

Burns Climate Blog

Anna Madison Burns

8/31/2020

Step 2 - Temperature Plot

```
strDates <- as.character(LakeCo$DATE)
LakeCo$Date <- as.Date(strDates, "%m/%d/%Y")

plot(TMAX~Date, data=LakeCo, main='Antioch, IL Maximum Daily Temperatures', sub='July 1, 1901 to June 30, 2020')
fit1 <- lm(TMAX~Date, data=LakeCo)
summary(fit1)

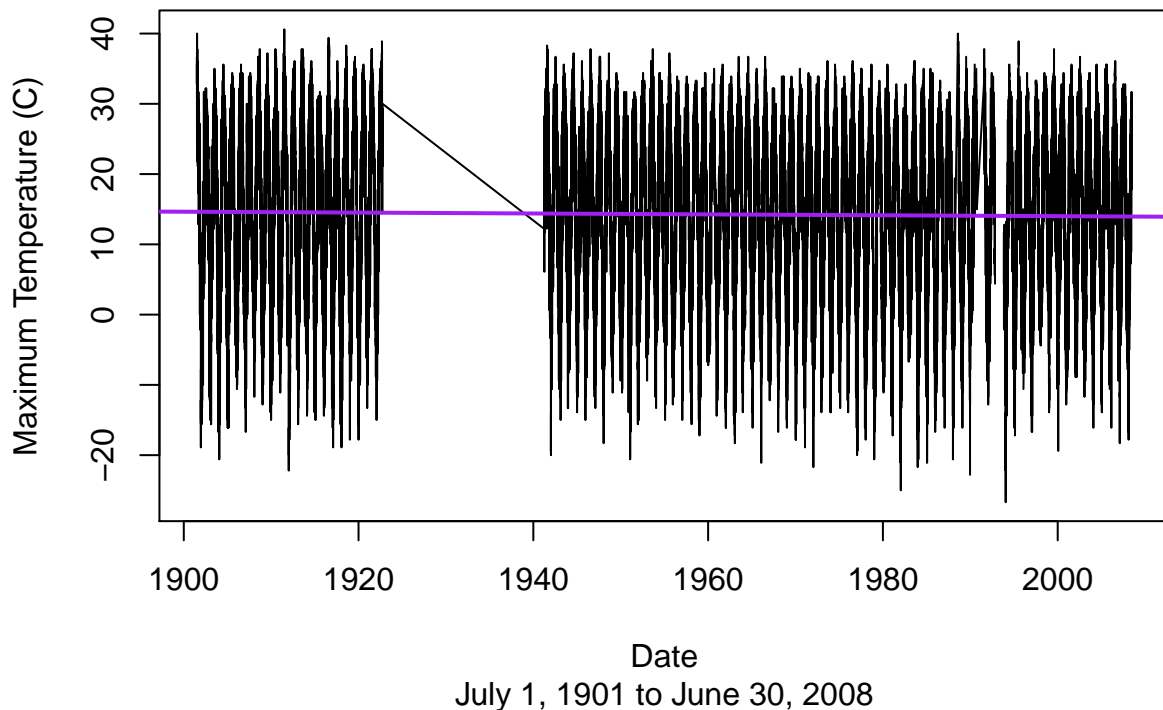
##
## Call:
## lm(formula = TMAX ~ Date, data = LakeCo)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -40.752 -10.380   1.037  10.722  26.024
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  1.420e+01  7.294e-02  194.743  < 2e-16 ***
## Date        -1.738e-05  5.943e-06   -2.924  0.00345 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 12.1 on 30958 degrees of freedom
## (231 observations deleted due to missingness)
## Multiple R-squared:  0.0002762, Adjusted R-squared:  0.0002439
## F-statistic: 8.552 on 1 and 30958 DF, p-value: 0.003453

coef(fit1)

##      (Intercept)           Date
## 1.420472e+01 -1.738002e-05

abline(coef(fit1), col = "purple", lwd = 2)
```

Antioch, IL Maximum Daily Temperatures



Since it's Illinois, the minimum temperature is also of some interest...

