All Dolphins

December 06, 2021

Dolphin6 <- read.csv('110606-Behavior\_QC.csv')

Dolphin7 <- read.csv('110607-Behavior\_QC.csv')

Dolphin8 <- read.csv('110608-Behavior\_QC.csv')

Dolphin10 <- read.csv('110610-Behavior\_QC.csv')

alldolph <- bind\_rows(Dolphin6, Dolphin7, Dolphin8, Dolphin10)

glimpse(alldolph)

## Rows: 9,888  
## Columns: 25  
## $ X <int> 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 2…  
## $ DeployID <chr> "Tt0019", "Tt0019", "Tt0019", "Tt0019", "Tt0019", "Tt0019"…  
## $ Ptt <int> 110606, 110606, 110606, 110606, 110606, 110606, 110606, 11…  
## $ DepthSensor <lgl> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA…  
## $ Source <chr> "Transmission", "Transmission", "Transmission", "Transmiss…  
## $ Instr <chr> "Mk10", "Mk10", "Mk10", "Mk10", "Mk10", "Mk10", "Mk10", "M…  
## $ Count <int> 3, 3, 3, 3, 3, 3, 3, 3, 3, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 1…  
## $ Start <chr> "8/30/2016 17:13", "8/30/2016 17:18", "8/30/2016 22:03", "…  
## $ End <chr> "8/30/2016 17:18", "8/30/2016 22:03", "8/30/2016 22:07", "…  
## $ What <chr> "Dive", "Surface", "Dive", "Surface", "Dive", "Surface", "…  
## $ Number <int> 1, NA, 1, NA, 1, NA, 1, NA, 1, NA, 1, NA, 1, NA, 1, NA, 1,…  
## $ Shape <chr> "U", "", "V", "", "U", "", "U", "", "U", "", "U", "", "V",…  
## $ DepthMin <dbl> 63.0, NA, 130.0, NA, 111.0, NA, 81.0, NA, 396.0, NA, 396.0…  
## $ DepthMax <dbl> 64.5, NA, 133.5, NA, 112.5, NA, 82.5, NA, 403.5, NA, 403.5…  
## $ DurationMin <int> 253, 17070, 257, 2935, 155, 221, 241, 95, 485, 193, 505, 5…  
## $ DurationMax <int> 255, 17130, 259, 2937, 157, 223, 243, 97, 487, 195, 507, 5…  
## $ Shallow <int> NA, 4413, NA, 1137, NA, 143, NA, 96, NA, 194, NA, 3074, NA…  
## $ Deep <int> NA, 12687, NA, 1799, NA, 79, NA, 0, NA, 0, NA, 2532, NA, 1…  
## $ start <chr> "8/30/2016 13:13", "8/30/2016 13:18", "8/30/2016 18:03", "…  
## $ end <chr> "8/30/2016 13:18", "8/30/2016 18:03", "8/30/2016 18:07", "…  
## $ t.diff <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0…  
## $ flag <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0…  
## $ divenum <int> 1, 1, 2, 2, 3, 3, 4, 4, 5, 5, 6, 6, 7, 7, 8, 8, 9, 9, 10, …  
## $ depth <dbl> 63.75, NA, 131.75, NA, 111.75, NA, 81.75, NA, 399.75, NA, …  
## $ duration <int> 254, 17100, 258, 2936, 156, 222, 242, 96, 486, 194, 506, 5…

alldolph = alldolph %>%  
 mutate(Ptt = case\_when(Ptt == 110606 ~ 'Dolphin6',  
Ptt == 110607 ~ 'Dolphin7',  
Ptt == 110608 ~ 'Dolphin8',  
Ptt == 110610 ~ 'Dolphin10'))

wide\_dolph\_dives <- alldolph %>%  
 pivot\_wider(names\_from = What,  
 # variables listed in values\_from are ones you want to keep/use   
 # that are DIFFERENT for dive and surfacing  
 values\_from = c(X, Number, Shape, DepthMin, DepthMax, DurationMin, DurationMax,  
 Count, Shallow, Deep, Start, End, start, end, t.diff, flag,  
 depth, duration)  
 ) %>%  
 # remove variables that are all NA  
 janitor::remove\_empty(which = 'cols') %>%  
 # make datetime variables datetime objects - will be easier for plotting  
 mutate(across(Start\_Dive:end\_Surface, lubridate::mdy\_hm))  
glimpse(wide\_dolph\_dives)

