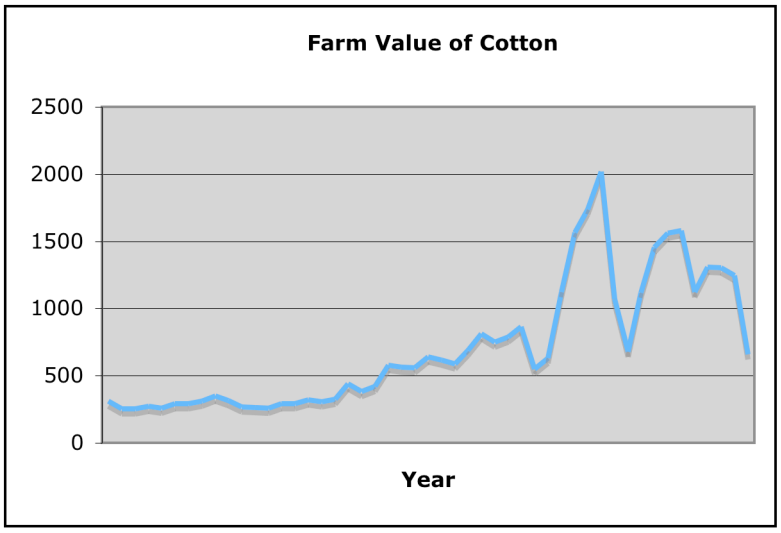
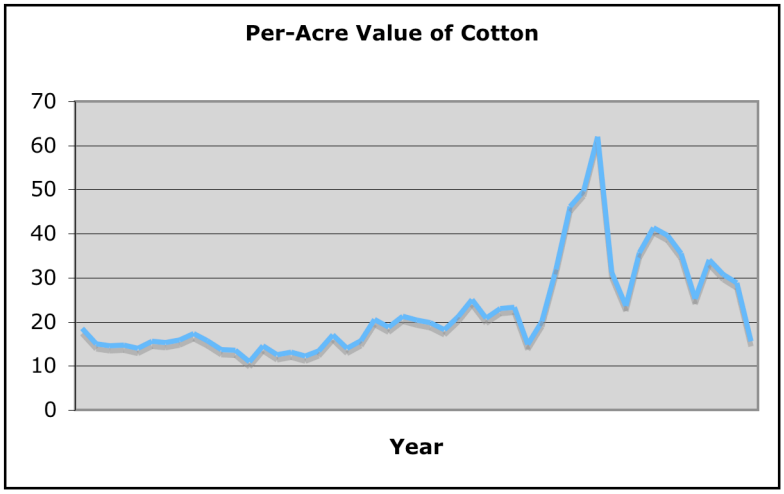
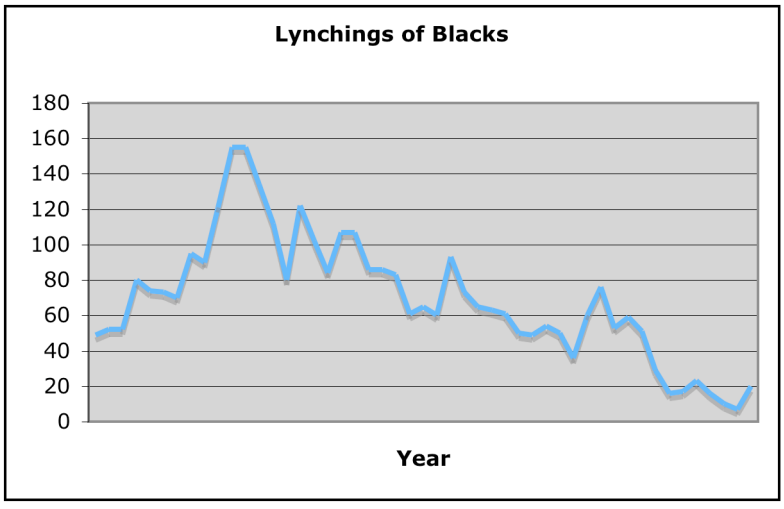
# Time Series Analysis of the Hovland-Sears Lynching Data

Hovland, C. I. and Sears, R. R.  Minor studies of aggression IV: Correlation of lynchings with economic indices. Journal of Psychology, 1940, 9, 301-310.