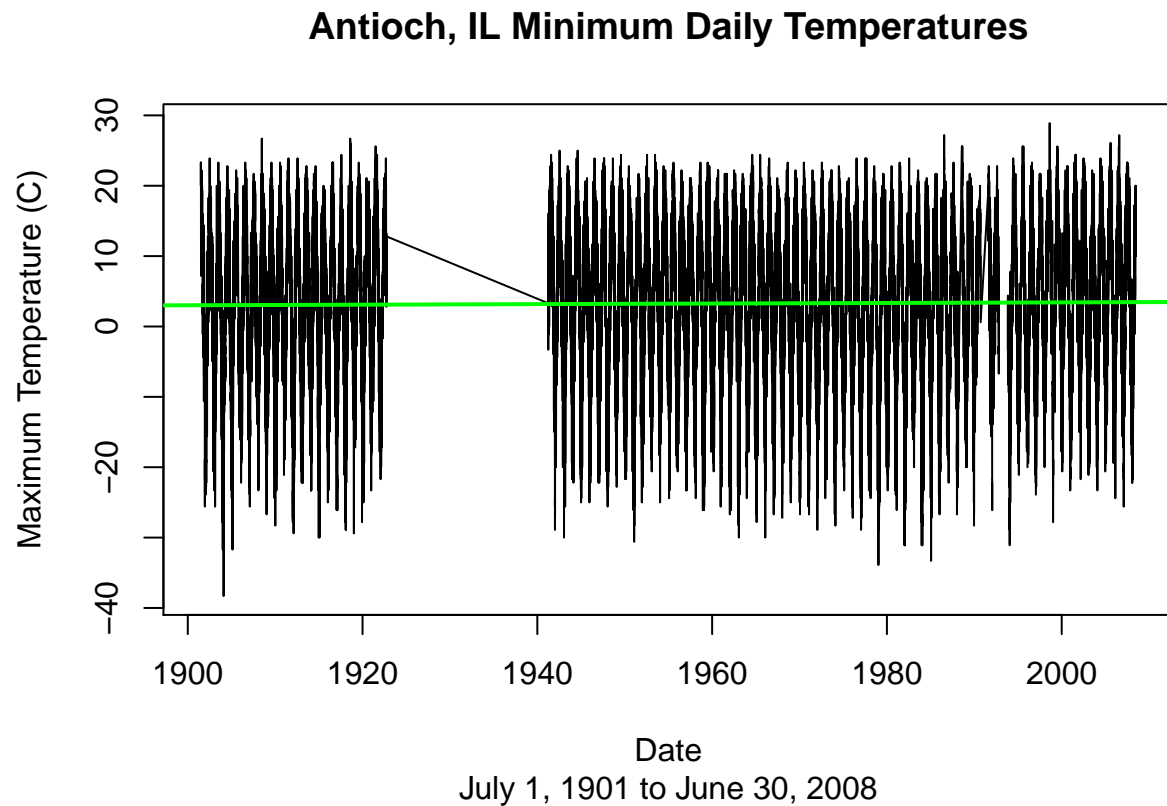
```
plot(TMIN~Date, data=LakeCo, main='Antioch, IL Minimum Daily Temperatures', sub='July 1, 1901 to June 30, 2008')
fit2 <- lm(TMIN~Date, data=LakeCo)
summary(fit2)
```

```
##
## Call:
## lm(formula = TMIN ~ Date, data = LakeCo)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -41.330  -7.211   0.464   8.949  25.485
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  3.299e+00  6.549e-02  50.365  <2e-16 ***
## Date         1.114e-05  5.336e-06   2.087   0.0369 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 10.86 on 30922 degrees of freedom
## (267 observations deleted due to missingness)
## Multiple R-squared:  0.0001409, Adjusted R-squared:  0.0001085
## F-statistic: 4.356 on 1 and 30922 DF, p-value: 0.03688
```

```
coef(fit2)
```

```
## (Intercept)      Date  
## 3.298514e+00 1.113766e-05
```

```
abline(coef(fit2), col = "green", lwd = 2)
```



