Logistic Regression Analysis

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2024-10-12

1 Load required and new packages

```
if (!require("pacman")) install.packages("pacman")
```

```
## Loading required package: pacman
```

```
library(pacman)
pacman::p_load("here", "glue", "crayon","readxl", "writexl", "dplyr", "tidyr", "rstatix")
pacman::p_load("DataExplorer")

`%ni%` = Negate(`%in%`)
```

2 Set data paths and details

```
main.path = here::here()
data.path = file.path(main.path, "02 Data")
output.path = file.path(main.path, "04 Outputs")

file.name = "Final Data.xlsx"
sheet.name = "FINAL"
output.name = paste0("OUTPUT_", format(Sys.Date(), "%m%d%y"), ".xlsx")
```

3 Load dataset

```
df = readxl::read_excel(file.path(data.path, file.name),
                        sheet = sheet.name) %>%
  dplyr::select(-c(id, id_mrn, gender, admission, seizures, enceph_type, comorbidities, risk_fac
tors, neuroimaging_findings, discharge_destination:eeg_triphasic_waves, new_classification, mrs,
mrs_classification))
```

4 Process data

```
summary(df)
```

```
##  gender_female     gender_male          age        admission_room
##  Min.   :0.0000   Min.   :0.0000   Min.   :20.00   Min.   :0.0000
##  1st Qu.:0.0000   1st Qu.:0.0000   1st Qu.:60.50   1st Qu.:0.0000
##  Median :1.0000   Median :0.0000   Median :71.50   Median :1.0000
##  Mean   :0.5417   Mean   :0.4583   Mean   :68.56   Mean   :0.5556
##  3rd Qu.:1.0000   3rd Qu.:1.0000   3rd Qu.:82.50   3rd Qu.:1.0000
##  Max.   :1.0000   Max.   :1.0000   Max.   :97.00   Max.   :1.0000
##  admission_icu    seizure_focal_motor seizure_generalized
##  Min.   :0.0000   Min.   :0.0000      Min.   :0.00000
##  1st Qu.:0.0000   1st Qu.:0.0000      1st Qu.:0.00000
##  Median :0.0000   Median :0.0000      Median :0.00000
##  Mean   :0.4444   Mean   :0.1111      Mean   :0.09722
##  3rd Qu.:1.0000   3rd Qu.:0.0000      3rd Qu.:0.00000
##  Max.   :1.0000   Max.   :1.0000      Max.   :1.00000
##  seizure_myoclonic_jerks  seizure_none  enceph_anorexic_ischemic
##  Min.   :0.00000         Min.   :0.00   Min.   :0.000
##  1st Qu.:0.00000         1st Qu.:0.75   1st Qu.:0.000
##  Median :0.00000         Median :1.00   Median :0.000
##  Mean   :0.04167         Mean   :0.75   Mean   :0.125
##  3rd Qu.:0.00000         3rd Qu.:1.00   3rd Qu.:0.000
##  Max.   :1.00000         Max.   :1.00   Max.   :1.000
##  enceph_drug_induced enceph_electrolyte_disturbance enceph_endocrine
##  Min.   :0.00000     Min.   :0.0000                 Min.   :0.00000
##  1st Qu.:0.00000     1st Qu.:0.0000                 1st Qu.:0.00000
##  Median :0.00000     Median :0.0000                 Median :0.00000
##  Mean   :0.02778     Mean   :0.1806                 Mean   :0.05556
##  3rd Qu.:0.00000     3rd Qu.:0.0000                 3rd Qu.:0.00000
##  Max.   :1.00000     Max.   :1.0000                 Max.   :1.00000
##  enceph_hepatic   enceph_hypercapnic enceph_septic    enceph_uremic
##  Min.   :0.0000   Min.   :0.00000    Min.   :0.0000   Min.   :0.00000
##  1st Qu.:0.0000   1st Qu.:0.00000    1st Qu.:0.0000   1st Qu.:0.00000
##  Median :0.0000   Median :0.00000    Median :1.0000   Median :0.00000
##  Mean   :0.1111   Mean   :0.01389    Mean   :0.5972   Mean   :0.09722
##  3rd Qu.:0.0000   3rd Qu.:0.00000    3rd Qu.:1.0000   3rd Qu.:0.00000
##  Max.   :1.0000   Max.   :1.00000    Max.   :1.0000   Max.   :1.00000
##  enceph_withdrawal   com_cancer        com_ckd        com_diabetes
##  Min.   :0.00000   Min.   :0.0000   Min.   :0.0000   Min.   :0.0000
##  1st Qu.:0.00000   1st Qu.:0.0000   1st Qu.:0.0000   1st Qu.:0.0000
##  Median :0.00000   Median :0.0000   Median :0.0000   Median :0.0000
##  Mean   :0.02778   Mean   :0.1389   Mean   :0.1806   Mean   :0.3056
##  3rd Qu.:0.00000   3rd Qu.:0.0000   3rd Qu.:0.0000   3rd Qu.:1.0000
##  Max.   :1.00000   Max.   :1.0000   Max.   :1.0000   Max.   :1.0000
##  com_hypertension com_liver_disease com_previous_stroke  risk_alcohol
##  Min.   :0.0000   Min.   :0.0000    Min.   :0.0000      Min.   :0.0000
##  1st Qu.:0.0000   1st Qu.:0.0000    1st Qu.:0.0000      1st Qu.:0.0000
##  Median :1.0000   Median :0.0000    Median :0.0000      Median :0.0000
##  Mean   :0.5833   Mean   :0.1389    Mean   :0.2361      Mean   :0.1389
##  3rd Qu.:1.0000   3rd Qu.:0.0000    3rd Qu.:0.0000      3rd Qu.:0.0000
##  Max.   :1.0000   Max.   :1.0000    Max.   :1.0000      Max.   :1.0000
##    risk_drug        risk_smoking      risk_none      nf_cerebral_edema
##  Min.   :0.00000   Min.   :0.0000   Min.   :0.0000   Min.   :0.00000
##  1st Qu.:0.00000   1st Qu.:0.0000   1st Qu.:0.0000   1st Qu.:0.00000
```

```
