Thema09_EDA

Personal Access Token: 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

EDA

Smoker epigenetic dataset

A CpG island or CpG site is a part of the DNA where the GC content is greater than 50%. In this dataset methylation values of certain CpG sites are displayed with also the age, gender and smoking status for 671 people.

Research Question

Is it possible to identify a person's gender, age or status of smoking with certain given CpG values using Machine Learning?

Codebook

columns	names	type	descriptions
GSM	Sample Accessions numbers	chr	GSM identifier testsubject
Smoking.Status	Smoking status	chr	Wether the person is smoking or not
Gender	Gender	chr	Gender
Age	Age	int	Age
Columns 5-24	CG Island	num	Methylation Rate of CG Island

Data exploration

Visualization

GSM	Smoking.Status	Gender	Age	cg00050873	cg00212031
GSM1051525	current	f	67	0.6075634	0.4228427
GSM1051526	current	f	49	0.3450542	0.5686615
GSM1051527	current	f	53	0.3213497	0.3609091
GSM1051528	current	f	62	0.2772675	0.3044371
GSM1051529	never	f	33	0.4135991	0.1312511
GSM1051530	current	f	59	0.6228599	0.5016849

GSM	cg00213748	cg00214611	cg00455876	cg01707559	cg02004872	cg02011394
GSM1051525	0.3724549	0.6215619	0.2907773	0.2671431	0.1791439	0.4802517
GSM1051526	0.5005995	0.4986067	0.3745909	0.1902743	0.1559775	0.4180809
GSM1051527	0.3527315	0.3738240	0.2306740	0.3147052	0.1057448	0.6151030
GSM1051528	0.4752352	0.4862581	0.2951815	0.2957931	0.1112862	0.3010196
GSM1051529	0.3675446	0.7611667	0.2357703	0.2505265	0.1691084	0.3929746
GSM1051530	0.2632270	0.4157459	0.4751891	0.2539041	0.2607587	0.5097921

GSM	cg02050847	cg02233190	cg02494853	cg02839557	cg02842889	cg03052502
GSM1051525	0.3276078	0.2411204	0.0670696	0.2469934	0.4692396	0.4002466
GSM1051526	0.3464627	0.1754907	0.0469389	0.2367423	0.3074666	0.3770313
GSM1051527	0.2375392	0.2464092	0.0382371	0.2446117	0.3577526	0.3050442
GSM1051528	0.3045353	0.1770279	0.0267163	0.0016414	0.4457390	0.2714746
GSM1051529	0.3062257	0.3017014	0.0370164	0.3343197	0.3950396	0.3265530
GSM1051530	0.4052457	0.3852716	0.0258346	0.3092102	0.3218573	0.5333670

GSM	cg03155755	cg03244189	cg03443143	cg03683899	cg03695421	cg03706273
GSM1051525	0.4150313	0.2214331	0.4758258	0.2077242	0.2091974	0.1299826
GSM1051526	0.3973715	0.2171221	0.5444690	0.1844462	0.1937732	0.0985327
GSM1051527	0.5212775	0.1850495	0.5370600	0.3931231	0.2680030	0.0402481
GSM1051528	0.4344920	0.1654187	0.5079167	0.2812089	0.2178572	0.1015163
GSM1051529	0.4300966	0.1811352	0.4054791	0.3107944	0.2800708	0.0778571
GSM1051530	0.5715522	0.2109749	0.3778239	0.4693609	0.3433317	0.0457791

```
##      GSM            Smoking.Status        Gender              Age        
##  Length:621         Length:621         Length:621         Min.   :18.00  
##  Class :character   Class :character   Class :character   1st Qu.:46.00  
##  Mode  :character   Mode  :character   Mode  :character   Median :54.00  
##                                                           Mean   :52.59  
##                                                           3rd Qu.:61.00  
##                                                           Max.   :70.00  
##    cg00050873       cg00212031         cg00213748       cg00214611      
##  Min.   :0.1186   Min.   :0.006949   Min.   :0.0000   Min.   :0.01247  
##  1st Qu.:0.4131   1st Qu.:0.063172   1st Qu.:0.3635   1st Qu.:0.06946  
##  Median :0.5052   Median :0.365545   Median :0.4713   Median :0.41575  
##  Mean   :0.5600   Mean   :0.309601   Mean   :0.5191   Mean   :0.34106  
##  3rd Qu.:0.8144   3rd Qu.:0.459813   3rd Qu.:0.7278   3rd Qu.:0.49745  
##  Max.   :0.8989   Max.   :0.709992   Max.   :0.9236   Max.   :0.80606  
##    cg00455876        cg01707559        cg02004872         cg02011394     
##  Min.   :0.05917   Min.   :0.04333   Min.   :0.002616   Min.   :0.0000  
##  1st Qu.:0.29300   1st Qu.:0.11080   1st Qu.:0.042835   1st Qu.:0.4261  
##  Median :0.37968   Median :0.23873   Median :0.149332   Median :0.5157  
##  Mean   :0.44718   Mean   :0.21435   Mean   :0.155417   Mean   :0.6058  
##  3rd Qu.:0.66283   3rd Qu.:0.28061   3rd Qu.:0.242627   3rd Qu.:0.9412  
##  Max.   :0.85443   Max.   :0.46999   Max.   :0.473844   Max.   :0.9792  
##    cg02050847        cg02233190         cg02494853         cg02839557     
##  Min.   :0.05234   Min.   :0.008632   Min.   :0.01162   Min.   :0.00000  
##  1st Qu.:0.33963   1st Qu.:0.088375   1st Qu.:0.02865   1st Qu.:0.06384  
##  Median :0.42754   Median :0.259817   Median :0.03695   Median :0.35042  
##  Mean   :0.54369   Mean   :0.232498   Mean   :0.04077   Mean   :0.30088  
##  3rd Qu.:0.95558   3rd Qu.:0.337023   3rd Qu.:0.04677   3rd Qu.:0.45786  
##  Max.   :0.98320   Max.   :0.511730   Max.   :0.28947   Max.   :0.82739  
##    cg02842889        cg03052502        cg03155755        cg03244189      
##  Min.   :0.01346   Min.   :0.0000   Min.   :0.2020   Min.   :0.02972  
##  1st Qu.:0.05483   1st Qu.:0.4025   1st Qu.:0.4245   1st Qu.:0.11976  
##  Median :0.39757   Median :0.4940   Median :0.4962   Median :0.20397  
##  Mean   :0.32362   Mean   :0.5907   Mean   :0.5895   Mean   :0.19552  
##  3rd Qu.:0.47385   3rd Qu.:0.9631   3rd Qu.:0.8988   3rd Qu.:0.24921  
##  Max.   :0.85625   Max.   :0.9902   Max.   :0.9696   Max.   :0.54074  
##    cg03443143        cg03683899         cg03695421        cg03706273      
##  Min.   :0.06496   Min.   :0.00788   Min.   :0.0949   Min.   :0.01120  
##  1st Qu.:0.40963   1st Qu.:0.06159   1st Qu.:0.2566   1st Qu.:0.03413  
##  Median :0.48314   Median :0.34422   Median :0.3208   Median :0.04961  
##  Mean   :0.56841   Mean   :0.28442   Mean   :0.3978   Mean   :0.05769  
##  3rd Qu.:0.85436   3rd Qu.:0.41866   3rd Qu.:0.5965   3rd Qu.:0.06916  
##  Max.   :0.93589   Max.   :0.65925   Max.   :0.8433   Max.   :0.34380
```

Below there are some histograms which visualizes the distribution of smoking status, age and gender.

