

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 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), method="ML")
```

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:  0.01225435 0.03564883
##
## Formula: ~Region | IndivGroup %in% LocCode
## Structure: Diagonal
##           (Intercept) Regionisl Residual
## StdDev:  0.01327499 0.02540958 0.02224762
##
## Fixed effects: Sl_dur ~ Region
##               Value Std.Error DF t-value p-value
## (Intercept) 0.10394313 0.005326244 1254 19.515277 0.0000
## Regionisl 0.03296707 0.018461414 12 1.785728 0.0994
## Correlation:
##           (Intr)
## Regionisl -0.289
##
## Standardized Within-Group Residuals:
##           Min           Q1           Med           Q3           Max
## -3.61500493 -0.55541019 -0.09427347  0.39473922  5.64541492
##
## 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) 0.09350154 0.10394313 0.11438473
## Regionisl -0.00722711 0.03296707 0.07316125
## attr("label")
## [1] "Fixed effects:"
##
## Random Effects:
## Level: LocCode
##           lower           est.           upper
## sd((Intercept)) 0.006287521 0.01225435 0.02388365
## sd(Rregionisl) 0.016887557 0.03564883 0.07525297
## Level: IndivGroup
##           lower           est.           upper
## sd((Intercept)) 0.01020716 0.01327499 0.01726489
```

```
## sd(Regionisl)    0.01870911 0.02540958 0.03450975
##
## Within-group standard error:
##      lower      est.      upper
## 0.02139408 0.02224762 0.02313522
```

```
VarCorr(f010)
```

```
##           Variance      StdDev
## LocCode =  pdDiag(Region)
## (Intercept) 0.0001501690 0.01225435
## Regionisl   0.0012708389 0.03564883
## IndivGroup = pdDiag(Region)
## (Intercept) 0.0001762255 0.01327499
## Regionisl   0.0006456467 0.02540958
## Residual    0.0004949568 0.02224762
```