CFP Indicators
Testing stability of indicator $\frac{F}{F_{MSY}}$ in the Mediterranean

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1 Background

```
library(lme4)
library(ggplot2)
library(lattice)
library(latticeExtra)
library(reshape2)
library(parallel)
library(influence.ME)
library(xtable)
load("../analysis/RData.med")
options(stringsAsFactors=FALSE, width = 60)
theme_set(theme_bw())
sc <- scale_x_continuous(breaks=2003:2017)
th <- theme(axis.text.x  = element_text(angle=90, vjust=0.5))
nc <- 3
it <- 240
# to control de seed in mclapply
RNGkind("L'Ecuyer-CMRG")
set.seed(1234)
```

2 $\frac{F}{F_{MSY}}$ in the Mediterranean

```
df0 <- sam
df0$Year <- factor(df0$Year)
yrs <- levels(df0$Year)
nd <- data.frame(Year=factor(yrs))
No <- length(unique(df0$stk))

# model
fit <- glmer(indF ~ Year + (1|stk), data = df0, family = Gamma("log"), control=glmerControl(optimizer="

summary(fit)

## Generalized linear mixed model fit by maximum likelihood
##   (Laplace Approximation) [glmerMod]
##  Family: Gamma  ( log )
## Formula: indF ~ Year + (1 | stk)
##    Data: df0
## Control: glmerControl(optimizer = "nlminbwrap")
##
##      AIC      BIC   logLik deviance df.resid
##   1318.9   1392.4   -642.5   1284.9      541
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.3081 -0.4925 -0.0192  0.4352  5.4525
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  stk      (Intercept) 0.08318  0.2884
##  Residual             0.10218  0.3197
## Number of obs: 558, groups:  stk, 42
##
```

```
## Fixed effects:
##               Estimate Std. Error t value Pr(>|z|)
## (Intercept)  8.697e-01  1.201e-01   7.239 4.51e-13 ***
## Year2004    -1.259e-02  8.352e-02  -0.151   0.8802
## Year2005     3.287e-02  8.166e-02   0.402   0.6873
## Year2006     3.933e-02  7.986e-02   0.492   0.6224
## Year2007    -2.842e-02  7.815e-02  -0.364   0.7162
## Year2008     1.772e-02  7.766e-02   0.228   0.8195
## Year2009    -6.202e-03  7.608e-02  -0.082   0.9350
## Year2010     4.144e-02  7.611e-02   0.544   0.5861
## Year2011     1.384e-01  7.619e-02   1.817   0.0693 .
## Year2012     8.094e-02  7.627e-02   1.061   0.2886
## Year2013     9.552e-02  7.639e-02   1.250   0.2111
## Year2014     3.647e-02  7.636e-02   0.478   0.6330
## Year2015     4.328e-02  7.627e-02   0.567   0.5704
## Year2016    -1.098e-02  7.624e-02  -0.144   0.8855
## Year2017    -8.235e-05  7.629e-02  -0.001   0.9991
## ---
## Signif. codes:
## 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
xyplot(residuals(fit)~predict(fit))
```

