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: 140 observations. Mean: The mean API usages for iot apps is approximately 20.38. Standard Deviation (std): The variability in API usages is relatively high with a standard deviation of around 18.51. Minimum: The minimum API usage observed is 0. 25th Percentile (Q1): 5.8, Median (50th percentile or Q2): 16.5, 75th Percentile (Q3): 28.2. Maximum: The maximum observed API usage for iot apps is 121.

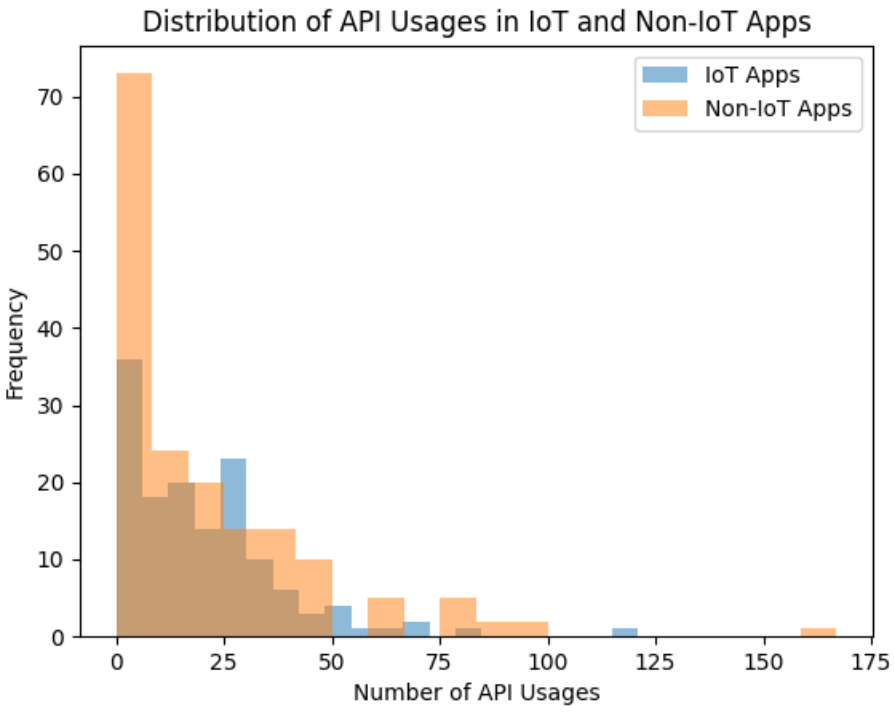
Non Iot Stats

For Non-IoT Apps: Count: 170 observations. Mean: The mean API usages for non-iot apps is approximately 20.77. Standard Deviation (std): The variability in API usages is relatively high with a standard deviation of around 24.93. Minimum: The minimum API usage observed is 0. 25th Percentile (Q1): 3.2, 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: 140 observations. Mean: The mean dynamic class loading usage for iot apps is approximately 6.1. Standard Deviation (std): The variability in dynamic class loading is relatively high with a standard deviation of around 5.38. Minimum: The minimum dynamic class loading observed is 0. 25th Percentile (Q1): 2.0, Median (50th percentile or Q2): 5.0, 75th Percentile (Q3): 9.25. Maximum: The maximum dynamic class loading observed for iot apps is 23.

