*To begin with, it would be good to estimate each of the three equations below separately. If I have time, I could estimate them together as a system of equations (SEM)*

*September/October – writing.*

*Most likely, I will not have time to do all tasks listed below or answer all the questions, but this list can serve as a guideline.*

# Equation 1 = Production function

**Prod = f(Temp, Precipitation, other climate data)**

* Aggregate the climate data for years - see the bullet points below. Then find which of them fits the best…LASSO
  + Binary variable 1 for counties and years when drought happened, 0 for counties and years when no drought happened
    - Various definitions of drought: -see which one of them pick the most variability?? Least absolute shrinkage operator – (Lasso)
      * Z- score bellow 1 (or below 2 or 3) in a months during both rainy season
      * Z- score bellow 1 (or below 2 or 3) in at least one month during any of the two rainy seasons
      * Z- score bellow 1 (or below 2 or 3) in at least two consecutive months during any of the two rainy seasons
      * ….. any other similar versions
    - Maybe also interactions of this binary drought indicator and climate variable(s)?
  + Average Z-score over 12 months per year ?
  + Cumulative rainfall?
  + Possibly just use December value of SPEI 12 for every year-> **Study how SPEI 12 is calculated** 
    - Can a December value of SPEI 12 be considered as an aggregated rainfall for the whole year?

# Equation 2 = Inverse demand function

**Price = f(production, international price, trade)**

* Match the price data to counties (the price data I have are per market place (towns), not for the counties)
  + - Do I have a data point for each county?
    - To begin with, I can do this just googling the locations of the market places. If I have enough time, I can use a more sophisticated method of interpolation (i.e. polygons, see e.g. Erin’s Lentz paper)
* Get international trade (possibly on the box within the ministry of Agriculture data) and price data
* What unit of analysis will I use?
  + Problem – Price monthly and county level, Production – yearly and county level, Trade – just national level, also International prices not at county level
  + What would be the frequency of international prices and trade data that will I be able to find and use? (monthly? Yearly?)
  + If I don’t find a good data or a way how to deal with the data (frequency) incompatibility, I may have to abandon estimating of the Equation..?
* Idea: first estimate Equation 1 using aggregated (average) z-scores per year. Then use the estimated coefficient to get fitted values of production per month and use these fitted values as inputs into this equation…
  + Does this way of interpolation make sense?
* For the crops data I need to match the county IDs

# Equation 3 = Social indicators (e.g. MUAC)

**MUAC (or other indicators) = f(price,….,)**

* Shall I only use price in this equation or also test for the climate data? I assume that I can also test for significance of the climate data in this equation - then shall I use yearly aggregates of the climate (as Erin Lentz) or the monthly aggregates?
  + If yearly aggregate-> more climate data needed. Climate data currently available for period 1999-2015 while NDMA phases available for 2014-2017-> not enough overlap
* Finish the replication of the Erin’s paper
* **Do we actually want to use the NDMA phase classification, given that we know the exact rule for change from Normal to Alert, and the rule is not always obeyed? There may be political factors behind the decisions about the phases, which I believe would be difficult to model using climate and weather data.**
  + **If we decide to use the NDMA phase classification anyways, what about using it as a binary response? I.e. just use the counties in Alert and Alarm or merge Alert and Alarm (there is only 10% of Alarms). I believe that using probit/logit model in panel context would be easier to apply (and less likely to do it incorrectly + saving more time) than ordinal probit (multiple response)**
* As for the data which I got from the NDMA reports (i.e. the EW phases, MUAC and CSI) - they are only available for the 23 ASAL counties. Is there a way to get them for the other (non-ASAL) counties?
  + If not, how can I deal with this? If I decide to only estimate the equation for the ASAL counties, I am not sure if it will be possible to estimate the 3 equations simultaneously. Maybe I would need to restrict all 3 equations for the ASAL counties.
    - What would this mean for the models and for their estimation?
* If we decide to model the phase classifications, I need to study carefully:
  + (Ordinal) Logit in panel data context – there is a whole chapter on the binomial response models in panel context in the Woodridge textbook
  + How the decisions about the early warning phases are made - reading the report ‘A broad scale summary of existing early warning systems in Kenya and regional initiatives in the Greater Horn of Africa’ (see email from Pedram 31. January – WP1.1\_Analysis\_EWS 2901118.docx). Maybe also reading the description/explanation of the decisions about the phases in a couple of the NDMA reports would be helpful

# All 3:

* How shall I prioritise all the tasks above and below?
* **Panel regression models:**

**Find the best specification as follows. I can estimate many possible specifications and do various (specification) tests on residuals or on raw data (see plm package and its documentation in R) . Study more about the specification / residual testing as I go. Possibly, even use some selection operator (lasso). This task can take at least a week or more for each equation (and if a new data or information appears after I have done this, I may need to do this again)**

* Do I actually need the fixed effects variables in the panel regression (e.g. education, life expectancy, mortality = the data from KNBS, surveys) which are only available for one or two years? Or do the county level dummy variables (fixed effects) account for these?
  + If these covariates are useful, it would be needed to digitalize them from the pdf files on the KNBS webpage, potentially get more detailed data from Kenya
* Maybe I should at least use a proxy for GDP (or not needed?)
  + If we decide yes for this – I should ask Alex Moradi if he could provide the historical railway data as a proxy of GDP
* Study once more carefully how VCI and SPEI for various periods (number of months) are constructed **(for VCI read carefully the paper of Klisch and Atzberger 2016**, see email from Pedram 4. April 2018)
* It would be good to get more county level climate data if possible. Currently I have tem for period 1999-2015. Maybe I could try to search google if I can find some county level aggregates of the climate data?
* Study spatial models in panel data context and apply them. Particularly for **equations 2 and 3** as Annemie said that for yields there are probably not much of the spatial effects
* Study more about System of equations models (SEM) and their applicability in panel data context. Is this even possible?
  + Good literature sources:
    - Wooldridge econometric textbook
    - Paper ‘systemfit: A Package for Estimating Systems of Simultaneous Equations in R’ by Henningsen and Hamann (2014) https://www.researchgate.net/publication/26538601\_systemfit\_A\_Package\_for\_Estimating\_Systems\_of\_Simultaneous\_Equations\_in\_R

* + Is it possible to have different numbers of observations and different time frequencies in each equation?
  + Which estimation methods would be the best? (e.g. Instrumental variables, SUR,…)
* Study about (S)ARIMA class of models
  + Could I apply (S)ARIMA relatively easily in my case? Or at least test for lagged dependent variables?
  + Or can the panel data structure (and/or the (lagged) independent variables) capture the effects of lagged dependent variables?
  + Study about Kalman filter and its applicability in my case (paper(s) of Molly Brown (2015)
* Maybe read again the papers of Molly Green and Greenstone. Time series (Kalman filter approach). But they use climate data in general not drought (this is what Pedram once pointed out, I believe)
  + Can I apply something like this in my case?