

## Appendix IV. Taper Equation

Kozak's variable exponent taper equation was used to calculate the merchantable volume of trees at each sample plot [Equation 1].

$$[1] \quad dib = a_0 D^{a_1} a_2^D X^{b_1 z^2 + b_2 \ln(z+0.001) + b_3 \sqrt{z} + b_4 e^z + b_5 (D/H)}$$

Where

$$[2] \quad X = (1 - \sqrt{h/H}) / (1 - \sqrt{p})$$

And

dib = top diameter inside bark (cm) at h

h = height above ground (m) to d,  $0 \leq h \leq H$

H = Total tree height (m)

D = diameter at breast height outside bark (cm)

Z = h/H

P = location of inflection point (22.5% of total height)

e = base of natural logarithm ( $\approx 2.71829$ )

$a_0, a_1, a_2, b_1, b_2, b_3, b_4, b_5$  = parameters to be estimated

The above equation and calculations procedures are provided in detail in an Alberta report prepared by Shongming Huang (1994) entitled "Ecologically Based Individual Tree Volume Estimation for Major Alberta Tree Species". All programming and calculation subroutines were carried out using S.A.S. programming language.

The base models used to create individual tree volumes include the above taper model, the diameter outside/inside bark model and the stump diameter and breast height diameter model. All models are fitted on the provincial tree sectioning data (stem analysis). The coefficients used to determine tree volume are as follows.

<b>Parameters</b>	<b>Jack Pine</b>	<b>Black Spruce</b>	<b>White Spruce</b>	<b>Aspen</b>	<b>White Birch</b>	<b>Balsam Poplar</b>
a <sub>0</sub>	1.032665	0.932687	0.886310	0.886430	0.790913	0.767020
a <sub>1</sub>	0.938855	0.998409	1.025046	0.996390	1.062430	1.017008
a <sub>2</sub>	1.000389	0.996101	0.995556	0.998604	0.995247	0.997743
b <sub>1</sub>	0.330882	0.489702	0.263889	0.162151	-0.194606	-0.367639
b <sub>2</sub>	-0.068225	-0.106226	-0.072889	-0.067440	0.024172	0.056375
b <sub>3</sub>	0.447639	0.935037	0.497900	0.181559	-1.853877	-2.018467
b <sub>4</sub>	-0.125772	-0.407412	-0.115357	0.263193	1.153796	1.238476
b <sub>5</sub>	0.153525	0.254396	0.161411	-0.196154	-0.40530	-0.037714
P	0.225	0.225	0.225	0.225		
n	2448	2128	951	393		
R <sup>2</sup>	0.9825	0.9845	0.9873	0.9836		
MSE	0.9025	0.4767	1.6764	0.7824		

Note: White Birch and Balsam Poplar coefficients were borrowed from Saskatchewan.