

Proyecto Beetles

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We used the metadata collected in the Bavarian Forest National Park in southeastern Germany, dominated by sub alpine forests of *Picea abies*. In a dead wood zone caused by the 2011 super German storm, 150 different species were monitored. Sampling season was conducted between May and September over four years (2008-2011).

The years passed but, did the forest restoration methods improved beetles richness?

First, let's calculate species richness by sampling site and year

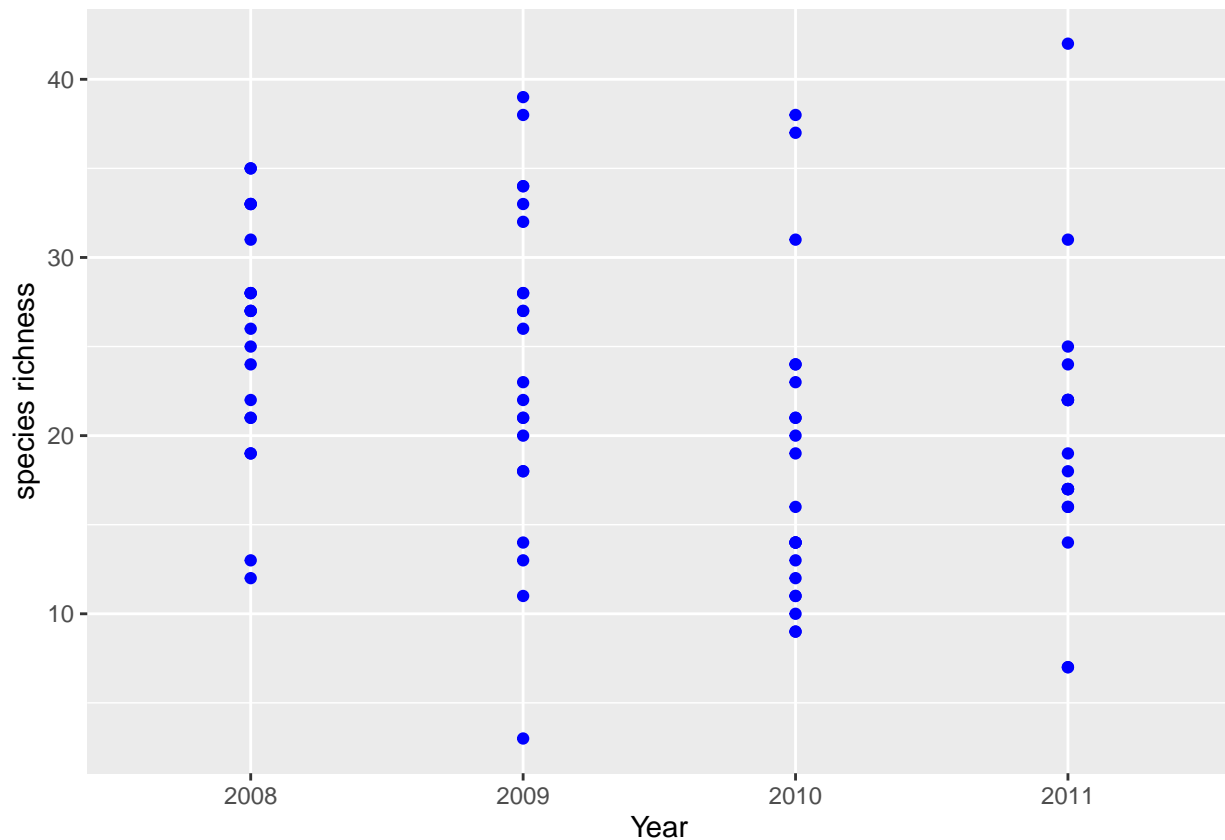
```
rawdata <- read.csv("datos/rawdata_bet.csv")
rawdata$YEAR<-as.factor(rawdata$YEAR)

bet_sum<-rawdata %>%
  group_by(PLOT, YEAR) %>%
  summarise(n_species = n(),ABUNDANCE = sum(ABUNDANCE))%>%
  rename(plot=PLOT, year=YEAR, abundance= ABUNDANCE)
```

plot	year	n_species	abundance
FAE_1	2008	12	52
FAE_11	2008	28	94
FAE_16	2008	27	125
FAE_18	2008	27	123
FAE_2	2008	28	115
FAE_21	2008	33	214
FAE_24	2008	21	104
FAE_3	2008	26	50
FAE_4	2008	19	51
FAE_7	2008	28	116
FAE_9	2008	35	119
FKN_1	2008	31	86
FKN_12	2008	19	41
FKN_14	2008	33	94
FKN_15	2008	35	136
FKN_4	2008	24	53

