GLMM and GLM Analysis

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knitr::opts\_chunk$set(echo = TRUE, message = FALSE)  
options(knitr.table.format = "html")

# Preparing files

## Libraries

library(BAT)  
library(readr)  
library(FD)   
library(car)  
library(MASS)  
library(lme4)  
library(here) # to locate files  
library(data.table) # to work with data  
library(dplyr) # to manage data  
library(magrittr) # to use the pipe operator %>%   
library(MuMIn)  
library(glmmTMB)  
library(bbmle)

## Calling results dataset

Results2 <- read.csv2(here("results","RESULTS.csv"), header=TRUE, row.names = 1, stringsAsFactors = T, sep = ",", dec = ".")  
str(Results2)

## 'data.frame': 21 obs. of 31 variables:  
## $ ForestID : Factor w/ 5 levels "Guilherme\_Moniz",..: 1 2 2 2 2 2 3 3 3 3 ...  
## $ Dist\_trail : int 0 0 0 0 50 235 0 0 0 50 ...  
## $ Dist\_edge : int 0 0 0 0 293 50 0 0 25 50 ...  
## $ Dist\_trail\_beginning : int 0 50 250 250 250 250 0 200 960 200 ...  
## $ Dist\_trail\_std : num 0 0 0 0 0.312 ...  
## $ Dist\_edge\_std : num 0 0 0 0 0.963 ...  
## $ Dist\_trail\_beginning\_std: num 0 0.0948 0.4741 0.4741 0.4741 ...  
## $ TAlphaAll : int 23 11 7 5 10 8 17 16 11 11 ...  
## $ TAlphaNat : int 12 8 7 5 8 8 10 11 10 9 ...  
## $ TAlphaNInd : int 11 3 0 0 2 0 7 5 1 2 ...  
## $ FAlphaAll : num 8.64 4.76 3.48 2.51 4.57 ...  
## $ FAlphaNat : num 2.73 2.03 1.87 1.51 2.02 ...  
## $ FAlphaNInd : num 1.84 1.09 0 0 1.04 ...  
## $ BetaAllTotalVector : num 0.0001 0.6429 0.3333 0.375 0.5 ...  
## $ BetaAllRichVector : num 0.0001 0.2143 0.1111 0.375 0.1667 ...  
## $ BetaAllReplVector : num 0.0001 0.4286 0.2222 0.0001 0.3333 ...  
## $ BetaFuncAllTotalVector : num 0.0001 0.4937 0.3104 0.4703 0.451 ...  
## $ BetaFuncAllRichVector : num 0.0001 0.2532 0.0247 0.1315 0.3152 ...  
## $ BetaFuncAllReplVector : num 0.0001 0.2405 0.2858 0.3388 0.1359 ...  
## $ BetaNatTotalVector : num 1e-04 1e+00 1e-04 1e-04 1e+00 ...  
## $ BetaNatRichVector : num 1e-04 1e+00 1e-04 1e-04 1e+00 ...  
## $ BetaNatReplVector : num 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.25 0.0001 0.5 0.5 ...  
## $ BetaFuncNatTotalVector : num 0.0001 0.5312 0.3708 0.5473 0.4373 ...  
## $ BetaFuncNatRichVector : num 0.0001 0.3065 0.0238 0.1248 0.3344 ...  
## $ BetaFuncNatReplVector : num 0.0001 0.2246 0.347 0.4225 0.1029 ...  
## $ BetaNIndTotalVector : num 1e-04 1e+00 1e-04 1e-04 1e+00 ...  
## $ BetaNIndRichVector : num 1e-04 1e+00 1e-04 1e-04 1e+00 ...  
## $ BetaNIndReplVector : num 0.0001 0.0001 0.0001 0.0001 0.0001 0.0001 0.25 0.0001 0.5 0.5 ...  
## $ BetaFuncNIndTotalVector : num 1e-04 1e+00 1e-04 1e-04 1e+00 ...  
## $ BetaFuncNIndRichVector : num 1e-04 1e+00 1e-04 1e-04 1e+00 ...  
## $ BetaFuncNIndReplVector : num 1e-04 1e-04 1e-04 1e-04 1e-04 ...

#Test results and analysis When model fits are ranked according to their AIC values, the model with the lowest AIC value being considered the ???best???. Models in which the difference in AIC relative to AICmin is < 2 will be considered also to have substantial support (Burnham, 2002; Burnham and Anderson, 1998). I will then assess the variables importance, by assessing their respective weights within each models fit. By these two criteria, I will then elavborate the discussion on what factors do accet the spiders community.

