Longitudinal Data: Repeated Measures

Analyzing Pain Tolerance in Children

Alan Hubbard

Nov 1, 2018

Read in data

```
dat = read_csv("Weisspain.csv")
```

```
## Parsed with column specification:
## cols(
##   id = col_integer(),
##   ses = col_double(),
##   cs = col_character(),
##   treatment = col_character(),
##   sex = col_character(),
##   age = col_double(),
##   trial = col_integer(),
##   paintol = col_double(),
##   l2paintol = col_double()
## )
```

```
tbl_df(dat)
```

```
## # A tibble: 256 x 9
##       id   ses cs       treatment     sex      age trial paintol l2paintol
##    <int> <dbl> <chr>    <chr>         <chr>  <dbl> <int>   <dbl>     <dbl>
##  1     1  73.5 attender attend        female 10.1      1   20.6       4.36
##  2     1  73.5 attender attend        female 10.1      2   35.3       5.14
##  3     1  73.5 attender attend        female 10.1      3   14.3       3.84
##  4     1  73.5 attender attend        female 10.1      4   11.7       3.55
##  5     3  81.5 attender no directions female  8.67     1   12         3.58
##  6     3  81.5 attender no directions female  8.67     2   10         3.32
##  7     3  81.5 attender no directions female  8.67     3   12.2       3.61
##  8     3  81.5 attender no directions female  8.67     4    8.27      3.05
##  9     5  54   attender attend        male   10.2      1   24.9       4.64
## 10     5  54   attender attend        male   10.2      2   23.4       4.55
## # ... with 246 more rows
```

Description of Data The Pediatric Pain data has up to four observations on 64 elementary school children aged eight to ten (Fanurik, Zeltzer, Roberts, and Blount 1993). The response is the length of time in seconds that a child can tolerate keeping his or her arm in very cold water (the cold pressor task), a proxy measure of pain tolerance (`paintol`). After the cold becomes intolerable, the child removes his or her arm, the arm is toweled off, and no harm is caused. There is some missing data due to kids having casts on an arm or being absent, but no one dropped out for reasons related to the experiment. Subjects underwent two trials during a first visit followed by two more trials during a second visit after a two-week gap (so, hierarchical data of trials within visits within children). The first trial uses the dominant arm, the right arm for right-handed children, and the left arm for left-handers. The second trial is with the non-dominant arm. Subjects were asked what they were thinking about during the first two trials. Those who were thinking about the experiment, the experimental apparatus, the feelings from their arms, and so on, were classified as having an attender coping style (cs). Those who thought about other things: the wall, homework from school, going to the amusement park, or things unrelated to the experiment were classified as having a distracter coping style.

A randomized treatment (treatment) was administered prior to the fourth trial. The treatment consisted of a ten-minute counseling intervention where coping advice was given either to attend, distract or no direction.

```
table(dat$treatment)
```

```
##
##         attend      distract no directions
##             84             92             80
```