| Year | Ayres' Index | Per-Acre Value of Cotton | Farm Value of Cotton | Negro Lynchings | Total Lynchings |
|---|---|---|---|---|---|
| 1882 | 7.8 | 18.46 | 310 | 49 | 114 |
| 1883 | 3.0 | 14.96 | 251 | 52 | 131 |
| 1884 | -6.4 | 14.56 | 254 | 52 | 210 |
| 1885 | -10.5 | 14.75 | 270 | 80 | 184 |
| 1886 | 0.8 | 13.94 | 257 | 74 | 137 |
| 1887 | 5.9 | 15.61 | 291 | 73 | 121 |
| 1888 | 1.3 | 15.33 | 292 | 70 | 140 |
| 1889 | 3.5 | 15.80 | 308 | 95 | 176 |
| 1890 | 9.8 | 17.34 | 350 | 90 | 127 |
| 1891 | 4.7 | 15.77 | 313 | 121 | 192 |
| 1892 | 7.1 | 13.61 | 268 | 155 | 255 |
| 1893 | -4.2 | 13.54 | 264 | 155 | 201 |
| 1894 | -11.5 | 10.94 | 259 | 134 | 190 |
| 1895 | -2.2 | 14.50 | 293 | 112 | 171 |
| 1896 | -9.2 | 12.54 | 292 | 80 | 131 |
| 1897 | -6.9 | 13.12 | 319 | 122 | 166 |
| 1898 | 0.3 | 12.21 | 305 | 102 | 127 |
| 1899 | 4.8 | 13.39 | 325 | 84 | 107 |
| 1900 | 3.3 | 17.02 | 438 | 107 | 115 |
| 1901 | 3.1 | 14.01 | 381 | 107 | 135 |
| 1902 | 3.3 | 15.65 | 422 | 86 | 97 |
| 1903 | 1.2 | 20.58 | 576 | 86 | 103 |
| 1904 | -4.3 | 18.77 | 561 | 83 | 87 |
| 1905 | 8.2 | 21.32 | 557 | 61 | 66 |
| 1906 | 10.3 | 20.41 | 640 | 65 | 73 |
| 1907 | 6.3 | 19.76 | 614 | 60 | 63 |
| 1908 | -14.1 | 18.18 | 589 | 93 | 100 |
| 1909 | 2.0 | 21.18 | 688 | 73 | 87 |
| 1910 | 1.3 | 24.99 | 810 | 65 | 74 |
| 1911 | -5.8 | 20.80 | 750 | 63 | 71 |
| 1912 | 4.2 | 22.95 | 787 | 61 | 65 |
| 1913 | 4.5 | 23.27 | 863 | 50 | 51 |
| 1914 | -5.3 | 14.79 | 549 | 49 | 52 |
| 1915 | -0.4 | 20.09 | 631 | 54 | 67 |
| 1916 | 13.7 | 31.82 | 1122 | 50 | 54 |
| 1917 | 11.9 | 46.20 | 1566 | 36 | 38 |
| 1918 | 7.2 | 49.60 | 1738 | 60 | 64 |
| 1919 | -0.3 | 62.00 | 2020 | 76 | 83 |
| 1920 | 1.8 | 31.10 | 1069 | 53 | 61 |
| 1921 | -23.9 | 23.60 | 676 | 59 | 64 |
| 1922 | -6.6 | 35.68 | 1116 | 51 | 57 |
| 1923 | 8.9 | 41.30 | 1454 | 29 | 33 |
| 1924 | -2.1 | 39.60 | 1561 | 16 | 16 |
| 1925 | 5.0 | 35.55 | 1577 | 17 | 17 |
| 1926 | 6.4 | 25.15 | 1121 | 23 | 30 |
| 1927 | 1.6 | 34.08 | 1308 | 16 | 16 |
| 1928 | 3.4 | 30.69 | 1302 | 10 | 11 |
| 1929 | 8.3 | 28.79 | 1245 | 7 | 10 |
| 1930 | -14.5 | 15.52 | 659 | 20 | 21 |


Farm Value of Cotton
2500
2000
1500
1000
500
0
Year


Per-Acre Value of Cotton
70
60
50
40
30
20
10
0
Year


Lynchings of Blacks
180
160
140
120
100
80
60
40
20
0
Year

```
                                    /* lynch2.sas */
options nodate linesize=79 pagesize=500 noovp formdlim='-' nodate;
title 'Hovland and Sears Lynching data';

data lynch;
     infile 'HSlynch.data' firstobs=6; /* Skipping the header */
     input year ayres cotton1 cotton2 Blynch Totlynch;
     label ayres = 'Ayres'' composite economic index'
           cotton1 = 'Per-acre value of cotton'
           cotton2 = 'Farm value of cotton'
           blynch  = 'Negro lynchings'
           totlynch = 'Total lynchings';
     olynch = totlynch-blynch;
     label olynch = 'Non-Black lynchings';
     /* Created differenced and lagged  variables after looking at
        autocorrelation and cross-correlation functions, etc. */
     dc1 = cotton1 - lag(cotton1);
     dc2 = cotton2 - lag(cotton2);
     dbl = blynch - lag(blynch);

proc corr;
     var year cotton1 -- olynch;

proc reg;
     title2 'Naive regression, but request Durbin-Watson statistic';
     model blynch = cotton1 cotton2 / dw;

proc arima;
     title2 'Autocorrelations and partial autocorrelations';
     identify var = cotton1;
     identify var = cotton2;
     identify var = blynch;

proc arima;
     title2 'Auto and partial autocorrelations: First differenced';
     identify var = cotton1(1);
     identify var = cotton2(1);
     identify var = blynch(1);

proc reg;
     title2 'DW on differenced data, save residuals';
