

Analysis of some Factors Affecting Post-Release Number of Bugs in Software Applications

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❖ Project Overview

This project aims to study and analyze some of the factors influencing the number of post-release bugs in software applications. The study involves analyzing data from a range of applications, focusing on the following indicators.

By analyzing these factors, the study aims to determine the direct and inverse relationships between each factor and the number of post-release bugs, with the goal of improving software quality and reducing future bugs.

❖ Variables under study

• Dependent Variables

- **Post-Release Number of Bugs:** The number of bugs discovered after the software release.

• Independent Variables

- **Active Lines of Code (LOC):** The total lines of code in the project.
- **General Code Complexity (MI):** A measure that represents the complexity of the code.
- **Halstead Time:** A metric based on the complexity of the code.
- **Automation Testing Hours:** The time spent on automated testing of the software.
- **Code Coverage:** The percentage of code that has been tested.
- **Number of Test Cases:** The number of tests used to examine the code.

❖ Frequencies

• Statistics

		Post-Release Num of Bugs (Number)	Active LOC (Lines)	General Code Complexity(MI) (Number)	Halstead Time (Minutes)	Automation Testing Hours (Hours)	Code Coverage (Percentage)	Test Cases (Number)
N	Valid	51	51	51	51	51	51	51
	Missing	0	0	0	0	0	0	0
Mean		60.41	10758.63	20.006	77.602	290.41	.7600	1114.10
Median		53.00	9850.00	19.200	75.600	261.00	.7700	1042.00
Mode		78	12480	20.5 ^a	78.9	211 ^a	.79	815 ^a
Std. Deviation		35.235	4925.496	6.9245	20.9542	146.689	.08651	438.736
Variance		1241.487	24260508.078	47.949	439.080	21517.647	.007	192488.890
Range		141	21220	27.6	84.6	873	.38	1932

a. Multiple modes exist. The smallest value is shown

- **The description of population:**

- The center value of Num of Bugs is around (53.00 - 60.41)
- The dispersion of Num of Bugs is 1241.487 and it represent Coefficient of variation of 58.33 %

- The center value of Active LOC is around (9850.00 - 10758.63)
- The dispersion of Active LOC is 24260508.078 and it represent Coefficient of variation of 45.78 %

- The center value of Code Complexity is around (19.2 - 20.5)
- The dispersion of Code Complexity a is 47.949 and it represent Coefficient of variation of 34.61 %

- The center value of Halstead Time attainment is around (75.6 - 78.9)
- The dispersion of Halstead Time attainment is 439.08 and it represent Coefficient of variation of 27 %

- The center value of Automation Testing Hours is around (261 - 290.41)
- The dispersion of Automation Testing Hours is 21517.647 and it represent Coefficient of variation of 50.51 %

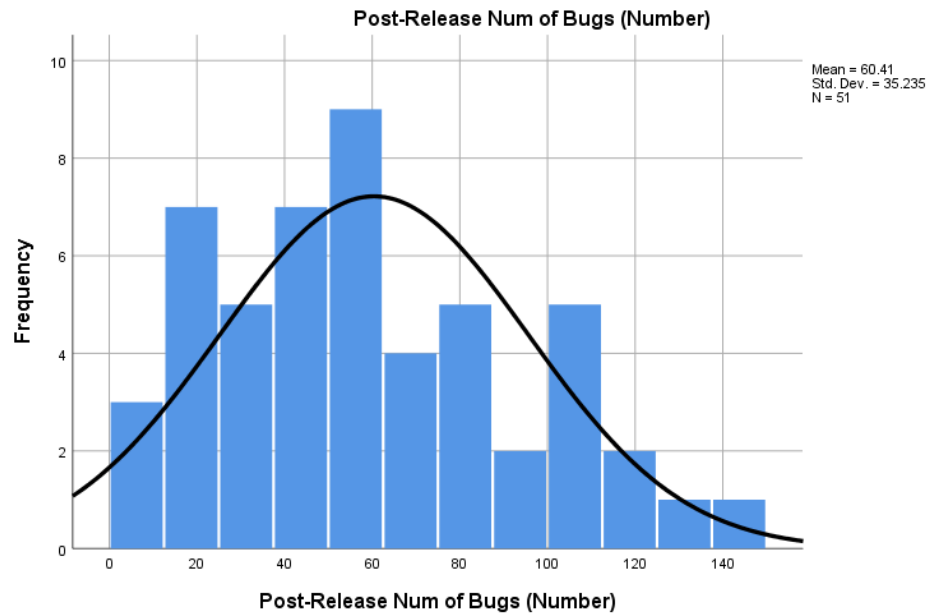
- The center value of Code Coverage is around (0.76 – 0.79)
- The dispersion of Code Coverage a is 0.007 and it represent Coefficient of variation of 11.38 %

- The center value of Test Cases attainment is around (1042 – 1114.1)
- The dispersion of Test Cases attainment is 192488.89 and it represent Coefficient of variation of 39.38 %