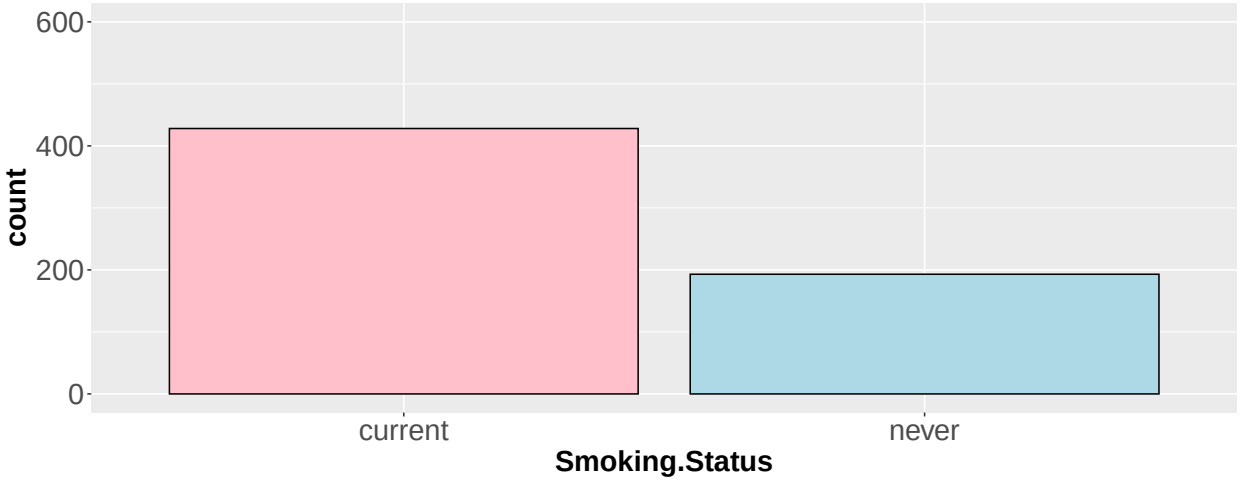


Figure 3.1: Number of people who are smoking

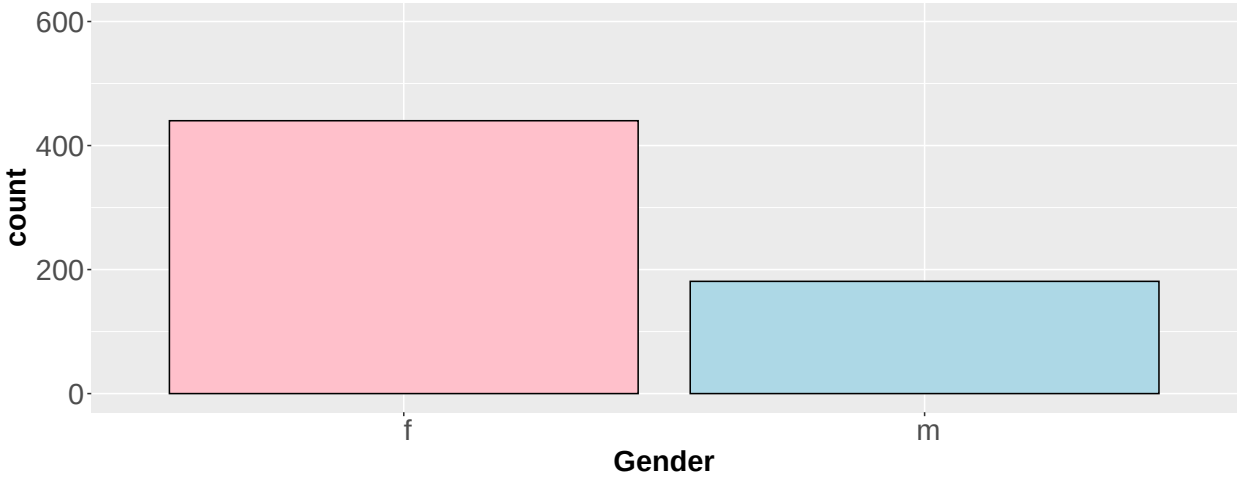


Figure 3.2: Gender distribution

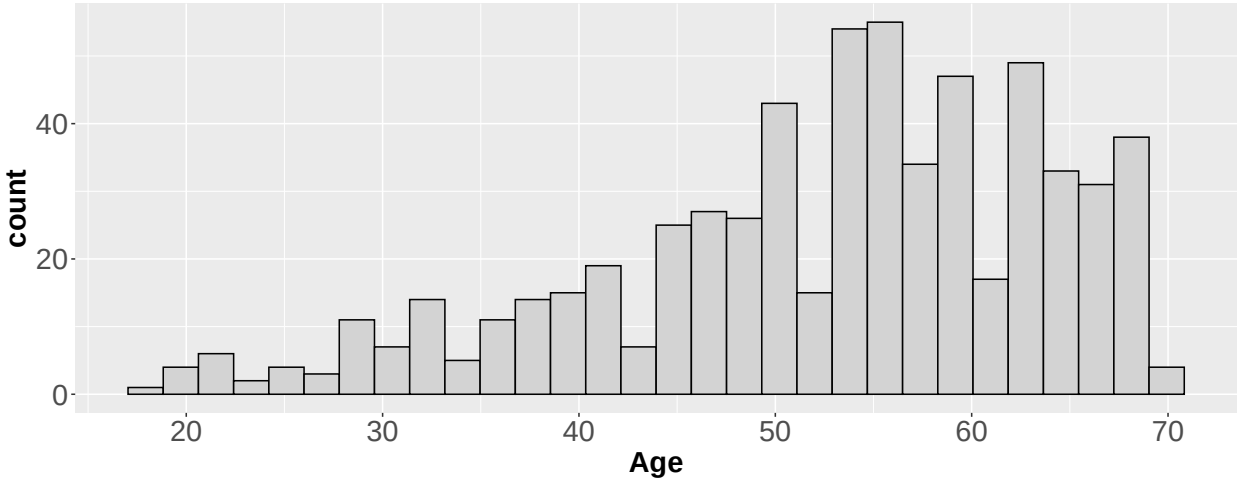
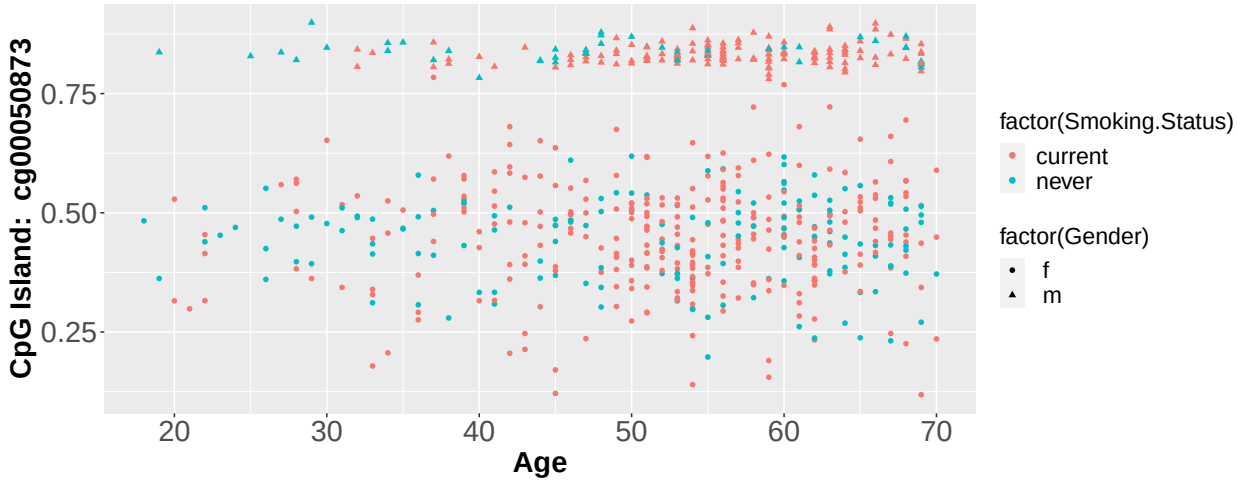