     model dbl = dc1 dc2 / dw;
     output out=lynch2 residual=dlynchre;

proc arima;
     title2 'Cross-corr of resid vs dcotton1';
     identify var = dlynchre
              crosscorr = dc1;

proc arima;
     title2 'Cross-corr of resid vs Dcotton2';
     identify var = dlynchre
              crosscorr = dc2 ;

proc autoreg;
     title2 'Demonstrate proc autoreg';
     model dbl =  dc1 dc2 /  nlag=1 method=ml;
     both: test dc1=dc2=0;
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Hovland and Sears Lynching data 1

The CORR Procedure

6 Variables: year cotton1 cotton2 Blynch Totlynch olynch

Simple Statistics

| Variable | N | Mean | Std Dev | Sum | Minimum | Maximum |
|---|---|---|---|---|---|---|
| year | 49 | 1906 | 14.28869 | 93394 | 1882 | 1930 |
| cotton1 | 49 | 22.54735 | 10.99082 | 1105 | 10.94000 | 62.00000 |
| cotton2 | 49 | 706.34694 | 473.98684 | 34611 | 251.00000 | 2020 |
| Blynch | 49 | 69.10204 | 35.24098 | 3386 | 7.00000 | 155.00000 |
| Totlynch | 49 | 97.16327 | 59.55017 | 4761 | 10.00000 | 255.00000 |
| olynch | 49 | 28.06122 | 34.90249 | 1375 | 0 | 158.00000 |

Simple Statistics

| Variable | Label |
|---|---|
| year | |
| cotton1 | Per-acre value of cotton |
| cotton2 | Farm value of cotton |
| Blynch | Negro lynchings |
| Totlynch | Total lynchings |
| olynch | Non-Black lynchings |

Pearson Correlation Coefficients, N = 49
Prob > |r| under H0: Rho=0

| | year | cotton1 | cotton2 |
|---|---|---|---|
| year | 1.00000 | 0.66746<br><.0001 | 0.81944<br><.0001 |
| cotton1<br>Per-acre value of cotton | 0.66746<br><.0001 | 1.00000 | 0.95829<br><.0001 |
| cotton2<br>Farm value of cotton | 0.81944<br><.0001 | 0.95829<br><.0001 | 1.00000 |
| Blynch<br>Negro lynchings | -0.66545<br><.0001 | -0.52214<br>0.0001 | -0.63590<br><.0001 |
| Totlynch<br>Total lynchings | -0.86563<br><.0001 | -0.60074<br><.0001 | -0.73750<br><.0001 |
| olynch<br>Non-Black lynchings | -0.80503<br><.0001 | -0.49777<br>0.0003 | -0.61625<br><.0001 |

Pearson Correlation Coefficients, N = 49
Prob > |r| under H0: Rho=0

| | Blynch | Totlynch | olynch |
|---|---|---|---|
| year | -0.66545 | -0.86563 | -0.80503 |
| | <.0001 | <.0001 | <.0001 |
| cotton1 | -0.52214 | -0.60074 | -0.49777 |
| Per-acre value of cotton | 0.0001 | <.0001 | 0.0003 |
| cotton2 | -0.63590 | -0.73750 | -0.61625 |
| Farm value of cotton | <.0001 | <.0001 | <.0001 |
| Blynch | 1.00000 | 0.85056 | 0.44151 |
| Negro lynchings | | <.0001 | 0.0015 |
| Totlynch | 0.85056 | 1.00000 | 0.84738 |
| Total lynchings | <.0001 | | <.0001 |
| olynch | 0.44151 | 0.84738 | 1.00000 |
| Non-Black lynchings | 0.0015 | <.0001 | |

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Naive regression, but request Durbin-Watson statistic

The REG Procedure
Model: MODEL1
Dependent Variable: Blynch Negro lynchings

Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Model | 2 | 29660 | 14830 | 22.78 | <.0001 |
| Error | 46 | 29952 | 651.13433 | | |
| Corrected Total | 48 | 59612 | | | |

| | | | |
|---|---|---|---|
| Root MSE | 25.51733 | R-Square | 0.4976 |
| Dependent Mean | 69.10204 | Adj R-Sq | 0.4757 |
| Coeff Var | 36.92703 | | |

Parameter Estimates

| Variable | Label | DF | Parameter Estimate | Standard Error | t Value |
|---|---|---|---|---|---|
| Intercept | Intercept | 1 | 79.03202 | 10.39033 | 7.61 |
| cotton1 | Per-acre value of cotton | 1 | 3.42479 | 1.17256 | 2.92 |
| cotton2 | Farm value of cotton | 1 | -0.12338 | 0.02719 | -4.54 |

Parameter Estimates

| Variable | Label | DF | Pr > \|t\| |
|---|---|---|---|
| Intercept | Intercept | 1 | <.0001 |
| cotton1 | Per-acre value of cotton | 1 | 0.0054 |
| cotton2 | Farm value of cotton | 1 | <.0001 |

