

c51

hlf

2022/3/30

```
library(readxl)
dat <-read_excel("BrownFat.xls")
head(dat)
```

```
## # A tibble: 6 x 23
##   Id Sex Diabetes Age Day Month Ext_Temp `2D_Temp` `3D_Temp` `7D_Temp`
##   <dbl> <dbl>   <dbl> <dbl> <dbl> <chr>   <dbl>   <dbl>   <dbl>   <dbl>
## 1 2 1 0 52.2 3 Janua~ -5.9 -3.3 -3.07 -7.29
## 2 3 2 0 69.0 3 Janua~ -5.9 -3.3 -3.07 -7.29
## 3 4 2 0 54.8 3 Janua~ -3.8 -3.3 -3.07 -7.29
## 4 5 2 1 70.4 3 Janua~ -3.8 -3.3 -3.07 -7.29
## 5 6 1 0 53.5 3 Janua~ -1.3 -3.3 -3.07 -7.29
## 6 7 2 0 45.1 3 Janua~ -1.3 -3.3 -3.07 -7.29
## # ... with 13 more variables: 1M_Temp <dbl>, Season <dbl>,
## # Duration_Sunshine <dbl>, Weigth <dbl>, Size <dbl>, BMI <dbl>,
## # Glycemy <dbl>, LBW <dbl>, Cancer_Status <chr>, Cancer_Type <chr>,
## # TSH <chr>, BrownFat <dbl>, Total_vol <dbl>
```

```
colnames(dat)[9]<- 'ThreeD_temp'
colnames(dat)[8]<- 'TwoD_temp'
colnames(dat)[10]<- 'SevenD_temp'
colnames(dat)[11]<- 'oneM_temp'
```

```
#Start: AIC=2161.95
```

```
model_test = glm(data= dat,BrownFat~as.factor(Sex)+as.factor(Diabetes)+Age+Day+Month+
                  Ext_Temp+TwoD_temp+ThreeD_temp+SevenD_temp+oneM_temp+as.factor(Season)+
                  Duration_Sunshine+Weigth+Size+BMI+Glycemy+LBW+as.factor(Cancer_Status)+as.factor(C
                  , family =binomial(link = 'logit'))
summary(model_test)
```

```
##
## Call:
## glm(formula = BrownFat ~ as.factor(Sex) + as.factor(Diabetes) +
##   Age + Day + Month + Ext_Temp + TwoD_temp + ThreeD_temp +
##   SevenD_temp + oneM_temp + as.factor(Season) + Duration_Sunshine +
##   Weigth + Size + BMI + Glycemy + LBW + as.factor(Cancer_Status) +
##   as.factor(Cancer_Type), family = binomial(link = "logit"),
##   data = dat)
##
## Deviance Residuals:
##   Min       1Q   Median       3Q      Max
## -1.3328  -0.4022  -0.2659  -0.1693   3.1065
##
## Coefficients: (1 not defined because of singularities)
```

	Estimate	Std. Error	z value	Pr(> z)
## (Intercept)	-0.582699	5.231003	-0.111	0.911304
## as.factor(Sex)2	-1.360414	0.236205	-5.759	8.44e-09 ***
## as.factor(Diabetes)1	-1.505254	0.431635	-3.487	0.000488 ***
## Age	-0.038052	0.004509	-8.438	< 2e-16 ***
## Day	-0.003750	0.007072	-0.530	0.595924
## MonthAugust	-0.503049	1.178006	-0.427	0.669354
## MonthDecember	1.397134	2.148992	0.650	0.515605
## MonthFebruary	0.490808	1.053285	0.466	0.641231
## MonthJanuary	0.259339	1.142788	0.227	0.820474
## MonthJuly	-0.203113	1.089901	-0.186	0.852163
## MonthJune	0.165188	0.881385	0.187	0.851332
## MonthMarch	0.636067	0.642290	0.990	0.322022
## MonthMay	0.077397	0.515423	0.150	0.880637
## MonthNovember	1.391052	1.862320	0.747	0.455096
## MonthOctober	0.971387	1.579522	0.615	0.538563
## MonthSeptember	-0.141274	1.300066	-0.109	0.913467
## Ext_Temp	-0.056674	0.014424	-3.929	8.52e-05 ***
## TwoD_temp	0.141252	0.044690	3.161	0.001574 **
## ThreeD_temp	-0.127123	0.046355	-2.742	0.006100 **
## SevenD_temp	0.000452	0.014286	0.032	0.974760
## oneM_temp	0.078556	0.051209	1.534	0.125022
## as.factor(Season)2	0.191794	0.443230	0.433	0.665220
## as.factor(Season)3	-1.167901	0.526201	-2.219	0.026453 *
## as.factor(Season)4	-0.908616	0.382085	-2.378	0.017405 *
## Duration_Sunshine	-0.004145	0.003104	-1.335	0.181718
## Weight	-0.086661	0.040172	-2.157	0.030986 *
## Size	0.028123	0.027905	1.008	0.313541
## BMI	0.118436	0.096837	1.223	0.221313
## Glycemy	-0.002876	0.055767	-0.052	0.958874
## LBW	0.057447	0.028022	2.050	0.040355 *
## as.factor(Cancer_Status)1	0.102388	0.446925	0.229	0.818796
## as.factor(Cancer_Status)NA	-0.080164	0.314287	-0.255	0.798671
## as.factor(Cancer_Type)1	0.073897	0.455509	0.162	0.871124
## as.factor(Cancer_Type)10	0.704756	0.724661	0.973	0.330786
## as.factor(Cancer_Type)11	0.005232	0.907991	0.006	0.995403
## as.factor(Cancer_Type)12	1.401707	0.887732	1.579	0.114342
## as.factor(Cancer_Type)13	-0.683190	0.538999	-1.268	0.204971
## as.factor(Cancer_Type)14	-0.146324	0.633249	-0.231	0.817261
## as.factor(Cancer_Type)15	0.029020	0.799806	0.036	0.971056
## as.factor(Cancer_Type)16	-13.834964	684.733824	-0.020	0.983880
## as.factor(Cancer_Type)17	0.231430	1.167481	0.198	0.842865
## as.factor(Cancer_Type)18	1.491822	1.247856	1.196	0.231889
## as.factor(Cancer_Type)2	-0.378259	0.492276	-0.768	0.442256
## as.factor(Cancer_Type)3	-0.577578	0.743192	-0.777	0.437065
## as.factor(Cancer_Type)4	0.114219	0.506010	0.226	0.821416
## as.factor(Cancer_Type)5	0.199957	0.503746	0.397	0.691411
## as.factor(Cancer_Type)6	0.840824	0.986248	0.853	0.393910
## as.factor(Cancer_Type)7	0.228724	0.687321	0.333	0.739303
## as.factor(Cancer_Type)8	-13.945180	365.481633	-0.038	0.969564
## as.factor(Cancer_Type)9	-0.194650	1.172888	-0.166	0.868190
## as.factor(Cancer_Type)NA	NA	NA	NA	NA

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```
##
## (Dispersion parameter for binomial family taken to be 1)
##
## Null deviance: 2399.3 on 4841 degrees of freedom
## Residual deviance: 2061.9 on 4792 degrees of freedom
## AIC: 2161.9
##
## Number of Fisher Scoring iterations: 15

#try step()
step(model_test, direction = 'backward', test = 'Chisq')

## Start: AIC=2161.95
## BrownFat ~ as.factor(Sex) + as.factor(Diabetes) + Age + Day +
## Month + Ext_Temp + TwoD_temp + ThreeD_temp + SevenD_temp +
## oneM_temp + as.factor(Season) + Duration_Sunshine + Weigth +
## Size + BMI + Glycemy + LBW + as.factor(Cancer_Status) + as.factor(Cancer_Type)
##
## Df Deviance AIC LRT Pr(>Chi)
## - as.factor(Cancer_Type) 18 2084.9 2148.9 22.973 0.191644
## - Month 11 2071.2 2149.2 9.258 0.598061
## - SevenD_temp 1 2061.9 2159.9 0.001 0.974726
## - Glycemy 1 2061.9 2159.9 0.003 0.958335
## - as.factor(Cancer_Status) 1 2062.1 2160.1 0.117 0.732411
## - Day 1 2062.2 2160.2 0.281 0.595754
## - Size 1 2063.0 2161.0 1.075 0.299773
## - BMI 1 2063.5 2161.5 1.569 0.210403
## - Duration_Sunshine 1 2063.7 2161.7 1.785 0.181494
## <none> 2061.9 2161.9
## - oneM_temp 1 2064.3 2162.3 2.360 0.124479
## - LBW 1 2066.3 2164.3 4.346 0.037100 *
## - Weigth 1 2066.9 2164.9 5.000 0.025346 *
## - as.factor(Season) 3 2071.5 2165.5 9.512 0.023199 *
## - ThreeD_temp 1 2069.5 2167.5 7.579 0.005904 **
## - TwoD_temp 1 2072.0 2170.0 10.028 0.001542 **
## - Ext_Temp 1 2077.6 2175.6 15.695 7.441e-05 ***
## - as.factor(Diabetes) 1 2079.7 2177.7 17.773 2.489e-05 ***
## - as.factor(Sex) 1 2098.2 2196.2 36.293 1.697e-09 ***
## - Age 1 2132.8 2230.8 70.813 < 2.2e-16 ***
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Step: AIC=2148.92
## BrownFat ~ as.factor(Sex) + as.factor(Diabetes) + Age + Day +
## Month + Ext_Temp + TwoD_temp + ThreeD_temp + SevenD_temp +
## oneM_temp + as.factor(Season) + Duration_Sunshine + Weigth +
## Size + BMI + Glycemy + LBW + as.factor(Cancer_Status)
##
## Df Deviance AIC LRT Pr(>Chi)
## - Month 11 2093.8 2135.8 8.910 0.6302288
## - as.factor(Cancer_Status) 2 2085.2 2145.2 0.226 0.8929491
## - SevenD_temp 1 2084.9 2146.9 0.003 0.9547595
## - Glycemy 1 2084.9 2146.9 0.003 0.9542051
## - Day 1 2085.1 2147.1 0.144 0.7047253
## - Size 1 2086.0 2148.0 1.042 0.3073735
```