## Checking for colinearity

results.variables <- Results2[,5:7] # selecting the variables relevant to the test  
  
numeric.results.variables <- Results2[,5:7] # selecting the variables relevant to the test  
cor(numeric.results.variables) #isto ontem funcionava, nÃ£o sei o que se passa

## Dist\_trail\_std Dist\_edge\_std  
## Dist\_trail\_std 1.0000000 0.5038650  
## Dist\_edge\_std 0.5038650 1.0000000  
## Dist\_trail\_beginning\_std 0.7667594 0.3780011  
## Dist\_trail\_beginning\_std  
## Dist\_trail\_std 0.7667594  
## Dist\_edge\_std 0.3780011  
## Dist\_trail\_beginning\_std 1.0000000

# Alpha Taxonomic - All Species

gm1 <- glmmTMB(TAlphaAll ~ Dist\_edge\_std + Dist\_trail\_std + Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2 , family = poisson)  
options(na.action = "na.fail")  
dredge(gm1)

## Global model call: glmmTMB(formula = TAlphaAll ~ Dist\_edge\_std + Dist\_trail\_std +   
## Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2,   
## family = poisson, ziformula = ~0, dispformula = ~1)  
## ---  
## Model selection table   
## cnd((Int)) dsp((Int)) cnd(Dst\_edg\_std) cnd(Dst\_trl\_bgn\_std)  
## 1 2.481 +   
## 3 2.517 + -0.06859  
## 5 2.493 +   
## 2 2.508 + -0.058030   
## 7 2.520 + -0.08736  
## 4 2.515 + 0.007253 -0.07182  
## 6 2.502 + -0.030400   
## 8 2.523 + -0.011770 -0.08596  
## cnd(Dst\_trl\_std) df logLik AICc delta weight  
## 1 2 -54.915 114.5 0.00 0.469  
## 3 3 -54.610 116.6 2.14 0.161  
## 5 -0.03570 3 -54.797 117.0 2.51 0.134  
## 2 3 -54.804 117.0 2.52 0.133  
## 7 0.02084 4 -54.594 119.7 5.19 0.035  
## 4 4 -54.610 119.7 5.22 0.034  
## 6 -0.02216 4 -54.784 120.1 5.57 0.029  
## 8 0.02513 5 -54.593 123.2 8.69 0.006  
## Models ranked by AICc(x)   
## Random terms (all models):   
## 'cond(1 | ForestID)'

# Alpha Taxonomic - Native Species

gm2 <- glmmTMB(TAlphaNat ~ Dist\_edge\_std +Dist\_trail\_std + Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2 , family = poisson)  
dredge(gm2)

## Global model call: glmmTMB(formula = TAlphaNat ~ Dist\_edge\_std + Dist\_trail\_std +   
## Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2,   
## family = poisson, ziformula = ~0, dispformula = ~1)  
## ---  
## Model selection table   
## cnd((Int)) dsp((Int)) cnd(Dst\_edg\_std) cnd(Dst\_trl\_bgn\_std)  
## 1 2.203 +   
## 3 2.189 + 0.02293  
## 2 2.191 + 0.01826   
## 5 2.199 +   
## 4 2.185 + 0.01076 0.01894  
## 7 2.187 + 0.03437  
## 6 2.191 + 0.01632   
## 8 2.179 + 0.01686 0.03483  
## cnd(Dst\_trl\_std) df logLik AICc delta weight  
## 1 2 -45.956 96.6 0.00 0.512  
## 3 3 -45.924 99.3 2.68 0.134  
## 2 3 -45.937 99.3 2.71 0.132  
## 5 0.010220 3 -45.948 99.3 2.73 0.131  
## 4 4 -45.919 102.3 5.76 0.029  
## 7 -0.012870 4 -45.919 102.3 5.76 0.029  
## 6 0.003244 4 -45.936 102.4 5.80 0.028  
## 8 -0.020380 5 -45.907 105.8 9.24 0.005  
## Models ranked by AICc(x)   
## Random terms (all models):   
## 'cond(1 | ForestID)'

# Alpha Taxonomic - Nind species

gm3 <- glmmTMB(TAlphaNInd ~ Dist\_edge\_std + Dist\_trail\_std + Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2 , family = poisson)  
dredge(gm3)

