Report Survival Function

Data and Methodology

The dataset used in the study was obtained from CVE website (cve.org) for the year 2021, 2022 and 2023. For each vulnerability, the patch was released by the respective companies. The killed count here refers to the number of vulnerabilities whose patch was created/made where as the censored here refers to those vulnerabilities who are still alive and no patch was made for them.

The survival function was used to asses the lifetime of CVE's. Survival function graphs visually depict the estimated likelihood that a subject will survive beyond a specific time point in survival analysis. These graphs play a crucial role in comprehending the survival journey of a population or a studied group. Below is an explanation of the elements and the interpretation of survival function graphs.

Cumulative Hazard Function: The survival function provides the probability of surviving past a specific time point, while the cumulative hazard function indicates the cumulative risk or failure rate leading up to that time point. Both functions are crucial in survival analysis for understanding time-to-event data and evaluating associated risk factors.

Empirical Results (Year 2023)

The survival analysis comprises of 390 vulnerabilities, 366 of whom were killed as their patch was made available. The number of censored vulnerabilities were 24 as their patch was not available. Our analysis observed a total of 365 days. (Table 1)

Table: 1 Killed and censored counts

Time	First Seen	Attribute: Name	Release Date	Patch Details	Killed Count	Censored/Uncensored
1	01-12-2022	CVE-2023-21537	Jan 10, 2023	CVE-2023-21537	21	0
2	16-12-2022	CVE-2023-21775	Jan 12, 2023	CVE-2023-21775	2	0
3	16-12-2022	CVE-2023-21795	Jan 17, 2023	CVE-2023-21795	1	0
4	13-12-2022	CVE-2023-21719	Jan 19, 2023	CVE-2023-21719	1	0
5	13-12-2022	CVE-2023-21720	Feb 3, 2023	CVE-2023-21720	1	0
6	16-12-2022	CVE-2023-21794	Feb 9, 2023	CVE-2023-21794	2	0
7	01-12-2022	CVE-2023-21528	Feb 14, 2023	CVE-2023-21528	37	0
8	11-01-2023	CVE-2023-23389	Mar 14, 2023	CVE-2023-23389	37	0
9	13-03-2023	CVE-2023-28261	Mar 24, 2023	CVE-2023-28261	2	0
10	31-01-2023	CVE-2023-24935	Apr 6, 2023	CVE-2023-24935	2	0
11	01-12-2022	CVE-2023-21554	Apr 11, 2023	CVE-2023-21554	28	0
12	31-01-2023	CVE-2023-24934	Apr 14, 2023	CVE-2023-24934	1	0
13	04-04-2023	CVE-2023-29334	Apr 28, 2023	CVE-2023-29334	1	0
14	04-04-2023	CVE-2023-29350	May 5, 2023	CVE-2023-29350	2	0
15	31-01-2023	CVE-2023-24881	May 9, 2023	CVE-2023-24881	9	0
16	04-04-2023	CVE-2023-29345	Jun 2, 2023	CVE-2023-29345	2	0
17	13-03-2023	CVE-2023-28310	Jun 13, 2023	CVE-2023-28310	19	0
18	04-04-2023	CVE-2023-29349	Jun 15, 2023	CVE-2023-29349	6	0
19	01-05-2023	CVE-2023-32033	Jul 11, 2023	CVE-2023-32033	36	0
20	27-06-2023	CVE-2023-36883	Jul 13, 2023	CVE-2023-36883	3	0
21	14-06-2023	CVE-2023-35392	Jul 21, 2023	CVE-2023-35392	3	0

