

Repeated Measures in Time

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The Big Picture

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- Repeated measures in time models can be useful when each individual is measured at several time points.
- The models allow each individual to have a different response profile versus time.
- Usually the individuals are grouped by a categorical variable of interest (such as treatment).
- Comparisons of the time trends among groups is often of interest.
- Repeated measures studies allow for the measurements within subjects to be modeled as *correlated*.
- There are several common correlation models to consider.

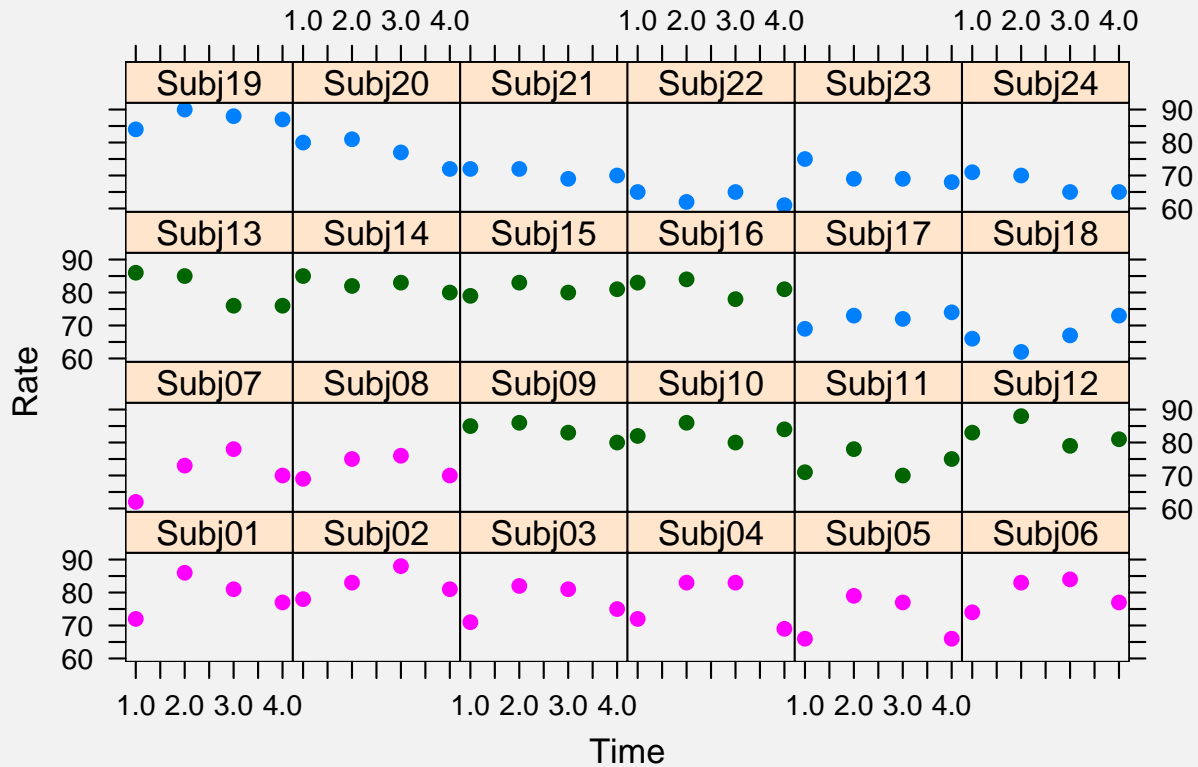
Heart Rate Example

- The experiment involved 3 drugs: AX23, BWW9, and a Control.
- For each drug there were 8 women randomly assigned to that drug (24 subjects in total).
- For each subject, heart rate was measured every 5 minutes, starting 5 minutes after administration of the drug.
- It will be interesting to compare the heart rate profiles by treatment group.

Data

AX23					BWW9					Control				
Subject	T1	T2	T3	T4	Subject	T1	T2	T3	T4	Subject	T1	T2	T3	T4
1	72	86	81	77	9	85	86	83	80	17	69	73	72	74
2	78	83	88	81	10	82	86	80	84	18	66	62	67	73
3	71	82	81	75	11	71	78	70	75	19	84	90	88	87
4	72	83	83	69	12	83	88	79	81	20	80	81	77	72
5	66	79	77	66	13	86	85	76	76	21	72	72	69	70
6	74	83	84	77	14	85	82	83	80	22	65	62	65	61
7	62	73	78	70	15	79	83	80	81	23	75	69	69	68
8	69	75	76	70	16	83	84	78	81	24	71	70	65	65
Avg:	70.5	80.5	81.0	73.1		81.8	84.0	78.6	79.8		72.8	72.4	71.5	71.3

Plots



Code for plot

```
> library(lattice)
> spp = read.table("spp.txt", header = T)
> attach(spp)
> print(xyplot(Rate ~ Time | Subject, groups = Treatment, pch = 16))
```

Model Choices

- See what treatment effect is.
- Subject is a random effect.
- Model separate lines for each subject?
- Model separate curves for each subject?
- Fit several models and compare estimates.

Models

- No treatment, separate lines for each subject.
`fit1a = lmer(Rate ~ Time + (Time | Subject))`
- As above, but subjects all have the same slope.
`fit1a = lmer(Rate ~ Time + (1 | Subject))`
- Separate lines for each treatment, separate lines for each subject.
`fit2a = lmer(Rate ~ Time*Treatment + (Time | Subject))`
- As above, but subjects all have the same slope.
`fit2b = lmer(Rate ~ Time*Treatment + (Time | Subject))`
- Separate curves for each treatment, separate curves for each subject.
`fit3a = lmer(Rate ~ Time*Treatment + I(Time^2)*Treatment + (Time | Subject) + (I(Time^2) | Subject))`
- As above, but subjects all have the same slope.
`fit3b = lmer(Rate ~ Time*Treatment + I(Time^2)*Treatment + (1 | Subject))`