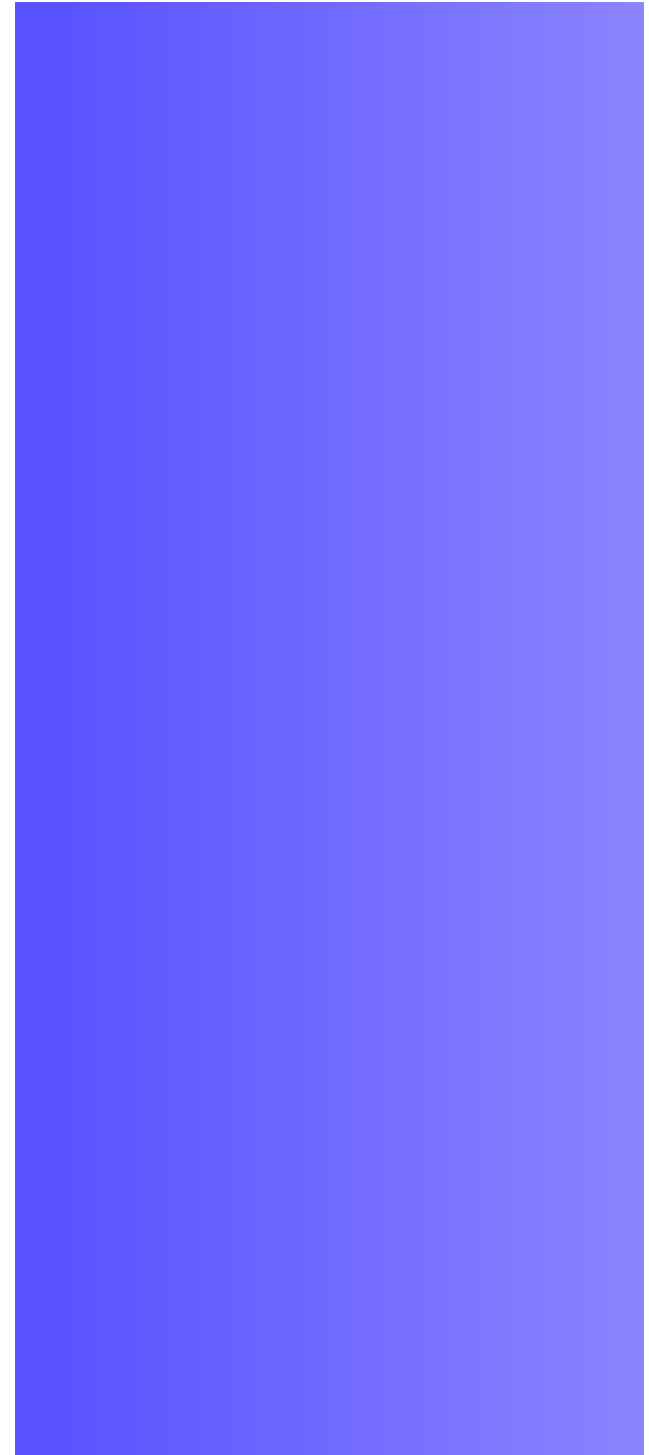


Loan Analytics

Michael Gerstein
March 2019

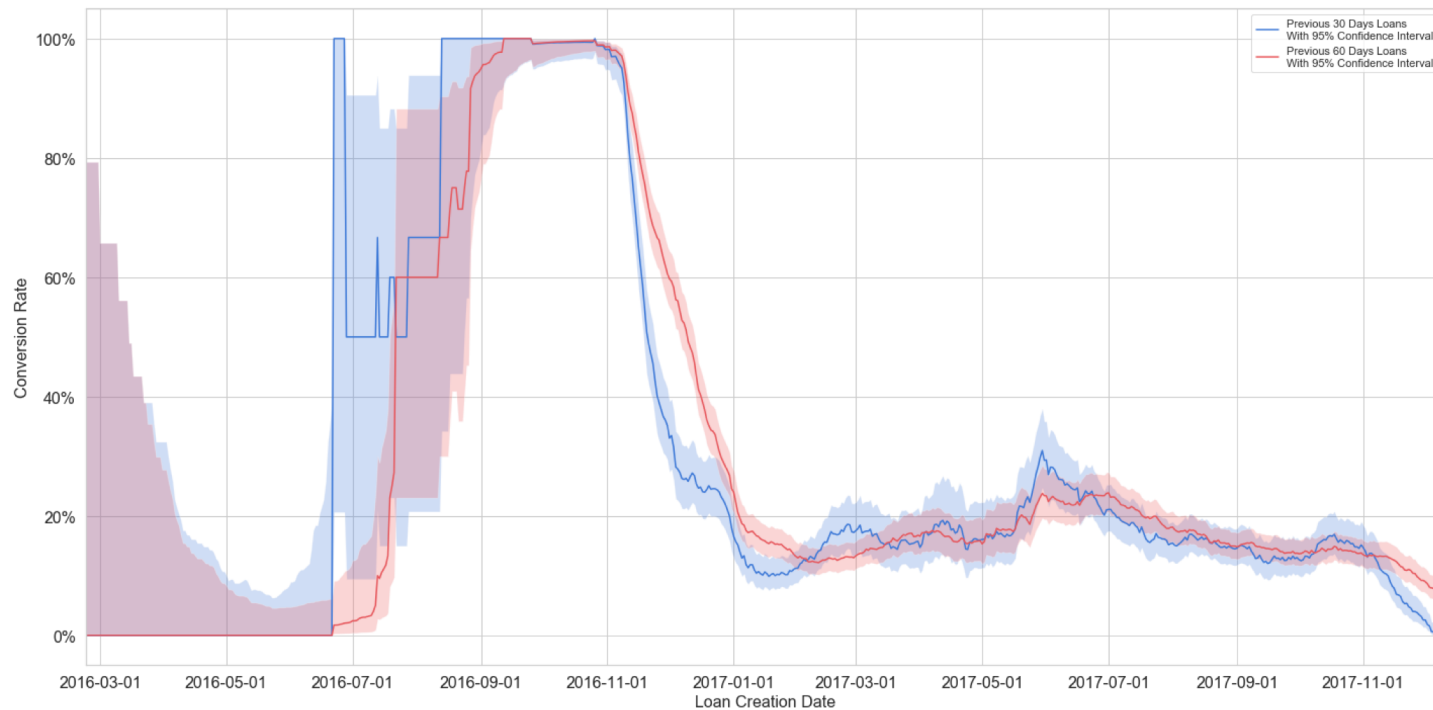


Agenda

- ❑ Loan Application Conversion Rate Trends
 - ❑ Standard Approach
 - ❑ Kaplan-Meier
- ❑ Loan Application Time to Conversion Trends
- ❑ Conversion Rate Comparison by Loan Type
 - ❑ Conforming
 - ❑ Jumbo
- ❑ Impact of Loan Type on Conversion Rates