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Naive regression, but request Durbin-Watson statistic

The REG Procedure
Model: MODEL1
Dependent Variable: Blynch Negro lynchings

| | |
|---|---|
| Durbin-Watson D | 0.549 |
| Number of Observations | 49 |
| 1st Order Autocorrelation | 0.659 |

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Autocorrelations and partial autocorrelations

The ARIMA Procedure

Name of Variable = cotton1

| | |
|---|---|
| Mean of Working Series | 22.54735 |
| Standard Deviation | 10.87809 |
| Number of Observations | 49 |

Autocorrelations

| Lag | Covariance | Correlation | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 |
|---|---|---|---|
| 0 | 118.333 | 1.00000 | \|**********\| |
| 1 | 93.610091 | 0.79107 | \|********** . \| |
| 2 | 70.599925 | 0.59662 | \|********** . \| |
| 3 | 56.816462 | 0.48014 | \|********** . \| |
| 4 | 55.109978 | 0.46572 | \|********* . \| |
| 5 | 56.388938 | 0.47653 | \|********** . \| |
| 6 | 55.916516 | 0.47254 | \|********* . \| |
| 7 | 43.474849 | 0.36739 | \|******* . \| |
| 8 | 35.509119 | 0.30008 | \|****** . \| |
| 9 | 31.054837 | 0.26244 | \|***** . \| |
| 10 | 24.939976 | 0.21076 | \|**** . \| |
| 11 | 11.150431 | 0.09423 | \|** . \| |
| 12 | 9.795871 | 0.08278 | \|** . \| |

"." marks two standard errors

Inverse Autocorrelations

| Lag | Correlation | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 |
|---|---|---|
| 1 | -0.51281 | \|  **********\|  .  \| |
| 2 | -0.01654 | \|  .  \|  .  \| |
| 3 | 0.04786 | \|  .  \|*  .  \| |
| 4 | 0.08848 | \|  .  \|**  .  \| |
| 5 | -0.02924 | \|  .  *\|  .  \| |
| 6 | -0.20041 | \|  . ****\|  .  \| |
| 7 | 0.12443 | \|  .  \|**  .  \| |
| 8 | 0.04032 | \|  .  \|*  .  \| |
| 9 | 0.00017 | \|  .  \|  .  \| |
| 10 | -0.21198 | \|  . ****\|  .  \| |
| 11 | 0.27880 | \|  .  \|******  \| |
| 12 | -0.10243 | \|  .  **\|  .  \| |

Partial Autocorrelations

| Lag | Correlation | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 |
|---|---|---|
| 1 | 0.79107 | \|  .  \|**********  \| |
| 2 | -0.07797 | \|  .  **\|  .  \| |
| 3 | 0.08886 | \|  .  \|**  .  \| |
| 4 | 0.20159 | \|  .  \|**** .  \| |
| 5 | 0.09702 | \|  .  \|**  .  \| |
| 6 | 0.05877 | \|  .  \|*  .  \| |
| 7 | -0.18615 | \|  . ****\|  .  \| |
| 8 | 0.07852 | \|  .  \|**  .  \| |
| 9 | -0.00678 | \|  .  \|  .  \| |
| 10 | -0.13320 | \|  .  ***\|  .  \| |
| 11 | -0.22581 | \| .*****\|  .  \| |
| 12 | 0.21505 | \|  .  \|**** .  \| |

Autocorrelation Check for White Noise

| To Lag | Chi-Square | DF | Pr > ChiSq | Autocorrelations | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 6 | 101.95 | 6 | <.0001 | 0.791 | 0.597 | 0.480 | 0.466 | 0.477 | 0.473 |
| 12 | 123.67 | 12 | <.0001 | 0.367 | 0.300 | 0.262 | 0.211 | 0.094 | 0.083 |

Name of Variable = cotton2

| | |
|---|---|
| Mean of Working Series | 706.3469 |
| Standard Deviation | 469.1253 |
| Number of Observations | 49 |

Autocorrelations

| Lag | Covariance | Correlation | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 |
|---|---|---|---|
| 0 | 220079 | 1.00000 | \|********************\| |
| 1 | 190709 | 0.86655 | \|*****************. \| |
| 2 | 153453 | 0.69726 | \|**************. \| |
| 3 | 131796 | 0.59886 | \|************. \| |
| 4 | 126865 | 0.57645 | \|************. \| |
| 5 | 131033 | 0.59539 | \|************. \| |
| 6 | 133584 | 0.60698 | \|************. \| |
| 7 | 115037 | 0.52271 | \|**********. \| |
| 8 | 98285.979 | 0.44659 | \|*********. \| |
| 9 | 89233.237 | 0.40546 | \|********. \| |
| 10 | 76543.647 | 0.34780 | \|*******. \| |
| 11 | 55460.257 | 0.25200 | \|*****. \| |
| 12 | 41678.143 | 0.18938 | \|****. \| |

"." marks two standard errors

Skipping Inverse Autocorrelations from now on ...

