

## Lab 4 R Source Code

### Code:

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1 #
2 # Shawn Schwartz, 2019
3 # EEB C174 UCLA Spring 2019
4 # Lab 4 HW – Evolution of Carnivoran Dentition and Body Size
5 #
6
7 #clean up workspace
8 rm(list=ls())
9
10 #includes
11 library(phytools)
12 library(geiger)
13 library(phyloilm)
14
15 cwd <- "~/Developer/EEB-C174-Labs/Lab4"
16 resources_path <- "resources/"
17 output_path <- "output/"
18
19 setwd(cwd)
20
21 ##### Read in Tree and Trait Data #####
22 carnivoran_tree <- read.tree(paste0(resources_path, "carnivoran_
    tree.tree"))
23 carnivoran_trait <- read.csv(paste0(resources_path, "carnivoran_
    trait.csv"), header = TRUE, sep = ",")
24 carnivoran_SE <- read.csv(paste0(resources_path, "carnivoran_SE.csv
    "), header = TRUE, sep = ",")
25
26 pdf(paste0(output_path, "1_carnivoran_trait.pdf"))
27 plot(carnivoran_tree, cex = 0.25)
28   axisPhylo()
29   add.scale.bar()
30 dev.off()
31
32 ##### Fit Models #####
33 #c1: fit models to cross sectional shape of the upper canine
34 C1_data <- carnivoran_trait$C1
35 names(C1_data) <- carnivoran_trait$Taxa
```

```
36 C1_SE <- carnivoran_SE$C1
37 names(C1_SE) <- carnivoran_SE$Taxa
38
39 carniv_fit_c1.bm <- fitContinuous(phy = carnivoran_tree, dat = C1_
  data, SE = C1_SE, model = c("BM"))
40 carniv_fit_c1.ou <- fitContinuous(phy = carnivoran_tree, dat = C1_
  data, SE = C1_SE, model = c("OU"))
41 carniv_fit_c1.eb <- fitContinuous(phy = carnivoran_tree, dat = C1_
  data, SE = C1_SE, model = c("EB"))
42 carniv_fit_c1.white <- fitContinuous(phy = carnivoran_tree, dat =
  C1_data, SE = C1_SE, model = c("white"))
43
44 #RLGA: fit models to the relative upper grinding area
45 RLGA_data <- carnivoran_trait$RLGA
46 names(RLGA_data) <- carnivoran_trait$Taxa
47 RLGA_SE <- carnivoran_SE$RLGA
48 names(RLGA_SE) <- carnivoran_SE$Taxa
49
50 carniv_fit_RLGA.bm <- fitContinuous(phy = carnivoran_tree, dat =
  RLGA_data, SE = RLGA_SE, model = c("BM"))
51 carniv_fit_RLGA.ou <- fitContinuous(phy = carnivoran_tree, dat =
  RLGA_data, SE = RLGA_SE, model = c("OU"))
52 carniv_fit_RLGA.eb <- fitContinuous(phy = carnivoran_tree, dat =
  RLGA_data, SE = RLGA_SE, model = c("EB"))
53 carniv_fit_RLGA.white <- fitContinuous(phy = carnivoran_tree, dat
  = RLGA_data, SE = RLGA_SE, model = c("white"))
54
55 #ln-cbrt-bodymass: fit models to the log cuberoot of body mass
56 lncbrt_bodymass_data <- carnivoran_trait$log_cuberoot_mass
57 names(lncbrt_bodymass_data) <- carnivoran_trait$Taxa
58 lncbrt_bodymass_SE <- carnivoran_SE$logMass
59 names(lncbrt_bodymass_SE) <- carnivoran_SE$Taxa
60
61 carniv_fit_lncbrt_bodymass.bm <- fitContinuous(phy = carnivoran_
  tree, dat = lncbrt_bodymass_data, SE = lncbrt_bodymass_SE, model
  = c("BM"))
62 carniv_fit_lncbrt_bodymass.ou <- fitContinuous(phy = carnivoran_
  tree, dat = lncbrt_bodymass_data, SE = lncbrt_bodymass_SE, model
  = c("OU"))
63 carniv_fit_lncbrt_bodymass.eb <- fitContinuous(phy = carnivoran_
  tree, dat = lncbrt_bodymass_data, SE = lncbrt_bodymass_SE, model
  = c("EB"))
```

