CubeSat Data Analysis
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Table of Contents

Table of Figures

Table of Tables

1 Introduction

"In November 2013, a single Minotaur rocket carried 29 satellites into orbit, setting a new record for the most satellites deployed in a single launch. Less than two days later, a single Dnepr beat that record, lifting 32 satellites into orbit. Such launch rates—inconceivable just a few years ago—are rendered all the more remarkable considering that many of these satellites were not sponsored by well-funded government agencies but by universities and small private entities.
Evidently, the space industry is starting to realize the potential of small satellites. Indeed, the last decade has seen a substantial boom in their development, both domestically and internationally. Much of this growth can be attributed to the popularity of CubeSats, a well-known subclass of small satellites. However, CubeSats are only part of this rapidly expanding picture. Furthermore, it appears that small satellites are starting to move beyond the demonstration phase to provide the performance and reliability needed for commercial ventures and governmental applications"[1].

The purpose of the CubeSats project is to provide a standard for design of picosatellites to reduce cost and development time, increase accessibility to space, and sustain frequent launches. CubeSat Project is an international collaboration of over 100 universities, high schools, and private firms developing picosatellites containing scientific, private, and government payload.

The history of the CubeSats began in 1999, and initial specifications were developed by Jordi Puig-Suari of California Polytechnic State University and Bob Twiggs of Stanford University. A *CubeSat* is a small satellite usually having a volume of exactly one liter (10 cm cube) and the mass of up to 1.33 kg., intended to use in low Earth orbit (LEO) to perform scientific research and explore new space technologies. The first CubeSats were launched in June 2003 on a Russian Eurockot, and approximately 75 CubeSats had been placed into orbit by 2012 [2].

In this paper, the CubeSat data collected by the Saint Luis University (SLU) are analyzed. The data records begin with 02/06/2000. The latest record is dated by 06/28/2015. There are 370 CubeSat records in total in this database.

According to the satellite classification based on mass, the satellites considered below belong to the class of *nanosatellites*[1] (see Section 4). It should be noted that in our study the CubeSat data are analyzed mainly from Reliability/Risk analysis standpoint.

[1] By definition, nanosatellite mass belong to the interval (1 – 10) kg

2 *Statement of Work*

Saint Louis University (SLU) has compiled a database of all CubeSats that have flown or have firm manifests. It includes mission status and functional status for each satellite. Part 3 will analyze the database and perform reliability/risk analysis, which includes the following subtasks:

- Review the existing database to identify any fields that may need to be added; request additional data and review
- Determine what useful knowledge can be gained from analysis of the data, i.e., determine the objectives of the analysis to be performed
- Identify the types of analyses that should be performed to meet the objectives.
- Perform statistical reliability/risk analyses
- Deliver a draft report to Task Monitor and NASA Headquarters customer with objectives and preliminary statistical analysis
- Deliver final report

3 *Database*

The SLU database consists of the records of 370 CubeSats. The database's 25 variables (V1 – V25) as specified by the database are:

V1. NORAD ID
V2. Name

V3. COSPAR name

V4. Launch Country

V5. Launch Date

V6 Launch Site

1. AFETR Cape Canaveral, USA
2. AFWTR Vandenberg (Air Force Western Test Range), USA
3. Brazil Alcantara, Brazil
4. FRGUI Europe's Spaceport, Kourou, French Guiana, Europe
5. ISS International Space Station Deployed, ISS
6. JSC Jiuquan Space Center, China
7. KAUAI Barking Sands, USA
8. KODAK Kodiak Alaska, USA
9. KSCUT Uchinoura Space Center (nee Kagoshima), Japan
10. KWAJ Kwajalein Atoll, USA
11. KYMTR Kapustin Yar, Russia

12. OREN Dnepr Bunker Site, Russia
13. PKMTR Plesetsk Missile and Space Complex, Russia
14. SRI Satish Dhawan Space Centre (nee Sriharikota), India
15. TNSTA Tanegashima Space Center, Japan
16. TSC Taiyuan Space Center, China
17. TTMTR Baikonur Cosmodrome, Russia (although in Kazakhstan)
18. WLPIS Wallops Island, USA
19. WRAS Western Range Airspace, USA
20. XSC Xichang Launch Facility, China

V7. Class

V7.1 Civ

V7.2 Com

V7.3 Mil

V7.4 Uni

V8. Type (Cube, or Pocket Cube (5 records only))

V9. Sub-type (in U: U1, U2, etc., U1 has one liter volume, U2 has two liter volume, etc.)