## Rows: 4,944  
## Columns: 35  
## $ DeployID <chr> "Tt0019", "Tt0019", "Tt0019", "Tt0019", "Tt0019", …  
## $ Ptt <chr> "Dolphin6", "Dolphin6", "Dolphin6", "Dolphin6", "D…  
## $ Source <chr> "Transmission", "Transmission", "Transmission", "T…  
## $ Instr <chr> "Mk10", "Mk10", "Mk10", "Mk10", "Mk10", "Mk10", "M…  
## $ divenum <int> 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15,…  
## $ X\_Dive <int> 3, 5, 7, 9, 11, 14, 16, 18, 20, 25, 27, 29, 31, 35…  
## $ X\_Surface <int> 4, 6, 8, 10, 13, 15, 17, 19, 21, 26, 28, 30, 32, 3…  
## $ Number\_Dive <int> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,…  
## $ Shape\_Dive <chr> "U", "V", "U", "U", "U", "U", "V", "V", "U", "V", …  
## $ Shape\_Surface <chr> "", "", "", "", "", "", "", "", "", "", "", "", ""…  
## $ DepthMin\_Dive <dbl> 63.0, 130.0, 111.0, 81.0, 396.0, 396.0, 89.0, 77.0…  
## $ DepthMax\_Dive <dbl> 64.5, 133.5, 112.5, 82.5, 403.5, 403.5, 90.5, 78.5…  
## $ DurationMin\_Dive <int> 253, 257, 155, 241, 485, 505, 135, 121, 157, 91, 9…  
## $ DurationMin\_Surface <int> 17070, 2935, 221, 95, 193, 5605, 697, 2987, 431, 1…  
## $ DurationMax\_Dive <int> 255, 259, 157, 243, 487, 507, 137, 123, 159, 93, 1…  
## $ DurationMax\_Surface <int> 17130, 2937, 223, 97, 195, 5607, 699, 2989, 433, 1…  
## $ Count\_Dive <int> 3, 3, 3, 3, 3, 2, 2, 2, 2, 1, 1, 1, 1, 1, 1, 1, 1,…  
## $ Count\_Surface <int> 3, 3, 3, 3, 2, 2, 2, 2, 2, 1, 1, 1, 1, 1, 1, 1, 1,…  
## $ Shallow\_Surface <int> 4413, 1137, 143, 96, 194, 3074, 585, 2121, 307, 11…  
## $ Deep\_Surface <int> 12687, 1799, 79, 0, 0, 2532, 113, 867, 125, 35, 63…  
## $ Start\_Dive <dttm> 2016-08-30 17:13:00, 2016-08-30 22:03:00, 2016-08…  
## $ Start\_Surface <dttm> 2016-08-30 17:18:00, 2016-08-30 22:07:00, 2016-08…  
## $ End\_Dive <dttm> 2016-08-30 17:18:00, 2016-08-30 22:07:00, 2016-08…  
## $ End\_Surface <dttm> 2016-08-30 22:03:00, 2016-08-30 22:56:00, 2016-08…  
## $ start\_Dive <dttm> 2016-08-30 13:13:00, 2016-08-30 18:03:00, 2016-08…  
## $ start\_Surface <dttm> 2016-08-30 13:18:00, 2016-08-30 18:07:00, 2016-08…  
## $ end\_Dive <dttm> 2016-08-30 13:18:00, 2016-08-30 18:07:00, 2016-08…  
## $ end\_Surface <dttm> 2016-08-30 18:03:00, 2016-08-30 18:56:00, 2016-08…  
## $ t.diff\_Dive <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 66480, 0, 0…  
## $ t.diff\_Surface <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,…  
## $ flag\_Dive <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0,…  
## $ flag\_Surface <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,…  
## $ depth\_Dive <dbl> 63.75, 131.75, 111.75, 81.75, 399.75, 399.75, 89.7…  
## $ duration\_Dive <int> 254, 258, 156, 242, 486, 506, 136, 122, 158, 92, 1…  
## $ duration\_Surface <int> 17100, 2936, 222, 96, 194, 5606, 698, 2988, 432, 1…

cluster\_data <- wide\_dolph\_dives %>%  
 select(depth\_Dive, duration\_Dive) %>%  
 mutate(depth=scale(depth\_Dive),  
 duration=scale(duration\_Dive))

c\_out <-cluster::clara(cluster\_data, k=2, metric = c("euclidean"))  
glimpse(c\_out)

