IoTWhiz Report

A Comprehensive Analysis Tool for IoT and Non-IoT Android Apps

Discover distinctive characteristics using API usage, permissions, UI layouts, code size, and more.

Visualizations unveil app differences, guiding efficient development choices.

API Usage Comparison

Iot Stats

For IoT Apps: Count: 173 observations. Mean: The mean API usages for iot apps is approximately 17.92. Standard Deviation (std): The variability in API usages is relatively high with a standard deviation of around 17.75. Minimum: The minimum API usage observed is 0. 25th Percentile (Q1): 4.0, Median (50th percentile or Q2): 14.0, 75th Percentile (Q3): 27.0. Maximum: The maximum observed API usage for iot apps is 121.

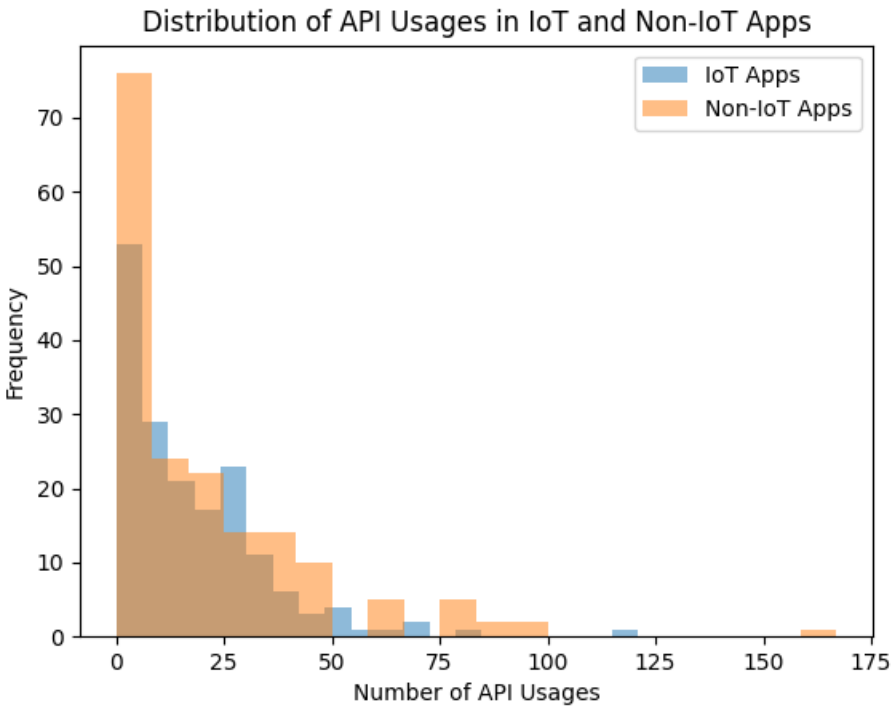
Non Iot Stats

For Non-IoT Apps: Count: 175 observations. Mean: The mean API usages for non-iot apps is approximately 20.49. Standard Deviation (std): The variability in API usages is relatively high with a standard deviation of around 24.67. Minimum: The minimum API usage observed is 0. 25th Percentile (Q1): 3.5, Median (50th percentile or Q2): 11.0, 75th Percentile (Q3): 29.0. Maximum: The maximum observed API usage for non-iot apps is 167.

Verdict

There is no significant difference between IoT and Non-IoT API usages.

Histogram



Dynamic Class Usage Comparison

Iot Stats

For IoT Apps: Count: 173 observations. Mean: The mean dynamic class loading usage for iot apps is approximately 5.52. Standard Deviation (std): The variability in dynamic class loading is relatively high with a standard deviation of around 5.21. Minimum: The minimum dynamic class loading observed is 0. 25th Percentile (Q1): 1.0, Median (50th percentile or Q2): 4.0, 75th Percentile (Q3): 9.0. Maximum: The maximum dynamic class loading observed for iot apps is 23.