Partial Autocorrelations

| Lag | Correlation | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 |
|---|---|---|
| 1 | 0.86655 | \|*****************. \| |
| 2 | -0.21534 | \|. ****. \| |
| 3 | 0.21528 | \|****. \| |
| 4 | 0.17520 | \|****. \| |
| 5 | 0.15512 | \|***. \| |
| 6 | 0.06543 | \|*. \| |
| 7 | -0.28386 | \|******. \| |
| 8 | 0.18428 | \|****. \| |
| 9 | -0.05058 | \|. *. \| |
| 10 | -0.22008 | \|. ****. \| |
| 11 | -0.21079 | \|. ****. \| |
| 12 | 0.10510 | \|**. \| |

Autocorrelation Check for White Noise

| To Lag | Chi-Square | DF | Pr > ChiSq | Autocorrelations | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 6 | 144.43 | 6 | <.0001 | 0.867 | 0.697 | 0.599 | 0.576 | 0.595 | 0.607 |
| 12 | 197.46 | 12 | <.0001 | 0.523 | 0.447 | 0.405 | 0.348 | 0.252 | 0.189 |

Name of Variable = Blynch

| | |
|---|---|
| Mean of Working Series | 69.10204 |
| Standard Deviation | 34.87953 |
| Number of Observations | 49 |

Autocorrelations

| Lag | Covariance | Correlation | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 |
|---|---|---|---|
| 0 | 1216.581 | 1.00000 | \|**********\| |
| 1 | 1046.213 | 0.85996 | \|*********  \| |
| 2 | 889.089 | 0.73081 | \|*******  \| |
| 3 | 777.584 | 0.63915 | \|******  \| |
| 4 | 661.741 | 0.54393 | \|*****.  \| |
| 5 | 550.594 | 0.45257 | \|****  .  \| |
| 6 | 486.167 | 0.39962 | \|****  .  \| |
| 7 | 404.038 | 0.33211 | \|***  .  \| |
| 8 | 334.193 | 0.27470 | \|***  .  \| |
| 9 | 236.015 | 0.19400 | \|**  .  \| |
| 10 | 183.470 | 0.15081 | \|*  .  \| |
| 11 | 168.819 | 0.13877 | \|*  .  \| |
| 12 | 121.033 | 0.09949 | \|*  .  \| |

"." marks two standard errors

Partial Autocorrelations

| Lag | Correlation | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 |
|---|---|---|
| 1 | 0.85996 | \|*********  \| |
| 2 | -0.03349 | \|  .  \| |
| 3 | 0.07088 | \|  .  \| |
| 4 | -0.06211 | \|  .  \| |
| 5 | -0.03054 | \|  .  \| |
| 6 | 0.08466 | \|  .  \| |
| 7 | -0.08734 | \|  .  \| |
| 8 | 0.01911 | \|  .  \| |
| 9 | -0.15122 | \|  .  \| |
| 10 | 0.10004 | \|  .  \| |
| 11 | 0.07440 | \|  .  \| |
| 12 | -0.10867 | \|  .  \| |

Autocorrelation Check for White Noise

| To Lag | Chi-Square | DF | Pr > ChiSq | Autocorrelations | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 6 | 126.44 | 6 | <.0001 | 0.860 | 0.731 | 0.639 | 0.544 | 0.453 | 0.400 |
| 12 | 143.34 | 12 | <.0001 | 0.332 | 0.275 | 0.194 | 0.151 | 0.139 | 0.099 |

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Auto and partial autocorrelations: First differenced

The ARIMA Procedure
Name of Variable = cotton1

| | |
|---|---|
| Period(s) of Differencing | 1 |
| Mean of Working Series | -0.06125 |
| Standard Deviation | 7.006789 |
| Number of Observations | 48 |
| Observation(s) eliminated by differencing | 1 |

Autocorrelations

| Lag | Covariance | Correlation | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 |
|---|---|---|---|
| 0 | 49.095094 | 1.00000 | \|**********\| |
| 1 | -0.086014 | -.00175 | \| . \| . \| |
| 2 | -9.154395 | -.18646 | \| . **** \| . \| |
| 3 | -11.791667 | -.24018 | \| .***** \| . \| |
| 4 | -4.410002 | -.08983 | \| . ** \| . \| |
| 5 | 3.477720 | 0.07084 | \| . \|* . \| |
| 6 | 12.818194 | 0.26109 | \| . \|***** . \| |
| 7 | -4.248287 | -.08653 | \| . ** \| . \| |
| 8 | -4.253475 | -.08664 | \| . ** \| . \| |
| 9 | -0.197777 | -.00403 | \| . \| . \| |
| 10 | 8.770201 | 0.17864 | \| . \|**** . \| |
| 11 | -8.115175 | -.16530 | \| . *** \| . \| |
| 12 | 1.594561 | 0.03248 | \| . \|* . \| |

"." marks two standard errors

Partial Autocorrelations

| Lag | Correlation | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 |
|---|---|---|
| 1 | -0.00175 | \| . \| . \| |
| 2 | -0.18647 | \| . **** \| . \| |
| 3 | -0.24957 | \| .***** \| . \| |
| 4 | -0.15115 | \| . *** \| . \| |
| 5 | -0.04160 | \| . * \| . \| |
| 6 | 0.17507 | \| . \|**** . \| |
| 7 | -0.11913 | \| . ** \| . \| |
| 8 | -0.02008 | \| . \| . \| |
| 9 | 0.06596 | \| . \|* . \| |
| 10 | 0.19982 | \| . \|**** . \| |