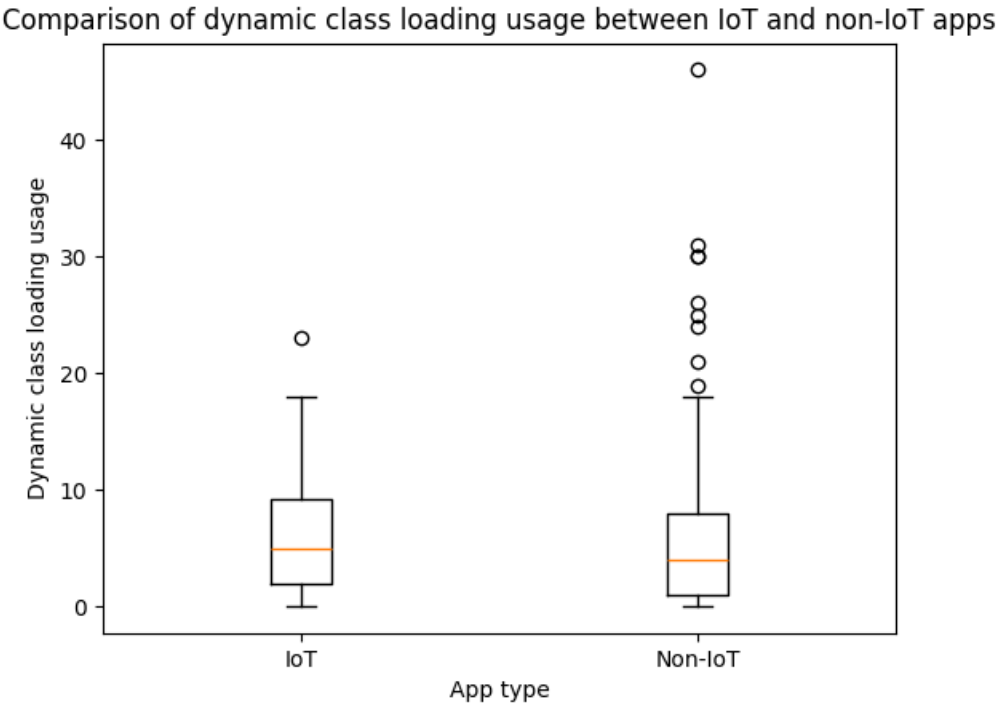
Non Iot Stats

For Non-IoT Apps: Count: 170 observations. Mean: The mean dynamic class loading usage for non-iot apps is approximately 6.17. Standard Deviation (std): The variability in dynamic class loading is relatively high with a standard deviation of around 7.05. 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': 140.0, 'non-iot': 170.0}, 'mean': {'iot': 17.178571428571427, 'non-iot': 9.764705882352942}, 'std': {'iot': 9.232619570390188, 'non-iot': 7.34064966382046}, 'min': {'iot': 0.0, 'non-iot': 0.0}, '25%': {'iot': 11.0, 'non-iot': 4.0}, '50%': {'iot': 17.0, 'non-iot': 8.0}, '75%': {'iot': 21.0, 'non-iot': 13.0}, 'max': {'iot': 65.0, 'non-iot': 33.0}}