##  Median :0.00000   Median :0.0000   Median :1.0000   Median :0.00000
##  Mean   :0.01389   Mean   :0.4306   Mean   :0.5278   Mean   :0.02778
##  3rd Qu.:0.00000   3rd Qu.:1.0000   3rd Qu.:1.0000   3rd Qu.:0.00000
##  Max.   :1.00000   Max.   :1.0000   Max.   :1.0000   Max.   :1.00000
##  nf_cerebrocerebellar_atrophy nf_chronic_infarct nf_white_matter_changes
##  Min.   :0.0000               Min.   :0.0000     Min.   :0.0000
##  1st Qu.:0.0000               1st Qu.:0.0000     1st Qu.:0.0000
##  Median :1.0000               Median :0.0000     Median :1.0000
##  Mean   :0.5833               Mean   :0.4167     Mean   :0.5139
##  3rd Qu.:1.0000               3rd Qu.:1.0000     3rd Qu.:1.0000
##  Max.   :1.0000               Max.   :1.0000     Max.   :1.0000
##  nf_unremarkable   malignance     classification_benign
##  Min.   :0.000   Min.   :0.0000   Min.   :0.0000
##  1st Qu.:0.000   1st Qu.:0.0000   1st Qu.:0.0000
##  Median :0.000   Median :0.0000   Median :1.0000
##  Mean   :0.125   Mean   :0.3472   Mean   :0.6528
##  3rd Qu.:0.000   3rd Qu.:1.0000   3rd Qu.:1.0000
##  Max.   :1.000   Max.   :1.0000   Max.   :1.0000
##  classification_malignant classification_highly_malignant    mrs_good
##  Min.   :0.0000           Min.   :0.00000                 Min.   :0.000
##  1st Qu.:0.0000           1st Qu.:0.00000                 1st Qu.:0.000
##  Median :0.0000           Median :0.00000                 Median :0.000
##  Mean   :0.2778           Mean   :0.06944                 Mean   :0.375
##  3rd Qu.:1.0000           3rd Qu.:0.00000                 3rd Qu.:1.000
##  Max.   :1.0000           Max.   :1.00000                 Max.   :1.000
##     mrs_poor        mrs_death
##  Min.   :0.0000   Min.   :0.0000
##  1st Qu.:0.0000   1st Qu.:0.0000
##  Median :0.0000   Median :0.0000
##  Mean   :0.3056   Mean   :0.3194
##  3rd Qu.:1.0000   3rd Qu.:1.0000
##  Max.   :1.0000   Max.   :1.0000
```

```
df.final = df %>%
  dplyr::mutate(dplyr::across(-c(age), ~ .x[!is.na(.x)] %>% as.factor()))

# set.seed(102899)

df.benign = df.final %>%
  dplyr::filter(classification_benign == 1) %>%
  dplyr::sample_n(47, replace = T)

# set.seed(061400)

df.malignant = df.final %>%
  dplyr::filter(classification_malignant == 1) %>%
  dplyr::sample_n(20, replace = T)

# set.seed(082624)

df.hmalignant = df.final %>%
  dplyr::filter(classification_highly_malignant == 1) %>%
  dplyr::sample_n(5, replace = T)

df.final = dplyr::bind_rows(df.final, df.benign, df.malignant, df.hmalignant)

summary(df.final)
```

```
##  gender_female gender_male      age        admission_room admission_icu
##  0:67          0:77        Min.   :20.00   0:65           0:79
##  1:77          1:67        1st Qu.:58.00   1:79           1:65
##                            Median :69.50
##                            Mean   :67.59
##                            3rd Qu.:84.00
##                            Max.   :97.00
##  seizure_focal_motor seizure_generalized seizure_myoclonic_jerks seizure_none
##  0:126               0:130               0:138                   0: 38
##  1: 18               1: 14               1:  6                   1:106
##
##
##
##
##  enceph_anorexic_ischemic enceph_drug_induced enceph_electrolyte_disturbance
##  0:127                    0:140               0:121
##  1: 17                    1:  4               1: 23
##
##
##
##
##  enceph_endocrine enceph_hepatic enceph_hypercapnic enceph_septic enceph_uremic
##  0:133            0:126          0:142              0:61          0:124
##  1: 11            1: 18          1:  2              1:83          1: 20
##
##
##
##
##  enceph_withdrawal com_cancer com_ckd com_diabetes com_hypertension
##  0:142             0:122      0:116   0:99         0:67
##  1:  2             1: 22      1: 28   1:45         1:77
##
##
##
##
##  com_liver_disease com_previous_stroke risk_alcohol risk_drug risk_smoking
##  0:123             0:113               0:124        0:142     0:79
##  1: 21             1: 31               1: 20        1:  2     1:65
##
##
##
##
##  risk_none nf_cerebral_edema nf_cerebrocerebellar_atrophy nf_chronic_infarct
##  0:71      0:140             0:64                         0:90
##  1:73      1:  4             1:80                         1:54
##
##
##
##
##  nf_white_matter_changes nf_unremarkable malignance classification_benign
##  0:68                    0:127           0:94       0:50
##  1:76                    1: 17           1:50       1:94
```

```
##
##
##
##
##  classification_malignant classification_highly_malignant mrs_good mrs_poor
##  0:104                    0:134                           0:87     0:97
##  1: 40                    1: 10                           1:57     1:47
##
##
##
##
##  mrs_death
##  0:104
##  1: 40
##
##
##
##
```

5 Implement methodology

5.1 Overall Logistic Regression

```
overall.model = stats::glm(malignance ~
                           gender_female +
                           age +
                           admission_icu +
                           seizure_focal_motor + seizure_generalized + seizure_myoclonic_jerks
+
                           com_cancer + com_ckd + com_diabetes + com_hypertension + com_liver_
disease + com_previous_stroke +
                           risk_alcohol + risk_drug + risk_smoking +
                           nf_cerebral_edema + nf_cerebrocerebellar_atrophy + nf_chronic_infar
ct + nf_white_matter_changes + nf_unremarkable +
                           mrs_poor + mrs_death,
                         data = df.final,
                         family = "binomial")
overall.model.summary = summary(overall.model)
overall.model.summary
```