## List of 10  
## $ sample : int [1:44] 56 76 149 200 499 660 733 836 864 882 ...  
## $ medoids : num [1:2, 1:4] 91.75 375.75 236 474 -0.943 ...  
## ..- attr(\*, "dimnames")=List of 2  
## .. ..$ : NULL  
## .. ..$ : chr [1:4] "depth\_Dive" "duration\_Dive" "depth" "duration"  
## $ i.med : int [1:2] 3791 1089  
## $ clustering: int [1:4944] 1 1 1 1 2 2 1 1 1 1 ...  
## $ objective : num 113  
## $ clusinfo : num [1:2, 1:4] 2335 2609 244.1 705.9 93.5 ...  
## ..- attr(\*, "dimnames")=List of 2  
## .. ..$ : NULL  
## .. ..$ : chr [1:4] "size" "max\_diss" "av\_diss" "isolation"  
## $ diss : 'dissimilarity' num [1:946] 483 473 307 433 381 ...  
## ..- attr(\*, "Size")= int 44  
## ..- attr(\*, "Metric")= chr "euclidean"  
## $ call : language cluster::clara(x = cluster\_data, k = 2, metric = c("euclidean"))  
## $ silinfo :List of 3  
## ..$ widths : num [1:44, 1:3] 1 1 1 1 1 1 1 1 1 1 ...  
## .. ..- attr(\*, "dimnames")=List of 2  
## ..$ clus.avg.widths: num [1:2] 0.632 0.645  
## ..$ avg.width : num 0.639  
## $ data : num [1:4944, 1:4] 63.8 131.8 111.8 81.8 399.8 ...  
## ..- attr(\*, "dimnames")=List of 2  
## .. ..$ : NULL  
## .. ..$ : chr [1:4] "depth\_Dive" "duration\_Dive" "depth" "duration"  
## - attr(\*, "class")= chr [1:2] "clara" "partition"

wide\_dolph\_dives <- wide\_dolph\_dives %>%  
 mutate(dtype=c\_out$clustering)  
glimpse(wide\_dolph\_dives)

## Rows: 4,944  
## Columns: 36  
## $ DeployID <chr> "Tt0019", "Tt0019", "Tt0019", "Tt0019", "Tt0019", …  
## $ Ptt <chr> "Dolphin6", "Dolphin6", "Dolphin6", "Dolphin6", "D…  
## $ Source <chr> "Transmission", "Transmission", "Transmission", "T…  
## $ Instr <chr> "Mk10", "Mk10", "Mk10", "Mk10", "Mk10", "Mk10", "M…  
## $ divenum <int> 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15,…  
## $ X\_Dive <int> 3, 5, 7, 9, 11, 14, 16, 18, 20, 25, 27, 29, 31, 35…  
## $ X\_Surface <int> 4, 6, 8, 10, 13, 15, 17, 19, 21, 26, 28, 30, 32, 3…  
## $ Number\_Dive <int> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,…  
## $ Shape\_Dive <chr> "U", "V", "U", "U", "U", "U", "V", "V", "U", "V", …  
## $ Shape\_Surface <chr> "", "", "", "", "", "", "", "", "", "", "", "", ""…  
## $ DepthMin\_Dive <dbl> 63.0, 130.0, 111.0, 81.0, 396.0, 396.0, 89.0, 77.0…  
## $ DepthMax\_Dive <dbl> 64.5, 133.5, 112.5, 82.5, 403.5, 403.5, 90.5, 78.5…  
## $ DurationMin\_Dive <int> 253, 257, 155, 241, 485, 505, 135, 121, 157, 91, 9…  
## $ DurationMin\_Surface <int> 17070, 2935, 221, 95, 193, 5605, 697, 2987, 431, 1…  
## $ DurationMax\_Dive <int> 255, 259, 157, 243, 487, 507, 137, 123, 159, 93, 1…  
## $ DurationMax\_Surface <int> 17130, 2937, 223, 97, 195, 5607, 699, 2989, 433, 1…  
## $ Count\_Dive <int> 3, 3, 3, 3, 3, 2, 2, 2, 2, 1, 1, 1, 1, 1, 1, 1, 1,…  
## $ Count\_Surface <int> 3, 3, 3, 3, 2, 2, 2, 2, 2, 1, 1, 1, 1, 1, 1, 1, 1,…  
## $ Shallow\_Surface <int> 4413, 1137, 143, 96, 194, 3074, 585, 2121, 307, 11…  
## $ Deep\_Surface <int> 12687, 1799, 79, 0, 0, 2532, 113, 867, 125, 35, 63…  
## $ Start\_Dive <dttm> 2016-08-30 17:13:00, 2016-08-30 22:03:00, 2016-08…  
## $ Start\_Surface <dttm> 2016-08-30 17:18:00, 2016-08-30 22:07:00, 2016-08…  
## $ End\_Dive <dttm> 2016-08-30 17:18:00, 2016-08-30 22:07:00, 2016-08…  
## $ End\_Surface <dttm> 2016-08-30 22:03:00, 2016-08-30 22:56:00, 2016-08…  
## $ start\_Dive <dttm> 2016-08-30 13:13:00, 2016-08-30 18:03:00, 2016-08…  
## $ start\_Surface <dttm> 2016-08-30 13:18:00, 2016-08-30 18:07:00, 2016-08…  
## $ end\_Dive <dttm> 2016-08-30 13:18:00, 2016-08-30 18:07:00, 2016-08…  
## $ end\_Surface <dttm> 2016-08-30 18:03:00, 2016-08-30 18:56:00, 2016-08…  
## $ t.diff\_Dive <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 66480, 0, 0…  
## $ t.diff\_Surface <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,…  
## $ flag\_Dive <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0,…  
## $ flag\_Surface <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,…  
## $ depth\_Dive <dbl> 63.75, 131.75, 111.75, 81.75, 399.75, 399.75, 89.7…  
## $ duration\_Dive <int> 254, 258, 156, 242, 486, 506, 136, 122, 158, 92, 1…  
## $ duration\_Surface <int> 17100, 2936, 222, 96, 194, 5606, 698, 2988, 432, 1…  
## $ dtype <int> 1, 1, 1, 1, 2, 2, 1, 1, 1, 1, 1, 1, 1, 2, 1, 2, 2,…

wide\_dolph\_dives = wide\_dolph\_dives %>%  
mutate(dtype = case\_when(dtype == 1 ~ 'shallow',  
dtype == 2 ~ 'deep'))

