# The Dendrometry Package

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## Contents

## 1   Introduction

The dendrometry package is a very small set of routines that begin to bring some functionality to **R** for reading and parsing old STX (Grosenbaugh, 1974) dendrometry files. The package is quite incomplete as it only handles measurements taken using the Barr and Stroud (B&S) FP-12 or FP-15 dendrometers. It uses some old Fortran code that was developed to read in the dendrometer measurements, translate them to diameters, heights, etc., and subsequently fitted several splines (Natural Cubic, Hermite and Akima) to the individual trees. The code has been adapted so that it can be called from **R**, and the spline algorithms have been removed because they were from licensed Fortran libraries at the time. However, the **R** spline routines are now used for fitting several spline functions rather than the old Fortran libraries. All but the Akima spline are fit, and this can be added later using the `Akima` package if desired[1]

The old Fortran code is written in Fortran-90 and was not originally designed to be anything but a stand-alone program, but has been modified to interface with **R**. Please note that the actual Fortran

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[1]Akima splines may be the best fitting splines from past experience, so it might be worth considering. I have not added these since it requires another package to be available and I did not want this at the current time.

routines that convert the dendrometry readings to range, diameter, etc. were taken directly from STXMOD (Space, 1974).[2]

The input file of dendrometry records should be in STXMOD format and should include the 10 control cards that are used in a normal run of STXMOD (Space, 1974; Rennie, 1977).[3]

As mentioned above, this is a *very* rudimentary package, and does not claim to do anything fancy other than get the data into **R** and allow you to plot some profiles. Suggestions for additions or modifications are welcome, as is code contributed from others to make this more useful.

## 2   Example

The main interface routine is called `SplineVolume` after the original Fortran routines at the core. The help files give more detail on each of the routines in the package. For now, assume that a file in valid STXMOD format resides in a `./data` subdirectory under the **R** working directory for this session.[4] In addition, there should be another subdirectory (e.g., `/Rwork/reports`) to hold the output files generated by the Fortran code. In this case, the file is named `odr_wp_1977.stx`, so...

```
R> args(SplineVolume)
```

```
function (fileName = "odr_wp_1977.stx", filePath = getwd(), dataPath = "data",
    reportPath = "reports", splineMethods = c("natural", "monoH"),
    ...)
NULL
```

```
R> dendro = SplineVolume()
R> names(dendro)
```

```
[1] "z"         "trees"     "segments"
```

```
R> head(dendro$trees)
```

|   | TreeNo | Spp | dbhob | dbThick | isForked | nReadings | totLen | LenFlag | conicVol | natVol |
|---|--------|-----|-------|---------|----------|-----------|--------|---------|----------|--------|
| 1 | 1 | WP | 15.8 | 1.2 | FALSE | 7 | 68.644 | FALSE | 34.806 | 35.246 |

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[2]The version is actually from 1990, and has contributions from Rennie (1977) and others as well.
[3]Also please see the comments at the beginning of the STXMOD program code.
[4]I.e., if you are working out of `/Rwork` then the file would be in `/Rwork/data`.

```
2        2  WP  18.4     1.6     FALSE       7 81.058   FALSE   52.706 55.137
3        3  WP  16.9     1.3     FALSE       7 79.567   FALSE   49.287 51.235
4        4  WP  18.8     1.6     FALSE       7 81.078   FALSE   60.091 65.381
5        5  WP  15.0     1.3     FALSE       8 69.704   FALSE   37.256 37.798
6        6  WP  18.3     1.5     FALSE       7 76.003   FALSE   49.882 48.481
  monVol
1 34.877
2 53.471
3 49.906
4 62.603
5 37.652
6 49.889
```

The output from the `SplineVolume` function is returned in a list. The first component holds the information passed in the call to the Fortran in list format, and will not be of much interest. The second component is a tree level summary with one record per tree, as shown above. The final component holds all of the individual dendrometer and segment or section values for each tree. For example,

```
R> nrs = dendro$trees[ dendro$trees$TreeNo==1, 'nReadings']
R> dendro$segments[1:nrs,]
```

```
  TreeNo Reading Spp    dob     dib prod tgrad fgrad sinelv instRange hgtHoriz
1      1        7  WP  0.100  0.096   TW -99.9 -99.9 0.6310     0.001   62.191
2      1        6  WP  6.388  6.084   TW  48.4  61.5 0.4830    86.758   41.915
3      1        5  WP  8.685  8.230   ST  47.7  65.8 0.4149    83.538   34.669
4      1        4  WP 11.723 11.015   ST  45.9  72.0 0.2220    76.400   16.965
5      1        3  WP 14.941 13.864   ST  45.5  78.4 0.0073    75.004    0.548
6      1        2  WP 15.800 14.600   ST   0.0  15.8 4.0000     0.001   -3.452
7      1        1  WP 18.600 16.883 <NA> -99.9  18.6 3.0000     0.001   -6.452
  segLen height conicVol natVol monVol
1 20.276 68.644    1.364  1.349  1.386
2  7.246 48.368    2.040  2.064  2.064
3 17.704 41.122    9.004  9.190  9.166
4 16.418 23.418   13.917 14.304 13.877
5  4.000  7.000    4.420  4.327  4.359
6  3.000  3.000    4.062  4.013  4.025
7  0.000  0.000    0.000  0.000  0.000
```