```
##
## Call:
## stats::glm(formula = malignance ~ gender_female + age + admission_icu +
##     seizure_focal_motor + seizure_generalized + seizure_myoclonic_jerks +
##     com_cancer + com_ckd + com_diabetes + com_hypertension +
##     com_liver_disease + com_previous_stroke + risk_alcohol +
##     risk_drug + risk_smoking + nf_cerebral_edema + nf_cerebrocerebellar_atrophy +
##     nf_chronic_infarct + nf_white_matter_changes + nf_unremarkable +
##     mrs_poor + mrs_death, family = "binomial", data = df.final)
##
## Coefficients:
##                                Estimate Std. Error z value Pr(>|z|)
## (Intercept)                    -3.12561    1.57385  -1.986  0.04704 *
## gender_female1                 -1.60225    0.62205  -2.576  0.01000 *
## age                             0.02482    0.02122   1.170  0.24209
## admission_icu1                  1.04771    0.65236   1.606  0.10827
## seizure_focal_motor1            2.48488    0.90988   2.731  0.00631 **
## seizure_generalized1           -2.76252    1.27867  -2.160  0.03074 *
## seizure_myoclonic_jerks1       -0.62197    1.29345  -0.481  0.63061
## com_cancer1                     0.19634    0.74639   0.263  0.79251
## com_ckd1                       -0.95364    0.73995  -1.289  0.19747
## com_diabetes1                   0.64890    0.58835   1.103  0.27007
## com_hypertension1              -0.10607    0.61680  -0.172  0.86346
## com_liver_disease1              1.21302    0.68520   1.770  0.07667 .
## com_previous_stroke1            0.51487    0.80326   0.641  0.52154
## risk_alcohol1                   2.37603    1.06163   2.238  0.02521 *
## risk_drug1                    -19.66568 2797.44218  -0.007  0.99439
## risk_smoking1                  -0.74252    0.63997  -1.160  0.24595
## nf_cerebral_edema1             18.36198 1718.75527   0.011  0.99148
## nf_cerebrocerebellar_atrophy1  -0.30713    0.87200  -0.352  0.72468
## nf_chronic_infarct1            -0.80303    0.78336  -1.025  0.30531
## nf_white_matter_changes1        1.04427    0.85813   1.217  0.22364
## nf_unremarkable1                1.55821    1.03614   1.504  0.13262
## mrs_poor1                      -0.27667    0.76357  -0.362  0.71710
## mrs_death1                      1.65122    0.73604   2.243  0.02487 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 185.96  on 143  degrees of freedom
## Residual deviance: 121.70  on 121  degrees of freedom
## AIC: 167.7
##
## Number of Fisher Scoring iterations: 16
```

```
overall.names = c("Intercept", names(overall.model.summary$contrasts)[1], "age", names(overall.m
odel.summary$contrasts)[2:21])
overall.crude = as.data.frame(overall.model.summary$coefficients) %>%
  dplyr::mutate(VARS = overall.names,
                OR = exp(`Estimate`),
                LL = exp(`Estimate` - (`Std. Error` * 1.96)),
                UL = exp(`Estimate` + (`Std. Error` * 1.96)),
                sig = ifelse(`Pr(>|z|)` <= 0.05, "S", "NS")) %>%
  dplyr::select(VARS, dplyr::everything())
```

5.2 Benign Logistic Regression

```
benign.model = stats::glm(classification_benign ~
                            enceph_anorexic_ischemic + enceph_drug_induced + enceph_electrolyte_d
isturbance + enceph_endocrine + enceph_hepatic + enceph_hypercapnic + enceph_septic + enceph_ure
mic + enceph_withdrawal +
                            mrs_poor + mrs_death,
                          data = df.final,
                          family = "binomial")
benign.model.summary = summary(benign.model)
benign.model.summary
```

