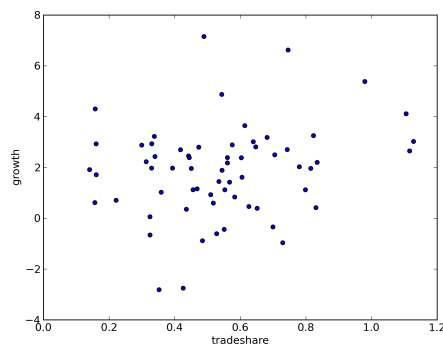## Problem 4

Part a.)

This relationship does not appear to be linear. We seem to be missing other relevant variables, which is probably why the second regressions is better than the first.

Part b.)

From regression 1, we'd expect Growth to increase by about $2 * 0.243 = .486$.

From regression 2, we'd expect Growth to increase by about $ln(2) * 1.1063 = .7044$

Part c.)

Individually, $Rev_{C}oups$ appears to be significant (t = -2.289) while $Assassinations$ does not (t = .0525). Using robust errors, the t-statistics for $Rev_{C}oups$ and $Assassinations$ drop to .877092 and .319188.

Jointly, for the non-robust test the F statistic is 2.82796. With 2 and 58 degrees of freedom, this gives a p-value of .06731. The robust test gives an F of 3.4085 and a p-value of .03985.

Part d.)

Regression 4 does not suggest that $TradeShare's$ effect is dependent upon $logSchool$ since the interaction variable is insignificant with a p-value of 0.168.

Part e.)

Regression 5 does not suggest a nonlinear relationship since the p-values for the square and cube of trade are both above 0.5. There could of course still be nonlinear, just in a non-cubic form.

Part f.)

From regression 3 we'd expect $Growth$ to increase by .55176. From regression 5 we'd expect $Growth$ to $decrease$ by about 1.074.

```
. ml model lf store_data (theta: y1 = ) (sigsq: y2 = )

. ml maximize

initial:       log likelihood =      -<inf>   (could not be evaluated)
feasible:      log likelihood = -2975.4372
rescale:       log likelihood =   -311.4592
rescale eq:    log likelihood =   -309.6101
Iteration 0:   log likelihood =   -309.6101
Iteration 1:   log likelihood = -309.30757
Iteration 2:   log likelihood = -309.24711
Iteration 3:   log likelihood = -309.24652
Iteration 4:   log likelihood = -309.24652

                                           Number of obs    =        100
                                           Wald chi2(0)     =          .
Log likelihood = -309.24652                Prob > chi2      =          .
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
theta						
_cons	.8877681	.4201469	2.11	0.035	.0642953	1.711241
sigsq						
_cons	28.41888	4.019036	7.07	0.000	20.54171	36.29604

```
.
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                     y1   R-squared:                       0.868
Model:                            OLS   Adj. R-squared:                  0.866
Method:                 Least Squares   F-statistic:                     643.2
Date:                Tue, 25 Sep 2012   Prob (F-statistic):           7.54e-45
Time:                        21:32:53   Log-Likelihood:                -309.08
No. Observations:                 100   AIC:                             622.2
Df Residuals:                      98   BIC:                             627.4
Df Model:                           1
==============================================================================
                 coef    std err          t      P>|t|      [95.0% Conf. Int.]
------------------------------------------------------------------------------
const          1.6251      1.023      1.588      0.115      -0.405       3.655
y2             0.9779      0.039     25.362      0.000       0.901       1.054
==============================================================================
Omnibus:                        9.668   Durbin-Watson:                   1.549
Prob(Omnibus):                  0.008   Jarque-Bera (JB):               11.024
Skew:                           0.552   Prob(JB):                      0.00404
Kurtosis:                       4.194   Cond. No.                         50.5
==============================================================================
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                 growth   R-squared:                       0.161
Model:                            OLS   Adj. R-squared:                  0.133
Method:                 Least Squares   F-statistic:                     5.836
Date:                Thu, 20 Sep 2012   Prob (F-statistic):            0.00480
Time:                        15:15:50   Log-Likelihood:                -122.90
No. Observations:                  64   AIC:                             251.8
Df Residuals:                      61   BIC:                             258.3
Df Model:                           2
==============================================================================
                 coef    std err          t      P>|t|      [95.0% Conf. Int.]
------------------------------------------------------------------------------
const         -0.1222      0.663     -0.184      0.854      -1.447       1.203
tradeshare     1.8978      0.936      2.027      0.047       0.026       3.770
yearsschool    0.2430      0.084      2.903      0.005       0.076       0.410
==============================================================================
Omnibus:                       10.227   Durbin-Watson:                   2.156
Prob(Omnibus):                  0.006   Jarque-Bera (JB):               10.906
Skew:                           0.745   Prob(JB):                      0.00428
Kurtosis:                       4.368   Cond. No.                         24.9
==============================================================================
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                 growth   R-squared:                       0.287
Model:                            OLS   Adj. R-squared:                  0.264
Method:                 Least Squares   F-statistic:                     12.29
Date:                Thu, 20 Sep 2012   Prob (F-statistic):           3.28e-05
Time:                        15:16:29   Log-Likelihood:                -117.67
No. Observations:                  64   AIC:                             241.3
Df Residuals:                      61   BIC:                             247.8
Df Model:                           2
==============================================================================
                 coef    std err          t      P>|t|      [95.0% Conf. Int.]
------------------------------------------------------------------------------
const         -0.1857      0.564     -0.329      0.743      -1.314       0.943
tradeshare     1.7490      0.860      2.034      0.046       0.029       3.469
logSchool      1.0163      0.223      4.556      0.000       0.570       1.462
==============================================================================
Omnibus:                       14.404   Durbin-Watson:                   2.127
Prob(Omnibus):                  0.001   Jarque-Bera (JB):               16.497
Skew:                           1.006   Prob(JB):                     0.000262
Kurtosis:                       4.461   Cond. No.                         8.69
==============================================================================
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                 growth   R-squared:                       0.453
Model:                            OLS   Adj. R-squared:                  0.406
Method:                 Least Squares   F-statistic:                     9.613
Date:                Thu, 20 Sep 2012   Prob (F-statistic):           1.01e-06
Time:                        15:16:46   Log-Likelihood:                -109.18
No. Observations:                  64   AIC:                             230.4
Df Residuals:                      58   BIC:                             243.3
Df Model:                           5
==============================================================================
                 coef    std err          t      P>|t|      [95.0% Conf. Int.]
------------------------------------------------------------------------------
const         11.7459      2.920      4.023      0.000       5.901      17.591
tradeshare     1.1035      0.833      1.325      0.191      -0.564       2.771
rev_coups     -2.2995      1.004     -2.289      0.026      -4.310      -0.289
assasinations  0.2277      0.434      0.525      0.602      -0.640       1.096
logSchool      2.1613      0.363      5.960      0.000       1.435       2.887
logRgdp60     -1.6211      0.399     -4.068      0.000      -2.419      -0.823
==============================================================================
Omnibus:                        3.780   Durbin-Watson:                   1.966
Prob(Omnibus):                  0.151   Jarque-Bera (JB):                2.930
Skew:                           0.379   Prob(JB):                        0.231
Kurtosis:                       3.724   Cond. No.                         136.
==============================================================================
```

