SVKM's NMIMS
Mukesh Patel School of Technology Management & Engineering
Computer Engineering Department
Program: MBA Tech EXTC

Course: MBA. Tech (EXTC)
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Batch:	Date of Experiment: 6/1/2022
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Aim: Feature extraction of EEG Signals

Time domain features: min, max, mean, variance, standard deviation, RMS value, skewness, Kurtosis, Shannon entropy and log entropy

Instructions and Objective:

1. Open the data base of Neuromax Select any subjects between 3-9
2. Set the gain 30 μ V/mm, page speed 30 mm/sec, lower freq. 0.5 and higher 99 Hz enable the notch filter 50 HZ and Mont 3
3. Export the data from in excel for 10 secs, samples 2560 (both filtered and unfiltered)
4. Import the CSVs in Google Colab
5. Remove NaN values if any from the data
6. Perform various statistical analysis (for both dataset)
   a. Plot the graphs of statistical feature for both filtered and unfiltered data
   b. Plot the spectral graphs

Observations:

A. Unfiltered data

i. Individual signal characteristics

Individual Data for 5_unfiltered.csv

	Mean	Median	Summation	Variance	Standard Deviation	Shannon Entropy	Log Energy Entropy
FP2-A2	-532.105078	-538.0	-1362189.0	34918.605992	186.865208	11.020299	-7.638689
F8 -A2	-912.291406	-919.5	-2335466.0	50633.135057	225.018077	11.160303	-7.735733
T4 -A2	-683.771094	-685.0	-1750454.0	36277.901470	190.467586	11.120128	-7.707885
T6 -A2	-291.118359	-296.5	-745263.0	40198.961757	200.496787	10.563676	-7.322182
F4 -A2	-1018.371875	-1019.0	-2607032.0	10643.294246	103.166343	11.292742	-7.827532
C4 -A2	-370.224609	-378.0	-947775.0	37360.661137	193.289061	10.767502	-7.463464
P4 -A2	-56.543750	-62.5	-144752.0	49656.828097	222.838121	10.774761	-7.468495
O2 -A2	-748.427344	-750.5	-1915974.0	30537.644582	174.750235	11.176100	-7.746682
FP1-A1	89.635156	89.0	229466.0	8488.654645	92.133895	10.433953	-7.232265
F7 -A1	182.542188	181.5	467308.0	9088.840736	95.335412	10.770833	-7.465772
T3 -A1	-268.410937	-268.0	-687132.0	9389.642710	96.900169	11.006232	-7.628939
T5 -A1	-174.315234	-176.0	-446247.0	8472.975618	92.048768	10.765435	-7.462031
F3 -A1	-5.176953	-6.0	-13253.0	11575.022603	107.587279	10.779446	-7.471743
C3 -A1	-280.126562	-280.0	-717124.0	5242.481826	72.404985	11.146279	-7.726012
P3 -A1	49.713672	49.0	127267.0	9956.438109	99.781953	10.560701	-7.320120
O1 -A1	349.441797	348.0	894571.0	12698.221699	112.686386	11.066104	-7.670439
BP1-REF	-908.325000	-936.0	-2325312.0	162914.573505	403.626775	11.107876	-7.699393

