

Diameter Structure Analysis of Forest Stand and Selection of Suitable Model

Tsogt Khongor¹, Chinsu Lin^{1*} and Zandraabal Tsogt²

¹Department of Forestry and Natural Resources, National Chiayi University, 300 University Road, Chiayi, 60004, Taiwan, *corresponding author: e-mail: chinsu@mail.nyu.edu.tw

²Department of Forest Resources, Institute of Botany, Mongolian Academy of Sciences, Jukov Avenue 77, Ulaanbaatar 210351, Mongolia

Abstract

Ecologically and economically it is important to understand how many tree stems are in each diameter class. The purpose of this study was to find larch forest (*Larix sibirica*) diameter distribution model among Weibull, Burr and Johnson SB distributions. Inventory was conducted near Gachuurt village, Ulaanbaatar, Mongolia. The goodness of fit test were accompanied with Kolmogorov-Smirnov, Anderson-Darling and Chi-Squared tests for distribution models. Study result shows Johnson SB distribution gave the best performance in terms of quality of fit to the diameter distribution of larch forest.

Key words: diameter distribution model, Weibull, Burr, Johnson SB, larch

Introduction

Detailed information of forest stand is crucial for forest research and planning. This information used for input of ecosystem modeling and/or forest growth and yield models. In the analysis of stand dynamics, detailed data for all trees on a plot is often lacking. In such case, we may generate missing data using various theoretical diameter (D) distributions. For many years there were various activity and interest in describing the frequency distribution of D measurements in forest stands using probability density functions. First study of D distribution mathematical description was negative exponential (DeLiocourt 1898), and since then, researchers used various distributions.

All distribution models have their advantage and sensitive in specific shape. Weibull distribution able to describe Exponential, Normal and Lognormal distribution shapes (Bailey & Dell, 1973; Lin *et al.*, 2007), while Burr distribution cover much larger area of skewness and kurtosis plane than the Weibull distribution (Lindsay *et al.*, 1996). Moreover, it is closely approximate with above mentioned distributions plus Gamma, Logistic and several Pearson type distributions. Johnson SB distribution cover different region of skewness and kurtosis plane than the Burr (Johnson, 1949; Hafley & Schreuder, 1977), and it is closely approximate

Beta and generalized Weibull distributions.

In case of Mongolian forests, Khongor *et al.* (2011a) published the birch forest D study using Weibull and Lognormal distributions and compared the accurateness of these models. For larch forest D distribution, Khongor *et al.*, (2011b) used Exponential, Lognormal and Gaussian (or Normal) distributions, but they did not used Weibull, Burr and Johnson SB before.

The purpose of this study is to investigate the suitability of the Weibull, Burr and Johnson SB distributions for modeling D distribution of larch forest (*Larix sibirica*).

Weibull distribution

One of the most popular models is the Weibull distribution, first introduced to the forestry research field by Bailey and Dell (1973). The popularity of the Weibull distribution depends largely on its simplicity and yet relatively good flexibility. It describes the inverse J shape for $\alpha < 1$ and the exponential distribution for $\alpha = 1$. For $1 < \alpha < 3.6$ the density function is mound shaped and positively skewed and for $\alpha = 3.6$ the density function becomes approximately normal. If $\alpha > 3.6$ the density function becomes increasingly negatively skewed. With the support random variable $x: \gamma \leq x < +\infty$ the Probability Density Function (pdf) of Weibull 3 parameter distribution is given as: