Effects of individual actions on perceived usefulness

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09 November, 2023

This file contains the code for the analysis of the effects of individual actions on perceived usefulness. Note that, due to the nature of the Bayesian *t*-tests, results will not always be the same for the means and standard deviations. From the output of the `print` of the result, we use the probability of the mean difference being larger and smaller than 0. From the output of the `summary` of the result, we use the mean and standard deviation values, and their 95% CIs.

```
## Loading required package: rjags
```

```
## Loading required package: coda
```

```
## Linked to JAGS 4.3.0
```

```
## Loaded modules: basemod,bugs
```

Run a Bayesian *t*-test on the raw data before and after the first change to the plan made, and calculate Cohen's *d* for these values.

```
# get the values for perceived usefulness before making the first change to the plan as a list
pu_changes_1_b = as.numeric(t(read.csv(
  "~/analysis/data/pu_changes_to_plan_1_before.csv", header = FALSE)))

# get the values for perceived usefulness after making the first change to the plan as a list
pu_changes_1_a = as.numeric(t(read.csv(
  "~/analysis/data/pu_changes_to_plan_1_after.csv", header = FALSE)))

# run the Bayesian t-test
pu_changes_to_plan_1 = bayes.t.test(pu_changes_1_b, pu_changes_1_a, paired = TRUE)

# print the results of the test, and the summary
print(pu_changes_to_plan_1)
```

```
##
##  Bayesian estimation supersedes the t test (BEST) - paired samples
##
## data: pu_changes_1_b and pu_changes_1_a, n = 114
##
##   Estimates [95% credible interval]
## mean paired difference: -4.1e-06 [-0.00042, 0.00042]
## sd of the paired differences: 0.0025 [0.0025, 0.0028]
##
## The mean difference is more than 0 by a probability of 0.492
## and less than 0 by a probability of 0.508
```

```
summary(pu_changes_to_plan_1)
```

```
##   Data
```

```
## pu_changes_1_b, n = 114
## pu_changes_1_a, n = 114
##
##   Model parameters and generated quantities
## mu_diff: the mean pairwise difference between pu_changes_1_b and pu_changes_1_a
## sigma_diff: the scale of the pairwise difference, a consistent
##   estimate of SD when nu is large.
## nu: the degrees-of-freedom for the t distribution fitted to the pairwise difference
## eff_size: the effect size calculated as (mu_diff - 0) / sigma_diff
## diff_pred: predicted distribution for a new datapoint generated
##   as the pairwise difference between pu_changes_1_b and pu_changes_1_a
##
##   Measures
##              mean    sd  HDIlo HDIup %<comp %>comp
## mu_diff     0.000 0.000  0.000 0.000  0.508  0.492
## sigma_diff  0.003 0.000  0.002 0.003  0.000  1.000
## nu          1.005 0.005  1.000 1.014  0.000  1.000
## eff_size   -0.002 0.085 -0.164 0.167  0.508  0.492
## diff_pred   0.006 1.194 -0.031 0.035  0.496  0.504
##
## 'HDIlo' and 'HDIup' are the limits of a 95% HDI credible interval.
## '%<comp' and '%>comp' are the probabilities of the respective parameter being
## smaller or larger than 0.
##
##   Quantiles
##             q2.5%   q25% median  q75% q97.5%
## mu_diff     0.000  0.000  0.000 0.000  0.000
## sigma_diff  0.002  0.002  0.003 0.003  0.003
## nu          1.000  1.001  1.003 1.006  1.017
## eff_size   -0.169 -0.059 -0.002 0.056  0.163
## diff_pred  -0.032 -0.003  0.000 0.003  0.034
```

```
# calculate Cohen's d
cohen.d(pu_changes_1_a, pu_changes_1_b, paired=TRUE)
```

```
##
## Cohen's d
##
## d estimate: 0.19689 (negligible)
## 95 percent confidence interval:
##      lower      upper
## 0.07604224 0.31773784
```

Run a Bayesian t-test on the raw data before and after the second change to the plan made, and calculate Cohen's d for these values.

