Introduction to R: Data

Holger Sennhenn-Reulen[a], Nordwestdeutsche Forstliche Versuchsanstalt (NW-FVA)

May 14, 2024 (Version 0.2)

Contents

[a]Private webpage: uncertaintree.github.io

1 Drought

Data basis: Fischer et al. [2006]. For further context information, another source working on and interpreting this data is Dobbertin et al. [2013, p. 202-203].

```
bair <- c(.505, .648, .523, .426, .64, .5, .257, .866, .434, .368, .54, .923, .702,
          .615, 1.013, .807, .262, .887, 1.281, 1.125, .99, 1.2, .983, .697, .606,
          .718, .48, .822, .944, .77, 1.036, 1.23, .68, .985)
elev <- c(335, 460, 480, 515, 540, 650, 680, 715, 730, 835, 860, 960,
          1020, 1025, 1100, 1150, 1150, 1170, 1190, 1350, 1400, 1500, 1540,
          475, 480, 507.5, 580, 750, 780, 800, 1025, 1100, 1150, 1200)
species <- c("Spruce", "Spruce", "Spruce", "Spruce", "Spruce", "Spruce",
             "Spruce", "Spruce", "Spruce", "Spruce", "Spruce", "Spruce", "Spruce",
             "Spruce", "Spruce", "Spruce", "Spruce", "Spruce", "Spruce", "Spruce",
             "Spruce", "Spruce", "Spruce", "Beech", "Beech", "Beech", "Beech",
             "Beech", "Beech", "Beech", "Beech", "Beech", "Beech", "Beech")
drought <- data.frame(bair = bair,
                      elev = elev,
                      species = species)
rm(bair, elev, species)
summary(drought)
```

```
##       bair             elev          species
##  Min.   :0.2570   Min.   : 335.0   Length:34
##  1st Qu.:0.5272   1st Qu.: 597.5   Class :character
##  Median :0.7100   Median : 847.5   Mode  :character
##  Mean   :0.7489   Mean   : 888.3
##  3rd Qu.:0.9732   3rd Qu.:1150.0
##  Max.   :1.2810   Max.   :1540.0
```

2 Frost

Data basis: Deutscher Wetterdienst, values shown here were generated based individual values, code by myself.

Direct download links for data basis (Stations Id 1691, Goettingen):

- historical data
- recent data

Some definitions:

- Budburst is estimated based on first day where dd > 220 [Thomson and Moncrieff, 1982] [degree days dd, start counting on March, 20].
- End of 1st development stage is estimated based on first day where dd > 320 (start counting on March, 20). *. . . I need to re-discover the source stating that 1st dev. stage is about 100 dd*
- Definition frost event: $\min\left(\text{Temp}_{50\text{cm}}\right) < -1.95°\text{C}$ [Hannerz, 1994].

```
frost <- data.frame(year = 1947:2023,
                    n_frost = c(0, 0, 2, 0, 0, 0, 0, 0, 0, 0, 2, 0, 0, 0, 0, 1,
                                0, 0, 2, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
                                0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
                                2, 0, 0, 0, 0, 0, 0, 0, 0, 1, 2, 0, 0, 0, 0, 0,
                                3, 2, 0, 0, 0, 0, 0, 0, 1, 5, 0, 0, 0),
                    bud_burst = as.Date(c(-19230, -18867, -18503, -18127, -17758, -17408, -17034,
                                          -16661, -16293, -15929, -15566, -15202, -14847, -14475,
                                          -14121, -13744, -13384, -13017, -12647, -12291, -11917,
                                          -11563, -11191, -10821, -10462, -10092, -9720, -9361,
                                          -8997, -8635, -8261, -7896, -7530, -7164, -6808, -6436,
                                          -6078, -5705, -5347, -4981, -4619, -4254, -3883, -3524,
                                          -3145, -2788, -2437, -2060, -1694, -1322, -958, -602,
                                          -237, 124, 499, 864, 1222, 1592, 1957, 2321, 2681, 3055,
                                          3408, 3789, 4137, 4513, 4877, 5234, 5610, 5976, 6345,
                                          6691, 7074, 7435, 7812, 8167, 8533),
                                        origin = as.Date("2000-01-01")),
                    end_1st_dev_stage = as.Date(c(-19222, -18859, -18489, -18118, -17746, -17397,
                                                  -17026, -16650, -16280, -15921, -15552, -15192,
                                                  -14837, -14464, -14104, -13726, -13370, -13006,
                                                  -12633, -12281, -11905, -11545, -11180, -10808,
                                                  -10455, -10078, -9710, -9349, -8984, -8623, -8248,
                                                  -7886, -7521, -7151, -6799, -6427, -6068, -5691,
                                                  -5338, -4972, -4601, -4246, -3875, -3513, -3131,
                                                  -2780, -2426, -2050, -1679, -1311, -944, -594,
                                                  -225, 132, 510, 873, 1235, 1608, 1972, 2332, 2694,
                                                  3067, 3422, 3802, 4152, 4525, 4891, 5250, 5623,
                                                  5988, 6354, 6703, 7086, 7450, 7824, 8175, 8547),
                                                origin = as.Date("2000-01-01")))
frost$may1st <- as.Date(paste0(frost$year, "-05-01"))
frost$bud_burst_days_since_may1st <- julian(frost$bud_burst, origin = as.Date("2000-01-01")) -
  julian(frost$may1st, origin = as.Date("2000-01-01"))
frost$end_1st_dev_stage_days_since_may1st <- julian(frost$end_1st_dev_stage,
                                                    origin = as.Date("2000-01-01")) -
  julian(frost$may1st, origin = as.Date("2000-01-01"))
summary(frost)
```

```
##       year         n_frost         bud_burst          end_1st_dev_stage
##  Min.   :1947   Min.   :0.0000   Min.   :1947-05-09   Min.   :1947-05-17
##  1st Qu.:1966   1st Qu.:0.0000   1st Qu.:1966-05-08   1st Qu.:1966-05-18
##  Median :1985   Median :0.0000   Median :1985-05-12   Median :1985-05-21
##  Mean   :1985   Mean   :0.3117   Mean   :1985-05-12   Mean   :1985-05-24
##  3rd Qu.:2004   3rd Qu.:0.0000   3rd Qu.:2004-05-11   3rd Qu.:2004-05-27
```

```
##  Max.   :2023   Max.   :5.0000   Max.   :2023-05-13   Max.   :2023-05-27
##      may1st           bud_burst_days_since_may1st
##  Min.   :1947-05-01   Min.   :-4.00
##  1st Qu.:1966-05-01   1st Qu.: 8.00
##  Median :1985-05-01   Median :11.00
##  Mean   :1985-04-30   Mean   :11.69
##  3rd Qu.:2004-05-01   3rd Qu.:16.00
##  Max.   :2023-05-01   Max.   :23.00
##  end_1st_dev_stage_days_since_may1st
##  Min.   : 8.00
##  1st Qu.:20.00
##  Median :24.00
##  Mean   :23.44
##  3rd Qu.:28.00
##  Max.   :36.00
```

3 df

This is just re-named spati2 that ships with lmfor [Mehtatalo, 2019]:

```
library("lmfor")
data(spati2)
df <- spati2
rm(spati2)
summary(df)
```

```
##       plot             d                h                n        
##  Min.   : 1.00   Min.   : 1.50   Min.   : 1.900   Min.   :  7.00  
##  1st Qu.:28.00   1st Qu.: 6.20   1st Qu.: 6.000   1st Qu.: 17.00  
##  Median :56.00   Median :10.20   Median : 8.000   Median : 58.00  
##  Mean   :45.41   Mean   :11.66   Mean   : 9.566   Mean   : 54.96  
##  3rd Qu.:61.00   3rd Qu.:14.70   3rd Qu.:11.700   3rd Qu.: 84.00  
##  Max.   :66.00   Max.   :51.00   Max.   :28.000   Max.   :105.00  
##       dvar            dmean      
##  Min.   : 1.867   Min.   : 4.821  
##  1st Qu.: 2.818   1st Qu.: 6.736  
##  Median : 3.691   Median :10.879  
##  Mean   : 4.649   Mean   :11.660  
##  3rd Qu.: 5.621   3rd Qu.:14.168  
##  Max.   :15.636   Max.   :29.569
```