```

## - BMI 1 2086.6 2148.6 1.692 0.1933513
## - Duration_Sunshine 1 2086.9 2148.9 1.942 0.1634925
## <none> 2084.9 2148.9
## - oneM_temp 1 2087.3 2149.3 2.397 0.1215726
## - LBW 1 2089.8 2151.8 4.824 0.0280646 *
## - Weigth 1 2090.2 2152.2 5.265 0.0217604 *
## - as.factor(Season) 3 2094.7 2152.7 9.778 0.0205495 *
## - ThreeD_temp 1 2092.8 2154.8 7.836 0.0051208 **
## - TwoD_temp 1 2095.1 2157.1 10.157 0.0014375 **
## - Ext_Temp 1 2099.7 2161.7 14.820 0.0001183 ***
## - as.factor(Diabetes) 1 2102.8 2164.8 17.908 2.318e-05 ***
## - as.factor(Sex) 1 2124.3 2186.3 39.355 3.533e-10 ***
## - Age 1 2162.9 2224.9 77.981 < 2.2e-16 ***
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Step: AIC=2135.83
## BrownFat ~ as.factor(Sex) + as.factor(Diabetes) + Age + Day +
## Ext_Temp + TwoD_temp + ThreeD_temp + SevenD_temp + oneM_temp +
## as.factor(Season) + Duration_Sunshine + Weigth + Size + BMI +
## Glycemy + LBW + as.factor(Cancer_Status)
##
## Df Deviance AIC LRT Pr(>Chi)
## - as.factor(Cancer_Status) 2 2094.1 2132.1 0.259 0.8783522
## - Glycemy 1 2093.8 2133.8 0.000 0.9948575
## - SevenD_temp 1 2093.9 2133.9 0.041 0.8398685
## - Day 1 2093.9 2133.9 0.059 0.8074194
## - Size 1 2094.8 2134.8 1.018 0.3129799
## - BMI 1 2095.5 2135.5 1.626 0.2022632
## <none> 2093.8 2135.8
## - as.factor(Season) 3 2100.3 2136.3 6.474 0.0906840 .
## - oneM_temp 1 2096.8 2136.8 2.978 0.0844135 .
## - Duration_Sunshine 1 2097.7 2137.7 3.851 0.0497149 *
## - LBW 1 2098.5 2138.5 4.645 0.0311500 *
## - Weigth 1 2099.0 2139.0 5.131 0.0234955 *
## - ThreeD_temp 1 2101.8 2141.8 7.941 0.0048322 **
## - TwoD_temp 1 2104.1 2144.1 10.239 0.0013751 **
## - Ext_Temp 1 2108.8 2148.8 14.921 0.0001121 ***
## - as.factor(Diabetes) 1 2111.4 2151.4 17.545 2.806e-05 ***
## - as.factor(Sex) 1 2132.9 2172.9 39.060 4.111e-10 ***
## - Age 1 2173.0 2213.0 79.176 < 2.2e-16 ***
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Step: AIC=2132.09
## BrownFat ~ as.factor(Sex) + as.factor(Diabetes) + Age + Day +
## Ext_Temp + TwoD_temp + ThreeD_temp + SevenD_temp + oneM_temp +
## as.factor(Season) + Duration_Sunshine + Weigth + Size + BMI +
## Glycemy + LBW
##
## Df Deviance AIC LRT Pr(>Chi)
## - Glycemy 1 2094.1 2130.1 0.000 0.9904939
## - SevenD_temp 1 2094.1 2130.1 0.051 0.8217622
## - Day 1 2094.2 2130.2 0.055 0.8153538

```

```

## - Size          1    2095.1 2131.1   1.018 0.3129541
## - BMI           1    2095.7 2131.7   1.629 0.2018623
## <none>          2094.1 2132.1
## - as.factor(Season) 3    2100.5 2132.5   6.453 0.0915276 .
## - oneM_temp      1    2097.1 2133.1   3.015 0.0825135 .
## - Duration_Sunshine 1    2098.0 2134.0   3.884 0.0487348 *
## - LBW            1    2098.7 2134.7   4.653 0.0310038 *
## - Weigth         1    2099.2 2135.2   5.142 0.0233554 *
## - ThreeD_temp     1    2102.1 2138.1   8.003 0.0046701 **
## - TwoD_temp       1    2104.4 2140.4  10.283 0.0013429 **
## - Ext_Temp        1    2109.0 2145.0  14.904 0.0001131 ***
## - as.factor(Diabetes) 1    2111.7 2147.7  17.582 2.752e-05 ***
## - as.factor(Sex)   1    2133.2 2169.2  39.145 3.934e-10 ***
## - Age             1    2174.2 2210.2  80.060 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Step:  AIC=2130.09
## BrownFat ~ as.factor(Sex) + as.factor(Diabetes) + Age + Day +
##      Ext_Temp + TwoD_temp + ThreeD_temp + SevenD_temp + oneM_temp +
##      as.factor(Season) + Duration_Sunshine + Weigth + Size + BMI +
##      LBW
##
##              Df Deviance    AIC    LRT Pr(>Chi)
## - SevenD_temp    1    2094.1 2128.1   0.051  0.821567
## - Day            1    2094.2 2128.2   0.055  0.815179
## - Size           1    2095.1 2129.1   1.019  0.312724
## - BMI            1    2095.7 2129.7   1.629  0.201838
## <none>           2094.1 2130.1
## - as.factor(Season) 3    2100.6 2130.6   6.455  0.091473 .
## - oneM_temp      1    2097.1 2131.1   3.015  0.082512 .
## - Duration_Sunshine 1    2098.0 2132.0   3.886  0.048681 *
## - LBW            1    2098.7 2132.7   4.653  0.031006 *
## - Weigth         1    2099.2 2133.2   5.143  0.023345 *
## - ThreeD_temp     1    2102.1 2136.1   8.004  0.004668 **
## - TwoD_temp       1    2104.4 2138.4  10.282  0.001343 **
## - Ext_Temp        1    2109.0 2143.0  14.906  0.000113 ***
## - as.factor(Diabetes) 1    2113.8 2147.8  19.673 9.190e-06 ***
## - as.factor(Sex)   1    2133.2 2167.2  39.151 3.923e-10 ***
## - Age             1    2176.4 2210.4  82.363 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Step:  AIC=2128.14
## BrownFat ~ as.factor(Sex) + as.factor(Diabetes) + Age + Day +
##      Ext_Temp + TwoD_temp + ThreeD_temp + oneM_temp + as.factor(Season) +
##      Duration_Sunshine + Weigth + Size + BMI + LBW
##
##              Df Deviance    AIC    LRT Pr(>Chi)
## - Day            1    2094.2 2126.2   0.062  0.803916
## - Size           1    2095.2 2127.2   1.025  0.311432
## - BMI            1    2095.8 2127.8   1.641  0.200197
## <none>           2094.1 2128.1
## - as.factor(Season) 3    2100.6 2128.6   6.424  0.092690 .

```

```

## - oneM_temp          1    2097.5 2129.5  3.383  0.065880 .
## - Duration_Sunshine  1    2098.0 2130.0  3.902  0.048241 *
## - LBW                 1    2098.8 2130.8  4.658  0.030916 *
## - Weigth              1    2099.3 2131.3  5.161  0.023100 *
## - ThreeD_temp         1    2103.5 2135.5  9.329  0.002255 **
## - TwoD_temp           1    2104.8 2136.8 10.612  0.001124 **
## - Ext_Temp            1    2109.0 2141.0 14.873  0.000115 ***
## - as.factor(Diabetes) 1    2113.8 2145.8 19.656  9.270e-06 ***
## - as.factor(Sex)      1    2133.2 2165.2 39.108  4.011e-10 ***
## - Age                 1    2176.5 2208.5 82.326 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Step:  AIC=2126.2
## BrownFat ~ as.factor(Sex) + as.factor(Diabetes) + Age + Ext_Temp +
##           TwoD_temp + ThreeD_temp + oneM_temp + as.factor(Season) +
##           Duration_Sunshine + Weigth + Size + BMI + LBW
##
##              Df Deviance    AIC    LRT Pr(>Chi)
## - Size          1    2095.2 2125.2  1.020 0.3126345
## - BMI           1    2095.8 2125.8  1.632 0.2013744
## <none>           2094.2 2126.2
## - as.factor(Season) 3    2100.6 2126.6  6.395 0.0939086 .
## - oneM_temp       1    2097.5 2127.5  3.322 0.0683463 .
## - Duration_Sunshine 1    2098.1 2128.1  3.891 0.0485314 *
## - LBW             1    2098.8 2128.8  4.648 0.0310850 *
## - Weigth          1    2099.3 2129.3  5.148 0.0232796 *
## - ThreeD_temp     1    2103.5 2133.5  9.274 0.0023244 **
## - TwoD_temp       1    2104.8 2134.8 10.550 0.0011616 **
## - Ext_Temp        1    2109.0 2139.0 14.813 0.0001187 ***
## - as.factor(Diabetes) 1    2113.9 2143.9 19.691 9.101e-06 ***
## - as.factor(Sex)   1    2133.3 2163.3 39.073 4.081e-10 ***
## - Age             1    2176.5 2206.5 82.278 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Step:  AIC=2125.22
## BrownFat ~ as.factor(Sex) + as.factor(Diabetes) + Age + Ext_Temp +
##           TwoD_temp + ThreeD_temp + oneM_temp + as.factor(Season) +
##           Duration_Sunshine + Weigth + BMI + LBW
##
##              Df Deviance    AIC    LRT Pr(>Chi)
## - BMI          1    2095.9 2123.9  0.663 0.4155915
## <none>           2095.2 2125.2
## - as.factor(Season) 3    2101.4 2125.4  6.216 0.1015501
## - oneM_temp       1    2098.5 2126.5  3.309 0.0688909 .
## - Duration_Sunshine 1    2099.0 2127.0  3.808 0.0510061 .
## - LBW             1    2100.2 2128.2  4.953 0.0260389 *
## - Weigth          1    2100.9 2128.9  5.717 0.0167991 *
## - ThreeD_temp     1    2104.4 2132.4  9.196 0.0024250 **
## - TwoD_temp       1    2105.8 2133.8 10.543 0.0011664 **
## - Ext_Temp        1    2110.3 2138.3 15.110 0.0001014 ***
## - as.factor(Diabetes) 1    2114.9 2142.9 19.664 9.232e-06 ***
## - as.factor(Sex)   1    2134.4 2162.4 39.157 3.911e-10 ***

