1. If the Q10 for an animal is 3.0, what is the increase in metabolic rate if the body temperature increases 5 °C?

2. Teleost fish have a resting rate of oxygen consumption of about 0.1 mmol h⁻¹ at 0 °C and 0.6 mmol h⁻¹ at 40 °C (Clarke and Johnston 1999). Calculate Q10 and then $E$ for these fishes. Does $E$ seem to correspond to the metabolic theory hypothesis of 0.65 eV for respiration? How would you statistically evaluate this hypothesis if you had additional estimates of $E$ for different fishes?

3. Work through the provided R code for bivariate and multiple regression fitting of metabolic scaling models. How do your conclusions regarding the temperature-dependence of ecosystem production change when using bivariate versus multiple regression approaches to data fitting?

4. Locate a unimodal temperature response curve for your favorite rate from your favorite organism(s). For inspiration you can consult this week’s readings (especially Pawar et al. 2016 Am Nat and Dell et al. 2011 PNAS). Using the temperature response curve fitting code provided, fit your data using
   a. Boltzmann-Arrhenius models for the complete curve
   b. Boltzmann-Arrhenius for the increasing and decreasing portions of the curve separately
   c. a second-order polynomial

   Summarize how the these different modeling approaches influence your estimates of the apparent activation energy, $E$. Also, comment on how you decided cutoff values for part (B) and how variation in this cutoff value influenced your estimates of $E$.

5. If you are feeling especially enthused and ambitious, you can download R code from Samraat Pawar’s group for fitting Sharpe-Schoolfield models to unimodal temperature response data (available on ResearchGate at https://goo.gl/3jhveL). This code is complex but I’m happy to help get you up and running if you’re interested. Compare the Sharpe-Schoolfield estimates of $E$ to those obtained in question 4 above, and comment on appropriateness of the various models for fitting biological temperature response data.