Collected Papers First Half of 2025

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26th May, 2025

Preface

To cite an article in this collection, you may do it the following way:

Mikko I. Malinen, ”The Article Name Comes Here”, in Collected Papers First Half of 2025, Mikko I. Malinen, Joensuu, Finland, May 2025

Joensuu, Finland 26th May, 2025

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Chapter 1

Sizes of bits in grated food are exponentially distributed

1.1 Introduction

A food processor is shown in Figure 1.1 (left) and its blade in Figure 1.1 (right). We show that the histogram of the sizes of bits in grated food made in food processor obey exponential distribution.

1.2 Theory

The probability density function (pdf) of the exponential distribution is

$$f(x) = \lambda e^{-\lambda x} = \frac{1}{\mu} e^{\frac{x}{\mu}}, \tag{1.1}$$

where λ (rate) or alternatively μ (mean) is the only parameter.
We put 100 bits of size 1 food into a food processor. The mean value of sizes will be

$$\mu = \frac{100}{\#bits}, \tag{1.2}$$

so f.eg. if processing will be done to 10.000 bits, the mean of sizes will be

$$\mu = \frac{100}{10.000} = 0,01. \tag{1.3}$$

We model the bits as one-dimensional objects; that is, they have only the length defining the size as a property. When we select which bit to cut next, the probability to be chosen will be directly proportional to bit size. When the bit is selected, we cut it from random location, so that

$$\text{size of smaller bit} + \text{size of bigger bit} = \text{size of the original bit}. \tag{1.4}$$

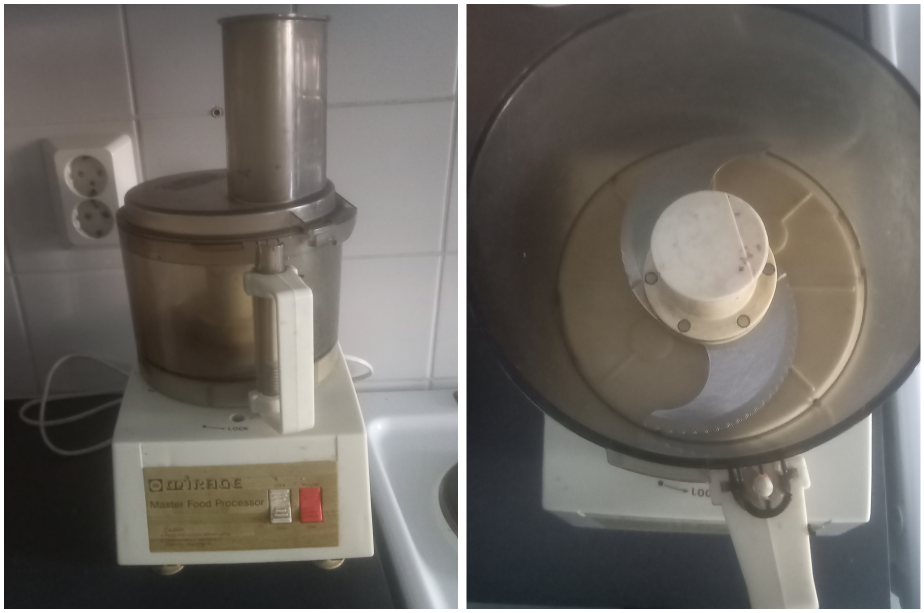

Figure 1.1: A food processor (left) and its blade (right).

1.3 Simulation

Cutting to 10.000 bits gives $\mu_{10.000} = 0,01$ (Figure 1.2) and 95% confidence interval $\mu_{ci} = [0,0092 \quad , \quad 0,0110]$. Cutting to 100.000 bits gives $\mu_{100.000} = 0,001$ (Figure 1.3) and 95% confidence interval $\mu_{ci} = [0,0010 \quad , \quad 0,0010]$.