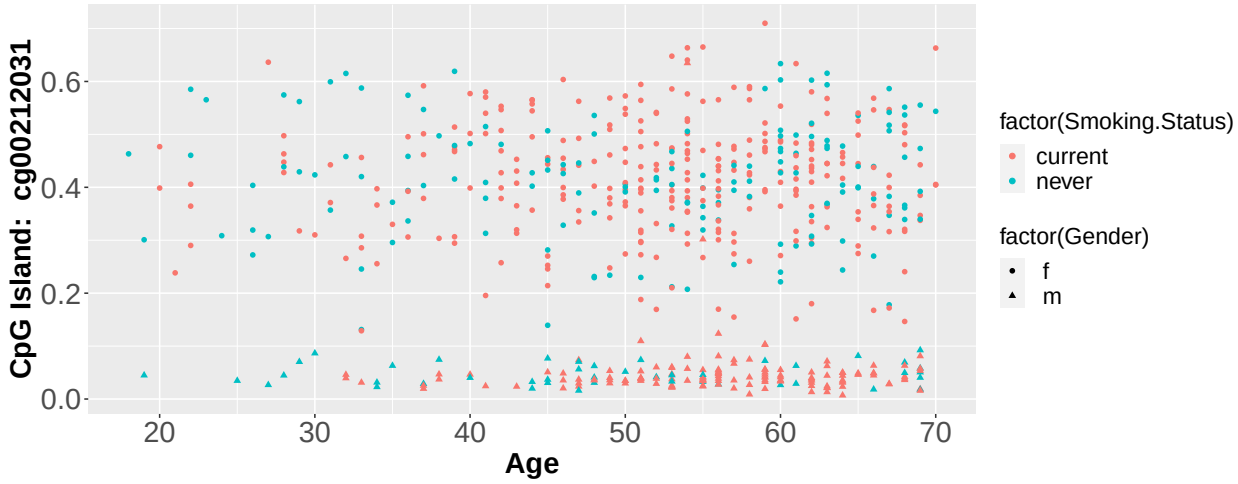
Figure 3.3: Age distribution

Plotting the data

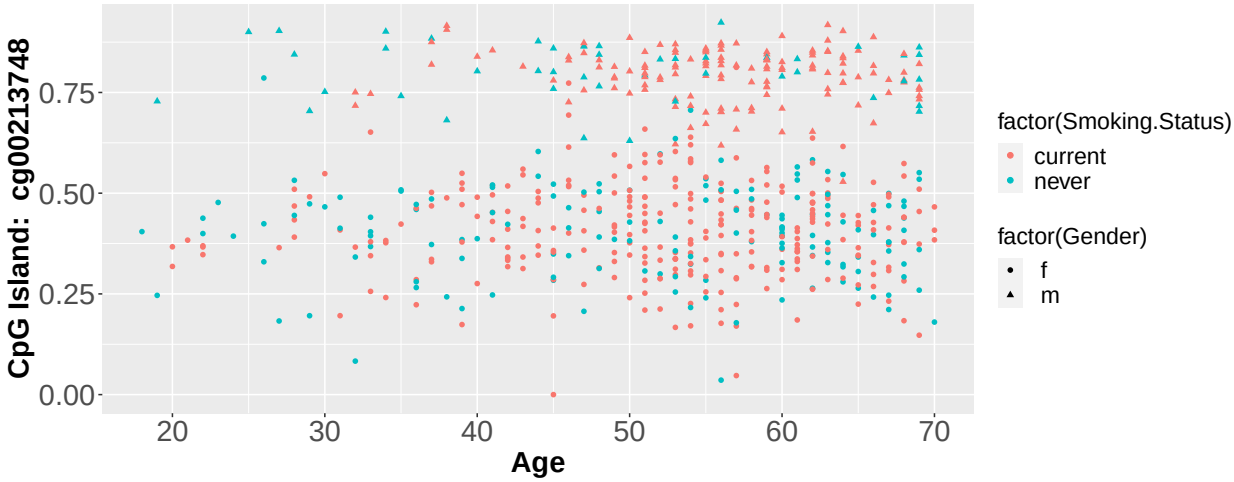
These are all the CpG sites plotted against age, with smokin status as color groups and gender as shape groups. What stands out here is that you see two groups in almost every graph, one of men and one of women, so apparently the cg methylation rate is different between men and women.



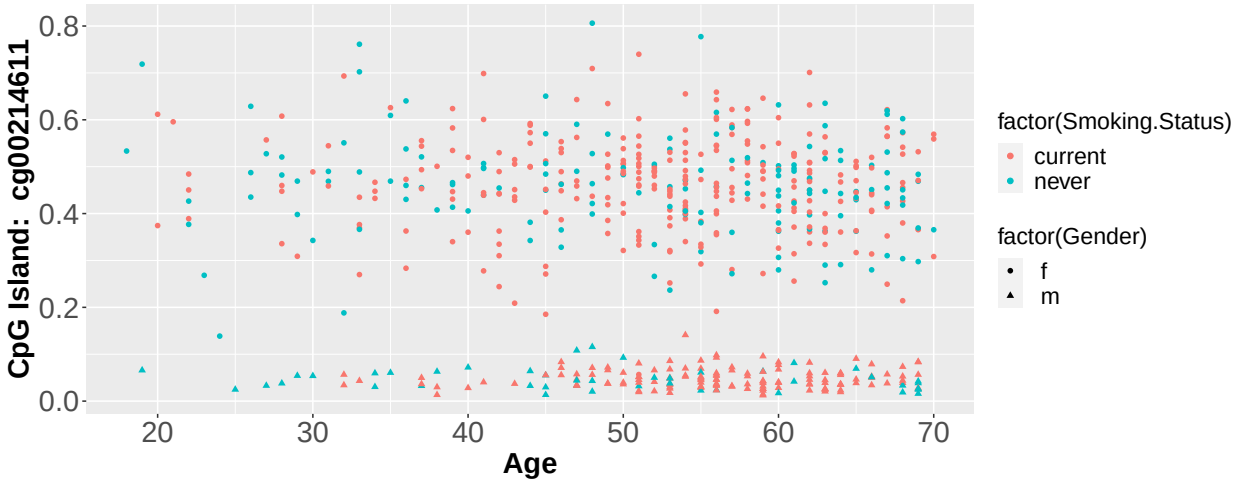
cg00050873 : Scatterplot visualizing the cg values of different ages and genders.