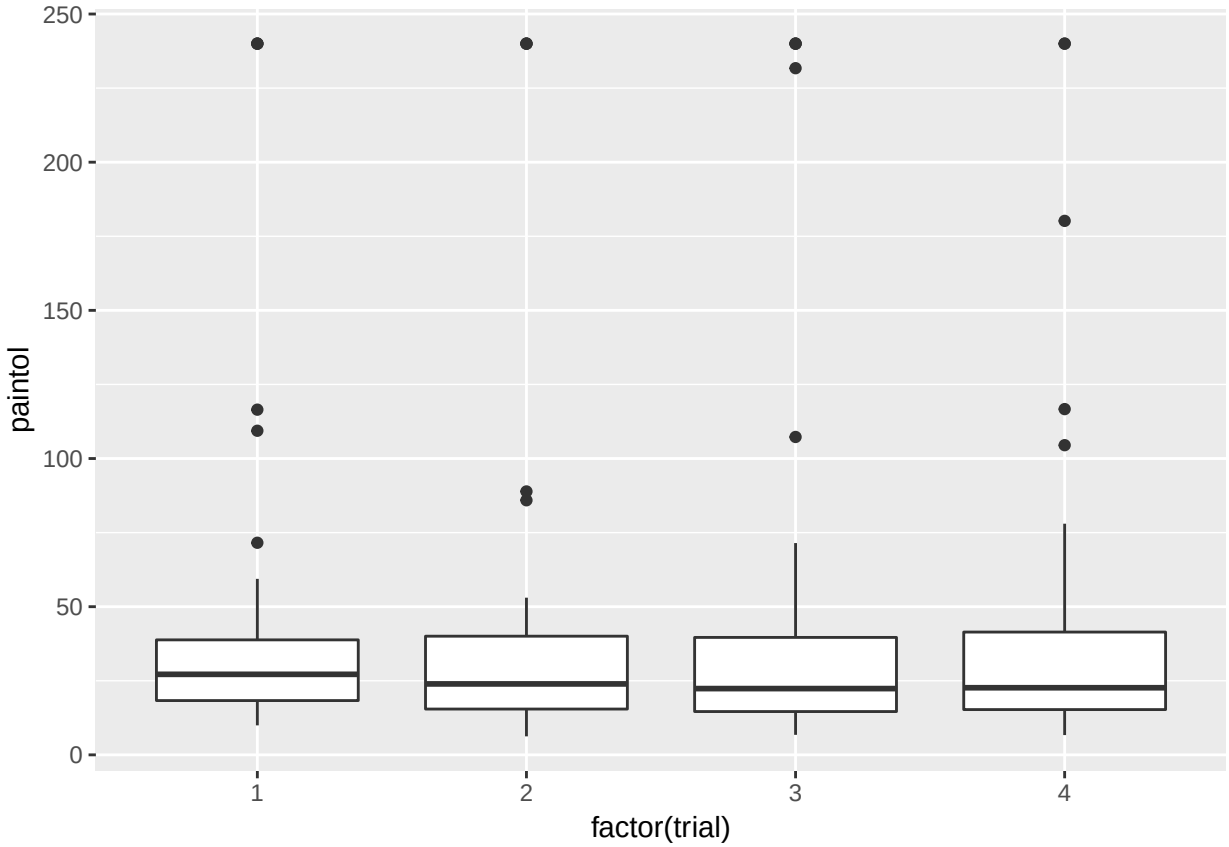
(NOTE - that means that there currently is not a variable that indicates specifically for time 4, there is three treatment groups). So we make one now.

```
# Make 2 dummy variables to indicate
# attend and distract
dat <- dat %>% mutate(attend = (treatment ==
```

```
    "attend" & trial == 4)) %>% mutate(distract = (treatment ==
    "distract" & trial == 4))
# Make indicator of visit and type
dat <- dat %>% mutate(visit = trial > 2) %>%
    mutate(attender = cs == "attender")
# make interaction terms
dat <- dat %>% mutate(attend_attender = attend *
    attender) %>% mutate(distract_attender = distract *
    attender)
```

Distribution by Trial

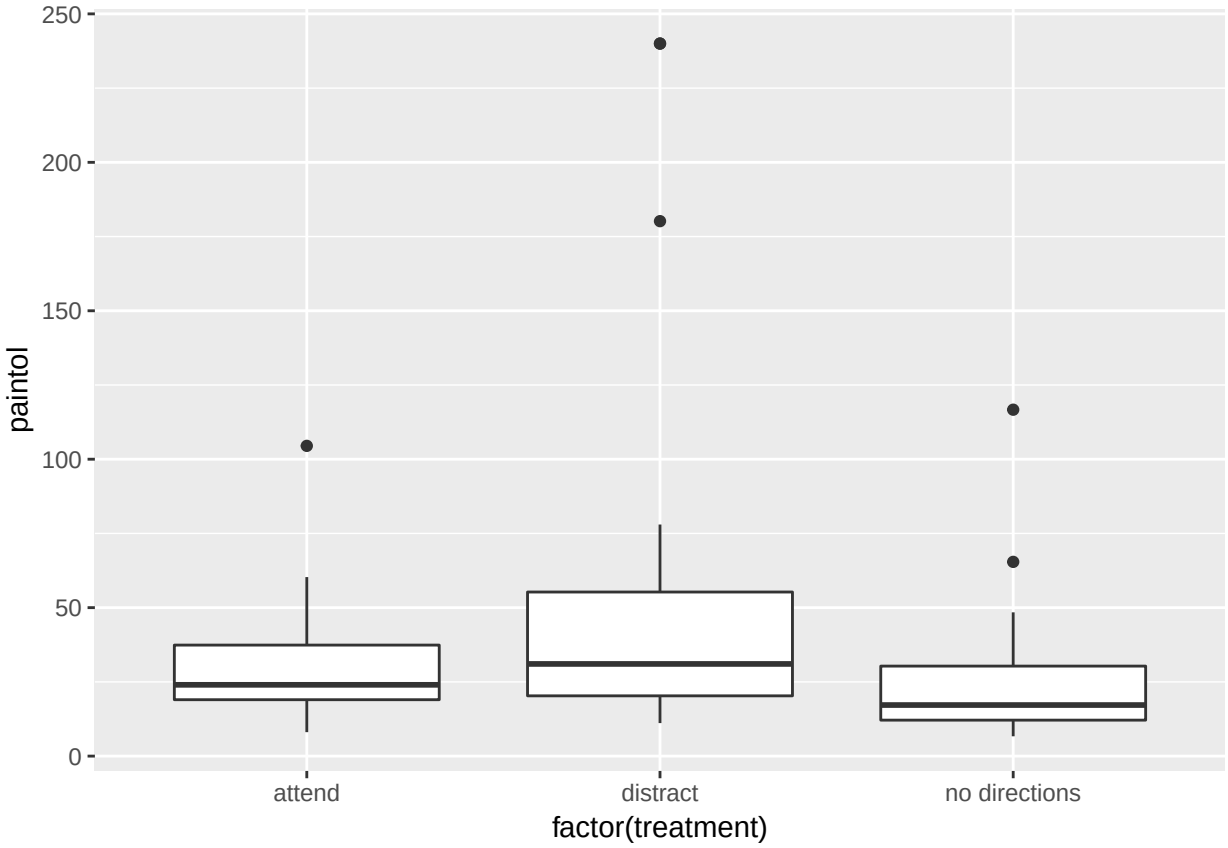
```
## Warning: Removed 11 rows containing non-finite values (stat_boxplot).
```