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```
## - Age          1    2177.3 2205.3 82.037 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Step:  AIC=2123.89
## BrownFat ~ as.factor(Sex) + as.factor(Diabetes) + Age + Ext_Temp +
##           TwoD_temp + ThreeD_temp + oneM_temp + as.factor(Season) +
##           Duration_Sunshine + Weigth + LBW
##
##              Df Deviance    AIC    LRT Pr(>Chi)
## <none>                2095.9 2123.9
## - as.factor(Season)    3    2102.1 2124.1  6.219  0.101418
## - oneM_temp            1    2099.1 2125.1  3.237  0.072009 .
## - Duration_Sunshine    1    2099.7 2125.7  3.781  0.051825 .
## - LBW                  1    2101.6 2127.6  5.664  0.017320 *
## - ThreeD_temp          1    2105.1 2131.1  9.179  0.002448 **
## - TwoD_temp             1    2106.6 2132.6 10.659  0.001096 **
## - Ext_Temp              1    2111.2 2137.2 15.340 8.980e-05 ***
## - as.factor(Diabetes)  1    2115.2 2141.2 19.289 1.124e-05 ***
## - Weigth                1    2120.9 2146.9 25.006 5.715e-07 ***
## - as.factor(Sex)        1    2134.4 2160.4 38.496 5.486e-10 ***
## - Age                   1    2178.4 2204.4 82.469 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Call:  glm(formula = BrownFat ~ as.factor(Sex) + as.factor(Diabetes) +
##           Age + Ext_Temp + TwoD_temp + ThreeD_temp + oneM_temp + as.factor(Season) +
##           Duration_Sunshine + Weigth + LBW, family = binomial(link = "logit"),
##           data = dat)
##
## Coefficients:
##           (Intercept)          as.factor(Sex)2  as.factor(Diabetes)1
##                3.004205                -1.364528                -1.471768
##                Age                Ext_Temp                TwoD_temp
##            -0.036875                -0.054511                0.137952
##            ThreeD_temp            oneM_temp  as.factor(Season)2
##            -0.123417                0.036954                -0.211946
##  as.factor(Season)3  as.factor(Season)4  Duration_Sunshine
##            -0.722405                -0.652931                -0.002716
##                Weigth                LBW
##            -0.037865                0.044979
##
## Degrees of Freedom: 4841 Total (i.e. Null);  4828 Residual
## Null Deviance:      2399
## Residual Deviance: 2096  AIC: 2124
```

#with AIC 2123.89

```
#              Df Deviance    AIC    LRT Pr(>Chi)
# <none>                2095.9 2123.9
# - as.factor(Season)    3    2102.1 2124.1  6.219  0.101418
# - oneM_temp            1    2099.1 2125.1  3.237  0.072009 .
# - Duration_Sunshine    1    2099.7 2125.7  3.781  0.051825 .
# - LBW                  1    2101.6 2127.6  5.664  0.017320 *
```

```

# - ThreeD_temp      1    2105.1 2131.1  9.179  0.002448 **
# - TwoD_temp        1    2106.6 2132.6 10.659  0.001096 **
# - Ext_Temp         1    2111.2 2137.2 15.340  8.980e-05 ***
# - as.factor(Diabetes) 1    2115.2 2141.2 19.289  1.124e-05 ***
# - Weigth           1    2120.9 2146.9 25.006  5.715e-07 ***
# - as.factor(Sex)    1    2134.4 2160.4 38.496  5.486e-10 ***
# - Age              1    2178.4 2204.4 82.469 < 2.2e-16 ***
# ---
after_step = glm(formula = BrownFat ~ as.factor(Sex) + as.factor(Diabetes) +
  Age + Ext_Temp + TwoD_temp + ThreeD_temp + oneM_temp + as.factor(Season) +
  Duration_Sunshine + Weigth + LBW, family = binomial(link = "logit"),
  data = dat)
summary(after_step)

##
## Call:
## glm(formula = BrownFat ~ as.factor(Sex) + as.factor(Diabetes) +
##      Age + Ext_Temp + TwoD_temp + ThreeD_temp + oneM_temp + as.factor(Season) +
##      Duration_Sunshine + Weigth + LBW, family = binomial(link = "logit"),
##      data = dat)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.3888  -0.4037  -0.2723  -0.1858   3.0223
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)      3.004205   1.232758   2.437 0.014811 *
## as.factor(Sex)2    -1.364528   0.227291  -6.003 1.93e-09 ***
## as.factor(Diabetes)1 -1.471768   0.420498  -3.500 0.000465 ***
## Age               -0.036875   0.004006  -9.205 < 2e-16 ***
## Ext_Temp          -0.054511   0.014021  -3.888 0.000101 ***
## TwoD_temp         0.137952   0.042334   3.259 0.001119 **
## ThreeD_temp       -0.123417   0.040866  -3.020 0.002527 **
## oneM_temp         0.036954   0.020569   1.797 0.072395 .
## as.factor(Season)2 -0.211946   0.239970  -0.883 0.377118
## as.factor(Season)3 -0.722405   0.329495  -2.192 0.028346 *
## as.factor(Season)4 -0.652931   0.279965  -2.332 0.019691 *
## Duration_Sunshine -0.002716   0.001394  -1.948 0.051418 .
## Weigth            -0.037865   0.008738  -4.333 1.47e-05 ***
## LBW               0.044979   0.019282   2.333 0.019663 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 2399.3  on 4841  degrees of freedom
## Residual deviance: 2095.9  on 4828  degrees of freedom
## AIC: 2123.9
##
## Number of Fisher Scoring iterations: 7
after_step :AIC=2123.89 try to improve the model

```



```

#try to find significant interaction term through 5 most significant variable
model_test_interaction = glm(formula = BrownFat ~Ext_Temp* as.factor(Diabetes)
                             *Weigth*as.factor(Sex) * Age, family = binomial(link = "logit"), data = da

step(model_test_interaction)

## Start:  AIC=2157.87
## BrownFat ~ Ext_Temp * as.factor(Diabetes) * Weigth * as.factor(Sex) *
##   Age
##
##
##               Df Deviance    AIC
## - Ext_Temp:as.factor(Diabetes):Weigth:as.factor(Sex):Age  1   2093.9 2155.9
## <none>                                                    2093.9 2157.9
##
## Step:  AIC=2155.87
## BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigth + as.factor(Sex) +
##   Age + Ext_Temp:as.factor(Diabetes) + Ext_Temp:Weigth + as.factor(Diabetes):Weigth +
##   Ext_Temp:as.factor(Sex) + as.factor(Diabetes):as.factor(Sex) +
##   Weigth:as.factor(Sex) + Ext_Temp:Age + as.factor(Diabetes):Age +
##   Weigth:Age + as.factor(Sex):Age + Ext_Temp:as.factor(Diabetes):Weigth +
##   Ext_Temp:as.factor(Diabetes):as.factor(Sex) + Ext_Temp:Weigth:as.factor(Sex) +
##   as.factor(Diabetes):Weigth:as.factor(Sex) + Ext_Temp:as.factor(Diabetes):Age +
##   Ext_Temp:Weigth:Age + as.factor(Diabetes):Weigth:Age + Ext_Temp:as.factor(Sex):Age +
##   as.factor(Diabetes):as.factor(Sex):Age + Weigth:as.factor(Sex):Age +
##   Ext_Temp:as.factor(Diabetes):Weigth:as.factor(Sex) + Ext_Temp:as.factor(Diabetes):Weigth:Age +
##   Ext_Temp:as.factor(Diabetes):as.factor(Sex):Age + Ext_Temp:Weigth:as.factor(Sex):Age +
##   as.factor(Diabetes):Weigth:as.factor(Sex):Age
##
##
##               Df Deviance    AIC
## - Ext_Temp:as.factor(Diabetes):Weigth:as.factor(Sex)  1   2093.9 2153.9
## - Ext_Temp:as.factor(Diabetes):Weigth:Age             1   2093.9 2153.9
## - as.factor(Diabetes):Weigth:as.factor(Sex):Age       1   2093.9 2153.9
## - Ext_Temp:Weigth:as.factor(Sex):Age                  1   2094.2 2154.2
## - Ext_Temp:as.factor(Diabetes):as.factor(Sex):Age     1   2094.3 2154.3
## <none>                                                  2093.9 2155.9
##
## Step:  AIC=2153.88
## BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigth + as.factor(Sex) +
##   Age + Ext_Temp:as.factor(Diabetes) + Ext_Temp:Weigth + as.factor(Diabetes):Weigth +
##   Ext_Temp:as.factor(Sex) + as.factor(Diabetes):as.factor(Sex) +
##   Weigth:as.factor(Sex) + Ext_Temp:Age + as.factor(Diabetes):Age +
##   Weigth:Age + as.factor(Sex):Age + Ext_Temp:as.factor(Diabetes):Weigth +
##   Ext_Temp:as.factor(Diabetes):as.factor(Sex) + Ext_Temp:Weigth:as.factor(Sex) +
##   as.factor(Diabetes):Weigth:as.factor(Sex) + Ext_Temp:as.factor(Diabetes):Age +
##   Ext_Temp:Weigth:Age + as.factor(Diabetes):Weigth:Age + Ext_Temp:as.factor(Sex):Age +
##   as.factor(Diabetes):as.factor(Sex):Age + Weigth:as.factor(Sex):Age +
##   Ext_Temp:as.factor(Diabetes):Weigth:Age + Ext_Temp:as.factor(Diabetes):as.factor(Sex):Age +
##   Ext_Temp:Weigth:as.factor(Sex):Age + as.factor(Diabetes):Weigth:as.factor(Sex):Age
##
##
##               Df Deviance    AIC
## - Ext_Temp:as.factor(Diabetes):Weigth:Age             1   2093.9 2151.9
## - as.factor(Diabetes):Weigth:as.factor(Sex):Age       1   2094.0 2152.0
## - Ext_Temp:Weigth:as.factor(Sex):Age                  1   2094.2 2152.2
## - Ext_Temp:as.factor(Diabetes):as.factor(Sex):Age     1   2094.4 2152.4

```