```
pu_changes_2_b = as.numeric(t(read.csv(
  "~/analysis/data/pu_changes_to_plan_2_before.csv", header = FALSE)))

pu_changes_2_a = as.numeric(t(read.csv(
  "~/analysis/data/pu_changes_to_plan_2_after.csv", header = FALSE)))

pu_changes_to_plan_2 = bayes.t.test(pu_changes_2_b, pu_changes_2_a, paired = TRUE)


print(pu_changes_to_plan_2)
```

```
##
##  Bayesian estimation supersedes the t test (BEST) - paired samples
##
## data: pu_changes_2_b and pu_changes_2_a, n = 59
##
##   Estimates [95% credible interval]
## mean paired difference: 1.6e-07 [-0.00023, 0.00022]
## sd of the paired differences: 0.0010 [0.0010, 0.0011]
##
## The mean difference is more than 0 by a probability of 0.501
## and less than 0 by a probability of 0.499
```

```
summary(pu_changes_to_plan_2)
```

```
##   Data
## pu_changes_2_b, n = 59
## pu_changes_2_a, n = 59
##
##   Model parameters and generated quantities
## mu_diff: the mean pairwise difference between pu_changes_2_b and pu_changes_2_a
## sigma_diff: the scale of the pairwise difference, a consistent
##   estimate of SD when nu is large.
## nu: the degrees-of-freedom for the t distribution fitted to the pairwise difference
## eff_size: the effect size calculated as (mu_diff - 0) / sigma_diff
## diff_pred: predicted distribution for a new datapoint generated
##   as the pairwise difference between pu_changes_2_b and pu_changes_2_a
##
##   Measures
##             mean    sd  HDIlo HDIup %<comp %>comp
## mu_diff    0.000 0.000  0.000 0.000  0.499  0.501
## sigma_diff 0.001 0.000  0.001 0.001  0.000  1.000
## nu         1.011 0.011  1.000 1.034  0.000  1.000
## eff_size   0.001 0.109 -0.214 0.214  0.499  0.501
## diff_pred  0.002 0.247 -0.014 0.012  0.500  0.500
##
## 'HDIlo' and 'HDIup' are the limits of a 95% HDI credible interval.
## '%<comp' and '%>comp' are the probabilities of the respective parameter being
## smaller or larger than 0.
##
##   Quantiles
##             q2.5%   q25% median  q75% q97.5%
## mu_diff     0.000  0.000  0.000 0.000  0.000
## sigma_diff  0.001  0.001  0.001 0.001  0.001
## nu          1.000  1.003  1.008 1.016  1.042
## eff_size   -0.212 -0.072  0.000 0.074  0.216
## diff_pred  -0.013 -0.001  0.000 0.001  0.014
```

```
cohen.d(pu_changes_2_a, pu_changes_2_b, paired=TRUE)
```

```
##
## Cohen's d
##
## d estimate: 0.07265283 (negligible)
## 95 percent confidence interval:
```

```
##      lower      upper
## 0.01089724 0.13440842
```

Run a Bayesian t-test on the raw data before and after explaining the importance of planning, and calculate Cohen's d for these values.

