All Dolphins

Grace Schotanus, Jonathan VanOyen, and Trevor VanVeldhuisen

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```
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, 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))
```

```
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"))
```

```
wide_dolph_dives <- wide_dolph_dives %>%
  mutate(dtype=c_out$clustering)
```

```
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)
```

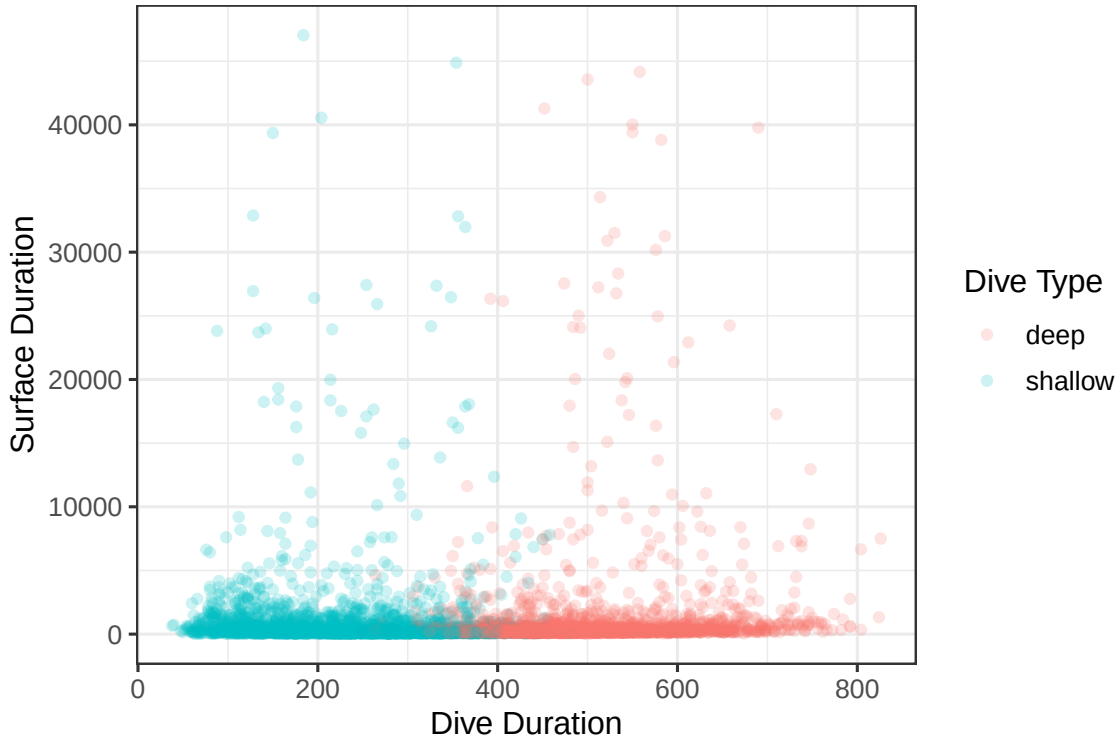
```
##    DeployID             Ptt               Source             Instr
##  Length:4944        Length:4944        Length:4944        Length:4944
##  Class :character   Class :character   Class :character   Class :character
##  Mode  :character   Mode  :character   Mode  :character   Mode  :character
##
##
##
##
##     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
```

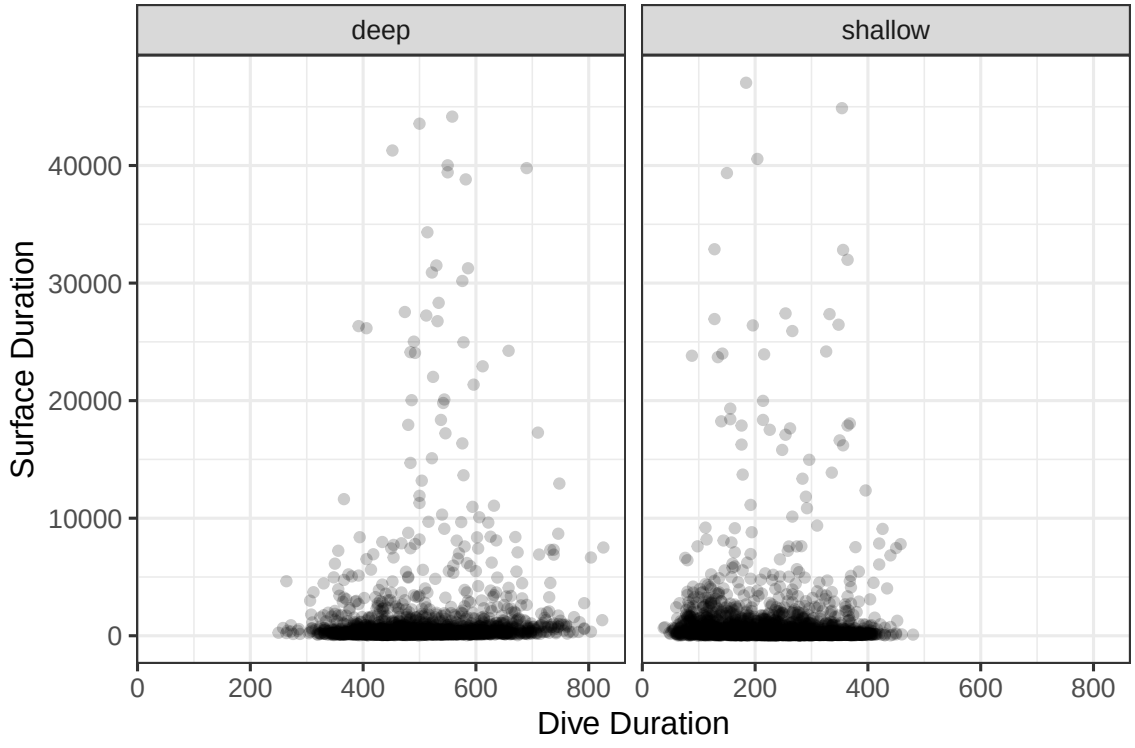
```
##  3rd Qu.:0      3rd Qu.:0.0000   3rd Qu.:0     3rd Qu.:383.75   3rd Qu.:488
##  Max.   :0      Max.   :1.0000   Max.   :0     Max.   :999.75   Max.   :826
##
##  duration_Surface    dtype
##  Min.   :    2    Length:4944
##  1st Qu.:  142    Class :character
##  Median :  244    Mode  :character
##  Mean   : 1017
##  3rd Qu.:  578
##  Max.   :47040
##
```

Exploratory Graph