- Frequency Tables and Histogram Charts

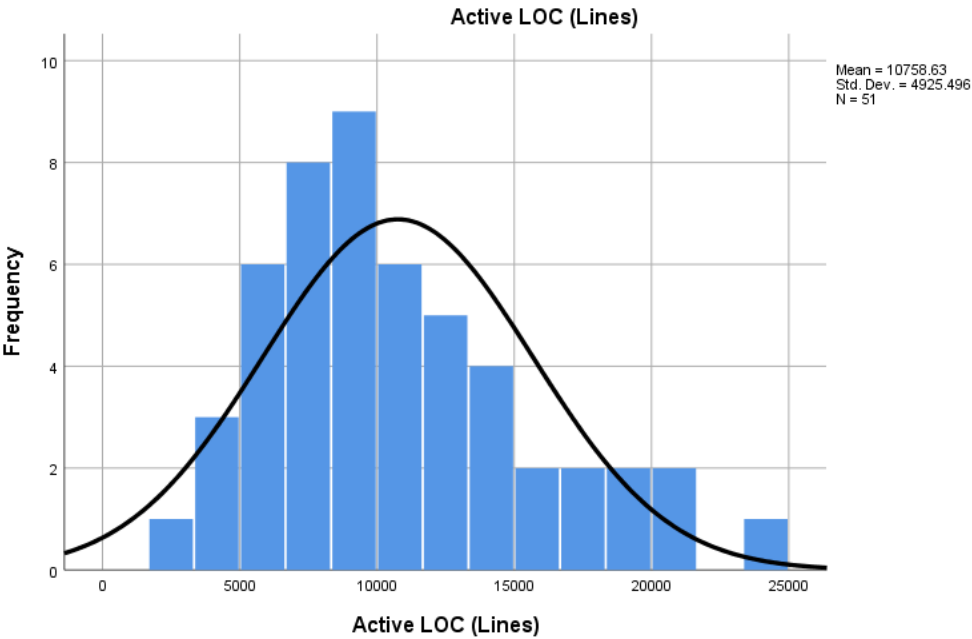
- Post-Release Num of Bugs (Number)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	7	1	2.0	2.0	2.0
	11	1	2.0	2.0	3.9
	12	1	2.0	2.0	5.9
	13	1	2.0	2.0	7.8
	17	2	3.9	3.9	11.8
	19	1	2.0	2.0	13.7
	20	1	2.0	2.0	15.7
	21	1	2.0	2.0	17.6
	22	1	2.0	2.0	19.6
	29	1	2.0	2.0	21.6
	31	1	2.0	2.0	23.5
	32	2	3.9	3.9	27.5
	33	1	2.0	2.0	29.4
	45	2	3.9	3.9	33.3
	46	1	2.0	2.0	35.3
	48	2	3.9	3.9	39.2
	49	2	3.9	3.9	43.1
	52	2	3.9	3.9	47.1
	53	2	3.9	3.9	51.0
	54	1	2.0	2.0	52.9
	58	1	2.0	2.0	54.9
	59	2	3.9	3.9	58.8
	62	1	2.0	2.0	60.8
	64	1	2.0	2.0	62.7
	72	2	3.9	3.9	66.7
	73	1	2.0	2.0	68.6
	78	3	5.9	5.9	74.5
	82	1	2.0	2.0	76.5
	85	1	2.0	2.0	78.4
	95	1	2.0	2.0	80.4
	98	1	2.0	2.0	82.4
	102	1	2.0	2.0	84.3
	103	1	2.0	2.0	86.3
	109	1	2.0	2.0	88.2
	110	1	2.0	2.0	90.2
	112	1	2.0	2.0	92.2
	118	1	2.0	2.0	94.1
	122	1	2.0	2.0	96.1
	134	1	2.0	2.0	98.0
	148	1	2.0	2.0	100.0
	Total	51	100.0	100.0	



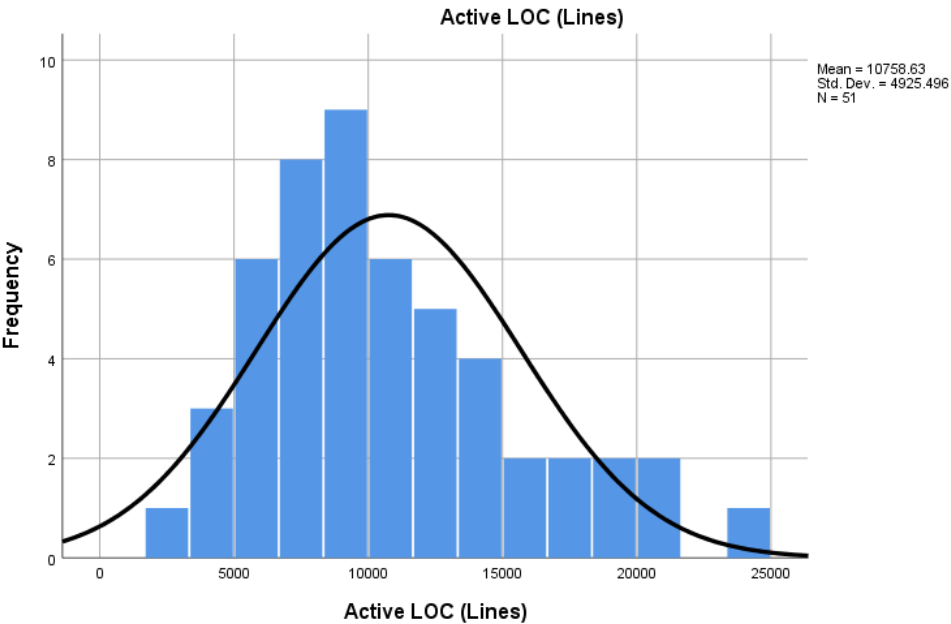
○ Active LOC (Lines)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3210	1	2.0	2.0	2.0
	3700	1	2.0	2.0	3.9
	4280	1	2.0	2.0	5.9
	4370	1	2.0	2.0	7.8
	5090	1	2.0	2.0	9.8
	5140	1	2.0	2.0	11.8
	5250	1	2.0	2.0	13.7
	5600	1	2.0	2.0	15.7
	6320	1	2.0	2.0	17.6
	6450	1	2.0	2.0	19.6
	6790	1	2.0	2.0	21.6
	6860	1	2.0	2.0	23.5
	7000	1	2.0	2.0	25.5
	7020	1	2.0	2.0	27.5
	7620	1	2.0	2.0	29.4
	7650	1	2.0	2.0	31.4
	8030	1	2.0	2.0	33.3
	8200	1	2.0	2.0	35.3
	8750	1	2.0	2.0	37.3
	8780	1	2.0	2.0	39.2
	8830	1	2.0	2.0	41.2
	9190	1	2.0	2.0	43.1
	9320	1	2.0	2.0	45.1
	9730	1	2.0	2.0	47.1
	9820	1	2.0	2.0	49.0
	9850	1	2.0	2.0	51.0
	9860	1	2.0	2.0	52.9
	10370	1	2.0	2.0	54.9
	10480	1	2.0	2.0	56.9
	10730	1	2.0	2.0	58.8
	10850	1	2.0	2.0	60.8
	11220	1	2.0	2.0	62.7
	11480	1	2.0	2.0	64.7
	11770	1	2.0	2.0	66.7
	12480	2	3.9	3.9	70.6
	12900	1	2.0	2.0	72.5
	12970	1	2.0	2.0	74.5
	13520	1	2.0	2.0	76.5
	13980	1	2.0	2.0	78.4
	14200	1	2.0	2.0	80.4
	14390	1	2.0	2.0	82.4
	16030	1	2.0	2.0	84.3
	16370	1	2.0	2.0	86.3
	16900	1	2.0	2.0	88.2
	17990	1	2.0	2.0	90.2
	18720	1	2.0	2.0	92.2
	19120	1	2.0	2.0	94.1
	21200	1	2.0	2.0	96.1
	21400	1	2.0	2.0	98.0
	24430	1	2.0	2.0	100.0
	Total	51	100.0	100.0	



