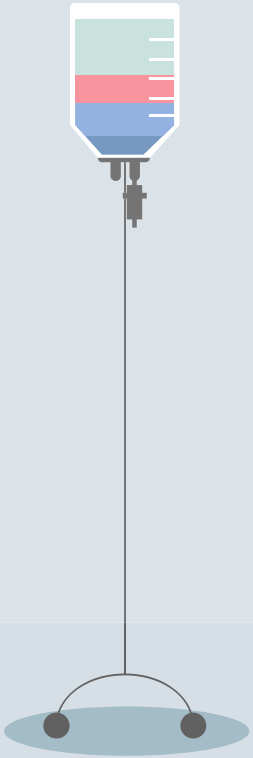
EPILEPSY DETECTION

Chi Hui, Wilson, Sabrina, Zachary

TABLE OF CONTENTS



01
PROBLEM STATEMENT

02
TIME SERIES

DATA PREPARATION
ANALYSIS
PROBLEM OF TIME SERIES

03
FOURIER SERIES

DATA PREPARATION
ANALYSIS

04
CONCLUSION

PROBLEM STATEMENT

- EEG Dataset
- Can we detect epilepsy?
  - Classification Problem
- What is the best model to detect epilepsy?
  - Accuracy and FNR

DATA PREPARATION FOR TIME SERIES

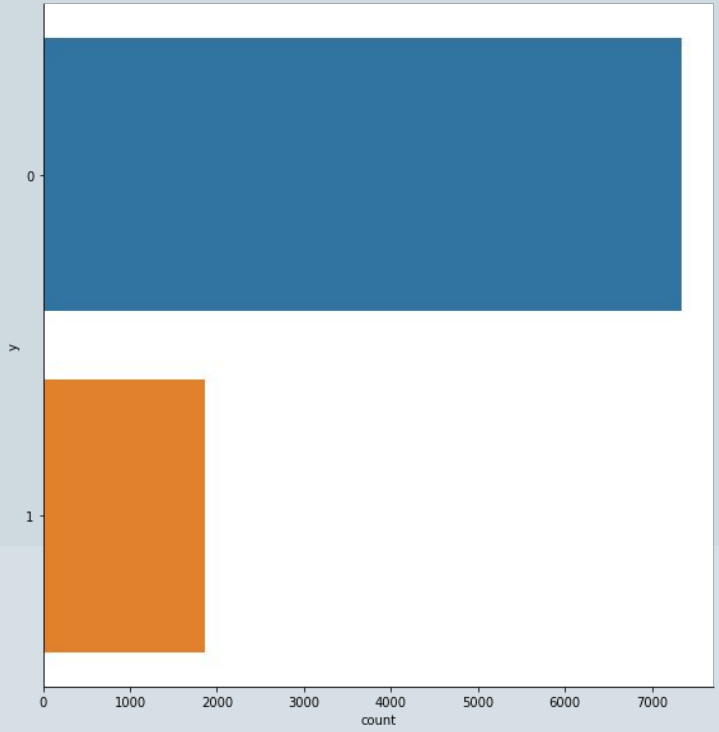
	Unnamed: 0	X1	X2	X3	X4	X5	X6	X7	X8	X9	...	X170	X171	X172	X173	X174	X175	X176	X177	X178	y
0	X21.V1.791	135	190	229	223	192	125	55	-9	-33	...	-17	-15	-31	-77	-103	-127	-116	-83	-51	4
1	X15.V1.924	386	382	356	331	320	315	307	272	244	...	164	150	146	152	157	156	154	143	129	1
2	X8.V1.1	-32	-39	-47	-37	-32	-36	-57	-73	-85	...	57	64	48	19	-12	-30	-35	-35	-36	5
3	X16.V1.60	-105	-101	-96	-92	-89	-95	-102	-100	-87	...	-82	-81	-80	-77	-85	-77	-72	-69	-65	5
4	X20.V1.54	-9	-65	-98	-102	-78	-48	-16	0	-21	...	4	2	-12	-32	-41	-65	-83	-89	-73	5

DATA PREPARATION FOR TIME SERIES

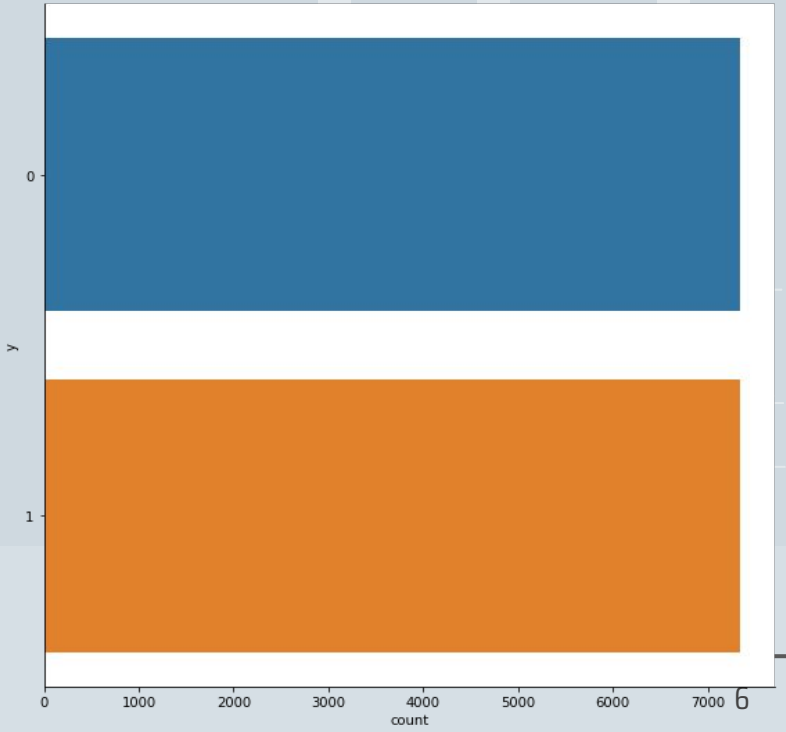
	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	...	X170	X171	X172	X173	X174	X175	X176	X177	X178	y
0	135	190	229	223	192	125	55	-9	-33	-38	...	-17	-15	-31	-77	-103	-127	-116	-83	-51	0
1	386	382	356	331	320	315	307	272	244	232	...	164	150	146	152	157	156	154	143	129	1
2	-32	-39	-47	-37	-32	-36	-57	-73	-85	-94	...	57	64	48	19	-12	-30	-35	-35	-36	0
3	-105	-101	-96	-92	-89	-95	-102	-100	-87	-79	...	-82	-81	-80	-77	-85	-77	-72	-69	-65	0
4	-9	-65	-98	-102	-78	-48	-16	0	-21	-59	...	4	2	-12	-32	-41	-65	-83	-89	-73	0