Step 3 - Evaluating Monthly Trends

```
lm(TMAX~Date, data=LakeCo)
```

```
##  
## Call:  
## lm(formula = TMAX ~ Date, data = LakeCo)  
##  
## Coefficients:  
## (Intercept)      Date  
## 1.420e+01    -1.738e-05
```

```
lm(TMIN~Date, data=LakeCo)
```

```
##  
## Call:  
## lm(formula = TMIN ~ Date, data = LakeCo)  
##
```

```
## Coefficients:
## (Intercept)      Date
## 3.299e+00    1.114e-05

LakeCo$Month = format(as.Date(LakeCo$Date), format = "%m")
LakeCo$Year = format(as.Date(LakeCo$Date), format = "%Y")
```

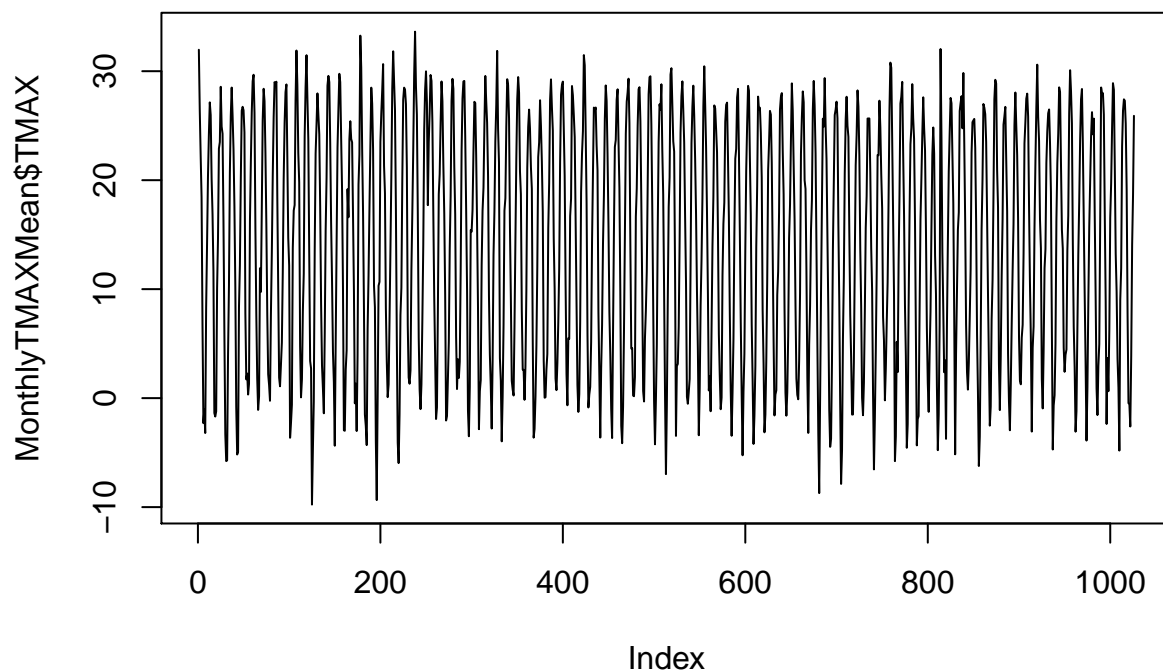
For Max:

```
MonthlyTMAXMean = aggregate(TMAX ~ Month + Year, data = LakeCo, mean)
MonthlyTMAXMean$YEAR = as.numeric(MonthlyTMAXMean$Year)
MonthlyTMAXMean$MONTH = as.numeric(MonthlyTMAXMean$Month)
```

```
str(MonthlyTMAXMean)
```

```
## 'data.frame': 1026 obs. of 5 variables:
## $ Month: chr "07" "08" "09" "10" ...
## $ Year : chr "1901" "1901" "1901" "1901" ...
## $ TMAX : num 31.97 26.43 22.28 18.42 6.69 ...
## $ YEAR : num 1901 1901 1901 1901 1901 ...
## $ MONTH: num 7 8 9 10 11 12 1 2 3 4 ...
```

```
plot(MonthlyTMAXMean$TMAX, ty='l')
```