```
gf_point(duration_Surface ~ duration_Dive, data = wide_dolph_dives, color = ~dtype, alpha = 0.2) %>%
  gf_labs( x = 'Dive Duration',
           y = 'Surface Duration') %>%
   gf_theme(scale_color_discrete('Dive Type'))
```




```
gf_point(duration_Surface ~ duration_Dive | ~dtype, data = wide_dolph_dives, alpha = 0.2) %>%
  gf_labs( x = 'Dive Duration',
           y = 'Surface Duration')
```



Fitting the model and summary

```
dolphdive <- glmmTMB(duration_Surface ~ duration_Dive*dtype + depth_Dive + (1| Ptt), data = wide_dolph_
summary(dolphdive)
```

```
##  Family: Gamma  ( log )
## Formula:          duration_Surface ~ duration_Dive * dtype + depth_Dive + (1 |
##     Ptt)
## Data: wide_dolph_dives
##
##      AIC      BIC   logLik deviance df.resid
##  76513.3  76558.8 -38249.7  76499.3     4937
##
## Random effects:
##
## Conditional model:
##  Groups Name        Variance Std.Dev.
##  Ptt    (Intercept) 0.005595 0.0748
## Number of obs: 4944, groups:  Ptt, 4
##
## Dispersion estimate for Gamma family (sigma^2):  1.8
##
## Conditional model:
##                               Estimate Std. Error z value Pr(>|z|)
## (Intercept)                  5.1105441  0.1570253   