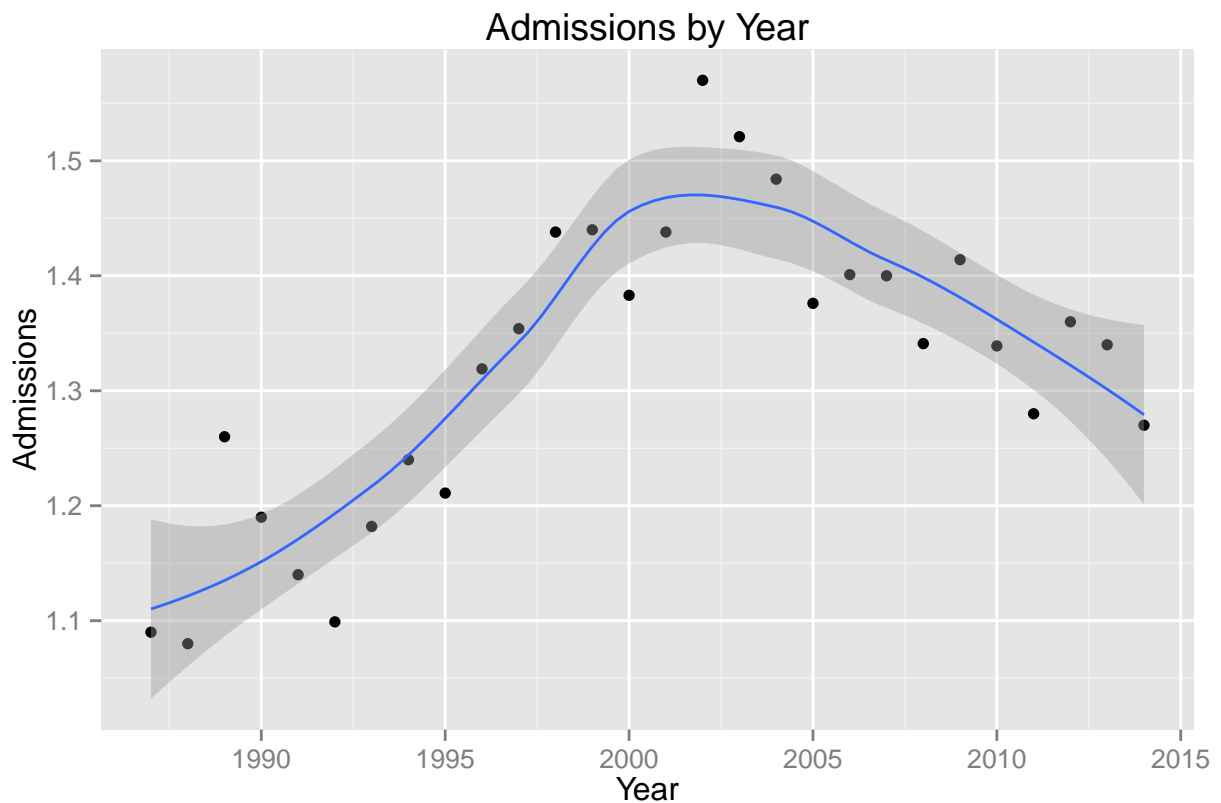
Introduction

The original goal of the project was to see just how much streaming and pirating hurt theatre attendance over the past decade. The reality of the problem obviously has many more facets than I was able to successfully test and quantify. To make the scope narrower and potentially more telling on a specific subject, I decided to stick closer to the impact ticket prices, and netflix had in particular. The theatre industry has been on a decline since 2002, where it had record sales. A roughly 27% decrease in revenue, and 250 million less ticket sales per year dictates that there are a number of factors creating the problem. My estimation is that online streaming is the largest contribution to the problem of ticket sales.

Movie Admissions

Taking a table from NATO Online, we can see the total admissions by year in the US and Canada combined. The **Admissions** column is in billions. There is a clear trend of increasing attendance from 1987 to the early 2000's, and a definite decline from then until present day. White Hutchinson Leisure and Learning Group reported a 27% drop in revenue since 2002 to accompany the decline in admissions. There are number of possible reasons for the trend of rise and decline. We'll take a look at a few of the possible factors in the next section.

