Epilepsy Analysis

2024-11-20

Statistical Analysis of Epilepsy Dataset

Libraries Used

```
df <- read.csv('epilepsy.csv') # Read in dataset

df <- na.omit(df) # Remove all empty values

head(df) # Peak
```

```
##    id treat ageyr sex learnx firstintm history totsezbase neursignx relsx
## 1  10   CBZ    76   M      0  9.243421       U          6         0     0
## 2  30   LTG    33   M      0  9.210526       U          4         0     0
## 3  70   CBZ    19   F      0 12.434211       U         12         0     0
## 4  80   LTG    29   M      0  4.506579       U          5         1     0
## 5 110   CBZ    45   M      0 14.703947       M          7         1     0
## 6 120   LTG    39   M      0 38.125000       U        150         0     0
##   withtime censall wdlcode Rem12
## 1   2408.0       0       0     1
## 2   2332.0       0       0     0
## 3      8.5       1       1     1
## 4   2381.0       0       0     1
## 5   2372.0       0       0     0
## 6     18.0       1       1     0
```

```
summary(df)
```

```
##        id           treat               ageyr           sex
##  Min.   :   10   Length:715         Min.   : 5.00   Length:715
##  1st Qu.: 3685   Class :character   1st Qu.:23.00   Class :character
##  Median : 8280   Mode  :character   Median :36.00   Mode  :character
##  Mean   : 8363                      Mean   :37.72
##  3rd Qu.:12910                      3rd Qu.:51.00
##  Max.   :17200                      Max.   :83.00
##      learnx          firstintm          history            totsezbase
##  Min.   :0.00000   Min.   :  0.3947   Length:715         Min.   :   2.00
##  1st Qu.:0.00000   1st Qu.:  6.5954   Class :character   1st Qu.:   4.00
##  Median :0.00000   Median : 16.9408   Mode  :character   Median :  12.00
##  Mean   :0.03357   Mean   : 59.5692                      Mean   :  69.54
##  3rd Qu.:0.00000   3rd Qu.: 58.5197                      3rd Qu.:  64.50
##  Max.   :1.00000   Max.   :703.1579                      Max.   :2700.00
```

```
##    neursignx          relsx            withtime         censall
##  Min.   :0.0000   Min.   :0.00000   Min.   :   8.0   Min.   :0.0000
##  1st Qu.:0.0000   1st Qu.:0.00000   1st Qu.: 218.0   1st Qu.:0.0000
##  Median :0.0000   Median :0.00000   Median : 715.0   Median :0.0000
##  Mean   :0.2671   Mean   :0.08252   Mean   : 820.6   Mean   :0.4364
##  3rd Qu.:1.0000   3rd Qu.:0.00000   3rd Qu.:1333.5   3rd Qu.:1.0000
##  Max.   :1.0000   Max.   :1.00000   Max.   :2422.0   Max.   :1.0000
##     wdlcode           Rem12
##  Min.   :0.0000   Min.   :0.0000
##  1st Qu.:0.0000   1st Qu.:0.0000
##  Median :0.0000   Median :0.0000
##  Mean   :0.6238   Mean   :0.3301
##  3rd Qu.:1.0000   3rd Qu.:1.0000
##  Max.   :2.0000   Max.   :1.0000
```

Logistic Regression Model

Fit Logit Model

```
model <- glm(Rem12~treat, family="binomial", data=df)
options(scipen=999)
summary(model)
```

```
##
## Call:
## glm(formula = Rem12 ~ treat, family = "binomial", data = df)
##
## Coefficients:
##             Estimate Std. Error z value    Pr(>|z|)
## (Intercept)  -0.5729     0.1105  -5.183 0.000000218 ***
## treatLTG     -0.2744     0.1595  -1.720      0.0854 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 906.95  on 714  degrees of freedom
## Residual deviance: 903.98  on 713  degrees of freedom
## AIC: 907.98
##
## Number of Fisher Scoring iterations: 4
```

N.B: The intercept is the CBZ group

```
exp(coef(model)) # Odds Ratio
```

```
## (Intercept)    treatLTG
##   0.5638767   0.7600446
```

Characteristic	OR[1]	95% CI[1]	p-value
Treatment Type			
CBZ	—	—	
LTG	0.76	0.56, 1.04	0.085

[1]OR = Odds Ratio, CI = Confidence Interval

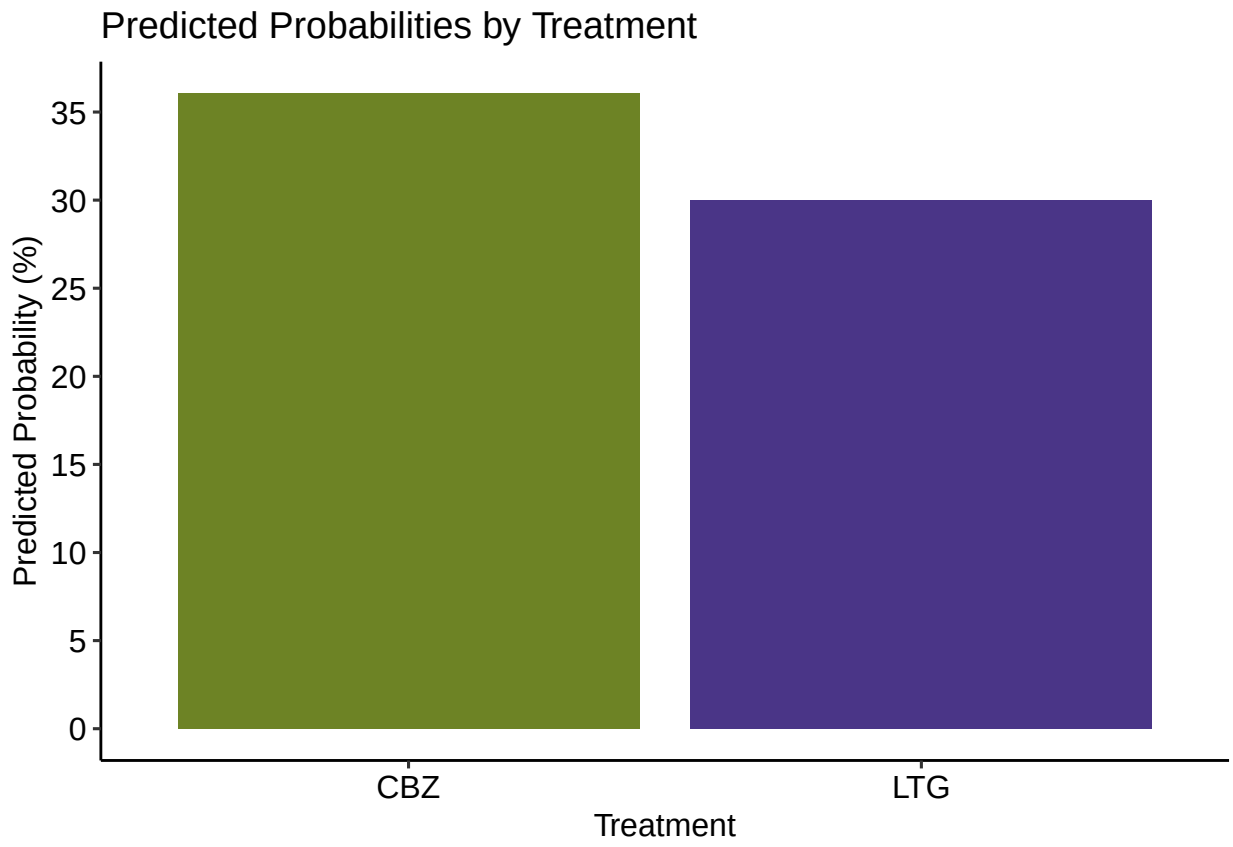
```
exp(confint(model)) # Confidence Intervals of the models
```

```
## Waiting for profiling to be done...
```

```
##                 2.5 %    97.5 %
## (Intercept) 0.4529524 0.6989011
## treatLTG    0.5554612 1.0384908
```

Visualisation

1. Bar plot for predicted probabibilities



2. ROC Curve

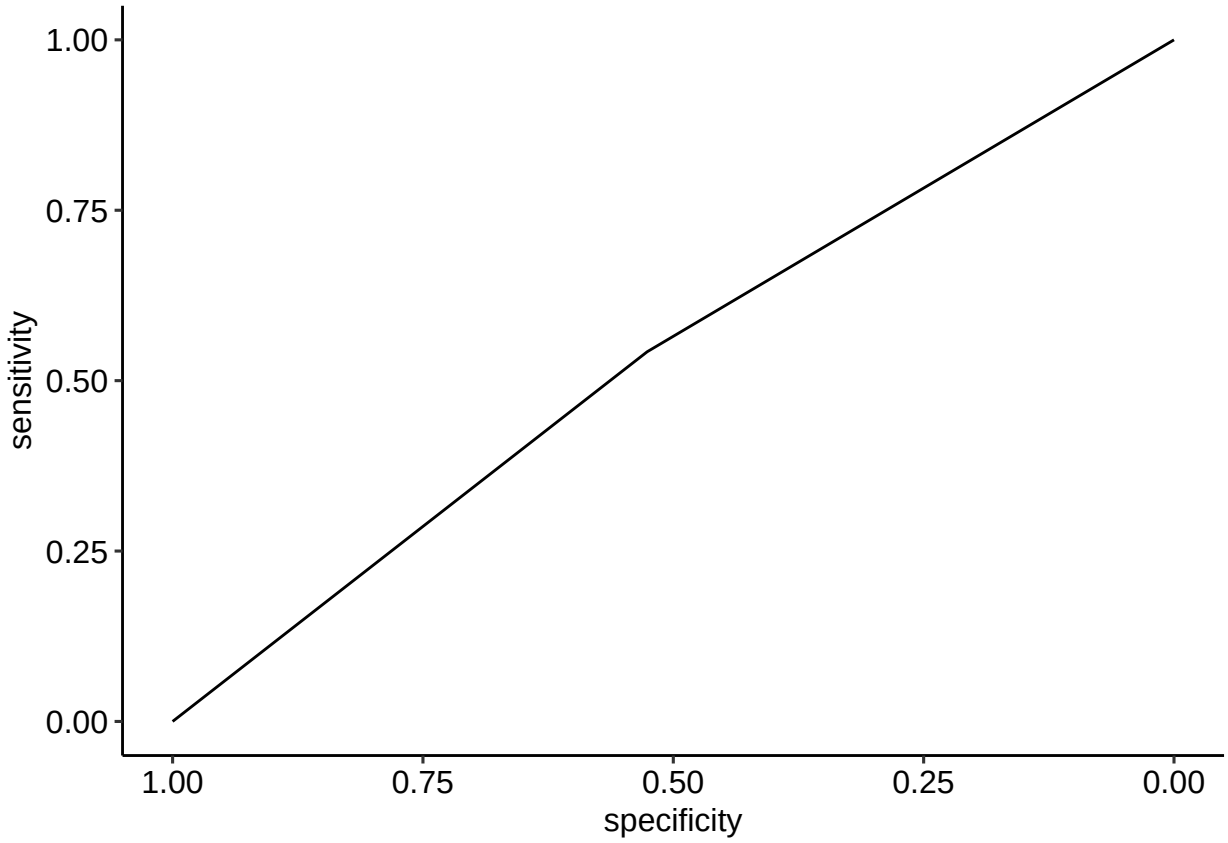
```
## Type 'citation("pROC")' for a citation.

##
## Attaching package: 'pROC'

## The following objects are masked from 'package:stats':
##
##     cov, smooth, var

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

## Setting direction: controls < cases
```




```
## Area under the curve: 0.5342
```

3. Forest Plot

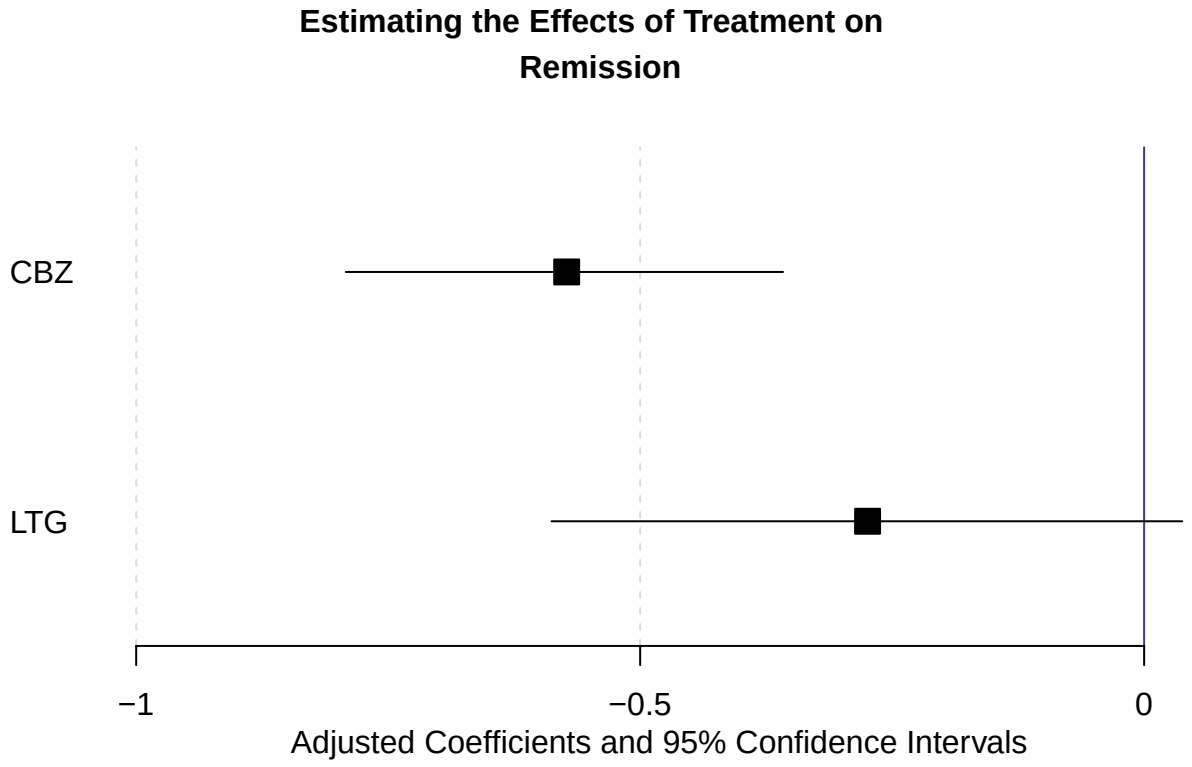
```
## Loading required package: grid

## Loading required package: checkmate

## Loading required package: abind
```

Characteristic	OR[1]	95% CI[1]	p-value
Treatment Type			
CBZ	—	—	
LTG	0.72	0.45, 1.15	0.2
sex			
F	—	—	
M	1.16	0.75, 1.80	0.5
Treatment Type * sex			
LTG * M	1.10	0.59, 2.07	0.8

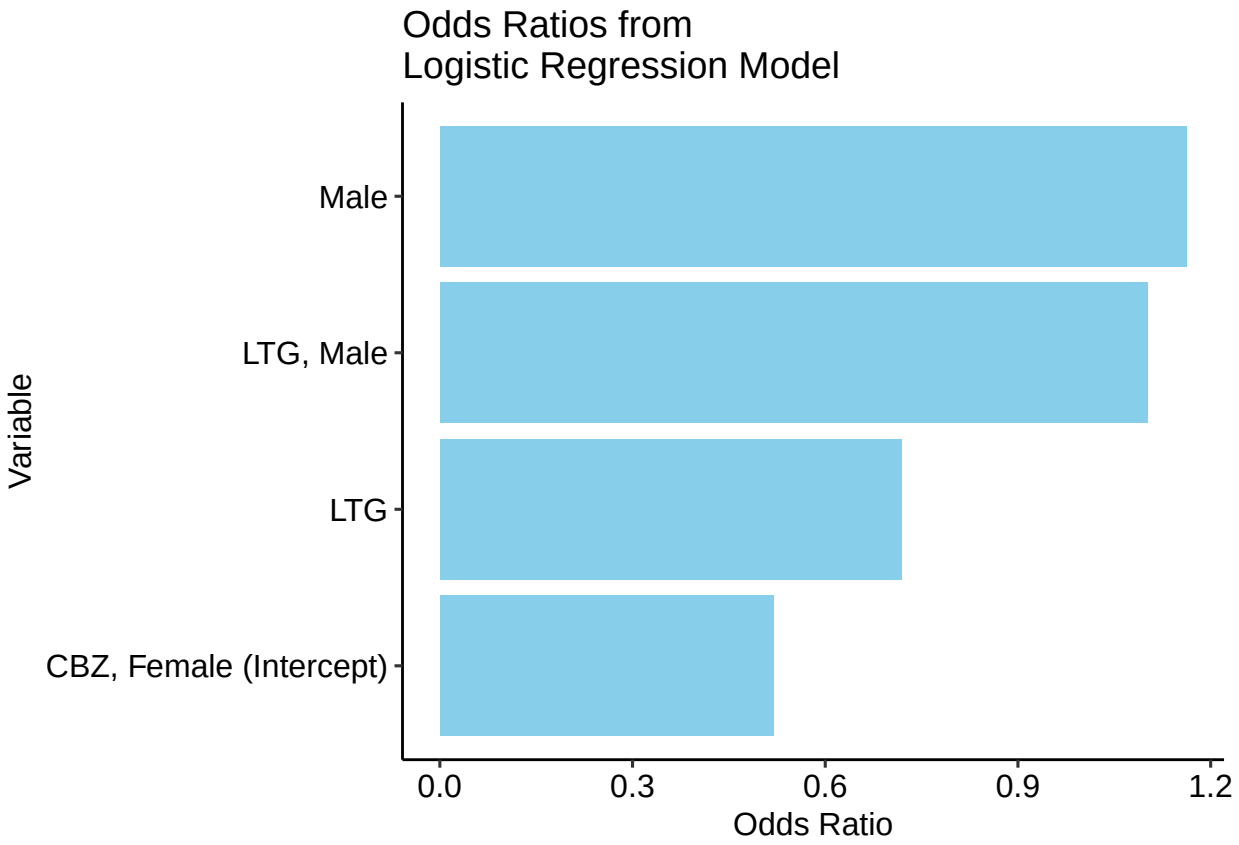
[1]OR = Odds Ratio, CI = Confidence Interval



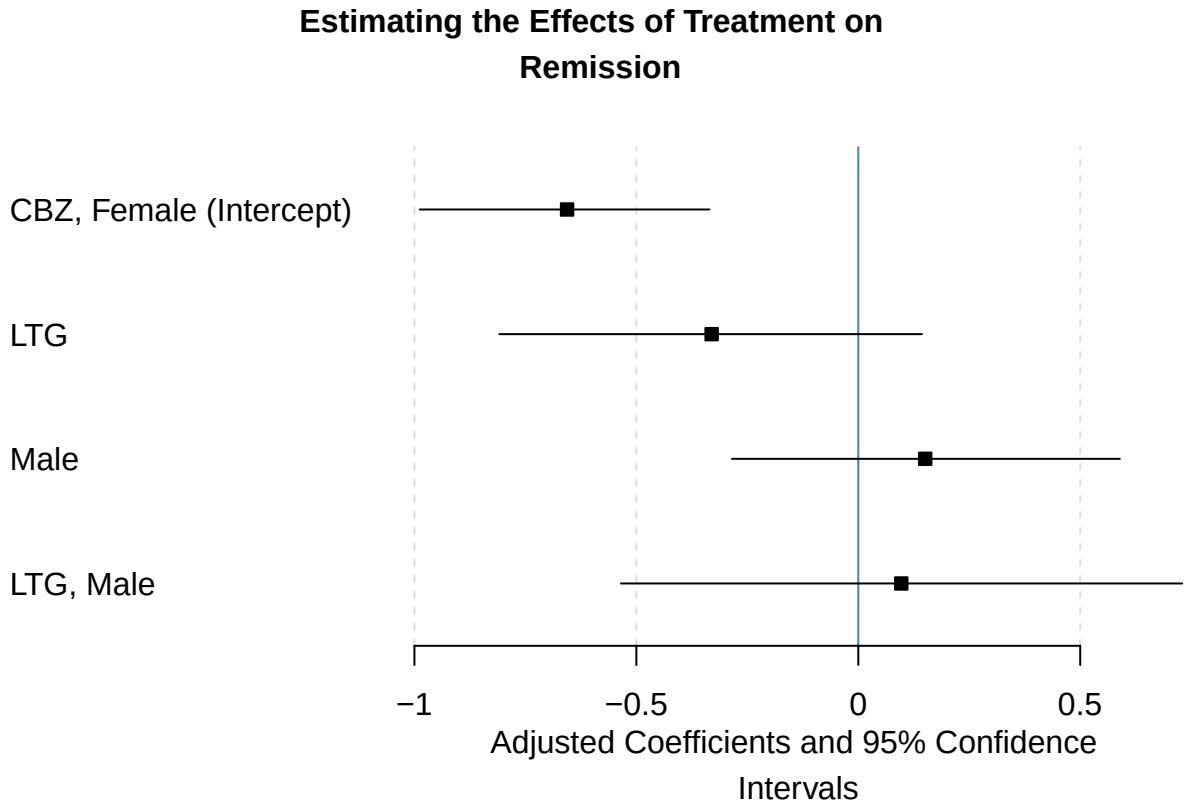
Gender Interaction Model

This model assess the interaction between patient gender and treatment group.

1. Bar Plot of Odds Ratios



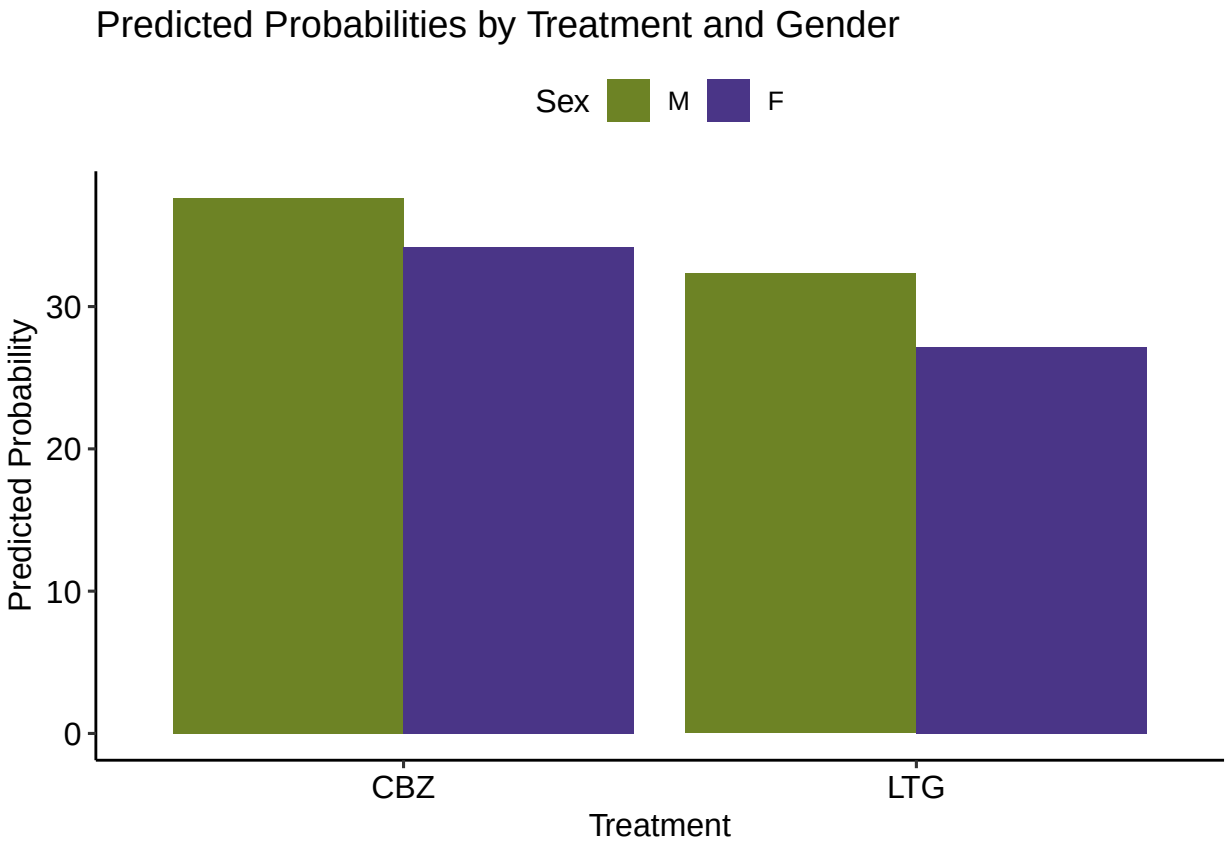
2. Forest Plot




```
drop1(modelII, .~., test = "Chisq")
```

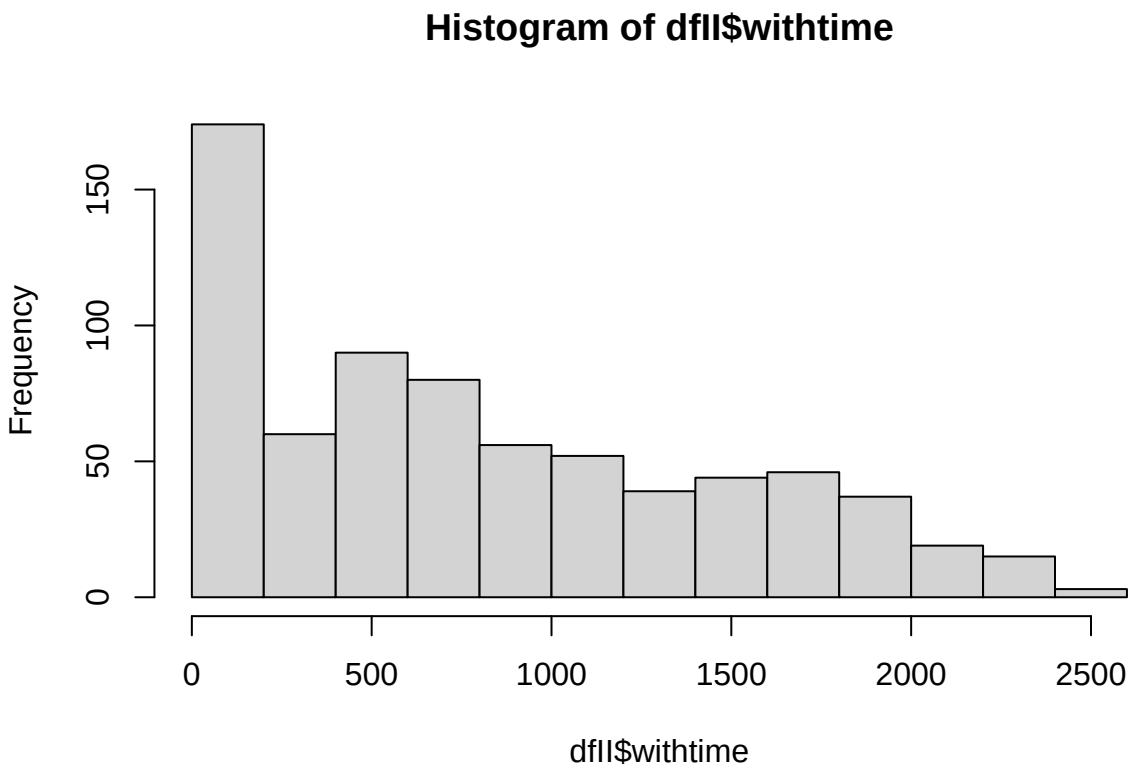
```
## Single term deletions
##
## Model:
## Rem12 ~ treat * sex
##           Df Deviance    AIC     LRT Pr(>Chi)
## <none>         902.38 910.38
## treat      1   904.25 910.25 1.86482   0.1721
## sex        1   902.84 908.84 0.45953   0.4978
## treat:sex  1   902.47 908.47 0.09018   0.7640
```

Making predictions with our model



Time to Event Analysis

```
# Make categorical variables factors
dfII$wdlcode <- factor(dfII$wdlcode, levels = c(0, 1, 2),
                       labels = c("NOT", "UAE", "ISC"))
dfII$treat <- factor(dfII$treat)
dfII$id <- factor(dfII$id)
```




```
survobj <- Surv(time = dfII$withtime, event = dfII$censall) # Define survival objects with time variabl

head(survobj)
```

```
## [1] 2408.0+ 2332.0+    8.5  2381.0+ 2372.0+   18.0
```

```
# Fit Kaplan-Meier Survival Curves for Treatment Groups
km_fit <- survfit(Surv(withtime, censall) ~ treat, data = dfII)
summary(km_fit)
```

```
## Call: survfit(formula = Surv(withtime, censall) ~ treat, data = dfII)
##
##                 treat=CBZ
##    time n.risk n.event survival std.err lower 95% CI upper 95% CI
##     8.5    354       3    0.992 0.00487        0.982        1.000
##    10.0    351       1    0.989 0.00562        0.978        1.000
##    11.0    350       3    0.980 0.00740        0.966        0.995
##    12.0    347       2    0.975 0.00837        0.958        0.991
##    15.0    345       3    0.966 0.00962        0.947        0.985
##    16.0    342       2    0.960 0.01036        0.940        0.981
##    18.0    340       1    0.958 0.01071        0.937        0.979
##    19.0    339       1    0.955 0.01104        0.933        0.977
##    20.0    338       1    0.952 0.01136        0.930        0.975
##    21.0    337       2    0.946 0.01198        0.923        0.970
##    22.0    335       4    0.935 0.01310        0.910        0.961
```

```
##    23.0    331       1    0.932 0.01336        0.906        0.959
##    24.0    330       1    0.929 0.01362        0.903        0.956
##    25.0    329       2    0.924 0.01411        0.896        0.952
##    27.0    327       2    0.918 0.01458        0.890        0.947
##    28.0    325       2    0.912 0.01502        0.883        0.942
##    29.0    323       1    0.910 0.01524        0.880        0.940
##    32.0    322       1    0.907 0.01545        0.877        0.938
##    33.0    321       2    0.901 0.01586        0.871        0.933
##    34.0    319       1    0.898 0.01606        0.867        0.930
##    39.0    318       1    0.895 0.01626        0.864        0.928
##    41.0    317       1    0.893 0.01645        0.861        0.925
##    44.0    315       2    0.887 0.01683        0.855        0.921
##    46.0    313       1    0.884 0.01701        0.851        0.918
##    48.0    312       1    0.881 0.01719        0.848        0.916
##    50.0    311       3    0.873 0.01771        0.839        0.908
##    53.0    308       1    0.870 0.01788        0.836        0.906
##    54.0    307       1    0.867 0.01805        0.832        0.903
##    55.0    306       3    0.859 0.01852        0.823        0.896
##    57.0    303       1    0.856 0.01868        0.820        0.893
##    62.0    302       1    0.853 0.01883        0.817        0.891
##    64.0    301       2    0.847 0.01913        0.811        0.886
##    65.0    299       1    0.844 0.01927        0.808        0.883
##    68.0    298       1    0.842 0.01941        0.804        0.881
##    71.0    297       1    0.839 0.01955        0.801        0.878
##    81.0    296       2    0.833 0.01983        0.795        0.873
##    85.0    294       1    0.830 0.01996        0.792        0.870
##    92.0    293       4    0.819 0.02048        0.780        0.860
##    95.0    289       1    0.816 0.02060        0.777        0.858
##    97.0    288       1    0.813 0.02073        0.774        0.855
##    99.0    287       1    0.810 0.02085        0.771        0.852
##   105.0    286       2    0.805 0.02108        0.765        0.847
##   110.0    284       1    0.802 0.02120        0.761        0.845
##   111.0    283       1    0.799 0.02131        0.758        0.842
##   112.0    282       1    0.796 0.02142        0.755        0.839
##   113.0    281       2    0.791 0.02164        0.749        0.834
##   124.0    278       1    0.788 0.02175        0.746        0.832
##   128.0    277       1    0.785 0.02186        0.743        0.829
##   137.0    276       1    0.782 0.02196        0.740        0.826
##   146.0    275       1    0.779 0.02207        0.737        0.824
##   158.0    274       1    0.776 0.02217        0.734        0.821
##   163.0    273       1    0.774 0.02227        0.731        0.818
##   165.0    272       1    0.771 0.02237        0.728        0.816
##   169.0    271       1    0.768 0.02247        0.725        0.813
##   171.0    270       1    0.765 0.02256        0.722        0.811
##   174.0    269       1    0.762 0.02266        0.719        0.808
##   176.0    268       1    0.759 0.02275        0.716        0.805
##   178.0    267       1    0.757 0.02284        0.713        0.803
##   181.0    266       1    0.754 0.02293        0.710        0.800
##   183.0    265       1    0.751 0.02302        0.707        0.797
##   186.0    264       1    0.748 0.02311        0.704        0.795
##   187.0    263       1    0.745 0.02320        0.701        0.792
##   189.0    262       1    0.742 0.02328        0.698        0.789
##   190.0    261       2    0.737 0.02345        0.692        0.784
##   192.0    259       1    0.734 0.02353        0.689        0.781
```

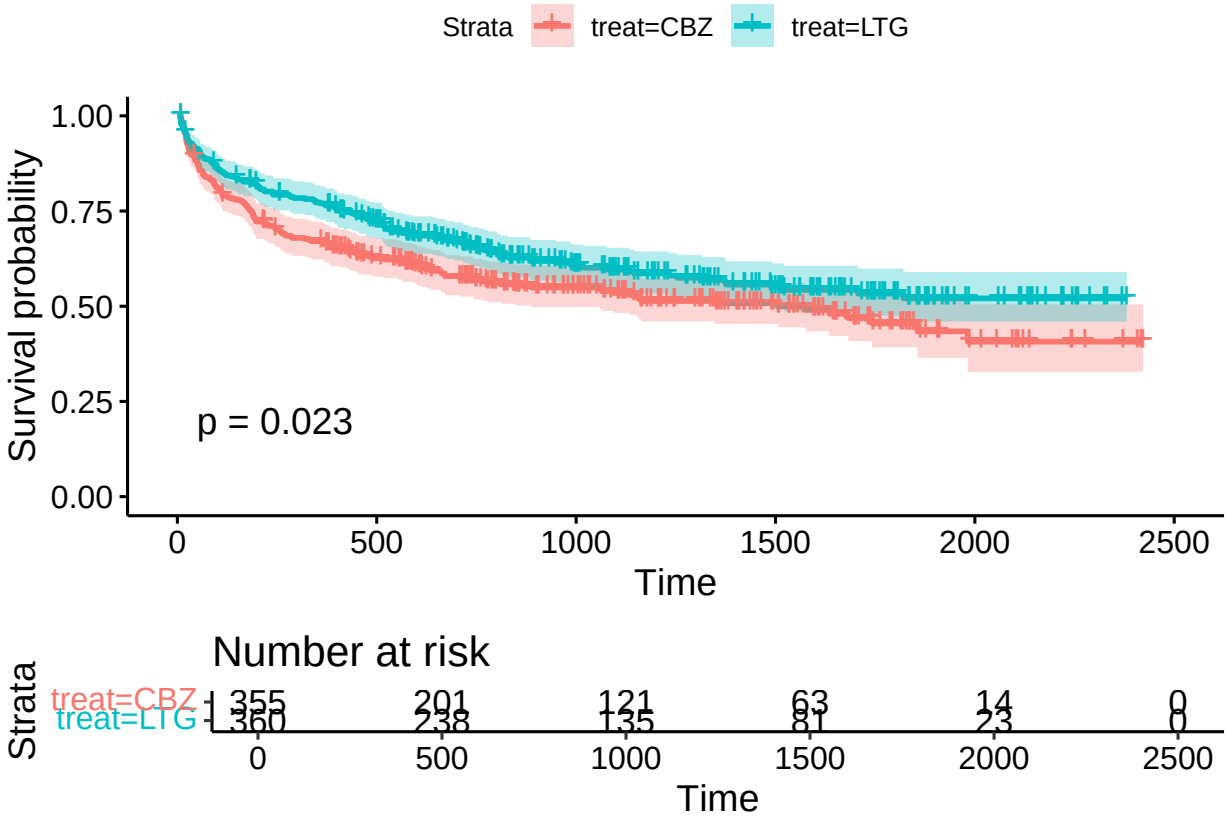
```
##   193.0    258       1    0.731 0.02361        0.686        0.779
##   196.0    257       1    0.728 0.02369        0.683        0.776
##   197.0    256       2    0.722 0.02384        0.677        0.771
##   218.0    253       1    0.720 0.02392        0.674        0.768
##   221.0    251       1    0.717 0.02399        0.671        0.765
##   225.0    250       1    0.714 0.02407        0.668        0.763
##   229.0    249       1    0.711 0.02414        0.665        0.760
##   241.0    248       1    0.708 0.02421        0.662        0.757
##   246.0    247       2    0.702 0.02435        0.656        0.752
##   256.0    244       1    0.699 0.02442        0.653        0.749
##   258.0    243       1    0.697 0.02449        0.650        0.746
##   259.0    242       1    0.694 0.02456        0.647        0.744
##   263.0    241       1    0.691 0.02463        0.644        0.741
##   269.0    240       1    0.688 0.02469        0.641        0.738
##   272.0    239       1    0.685 0.02475        0.638        0.735
##   285.0    238       1    0.682 0.02482        0.635        0.733
##   288.0    237       1    0.679 0.02488        0.632        0.730
##   320.0    236       1    0.676 0.02494        0.629        0.727
##   331.0    235       1    0.674 0.02500        0.626        0.724
##   336.0    234       1    0.671 0.02506        0.623        0.722
##   365.0    232       1    0.668 0.02512        0.620        0.719
##   366.0    231       1    0.665 0.02517        0.617        0.716
##   372.0    230       1    0.662 0.02523        0.614        0.713
##   380.0    227       1    0.659 0.02529        0.611        0.711
##   383.0    226       1    0.656 0.02534        0.608        0.708
##   386.0    225       1    0.653 0.02540        0.605        0.705
##   404.0    221       1    0.650 0.02545        0.602        0.702
##   424.0    217       1    0.647 0.02551        0.599        0.699
##   431.0    215       1    0.644 0.02557        0.596        0.696
##   434.0    214       1    0.641 0.02563        0.593        0.694
##   449.0    212       1    0.638 0.02568        0.590        0.691
##   450.0    211       1    0.635 0.02574        0.587        0.688
##   456.0    208       1    0.632 0.02580        0.584        0.685
##   483.0    204       1    0.629 0.02586        0.580        0.682
##   494.0    202       1    0.626 0.02591        0.577        0.679
##   519.0    200       1    0.623 0.02597        0.574        0.676
##   551.0    197       1    0.620 0.02603        0.571        0.673
##   562.0    194       1    0.616 0.02609        0.567        0.670
##   567.0    193       1    0.613 0.02615        0.564        0.667
##   590.0    185       1    0.610 0.02622        0.561        0.664
##   597.0    183       1    0.607 0.02629        0.557        0.660
##   602.0    181       1    0.603 0.02636        0.554        0.657
##   614.0    178       1    0.600 0.02643        0.550        0.654
##   625.0    175       1    0.596 0.02650        0.547        0.651
##   635.0    174       1    0.593 0.02656        0.543        0.647
##   660.0    172       1    0.590 0.02663        0.540        0.644
##   662.0    171       1    0.586 0.02670        0.536        0.641
##   671.0    170       2    0.579 0.02683        0.529        0.634
##   707.0    168       1    0.576 0.02689        0.525        0.631
##   743.0    160       2    0.569 0.02703        0.518        0.624
##   764.0    154       1    0.565 0.02710        0.514        0.621
##   778.0    152       1    0.561 0.02718        0.510        0.617
##   811.0    146       1    0.557 0.02726        0.506        0.613
##   848.0    140       1    0.553 0.02736        0.502        0.610
```

```
##   888.0    133       1    0.549 0.02747        0.498        0.606
##  1060.0    115       1    0.544 0.02764        0.493        0.601
##  1064.0    114       1    0.540 0.02781        0.488        0.597
##  1093.0    109       1    0.535 0.02799        0.483        0.592
##  1134.0    103       1    0.530 0.02820        0.477        0.588
##  1152.0    101       1    0.524 0.02840        0.471        0.583
##  1157.0    100       1    0.519 0.02859        0.466        0.578
##  1163.0     99       1    0.514 0.02878        0.460        0.573
##  1348.0     82       1    0.508 0.02911        0.454        0.568
##  1506.0     63       1    0.499 0.02974        0.444        0.561
##  1576.0     54       1    0.490 0.03059        0.434        0.554
##  1635.0     48       1    0.480 0.03161        0.422        0.546
##  1683.0     42       1    0.469 0.03286        0.408        0.538
##  1742.0     34       1    0.455 0.03466        0.392        0.528
##  1856.0     22       1    0.434 0.03877        0.364        0.517
##  1982.0     16       1    0.407 0.04484        0.328        0.505
##
##                treat=LTG
##    time n.risk n.event survival std.err lower 95% CI upper 95% CI
##     8.5    359       5    0.986 0.00619        0.974        0.998
##     9.0    354       2    0.981 0.00730        0.966        0.995
##    10.0    352       1    0.978 0.00779        0.963        0.993
##    12.0    351       1    0.975 0.00825        0.959        0.991
##    13.0    350       1    0.972 0.00869        0.955        0.989
##    16.0    349       1    0.969 0.00910        0.952        0.987
##    18.0    348       3    0.961 0.01022        0.941        0.981
##    19.0    345       1    0.958 0.01056        0.938        0.979
##    20.0    344       1    0.955 0.01089        0.934        0.977
##    21.0    342       1    0.953 0.01121        0.931        0.975
##    22.0    341       1    0.950 0.01152        0.928        0.973
##    24.0    340       2    0.944 0.01211        0.921        0.968
##    25.0    338       2    0.939 0.01267        0.914        0.964
##    26.0    336       2    0.933 0.01319        0.908        0.959
##    30.0    334       1    0.930 0.01345        0.904        0.957
##    31.0    333       1    0.927 0.01369        0.901        0.955
##    37.0    332       2    0.922 0.01417        0.895        0.950
##    41.0    330       1    0.919 0.01440        0.891        0.948
##    43.0    329       2    0.914 0.01484        0.885        0.943
##    52.0    327       1    0.911 0.01506        0.882        0.941
##    54.0    326       1    0.908 0.01527        0.878        0.938
##    56.0    325       1    0.905 0.01548        0.875        0.936
##    57.0    324       1    0.902 0.01568        0.872        0.934
##    58.0    323       3    0.894 0.01626        0.863        0.926
##    64.0    320       1    0.891 0.01645        0.860        0.924
##    65.0    319       1    0.888 0.01663        0.856        0.922
##    73.0    318       1    0.886 0.01682        0.853        0.919
##    82.0    317       1    0.883 0.01699        0.850        0.917
##    84.0    316       1    0.880 0.01717        0.847        0.914
##    85.0    315       1    0.877 0.01734        0.844        0.912
##    89.0    314       1    0.874 0.01751        0.841        0.909
##    93.0    312       1    0.872 0.01767        0.838        0.907
##    99.0    311       3    0.863 0.01816        0.828        0.900
##   100.0    308       1    0.860 0.01831        0.825        0.897
##   105.0    307       1    0.858 0.01847        0.822        0.895
```

```
##   107.0    306       1    0.855 0.01862        0.819        0.892
##   112.0    305       1    0.852 0.01877        0.816        0.890
##   115.0    304       1    0.849 0.01891        0.813        0.887
##   120.0    303       1    0.846 0.01906        0.810        0.885
##   121.0    302       1    0.844 0.01920        0.807        0.882
##   134.0    301       1    0.841 0.01934        0.804        0.880
##   145.0    300       1    0.838 0.01948        0.801        0.877
##   149.0    298       1    0.835 0.01961        0.798        0.875
##   152.0    297       1    0.832 0.01975        0.795        0.872
##   164.0    296       1    0.830 0.01988        0.791        0.869
##   166.0    295       1    0.827 0.02001        0.788        0.867
##   190.0    292       1    0.824 0.02014        0.785        0.864
##   191.0    291       1    0.821 0.02027        0.782        0.862
##   198.0    289       1    0.818 0.02040        0.779        0.859
##   200.0    288       1    0.815 0.02052        0.776        0.857
##   204.0    287       1    0.813 0.02065        0.773        0.854
##   205.0    286       1    0.810 0.02077        0.770        0.851
##   209.0    285       1    0.807 0.02089        0.767        0.849
##   218.0    284       1    0.804 0.02101        0.764        0.846
##   219.0    283       1    0.801 0.02113        0.761        0.844
##   239.0    282       1    0.798 0.02124        0.758        0.841
##   240.0    281       2    0.793 0.02147        0.752        0.836
##   281.0    277       1    0.790 0.02158        0.749        0.833
##   284.0    276       1    0.787 0.02169        0.746        0.831
##   292.0    275       1    0.784 0.02180        0.742        0.828
##   320.0    274       1    0.781 0.02191        0.739        0.825
##   340.0    273       1    0.778 0.02201        0.736        0.823
##   345.0    272       1    0.775 0.02212        0.733        0.820
##   346.0    271       1    0.773 0.02222        0.730        0.817
##   358.0    270       1    0.770 0.02232        0.727        0.815
##   372.0    269       2    0.764 0.02252        0.721        0.809
##   393.0    264       1    0.761 0.02262        0.718        0.807
##   395.0    263       1    0.758 0.02272        0.715        0.804
##   400.0    261       1    0.755 0.02282        0.712        0.801
##   401.0    260       1    0.752 0.02291        0.709        0.799
##   405.0    259       1    0.750 0.02301        0.706        0.796
##   418.0    256       1    0.747 0.02310        0.703        0.793
##   438.0    254       1    0.744 0.02320        0.700        0.791
##   445.0    253       1    0.741 0.02329        0.696        0.788
##   454.0    251       1    0.738 0.02339        0.693        0.785
##   456.0    250       1    0.735 0.02348        0.690        0.782
##   473.0    248       1    0.732 0.02357        0.687        0.780
##   474.0    247       1    0.729 0.02366        0.684        0.777
##   482.0    245       1    0.726 0.02375        0.681        0.774
##   494.0    241       1    0.723 0.02384        0.678        0.771
##   514.0    235       2    0.717 0.02403        0.671        0.765
##   515.0    233       1    0.714 0.02412        0.668        0.763
##   518.0    232       1    0.711 0.02422        0.665        0.760
##   521.0    229       1    0.708 0.02431        0.661        0.757
##   522.0    228       1    0.704 0.02440        0.658        0.754
##   528.0    227       1    0.701 0.02449        0.655        0.751
##   541.0    223       1    0.698 0.02458        0.652        0.748
##   548.0    222       1    0.695 0.02467        0.648        0.745
##   564.0    219       1    0.692 0.02476        0.645        0.742
```

```
##   576.0    217       1    0.689 0.02485        0.642        0.739
##   590.0    212       1    0.685 0.02494        0.638        0.736
##   639.0    206       1    0.682 0.02504        0.635        0.733
##   650.0    203       1    0.679 0.02514        0.631        0.730
##   669.0    199       1    0.675 0.02525        0.628        0.727
##   676.0    198       1    0.672 0.02535        0.624        0.723
##   694.0    194       1    0.668 0.02545        0.620        0.720
##   716.0    192       1    0.665 0.02556        0.617        0.717
##   717.0    190       1    0.661 0.02566        0.613        0.714
##   730.0    183       1    0.658 0.02578        0.609        0.710
##   736.0    181       1    0.654 0.02589        0.605        0.707
##   757.0    174       1    0.650 0.02601        0.601        0.703
##   770.0    171       1    0.647 0.02614        0.597        0.700
##   780.0    169       1    0.643 0.02626        0.593        0.696
##   802.0    165       2    0.635 0.02651        0.585        0.689
##   811.0    162       1    0.631 0.02664        0.581        0.686
##   829.0    158       1    0.627 0.02677        0.577        0.682
##   884.0    150       1    0.623 0.02691        0.572        0.678
##   885.0    149       1    0.619 0.02706        0.568        0.674
##   949.0    143       1    0.614 0.02721        0.563        0.670
##   985.0    139       1    0.610 0.02737        0.559        0.666
##   989.0    137       1    0.606 0.02753        0.554        0.662
##  1018.0    131       1    0.601 0.02771        0.549        0.658
##  1078.0    127       1    0.596 0.02789        0.544        0.653
##  1133.0    116       1    0.591 0.02812        0.538        0.649
##  1145.0    115       1    0.586 0.02834        0.533        0.644
##  1233.0    105       1    0.580 0.02861        0.527        0.639
##  1254.0    104       1    0.575 0.02888        0.521        0.634
##  1316.0     99       1    0.569 0.02916        0.515        0.629
##  1373.0     92       1    0.563 0.02950        0.508        0.624
##  1376.0     91       1    0.557 0.02981        0.501        0.618
##  1491.0     83       1    0.550 0.03020        0.494        0.612
##  1522.0     77       1    0.543 0.03064        0.486        0.606
##  1707.0     56       1    0.533 0.03159        0.475        0.599
##  1821.0     43       1    0.521 0.03320        0.459        0.590
```

Survival Plots by Treatment Groups



Log Rank Test between Groups

```
survdiff(Surv(withtime, censall) ~ treat, data = df)
```

```
## Call:
## survdiff(formula = Surv(withtime, censall) ~ treat, data = df)
##
##              N Observed Expected (O-E)^2/E (O-E)^2/V
## treat=CBZ 355      168      148      2.71      5.18
## treat=LTG 360      144      164      2.45      5.18
##
##  Chisq= 5.2  on 1 degrees of freedom, p= 0.02
```

Cox Prop Hazards Model

```
survb <- Surv(df$withtime, df$censall)

cox_model <- coxph(survb ~ treat, data =df)
summary(cox_model)
```

```
## Call:
```

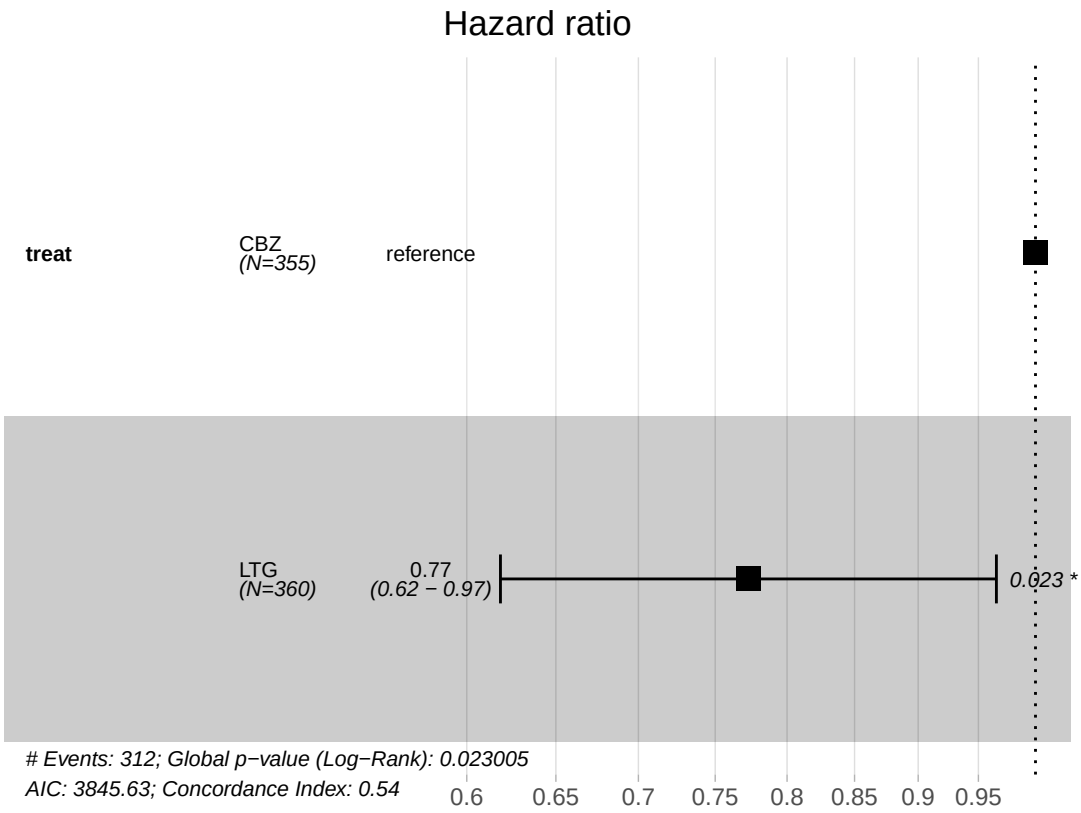
```
## coxph(formula = survb ~ treat, data = df)
##
##   n= 715, number of events= 312
##
##             coef exp(coef) se(coef)      z Pr(>|z|)
## treatLTG -0.2578    0.7727   0.1136 -2.269   0.0233 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##          exp(coef) exp(-coef) lower .95 upper .95
## treatLTG    0.7727      1.294    0.6184    0.9655
##
## Concordance= 0.536  (se = 0.015 )
## Likelihood ratio test= 5.17  on 1 df,   p=0.02
## Wald test            = 5.15  on 1 df,   p=0.02
## Score (logrank) test = 5.18  on 1 df,   p=0.02
```

```
ci <- exp(confint(cox_model))
```

```
ci # Confidence Intervals
```

```
##              2.5 %    97.5 %
## treatLTG 0.6184301 0.9654932
```

Forest Plot



Assess reasonableness of underlying cox model assumptions

```
# Proportional Hazards
ph_assumption <- cox.zph(cox_model)

ph_assumption
```

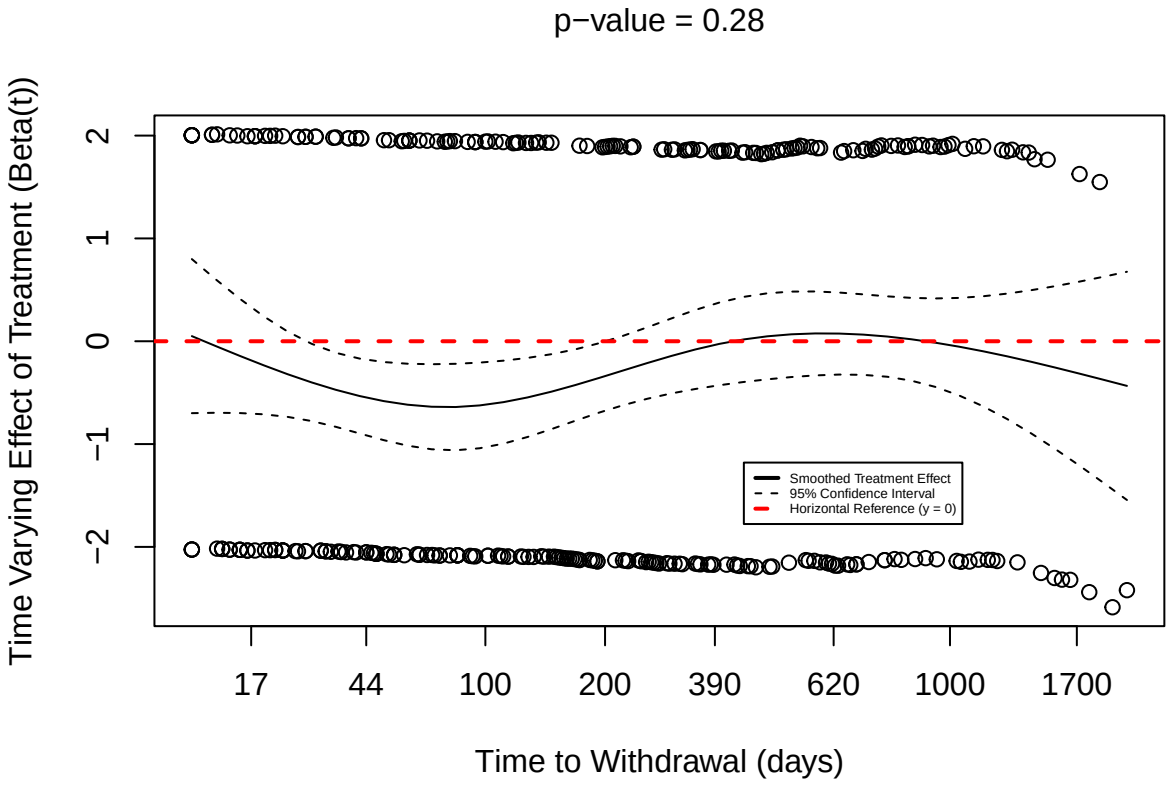
```
##        chisq df    p
## treat   1.16  1 0.28
## GLOBAL  1.16  1 0.28
```

```
library(ggpubr)
# Linearity
plot(ph_assumption,
     xlab = "Time to Withdrawal (days)",                    # Change x-axis title
     ylab = "Time Varying Effect of Treatment (Beta(t))")


# Add a horizontal reference line at y = 0
abline(h = 0, col = "red", lty = 2, lwd = 2)

mtext("p-value = 0.28", side = 3, line = 2)

legend(
  "bottomright",                                    # Position
  legend = c(
    "Smoothed Treatment Effect",
    "95% Confidence Interval",
    "Horizontal Reference (y = 0)"
  ),                                                # Legend text
  col = c("black", "black", "red"),                 # Colors for each line
  lty = c(1, 2, 2),                                 # Line types
  lwd = c(2, 1, 2),
  xpd =TRUE,
  cex = 0.4,
  inset = c(0.2, 0.2)  # Adjust legend text size
)
```




```
# Assessing the Overall Model Fit

# Likelihood ratio test
anova(cox_model, test = "Chisq")
```

```
## Analysis of Deviance Table
##  Cox model: response is survb
## Terms added sequentially (first to last)
##
##        loglik  Chisq Df Pr(>|Chi|)
## NULL  -1924.4
## treat -1921.8 5.1681  1      0.023 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#
AIC(cox_model)
```

```
## [1] 3845.632
```

Competing Risk Analysis

```r
library(cmprsk)
```

```
##
## Attaching package: 'cmprsk'

## The following objects are masked from 'package:tidycmprsk':
##
##     crr, cuminc
```

```r
library(survival)
library(crrstep)
```

```r
# Cummulative Incidence Function

dfIIx <- df



dfIIx$time <- dfIIx$withtime
dfIIx$group <- dfIIx$treat

dfIIx$status <- factor(dfIIx$wdlcode, labels = c("CEN", "UAE", "ISC"), levels = 0:2) # These are the th

dfIIx <- dfIIx[dfIIx$status != "CEN", ]
## this is used to estimate the probability of each event over time
```

```r
cif <- cuminc(ftime = dfIIx$time,
              fstatus = dfIIx$status,
              group=dfIIx$group)
```

```r
cif
```

```
## Tests:
##         stat         pv df
## UAE 4.185497 0.04077125  1
## ISC 4.318252 0.03770563  1
## Estimates and Variances:
## $est
##                500      1000      1500
## CBZ UAE 0.5654762 0.6071429 0.6190476
## LTG UAE 0.4236111 0.5000000 0.5000000
## CBZ ISC 0.2142857 0.3035714 0.3392857
## LTG ISC 0.2569444 0.4097222 0.4791667
##
## $var
##                  500        1000        1500
## CBZ UAE 0.001479754 0.001441052 0.001428538
## LTG UAE 0.001713409 0.001763375 0.001763375
## CBZ ISC 0.001015056 0.001282661 0.001366823
## LTG ISC 0.001343424 0.001715545 0.001783099
```

```r
names(cif)
```

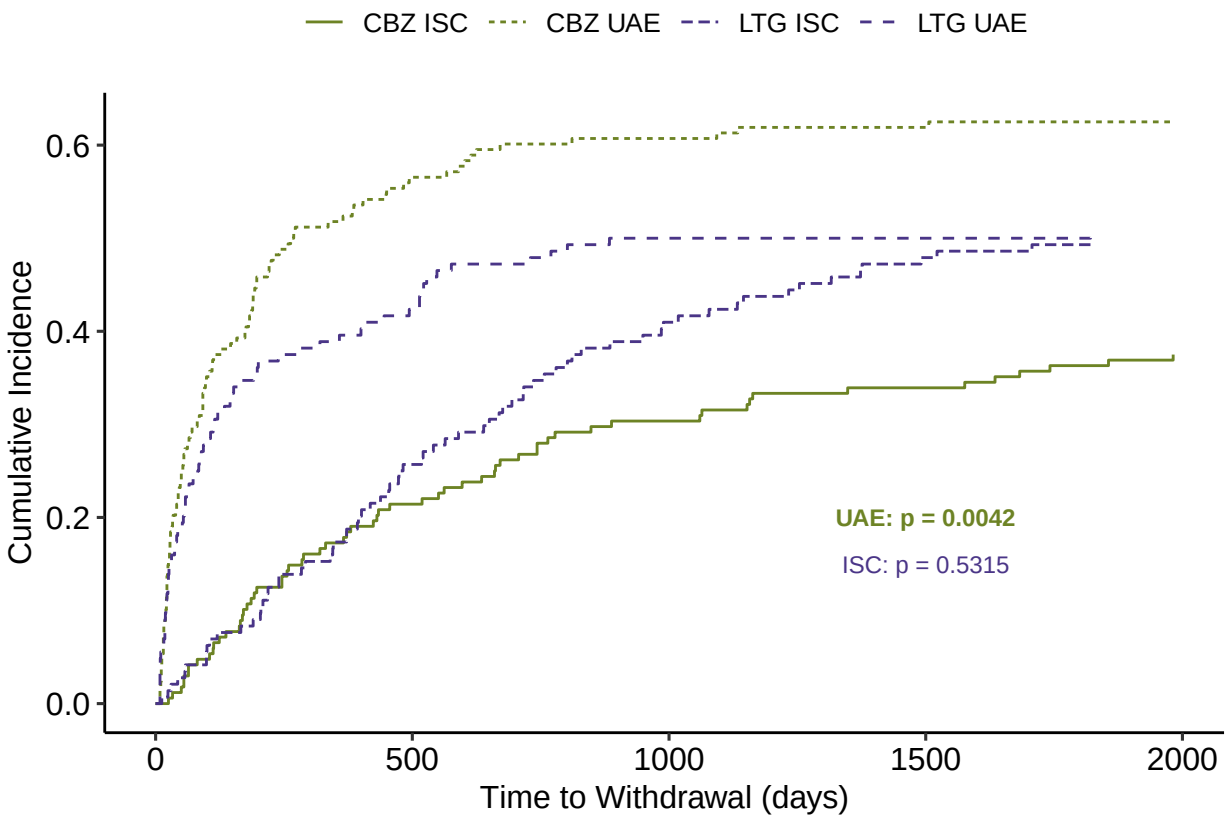
```
## [1] "CBZ UAE" "LTG UAE" "CBZ ISC" "LTG ISC" "Tests"
```

```r
groups <- c("CBZ UAE", "LTG UAE", "CBZ ISC" ,"LTG ISC")
cif_list <- list()
```

```r
for (group in groups) {
  cif_list[[group]] <- data.frame(
    time = cif[[group]]$time,
    estimate = cif[[group]]$est,
    group = group
  )
}

cif_data <- bind_rows(cif_list)
```

```r
ggplot(cif_data, aes(x = time, y = estimate, color = group, linetype = group)) +
  geom_line() +
  labs(
    x = "Time to Withdrawal (days)",
    y = "Cumulative Incidence"
  ) +
  theme_pubr() +
  theme(legend.title = element_blank()) +
  scale_color_manual(values = c("#6D8325FF","#6D8325FF","#4A3587FF", "#4A3587FF")) +
  annotate("text", x = 1500, y = 0.20, label = "UAE: p = 0.0042", color = "#6D8325FF", size = 3, fontfa
  annotate("text", x = 1500, y = 0.15, label = "ISC: p = 0.5315", color="#4A3587FF", size = 3)
```



Gray's Test

```
# Gray test assesses whether CIF is significantly different between groups for each event.

gt <- cuminc(ftime = dfIIx$time,
             fstatus = dfIIx$status,
             group=dfIIx$group)
gt
```

```
## Tests:
##         stat         pv df
## UAE 4.185497 0.04077125  1
## ISC 4.318252 0.03770563  1
## Estimates and Variances:
## $est
##                500      1000      1500
## CBZ UAE 0.5654762 0.6071429 0.6190476
## LTG UAE 0.4236111 0.5000000 0.5000000
## CBZ ISC 0.2142857 0.3035714 0.3392857
## LTG ISC 0.2569444 0.4097222 0.4791667
##
## $var
##                  500        1000        1500
## CBZ UAE 0.001479754 0.001441052 0.001428538
```

```
## LTG UAE 0.001713409 0.001763375 0.001763375
## CBZ ISC 0.001015056 0.001282661 0.001366823
## LTG ISC 0.001343424 0.001715545 0.001783099
```

Fine and Gray Test

```
fgdf$etime <- fgdf$time

fgdf$event <- fgdf$wdlcode

fgdf$event2 <- factor(fgdf$event, 0:2, labels = c("CEN", "UAE", "ISC"))
```

```
table(fgdf$event2)
```

```
##
## CEN UAE ISC
##   0 178 134
```

```
isc <- finegray(Surv(etime, event2) ~ treat, data=fgdf, etype="ISC")
```

```
uae <- finegray(Surv(etime, event2) ~ treat, data=fgdf, etype="UAE")
```

```
fgfitisc <- coxph(Surv(fgstart, fgstop, fgstatus) ~ treat, data=isc,
weight= fgwt)

fgfituae <- coxph(Surv(fgstart, fgstop, fgstatus) ~ treat, data=uae,
weight= fgwt)
```

```
summary(fgfitisc)
```

```
## Call:
## coxph(formula = Surv(fgstart, fgstop, fgstatus) ~ treat, data = isc,
##     weights = fgwt)
##
##   n= 312, number of events= 134
##
##            coef exp(coef) se(coef)     z Pr(>|z|)
## treatLTG 0.3366    1.4001   0.1732 1.943    0.052 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##          exp(coef) exp(-coef) lower .95 upper .95
## treatLTG       1.4     0.7142    0.9971     1.966
##
## Concordance= 0.538  (se = 0.022 )
## Likelihood ratio test= 3.78  on 1 df,   p=0.05
## Wald test            = 3.78  on 1 df,   p=0.05
## Score (logrank) test = 3.81  on 1 df,   p=0.05
```

```r
summary(fgfituae)
```

```
## Call:
## coxph(formula = Surv(fgstart, fgstop, fgstatus) ~ treat, data = uae,
##     weights = fgwt)
##
##   n= 312, number of events= 178
##
##             coef exp(coef) se(coef)     z Pr(>|z|)
## treatLTG -0.3113    0.7325   0.1526 -2.04   0.0413 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##          exp(coef) exp(-coef) lower .95 upper .95
## treatLTG    0.7325      1.365    0.5432    0.9878
##
## Concordance= 0.536  (se = 0.019 )
## Likelihood ratio test= 4.22  on 1 df,   p=0.04
## Wald test            = 4.16  on 1 df,   p=0.04
## Score (logrank) test = 4.2  on 1 df,   p=0.04
```

Findings

1. Lamotrigine demonstrated a slight advantage over Carbamazepine in helping participants stay seizure-free for 12 months, though this difference was not statistically significant.
2. The gender-specific analysis showed women on CBZ had the lowest overall probability of achieving 12-month remission. Overall, no significant differences were observed between men and women in their response to treatment
3. Survival analysis presented a clear comparison between the AEDs, with the Lamotrigine group consistently having lower withdrawal rates than Carbamazepine over the study period. LTG also had the lowest withdrawal rates due to unexpected adverse events. Lamotrigine may have been a more tolerable treatment and may have a reduced risk of withdrawal, ultimately making it a preferable option to improve adherence and tolerability.
4. The competing risks analysis also highlights notable differences in treatment effects based on withdrawal causes. In withdrawal due to UAE, Lamotrigine had a statistically significant lower cumulative incidence suggesting it may be preferable due to fewer adverse effects.

Limitations

1. Models were not fitted with other variables in mind i.e Age & Seizure Frequency.