| 11 | -0.21900 | \| . **** \| . \| |
| 12 | 0.04772 | \| . \|* . \| |

Autocorrelation Check for White Noise

| To Lag | Chi-Square | DF | Pr > ChiSq | Autocorrelations | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 6 | 9.51 | 6 | 0.1470 | -0.002 | -0.186 | -0.240 | -0.090 | 0.071 | 0.261 |
| 12 | 14.25 | 12 | 0.2848 | -0.087 | -0.087 | -0.004 | 0.179 | -0.165 | 0.032 |

Name of Variable = cotton2

| | |
|---|---|
| Period(s) of Differencing | 1 |
| Mean of Working Series | 7.270833 |
| Standard Deviation | 237.889 |
| Number of Observations | 48 |
| Observation(s) eliminated by differencing | 1 |

Autocorrelations

| Lag | Covariance | Correlation | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 |
|---|---|---|---|
| 0 | 56591.197 | 1.00000 | \|**********\| |
| 1 | 7989.269 | 0.14118 | \|***  . \| |
| 2 | -16003.470 | -.28279 | \|******  . \| |
| 3 | -17097.036 | -.30211 | \|******  . \| |
| 4 | -9715.405 | -.17168 | \|  ***  . \| |
| 5 | 2180.404 | 0.03853 | \|*  . \| |
| 6 | 21330.690 | 0.37693 | \|******** \| |
| 7 | -1986.905 | -.03511 | \|  *  . \| |
| 8 | -7970.591 | -.14085 | \|  ***  . \| |
| 9 | 2908.185 | 0.05139 | \|*  . \| |
| 10 | 8452.404 | 0.14936 | \|***  . \| |
| 11 | -6826.460 | -.12063 | \|  **  . \| |
| 12 | 679.689 | 0.01201 | \|  . \| |

"." marks two standard errors

Partial Autocorrelations

| Lag | Correlation | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 |
|---|---|---|
| 1 | 0.14118 | \|***  . \| |
| 2 | -0.30888 | \|******  . \| |
| 3 | -0.23264 | \|*****  . \| |
| 4 | -0.21454 | \|. ****  . \| |
| 5 | -0.09609 | \|.  **  . \| |
| 6 | 0.25067 | \|*****. \| |
| 7 | -0.24549 | \|*****  . \| |
| 8 | 0.02712 | \|*  . \| |
| 9 | 0.17461 | \|***  . \| |
| 10 | 0.17931 | \|****  . \| |
| 11 | -0.18036 | \|. ****  . \| |
| 12 | 0.07436 | \|*  . \| |

Autocorrelation Check for White Noise

| To Lag | Chi-Square | DF | Pr > ChiSq | Autocorrelations | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 6 | 19.87 | 6 | 0.0029 | 0.141 | -0.283 | -0.302 | -0.172 | 0.039 | 0.377 |
| 12 | 23.65 | 12 | 0.0227 | -0.035 | -0.141 | 0.051 | 0.149 | -0.121 | 0.012 |

Name of Variable = Blynch

| | |
|---|---|
| Period(s) of Differencing | 1 |
| Mean of Working Series | -0.60417 |
| Standard Deviation | 16.99478 |
| Number of Observations | 48 |
| Observation(s) eliminated by differencing | 1 |

Autocorrelations

| Lag | Covariance | Correlation | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 |
|---|---|---|---|
| 0 | 288.822 | 1.00000 | \|**********\| |
| 1 | -26.136511 | -.09049 | \| . ** \| . \| |
| 2 | -44.043855 | -.15249 | \| . *** \| . \| |
| 3 | 21.463298 | 0.07431 | \| . \| * . \| |
| 4 | -0.818179 | -.00283 | \| . \| . \| |
| 5 | -54.992884 | -.19040 | \| . **** \| . \| |
| 6 | 15.066352 | 0.05216 | \| . \| * . \| |
| 7 | 10.345206 | 0.03582 | \| . \| * . \| |
| 8 | 48.781612 | 0.16890 | \| . \| *** . \| |
| 9 | -26.265489 | -.09094 | \| . ** \| . \| |
| 10 | -31.943233 | -.11060 | \| . ** \| . \| |
| 11 | 56.276159 | 0.19485 | \| . \| **** . \| |
| 12 | -13.522678 | -.04682 | \| . * \| . \| |

"." marks two standard errors

Partial Autocorrelations

| Lag | Correlation | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 |
|---|---|---|
| 1 | -0.09049 | \| . ** \| . \| |
| 2 | -0.16201 | \| . *** \| . \| |
| 3 | 0.04516 | \| . \| * . \| |
| 4 | -0.01604 | \| . \| . \| |
| 5 | -0.18017 | \| . **** \| . \| |
| 6 | 0.01091 | \| . \| . \| |
| 7 | -0.01270 | \| . \| . \| |
| 8 | 0.21118 | \| . \| **** . \| |
| 9 | -0.06749 | \| . * \| . \| |
| 10 | -0.11471 | \| . ** \| . \| |
| 11 | 0.16876 | \| . \| *** . \| |
| 12 | -0.03380 | \| . * \| . \| |

Autocorrelation Check for White Noise

| To Lag | Chi-Square | DF | Pr > ChiSq | Autocorrelations | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 6 | 4.11 | 6 | 0.6624 | -0.090 | -0.152 | 0.074 | -0.003 | -0.190 | 0.052 |
| 12 | 9.78 | 12 | 0.6351 | 0.036 | 0.169 | -0.091 | -0.111 | 0.195 | -0.047 |