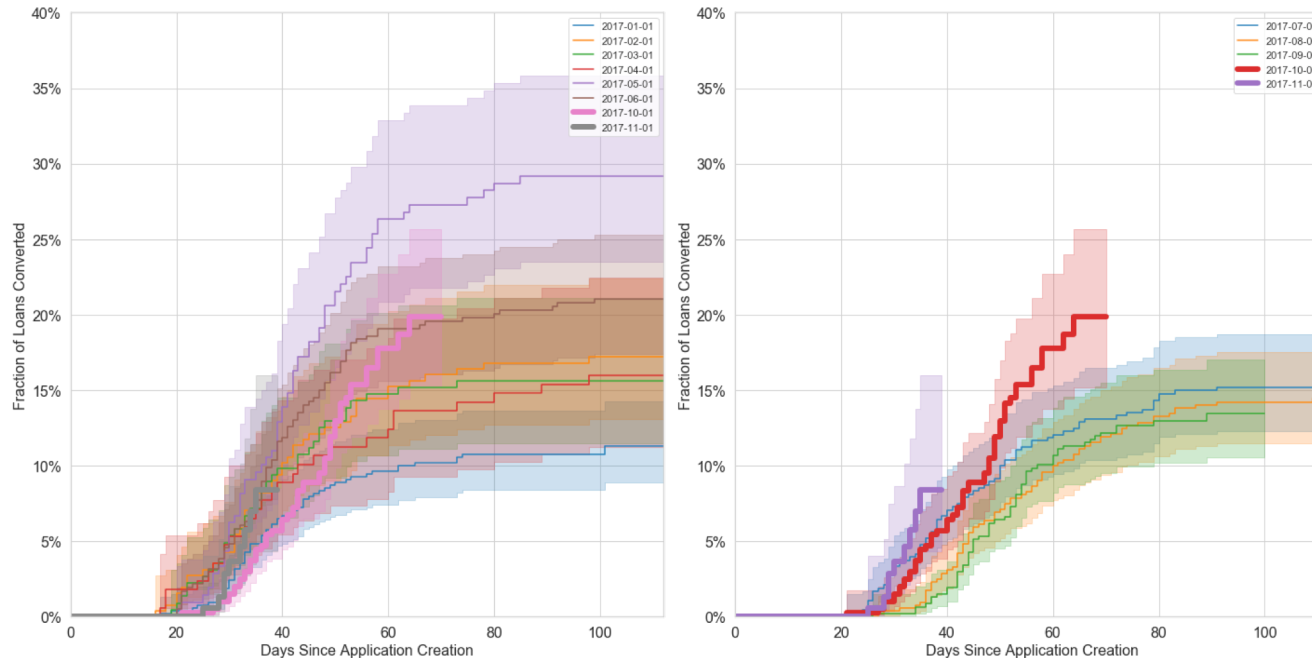
Loan Application Conversion Rate Trends – Standard Approach

3Q 2017 conversion rates are **down** from 2Q 2017 but **in line** with most of the **first half of 2017**



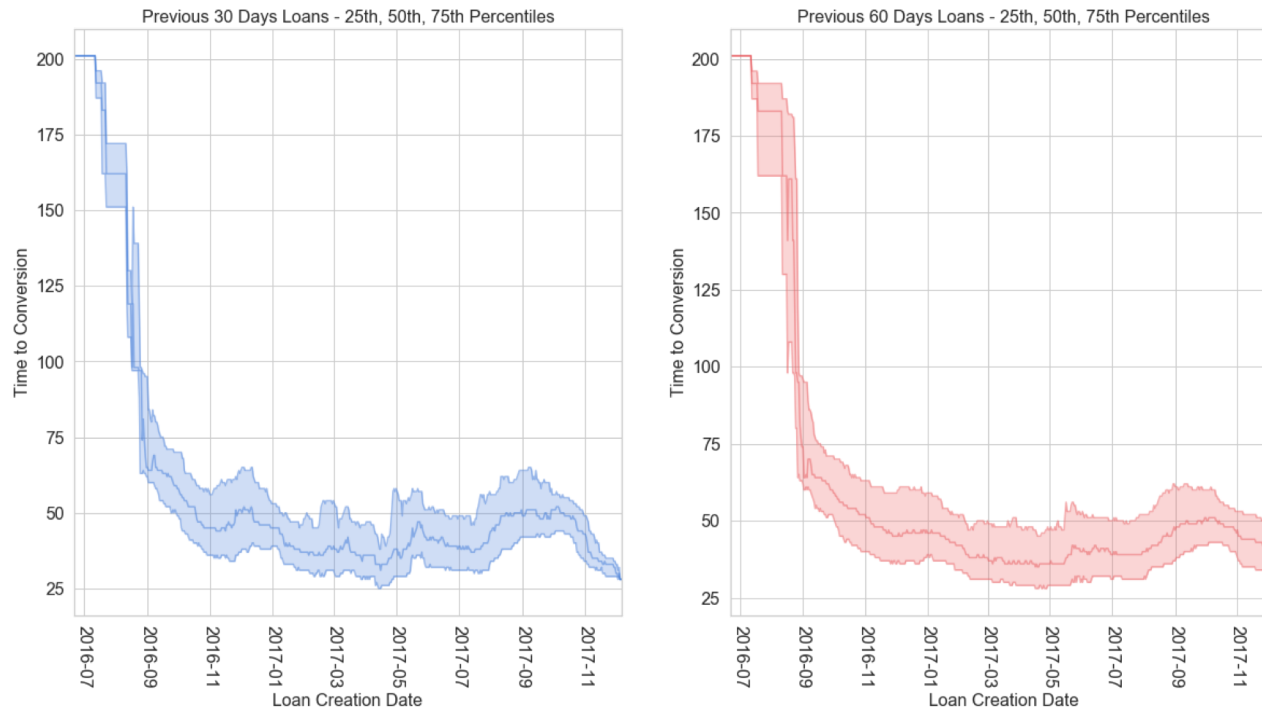
- ❑ The standard approach calculates a conversion rate as the ratio of the number of loans converted from applications over the last N days to the number of loan applications created over the last N days
- ❑ The issue with this approach is that, in the most recent period (4Q 2017), there are loan applications that have not converted but could possibly convert in the future (right censored data). This serves to understate conversion rates in the most recent periods (i.e., after 11/2017).
- ❑ Given that the 95th percentile for time to conversion is 83 days, conversion rates for dates before 9/2017 are less impacted by outstanding applications and therefore more accurate