FKN_5	2008	27	103
FKO_4	2008	33	86
FKO_6	2008	25	65
LAO_3	2008	13	20
LAW_18	2008	21	89
LAW_5	2008	22	50

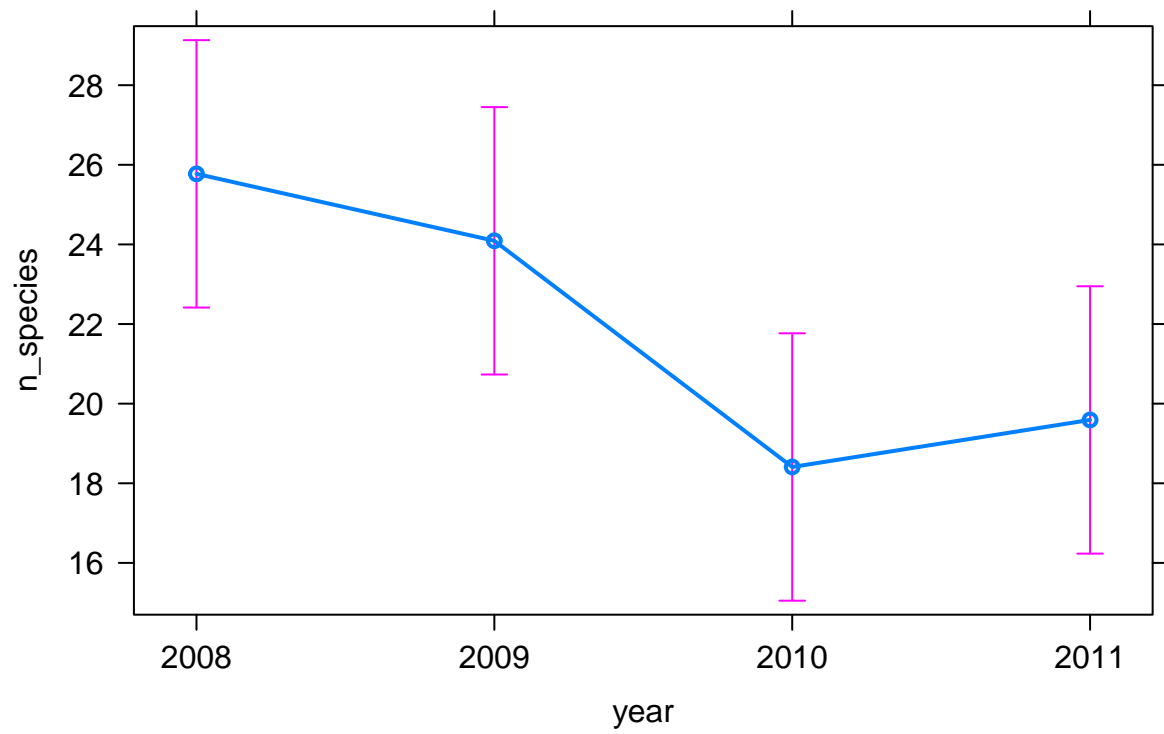
Second, plot that nice data



Is there any differences in species richness by year?