DATA PREPARATION
BALANCING THE DATASET

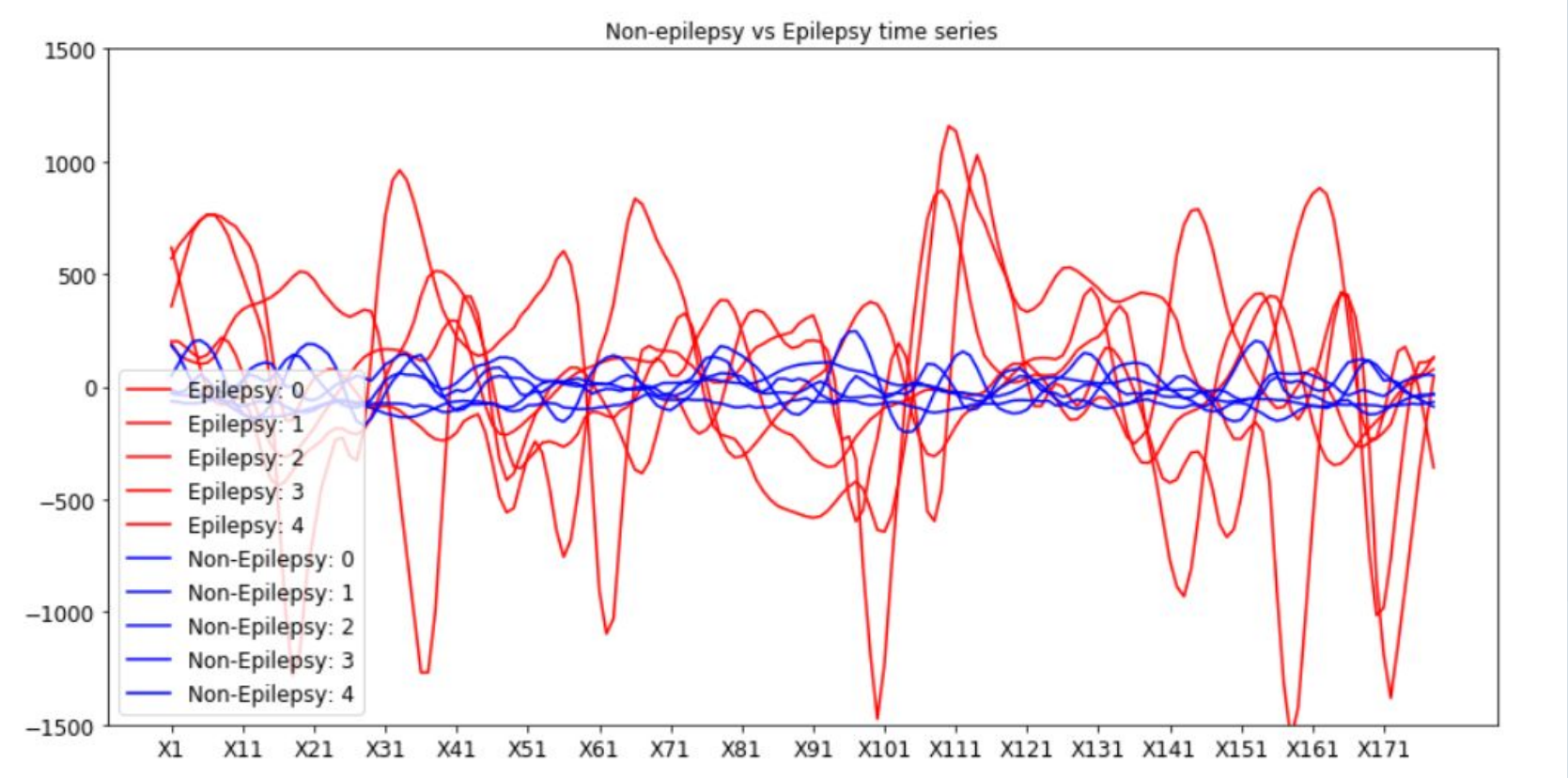
Before



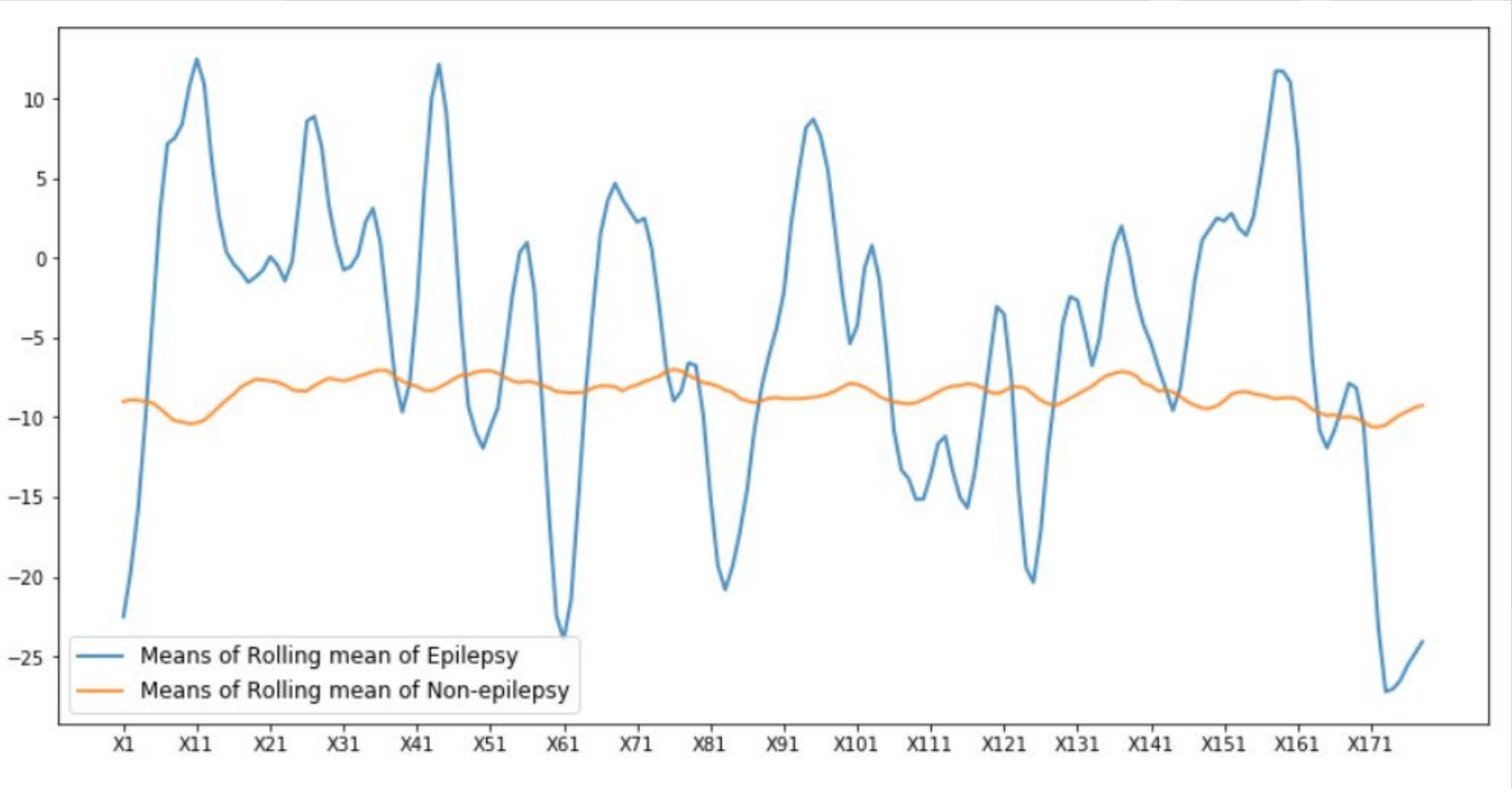
After



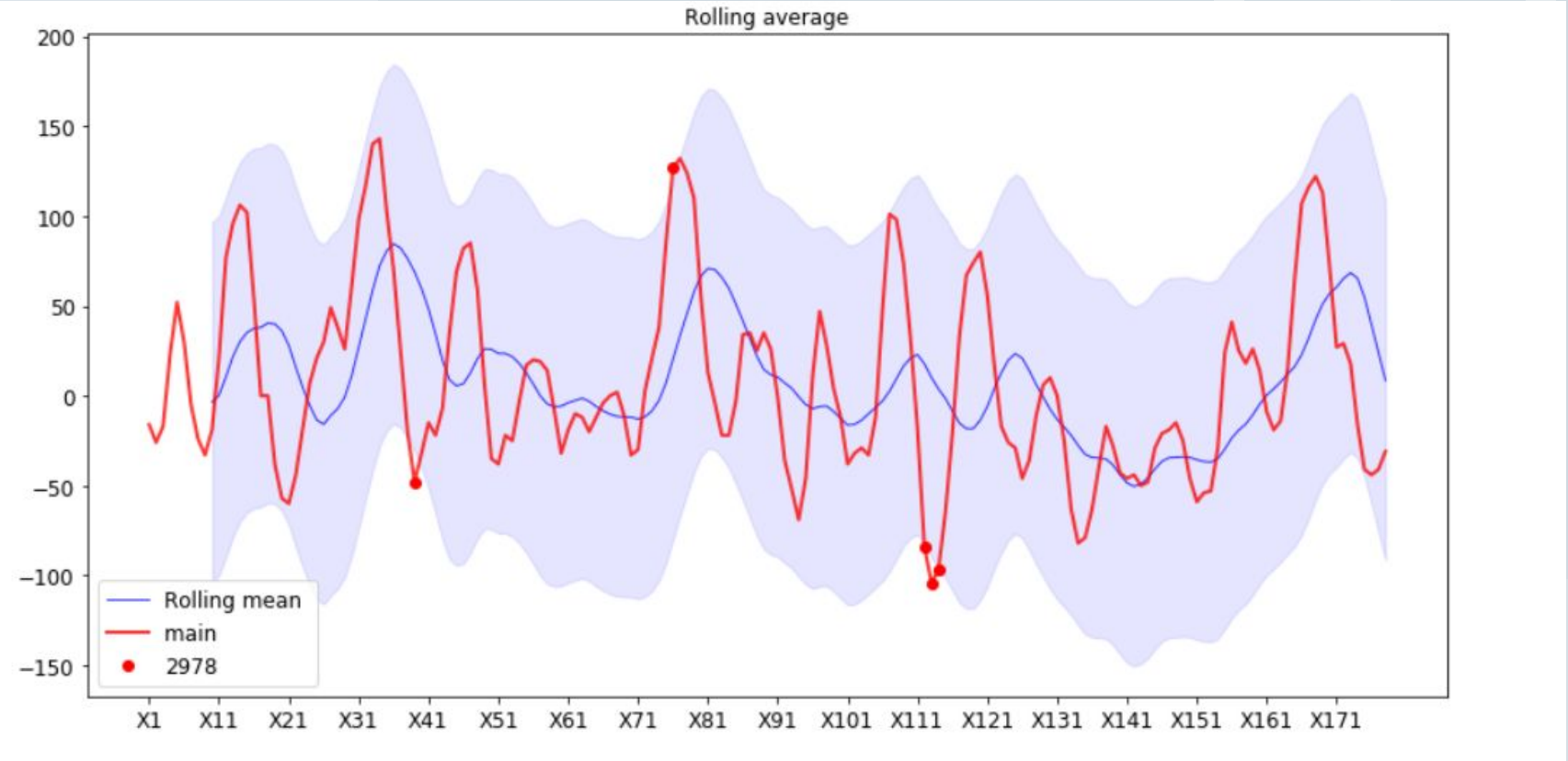
EXPLORATORY ANALYSIS FOR TIME SERIES



EXPLORATORY ANALYSIS FOR TIME SERIES

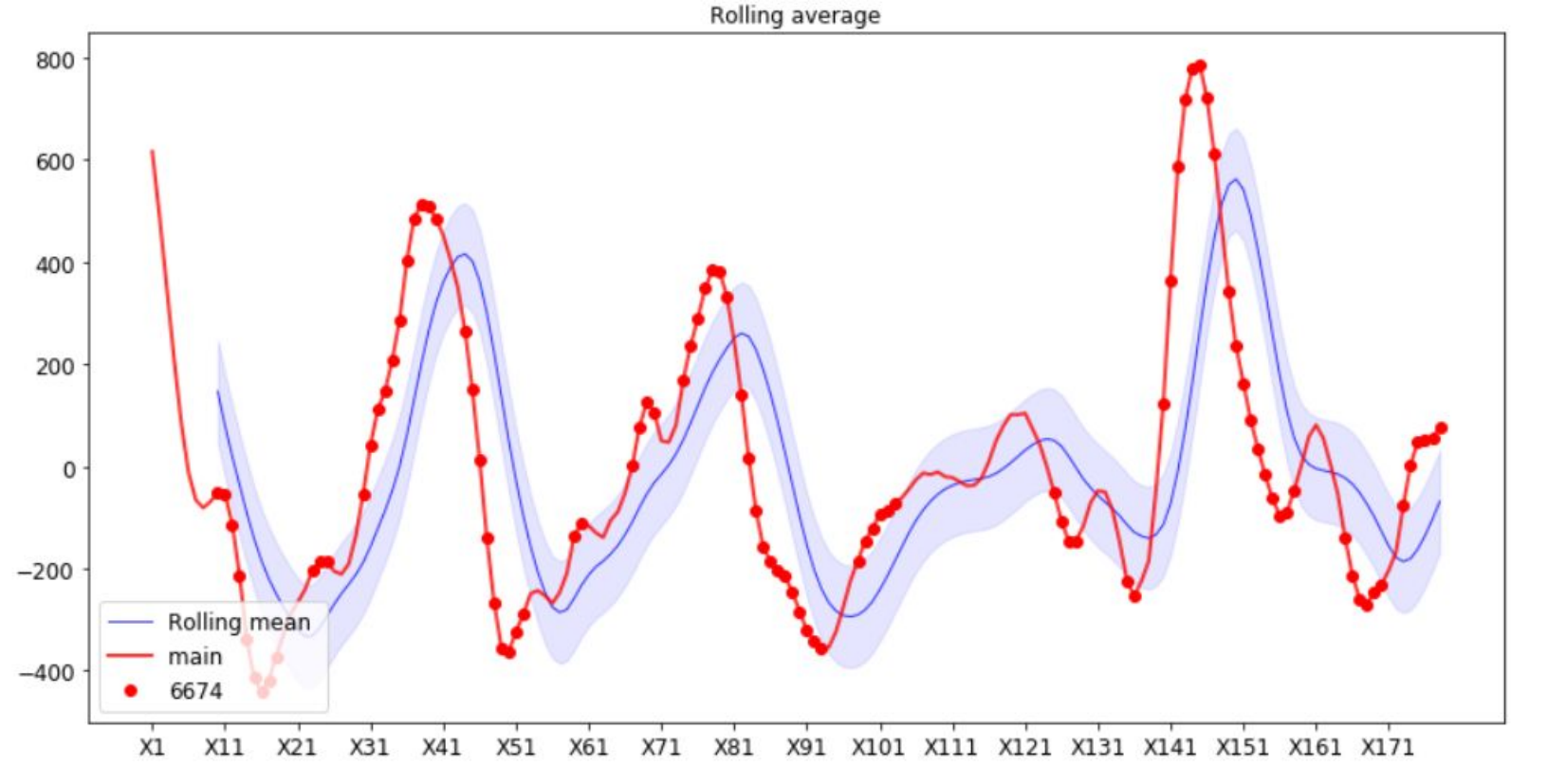


NON-EPILEPSY ANOMALY DETECTION



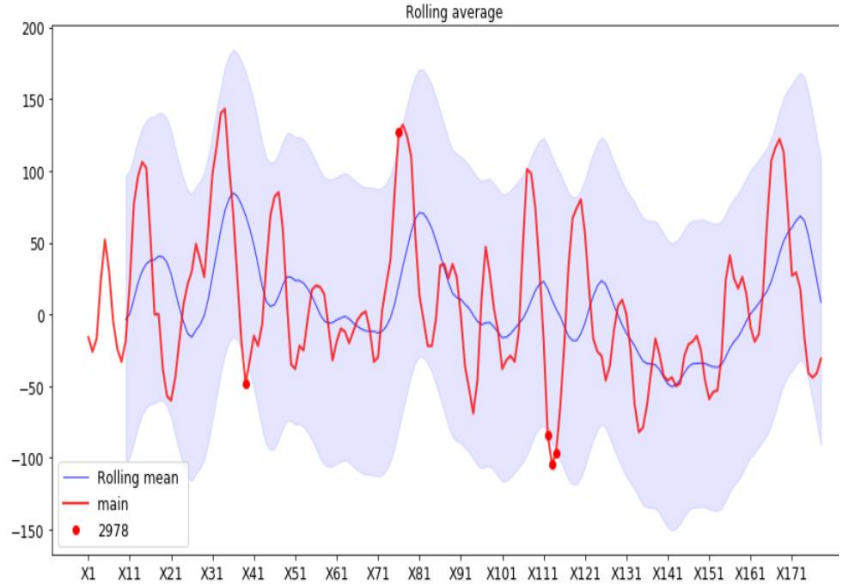