```
pu_planning_b = as.numeric(t(read.csv(
  "~/analysis/data/pu_explain_planning_before.csv", header = FALSE)))

pu_planning_a = as.numeric(t(read.csv(
  "~/analysis/data/pu_explain_planning_after.csv", header = FALSE)))

pu_explain_planning = bayes.t.test(pu_planning_b, pu_planning_a, paired = TRUE)


print(pu_explain_planning)
```

```
##
##  Bayesian estimation supersedes the t test (BEST) - paired samples
##
## data: pu_planning_b and pu_planning_a, n = 86
##
##   Estimates [95% credible interval]
## mean paired difference: -4.3e-06 [-5e-04, 0.00046]
## sd of the paired differences: 0.0025 [0.0025, 0.0028]
##
## The mean difference is more than 0 by a probability of 0.493
## and less than 0 by a probability of 0.507
```

```
summary(pu_explain_planning)
```

```
##   Data
## pu_planning_b, n = 86
## pu_planning_a, n = 86
##
##   Model parameters and generated quantities
## mu_diff: the mean pairwise difference between pu_planning_b and pu_planning_a
## sigma_diff: the scale of the pairwise difference, a consistent
##   estimate of SD when nu is large.
## nu: the degrees-of-freedom for the t distribution fitted to the pairwise difference
## eff_size: the effect size calculated as (mu_diff - 0) / sigma_diff
## diff_pred: predicted distribution for a new datapoint generated
##   as the pairwise difference between pu_planning_b and pu_planning_a
##
##   Measures
##              mean     sd  HDIlo HDIup %<comp %>comp
## mu_diff     0.000  0.000  0.000 0.000  0.507  0.493
## sigma_diff  0.003  0.000  0.002 0.003  0.000  1.000
## nu          1.007  0.007  1.000 1.020  0.000  1.000
## eff_size   -0.002  0.095 -0.192 0.180  0.507  0.493
## diff_pred  -0.181 31.447 -0.032 0.032  0.501  0.499
##
## 'HDIlo' and 'HDIup' are the limits of a 95% HDI credible interval.
## '%<comp' and '%>comp' are the probabilities of the respective parameter being
## smaller or larger than 0.
##
```

```
##   Quantiles
##             q2.5%   q25% median  q75% q97.5%
## mu_diff     0.000  0.000  0.000 0.000  0.000
## sigma_diff  0.002  0.002  0.003 0.003  0.003
## nu          1.000  1.002  1.005 1.010  1.025
## eff_size   -0.189 -0.065 -0.002 0.062  0.183
## diff_pred  -0.032 -0.003  0.000 0.003  0.032
```

```
cohen.d(pu_planning_a, pu_planning_b, paired=TRUE)
```

```
##
## Cohen's d
##
## d estimate: 0.1536769 (negligible)
## 95 percent confidence interval:
##      lower      upper
## 0.01660147 0.29075237
```

Run a Bayesian t-test on the raw data before and after identifying barriers, and calculate Cohen's d for these values.

```
pu_i_barriers_b = as.numeric(t(read.csv(
  "~/analysis/data/pu_identify_barriers_before.csv", header = FALSE)))

pu_i_barriers_a = as.numeric(t(read.csv(
  "~/analysis/data/pu_identify_barriers_after.csv", header = FALSE)))

pu_identify_barriers = bayes.t.test(pu_i_barriers_b, pu_i_barriers_a, paired = TRUE)


print(pu_identify_barriers)
```

```
##
##  Bayesian estimation supersedes the t test (BEST) - paired samples
##
## data: pu_i_barriers_b and pu_i_barriers_a, n = 85
##
##   Estimates [95% credible interval]
## mean paired difference: -1.5e-06 [-0.00025, 0.00025]
## sd of the paired differences: 0.0013 [0.0013, 0.0014]
##
## The mean difference is more than 0 by a probability of 0.495
## and less than 0 by a probability of 0.505
```

```
summary(pu_identify_barriers)
```