```
##
## Call:
## stats::glm(formula = classification_benign ~ enceph_anorexic_ischemic +
##     enceph_drug_induced + enceph_electrolyte_disturbance + enceph_endocrine +
##     enceph_hepatic + enceph_hypercapnic + enceph_septic + enceph_uremic +
##     enceph_withdrawal + mrs_poor + mrs_death, family = "binomial",
##     data = df.final)
##
## Coefficients:
##                                 Estimate Std. Error z value Pr(>|z|)
## (Intercept)                       2.4656     0.7279   3.387 0.000706 ***
## enceph_anorexic_ischemic1        -0.8132     0.7768  -1.047 0.295166
## enceph_drug_induced1             -3.3138     1.3408  -2.471 0.013456 *
## enceph_electrolyte_disturbance1  -1.5644     0.6295  -2.485 0.012948 *
## enceph_endocrine1                -2.1552     0.8450  -2.550 0.010760 *
## enceph_hepatic1                  -1.8259     0.7728  -2.363 0.018136 *
## enceph_hypercapnic1              15.4428  1696.7344   0.009 0.992738
## enceph_septic1                   -1.1156     0.5826  -1.915 0.055530 .
## enceph_uremic1                    1.1119     0.7501   1.482 0.138255
## enceph_withdrawal1               14.1005  1696.7345   0.008 0.993369
## mrs_poor1                        -0.2268     0.5115  -0.443 0.657508
## mrs_death1                       -1.2833     0.5467  -2.347 0.018906 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 185.96  on 143  degrees of freedom
## Residual deviance: 157.90  on 132  degrees of freedom
## AIC: 181.9
##
## Number of Fisher Scoring iterations: 15
```

```
benign.names = c("Intercept", names(benign.model.summary$contrasts))
benign.crude = as.data.frame(benign.model.summary$coefficients) %>%
  dplyr::mutate(VARS = benign.names,
                `Pr(>|z|)` = `Pr(>|z|)`,
                OR = exp(`Estimate`),
                LL = exp(`Estimate` - (`Std. Error` * 1.96)),
                UL = exp(`Estimate` + (`Std. Error` * 1.96)),
                sig = ifelse(`Pr(>|z|)` <= 0.05, "S", "NS")) %>%
  dplyr::select(VARS, dplyr::everything())

benign.model.step = MASS::stepAIC(benign.model, direction = "both")
```

```
## Start:  AIC=181.9
## classification_benign ~ enceph_anorexic_ischemic + enceph_drug_induced +
##     enceph_electrolyte_disturbance + enceph_endocrine + enceph_hepatic +
##     enceph_hypercapnic + enceph_septic + enceph_uremic + enceph_withdrawal +
##     mrs_poor + mrs_death
##
##                                 Df Deviance    AIC
## - mrs_poor                       1   158.10 180.10
## - enceph_withdrawal              1   158.21 180.21
## - enceph_hypercapnic             1   158.99 180.99
## - enceph_anorexic_ischemic       1   159.06 181.06
## <none>                               157.90 181.90
## - enceph_uremic                  1   160.36 182.36
## - enceph_septic                  1   162.06 184.06
## - mrs_death                      1   163.70 185.70
## - enceph_hepatic                 1   163.93 185.93
## - enceph_electrolyte_disturbance 1   164.42 186.42
## - enceph_endocrine               1   164.97 186.97
## - enceph_drug_induced            1   165.38 187.38
##
## Step:  AIC=180.1
## classification_benign ~ enceph_anorexic_ischemic + enceph_drug_induced +
##     enceph_electrolyte_disturbance + enceph_endocrine + enceph_hepatic +
##     enceph_hypercapnic + enceph_septic + enceph_uremic + enceph_withdrawal +
##     mrs_death
##
##                                 Df Deviance    AIC
## - enceph_withdrawal              1   158.46 178.46
## - enceph_hypercapnic             1   159.10 179.10
## - enceph_anorexic_ischemic       1   159.15 179.15
## <none>                               158.10 180.10
## - enceph_uremic                  1   161.26 181.26
## + mrs_poor                       1   157.90 181.90
## - enceph_septic                  1   162.10 182.10
## - mrs_death                      1   164.12 184.12
## - enceph_hepatic                 1   164.13 184.13
## - enceph_electrolyte_disturbance 1   164.76 184.76
## - enceph_endocrine               1   165.00 185.00
## - enceph_drug_induced            1   165.38 185.38
##
## Step:  AIC=178.46
## classification_benign ~ enceph_anorexic_ischemic + enceph_drug_induced +
##     enceph_electrolyte_disturbance + enceph_endocrine + enceph_hepatic +
##     enceph_hypercapnic + enceph_septic + enceph_uremic + mrs_death
##
##                                 Df Deviance    AIC
## - enceph_hypercapnic             1   159.45 177.45
## - enceph_anorexic_ischemic       1   159.64 177.64
## <none>                               158.46 178.46
## - enceph_uremic                  1   161.54 179.54
## + enceph_withdrawal              1   158.10 180.10
## + mrs_poor                       1   158.21 180.21
```

```
## - enceph_septic                   1   163.04 181.04
## - mrs_death                       1   164.57 182.57
## - enceph_hepatic                  1   164.95 182.95
## - enceph_electrolyte_disturbance  1   165.64 183.64
## - enceph_endocrine                1   165.70 183.70
## - enceph_drug_induced             1   166.05 184.05
##
## Step:  AIC=177.45
## classification_benign ~ enceph_anorexic_ischemic + enceph_drug_induced +
##     enceph_electrolyte_disturbance + enceph_endocrine + enceph_hepatic +
##     enceph_septic + enceph_uremic + mrs_death
##
##                                 Df Deviance    AIC
## - enceph_anorexic_ischemic       1   160.66 176.66
## <none>                               159.45 177.45
## + enceph_hypercapnic             1   158.46 178.46
## - enceph_uremic                  1   162.48 178.48
## + enceph_withdrawal              1   159.10 179.10
## + mrs_poor                       1   159.30 179.30
## - enceph_septic                  1   163.95 179.95
## - mrs_death                      1   165.88 181.88
## - enceph_hepatic                 1   166.12 182.12
## - enceph_electrolyte_disturbance 1   166.94 182.94
## - enceph_endocrine               1   166.95 182.95
## - enceph_drug_induced            1   167.23 183.23
##
## Step:  AIC=176.66
## classification_benign ~ enceph_drug_induced + enceph_electrolyte_disturbance +
##     enceph_endocrine + enceph_hepatic + enceph_septic + enceph_uremic +
##     mrs_death
##
##                                 Df Deviance    AIC
## <none>                               160.66 176.66
## + enceph_anorexic_ischemic       1   159.45 177.45
## + enceph_hypercapnic             1   159.64 177.64
## - enceph_septic                  1   163.98 177.98
## + enceph_withdrawal              1   160.19 178.19
## + mrs_poor                       1   160.59 178.59
## - enceph_uremic                  1   165.04 179.04
## - enceph_hepatic                 1   166.15 180.15
## - enceph_electrolyte_disturbance 1   167.00 181.00
## - enceph_drug_induced            1   167.62 181.62
## - enceph_endocrine               1   168.28 182.28
## - mrs_death                      1   170.81 184.81
```

```
benign.model.step.summary = summary(benign.model.step)
benign.model.step.summary
```