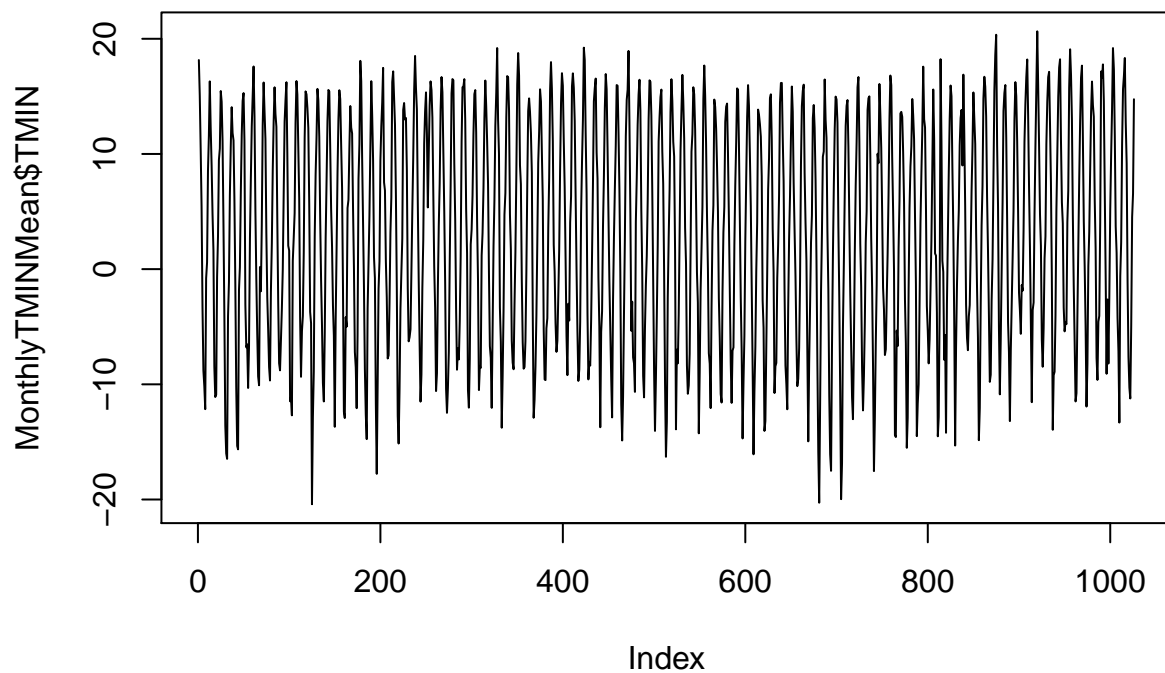
For Min:

```
MonthlyTMINMean = aggregate(TMIN ~ Month + Year, data = LakeCo, mean)
MonthlyTMINMean$YEAR = as.numeric(MonthlyTMINMean$Year)
MonthlyTMINMean$MONTH = as.numeric(MonthlyTMINMean$Month)
```

```
str(MonthlyTMINMean)
```

```
## 'data.frame': 1026 obs. of 5 variables:
## $ Month: chr "07" "08" "09" "10" ...
## $ Year : chr "1901" "1901" "1901" "1901" ...
## $ TMIN : num 18.15 15.09 10.5 5.44 -3.31 ...
## $ YEAR : num 1901 1901 1901 1901 1901 ...
## $ MONTH: num 7 8 9 10 11 12 1 2 3 4 ...
```

```
plot(MonthlyTMINMean$TMIN, ty = 'l')
```