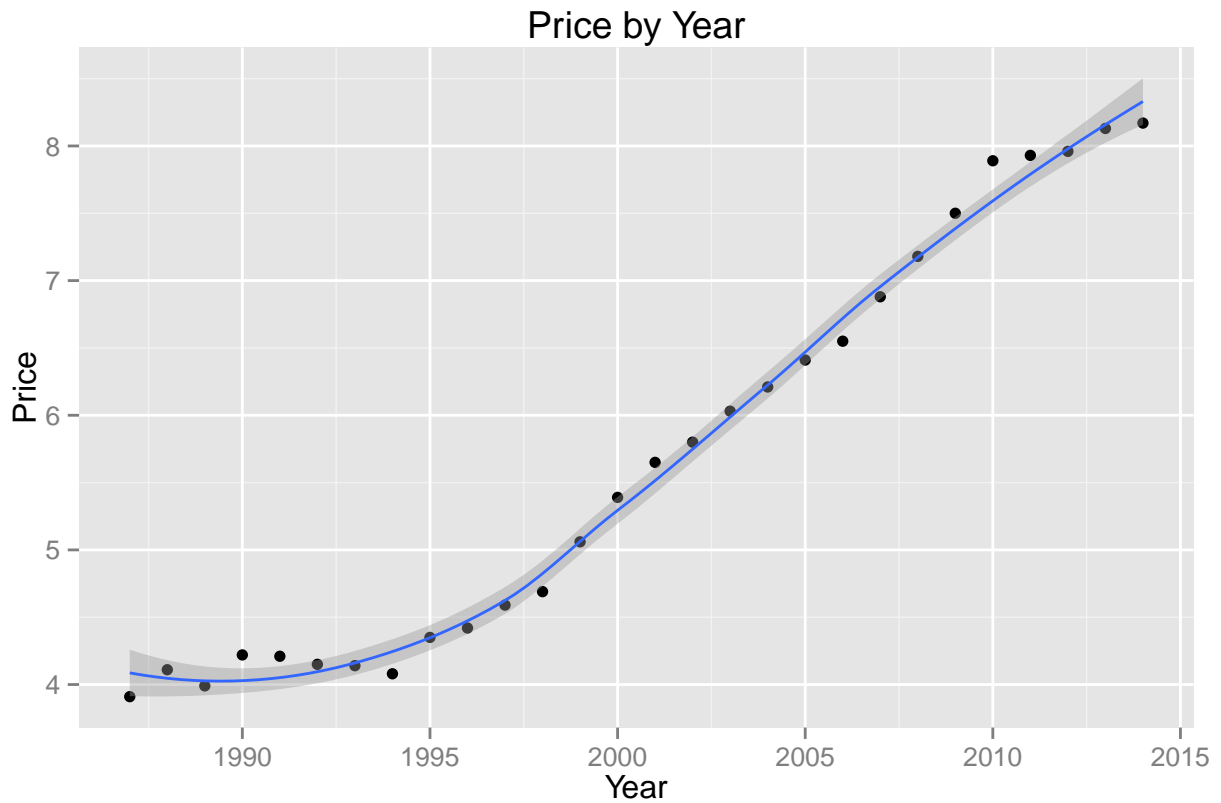
Year	Admissions	Year	Admissions
1987	1.090	2001	1.438
1988	1.080	2002	1.570
1989	1.260	2003	1.521
1990	1.190	2004	1.484
1991	1.140	2005	1.376
1992	1.099	2006	1.401
1993	1.182	2007	1.400
1994	1.240	2008	1.341
1995	1.211	2009	1.414
1996	1.319	2010	1.339
1997	1.354	2011	1.280
1998	1.438	2012	1.360
1999	1.440	2013	1.340
2000	1.383	2014	1.270



Ticket Prices

A table from NATO Online has information on the yearly average US movie ticket price. Ticket prices, as expected, increased linearly for each year. The **Price** column is in USD. The plot below for prices do not indicate any sort of trend that would indicate a reason for the early 2000's peak in attendance. A potential reason for decline directly following could be that customers did not feel movies were worth the increased price.