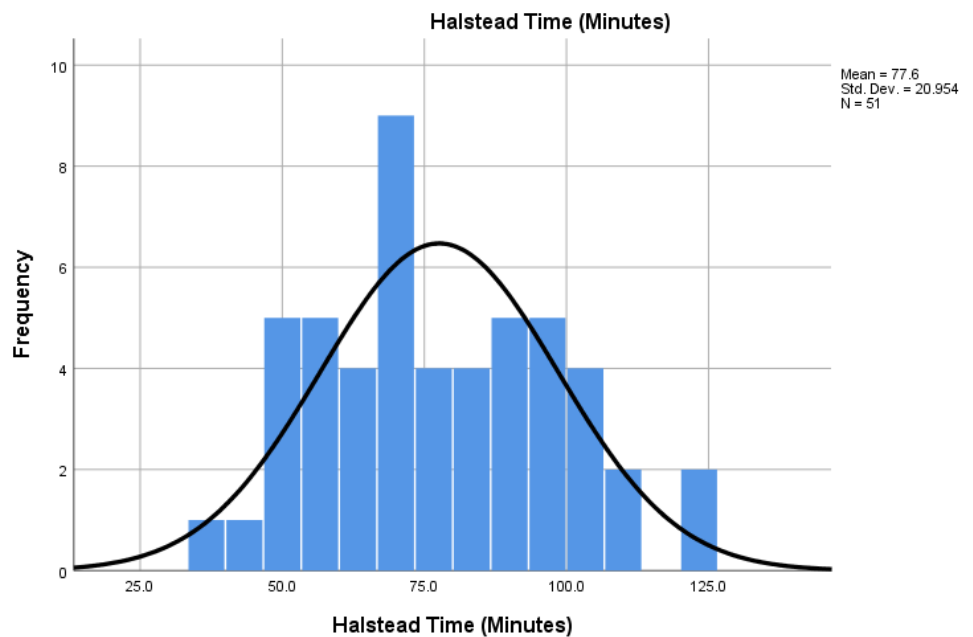
○ General Code Complexity (MI)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	7.1	1	2.0	2.0	2.0
	8.2	1	2.0	2.0	3.9
	9.3	1	2.0	2.0	5.9
	10.2	1	2.0	2.0	7.8
	11.5	1	2.0	2.0	9.8
	11.8	1	2.0	2.0	11.8
	12.4	1	2.0	2.0	13.7
	12.8	1	2.0	2.0	15.7
	13.6	1	2.0	2.0	17.6
	13.7	1	2.0	2.0	19.6
	14.3	1	2.0	2.0	21.6
	14.7	1	2.0	2.0	23.5
	14.8	1	2.0	2.0	25.5
	14.9	1	2.0	2.0	27.5
	15.3	1	2.0	2.0	29.4
	15.8	1	2.0	2.0	31.4
	16.4	1	2.0	2.0	33.3
	16.5	1	2.0	2.0	35.3
	17.2	1	2.0	2.0	37.3
	17.3	1	2.0	2.0	39.2
	17.8	1	2.0	2.0	41.2
	18.2	1	2.0	2.0	43.1
	18.5	1	2.0	2.0	45.1
	18.6	1	2.0	2.0	47.1
	18.9	1	2.0	2.0	49.0
	19.2	1	2.0	2.0	51.0
	19.4	1	2.0	2.0	52.9
	19.8	1	2.0	2.0	54.9
	20.0	1	2.0	2.0	56.9
	20.5	2	3.9	3.9	60.8
	21.7	1	2.0	2.0	62.7
	22.1	2	3.9	3.9	66.7
	22.4	1	2.0	2.0	68.6
	23.4	1	2.0	2.0	70.6
	23.8	1	2.0	2.0	72.5
	24.1	1	2.0	2.0	74.5
	24.5	1	2.0	2.0	76.5
	25.3	1	2.0	2.0	78.4
	26.2	1	2.0	2.0	80.4
	26.3	1	2.0	2.0	82.4
	26.7	1	2.0	2.0	84.3
	28.5	1	2.0	2.0	86.3
	28.9	1	2.0	2.0	88.2
	29.6	1	2.0	2.0	90.2
	30.8	1	2.0	2.0	92.2
	32.5	1	2.0	2.0	94.1
	33.3	1	2.0	2.0	96.1
	34.2	1	2.0	2.0	98.0
	34.7	1	2.0	2.0	100.0
	Total	51	100.0	100.0	