22	12-07-2023	CVE-2023-38157	Aug 7, 2023	CVE-2023-38157	1	0
23	13-12-2022	CVE-2023-21709	Aug 8, 2023	CVE-2023-21709	35	0
24	27-06-2023	CVE-2023-36769	Aug 15, 2023	CVE-2023-36769	1	0
25	27-06-2023	CVE-2023-36787	Aug 21, 2023	CVE-2023-36787	2	0
26	26-06-2023	CVE-2023-36741	Aug 25, 2023	CVE-2023-36741	1	0
27	04-04-2023	CVE-2023-29332	Sep 12, 2023	CVE-2023-29332	18	0
28	23-06-2023	CVE-2023-36562	Sep 15, 2023	CVE-2023-36562	3	0
29	14-06-2023	CVE-2023-35349	Oct 10, 2023	CVE-2023-35349	42	0
30	23-06-2023	CVE-2023-36559	Oct 13, 2023	CVE-2023-36559	1	0
31	21-06-2023	CVE-2023-36409	Oct 20, 2023	CVE-2023-36409	1	0
32	20-06-2023	CVE-2023-36022	Nov 2, 2023	CVE-2023-36022	3	0
33	20-06-2023	CVE-2023-36014	Nov 9, 2023	CVE-2023-36014	2	0
34	20-06-2023	CVE-2023-36027	Nov 10, 2023	CVE-2023-36027	1	0
35	20-06-2023	CVE-2023-36007	Nov 14, 2023	CVE-2023-36007	23	0
36	20-06-2023	CVE-2023-36008	Nov 16, 2023	CVE-2023-36008	2	0
37	15-06-2023	CVE-2023-35618	Dec 7, 2023	CVE-2023-35618	3	0
38	15-06-2023	CVE-2023-35619	Dec 12, 2023	CVE-2023-35619	10	0
39	27-06-2023	CVE-2023-36878	Dec 14, 2023	CVE-2023-36878	1	0
40	2023-07-17	CVE-2023-38402			0	1
41	2023-07-24	CVE-2023-38696			0	1
42	2023-07-25	CVE-2023-38817			0	1
43	2023-07-13	CVE-2023-38245			0	1
44	2023-09-01	CVE-2023-4706			0	1
45	2023-11-10	CVE-2023-47800			0	1
46	2023-11-13	CVE-2023-48289			0	1
47	2023-11-24	CVE-2023-49282			0	1
48	2023-11-24	CVE-2023-49283			0	1
49	2023-11-24	CVE-2023-49289			0	1
50	2023-12-21	CVE-2023-51662			0	1
51	2023-12-21	CVE-2023-51663			0	1
52	2023-11-21	CVE-2023-6235			0	1
53	2023-11-28	CVE-2023-6352			0	1
54	2023-02-01	CVE-2023-0620			0	1
55	2023-02-01	CVE-2023-22440			0	1
56	2023-01-09	CVE-2023-22880			0	1
57	2023-06-14	CVE-2023-34355			0	1
58	2023-06-14	CVE-2023-34362			0	1
59	2023-06-14	CVE-2023-3440			0	1
60	2023-06-14	CVE-2023-3527			0	1
61	2023-05-01	CVE-2023-31222			0	1
62	2023-03-13	CVE-2023-28005			0	1
63	2023-03-13	CVE-2023-28284			0	1

The survival plots for the survivor, cumulative hazard and actual data are represent in the fig. 1, 2 and 3 respectively.

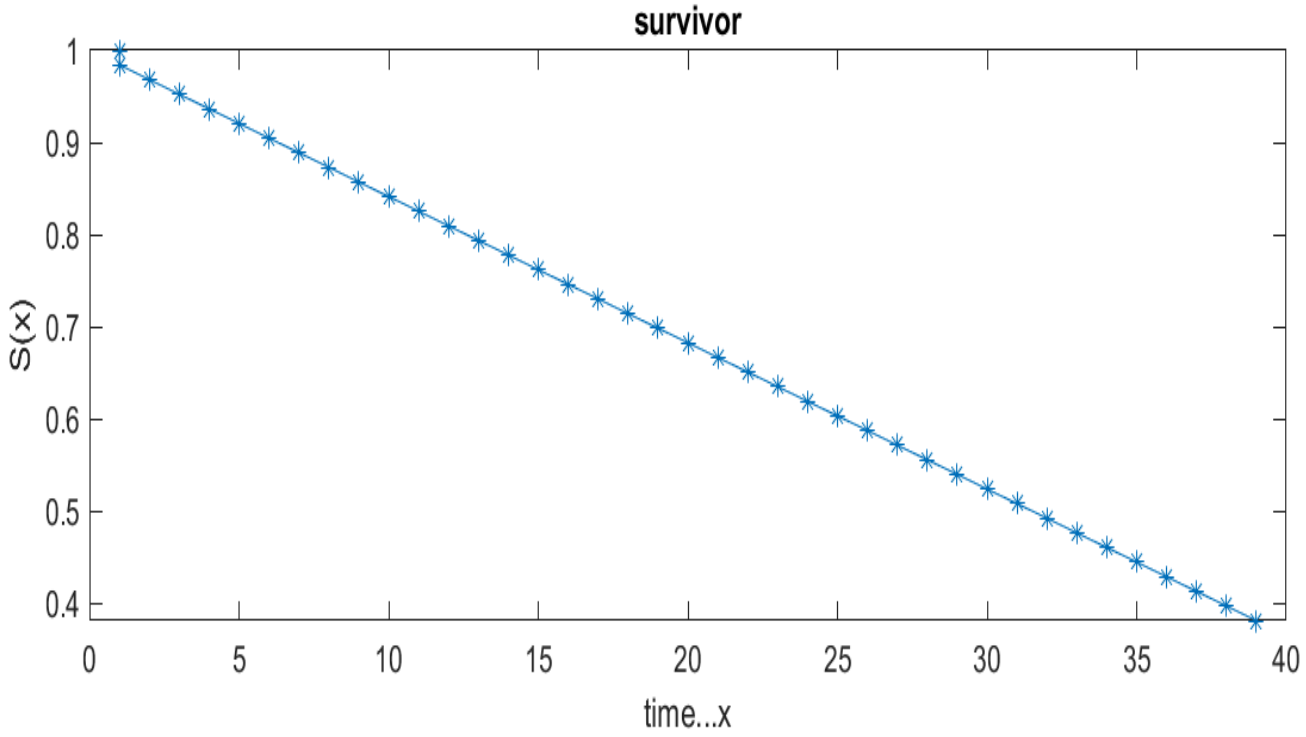

Fig. 1: Survivor Function

From the above figure it can be said that the overall trend of vulnerabilities is decreasing with respect to time. We can see that 92% of the vulnerabilities are alive for about 5 days, 84% of the vulnerabilities live for about 10 days. As the period of time increases, the number of vulnerabilities decreases as the patch was made available for them.