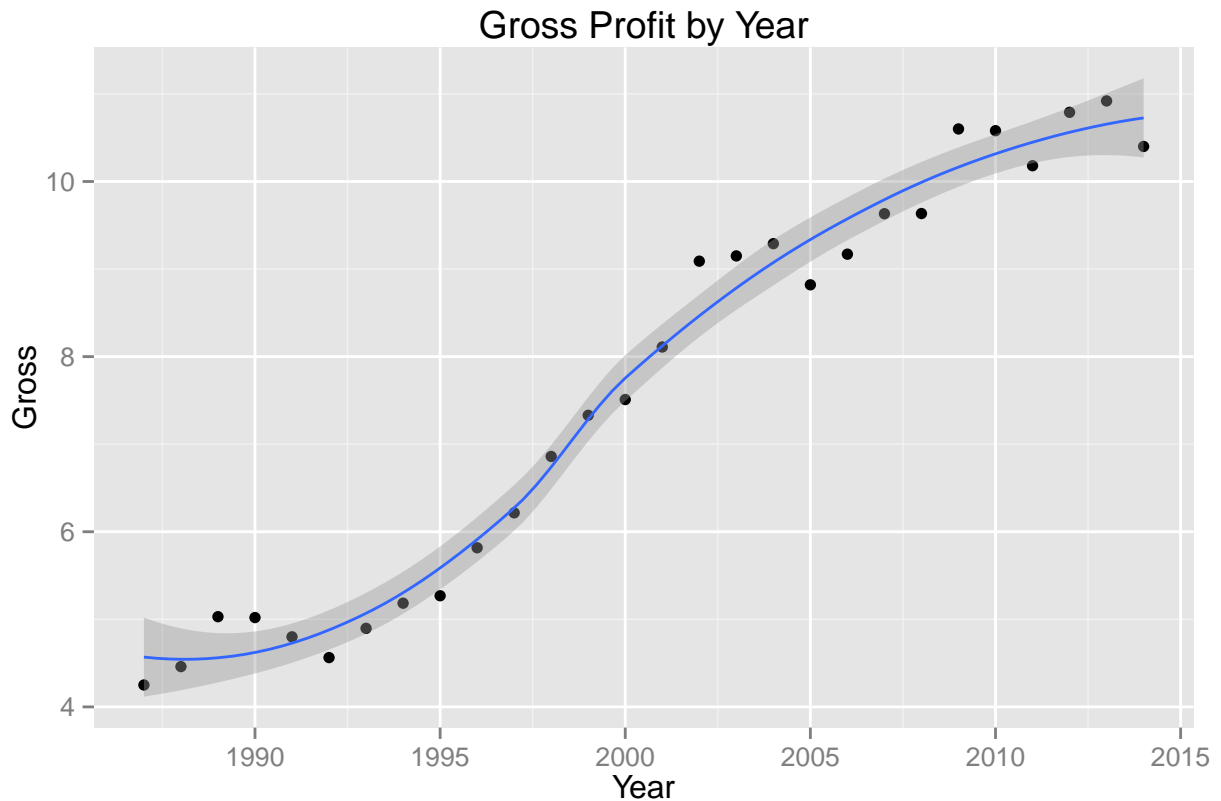
	Year	Price	Year	Price
20	1987	3.91	2001	5.65
21	1988	4.11	2002	5.80
22	1989	3.99	2003	6.03
23	1990	4.22	2004	6.21
24	1991	4.21	2005	6.41
25	1992	4.15	2006	6.55
26	1993	4.14	2007	6.88
27	1994	4.08	2008	7.18
28	1995	4.35	2009	7.50
29	1996	4.42	2010	7.89
30	1997	4.59	2011	7.93
31	1998	4.69	2012	7.96
32	1999	5.06	2013	8.13
33	2000	5.39	2014	8.17



Box Office Gross Profit

The following data on US and Canadian gross profit is from NATO Online. The inclusion of gross profit and exclusion of net profit is purely due to a lack of data for accurate net profit. The importance of the sudden rise and tapering in more recent years is very telling of the net profit, without knowing the actual net figure. The running costs of theatres has increased with the presence of newer projectors and expenses. This means the running cost has continued to rise, while the gross has begun to taper.

Year	Gross	Year	Gross
1987	4.250	2001	8.110
1988	4.460	2002	9.090
1989	5.030	2003	9.150
1990	5.020	2004	9.290
1991	4.800	2005	8.820
1992	4.563	2006	9.170
1993	4.897	2007	9.632
1994	5.184	2008	9.634
1995	5.269	2009	10.600
1996	5.817	2010	10.580
1997	6.216	2011	10.180
1998	6.860	2012	10.790
1999	7.330	2013	10.920
2000	7.510	2014	10.400




Internet Traffic

The following table from Cisco shows a relative estimate of internet bandwidth used. The first row is per day, the second is per hour, and the rest are per second. The bandwidth used from 1992 to 1997 is relatively small. The amount begins to be substantial in 2002, and only increases from there. The estimated usage in 2019 is a staggering 51,694% increase over the usage in 2002.

