TV Survival

Objective

The objective is to determine the lifespan of Vizio TVs. Lifespan is determined as time that elapses between when the TV is activated for the first time (TV DoB) and the time when there is no longer any detection for a 12-month period – in other words, 1 year active.

High Level Summary

The Inactive TVs analyzed represent 11% of the TVs eligible for this analysis and are unrepresentative of the overall Inactive population. The average age of deactivated TVs is 20 months. This is likely down to the failure of older chipsets and the introduction of improved SMART TV technology, which prompted early adopters to decommission their existing TVs. More recent chipset data is not yet available for the timeframe needed to test this hypothesis.

However, 89% of TVs analyzed, remain active, which points to robustness of Vizio TVs. In fact, there is a 73% chance that the TV will be active after 46 months of life. It would be safe to use a 6 year average lifespan for a Vizio TV.

Limitations

There was one major limiting factor that impeded this analysis – although more than enough TVs were eligible (~6.5m), these TVs spanned a time window that was not long enough.

This is highlighted by the fact that, of the TVs eligible for this analysis, 11% are inactive versus 89% active. Clearly, not enough time has elapsed for TVs to go through their natural life cycle. For those TVs that are inactive, the average life for these TVs is 20 months, versus 25 months, for those still active TVs. The TVs that are inactive are more representative of that small percentage of TVs that become inactive for a reason other than their natural life cycle of a wider TV population.

Observations

- Although we Vizio TV data dating back to 2012, the quantity of available TVs did not ramp up in earnest until 2014

- Detection began in November 2015. This was not a limiting factor. However, it did mean that a TV that joined Vizio in January, 2014 would not demonstrate any activity until Month 23

- Given the definition of a deactivated TV as "no activity in the last 12 months", the upper date limit available is February 22nd, 2018 – at time of writing (current date being February 22nd, 2019). This severely limits our time window to ~4.5 years

Methodology

For this exercise, a Kaplan Meier Estimate Survival Analysis was performed. The data was prepared based on the following rules:

- If a TV has no activity during the last 12 months, it is deemed as Inactive – otherwise, still Active

- Exclude TVs that have a Joined Date (activation) within the last 2 years

- The most recent TV session is that which was closest to the upper window of February 22nd, 2018 since this was the cutoff in identifying Inactive TVs – given that there was zero activity for the subsequent 12 months. The same rule was applied for still active TVs. This most recent session date was then subtracted from the TV DoB to determine the number of months elapsed from Birth >> Death (in the case of Inactive TVs)

- At each point in time, the calculation is as follows:

$$\frac{\text{Number of TVs that survived in month N and are entering Month N+1}}{\text{Number of TVs that deactivated in Month N+1}}$$

$$\text{Number of TVs that survived Month N and are entering Month N+1}$$

Event Table

The analysis was performed against the list of Active and Inactive TVs to more accurately determine probability of life after N months have elapsed – beginning at Month 1.

The analysis was then recalculated against Inactive TVs only.

The Events Tables and KM estimates for both cases are provided below, as well as descriptions of the Events table.

Events Table Described

REMOVED contains the number of observations removed during that time period, whether due to death (the value in the OBSERVED column) or censorship. The REMOVED column is the sum of the OBSERVED and CENSORED columns.

The CENSORED column represents those TVs that are part of the population at that point and remain active. This will be a high % of total in the early months given the very low deactivation rate of TVs at the beginning of their life.

The ENTRANCE column tells us whether any new TVs entered the population at that time period. Since all TVs start at time=0, the entrance value is 6.5m at that time and 0 for all other times.

The AT RISK column contains the number of TVs that are still active during a given time. The value for AT RISK at time=0, is just equal to the entrance value. For the remaining time periods,
the AT RISK value is equal to the difference between the time previous period's AT RISK value and removed value, plus the current period's entrance value.

