Analysis of DISH Network Customer Acquisition

1996-2016

Contents

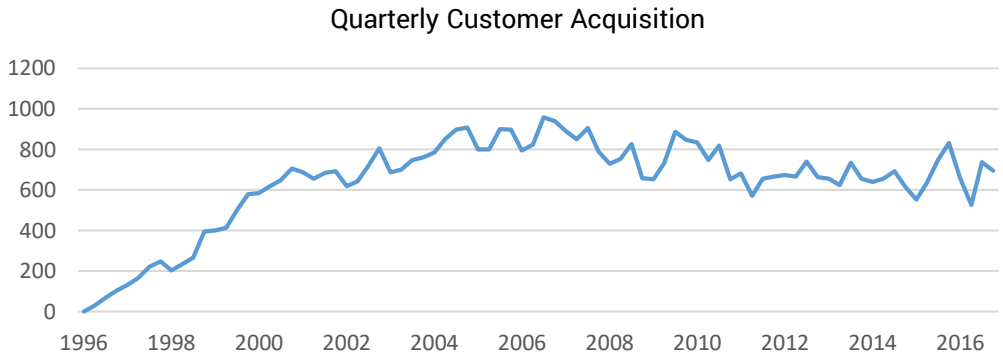
1. Executive Summary

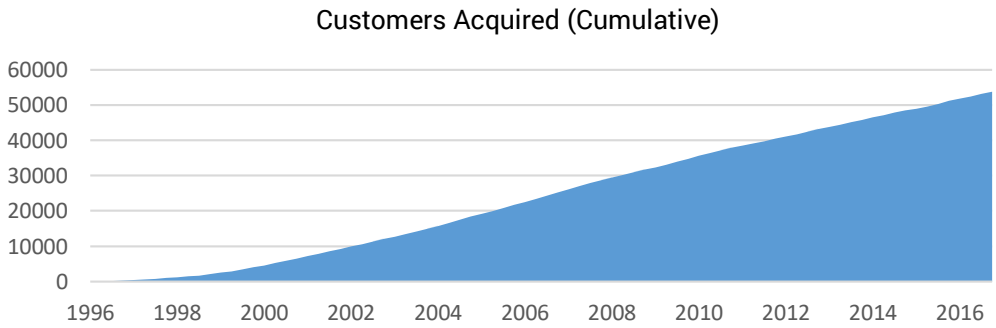
In this paper, the Weibull-Gamma model is used to study Dish Network's quarterly customer acquisition. Due to limited information, only two covariates are incorporated. One for the 2008 recession and the other for the launch of Sling TV. The recession had an immediate and seemingly permanent adverse effect while Sling TV caused a momentary boost. Finally, the model is extended to predict customer acquisitions in Q1-Q4 2017.

2. Introduction

DISH Network is a direct broadcast satellite service provider founded in 1996. Its main service is satellite television and serves both residential and commercial customers. Customer acquisition is certainly not a definitive measure of profitability but it can be an indicator of a company's overall performance. Modelling this process can help to assess managerial decisions and predict customer acquisitions in future time periods. These are all useful in decision-making.

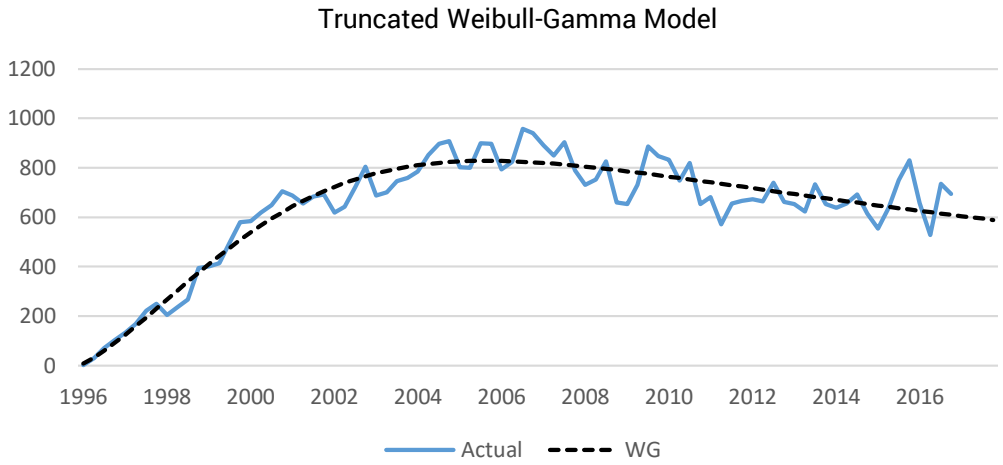
It is assumed that there are no reacquired customers, i.e., a single customer cannot never be counted more than once. This naturally becomes an adoption process.





