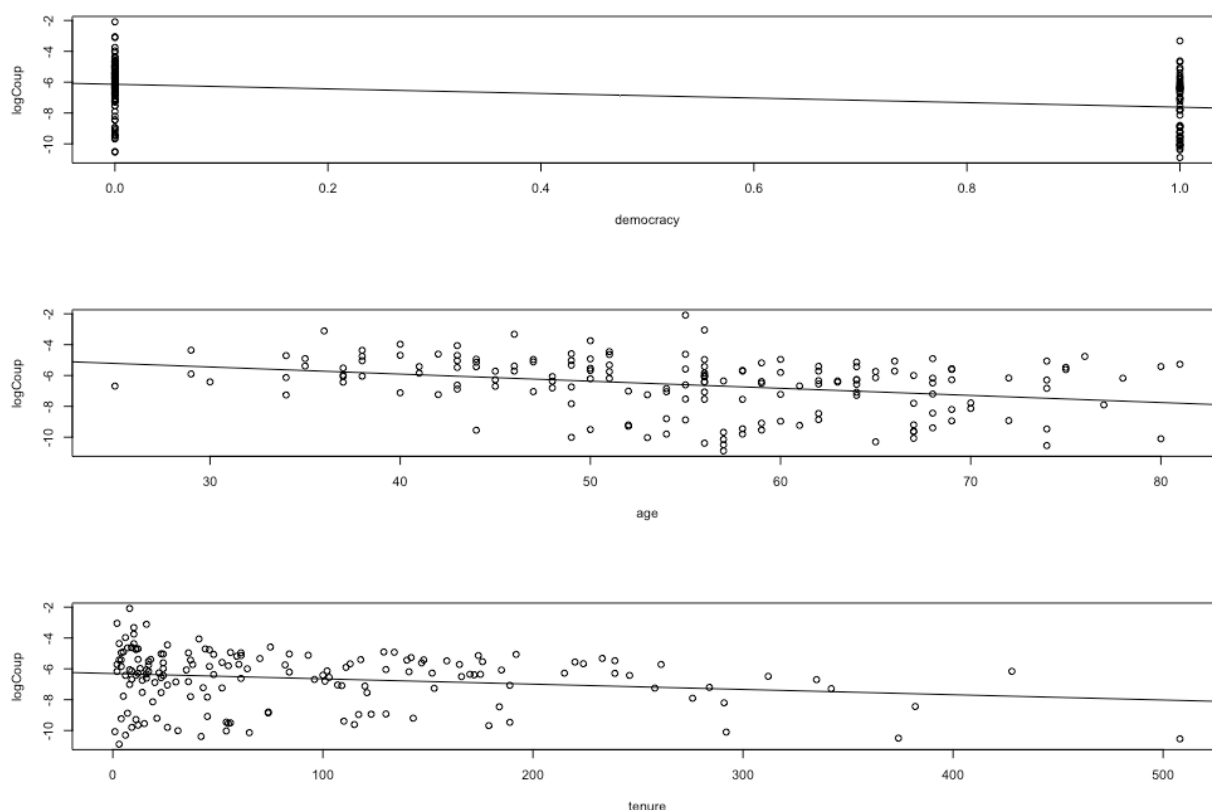


## MATH 426: Applied Longitudinal Analysis

1. Provide a plot of  $\log(\text{coupRisk})$  against each of democracy, age, and tenure. Very briefly, provide a qualitative characterization of the associations that you see.

According to the first plot showing  $\log(\text{CoupRisk})$  against democracy, it looks like there appears to be a higher probability of coup for those countries that are not considered a democracy, though this is a correlation as opposed to causation of course. In terms of age, it appears that a leader being older is correlated with a lower probability of coup. Similarly, there appears to be a negative relationship between a leader's tenure and probability of a coup.



2. Fit separate regression models to describe each of the three associations plotted in response to question
  - a. Provide a table showing, for each parameter in the mean part of the model, the estimated parameter, standard error and p-value from a test that the true parameter is equal to zero. Provide a brief quantitative characterization of the two associations.