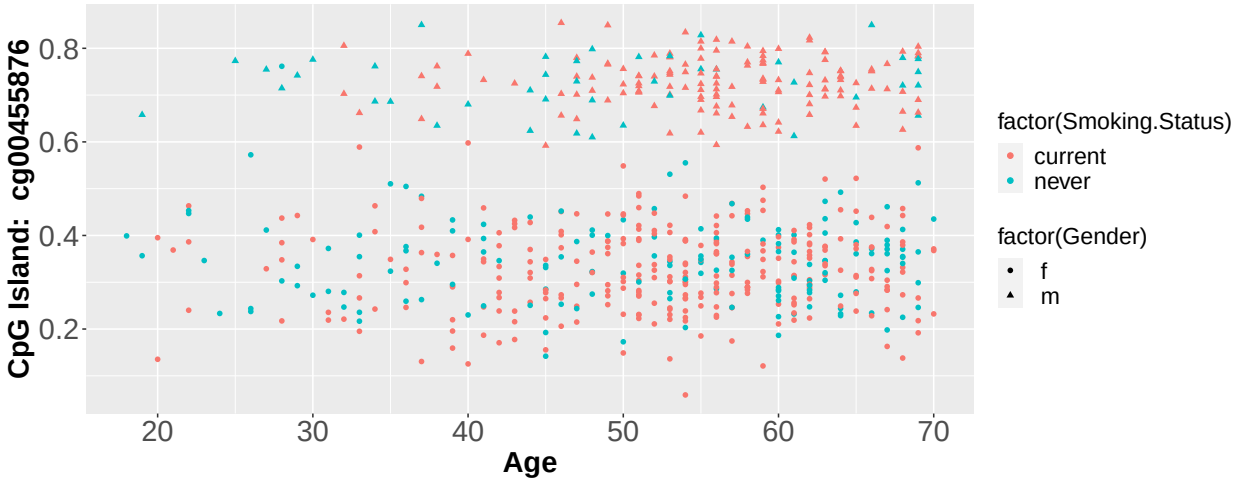
cg00212031 : Scatterplot visualizing the cg values of different ages and genders.



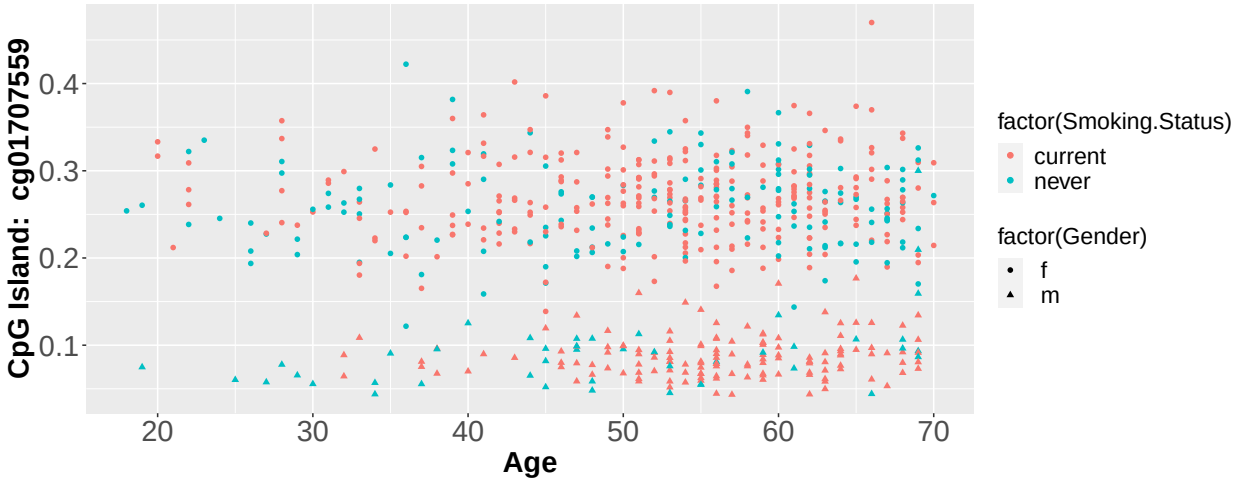
cg00213748 : Scatterplot visualizing the cg values of different ages and genders.



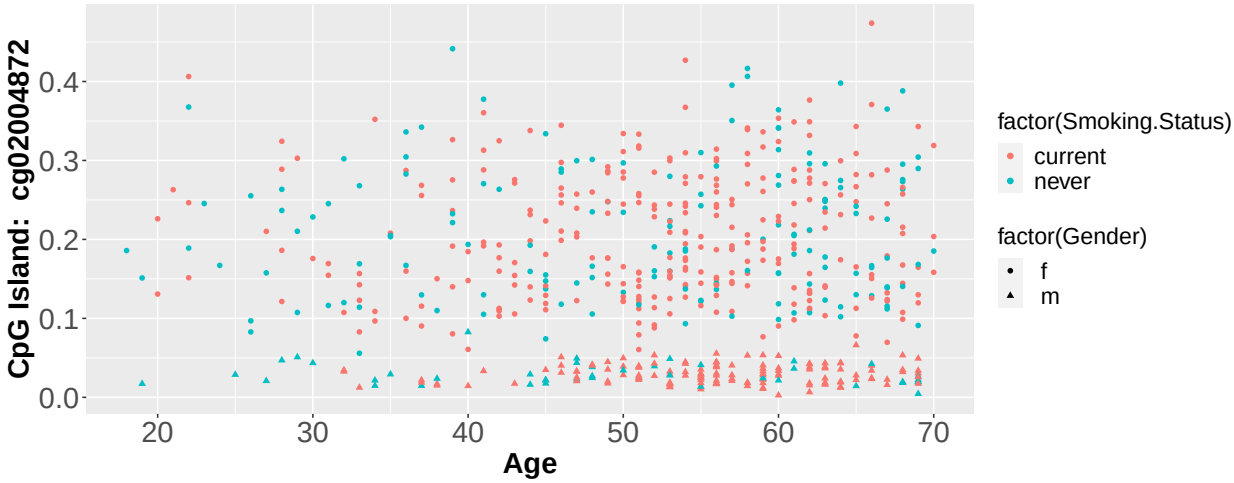
cg00214611 : Scatterplot visualizing the cg values of different ages and genders.