```

## <none>                                2093.9 2153.9
##
## Step: AIC=2151.89
## BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigth + as.factor(Sex) +
##   Age + Ext_Temp:as.factor(Diabetes) + Ext_Temp:Weigth + as.factor(Diabetes):Weigth +
##   Ext_Temp:as.factor(Sex) + as.factor(Diabetes):as.factor(Sex) +
##   Weigth:as.factor(Sex) + Ext_Temp:Age + as.factor(Diabetes):Age +
##   Weigth:Age + as.factor(Sex):Age + Ext_Temp:as.factor(Diabetes):Weigth +
##   Ext_Temp:as.factor(Diabetes):as.factor(Sex) + Ext_Temp:Weigth:as.factor(Sex) +
##   as.factor(Diabetes):Weigth:as.factor(Sex) + Ext_Temp:as.factor(Diabetes):Age +
##   Ext_Temp:Weigth:Age + as.factor(Diabetes):Weigth:Age + Ext_Temp:as.factor(Sex):Age +
##   as.factor(Diabetes):as.factor(Sex):Age + Weigth:as.factor(Sex):Age +
##   Ext_Temp:as.factor(Diabetes):as.factor(Sex):Age + Ext_Temp:Weigth:as.factor(Sex):Age +
##   as.factor(Diabetes):Weigth:as.factor(Sex):Age
##
##                                     Df Deviance    AIC
## - Ext_Temp:as.factor(Diabetes):Weigth      1   2093.9 2149.9
## - as.factor(Diabetes):Weigth:as.factor(Sex):Age 1   2094.0 2150.0
## - Ext_Temp:Weigth:as.factor(Sex):Age        1   2094.2 2150.2
## - Ext_Temp:as.factor(Diabetes):as.factor(Sex):Age 1   2094.4 2150.4
## <none>                                     2093.9 2151.9
##
## Step: AIC=2149.93
## BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigth + as.factor(Sex) +
##   Age + Ext_Temp:as.factor(Diabetes) + Ext_Temp:Weigth + as.factor(Diabetes):Weigth +
##   Ext_Temp:as.factor(Sex) + as.factor(Diabetes):as.factor(Sex) +
##   Weigth:as.factor(Sex) + Ext_Temp:Age + as.factor(Diabetes):Age +
##   Weigth:Age + as.factor(Sex):Age + Ext_Temp:as.factor(Diabetes):as.factor(Sex) +
##   Ext_Temp:Weigth:as.factor(Sex) + as.factor(Diabetes):Weigth:as.factor(Sex) +
##   Ext_Temp:as.factor(Diabetes):Age + Ext_Temp:Weigth:Age +
##   as.factor(Diabetes):Weigth:Age + Ext_Temp:as.factor(Sex):Age +
##   as.factor(Diabetes):as.factor(Sex):Age + Weigth:as.factor(Sex):Age +
##   Ext_Temp:as.factor(Diabetes):as.factor(Sex):Age + Ext_Temp:Weigth:as.factor(Sex):Age +
##   as.factor(Diabetes):Weigth:as.factor(Sex):Age
##
##                                     Df Deviance    AIC
## - as.factor(Diabetes):Weigth:as.factor(Sex):Age 1   2094.0 2148.0
## - Ext_Temp:Weigth:as.factor(Sex):Age            1   2094.2 2148.2
## - Ext_Temp:as.factor(Diabetes):as.factor(Sex):Age 1   2094.4 2148.4
## <none>                                     2093.9 2149.9
##
## Step: AIC=2148.04
## BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigth + as.factor(Sex) +
##   Age + Ext_Temp:as.factor(Diabetes) + Ext_Temp:Weigth + as.factor(Diabetes):Weigth +
##   Ext_Temp:as.factor(Sex) + as.factor(Diabetes):as.factor(Sex) +
##   Weigth:as.factor(Sex) + Ext_Temp:Age + as.factor(Diabetes):Age +
##   Weigth:Age + as.factor(Sex):Age + Ext_Temp:as.factor(Diabetes):as.factor(Sex) +
##   Ext_Temp:Weigth:as.factor(Sex) + as.factor(Diabetes):Weigth:as.factor(Sex) +
##   Ext_Temp:as.factor(Diabetes):Age + Ext_Temp:Weigth:Age +
##   as.factor(Diabetes):Weigth:Age + Ext_Temp:as.factor(Sex):Age +
##   as.factor(Diabetes):as.factor(Sex):Age + Weigth:as.factor(Sex):Age +
##   Ext_Temp:as.factor(Diabetes):as.factor(Sex):Age + Ext_Temp:Weigth:as.factor(Sex):Age
##
##                                     Df Deviance    AIC

```

```

## - as.factor(Diabetes):Weigth:as.factor(Sex)      1  2094.1 2146.1
## - as.factor(Diabetes):Weigth:Age                 1  2094.2 2146.2
## - Ext_Temp:Weigth:as.factor(Sex):Age             1  2094.3 2146.3
## - Ext_Temp:as.factor(Diabetes):as.factor(Sex):Age 1  2094.5 2146.5
## <none>                                           2094.0 2148.0
##
## Step:  AIC=2146.12
## BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigth + as.factor(Sex) +
##   Age + Ext_Temp:as.factor(Diabetes) + Ext_Temp:Weigth + as.factor(Diabetes):Weigth +
##   Ext_Temp:as.factor(Sex) + as.factor(Diabetes):as.factor(Sex) +
##   Weigth:as.factor(Sex) + Ext_Temp:Age + as.factor(Diabetes):Age +
##   Weigth:Age + as.factor(Sex):Age + Ext_Temp:as.factor(Diabetes):as.factor(Sex) +
##   Ext_Temp:Weigth:as.factor(Sex) + Ext_Temp:as.factor(Diabetes):Age +
##   Ext_Temp:Weigth:Age + as.factor(Diabetes):Weigth:Age + Ext_Temp:as.factor(Sex):Age +
##   as.factor(Diabetes):as.factor(Sex):Age + Weigth:as.factor(Sex):Age +
##   Ext_Temp:as.factor(Diabetes):as.factor(Sex):Age + Ext_Temp:Weigth:as.factor(Sex):Age
##
##                                     Df Deviance    AIC
## - as.factor(Diabetes):Weigth:Age      1  2094.2 2144.2
## - Ext_Temp:Weigth:as.factor(Sex):Age   1  2094.4 2144.4
## - Ext_Temp:as.factor(Diabetes):as.factor(Sex):Age 1  2094.6 2144.6
## <none>                                2094.1 2146.1
##
## Step:  AIC=2144.2
## BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigth + as.factor(Sex) +
##   Age + Ext_Temp:as.factor(Diabetes) + Ext_Temp:Weigth + as.factor(Diabetes):Weigth +
##   Ext_Temp:as.factor(Sex) + as.factor(Diabetes):as.factor(Sex) +
##   Weigth:as.factor(Sex) + Ext_Temp:Age + as.factor(Diabetes):Age +
##   Weigth:Age + as.factor(Sex):Age + Ext_Temp:as.factor(Diabetes):as.factor(Sex) +
##   Ext_Temp:Weigth:as.factor(Sex) + Ext_Temp:as.factor(Diabetes):Age +
##   Ext_Temp:Weigth:Age + Ext_Temp:as.factor(Sex):Age + as.factor(Diabetes):as.factor(Sex):Age +
##   Weigth:as.factor(Sex):Age + Ext_Temp:as.factor(Diabetes):as.factor(Sex):Age +
##   Ext_Temp:Weigth:as.factor(Sex):Age
##
##                                     Df Deviance    AIC
## - as.factor(Diabetes):Weigth          1  2094.3 2142.3
## - Ext_Temp:Weigth:as.factor(Sex):Age   1  2094.5 2142.5
## - Ext_Temp:as.factor(Diabetes):as.factor(Sex):Age 1  2094.7 2142.7
## <none>                                2094.2 2144.2
##
## Step:  AIC=2142.28
## BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigth + as.factor(Sex) +
##   Age + Ext_Temp:as.factor(Diabetes) + Ext_Temp:Weigth + Ext_Temp:as.factor(Sex) +
##   as.factor(Diabetes):as.factor(Sex) + Weigth:as.factor(Sex) +
##   Ext_Temp:Age + as.factor(Diabetes):Age + Weigth:Age + as.factor(Sex):Age +
##   Ext_Temp:as.factor(Diabetes):as.factor(Sex) + Ext_Temp:Weigth:as.factor(Sex) +
##   Ext_Temp:as.factor(Diabetes):Age + Ext_Temp:Weigth:Age +
##   Ext_Temp:as.factor(Sex):Age + as.factor(Diabetes):as.factor(Sex):Age +
##   Weigth:as.factor(Sex):Age + Ext_Temp:as.factor(Diabetes):as.factor(Sex):Age +
##   Ext_Temp:Weigth:as.factor(Sex):Age
##
##                                     Df Deviance    AIC
## - Ext_Temp:Weigth:as.factor(Sex):Age   1  2094.6 2140.6
## - Ext_Temp:as.factor(Diabetes):as.factor(Sex):Age 1  2094.8 2140.8

```