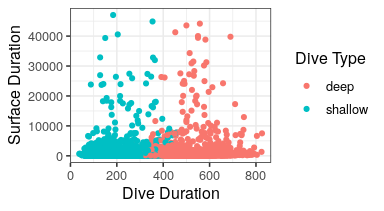
Trevor——————————————— Looking at a summary of all of the variables

summary(wide\_dolph\_dives)

## DeployID Ptt Source Instr   
## Length:4944 Length:4944 Length:4944 Length:4944   
## Class :character Class :character Class :character Class :character   
## Mode :character Mode :character Mode :character Mode :character   
##   
##   
##   
##   
## divenum X\_Dive X\_Surface Number\_Dive  
## Min. : 1.0 Min. : 2.0 Min. : 3.0 Min. :1   
## 1st Qu.: 309.8 1st Qu.: 697.8 1st Qu.: 698.8 1st Qu.:1   
## Median : 619.0 Median :1393.0 Median :1394.0 Median :1   
## Mean : 659.1 Mean :1485.5 Mean :1486.5 Mean :1   
## 3rd Qu.: 997.2 3rd Qu.:2248.0 3rd Qu.:2249.0 3rd Qu.:1   
## Max. :1571.0 Max. :3531.0 Max. :3532.0 Max. :1   
##   
## Shape\_Dive Shape\_Surface DepthMin\_Dive DepthMax\_Dive   
## Length:4944 Length:4944 Min. : 49.5 Min. : 50.0   
## Class :character Class :character 1st Qu.: 99.0 1st Qu.: 100.5   
## Mode :character Mode :character Median :238.0 Median : 241.5   
## Mean :259.4 Mean : 264.8   
## 3rd Qu.:380.0 3rd Qu.: 387.5   
## Max. :992.0 Max. :1007.5   
##   
## DurationMin\_Dive DurationMin\_Surface DurationMax\_Dive DurationMax\_Surface  
## Min. : 37 Min. : 1 Min. : 39 Min. : 3   
## 1st Qu.:245 1st Qu.: 141 1st Qu.:247 1st Qu.: 143   
## Median :385 Median : 243 Median :387 Median : 245   
## Mean :372 Mean : 1015 Mean :374 Mean : 1018   
## 3rd Qu.:487 3rd Qu.: 577 3rd Qu.:489 3rd Qu.: 579   
## Max. :825 Max. :47010 Max. :827 Max. :47070   
##   
## Count\_Dive Count\_Surface Shallow\_Surface Deep\_Surface   
## Min. :1.000 Min. :1.000 Min. : 2.0 Min. : 0.0   
## 1st Qu.:1.000 1st Qu.:1.000 1st Qu.: 120.0 1st Qu.: 6.0   
## Median :1.000 Median :1.000 Median : 192.0 Median : 35.0   
## Mean :1.501 Mean :1.502 Mean : 691.9 Mean : 324.8   
## 3rd Qu.:2.000 3rd Qu.:2.000 3rd Qu.: 392.0 3rd Qu.: 168.0   
## Max. :8.000 Max. :8.000 Max. :40750.0 Max. :27964.0   
##   
## Start\_Dive Start\_Surface   
## Min. :2016-08-30 17:13:00 Min. :2016-08-30 17:18:00   
## 1st Qu.:2016-09-12 01:51:30 1st Qu.:2016-09-12 01:56:45   
## Median :2016-09-28 07:21:00 Median :2016-09-28 07:27:00   
## Mean :2016-09-29 06:35:44 Mean :2016-09-29 06:41:52   
## 3rd Qu.:2016-10-15 09:19:45 3rd Qu.:2016-10-15 09:27:00   
## Max. :2016-11-06 05:44:00 Max. :2016-11-06 05:49:00   
##   
## End\_Dive End\_Surface   
## Min. :2016-08-30 17:18:00 Min. :2016-08-30 20:55:00   
## 1st Qu.:2016-09-12 01:56:45 1st Qu.:2016-09-12 02:15:45   
## Median :2016-09-28 07:27:00 Median :2016-09-28 07:33:30   
## Mean :2016-09-29 06:41:52 Mean :2016-09-29 06:58:48   
## 3rd Qu.:2016-10-15 09:27:00 3rd Qu.:2016-10-15 09:30:30   
## Max. :2016-11-06 05:49:00 Max. :2016-11-06 05:51:00   
##   
## start\_Dive start\_Surface   
## Min. :2016-08-30 13:13:00 Min. :2016-08-30 13:18:00   
## 1st Qu.:2016-09-12 16:21:00 1st Qu.:2016-09-12 16:28:30   
## Median :2016-09-28 19:52:00 Median :2016-09-28 19:59:00   
## Mean :2016-09-29 04:40:40 Mean :2016-09-29 04:46:40   
## 3rd Qu.:2016-10-15 01:10:30 3rd Qu.:2016-10-15 01:17:30   
## Max. :2016-11-02 17:26:00 Max. :2016-11-02 17:37:00   
## NA's :3373 NA's :3373   
## end\_Dive end\_Surface t.diff\_Dive   
## Min. :2016-08-30 13:18:00 Min. :2016-08-30 18:03:00 Min. :-1005540   
## 1st Qu.:2016-09-12 16:28:30 1st Qu.:2016-09-12 18:02:00 1st Qu.: 0   
## Median :2016-09-28 19:59:00 Median :2016-09-28 20:02:00 Median : 0   
## Mean :2016-09-29 04:46:40 Mean :2016-09-29 05:03:27 Mean : 2242   
## 3rd Qu.:2016-10-15 01:17:30 3rd Qu.:2016-10-15 01:26:00 3rd Qu.: 0   
## Max. :2016-11-02 17:37:00 Max. :2016-11-02 17:44:00 Max. : 333180   
## NA's :3373 NA's :3373 NA's :1   
## t.diff\_Surface flag\_Dive flag\_Surface depth\_Dive duration\_Dive  
## Min. :0 Min. :0.0000 Min. :0 Min. : 49.75 Min. : 38   
## 1st Qu.:0 1st Qu.:0.0000 1st Qu.:0 1st Qu.: 99.75 1st Qu.:246   
## Median :0 Median :0.0000 Median :0 Median :239.75 Median :386   
## Mean :0 Mean :0.1157 Mean :0 Mean :262.11 Mean :373   
## 3rd Qu.:0 3rd Qu.:0.0000 3rd Qu.:0 3rd Qu.:383.75 3rd Qu.:488   
## Max. :0 Max. :1.0000 Max. :0 Max. :999.75 Max. :826   
##   
## duration\_Surface dtype   
## Min. : 2 Length:4944   
## 1st Qu.: 142 Class :character   
## Median : 244 Mode :character   
## Mean : 1017   
## 3rd Qu.: 578   
## Max. :47040   
##