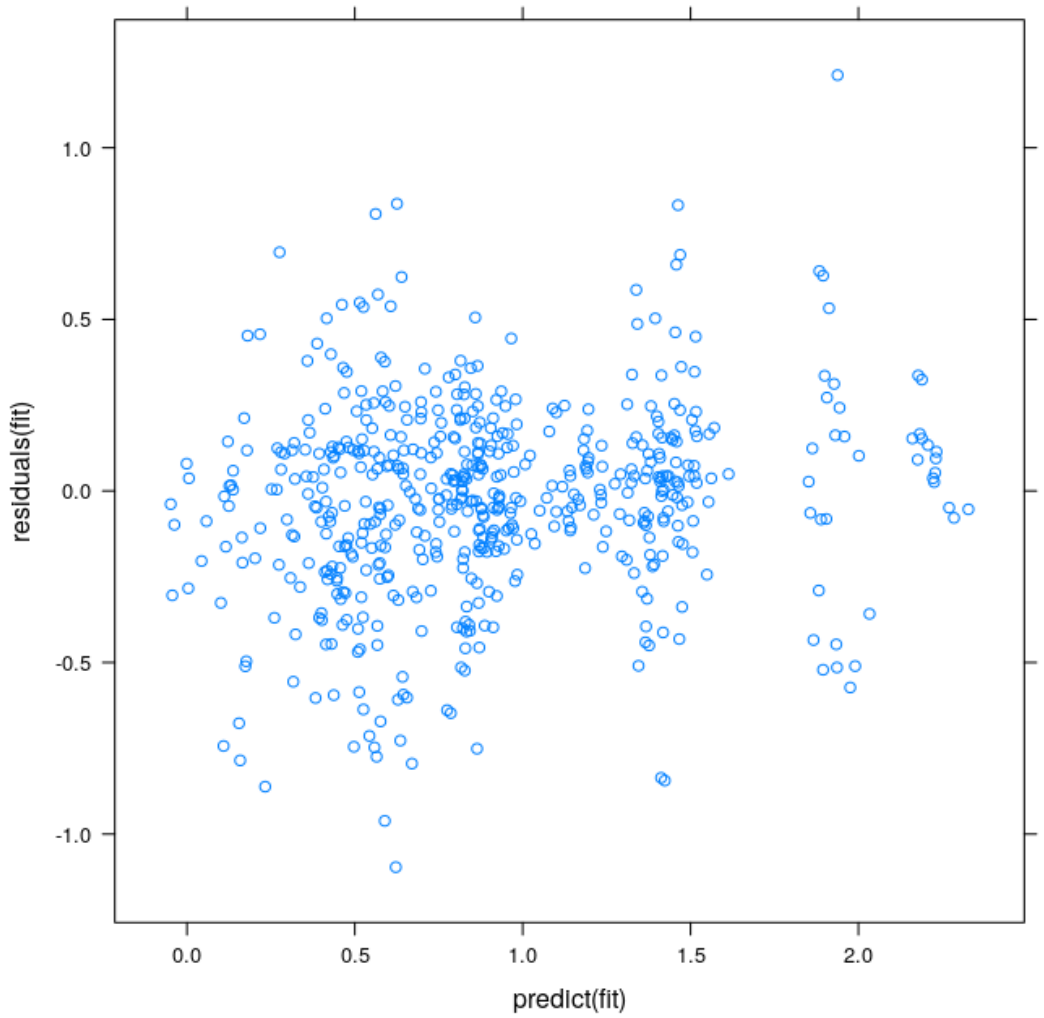


Figure 1: Homogeneity of variance in the GLMM

```
xyplot(residuals(fit)~predict(fit)|df0[,"stk"], main="homogeneity of variance",
    scales=list(x=list(relation="free")))
```

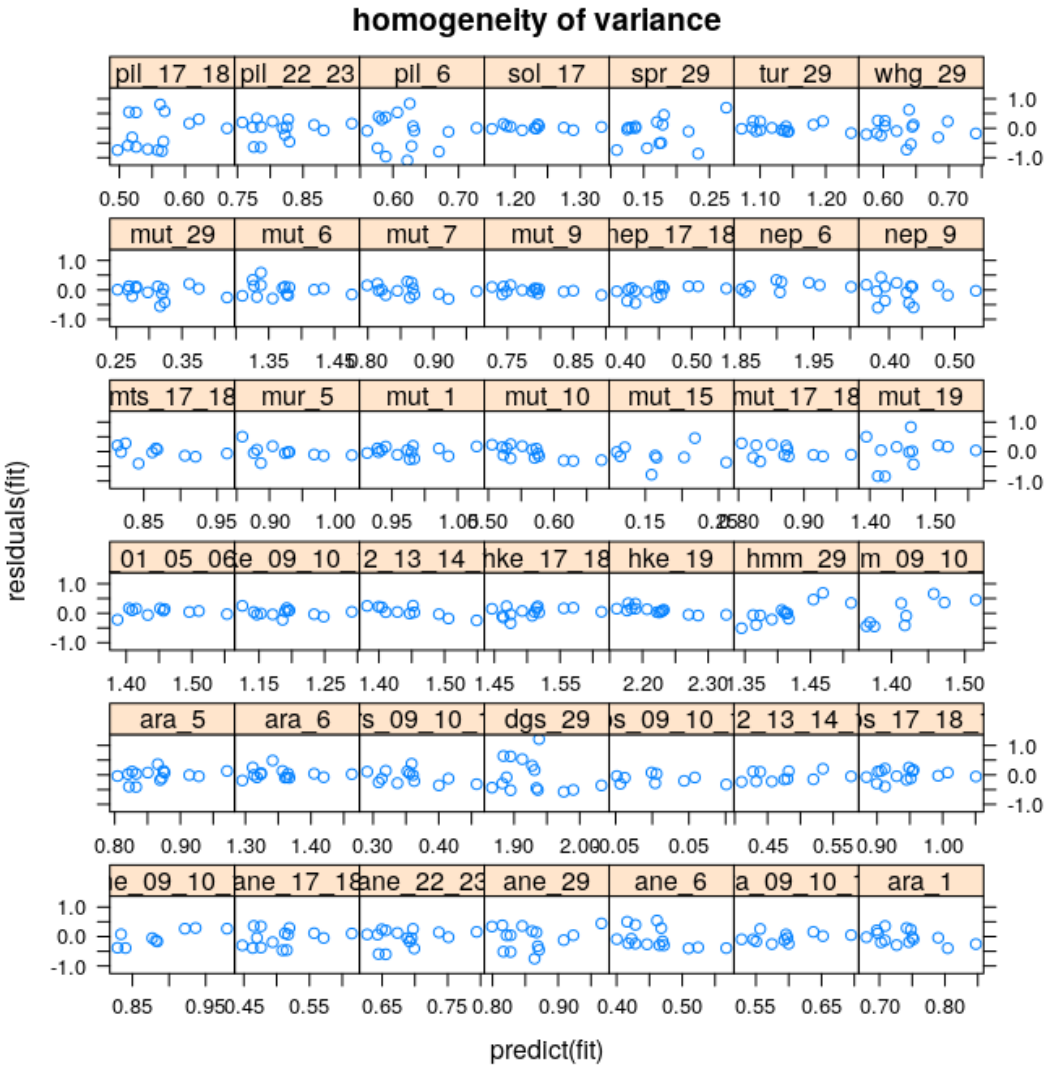


Figure 2: Homogeneity of variance by stock in the GLMM

```
pfun <- function(x, ...){
        panel.qqmathline(x, col="gray50")
        panel.qqmath(x, ...)
}

qqmath(residuals(fit), panel=pfun, pch=19, cex=0.5)
```