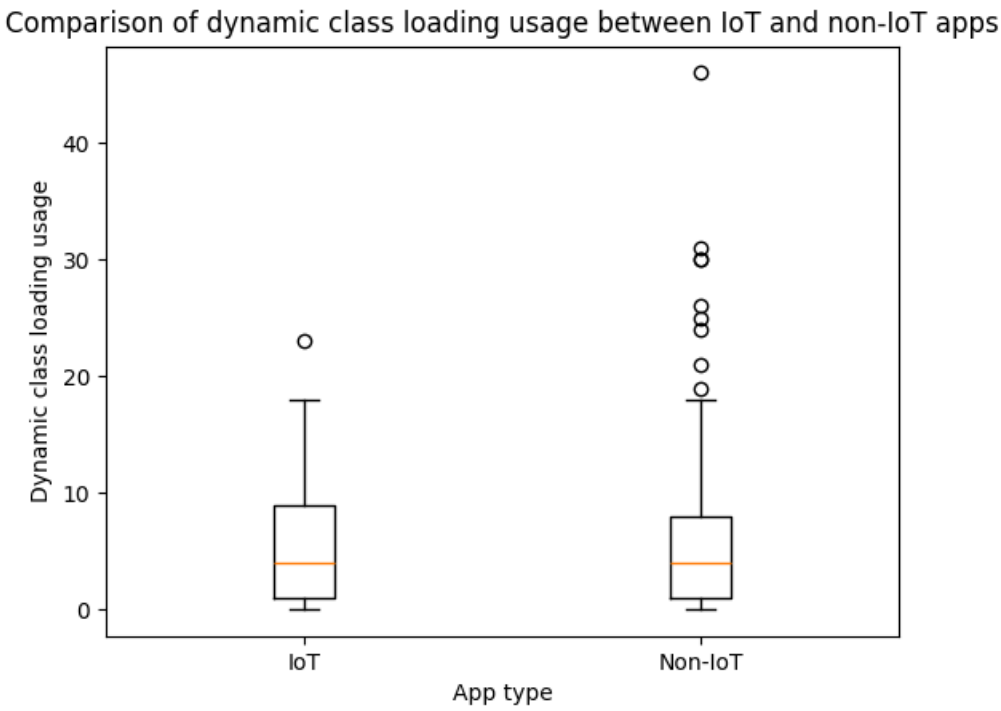
Non Iot Stats

For Non-IoT Apps: Count: 175 observations. Mean: The mean dynamic class loading usage for non-iot apps is approximately 6.09. Standard Deviation (std): The variability in dynamic class loading is relatively high with a standard deviation of around 6.98. Minimum: The minimum dynamic class loading observed is 0. 25th Percentile (Q1): 1.0, Median (50th percentile or Q2): 4.0, 75th Percentile (Q3): 8.0. Maximum: The maximum dynamic class loading observed for non-iot apps is 46.

Verdict

There is no statistically significant difference in the mean dynamic class loading usage between IoT and non-IoT apps.

Histogram



App Permissions Comparison

Permission Stats

{'count': {'iot': 169.0, 'non-iot': 175.0}, 'mean': {'iot': 16.355029585798817, 'non-iot': 9.668571428571429}, 'std': {'iot': 9.058900590570236, 'non-iot': 7.258279910405748}, 'min': {'iot': 0.0, 'non-iot': 0.0}, '25%': {'iot': 10.0, 'non-iot': 4.0}, '50%': {'iot': 15.0, 'non-iot': 8.0}, '75%': {'iot': 21.0, 'non-iot': 12.5}, 'max': {'iot': 65.0, 'non-iot': 33.0}}