V10. Ejector (16 names)

V11. Mission Type

"Mission Type is based on primary mission (the one paying the bills, if such a mission exists):

T - Technology demonstration

S - Science

C - Communications

M - Military (some military comm./tracking missions don't fit any other category)

I - Commercial Earth imaging; I count this separately from S-class to distinguish the commercial aspect, and because it keeps Planet Labs from taking over one of the other categories.

E - education/training" [3]

V12. Mission Status

0 - prelaunch
1 - launch (the rocket lifted off the ground, but the CubeSat is still inside)
2 - release (the CubeSat is free-flying)
3 - initial operations/checkout (confirmed uplink and downlink)
4 - preliminary mission operations
5 - primary mission accomplished (though it may continue to be in main operations)

V13. Decay Date - is the UTC date of reentry, taken directly from Jonathan's Space Report [3]

V14. Mass (kg)

V15. Ops End (Date)

V16. Mission End (Date)

V17. Functional Status[2]

D - Deorbited (pre-launch or disposal)
N - Nonoperational
S - Semioperational
A – active

V18. Inc.
V.19 Apogee
V20. Perigee
V21. Users (e.g., *Aerospace Corporation or University of Tokyo*)
V22. Failures -- are grouped by subsystem, if a leading cause could be identified

NC – not categorized
Comm – loss of communication
Power -- something in the electrical power subsystem
Mech – structural/mechanical failure (including binding/sticking of deployment mechanisms)
CPU -- hardware or software failures in on-board computing/command
ADC – attitude determination & control
Software -- usually an unrecovered system crash
Debris – on-orbit collision
LF – launcher failure

V23. Contractor (it can coincide with *Users*)
V24. Orbit Vehicle
V25. Summary (comments)

The data records begin with 02/06/2000 (the launch date). The latest record is dated 06/28/2015. It should be noted that many of the 370 records have missing data of some of the above listed variables. The information about the design satellite life is missing, which makes reliability estimation difficult.

4 Distributions by Satellite Classes, Users, Mass, and Volume

4.1 Distribution by satellite classes

The database divides the 370 satellites into the following 4 classes shown in **Table 4-1**:

Table 4-1

	Class	Notation in Database	Number of records (satellites)
1	Communication	Com	145
2	University	Uni	143
3	Military	Mil	49
4	Civilian	Civ	33

[2] Mission Status and Functional Status are quasi-independent; the Spirit Mars Rover would be classified as 5N, while Curiosity is 4A (or maybe 5A, depending on who you talk to) [3].

4.2 Distribution by satellite users

The major CubeSats users are shown in **Table 4-2**below.

Table 4-2

	User	Number of CubeSats in database
1	Planet Labs[3]	110
2	NASA (Ames and JPL)	14
3	Cal Poly	11
4	Aerospace Corporation	9
5	All others that have ≤ 4 satellites	226

The other CubeSats users have 4 or less than 4 satellites. It is obvious that the telecommunication and academic (university) communities are the two major classes of the CubeSat users, and among these users, the Planet Labs is the major one.

4.3 CubeSat Distribution by mass

The satellite distribution by mass is shown in Figure 4-1 below. The figure reveals that the prevalent masses of the CubeSats are 1 kg and 5 kg (34% and 42% of the population, correspondingly).