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The REG Procedure
Model: MODEL1
Dependent Variable: dbl

Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Model | 2 | 292.25070 | 146.12535 | 0.48 | 0.6192 |
| Error | 45 | 13571 | 301.58285 | | |
| Corrected Total | 47 | 13863 | | | |

| | | | |
|---|---|---|---|
| Root MSE | 17.36614 | R-Square | 0.0211 |
| Dependent Mean | -0.60417 | Adj R-Sq | -0.0224 |
| Coeff Var | -2874.39576 | | |

Parameter Estimates

| Variable | DF | Parameter Estimate | Standard Error | t Value | Pr > \|t\| |
|---|---|---|---|---|---|
| Intercept | 1 | -0.28958 | 2.52688 | -0.11 | 0.9093 |
| dc1 | 1 | 1.11734 | 1.17011 | 0.95 | 0.3447 |
| dc2 | 1 | -0.03385 | 0.03446 | -0.98 | 0.3312 |

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The REG Procedure
Model: MODEL1
Dependent Variable: dbl

| | |
|---|---|
| Durbin-Watson D | 2.193 |
| Number of Observations | 48 |
| 1st Order Autocorrelation | -0.100 |

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The ARIMA Procedure

Name of Variable = dlynchre

| | |
|---|---|
| Mean of Working Series | -148E-18 |
| Standard Deviation | 16.81469 |
| Number of Observations | 48 |

Autocorrelations

| Lag | Covariance | Correlation | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 |
|---|---|---|---|
| 0 | 282.734 | 1.00000 | \|**********\| |
| 1 | -28.263167 | -.09996 | \| . **\| . \| |
| 2 | -44.628736 | -.15785 | \| . ***\| . \| |
| 3 | 20.854836 | 0.07376 | \| . \|* . \| |
| 4 | -4.882549 | -.01727 | \| . \| . \| |
| 5 | -50.246097 | -.17772 | \| . ****\| . \| |
| 6 | 21.019512 | 0.07434 | \| . \|* . \| |
| 7 | 15.577970 | 0.05510 | \| . \|* . \| |
| 8 | 44.935029 | 0.15893 | \| . \|*** . \| |
| 9 | -21.928367 | -.07756 | \| . **\| . \| |
| 10 | -23.961975 | -.08475 | \| . **\| . \| |
| 11 | 43.114541 | 0.15249 | \| . \|*** . \| |
| 12 | -10.847091 | -.03837 | \| . *\| . \| |

"." marks two standard errors

Partial Autocorrelations

| Lag | Correlation | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 |
|---|---|---|
| 1 | -0.09996 | \| . **\| . \| |
| 2 | -0.16953 | \| . ***\| . \| |
| 3 | 0.03989 | \| . \|* . \| |
| 4 | -0.03248 | \| . *\| . \| |
| 5 | -0.17159 | \| . ***\| . \| |
| 6 | 0.02732 | \| . \|* . \| |
| 7 | 0.01512 | \| . \| . \| |
| 8 | 0.21054 | \| . \|**** . \| |
| 9 | -0.04562 | \| . *\| . \| |
| 10 | -0.07807 | \| . **\| . \| |
| 11 | 0.13729 | \| . \|*** . \| |
| 12 | -0.00732 | \| . \| . \| |

Autocorrelation Check for White Noise

| To Lag | Chi-Square | DF | Pr > ChiSq | Autocorrelations | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 6 | 4.20 | 6 | 0.6503 | -0.100 | -0.158 | 0.074 | -0.017 | -0.178 | 0.074 |
| 12 | 8.32 | 12 | 0.7598 | 0.055 | 0.159 | -0.078 | -0.085 | 0.152 | -0.038 |

Correlation of dlynchre and dc1

Variance of input = 49.09509
Number of Observations 48

Crosscorrelations

| Lag | Covariance | Correlation | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 |
|---|---|---|---|
| -12 | -24.244599 | -.20578 | . **** . |
| -11 | 14.492457 | 0.12301 | . ** . |
| -10 | 0.406727 | 0.00345 | . . |
| -9 | 14.473566 | 0.12285 | . ** . |
| -8 | 6.216129 | 0.05276 | . * . |
| -7 | -9.988496 | -.08478 | . ** . |
| -6 | -0.119797 | -.00102 | . . |
| -5 | -4.552900 | -.03864 | . * . |
| -4 | 2.079813 | 0.01765 | . . |
| -3 | 9.063472 | 0.07693 | . ** . |
| -2 | -16.884641 | -.14331 | . *** . |
| -1 | -2.051781 | -.01741 | . . |
| 0 | 1.4803E-14 | 0.00000 | . . |
| 1 | -4.368708 | -.03708 | . * . |
| 2 | 14.845026 | 0.12600 | . *** . |
| 3 | 17.403360 | 0.14772 | . *** . |
| 4 | -11.100595 | -.09422 | . ** . |
| 5 | -14.655549 | -.12439 | . ** . |
| 6 | -4.131735 | -.03507 | . * . |
| 7 | -4.678096 | -.03971 | . * . |
| 8 | 0.255853 | 0.00217 | . . |
| 9 | 4.043301 | 0.03432 | . * . |
| 10 | -9.989494 | -.08479 | . ** . |
| 11 | -0.571816 | -.00485 | . . |
| 12 | -3.014653 | -.02559 | . * . |

"." marks two standard errors

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Skipping output we've already seen ...