32.55  < 2e-16 ***
## duration_Dive                0.0024914  0.0003612    6.90 5.28e-12 ***
## dtypeshallow                 2.0431838  0.1674598   12.20  < 2e-16 ***
## depth_Dive                   0.0012681  0.0002308    5.49 3.95e-08 ***
## duration_Dive:dtypeshallow -0.0039434  0.0004351   -9.06  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
confint(dolphdive)
```

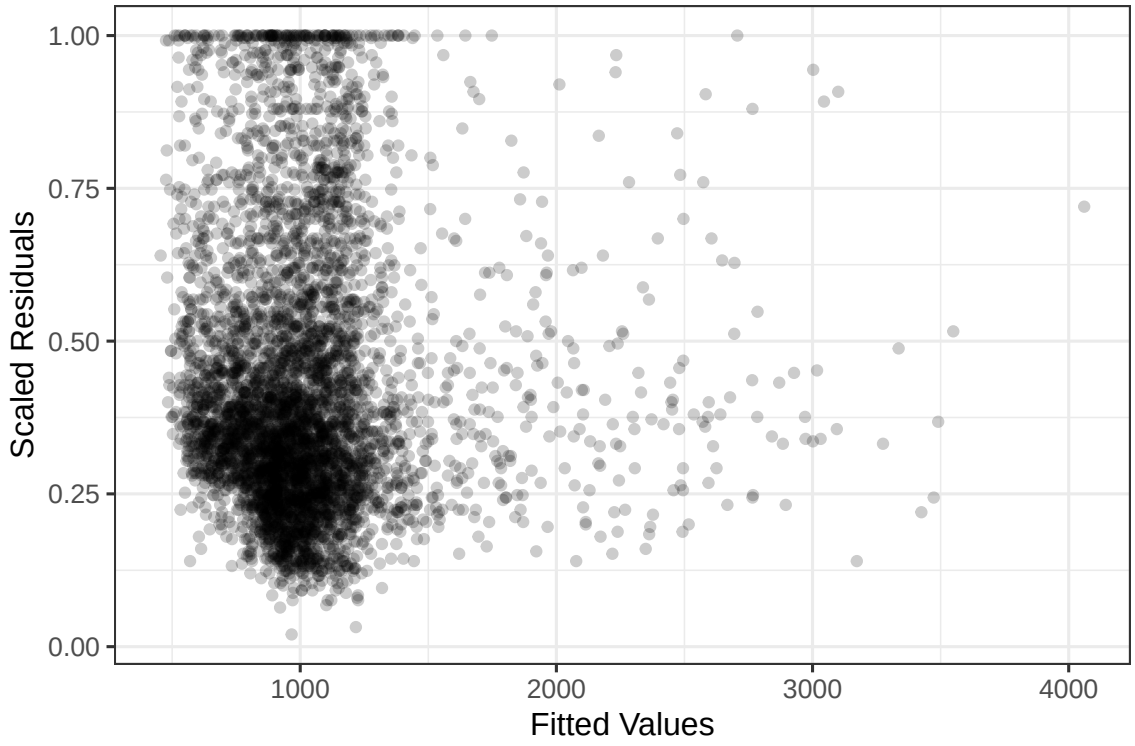
```
##                                          2.5 %       97.5 %     Estimate
## cond.(Intercept)                    4.8027802810  5.418308017  5.110544149
## cond.duration_Dive                  0.0017834867  0.003199291  0.002491389
## cond.dtypeshallow                   1.7149686419  2.371398974  2.043183808
## cond.depth_Dive                     0.0008156664  0.001720580  0.001268123
## cond.duration_Dive:dtypeshallow -0.0047960784 -0.003090695 -0.003943387
## Ptt.cond.Std.Dev.(Intercept)        0.0280095444  0.199748710  0.074798866
```

Creating predictors and Residuals

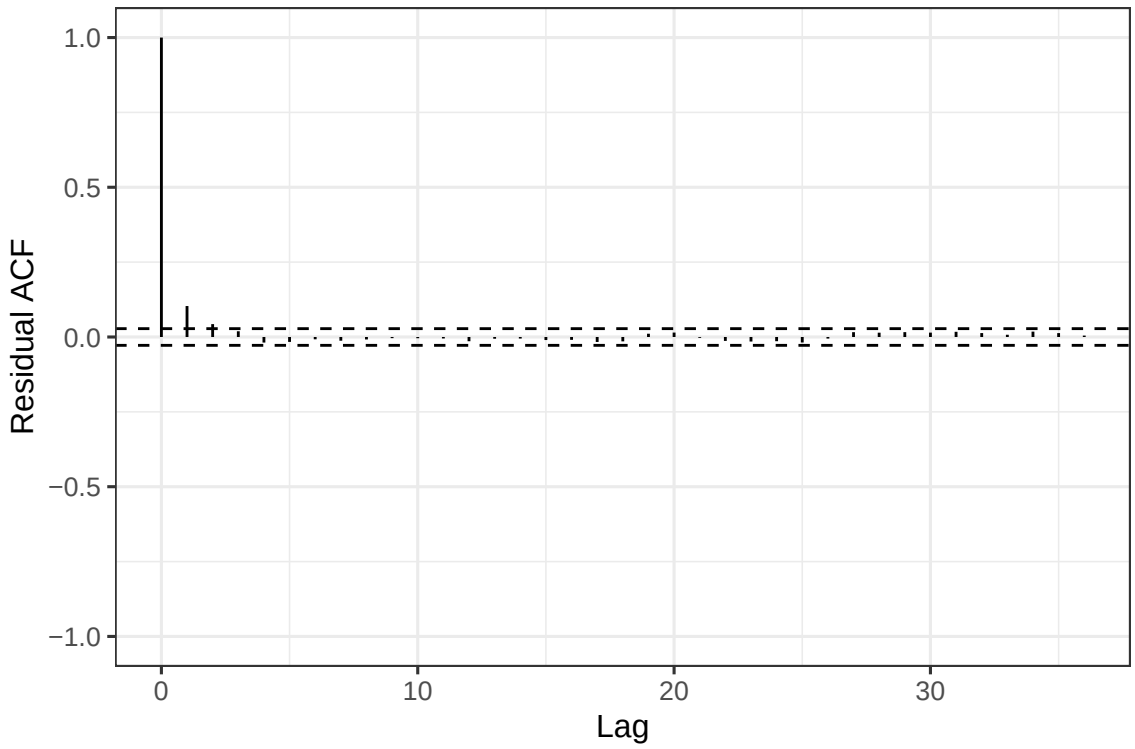
```
conditions <- wide_dolph_dives %>%
  mutate(preds = predict(dolphdive),
         resids = resid(dolphdive))
```

Model Assessment