Top 10 Permission Co-occurrences

T Statistic

7.5677733035498544

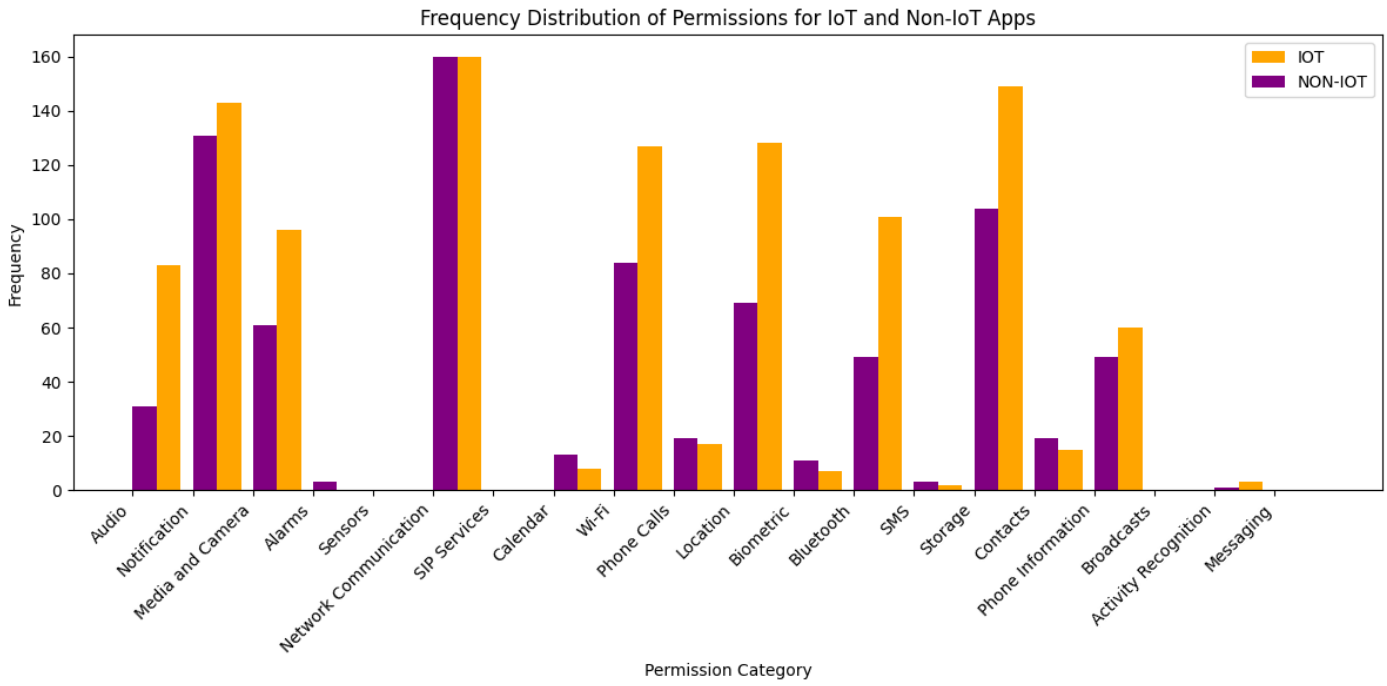
P Value

3.5536672905442825e-13

Verdict

IoT apps require significantly more permissions than non-IoT apps.

Distribution Path



Code Length Comparison

Iot Data Numeric

{'lines_of_code': {'count': 8.0, 'mean': 613234.4804198493, 'std': 765174.816324876, 'min': 0.0, '25%': 154315.25, '50%': 459926.83497419464, '75%': 639947.6300578035, 'max': 2368397.0}, 'number_of_classes': {'count': 8.0, 'mean': 8014.341997645739, 'std': 10256.47356177314, 'min': 0.0, '25%': 2016.5, '50%': 5704.584753588735, '75%': 8136.42485549133, 'max': 31699.0}, 'number_of_methods': {'count': 8.0, 'mean': 84945.89210313908, 'std': 111125.38229797913, 'min': 0.0, '25%': 21969.5, '50%': 60063.198470359755, '75%': 83867.05491329479, 'max': 343504.0}}

Non Iot Data

{'lines_of_code': {'count': 8.0, 'mean': 589143.6936326774, 'std': 858681.601331151, 'min': 175.0, '25%': 123765.75, '50%': 404661.4488164241, '75%': 514060.4885714286, 'max': 2637678.0}, 'number_of_classes': {'count': 8.0, 'mean': 8328.731287648676, 'std': 12538.0764241115, 'min': 15.0, '25%': 1489.75, '50%': 5363.837142857143, '75%': 7225.132011606342, 'max': 38350.0}, 'number_of_methods': {'count': 8.0, 'mean': 79936.78367637758, 'std': 114946.10039277285, 'min': 12.0, '25%': 16945.0, '50%': 54792.22184836751, '75%': 71058.86928571429, 'max': 353231.0}}