Exploratory Graph

gf\_point(duration\_Surface ~ duration\_Dive, data = wide\_dolph\_dives, color = ~dtype) %>%  
 gf\_labs( x = 'Dive Duration',  
 y = 'Surface Duration') %>%  
 gf\_theme(scale\_color\_discrete('Dive Type'))



Fitting the model and summary

dolphdive <- glmmTMB(duration\_Surface ~ duration\_Dive + (1| Ptt), data = wide\_dolph\_dives, family = Gamma(link='log'))   
summary(dolphdive)

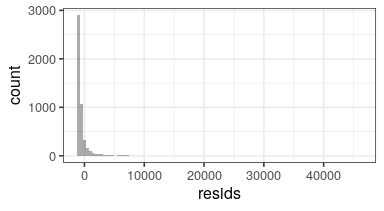
## Family: Gamma ( log )  
## Formula: duration\_Surface ~ duration\_Dive + (1 | Ptt)  
## Data: wide\_dolph\_dives  
##   
## AIC BIC logLik deviance df.resid   
## 76707.9 76734.0 -38350.0 76699.9 4940   
##   
## Random effects:  
##   
## Conditional model:  
## Groups Name Variance Std.Dev.  
## Ptt (Intercept) 0.001981 0.04451   
## Number of obs: 4944, groups: Ptt, 4  
##   
## Dispersion estimate for Gamma family (sigma^2): 1.86   
##   
## Conditional model:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) 6.8217543 0.0638378 106.86 <2e-16 \*\*\*  
## duration\_Dive 0.0002879 0.0001396 2.06 0.0392 \*   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Model Equation: duration\_Surface = 6.821 + 0.0002 + E

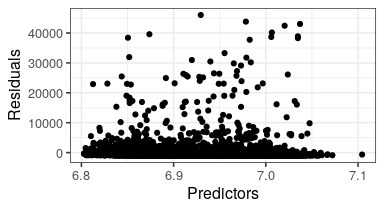
conditions <- wide\_dolph\_dives %>%  
 mutate(preds = predict(dolphdive),  
 resids = resid(dolphdive))