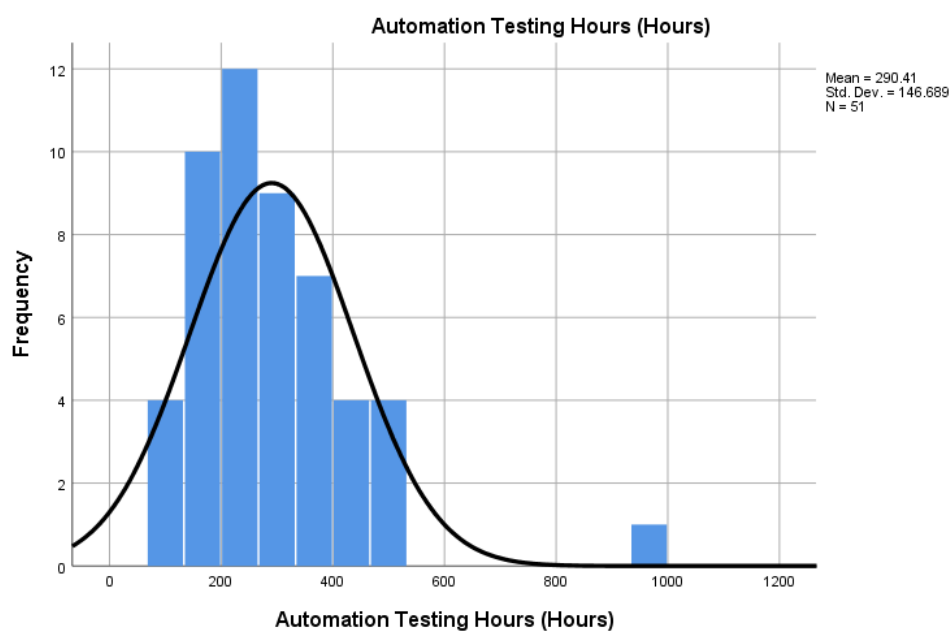
○ **Halstead Time (Minutes)**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	38.2	1	2.0	2.0	2.0
	45.2	1	2.0	2.0	3.9
	47.2	1	2.0	2.0	5.9
	47.4	1	2.0	2.0	7.8
	48.4	1	2.0	2.0	9.8
	49.1	1	2.0	2.0	11.8
	52.1	1	2.0	2.0	13.7
	54.4	1	2.0	2.0	15.7
	56.1	1	2.0	2.0	17.6
	56.6	1	2.0	2.0	19.6
	56.7	1	2.0	2.0	21.6
	57.6	1	2.0	2.0	23.5
	60.5	1	2.0	2.0	25.5
	63.4	1	2.0	2.0	27.5
	64.5	1	2.0	2.0	29.4
	64.6	1	2.0	2.0	31.4
	67.3	1	2.0	2.0	33.3
	68.4	1	2.0	2.0	35.3
	69.3	1	2.0	2.0	37.3
	69.6	1	2.0	2.0	39.2
	71.5	1	2.0	2.0	41.2
	71.9	1	2.0	2.0	43.1
	72.1	1	2.0	2.0	45.1
	72.4	1	2.0	2.0	47.1
	72.9	1	2.0	2.0	49.0
	75.6	1	2.0	2.0	51.0
	78.9	2	3.9	3.9	54.9
	79.6	1	2.0	2.0	56.9
	82.1	1	2.0	2.0	58.8
	84.7	1	2.0	2.0	60.8
	85.3	1	2.0	2.0	62.7
	85.4	1	2.0	2.0	64.7
	87.5	1	2.0	2.0	66.7
	88.1	1	2.0	2.0	68.6
	88.4	1	2.0	2.0	70.6
	89.2	1	2.0	2.0	72.5
	91.2	1	2.0	2.0	74.5
	94.5	1	2.0	2.0	76.5
	95.4	1	2.0	2.0	78.4
	96.7	1	2.0	2.0	80.4
	98.6	1	2.0	2.0	82.4
	99.5	1	2.0	2.0	84.3
	101.6	1	2.0	2.0	86.3
	102.3	1	2.0	2.0	88.2
	105.8	1	2.0	2.0	90.2
	106.3	1	2.0	2.0	92.2
	110.1	1	2.0	2.0	94.1
	111.3	1	2.0	2.0	96.1
	120.5	1	2.0	2.0	98.0
	122.8	1	2.0	2.0	100.0
	Total	51	100.0	100.0	