In the above listing for the first tree we see that each segment is listed in order from top to bottom within the tree. Diameter, height, instrument information and volumes are listed.

The same information listed in the tree and segments data frames above is also available in separate files in the report subdirectory (`*.tre` and `*.seg` files). In addition, a nicely formatted report (`*.rpt`) is also generated for each tree that is reminiscent of some of the STX output.

Finally, the package enables some rudimentary plotting of tree profiles.

```
R> taperPlot(dendro, grid=TRUE, TreeNos = c(1,2,7,8,9,10), diamType='xsection',
+          standUp=TRUE, method='mono')
```
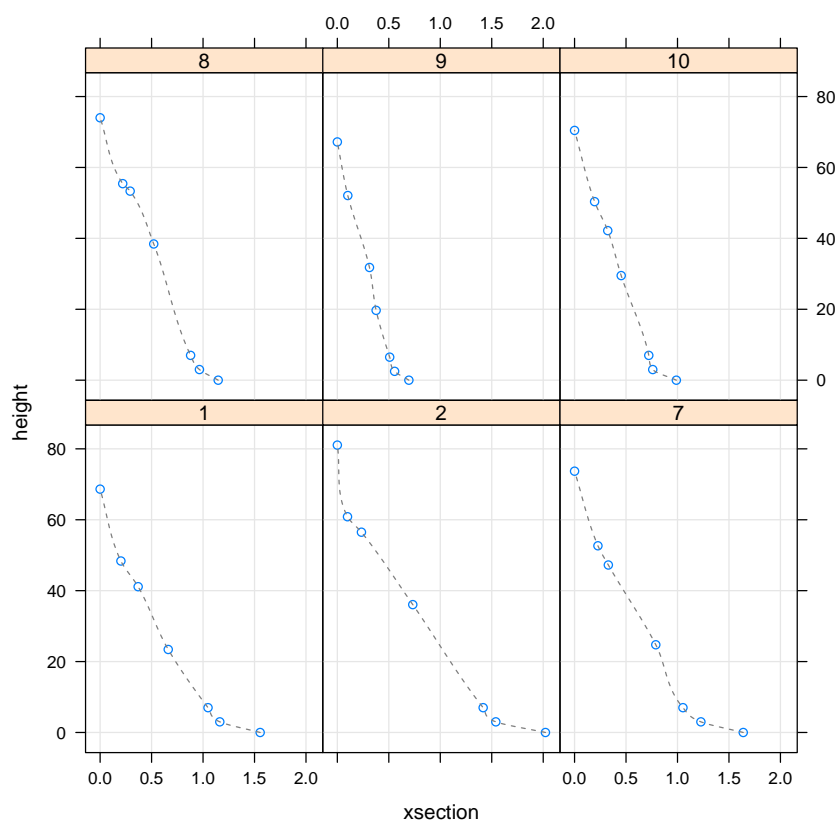


Figure 1: Some tree profiles in cross-sectional area for dendrometered trees.

# 3   Summary

The `Dendrometry` package is a start to getting B&S dendrometry information compatible with STX into R. It provides a rudimentary set of routines for translating and plotting B&S measurements.

At present, the package has only been tested in Linux machines. The package builds fine using the `Makefile` for the Fortran code. However, compiling on other platforms will be different, specifically for Microsoft.[5]

Finally, please note that this package is not a substitute for STX. It does not do any sampling calculations, etc., it only imports the data into **R** and calculates a few volume related quantities.

## References

L. R. Grosenbaugh. STX 3-3-73: Tree content and value estimation using various sample designs, dendrometry methods, and v-s-l conversion coefficients. Research Paper SE-117, U.S. Forest Service, 1974. 1

J. C. Rennie. STX: a computer system for processing timber inventory data. Technical report, 1977. Unpublish manuscript. 2

J. C. Space. 3-P forest inventory: Design, procedures, data processing. Technical report, U.S. Forest Service State and Private Forestry, Southeastern Area, 1974. 2

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[5]It would be great if someone who uses this platform could contribute the `Makefile.win` file that would assure the Fortran compiles correctly for Windows.