Starting point:

lmer(Yield~1+PrecZscore+PrecVar+TempZscore+TempVar+ (PrecZscore+TempZscore|ID))

* scaling or z-scores needed
* estimates of similar specifications seem to be similar -> **robust,** **good**

# The best models:

1. **No weights**

The best specifications of the error structure based on LR tests of serial correlation, and LR tests of random effects:

1. AR(1) errors

lme(Yield~1+PrecZscore +TempZscore , random= ~ PrecZscore + TempZscore|ID, correlation=corAR1(0,form= ~ as.numeric(Year)|ID))

1. MA(3) errors

lme(Yield~1+PrecZscore +TempZscore , random= ~ PrecZscore + TempZscore|ID, correlation=corARMA(0,form= ~ as.numeric(Year)|ID, p=0,q=3))

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **No weights** |  |  |  | pvcm from plm package (no AR or MA) | |
| Fixed effects | **No AR** | **AR(1)** | **MA(3)** | **Swamy 1970** | **Counties separately (mean)** |
| Intercept | 1.647\*\*\* | 1.685\*\*\* | 1.692\*\*\* | 1.610\*\*\* | 1.636 |
| Precipitation (Z – score) | 0.171\*\*\* | 0.155\*\*\* | 0.162\*\*\* | 0.196\*\*\* | 0.201 |
| Temperature (Z – score) | -0.109\* | -0.137\*\* | -0.141\*\* | -0.089 (p-val= 0.141) | -0.106 |
| AIC | 1180.105 | 1130.211 | 1122.896 |  |  |
| BIC | 1225.9 | 1180.522 | 1182.354 |  |  |

ANOVA: Precipitation explains much more than temperature (F tests: 44.4 and 7.8)

1. **Weights = Area of cropland**

lme(Yield~1+PrecZscore +cv\_Prec, random= ~PrecZscore+TempZscore|ID , weights=~Area, correlation= corARMA(form = ~ as.numeric(Year)|ID, p=2,q=2))

The best specification of the error structure based on LR tests of serial correlation, and LR tests of random effects:

ARMA(2,2) errors:

**AIC:** 1817.509 **BIC:** 1881.509

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Weights = Area** |  |  | pvcm from plm package (no AR or MA) | |
| Fixed effects | **No AR** | **ARMA(2,2)** | **Swamy (1970)** | **Counties separately (mean)** |
| Intercept | 1.237\*\*\* | 1.036\*\*\* | 1.515\*\*\* | 1.519 |
| Precipitation (Z – score) | 0.214\*\*\* | 0.187\*\*\* | 0.218\*\*\* | 0.224 |
| Precipitation – coef. of variation | 0.207\*\* | 0.143\* | 0.107 | 0.198 |
| AIC | 1868.164 | 1817.509 |  |  |
| BIC | 1913.9 | 1881.54 |  |  |