3. Preliminary Analysis

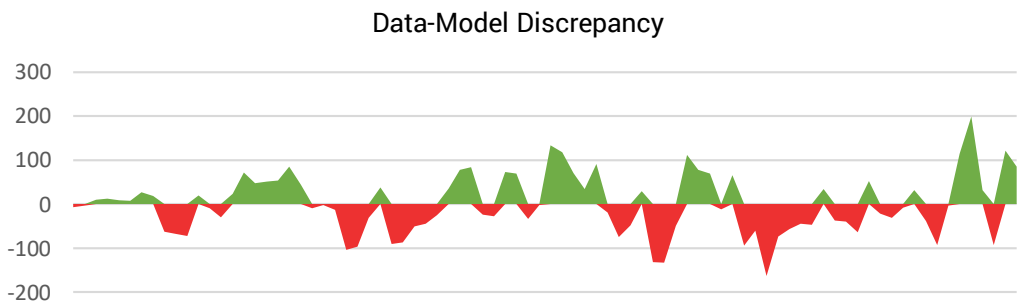
Due to time dependency, the Weibull distribution is selected to be the individual model. For the mixing distribution, the gamma distribution is picked over latent-classes (3 & 4 classes) using LRT. Then, both the normal WG the truncated WG (tWG) adoption model were both attempted without covariates. The tWG is superior based on LL, MdAPE, and visual fit. The set of parameters maximizing LL instead of minimizing MdAPE was ultimately chosen due to better R^2, and visual fit. ($\alpha = 10^{-5}, r = 3023.9, c = 2.246$)



c is way larger than 1, implying that the hazard function increases rapidly over time, i.e., costumers are increasingly likely to be acquired as time elapses. However, this might be exaggerated by the assumption that the customer pool is unchanging.

A spike at 0 in the mixing distribution was also attempted to account for HCNBs but the LRT gives $p > 0.05$ so the it does not significantly improve the model. This is somewhat expected as the distribution is already very left-heavy (huge α , tiny r). Thus, the plain tWG model was chosen to be the "skeleton" upon which a more elaborate model will be built.

An observation is that customer acquisition spiked in Q4's from 1996 to 2004 and then shifted to Q3's after 2004. Many events could have caused it but, before introducing event covariates, it is worthwhile to first handle the seasonal fluctuations (as seen below).



4. Seasonal fluctuations

To account for seasonal fluctuations, 2 covariates are introduced: season_1 (before 2005) and season_2 (after 2005). Since each of the covariates should act in both directions, sine functions will best capture their effect on $A(t)$:

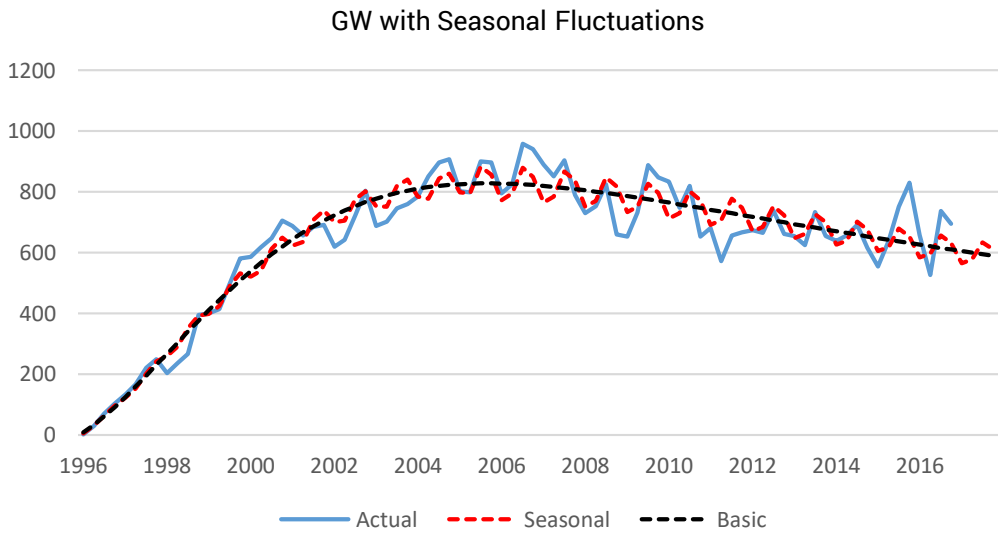
$$\beta_{season\_i} \cdot \sin\left[\frac{(t + k_i)2\pi}{4}\right]$$