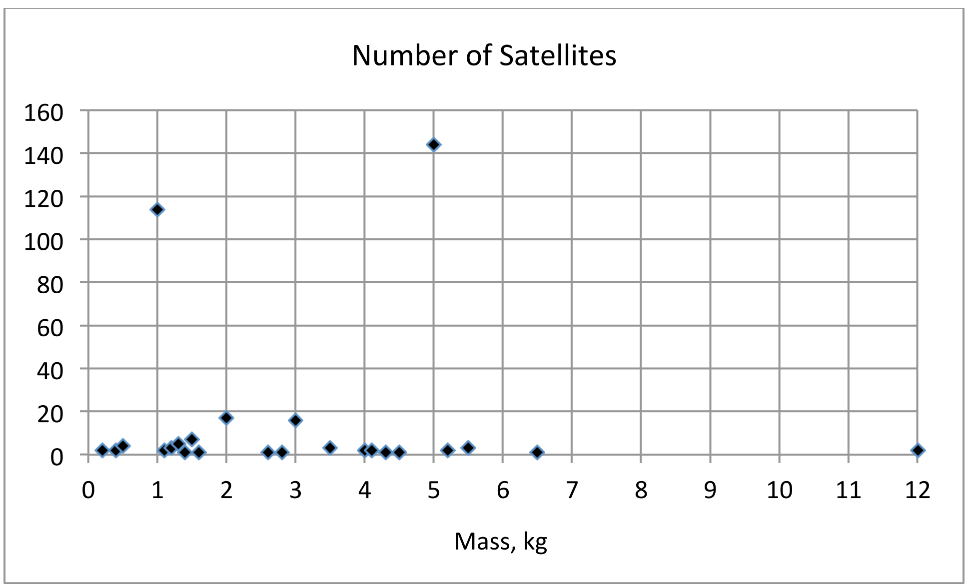

Figure 4-1 CubeSats distribution by mass

4.4 CubeSat Distribution by volume

The CubeSat volume is defined by its sub-type. For example, the subtype U1 has the volume of 1 liter, the sub-type U2 has the volume of 2 liters, etc. The satellite distribution by volume is shown in Figure 4-2

[3] Founded in 2010, Planet Labs, Inc. (formerly Cosmogia, Inc.) is an American private company that aims to create an Earth observation satellite constellation with open data access

below. The figure reveals that the most common volumes are 1 liter and 3 liters (35% and 52% respectively).

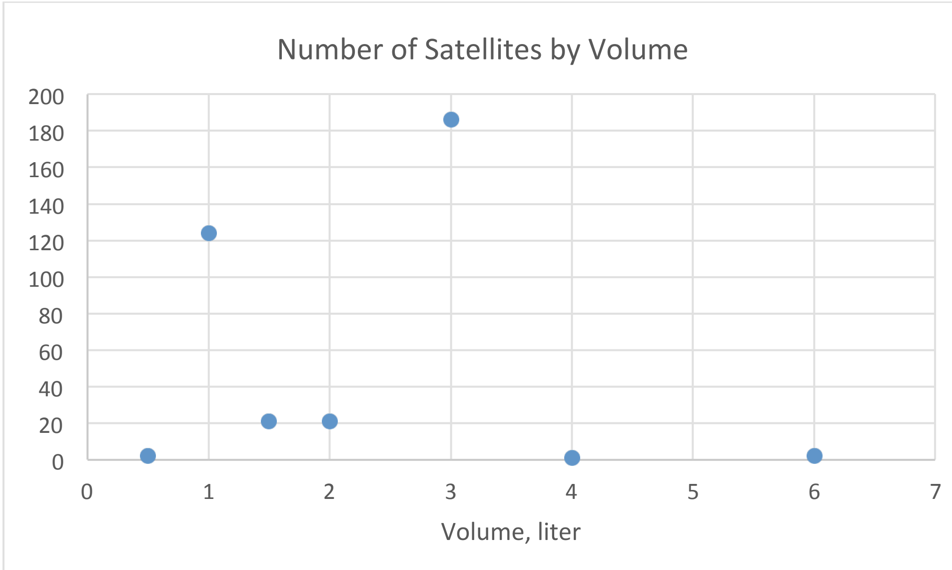

Figure 4-2 CubeSat distribution by volume

5 Annual Number of CubeSats Launched

Table 5-1 below shows the annual number of CubeSats launched from 2000 through 2015.

Table 5-1 Annual number of CubeSats launched

Year	Number of CubeSats	Year	Number of CubeSats
2000	5	2008	8
2001	1	2009	11
2002	1	2010	15
2003	6	2011	12
2004	0	2012	23
2005	3	2013	84
2006	20	2014	118
2007	7	2015	56[4]

It should be noted that annual number of CubeSats launched increased about ten times in 2014 compared to the number CubeSats launched in 2011.

[4] The data are truncated on 07/17/2015

6 Reliability Data Analysis

6.1 Introducing "Time to Event" variable

In order to estimate the CubeSats reliability, a variable similar to the time to failure should be introduced. We will use "Time to Event" for this purpose. An event might be failure (due to all failure modes, or due to a given failure mode) or it can be censoring, in which case it is an event when observations were terminated for any reason except for a failure.

6.2 Probability of a Successful Launch

The database provides information on 370 CubeSats (370 records). To estimate the probability of a successful launch, the following variable is introduced:

Var1 = "Mission End Date" – "Launch Date"

The launch date is available for all 370 records, but there are only 96 records having the mission end date. Thus, there are only 96 records, for which the Var1 is available.

