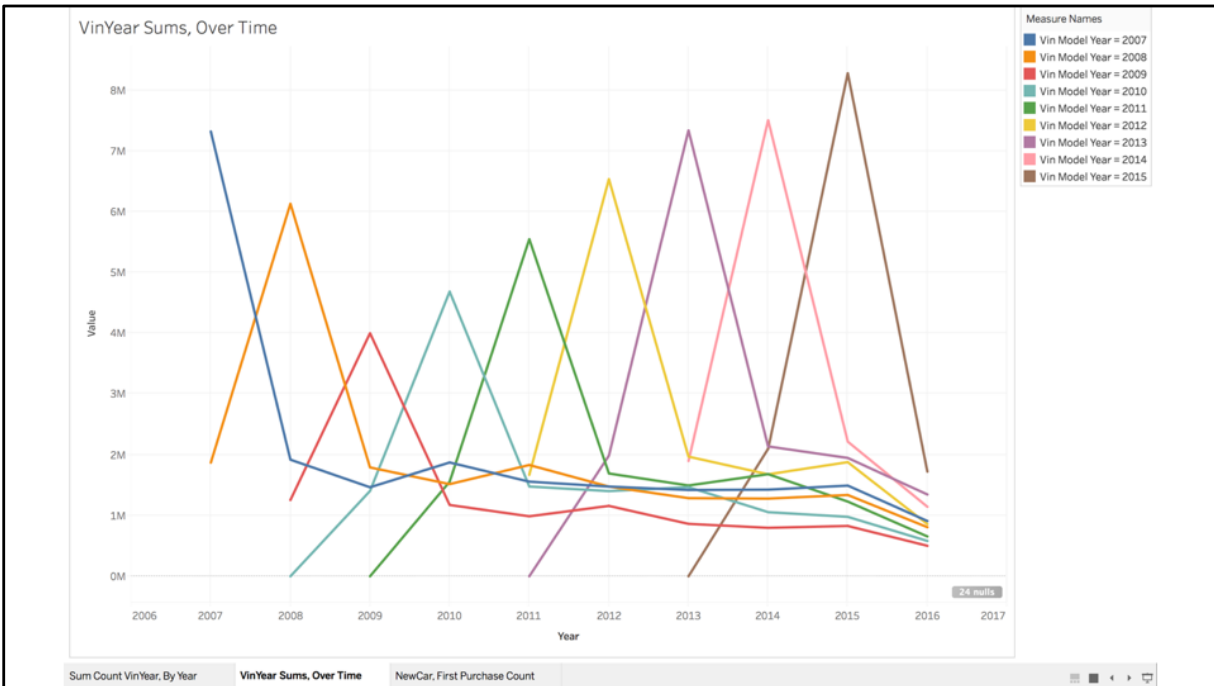
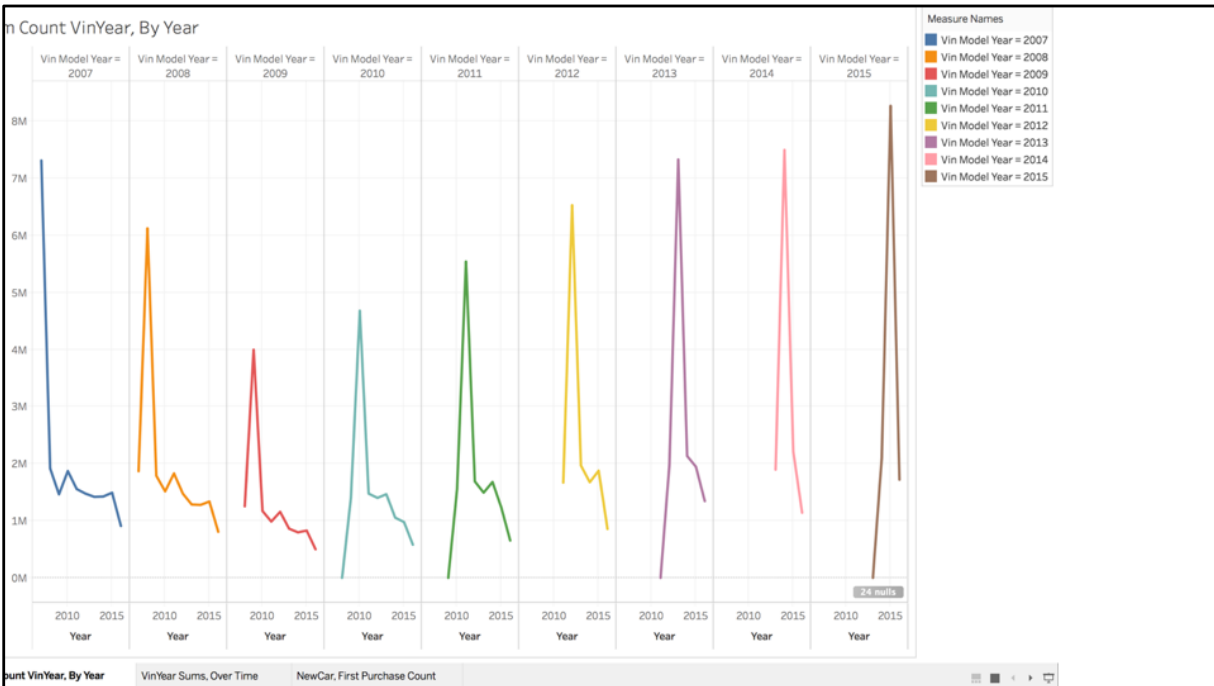