```
##
## Call:
## stats::glm(formula = classification_benign ~ enceph_drug_induced +
##     enceph_electrolyte_disturbance + enceph_endocrine + enceph_hepatic +
##     enceph_septic + enceph_uremic + mrs_death, family = "binomial",
##     data = df.final)
##
## Coefficients:
##                                 Estimate Std. Error z value Pr(>|z|)
## (Intercept)                       2.1116     0.5322   3.968 7.25e-05 ***
## enceph_drug_induced1             -3.0317     1.2568  -2.412  0.01586 *
## enceph_electrolyte_disturbance1  -1.4313     0.5749  -2.490  0.01278 *
## enceph_endocrine1                -2.0724     0.7586  -2.732  0.00630 **
## enceph_hepatic1                  -1.6045     0.7052  -2.275  0.02290 *
## enceph_septic1                   -0.8523     0.4829  -1.765  0.07754 .
## enceph_uremic1                    1.3593     0.7123   1.908  0.05637 .
## mrs_death1                       -1.4166     0.4581  -3.092  0.00199 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 185.96  on 143  degrees of freedom
## Residual deviance: 160.66  on 136  degrees of freedom
## AIC: 176.66
##
## Number of Fisher Scoring iterations: 4
```

```
benign.step.names = c("Intercept", names(benign.model.step.summary$contrasts))
benign.adj = as.data.frame(benign.model.step.summary$coefficients) %>%
  dplyr::mutate(VARS = benign.step.names,
                OR = exp(`Estimate`),
                LL = exp(`Estimate` - (`Std. Error` * 1.96)),
                UL = exp(`Estimate` + (`Std. Error` * 1.96)),
                sig = ifelse(`Pr(>|z|)` <= 0.05, "S", "NS")) %>%
  dplyr::select(VARS, dplyr::everything())
```

5.3 Malignant Logistic Regression

```
malignant.model = stats::glm(classification_malignant ~
                             enceph_anorexic_ischemic + enceph_drug_induced + enceph_electrolyte_
disturbance + enceph_endocrine + enceph_hepatic + enceph_hypercapnic + enceph_septic + enceph_ur
emic + enceph_withdrawal +
                             mrs_poor + mrs_death,
                           data = df.final,
                           family = "binomial")
malignant.model.summary = summary(malignant.model)
malignant.model.summary
```

```
##
## Call:
## stats::glm(formula = classification_malignant ~ enceph_anorexic_ischemic +
##     enceph_drug_induced + enceph_electrolyte_disturbance + enceph_endocrine +
##     enceph_hepatic + enceph_hypercapnic + enceph_septic + enceph_uremic +
##     enceph_withdrawal + mrs_poor + mrs_death, family = "binomial",
##     data = df.final)
##
## Coefficients:
##                                 Estimate Std. Error z value Pr(>|z|)
## (Intercept)                      -2.2375     0.7237  -3.092  0.00199 **
## enceph_anorexic_ischemic1         0.5935     0.8070   0.735  0.46206
## enceph_drug_induced1              3.1954     1.3055   2.448  0.01438 *
## enceph_electrolyte_disturbance1   1.3329     0.6560   2.032  0.04217 *
## enceph_endocrine1                 2.1074     0.8462   2.490  0.01276 *
## enceph_hepatic1                   2.1521     0.8285   2.598  0.00939 **
## enceph_hypercapnic1             -16.9700  4612.2020  -0.004  0.99706
## enceph_septic1                    1.0793     0.5998   1.799  0.07195 .
## enceph_uremic1                  -17.7720  1374.1345  -0.013  0.98968
## enceph_withdrawal1              -16.3286  4612.2020  -0.004  0.99718
## mrs_poor1                        -0.4379     0.5358  -0.817  0.41379
## mrs_death1                        0.5278     0.6053   0.872  0.38325
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 170.16  on 143  degrees of freedom
## Residual deviance: 134.78  on 132  degrees of freedom
## AIC: 158.78
##
## Number of Fisher Scoring iterations: 17
```

```
malignant.names = c("Intercept", names(malignant.model.summary$contrasts))
malignant.crude = as.data.frame(malignant.model.summary$coefficients) %>%
  dplyr::mutate(VARS = malignant.names,
                OR = exp(`Estimate`),
                LL = exp(`Estimate` - (`Std. Error` * 1.96)),
                UL = exp(`Estimate` + (`Std. Error` * 1.96)),
                sig = ifelse(`Pr(>|z|)` <= 0.05, "S", "NS")) %>%
  dplyr::select(VARS, dplyr::everything())

malignant.model.step = MASS::stepAIC(malignant.model, direction = "both")
```

```
## Start:  AIC=158.78
## classification_malignant ~ enceph_anorexic_ischemic + enceph_drug_induced +
##     enceph_electrolyte_disturbance + enceph_endocrine + enceph_hepatic +
##     enceph_hypercapnic + enceph_septic + enceph_uremic + enceph_withdrawal +
##     mrs_poor + mrs_death
##
##                                  Df Deviance    AIC
## - enceph_withdrawal               1   135.16 157.16
## - enceph_anorexic_ischemic        1   135.34 157.34
## - mrs_poor                        1   135.44 157.44
## - enceph_hypercapnic              1   135.49 157.49
## - mrs_death                       1   135.54 157.54
## <none>                                134.78 158.78
## - enceph_septic                   1   138.38 160.38
## - enceph_electrolyte_disturbance  1   138.91 160.91
## - enceph_endocrine                1   141.41 163.41
## - enceph_drug_induced             1   142.00 164.00
## - enceph_hepatic                  1   142.07 164.07
## - enceph_uremic                   1   146.72 168.72
##
## Step:  AIC=157.16
## classification_malignant ~ enceph_anorexic_ischemic + enceph_drug_induced +
##     enceph_electrolyte_disturbance + enceph_endocrine + enceph_hepatic +
##     enceph_hypercapnic + enceph_septic + enceph_uremic + mrs_poor +
##     mrs_death
##
##                                  Df Deviance    AIC
## - mrs_poor                        1   135.75 155.75
## - enceph_anorexic_ischemic        1   135.82 155.82
## - enceph_hypercapnic              