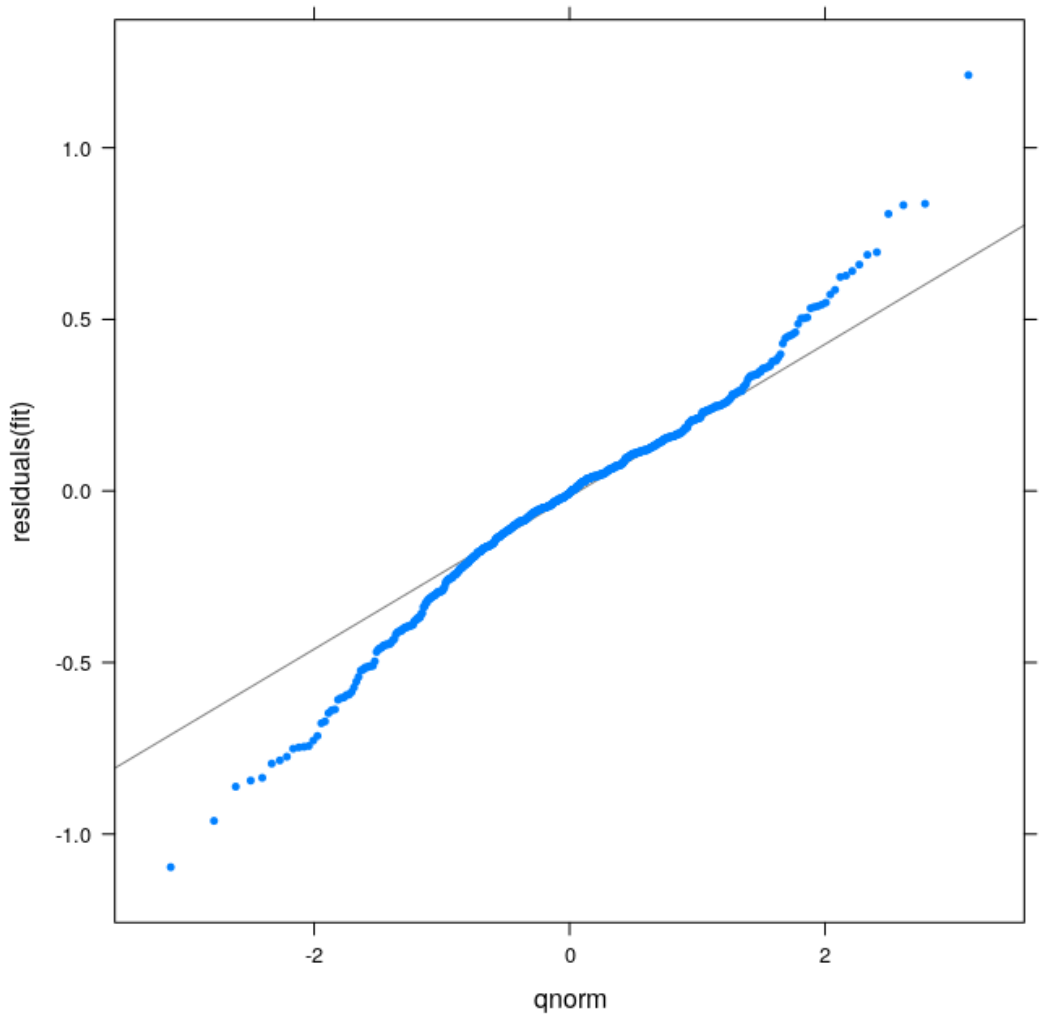


Figure 3: Normality of residuals in the GLMM

```
qqmath(~residuals(fit)|df0[,"stk"], panel=pfun, pch=19, cex=0.5)
```