Year	Bandwidth
1992	100 GBpd
1997	100 GBph
2002	100 GBps
2007	2000 GBps
2014	16144 GBps
2019	51794 GBps

The following is a table from Sandvine, outlining the overall bandwidth distribution from 2013. Netflix, Youtube, Amazon Video, and Hulu are all inside the top 10 for total bandwidth, with Netflix accounting for almost 32% of all data transferred. What this means is that people are watching a substantial amount of video every day, and aren't going to the theatre to do it. BitTorrent and HTTP are important to the overall view as well. Not all file sharing and BitTorrent traffic are media files, but the majority are, and together they account for 14% of all traffic.

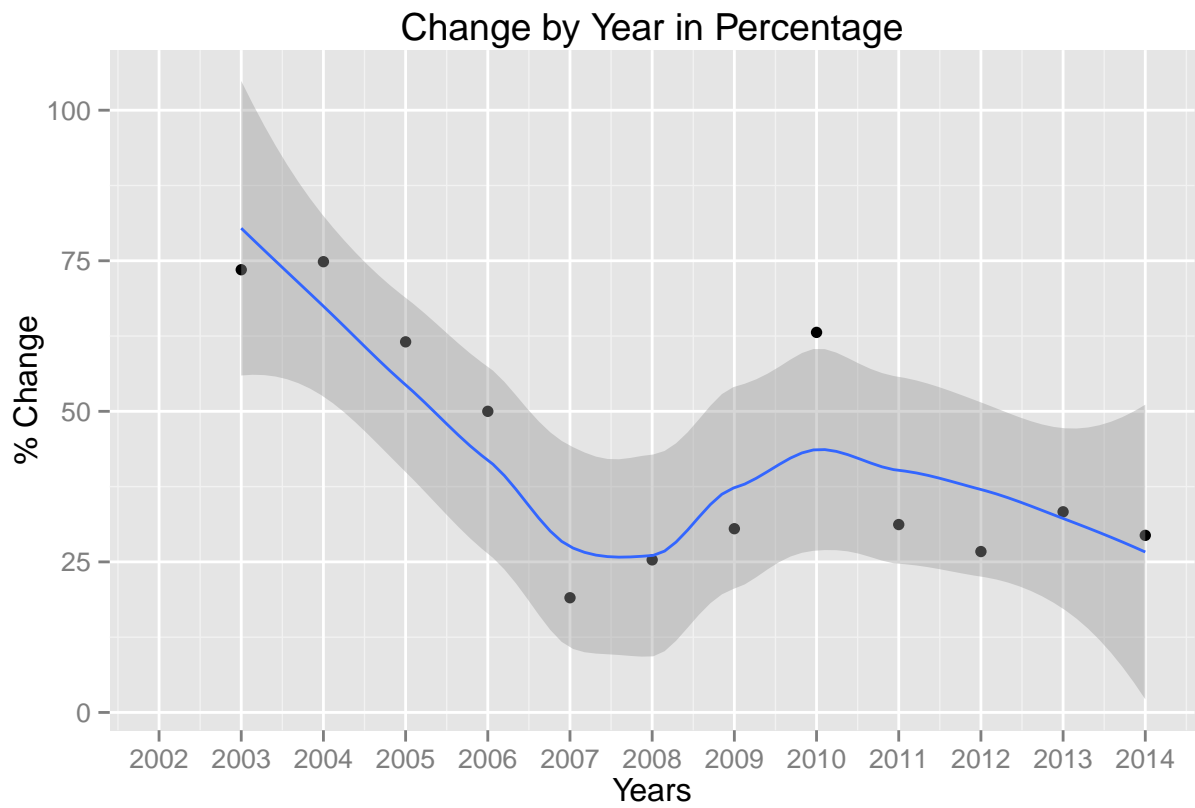
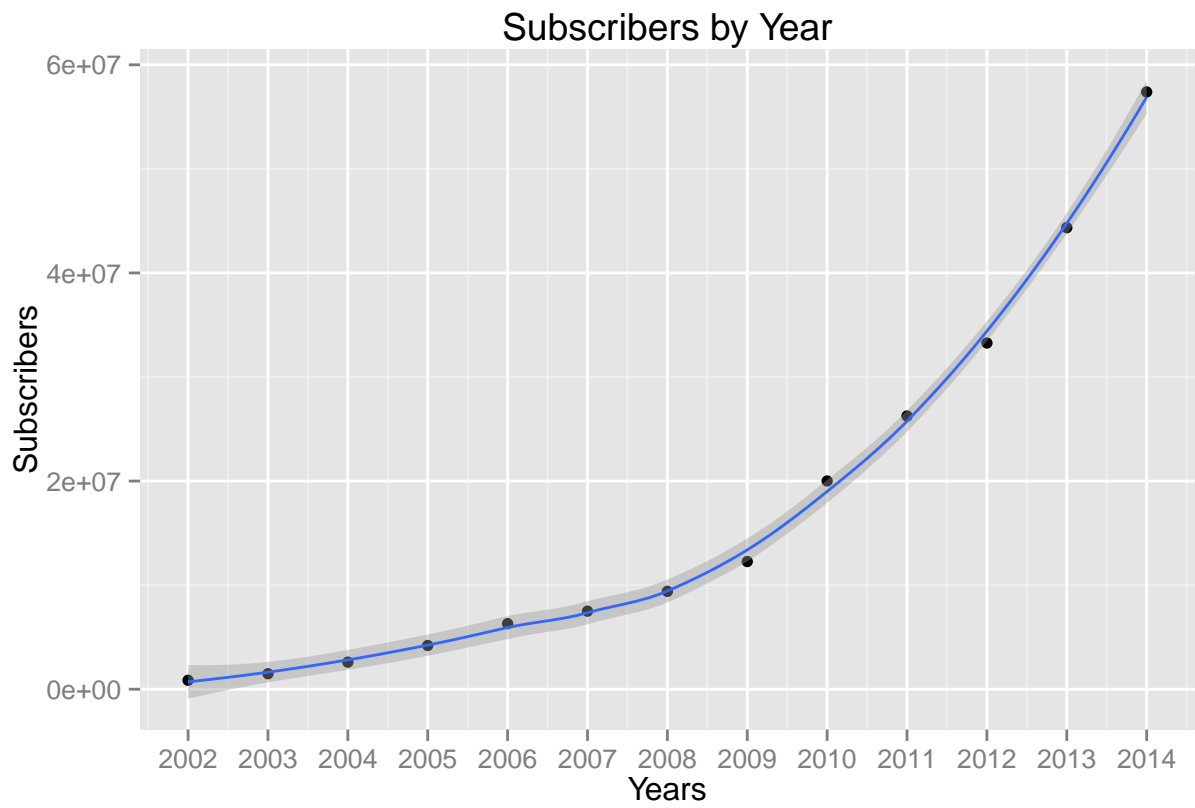
Rank	Upstream		Downstream		Aggregate	
	Application	Share	Application	Share	Application	Share
1	BitTorrent	36.35%	Netflix	31.62%	Netflix	28.18%
2	HTTP	6.03%	YouTube	18.69%	YouTube	16.78%
3	SSL	5.87%	HTTP	9.74%	HTTP	9.26%
4	Netflix	4.44%	BitTorrent	4.05%	BitTorrent	7.39%
5	YouTube	3.63%	iTunes	3.27%	iTunes	2.91%
6	Skype	2.76%	MPEG - Other	2.60%	SSL	2.54%
7	QVoD	2.55%	SSL	2.05%	MPEG - Other	2.32%
8	Facebook	1.54%	Amazon Video	1.61%	Amazon Video	1.48%
9	FaceTime	1.44%	Facebook	1.31%	Facebook	1.34%
10	Dropbox	1.39%	Hulu	1.29%	Hulu	1.15%
		66.00%		76.23%		73.35%