```

## <none>                                2094.3 2142.3
##
## Step: AIC=2140.58
## BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigth + as.factor(Sex) +
##   Age + Ext_Temp:as.factor(Diabetes) + Ext_Temp:Weigth + Ext_Temp:as.factor(Sex) +
##   as.factor(Diabetes):as.factor(Sex) + Weigth:as.factor(Sex) +
##   Ext_Temp:Age + as.factor(Diabetes):Age + Weigth:Age + as.factor(Sex):Age +
##   Ext_Temp:as.factor(Diabetes):as.factor(Sex) + Ext_Temp:Weigth:as.factor(Sex) +
##   Ext_Temp:as.factor(Diabetes):Age + Ext_Temp:Weigth:Age +
##   Ext_Temp:as.factor(Sex):Age + as.factor(Diabetes):as.factor(Sex):Age +
##   Weigth:as.factor(Sex):Age + Ext_Temp:as.factor(Diabetes):as.factor(Sex):Age
##
##                                     Df Deviance    AIC
## - Ext_Temp:Weigth:Age                1   2094.6 2138.6
## - Ext_Temp:as.factor(Diabetes):as.factor(Sex):Age  1   2095.1 2139.1
## - Ext_Temp:Weigth:as.factor(Sex)       1   2095.3 2139.3
## <none>                                2094.6 2140.6
## - Weigth:as.factor(Sex):Age           1   2098.4 2142.4
##
## Step: AIC=2138.58
## BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigth + as.factor(Sex) +
##   Age + Ext_Temp:as.factor(Diabetes) + Ext_Temp:Weigth + Ext_Temp:as.factor(Sex) +
##   as.factor(Diabetes):as.factor(Sex) + Weigth:as.factor(Sex) +
##   Ext_Temp:Age + as.factor(Diabetes):Age + Weigth:Age + as.factor(Sex):Age +
##   Ext_Temp:as.factor(Diabetes):as.factor(Sex) + Ext_Temp:Weigth:as.factor(Sex) +
##   Ext_Temp:as.factor(Diabetes):Age + Ext_Temp:as.factor(Sex):Age +
##   as.factor(Diabetes):as.factor(Sex):Age + Weigth:as.factor(Sex):Age +
##   Ext_Temp:as.factor(Diabetes):as.factor(Sex):Age
##
##                                     Df Deviance    AIC
## - Ext_Temp:as.factor(Diabetes):as.factor(Sex):Age  1   2095.1 2137.1
## - Ext_Temp:Weigth:as.factor(Sex)                   1   2095.4 2137.4
## <none>                                                2094.6 2138.6
## - Weigth:as.factor(Sex):Age                         1   2098.7 2140.7
##
## Step: AIC=2137.09
## BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigth + as.factor(Sex) +
##   Age + Ext_Temp:as.factor(Diabetes) + Ext_Temp:Weigth + Ext_Temp:as.factor(Sex) +
##   as.factor(Diabetes):as.factor(Sex) + Weigth:as.factor(Sex) +
##   Ext_Temp:Age + as.factor(Diabetes):Age + Weigth:Age + as.factor(Sex):Age +
##   Ext_Temp:as.factor(Diabetes):as.factor(Sex) + Ext_Temp:Weigth:as.factor(Sex) +
##   Ext_Temp:as.factor(Diabetes):Age + Ext_Temp:as.factor(Sex):Age +
##   as.factor(Diabetes):as.factor(Sex):Age + Weigth:as.factor(Sex):Age
##
##                                     Df Deviance    AIC
## - Ext_Temp:as.factor(Diabetes):as.factor(Sex)      1   2095.4 2135.4
## - Ext_Temp:Weigth:as.factor(Sex)                   1   2096.0 2136.0
## - Ext_Temp:as.factor(Sex):Age                       1   2096.5 2136.5
## - as.factor(Diabetes):as.factor(Sex):Age            1   2097.0 2137.0
## <none>                                                2095.1 2137.1
## - Ext_Temp:as.factor(Diabetes):Age                  1   2097.3 2137.3
## - Weigth:as.factor(Sex):Age                        1   2099.2 2139.2
##
## Step: AIC=2135.41

```

```

## BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigth + as.factor(Sex) +
##   Age + Ext_Temp:as.factor(Diabetes) + Ext_Temp:Weigth + Ext_Temp:as.factor(Sex) +
##   as.factor(Diabetes):as.factor(Sex) + Weigth:as.factor(Sex) +
##   Ext_Temp:Age + as.factor(Diabetes):Age + Weigth:Age + as.factor(Sex):Age +
##   Ext_Temp:Weigth:as.factor(Sex) + Ext_Temp:as.factor(Diabetes):Age +
##   Ext_Temp:as.factor(Sex):Age + as.factor(Diabetes):as.factor(Sex):Age +
##   Weigth:as.factor(Sex):Age
##
##
##           Df Deviance    AIC
## - Ext_Temp:Weigth:as.factor(Sex)      1   2096.2 2134.2
## - Ext_Temp:as.factor(Sex):Age         1   2096.8 2134.8
## - as.factor(Diabetes):as.factor(Sex):Age 1   2097.1 2135.1
## - Ext_Temp:as.factor(Diabetes):Age     1   2097.3 2135.3
## <none>                                2095.4 2135.4
## - Weigth:as.factor(Sex):Age           1   2099.5 2137.5
##
## Step:  AIC=2134.23
## BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigth + as.factor(Sex) +
##   Age + Ext_Temp:as.factor(Diabetes) + Ext_Temp:Weigth + Ext_Temp:as.factor(Sex) +
##   as.factor(Diabetes):as.factor(Sex) + Weigth:as.factor(Sex) +
##   Ext_Temp:Age + as.factor(Diabetes):Age + Weigth:Age + as.factor(Sex):Age +
##   Ext_Temp:as.factor(Diabetes):Age + Ext_Temp:as.factor(Sex):Age +
##   as.factor(Diabetes):as.factor(Sex):Age + Weigth:as.factor(Sex):Age
##
##           Df Deviance    AIC
## - Ext_Temp:Weigth      1   2096.4 2132.4
## - Ext_Temp:as.factor(Sex):Age 1   2097.4 2133.4
## - as.factor(Diabetes):as.factor(Sex):Age 1   2097.9 2133.9
## - Ext_Temp:as.factor(Diabetes):Age     1   2098.1 2134.1
## <none>                                2096.2 2134.2
## - Weigth:as.factor(Sex):Age           1   2100.4 2136.4
##
## Step:  AIC=2132.39
## BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigth + as.factor(Sex) +
##   Age + Ext_Temp:as.factor(Diabetes) + Ext_Temp:as.factor(Sex) +
##   as.factor(Diabetes):as.factor(Sex) + Weigth:as.factor(Sex) +
##   Ext_Temp:Age + as.factor(Diabetes):Age + Weigth:Age + as.factor(Sex):Age +
##   Ext_Temp:as.factor(Diabetes):Age + Ext_Temp:as.factor(Sex):Age +
##   as.factor(Diabetes):as.factor(Sex):Age + Weigth:as.factor(Sex):Age
##
##           Df Deviance    AIC
## - Ext_Temp:as.factor(Sex):Age      1   2097.6 2131.6
## - as.factor(Diabetes):as.factor(Sex):Age 1   2098.1 2132.1
## - Ext_Temp:as.factor(Diabetes):Age   1   2098.2 2132.2
## <none>                                2096.4 2132.4
## - Weigth:as.factor(Sex):Age         1   2100.4 2134.4
##
## Step:  AIC=2131.58
## BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigth + as.factor(Sex) +
##   Age + Ext_Temp:as.factor(Diabetes) + Ext_Temp:as.factor(Sex) +
##   as.factor(Diabetes):as.factor(Sex) + Weigth:as.factor(Sex) +
##   Ext_Temp:Age + as.factor(Diabetes):Age + Weigth:Age + as.factor(Sex):Age +
##   Ext_Temp:as.factor(Diabetes):Age + as.factor(Diabetes):as.factor(Sex):Age +
##   Weigth:as.factor(Sex):Age

```