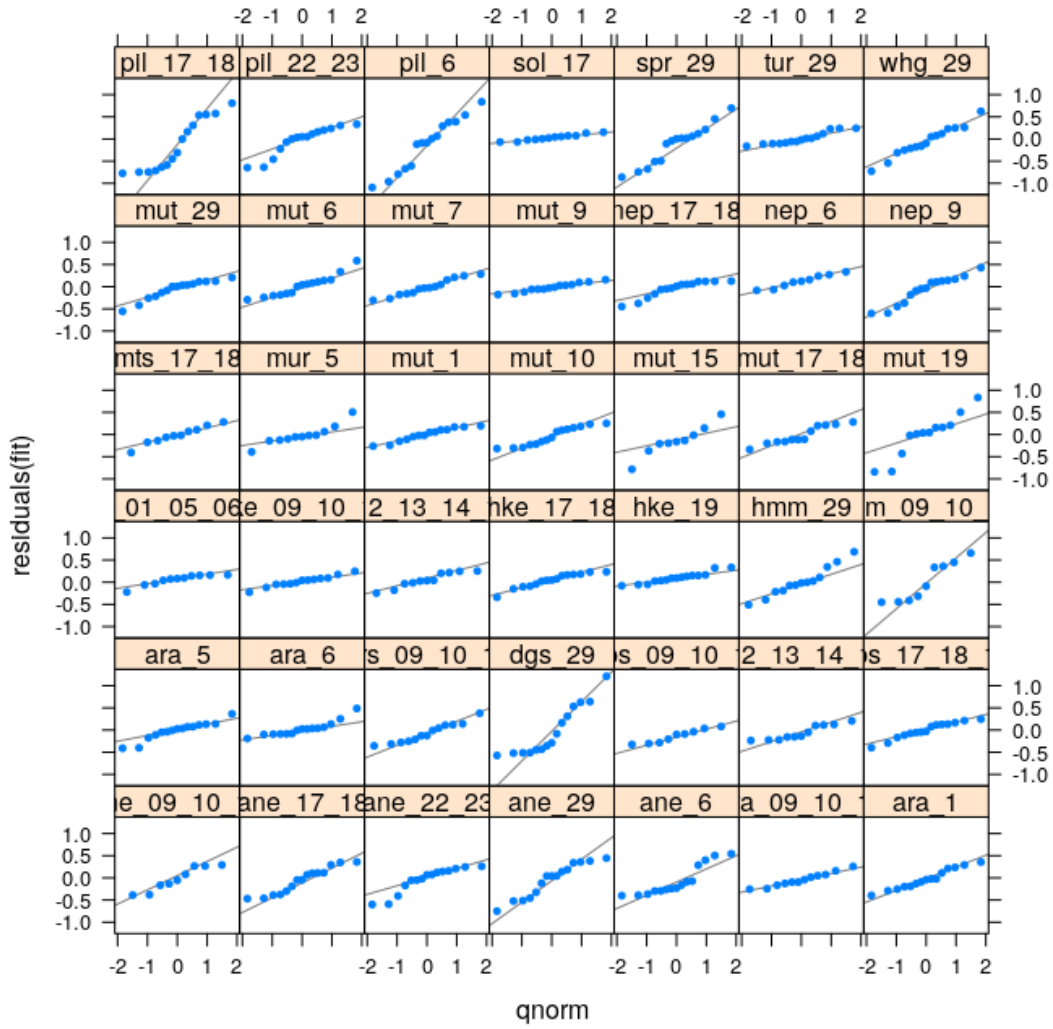


Figure 4: Normality of residuals by stock in the GLMM

```
dotplot(ranef(fit, condVar = TRUE), main=FALSE)

## $stk
```