Here, β_{season_i} is the weight and determines the effect's magnitude. k_i is the shift and it determines where the peaks occur. It also influences the magnitude. The period must be 4 quarters. Each covariate adds 2 parameters which all fall within narrow ranges. This is a significant increase in the number of parameters but it is useful due to two reasons:

1. It helps to detect anomalies. In short, it helps us to detect less obvious anomalies and prevent false positives. Seemingly large spikes might not be as anomalous as it looks because it could be amplified by seasonal fluctuations and vice versa. This can be useful when, say, we assess the effectiveness of a marketing campaign in a specific quarter.

2. It improves the model's predictive abilities. The basic tGW model is smooth and it would not be a problem when projecting yearly averages. However, if we want to predict customer acquisition for a specific quarter, taking into account the seasonal fluctuations allow us to predict more precisely.

The model obtained by maximizing LL looks reasonable. The LRT gives $p < 0.01$, justifying the 4 extra parameters. MdAPE dropped by 10%, which is an improvement, but R^2 dropped by 2.5%.



The causes of the fluctuations are unknown. However, the fact that the spike shifted abruptly from Q4 to Q3 suggests that managerial decisions are at least partially responsible. This is because the timing of most external causes like public holidays and seldom change.

The poor man's alternative to the sine function – adding annual spikes at Q3/Q4 – was also considered. This adds 2 parameters instead of 4 since the shift parameters are not needed. However, an unnatural shape arises and once again the LRT gives $p < 0.01$, implying that the 2 additional parameters in the sine function did improve the model significantly.

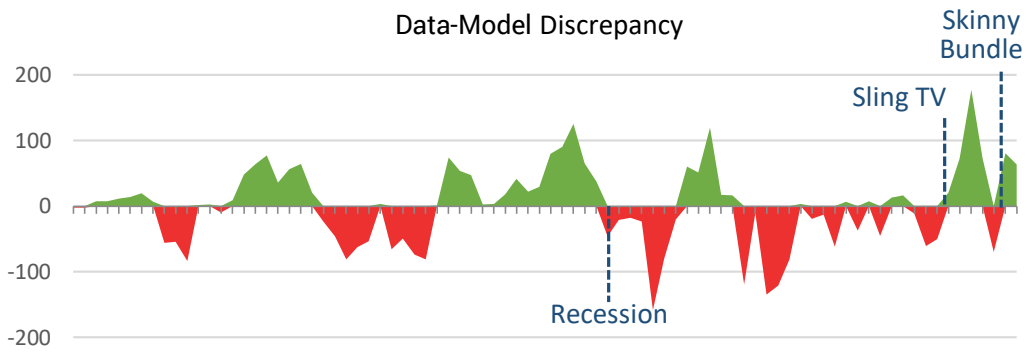
5. Event Covariates

Now that the seasonal fluctuations are partially accounted for, we can start looking for event covariates.

Note that not every spike/dip has a single corresponding major event that caused it. It could due to an accumulation of minor event or simply random chance. Also, even major events can be offset by other events that have the opposite effect.

The traditional satellite TV industry has faced many challenges over the last decade, especially with the emergence of online TV. It would be hard to accurately represent such subtle influences on customer acquisition so only acute events were considered. After searching through the archives, here is a shortlist of events:

2016 Q3 – Skinny Bundle Offer ▲
2015 Q1 – Sling TV launches ▲
2008 Q1 – 2008 Recession ▼



5a. The 2008 Recession Covariate

The recession in 2008, triggered by the Financial Crisis, is by far the worst since the Great Depression of the 30's. It is likely to have a profound impact on consumer behavior, especially for non-necessities like satellite TV. DISH Network also separated from EchoStar in 2008, possibly bringing about massive restructuring that could have amplified the effects of the recession.