```

##
##
##           Df Deviance    AIC
## - Ext_Temp:as.factor(Sex)           1    2098.2 2130.2
## - Ext_Temp:as.factor(Diabetes):Age    1    2099.4 2131.4
## <none>                                2097.6 2131.6
## - as.factor(Diabetes):as.factor(Sex):Age 1    2099.6 2131.6
## - Weigh:as.factor(Sex):Age           1    2101.7 2133.7
##
## Step:  AIC=2130.19
## BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigh + as.factor(Sex) +
##           Age + Ext_Temp:as.factor(Diabetes) + as.factor(Diabetes):as.factor(Sex) +
##           Weigh:as.factor(Sex) + Ext_Temp:Age + as.factor(Diabetes):Age +
##           Weigh:Age + as.factor(Sex):Age + Ext_Temp:as.factor(Diabetes):Age +
##           as.factor(Diabetes):as.factor(Sex):Age + Weigh:as.factor(Sex):Age
##
##           Df Deviance    AIC
## - Ext_Temp:as.factor(Diabetes):Age    1    2100.2 2130.2
## <none>                                2098.2 2130.2
## - as.factor(Diabetes):as.factor(Sex):Age 1    2100.2 2130.2
## - Weigh:as.factor(Sex):Age           1    2102.2 2132.2
##
## Step:  AIC=2130.16
## BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigh + as.factor(Sex) +
##           Age + Ext_Temp:as.factor(Diabetes) + as.factor(Diabetes):as.factor(Sex) +
##           Weigh:as.factor(Sex) + Ext_Temp:Age + as.factor(Diabetes):Age +
##           Weigh:Age + as.factor(Sex):Age + as.factor(Diabetes):as.factor(Sex):Age +
##           Weigh:as.factor(Sex):Age
##
##           Df Deviance    AIC
## - Ext_Temp:Age                        1    2100.2 2128.2
## - Ext_Temp:as.factor(Diabetes)         1    2100.2 2128.2
## <none>                                2100.2 2130.2
## - as.factor(Diabetes):as.factor(Sex):Age 1    2103.4 2131.4
## - Weigh:as.factor(Sex):Age            1    2104.1 2132.1
##
## Step:  AIC=2128.16
## BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigh + as.factor(Sex) +
##           Age + Ext_Temp:as.factor(Diabetes) + as.factor(Diabetes):as.factor(Sex) +
##           Weigh:as.factor(Sex) + as.factor(Diabetes):Age + Weigh:Age +
##           as.factor(Sex):Age + as.factor(Diabetes):as.factor(Sex):Age +
##           Weigh:as.factor(Sex):Age
##
##           Df Deviance    AIC
## - Ext_Temp:as.factor(Diabetes)         1    2100.2 2126.2
## <none>                                2100.2 2128.2
## - as.factor(Diabetes):as.factor(Sex):Age 1    2103.4 2129.4
## - Weigh:as.factor(Sex):Age            1    2104.1 2130.1
##
## Step:  AIC=2126.17
## BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigh + as.factor(Sex) +
##           Age + as.factor(Diabetes):as.factor(Sex) + Weigh:as.factor(Sex) +
##           as.factor(Diabetes):Age + Weigh:Age + as.factor(Sex):Age +
##           as.factor(Diabetes):as.factor(Sex):Age + Weigh:as.factor(Sex):Age
##

```

```
##                                Df Deviance    AIC
## <none>                        2100.2 2126.2
## - as.factor(Diabetes):as.factor(Sex):Age  1   2103.4 2127.4
## - Weigth:as.factor(Sex):Age              1   2104.1 2128.1
## - Ext_Temp                             1   2121.1 2145.1
```

```
##
## Call: glm(formula = BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigth +
##          as.factor(Sex) + Age + as.factor(Diabetes):as.factor(Sex) +
##          Weigth:as.factor(Sex) + as.factor(Diabetes):Age + Weigth:Age +
##          as.factor(Sex):Age + as.factor(Diabetes):as.factor(Sex):Age +
##          Weigth:as.factor(Sex):Age, family = binomial(link = "logit"),
##          data = dat)
```

```
## Coefficients:
```

```
##              (Intercept)
##              7.199e-01
##              Ext_Temp
##              -2.053e-02
##          as.factor(Diabetes)1
##              4.742e+00
##              Weigth
##              -1.425e-02
##          as.factor(Sex)2
##              -2.610e+00
##              Age
##              -2.370e-02
##  as.factor(Diabetes)1:as.factor(Sex)2
##              -7.441e+00
##          Weigth:as.factor(Sex)2
##              4.129e-02
##          as.factor(Diabetes)1:Age
##              -1.064e-01
##              Weigth:Age
##              -9.841e-05
##          as.factor(Sex)2:Age
##              4.589e-02
##  as.factor(Diabetes)1:as.factor(Sex)2:Age
##              1.202e-01
##          Weigth:as.factor(Sex)2:Age
##              -9.757e-04
##
```

```
## Degrees of Freedom: 4841 Total (i.e. Null);  4829 Residual
## Null Deviance:      2399
## Residual Deviance: 2100  AIC: 2126
```

```
#with AIC=2126
```

```
# glm(formula = BrownFat ~ Ext_Temp + as.factor(Diabetes) + Weigth + as.factor(Sex)+ Age + as.factor(Diabetes):as.factor(Sex):Age + Weigth:as.factor(Sex):Age, family = binomial(link = "logit"), data = dat)
```

Then we get some interaction terms

```
#add interaction terms to the original model
```

```
model_test_interaction = glm(data= dat,BrownFat~as.factor(Sex)+as.factor(Diabetes)+Age+Day+Month+Ext_Temp+Weigth+as.factor(Sex):Age+as.factor(Diabetes):as.factor(Sex):Age+Weigth:as.factor(Sex):Age+Weigth:Age+as.factor(Sex):Age+as.factor(Diabetes):as.factor(Sex):Age+Weigth:as.factor(Sex):Age, family = binomial(link = "logit"), data = dat)
```

```
step(model_test_interaction)
```

```
## Start: AIC=2155.08
```

```
## BrownFat ~ as.factor(Sex) + as.factor(Diabetes) + Age + Day +
##   Month + Ext_Temp + TwoD_temp + ThreeD_temp + SevenD_temp +
##   oneM_temp + as.factor(Season) + Duration_Sunshine + Weigth +
##   Size + BMI + Glycemy + LBW + as.factor(Cancer_Status) + as.factor(Cancer_Type) +
##   as.factor(Diabetes):as.factor(Sex) + Weigth:as.factor(Sex) +
##   as.factor(Diabetes):Age + Weigth:Age + as.factor(Sex):Age +
##   as.factor(Diabetes):as.factor(Sex):Age + Weigth:as.factor(Sex):Age
```

	Df	Deviance	AIC
## - as.factor(Cancer_Type)	18	2062.9	2140.9
## - Month	11	2050.7	2142.7
## - SevenD_temp	1	2041.1	2153.1
## - Glycemy	1	2041.1	2153.1
## - Size	1	2041.1	2153.1
## - as.factor(Cancer_Status)	1	2041.2	2153.2
## - BMI	1	2041.3	2153.3
## - Day	1	2041.4	2153.4
## - Duration_Sunshine	1	2042.7	2154.7
## <none>		2041.1	2155.1
## - as.factor(Sex):as.factor(Diabetes):Age	1	2043.5	2155.6
## - oneM_temp	1	2043.8	2155.8
## - as.factor(Sex):Age:Weigth	1	2044.5	2156.6
## - LBW	1	2046.2	2158.2
## - as.factor(Season)	3	2050.3	2158.3
## - ThreeD_temp	1	2049.3	2161.3
## - TwoD_temp	1	2051.5	2163.5
## - Ext_Temp	1	2055.4	2167.4

```
## Step: AIC=2140.88
```

```
## BrownFat ~ as.factor(Sex) + as.factor(Diabetes) + Age + Day +
##   Month + Ext_Temp + TwoD_temp + ThreeD_temp + SevenD_temp +
##   oneM_temp + as.factor(Season) + Duration_Sunshine + Weigth +
##   Size + BMI + Glycemy + LBW + as.factor(Cancer_Status) + as.factor(Sex):as.factor(Diabetes) +
##   as.factor(Sex):Weigth + as.factor(Diabetes):Age + Age:Weigth +
##   as.factor(Sex):Age + as.factor(Sex):as.factor(Diabetes):Age +
##   as.factor(Sex):Age:Weigth
```

	Df	Deviance	AIC
## - Month	11	2072.0	2128.0
## - as.factor(Cancer_Status)	2	2063.1	2137.1
## - SevenD_temp	1	2062.9	2138.9
## - Glycemy	1	2062.9	2138.9
## - Size	1	2062.9	2138.9
## - Day	1	2063.0	2139.0
## - BMI	1	2063.1	2139.1
## - Duration_Sunshine	1	2064.7	2140.7
## <none>		2062.9	2140.9
## - as.factor(Sex):as.factor(Diabetes):Age	1	2065.3	2141.3
## - oneM_temp	1	2065.6	2141.6
## - as.factor(Sex):Age:Weigth	1	2066.8	2142.8
## - as.factor(Season)	3	2072.2	2144.2