Sum Cars Purchased, Per State and Year, By Vin Year

This section displays each the new registration of each VinYear vehicle, over time. Here, we see not only the initial spike of new car sales, but also the secondary spike which shows the count of new cars that return to the pool and are again purchased. Because registration implies purchase, we are using this data to inform our understanding of the pattern of used-vehicle purchasing for each VinYear. The pattern appears consistent in frequency.

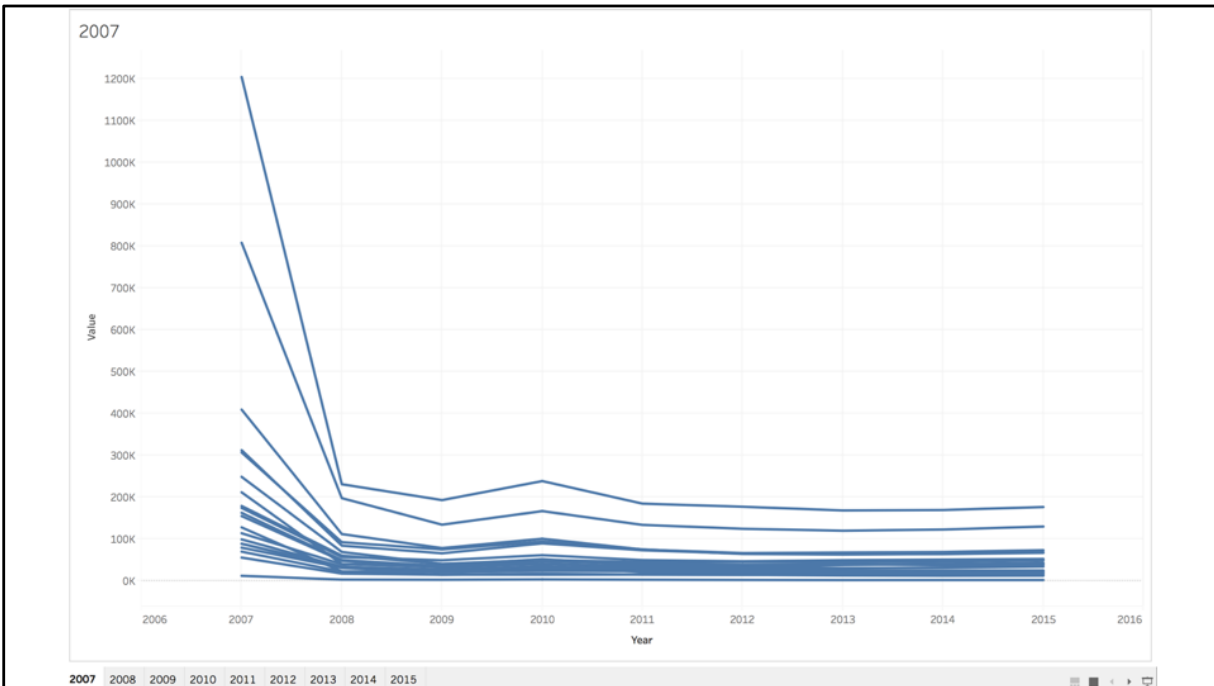


This graph depicts the totals of all new vehicle registration, over time, by VinYear.