Monthly Plots

Daily Minimum Temperatures

```
Months <- c("January", "February", "March", "April", "May", "June", "July", "August", "September", "October", "November", "December")

par(mfrow = c(3,4), mar = c(5, 4, 3, 2) + 0.1)
TMINresult <- NA

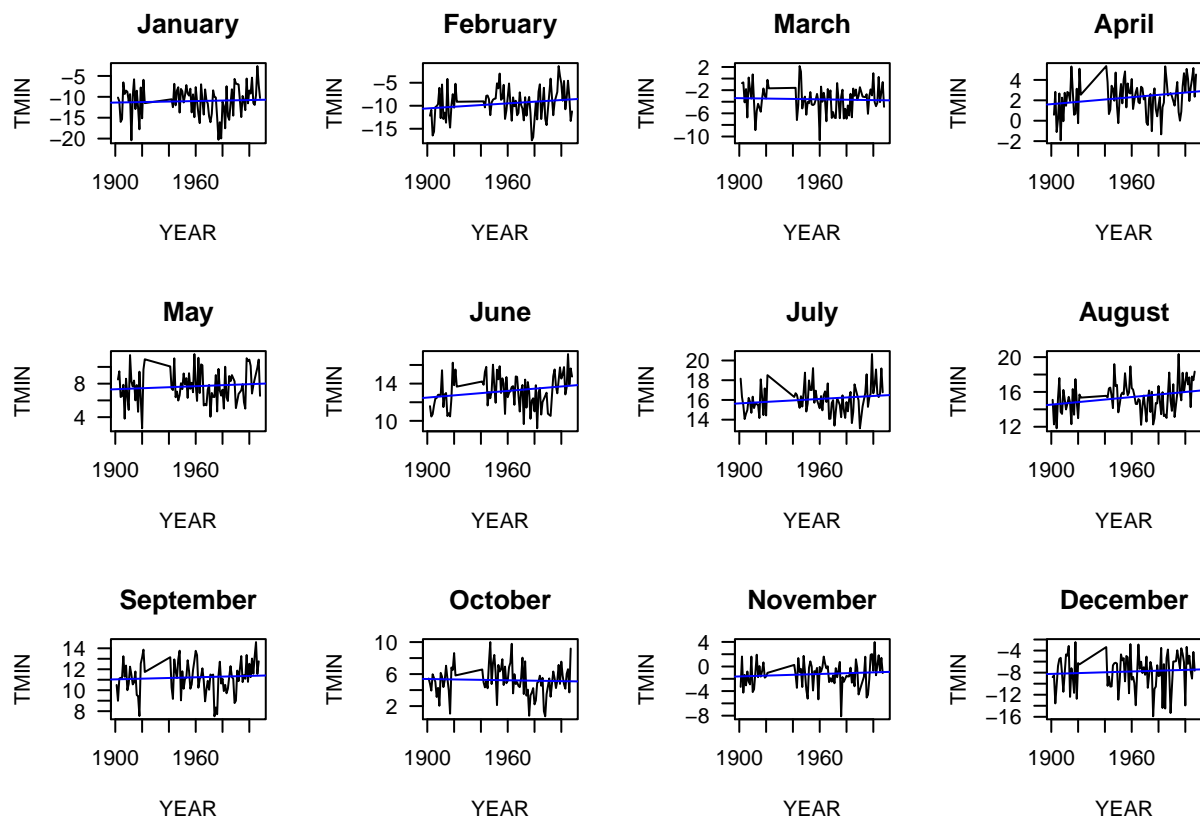
for(i in 1:12) {
  plot(TMIN~YEAR, data = MonthlyTMINMean[MonthlyTMINMean$MONTH == i, ], ty = 'l', las = 1, xlim = c(1900, 1910))
  MonthMin.lm <- lm(TMIN~YEAR, data = MonthlyTMINMean[MonthlyTMINMean$MONTH == i, ])
  summary(MonthMin.lm)
```

```

abline(coef(MonthMin.lm), col = 'blue')

TMINresult <- rbind(TMInresult, cbind(Months[i],
round(coef(MonthMin.lm)[2], 4), round(summary(MonthMin.lm)$coefficients[2,
4], 4), round(summary(MonthMin.lm)$r.squared,
3)))
}