EXPLORATORY ANALYSIS FOR TIME SERIES

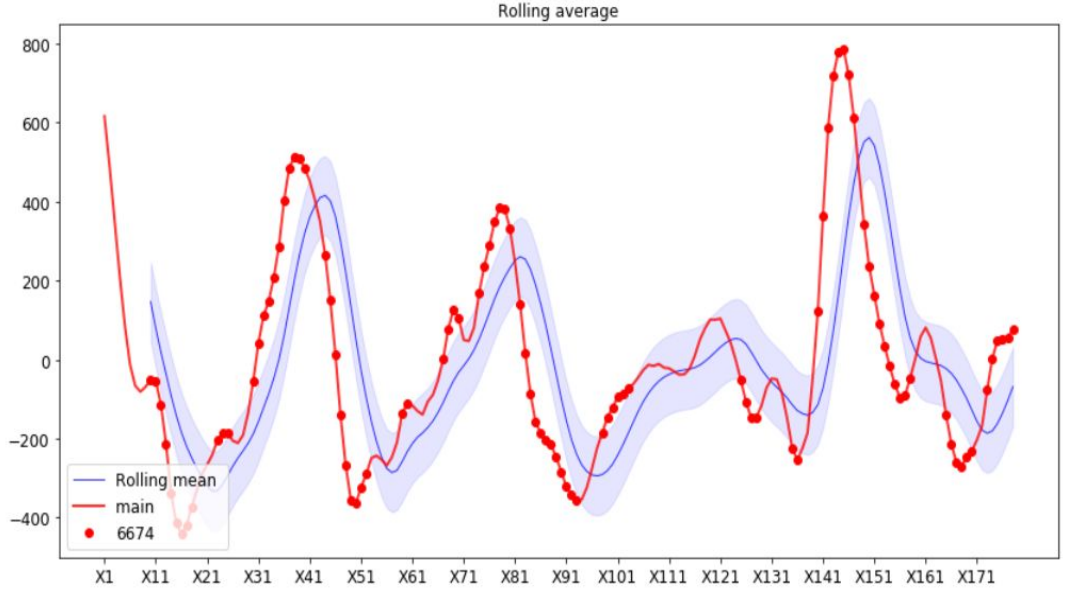
EPILEPSY ANOMALY DETECTION



EXPLORATORY ANALYSIS FOR TIME SERIES

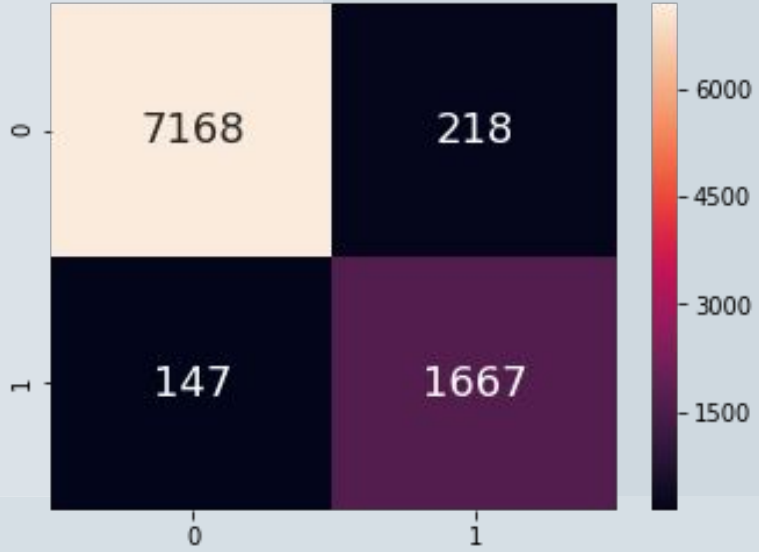
EPILEPSY ANOMALY DETECTION





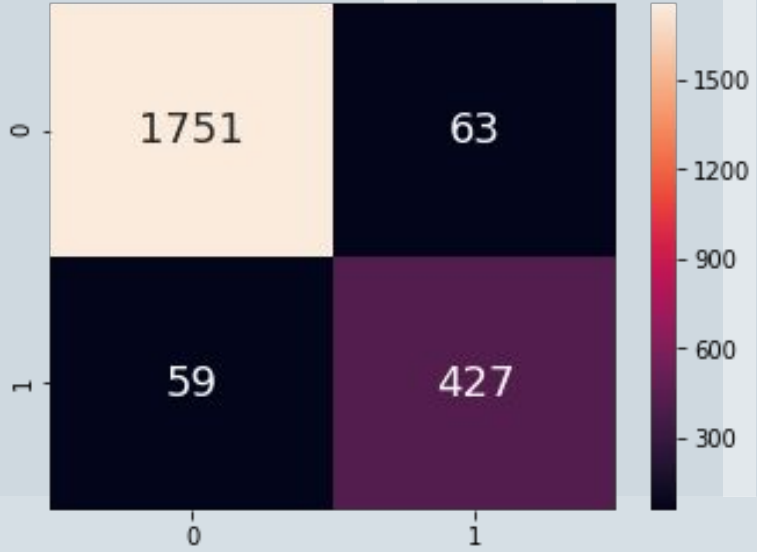
ANOMALY DETECTION

TRAIN DATASET



False Negative Rate : 0.0383
Accuracy: 0.9532