Netflix

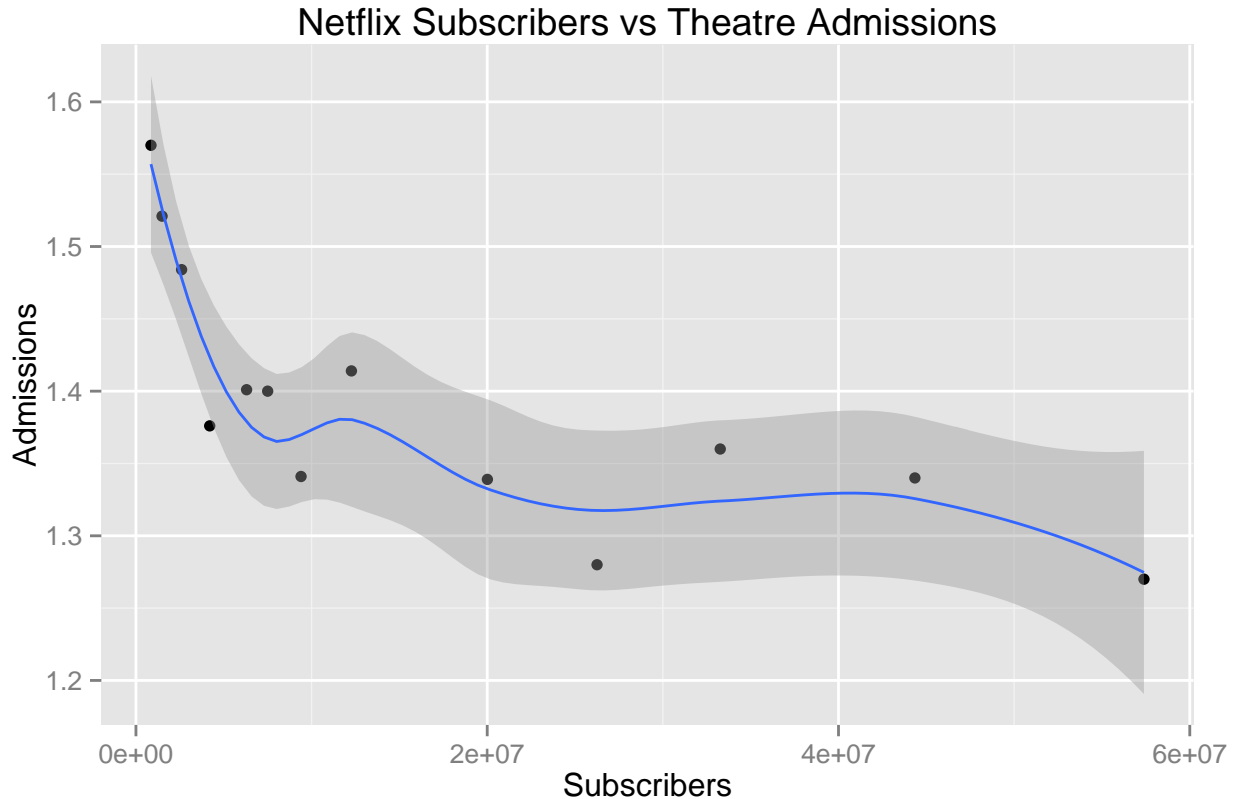
Taking a closer look at Netflix in particular, and grabbing their subscriber data directly from their revenue excel documents, we can see that their userbase has substantially increased each year following 2002.

Year	Subscribers	% Change
2002	857000	NA
2003	1487000	73.51225
2004	2600000	74.84869
2005	4200000	61.53846
2006	6300000	50.00000
2007	7500000	19.04762
2008	9400000	25.33333
2009	12268000	30.51064
2010	20010000	63.10727
2011	26253000	31.19940
2012	33267000	26.71695
2013	44350000	33.31530
2014	57391000	29.40474



Netflix and Theatre Attendance

Below is a plot, correlation, and summary stats on admissions numbers for theatres and netflix usage. The initial look is that as subscribers to netflix increase, the admissions to theatres go down.



```
##
## Pearson's product-moment correlation
##
## data: netflix_tickets$Subscribers and netflix_tickets$Admissions
## t = -3.5237, df = 11, p-value = 0.004768
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
## -0.9128949 -0.2959170
## sample estimates:
## cor
## -0.7281761
```

The correlation value above of -0.7281761 indicates that that the correlation is significant, while can also be gained from the p-value being below 0.05.