Loan Application Conversion Trends – Kaplan-Meier



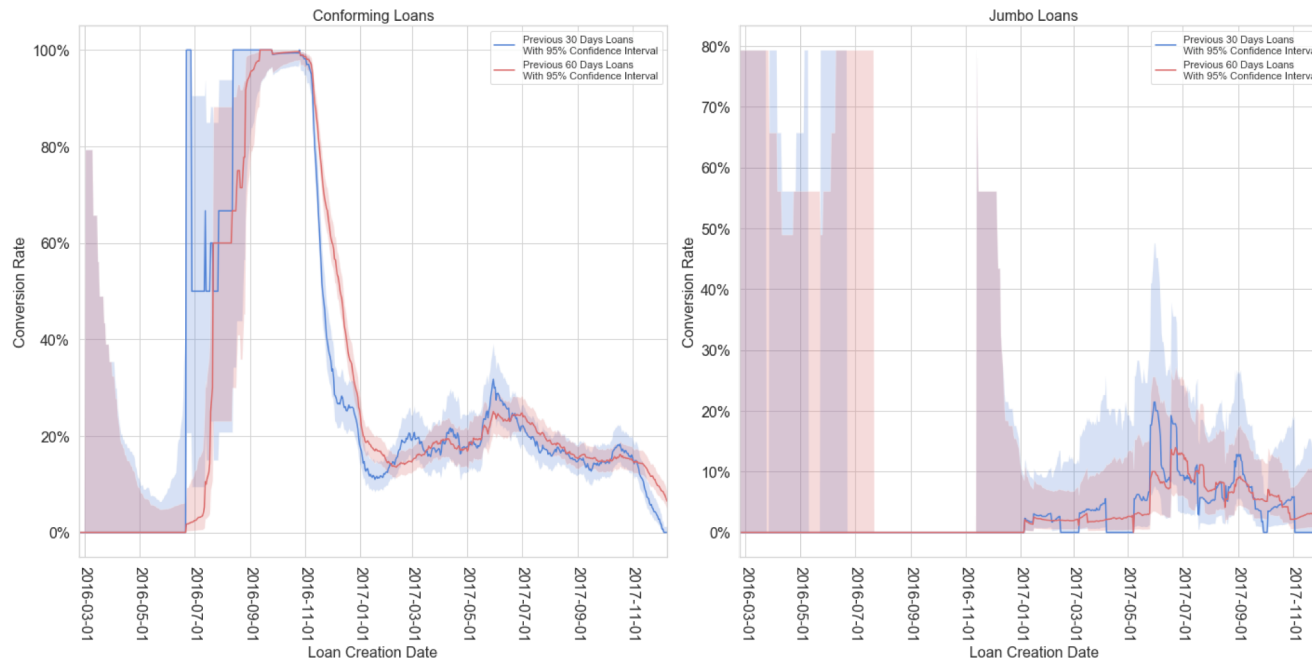
- Kaplan-Meier is a technique used to estimate the survival function from lifetime data. In this case, lifetime is equivalent to time to conversion.
- Kaplan-Meier takes into account some types of censoring, particularly right-censoring which is what occurs in the loan data (i.e., most recent loan applications that have yet to convert but may convert in the future)
- The left chart shows that conversion rates for loans created in **October and November 2017** are **higher than** rates for **January through April 2017** but **lower than May and June 2017**
- The right chart shows that conversion rates for loans created in **October and November 2017** are **higher than** rates for the other **months in the second half of 2017**

