Body temperature investigation

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1 Introduction

The data available at https://uoepsy.github.io/data/BodyTemp.csv comprise measurements of the body temperature (`BodyTemp`, in Celsius) and pulse rate (`Pulse`) for a random sample of 50 healthy individuals. We are interested in estimating the mean body temperature for all healthy humans and testing whether this is different from the commonly thought value of 37 °C. As such, for the purpose of this investigation, we will only focus on the variable `BodyTemp`.

2 Analysis

Figure 1 shows that the body temperatures of the sample of 50 healthy individuals follow roughly a bell-shaped distribution, with most values between 36.5 and 37.5 °C and fewer in the tails of the distribution. No values were lower than 35.75 or larger than 38.22. The average body temperature in the sample was 36.81 °C, see Table 1, with a SE of 0.06 and 95% CI [36.69, 36.93]. Hence, we are 95% confident that the average body temperature for a healthy individual is between 36.69 °C and 36.93 °C.

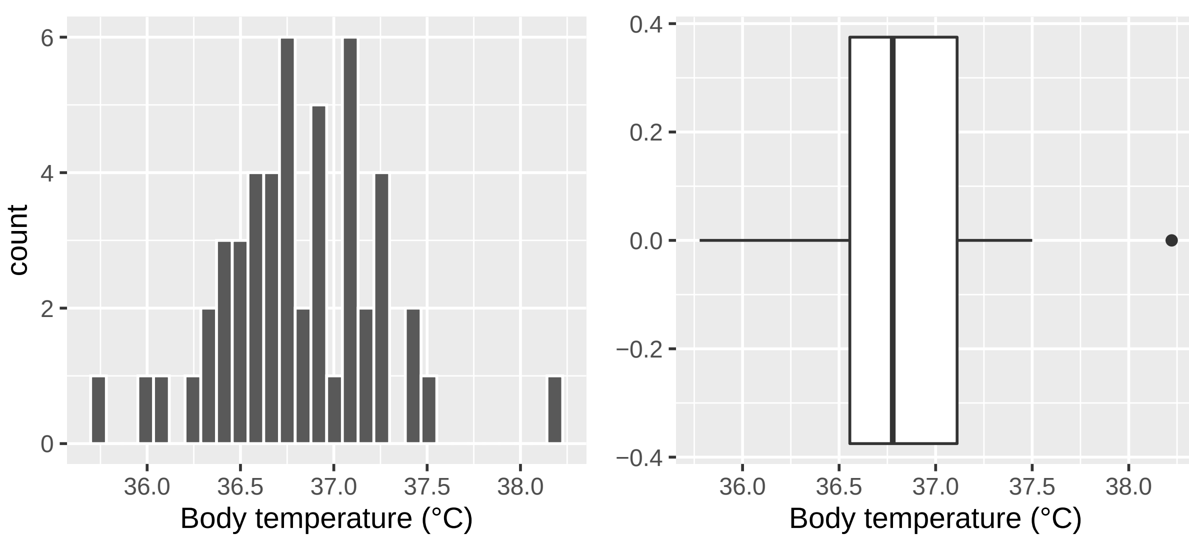

Figure 1: Distribution of body temperatures (°C)

If you were to use the p-value method:

At the 5% significance level, we tested whether the average body temperature of all healthy individuals was significantly different from the commonly thought value of 37 °C. The sample data provide very strong

Table 1: Descriptive statistics of body temperatures (°C)

n	M	SD	Min	Max
50	36.81	0.43	35.78	38.22

evidence against the null hypothesis and in favour of the alternative one that the mean body temperature is different from the hypothesised value of 37 °C, $t(49) = -3.14, p = .003$, two-sided.

If you were to use the critical value method:

At the 5% significance level, we tested whether the average body temperature of all healthy individuals was significantly different from the commonly thought value of 37 °C. The sample data provide significant evidence against the null hypothesis and in favour of the alternative one that the mean body temperature is different from the hypothesised value of 37 °C, $t(49) = -3.14, p < .05$, two-sided.

3 Discussion

This report estimated the mean body temperature of all healthy humans and tested whether, at the 5% significance level, that value is different from the long thought 37 °C.

The sample data provided very strong evidence that the population mean body temperature is different from 37 °C. Furthermore, we are 95% confident that the true mean value is between 36.69 °C and 36.93 °C, which is between 0.07 and 0.31 lower than the commonly thought value of 37 °C.

3.1 Appendix

```
knitr::opts_chunk$set(echo = FALSE, message = FALSE, warning = FALSE)
##### week 1 code
library(tidyverse)
library(patchwork)
library(kableExtra)

temp_data <- read_csv("https://uoepsy.github.io/data/BodyTemp.csv")

temp_data <- temp_data %>%
  select(BodyTemp)

dim(temp_data)
head(temp_data)
glimpse(temp_data)   # str()
summary(temp_data)

plt.h <- ggplot(temp_data, aes(x = BodyTemp)) +
  geom_histogram(color = 'white') +
  labs(x="Body temperature (°C)")
plt.h

plt.d <- ggplot(temp_data, aes(x = BodyTemp)) +
  geom_density() +
  labs(x="Body temperature (°C)")
```

```r
plt.d

plt.b <- ggplot(temp_data, aes(x = BodyTemp)) +
  geom_boxplot() +
  labs(x="Body temperature (°C)")
plt.b

plt.h | plt.b

# Option 1: with a descriptives table
stats <- temp_data %>%
  summarise(
    n = n(),
    M = mean(BodyTemp),
    SD = sd(BodyTemp),
    Min = min(BodyTemp),
    Max = max(BodyTemp)
  )
stats

tstar <- qt(c(0.025, 0.975), df = stats$n - 1)
stats$M + tstar * (stats$SD / sqrt(stats$n))


# Option 2: creating each variable
xbar <- mean(temp_data$BodyTemp)
n <- nrow(temp_data)
s <- sd(temp_data$BodyTemp)
se <- s / sqrt(n)
tstar <- qt(c(0.025, 0.975), df = n - 1)
xbar + tstar * se


##### week 2 code

# Step 1. Specify null and alternative hypotheses
# H0 : mu = 37
# H1 : mu not equal to 37

# Step 2. Compute t-statistic
# t_obs = (xbar - mu0) / SE     where SE = s / sqrt(n)

t_obs <- (stats$M - 37) / (stats$SD / sqrt(stats$n))
t_obs

# Step 3. Compute the p-value
pvalue <- 2 * pt(abs(t_obs), df = stats$n - 1, lower.tail = FALSE)
pvalue

# Step 4. Make a decision by comparing the p-value to alpha (significance level)
# - Reject H0 if pvalue <= alpha
# - Do not reject H0 if pvalue > alpha
```

```r
pvalue <= 0.05

# Step 5. Writing up


##### week 3 code

# Step 1. Specify null and alternative hypothesis

# H0 : mu = 37
# H1 : mu not equal to 37

# Step 2. Compute the t-statistic
# t_obs = (xbar - mu0) / SE   where SE = s / sqrt(n)

t_obs <- (stats$M - 37) / (stats$SD / sqrt(stats$n))
t_obs

# Step 3. Computing the critical values for the appropriate null distribution
# df = n - 1 = 49

tstar <- qt(c(0.025, 0.975), df = stats$n - 1)
tstar

# Step 4. Make a decision by comparing the observed t-statistic to the critical values -t^* and +t^*

t_obs
tstar

# Step 5. Writing up

plt.h | plt.b
kbl(stats, booktabs = TRUE, digits = 2,
    caption = "Descriptive statistics of body temperatures (°C)")
```