## Global model call: glmmTMB(formula = TAlphaNInd ~ Dist\_edge\_std + Dist\_trail\_std +   
## Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2,   
## family = poisson, ziformula = ~0, dispformula = ~1)  
## ---  
## Model selection table   
## cnd((Int)) dsp((Int)) cnd(Dst\_edg\_std) cnd(Dst\_trl\_bgn\_std)  
## 1 0.8873 +   
## 3 1.0240 + -0.3052  
## 5 0.9374 +   
## 2 1.0070 + -0.26650   
## 4 0.9902 + 0.12500 -0.3560  
## 7 1.0280 + -0.3394  
## 6 0.9306 + 0.02091   
## 8 0.9868 + 0.13430 -0.3526  
## cnd(Dst\_trl\_std) df logLik AICc delta weight  
## 1 2 -40.953 86.6 0.00 0.318  
## 3 3 -39.775 87.0 0.39 0.261  
## 5 -0.187200 3 -40.362 88.1 1.56 0.145  
## 2 3 -40.547 88.5 1.93 0.121  
## 4 4 -39.741 90.0 3.41 0.058  
## 7 0.042300 4 -39.765 90.0 3.46 0.056  
## 6 -0.196900 4 -40.361 91.2 4.65 0.031  
## 8 -0.008777 5 -39.741 93.5 6.91 0.010  
## Models ranked by AICc(x)   
## Random terms (all models):   
## 'cond(1 | ForestID)'

# Alpha Functional - All Species

gm4 <- glmmTMB(FAlphaAll ~ Dist\_edge\_std + Dist\_trail\_std + Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2 , family = Gamma)  
dredge(gm4)

## Global model call: glmmTMB(formula = FAlphaAll ~ Dist\_edge\_std + Dist\_trail\_std +   
## Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2,   
## family = Gamma, ziformula = ~0, dispformula = ~1)  
## ---  
## Model selection table   
## cnd((Int)) dsp((Int)) cnd(Dst\_edg\_std) cnd(Dst\_trl\_bgn\_std)  
## 1 0.2074 +   
## 3 0.2002 + 0.01470  
## 5 0.2053 +   
## 2 0.2039 + 0.007620   
## 4 0.2045 + -0.017960 0.02264  
## 7 0.1993 + 0.02097  
## 6 0.2073 + -0.006271   
## 8 0.2041 + -0.016910 0.02303  
## cnd(Dst\_trl\_std) df logLik AICc delta weight  
## 1 3 -31.476 70.4 0.00 0.453  
## 3 4 -30.711 71.9 1.56 0.208  
## 5 0.0067250 4 -31.253 73.0 2.64 0.121  
## 2 4 -31.381 73.3 2.90 0.106  
## 4 5 -30.485 75.0 4.61 0.045  
## 7 -0.0070860 5 -30.610 75.2 4.86 0.040  
## 6 0.0095620 5 -31.233 76.5 6.10 0.021  
## 8 -0.0009545 6 -30.484 79.0 8.60 0.006  
## Models ranked by AICc(x)   
## Random terms (all models):   
## 'cond(1 | ForestID)'

# Alpha Functional - Native Species

gm5 <- glmmTMB(FAlphaNat ~ Dist\_edge\_std + Dist\_trail\_std + Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2 , family = Gamma)  
dredge(gm5)

## Global model call: glmmTMB(formula = FAlphaNat ~ Dist\_edge\_std + Dist\_trail\_std +   
## Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2,   
## family = Gamma, ziformula = ~0, dispformula = ~1)  
## ---  
## Model selection table   
## cnd((Int)) dsp((Int)) cnd(Dst\_edg\_std) cnd(Dst\_trl\_bgn\_std)  
## 1 0.4686 +   
## 3 0.4632 + 0.009359  
## 2 0.4707 + -0.004285   
## 5 0.4680 +   
## 4 0.4684 + -0.025890 0.021420  
## 7 0.4614 + 0.019420  
## 6 0.4727 + -0.014770   
## 8 0.4675 + -0.023440 0.022710  
## cnd(Dst\_trl\_std) df logLik AICc delta weight  
## 1 3 -0.934 9.3 0.00 0.535  
## 3 4 -0.728 12.0 2.68 0.140  
## 2 4 -0.911 12.3 3.04 0.117  
## 5 0.001529 4 -0.926 12.4 3.07 0.115  
## 4 5 -0.323 14.6 5.37 0.037  
## 7 -0.010890 5 -0.557 15.1 5.83 0.029  
## 6 0.008125 5 -0.814 15.6 6.35 0.022  
## 8 -0.002625 6 -0.316 18.6 9.35 0.005  
## Models ranked by AICc(x)   
## Random terms (all models):   
## 'cond(1 | ForestID)'