Out of these 96 records, in 34 cases Var1 takes on zero value (Var1 = 0), which corresponds to the respective launch failure. Based on these data, the probability of a successful launch can be estimated as follows:

Point Estimate: (96 – 34)/96 = 0.646

The corresponding 60% lower confidence limit: 0.628

Out of these 96 records, in 39 cases Var1 takes on the value of zero or one (Var1 $\leq$ 1), which also might be considered as a launch failure (a launch failure or a failure on the first day). Based on this definition, the probability of a successful launch can be estimated as follows:

Point Estimate: (96 – 39)/96 = 0.594

The corresponding 60% lower confidence limit: 0.575

6.3 Estimation of Probability of Mission Success after Successful Launch. Kaplan-Meier Nonparametric Estimate and Weibull Distribution.

6.3.1 Kaplan-Meier Estimate

The data available for CubeSats reliability estimation are given in Appendix Table A1.

The results of the Kaplan-Meier (K-M) estimation are shown in Table 6-1, and illustrated by **Figure 6-1** below. The figure reveals that the CubeSat Reliability function is difficult to fit parametrically.

The Kaplan-Meier (non-parametric) estimate of the median life is 110 days.

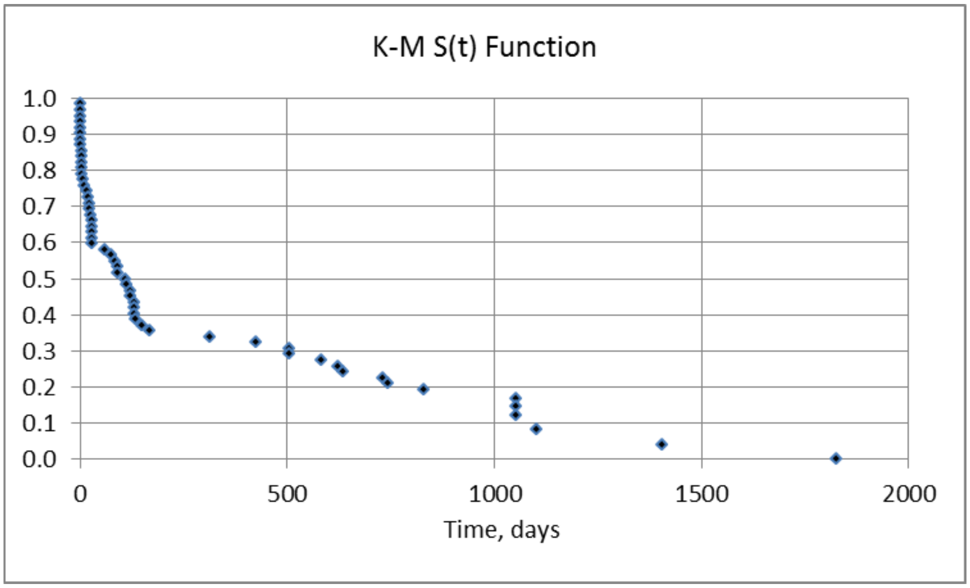

Figure 6-1 Kaplan-Meier Reliability (Survival) function of the CubeSats after successful launch

6.3.2 Weibull Distribution Estimation

The results of the Weibull distribution estimation using the Weibull++ are as follows: the scale parameter α = 200.25 days, and the shape parameter β = 0.54. The value of the shape parameter indicates the decreasing failure rate (rejuvenation) distribution. The R^2 is 0.92 that shows that the goodness of the distribution fit is not very good, which is seen in the **Figure 6-2**.

Table 6-1 Kaplan-Meier Reliability estimate S(t) *and its standard deviation (STD)*

#	Time, days	S(t)	STD	#	Time, days	S(t)	STD
1	1	0.983871	0.015998	43	505	0.306452	0.058550
2	1	0.967742	0.022439	44	506	0.290323	0.057647
3	1	0.951613	0.027252	45	581	0.274194	0.056656
4	1	0.935484	0.031200	46	622	0.258065	0.055571
5	1	0.919355	0.034581	47	635	0.241936	0.054388
6	2	0.903226	0.037548	48	731	0.225806	0.053100
7	2	0.887097	0.040192	49	742	0.209677	0.051699
8	2	0.870968	0.042575	50	830	0.193548	0.050175
9	3	0.854839	0.044738	51	833		
10	3	0.838710	0.046710	52	833		
11	3	0.822581	0.048517	53	833		
12	4	0.806452	0.050175	54	886		
13	5	0.790323	0.051699	55	1051	0.169355	0.049393
14	7	0.774194	0.053100	56	1051	0.145161	0.047897
15	10	0.758065	0.054388	57	1051	0.120968	0.045617
16	16	0.741936	0.055571	58	1051		
17	18	0.725807	0.056656	59	1071		
18	21	0.709677	0.057647	60	1101	0.080645	0.044819
19	21	0.693548	0.058550	61	1405	0.040323	0.036265