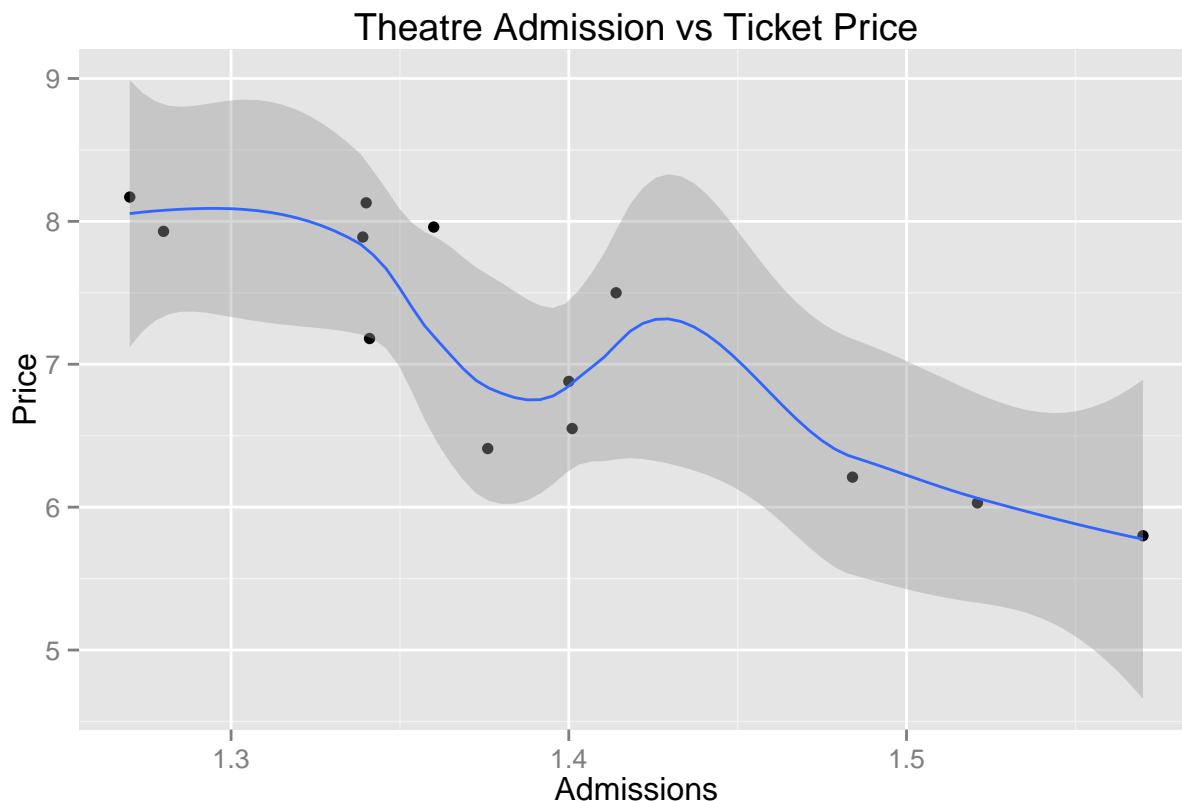
```
##
## Call:
## lm(formula = netflix_tickets$Subscribers ~ netflix_tickets$Admissions)
##
## Residuals:
```

```
##      Min      1Q      Median      3Q      Max
## -15543993 -8691426 -1851095  9829591 21956502
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)      223424510   58584966   3.814  0.00287 **
## netflix_tickets$Admissions -148023631   42008393  -3.524  0.00477 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 12900000 on 11 degrees of freedom
## Multiple R-squared:  0.5302, Adjusted R-squared:  0.4875
## F-statistic: 12.42 on 1 and 11 DF,  p-value: 0.004768
```

