Mixed Models

Pedro Victor Brasil Ribeiro

2021-11-22 - Last changed in 2021-12-01

Longitudinal Data

Longitudinal data, also called as panel data, is data that is collected through a series of repeated observations of the same subject overtime. Longitudinal experiments planning concern the observation of one or more variables in the same subject on different ocassions or condicion of evaluation, time is a commom factor used in most of experiment, but it can be use on distances among other factors, but in the present work it will be implied that the subjects measures is taken over time.

Given that longitudinal data are measures of the same subject taken in a systematic way, is expected not null correlations between the measures, especially the one taken in consecutive. Furthermore is expected heterocedasticidy.

About the data structure is expected 3 characteristics, but have in mind that in a real experiement ambient, not necessarily those characteristics can actually be hold:

- Regular (in respect to time): The interval of time between one measure and other are the same;

- Balanced (in respect to time): All observations are taken in the same time, on the same condictions in all subjects;

- Complete: No lost observations.

Table 1: Basic structure of balanced and complete longitudinal data

| Grupo ou Tratamento	Unidade Experimental	Condições de Avaliação			
		1	2	$\cdots$	t
1	1	y_{111}	y_{112}	$\cdots$	y_{11t}
	2	y_{121}	y_{122}	$\cdots$	y_{12t}
	$\vdots$	$\vdots$	$\vdots$	$\ddots$	$\vdots$
	n_1	y_{1n_11}	y_{1n_12}	$\cdots$	y_{1n_1t}
2	1	y_{211}	y_{212}	$\cdots$	y_{21t}
	2	y_{221}	y_{222}	$\cdots$	y_{22t}
	$\vdots$	$\vdots$	$\vdots$	$\ddots$	$\vdots$
	n_2	y_{2n_21}	y_{2n_22}	$\cdots$	y_{2n_2t}
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
g	1	y_{g11}	y_{g12}	$\cdots$	y_{g1t}
	2	y_{g21}	y_{g22}	$\cdots$	y_{g2t}
	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
	n_g	y_{gn_g1}	y_{gn_g2}	$\cdots$	y_{gn_gt}