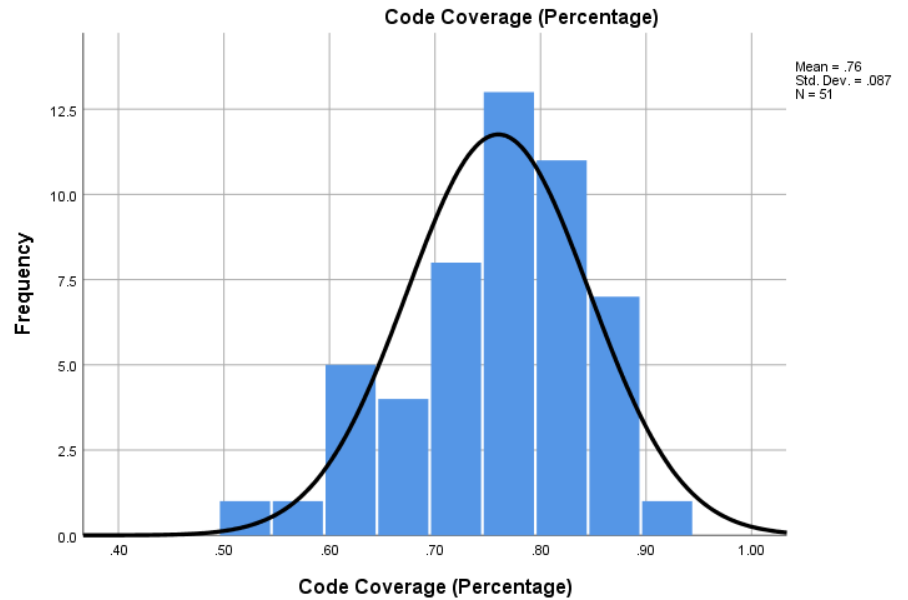
○ Automation Testing Hours (Hours)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	89	1	2.0	2.0	2.0
	106	1	2.0	2.0	3.9
	116	1	2.0	2.0	5.9
	124	1	2.0	2.0	7.8
	138	1	2.0	2.0	9.8
	142	1	2.0	2.0	11.8
	147	1	2.0	2.0	13.7
	161	1	2.0	2.0	15.7
	163	1	2.0	2.0	17.6
	172	1	2.0	2.0	19.6
	174	1	2.0	2.0	21.6
	177	1	2.0	2.0	23.5
	188	1	2.0	2.0	25.5
	192	1	2.0	2.0	27.5
	208	1	2.0	2.0	29.4
	211	2	3.9	3.9	33.3
	215	1	2.0	2.0	35.3
	218	1	2.0	2.0	37.3
	225	1	2.0	2.0	39.2
	239	2	3.9	3.9	43.1
	245	1	2.0	2.0	45.1
	246	1	2.0	2.0	47.1
	259	1	2.0	2.0	49.0
	261	1	2.0	2.0	51.0
	270	1	2.0	2.0	52.9
	294	1	2.0	2.0	54.9
	296	1	2.0	2.0	56.9
	303	1	2.0	2.0	58.8
	312	2	3.9	3.9	62.7
	314	1	2.0	2.0	64.7
	320	1	2.0	2.0	66.7
	329	1	2.0	2.0	68.6
	341	1	2.0	2.0	70.6
	345	1	2.0	2.0	72.5
	362	1	2.0	2.0	74.5
	366	1	2.0	2.0	76.5
	379	1	2.0	2.0	78.4
	388	1	2.0	2.0	80.4
	392	1	2.0	2.0	82.4
	401	1	2.0	2.0	84.3
	403	1	2.0	2.0	86.3
	424	1	2.0	2.0	88.2
	455	1	2.0	2.0	90.2
	470	1	2.0	2.0	92.2
	472	1	2.0	2.0	94.1
	507	1	2.0	2.0	96.1
	528	1	2.0	2.0	98.0
	962	1	2.0	2.0	100.0
Total		51	100.0	100.0	



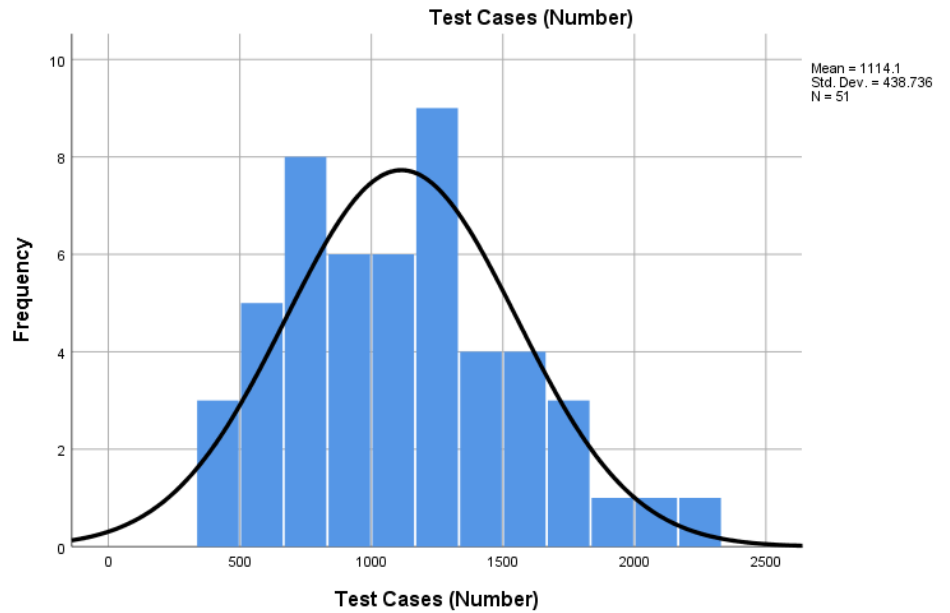
○ Code Coverage (Percentage)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.52	1	2.0	2.0	2.0
	.56	1	2.0	2.0	3.9
	.61	1	2.0	2.0	5.9
	.62	2	3.9	3.9	9.8
	.63	1	2.0	2.0	11.8
	.64	1	2.0	2.0	13.7
	.66	1	2.0	2.0	15.7
	.67	1	2.0	2.0	17.6
	.68	1	2.0	2.0	19.6
	.69	1	2.0	2.0	21.6
	.71	1	2.0	2.0	23.5
	.72	3	5.9	5.9	29.4
	.73	1	2.0	2.0	31.4
	.74	3	5.9	5.9	37.3
	.76	4	7.8	7.8	45.1
	.77	3	5.9	5.9	51.0
	.78	1	2.0	2.0	52.9
	.79	5	9.8	9.8	62.7
	.80	2	3.9	3.9	66.7
	.81	3	5.9	5.9	72.5
	.82	4	7.8	7.8	80.4
	.83	1	2.0	2.0	82.4
	.84	1	2.0	2.0	84.3
	.85	1	2.0	2.0	86.3
	.86	2	3.9	3.9	90.2
	.87	2	3.9	3.9	94.1
	.88	1	2.0	2.0	96.1
	.89	1	2.0	2.0	98.0
	.90	1	2.0	2.0	100.0
	Total	51	100.0	100.0	



