Analysis Report

Purpose:

This is to provide a writeup about the DNA methylation data analysis lecture's homework for the course "*Setting Bioinformatics Pipelines*". The report summarizes the group work doing the analysis of described in the following paper (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9706884/) and using the https://www.ncbi.nlm.nih.gov/geo/query/acc.cgi?acc=GSE188573 dataset.

Pre-implementation thoughts:

The paper conducted analysis on COVID19 individuals (48) and used another 11 participants as "healthy" or reference controls. The research team done multiple analysis using different original and public monocytes datasets. DNA methylation was done using the EPIC arrays.

Implementation:

1. Dataset
   1.1. The Methylation array dataset (GSE188573) was downloaded using GEOquery.
   1.2. The Data sample was created to accommodate the analysis tools requirements.
2. ShinyÉPICo– differentially methylated positions (DMPs).
   2.1. CpH and SNP removed by the Noob method.
   2.2. Sex chromosomes (X and Y) were removed.
   2.3. Quantile normalization.
   2.4. Group & gender was used as variable for the model.
   2.5 DMPs analysis.
3. ChAMP– differentially methylation regions (DMRs).
   3.1. The dataset was filtered and normalized using the Beta MIxture Quantile dilation (BMIQ).
   3.2. The DMRs was detected using the Bumphunter method.
   3.3. GSEA analysis was done based on the DMRs and normalized results.
4. ChAMP – DMRS.

Results:

ShinyÉPICo pre-analysis and QC plots

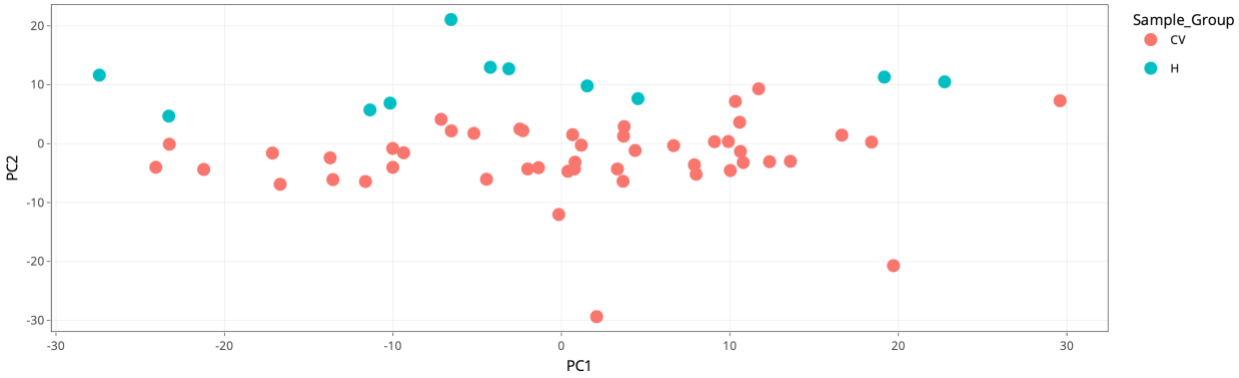

Figure 1: PCA plot.

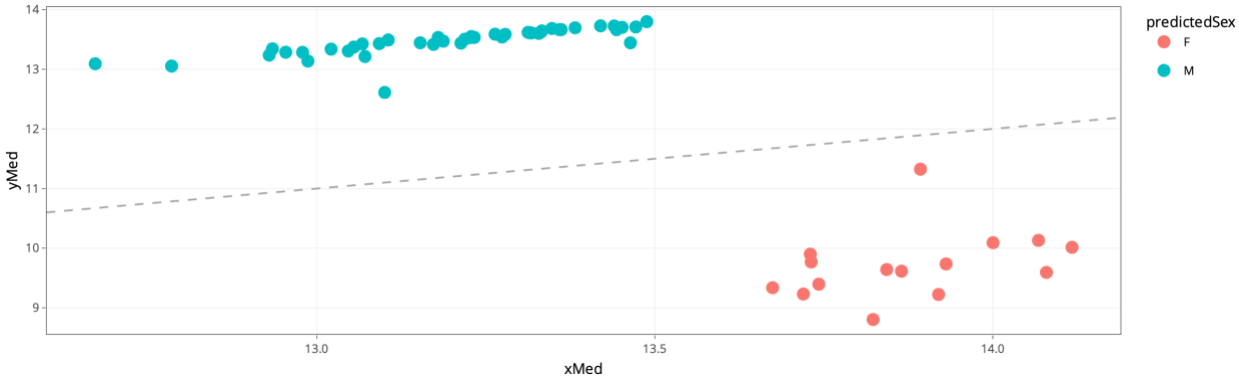

Figure 2: Gender prediction.