```
##   Data
## pu_i_barriers_b, n = 85
## pu_i_barriers_a, n = 85
##
##   Model parameters and generated quantities
## mu_diff: the mean pairwise difference between pu_i_barriers_b and pu_i_barriers_a
## sigma_diff: the scale of the pairwise difference, a consistent
##   estimate of SD when nu is large.
## nu: the degrees-of-freedom for the t distribution fitted to the pairwise difference
## eff_size: the effect size calculated as (mu_diff - 0) / sigma_diff
## diff_pred: predicted distribution for a new datapoint generated
```

```
##   as the pairwise difference between pu_i_barriers_b and pu_i_barriers_a
##
##   Measures
##              mean    sd  HDIlo HDIup %<comp %>comp
## mu_diff     0.000 0.000  0.000 0.000  0.505  0.495
## sigma_diff  0.001 0.000  0.001 0.001  0.000  1.000
## nu          1.007 0.007  1.000 1.021  0.000  1.000
## eff_size   -0.001 0.094 -0.186 0.185  0.505  0.495
## diff_pred   0.000 0.189 -0.017 0.017  0.499  0.501
##
## 'HDIlo' and 'HDIup' are the limits of a 95% HDI credible interval.
## '%<comp' and '%>comp' are the probabilities of the respective parameter being
## smaller or larger than 0.
##
##   Quantiles
##              q2.5%   q25% median  q75% q97.5%
## mu_diff     0.000  0.000  0.000 0.000  0.000
## sigma_diff  0.001  0.001  0.001 0.001  0.001
## nu          1.000  1.002  1.005 1.010  1.026
## eff_size   -0.185 -0.063 -0.001 0.062  0.185
## diff_pred  -0.017 -0.001  0.000 0.001  0.017
```

```
cohen.d(pu_i_barriers_a, pu_i_barriers_b, paired=TRUE)
```

```
##
## Cohen's d
##
## d estimate: -0.003043804 (negligible)
## 95 percent confidence interval:
##       lower       upper
## -0.07532504  0.06923743
```

Run a Bayesian t-test on the raw data before and after dealing with barriers, and calculate Cohen's d for these values.

```
pu_d_barriers_b = as.numeric(t(read.csv(
  "~/analysis/data/pu_deal_with_barriers_before.csv", header = FALSE)))

pu_d_barriers_a = as.numeric(t(read.csv(
  "~/analysis/data/pu_deal_with_barriers_after.csv", header = FALSE)))

pu_deal_with_barriers = bayes.t.test(pu_d_barriers_b, pu_d_barriers_a, paired = TRUE)


print(pu_deal_with_barriers)
```

```
##
##  Bayesian estimation supersedes the t test (BEST) - paired samples
##
## data: pu_d_barriers_b and pu_d_barriers_a, n = 85
##
##   Estimates [95% credible interval]
## mean paired difference: 7.7e-08 [-0.00028, 0.00026]
## sd of the paired differences: 0.0015 [0.0014, 0.0016]
##
## The mean difference is more than 0 by a probability of 0.5
```

```
## and less than 0 by a probability of 0.5
```

```
summary(pu_deal_with_barriers)
```

