Confusion Matrices and Performance Measures

Evaluate Techniques for Wifi Locationing

XTOL Data Analytics and Big Data program

Module 3, Task 3

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KNN

Building-only classifier Confusion Matrix

Reference

Prediction 0 1 2
0 532 1 0
1 2 304 1
2 2 2 267

Overall Statistics

Accuracy Kappa 0.9927993 0.9886307

Accuracy : 0.9928

95% CI: (0.9859, 0.9969)

No Information Rate : 0.4824 P-Value [Acc > NIR] : <2e-16

Kappa : 0.9886

Mcnemar's Test P-Value : 0.4459

| | Class: 0 | Class: 1 | Class: 2 |
|----------------------|----------|----------|----------|
| Sensitivity | 0.9925 | 0.9902 | 0.9963 |
| Specificity | 0.9983 | 0.9963 | 0.9953 |
| Pos Pred Value | 0.9981 | 0.9902 | 0.9852 |
| Neg Pred Value | 0.9931 | 0.9963 | 0.9988 |
| Prevalence | 0.4824 | 0.2763 | 0.2412 |
| Detection Rate | 0.4788 | 0.2736 | 0.2403 |
| Detection Prevalence | 0.4797 | 0.2763 | 0.2439 |
| Balanced Accuracy | 0.9954 | 0.9932 | 0.9958 |

Building and Floor classifier

Format of predicted classes: BuildingID | FloorNumber

Confusion Matrix

Reference

| Prediction | 0 0 | 0 1 | 0 2 | 0 3 | 1 0 | 1 1 | 1 2 | 1 3 | 2 0 | 2 1 | 2 2 | 2 3 | 2 4 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|-------|-----|
| 0 0 | 58 | 29 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 1 | 17 | 146 | 10 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 2 | 2 | 25 | 107 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 3 | 1 | 7 | 45 | 58 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 1 0 | 0 | 0 | 0 | 0 | 21 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 1 | 0 | 0 | 0 | 0 | 5 | 78 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 2 | 0 | 0 | 1 | 1 | 4 | 47 | 64 | 2 | 0 | 0 | 0 | 0 | 0 |
| 1 3 | 0 | 1 | 0 | 0 | 0 | 2 | 21 | 42 | 0 | 0 | 0 | 1 | 2 |
| 2 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 5 | 0 | 0 | 0 |
| 2 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 101 | 17 | 0 | 0 |
| 2 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 24 | 0 | 0 |
| 2 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 3 | 13 | 35 | 14 |
| 214 | а | а | а | а | а | а | а | а | а | а | а | 4 | 22 |

Overall Statistics

Accuracy Kappa 0.6984698 0.6645994

Accuracy : 0.6985

95% CI: (0.6705, 0.7254)