20	27	0.677419	0.059368	62	1825	0.000000	0.000000
21	30	0.661290	0.060105				
22	30	0.645161	0.060765				
23	30	0.629032	0.061349				
24	30	0.612903	0.061860				
25	30	0.596774	0.062299				
26	60	0.580645	0.062669				
27	75	0.564516	0.062969				
28	84	0.548387	0.063202				
29	90	0.532258	0.063368				
30	91	0.516129	0.063467				
31	110	0.500000	0.063500				
32	112	0.483871	0.063467				
33	120	0.467742	0.063368				
34	120	0.451613	0.063202				
35	130	0.435484	0.062969				
36	131	0.419355	0.062669				
37	132	0.403226	0.062299				
38	135	0.387097	0.061860				
39	150	0.370968	0.061349				
40	167	0.354839	0.060765				
41	314	0.338710	0.060105				
42	425	0.322581	0.059368				

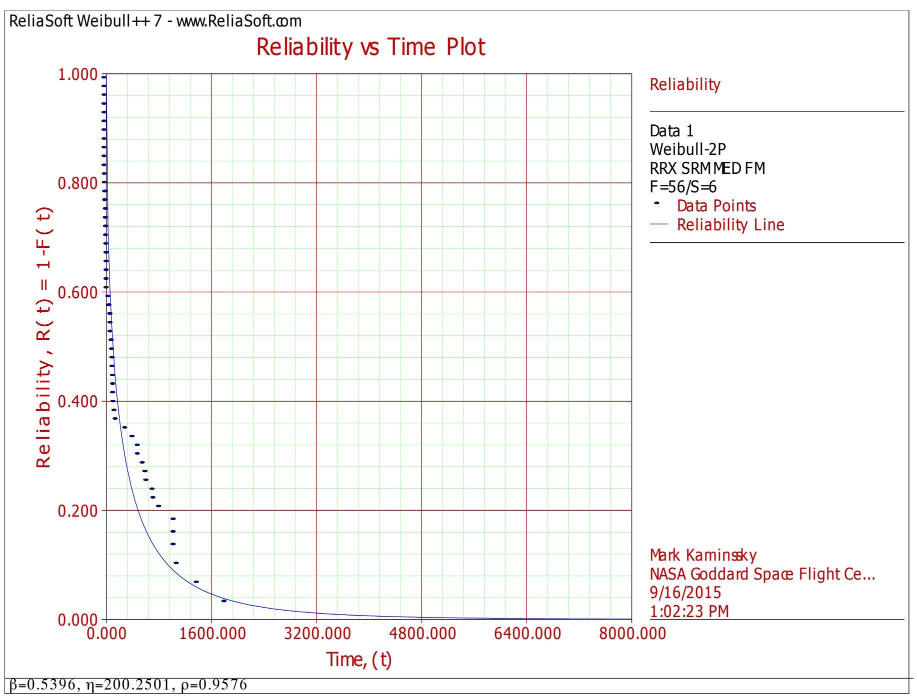

Figure 6-2 The Weibull Reliability (Survival) function of the CubeSats after successful launch. The time axis units are days

6.4 Estimation of Probability of mission success after successful launch as a function of time and satellite mass using Weibull Regression

6.4.1 Weibull Regression

The Weibull regression in its general form is given by [4]:

$$S(t,x) = exp\left[-\left(\frac{t}{\eta(x)}\right)^{\beta}\right] \qquad (1)$$

where $S(t, x)$ is Reliability function, $\eta(x) = f(a, x)$ is a function of a vector of explanatory variables x, having a vector of parameters a.

At this point, we are going to consider a simple case, in which the only explanatory variable is the satellite mass x, and the function $f(a, x)$ is the power law model:

$$\eta(x) = ax^{-b} \qquad (2)$$

where $a > 0$, and $b > 0$.