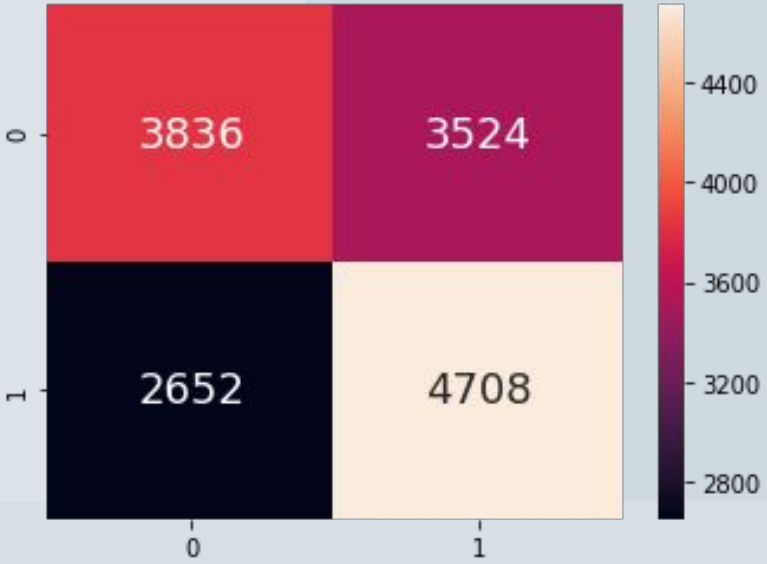
TEST DATASET



False Negative Rate : 0.0482
Accuracy: 0.9452

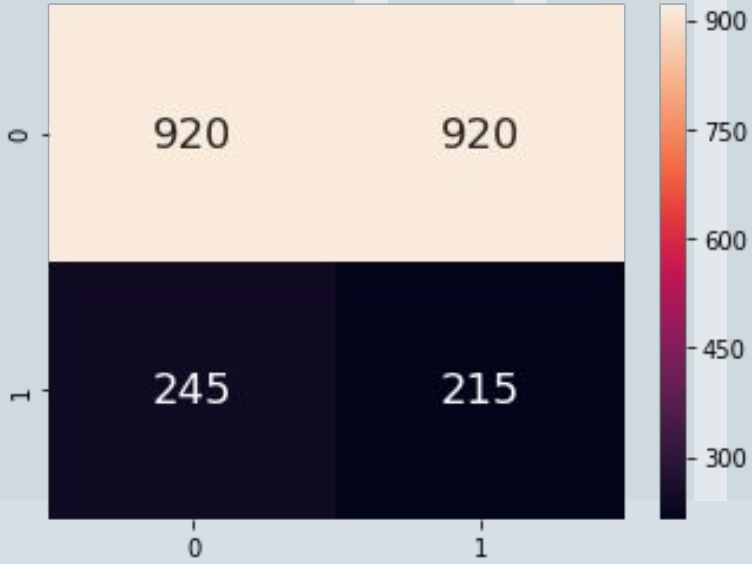
LOGISTIC REGRESSION

TRAIN DATASET



False Negative Rate : 0.3603
Accuracy: 0.5804

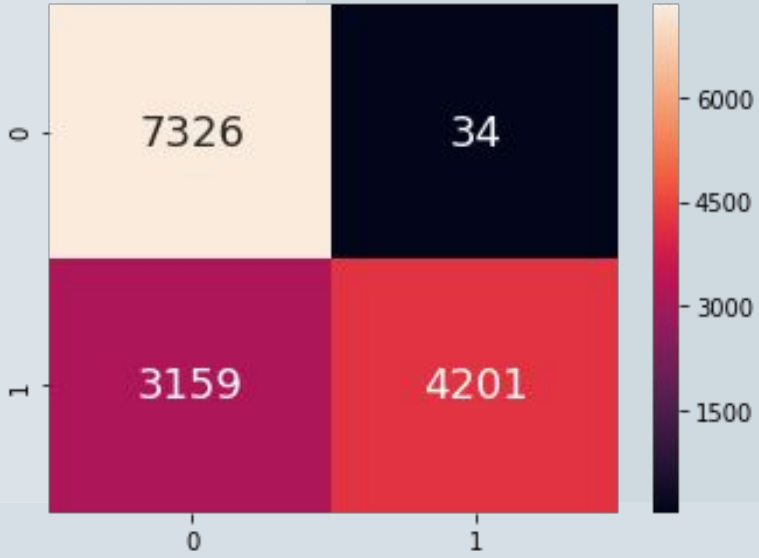
TEST DATASET



False Negative Rate : 0.5326
Accuracy: 0.4935

KNN (K NEAREST NEIGHBOURS)

