FOREST MODELS

4 Growth functions – Exercises

1 Fitting the Lundqvist-Korf function to data from one permanent plot

Use the EXCEL to fit the Lundqvist-Korf function to the data in the file 4GrowthFunctions-Exercises-data.xls. Start by making a "trial and error" fitting and, finally, use the SOLVER tool.

2 Analysis of the shape of the Lundqvist-Korf function for different values of the parameters

Using the EXCEL illustrate the shape of the Lundqvist-Korf function:

a) Varying the asymptote *A* and keeping parameters *k* and *m* constant
Suggestion: *A*=40,…,100; *k*=3; *m*=0.7

b) Varying parameter *k* and keeping both the asymptote *A* and the parameter *m* constant
Suggestion: *A*=90; *k*=1,…,7; *m*=0.5

c) Varying parameter *m* and keeping the asymptote *A* and the parameter *k* both constant
Suggestion: *A*=90; *k*=3; *m*=0.2,…,0.8

d) Using the dominant height data from the permanent plot of the Exercise 1.1 designated by "3x3 Iqe=26.4" find values for the parameters *A*, *k* and *n* that lead to a curve with a behavior similar to the evolution of plot dominant height (you may use the EXCEL SOLVER tool). By fixing the values of the asymptote *A* and the parameter *m*, analyze the changes in the parameter *k* in order to adapt the curve to the plots with different values of site index.

3 Analysis of the shape of the Richards function for different values of the parameters

Using the EXCEL, illustrate the shape of the Richards function:

a) Varying the asymptote *A* and keeping the parameters *k* and *m* constant
Suggestion: *A*=40,…,100; *k*=0.05; *m*=0.2

b) Varying parameter *k* and keeping both the asymptote *A* and the parameter *m*constant
Suggestion: *A*=90; *k*=0.2,…,0.08; *m*=0.2

c) Varying parameter *m* and keeping the asymptote *A* and the parameter *k* both constant
Suggestion: *A*=90; *k*=0.05; *m*=-0.6,…,0.6

4 Analysis of the shape of the Hossfeld IV function for different values of the parameters

Using the EXCEL, illustrate the shape of the Hossfeld IV function:

a) Varying the asymptote *A* and keeping parameters c_1 and *k* constant
Suggestion: *A*=40,…,100; c_1=0.20; *k*=1.20

b) Varying parameter c_1 and keeping the asymptote *A* and parameter *k* constant
Suggestion: *A*=90; c_1=0.10,…,0.70; *k*=1.20

c) Varying parameter *k* and keeping the asymptote A and parameter c_1 constant
Suggestion: *A*=90; c_1=0.40; *k*=0.90,…,1.50

5 Formulate the Lundqvist-Korf growth function as difference equations

a) Formulate the difference equations solving the function for *A*, *K* and *n*

b) Formulate the age independent difference equation form for the Lunqvist-Korf growth function

6 Formulate the Richards growth function as difference equations

a) Formulate the difference equations solving the function for *A*, *K* and *n*

b) Formulate the age independent difference equation form for the Richards growth function

7 Formulate the Hossfeld growth function as difference equations

c) Formulate the difference equations solving the function for *A*, c_1 and *k*

d) Formulate the age independent difference equation form for the Hossfeld growth function

8. Showing the relationship between the integral form of a growth function and the respective difference formulations.

a. Make a plot of the difference formulation of the Lundqvist function

$$Y = Y_0 \; e^{-k\left(\frac{1}{t^m}-\frac{1}{t_0^m}\right)}$$

using k=3, m=0.7 and the following initial values

t0	5	5	5	5	5
Y0	38	30	23	18	15

b. Now compute the values of the asymptote for each pair of initial values in a) and using the integral form of the Lundqvist function make again the graphs for the 5 plots.

9. Go to the link http://home.isa.utl.pt/~joaopalma/modelos/fgfp/index2.html and use the Forest Growth functions Playground to learn more about the role of each parameter on the shape of the growth functions.

10. Use the growth data from permanent plots of eucalyptus:

a. Plot the evolution of dominant height for the different plots

b. use the solver function from EXCEL to fit the Lundqvist function to the data and plot the estimated values together with the original data

c. estimate de site index (S) for each plot and fit the Lundqvist function with the A parameter expressed as a linear function of the site index and plot the estimated values together with the original data

d. use the solver function from EXCEL to fit the difference equation derived from Lundqvist function with k as the free parameter and plot the estimated values together with the original data

e. Compare the results looking at the residual sum of squares obtained with the 3 methods used

11. Suppose that you went to the field and measured the dominant height of an eucalyptus stand with the age of 5 years and found a value equal to 12.5 m. Estimate the site index of the stand (base age 10).