Loan Application Time to Conversion



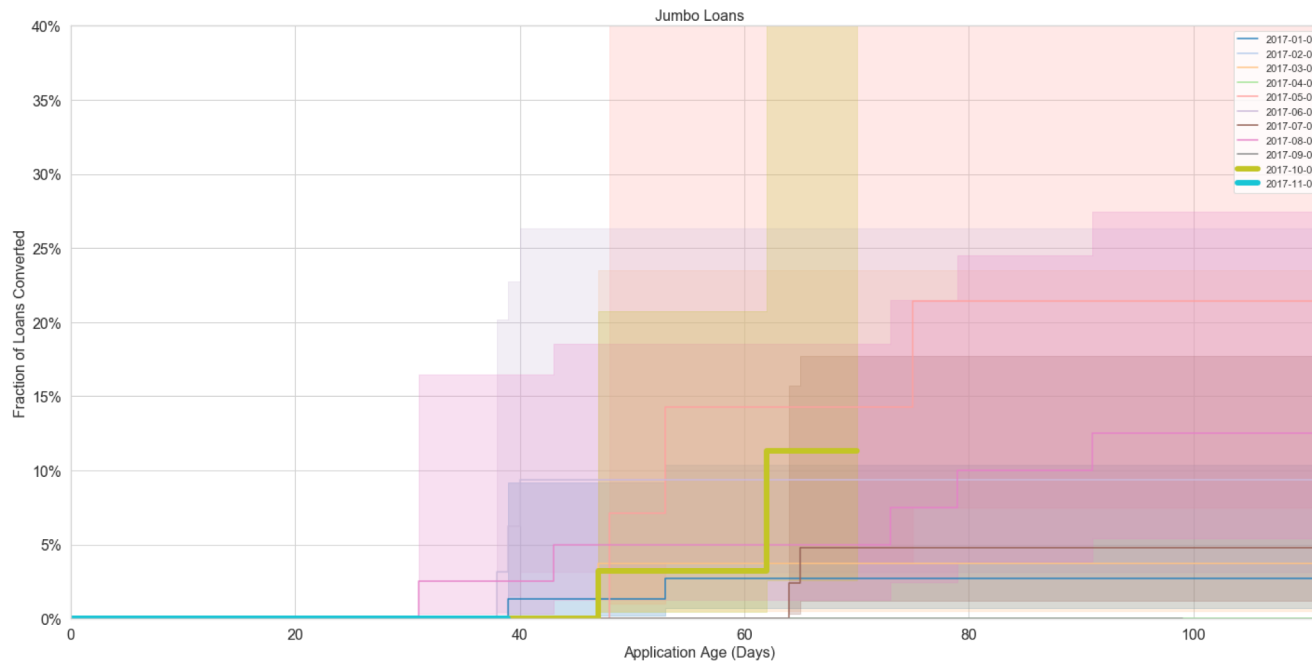
- ❑ Time to conversion suffers from the same issue as conversion rates, right censoring, which leads to an understatement of time to conversion for more recent loan applications
- ❑ By focusing on loans created before 11/2017, **loans** created in the **most recent period** have taken **longer to convert** than **loans created in the first half of 2017**. Time to conversion is currently at levels consistent with late 2016.