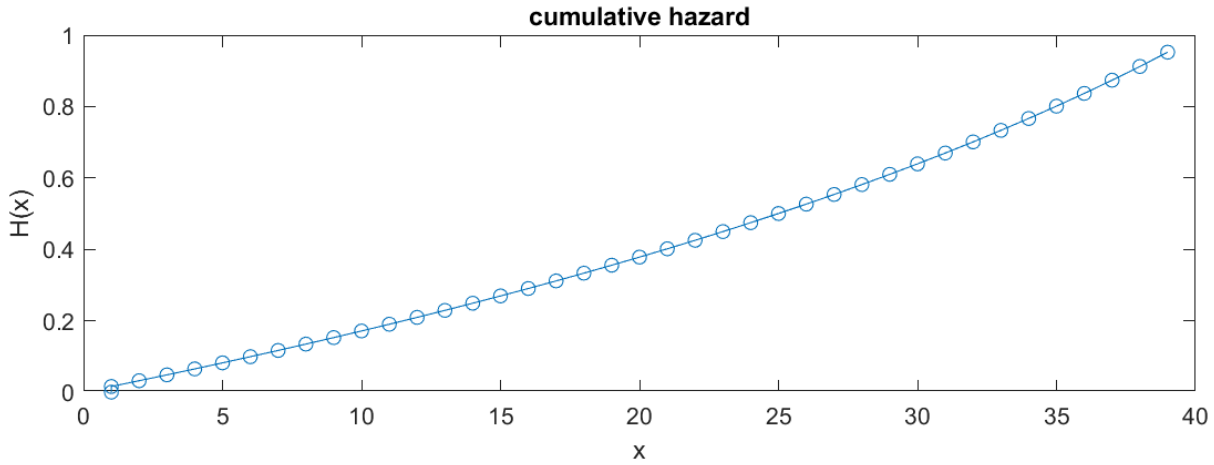

Fig. 2: Cumulative Hazard Function

From the above figure, it can be said that, at any given time, t, the value of H(x) signifies the cumulative risk of experiencing the vulnerability up to that particular date. A higher H(x) value indicates a greater cumulative risk or failure rate up to time t.

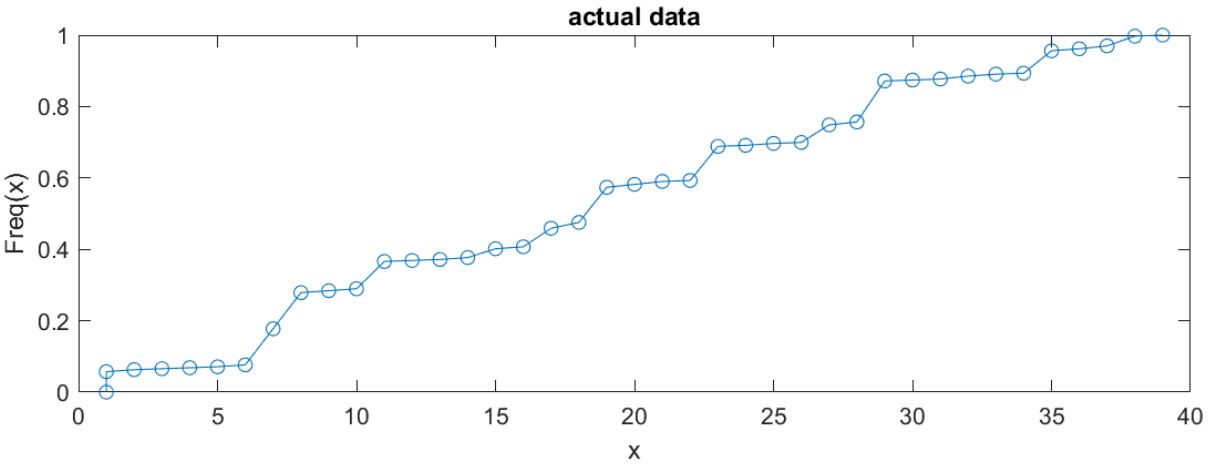

Fig. 3: Actual Data

From the above figure, the overall trend of vulnerabilities is increasing day by day. The increasing trend in the curve can be seen from the actual data.