○ Test Cases (Number)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	363	1	2.0	2.0	2.0
	421	1	2.0	2.0	3.9
	477	1	2.0	2.0	5.9
	516	1	2.0	2.0	7.8
	522	1	2.0	2.0	9.8
	601	1	2.0	2.0	11.8
	608	1	2.0	2.0	13.7
	611	1	2.0	2.0	15.7
	685	1	2.0	2.0	17.6
	727	1	2.0	2.0	19.6
	729	1	2.0	2.0	21.6
	776	1	2.0	2.0	23.5
	815	2	3.9	3.9	27.5
	825	1	2.0	2.0	29.4
	827	1	2.0	2.0	31.4
	890	1	2.0	2.0	33.3
	912	1	2.0	2.0	35.3
	922	1	2.0	2.0	37.3
	930	1	2.0	2.0	39.2
	962	1	2.0	2.0	41.2
	998	1	2.0	2.0	43.1
	1013	1	2.0	2.0	45.1
	1020	1	2.0	2.0	47.1
	1029	1	2.0	2.0	49.0
	1042	1	2.0	2.0	51.0
	1052	1	2.0	2.0	52.9
	1101	1	2.0	2.0	54.9
	1168	1	2.0	2.0	56.9
	1183	1	2.0	2.0	58.8
	1185	1	2.0	2.0	60.8
	1217	1	2.0	2.0	62.7
	1221	1	2.0	2.0	64.7
	1239	1	2.0	2.0	66.7
	1294	1	2.0	2.0	68.6
	1321	1	2.0	2.0	70.6
	1325	1	2.0	2.0	72.5
	1392	1	2.0	2.0	74.5
	1402	1	2.0	2.0	76.5
	1453	1	2.0	2.0	78.4
	1484	1	2.0	2.0	80.4
	1516	1	2.0	2.0	82.4
	1530	1	2.0	2.0	84.3
	1560	1	2.0	2.0	86.3
	1594	1	2.0	2.0	88.2
	1760	2	3.9	3.9	92.2
	1784	1	2.0	2.0	94.1
	1880	1	2.0	2.0	96.1
	2067	1	2.0	2.0	98.0
	2295	1	2.0	2.0	100.0
	Total	51	100.0	100.0	



❖ **Correlations**

		Post-Release Num of Bugs (Number)	Active LOC (Lines)	General Code Complexity(MI) (Number)	Halstead Time (Minutes)	Automation Testing Hours (Hours)	Code Coverage (Percentage)	Test Cases (Number)
Post-Release Num of Bugs (Number)	Pearson Correlation	1	.416**	.362**	.623**	.605**	.762**	.843**
	Sig. (2-tailed)		.002	.009	.000	.000	.000	.000
	N	51	51	51	51	51	51	51
Active LOC (Lines)	Pearson Correlation	.416**	1	.896**	.777**	.119	.329*	.415**
	Sig. (2-tailed)	.002		.000	.000	.405	.018	.002
	N	51	51	51	51	51	51	51
General Code Complexity(MI) (Number)	Pearson Correlation	.362**	.896**	1	.824**	.123	.424**	.444**
	Sig. (2-tailed)	.009	.000		.000	.391	.002	.001
	N	51	51	51	51	51	51	51
Halstead Time (Minutes)	Pearson Correlation	.623**	.777**	.824**	1	.225	.606**	.686**
	Sig. (2-tailed)	.000	.000	.000		.112	.000	.000
	N	51	51	51	51	51	51	51
Automation Testing Hours (Hours)	Pearson Correlation	.605**	.119	.123	.225	1	.522**	.556**
	Sig. (2-tailed)	.000	.405	.391	.112		.000	.000
	N	51	51	51	51	51	51	51
Code Coverage (Percentage)	Pearson Correlation	.762**	.329*	.424**	.606**	.522**	1	.750**
	Sig. (2-tailed)	.000	.018	.002	.000	.000		.000
	N	51	51	51	51	51	51	51
Test Cases (Number)	Pearson Correlation	.843**	.415**	.444**	.686**	.556**	.750**	1
	Sig. (2-tailed)	.000	.002	.001	.000	.000	.000	
	N	51	51	51	51	51	51	51

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

- **Active LOC Variable**

- Weak Direct relation between (Active LOC and Post-Release Num of Bugs)
- The Active LOC variable is significant

- **General Code Complexity Variable**

- Weak Direct relation between (General Code Complexity and Post-Release Num of Bugs)
- General Code Complexity variable is significant

- **Halstead Time Variable**

- Moderate Direct relation between (Halstead Time and Post-Release Num of Bugs)
- Halstead Time variable is significant

- **Automation Testing Hours Variable**

- Moderate Direct relation between (Automation Testing Hours and Post-Release Num of Bugs)
- Automation Testing Hours variable is significant

- **Code Coverage Variable**

- Strong Direct relation between (Code Coverage and Post-Release Num of Bugs)
- Code Coverage variable is significant

- **Test Cases Variable**

- Strong Direct relation between (Test Cases and Post-Release Num of Bugs)
- Test Cases variable is significant

❖ Regression

○ Active LOC Variable

○ Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.416 ^a	.173	.156	32.363

a. Predictors: (Constant), Active LOC (Lines)

- Active LOC with margin of Error can explain 17.3% of Post-Release Num of Bugs
- Active LOC without margin of Error can explain 15.6% of Post-Release Num of Bugs
- Margin of Error = 1.7 % of Post-Release Num of Bugs
- The other factors can explain 82.7% of Post-Release Num of Bugs

○ ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10753.106	1	10753.106	10.267	.002 ^b
	Residual	51321.247	49	1047.372		
	Total	62074.353	50			

a. Dependent Variable: Post-Release Num of Bugs (Number)

b. Predictors: (Constant), Active LOC (Lines)

- Active LOC variable is Suitable to study the Post-Release Num of Bugs

○ Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	28.379	10.976		2.586	.013
	Active LOC (Lines)	.003	.001	.416	3.204	.002

a. Dependent Variable: Post-Release Num of Bugs (Number)