```
dolphin_dur <- simulateResiduals(dolphdive)
gf_point(dolphin_dur$scaledResiduals ~ fitted(dolphdive),
 alpha = 0.2) %>%
 gf_labs(x = 'Fitted Values',
 y = 'Scaled Residuals')
```




```
s245::gf_acf(~dolphdive) %>%
  gf_lims(y = c(-1,1))
```



Predicted Values of Surface Duration

```
ggeffects::ggpredict(dolphdive)
```

```
## $duration_Dive
## # Predicted values of duration_Surface
##
## duration_Dive | Predicted |             95% CI
## ----------------------------------------------
##             0 |    231.12 | [ 165.50,  322.76]
##           100 |    296.51 | [ 226.88,  387.50]
##           200 |    380.39 | [ 310.09,  466.64]
##           300 |    488.01 | [ 420.87,  565.87]
##           500 |    803.22 | [ 719.00,  897.30]
##           600 |   1030.46 | [ 886.98, 1197.16]
##           700 |   1322.00 | [1075.15, 1625.53]
##           900 |   2175.86 | [1554.08, 3046.42]
##
## Adjusted for:
## *      dtype =   deep
## * depth_Dive = 262.11
## *        Ptt = NA (population-level)
##
## $dtype
## # Predicted values of duration_Surface
##
## dtype   | Predicted |            95% CI
## --------------------------------------
## shallow |   1018.05 | [889.78, 1164.80]
## deep    |    604.62 | [539.82,  677.20]
##
```

```
## Adjusted for:
## * duration_Dive = 386.00
## *    depth_Dive = 262.11
## *           Ptt = NA (population-level)
##
## $depth_Dive
## # Predicted values of duration_Surface
##
## depth_Dive | Predicted |             95% CI
## ----------------------------------------
##          0 |    433.64 | [ 362.98,  518.06]
##        100 |    492.27 | [ 425.64,  569.33]
##        300 |    634.39 | [ 567.38,  709.31]
##        400 |    720.16 | [ 639.10,  811.50]
##        500 |    817.53 | [ 709.34,  942.22]
##        600 |    928.06 | [ 780.16, 1104.00]
##        700 |   1053.54 | [ 853.74, 1300.08]
##       1000 |   1541.24 | [1104.50, 2150.69]
##
## Adjusted for:
## * duration_Dive = 386.00
## *         dtype =   deep
## *           Ptt = NA (population-level)
##
## attr(,"class")
## [1] "ggalleffects" "list"
## attr(,"model.name")
## [1] "dolphdive"
```

