In-class discussion
15%

Laboratory exercises (4)
20%

Mid-term exam
25%

Research project
40%
Signal Processing
Class 17: Signal processing

This week we continue the dendrochronology teaching lab (January Social Sciences 167) to complete our final exercise related to tree-ring dating and analysis. In the earlier assignments, we reviewed the fundamental anatomical features of annual growth rings in tree rings, applied cross-dating to real specimens using the least squares, skeleton plotting and statistical cross-dating. In this final assignment, we will spend two class periods learning how to produce a stand-level summary sequence -- a tree-ring chronology -- using an industry-standard software package.

On Tuesday, we'll conduct a test run of the ARSTAN chronology-building tool, and on Thursday, we'll step through a few examples to determine what effects our choices have on the final chronology.

Step 1: Download tree-ring data
Before we begin, we need to download the real-world tree-ring measurements that will provide the starting point for this exercise. First, navigate to the International Tree-Ring Data Bank. Under the 'Search Datasets' option, use the first link and go to the 'Tree Ring Search Engine'. Here you'll be welcomed by the default 'Paleo Search Engine' with the data type of 'tree ring' already selected.

We're going to download the tree-ring measurement files for the following six records:

- Cat Mesa (NM556)
- Abouelman Spring (NM555)
- Baca (NM558)
- Fenton Lake (NM550)
- Rito de los Frijoles (NM501)
- Los Alamos New Mexico (NM046)

For each record, enter either the record name or the five-digit alphanumeric code into the text box under 'General Search' and hit 'enter'. Your search results (which should return only one record) will be shown at the bottom of the page. Scroll down past the metadata information until the 'Download Data' option is visible. You'll see a table containing links to the same record available in different formats. Click the link next to 'Raw measurements' (in the first case, the file name will be 'nm556.rwl'). Save this file in a dedicated folder and repeat the search until you've downloaded all six measurement files from these New Mexico sites.
JEMEZ, NEW MEXICO
Class 18: Signal processing II
posted 10 minutes ago by Scott St. George [ updated 8 minutes ago ]

In today's lab session, we'll continue our experiments to estimate and remove the (confounding or trivial) effects of tree age and size on ring-width and produce composite tree-ring chronologies. And because at least a few people bumped into technical problems with the (user-hostile) research tool ARSTAN, I've modified the exercise so everyone has the opportunity to review our decisions and final products.

First, let's return to the final few steps of the exercise from last class. In session 1, I asked you to apply two different methods -- horizontal or arithmetic means and negative exponential curves -- to standardize or detrend tree-ring width measurements from northwestern New Mexico. And by this point, I hope everyone has had the opportunity to (1) download tree-ring measurements from the International Tree-Ring Data Bank, (2) get a copy of ARSTAN from the Lamont-Doherty Tree-Ring Laboratory and (3) try (or help another person) to use ARSTAN to produce chronologies from our New Mexico collections.

If you were able to cajole or wrestle ARSTAN into working properly, then you should have produced two separate chronologies from NM556. If ARSTAN refused to cooperate, then you may access those two chronologies on our shared Google Drive (a direct link is here).

ASSIGNMENT FOUR: SIGNAL PROCESSING

Question 1
Within the 'Tree-ring data' folder, I've uploaded plots that illustrate the application of the two different detrending methods (horizontal mean and negative exponential) to the same single tree-ring width measurement sequence from a single core within the NM556 collection. In the first example, explain briefly (one sentence) how applying the (arithmetic) mean of the measurement series changes or alters the detrended version (hint: the change is very modest). Second, examine the same data detrended using a growth curve estimated from a negative exponential function. How does the detrended series differ from the original (raw) data measured under the microscope?
CATD11 detrending

horizontal mean curve

\[ f(t) = a \times t(b+c) + b \times \exp(-c \times t(b+c)) + k \]

\[ a \quad b \quad c \quad k \quad p \]

0.000 0.000 0.000 1.01 0

---

CATD11 tree-ring indices

measurements (y)

indices (z)

years
CAT011 detrending

negative exponential curve

\[ f(t) = a \cdot t + b \cdot \exp(-c \cdot t + p) + k \]

\[ \begin{align*}
  a &= 4.754 \\
  b &= 0.021 \\
  c &= 0.000 \\
  k &= 0.37 \\
  p &= 18
\end{align*} \]

measurements (y)

CAT011 tree-ring indices

indices (z)

years
ABS041 detrending

linear regression curve

\[ f(i) = a \cdot t(i+p) + b + \exp(-c \cdot t(i+p)) + k \]

\[ a \quad b \quad c \quad k \quad p \]

\[ -0.008 \quad 1.000 \quad 0.000 \quad 1.69 \quad 0 \]
EXERCISE FOUR IS DUE

NOVEMBER 19
PROJECT WORK

NOVEMBER 12

NOVEMBER 14
10-15 Citations
Also on November 19

Please bring a hardcopy list of your (preliminary) citations to share with me and your peers.

no judging/evaluation, just to keep everyone on track
GRADUATE PRESENTATIONS

NOVEMBER 19

NOVEMBER 21
In-class discussion
15%

Laboratory exercises (4)
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