Top 10 Permission Co-occurrences

T Statistic

7.87558056340888

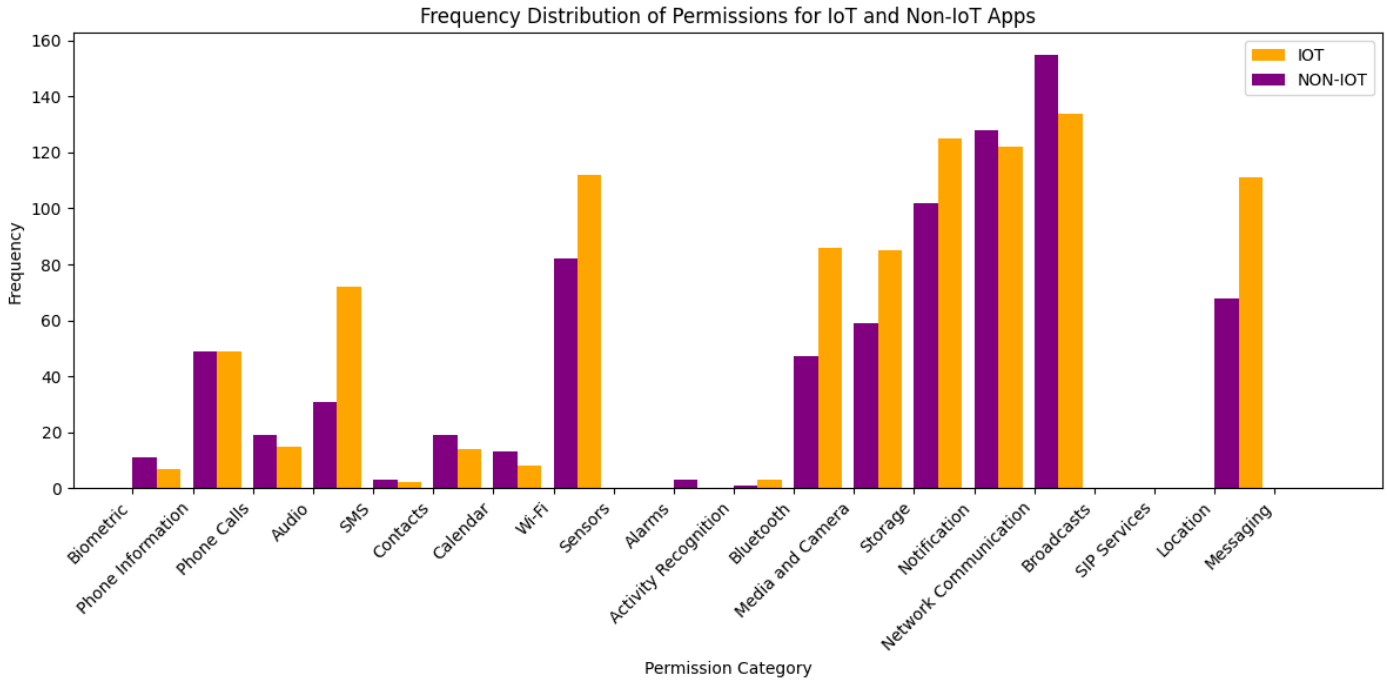
P Value

5.857508912109153e-14

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': 653995.3921560324, 'std': 763126.7222414135, 'min': 0.0, '25%': 196032.5, '50%': 508256.95433841523, '75%': 716422.7964285715, 'max': 2368397.0}, 'number_of_classes': {'count': 8.0, 'mean': 8509.567603765627, 'std': 10236.826179100455, 'min': 0.0, '25%': 2364.3125, '50%': 6391.027557919651, '75%': 9082.176785714286, 'max': 31699.0}, 'number_of_methods': {'count': 8.0, 'mean': 89787.78968737306, 'std': 110951.31298700727, 'min': 0.0, '25%': 26208.3125, '50%': 65067.483749492225, '75%': 93750.57500000001, 'max': 343504.0}}

Non Iot Data

{'lines_of_code': {'count': 8.0, 'mean': 590856.436300108, 'std': 858586.0450224077, 'min': 170.0, '25%': 122377.875, '50%': 407937.1231416082, '75%': 518632.9330882353, 'max': 2637678.0}, 'number_of_classes': {'count': 8.0, 'mean': 8368.116648197343, 'std': 12534.540084194867, 'min': 15.0, '25%': 1499.375, '50%': 5410.317647058824, '75%': 7309.598418595828, 'max': 38350.0}, 'number_of_methods': {'count': 8.0, 'mean': 80205.20127318794, 'std': 114938.79851441413, 'min': 12.0, '25%': 16857.875, '50%': 55150.085975104696, '75%': 71744.07867647058, 'max': 353231.0}}

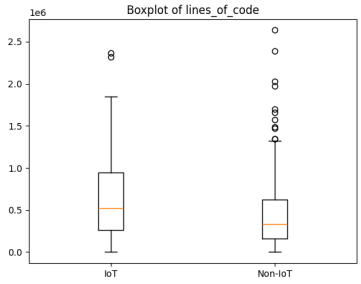
Correlation Matrix (IoT)

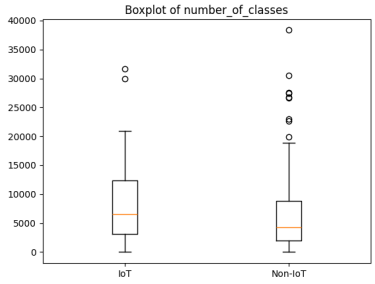
	lines_of_code	number_of_classes	number_of_methods
lines_of_code	1.0	0.9691102876951174	0.9777782783948679
number_of_classes	0.9691102876951174	1.0	0.9791479820930408
number_of_methods	0.9777782783948679	0.9791479820930408	1.0

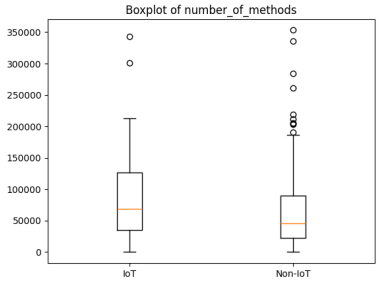
Correlation Matrix (Non-IoT)

	lines_of_code	number_of_classes	number_of_methods
lines_of_code	1.0	0.988824973258328	0.9975449764135624
number_of_classes	0.988824973258328	1.0	0.9839326571840025
number_of_methods	0.9975449764135624	0.9839326571840025	1.0

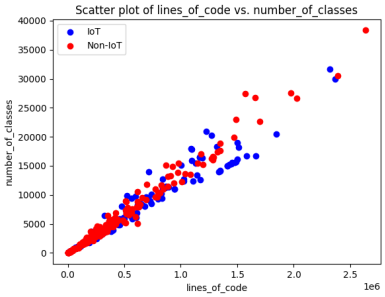
Boxplots (IoT vs Non-IoT)

