Análisis de las llamadas de A. pertinax (variable T1 dur)

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Leemos el archivo de datos de Aratinga pertinax, versión de 2019, y reclassificamos la variable Region para facilitar interpretación:

```
dts <- read.csv(sprintf("%s/data/mdf_JR_15viii19.csv",script.dir))

str(dts)
```

```
## 'data.frame':    1351 obs. of  9 variables:
##  $ IndivGroup: Factor w/ 97 levels "AUA01","AUA02",..: 1 1 1 1 1 1 1 2 2 ...
##  $ soundfile : Factor w/ 1351 levels "0211327a","0211344a",..: 1 2 3 4 5 6 7 8 9 10 ...
##  $ S1_dur    : num  0.156 0.133 0.14 0.136 0.149 ...
##  $ Tcall_dur : num  0.154 0.137 0.144 0.137 0.144 ...
##  $ RecSite   : Factor w/ 37 levels "A6","A7","B1",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ Lat       : num  12.5 12.5 12.5 12.5 12.5 ...
##  $ Long      : num  -69.9 -69.9 -69.9 -69.9 -69.9 ...
##  $ LocCode   : Factor w/ 14 levels "AUA","BON","CUR",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ Region    : Factor w/ 2 levels "isl","main": 1 1 1 1 1 1 1 1 1 1 ...
```

```
dts$Region <- factor(dts$Region,levels=c("main","isl"))
```

Vamos a comparar ocho modelos para la variable S1_dur

MODELO	efecto fijo	efecto aleatorio	heterocedasticidad
f000	isla	constante	sin
f010	isla	isla	sin
f001	isla	constante	isla
f011	isla	isla	isla
f100	isla+long	constante	sin
f110	isla+long	isla	sin
f101	isla+long	constante	isla
f111	isla+long	isla	isla

El modelo nulo con efecto fijo de la isla

```
f000 <- lme(S1_dur~Region,dts,random=~1|LocCode/IndivGroup, method="ML")
```

Nulo + efecto aleatorio de isla/continente

```
f010 <- lme(S1_dur~Region,dts,
  random=list(LocCode=pdDiag(~Region),IndivGroup=pdDiag(~Region)), method="ML")
```

Nulo + heterocedasticidad

```
f001 <- lme(S1_dur~Region,dts,random=~1|LocCode/IndivGroup,weights=varIdent(form=~1|Region), method="ML
```

Nulo + efecto aleatorio de isla/continente + heterocedasticidad

```
f011 <-
 lme(S1_dur~Region,dts,
   random=list(LocCode=pdDiag(~Region),IndivGroup=pdDiag(~Region)),
   weights=varIdent(form=~1|Region), method="ML")
```

Modelo alternativo con efecto fijo de la isla y longitud

```
f100 <- lme(S1_dur~Region+Long,dts,random=~1|LocCode/IndivGroup, method="ML")
```

Alternativo + efecto aleatorio de isla/continente

```
f110 <- lme(S1_dur~Region+Long,dts,
     random=list(LocCode=pdDiag(~Region),IndivGroup=pdDiag(~Region)), method="ML")
```

Alternativo + heterocedasticidad

```
f101 <- lme(S1_dur~Region+Long,dts,random=~1|LocCode/IndivGroup,weights=varIdent(form=~1|Region), metho
```

Alternativo + efecto aleatorio de isla/continente + heterocedasticidad

```
f111 <-
      lme(S1_dur~Region+Long,dts,
        random=list(LocCode=pdDiag(~Region),IndivGroup=pdDiag(~Region)),
        weights=varIdent(form=~1|Region), method="ML")
```