Distribution by Treatment at trial 4

```
ggplot(subset(dat, trial == 4), aes(x = factor(treatment),
    y = paintol)) + geom_boxplot()
```

```
## Warning: Removed 3 rows containing non-finite values (stat_boxplot).
```



Other relevant graphical summaries?

```
# << PUT YOUR CODE HERE >>
```

Fit and summarize models

The goal is to, with one model, estimate the association of the type (cs) of subject and pain tolerance when not treated, as well as the impact of the two treatments (vs. no direction), as well as if the treatment effects differ by type (cs). Fit a series of models starting from simple ordinary linear regression up to different types of random effects models.

Data

- Y_{ijk} is outcome for ith person ($i = 1, \ldots, 64$), jth visit ($j = 1, 2$), kth repeat ($k = 1, 2$),
- T_{ijk1} is indicator of attend (treatment),
- T_{ijk2} is indicator of distract (treatment),
- A_{ijk} is indicator of being an attender (cs),
- sex_{ijk} is indicator of male
- age_{ijk} is age in years, and
- ses_{ijk} is the socio-economic status.

- $O_i = (Y_{ijk}, \vec{T}_{ijk}, A_{ijk}, age_{ijk}, ses_{ijk}, sex_{ijk}, j = 1, 2, k = 1, 2)$

Models

1. $Y_{ijk} = \beta_0 + \beta_1 age_{ijk} + \beta_2 ses_{ijk} + \beta_3 sex_{ijk} + \beta_4 A_{ijk} + \beta_5 T_{ijk1} + \beta_6 T_{ijk2} + \beta_7 A * T_{ijk1} + \beta_8 A * T_{ijk1} + e_{ijk}$
2. Put other potential mixed models (see Chapter7CodePart2.Rmd).

Parameters/Tests of Interests

Impact of treated (relative to no direction). 1. Difference in means of those with got attend vs. no direction.

$$E(Y_{ijk}|age_{ijk} = age, ses_{ijk} = s, sex_{ijk} = sx, A_{ijk} = a, T_{ijk1} = 1, T_{ijk1} = 0)$$
$$-E(Y_{ijk}|age_{ijk} = age, ses_{ijk} = s, sex_{ijk} = sx, A_{ijk} = a, T_{ijk1} = 0, T_{ijk1} = 0)$$
$$= (\beta_0 + \beta_1 age + \beta_2 ses + \beta_3 sx + \beta_4 a + \beta_5 * 1 + \beta_6 * 0 + \beta_7 * a * 1 + \beta_8 * a * 0$$
$$-(\beta_0 + \beta_1 age + \beta_2 ses + \beta_3 sx + \beta_4 a + \beta_5 * 0 + \beta_6 * 0 + \beta_7 * a * 0 + \beta_8 * a * 0$$
$$= \beta_5 + \beta_7 * a$$

2. Difference in means of those with got distract vs. no direction.

$$= \beta_6 + \beta_8 * a$$

Model 1

```
# << PUT YOUR CODE HERE >> OLS
```

Estimates of parameters of interest

```
## Attend vs. no direction among
## non-attenders and attenders distract
## vs. no direction among non-attenders
## and attenders << Put your code here
```

Model 2

```
# << PUT CODE HERE >>
```

Model 2 Stats

```
# << PUT CODE HERE >>
```

Estimates of parameters of interest

```
# << PUT CODE HERE >>
```

Other Models

```
# << PUT CODE HERE >>
```

Compare fit of the 4 models

```
# << PUT CODE HERE >>
```

Report the results of the chosen model

Put your answer here