```

## - LBW                                1    2068.5 2144.5
## - ThreeD_temp                        1    2071.3 2147.3
## - TwoD_temp                          1    2073.4 2149.4
## - Ext_Temp                          1    2076.3 2152.3
##
## Step: AIC=2128.04
## BrownFat ~ as.factor(Sex) + as.factor(Diabetes) + Age + Day +
##   Ext_Temp + TwoD_temp + ThreeD_temp + SevenD_temp + oneM_temp +
##   as.factor(Season) + Duration_Sunshine + Weigth + Size + BMI +
##   Glycemy + LBW + as.factor(Cancer_Status) + as.factor(Sex):as.factor(Diabetes) +
##   as.factor(Sex):Weigth + as.factor(Diabetes):Age + Age:Weigth +
##   as.factor(Sex):Age + as.factor(Sex):as.factor(Diabetes):Age +
##   as.factor(Sex):Age:Weigth
##
##                                     Df Deviance    AIC
## - as.factor(Cancer_Status)         2    2072.3 2124.3
## - Glycemy                           1    2072.0 2126.0
## - SevenD_temp                      1    2072.1 2126.1
## - Size                             1    2072.1 2126.1
## - Day                              1    2072.1 2126.1
## - BMI                              1    2072.3 2126.3
## <none>                             1    2072.0 2128.0
## - as.factor(Season)                 3    2078.3 2128.3
## - as.factor(Sex):as.factor(Diabetes):Age 1    2074.7 2128.7
## - oneM_temp                         1    2075.6 2129.6
## - as.factor(Sex):Age:Weigth         1    2075.9 2129.9
## - Duration_Sunshine                 1    2076.1 2130.1
## - LBW                              1    2077.5 2131.5
## - ThreeD_temp                      1    2080.5 2134.5
## - TwoD_temp                        1    2082.6 2136.6
## - Ext_Temp                         1    2085.6 2139.6
##
## Step: AIC=2124.31
## BrownFat ~ as.factor(Sex) + as.factor(Diabetes) + Age + Day +
##   Ext_Temp + TwoD_temp + ThreeD_temp + SevenD_temp + oneM_temp +
##   as.factor(Season) + Duration_Sunshine + Weigth + Size + BMI +
##   Glycemy + LBW + as.factor(Sex):as.factor(Diabetes) + as.factor(Sex):Weigth +
##   as.factor(Diabetes):Age + Age:Weigth + as.factor(Sex):Age +
##   as.factor(Sex):as.factor(Diabetes):Age + as.factor(Sex):Age:Weigth
##
##                                     Df Deviance    AIC
## - Glycemy                           1    2072.3 2122.3
## - SevenD_temp                      1    2072.3 2122.3
## - Day                              1    2072.3 2122.3
## - Size                             1    2072.3 2122.3
## - BMI                              1    2072.5 2122.5
## <none>                             1    2072.3 2124.3
## - as.factor(Season)                 3    2078.6 2124.6
## - as.factor(Sex):as.factor(Diabetes):Age 1    2075.1 2125.1
## - oneM_temp                         1    2075.9 2125.9
## - as.factor(Sex):Age:Weigth         1    2076.1 2126.1
## - Duration_Sunshine                 1    2076.4 2126.4
## - LBW                              1    2077.7 2127.7
## - ThreeD_temp                      1    2080.9 2130.9

```

```

## - TwoD_temp          1    2082.9 2132.9
## - Ext_Temp           1    2085.8 2135.8
##
## Step:  AIC=2122.31
## BrownFat ~ as.factor(Sex) + as.factor(Diabetes) + Age + Day +
##   Ext_Temp + TwoD_temp + ThreeD_temp + SevenD_temp + oneM_temp +
##   as.factor(Season) + Duration_Sunshine + Weigth + Size + BMI +
##   LBW + as.factor(Sex):as.factor(Diabetes) + as.factor(Sex):Weigth +
##   as.factor(Diabetes):Age + Age:Weigth + as.factor(Sex):Age +
##   as.factor(Sex):as.factor(Diabetes):Age + as.factor(Sex):Age:Weigth
##
##                                Df Deviance    AIC
## - SevenD_temp                1    2072.3 2120.3
## - Day                        1    2072.3 2120.3
## - Size                       1    2072.3 2120.3
## - BMI                        1    2072.5 2120.5
## <none>                       1    2072.3 2122.3
## - as.factor(Season)          3    2078.6 2122.6
## - as.factor(Sex):as.factor(Diabetes):Age 1    2075.1 2123.1
## - oneM_temp                  1    2075.9 2123.9
## - as.factor(Sex):Age:Weigth  1    2076.1 2124.1
## - Duration_Sunshine          1    2076.4 2124.4
## - LBW                        1    2077.7 2125.7
## - ThreeD_temp                1    2080.9 2128.9
## - TwoD_temp                  1    2082.9 2130.9
## - Ext_Temp                   1    2085.8 2133.8
##
## Step:  AIC=2120.33
## BrownFat ~ as.factor(Sex) + as.factor(Diabetes) + Age + Day +
##   Ext_Temp + TwoD_temp + ThreeD_temp + oneM_temp + as.factor(Season) +
##   Duration_Sunshine + Weigth + Size + BMI + LBW + as.factor(Sex):as.factor(Diabetes) +
##   as.factor(Sex):Weigth + as.factor(Diabetes):Age + Age:Weigth +
##   as.factor(Sex):Age + as.factor(Sex):as.factor(Diabetes):Age +
##   as.factor(Sex):Age:Weigth
##
##                                Df Deviance    AIC
## - Size                       1    2072.3 2118.3
## - Day                        1    2072.3 2118.3
## - BMI                        1    2072.6 2118.6
## <none>                       1    2072.3 2120.3
## - as.factor(Season)          3    2078.6 2120.6
## - as.factor(Sex):as.factor(Diabetes):Age 1    2075.1 2121.1
## - as.factor(Sex):Age:Weigth  1    2076.1 2122.1
## - oneM_temp                  1    2076.3 2122.3
## - Duration_Sunshine          1    2076.4 2122.4
## - LBW                        1    2077.8 2123.8
## - ThreeD_temp                1    2082.6 2128.6
## - TwoD_temp                  1    2083.4 2129.4
## - Ext_Temp                   1    2085.8 2131.8
##
## Step:  AIC=2118.35
## BrownFat ~ as.factor(Sex) + as.factor(Diabetes) + Age + Day +
##   Ext_Temp + TwoD_temp + ThreeD_temp + oneM_temp + as.factor(Season) +
##   Duration_Sunshine + Weigth + BMI + LBW + as.factor(Sex):as.factor(Diabetes) +

```

```

##      as.factor(Sex):Weigth + as.factor(Diabetes):Age + Age:Weigth +
##      as.factor(Sex):Age + as.factor(Sex):as.factor(Diabetes):Age +
##      as.factor(Sex):Age:Weigth
##
##
##              Df Deviance    AIC
## - Day          1   2072.4 2116.4
## - BMI           1   2073.0 2117.0
## <none>          2072.3 2118.3
## - as.factor(Season)      3   2078.6 2118.6
## - as.factor(Sex):as.factor(Diabetes):Age  1   2075.1 2119.1
## - as.factor(Sex):Age:Weigth      1   2076.2 2120.2
## - oneM_temp          1   2076.3 2120.3
## - Duration_Sunshine     1   2076.4 2120.4
## - LBW                 1   2078.3 2122.3
## - ThreeD_temp          1   2082.6 2126.6
## - TwoD_temp           1   2083.4 2127.4
## - Ext_Temp            1   2085.9 2129.9
##
## Step:  AIC=2116.37
## BrownFat ~ as.factor(Sex) + as.factor(Diabetes) + Age + Ext_Temp +
##      TwoD_temp + ThreeD_temp + oneM_temp + as.factor(Season) +
##      Duration_Sunshine + Weigth + BMI + LBW + as.factor(Sex):as.factor(Diabetes) +
##      as.factor(Sex):Weigth + as.factor(Diabetes):Age + Age:Weigth +
##      as.factor(Sex):Age + as.factor(Sex):as.factor(Diabetes):Age +
##      as.factor(Sex):Age:Weigth
##
##
##              Df Deviance    AIC
## - BMI           1   2073.1 2115.1
## <none>          2072.4 2116.4
## - as.factor(Season)      3   2078.6 2116.6
## - as.factor(Sex):as.factor(Diabetes):Age  1   2075.1 2117.1
## - as.factor(Sex):Age:Weigth      1   2076.2 2118.2
## - oneM_temp          1   2076.3 2118.3
## - Duration_Sunshine     1   2076.5 2118.5
## - LBW                 1   2078.4 2120.4
## - ThreeD_temp          1   2082.6 2124.6
## - TwoD_temp           1   2083.4 2125.4
## - Ext_Temp            1   2085.9 2127.9
##
## Step:  AIC=2115.06
## BrownFat ~ as.factor(Sex) + as.factor(Diabetes) + Age + Ext_Temp +
##      TwoD_temp + ThreeD_temp + oneM_temp + as.factor(Season) +
##      Duration_Sunshine + Weigth + LBW + as.factor(Sex):as.factor(Diabetes) +
##      as.factor(Sex):Weigth + as.factor(Diabetes):Age + Age:Weigth +
##      as.factor(Sex):Age + as.factor(Sex):as.factor(Diabetes):Age +
##      as.factor(Sex):Age:Weigth
##
##
##              Df Deviance    AIC
## <none>          2073.1 2115.1
## - as.factor(Season)      3   2079.3 2115.3
## - as.factor(Sex):as.factor(Diabetes):Age  1   2075.9 2115.9
## - oneM_temp          1   2076.9 2116.9
## - as.factor(Sex):Age:Weigth      1   2077.0 2117.0
## - Duration_Sunshine     1   2077.2 2117.2

```

```

## - LBW                                1    2079.8 2119.8
## - ThreeD_temp                        1    2083.3 2123.3
## - TwoD_temp                          1    2084.2 2124.2
## - Ext_Temp                           1    2086.8 2126.8