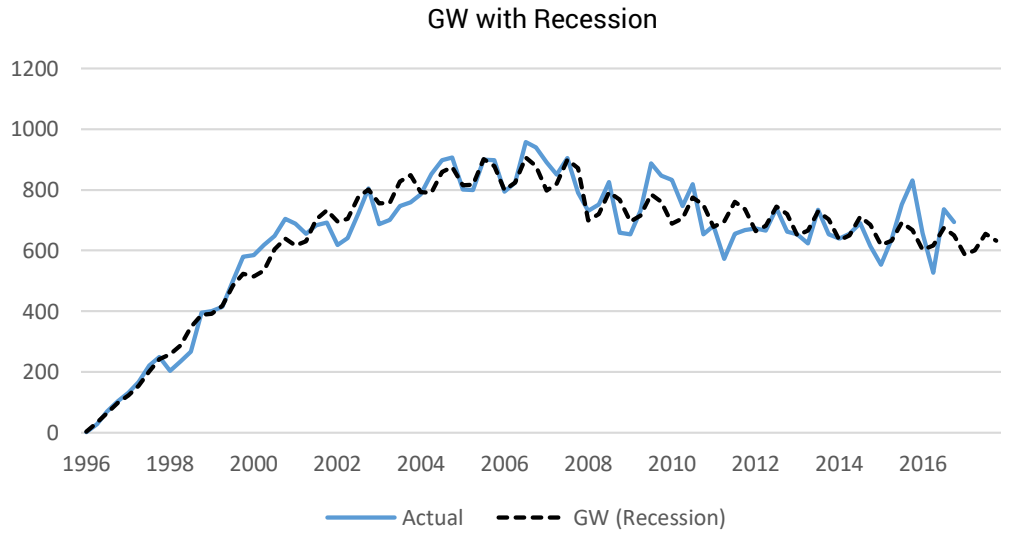
The recession is likely to have both an immediate effect and a long-term effect on customer acquisition so an exponential function was selected to capture this:

$$\beta_{recession}[1 - \gamma(1 - e^{-\delta(t - t_{recession})})]$$

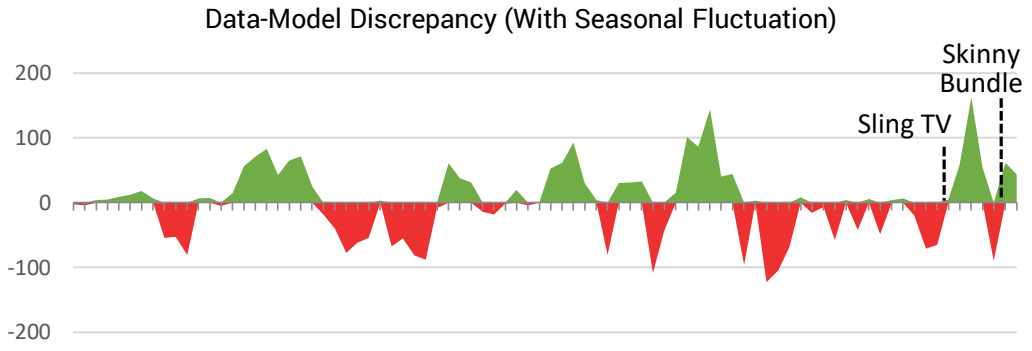
δ is the rate at which the instantaneous effect wears off and γ will determine the "new normal" that the model returns to in the future. If $\gamma = 1$, we go back to the "old normal" as $t \to \infty$, implying that there will be a full recovery.

After adding the covariate and maximizing LL, the model below is obtained. There's a slight but noticeable dip in 2008 and permanently lowered acquisitions. It gives $p < 0.05$ on the LRT, justifying this covariate. MdAPE and R^2 both improved.

In addition, solver drives γ down to 0, implying that the effects are immediate and that the "new normal" is established within a single quarter. This renders δ and γ obsolete, saving us 2 parameters.



With this new model, we can take a second look at the data-model discrepancy (below). The huge spikes and dips in 2009-2012 persists but it is hard to attribute them to any major event. The chairman did mention some challenges and operational changes in the annual reports but their effect on customer acquisition is unclear. Thus, they are left out to avoid over-fitting.