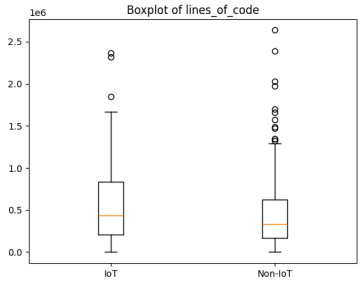
Correlation Matrix (IoT)

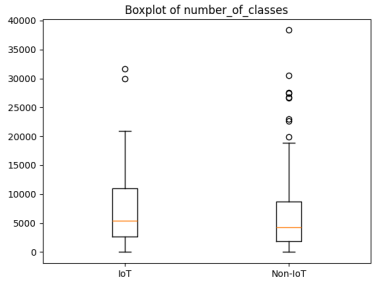
	lines_of_code	number_of_classes	number_of_methods
lines_of_code	1.0	0.973129929638601	0.9804395005142179
number_of_classes	0.973129929638601	1.0	0.9817521257556118
number_of_methods	0.9804395005142179	0.9817521257556118	1.0

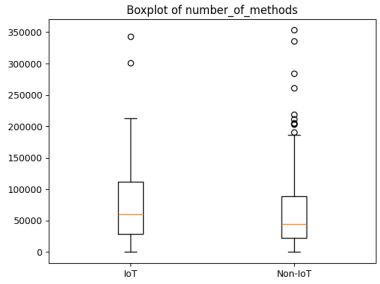
Correlation Matrix (Non-IoT)

	lines_of_code	number_of_classes	number_of_methods
lines_of_code	1.0	0.988866359964908	0.9974828510776872
number_of_classes	0.988866359964908	1.0	0.9839201567189714
number_of_methods	0.9974828510776872	0.9839201567189714	1.0

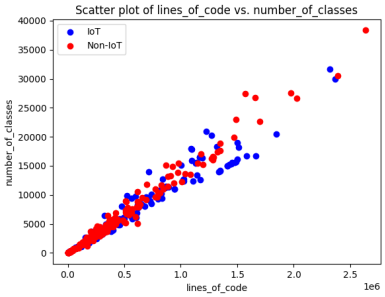
Boxplots (IoT vs Non-IoT)

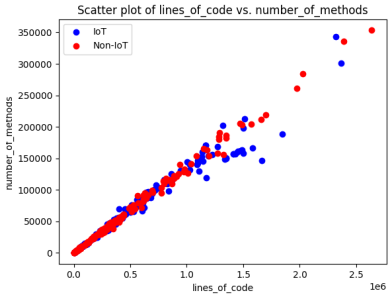


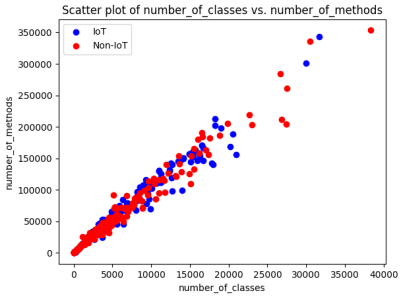




Scatterplots (IoT vs Non-IoT)







Database Storage Comparison

Database Strategy Percentages

Cursor	28633.5260	26549.7143
ContentResolver	4495.9538	4416.5714
MediaStoreQueries	1140.4624	662.2857
SQLiteOpenHelper	2680.3468	3033.7143
RoomDatabasePatterns	106.9364	200.5714
RealmDatabase	9321.3873	7725.7143
FirebaseDatabase	276.3006	213.7143
ObjectBoxDatabase	0.0000	0.0000
SQLiteDatabase	11697.6879	12040.5714