1   135.88 155.88
## - mrs_death                       1   136.01 156.01
## <none>                                135.16 157.16
## + enceph_withdrawal               1   134.78 158.78
## - enceph_septic                   1   139.39 159.39
## - enceph_electrolyte_disturbance  1   139.64 159.64
## - enceph_endocrine                1   142.30 162.30
## - enceph_drug_induced             1   142.81 162.81
## - enceph_hepatic                  1   142.92 162.92
## - enceph_uremic                   1   146.91 166.91
##
## Step:  AIC=155.75
## classification_malignant ~ enceph_anorexic_ischemic + enceph_drug_induced +
##     enceph_electrolyte_disturbance + enceph_endocrine + enceph_hepatic +
##     enceph_hypercapnic + enceph_septic + enceph_uremic + mrs_death
##
##                                  Df Deviance    AIC
## - enceph_anorexic_ischemic        1   136.49 154.49
## - enceph_hypercapnic              1   136.62 154.62
## - mrs_death                       1   137.75 155.75
## <none>                                135.75 155.75
## + mrs_poor                        1   135.16 157.16
## + enceph_withdrawal               1   135.44 157.44
```

```
## - enceph_electrolyte_disturbance  1   140.04 158.04
## - enceph_septic                   1   140.26 158.26
## - enceph_hepatic                  1   143.20 161.20
## - enceph_drug_induced             1   144.06 162.06
## - enceph_endocrine                1   144.21 162.21
## - enceph_uremic                   1   146.92 164.92
##
## Step:  AIC=154.49
## classification_malignant ~ enceph_drug_induced + enceph_electrolyte_disturbance +
##     enceph_endocrine + enceph_hepatic + enceph_hypercapnic +
##     enceph_septic + enceph_uremic + mrs_death
##
##                                  Df Deviance    AIC
## - enceph_hypercapnic              1   137.38 153.38
## <none>                                136.49 154.49
## + enceph_anorexic_ischemic        1   135.75 155.75
## + mrs_poor                        1   135.82 155.82
## - mrs_death                       1   140.11 156.11
## + enceph_withdrawal               1   136.12 156.12
## - enceph_electrolyte_disturbance  1   140.16 156.16
## - enceph_septic                   1   140.26 156.26
## - enceph_hepatic                  1   143.24 159.24
## - enceph_drug_induced             1   144.24 160.24
## - enceph_endocrine                1   145.24 161.24
## - enceph_uremic                   1   149.05 165.05
##
## Step:  AIC=153.38
## classification_malignant ~ enceph_drug_induced + enceph_electrolyte_disturbance +
##     enceph_endocrine + enceph_hepatic + enceph_septic + enceph_uremic +
##     mrs_death
##
##                                  Df Deviance    AIC
## <none>                                137.38 153.38
## + enceph_hypercapnic              1   136.49 154.49
## + mrs_poor                        1   136.54 154.54
## + enceph_anorexic_ischemic        1   136.62 154.62
## + enceph_withdrawal               1   137.01 155.01
## - enceph_septic                   1   141.03 155.03
## - enceph_electrolyte_disturbance  1   141.27 155.27
## - mrs_death                       1   141.28 155.28
## - enceph_hepatic                  1   144.26 158.26
## - enceph_drug_induced             1   145.30 159.30
## - enceph_endocrine                1   146.41 160.41
## - enceph_uremic                   1   149.87 163.87
```

```
malignant.model.step.summary = summary(malignant.model.step)
malignant.model.step.summary
```

```
##
## Call:
## stats::glm(formula = classification_malignant ~ enceph_drug_induced +
##     enceph_electrolyte_disturbance + enceph_endocrine + enceph_hepatic +
##     enceph_septic + enceph_uremic + mrs_death, family = "binomial",
##     data = df.final)
##
## Coefficients:
##                                 Estimate Std. Error z value Pr(>|z|)
## (Intercept)                      -2.3759     0.5722  -4.153 3.29e-05 ***
## enceph_drug_induced1              3.2789     1.2740   2.574   0.0101 *
## enceph_electrolyte_disturbance1   1.2321     0.6209   1.984   0.0472 *
## enceph_endocrine1                 2.3116     0.7816   2.958   0.0031 **
## enceph_hepatic1                   1.9020     0.7468   2.547   0.0109 *
## enceph_septic1                    0.9572     0.5232   1.829   0.0673 .
## enceph_uremic1                  -17.6910  1376.1824  -0.013   0.9897
## mrs_death1                        0.9855     0.4996   1.972   0.0486 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 170.16  on 143  degrees of freedom
## Residual deviance: 137.38  on 136  degrees of freedom
## AIC: 153.38
##
## Number of Fisher Scoring iterations: 17
```

```
malignant.step.names = c("Intercept", names(malignant.model.step.summary$contrasts))
malignant.adj = as.data.frame(malignant.model.step.summary$coefficients) %>%
  dplyr::mutate(VARS = malignant.step.names,
                OR = exp(`Estimate`),
                LL = exp(`Estimate` - (`Std. Error` * 1.96)),
                UL = exp(`Estimate` + (`Std. Error` * 1.96)),
                sig = ifelse(`Pr(>|z|)` <= 0.05, "S", "NS")) %>%
  dplyr::select(VARS, dplyr::everything())
```

5.4 Highly Malignant Logistic Regression

```
hmalignant.model = stats::glm(classification_highly_malignant ~
                                enceph_anorexic_ischemic + enceph_drug_induced + enceph_electroly
te_disturbance + enceph_endocrine + enceph_hepatic + enceph_hypercapnic + enceph_septic + enceph
_uremic + enceph_withdrawal +
                                mrs_poor + mrs_death,
                              data = df.final,
                              family = "binomial")
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
hmalignant.model.summary = summary(hmalignant.model)
hmalignant.model.summary
```