# FAILED Alpha Functional - N/Ind Species

{r, warning=FALSE} gm6 <- glmmTMB(FAlphaNInd ~ Dist\_edge\_std + Dist\_trail\_std + Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2 , family = Gamma) dredge(gm6) FAILED - Error in eval(family$initialize, rho) : non-positive values not allowed for the ‘gamma’ family

# Beta Taxonomic - All Species

gm7 <- glmmTMB(BetaAllTotalVector ~ Dist\_edge\_std + Dist\_trail\_std + Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2 , family = beta\_family)  
dredge(gm7)

## Global model call: glmmTMB(formula = BetaAllTotalVector ~ Dist\_edge\_std + Dist\_trail\_std +   
## Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2,   
## family = beta\_family, ziformula = ~0, dispformula = ~1)  
## ---  
## Model selection table   
## cnd((Int)) dsp((Int)) cnd(Dst\_edg\_std) cnd(Dst\_trl\_bgn\_std)  
## 5 -0.8334 +   
## 6 -1.2500 + 1.13200   
## 7 -0.9170 + 0.2623  
## 8 -1.2770 + 1.08800 0.1329  
## 1 -0.9398 +   
## 3 -0.6597 + -0.4729  
## 2 -0.8049 + -0.22160   
## 4 -0.6868 + 0.07433 -0.5085  
## cnd(Dst\_trl\_std) df logLik AICc delta weight  
## 5 -1.255 4 20.944 -31.4 0.00 0.442  
## 6 -1.704 5 22.585 -31.2 0.22 0.396  
## 7 -1.325 5 21.071 -28.1 3.25 0.087  
## 8 -1.732 6 22.618 -27.2 4.15 0.055  
## 1 3 15.419 -23.4 7.96 0.008  
## 3 4 16.783 -23.1 8.32 0.007  
## 2 4 15.671 -20.8 10.55 0.002  
## 4 5 16.805 -19.6 11.78 0.001  
## Models ranked by AICc(x)   
## Random terms (all models):   
## 'cond(1 | ForestID)'

## 

gm7.5 <- glmmTMB(BetaAllTotalVector ~ Dist\_trail\_std + (1 | ForestID), data = Results2 , family = beta\_family)  
summary(gm7.5)

## Family: beta ( logit )  
## Formula: BetaAllTotalVector ~ Dist\_trail\_std + (1 | ForestID)  
## Data: Results2  
##   
## AIC BIC logLik deviance df.resid   
## -33.9 -29.7 20.9 -41.9 17   
##   
## Random effects:  
##   
## Conditional model:  
## Groups Name Variance Std.Dev.  
## ForestID (Intercept) 0.8608 0.9278   
## Number of obs: 21, groups: ForestID, 5  
##   
## Overdispersion parameter for beta family (): 3   
##   
## Conditional model:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -0.8334 0.4983 -1.673 0.09443 .   
## Dist\_trail\_std -1.2546 0.4024 -3.118 0.00182 \*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

## 

gm7.6 <- glmmTMB(BetaAllTotalVector ~ Dist\_edge\_std + (1 | ForestID), data = Results2 , family = beta\_family)  
summary(gm7.6)

## Family: beta ( logit )  
## Formula: BetaAllTotalVector ~ Dist\_edge\_std + (1 | ForestID)  
## Data: Results2  
##   
## AIC BIC logLik deviance df.resid   
## -23.3 -19.2 15.7 -31.3 17   
##   
## Random effects:  
##   
## Conditional model:  
## Groups Name Variance Std.Dev.   
## ForestID (Intercept) 4.05e-10 2.013e-05  
## Number of obs: 21, groups: ForestID, 5  
##   
## Overdispersion parameter for beta family (): 1.27   
##   
## Conditional model:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -0.8049 0.3528 -2.282 0.0225 \*  
## Dist\_edge\_std -0.2216 0.3125 -0.709 0.4783   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

## 

gm7.7 <- glmmTMB(BetaAllTotalVector ~ Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2 , family = beta\_family)  
summary(gm7.7)