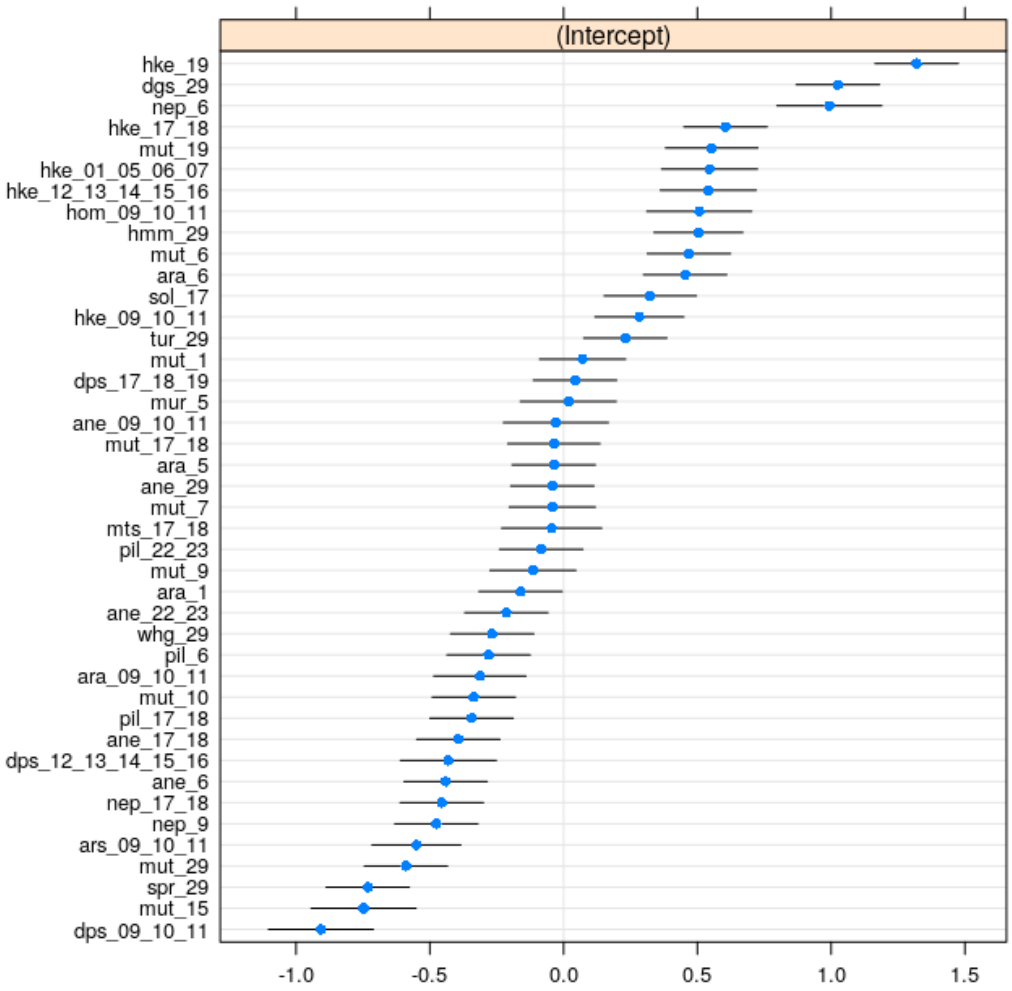


Figure 5: Random effects

```
ifl.stk <- influence.stk(fit, df0, "stk", nc, nd)
dotplot(stk~sd, data=ifl.stk)
```

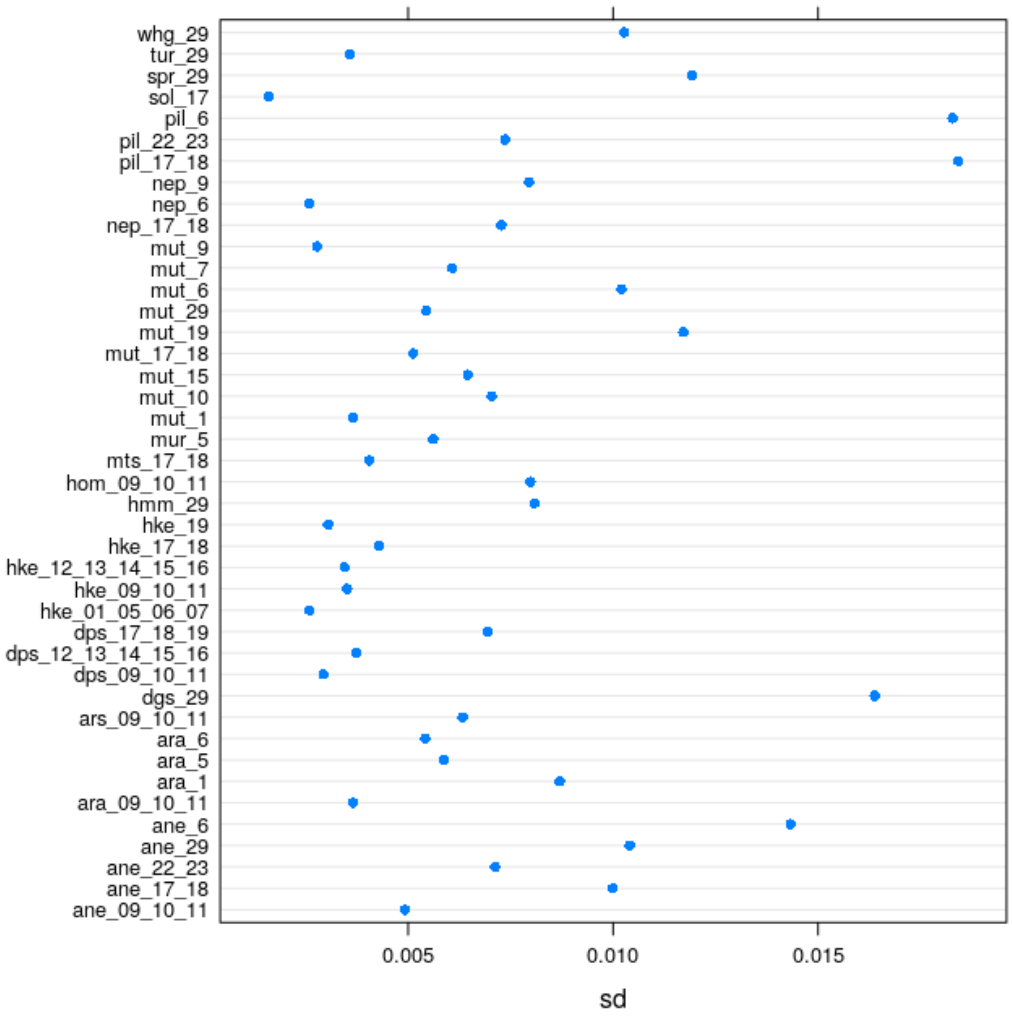
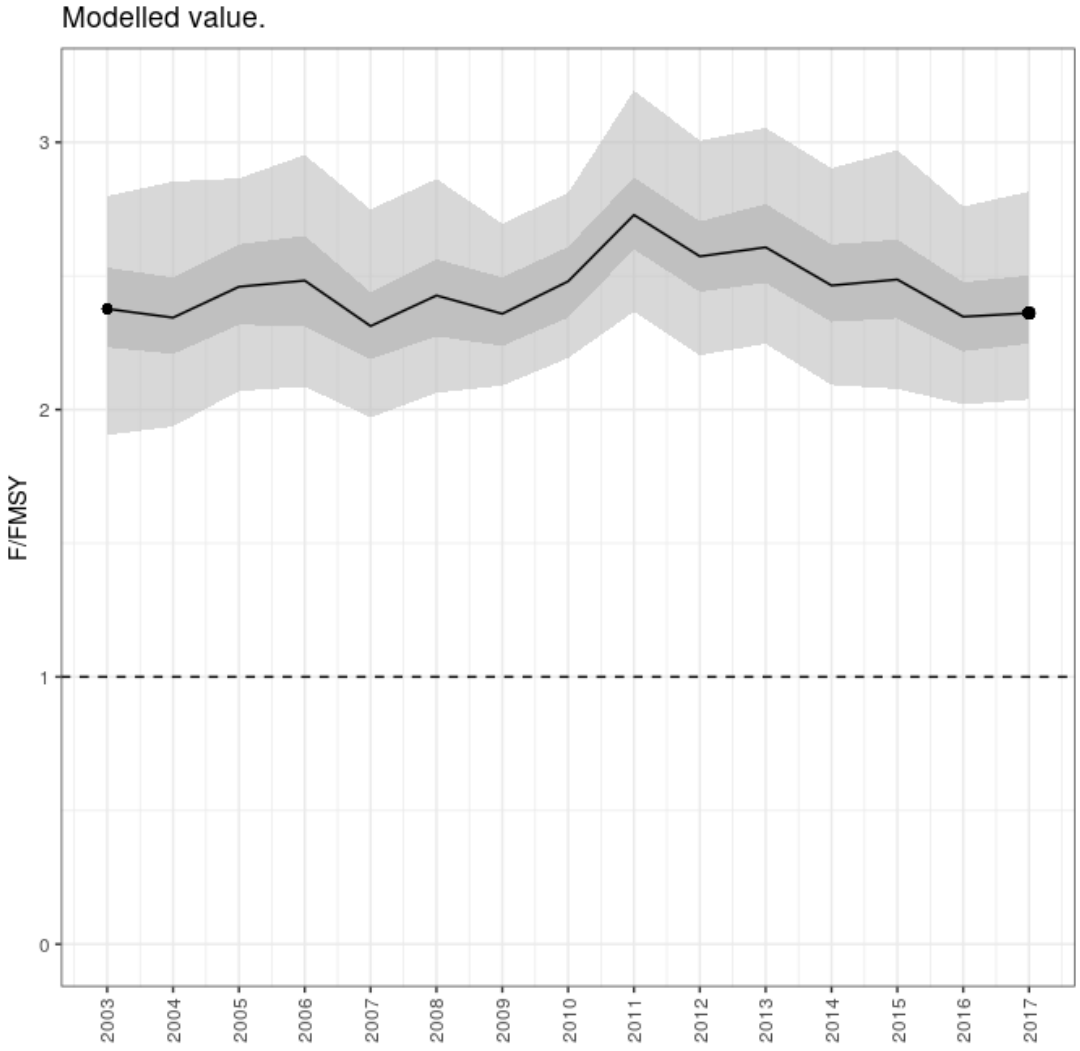