```
                    OLS Regression Results                                                OLS Regression Results
========================================================                  ================================================================
Dep. Variable:              growth   R-squared:              0.471        Dep. Variable:              growth   R-squared:                 0.471
Model:                         OLS   Adj. R-squared:         0.416        Model:                         OLS   Adj. R-squared:            0.405
Method:              Least Squares   F-statistic:            8.467        Method:              Least Squares   F-statistic:               7.126
Date:             Thu, 20 Sep 2012   Prob (F-statistic):   1.40e-06       Date:             Thu, 20 Sep 2012   Prob (F-statistic):       4.38e-06
Time:                     15:17:27   Log-Likelihood:        -108.11       Time:                     15:17:57   Log-Likelihood:           -108.12
No. Observations:               64   AIC:                     230.2       No. Observations:               64   AIC:                        232.2
Df Residuals:                   57   BIC:                     245.3       Df Residuals:                   56   BIC:                        249.5
Df Model:                        6                                        Df Model:                        7
========================================================                  ================================================================
                 coef   std err        t    P>|t|   [95.0% Conf. Int.]                     coef   std err        t    P>|t|   [95.0% Conf. Int.]
--------------------------------------------------------                  ----------------------------------------------------------------
const         13.4322     3.138    4.280    0.000      7.148   19.716     const         12.9291     3.098    4.173    0.000      6.722   19.136
tradeshare    -0.4487     1.385   -0.324    0.747     -3.223    2.326     tradeshare    -5.7019     9.755   -0.585    0.561    -25.244   13.840
rev_coups     -2.0498     1.012   -2.025    0.048     -4.077   -0.023     rev_coups     -2.0355     1.026   -1.984    0.052     -4.091    0.020
assasinations  0.1036     0.439    0.236    0.814     -0.776    0.983     assasinations  0.1021     0.444    0.230    0.819     -0.786    0.991
logSchool      2.1359     0.360    5.930    0.000      1.415    2.857     tradeSquared   8.4879    17.435    0.487    0.628    -26.439   43.414
logRgdp60     -1.5909     0.396   -4.019    0.000     -2.384   -0.798     tradeCubed    -2.7597     9.250   -0.298    0.767    -21.289   15.770
tradeLnSchool  3.7266     2.670    1.396    0.168     -1.619    9.072     logSchool      2.1332     0.367    5.813    0.000      1.398    2.868
                                                                         logRgdp60     -1.5843     0.408   -3.884    0.000     -2.402   -0.767
========================================================                  ================================================================
Omnibus:                     6.912   Durbin-Watson:           2.031       Omnibus:                     7.017   Durbin-Watson:              2.030
Prob(Omnibus):               0.032   Jarque-Bera (JB):        6.726       Prob(Omnibus):               0.030   Jarque-Bera (JB):           6.867
Skew:                        0.539   Prob(JB):               0.0346       Skew:                        0.544   Prob(JB):                  0.0323
Kurtosis:                    4.166   Cond. No.                  166.      Kurtosis:                    4.179   Cond. No.                    994.
========================================================                  ================================================================
```

I apologize for the terrible formatting. Still working on a good way to get LaTeX output.
The order going left to right, top to bottom:

- Part 3b MLE

- Part 3b OLS

- Part 4, model 1, 2, 3, 4, 5