ii. Left and right hemisphere characteristics

Hemisphere Data for 5_unfiltered.csv

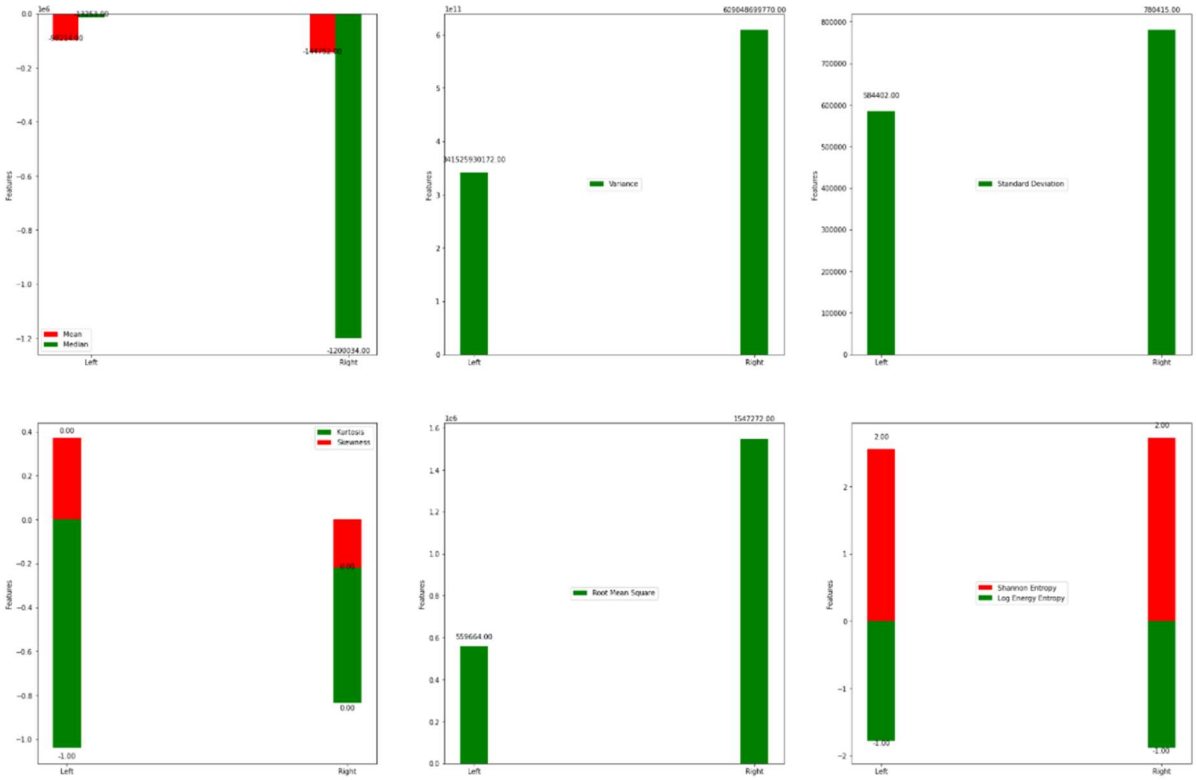
	Left	Right
Mean	-1.814300e+04	-1.476113e+06
Median	5.700700e+04	-1.556322e+06
Summation	-1.451440e+05	-1.180890e+07
Variance	3.243688e+11	6.978557e+11
Standard Deviation	5.695338e+05	8.353776e+05
Shannon Entropy	2.296372e+00	2.467787e+00

iii. ECG characteristics

ECG Data for 5_unfiltered.csv

	BP1	BP2
Mean	-6.062273e+02	-9.083250e+02
Median	-6.050000e+02	-9.360000e+02
Summation	-1.551942e+06	-2.325312e+06
Variance	5.767807e+02	1.629146e+05
Standard Deviation	2.401626e+01	4.036268e+02
Shannon Entropy	1.131739e+01	1.110788e+01
Log Energy Entropy	-7.844618e+00	-7.699393e+00

iv. Graphs



B. Filtered data

i. Individual signal characteristics

Individual Data for 5_filtered.csv

	Mean	Median	Summation	Variance	Standard Deviation	Shannon Entropy	Log Energy Entropy
FP2-A2	0.037109	-1.0	95.0	826.277247	28.745039	9.991692	-6.925713
F8 -A2	0.013281	0.0	34.0	374.283528	19.346409	9.989861	-6.924444
T4 -A2	0.019922	-1.0	51.0	629.104331	25.081952	9.702919	-6.725551
T6 -A2	-0.014453	0.0	-37.0	361.839963	19.022091	9.910432	-6.869388
F4 -A2	0.015234	-0.5	39.0	367.993906	19.183167	10.286965	-7.130381
C4 -A2	0.032813	-1.0	84.0	399.743354	19.993583	9.960380	-6.904010
P4 -A2	0.003125	0.0	8.0	576.565836	24.011785	10.069736	-6.979809
O2 -A2	0.007422	0.0	19.0	325.106236	18.030703	10.051941	-6.967474
FP1-A1	-0.016016	1.0	-41.0	1015.930576	31.873666	9.845378	-6.824296
F7 -A1	-0.012109	0.0	-31.0	682.249560	26.119907	10.197430	-7.068320
T3 -A1	-0.008594	0.0	-22.0	475.606804	21.808411	10.057748	-6.971500
T5 -A1	-0.006250	0.0	-16.0	524.801837	22.908554	10.117729	-7.013075
F3 -A1	0.001953	0.0	5.0	542.681903	23.295534	9.989024	-6.923864
C3 -A1	-0.013672	0.0	-35.0	510.626230	22.597040	10.054928	-6.969545
P3 -A1	-0.024219	1.0	-62.0	521.439820	22.835057	10.057916	-6.971616
O1 -A1	-0.017188	2.0	-44.0	1264.352186	35.557730	9.956933	-6.901620
BP1-REF	0.066016	-37.0	169.0	125332.497790	354.023301	9.165193	-6.352828