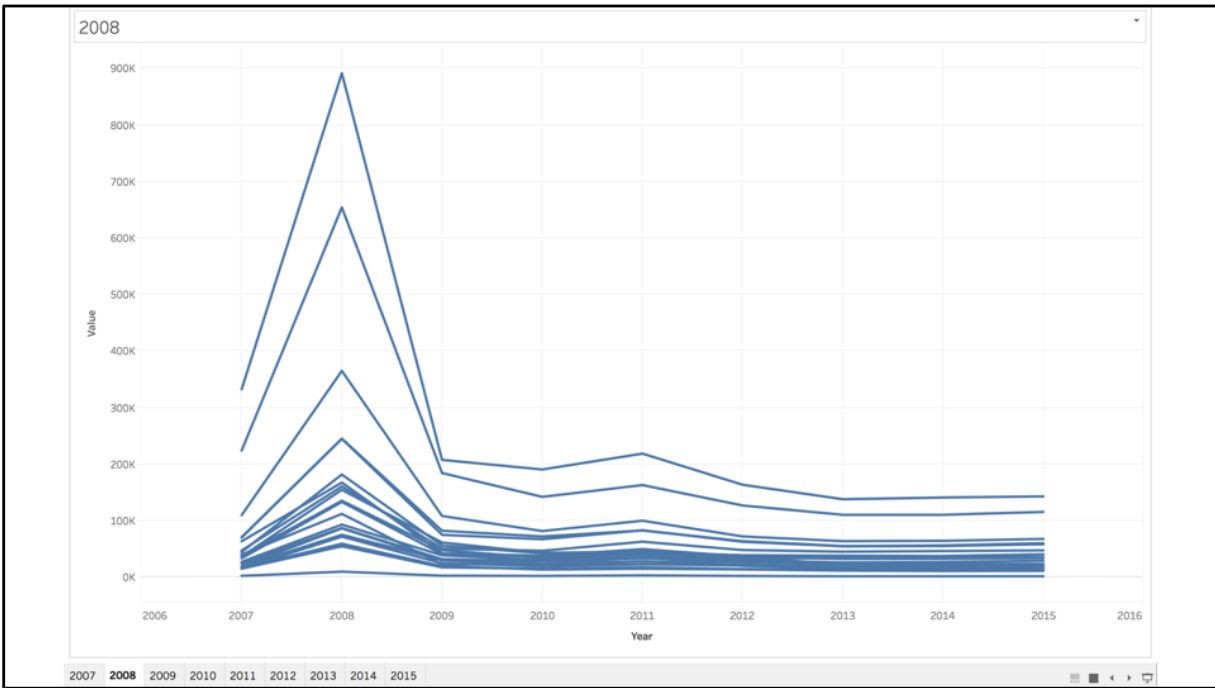
Yearly sums for each VinYear model registration count, displayed over time.

This graph appears to indicate that the number of new cars purchased is increasing since 2008, and is even surpassing (what we can assume is) the pre-recession threshold. This graph also follows each year's new car, over time. Here, we see an indication, consistent in all cars that age long enough, a secondary, and tertiary purchasing peak.

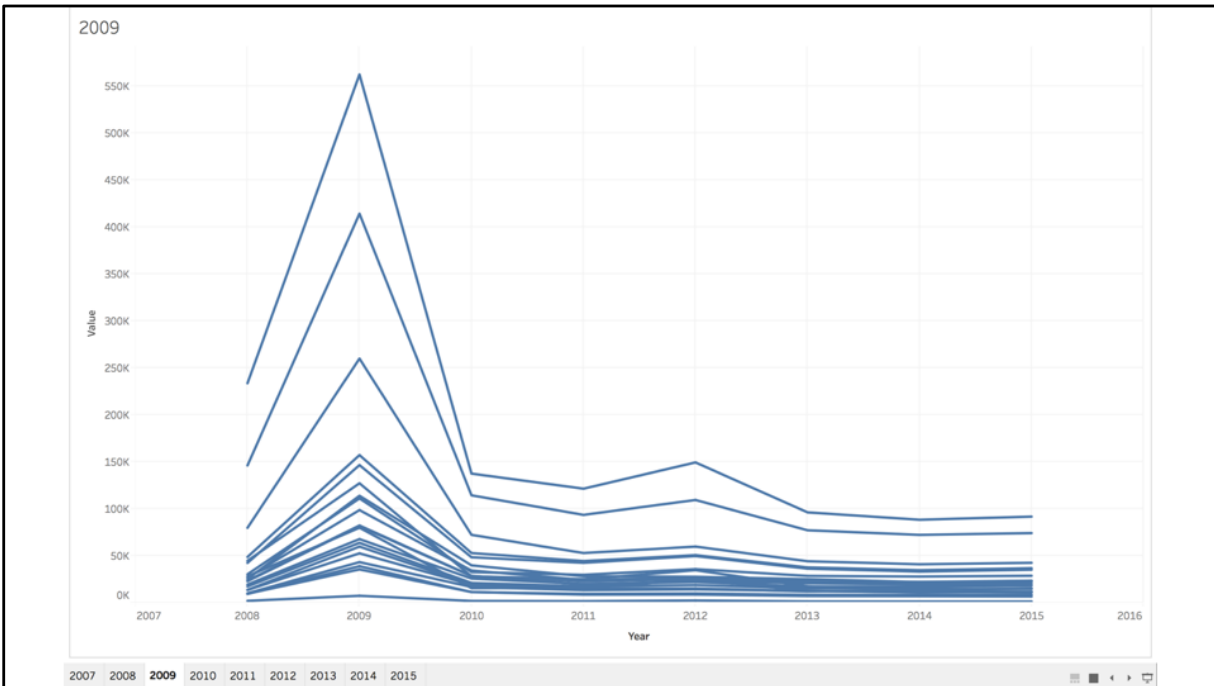


The primary and secondary peak for new-in-2007 vehicles – the secondary apex emerges 3 years after the initial wave of new-car purchases.