## Family: beta ( logit )  
## Formula:   
## BetaAllTotalVector ~ Dist\_trail\_beginning\_std + (1 | ForestID)  
## Data: Results2  
##   
## AIC BIC logLik deviance df.resid   
## -25.6 -21.4 16.8 -33.6 17   
##   
## Random effects:  
##   
## Conditional model:  
## Groups Name Variance Std.Dev.   
## ForestID (Intercept) 1.243e-09 3.526e-05  
## Number of obs: 21, groups: ForestID, 5  
##   
## Overdispersion parameter for beta family (): 1.39   
##   
## Conditional model:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -0.6597 0.3378 -1.953 0.0508 .  
## Dist\_trail\_beginning\_std -0.4729 0.3143 -1.505 0.1324   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

# Beta Taxonomic - Nat Species

gm8 <- glmmTMB(BetaNatTotalVector ~ Dist\_edge\_std + Dist\_trail\_std + Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2 , family = beta\_family)  
dredge(gm8)

## Global model call: glmmTMB(formula = BetaNatTotalVector ~ Dist\_edge\_std + Dist\_trail\_std +   
## Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2,   
## family = beta\_family, ziformula = ~0, dispformula = ~1)  
## ---  
## Model selection table   
## cnd((Int)) dsp((Int)) cnd(Dst\_edg\_std) cnd(Dst\_trl\_bgn\_std)  
## 6 -0.03587 + 0.9071   
## 1 0.14330 +   
## 5 0.38820 +   
## 2 -0.05676 + 0.3343   
## 3 0.30980 + -0.2725  
## 8 -0.24970 + 0.9554 0.5862  
## 7 0.24040 + 0.4746  
## 4 0.09743 + 0.5312 -0.4927  
## cnd(Dst\_trl\_std) df logLik AICc delta weight  
## 6 -0.9786 5 81.695 -149.4 0.00 0.278  
## 1 3 78.261 -149.1 0.28 0.242  
## 5 -0.5428 4 79.614 -148.7 0.66 0.200  
## 2 4 78.588 -146.7 2.72 0.072  
## 3 4 78.530 -146.6 2.83 0.068  
## 8 -1.4030 6 82.261 -146.5 2.87 0.066  
## 7 -0.8633 5 79.982 -146.0 3.43 0.050  
## 4 5 79.252 -144.5 4.89 0.024  
## Models ranked by AICc(x)   
## Random terms (all models):   
## 'cond(1 | ForestID)'

## Testing specific models

gm8.6 <- glmmTMB(BetaNatTotalVector ~ Dist\_edge\_std + Dist\_trail\_std + (1 | ForestID), data = Results2 , family = beta\_family)  
summary(gm8.6)

## Family: beta ( logit )  
## Formula:   
## BetaNatTotalVector ~ Dist\_edge\_std + Dist\_trail\_std + (1 | ForestID)  
## Data: Results2  
##   
## AIC BIC logLik deviance df.resid   
## -153.4 -148.2 81.7 -163.4 16   
##   
## Random effects:  
##   
## Conditional model:  
## Groups Name Variance Std.Dev.   
## ForestID (Intercept) 1.876e-09 4.331e-05  
## Number of obs: 21, groups: ForestID, 5  
##   
## Overdispersion parameter for beta family (): 0.396   
##   
## Conditional model:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -0.03587 0.38041 -0.094 0.9249   
## Dist\_edge\_std 0.90713 0.44137 2.055 0.0399 \*  
## Dist\_trail\_std -0.97860 0.40175 -2.436 0.0149 \*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

gm8.7 <- glmmTMB(BetaNatTotalVector ~ Dist\_trail\_std + (1 | ForestID), data = Results2 , family = beta\_family)  
summary(gm8.7)

## Family: beta ( logit )  
## Formula: BetaNatTotalVector ~ Dist\_trail\_std + (1 | ForestID)  
## Data: Results2  
##   
## AIC BIC logLik deviance df.resid   
## -151.2 -147.1 79.6 -159.2 17   
##   
## Random effects:  
##   
## Conditional model:  
## Groups Name Variance Std.Dev.   
## ForestID (Intercept) 7.475e-09 8.646e-05  
## Number of obs: 21, groups: ForestID, 5  
##   
## Overdispersion parameter for beta family (): 0.327   
##   
## Conditional model:  
## Estimate Std. Error z value Pr(>|z|)  
## (Intercept) 0.3882 0.3348 1.160 0.246  
## Dist\_trail\_std -0.5428 0.3386 -1.603 0.109