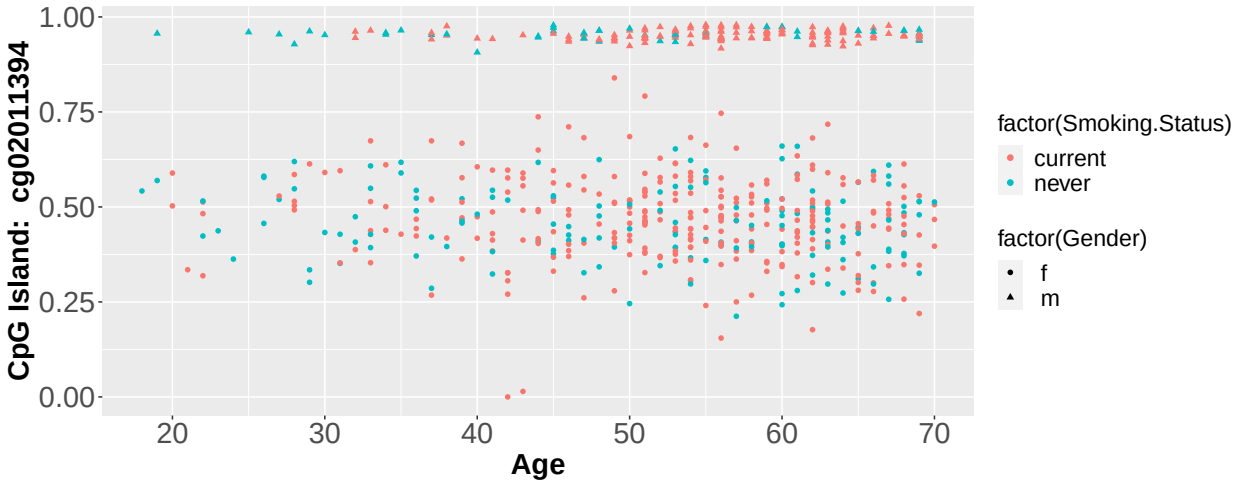
cg00455876 : Scatterplot visualizing the cg values of different ages and genders.



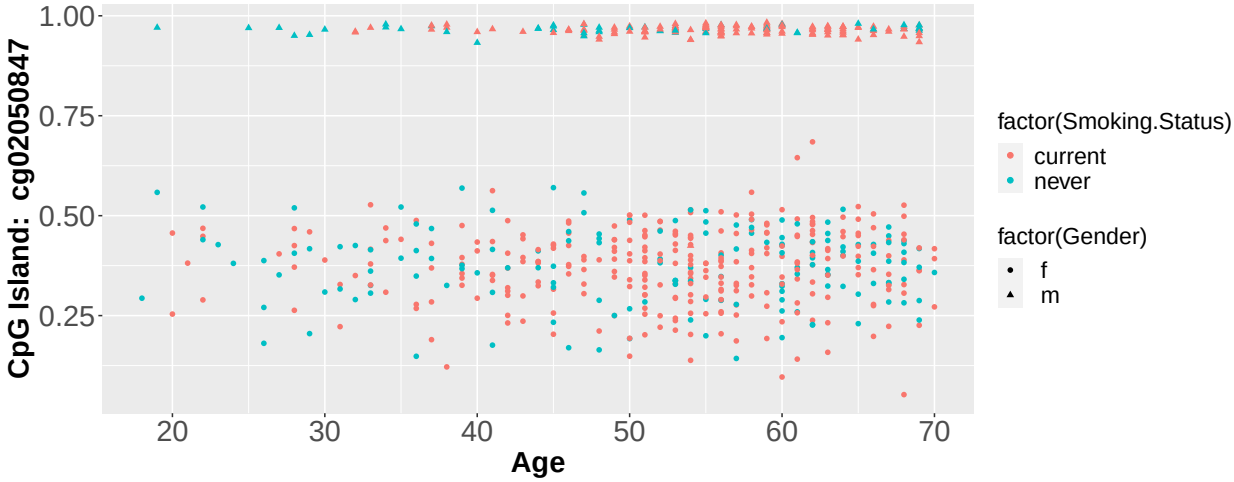
cg01707559 : Scatterplot visualizing the cg values of different ages and genders.



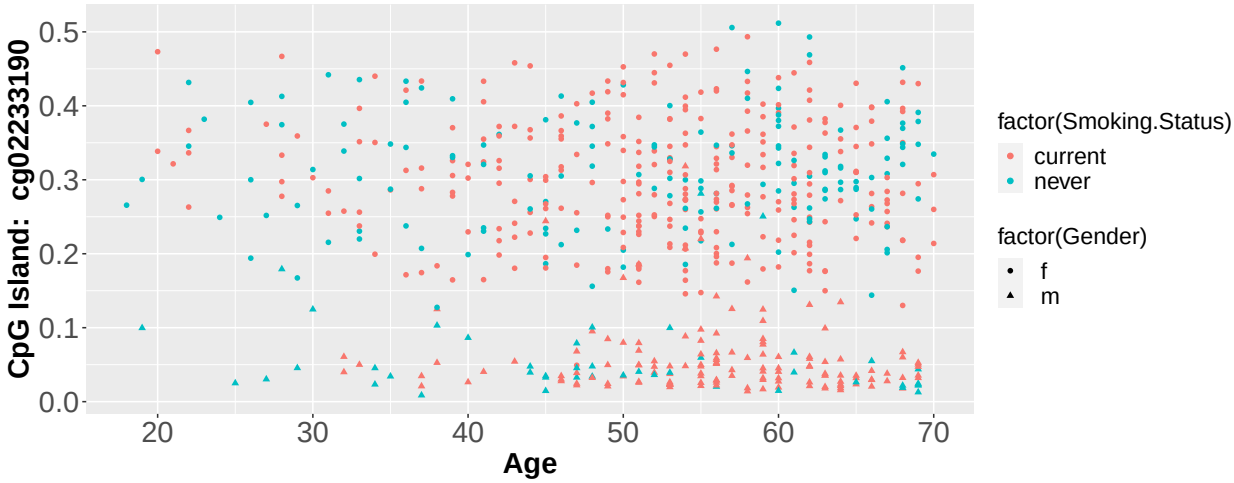
cg02004872 : Scatterplot visualizing the cg values of different ages and genders.



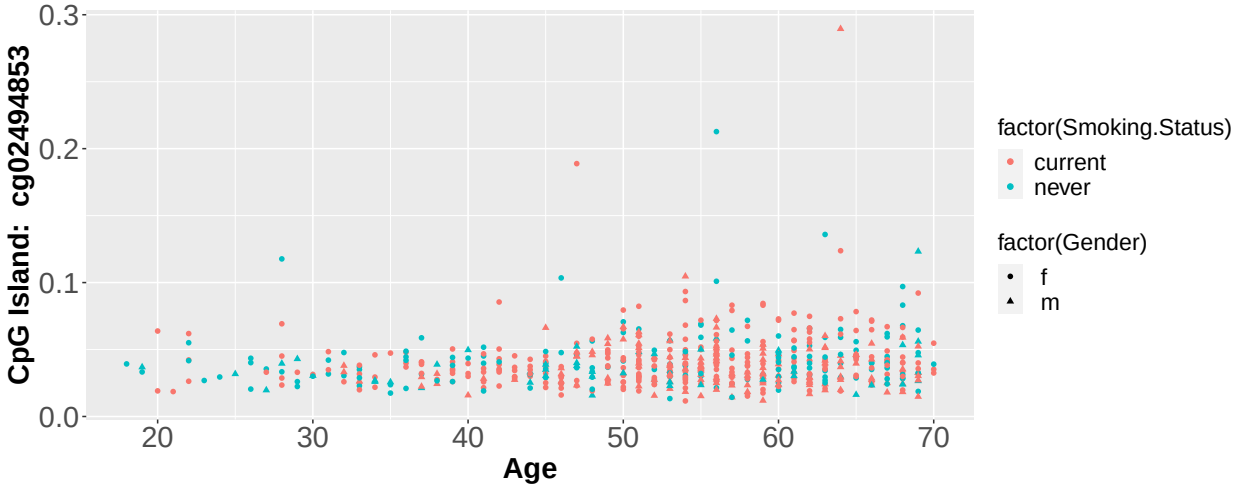
cg02011394 : Scatterplot visualizing the cg values of different ages and genders.