```
##   Data
## pu_d_barriers_b, n = 85
## pu_d_barriers_a, n = 85
##
##   Model parameters and generated quantities
## mu_diff: the mean pairwise difference between pu_d_barriers_b and pu_d_barriers_a
## sigma_diff: the scale of the pairwise difference, a consistent
##   estimate of SD when nu is large.
## nu: the degrees-of-freedom for the t distribution fitted to the pairwise difference
## eff_size: the effect size calculated as (mu_diff - 0) / sigma_diff
## diff_pred: predicted distribution for a new datapoint generated
##   as the pairwise difference between pu_d_barriers_b and pu_d_barriers_a
##
##   Measures
##              mean    sd  HDIlo HDIup %<comp %>comp
## mu_diff     0.000 0.000  0.000 0.000    0.5    0.5
## sigma_diff  0.001 0.000  0.001 0.002    0.0    1.0
## nu          1.007 0.007  1.000 1.022    0.0    1.0
## eff_size   -0.001 0.093 -0.180 0.185    0.5    0.5
## diff_pred  -0.002 0.282 -0.019 0.018    0.5    0.5
##
## 'HDIlo' and 'HDIup' are the limits of a 95% HDI credible interval.
## '%<comp' and '%>comp' are the probabilities of the respective parameter being
## smaller or larger than 0.
##
##   Quantiles
##             q2.5%   q25% median  q75% q97.5%
## mu_diff     0.000  0.000  0.000 0.000  0.000
## sigma_diff  0.001  0.001  0.001 0.001  0.002
## nu          1.000  1.002  1.005 1.010  1.027
## eff_size   -0.186 -0.063  0.000 0.062  0.180
## diff_pred  -0.019 -0.001  0.000 0.002  0.019
```

```
cohen.d(pu_d_barriers_a, pu_d_barriers_b, paired=TRUE)
```

```
##
## Cohen's d
##
## d estimate: 0.1094427 (negligible)
## 95 percent confidence interval:
##      lower      upper
## 0.02525845 0.19362686
```

Run a Bayesian t-test on the raw data before and after showing testimonials from other people who created plans, and calculate Cohen's d for these values.

```
pu_testimonials_b = as.numeric(t(read.csv(
  "~/analysis/data/pu_show_testimonials_before.csv", header = FALSE)))

pu_testimonials_a = as.numeric(t(read.csv(
  "~/analysis/data/pu_show_testimonials_after.csv", header = FALSE)))
```

```r
pu_show_testimonials = bayes.t.test(pu_testimonials_b, pu_testimonials_a, paired = TRUE)


print(pu_show_testimonials)
```

```
##
##  Bayesian estimation supersedes the t test (BEST) - paired samples
##
## data: pu_testimonials_b and pu_testimonials_a, n = 90
##
##   Estimates [95% credible interval]
## mean paired difference: -8.2e-07 [-0.00031, 3e-04]
## sd of the paired differences: 0.0017 [0.0016, 0.0018]
##
## The mean difference is more than 0 by a probability of 0.497
## and less than 0 by a probability of 0.503
```

```r
summary(pu_show_testimonials)
```

```
##   Data
## pu_testimonials_b, n = 90
## pu_testimonials_a, n = 90
##
##   Model parameters and generated quantities
## mu_diff: the mean pairwise difference between pu_testimonials_b and pu_testimonials_a
## sigma_diff: the scale of the pairwise difference, a consistent
##   estimate of SD when nu is large.
## nu: the degrees-of-freedom for the t distribution fitted to the pairwise difference
## eff_size: the effect size calculated as (mu_diff - 0) / sigma_diff
## diff_pred: predicted distribution for a new datapoint generated
##   as the pairwise difference between pu_testimonials_b and pu_testimonials_a
##
##   Measures
##              mean    sd  HDIlo HDIup %<comp %>comp
## mu_diff     0.000 0.000  0.000 0.000  0.503  0.497
## sigma_diff  0.002 0.000  0.002 0.002  0.000  1.000
## nu          1.007 0.007  1.000 1.020  0.000  1.000
## eff_size   -0.001 0.092 -0.188 0.174  0.503  0.497
## diff_pred  -0.002 0.242 -0.020 0.021  0.502  0.498
##
## 'HDIlo' and 'HDIup' are the limits of a 95% HDI credible interval.
## '%<comp' and '%>comp' are the probabilities of the respective parameter being
## smaller or larger than 0.
##
##   Quantiles
##             q2.5%   q25% median  q75% q97.5%
## mu_diff     0.000  0.000  0.000 0.000  0.000
## sigma_diff  0.002  0.002  0.002 0.002  0.002
## nu          1.000  1.002  1.005 1.009  1.025
## eff_size   -0.181 -0.063  0.000 0.062  0.182
## diff_pred  -0.021 -0.002  0.000 0.002  0.021
```

```r
cohen.d(pu_testimonials_a, pu_testimonials_b, paired=TRUE)
```

```
##
```

```
## Cohen's d
##
## d estimate: 0.01132866 (negligible)
## 95 percent confidence interval:
##       lower       upper
## -0.07424639  0.09690371
```