TRAIN DATASET



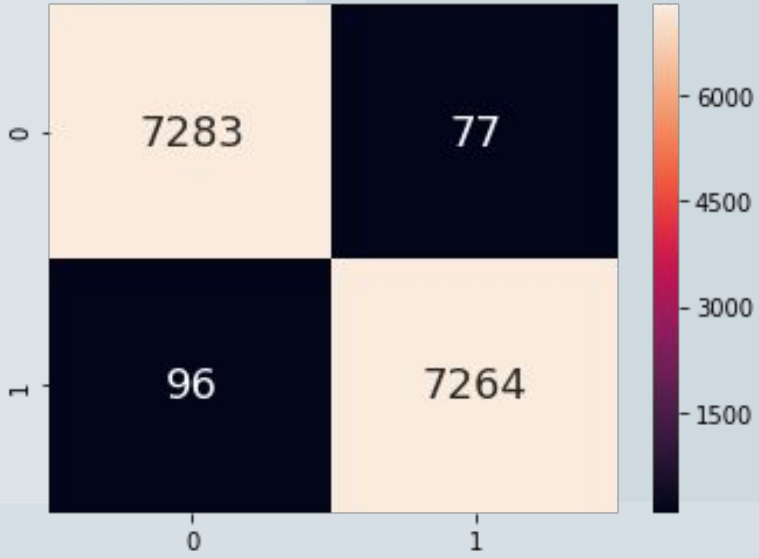
False Negative Rate : 0.4292
Accuracy: 0.7831

TEST DATASET

False Negative Rate : 0.3478
Accuracy: 0.9278

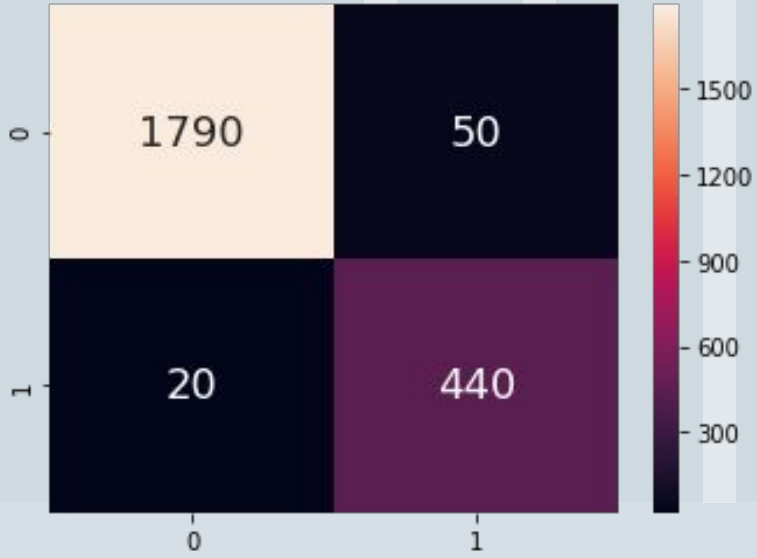
GRADIENT BOOSTING CLASSIFIER

TRAIN DATASET



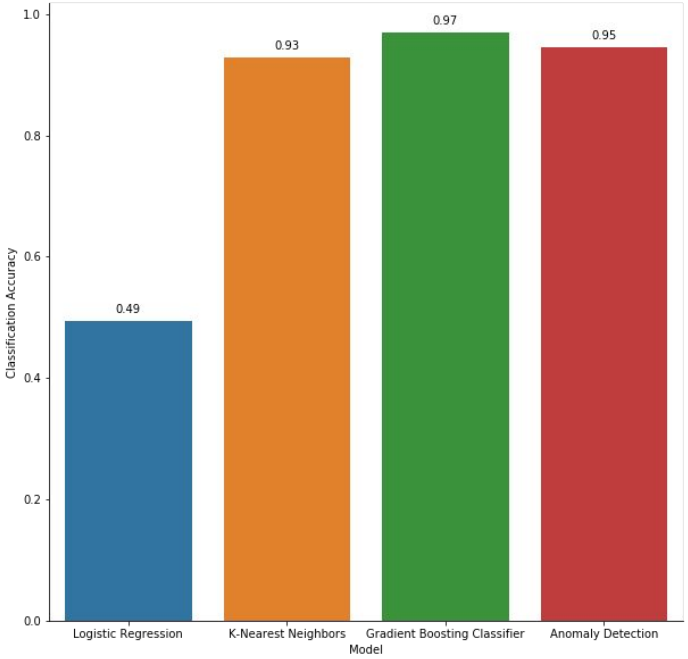
False Negative Rate : 0.0130
Accuracy: 0.9882