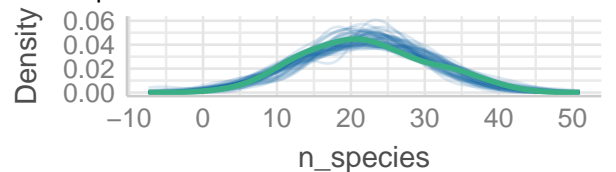
```
##
## Call:
## lm(formula = n_species ~ year, data = bet_sum)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -21.0909  -4.5000  -0.6818   4.0341  22.4091
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   25.773      1.689   15.261 < 2e-16 ***
## year2009      -1.682      2.388   -0.704  0.48326
## year2010      -7.364      2.388   -3.083  0.00277 **
## year2011      -6.182      2.388   -2.588  0.01136 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 7.921 on 84 degrees of freedom
## Multiple R-squared:  0.1347, Adjusted R-squared:  0.1038
## F-statistic:  4.36 on 3 and 84 DF,  p-value: 0.006647
```

year effect plot



Posterior Predictive Check

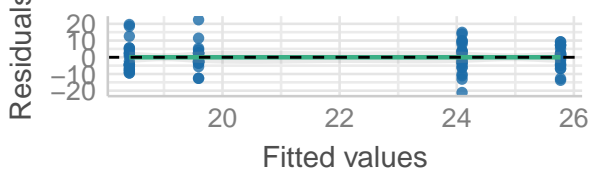
Model-predicted lines should resemble observed data