```
d2 <- wide_dolph_dives %>%
  select(duration_Dive, duration_Surface, dtype, depth_Dive) %>%
  na.omit() %>%
  mutate(preds = predict(dolphdive))
```

"{r} ggpredict(dolphdive, terms = c('duration_Dive', 'dtype [0]', 'depth_Dive [1]'), type = 'fixed') %>% plot() %>% gf_labs(y = 'Predicted Duration on Surface', x = 'Dive Duration')

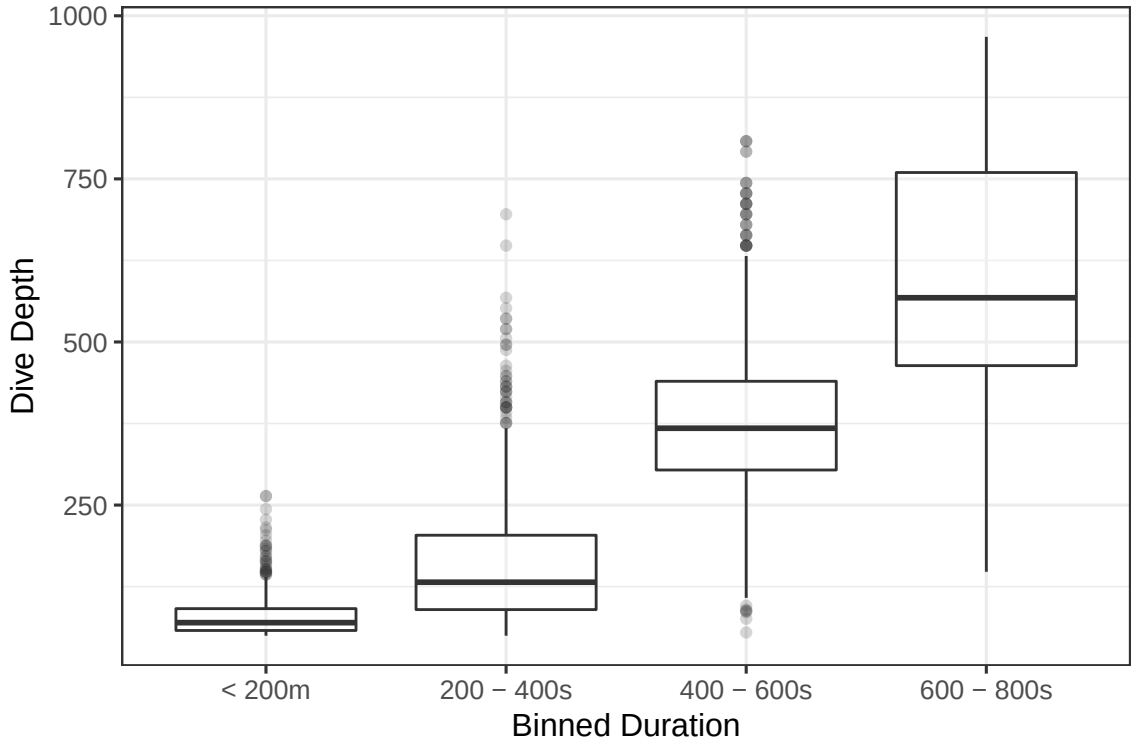
ALL OF THIS IS DOLPHIN 8:

```r
#gf_bar( ~ DepthMax, data = divedata)
```

```
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"))
```

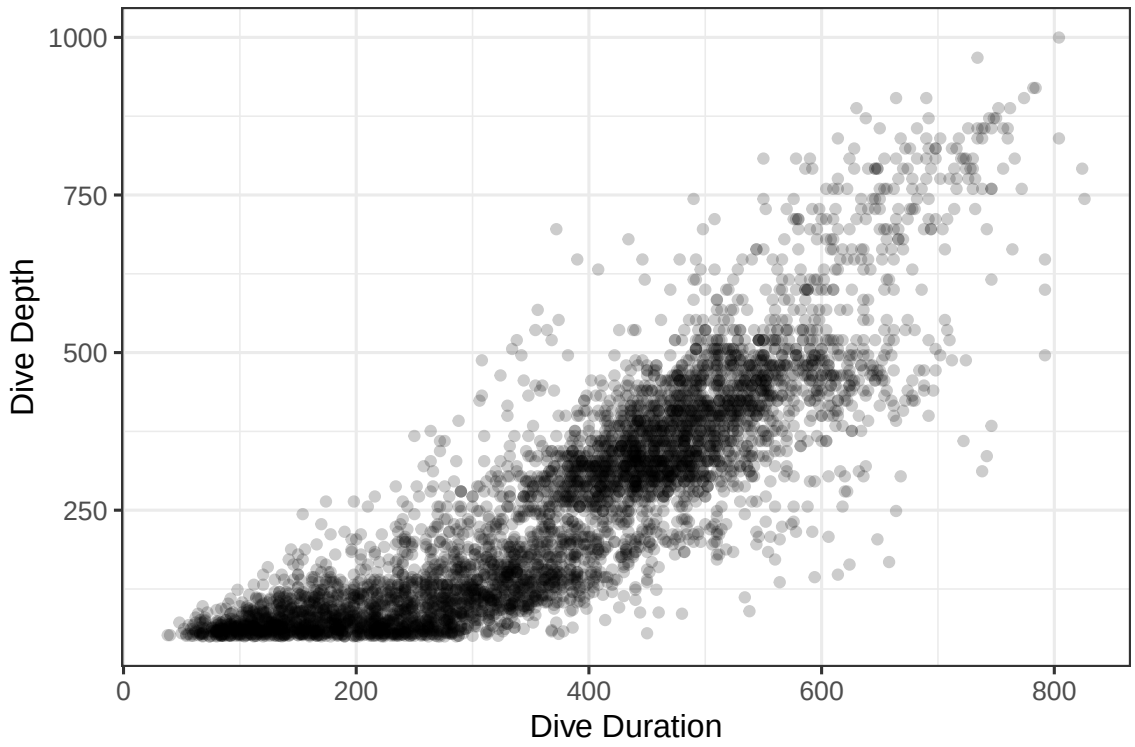
```
gf_boxplot(depth_Dive ~ binned_dur, alpha = 0.2, data = AllDolphinsBin %>%
             select(depth_Dive, binned_dur) %>%
             na.omit()) %>%
  gf_labs(x = 'Binned Duration', y = "Dive Depth")
```



Looking at the distribution of dive depths and duration

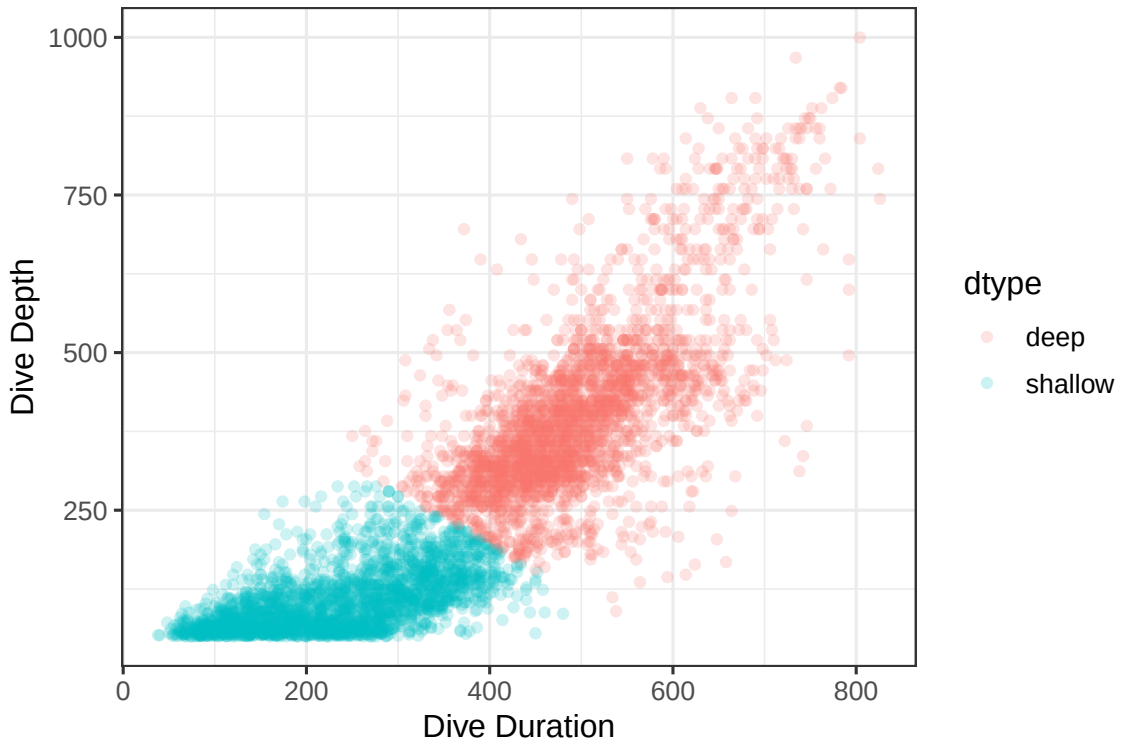
Initial look at depth and duration of a dive:

```
gf_point(depth_Dive ~ duration_Dive,
 data = wide_dolph_dives, alpha = 0.2)%>%
  gf_labs( x = 'Dive Duration',
           y = 'Dive Depth')
```



Depth and Duration of Dives with separation by new variable dtype

```
gf_point(depth_Dive ~ duration_Dive,
 data = wide_dolph_dives,
 color= ~dtype, alpha = 0.2) %>%
  gf_labs( x = 'Dive Duration',
           y = 'Dive Depth')
```