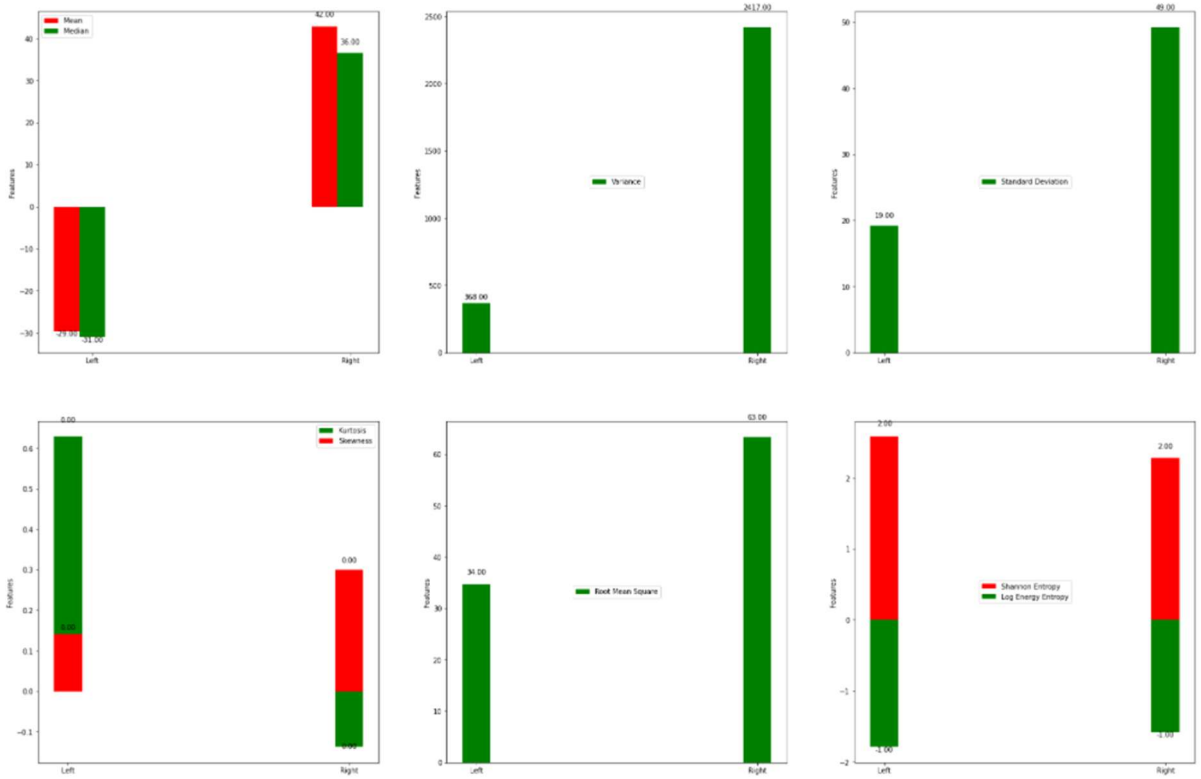
ii. Left and right hemisphere characteristics

Hemisphere Data for 5_filtered.csv		
	Left	Right
Mean	-30.750000	36.625000
Median	-33.000000	36.500000
Summation	-246.000000	293.000000
Variance	406.785714	1774.553571
Standard Deviation	20.168929	42.125450
Shannon Entropy	2.445421	2.238853
Log Energy Entropy	-1.695037	-1.551855

iii. ECG characteristics

ECG Data for 5_filtered.csv		
	BP1	BP2
Mean	-0.024219	0.066016
Median	0.000000	-37.000000
Summation	-62.000000	169.000000
Variance	246.054122	125332.497790
Standard Deviation	15.686112	354.023301
Shannon Entropy	9.299781	9.165193
Log Energy Entropy	-6.446117	-6.352828

iv. Graphs



Conclusion: In this experiment, we extracted data from NeuroMax, and used python to find characteristics like mean, median, variance, deviation, Shannon entropy and others, for individual parameters, and the two hemispheres. Then we plotted data for parameters obtained for the hemispheres