Figure 6: Influence on fixed effect "year" in the GLMM

```
set.seed(1234)
stk <- unique(df0$stk)
bs <- split(1:it, 1:it)
bs <- mclapply(bs, function(x){
        stk <- sample(stk, replace=TRUE)
        df1 <- df0[0,]
        for(i in stk) df1 <- rbind(df1, subset(df0, stk==i))
        fit <- glmer(indF ~ Year + (1|stk), data = df1, family = Gamma("log"), control=glmerControl(opt
        v0 <- predict(fit, re.form=~0, type="response", newdata=nd)
        if(length(fit@optinfo$conv$lme4)>0) v0[] <- NA
        v0
}, mc.cores=nc)
# remove failed iters
bs <- bs[unlist(lapply(mfit.bs, is.numeric))]

ifitm <- do.call("rbind", bs)
ifitq <- apply(ifitm, 2, quantile, c(0.025, 0.25, 0.50, 0.75, 0.975), na.rm=TRUE)
ifitq <- cbind(Year=as.numeric(yrs), as.data.frame(t(ifitq)))
```

```
#png("figNEAI5outmod.png", 600, 400)
ggplot(ifitq, aes(x=Year)) +
  geom_ribbon(aes(ymin = `2.5%`, ymax = `97.5%`), fill="gray", alpha=0.60) +
  geom_ribbon(aes(ymin = `25%`, ymax = `75%`), fill="gray", alpha=0.95) +
  geom_line(aes(y=`50%`)) + expand_limits(y=0) +
  geom_point(aes(x=Year[1], y=`50%`[1])) +
  geom_point(aes(x=Year[length(Year)], y=`50%`[length(`50%`)]), size=2) +
  geom_hline(yintercept = 1, linetype=2) +
  ylab("F/FMSY") + xlab("") +
  theme(legend.position = "none") + sc + th +
    ggtitle("Modelled value.")
```