The number of observations is as follows:

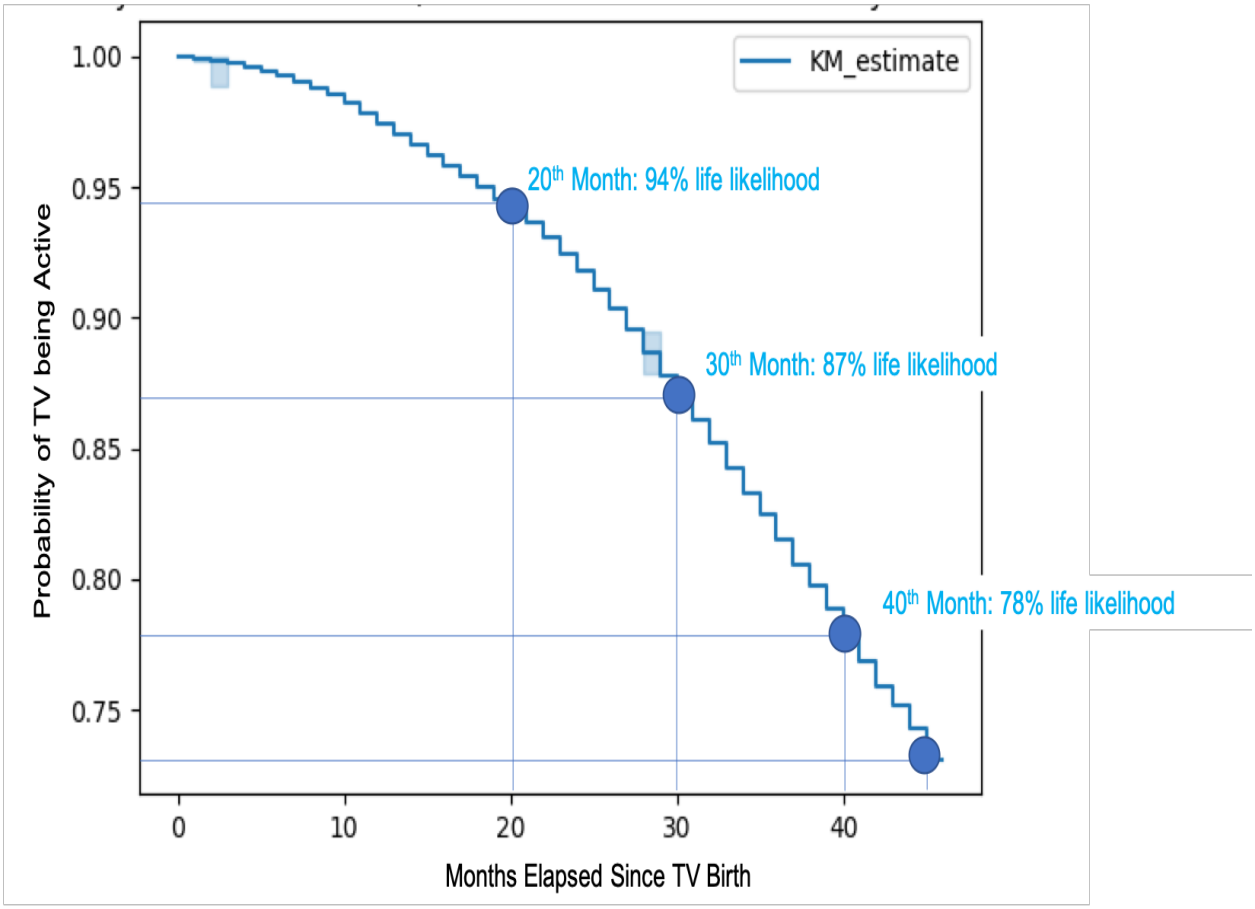
Still Active TVs:	5,824,933
Inactive TVs:	705,583

Active and Inactive TVs

Event Table 1 and Accompanying Kaplan Meier Estimate Survival chart:

event_at	removed	observed	censored	entrance	at_risk
-	11,315	1,199	10,116	6,530,516	6,530,516
1	13,122	3,854	9,268	-	6,519,201
2	14,890	5,288	9,602	-	6,506,079
3	17,166	6,987	10,179	-	6,491,189
4	18,361	8,458	9,903	-	6,474,023
5	21,075	10,267	10,808	-	6,455,662
6	24,285	12,121	12,164	-	6,434,587
7	27,630	13,919	13,711	-	6,410,302
8	32,107	16,145	15,962	-	6,382,672
9	37,351	18,502	18,849	-	6,350,565
10	40,745	19,775	20,970	-	6,313,214
11	49,928	22,751	27,177	-	6,272,469
12	160,616	25,274	135,342	-	6,222,541
13	217,360	25,077	192,283	-	6,061,925
14	330,754	23,787	306,967	-	5,844,565
15	239,559	22,813	216,746	-	5,513,811
16	188,910	22,222	166,688	-	5,274,252
17	184,039	21,977	162,062	-	5,085,342
18	207,938	21,684	186,254	-	4,901,303
19	180,466	21,732	158,734	-	4,693,365
20	169,135	21,850	147,285	-	4,512,899
21	200,350	21,959	178,391	-	4,343,764
22	210,308	24,038	186,270	-	4,143,414
23	275,198	26,730	248,468	-	3,933,106
24	233,954	26,891	207,063	-	3,657,908
25	302,030	25,637	276,393	-	3,423,954
26	256,874	25,700	231,174	-	3,121,924
27	106,995	25,286	81,709	-	2,865,050
28	177,650	26,261	151,389	-	2,758,055
29	187,833	25,714	162,119	-	2,580,405
30	209,773	23,093	186,680	-	2,392,572
31	213,767	21,437	192,330	-	2,182,799
32	232,953	20,758	212,195	-	1,969,032
33	182,201	19,767	162,434	-	1,736,079
34	147,073	17,415	129,658	-	1,553,878
35	951,587	13,608	937,979	-	1,406,805
36	80,391	5,429	74,962	-	455,218
37	47,738	4,304	43,434	-	374,827
38	218,941	3,308	215,633	-	327,089
39	56,448	1,146	55,302	-	108,148
40	20,386	628	19,758	-	51,700
41	13,221	434	12,787	-	31,314
42	9,114	227	8,887	-	18,093
43	5,912	89	5,823	-	8,979
44	2,681	36	2,645	-	3,067
45	379	6	373	-	386
46	7	-	7	-	7

Kaplan Meier Estimate Survival chart – Active and Inactive TVs



Vizio TVs demonstrate a robust lifespan. After 46 months, there is a 73% chance that the TV is still active.