Model Assessment

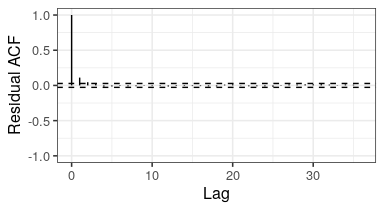
gf\_histogram( ~resids, data = conditions, bins = 100)

 Looking for normal distribution

gf\_point(resids ~ preds, data = conditions) %>%  
 gf\_labs( x = 'Predictors',  
 y = 'Residuals')

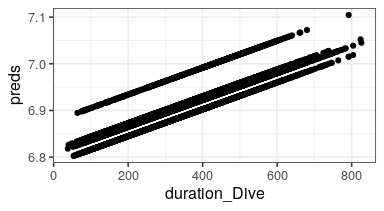


s245::gf\_acf(~dolphdive) %>%  
 gf\_lims(y = c(-1,1))



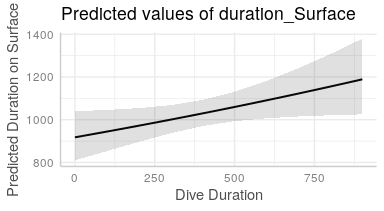
d2 <- wide\_dolph\_dives %>%  
 select(duration\_Dive, duration\_Surface, Shallow\_Surface, Deep\_Surface,) %>%  
 na.omit() %>%  
 mutate(preds = predict(dolphdive))

gf\_point(preds ~ duration\_Dive, data = d2)

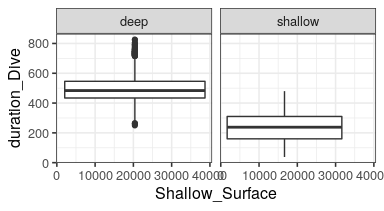
 Prediction Plot

ggpredict(dolphdive,  
 terms = c('duration\_Dive',  
 'Shallow\_Surface [1]',  
 'Deep\_Surface [0]'),  
 type = 'fixed') %>%  
 plot() %>%  
 gf\_labs(y = 'Predicted Duration on Surface',  
 x = 'Dive Duration')

## `Shallow\_Surface` was not found in model terms. Maybe misspelled?  
## `Deep\_Surface` was not found in model terms. Maybe misspelled?

 Prediction plot

gf\_boxplot(duration\_Dive ~ Shallow\_Surface | dtype , data = wide\_dolph\_dives)

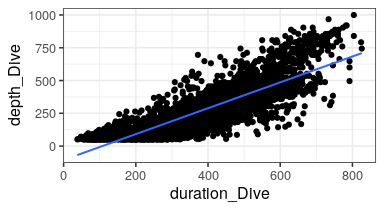


ALL OF THIS IS DOLPHIN 8:

#gf\_bar( ~ DepthMax, data = divedata)

Looking at the distribution of dive depths and duration

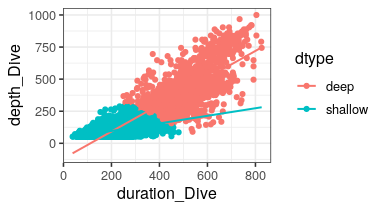
gf\_point(depth\_Dive ~ duration\_Dive,  
 data = wide\_dolph\_dives) %>%  
 gf\_lm()



dives.lm <- lm(depth\_Dive ~ duration\_Dive,  
 data = wide\_dolph\_dives)  
summary(dives.lm)

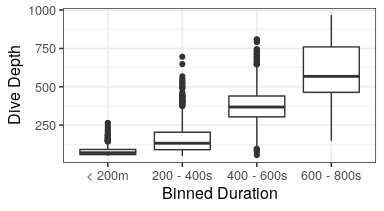
##   
## Call:  
## lm(formula = depth\_Dive ~ duration\_Dive, data = wide\_dolph\_dives)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -375.58 -60.14 -1.06 54.32 434.64   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) -1.060e+02 3.313e+00 -31.98 <2e-16 \*\*\*  
## duration\_Dive 9.868e-01 8.177e-03 120.67 <2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 90.92 on 4942 degrees of freedom  
## Multiple R-squared: 0.7466, Adjusted R-squared: 0.7466   
## F-statistic: 1.456e+04 on 1 and 4942 DF, p-value: < 2.2e-16

gf\_point(depth\_Dive ~ duration\_Dive,  
 data = wide\_dolph\_dives,  
 color= ~dtype) %>%  
 gf\_lm()



AllDolphinsBin <- wide\_dolph\_dives %>%  
 mutate(binned\_dur = case\_when(duration\_Dive < 200 ~ "< 200m",  
 duration\_Dive >=200 & duration\_Dive < 400 ~ "200 - 400s",  
 duration\_Dive >=400 & duration\_Dive < 600 ~ "400 - 600s",  
 duration\_Dive >=600 & duration\_Dive < 800 ~ "600 - 800s"))