ShinyÉPICo DMPs

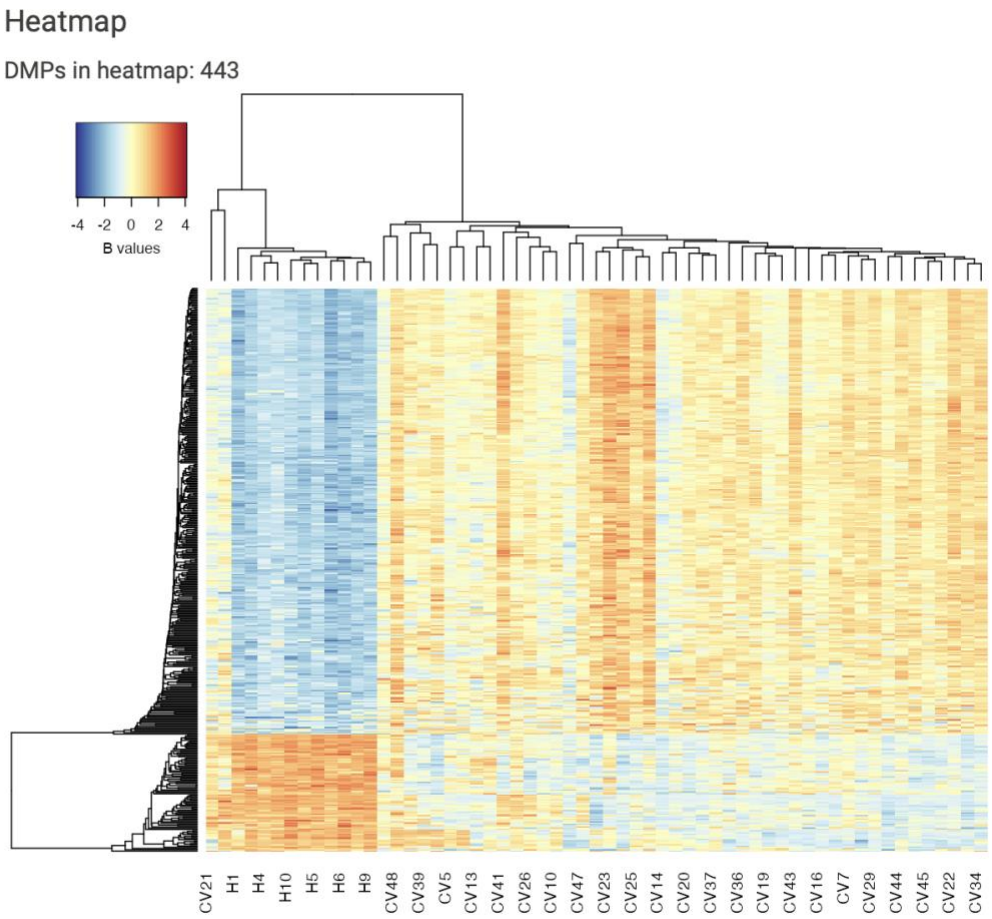

Figure 3: Heatmap based of significantly DMPs using group and gender as variables.

ChAMP DMPs

	seqnames	start	end	value	p.valueAre
DMR_1	chr22	45608345	45608713	-1.5409019	0.00096504
DMR_2	chr2	128458240	128458556	-1.5268398	0.00135365
DMR_3	chr1	1182418	1182424	2.0601044	0.03302525
DMR_4	chr12	6657744	6657972	-1.3327601	0.01802496
DMR_5	chr3	189348936	189349323	-1.2350003	0.00481875
DMR_6	chr13	26796956	26797529	-1.2351084	0.02153539
DMR_7	chr19	827576	827843	1.1663558	0.00571255

DMR_8	chr6	31543169	31543686	-0.9304682	0.00194952
DMR_9	chr1	25291385	25292274	-0.9912104	0.00203372
DMR_10	chr12	86229804	86230557	1.1000454	0.01025279
DMR_11	chr20	19866974	19867423	-1.0698765	0.01110125
DMR_12	chr6	30624395	30624769	-1.0228192	0.00566073
DMR_13	chr8	41522721	41523480	-0.9772544	0.00639909
DMR_14	chr12	6745057	6745707	-0.8319037	0.00323193
DMR_15	chr17	58499679	58499911	-0.9648038	0.00950796
DMR_16	chr10	135202522	135203102	-0.9445639	0.01020745
DMR_17	chr17	27044685	27045548	0.4372582	0.00729936
DMR_18	chr1	10509906	10510054	-0.9294847	0.04093991
DMR_19	chr17	79004850	79005662	-0.8435962	0.00691076
DMR_20	chr19	41882368	41882741	0.9243764	0.02537614
DMR_21	chr1	27961680	27961868	0.8960641	0.01765578
DMR_22	chr12	14996143	14996272	-0.9090594	0.04273399
DMR_23	chr6	31539973	31540750	-0.4545614	0.00776569
DMR_24	chr16	1494876	1495363	-0.8722121	0.01886047
DMR_25	chr19	9785295	9786077	0.7712042	0.00509725
DMR_26	chr6	30619137	30619242	-0.848729	0.02007811
DMR_27	chr9	125795488	125795935	0.8099939	0.01533709
DMR_28	chr5	102898463	102898733	0.7975814	0.0112826
DMR_29	chr20	20036632	20037346	-0.7928162	0.01147043
DMR_30	chr4	1294783	1295078	0.8214114	0.02168436
DMR_31	chr16	89043510	89043707	0.783408	0.01663245
DMR_32	chr6	28543508	28543693	-0.825323	0.03291515
DMR_33	chr20	62367108	62368256	-0.5464008	0.00829679
DMR_34	chr5	135415693	135416613	-0.5364433	0.00875017