Resultados

Comparamos el AIC de los modelos ajustados

```
anova(f000,f010,f001,f011,
  f100,f110,f101,f111)
```

```
##      Model df       AIC       BIC   logLik   Test  L.Ratio p-value
## f000     1  5 -6171.918 -6145.875 3090.959
## f010     2  7 -6192.394 -6155.934 3103.197 1 vs 2 24.47592  <.0001
## f001     3  6 -6170.306 -6139.055 3091.153 2 vs 3 24.08761  <.0001
## f011     4  8 -6190.912 -6149.243 3103.456 3 vs 4 24.60566  <.0001
## f100     5  6 -6171.541 -6140.289 3091.771 4 vs 5 23.37118  <.0001
## f110     6  8 -6190.970 -6149.301 3103.485 5 vs 6 23.42902  <.0001
## f101     7  7 -6169.927 -6133.467 3091.963 6 vs 7 23.04318  <.0001
## f111     8  9 -6189.484 -6142.606 3103.742 7 vs 8 23.55687  <.0001
```

Reordenamos los modelos según el AIC

```
mis.aics <- AIC(f000,f010,f001,f011,
  f100,f110,f101,f111)
aic.tab <- cbind(mis.aics,delta.AIC=mis.aics[,2]-min(mis.aics[,2]))
aic.tab[order(aic.tab$AIC),]
```

```
##      df       AIC delta.AIC
## f010  7 -6192.394  0.000000
## f110  8 -6190.970  1.424114
## f011  8 -6190.912  1.481951
## f111  9 -6189.484  2.910423
## f000  5 -6171.918 20.475921
## f100  6 -6171.541 20.853132
## f001  6 -6170.306 22.087613
## f101  7 -6169.927 22.467296
```

El Mejor modelo incluye efectos fijos y aleatorios de Isla, sin heterocedasticidad. Los modelos con longitud en el efecto fijo o heterocedasticidad son casi equivalentes (delta AIC < 2).

Los detalles del modelo a continuación:

```
summary(f010)
```

```
## Linear mixed-effects model fit by maximum likelihood
##  Data: dts
##         AIC       BIC   logLik
##   -6192.394 -6155.934 3103.197
##
## Random effects:
##  Formula: ~Region | LocCode
##  Structure: Diagonal
##         (Intercept)  Regionisl
## StdDev:  0.01225407 0.03564827
##
##  Formula: ~Region | IndivGroup %in% LocCode
##  Structure: Diagonal
##         (Intercept)  Regionisl   Residual
## StdDev:  0.01327504 0.02540965 0.02224762
##
## Fixed effects: S1_dur ~ Region
##                  Value   Std.Error   DF   t-value p-value
## (Intercept) 0.10394315 0.005326166 1254 19.515568  0.0000
## Regionisl   0.03296709 0.018461144   12  1.785755  0.0994
##  Correlation:
##           (Intr)
## Regionisl -0.289
##
## Standardized Within-Group Residuals:
##        Min         Q1        Med         Q3        Max
## -3.6150052 -0.5554097 -0.0942740  0.3947379  5.6454153
##
## Number of Observations: 1351
## Number of Groups:
##                 LocCode IndivGroup %in% LocCode
##                      14                      97
```

```
intervals(f010)
```

```
## Approximate 95% confidence intervals
##
##  Fixed effects:
##                     lower       est.      upper
## (Intercept)  0.093501706 0.10394315 0.11438459
## Regionisl   -0.007226506 0.03296709 0.07316068
## attr(,"label")
## [1] "Fixed effects:"
##
##  Random Effects:
##   Level: LocCode
##                         lower       est.      upper
## sd((Intercept)) 0.006287163 0.01225407 0.02388392
## sd(Regionisl)   0.016885509 0.03564827 0.07525977
##   Level: IndivGroup
##                       lower       est.      upper
## sd((Intercept)) 0.01020718 0.01327504 0.01726497
```

```
## sd(Regionisl)   0.01870918 0.02540965 0.03450981
##
##  Within-group standard error:
##      lower       est.      upper
## 0.02139408 0.02224762 0.02313522
```

```
VarCorr(f010)
```

```
##              Variance       StdDev
## LocCode =    pdDiag(Region)
## (Intercept)  0.0001501621   0.01225407
## Regionisl    0.0012707994   0.03564827
## IndivGroup = pdDiag(Region)
## (Intercept)  0.0001762266   0.01327504
## Regionisl    0.0006456502   0.02540965
## Residual     0.0004949568   0.02224762
```