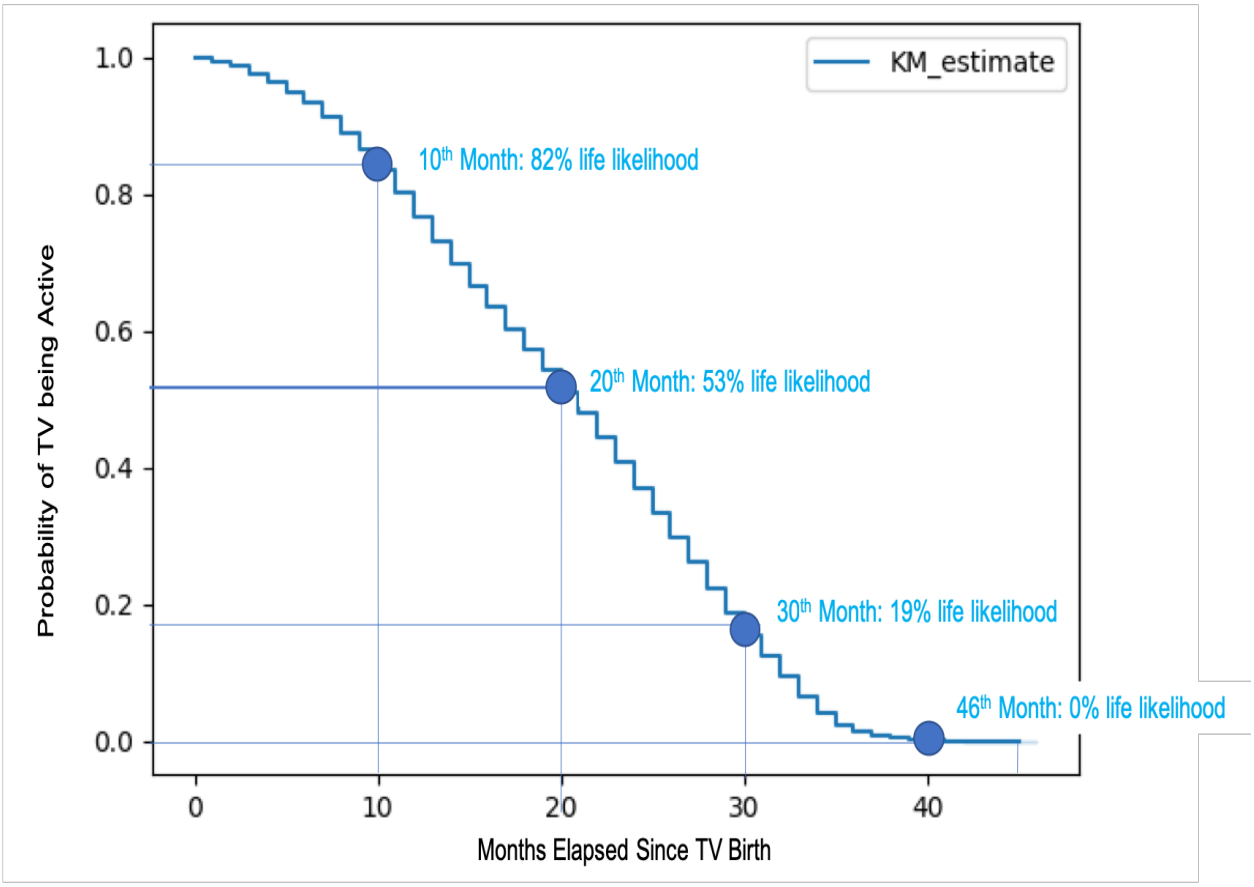
Inactive TVs

Conducting this analysis for Inactive TVs only, the landscape changes dramatically. It is very unlikely that a TV will be active after 40 months when considering inactive TVs in isolation. Caution must be taken here as the data is overfit to these inactive TVs that are unrepresentative of the Inactive population, which will become available as a wider time window becomes available.

Event Table 2 and Accompanying Kaplan Meier Estimate Survival chart: Inactive TVs Only

event at	removed	observed	censored	entrance	at_risk
-	1,199	1,199	-	705,583	705,583
1	3,854	3,854	-	-	704,384
2	5,288	5,288	-	-	700,530
3	6,987	6,987	-	-	695,242
4	8,458	8,458	-	-	688,255
5	10,267	10,267	-	-	679,797
6	12,121	12,121	-	-	669,530
7	13,919	13,919	-	-	657,409
8	16,145	16,145	-	-	643,490
9	18,502	18,502	-	-	627,345
10	19,775	19,775	-	-	608,843
11	22,751	22,751	-	-	589,068
12	25,274	25,274	-	-	566,317
13	25,077	25,077	-	-	541,043
14	23,787	23,787	-	-	515,966
15	22,813	22,813	-	-	492,179
16	22,222	22,222	-	-	469,366
17	21,977	21,977	-	-	447,144
18	21,684	21,684	-	-	425,167
19	21,732	21,732	-	-	403,483
20	21,850	21,850	-	-	381,751
21	21,959	21,959	-	-	359,901
22	24,038	24,038	-	-	337,942
23	26,730	26,730	-	-	313,904
24	26,891	26,891	-	-	287,174
25	25,637	25,637	-	-	260,283
26	25,700	25,700	-	-	234,646
27	25,286	25,286	-	-	208,946
28	26,261	26,261	-	-	183,660
29	25,714	25,714	-	-	157,399
30	23,093	23,093	-	-	131,685
31	21,437	21,437	-	-	108,592
32	20,758	20,758	-	-	87,155
33	19,767	19,767	-	-	66,397
34	17,415	17,415	-	-	46,630
35	13,608	13,608	-	-	29,215
36	5,429	5,429	-	-	15,607
37	4,304	4,304	-	-	10,178
38	3,308	3,308	-	-	5,874
39	1,146	1,146	-	-	2,566
40	628	628	-	-	1,420
41	434	434	-	-	792
42	227	227	-	-	358
43	89	89	-	-	131
44	36	36	-	-	42
45	6	6	-	-	6

Kaplan Meier Estimate Survival chart – Inactive TVs Only



This represents is a subset of TVs that have a shorter life cycle. It is likely that this earlier birth >> death could be down to failure of older chipsets and the introduction of improved SMART TVs that prompt consumers to migrate before the end of the TV natural life. This hypothesis can be tested as we obtain a wider time frame of chipset data. Failure began rapidly after Month 20 with a 53% chance of being alive at that point, and a 19% chance at Month 30.