# Beta Taxonomic - NInd Species

gm9 <- glmmTMB(BetaNIndTotalVector ~ Dist\_edge\_std + Dist\_trail\_std + Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2 , family = beta\_family)  
dredge(gm9)

## Global model call: glmmTMB(formula = BetaNIndTotalVector ~ Dist\_edge\_std + Dist\_trail\_std +   
## Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2,   
## family = beta\_family, ziformula = ~0, dispformula = ~1)  
## ---  
## Model selection table   
## cnd((Int)) dsp((Int)) cnd(Dst\_edg\_std) cnd(Dst\_trl\_bgn\_std)  
## 6 -0.03587 + 0.9071   
## 1 0.14330 +   
## 5 0.38820 +   
## 2 -0.05676 + 0.3343   
## 3 0.30980 + -0.2725  
## 8 -0.24970 + 0.9554 0.5862  
## 7 0.24040 + 0.4746  
## 4 0.09743 + 0.5312 -0.4927  
## cnd(Dst\_trl\_std) df logLik AICc delta weight  
## 6 -0.9786 5 81.695 -149.4 0.00 0.278  
## 1 3 78.261 -149.1 0.28 0.242  
## 5 -0.5428 4 79.614 -148.7 0.66 0.200  
## 2 4 78.588 -146.7 2.72 0.072  
## 3 4 78.530 -146.6 2.83 0.068  
## 8 -1.4030 6 82.261 -146.5 2.87 0.066  
## 7 -0.8633 5 79.982 -146.0 3.43 0.050  
## 4 5 79.252 -144.5 4.89 0.024  
## Models ranked by AICc(x)   
## Random terms (all models):   
## 'cond(1 | ForestID)'

gm9.5 <- glmmTMB(BetaNIndTotalVector ~ Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2 , family = beta\_family)  
summary(gm9.5)

## Family: beta ( logit )  
## Formula:   
## BetaNIndTotalVector ~ Dist\_trail\_beginning\_std + (1 | ForestID)  
## Data: Results2  
##   
## AIC BIC logLik deviance df.resid   
## -149.1 -144.9 78.5 -157.1 17   
##   
## Random effects:  
##   
## Conditional model:  
## Groups Name Variance Std.Dev.   
## ForestID (Intercept) 5.135e-09 7.166e-05  
## Number of obs: 21, groups: ForestID, 5  
##   
## Overdispersion parameter for beta family (): 0.295   
##   
## Conditional model:  
## Estimate Std. Error z value Pr(>|z|)  
## (Intercept) 0.3098 0.3787 0.818 0.413  
## Dist\_trail\_beginning\_std -0.2725 0.3633 -0.750 0.453

# Beta Functional - All

gm10 <- glmmTMB(BetaFuncAllTotalVector ~ Dist\_edge\_std +Dist\_trail\_std + Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2 , family = beta\_family)  
dredge(gm10)

## Global model call: glmmTMB(formula = BetaFuncAllTotalVector ~ Dist\_edge\_std + Dist\_trail\_std +   
## Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2,   
## family = beta\_family, ziformula = ~0, dispformula = ~1)  
## ---  
## Model selection table   
## cnd((Int)) dsp((Int)) cnd(Dst\_edg\_std) cnd(Dst\_trl\_bgn\_std)  
## 5 -0.8169 +   
## 6 -1.2040 + 1.0580   
## 7 -0.9079 + 0.3016  
## 8 -1.2490 + 0.9810 0.2440  
## 1 -0.9474 +   
## 3 -0.6636 + -0.4804  
## 2 -0.8303 + -0.1924   
## 4 -0.7083 + 0.1222 -0.5392  
## cnd(Dst\_trl\_std) df logLik AICc delta weight  
## 5 -1.169 4 20.725 -30.9 0.00 0.416  
## 6 -1.596 5 22.457 -30.9 0.03 0.409  
## 7 -1.247 5 20.887 -27.8 3.18 0.085  
## 8 -1.634 6 22.555 -27.1 3.84 0.061  
## 1 3 15.685 -24.0 6.99 0.013  
## 3 4 17.081 -23.7 7.29 0.011  
## 2 4 15.874 -21.2 9.70 0.003  
## 4 5 17.139 -20.3 10.67 0.002  
## Models ranked by AICc(x)   
## Random terms (all models):   
## 'cond(1 | ForestID)'