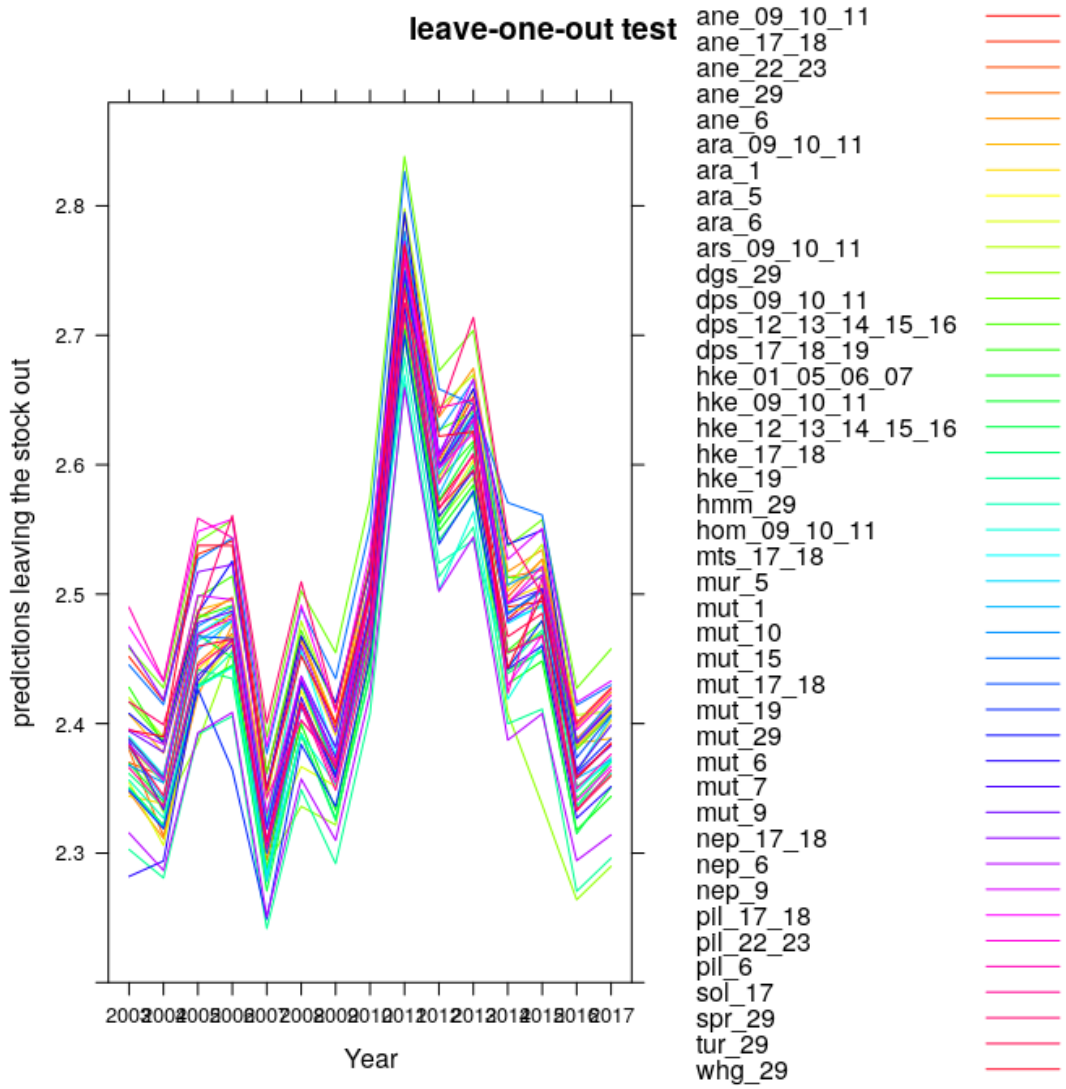

```
#dev.off()
```

```
neafout <- list(fit=fit, bs=bs)
```

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
2.5%	1.90	1.94	2.07	2.09	1.97	2.06	2.09	2.19	2.37	2.20	2.25	2.09	2.08	2.02	2.04
25%	2.23	2.21	2.32	2.31	2.19	2.27	2.24	2.34	2.60	2.44	2.47	2.33	2.34	2.22	2.25
50%	2.38	2.34	2.46	2.48	2.31	2.43	2.36	2.48	2.73	2.57	2.61	2.46	2.49	2.35	2.36
75%	2.53	2.49	2.62	2.65	2.44	2.56	2.49	2.61	2.87	2.70	2.77	2.62	2.64	2.48	2.50
97.5%	2.80	2.85	2.86	2.95	2.75	2.86	2.70	2.81	3.19	3.01	3.05	2.90	2.97	2.76	2.82