Taking logarithm of Equation (1) twice, one gets

$$\begin{aligned} ln\{-ln[S(t,x)]\} &= \beta \ln(t) - \beta \ln[\eta(x)] \qquad (3) \\ &= A_0 + A_1 X_1 + A_2 X_2 \end{aligned}$$

where $X_1 = \ln(t)$, $X_2 = \ln(x)$, $A_0 = -\beta\ln(a)$, $A_1 = \beta$, and $A2 = \beta b$.

Equation (3) is the two variable linear regression.

6.4.2 Data used for estimation of the model parameters

In the following analysis, the time to failure (TTF) is defined as “Mission End Date” (with the Functional Status D, N, or S) minus “Launch Date”. Respectively, the time to censoring (TTC) is defined as “Mission End Date” (with the Functional Status A) minus “Launch Date”. There are only 62 records, for which TTF/TTC can be evaluated.

Out of these 62 records, there are only 21 records that have 3 or more satellites with equal mass. Thus, we have only 21 records that can be used for fitting the Weibull regression model. These data are displayed in **Table 6-2** below.

Table 6-2 Data used for fitting Weibull Regression Model

	NORAD ID	Name	TTE Mission End Date - Launch Date	Censoring Indicator = 0 if Failure (D, N, S)*, = 1 if Censoring (A)*	Mass (kg)
1	27844	CUTE-1 (CO-55)	1825	0	1.00
2	27846	AAU CUBESAT 1	84	0	1.00
3	28892	UWE-1	21	0	1.00
4	31128	LIBERTAD 1	30	0	1.00
5	31130	CAPE 1	120	0	1.00
6	31132	CP4	425	0	1.00
7	32787	COMPASS 1	1405	0	1.00
8	35934	UWE-2	3	0	1.00
9	36575	NEGAI-STAR (Negai-Boshi)	30	0	1.00
10	38079	e-st@r	3	0	1.00
11	38080	Goliat	5	0	1.00
12	38083	PW-Sat 1	314	0	1.00
13	38763	CP5	120	0	1.00
14	39134	BeeSat 3	833	1	1.00
15	31126	MAST	21	0	3.00
16	37223	RAX 1 (USA 218)	60	0	3.00
17	37853	RAX 2	581	0	3.00
18	29655	GENESAT (GeneSat 1)	90	0	4.00
19	38765	Re (STARE)	506	0	4.00
20	39152	TURKSAT 3USAT	7	0	4.00
21	39424	CINEMA 2 (KHUSat-1)	16	0	4.00

* D – Deorbited (pre-launch or disposal)
N - Nonoperational
S - Semioperational
A – active

For the mass values of 1, 3, and 4 kg, the Reliability function was estimated using the Kaplan-Meier method as shown in Table 6-3 below.

Table 6-3 Kaplan-Meier S(t) estimates for different satellite masses

Order #	Time, days	Reliability Function	Std. Error	Mass, kg
1	3	0.928571	0.068830	1.00
2	3	0.857143	0.093522	1.00
3	5	0.785714	0.109664	1.00
4	21	0.714286	0.120736	1.00
5	30	0.642857	0.128060	1.00
6	30	0.571429	0.132260	1.00
7	84	0.500000	0.133631	1.00
8	120	0.428571	0.132260	1.00
9	120	0.357143	0.128060	1.00
10	314	0.285714	0.120736	1.00
11	425	0.214286	0.109664	1.00
12	833			1.00
13	1405	0.107143	0.093522	1.00
14	1825	0.000000	0.000000	1.00
15	21	0.666667	0.272166	3.00
16	60	0.333333	0.272166	3.00
17	581	0.000000	0.000000	3.00
18	7	0.750000	0.216506	4.00
19	16	0.500000	0.250000	4.00
20	90	0.250000	0.216506	4.00
21	506	0.000000	0.000000	4.00

Table 6-4 below shows the regression analysis results. **It is clear that all the model parameters are statistically significant, and the Reliability function is dependent not only on time but also on the satellite mass.**

Table 6-4 Regression summary for dependent variable: Ln(-Ln(*S(t)*))

	Parameter Estimate	Std.Err.	t-ratio	p-level
Intercept	A_0 = -2.56056	0.162441	-15.7631	0.000000
Ln(Time)	A_1 = 0.49830	0.037129	13.4210	0.000000
LN(Mass)	A_2 = 0.40691	0.107772	3.7757	0.002047

The estimates of the parameters of the Weibull regression model given by Equations (1) and (2) are:

$\beta = A_1 = 0.4983,\ b = A2/\beta = 0.8166,\ a = exp\left(-\frac{A_0}{\beta}\right) = 170.4754$

The respective squared correlation coefficient $R^2 = 0.971$, which reveals a good adequacy of the obtained model.