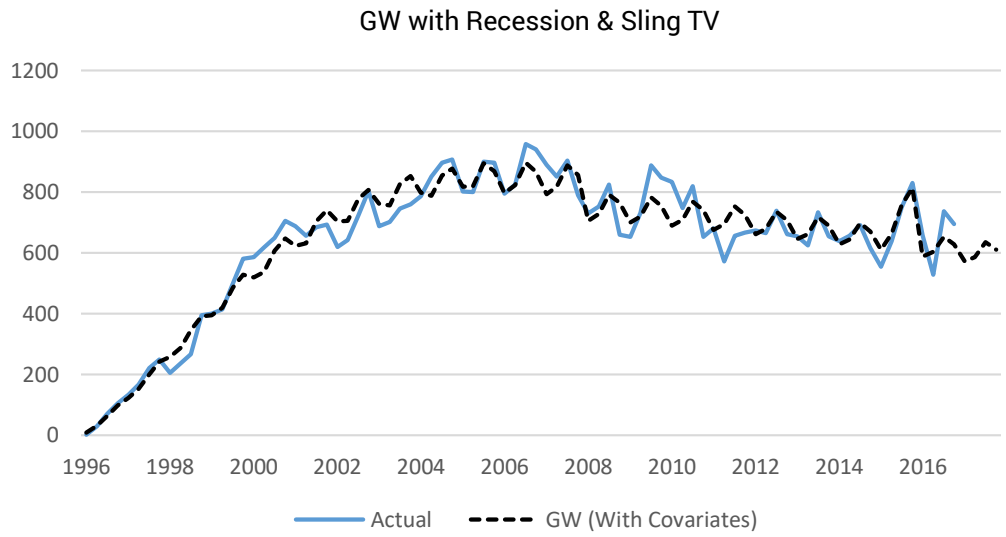
5b. The Sling TV covariate

The launch of Sling TV (called "transformative" by the DISH Network chairman) is likely behind the huge spike in 2015. It is also reasonable to assume that the launch was accompanied by some heavy advertising which amplified the effect.

Intuitively, a new service should have a long-term effect on the customer acquisition rate. However, there simply isn't enough data after 2015 to accurately estimate it. In addition, the customer acquisition actually fell below the predicted value in early 2016, working against the claim of a long-term effect.

Therefore, the Sling TV covariate will be treated as a one-off event starting in Q2 and taking full effect in Q4. This is to account for the time taken for advertisements to take effect and the subsequent release of a few related services like Sling Latino.

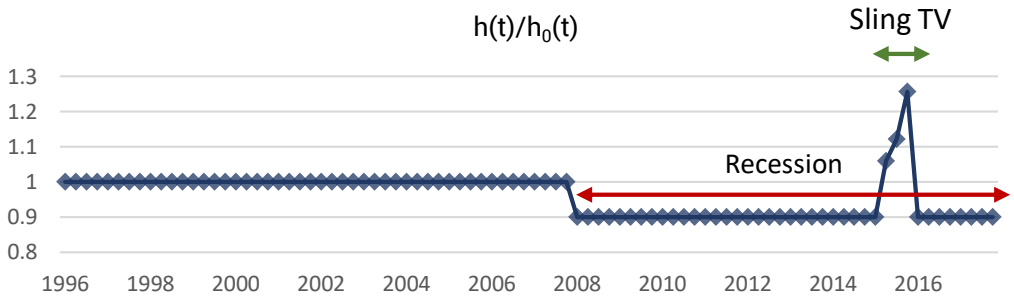
The LRT gives $p < 0.05$, the MdAPE improved, while R^2 increased very slightly. Admittedly, some curve-fitting was done to determine the progression of the effect over three quarters.



