Lognormal Probability Distribution

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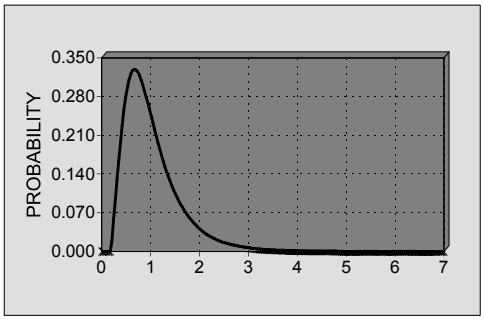
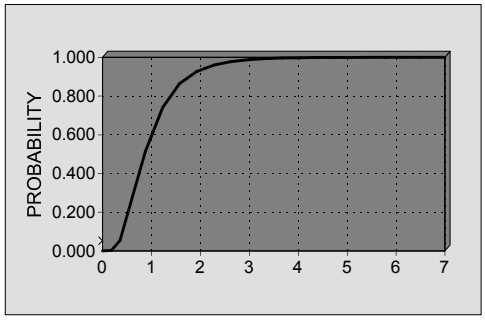
Properties of the Lognormal Distribution

The lognormal distribution is one of the most widely used distributions in probabilistic assessments. The two parameter lognormal distribution only assumes non-negative values. The lognormal distribution could be used to represent herd and flock sizes, weight of plate waste ingested by sows, weight of processed hams, vaccine doses administered by swine operations, farm or family income and the concentration of a chemical in the environment. The lognormal distribution may be used to describe random variables resulting from multiplicative processes as the product of two or more distributions from Monte Carlo simulation.

Density function for the Lognormal distribution with parameters (1, 0.6) as an output of @RISK simulation



Cumulative distribution for Lognormal (1, 0.6) as an output of @RISK simulation



Lognormal Distribution

Areas of Application

- used for the distribution of particle sizes in natural aggregates such as the concentration of dust in an industrial atmosphere
- models the duration of absence due to sickness and the physician's time for consultation
- describes dye-dilution curves of concentration of indicator as a function of time has applications in the area of quality control
- a strong competitor of the Weibull distribution in representing life-time distributions
- often better than the normal distribution in describing such variables as height, weight and density among others since unlike the normal it does not ascribe probabilities to negative values of these variables
- applied to production data/functions as the distribution of size for varied kinds of 'natural' economic units
- as good as the extreme value distributions in representing flood flows
- can replace the normal distribution to facilitate the calculation of confidence limits to estimate the coefficient of variation
- useful in describing the distribution of the critical dose for a number of forms of drug application, which has lead to quantal response data analysis or probit analysis
- arises as a limiting distribution of order statistics if the sample size and order increase in specific relationships
- even has applications in geological, agricultural, entomological and literary research

Properties of the Lognormal Distribution

Probability density function:

$$f(x) = \frac{1}{x\sqrt{2\pi\sigma_1^2}} e^{-(\ln x - \mu_1)^2/2\sigma_1^2}$$

$$where$$

$$\mu_1 = \ln\left(\frac{\mu^2}{\sqrt{\sigma^2 + \mu^2}}\right)$$

$$\sigma_1 = \sqrt{\ln\left(\frac{\sigma^2 + \mu^2}{\mu^2}\right)}$$

Cumulative distribution function: no closed form.

Parameters: $\sigma > 0$, $\mu > 0$

Domain: $x > 0$

Mean (μ): μ

Variance (σ^2): σ^2

Mode: $e^{(\mu_1 - \sigma_1^2)}$

Coefficient of skewness (α_3): $(e^{\sigma^2} + 2)\sqrt{(e^{\sigma^2} - 1)}$

Coefficient of kurtosis (α_4): $(e^{\sigma^2})^4 + 2(e^{\sigma^2})^3 + 3(e^{\sigma^2})^2 - 3$