Data_analysis

September 17, 2019

1 Introduction

In this notebook I will apply the data from the experiments to the theory to try and predict the change in temperature senstivity of respiration as interaction change. To do this I will need to consider:

1. how to parameterise the basic growth model (i.e. dynamics in the absence of interactions)
2. how to parameterise the interactions between species
3. What we can predict exactly at the community level

2 Growth model data

So for each species we have: * r - Growth Rate * R - Respiration Rate
as well as their temperature dependence's (roughly). In this section I derive these parameters from the experimental data.

```
In [5]: library(tidyverse)
        library(broom)
        #Define boltzman constant (Ev)
        k <- 8.617e-5
```

2.1 Growth - r

In order to parameterise the growth of species and its temperature dependence we need an r_0 value and a E_r value.

Though the temperature dependence of growth was not directly measured we can estimate E_r by using the optical density (OD) from the respiration experiments. Here the OD is known at two timepoints for each species/treatment combination across a range of temperatures. Assuming we are in exponential growth we can estimate the growth rate over this period using the formula:

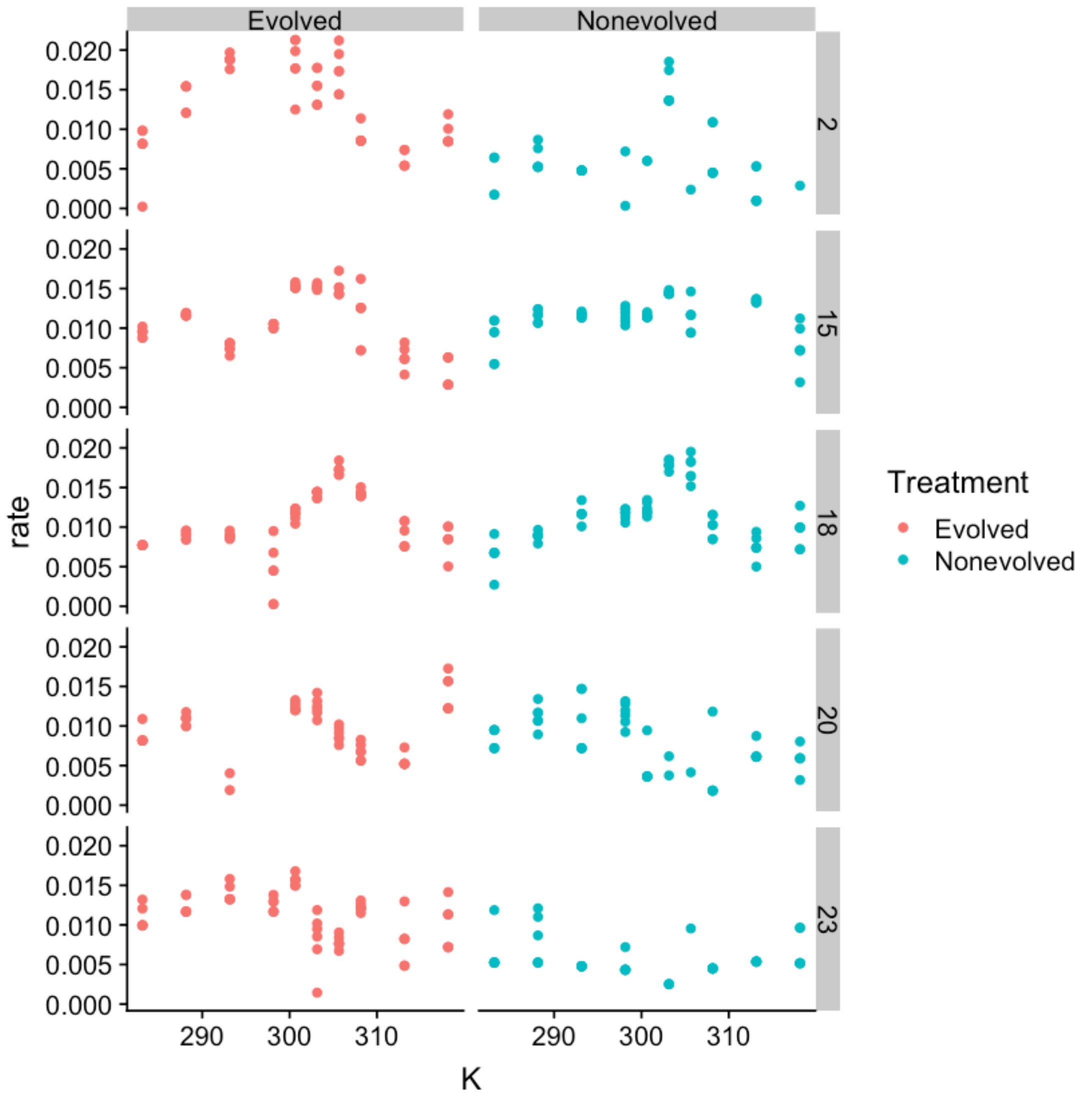
$$r = \frac{log\left(\frac{C(t)}{C(0)}\right)}{t}$$

First we read in the data and calulate the growth rates:

```
In [149]: OTU_OD <- read_csv("../data/Francisca/respirationandODData/DatosOD_5OTUs_evNev.csv",
                                col_types = cols(
                                Replicate = col_double(),
                                OTU = col_double(),
                                OD = col_double(),
                                T = col_double(),
                                t = col_character(),
                                OD_T0 = col_double(),
                                Tf = col_double(),
                                u = col_double(),
                                Treatment = col_character()
                              ))

          #get growth (need to correct for the negative growth rates)
          OTU_growth <- OTU_OD %>%
              mutate(r = (log(OD) - log(OD_T0))/Tf , K = T + 273.15 ) %>%
              filter(r > quantile(r,probs = c(0.1))[1]) %>%
              mutate(rate = r - min(r)) %>%
              filter(rate > 0)

          OTU_growth %>%
          ggplot(aes(x = K, y = rate, colour = Treatment))+
          geom_point()+
          facet_grid(OTU~Treatment)
```



as we can see the TPCs are not great. However as we just need a general idea as to the temperature sensitivty we can use the approach used by Dell et al. and just fit a boltzmann to the rising portion. Though a bit rough we can do this by taking only the points that are at temperatures lower than the maximum growth rate, and taking the slope of a linear fit between $log(r) \sim \frac{1}{kT}$.

```
In [155]: OTU_rising <- OTU_growth %>%
              group_by(OTU,Treatment) %>%
              mutate(rmax = max(r),Tmax = max(ifelse(r == rmax,K,0))) %>%
              filter(K <= Tmax, r > 0) %>%
              mutate(T_boltz = 1 / (K * k), r = log(r))

          OTU_r_E <- OTU_rising %>%
              select(OTU,Treatment,r,T_boltz) %>%
              group_by(OTU,Treatment) %>%
```