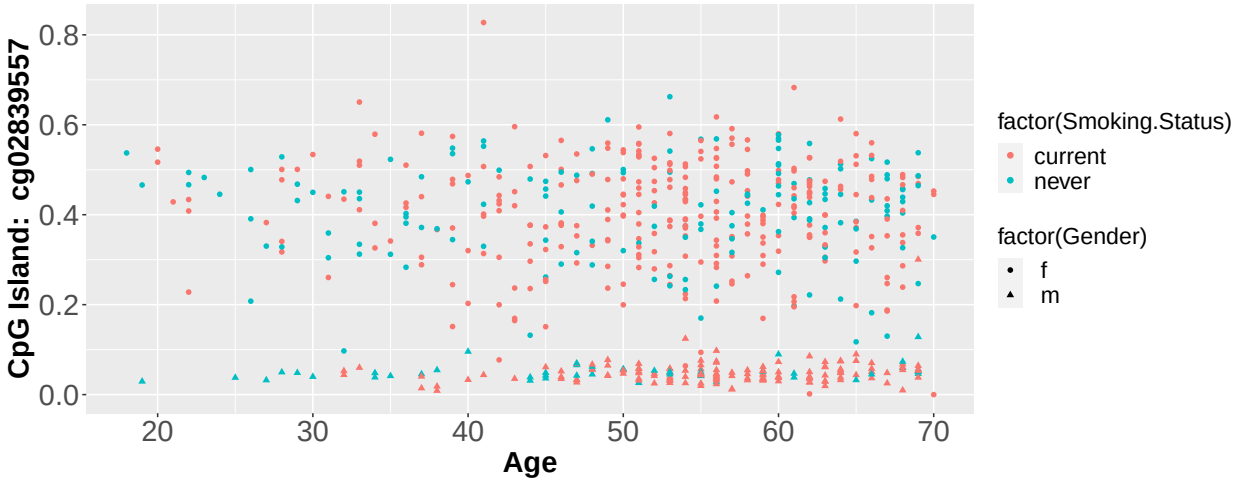
cg02050847 : Scatterplot visualizing the cg values of different ages and genders.



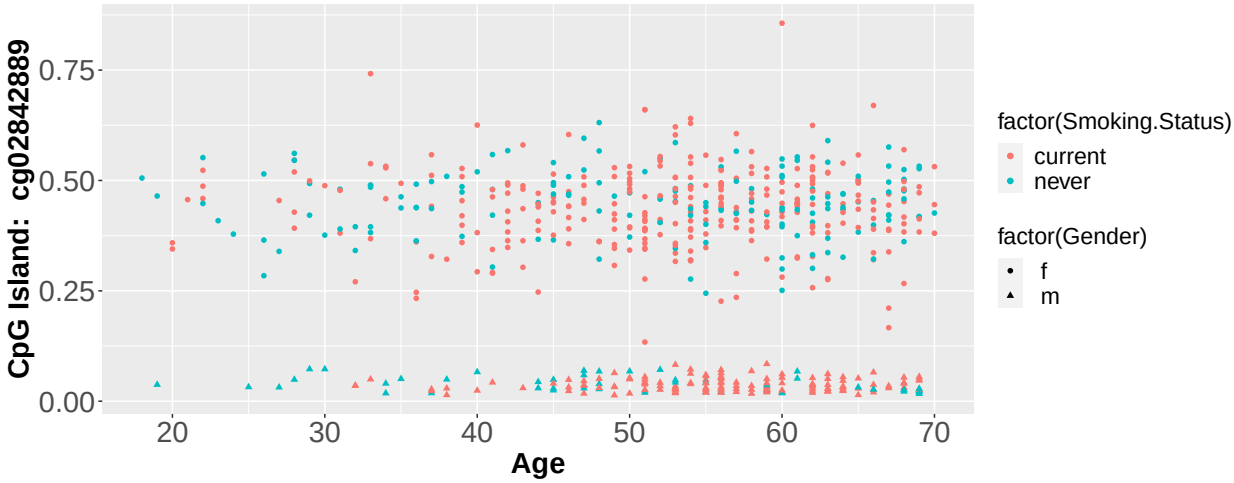
cg02233190 : Scatterplot visualizing the cg values of different ages and genders.



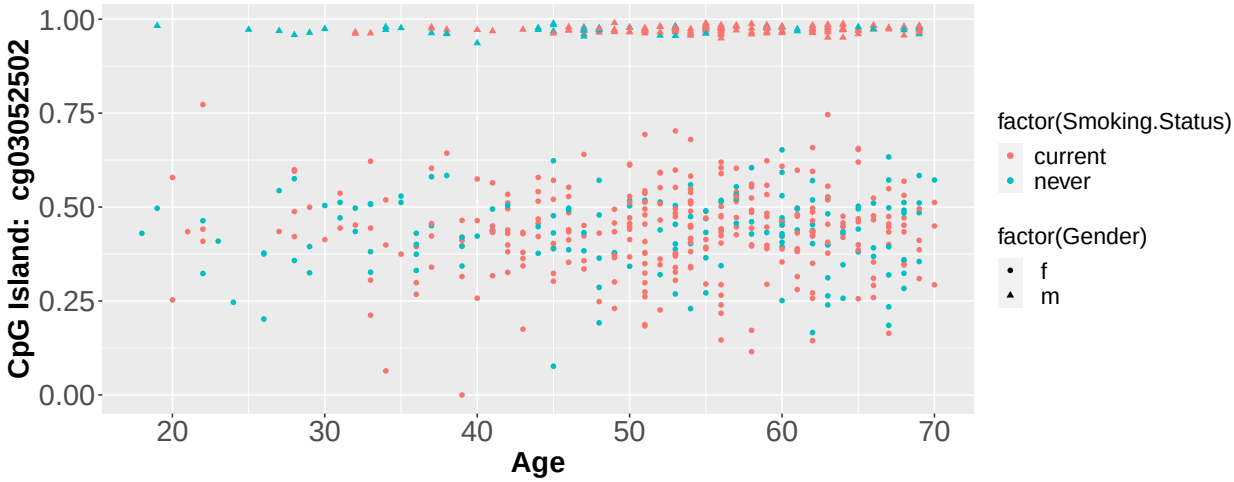
cg02494853 : Scatterplot visualizing the cg values of different ages and genders.