No Information Rate : 0.1872 P-Value [Acc > NIR] : < 2.2e-16

Kappa : 0.6646

Mcnemar's Test P-Value : NA

Detection Prevalence

Balanced Accuracy

0.06031

0.92256

0.0234

0.7802

| | Class: 0 0 | Class: 0 1 | Class: 0 2 | Class: 0 3 | Class: 1 0 | Class: 1 1 | Class: 1 2 | Class: 1 3 | Class: 2 0 | Class: 2 1 | Class: 2 2 |
|----------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Sensitivity | 0.74359 | 0.7019 | 0.64848 | 0.68235 | 0.7000 | 0.54545 | 0.73563 | 0.89362 | 0.8333 | 0.90991 | 0.4444 |
| Specificity | 0.96709 | 0.9690 | 0.94926 | 0.94737 | 0.9843 | 0.99277 | 0.94629 | 0.97462 | 0.9954 | 0.97900 | 0.9972 |
| Pos Pred Value | 0.63043 | 0.8391 | 0.69032 | 0.51786 | 0.5526 | 0.91765 | 0.53782 | 0.60870 | 0.8000 | 0.82787 | 0.8889 |
| Neg Pred Value | 0.98037 | 0.9338 | 0.93933 | 0.97297 | 0.9916 | 0.93665 | 0.97681 | 0.99520 | 0.9963 | 0.98989 | 0.9723 |
| Prevalence | 0.07021 | 0.1872 | 0.14851 | 0.07651 | 0.0270 | 0.12871 | 0.07831 | 0.04230 | 0.0216 | 0.09991 | 0.0486 |
| Detection Rate | 0.05221 | 0.1314 | 0.09631 | 0.05221 | 0.0189 | 0.07021 | 0.05761 | 0.03780 | 0.0180 | 0.09091 | 0.0216 |
| Detection Prevalence | 0.08281 | 0.1566 | 0.13951 | 0.10081 | 0.0342 | 0.07651 | 0.10711 | 0.06211 | 0.0225 | 0.10981 | 0.0243 |
| Balanced Accuracy | 0.85534 | 0.8355 | 0.79887 | 0.81486 | 0.8421 | 0.76911 | 0.84096 | 0.93412 | 0.9144 | 0.94445 | 0.7208 |
| | Class: 2 3 | Class: 2 4 | | | | | | | | | |
| Sensitivity | 0.87500 | 0.5641 | | | | | | | | | |
| Specificity | 0.97012 | 0.9963 | | | | | | | | | |
| Pos Pred Value | 0.52239 | 0.8462 | | | | | | | | | |
| Neg Pred Value | 0.99521 | 0.9843 | | | | | | | | | |
| Prevalence | 0.03600 | 0.0351 | | | | | | | | | |
| Detection Rate | 0.03150 | 0.0198 | | | | | | | | | |

Random Forest Building-only classifier Confusion Matrix

Reference

Prediction 0 1 2
0 536 0 0
1 0 307 1
2 0 0 267

Overall Statistics

Accuracy Kappa 0.9990999 0.9985773

Accuracy : 0.9991

95% CI : (0.995, 1)

No Information Rate : 0.4824 P-Value [Acc > NIR] : < 2.2e-16

Kappa : 0.9986

Mcnemar's Test P-Value : NA

Statistics by Class:

| | Class: 0 | Class: 1 | Class: 2 |
|----------------------|----------|----------|----------|
| Sensitivity | 1.0000 | 1.0000 | 0.9963 |
| Specificity | 1.0000 | 0.9988 | 1.0000 |
| Pos Pred Value | 1.0000 | 0.9968 | 1.0000 |
| Neg Pred Value | 1.0000 | 1.0000 | 0.9988 |
| Prevalence | 0.4824 | 0.2763 | 0.2412 |
| Detection Rate | 0.4824 | 0.2763 | 0.2403 |
| Detection Prevalence | 0.4824 | 0.2772 | 0.2403 |
| Balanced Accuracy | 1.0000 | 0.9994 | 0.9981 |

Building and Floor classifier Confusion Matrix

Reference

| Prediction | 0 0 | 0 1 | 0 2 | 0 3 | 1 0 | 1 1 | 1 2 | 1 3 | 2 0 | 2 1 | 2 2 | 2 3 | 2 4 |
|------------|-----|-----|-----|-----|-----|-----|-------|-----|-----|-----|-------|-----|-----|
| 0 0 | 38 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 1 | 28 | 118 | 8 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 2 | 12 | 69 | 143 | 40 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| 0 3 | 0 | 3 | 14 | 44 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 0 | 0 | 0 | 0 | 0 | 15 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 1 | 0 | 0 | 0 | 0 | 9 | 93 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 2 | 0 | 0 | 0 | 0 | 6 | 47 | 80 | 8 | 0 | 0 | 0 | 0 | 0 |
| 1 3 | 0 | 0 | 0 | 0 | 0 | 1 | 6 | 39 | 0 | 0 | 0 | 0 | 0 |
| 2 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 2 | 0 | 0 | 0 |
| 2 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 108 | 19 | 1 | 1 |
| 2 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 17 | 0 | 0 |
| 2 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 39 | 21 |
| 2 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 |

Overall Statistics

Accuracy Kappa 0.6903690 0.6521745

Accuracy : 0.6904

95% CI: (0.6623, 0.7175)