## Exploring best ranked models

gm10.5 <- glmmTMB(BetaFuncAllTotalVector ~ Dist\_trail\_std + (1 | ForestID), data = Results2 , family = beta\_family)  
summary(gm10.5)

## Family: beta ( logit )  
## Formula: BetaFuncAllTotalVector ~ Dist\_trail\_std + (1 | ForestID)  
## Data: Results2  
##   
## AIC BIC logLik deviance df.resid   
## -33.4 -29.3 20.7 -41.4 17   
##   
## Random effects:  
##   
## Conditional model:  
## Groups Name Variance Std.Dev.  
## ForestID (Intercept) 0.6208 0.7879   
## Number of obs: 21, groups: ForestID, 5  
##   
## Overdispersion parameter for beta family (): 2.66   
##   
## Conditional model:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -0.8169 0.4538 -1.800 0.07186 .   
## Dist\_trail\_std -1.1691 0.4214 -2.775 0.00553 \*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

gm10.6 <- glmmTMB(BetaFuncAllTotalVector ~ Dist\_edge\_std +Dist\_trail\_std + (1 | ForestID), data = Results2 , family = beta\_family)  
summary(gm10.6)

## Family: beta ( logit )  
## Formula:   
## BetaFuncAllTotalVector ~ Dist\_edge\_std + Dist\_trail\_std + (1 |   
## ForestID)  
## Data: Results2  
##   
## AIC BIC logLik deviance df.resid   
## -34.9 -29.7 22.5 -44.9 16   
##   
## Random effects:  
##   
## Conditional model:  
## Groups Name Variance Std.Dev.  
## ForestID (Intercept) 0.5002 0.7072   
## Number of obs: 21, groups: ForestID, 5  
##   
## Overdispersion parameter for beta family (): 3.03   
##   
## Conditional model:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -1.2038 0.4923 -2.445 0.01448 \*   
## Dist\_edge\_std 1.0580 0.6150 1.720 0.08536 .   
## Dist\_trail\_std -1.5955 0.4718 -3.382 0.00072 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

# Beta Functional - Nat

gm11 <- glmmTMB(BetaFuncNatTotalVector ~ Dist\_edge\_std + Dist\_trail\_std + Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2 , family = beta\_family)  
dredge(gm11)

## Global model call: glmmTMB(formula = BetaFuncNatTotalVector ~ Dist\_edge\_std + Dist\_trail\_std +   
## Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2,   
## family = beta\_family, ziformula = ~0, dispformula = ~1)  
## ---  
## Model selection table   
## cnd((Int)) dsp((Int)) cnd(Dst\_edg\_std) cnd(Dst\_trl\_bgn\_std)  
## 5 -0.7555 +   
## 6 -1.1000 + 0.94760   
## 7 -0.7907 + 0.1323  
## 8 -1.1050 + 0.93430 0.0367  
## 1 -0.9078 +   
## 3 -0.6049 + -0.5114  
## 2 -0.7745 + -0.21890   
## 4 -0.6392 + 0.09243 -0.5541  
## cnd(Dst\_trl\_std) df logLik AICc delta weight  
## 5 -1.145 4 20.221 -29.9 0.00 0.479  
## 6 -1.523 5 21.649 -29.3 0.64 0.347  
## 7 -1.168 5 20.248 -26.5 3.45 0.086  
## 8 -1.526 6 21.651 -25.3 4.64 0.047  
## 1 3 15.313 -23.2 6.73 0.017  
## 3 4 16.857 -23.2 6.73 0.017  
## 2 4 15.554 -20.6 9.33 0.005  
## 4 5 16.890 -19.8 10.16 0.003  
## Models ranked by AICc(x)   
## Random terms (all models):   
## 'cond(1 | ForestID)'

## Exploring best ranked models

gm11.5 <- glmmTMB(BetaFuncNatTotalVector ~ Dist\_trail\_std + (1 | ForestID), data = Results2 , family = beta\_family)  
summary(gm11.5)