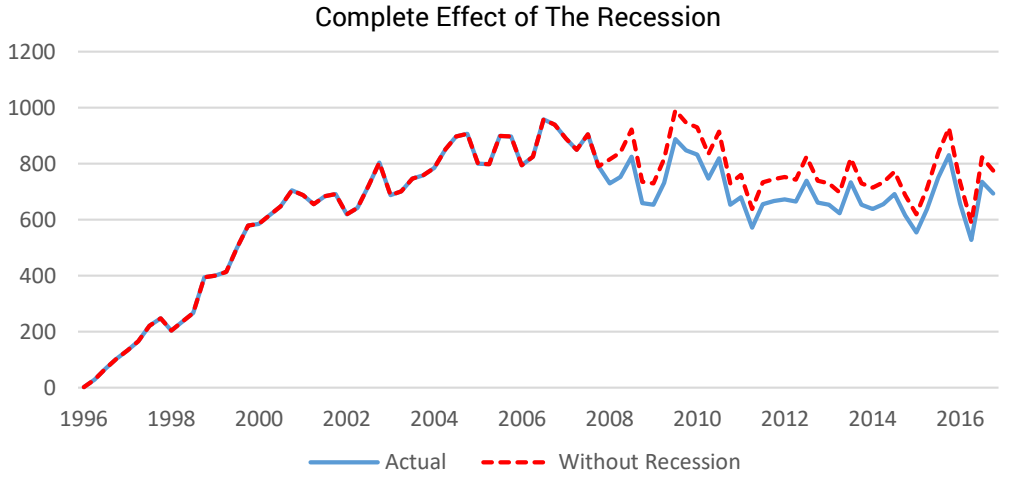
The Skinny Bundle covariate was eventually left out because the Skinny Bundle was released too recently and there isn't enough data for a good estimate.

6. Covariate Effects

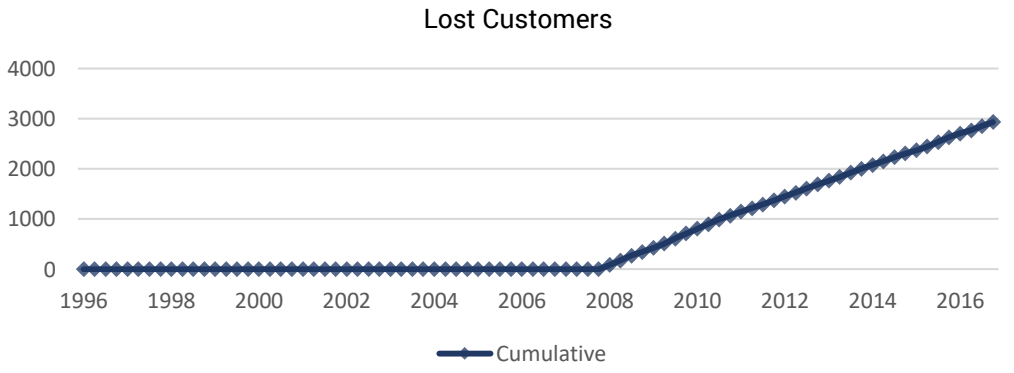
The big picture is shown below.



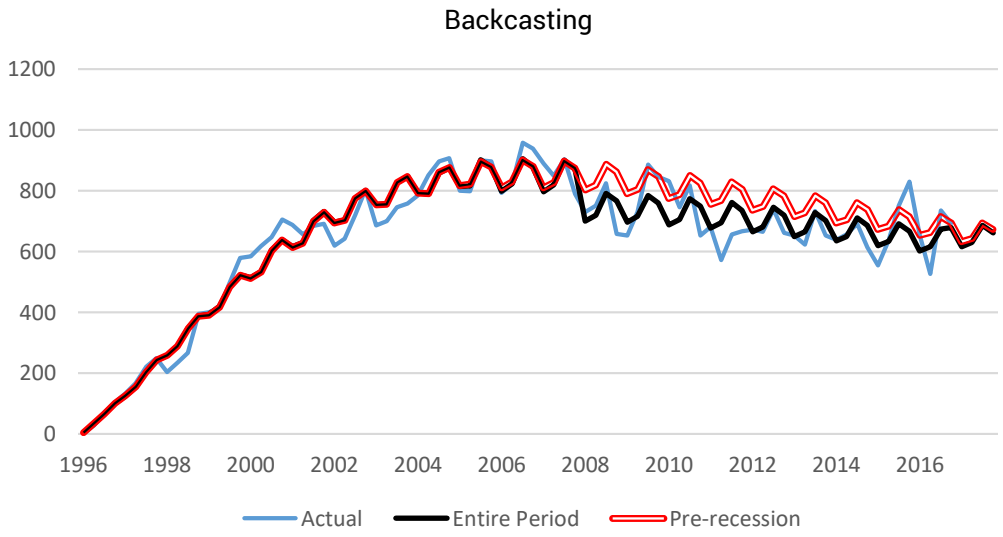
Effects of 2008 Recession:



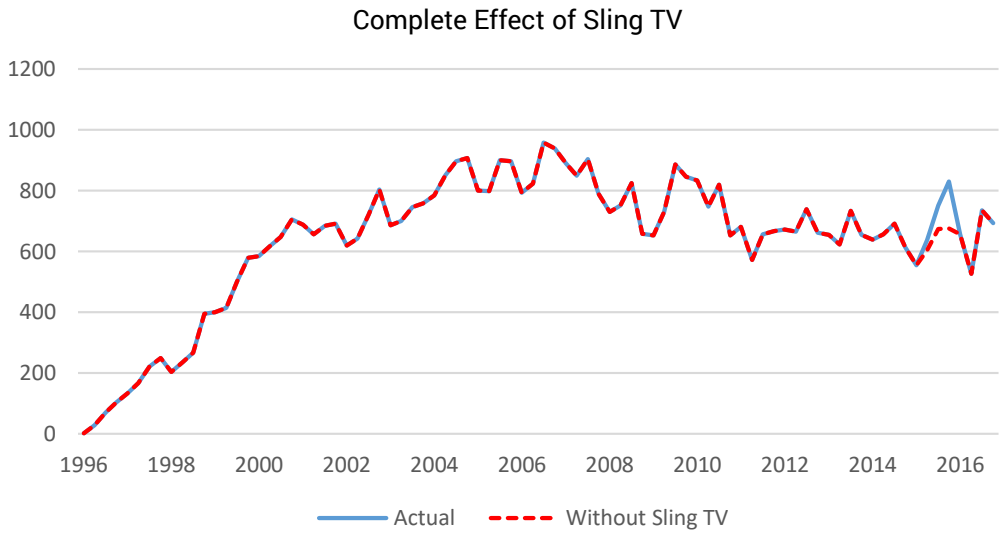
About 2,937,000 customers (~12% of the total acquisitions since 2008) are lost since the recession and this number is still growing rather consistently.



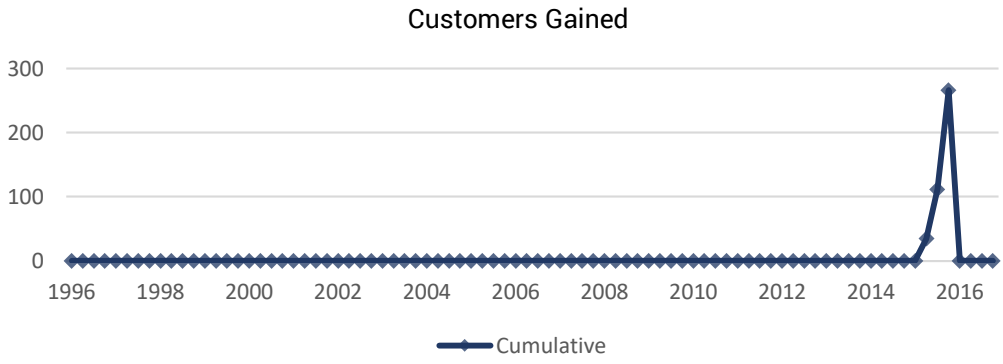
The model built using the pre-2008 data traces the path of the final GW model, confirming that the recession covariate is not skewing parameter estimates.