Log(CoupRisk) Against Each Democracy, Age, Tenure

=====

Dependent variable:

	logCoup		
	(1)	(2)	(3)
democracy	-1.5003*** (0.2755) t = -5.4453 p = 0.000001		
age		-0.0464*** (0.0111) t = -4.1701 p = 0.00005	
tenure			-0.0035** (0.0014) t = -2.4488 p = 0.0154
Constant	-6.1383*** (0.1557) t = -39.4276 p = 0.0000	-4.0579*** (0.6279) t = -6.4624 p = 0.0000	-6.3074*** (0.1866) t = -33.8085 p = 0.0000
Observations	166	166	166
R2	0.1531	0.0959	0.0353
Adjusted R2	0.1480	0.0904	0.0294
Residual Std. Error (df = 164)	1.6550	1.7100	1.7663
F Statistic (df = 1; 164)	29.6509*** (p = 0.000001)	17.3896*** (p = 0.00005)	5.9967** (p = 0.0154)

Note:

\*p<0.1; \*\*p<0.05; \*\*\*p<0.01

A country being a democracy is associated with a 150% negative change in the probability of a coup. A one year increase in age is associated with a 4.6% reduction in the probability of a coup. A one-month increase in tenure is associated with a 3% negative change in the probability of a coup. All three relationships demonstrate statistical significance at the .1% level of statistical significance.

3. Fit a single model describing the multivariable association between log(coupRisk) and democracy, age, and tenure.
  - a. Write down a complete algebraic definition of the model being fitted, including assumptions.

$$\text{Log}(\text{coupRisk})_i = \beta_0 + \hat{\beta}_1 \text{democracy} + \hat{\beta}_2 \text{age} + \hat{\beta}_3 \text{tenure} + \epsilon_i$$

- b. Based on your algebraic definition, show how log(coupRisk) is associated with democracy, age, and tenure.

$$E[\text{Log}(\text{coupRisk})_1 | \text{democracy}_i, \text{age}_i, \text{tenure}_i] = \beta_0 + \hat{\beta}_1 \text{democracy} + \hat{\beta}_2 \text{age} + \hat{\beta}_3 \text{tenure}$$

- c. Provide a table showing, for each parameter in the mean part of the model, the estimated parameter, standard error and p-value from a test that the true parameter is equal to zero. Provide a quantitative interpretation of the estimates and 95% confidence intervals for the parameters in this model.

Dependent variable:	
logCoup	
democracy	-1.8263*** (-2.3704, -1.2822) t = -6.5787 p = 0.0000
age	-0.0245** (-0.0460, -0.0031) t = -2.2442 p = 0.0262
tenure	-0.0053*** (-0.0081, -0.0026) t = -3.7605 p = 0.0003
Constant	-4.2002*** (-5.3117, -3.0886) t = -7.4059 p = 0.0000
Observations	166
R2	0.2917
Adjusted R2	0.2786
Residual Std. Error	1.5228 (df = 162)
F Statistic	22.2429*** (df = 3; 162) (p = 0.0000)

Note: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

A country being a democracy is associated with a 182% decrease in the probability of a coup (1.8 times less likely that a coup will happen relative to a non-democracy). A one year increase in age is associated with a 2.5% reduction in the probability of a coup (.025 times less likely that a coup will happen with each year increase in age). A one-month increase in tenure is associated with a .5% reduction in the probability of a coup (.005 times less likely that a coup will happen with each year of tenure). While both democracy and tenure demonstrate statistical significance

at the .1% level of statistical significance, age demonstrates statistical significance at the 5% level of significance.

In 95% of randomly drawn samples from the population, the estimated democracy parameter will fall between -5.320 and -3.080. In 95% of randomly drawn samples from the population, the estimated value of the age parameter will fall between -0.046 and -0.003.

In 95% of randomly drawn samples from the population, the estimated value of the democracy parameter will fall between -0.008 and -0.003.

4. Based on the results of the analyses conducted in response to questions 1 to 3, summarize the methods, results and interpretation of this study and analysis in a brief structured paragraph in a form that is informative and suitable for an abstract for submission to a conference (which has a 250 word limit, see class style guide). [HINT: It would be good to provide information about the association of coup risk with each predictor, not  $\log(\text{coupRisk})$ ].

This article aims to evaluate the relationship between specific political conditions and the risk of a coup occurring in specific countries. Based on a Rulers, Elections, and Irregular Governance (REIGN) data set that covers 117 countries in 1980, a multivariate regression model is developed to empirically estimate the relationship between whether a country is considered a democracy or not and the age and tenure of country leadership and the risk of a coup occurring in that country in 1980. Holding all else constant, our results demonstrate that a country being a democracy has a strong relationship with the probability of a coup happening within a country, with democratic countries being 1.8 times less likely to experience a coup compared to a non-democratic country. A one-month increase in tenure is associated with a .5% reduction in the probability of a coup. A one-year increase in age, though less statistically significant than the correlation of democracy and tenure and the probability of a coup, respectively, is associated with a 2.5% reduction in the probability of a coup. The evidence suggests that more frequent leadership turnover or coming to power of younger country leaders may be associated with greater likelihood of a coup.