No Information Rate : 0.1872 P-Value [Acc > NIR] : < 2.2e-16

Kappa : 0.6522

Mcnemar's Test P-Value : NA

Detection Rate
Detection Prevalence

Balanced Accuracy

0.03510

0.06931

0.96976

0.0153

0.0153

0.7179

| | Class: 0 0 (| Class: 0 1 | Class: 0 2 | Class: 0 3 | Class: 1 0 | Class: 1 1 | Class: 1 2 | Class: 1 3 | Class: 2 0 | Class: 2 1 (| Class: 2 2 |
|----------------------|--------------|------------|------------|------------|------------|------------|------------|------------|------------|--------------|------------|
| Sensitivity | 0.48718 | 0.5673 | 0.8667 | 0.51765 | 0.5000 | 0.65035 | 0.91954 | 0.8298 | 0.6667 | 0.97297 | 0.3148 |
| Specificity | 0.98258 | 0.9590 | 0.8710 | 0.98343 | 0.9981 | 0.98967 | 0.94043 | 0.9934 | 0.9982 | 0.97100 | 0.9991 |
| Pos Pred Value | 0.67857 | 0.7613 | 0.5396 | 0.72131 | 0.8824 | 0.90291 | 0.56738 | 0.8478 | 0.8889 | 0.78832 | 0.9444 |
| Neg Pred Value | 0.96209 | 0.9059 | 0.9740 | 0.96095 | 0.9863 | 0.95040 | 0.99278 | 0.9925 | 0.9927 | 0.99692 | 0.9661 |
| Prevalence | 0.07021 | 0.1872 | 0.1485 | 0.07651 | 0.0270 | 0.12871 | 0.07831 | 0.0423 | 0.0216 | 0.09991 | 0.0486 |
| Detection Rate | 0.03420 | 0.1062 | 0.1287 | 0.03960 | 0.0135 | 0.08371 | 0.07201 | 0.0351 | 0.0144 | 0.09721 | 0.0153 |
| Detection Prevalence | 0.05041 | 0.1395 | 0.2385 | 0.05491 | 0.0153 | 0.09271 | 0.12691 | 0.0414 | 0.0162 | 0.12331 | 0.0162 |
| Balanced Accuracy | 0.73488 | 0.7632 | 0.8689 | 0.75054 | 0.7491 | 0.82001 | 0.92998 | 0.9116 | 0.8324 | 0.97199 | 0.6569 |
| | Class: 2 3 (| Class: 2 4 | | | | | | | | | |
| Sensitivity | 0.97500 | 0.4359 | | | | | | | | | |
| Specificity | 0.96452 | 1.0000 | | | | | | | | | |
| Pos Pred Value | 0.50649 | 1.0000 | | | | | | | | | |
| Neg Pred Value | 0.99903 | 0.9799 | | | | | | | | | |
| Prevalence | 0.03600 | 0.0351 | | | | | | | | | |

C5.0

Building-only classifier Confusion Matrix

Reference

Prediction 0 1 2 0 533 0 0 1 0 307 0 2 3 0 268

Overall Statistics

Accuracy Kappa 0.9972997 0.9957365

Accuracy : 0.9973

95% CI: (0.9921, 0.9994)

No Information Rate : 0.4824 P-Value [Acc > NIR] : < 2.2e-16

Kappa : 0.9957

Mcnemar's Test P-Value : NA

Statistics by Class:

| | Class: 0 | Class: 1 | Class: 2 |
|----------------------|----------|----------|----------|
| Sensitivity | 0.9944 | 1.0000 | 1.0000 |
| Specificity | 1.0000 | 1.0000 | 0.9964 |
| Pos Pred Value | 1.0000 | 1.0000 | 0.9889 |
| Neg Pred Value | 0.9948 | 1.0000 | 1.0000 |
| Prevalence | 0.4824 | 0.2763 | 0.2412 |
| Detection Rate | 0.4797 | 0.2763 | 0.2412 |
| Detection Prevalence | 0.4797 | 0.2763 | 0.2439 |
| Balanced Accuracy | 0.9972 | 1.0000 | 0.9982 |