T-Test Results

t-test for Cursor	0.9675	0.3340
t-test for ContentResolver	0.1904	0.8491
t-test for MediaStoreQueries	3.4315	0.0007
t-test for SQLiteOpenHelper	-0.8958	0.3710
t-test for RoomDatabasePatterns	-0.9652	0.3351
t-test for RealmDatabase	0.2853	0.7756
t-test for FirebaseDatabase	0.5652	0.5723
t-test for ObjectBoxDatabase	nan	nan
t-test for SQLiteDatabase	-0.1943	0.8460

Chi-Square Test Results

Chi-square test for Cursor	254.6030	0.3901	249.0000
Chi-square test for ContentResolver	110.1819	0.5309	112.0000
Chi-square test for MediaStoreQueries	60.0555	0.0539	44.0000
Chi-square test for SQLiteOpenHelper	82.8855	0.6624	89.0000
Chi-square test for RoomDatabasePatterns	16.3343	0.3602	15.0000
Chi-square test for RealmDatabase	38.0639	0.2127	32.0000
Chi-square test for FirebaseDatabase	12.2082	0.4291	12.0000
Chi-square test for SQLiteDatabase	185.3685	0.2813	175.0000

Correlation Matrix

Cursor	1.0000	0.7825	0.5234	0.7858	0.4233	0.1606	0.1734	nan	0.8261
ContentResolver	0.7825	1.0000	0.6348	0.6799	0.2107	0.1769	0.1070	nan	0.6384
MediaStoreQueries	0.5234	0.6348	1.0000	0.3806	0.0799	0.2359	0.0818	nan	0.3589
SQLiteOpenHelper	0.7858	0.6799	0.3806	1.0000	0.4565	0.0695	0.2033	nan	0.9264
RoomDatabasePatterns	0.4233	0.2107	0.0799	0.4565	1.0000	0.0449	-0.0215	nan	0.6258
RealmDatabase	0.1606	0.1769	0.2359	0.0695	0.0449	1.0000	0.1224	nan	0.0457
FirebaseDatabase	0.1734	0.1070	0.0818	0.2033	-0.0215	0.1224	1.0000	nan	0.1105
ObjectBoxDatabase	nan	nan	nan	nan	nan	nan	nan	nan	nan
SQLiteDatabase	0.8261	0.6384	0.3589	0.9264	0.6258	0.0457	0.1105	nan	1.0000

Reflection Usage Comparison

Class Loading Count

App_Type IoT 173.0 Non-IoT 175.0 Name: (Class_Loading, count), dtype: float64

Class Loading Mean

App_Type IoT 87.069364 Non-IoT 87.480000 Name: (Class_Loading, mean), dtype: float64

Class Loading Std

App_Type IoT 70.119962 Non-IoT 125.208830 Name: (Class_Loading, std), dtype: float64

Class Loading Min

App_Type IoT 0.0 Non-IoT 0.0 Name: (Class_Loading, min), dtype: float64

Class Loading 25%

App_Type IoT 25.0 Non-IoT 20.5 Name: (Class_Loading, 25%), dtype: float64

Class Loading 50%

App_Type IoT 77.0 Non-IoT 52.0 Name: (Class_Loading, 50%), dtype: float64

Class Loading 75%

App_Type IoT 144.0 Non-IoT 119.5 Name: (Class_Loading, 75%), dtype: float64

Class Loading Max

App_Type IoT 341.0 Non-IoT 1289.0 Name: (Class_Loading, max), dtype: float64

Method Retrieval Count

App_Type IoT 173.0 Non-IoT 175.0 Name: (Method_Retrieval, count), dtype: float64

Method Retrieval Mean

App_Type IoT 166.092486 Non-IoT 175.360000 Name: (Method_Retrieval, mean), dtype: float64

Method Retrieval Std

App_Type IoT 116.766128 Non-IoT 203.075185 Name: (Method_Retrieval, std), dtype: float64