4 All-in-one

. . . just for convenience, copy-paste only once!

```
library("lmfor")
bair <- c(.505, .648, .523, .426, .64, .5, .257, .866, .434, .368, .54, .923, .702,
          .615, 1.013, .807, .262, .887, 1.281, 1.125, .99, 1.2, .983, .697, .606,
          .718, .48, .822, .944, .77, 1.036, 1.23, .68, .985)
elev <- c(335, 460, 480, 515, 540, 650, 680, 715, 730, 835, 860, 960,
          1020, 1025, 1100, 1150, 1150, 1170, 1190, 1350, 1400, 1500, 1540,
          475, 480, 507.5, 580, 750, 780, 800, 1025, 1100, 1150, 1200)
species <- c("Spruce", "Spruce", "Spruce", "Spruce", "Spruce", "Spruce",
             "Spruce", "Spruce", "Spruce", "Spruce", "Spruce", "Spruce", "Spruce",
             "Spruce", "Spruce", "Spruce", "Spruce", "Spruce", "Spruce", "Spruce",
             "Spruce", "Spruce", "Spruce", "Beech", "Beech", "Beech", "Beech",
             "Beech", "Beech", "Beech", "Beech", "Beech", "Beech", "Beech")
drought <- data.frame(bair = bair,
                      elev = elev,
                      species = species)
frost <- data.frame(year = 1947:2021,
                    n_frost = c(0, 0, 2, 0, 0, 0, 0, 0, 0, 0, 2, 0, 0, 0, 0, 1,
                                0, 0, 2, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
                                0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
                                2, 0, 0, 0, 0, 0, 0, 0, 0, 1, 2, 0, 0, 0, 0, 0,
                                3, 2, 0, 0, 0, 0, 0, 0, 1, 5, 0),
                    bud_burst = as.Date(c(-19230, -18867, -18503, -18127, -17758, -17408, -17034,
                                          -16661, -16293, -15929, -15566, -15202, -14847, -14475,
                                          -14121, -13744, -13384, -13017, -12647, -12291, -11917,
                                          -11563, -11191, -10821, -10462, -10092, -9720, -9361,
                                          -8997, -8635, -8261, -7896, -7530, -7164, -6808, -6436,
                                          -6078, -5705, -5347, -4981, -4619, -4254, -3883, -3524,
                                          -3145, -2788, -2437, -2060, -1694, -1322, -958, -602,
                                          -237, 124, 499, 864, 1222, 1592, 1957, 2321, 2681, 3055,
                                          3408, 3789, 4137, 4513, 4877, 5234, 5610, 5976, 6345,
                                          6691, 7074, 7435, 7812),
                                        origin = as.Date("2000-01-01")),
                    end_1st_dev_stage = as.Date(c(-19222, -18859, -18489, -18118, -17746, -17397,
                                                  -17026, -16650, -16280, -15921, -15552, -15192,
                                                  -14837, -14464, -14104, -13726, -13370, -13006,
                                                  -12633, -12281, -11905, -11545, -11180, -10808,
                                                  -10455, -10078, -9710, -9349, -8984, -8623, -8248,
                                                  -7886, -7521, -7151, -6799, -6427, -6068, -5691,
                                                  -5338, -4972, -4601, -4246, -3875, -3513, -3131,
                                                  -2780, -2426, -2050, -1679, -1311, -944, -594,
                                                  -225, 132, 510, 873, 1235, 1608, 1972, 2332, 2694,
                                                  3067, 3422, 3802, 4152, 4525, 4891, 5250, 5623,
                                                  5988, 6354, 6703, 7086, 7450, 7824),
                                                origin = as.Date("2000-01-01")))
frost$may1st <- as.Date(paste0(frost$year, "-05-01"))
frost$bud_burst_days_since_may1st <- julian(frost$bud_burst, origin = as.Date("2000-01-01")) -
  julian(frost$may1st, origin = as.Date("2000-01-01"))
frost$end_1st_dev_stage_days_since_may1st <- julian(frost$end_1st_dev_stage,
                                                    origin = as.Date("2000-01-01")) -
  julian(frost$may1st, origin = as.Date("2000-01-01"))
data(spati2)
df <- spati2
rm(bair, elev, species, spati2)
ls()
```

```
## [1] "df"      "drought" "frost"
```

References

Matthias Dobbertin, Markus Neumann, and Hans-Werner Schroeck. Tree growth measurements in long-term forest monitoring in europe. pages 183–204. Elsevier, 2013. doi: 10.1016/b978-0-08-098222-9.00010-8. URL https://doi.org/10.1016/b978-0-08-098222-9.00010-8.

R Fischer, M Dobbertin, O Granke, K Karoles, M Köhl, P Kraft, P Meyer, V Mues, M Lorenz, H-D Nagel, and W Seidling. The condition of forests in europe. 2006 executive report. *UNECE, Hamburg*, 2006. ISSN 1020-587X.

Mats Hannerz. Predicting the risk of frost occurrence after budburst of norway spruce in sweden. 28(4), 1994. doi: 10.14214/sf.a9175. URL https://doi.org/10.14214/sf.a9175.

Lauri Mehtatalo. *lmfor: Functions for Forest Biometrics*, 2019. URL https://CRAN.R-project.org/package=lmfor. R package version 1.3.

A. J. Thomson and S. M. Moncrieff. Prediction of bud burst in douglas-fir by degree-day accumulation. 12(2): 448–452, June 1982. doi: 10.1139/x82-069. URL https://doi.org/10.1139/x82-069.