```
##
## Call:
## stats::glm(formula = classification_highly_malignant ~ enceph_anorexic_ischemic +
##     enceph_drug_induced + enceph_electrolyte_disturbance + enceph_endocrine +
##     enceph_hepatic + enceph_hypercapnic + enceph_septic + enceph_uremic +
##     enceph_withdrawal + mrs_poor + mrs_death, family = "binomial",
##     data = df.final)
##
## Coefficients:
##                                  Estimate Std. Error z value Pr(>|z|)
## (Intercept)                     -22.8579  2097.8130  -0.011   0.9913
## enceph_anorexic_ischemic1         2.6041     1.8938   1.375   0.1691
## enceph_drug_induced1            -16.2412  6867.7931  -0.002   0.9981
## enceph_electrolyte_disturbance1   1.0995     1.0684   1.029   0.3034
## enceph_endocrine1               -15.0000  4186.5351  -0.004   0.9971
## enceph_hepatic1                   1.1482     1.5313   0.750   0.4534
## enceph_hypercapnic1             -18.1381 12537.2648  -0.001   0.9988
## enceph_septic1                    0.9445     1.0648   0.887   0.3751
## enceph_uremic1                    3.0074     1.5453   1.946   0.0516 .
## enceph_withdrawal1                2.2919 12711.5628   0.000   0.9999
## mrs_poor1                        19.4855  2097.8125   0.009   0.9926
## mrs_death1                       18.5424  2097.8121   0.009   0.9929
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 72.633  on 143  degrees of freedom
## Residual deviance: 54.604  on 132  degrees of freedom
## AIC: 78.604
##
## Number of Fisher Scoring iterations: 19
```

```
hmalignant.names = c("Intercept", names(hmalignant.model.summary$contrasts))
hmalignant.crude = as.data.frame(hmalignant.model.summary$coefficients) %>%
  dplyr::mutate(VARS = hmalignant.names,
                OR = exp(`Estimate`),
                LL = exp(`Estimate` - (`Std. Error` * 1.96)),
                UL = exp(`Estimate` + (`Std. Error` * 1.96)),
                sig = ifelse(`Pr(>|z|)` <= 0.05, "S", "NS")) %>%
  dplyr::select(VARS, dplyr::everything())

hmalignant.model.step = MASS::stepAIC(hmalignant.model, direction = "both")
```

```
## Start:  AIC=78.6
## classification_highly_malignant ~ enceph_anorexic_ischemic +
##     enceph_drug_induced + enceph_electrolyte_disturbance + enceph_endocrine +
##     enceph_hepatic + enceph_hypercapnic + enceph_septic + enceph_uremic +
##     enceph_withdrawal + mrs_poor + mrs_death
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
##                                 Df Deviance    AIC
## - enceph_withdrawal              1   54.604 76.604
## - enceph_endocrine               1   54.733 76.733
## - enceph_drug_induced            1   54.771 76.771
## - enceph_hypercapnic             1   54.931 76.931
## - enceph_hepatic                 1   55.130 77.130
## - enceph_septic                  1   55.371 77.371
## - enceph_electrolyte_disturbance 1   55.617 77.617
## <none>                               54.604 78.604
## - enceph_anorexic_ischemic       1   56.675 78.675
## - enceph_uremic                  1   59.177 81.177
## - mrs_death                      1   62.612 84.612
## - mrs_poor                       1   63.298 85.298
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
##
## Step:  AIC=76.6
## classification_highly_malignant ~ enceph_anorexic_ischemic +
##     enceph_drug_induced + enceph_electrolyte_disturbance + enceph_endocrine +
##     enceph_hepatic + enceph_hypercapnic + enceph_septic + enceph_uremic +
##     mrs_poor + mrs_death
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
##                                  Df Deviance    AIC
## - enceph_endocrine                1   54.733 74.733
## - enceph_drug_induced             1   54.771 74.771
## - enceph_hypercapnic              1   54.931 74.931
## - enceph_hepatic                  1   55.130 75.130
## - enceph_septic                   1   55.371 75.371
## - enceph_electrolyte_disturbance  1   55.617 75.617
## <none>                                54.604 76.604
## - enceph_anorexic_ischemic        1   56.675 76.675
## + enceph_withdrawal               1   54.604 78.604
## - enceph_uremic                   1   59.177 79.177
## - mrs_death                       1   62.636 82.636
## - mrs_poor                        1   63.387 83.387
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
##
## Step:  AIC=74.73
## classification_highly_malignant ~ enceph_anorexic_ischemic +
##     enceph_drug_induced + enceph_electrolyte_disturbance + enceph_hepatic +
##     enceph_hypercapnic + enceph_septic + enceph_uremic + mrs_poor +
##     mrs_death
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
##                                  Df Deviance    AIC
## - enceph_drug_induced             1   54.896 72.896
## - enceph_hypercapnic              1   55.053 73.053
## - enceph_hepatic                  1   55.345 73.345
## - enceph_septic                   1   55.683 73.683
## - enceph_electrolyte_disturbance  1   55.911 73.911
## <none>                                54.733 74.733
## - enceph_anorexic_ischemic        1   57.044 75.044
## + enceph_endocrine                1   54.604 76.604
## + enceph_withdrawal               1   54.733 76.733
## - enceph_uremic                   1   59.506 77.506
## - mrs_poor                        1   64.166 82.166
## - mrs_death                       1   64.308 82.308
##
## Step:  AIC=72.9
## classification_highly_malignant ~ enceph_anorexic_ischemic +
##     enceph_electrolyte_disturbance + enceph_hepatic + enceph_hypercapnic +
##     enceph_septic + enceph_uremic + mrs_poor + mrs_death
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
##                                  Df Deviance    AIC
## - enceph_hypercapnic              1   55.206 71.206
## - enceph_hepatic                  1   55.527 71.527
## - enceph_septic                   1   55.831 71.831
## - enceph_electrolyte_disturbance  1   56.112 72.112
## <none>                                54.896 72.896
## - enceph_anorexic_ischemic        1   57.210 73.210
## + enceph_drug_induced             1   54.733 74.733
## + enceph_endocrine                1   54.771 74.771
## + enceph_withdrawal               1   54.896 74.896
## - enceph_uremic                   1   59.652 75.652
## - mrs_poor                        1   64.337 80.337
## - mrs_death                       1   64.505 80.505
##
## Step:  AIC=71.21
## classification_highly_malignant ~ enceph_anorexic_ischemic +
##     enceph_electrolyte_disturbance + enceph_hepatic + enceph_septic +
##     enceph_uremic + mrs_poor + mrs_death
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