TEST DATASET

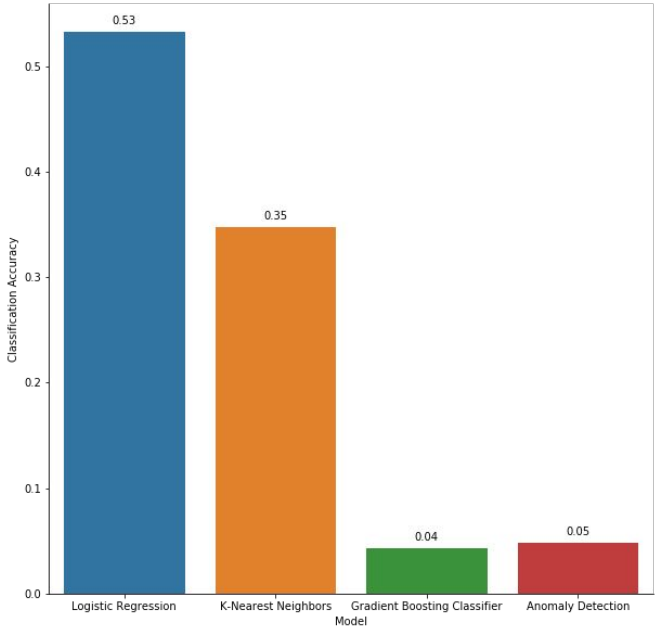


False Negative Rate : 0.0435
Accuracy: 0.9696

Comparing Models



ACCURACY



FNR

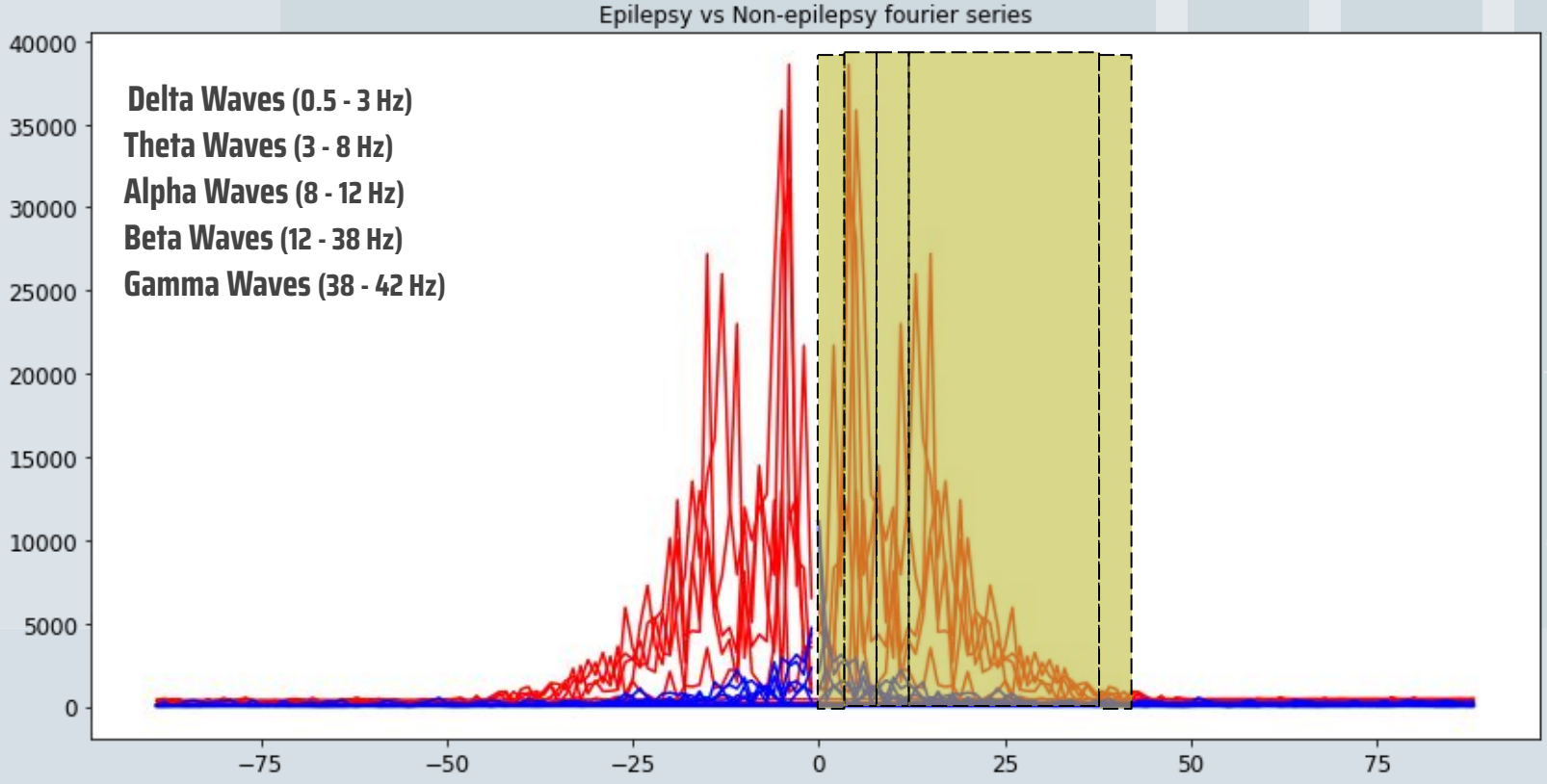
PROBLEMS WITH TIME SERIES

- Time series is dependent
  - Models will not work well
- Way to extract independent variables?
  - Fourier Series Transformation
  - Get coefficients of FST

DATA PREPARATION FOR FOURIER SERIES

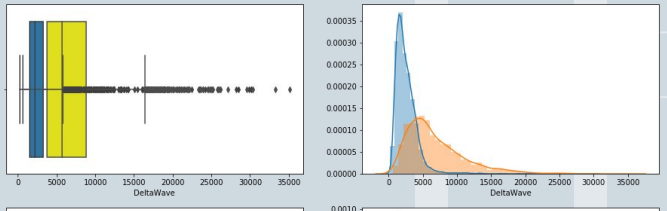
	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	...	-9.0	y
0	3010.0	2487.874510	3042.670412	4575.540392	2968.235055	918.227021	652.030611	825.916491	1896.711337	1315.552672	...	1315.552672	0
1	5004.0	7519.125524	16627.178261	31208.375473	22005.586446	17737.282651	6466.805002	16606.376540	17263.041626	6065.217440	...	6065.217440	1
2	7840.0	1148.524936	2400.247875	1338.690640	1356.274600	1271.831669	871.045139	1313.823920	1628.227864	1380.181087	...	1380.181087	0
3	12266.0	654.630444	617.868310	527.325447	478.143526	157.997898	176.298853	629.846337	97.879412	423.160998	...	423.160998	0
4	1184.0	2595.209155	728.397261	1141.155591	730.139183	1019.432565	488.478147	500.453402	621.851542	952.974618	...	952.974618	0

EXPLORATORY ANALYSIS FOR FOURIER SERIES

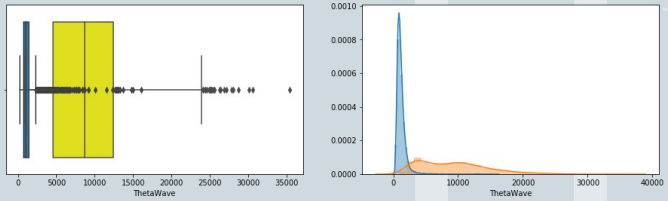


EXPLORATORY ANALYSIS FOR FOURIER SERIES

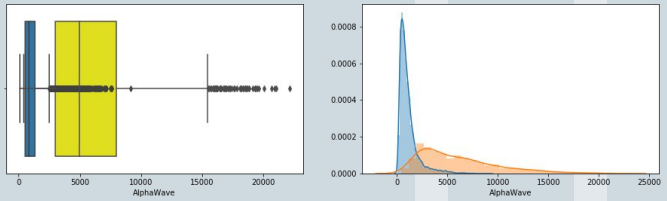
Delta Waves (0.5 - 3 Hz)



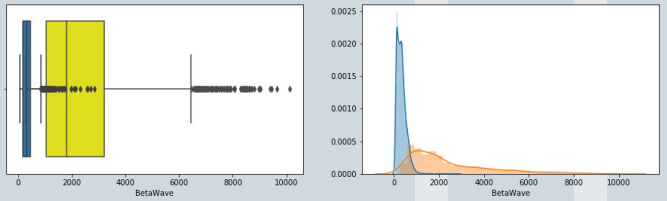
Theta Waves (3 - 8 Hz)



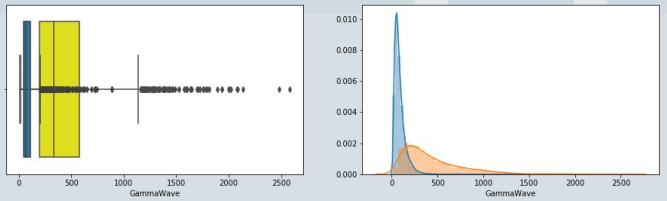
Alpha Waves (8 - 12 Hz)



Gamma Waves (38 - 42 Hz)



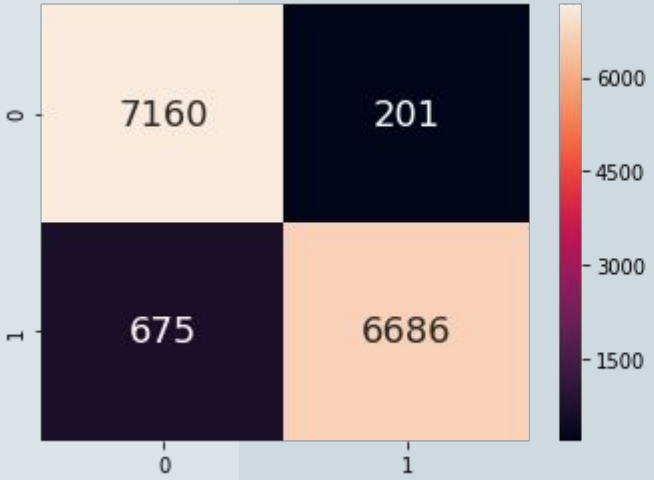
Beta Waves (12 - 38 Hz)