1.4 Conclusion

The results give strong evidence that the cutting gives an exponentially distributed histogram of sizes. Cutting to 100.000 bits gives already a confidence interval that has no width at first two significant digits.

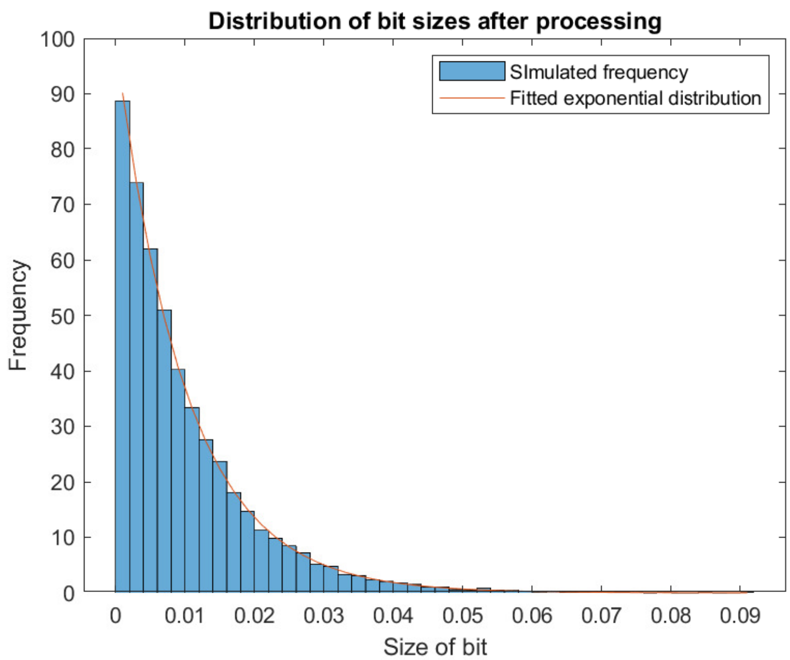

Figure 1.2: Size distribution, when there are 10.000 bits. The fitted exponential distribution in red.

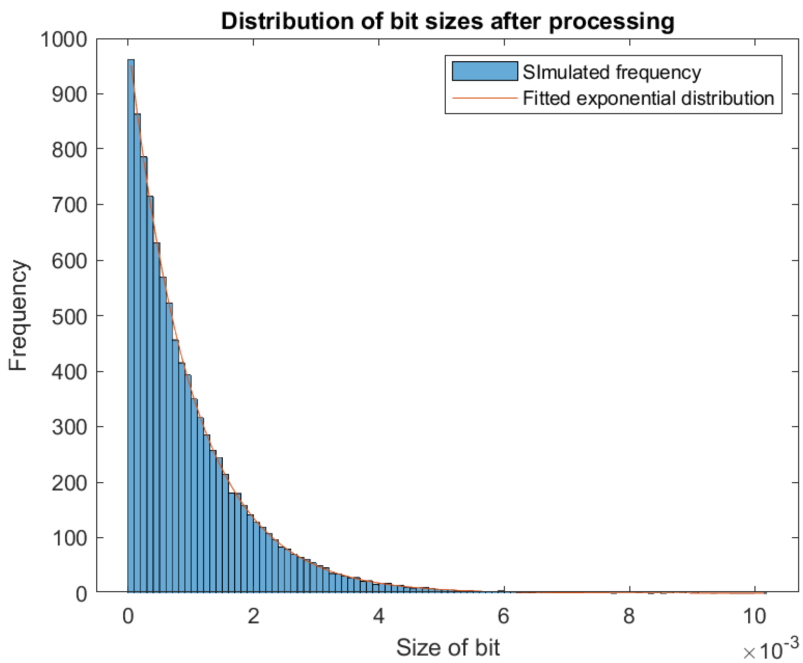

Figure 1.3: Size distribution, when there are 100.000 bits. The fitted exponential distribution in red.