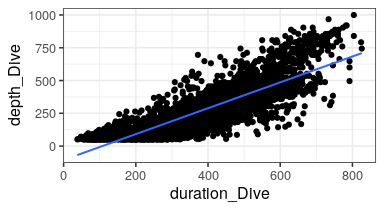
gf\_boxplot(depth\_Dive ~ binned\_dur, data = AllDolphinsBin %>%  
 select(depth\_Dive, binned\_dur) %>%  
 na.omit()) %>%  
 gf\_labs(x = 'Binned Duration', y = "Dive Depth")



Looking at the distribution of dive depths and duration

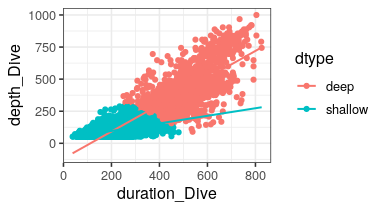
Initial look at depth and duration of a dive:

gf\_point(depth\_Dive ~ duration\_Dive,  
 data = wide\_dolph\_dives) %>%  
 gf\_lm()



Depth and Duration of Dives with separation by new variable dtype

gf\_point(depth\_Dive ~ duration\_Dive,  
 data = wide\_dolph\_dives,  
 color= ~dtype) %>%  
 gf\_lm()



wide\_dolph\_dives <- wide\_dolph\_dives %>% group\_by(Ptt) %>%  
 mutate(tsec = as.numeric(Start\_Dive - first(Start\_Dive)),  
 time\_block = cut\_width(tsec, width = 6\*60\*60, boundary = 0))  
glimpse(wide\_dolph\_dives)

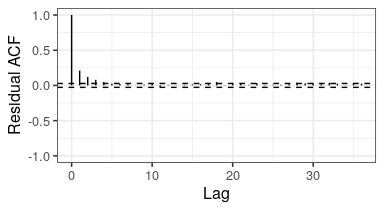
## Rows: 4,944  
## Columns: 38  
## Groups: Ptt [4]  
## $ DeployID <chr> "Tt0019", "Tt0019", "Tt0019", "Tt0019", "Tt0019", …  
## $ Ptt <chr> "Dolphin6", "Dolphin6", "Dolphin6", "Dolphin6", "D…  
## $ Source <chr> "Transmission", "Transmission", "Transmission", "T…  
## $ Instr <chr> "Mk10", "Mk10", "Mk10", "Mk10", "Mk10", "Mk10", "M…  
## $ divenum <int> 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15,…  
## $ X\_Dive <int> 3, 5, 7, 9, 11, 14, 16, 18, 20, 25, 27, 29, 31, 35…  
## $ X\_Surface <int> 4, 6, 8, 10, 13, 15, 17, 19, 21, 26, 28, 30, 32, 3…  
## $ Number\_Dive <int> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,…  
## $ Shape\_Dive <chr> "U", "V", "U", "U", "U", "U", "V", "V", "U", "V", …  
## $ Shape\_Surface <chr> "", "", "", "", "", "", "", "", "", "", "", "", ""…  
## $ DepthMin\_Dive <dbl> 63.0, 130.0, 111.0, 81.0, 396.0, 396.0, 89.0, 77.0…  
## $ DepthMax\_Dive <dbl> 64.5, 133.5, 112.5, 82.5, 403.5, 403.5, 90.5, 78.5…  
## $ DurationMin\_Dive <int> 253, 257, 155, 241, 485, 505, 135, 121, 157, 91, 9…  
## $ DurationMin\_Surface <int> 17070, 2935, 221, 95, 193, 5605, 697, 2987, 431, 1…  
## $ DurationMax\_Dive <int> 255, 259, 157, 243, 487, 507, 137, 123, 159, 93, 1…  
## $ DurationMax\_Surface <int> 17130, 2937, 223, 97, 195, 5607, 699, 2989, 433, 1…  
## $ Count\_Dive <int> 3, 3, 3, 3, 3, 2, 2, 2, 2, 1, 1, 1, 1, 1, 1, 1, 1,…  
## $ Count\_Surface <int> 3, 3, 3, 3, 2, 2, 2, 2, 2, 1, 1, 1, 1, 1, 1, 1, 1,…  
## $ Shallow\_Surface <int> 4413, 1137, 143, 96, 194, 3074, 585, 2121, 307, 11…  
## $ Deep\_Surface <int> 12687, 1799, 79, 0, 0, 2532, 113, 867, 125, 35, 63…  
## $ Start\_Dive <dttm> 2016-08-30 17:13:00, 2016-08-30 22:03:00, 2016-08…  
## $ Start\_Surface <dttm> 2016-08-30 17:18:00, 2016-08-30 22:07:00, 2016-08…  
## $ End\_Dive <dttm> 2016-08-30 17:18:00, 2016-08-30 22:07:00, 2016-08…  
## $ End\_Surface <dttm> 2016-08-30 22:03:00, 2016-08-30 22:56:00, 2016-08…  
## $ start\_Dive <dttm> 2016-08-30 13:13:00, 2016-08-30 18:03:00, 2016-08…  
## $ start\_Surface <dttm> 2016-08-30 13:18:00, 2016-08-30 18:07:00, 2016-08…  
## $ end\_Dive <dttm> 2016-08-30 13:18:00, 2016-08-30 18:07:00, 2016-08…  
## $ end\_Surface <dttm> 2016-08-30 18:03:00, 2016-08-30 18:56:00, 2016-08…  
## $ t.diff\_Dive <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 66480, 0, 0…  
## $ t.diff\_Surface <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,…  
## $ flag\_Dive <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0,…  
## $ flag\_Surface <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,…  
## $ depth\_Dive <dbl> 63.75, 131.75, 111.75, 81.75, 399.75, 399.75, 89.7…  
## $ duration\_Dive <int> 254, 258, 156, 242, 486, 506, 136, 122, 158, 92, 1…  
## $ duration\_Surface <int> 17100, 2936, 222, 96, 194, 5606, 698, 2988, 432, 1…  
## $ dtype <chr> "shallow", "shallow", "shallow", "shallow", "deep"…  
## $ tsec <dbl> 0, 17400, 20580, 20940, 21300, 21960, 28080, 28920…  
## $ time\_block <fct> "[0,2.16e+04]", "[0,2.16e+04]", "[0,2.16e+04]", "[…