DMR_35	chr18	77623199	77623598	-0.7454313	0.01348472
DMR_36	chr17	72620022	72620274	0.7592764	0.02626994
DMR_37	chr3	196065318	196065569	0.7573929	0.02640595
DMR_38	chr15	91427184	91428203	0.5302502	0.01137328
DMR_39	chr6	32904074	32904889	-0.7510639	0.02695648
DMR_40	chr11	47399813	47400199	0.6906055	0.01218936
DMR_41	chr16	85935556	85936480	-0.7212985	0.0146635
DMR_42	chr6	149805995	149806502	-0.7036971	0.01561559
DMR_43	chr21	36259067	36259797	0.6019892	0.01319974
DMR_44	chr16	1538347	1538826	-0.690266	0.01634747
DMR_45	chr2	239008705	239009246	-0.6826667	0.016898
DMR_46	chr3	195489708	195490309	0.6806052	0.01696276
DMR_47	chr12	54446019	54446576	0.5803319	0.01448862
DMR_48	chr8	1900353	1901041	-0.5773261	0.01465054
DMR_49	chr17	79792777	79793208	-0.5690778	0.01516869
DMR_50	chr8	19539991	19540479	0.6759086	0.01738376
DMR_51	chr17	79201972	79202947	-0.6754752	0.01740319
DMR_52	chr5	35230549	35230935	-0.6713844	0.01770112
DMR_53	chr6	10555682	10556326	-0.6701891	0.01777884
DMR_54	chr10	77542302	77542585	-0.5871206	0.01832289
DMR_55	chr19	7766717	7767566	-0.6760159	0.02400953
DMR_56	chr1	153599479	153599831	-0.4515244	0.01722831
DMR_57	chr5	157079404	157079668	0.6363438	0.02770779
DMR_58	chr20	57582706	57583091	0.5171205	0.01938509
DMR_59	chr12	123752628	123753272	0.5553626	0.02096543
DMR_60	chr7	100881007	100881367	0.627343	0.02858216
DMR_61	chr1	230415185	230415668	-0.6599501	0.03593982
DMR_62	chr17	33775779	33776683	0.4920248	0.01733842

DMR_63	chr16	57701317	57702239	0.6083725	0.02246805
DMR_64	chr15	91473059	91473569	0.4801285	0.02316107
DMR_65	chr12	122356033	122356852	0.4698499	0.02444348
DMR_66	chr15	22833149	22833400	0.5723277	0.02595258
DMR_67	chr8	22132874	22133356	-0.5711024	0.02610154
DMR_68	chr10	128994297	128994702	0.5447375	0.02906145
DMR_69	chr20	13976093	13976218	0.544179	0.02913917
DMR_70	chr12	322587	322920	-0.4826983	0.02928166
DMR_71	chr21	34774627	34775045	0.6159099	0.02970913
DMR_72	chr16	53407328	53407808	-0.471984	0.03073894
DMR_73	chr17	7461260	7461678	0.577743	0.0344372
DMR_74	chr7	27197614	27198429	0.5722298	0.03513669
DMR_75	chr19	57019005	57019373	0.5601902	0.03667817
DMR_76	chr5	162864268	162864496	0.3813276	0.03881552
DMR_77	chr20	3051954	3052274	0.4179171	0.03998782
DMR_78	chr2	183943388	183943938	0.4684796	0.04029871
DMR_79	chr17	80196719	80197538	-0.614964	0.04158112
DMR_80	chr12	4488749	4489155	-0.5229343	0.04221585
DMR_81	chr12	122711988	122712381	-0.4372889	0.04566799
DMR_82	chr6	33091567	33092097	0.5802296	0.04606307
DMR_83	chr8	27468981	27469338	0.5798805	0.04609546
DMR_84	chr3	182817338	182817626	-0.3833791	0.04682086
DMR_85	chr8	87521177	87521456	-0.5730733	0.04700869
DMR_86	chr8	17433625	17433926	0.5683734	0.04786362
DMR_87	chr11	112034801	112035175	0.5676912	0.04797373
DMR_88	chr9	130524679	130524915	0.4793449	0.04922375
DMR_89	chr3	155421735	155422159	0.4767273	0.04965122

Table 1: DMRs with significant FDR (< 0.05).