- **Post-Release Num of Bugs = 28.379 + (.003 × Active LOC) + ε**

○ General Code Complexity

○ Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.362a	.131	.113	33.176

a. Predictors: (Constant), General Code Complexity (MI) (Number)

- General Code Complexity with margin of Error can explain 13.1% of Post-Release Num of Bugs
- General Code Complexity without margin of Error can explain 11.3% of Post-Release Num of Bugs
- Margin of Error = 1.8 % of Post-Release Num of Bugs
- The other factors can explain 86.9% of Post-Release Num of Bugs

○ ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8143.282	1	8143.282	7.399	.009b
	Residual	53931.071	49	1100.634		
	Total	62074.353	50			

a. Dependent Variable: Post-Release Num of Bugs (Number)

b. Predictors: (Constant), General Code Complexity (MI) (Number)

- General Code Complexity variable is Suitable to study the Post-Release Num of Bugs

○ Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	23.541	14.329		1.643	.107
	General Code Complexity (MI) (Number)	1.843	.678	.362	2.720	.009

a. Dependent Variable: Post-Release Num of Bugs (Number)

- **Post-Release Num of Bugs = $(1.843 \times \text{General Code Complexity}) + \epsilon$**

○ Halstead Time

○ Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.623a	.388	.375	27.849

a. Predictors: (Constant), Halstead Time (Minutes)

- Halstead Time with margin of Error can explain 38.8% of Post-Release Num of Bugs
- Halstead Time without margin of Error can explain 37.5% of Post-Release Num of Bugs
- Margin of Error = 1.3% of Post-Release Num of Bugs
- The other factors can explain 61.2% of Post-Release Num of Bugs

○ ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	24070.834	1	24070.834	31.036	.000b
	Residual	38003.519	49	775.582		
	Total	62074.353	50			

a. Dependent Variable: Post-Release Num of Bugs (Number)

b. Predictors: (Constant), Halstead Time (Minutes)

- Halstead Time variable is Suitable to study the Post-Release Num of Bugs

○ Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-20.845	15.098		-1.381	.174
	Halstead Time (Minutes)	1.047	.188	.623	5.571	.000

a. Dependent Variable: Post-Release Num of Bugs (Number)

- **Post-Release Num of Bugs = (1.047× Halstead Time) + ε**

○ Automation Testing Hours

○ Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.605a	.366	.353	28.346

a. Predictors: (Constant), Automation Testing Hours (Hours)

- Automation Testing Hours with margin of Error can explain 36.6% of Post-Release Num of Bugs
- Automation Testing Hours without margin of Error can explain 35.3% of Post-Release Num of Bugs
- Margin of Error = 1.3% of Post-Release Num of Bugs
- The other factors can explain 63.4% of Post-Release Num of Bugs

○ ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	22704.143	1	22704.143	28.257	.000b
	Residual	39370.210	49	803.474		
	Total	62074.353	50			

a. Dependent Variable: Post-Release Num of Bugs (Number)

b. Predictors: (Constant), Automation Testing Hours (Hours)

- Automation Testing Hours variable is Suitable to study the Post-Release Num of Bugs

○ Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	18.224	8.874		2.054	.045
	Automation Testing Hours (Hours)	.145	.027	.605	5.316	.000

a. Dependent Variable: Post-Release Num of Bugs (Number)

- **Post-Release Num of Bugs = 18.224 + (0.145 × Automation Testing Hours) + ε**

○ Code Coverage

○ Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.762a	.580	.571	23.067

a. Predictors: (Constant), Code Coverage (Percentage)

- Code Coverage with margin of Error can explain 58.0% of Post-Release Num of Bugs
- Code Coverage without margin of Error can explain 57.1% of Post-Release Num of Bugs
- Margin of Error = 0.9% of Post-Release Num of Bugs
- The other factors can explain 42% of Post-Release Num of Bugs

○ ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	36002.792	1	36002.792	67.665	.000b
	Residual	26071.561	49	532.073		
	Total	62074.353	50			

a. Dependent Variable: Post-Release Num of Bugs (Number)

b. Predictors: (Constant), Code Coverage (Percentage)

- Code Coverage variable is Suitable to study the Post-Release Num of Bugs

○ Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-175.326	28.840		-6.079	.000
	Code Coverage (Percentage)	310.182	37.708	.762	8.226	.000

a. Dependent Variable: Post-Release Num of Bugs (Number)

- **Post-Release Num of Bugs = -175.326 + (310.182× Code Coverage) + ε**

○ Test Cases

○ Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.843a	.711	.705	19.147

a. Predictors: (Constant), Test Cases (Number)

- Test Cases with margin of Error can explain 71.1% of Post-Release Num of Bugs
- Test Cases without margin of Error can explain 70.5% of Post-Release Num of Bugs
- Margin of Error = 0.6% of Post-Release Num of Bugs
- The other factors can explain 28.9% of Post-Release Num of Bugs

○ ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	44109.731	1	44109.731	120.313	.000b
	Residual	17964.622	49	366.625		
	Total	62074.353	50			

a. Dependent Variable: Post-Release Num of Bugs (Number)

b. Predictors: (Constant), Test Cases (Number)

- Test Cases variable is Suitable to study the Post-Release Num of Bugs

○ Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients		t	Sig.
		B	Std. Error	Beta			
1	(Constant)	-15.011	7.380			-2.034	.047
	Test Cases (Number)	.068	.006	.843		10.969	.000

a. Dependent Variable: Post-Release Num of Bugs (Number)

- **Post-Release Num of Bugs = -15.011 + (0.068 × Test Cases) + ε**

- **All Variables (Active LOC, General Code Complexity, Halstead Time, Automation Testing Hours, Code Coverage, Test Cases Variable)**

- **Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.906a	.820	.796	15.932

a. Predictors: (Constant), Test Cases (Number), Active LOC (Lines), Automation Testing Hours (Hours), Code Coverage (Percentage), Halstead Time (Minutes), General Code Complexity(MI) (Number)