```
64 carniv_fit_lncbrt_bodymass.white <- fitContinuous(phy = carnivoran
   _tree, dat = lncbrt_bodymass_data, SE = lncbrt_bodymass_SE,
   model = c("white"))
65
66 ##### Compare Results Using AIC #####
67 c1.data <- c(carniv_fit_c1.bm$opt$aic, carniv_fit_c1.ou$opt$aic,
   carniv_fit_c1.eb$opt$aic, carniv_fit_c1.white$opt$aic)
68 rlga.data <- c(carniv_fit_RLGA.bm$opt$aic, carniv_fit_RLGA.ou$opt$
   aic, carniv_fit_RLGA.eb$opt$aic, carniv_fit_RLGA.white$opt$aic)
69 lncbrt.data <- c(carniv_fit_lncbrt_bodymass.bm$opt$aic, carniv_fit
   _lncbrt_bodymass.ou$opt$aic, carniv_fit_lncbrt_bodymass.eb$opt$
   aic, carniv_fit_lncbrt_bodymass.white$opt$aic)
70 AICresults <- rbind(c1.data, rlga.data, lncbrt.data)
71 colnames(AICresults) <- c("Brownian Motion", "Ornstein Uhlenbeck",
   "Early Burst", "White noise")
72 AICresults
73
74 write.csv(AICresults, file = paste0(output_path, "AICresults.csv"))
75
76 #transform AIC values into Akaike weights
77 ##which can be interpreted as conditional probabilities for each
   model
78 AICw_c1_vals <- aicw(c1.data)
79 AICw_rlga_vals <- aicw(rlga.data)
80 AICw_lncbrt_vals <- aicw(lncbrt.data)
81
82 write.csv(AICw_c1_vals, file = paste0(output_path, "AICw_c1_vals.
   csv"))
83 write.csv(AICw_rlga_vals, file = paste0(output_path, "AICw_rlga_
   vals.csv"))
84 write.csv(AICw_lncbrt_vals, file = paste0(output_path, "AICw_lncbrt
   _vals.csv"))
85
86 pdf(paste0(output_path, "c1_AICw_barplot.pdf"))
87 barplot(AICw_c1_vals[,3], names.arg = c("Brownian Motion", "
   Ornstein Uhlenbeck", "Early Burst", "White noise"), ylim = c
   (0,1), main = "Cross Sectional Shape of Upper Canine", cex.
   names = 0.7)
88 abline(h = 1, lty = "dashed")
89 dev.off()
90
91 pdf(paste0(output_path, "rlga_AICw_barplot.pdf"))
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```
92   barplot(AICw_rlga_vals[,3], names.arg = c("Brownian Motion", "
      Ornstein Uhlenbeck", "Early Burst", "White noise"), ylim = c
      (0,1), main = "Relative Upper Grinding Area", cex.names = 0.7)
93   abline(h = 1, lty = "dashed")
94 dev.off()
95
96 pdf(paste0(output_path, "lncbrt_AICw_barplot.pdf"))
97   barplot(AICw_lncbrt_vals[,3], names.arg = c("Brownian Motion", "
      Ornstein Uhlenbeck", "Early Burst", "White noise"), ylim = c
      (0,1), main = "Log Cuberoot of Body Mass", cex.names = 0.7)
98   abline(h = 1, lty = "dashed")
99 dev.off()
100
101 ##### Disparity Through Time Plots #####
102 pdf(paste0(output_path, "c1_dtt_plot.pdf"))
103   c1.dtt <- dtt(phy = carnivoran_tree, data = C1_data, nsim = 100,
      index = c("avg.sq"), plot = TRUE)
104   title("Cross Sectional Shape of Upper Canine")
105 dev.off()
106
107 pdf(paste0(output_path, "rlga_dtt_plot.pdf"))
108   rlga.dtt <- dtt(phy = carnivoran_tree, data = RLGA_data, nsim =
      100, index = c("avg.sq"), plot = TRUE)
109   title("Relative Upper Grinding Area")
110 dev.off()
111
112 pdf(paste0(output_path, "lncbrt_dtt_plot.pdf"))
113   lncbrt.dtt <- dtt(phy = carnivoran_tree, data = lncbrt_bodymass_
      data, nsim = 100, index = c("avg.sq"), plot = TRUE)
114   title("Log Cuberoot of Body Mass")
115 dev.off()
```