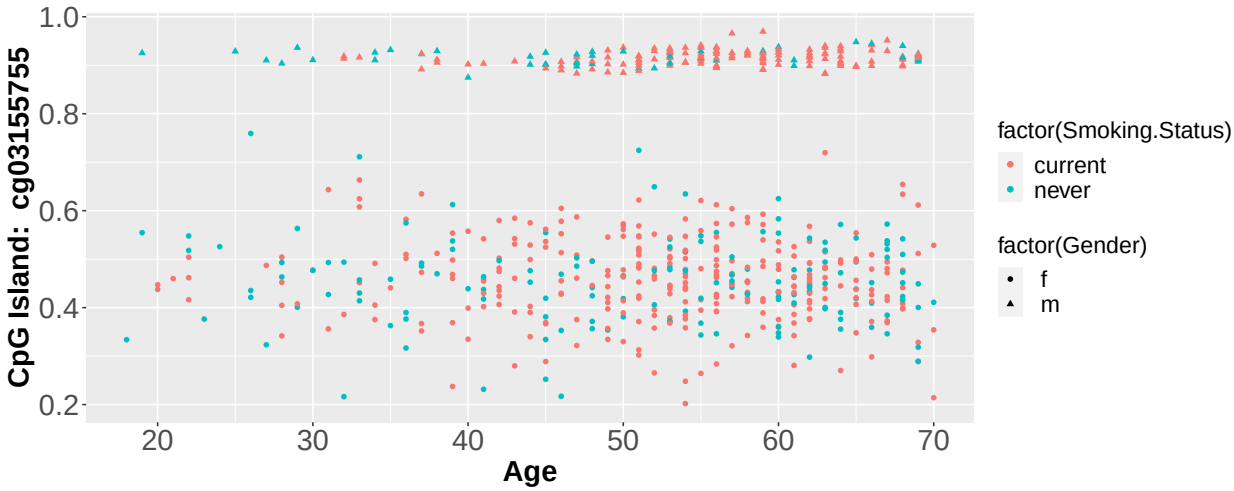
cg02839557 : Scatterplot visualizing the cg values of different ages and genders.



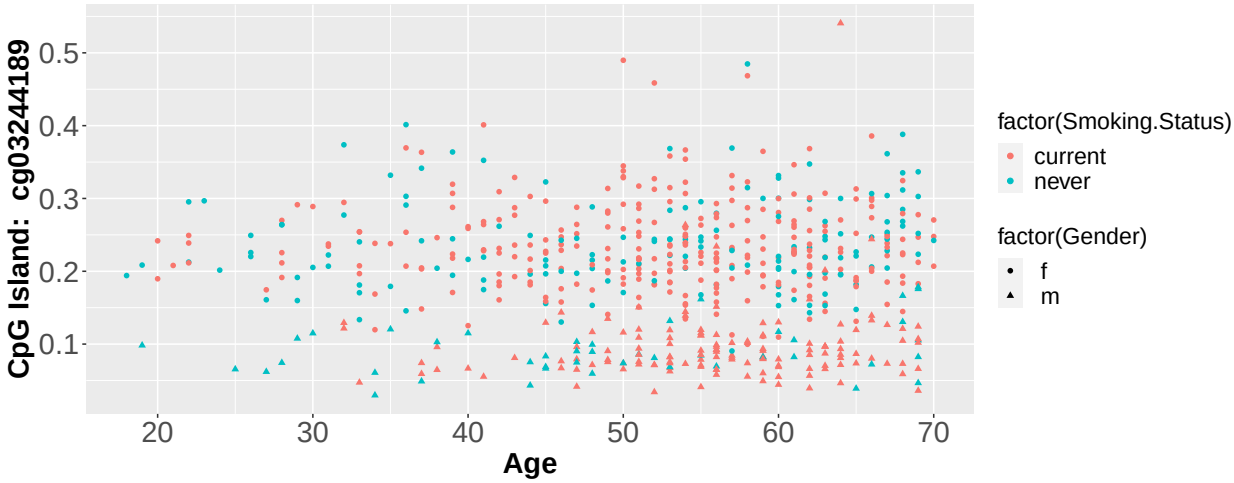
cg02842889 : Scatterplot visualizing the cg values of different ages and genders.



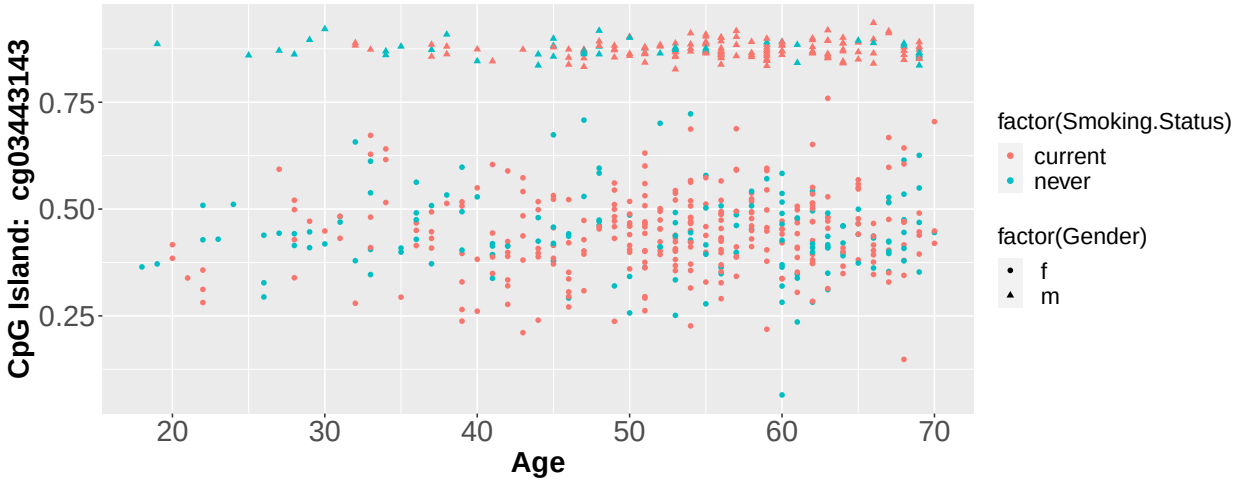
cg03052502 : Scatterplot visualizing the cg values of different ages and genders.



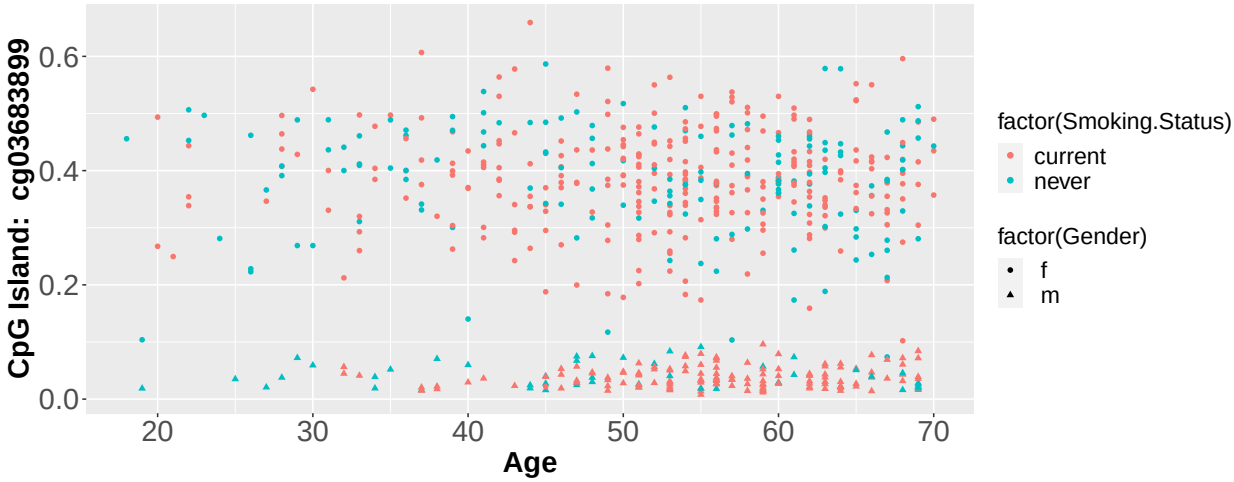
cg03155755 : Scatterplot visualizing the cg values of different ages and genders.



cg03244189 : Scatterplot visualizing the cg values of different ages and genders.