##                                  Df Deviance    AIC
## - enceph_hepatic                  1   55.874 69.874
## - enceph_septic                   1   56.116 70.116
## - enceph_electrolyte_disturbance  1   56.496 70.496
## <none>                                55.206 71.206
## - enceph_anorexic_ischemic        1   57.526 71.526
## + enceph_hypercapnic              1   54.896 72.896
## + enceph_drug_induced             1   55.053 73.053
## + enceph_endocrine                1   55.087 73.087
## + enceph_withdrawal               1   55.206 73.206
## - enceph_uremic                   1   59.931 73.931
## - mrs_poor                        1   64.444 78.444
## - mrs_death                       1   64.790 78.790
##
## Step:  AIC=69.87
## classification_highly_malignant ~ enceph_anorexic_ischemic +
##     enceph_electrolyte_disturbance + enceph_septic + enceph_uremic +
##     mrs_poor + mrs_death
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
##                                  Df Deviance    AIC
## - enceph_septic                   1   56.258 68.258
## - enceph_electrolyte_disturbance  1   56.638 68.638
## - enceph_anorexic_ischemic        1   57.526 69.526
## <none>                                55.874 69.874
## + enceph_hepatic                  1   55.206 71.206
## + enceph_hypercapnic              1   55.527 71.527
## + enceph_endocrine                1   55.671 71.671
## + enceph_drug_induced             1   55.703 71.703
## + enceph_withdrawal               1   55.874 71.874
## - enceph_uremic                   1   59.947 71.947
## - mrs_poor                        1   64.469 76.469
## - mrs_death                       1   64.835 76.835
##
## Step:  AIC=68.26
## classification_highly_malignant ~ enceph_anorexic_ischemic +
##     enceph_electrolyte_disturbance + enceph_uremic + mrs_poor +
##     mrs_death
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
##                                  Df Deviance    AIC
## - enceph_electrolyte_disturbance  1   56.699 66.699
## - enceph_anorexic_ischemic        1   57.531 67.531
## <none>                                56.258 68.258
## + enceph_septic                   1   55.874 69.874
## - enceph_uremic                   1   59.947 69.947
## + enceph_hypercapnic              1   55.949 69.949
## + enceph_endocrine                1   55.949 69.949
## + enceph_drug_induced             1   56.105 70.105
## + enceph_hepatic                  1   56.116 70.116
## + enceph_withdrawal               1   56.258 70.258
## - mrs_poor                        1   64.633 74.633
## - mrs_death                       1   65.258 75.258
##
## Step:  AIC=66.7
## classification_highly_malignant ~ enceph_anorexic_ischemic +
##     enceph_uremic + mrs_poor + mrs_death
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
##                                  Df Deviance    AIC
## - enceph_anorexic_ischemic        1   57.858 65.858
## <none>                                56.699 66.699
## + enceph_electrolyte_disturbance  1   56.258 68.258
## + enceph_hypercapnic              1   56.335 68.335
## + enceph_endocrine                1   56.335 68.335
## + enceph_drug_induced             1   56.519 68.519
## + enceph_septic                   1   56.638 68.638
## + enceph_hepatic                  1   56.643 68.643
## + enceph_withdrawal               1   56.699 68.699
## - enceph_uremic                   1   61.140 69.140
## - mrs_poor                        1   66.322 74.322
## - mrs_death                       1   66.756 74.756
##
## Step:  AIC=65.86
## classification_highly_malignant ~ enceph_uremic + mrs_poor +
##     mrs_death
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
##                                  Df Deviance    AIC
## <none>                                57.858 65.858
## + enceph_anorexic_ischemic        1   56.699 66.699
## - enceph_uremic                   1   61.177 67.177
## + enceph_hypercapnic              1   57.494 67.494
## + enceph_endocrine                1   57.494 67.494
## + enceph_electrolyte_disturbance  1   57.531 67.531
## + enceph_drug_induced             1   57.678 67.678
## + enceph_septic                   1   57.790 67.790
## + enceph_hepatic                  1   57.851 67.851
## + enceph_withdrawal               1   57.858 67.858
## - mrs_poor                        1   66.444 72.444
## - mrs_death                       1   69.621 75.621
```

```
hmalignant.model.step.summary = summary(hmalignant.model.step)
hmalignant.model.step.summary
```

```
##
## Call:
## stats::glm(formula = classification_highly_malignant ~ enceph_uremic +
##     mrs_poor + mrs_death, family = "binomial", data = df.final)
##
## Coefficients:
##                 Estimate Std. Error z value Pr(>|z|)
## (Intercept)     -21.1787  2249.8831  -0.009   0.9925
## enceph_uremic1    1.7579     0.9493   1.852   0.0641 .
## mrs_poor1        18.8038  2249.8832   0.008   0.9933
## mrs_death1       18.9100  2249.8831   0.008   0.9933
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 72.633  on 143  degrees of freedom
## Residual deviance: 57.858  on 140  degrees of freedom
## AIC: 65.858
##
## Number of Fisher Scoring iterations: 19
```

```
hmalignant.step.names = c("Intercept", names(hmalignant.model.step.summary$contrasts))
hmalignant.adj = as.data.frame(hmalignant.model.step.summary$coefficients) %>%
  dplyr::mutate(VARS = hmalignant.step.names,
                OR = exp(`Estimate`),
                LL = exp(`Estimate` - (`Std. Error` * 1.96)),
                UL = exp(`Estimate` + (`Std. Error` * 1.96)),
                sig = ifelse(`Pr(>|z|)` <= 0.05, "S", "NS")) %>%
  dplyr::select(VARS, dplyr::everything())
```

6 Export necessary data

```
export.list = list(Overall = overall.crude,
                   Benign_Crude = benign.crude,
                   Benign_Adj = benign.adj,
                   Malignant_Crude = malignant.crude,
                   Malignant_Adj = malignant.adj,
                   Highly_Malignant_Crude = hmalignant.crude,
                   Highly_Malignant_Adj = hmalignant.adj)

if(length(export.list) != 0){
  if (!file.exists(file.path(output.path, output.name))) {
    writexl::write_xlsx(export.list, file.path(output.path, output.name))
    cat(crayon::green("File successfully written."))
  } else {
    cat(crayon::red(glue::glue("Filename already used: {output.name}")))
    overwrite = readline(prompt = "Overwrite (1 for Yes, 0 for No): ")
    if (overwrite == "1") {
      writexl::write_xlsx(export.list, file.path(output.path, output.name))
      cat(crayon::green("File successfully overwritten"))
    } else {
      cat(crayon::red("File not overwritten"))
    }
  }
}
```

```
## Filename already used: OUTPUT_071025.xlsxOverwrite (1 for Yes, 0 for No):
## File not overwritten
```