3 Individual stocks' impact with leave-one-out algorithm

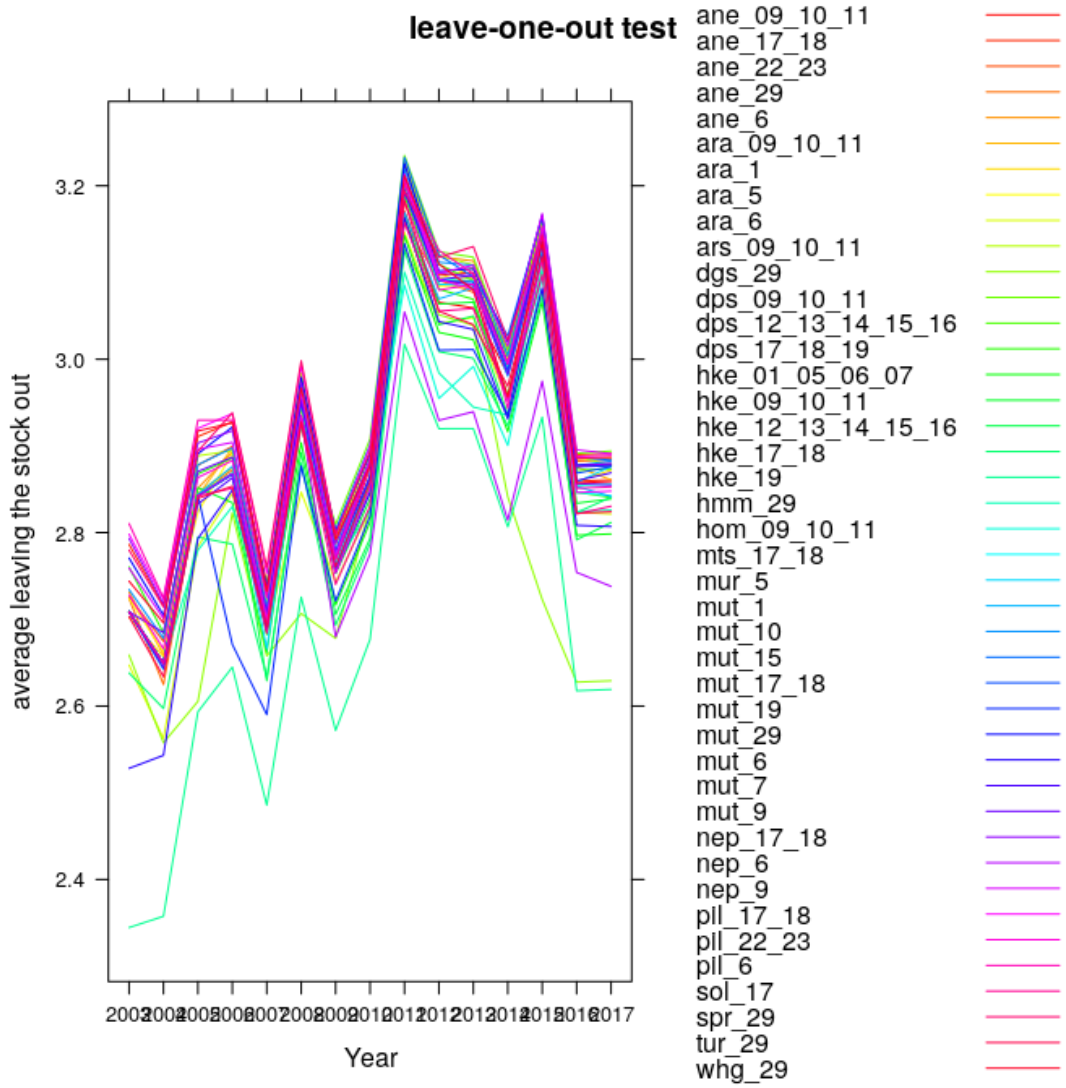
```
stks <- unique(df0$stk)
test <- split(stks, stks)
for(i in stks){
        fit <- glmer(indF ~ Year + (1|stk), data = df0[df0$stk!=i,],
                family = Gamma("log"), control=glmerControl(optimizer="nlminbwrap"))
        test[[i]] <- data.frame(nd, spp=i,
                pred=predict(fit, re.form=~0, type="response", newdata=nd))
}
test <- do.call("rbind", test)
```



4 Individual stocks' impact on average estimates with leave-one-out algorithm

```
test2 <- split(stks, stks)
for(i in stks){
        test2[[i]] <- data.frame(nd, spp=i,
                avg=tapply(df0[df0$stk!=i,'indF'], df0[df0$stk!=i,'Year'], mean))
```

```
}
test2 <- do.call("rbind", test2)
```



5 Conclusions

6 References

ICES 2012. ICES Implementation of Advice for Data-limited Stocks in 2012 in its 2012 Advice. ICES CM 2012/ACOM 68. 42 pp.

Jardim E., Scott F., Mosqueira I., Osio C., Vasilakopoulos P., Mannini A., Casey J. (Editors) 2017. Scientific, Technical and Economic Committee for Fisheries (STECF) - Monitoring the performance of the Common Fisheries Policy (STECF-17-XX). EUR XXXX EN; doi:XXXXXXXX

Vasilakopoulos P., Jardim E. 2017. Compilation and quality check of the ICES stock assessment data. EUR XXXX EN; doi:XXXXXXXX