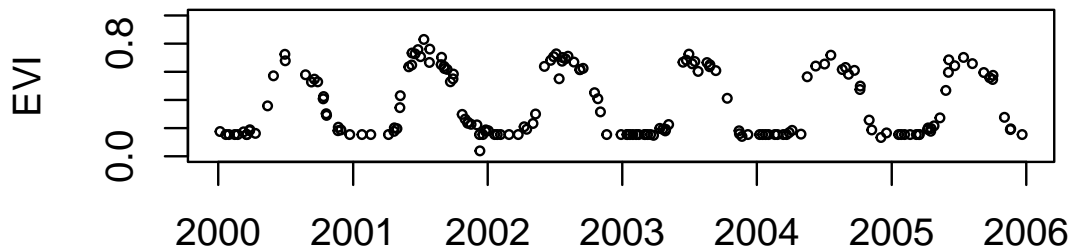


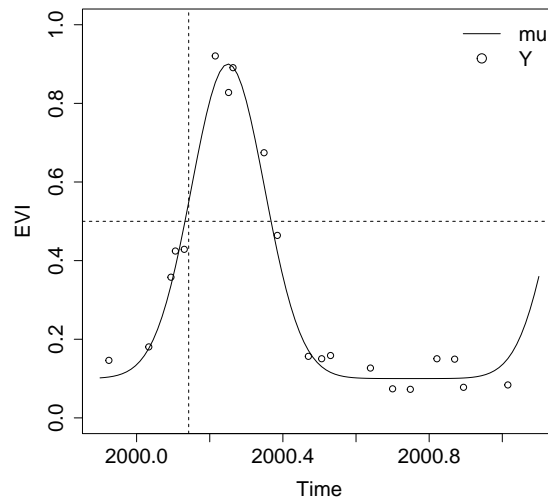
ST440/540 – Mid-term exam 2 - Due April 15

THIS IS AN EXAM - DO NOT DISCUSS THE PROBLEM WITH ANYONE (INCLUDING OTHER STUDENTS OR THE TA)! If you have questions, please email me.

The enhanced vegetation index (EVI) is a satellite-derived measure of the greenness at a spatial location. In this exam, you will use EVI measurements at one location¹ to estimate the “green-up time” (GUT) each year and test whether the timing of GUT has changed over the study period. EVI is a unitless quantity that is between zero and one. At this site it is measured 802 times (between 6 and 38 times per year) from 1984 to 2019. As shown in the plot below for 2000-2005, EVI exhibits strong seasonality.



Let Y_i be the EVI measured at time t_i . We assume the true EVI at time t is the curve $\mu(t)$, and that Y_i is a noisy measurement of $\mu(t_i)$. Define the GUT for year i as the first time in year i that $\mu(t) > 0.5$ (this a simplification of the real definition). For example, the GUT for the year 2000 (this not real data) is the time value for the dashed vertical line below.



¹Thanks to Xiaojie Gao for providing data!

Analyze these data in the following sections:

1. **Model definition:** Define a statistical model for the analysis, including the distribution of the data Y_i given the true EVI curve $\mu(t)$, the model for the true EVI curve and all prior distributions. Write the model description in a paragraph with at least two equations and conceptual justification that the model is reasonable.
2. **MCMC convergence:** For one model fit, describe the MCMC algorithm and convergence diagnostics.
3. **Model comparisons:** Compare the fit of 2-3 models.
4. **Model fit:** Summarize (with uncertainty) the estimate of $\mu(t)$.
5. **GUT analysis:** Summarize the posterior distribution of GUT for each year.
6. **Time-trend analysis:** Evaluate whether there is a change in the distribution of GUT across the years.

Organize your report with sections labeled as above. With the exception of the first section, each section should have the format:

1. One sentence (no more than three lines) describing the analysis
2. One clearly-labeled (with informative caption) table or plot with the main results
3. One sentence (no more than three lines) summarizing the results

Summarize your analysis in a PDF document that is **no more than four pages long** (excluding code). Append your code to the end of this document and submit a single document on moodle.

HAVE FUN!