(These happen to be sorted by state, but this doesn't matter – California is at the top)

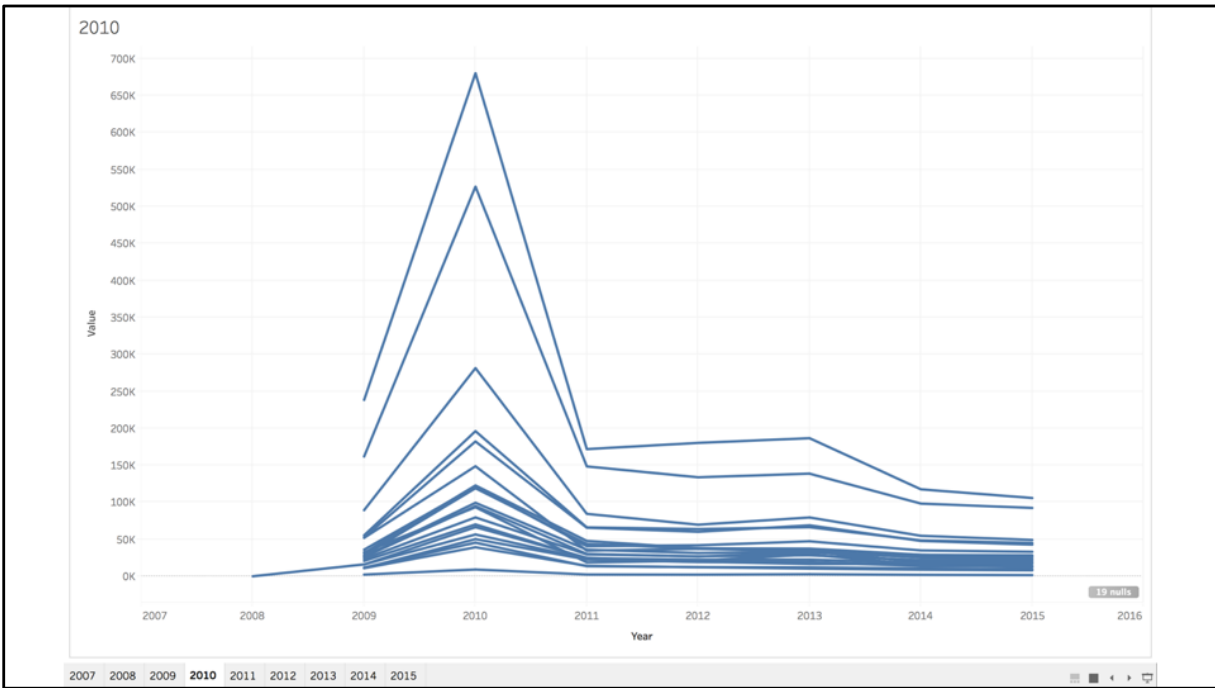


New-in-2008 vehicles – again three years between the first and second waves.