Conversion Rate Comparison by Loan Type



- About 8.4% of loan applications (or 429) are for jumbo loans with only 18 of those loans being converted. Because of such a small sample size, conversion rate estimates for jumbo loans have a level of uncertainty as indicated by the confidence intervals in the chart on the right.
- As the majority of loans in the dataset are conforming, conversion rate trends seen in the previous slides hold for conforming loans
- Based on aggregate numbers, the **conversion rate for jumbo loans is 4.2%** versus **22.0% for conforming loans**
- Note that a small sample of jumbo loan applications created during 2Q 2017 have an aggregate conversion rate near 10%

Conversion Rate Comparison by Loan Type



- The Kaplan-Meier approach to calculating conversion rates for jumbo loans corroborates what is seen using the standard approach
- The chart shows conversion rates around 4% with high uncertainty for most periods and higher conversion rates for months during 2Q 2017

Impact of Loan Type on Conversion Rates

- A logistic regression with a dependent variable of has_converted and independent variables of loan_type and loan_amount measures the impact of a loan being jumbo versus conforming while controlling for the loan amount

Log odds of conversion = $-1.3086 - 2.7265 \times \text{loan_type} - 0.00000133 \times \text{loan_amount}$

Predicted conversion rate for \$500K conforming loan = [0.3191, 0.3698]*

Predicted conversion rate for \$500K jumbo loan = [0.0162, 0.0503]*

Percentage change in conversion rate as a result of jumbo status = [-95.6%, -84.3%]*

- A similar model which includes the US state where the loan application was created measures the impact of a loan being jumbo versus conforming while controlling for state and loan amount

State	Predicted Conversion Rate			Actual Conversion Rate	
	Conforming*	Jumbo*	Impact of Jumbo*	Conforming	Jumbo
AZ	[0.1460, 0.3852]	[0.0073, 0.0532]	[-98.1%, -63.6%]	0.2295	0.0000
CA	[0.3259, 0.3821]	[0.0223, 0.0680]	[-94.2%, -79.1%]	0.3339	0.0333
CO	[0.1574, 0.3930]	[0.0080, 0.0554]	[-98.0%, -64.8%]	0.2500	0.0000
CT	[0.0641, 0.3154]	[0.0013, 0.0383]	[-99.6%, -40.3%]	0.1220	0.2500
DC	[0.0769, 0.4167]	[0.0000, 0.0557]	[-100.0%, -27.5%]	0.2000	0.2500
FL	[0.2482, 0.5743]	[0.0132, 0.1005]	[-97.7%, -59.5%]	0.3590	0.0000
GA	[0.2400, 0.4322]	[0.0162, 0.0675]	[-96.3%, -71.9%]	0.2793	0.1667
IL	[0.0755, 0.1944]	[0.0040, 0.0225]	[-97.9%, -70.1%]	0.1147	0.0000
MD	[0.0000, 0.0002]	[0.0000, 0.0000]	[-100.0%, -100.0%]	0.0000	0.0000
NC	[0.1941, 0.3398]	[0.0126, 0.0483]	[-96.3%, -75.1%]	0.2246	0.0769
NJ	[0.2207, 0.3442]	[0.0141, 0.0516]	[-95.9%, -76.6%]	0.2551	0.0000
NY	[0.0000, 0.0000]	[0.0000, 0.0000]	[-100.0%, -100.0%]	0.0000	0.0000
OR	[0.1454, 0.3238]	[0.0083, 0.0432]	[-97.4%, -70.3%]	0.1961	0.1111
PA	[0.1109, 0.2259]	[0.0066, 0.0278]	[-97.1%, -75.0%]	0.1364	0.0909
WA	[0.3511, 0.4509]	[0.0264, 0.0828]	[-94.2%, -76.4%]	0.3680	0.0811

- For all states, jumbo status has a large impact on conversion rates when controlling for the loan amount
- CT, DC, and GA have conversion rates for jumbos that are inline with conversion rates for conforming
- AZ, CO, FL, and NJ do not have any conversions for jumbo loan applications

*95% confidence interval