```



Daily Maximum Temperatures

```

Months <- c("January", "February", "March", "April", "May", "June", "July", "August", "September", "October", "November", "December")

par(mfrow = c(3,4), mar = c(5, 4, 3, 2) + 0.1)
TMAXresult <- NA

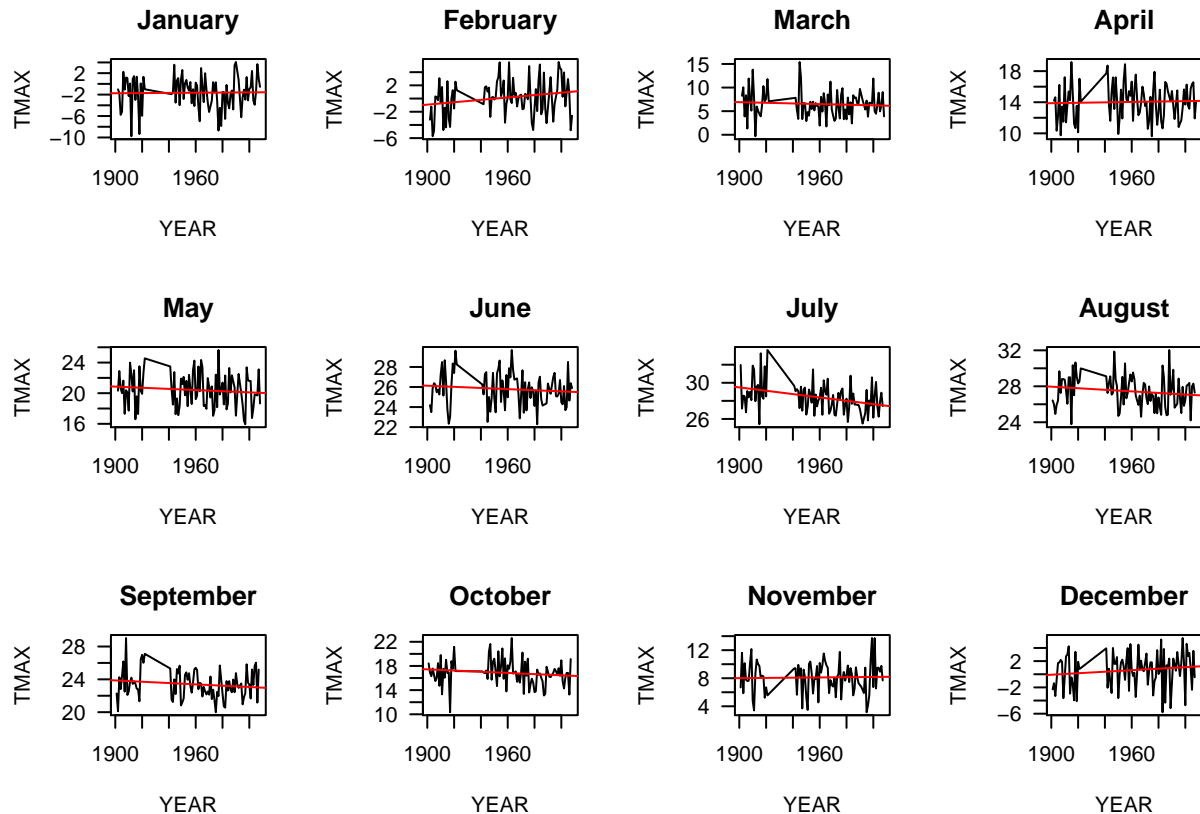
for(i in 1:12) {
  plot(TMAX~YEAR, data = MonthlyTMAXMean[MonthlyTMAXMean$MONTH == i, ], ty = 'l', las = 1, xlim = c(1900, 1960))
  MonthMax.lm <- lm(TMAX~YEAR, data = MonthlyTMAXMean[MonthlyTMAXMean$MONTH == i, ])
  summary(MonthMax.lm)

  abline(coef(MonthMax.lm), col = 'red')

  TMAXresult <- rbind(TMAXresult, cbind(Months[i],
round(coef(MonthMax.lm)[2], 4), round(summary(MonthMax.lm)$coefficients[2,
4], 4), round(summary(MonthMax.lm)$r.squared,
3)))
}