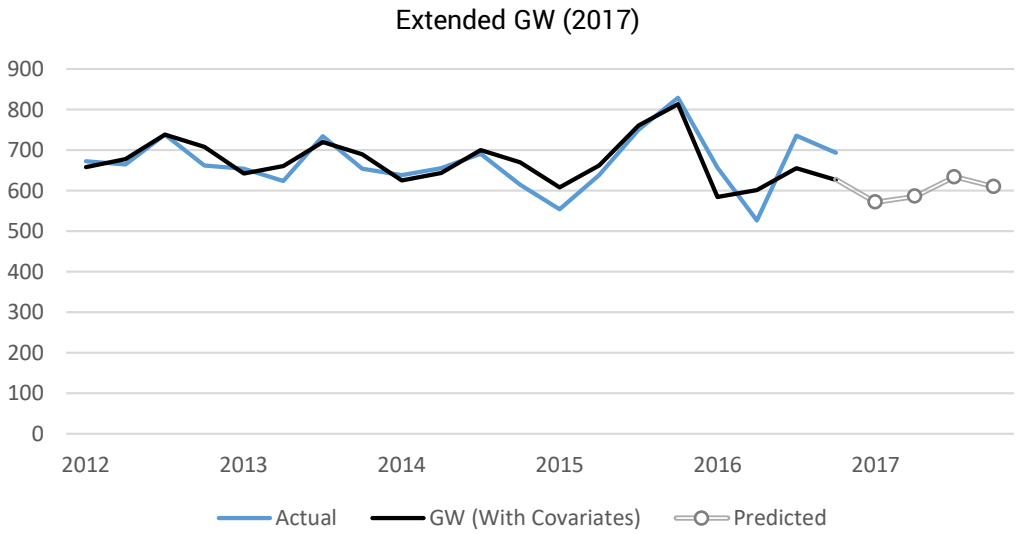
Effects of Sling TV:



The launch of Sling TV resulted in a total gain of 280,000 customers by the end of 2015. At the peak of the spike in Q4 2015, 150,000 additional customers were acquired. That's a 22.3% boost.



7. Predicting 2017



Numerical estimates for Q1-Q4 2017:

571, 586, 634, 610

The plot above shows final model extended to Q4-2017. It looks reasonable but the data ended off significantly higher than what the model predicted. This could be caused by the Skinny Bundle promotion, the lingering effect of Sling TV, or many other factors. While it is indeed tempting to boost the estimates slightly, the lack of data makes it hard to put a specific number to it.

8. Model Assessment

Firstly, the model relies on a few key assumptions:

1. Customers cannot be reacquired. The prices of similar services are always changing and so are the services themselves. Therefore, it shouldn't be surprising if many people switched to a cheaper service before switching back to DISH Network in the last 20 years.

2. The customer pool is unchanged. The GW model assumes that there is a fixed pool of customer. However, over 20 years, people enter and exit the pool and the changes cannot be accurately reflected by a fixed gamma distribution. This could have caused an over-estimate of c as mentioned earlier. Also, if the pool is fixed and there are indeed only 60 million customers, the quarterly acquisition should die off very abruptly (and unnaturally) in the near future.

3. There are no HCNBs. Although having a HCNB segment didn't significantly improve the fit, there has to be some HCNBs at some point. There are plenty of people who do not even own television sets or have never heard of DISH Network's services.

General Assessment:
Even though the assumptions are somewhat shaky, the tGW model did capture the general shape of the data reasonably well. It also accounted for one of the most important economic events since 1996 and the sharpest spike in the entire time period.

Every additional set of parameters gives $p \ll 0.05$ on the LRT, implying that the parameters are likely improving the model significantly. However, the BIC did drop noticeable with each added parameter. Therefore, besides using quantitative tests, the decision to add parameters were also heavily influenced by visual fit and intuition.

Once again, it is important to realize that the trends in the data cannot be easily explained and it is over-simplistic to assign a single event to each spike/dip. Nevertheless, I think this is a serviceable model and a good framework for future additions.

9. Managerial Applications

The covariates can help the manager to assess the damage of the recession and make long-term plans. In addition, the numbers provided earlier can help the manager to determine the short-term success of Sling TV. However, customer acquisition is not the sole indicator of success and it needs to analyzed together with other facts. A lot more research still needs to be done before drawing conclusions from the model.

10. Future Work

1. Long-term effects of Sling TV: After gathering more data for the next few years, we can estimate the long-term effect of Sling TV (and maybe even the Skinny Bundle).

2. Introducing more covariates: Many macroeconomic trends and managerial decisions that could have potentially caused some of the anomalies in the data. Also, the effects of new technologies and recently emerged competitors, like Hulu, can be studied in more detail and included as covariates with possibly growing long-term effects.

3. Dynamic customer pool: Maybe a mixing distribution with parameters $\alpha(t)$ and $r(t)$ can help to account for demographic changes in the customer pool. In addition, a time dependent spike at 0 that starts out small in the 1996 and grows rapidly in the late 2000s could capture the potential effects of technological growth on the satellite TV industry. This is because the growing reliance on the internet might be pushing newer generations into the HCNB segment.