```
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]", "[~
```

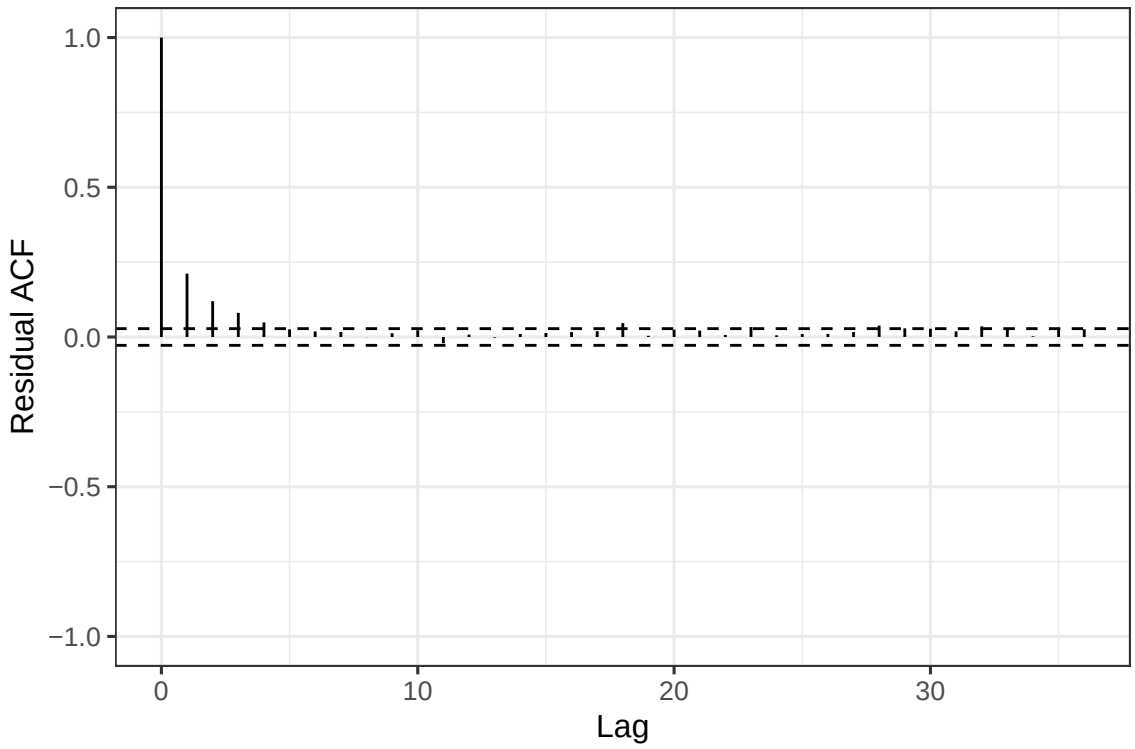
```
dolphin_bin <- glmmTMB(depth_Dive ~ duration_Dive*dtype + duration_Surface + (1|Ptt) + (1|time_block), d

summary(dolphin_bin)
```

```
##  Family: Gamma  ( log )
## Formula:          depth_Dive ~ duration_Dive * dtype + duration_Surface + (1 |
##     Ptt) + (1 | time_block)
## Data: wide_dolph_dives
##
##      AIC      BIC   logLik deviance df.resid
##  54347.3  54399.3 -27165.6  54331.3     4936
##
## Random effects:
##
## Conditional model:
##  Groups     Name        Variance Std.Dev.
##  Ptt        (Intercept) 0.001112 0.03335
##  time_block (Intercept) 0.009776 0.09888
## 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)                 4.788e+00  3.705e-02  129.23  < 2e-16 ***
## duration_Dive               2.369e-03  6.381e-05   37.13  < 2e-16 ***
## dtypeshallow               -8.529e-01  3.639e-02  -23.44  < 2e-16 ***
## duration_Surface            2.976e-06  1.225e-06    2.43   0.0151 *
## duration_Dive:dtypeshallow  5.607e-04  9.339e-05    6.00 1.93e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