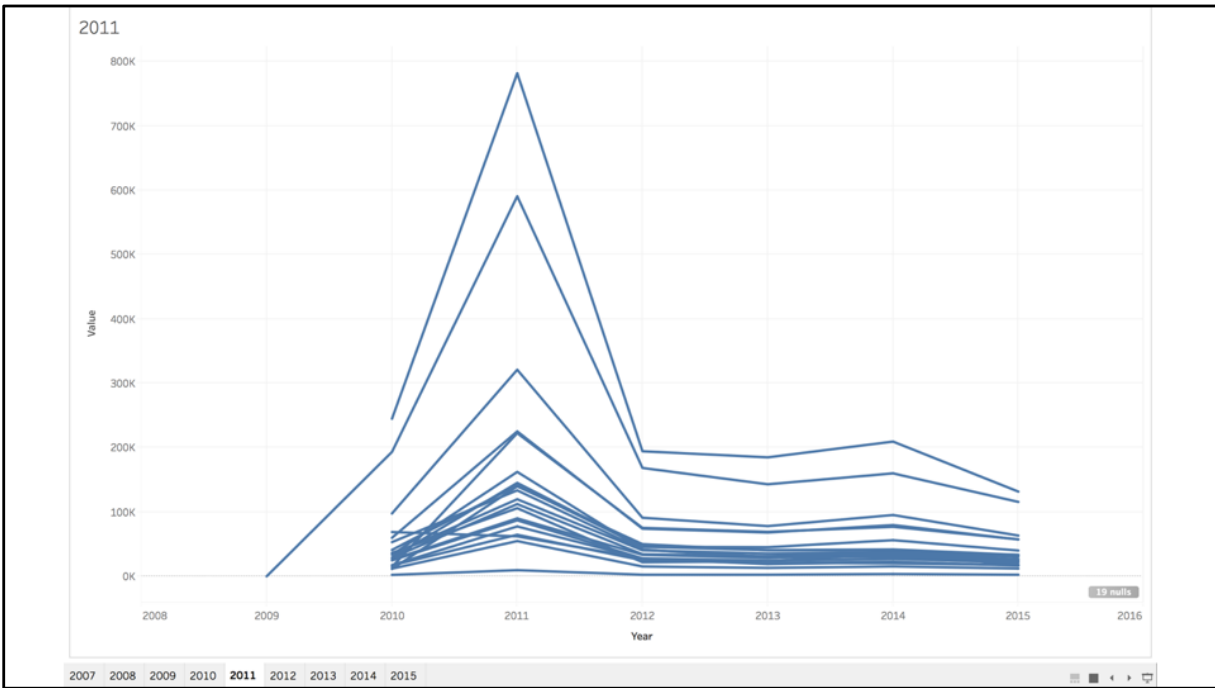


New-in-2009 vehicles – again, three years between first and second purchasing waves – counts at the first peak have dropped dramatically, and at the second peak, more steadily.

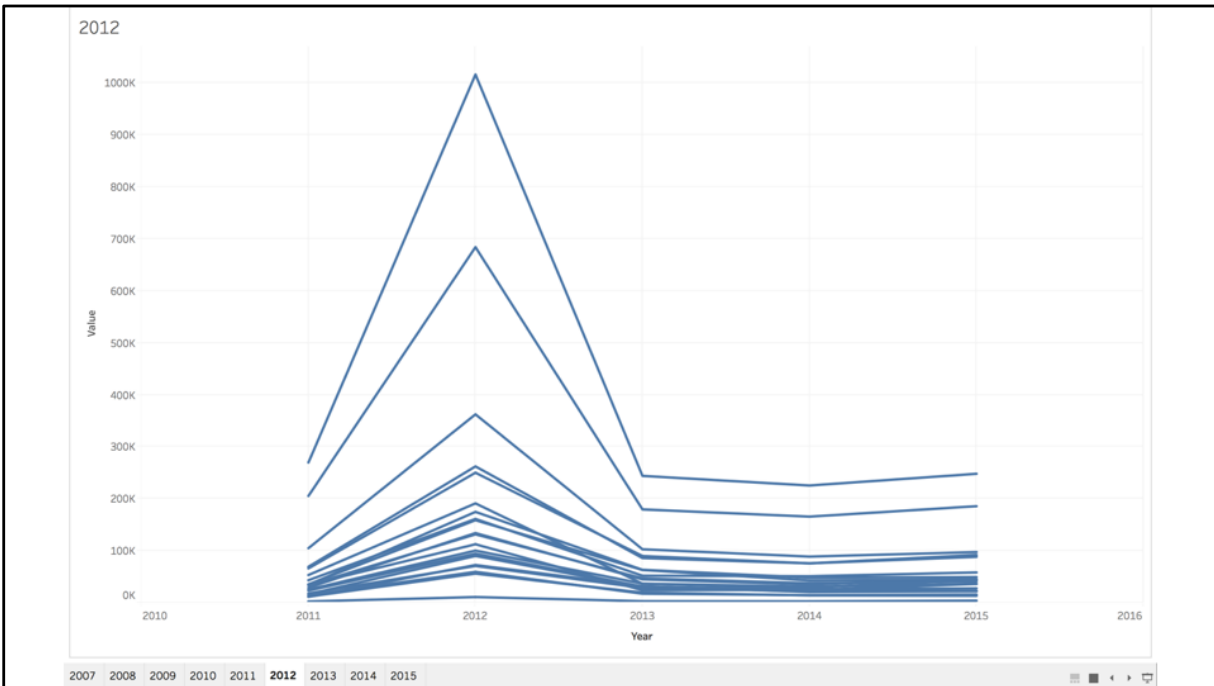
Here is the effect of the 2008 economic crisis.