ANALYSIS
FOR FOURIER SERIES

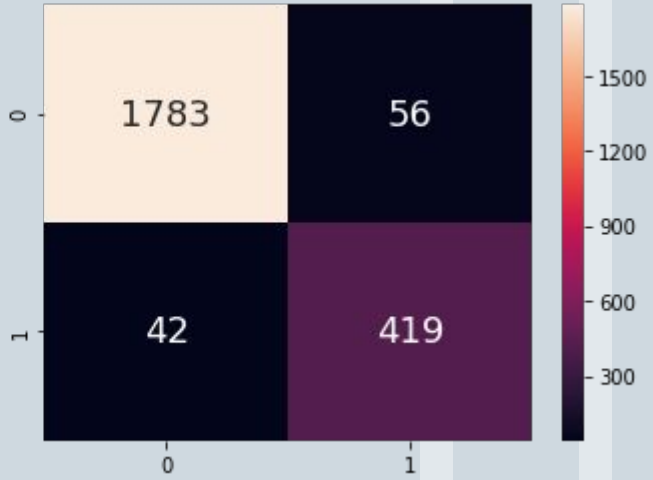
ANOMALY DETECTION

TRAIN DATASET



False Negative Rate: 0.0916
Accuracy: 0.9404

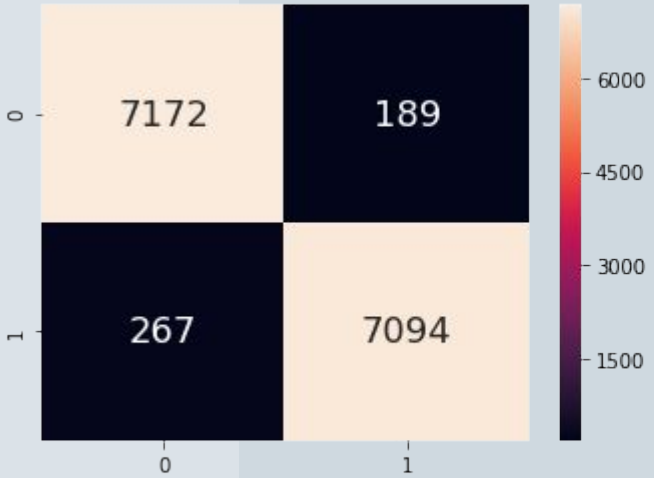
TEST DATASET



False Negative Rate: 0.0911
Accuracy: 0.9573

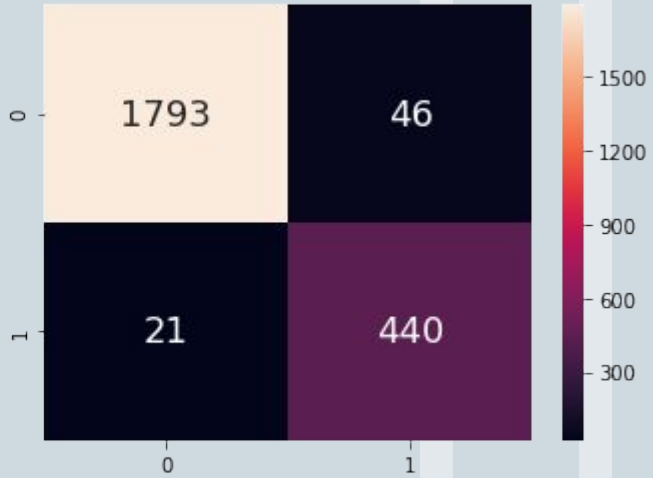
LOGISTIC REGRESSION

TRAIN DATASET



False Negative Rate: 0.0362
Accuracy: 0.9690

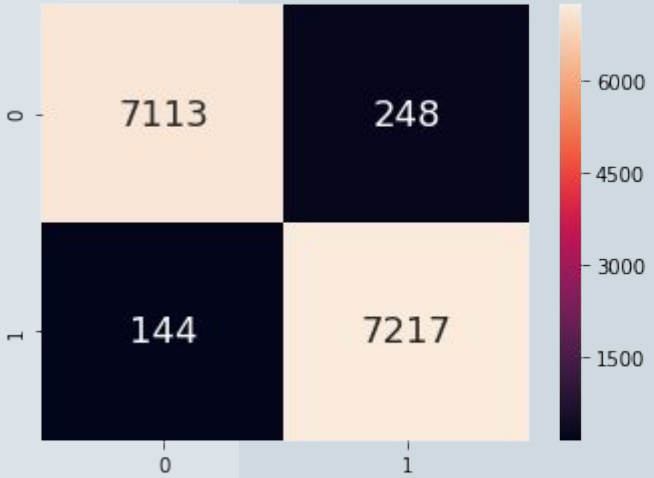
TEST DATASET



False Negative Rate: 0.0455
Accuracy: 0.9708

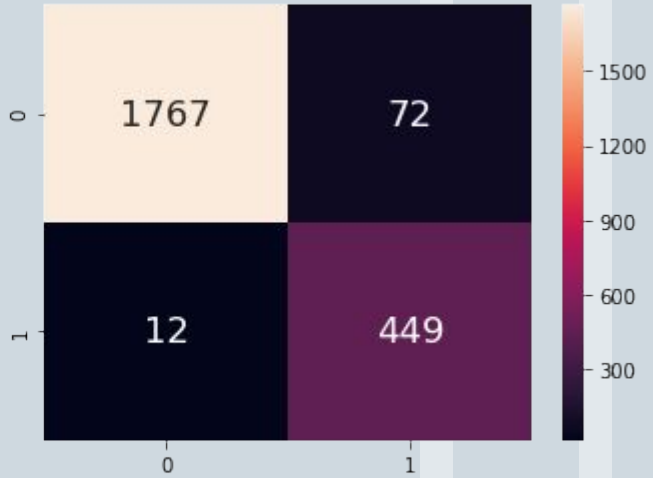
K NEAREST NEIGHBOUR

TRAIN DATASET



False Negative Rate: 0.0195
Accuracy: 0.9733

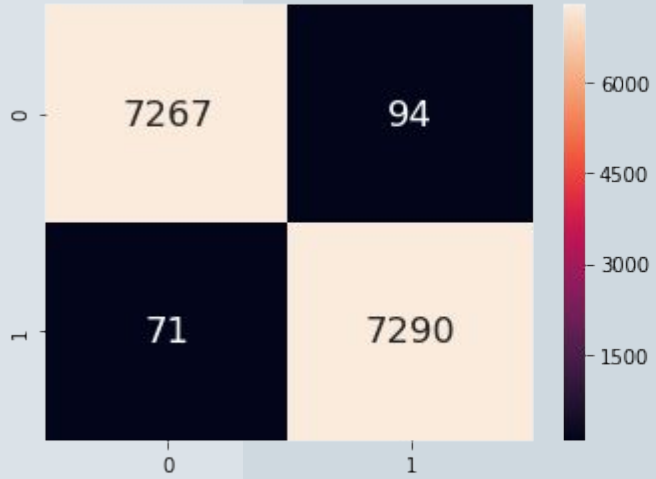
TEST DATASET



False Negative Rate: 0.0260
Accuracy: 0.9634

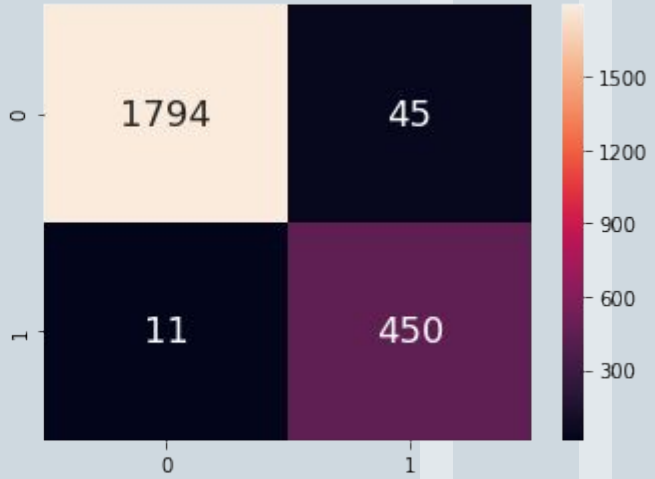
GRADIENT BOOSTING CLASSIFIER

TRAIN DATASET



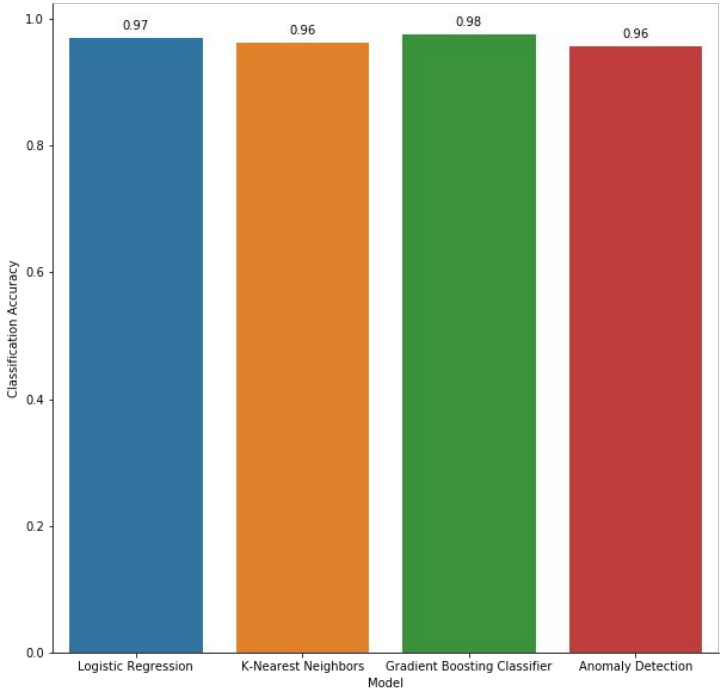
False Negative Rate: 0.0096
Accuracy: 0.9887