Correlation of dlynchre and dc2

Variance of input = 56591.2
Number of Observations 48

Crosscorrelations

| Lag | Covariance | Correlation | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 |
|---|---|---|---|
| -12 | -823.624 | -.20590 | . **** . |
| -11 | 230.845 | 0.05771 | * . |
| -10 | 197.529 | 0.04938 | * . |
| -9 | 621.649 | 0.15541 | *** . |
| -8 | -36.039787 | -.00901 | . |
| -7 | -225.202 | -.05630 | * . |
| -6 | 88.216679 | 0.02205 | . |
| -5 | -36.869736 | -.00922 | . |
| -4 | 73.363775 | 0.01834 | . |
| -3 | 299.401 | 0.07485 | * . |
| -2 | -643.082 | -.16077 | *** . |
| -1 | -205.097 | -.05127 | * . |
| 0 | 0 | 0.00000 | . |
| 1 | -100.403 | -.02510 | * . |
| 2 | 551.626 | 0.13791 | *** . |
| 3 | 527.238 | 0.13181 | *** . |
| 4 | -501.504 | -.12537 | *** . |
| 5 | -447.508 | -.11188 | ** . |
| 6 | -82.542485 | -.02064 | . |
| 7 | -96.580025 | -.02414 | . |
| 8 | 121.181 | 0.03030 | * . |
| 9 | 115.424 | 0.02886 | * . |
| 10 | -274.451 | -.06861 | * . |
| 11 | -174.338 | -.04358 | * . |
| 12 | 43.717739 | 0.01093 | . |

"." marks two standard errors

The AUTOREG Procedure

Dependent Variable dbl

Ordinary Least Squares Estimates

| | | | |
|---|---|---|---|
| SSE | 13571.2285 | DFE | 45 |
| MSE | 301.58285 | Root MSE | 17.36614 |
| SBC | 418.768003 | AIC | 413.1544 |
| Regress R-Square | 0.0211 | Total R-Square | 0.0211 |
| Durbin-Watson | 2.1929 | | |

| Variable | DF | Estimate | Standard Error | t Value | Approx Pr > \|t\| |
|---|---|---|---|---|---|
| Intercept | 1 | -0.2896 | 2.5269 | -0.11 | 0.9093 |
| dc1 | 1 | 1.1173 | 1.1701 | 0.95 | 0.3447 |
| dc2 | 1 | -0.0339 | 0.0345 | -0.98 | 0.3312 |

Test BOTH

| Source | DF | Mean Square | F Value | Pr > F |
|---|---|---|---|---|
| Numerator | 2 | 146.125351 | 0.48 | 0.6192 |
| Denominator | 45 | 301.582855 | | |

Estimates of Autocorrelations

| Lag | Covariance | Correlation | -1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1 |
|---|---|---|---|
| 0 | 282.7 | 1.000000 | \|********************\| |
| 1 | -28.2632 | -0.099964 | \| **\| \| |

Preliminary MSE 279.9

Estimates of Autoregressive Parameters

| Lag | Coefficient | Standard Error | t Value |
|---|---|---|---|
| 1 | 0.099964 | 0.150001 | 0.67 |

Algorithm converged.

Maximum Likelihood Estimates

| | | | |
|---|---|---|---|
| SSE | 13433.4947 | DFE | 44 |
| MSE | 305.30670 | Root MSE | 17.47303 |
| SBC | 422.159499 | AIC | 414.674695 |
| Regress R-Square | 0.0230 | Total R-Square | 0.0310 |
| Durbin-Watson | 2.0312 | | |

| Variable | DF | Estimate | Standard Error | t Value | Approx Pr > \|t\| |
|---|---|---|---|---|---|
| Intercept | 1 | -0.2986 | 2.3223 | -0.13 | 0.8983 |
| dc1 | 1 | 1.1631 | 1.2125 | 0.96 | 0.3427 |
| dc2 | 1 | -0.0356 | 0.0353 | -1.01 | 0.3179 |
| AR1 | 1 | 0.0994 | 0.1513 | 0.66 | 0.5144 |

Test BOTH

| Source | DF | Mean Square | F Value | Pr > F |
|---|---|---|---|---|
| Numerator | 2 | 155.844799 | 0.51 | 0.6037 |
| Denominator | 44 | 305.306698 | | |

Autoregressive parameters assumed given.

| Variable | DF | Estimate | Standard Error | t Value | Approx Pr > \|t\| |
|---|---|---|---|---|---|
| Intercept | 1 | -0.2986 | 2.3223 | -0.13 | 0.8983 |
| dc1 | 1 | 1.1631 | 1.2064 | 0.96 | 0.3402 |
| dc2 | 1 | -0.0356 | 0.0351 | -1.02 | 0.3150 |