Dados Dieta - Frango

```r
data("ChickWeight")

frango <- groupedData(
  weight~Time|Chick, outer = ~Diet, data = ChickWeight,
  order.groups = F,
  labels=list(x="tempo (semana)", y="Peso corporal (g)")
)

plot(frango,between = list(y = c(0, 0.5, 0)))
```
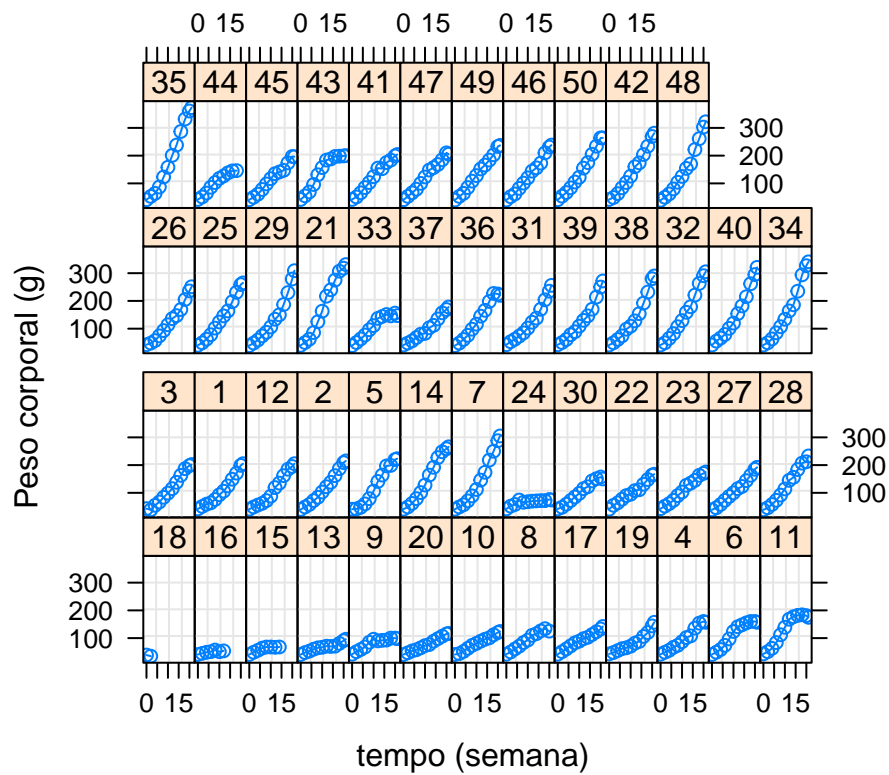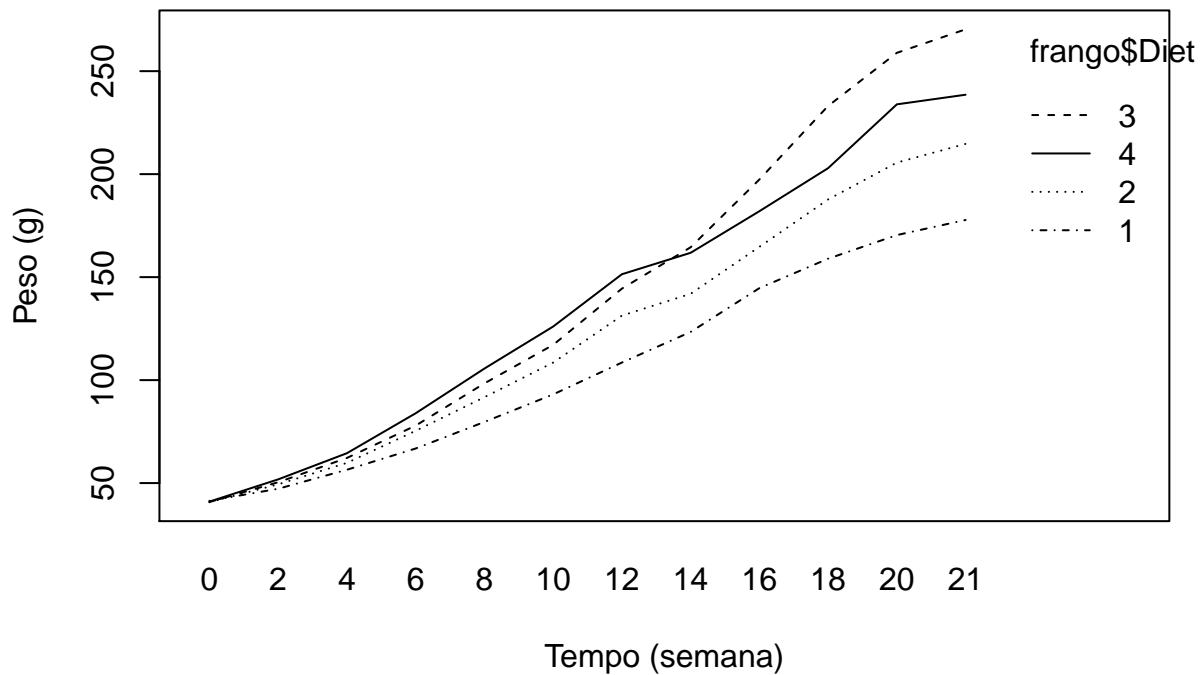


```r
plot(frango, outer = T, key=FALSE) # key omite a legenda
```

Peso corporal (g)
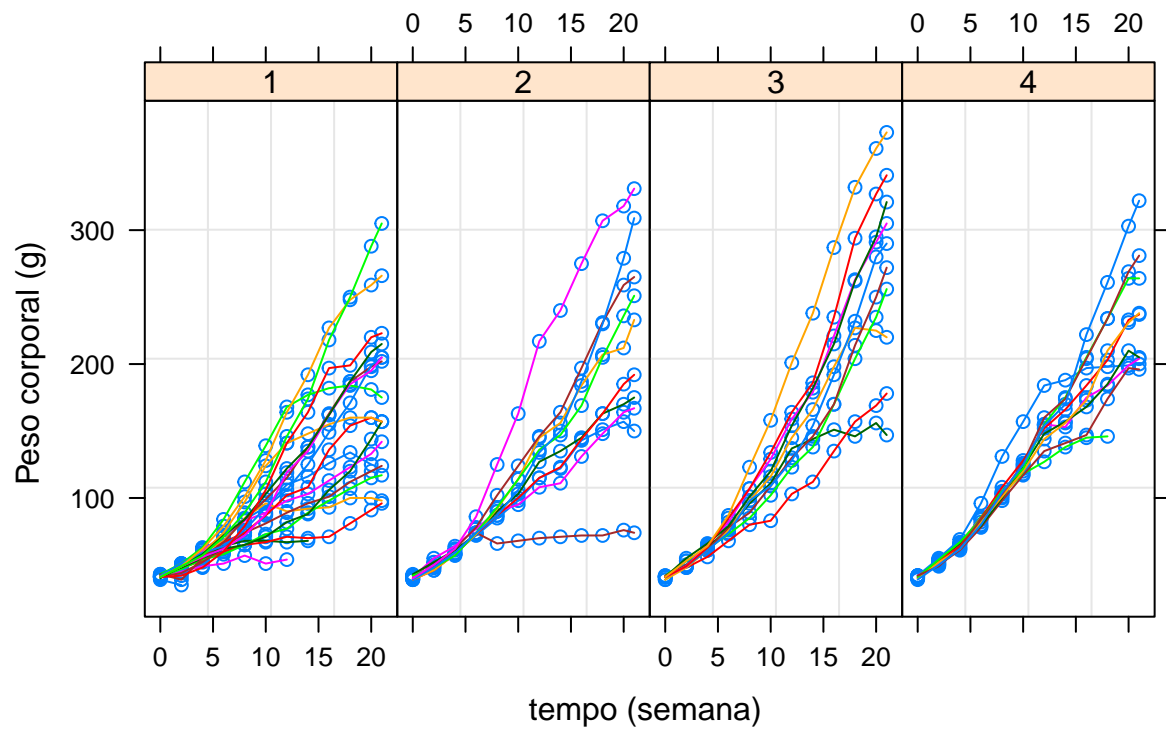
tempo (semana)

```
interaction.plot(frango$Time,frango$Diet,frango$weight,ylab="Peso (g)", xlab="Tempo (semana)")
```