TEST DATASET

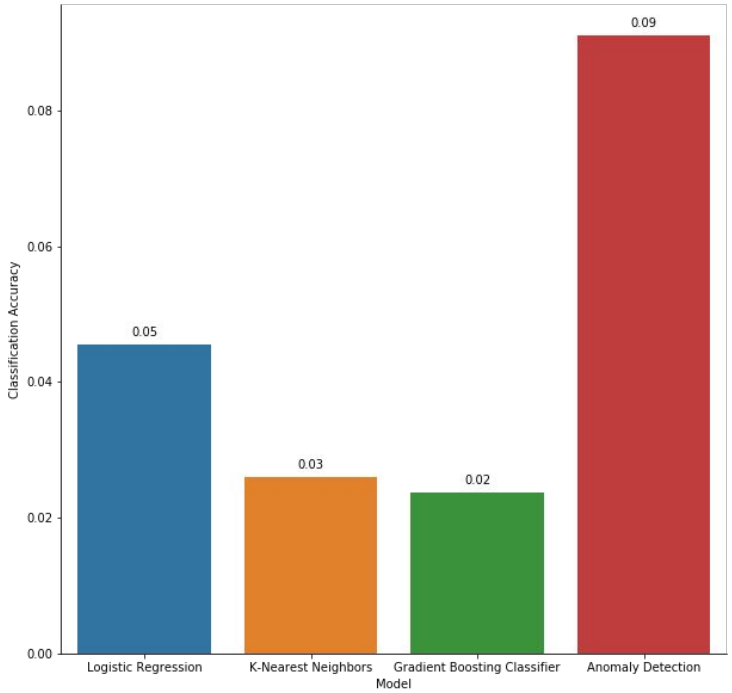


False Negative Rate: 0.0238
Accuracy: 0.9756

Comparing Models



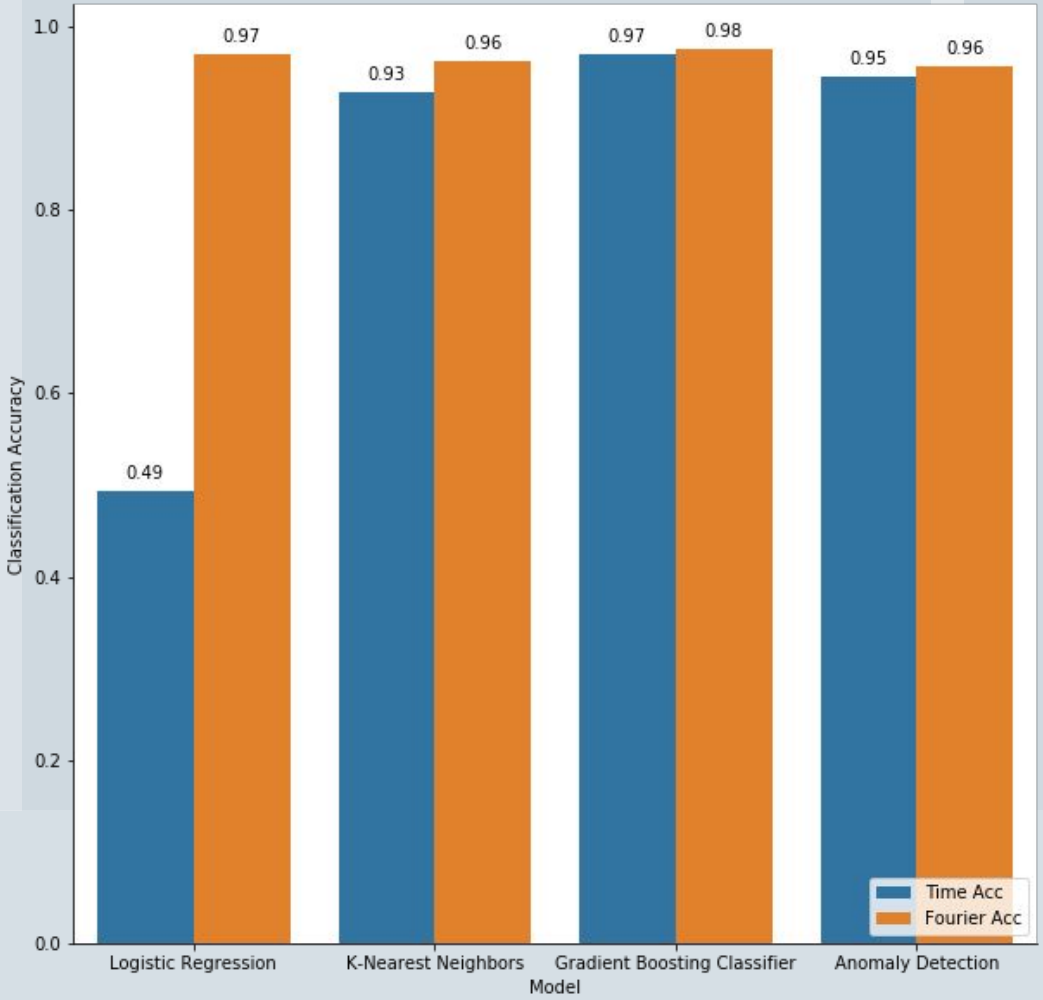
ACCURACY



FNR

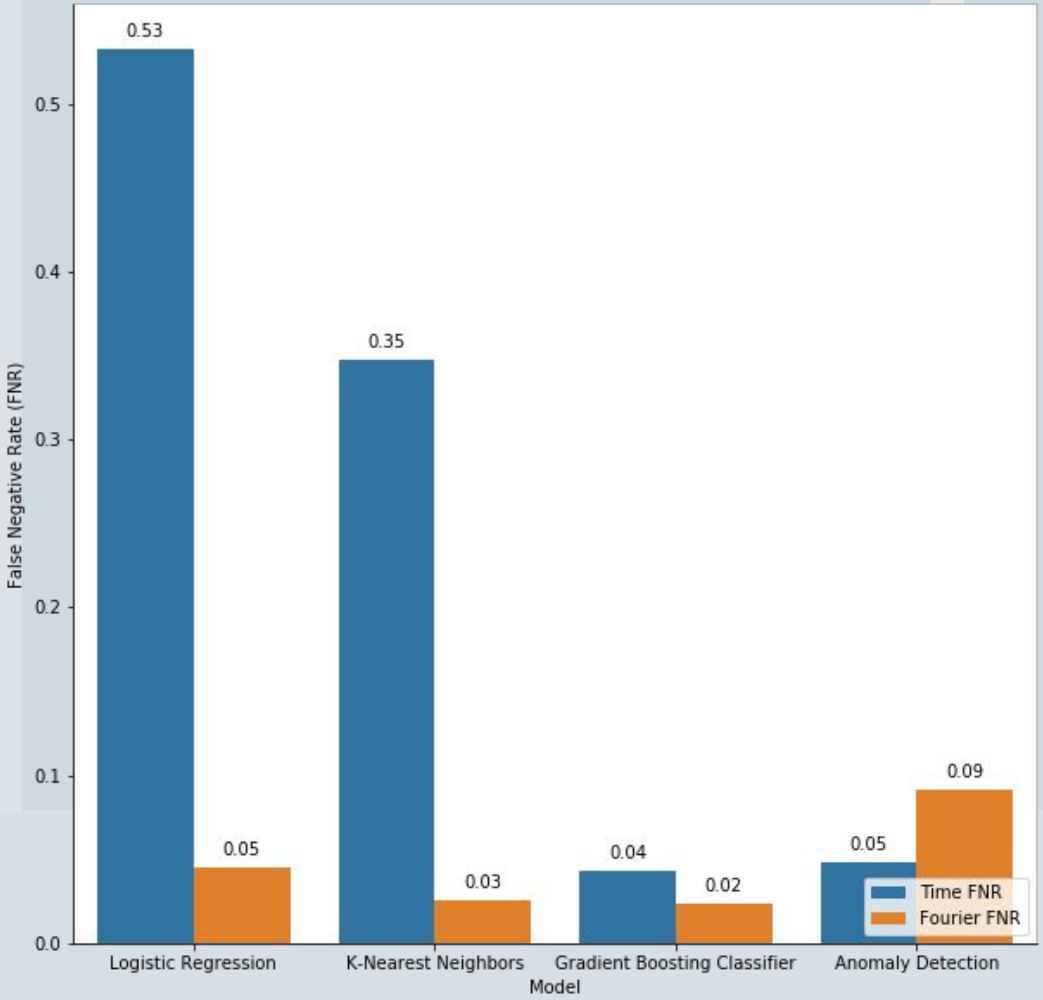
ANALYSIS

Classification Accuracy



ANALYSIS

False Negative Rate



CONCLUSION

- **Fourier Series**
- **Gradient Boosting Classifier**

FNR: **0.0238**

ACCURACY: **97.56%**

INDIVIDUAL CONTRIBUTIONS

- Time Series - Zach, Chi Hui
- Fourier Series - Wilson, Sabrina