Method Retrieval Min

App_Type IoT 0.0 Non-IoT 0.0 Name: (Method_Retrieval, min), dtype: float64

Method Retrieval 25%

App_Type IoT 74.0 Non-IoT 60.5 Name: (Method_Retrieval, 25%), dtype: float64

Method Retrieval 50%

App_Type IoT 161.0 Non-IoT 122.0 Name: (Method_Retrieval, 50%), dtype: float64

Method Retrieval 75%

App_Type IoT 229.0 Non-IoT 226.0 Name: (Method_Retrieval, 75%), dtype: float64

Method Retrieval Max

App_Type IoT 630.0 Non-IoT 2008.0 Name: (Method_Retrieval, max), dtype: float64

Instance Creation Count

App_Type IoT 173.0 Non-IoT 175.0 Name: (Instance_Creation, count), dtype: float64

Instance Creation Mean

App_Type IoT 281.502890 Non-IoT 204.925714 Name: (Instance_Creation, mean), dtype: float64

Instance Creation Std

App_Type IoT 484.428009 Non-IoT 251.357442 Name: (Instance_Creation, std), dtype: float64

Instance Creation Min

App_Type IoT 0.0 Non-IoT 0.0 Name: (Instance_Creation, min), dtype: float64

Instance Creation 25%

App_Type IoT 73.0 Non-IoT 46.0 Name: (Instance_Creation, 25%), dtype: float64

Instance Creation 50%

App_Type IoT 184.0 Non-IoT 123.0 Name: (Instance_Creation, 50%), dtype: float64

Instance Creation 75%

App_Type IoT 375.0 Non-IoT 273.5 Name: (Instance_Creation, 75%), dtype: float64

Instance Creation Max

App_Type IoT 5782.0 Non-IoT 1572.0 Name: (Instance_Creation, max), dtype: float64

Method Invocation Count

App_Type IoT 173.0 Non-IoT 175.0 Name: (Method_Invocation, count), dtype: float64

Method Invocation Mean

App_Type IoT 1028.589595 Non-IoT 949.948571 Name: (Method_Invocation, mean), dtype: float64

Method Invocation Std

App_Type IoT 2120.977410 Non-IoT 1731.531603 Name: (Method_Invocation, std), dtype: float64

Method Invocation Min

App_Type IoT 0.0 Non-IoT 0.0 Name: (Method_Invocation, min), dtype: float64

Method Invocation 25%

App_Type IoT 106.0 Non-IoT 78.5 Name: (Method_Invocation, 25%), dtype: float64

Method Invocation 50%

App_Type IoT 222.0 Non-IoT 177.0 Name: (Method_Invocation, 50%), dtype: float64

Method Invocation 75%

App_Type IoT 923.0 Non-IoT 507.0 Name: (Method_Invocation, 75%), dtype: float64

Method Invocation Max

App_Type IoT 17695.0 Non-IoT 8830.0 Name: (Method_Invocation, max), dtype: float64

Field Retrieval Count

App_Type IoT 173.0 Non-IoT 175.0 Name: (Field_Retrieval, count), dtype: float64

Field Retrieval Mean

App_Type IoT 7.063584 Non-IoT 7.262857 Name: (Field_Retrieval, mean), dtype: float64

Field Retrieval Std

App_Type IoT 7.066256 Non-IoT 9.104094 Name: (Field_Retrieval, std), dtype: float64