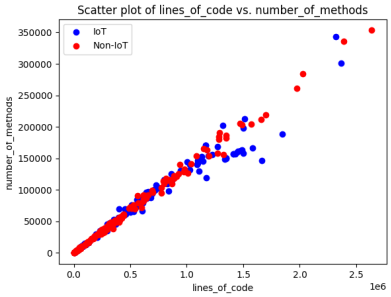


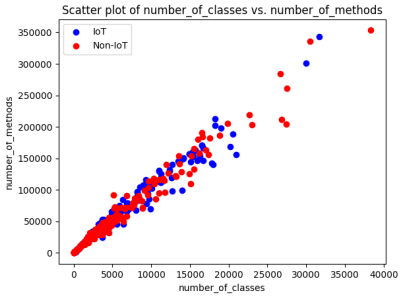




Scatterplots (IoT vs Non-IoT)







Database Storage Comparison

Database Strategy Percentages

Cursor	31102.8571	26694.1176
ContentResolver	4892.8571	4472.3529
MediaStoreQueries	1283.5714	673.5294
SQLiteOpenHelper	3043.5714	3039.4118
RoomDatabasePatterns	132.1429	196.4706
RealmDatabase	9057.1429	7951.1765
FirebaseDatabase	247.1429	220.0000
ObjectBoxDatabase	0.0000	0.0000
SQLiteDatabase	13358.5714	12025.8824

T-Test Results

t-test for Cursor	1.8817	0.0608
t-test for ContentResolver	0.9210	0.3578
t-test for MediaStoreQueries	4.0093	0.0001
t-test for SQLiteOpenHelper	0.0096	0.9924
t-test for RoomDatabasePatterns	-0.5893	0.5561
t-test for RealmDatabase	0.1866	0.8521
t-test for FirebaseDatabase	0.2334	0.8156
t-test for ObjectBoxDatabase	nan	nan
t-test for SQLiteDatabase	0.6828	0.4953

Chi-Square Test Results

Chi-square test for Cursor	238.4970	0.2871	227.0000
Chi-square test for ContentResolver	110.4759	0.4425	109.0000
Chi-square test for MediaStoreQueries	69.9744	0.0076	44.0000
Chi-square test for SQLiteOpenHelper	89.7363	0.4582	89.0000
Chi-square test for RoomDatabasePatterns	13.1730	0.5889	15.0000
Chi-square test for RealmDatabase	38.7248	0.1320	30.0000
Chi-square test for FirebaseDatabase	11.7437	0.3832	11.0000
Chi-square test for SQLiteDatabase	181.3991	0.1958	166.0000

Correlation Matrix

Cursor	1.0000	0.7746	0.5255	0.7843	0.4299	0.1588	0.1707	nan	0.8283
ContentResolver	0.7746	1.0000	0.6452	0.6734	0.2100	0.1821	0.0994	nan	0.6339
MediaStoreQueries	0.5255	0.6452	1.0000	0.3794	0.0792	0.2451	0.0762	nan	0.3580
SQLiteOpenHelper	0.7843	0.6734	0.3794	1.0000	0.4570	0.0785	0.2167	nan	0.9249
RoomDatabasePatterns	0.4299	0.2100	0.0792	0.4570	1.0000	0.0491	-0.0196	nan	0.6282
RealmDatabase	0.1588	0.1821	0.2451	0.0785	0.0491	1.0000	0.0581	nan	0.0504
FirebaseDatabase	0.1707	0.0994	0.0762	0.2167	-0.0196	0.0581	1.0000	nan	0.1173
ObjectBoxDatabase	nan	nan	nan	nan	nan	nan	nan	nan	nan
SQLiteDatabase	0.8283	0.6339	0.3580	0.9249	0.6282	0.0504	0.1173	nan	1.0000

Reflection Usage Comparison

Class Loading Count

App_Type IoT 140.0 Non-IoT 170.0 Name: (Class_Loading, count), dtype: float64

Class Loading Mean

App_Type IoT 96.757143 Non-IoT 88.305882 Name: (Class_Loading, mean), dtype: float64

Class Loading Std

App_Type IoT 70.580519 Non-IoT 126.697798 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 33.00 Non-IoT 20.25 Name: (Class_Loading, 25%), dtype: float64