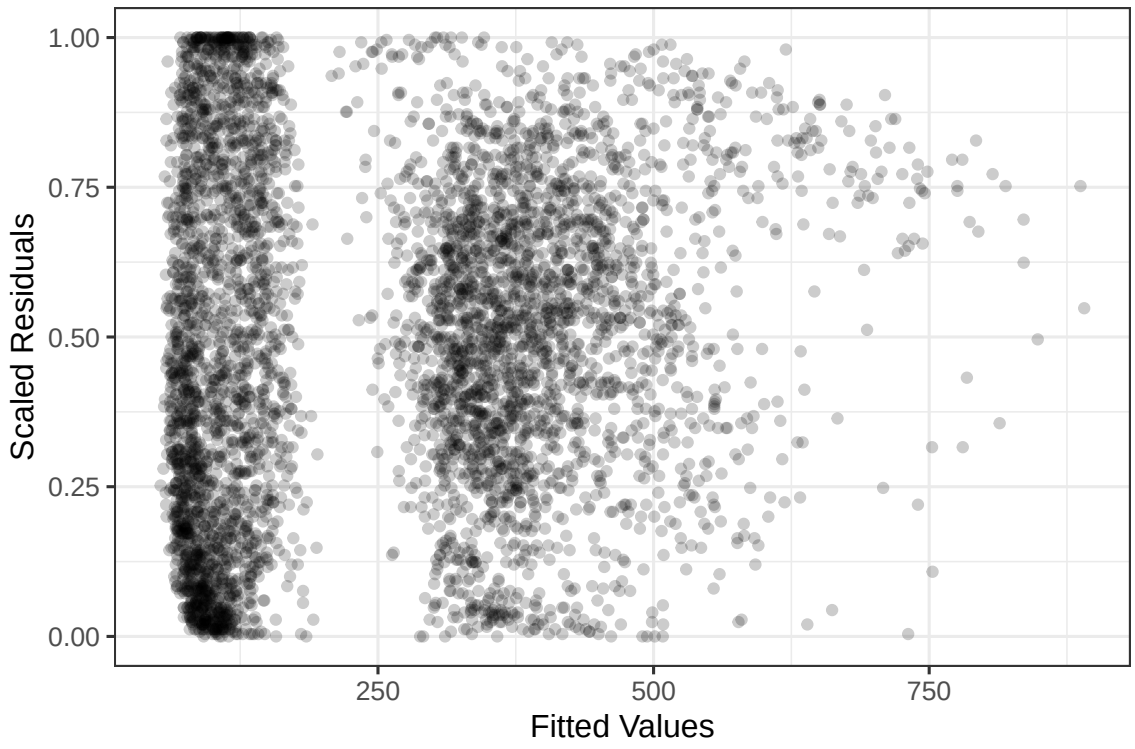
ACF graph for model

```
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')
```



Predicted Values of Dive Depth

```
ggeffects::ggpredict(dolphin_bin)
```

```
## $duration_Dive
## # Predicted values of depth_Dive
##
## duration_Dive | Predicted |            95% CI
## ---------------------------------------------
##             0 |    120.12 | [111.65,  129.24]
##           100 |    152.23 | [142.99,  162.08]
##           200 |    192.93 | [182.96,  203.44]
##           300 |    244.50 | [233.75,  255.75]
##           500 |    392.70 | [378.33,  407.62]
##           600 |    497.67 | [478.47,  517.65]
##           700 |    630.71 | [602.96,  659.75]
##           900 |   1013.00 | [951.45, 1078.52]
##
## Adjusted for:
## *            dtype =   deep
## * duration_Surface = 244.00
## *              Ptt = NA (population-level)
## *       time_block = NA (population-level)
##
## $dtype
## # Predicted values of depth_Dive
##
## dtype   | Predicted |           95% CI
## ------------------------------------
## shallow |    158.62 | [152.01, 165.51]
## deep    |    299.76 | [288.02, 311.97]
```

```
##
## Adjusted for:
## *    duration_Dive = 386.00
## * duration_Surface = 244.00
## *              Ptt = NA (population-level)
## *       time_block = NA (population-level)
##
## $duration_Surface
## # Predicted values of depth_Dive
##
## duration_Surface | Predicted |           95% CI
## ------------------------------------------------
##                0 |    299.54 | [287.81, 311.74]
##             6000 |    304.93 | [292.99, 317.36]
##            12000 |    310.43 | [298.27, 323.08]
##            18000 |    316.02 | [303.64, 328.90]
##            24000 |    321.71 | [309.11, 334.83]
##            30000 |    327.51 | [314.68, 340.86]
##            36000 |    333.41 | [320.34, 347.00]
##            48000 |    345.53 | [331.99, 359.62]
##
## Adjusted for:
## * duration_Dive = 386.00
## *         dtype =   deep
## *           Ptt = NA (population-level)
## *    time_block = NA (population-level)
##
## attr(,"class")
## [1] "ggalleffects" "list"
## attr(,"model.name")
## [1] "dolphin_bin"
```