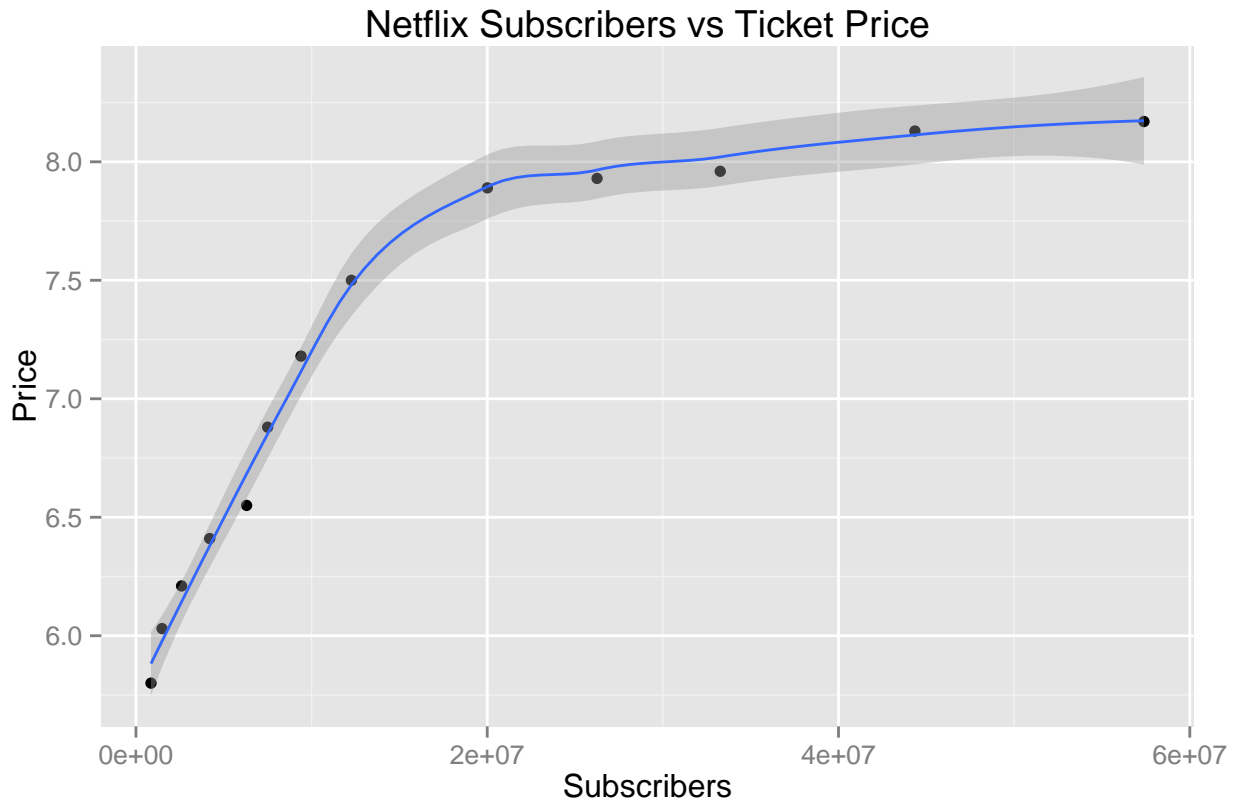
The important note here is that the p value is much lower than the acceptable 0.05, and that the R-squared value is relatively high.

Netflix, Theatre Price & Attendance

The question is whether the price of tickets has any indication on whether theatre attendance will be up that year, in addition, whether netflix usage has influence on both variables. The first look is at theatre attendance vs the price for a single movie. There is a slight trend for lower ticket prices to correlate with higher admission numbers. The actual correlation coefficient for Admissions and Price is -0.862661, which indicates a very strong negative relationship between the two, where admissions were significantly higher when ticket prices were lower. Adjusting for inflation may prove this relationship slightly less significant.



In the plot below, the count of Netflix subscribers vs price of the average ticket price is shown. This plot is saying that as subscribers for Netflix increase, the average price of tickets increases. This is mostly due to the price rising over time, and Netflix gaining popularity at the same time. It could be interpreted as the theatres needing to charge more in order to make up for lost quantity of tickets sold, or could be coincidence.



Below we can look at a model including price, attendance, and Netflix subscribers. According to the model, the price of a ticket is a much better indicator than the amount of netflix subscribers when trying to predict the total admissions to movies. How accurate the model is remains debateable.

```
##
## Call:
## lm(formula = net_tick_price$Admissions ~ net_tick_price$Subscribers +
##     net_tick_price$Price)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.07961 -0.03897  0.01005  0.03481  0.05852
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    2.056e+00  2.084e-01   9.868  1.8e-06 ***
## net_tick_price$Subscribers  2.767e-10  1.544e-09   0.179   0.8614
## net_tick_price$Price    -9.391e-02  3.236e-02  -2.902   0.0158 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.04902 on 10 degrees of freedom
```

Multiple R-squared: 0.745, Adjusted R-squared: 0.694
F-statistic: 14.61 on 2 and 10 DF, p-value: 0.001078

Sources

- <http://rpubs.com/catlin/rvest>
- <http://natoonline.org/data>
- <https://www.whitehutchinson.com/blog/2015/01/movie-attendance-continues-its-12-year-decline/>
- http://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/VNI_Hyperconnectivity_WP.html
- <https://www.sandvine.com/downloads/general/global-internet-phenomena/2013/2h-2013-global-internet-phenomena-report.pdf>
- <http://ir.netflix.com/results.cfm>