

# Lognormal Behavior of the Size Distributions of Animation Characters

Ken YAMAMOTO\*

Department of Physics, Chuo University, 1-13-27 Kasuga, Bunkyo-ku, Tokyo 112-8551 Japan

E-mail: \*yamamoto@phys.chuo-u.ac.jp

**Keyword:** Size distribution, Lognormal behavior, Weber-Fechner law

In some animations, superhero series, and video games, the sizes of characters (e.g. heights and weights) are set officially. We investigate the statistical properties of these character sizes in this study.

In this abstract, we show the result of *Pokémon*, where 808 different Pokémon (fictional species) are listed [1], as of April 2016. We show the cumulative distributions of heights and weights of Pokémon in Fig. 1. The distribution of weight (Fig. 1b) well fits the cumulative form of the lognormal distribution

$$F(x) = \frac{N}{2} \left( 1 - \operatorname{erf} \left( \frac{\ln x - \mu}{\sqrt{2} \sigma} \right) \right),$$

where  $N = 808$  is the total number of Pokémon and  $\mu$  and  $\sigma$  are the fitting parameters.

We attempt to explain why the weight distribution follows the lognormal distribution. We assume that the Pokémon size can be considered to be a random variable. The size does not become too small or too large compared with a human size, and the natural size distribution is Gaussian. According to the Weber-Fechner law in psychophysics, perceived intensity is given by the logarithm of a physical stimulus; conversely, the stimulus is given by the exponential of the perception. Since Pokémon are fictional creatures, their sizes have been designed in the mind. Therefore, the Gaussian distribution in the mind leads to the lognormal distribution, due to the Weber-Fechner law; note that the lognormal distribution is the exponential of the Gaussian [2]. In addition, the height of a character is directly related to graphic aspects, so the height probably cannot be assigned more freely than the weight. We surmise that the height distribution (Fig. 1a) deviates from the lognormal because of this effect.

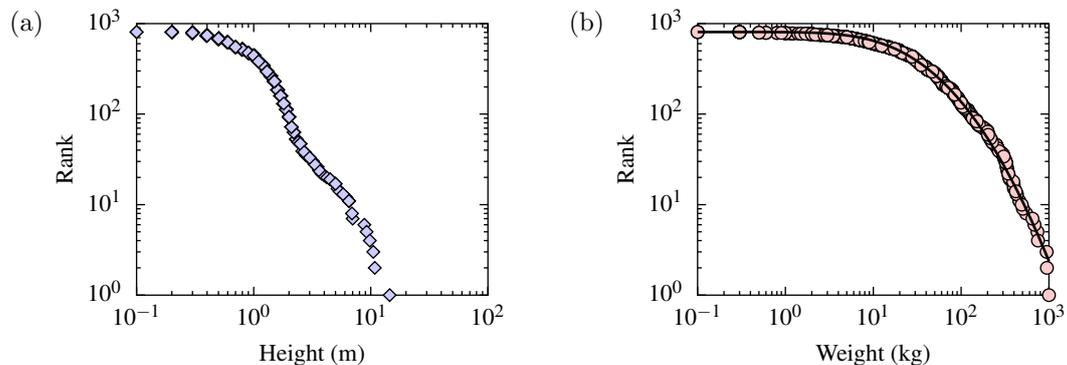


Figure 1: Cumulative distribution of the heights (a) and weights (b) of 808 Pokémon. The solid curve in (b) is the lognormal fitting curve.

## References

- [1] Pokémon Zukan (Japanese official Pokémon index): <http://www.pokemon.jp/zukan/> [in Japanese], Pokédex (American official Pokémon index): <http://www.pokemon.com/us/pokedex/>
- [2] E. L. Crow and K. Shimizu, “Lognormal distribution”, Dekker, New York, (1988).