## Family: beta ( logit )  
## Formula: BetaFuncNatTotalVector ~ Dist\_trail\_std + (1 | ForestID)  
## Data: Results2  
##   
## AIC BIC logLik deviance df.resid   
## -32.4 -28.3 20.2 -40.4 17   
##   
## Random effects:  
##   
## Conditional model:  
## Groups Name Variance Std.Dev.  
## ForestID (Intercept) 0.5708 0.7555   
## Number of obs: 21, groups: ForestID, 5  
##   
## Overdispersion parameter for beta family (): 2.48   
##   
## Conditional model:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -0.7555 0.4443 -1.701 0.08903 .   
## Dist\_trail\_std -1.1455 0.4259 -2.690 0.00715 \*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

gm11.6 <- glmmTMB(BetaFuncNatTotalVector ~ Dist\_edge\_std + Dist\_trail\_std + (1 | ForestID), data = Results2 , family = beta\_family)  
summary(gm11.6)

## Family: beta ( logit )  
## Formula:   
## BetaFuncNatTotalVector ~ Dist\_edge\_std + Dist\_trail\_std + (1 |   
## ForestID)  
## Data: Results2  
##   
## AIC BIC logLik deviance df.resid   
## -33.3 -28.1 21.6 -43.3 16   
##   
## Random effects:  
##   
## Conditional model:  
## Groups Name Variance Std.Dev.  
## ForestID (Intercept) 0.4731 0.6878   
## Number of obs: 21, groups: ForestID, 5  
##   
## Overdispersion parameter for beta family (): 2.74   
##   
## Conditional model:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -1.0996 0.4853 -2.266 0.02345 \*   
## Dist\_edge\_std 0.9476 0.6052 1.566 0.11739   
## Dist\_trail\_std -1.5235 0.4747 -3.209 0.00133 \*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

# Beta Functional - NInd

gm12 <- glmmTMB(BetaFuncNIndTotalVector ~ Dist\_edge\_std + Dist\_trail\_std + Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2 , family = beta\_family)  
dredge(gm12)

## Global model call: glmmTMB(formula = BetaFuncNIndTotalVector ~ Dist\_edge\_std + Dist\_trail\_std +   
## Dist\_trail\_beginning\_std + (1 | ForestID), data = Results2,   
## family = beta\_family, ziformula = ~0, dispformula = ~1)  
## ---  
## Model selection table   
## cnd((Int)) dsp((Int)) cnd(Dst\_edg\_std) cnd(Dst\_trl\_bgn\_std)  
## 6 -0.224400 + 1.1160   
## 1 0.071840 +   
## 5 0.310600 +   
## 8 -0.365200 + 1.1390 0.3851  
## 2 -0.200700 + 0.4577   
## 3 0.286000 + -0.3483  
## 4 -0.007551 + 0.7583 -0.6790  
## 7 0.218400 + 0.2931  
## cnd(Dst\_trl\_std) df logLik AICc delta weight  
## 6 -1.0830 5 73.187 -132.4 0.00 0.462  
## 1 3 68.811 -130.2 2.16 0.157  
## 5 -0.5319 4 70.150 -129.8 2.57 0.127  
## 8 -1.3520 6 73.417 -128.8 3.54 0.079  
## 2 4 69.406 -128.3 4.06 0.061  
## 3 4 69.265 -128.0 4.34 0.053  
## 4 5 70.668 -127.3 5.04 0.037  
## 7 -0.7285 5 70.282 -126.6 5.81 0.025  
## Models ranked by AICc(x)   
## Random terms (all models):   
## 'cond(1 | ForestID)'

## Exploring best ranked models

gm12.6 <- glmmTMB(BetaFuncNIndTotalVector ~ Dist\_edge\_std + Dist\_trail\_std + (1 | ForestID), data = Results2 , family = beta\_family)  
summary(gm12.6)

## Family: beta ( logit )  
## Formula:   
## BetaFuncNIndTotalVector ~ Dist\_edge\_std + Dist\_trail\_std + (1 |   
## ForestID)  
## Data: Results2  
##   
## AIC BIC logLik deviance df.resid   
## -136.4 -131.2 73.2 -146.4 16   
##   
## Random effects:  
##   
## Conditional model:  
## Groups Name Variance Std.Dev.   
## ForestID (Intercept) 1.254e-09 3.541e-05  
## Number of obs: 21, groups: ForestID, 5  
##   
## Overdispersion parameter for beta family (): 0.468   
##   
## Conditional model:  
## Estimate Std. Error z value Pr(>|z|)   
## (Intercept) -0.2244 0.3775 -0.594 0.55231   
## Dist\_edge\_std 1.1157 0.4471 2.496 0.01258 \*   
## Dist\_trail\_std -1.0829 0.4067 -2.663 0.00775 \*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1