TobiasRoth / BK-pvalues

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174 lines (149 sloc) 6.64 KB

title	author	date	output	df_print	smaller
P-value project	Blockkurs 2018	28.03.2018	ioslides_presentation	paged	true

```
rm(list=ls(all=TRUE))
knitr::opts_chunk$set(echo = FALSE, cache = TRUE, fig.asp = 0.6, fig.height=5)

# Libraries
library(knitr)
library(tidyverse)
library(arm)
library(readxl)

# Gestaltung der plots in ggplot
theme_set(theme_classic())

# Daten einlesen
dat <- read_xlsx("Data/Masterfile R.xlsx") %>%
  filter(!is.na(date))
dat$Reihenfolge <- rep(1:10, 172)
```

Data

- Number of persons interviewed: `r length(unique(dat$ID_person))`
- Proportion of females: `r formatC(mean(tapply(dat$gender, dat$ID_person, function(x) x[1]) == 0), 2, format = "f")`
- Average proportion of correct answers: `r formatC(mean(dat$say_correct), 2, format = "f")`

Statistical experience

```
plot(table(tapply(dat$experience, dat$ID_person, function(x) x[1])),
     xlab = "Years with statistical experience",
     ylab = "Number of persons")
```

Statistical methods

- Logistic regression (outcome 0 or 1)
- Person ID as random effect to account for repeated measurements (each person gave 10 answers)
- Experimental treatment: figures with or without p-value
- Covariate: statistical experience of person (in log(years+1))
- Interaction treatment x experience

Main result

```
mod <- glmer(say_correct ~ log(experience + 1) + p_value_shown + (1|ID_person),
             family = binomial, data = dat)
res <- summary(mod)$coefficients[, c(1,2,4)] %>% data.frame()
row.names(res) <- c("Intercept", "Statistical experience [log(years+1)]", "Treatment", "Treatment x
Experience")
names(res) <- c("Estimate", "Std. Error", "P-Value")
kable(res, digits = 3)
```

Experienced persons excluded

```
res <- summary(glmer(say_correct ~ log(experience + 1) + p_value_shown + (1|ID_person), family =
binomial, data = dat %>% filter(experience < 10))$coefficients[, c(1,2,4)] %>% data.frame()
row.names(res) <- c("Intercept", "Statistical experience [log(years+1)]", "Treatment", "Treatment x
Experience")
names(res) <- c("Estimate", "Std. Error", "P-Value")
kable(res, digits = 3)
```

- Persons with more more than 9 years of statistical experience excluded.
- Results remain remarkably stable.

Deceived by p-values

```
nsim <- 100
newdat <- expand.grid(experience = seq(0, 5, 0.1), pvalue = c(0, 1))
simres <- sim(mod, nsim)@fixef
tmpres <- array(NA, dim = c(nrow(newdat), nsim))
for(x in 1:nsim) {
  tmpres[, x] <- plogis(simres[x, 1] +
                        simres[x, 2] * newdat$experience +
                        simres[x, 3] * newdat$pvalue +
                        simres[x, 4] * newdat$experience * newdat$pvalue)
}
newdat$mean <- apply(tmpres, 1, mean)
newdat$low <- apply(tmpres, 1, quantile, probs = 0.025)
newdat$up <- apply(tmpres, 1, quantile, probs = 0.975)
newdat$pvaluel <- "no p-values presented"
newdat$pvaluel[newdat$pvalue == 1] <- "p-values presented"
ggplot(newdat) +  ylim(0, 1) +
  aes(experience, mean, fill = pvaluel) +
  geom_ribbon(aes(ymin = low, ymax = up), alpha = 0.3) +
  geom_line(aes(colour = pvaluel), lwd = 1.5) +
  labs(x = "Years with statistical experience", y = "Proportion of correct answers") +
  theme(legend.title=element_blank()) +
  theme(legend.position="bottom")
```

Correct answers increased with statistical experience, but less so when p-values were presented. Given are model predictions (lines) and 95% credible intervals (shaded areas).

What affects the answers?

- Only data from figures that shows confidence intervals AND p-values
- Logistic regression
- Outcome variable: 1 if person say left figure is correct, 0 otherwise.
- First predictor: difference in confidence interval length
- Second predictor: difference in p-values
- Person ID as random effect to account for repeated measurements (each person gave 5 answers)

What affects the answers?

If figures with confidence intervals and p-values are presented, the answers are more strongly guided by the difference in p-value than the differences in confidence interval length.

```
d <- dat %>%
  filter(CI == 1 & p_value_shown == 1) %>%
  transmute(say_left = say_left,
            confdiff = length_CI2 - length_CI1,
            pdiff = p_value2 - p_value1,
            ID_person = ID_person)
mod <- glmer(say_left ~ confdiff + pdiff + (1|ID_person),
             family = binomial, data = d)
res <- summary(mod)$coefficients[, c(1,2,4)] %>% data.frame()
row.names(res) <- c("Intercept", "Delta conf. intervals", "Delta p-values")
names(res) <- c("Estimate", "Std. Error", "P-Value")
kable(res, digits = 3)
```

Boxplots vs. confidence intervals?

- Only data from figures that do NOT show p-values
- Logistic regression
- Outcome variable: 1 answer is correct, 0 answer is not correct
- Predictor: 1 Figure shows a box-plot, 0 otherwise.
- Person ID as random effect to account for repeated measurements (each person gave 5 answers)

Boxplots vs. confidence intervals?

```
d <- dat %>%
  filter(p_value_shown == 0) %>%
  transmute(say_correct = say_correct,
            Boxplot = as.integer(substr(Image, 1,2) == "BP"),
            ID_person = ID_person)
mod <- glmer(say_correct ~ Boxplot + (1|ID_person),
             family = binomial, data = d)
res <- summary(mod)$coefficients[, c(1,2,4)] %>% data.frame()
row.names(res) <- c("Intercept", "Boxplot")
names(res) <- c("Estimate", "Std. Error", "P-Value")
kable(res, digits = 3)
```

The proportion of correct answers was slightly higher for figures with confidence intervals (`r formatC(plogis(res$Estimate[1]), 2, format = "f")`) than for figures with box-plots (`r formatC(plogis(sum(res$Estimate)), 2, format = "f")`). But the difference was not significant.

Effect of observer and gender

```
mod <- glmer(say_correct ~ log(experience + 1) + p_value_shown +
               observer + gender + (1|ID_person), family = binomial, data = dat)
res <- summary(mod)$coefficients[, c(1,2,4)] %>% data.frame()
row.names(res) <- c("Intercept", "Statistical experience [log(years+1)]", "Treatment",
                    "Observer", "Gender", "Treatment x Experience")
names(res) <- c("Estimate", "Std. Error", "P-Value")
kable(res, digits = 3)
```

Learning effect

```
mod <- glmer(say_correct ~ log(experience + 1) + p_value_shown + Reihenfolge
             + (1|ID_person), family = binomial, data = dat)
res <- summary(mod)$coefficients[, c(1,2,4)] %>% data.frame()
row.names(res) <- c("Intercept", "Statistical experience [log(years+1)]", "Treatment",
                    "Learn-effect", "Treatment x Experience")
names(res) <- c("Estimate", "Std. Error", "P-Value")
kable(res, digits = 3)
```