How many grains are there in 5 kg of rice?

Adrian Lam

20 March 2022

Abstract

In this paper, the number of grains in 5 kg of rice is estimated by counting 4 samples of 10 g each from a bag of Green Dragon AAA Thai Hom Mali Fragrant Rice. The result is found to be 280375 ± 21770 at a 95 % confidence level.

1 Method

The 10 kg bag of rice was shook to mix the rice well. $n = 4$ samples of 10 g each were then measured out using a electronic kitchen scale with a precision of 1 g. The samples were then placed on plates and counted.

2 Results

Table 1 summarizes the obtained data, from which sample mean

$$\bar{x} = \frac{1}{n}\sum_{i}^{n} x_i = 560.75$$

and sample variance

$$S^2 = \frac{1}{n-1}\sum_{i}^{n} (x_i - \bar{x})^2 = 748.9167$$

were calculated.

The margin of error can then be calculated by

$$MOE = t_{n-1}\frac{S}{\sqrt{n}}$$

and is summarized in Table 2 for various confidence levels, using t_3 values tabulated in [1].

Finally, the results can be scaled up by a factor of $5000/10 = 500$ to get the final answer of

$$\begin{matrix} 16098 & 90 \\ 280375 \pm 21770 \text{ at } 95\,\% \text{ confidence level.} \\ 39962 & 99 \end{matrix}$$

x_i	$x_i - \bar{x}$	$(x_i - \bar{x})^2$
524	−36.75	1350.5625
590	29.25	855.5625
567	6.25	39.0625
562	1.25	1.5625

Table 1: Summary of obtained data

Confidence level	t_3 percentile point	MOE
90 %	$t_{3,\,0.050} = 2.353$	32.20
95 %	$t_{3,\,0.025} = 3.182$	43.54
99 %	$t_{3,\,0.005} = 5.841$	79.92

Table 2: Margin of error at 10 g for various confidence levels

3 Discussions

A major source of uncertainty is the precision of the kitchen scale used, corresponding to a ±5 % uncertainty. The margin of error is expected to decrease significantly with a more precise scale.

While the bag of rice was shook, it is inevitable that smaller grains will usually sink to the bottom, making it more difficult to get a representative sample. This means that the obtained value could be an underestimate.

It was also difficult to determine how to count tiny bits that were broken off from other grains. In this paper, the author's subjective decision was used to decide what does and does not count as one grain. A more objective approach could have been taken, for example by defining a minimum required length. This was not done here in the interest of time.

A Twitch streamer (tansan_miz) is attempting to estimate the same quantity by counting all grains in 5 kg of rice. When he finishes, his count is expected to be greater than the estimate provided here. This is because he is counting Japonica rice [2], which has a smaller grain size than the Hom Mali rice used here.

References

[1] Edexcel, "Edexcel AS/A level Mathematics Formulae List," Issue 1, Sep. 2009.

[2] @tansan_miz, "これで10粒…" Mar. 19, 2022. [Online]. Available: `https://twitter.com/tansan_miz/status/1505098019003269123`. [Accessed Mar. 20, 2022].