Class Loading 50%

App_Type IoT 96.5 Non-IoT 52.5 Name: (Class_Loading, 50%), dtype: float64

Class Loading 75%

App_Type IoT 148.00 Non-IoT 119.75 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 140.0 Non-IoT 170.0 Name: (Method_Retrieval, count), dtype: float64

Method Retrieval Mean

App_Type IoT 180.321429 Non-IoT 174.911765 Name: (Method_Retrieval, mean), dtype: float64

Method Retrieval Std

App_Type IoT 117.067051 Non-IoT 205.095730 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 103.00 Non-IoT 60.25 Name: (Method_Retrieval, 25%), dtype: float64

Method Retrieval 50%

App_Type IoT 184.5 Non-IoT 119.0 Name: (Method_Retrieval, 50%), dtype: float64

Method Retrieval 75%

App_Type IoT 233.25 Non-IoT 218.75 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 140.0 Non-IoT 170.0 Name: (Instance_Creation, count), dtype: float64

Instance Creation Mean

App_Type IoT 318.650000 Non-IoT 207.164706 Name: (Instance_Creation, mean), dtype: float64

Instance Creation Std

App_Type IoT 527.831480 Non-IoT 253.969473 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 94.00 Non-IoT 48.25 Name: (Instance_Creation, 25%), dtype: float64

Instance Creation 50%

App_Type IoT 233.0 Non-IoT 121.5 Name: (Instance_Creation, 50%), dtype: float64

Instance Creation 75%

App_Type IoT 412.00 Non-IoT 275.75 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 140.0 Non-IoT 170.0 Name: (Method_Invocation, count), dtype: float64

Method Invocation Mean

App_Type IoT 1193.792857 Non-IoT 973.376471 Name: (Method_Invocation, mean), dtype: float64

Method Invocation Std

App_Type IoT 2305.575705 Non-IoT 1751.362695 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 133.75 Non-IoT 78.25 Name: (Method_Invocation, 25%), dtype: float64

Method Invocation 50%

App_Type IoT 286.5 Non-IoT 178.0 Name: (Method_Invocation, 50%), dtype: float64

Method Invocation 75%

App_Type IoT 1069.25 Non-IoT 604.50 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 140.0 Non-IoT 170.0 Name: (Field_Retrieval, count), dtype: float64

Field Retrieval Mean

App_Type IoT 7.857143 Non-IoT 7.276471 Name: (Field_Retrieval, mean), dtype: float64

Field Retrieval Std

App_Type IoT 7.354900 Non-IoT 9.174832 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 6.0 Non-IoT 4.0 Name: (Field_Retrieval, 50%), dtype: float64

Field Retrieval 75%

App_Type IoT 11.00 Non-IoT 9.75 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 140.0 Non-IoT 170.0 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 140.0 Non-IoT 170.0 Name: (Annotations_Retrieval, count), dtype: float64

Annotations Retrieval Mean

App_Type IoT 1.914286 Non-IoT 2.135294 Name: (Annotations_Retrieval, mean), dtype: float64

Annotations Retrieval Std

App_Type IoT 4.831679 Non-IoT 5.819722 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 2.0 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 140.0 Non-IoT 170.0 Name: (Total_Reflections, count), dtype: float64

Total Reflections Mean

App_Type IoT 1799.292857 Non-IoT 1453.170588 Name: (Total_Reflections, mean), dtype: float64

Total Reflections Std

App_Type IoT 2691.711176 Non-IoT 2152.780506 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 373.50 Non-IoT 214.75 Name: (Total_Reflections, 25%), dtype: float64

Total Reflections 50%

App_Type IoT 906.5 Non-IoT 549.0 Name: (Total_Reflections, 50%), dtype: float64

Total Reflections 75%

App_Type IoT 1835.5 Non-IoT 1631.0 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	0.7043	0.4818	No significant difference between IoT & non-IoT apps in terms of Class_Loading
Method_Retrieval	0.2771	0.7819	No significant difference between IoT & non-IoT apps in terms of Method_Retrieval
Instance_Creation	2.4336	0.0155	There is significant difference between IoT & non-IoT apps in terms of Instance_Creation
Method_Invocation	0.9559	0.3399	No significant difference between IoT & non-IoT apps in terms of Method_Invocation
Field_Retrieval	0.6055	0.5453	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	-0.3589	0.7199	No significant difference between IoT & non-IoT apps in terms of Annotations_Retrieval
Total_Reflections	1.2579	0.2094	No significant difference between IoT & non-IoT apps in terms of Total_Reflections

Reflection (IoT vs Non-IoT)