2010 Vin Year vehicles -- same three year frequency between crests -- counts of both waves are increasing.



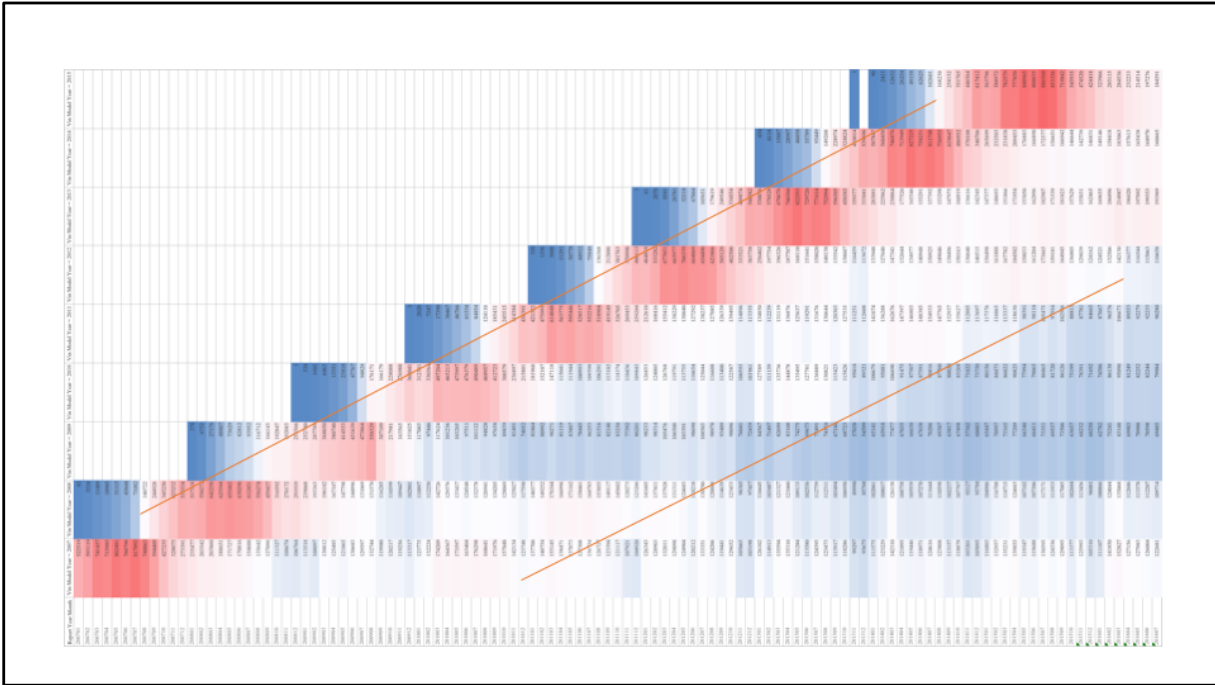
VinYear 2011 – same three year frequency between crests – counts of both waves are steadily increasing.



VinYear 2012 – from closer examination of the data, the value in 2015 appears to include the max values for this crest. Here, we see the same three-year frequency between crests – counts of both waves continue to increase. This is the last VinYear from our dataset that containing the second purchasing wave.

Trend Line Analysis

In this section, data discovery is applied to create a forecasting capability that, when annually update with the most recent year's data, supports the future-year predictions of the number of available cars to used-car dealers. Because these trend lines follow car purchasing patterns over time, what we are predicting is the total number of vehicles that are *likely* to return to market – not the total number of previously produced cars. We anticipate that this distinction is important, and the difference more useful to dealers.