6.4.3 Comparison of the Kaplan-Meier estimates of the Reliability function and the estimates based on the Weibull regression

The Kaplan-Meier estimates of the Reliability function and the estimates based on the above Weibull regression are displayed in **Table 6-5** below.

Table 6-5 Kaplan-Meier estimates of Reliability Function and Estimates Based on Weibull Regression

Mass, kg	Time, Days	S(t), Kaplan-Meier	S(t), Weibull Regression
1	3	0.929	0.875
1	3	0.857	0.875
1	5	0.786	0.842
1	21	0.714	0.703
1	30	0.643	0.657
1	30	0.571	0.657
1	84	0.500	0.495
1	120	0.429	0.432
1	120	0.357	0.432
1	314	0.286	0.258
1	425	0.214	0.207
1	1405	0.107	0.057
1	1825	0.000	0.038
3	21	0.667	0.576
3	60	0.333	0.395
3	581	0.000	0.056
4	7	0.750	0.699
4	16	0.500	0.582
4	90	0.250	0.278
4	506	0.000	0.049

Figure 6-3 below illustrates the fitted Weibull regression Reliability function.

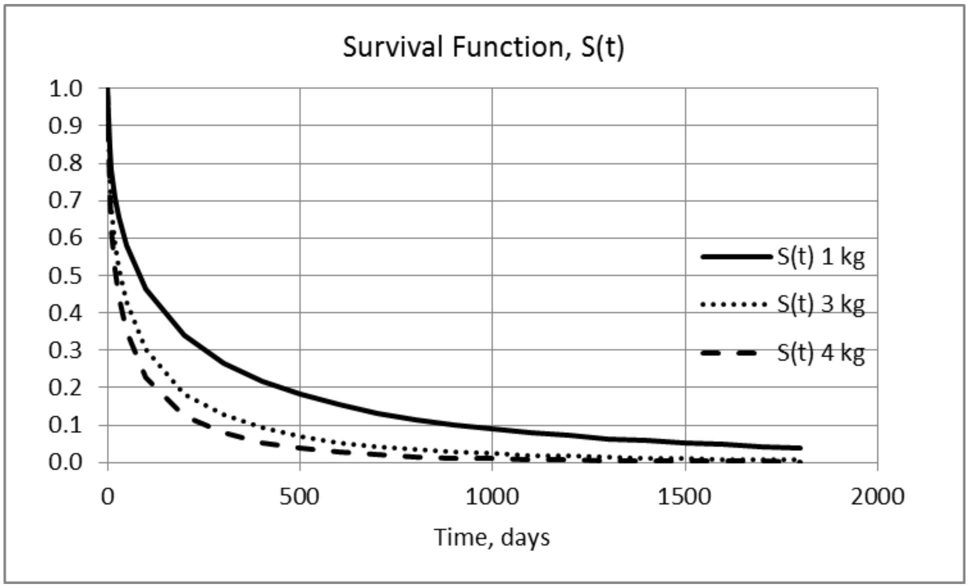

Figure 6-3 Weibull regression Reliability function

Using the Weibull regression Reliability model, a CubeSat Reliability can be estimated not only as a function of time, but also as a function of the satellites mass. For example, the median life of a 1 kg CubeSat is estimated as 85 days. In contrast, the median life of a 4 kg CubeSat is about 22 days only.

7 *Conclusion*

- The SLU database consists of the records of 370 CubeSats, most of which are the nanosatellites. Each record has up to 25 variables, but many of these records are incomplete. The information on the satellite design life are not available (i.e., missing), which makes practical reliability estimation difficult.
- Telecommunication and academic (university) communities are the two major classes of the CubeSat users, and among these users, the Planet Labs is major one (more than 75% of the satellites in the database are from Planet Labs).
- The satellite distributions by mass and by volume are bi-modal. The most popular volumes of the CubeSats are 1 liter and 3 liters (35% and 52% respectively). The most common masses are 1 kg and 5 kg (34% and 42% correspondingly).
- Annual number of CubeSats launched increased about ten times in 2015 compared to the number CubeSats launched in 2011.
- Based on 96 available records, the probability of a successful CubeSat launch can be estimated as follows:

  Point Estimate: 0.65, and the corresponding 60% Lower Confidence Limit as 0.63

- The CubeSat time to failure (after successful launch) distribution is difficult to estimate parametrically. The Kaplan-Meier (non-parametric) estimate of the median life is 110 days.
- The results of the Weibull distribution estimation yield the scale parameter $\alpha = 200.25$ days, and the shape parameter $\beta = 0.54$. The value of the shape parameter indicates the decreasing failure rate (rejuvenation) distribution. The R^2 is 0.92 that shows that the goodness of the distribution fit is not very good.
- In order to get better reliability estimation, the Weibull Regression with the satellite mass as an explanatory variable was applied. The fitted model provides a better goodness-of-fit ($R^2 = 0.97$). Based on the model, the median life of a 1 kg CubeSat is estimated as 85 days. In contrast, the median life of a 4 kg CubeSat is about 22 days only.

8 *Acknowledgement*

We are most grateful to Professor Michael Swartwout from SLU for sharing with us the SLU CubeSats database, as well as for providing the new variables as a response to our request.

9 *References*

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10 Appendix

Table A1. Data available for CubeSats reliability estimation

	NORAD ID	Name	Mission End Date - Launch Date	Censoring Indicator = 0, if Failure (D, N, S,), = 1 if Censoring
1	26080	PICOSAT 1&2 (TETHERED)	2	0
2	26904	PICOSAT 7&8 (TETHERED)	1	0
3	27562	MEPSI	2	0
4	27844	CUTE-1 (CO-55)	1825	0
5	27845	QUAKESAT 1	731	0
6	27846	AAU CUBESAT 1	84	0
7	28892	UWE-1	21	0
8	28941	CUTE 1.7	75	0
9	29484	HITSAT (HO-59)	635	0
10	29655	GENESAT (GeneSat 1)	90	0
11	29660	MEPSI (MEPSI 2A)	3	0
12	29661	RAFT (NO 60)	150	0
13	31126	MAST	21	0
14	31128	LIBERTAD 1	30	0
15	31130	CAPE 1	120	0
16	31132	CP4	425	0
17	31133	AEROCUBE 2	1	0
18	32787	COMPASS 1	1405	0
19	33445	PSSC-Testbed 1	110	0
20	35934	UWE-2	3	0
21	36573	HAYATO (K-SAT)	18	0
22	36575	NEGAI-STAR (Negai-Boshi)	30	0
23	36796	STUDSAT	1101	0
24	37223	RAX 1 (USA 218)	60	0
25	37252	Mayflower-Caerus	2	0
26	37853	RAX 2	581	0
27	38079	e-st@r	3	0
28	38080	Goliat	5	0
29	38083	PW-Sat 1	314	0
30	38084	ROBUSTA	1	0
31	38085	UniCubeSat-GGs	4	0
32	38759	SMDC ONE 1.2	1071	1
33	38761	CSSWE	830	0
34	38762	CXBN	135	0

Table A1 (Continued). Data available for CubeSats reliability estimation				
	NORAD ID	**Name**	**Mission End Date - Launch Date**	**Censoring Indicator = 0 if Failure (D, N, S,), =1 if Censoring (A)**
35	38763	CP5	120	0
36	38764	CINEMA 1	1051	1
37	38765	Re (STARE)	506	0
38	38766	SMDC ONE 1.1	1051	0
39	38767	AeroCube 4.5A	1051	0
40	38768	AeroCube 4.5B	1051	0
41	38769	AeroCube 4.0	505	0
42	39087	AAUSAT 3	886	1
43	39132	Dove 2	622	0
44	39134	BeeSat 3	833	1
45	39135	SOMP	833	1
46	39136	BeeSat 2	833	1
47	39151	NEE 01 Pegaso	30	0
48	39152	TURKSAT 3USAT	7	0
49	39161	ESTCube-1	742	0
50	39404	KYSat II	131	0
51	39412	ArduSat 1	30	0
52	39420	OPTOS	1	0
53	39424	CINEMA 2 (KHUSat-1)	16	0
54	39427	Triton 1	112	0
55	39428	Delfi-n3Xt	91	0
56	39438	VELOX-P 2	130	0
57	39439	First-MOVE	30	0
58	39469	M-Cubed-2	167	0
59	39567	SkyCube	27	0
60	39578	KSAT 2 (Hayato 2)	10	0
61	40024	NanoSatC-Br 1	132	0
62	40030	DTUSat 2	1	0