5. Now suppose interest focuses on whether tenure modifies the association between  $\log(\text{coupRisk})$  and democracy.

Extend the model in question 3 to address this question, and report the results. Assess whether the data provide strong evidence that tenure modifies the  $\log(\text{coupRisk})$ /democracy association.

$$Y_1 = \beta_0 + \hat{\beta}_1 \text{democracy} + \hat{\beta}_2 \text{age} + \hat{\beta}_3 \text{tenure} + \hat{\beta}_4 (\text{democracy} * \text{tenure}) + \epsilon_i$$

As evidenced by the .1727 p-value on the interaction variable, there is not strong evidence that tenure modifies the relationship between a country being a democracy and the likelihood of a coup. Tenure does appear, however, to influence at a statistically significant level the relationship between democracy and the probability of a coup when a country is a non-democracy.

- a. Explain why the main effect of democracy use does not represent a meaningful effect in this model.

The main effect of democracy is not a meaningful effect because you're talking about democracy only when tenure is 0. There is obviously no real democracy (at least not in this dataset) that has a leader in power with 0 years of tenure.

- b. Construct a new variable (centered tenure) defined as  $\text{tenure} - \text{mean}(\text{tenure})$ , where this mean is taken over the entire dataset. Re-fit the model in this question replacing tenure with this centered version, and report the results. Explain why the main effect of democracy now represents a meaningful quantity.

Because we're now looking at the correlation of democracy at the average level of tenure, the regression analysis is actually accounting for real countries now instead of those that would unrealistically have a tenure of 0.

#### Log(CoupRisk) Against Democracy, Age, Centered Tenure, and Interacted Democracy and Centered Tenure

Dependent variable:	
-----	
	logCoup
-----	
democracy	-1.5904*** (-2.2295, -0.9513) t = -4.8775 p = 0.000003
age	-0.0258** (-0.0472, -0.0044) t = -2.3578 p = 0.0196
Demeaned	-0.0059*** (-0.0088, -0.0030) t = -4.0021 p = 0.0001
MeanCTen	0.0056 (-0.0024, 0.0137) t = 1.3695 p = 0.1728
Constant	-4.5985*** (-5.7778, -3.4191) t = -7.6423 p = 0.0000
-----	
Observations	166
R2	0.2999
Adjusted R2	0.2825
Residual Std. Error	1.5187 (df = 161)
F Statistic	17.2413*** (df = 4; 161) (p = 0.0000)

---

Note:                    \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

```

Reign <-
read.table("/Users/christianmconroy/Desktop/Documents/GeorgetownMPPMSFS/McCourtMPP/Semester3Fall2017MPP/Math426ALA/coup
header=T, sep="")
attach(Reign)

# Questions 1 and 2 part 1
layout(1:3)
plot(democracy, logCoup)
abline(lm(logCoup~democracy))
plot(age, logCoup)
abline(lm(logCoup~age))
plot(tenure, logCoup)
abline(lm(logCoup~tenure))

# Question 2 part 2
# For printing output purposes
install.packages("stargazer")
library(stargazer)

RegDem<- lm(logCoup~democracy)
summary(RegDem)
RegAge<- lm(logCoup~age)
summary(RegAge)
RegTen<- lm(logCoup~tenure)
summary(RegTen)
stargazer(RegDem, RegAge, RegTen, type="text",title="Log(CoupRisk) Against Each Democracy, Age, Tenure",
digits=4,style="all", out="LCDem.txt")

# Question 3

MVReg <- lm(logCoup~democracy+age+tenure)
summary(MVReg)
confint(MVReg,level=0.95)
stargazer(MVReg, type="text",title="Log(CoupRisk) Against Democracy, Age, Tenure", digits=4,style="all", ci=TRUE,
ci.level=0.95, out="MVReg.txt")

# Question 5a
Reign$TenDemInt <- tenure*democracy
MVReg3 <- lm(logCoup~democracy+age+tenure+Reign$TenDemInt)
summary(MVReg3)

# Question 5b
Reign$MeanTenure <- mean(tenure)
Reign$Demeaned <- Reign$tenure- Reign$MeanTenure
Reign$MeanCTen <- Reign$Demeaned*democracy
MVReg4 <- lm(logCoup~democracy+age+Reign$Demeaned+Reign$MeanCTen)
summary(MVReg4)
stargazer(MVReg4, type="text",title="Log(CoupRisk) Against Democracy, Age, Centered Tenure, and Interacted Democracy
and Centered Tenure", digits=4,style="all", ci=TRUE, ci.level=0.95, out="MVReg4.txt")

```