- All that variables together have a Very Strong effect on Post-Release Num of Bugs
- All variables + ϵ can explain 82% of Post-Release Num of Bugs
- All variables without ϵ can explain 79.6% of Post-Release Num of Bugs
- Margin of Error = 2.4% of Post-Release Num of Bugs
- The other factors can explain 18% of Post-Release Num of Bugs

- **ANOVA^a**

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	50905.808	6	8484.301	33.425	.000b
Residual	11168.545	44	253.831		
Total	62074.353	50			

a. Dependent Variable: Post-Release Num of Bugs (Number)

b. Predictors: (Constant), Test Cases (Number), Active LOC (Lines), Automation Testing Hours (Hours), Code Coverage (Percentage), Halstead Time (Minutes), General Code Complexity(MI) (Number)

- All the variables together are Suitable to study the Post-Release Num of Bugs

- **Coefficients^a**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-90.870	24.604		-3.693	.001
	Active LOC (Lines)	.003	.001	.457	3.023	.004
	General Code Complexity(MI) (Number)	-2.871	.848	-.564	-3.387	.001
	Halstead Time (Minutes)	.352	.260	.209	1.353	.183
	Automation Testing Hours (Hours)	.041	.020	.170	2.049	.046
	Code Coverage (Percentage)	125.697	42.882	.309	2.931	.005
	Test Cases (Number)	.035	.010	.434	3.584	.001

a. Dependent Variable: Post-Release Num of Bugs (Number)

- **Post-Release Num of Bugs = - 90.870 + (.003 × Active LOC) – (2.871 × General Code Complexity) + (.041 × Automation Testing Hours) + (125.697 × Code Coverage) + (.035 × Test Cases) + ϵ**

○ The Data Studied

N.	App	Post-Release Num of Bugs	Active LOC	General Code Complexity(MI)	Halstead Time	Automation Testing Hours	Code Coverage	Test Cases
	Name	Number	Lines	Number	Minutes	Hours	Percentage	Number
1	Signal	53	12480	20.5	69.3	312	74%	1239
2	K-9 Mail	59	9320	15.3	63.4	239	72%	998
3	Amaze File Manager	22	7650	13.7	57.6	215	67%	827
4	Open Camera	17	5140	11.8	48.4	163	63%	611
5	Simple Notes	12	3210	8.2	38.2	106	56%	421
6	Telegram	82	16900	23.4	91.2	388	84%	1484
7	Firefox for Android	103	14200	22.1	102.3	341	81%	1183
8	Termux	32	6450	16.5	60.5	147	69%	727
9	DuckDuckGo Privacy Browser	45	8750	18.9	68.4	218	76%	912
10	Simple Mobile Tools	7	3700	7.1	45.2	89	52%	363
11	GitHub Android	73	10850	21.7	69.6	314	79%	1042
12	Nextcloud	118	19120	29.6	95.4	455	89%	1784
13	Blokada	53	8200	14.8	56.7	177	77%	815
14	Jitsi Meet	148	21400	33.3	120.5	507	82%	2067
15	WiFi Analyzer	11	4280	10.2	49.1	124	61%	516
16	F-Droid	21	6320	12.4	54.4	362	66%	608
17	Krita (Android)	62	13980	18.5	75.6	296	72%	1168
18	LibreOffice Viewer	48	12480	17.2	72.1	259	76%	1013
19	Fennec F-Droid	49	9850	19.8	71.9	392	81%	922
20	VLC for Android	112	9860	24.1	85.4	528	86%	1516
21	WordPress	134	16370	26.3	106.3	379	90%	2295
22	Tor Browser for Android	95	24430	34.7	122.8	211	80%	1402
23	DuckDuckGo	78	12970	24.5	94.5	245	78%	890
24	OpenStreetMap	49	7000	14.3	47.2	962	74%	962
25	Brave Browser	102	8830	17.8	87.5	401	83%	1560
26	ProtonMail	72	14390	28.5	101.6	320	87%	1760
27	GIMP for Android	31	10730	23.8	78.9	192	80%	1221
28	Calibre	29	7620	16.4	47.4	172	74%	1101
29	Syncthing	85	6860	14.9	52.1	345	86%	729
30	KeePassDX	19	12900	26.2	71.5	138	62%	815
31	Obsidian	110	5090	11.5	88.1	424	87%	1760
32	Telegram X	98	16030	30.8	105.8	470	82%	1530
33	Simplenote	17	18720	32.5	88.4	161	62%	601
34	VLC Media Player	109	5600	13.6	64.6	403	85%	1594
35	OBS Studio	122	17990	28.9	111.3	472	79%	1880
36	Aegis Authenticator	13	21200	34.2	98.6	116	79%	477
37	Bitwarden	72	4370	9.3	56.1	303	77%	1029
38	Android Messages	59	11770	22.4	72.9	239	76%	930
39	Quod Libet	33	9820	19.2	64.5	174	71%	685
40	OpenSSH	46	7020	15.8	67.3	225	77%	825
41	Mycroft	54	10480	19.4	82.1	211	73%	776
42	Pure Maps	20	9190	17.3	56.6	142	64%	522
43	F-Stop	78	5250	12.8	72.4	366	79%	1453
44	ColorNote	48	6790	20.5	85.3	294	82%	1294
45	Blender	58	8030	26.7	110.1	261	88%	1321
46	Tutanota	64	13520	22.1	96.7	208	72%	1052
47	Krita	45	10370	18.2	78.9	188	68%	1217
48	OsmAnd	32	9730	25.3	89.2	246	79%	1325
49	Android Auto	52	8780	18.6	79.6	329	81%	1185
50	Joplin	78	11220	14.7	84.7	270	82%	1020
51	Notion	52	11480	20	99.5	312	76%	1392

❖ Data Sources

<https://sendgb.com/tqpDofa1Jhk>