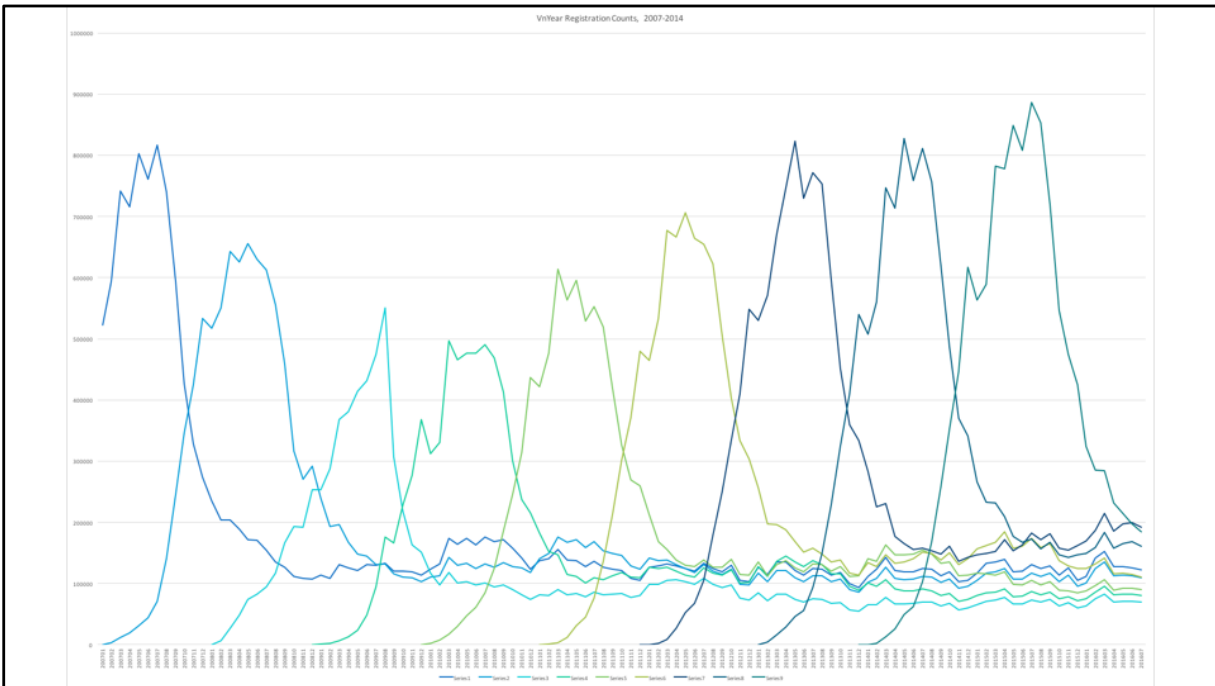


Each row in this graph shows a VinYear car, starting with 2007 at the bottom, and continuing to 2015 at the top. Each month is depicted across the horizontal axis, starting at January 2007 and continuing to July 2016.

The blue represent an increase, the red represents a decrease. The red and the blue together are the wave.

The orange lines delineate the peaks of the crests of both the first and second waves.

This graph informs the model on the next slide...