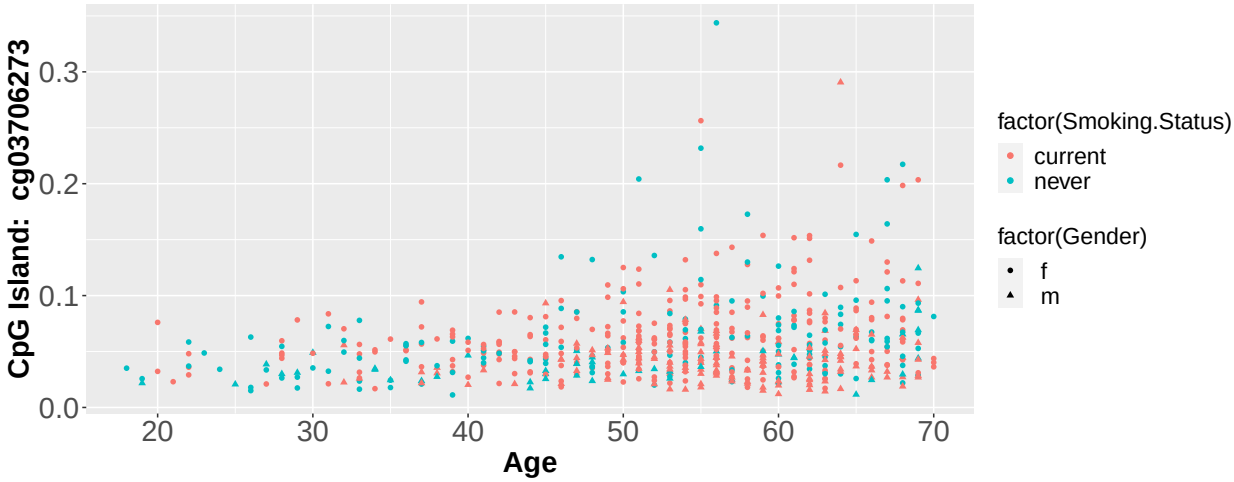


cg03443143 : Scatterplot visualizing the cg values of different ages and genders.



cg03683899 : Scatterplot visualizing the cg values of different ages and genders.

cg03695421 : Scatterplot visualizing the cg values of different ages and genders.



cg03706273 : Scatterplot visualizing the cg values of different ages and genders.

PCA

These PCA plots show quite the same thing as previous graphs. But there is a slight difference in smoking status where the current smoking group is slightly to the left. This can also be, because there is a huge different in the number of current smokers and non-smokers. In the age graph, all males are left and all females are right with no exceptions. The graph is a bit scaled to make it more readable.

```
## Importance of components:
##                           PC1     PC2     PC3     PC4     PC5     PC6     PC7
## Standard deviation     0.7601 0.14718 0.10089 0.09257 0.09146 0.08919 0.08813
## Proportion of Variance 0.8360 0.03135 0.01473 0.01240 0.01210 0.01151 0.01124
## Cumulative Proportion  0.8360 0.86739 0.88212 0.89452 0.90662 0.91813 0.92937
##                           PC8     PC9     PC10     PC11     PC12     PC13     PC14
## Standard deviation     0.08618 0.08128 0.07387 0.07271 0.07201 0.06779 0.06360
## Proportion of Variance 0.01075 0.00956 0.00790 0.00765 0.00750 0.00665 0.00585
## Cumulative Proportion  0.94012 0.94968 0.95758 0.96523 0.97273 0.97938 0.98524
##                           PC15    PC16    PC17    PC18    PC19    PC20
## Standard deviation     0.05677 0.04934 0.04035 0.03801 0.03522 0.01522
## Proportion of Variance 0.00466 0.00352 0.00236 0.00209 0.00179 0.00034
## Cumulative Proportion  0.98990 0.99342 0.99578 0.99787 0.99966 1.00000
```

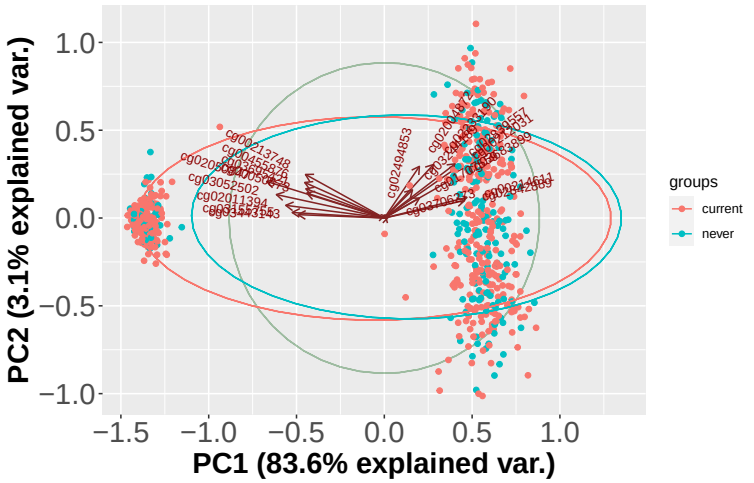


Figure 3.4: PCA graph displaying smoking status as different groups

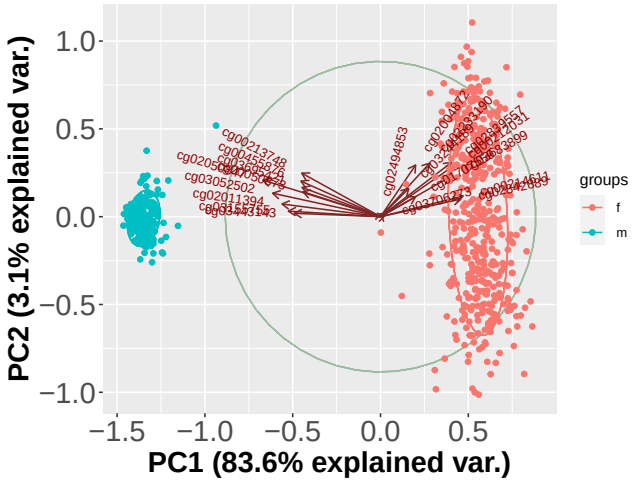


Figure 3.4: PCA graph displaying gender as different groups