Por tanto podemos observar que os perfis individuais apresentados para cada frango diferem entre si, apresentando um perfil médio o qual apresenta uma clara modificação na variância, quando observado o peso em relação ao tempo, perfil o qual, varia de acordo com cada dieta utilizada.

```
mod1 <- lme(
  fixed = weight~Time+Diet+Time:Diet,
  random = ~1,
  data = frango,
  control = lmeControl(opt="optim")
)
mod2 <- lme(
  fixed = weight~Time+Diet+Time:Diet,
  random = ~ Diet,
  data = frango,
  control = lmeControl(opt="optim")
)
mod3 <- lme(
  fixed = weight~Time+Diet+Time:Diet,
  random = ~Time,
  data = frango,
  control = lmeControl(opt="optim")
)
mod4 <- lme(
  fixed = weight~Time+Diet+Time:Diet,
  random = ~Time + Diet,
  data = frango,
```

```
  control = lmeControl(opt="optim")
)
mod5 <- lme(
  fixed = weight~Time+Diet+Time:Diet,
  random = ~Time + Diet + Time:Diet,
  data = frango,
  control = lmeControl(opt="optim")
)
```

```
coef(mod3) %>%
  as_tibble() %>%
  kable(format = "latex", booktabs = TRUE)
```

(Intercept)	Time	Diet2	Diet3	Diet4	Time:Diet2	Time:Diet3	Time:Diet4
33.94980	6.0821404	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
48.91139	0.9275944	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
46.57686	2.0830318	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
46.01675	2.1230021	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
45.12966	3.1065073	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
41.35582	3.5399976	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
40.41212	3.9860585	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
38.24910	5.1860977	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
39.21681	4.7721350	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
37.07350	4.7542116	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
34.17914	6.0132306	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
33.79654	6.9839217	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
30.60247	8.5171166	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
26.67009	8.2613885	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
28.20287	7.7521221	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
26.75626	8.1371705	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
26.04689	8.6191198	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
21.76361	9.7336397	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
16.21147	12.1820996	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
11.97323	12.7796153	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
56.59527	-0.9669800	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
42.12084	3.7099195	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
42.22226	3.7409063	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
39.76045	4.5887702	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
37.34690	4.9138575	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
30.21870	7.2899561	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
28.89805	7.5706638	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
25.29045	8.9128557	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
21.31593	9.4732140	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
12.77832	13.5369374	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
51.29844	1.3458263	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
48.18251	1.3897275	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
38.21537	5.0369531	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
37.82660	4.7000759	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
35.63375	5.4100898	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
31.44800	6.5930090	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
28.25827	8.0676981	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
27.36432	8.2114639	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
22.51005	9.7015956	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
15.80988	12.3136613	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
43.34374	3.3758280	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
39.27597	4.3397792	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
38.09903	6.0057850	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
38.02867	5.0974285	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
37.27198	5.1875901	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
33.09317	6.4797517	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
32.86842	6.2846650	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
27.98019	7.9168952	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
26.32363	8.2831550	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743
20.26239	9.7992229	-5.021124	-15.40439	-1.742559	2.332126	5.145861	3.254743