— Model-predicted data — Observed data

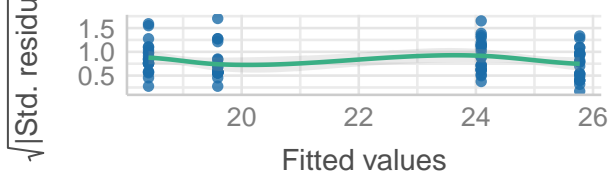
Linearity

Reference line should be flat and horizontal



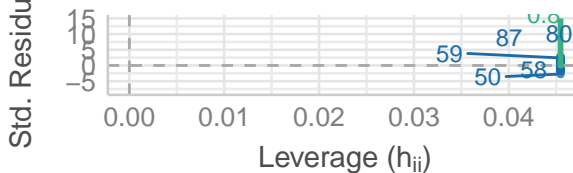
Homogeneity of Variance

Reference line should be flat and horizontal



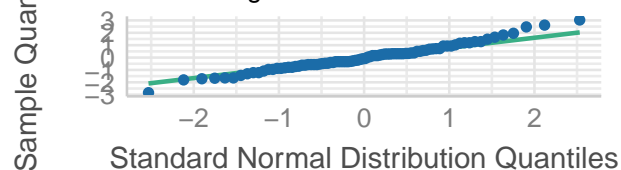
Influential Observations

Points should be inside the contour lines



Normality of Residuals

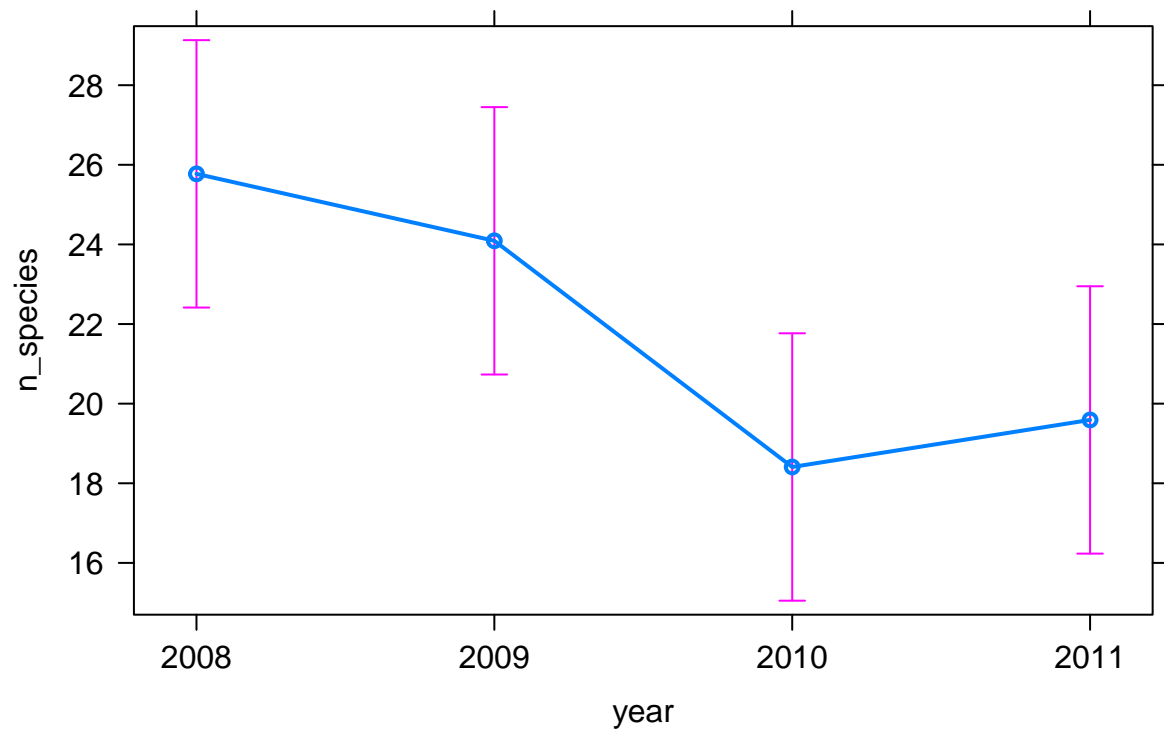
Points should fall along the line



Mixed model with random = plot

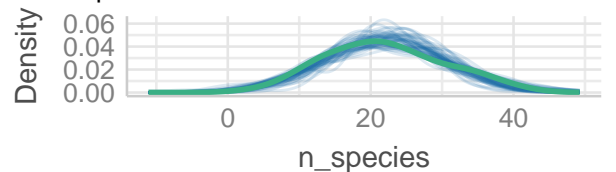
```
## Linear mixed model fit by REML ['lmerMod']
## Formula: n_species ~ year + (1 | plot)
## Data: bet_sum
##
## REML criterion at convergence: 593.1
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.32520 -0.53554 -0.05196  0.40806  2.73103
##
## Random effects:
## Groups Name Variance Std.Dev.
## plot (Intercept) 14.33 3.785
## Residual 48.42 6.958
## Number of obs: 88, groups: plot, 22
##
## Fixed effects:
## Estimate Std. Error t value
## (Intercept) 25.773 1.689 15.261
## year2009 -1.682 2.098 -0.802
## year2010 -7.364 2.098 -3.510
## year2011 -6.182 2.098 -2.947
##
## Correlation of Fixed Effects:
## (Intr) yr2009 yr2010
## year2009 -0.621
## year2010 -0.621 0.500
## year2011 -0.621 0.500 0.500
```

year effect plot



Posterior Predictive Check

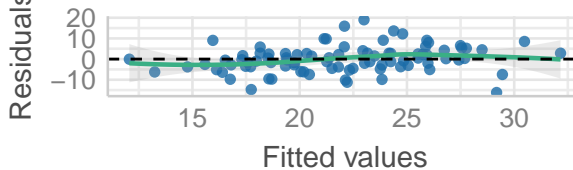
Model-predicted lines should resemble observed data



— Model-predicted data — Observed data

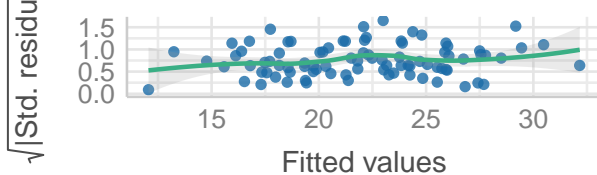
Linearity

Reference line should be flat and horizontal



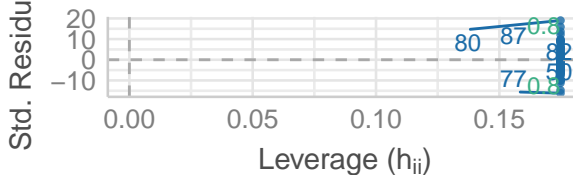
Homogeneity of Variance

Reference line should be flat and horizontal



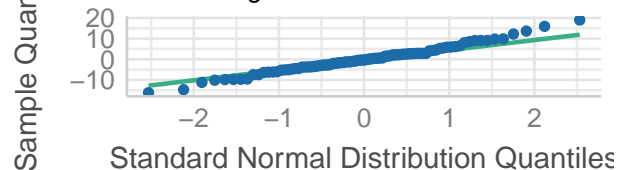
Influential Observations

Points should be inside the contour lines



Normality of Residuals

Dots should fall along the line



Normality of Random Effects (plot)

Dots should be plotted along the line