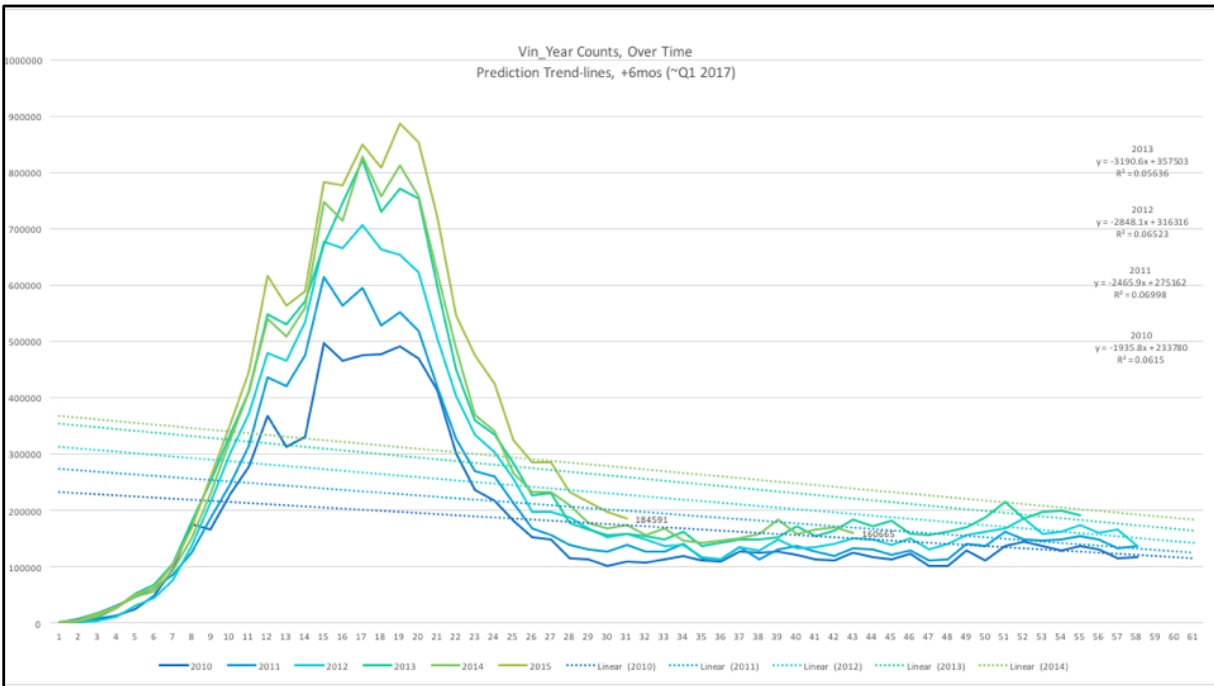


Voila, recreation of each VinYear, in context, over time

QUARTER	2010	2011	2012	2013	2014	2015
Q1	518	2620	330	61	414	40
Q1	1602	7247	1330	2070	4114	2413
Q1	6463	17390	3600	8341	13587	12632
Q2	13351	30467	11291	26781	28997	26254
Q2	23818	46766	30778	52118	46058	40158
Q2	47707	61334	44932	67664	55789	62625
Q3	94828	84854	78448	105651	93449	102601
Q3	176171	124110	136368	179619	149208	168230
Q3	166179	185431	212880	240546	228974	258152
Q4	228088	245515	301763	334554	324824	351765
Q4	276988	314384	370990	409874	410014	446564
Q4	368041	436391	480113	548382	539696	617412
Q1	321281	421322	464818	530076	507847	563796
Q1	330364	475991	533282	570528	560450	588972
Q1	497304	616048	677051	670676	746876	782379
Q2	465213	563775	665977	746560	713349	777850
Q2	475997	595446	706339	822593	827225	848065
Q2	476379	528517	664069	729720	738251	808035
Q3	490489	552216	654490	771614	811748	886500
Q3	468957	518994	621866	752994	756953	853356
Q3	412723	419149	505129	596505	619647	719842
Q4	300579	326705	402500	450385	486952	545935
Q4	236897	269453	333521	359377	370108	474220
Q4	215801	259284	307558	331681	340796	424418
Q1	181860	212610	256402	283091	265699	323966
Q1	152107	168416	197754	225862	232503	285115
Q1	147118	155412	196326	230864	231838	284536
Q2	115041	138229	187707	177526	209453	232233
Q2	111944	130040	168110	165146	176883	214514
Q2	106993	127292	151641	155291	166890	197276
Q3	109398	138237	158020	157392	156651	
Q3	106291	127085	148138	153298	147975	166942
Q3	113102	126339	135542	147975	147975	
Q4	118374	139495	138607	160919	146644	
Q4	110436	114896	114459	136616	142739	
Q4	109843	113355	113672	142145	140831	
Q1	126853	134850	133948	147377	149146	
Q1	124605	112239	127640	148693	158418	
Q1	126768	131119	147741	151866	183063	
Q2	119791	136876	132644	171954	157613	
Q2	113755	125637	134977	153050	165438	
Q2	110654	119291	140948	162896	168970	
Q3	125044	111676	150925	182907	160665	
Q3	116608	130644	148046	171339		
Q3	113400	120303	138496	181823		
Q4	122587	127535	150163	157629		
Q4	106593	111251	138640	155031		
Q4	101961	112608	140515	162465		
Q1	127589	141074	156498	169655		
Q1	111159	136288	161888	186896		
Q1	135736	162676	167782	214987		
Q2	144878	147397	184502	186020		
Q2	135495	146803	158033	197092		
Q2	127781	148385	161204	199353		
Q3	136889	154933	173665	191969		
Q3	130821	147765	159181			
Q3	115423	112937	164945			
Q4	115826	135627	136805			

The second and third purchasing waves, when the VinYears are shifted to reflect the same annual timeline, depicted in quarters.

This shift is important because it gives us the best model for predicting future count estimates.



The forecasting model and its equations.

2017 Estimate Range for Given Polk States

Total estimate 2011-2015 used cars in 2017				
2015	184561	184561	184561	184561
2014	160665	160665	160665	160665
2013	162876.4	159685.8	156495.2	153304.6
2012	142581.9	139733.8	136885.7	134037.6
2011	124742.1	122276.2	119810.3	117344.4
	775426.4	766921.8	758417.2	749912.6
				3050678

Application of the model yields the following estimated 2017 total for our given set of states

2017 Population-Informed Estimates Across All States

Total estimate 2011-2015 used cars in 2017				
2015	184561	184561	184561	184561
2014	160665	160665	160665	160665
2013	162876.4	159685.8	156495.2	153304.6
2012	142581.9	139733.8	136885.7	134037.6
2011	124742.1	122276.2	119810.3	117344.4
	775426.4	766921.8	758417.2	749912.6
				3050678
(2) Total Estimate across all states:				
		3050678	4588269.7	

Total expanded across all states – regions can be defined freely since we have state specific totals. The method for reaching this total is the important thing because this same method is how you would define state totals. If you want region groupings, send me the states for each group, and I'll put them in a table and someone can run this through Tableau for a beautiful graphic... To me, this seem unnecessary for our purposes this Friday.

It would be more useful to look at the distribution of Makes and Models within a region to determine consumer trends over time, but that is not going to answer their question, so I didn't focus on it. Remember, we were "hired" to answer their question. This model accomplishes both. We have a way to forecast if we keep current with the last year's data.

To forecast car production, we need to look at the correlation between the past 20 years of US economic data (like the S&P index) and new car purchases. Even the, we would only be able to accurately predict as far as we can accurately predict future US economic trends.

Currently, we see several indication that the auto industry is approaching a flooded

market. Currently, new car supply supersedes demand, but this is because the market is still stabilizing after the 2008 economic effects. What this means is that CarMax will have to get VERY precise about the cars they purchase in order to withstand the upcoming dramatic swells.