

Instructions

Upload your own solutions (handwritten or typed) to the corresponding Canvas Assignment on or before the due date: 03/12/2021.

Grading scheme

a	b	c	d	e	f	g	h	Total
3	2	3	3	2	2	3	2	20

A usability study. The aim in usability studies is to assess a product regarding its quality, performance or the satisfaction of the target group with the product. Collecting metrics in such studies (such as success, time on task, number of errors etc.) has become a common practice. Suppose that a startup company would like to test a working version of an app that they have developed, before it is officially released. With this app, the user should be able to perform certain tasks efficiently. In order to test their product, a representative group of subjects performs a specific task and the time on task is evaluated. In the table below, the task times (in minutes) are listed.

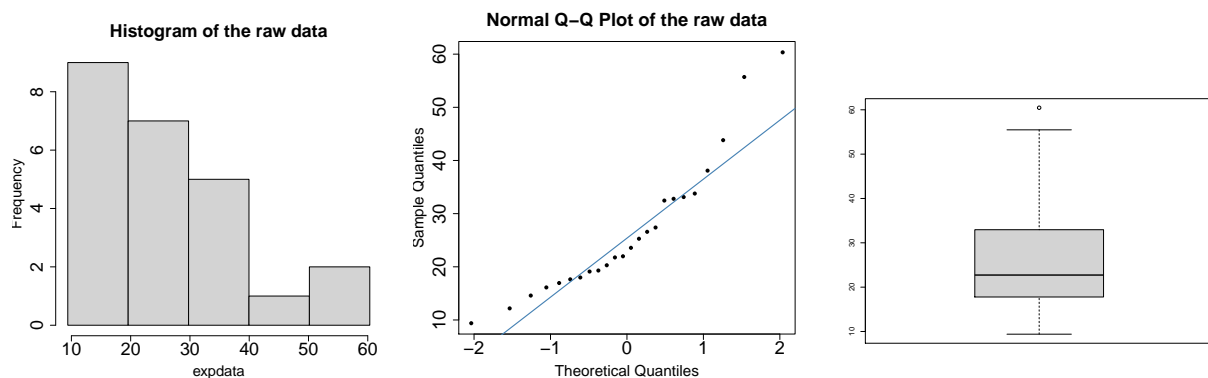
Raw data: task times (in minutes)							
37.94	14.59	16.09	33.72	19.30	21.89	9.39	16.88
43.90	21.67	19.03	26.47	23.57	60.46	25.38	55.48
33.25	32.66	32.59	20.25	12.16	17.64	17.92	27.44

a. Assume that the observations can be interpreted as **a random sample, drawn from a normal distribution**. Determine a 95% confidence interval for the expected task time. You may use that the mean and the sample standard deviation are given by $\bar{x} = 26.676$ and $s = 12.839$, respectively.

b. In an advertisement of the app, the startup claims that **the median of the task times is smaller than 30 minutes** using this new app (This means that 50% of the users can perform the task in less than 30 minutes). Based on the confidence interval of part a, is this claim reasonable?

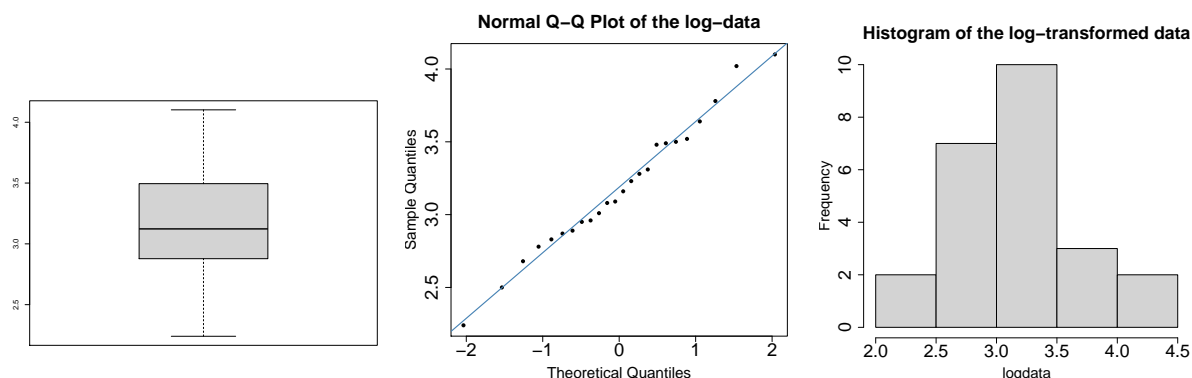
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c. In part a., we assumed that the observations can be interpreted as a random sample, drawn from a normal distribution. Your task is now to visually explore the distribution of the data based on the histogram, the normal Q-Q plot and the boxplot diagram given below. Do you think that the normality assumption is justified for the task times?



¹Notice that for a normal distribution, the mean and the median are identical. If a normal distribution is assumed, a confidence interval for the mean is also a confidence interval for the median!

d. In practice, it is very common to apply a log-transformation to task times. To obtain the transformed data, the natural logarithm of the task time (in minutes) of each subject is computed. Based on the histogram, the normal Q-Q plot and the boxplot diagram of the log-transformed data shown below, do you think it is justified to assume a normal distribution?



e. A 95% confidence interval for the average log-transformed task time is given by (2.991, 3.375). Argue that the interval

$$(e^{2.991}, e^{3.375}) = (19.906, 29.224) \quad (1)$$

is a 95% confidence for the **median** task time (in minutes). **You may use that**

$$e^{\text{average log-time}} = \text{median}(\text{task time}).$$

f. Based on all above considerations, is the claim that **the median of the task times is smaller than 30 minutes** using this new app, justified?

g. In a different part of the usability study, a group of 50 representative subjects performs a different task. 43 out of 50 subjects manage to complete the task in less than 10 minutes. Compute a large sample 90% confidence interval for the proportion of users that are able to complete this task in less than 10 minutes. Also argue why the assumptions are met to apply this large sample approach in this case.

h. Give an interpretation of the interval in part g. (in words) and explain what “90% confident” means.

Do's and Do not's for statistical inference with confidence intervals

- 👍 Always exercise caution and be critical (but remember we never have absolute certainty)
- 👍 Be careful regarding the conclusions that you draw: The differences between a wrong conclusion and a correct one can be very subtle!
- 👎 Don't apply a method without checking the assumptions!