```

```
4], 4), round(summary(MonthMax.lm)$r.squared,
3)))
}
```



Summary

```
library(xtable)
Results <- data.frame(Month = TMINresult[c(2:13),1],
TMINslope = TMINresult[c(2:13),2],
TMIN_P = as.numeric(TMINresult[c(2:13),3]),
TMINRsq = TMINresult[c(2:13),4],
TMAXslope = TMAXresult[c(2:13),2],
TMAX_P = as.numeric(TMAXresult[c(2:13),3]),
TMAXRsq = TMAXresult[c(2:13),4])
Results$starTMIN = "NS"
Results$starTMIN[Results$TMIN_P <= .05] = "*"
Results$starTMIN[Results$TMIN_P < 0.01] = "**"
Results$starTMIN[Results$TMIN_P < 0.001] = "***"
Results$starTMAX = "NS"
Results$starTMAX[Results$TMAX_P < 0.05] = "*"
Results$starTMAX[Results$TMAX_P < 0.01] = "**"
Results$starTMAX[Results$TMAX_P < 0.001] = "***"
Results$TMINslope=paste(Results$TMINslope, Results$starTMIN)
```

```
Results$TMAXslope=paste(Results$TMAXSlope, Results$starTMAX)
colnames(Results) <- c("Month", "2", "3", "R^2", "5", "6",
"R^2", "8", "9", "Slope TMIN", "Slope TMAX")
print.xtable(Results[,c(1, 10, 4, 11, 7)])
```

```
## % latex table generated in R 3.6.0 by xtable 1.8-4 package
## % Thu Sep 10 09:55:34 2020
## \begin{table}[ht]
## \centering
## \begin{tabular}{c}
## \hline
## & Month & Slope TMIN & R\verb|^|^2 & Slope TMAX & R\verb|^|^2.1 \\\
## \hline
## 1 & January & 0.006 NS & 0.003 & 0.0016 NS & 0 \\\
## 2 & February & 0.0182 NS & 0.031 & 0.0182 * & 0.046 \\\
## 3 & March & -0.0034 NS & 0.002 & -0.0067 NS & 0.006 \\\
## 4 & April & 0.0114 * & 0.047 & 0.0027 NS & 0.001 \\\
## 5 & May & 0.0061 NS & 0.01 & -0.0076 NS & 0.011 \\\
## 6 & June & 0.0119 * & 0.049 & -0.0056 NS & 0.011 \\\
## 7 & July & 0.0075 NS & 0.029 & -0.0185 ** & 0.123 \\\
## 8 & August & 0.0145 * & 0.071 & -0.0087 NS & 0.025 \\\
## 9 & September & 0.0033 NS & 0.005 & -0.008 NS & 0.022 \\\
## 10 & October & -0.0027 NS & 0.002 & -0.0099 NS & 0.021 \\\
## 11 & November & 0.0066 NS & 0.011 & 0.0017 NS & 0.001 \\\
## 12 & December & 0.0073 NS & 0.005 & 0.0116 NS & 0.019 \\\
## \hline
## \end{tabular}
## \end{table}
```

Precipitation