Laboratory 4: Reineke Line Graph in R

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In this Lab we will learn how to:

- Graph the Reineke line
- Add the lines of self-thinning and full site occupancy limits and the on-set competition
- Add a grid and text inside the plot
- Fit a Reineke line

We will use also the knowledge we acquire in our previous labs and the Reineke line fitted for *Pinus halepensis* Mill plantations in Aragon (Spain) by Hernández and Arrechea (2010) As usual, first we must define our working directory. In this lab we do not need any data set.

```
# establishing the working directory

setwd('C:/your_desired_working_directoryR')
```

Now we should define the variables and the maximum density line and the associated limits defined by Long (1985) by using this code:

```
# Variables and selfthinning line

Dg<-c(1:60)
Nmax <-(1:2500)
Nmax <-exp(11.9358)*Dg^(-1.605) #maximun density line

N60<-0.60*Nmax #lower limit or self-thinning
N35<-0.35*Nmax #lower limit of 'full site occupancy'
N25<-0.25*Nmax #On-set of competition (initial crown closure)
```

Basic graph

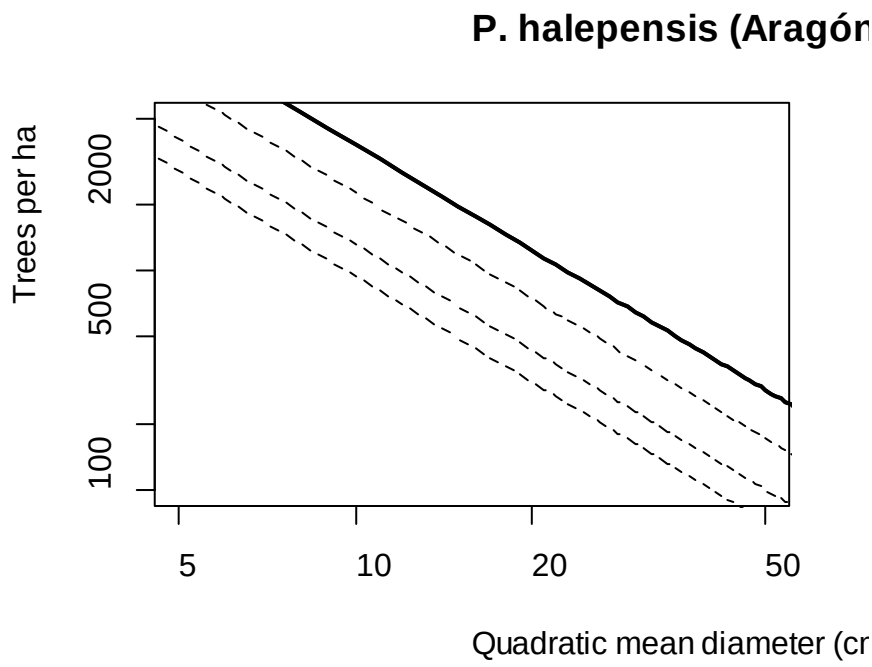
In our previous labs we have knew how to draw different plot types. Now we will draw a maximum density line graph by using the previous defined objects (Dg, Nmax, N60, N35 and N25) and a log transformation of the variables. The script to do that is the following:

```
# Graphing a maximum line density line

plot (Dg, Nmax, log=("xy"), type="l", lwd=2, col="black"
    ,ylab="Trees per ha"
    ,xlab="Quadratic mean diameter (cm)"
```

```
    ,main="P. halepensis (Aragón, Spain)"
    ,ylim= c(100,5000)
    ,xlim= c (5, 50)
    )
lines(Dg,Nmax,type="l",lwd=2, col="black")
lines(Dg,N60, type="l",lty=2, col="black")
lines(Dg,N35, type="l", lty=2, col="black")
lines (Dg,N25, type="l", lty=2, col="black")
```

To obtain the following plot:



Adding a grid

Now we have a maximum line density graph with log scales both for the x-axes (Quadratic mean diameter) and y-axes (trees per ha). If we want to add a grid on this graph we should use the instruction *abline* that will allow us to draw lines superimposed on the graph. The script is the following

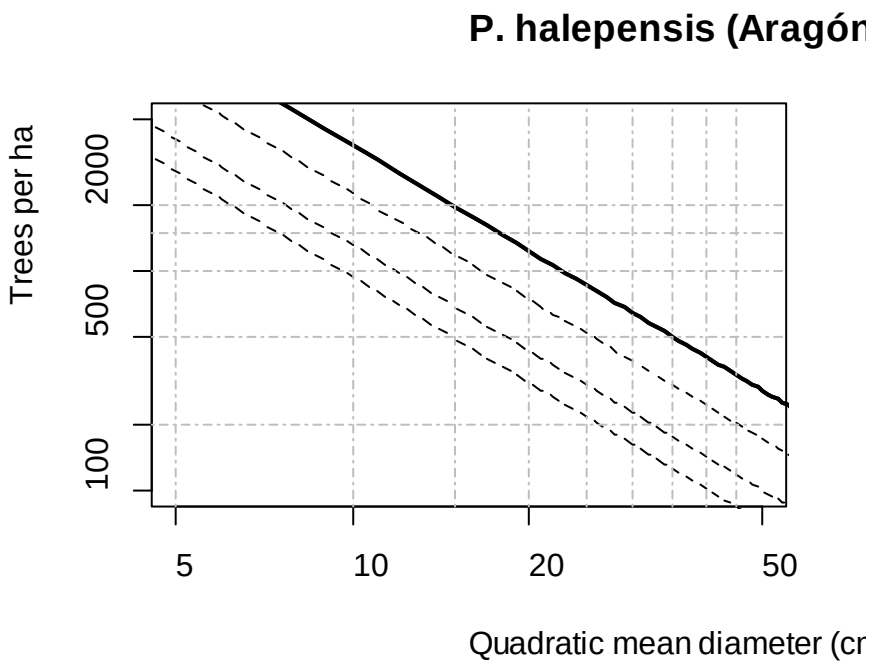
```
# adding a grid

#vertical lines
abline(v=5, lty=4, col="grey")
abline(v=10, lty=4, col="grey")
abline(v=15, lty=4, col="grey")
abline(v=20, lty=4, col="grey")
abline(v=25, lty=4, col="grey")
abline(v=30, lty=4, col="grey")
abline(v=35, lty=4, col="grey")
abline(v=40, lty=4, col="grey")
```

```
abline(v=45, lty=4, col="grey")

#horizontal lines
abline(h=200, lty=4, col="grey")
abline(h=500, lty=4, col="grey")
abline(h=1000, lty=4, col="grey")
abline(h=1500, lty=4, col="grey")
abline(h=2000, lty=4, col="grey")
```

to obtain:



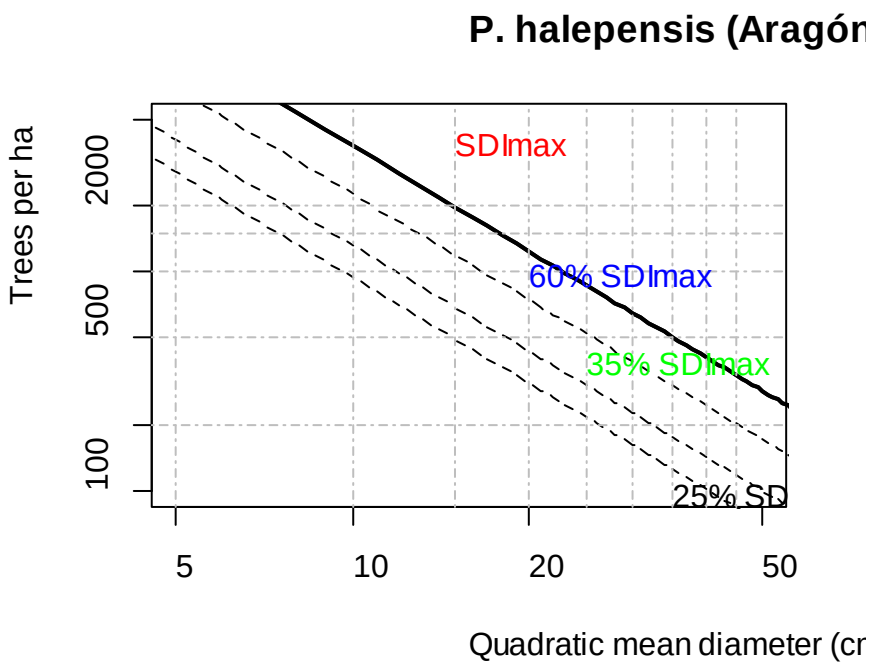
Writing a text on the grpah

Sometimes, you would like to include inside the graph some explanatory text to facilitate the readers to understand the output. In R you can include text inside the graph as follow:

```
# Adding explanatory text
# the first two digit in each text instruction indicate the position of the text

text(15,4000,"SDImax", col="red")
text(25,400, "35% SDImax", col="green")
text(20,1000,"60% SDImax", col="blue")
text(35, 100, "25% SDImax", clo="black")
```

to obtain:



Exporting the graph

Finally, you can export your graph to your desired path and in your preferred format by using this code line:

```
# Exporting the graph
# png format and indicate size (width and height)

png('C:/your_desired_ouptut_directoryR', width = 683, height = 495)
```

Fitting a Reineke line

We will use the Pnig_34_en_noSDI.csv dataset. This dataset comes from the Spanish National Forest Inventory and content *Pinus nigra* plots in the province of Palencia (northern Spain). Follow this script to insight on the Reineke line fitting.

```
# Fitting a Reineke line

# establish the working directory
setwd("C://datosR")

# import data sets

newdata <- read.csv2("Pnig_34_eng_noSDI.csv")

# check data structure

names(newdata)
```

```
head(newdata)
tail(newdata)
View (newdata)

# we will use newdata dataset
# calculate SDI and its maximum

newdata$SDI <- newdata$N*(25/newdata$DG)**(-1.605)

names(newdata)

max(newdata$SDI)

# subsetting newdata to create newdata2 with only
# the 80% upper SDI observations

newdata2 <- subset(newdata, SDI >= 0.8*889.8126)

# creating new variables, logarithm transformations,
# in newdata2

newdata2$LOGN <- log(newdata2$N)
newdata2$LOGDG <- log(newdata2$DG)

# checking if variables are created

names(newdata2)

#plotting the logarithm transformated variables


plot(newdata2$LOGN, newdata2$LOGDG)

# fitting the straight line by simple regression

model <- lm(newdata2$LOGN~ newdata2$LOGDG)
summary(model)

#plotting the line over the scatterplot
plot(newdata2$LOGDG, newdata2$LOGN)
abline(model, col= "olivegreendark2",
       lty = 2, lwd =1)
# forcing the line to pass through
# the maximum SDI point
View(newdata2) # to identify max SDI point

# with this max SDI point we calculate the new b0
# create a new object to draw the maximum line

abline(a=11.8077, b=-1.5512, col="red", lty=2, lwd=1)
```

References

Hernández, A. and Arrechea, E. 2010 *Ensayo de claras en el M.U.P. nº 250 "El Cierzo" de Tarazona (Zaragoza). El tratamiento de las masas repobladas de pino carrasco (Pinus halepensis Mill.) en el Sistema Ibérico aragonés.* Internal report 28 pages

Long, J.N. 1985 A practical approach to density management *The Forestry Chronicle* 61:23-27