Building and Floor classifier Confusion Matrix

Reference

| Prediction | 0 0 | 0 1 | 0 2 | 0 3 | 1 0 | 1 1 | 1 2 | 1 3 | 2 0 | 2 1 | 2 2 | 2 3 | 2 4 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|-------|-----|
| 0 0 | 41 | 22 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 1 | 24 | 115 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 2 | 8 | 50 | 111 | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 3 | 5 | 19 | 44 | 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 0 | 0 | 0 | 0 | 0 | 16 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 1 | 0 | 1 | 0 | 0 | 9 | 90 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 2 | 0 | 0 | 0 | 0 | 5 | 48 | 76 | 11 | 0 | 0 | 0 | 0 | 0 |
| 1 3 | 0 | 0 | 0 | 0 | 0 | 1 | 10 | 36 | 0 | 0 | 0 | 0 | 0 |
| 2 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 1 | 0 | 0 | 1 |
| 2 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 108 | 24 | 1 | 0 |
| 2 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 14 | 0 | 0 |
| 2 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 32 | 12 |
| 2 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 7 | 26 |

Overall Statistics

Accuracy Kappa 0.6669667 0.6283008

Accuracy: 0.667

95% CI: (0.6384, 0.6947)

No Information Rate : 0.1872 P-Value [Acc > NIR] : < 2.2e-16

Kappa : 0.6283

Mcnemar's Test P-Value : NA

0.03600

0.02880

0.05311

0.88739

0.0351

0.0234

0.0306

0.8296

Prevalence

Detection Rate

Detection Prevalence

Balanced Accuracy

| | Class: 0 0 | Class: 0 1 | Class: 0 2 | Class: 0 3 | Class: 1 0 | Class: 1 1 | Class: 1 2 | Class: 1 3 | Class: 2 0 | Class: 2 1 | Class: 2 2 |
|----------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Sensitivity | 0.52564 | 0.5529 | 0.67273 | 0.76471 | 0.5333 | 0.62937 | 0.87356 | 0.7660 | 0.458333 | 0.97297 | 0.2593 |
| Specificity | 0.97386 | 0.9668 | 0.91860 | 0.93372 | 0.9963 | 0.98864 | 0.93750 | 0.9897 | 0.998160 | 0.96100 | 0.9981 |
| Pos Pred Value | 0.60294 | 0.7931 | 0.59043 | 0.48872 | 0.8000 | 0.89109 | 0.54286 | 0.7660 | 0.846154 | 0.73469 | 0.8750 |
| Neg Pred Value | 0.96453 | 0.9037 | 0.94150 | 0.97955 | 0.9872 | 0.94752 | 0.98867 | 0.9897 | 0.988160 | 0.99689 | 0.9635 |
| Prevalence | 0.07021 | 0.1872 | 0.14851 | 0.07651 | 0.0270 | 0.12871 | 0.07831 | 0.0423 | 0.021602 | 0.09991 | 0.0486 |
| Detection Rate | 0.03690 | 0.1035 | 0.09991 | 0.05851 | 0.0144 | 0.08101 | 0.06841 | 0.0324 | 0.009901 | 0.09721 | 0.0126 |
| Detection Prevalence | 0.06121 | 0.1305 | 0.16922 | 0.11971 | 0.0180 | 0.09091 | 0.12601 | 0.0423 | 0.011701 | 0.13231 | 0.0144 |
| Balanced Accuracy | 0.74975 | 0.7598 | 0.79567 | 0.84921 | 0.7648 | 0.80900 | 0.90553 | 0.8778 | 0.728247 | 0.96699 | 0.6287 |
| | Class: 2 3 | Class: 2 4 | | | | | | | | | |
| Sensitivity | 0.80000 | 0.6667 | | | | | | | | | |
| Specificity | 0.97479 | 0.9925 | | | | | | | | | |
| Pos Pred Value | 0.54237 | 0.7647 | | | | | | | | | |
| Neg Pred Value | 0.99240 | 0.9879 | | | | | | | | | |