Field Retrieval Min

App_Type IoT 0.0 Non-IoT 0.0 Name: (Field_Retrieval, min), dtype: float64

Field Retrieval 25%

App_Type IoT 2.0 Non-IoT 1.0 Name: (Field_Retrieval, 25%), dtype: float64

Field Retrieval 50%

App_Type IoT 5.0 Non-IoT 4.0 Name: (Field_Retrieval, 50%), dtype: float64

Field Retrieval 75%

App_Type IoT 9.0 Non-IoT 10.0 Name: (Field_Retrieval, 75%), dtype: float64

Field Retrieval Max

App_Type IoT 35.0 Non-IoT 55.0 Name: (Field_Retrieval, max), dtype: float64

Access Control Count

App_Type IoT 173.0 Non-IoT 175.0 Name: (Access_Control, count), dtype: float64

Access Control Mean

App_Type IoT 0.0 Non-IoT 0.0 Name: (Access_Control, mean), dtype: float64

Access Control Std

App_Type IoT 0.0 Non-IoT 0.0 Name: (Access_Control, std), dtype: float64

Access Control Min

App_Type IoT 0.0 Non-IoT 0.0 Name: (Access_Control, min), dtype: float64

Access Control 25%

App_Type IoT 0.0 Non-IoT 0.0 Name: (Access_Control, 25%), dtype: float64

Access Control 50%

App_Type IoT 0.0 Non-IoT 0.0 Name: (Access_Control, 50%), dtype: float64

Access Control 75%

App_Type IoT 0.0 Non-IoT 0.0 Name: (Access_Control, 75%), dtype: float64

Access Control Max

App_Type IoT 0.0 Non-IoT 0.0 Name: (Access_Control, max), dtype: float64

Annotations Retrieval Count

App_Type IoT 173.0 Non-IoT 175.0 Name: (Annotations_Retrieval, count), dtype: float64

Annotations Retrieval Mean

App_Type IoT 1.572254 Non-IoT 2.097143 Name: (Annotations_Retrieval, mean), dtype: float64

Annotations Retrieval Std

App_Type IoT 4.410839 Non-IoT 5.746237 Name: (Annotations_Retrieval, std), dtype: float64

Annotations Retrieval Min

App_Type IoT 0.0 Non-IoT 0.0 Name: (Annotations_Retrieval, min), dtype: float64

Annotations Retrieval 25%

App_Type IoT 0.0 Non-IoT 0.0 Name: (Annotations_Retrieval, 25%), dtype: float64

Annotations Retrieval 50%

App_Type IoT 0.0 Non-IoT 0.0 Name: (Annotations_Retrieval, 50%), dtype: float64

Annotations Retrieval 75%

App_Type IoT 0.0 Non-IoT 0.0 Name: (Annotations_Retrieval, 75%), dtype: float64

Annotations Retrieval Max

App_Type IoT 31.0 Non-IoT 35.0 Name: (Annotations_Retrieval, max), dtype: float64

Total Reflections Count

App_Type IoT 173.0 Non-IoT 175.0 Name: (Total_Reflections, count), dtype: float64

Total Reflections Mean

App_Type IoT 1571.890173 Non-IoT 1427.074286 Name: (Total_Reflections, mean), dtype: float64

Total Reflections Std

App_Type IoT 2495.615065 Non-IoT 2127.985084 Name: (Total_Reflections, std), dtype: float64

Total Reflections Min

App_Type IoT 0.0 Non-IoT 0.0 Name: (Total_Reflections, min), dtype: float64

Total Reflections 25%

App_Type IoT 312.0 Non-IoT 218.5 Name: (Total_Reflections, 25%), dtype: float64

Total Reflections 50%

App_Type IoT 712.0 Non-IoT 530.0 Name: (Total_Reflections, 50%), dtype: float64

Total Reflections 75%

App_Type IoT 1752.0 Non-IoT 1599.5 Name: (Total_Reflections, 75%), dtype: float64

Total Reflections Max

App_Type IoT 19178.0 Non-IoT 11205.0 Name: (Total_Reflections, max), dtype: float64

T-Test Results

Class_Loading	-0.0377	0.9700	No significant difference between IoT & non-IoT apps in terms of Class_Loading
Method_Retrieval	-0.5211	0.6026	No significant difference between IoT & non-IoT apps in terms of Method_Retrieval
Instance_Creation	1.8539	0.0646	No significant difference between IoT & non-IoT apps in terms of Instance_Creation
Method_Invocation	0.3791	0.7049	No significant difference between IoT & non-IoT apps in terms of Method_Invocation
Field_Retrieval	-0.2279	0.8198	No significant difference between IoT & non-IoT apps in terms of Field_Retrieval
Access_Control	nan	nan	No significant difference between IoT & non-IoT apps in terms of Access_Control
Annotations_Retrieval	-0.9551	0.3402	No significant difference between IoT & non-IoT apps in terms of Annotations_Retrieval
Total_Reflections	0.5827	0.5605	No significant difference between IoT & non-IoT apps in terms of Total_Reflections

Reflection (IoT vs Non-IoT)