##
## Call: glm(formula = BrownFat ~ as.factor(Sex) + as.factor(Diabetes) +
##   Age + Ext_Temp + TwoD_temp + ThreeD_temp + oneM_temp + as.factor(Season) +
##   Duration_Sunshine + Weigth + LBW + as.factor(Sex):as.factor(Diabetes) +
##   as.factor(Sex):Weigth + as.factor(Diabetes):Age + Age:Weigth +
##   as.factor(Sex):Age + as.factor(Sex):as.factor(Diabetes):Age +
##   as.factor(Sex):Age:Weigth, family = binomial(link = "logit"),
##   data = dat)
##
## Coefficients:
##               (Intercept)
##               1.992e+00
##               as.factor(Sex)2
##               -2.643e+00
##               as.factor(Diabetes)1
##               4.433e+00
##               Age
##               -2.446e-02
##               Ext_Temp
##               -5.159e-02
##               TwoD_temp
##               1.408e-01
##               ThreeD_temp
##               -1.301e-01
##               oneM_temp
##               4.022e-02
##               as.factor(Season)2
##               -2.451e-01
##               as.factor(Season)3
##               -7.441e-01
##               as.factor(Season)4
##               -6.345e-01
##               Duration_Sunshine
##               -2.838e-03
##               Weigth
##               -3.341e-02
##               LBW
##               5.112e-02
##               as.factor(Sex)2:as.factor(Diabetes)1
##               -6.941e+00
##               as.factor(Sex)2:Weigth
##               3.660e-02
##               as.factor(Diabetes)1:Age
##               -1.003e-01
##               Age:Weigth
##               -4.462e-05
##               as.factor(Sex)2:Age
##               4.958e-02
## as.factor(Sex)2:as.factor(Diabetes)1:Age

```

```

##                                1.121e-01
##                as.factor(Sex)2:Age:Weigth
##                                -1.060e-03
##
## Degrees of Freedom: 4841 Total (i.e. Null);  4821 Residual
## Null Deviance:                2399
## Residual Deviance: 2073  AIC: 2115

# Step:  AIC=2115.1
# BrownFat ~ as.factor(Sex) + as.factor(Diabetes) + Age + Ext_Temp +
#   TwoD_temp + ThreeD_temp + oneM_temp + as.factor(Season) +
#   Duration_Sunshine + Weigth + LBW + as.factor(Sex):as.factor(Diabetes) +
#   as.factor(Sex):Weigth + as.factor(Diabetes):Age + Age:Weigth +
#   as.factor(Sex):Age + as.factor(Sex):as.factor(Diabetes):Age +
#   as.factor(Sex):Age:Weigth

updated_model = glm(data=dat, BrownFat ~ as.factor(Sex) + as.factor(Diabetes) + Age + Ext_Temp +
  TwoD_temp + ThreeD_temp + oneM_temp + as.factor(Season) +
  Duration_Sunshine + Weigth + LBW + as.factor(Sex):as.factor(Diabetes) +
  as.factor(Sex):Weigth + as.factor(Diabetes):Age + Age:Weigth +
  as.factor(Sex):Age + as.factor(Sex):as.factor(Diabetes):Age +
  as.factor(Sex):Age:Weigth, family =binomial(link = 'logit'))
summary(updated_model)

##
## Call:
## glm(formula = BrownFat ~ as.factor(Sex) + as.factor(Diabetes) +
##   Age + Ext_Temp + TwoD_temp + ThreeD_temp + oneM_temp + as.factor(Season) +
##   Duration_Sunshine + Weigth + LBW + as.factor(Sex):as.factor(Diabetes) +
##   as.factor(Sex):Weigth + as.factor(Diabetes):Age + Age:Weigth +
##   as.factor(Sex):Age + as.factor(Sex):as.factor(Diabetes):Age +
##   as.factor(Sex):Age:Weigth, family = binomial(link = "logit"),
##   data = dat)
##
## Deviance Residuals:
##      Min       1Q   Median       3Q      Max
## -1.1821  -0.4270  -0.2724  -0.1424   3.4693
##
## Coefficients:
##                                Estimate Std. Error z value Pr(>|z|)
## (Intercept)                   1.992e+00  1.685e+00   1.183 0.236968
## as.factor(Sex)2                -2.643e+00  1.999e+00  -1.322 0.186049
## as.factor(Diabetes)1           4.433e+00  2.720e+00   1.630 0.103161
## Age                          -2.446e-02  2.093e-02  -1.169 0.242567
## Ext_Temp                      -5.159e-02  1.403e-02  -3.676 0.000237
## TwoD_temp                     1.408e-01  4.226e-02   3.331 0.000864
## ThreeD_temp                   -1.301e-01  4.085e-02  -3.184 0.001452
## oneM_temp                    4.022e-02  2.049e-02   1.963 0.049638
## as.factor(Season)2            -2.451e-01  2.402e-01  -1.021 0.307406
## as.factor(Season)3            -7.441e-01  3.292e-01  -2.261 0.023788
## as.factor(Season)4            -6.345e-01  2.794e-01  -2.271 0.023144
## Duration_Sunshine             -2.838e-03  1.393e-03  -2.037 0.041625
## Weigth                       -3.341e-02  2.119e-02  -1.576 0.114955
## LBW                          5.112e-02  2.037e-02   2.509 0.012090
## as.factor(Sex)2:as.factor(Diabetes)1 -6.941e+00  4.402e+00  -1.577 0.114848

```

```
## as.factor(Sex)2:Weigth      3.660e-02  2.854e-02   1.282 0.199707
## as.factor(Diabetes)1:Age    -1.003e-01  4.986e-02  -2.011 0.044306
## Age:Weigth                 -4.462e-05  3.368e-04  -0.132 0.894623
## as.factor(Sex)2:Age        4.958e-02  3.693e-02   1.343 0.179420
## as.factor(Sex)2:as.factor(Diabetes)1:Age 1.121e-01  7.456e-02   1.503 0.132835
## as.factor(Sex)2:Age:Weigth -1.060e-03  5.373e-04  -1.973 0.048536
##
## (Intercept)
## as.factor(Sex)2
## as.factor(Diabetes)1
## Age
## Ext_Temp                    ***
## TwoD_temp                   ***
## ThreeD_temp                 **
## oneM_temp                   *
## as.factor(Season)2
## as.factor(Season)3          *
## as.factor(Season)4          *
## Duration_Sunshine           *
## Weigth
## LBW                         *
## as.factor(Sex)2:as.factor(Diabetes)1
## as.factor(Sex)2:Weigth
## as.factor(Diabetes)1:Age     *
## Age:Weigth
## as.factor(Sex)2:Age
## as.factor(Sex)2:as.factor(Diabetes)1:Age
## as.factor(Sex)2:Age:Weigth  *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
## Null deviance: 2399.3 on 4841 degrees of freedom
## Residual deviance: 2073.1 on 4821 degrees of freedom
## AIC: 2115.1
##
## Number of Fisher Scoring iterations: 8
```

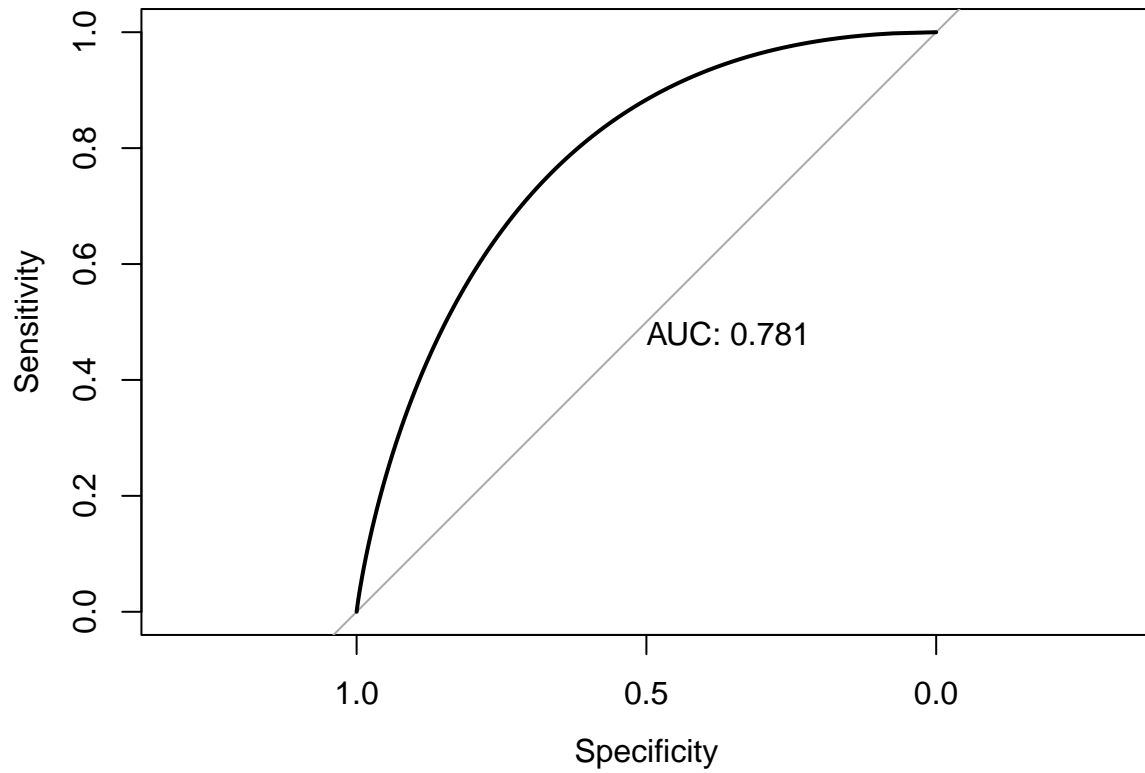
We get `updated_model`'s AIC = 2115.1 which is smaller than the `after_step`'s AIC = 2123.89.

```
Sys.setenv(LANGUAGE = 'en')
library(pROC)
```

```
## Type 'citation("pROC")' for a citation.
##
## Attaching package: 'pROC'
## The following objects are masked from 'package:stats':
##
## cov, smooth, var
roc1<-roc(dat$BrownFat~fitted(updated_model),smooth = TRUE)

## Setting levels: control = 0, case = 1
```

```
## Setting direction: controls < cases  
plot(roc1, print.auc=TRUE, plot=TRUE)
```



AUC tells how much the model is capable of distinguishing between classes.