dolphin\_bin <- glmmTMB(depth\_Dive ~ duration\_Dive\*dtype + Shallow\_Surface + Deep\_Surface + (1|Ptt) + (1|time\_block), data = wide\_dolph\_dives, family = Gamma(link='log'))   
  
summary(dolphin\_bin)

## Family: Gamma ( log )  
## Formula:   
## depth\_Dive ~ duration\_Dive \* dtype + Shallow\_Surface + Deep\_Surface +   
## (1 | Ptt) + (1 | time\_block)  
## Data: wide\_dolph\_dives  
##   
## AIC BIC logLik deviance df.resid   
## 54346.2 54404.7 -27164.1 54328.2 4935   
##   
## Random effects:  
##   
## Conditional model:  
## Groups Name Variance Std.Dev.  
## Ptt (Intercept) 0.001104 0.03323   
## time\_block (Intercept) 0.009719 0.09859   
## Number of obs: 4944, groups: Ptt, 4; time\_block, 241  
##   
## Dispersion estimate for Gamma family (sigma^2): 0.0803   
##   
## Conditional model:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) 4.787e+00 3.701e-02 129.33 < 2e-16 \*\*\*  
## duration\_Dive 2.369e-03 6.379e-05 37.14 < 2e-16 \*\*\*  
## dtypeshallow -8.533e-01 3.638e-02 -23.46 < 2e-16 \*\*\*  
## Shallow\_Surface 7.794e-06 3.011e-06 2.59 0.00963 \*\*   
## Deep\_Surface -5.486e-06 4.897e-06 -1.12 0.26261   
## duration\_Dive:dtypeshallow 5.641e-04 9.339e-05 6.04 1.54e-09 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

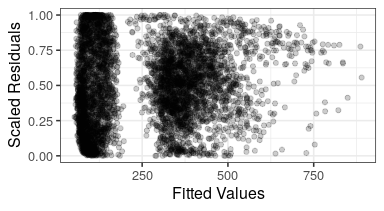
ACF graph for model

s245::gf\_acf(~dolphin\_bin) %>%  
 gf\_lims(y = c(-1,1))

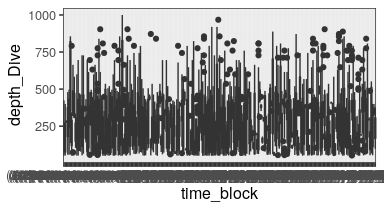


Scaled resid. by fitted model

require(DHARMa)  
dolphin\_sim <- simulateResiduals(dolphin\_bin)  
gf\_point(dolphin\_sim$scaledResiduals ~ fitted(dolphin\_bin),  
 alpha = 0.2) %>%  
 gf\_labs(x = 'Fitted Values',  
 y = 'Scaled Residuals')



gf\_boxplot(depth\_Dive ~ time\_block, data = wide\_dolph\_dives)



time\_block\_duration <- wide\_dolph\_dives %>%  
 mutate(time\_binned = case\_when(tsec < 21600 ~ "Block 1",  
 tsec >=21600 & tsec < 43200 ~ "Block 2",  
 tsec >=43200 & tsec < 64800 ~ "Block 3",  
 tsec >=64800 & tsec < 86400 ~ "Block 4"))

Depth and time categories

gf\_boxplot(depth\_Dive ~ time\_binned, data = time\_block\_duration %>%  
 select(depth\_Dive, time\_binned, Ptt) %>%  
 na.omit()) %>%  
 gf\_labs(x = 'Binned Duration', y = "Dive Depth")

