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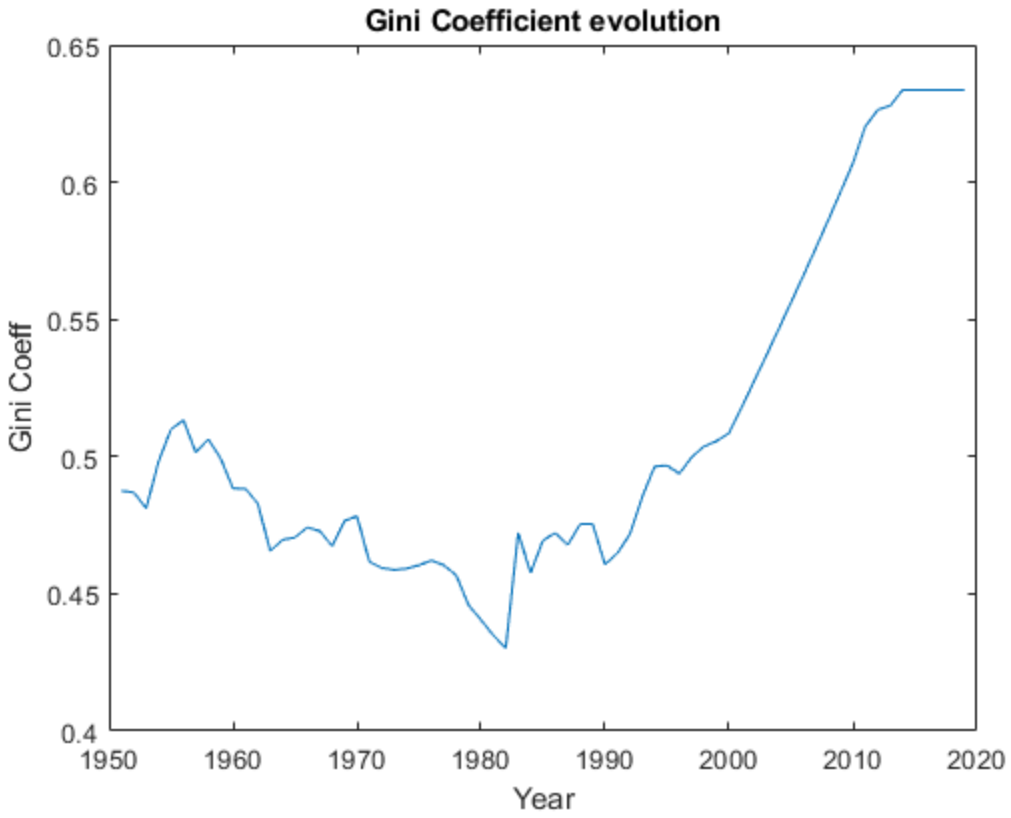
```
clear; close all;
```

# Get utility functions

```
[f1,~] = utils();
```

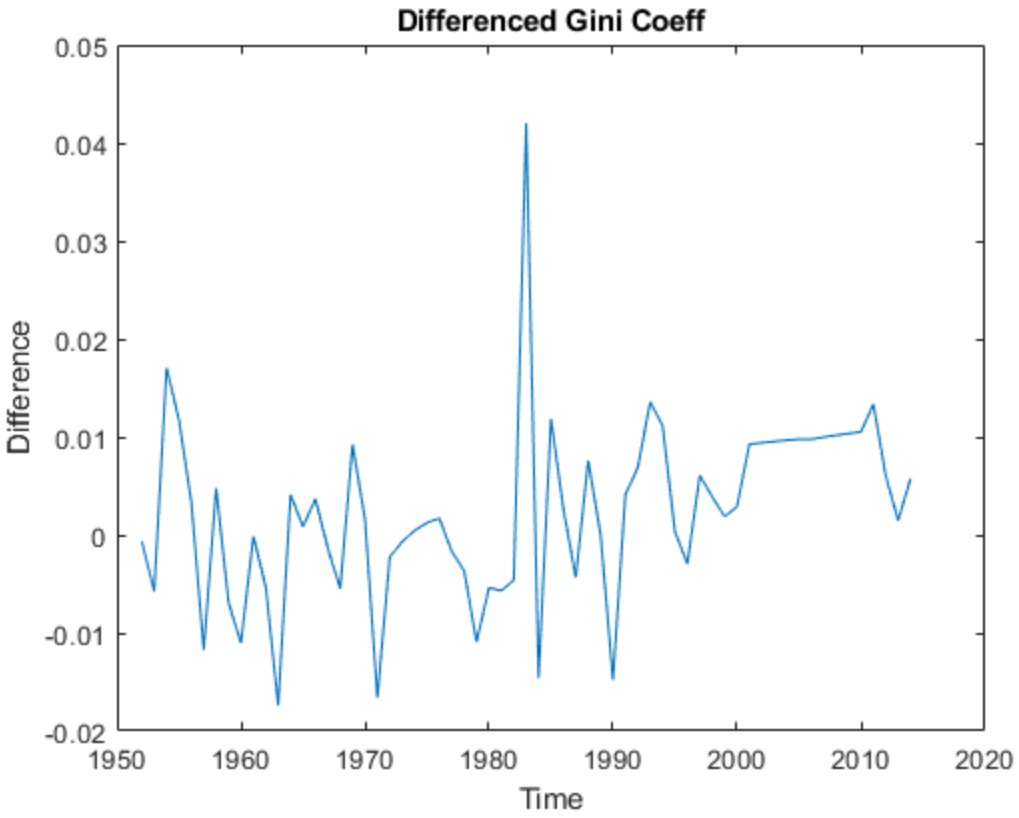
# Open and visualise data

```
path = "./Data/Gini_index.xlsx";
data = table2array(readtable(path));
time = data(:,1); gini = data(:,2);
plot(time,gini);
title('Gini Coefficient evolution');
xlabel('Year'); ylabel('Gini Coeff');
% Exhibits an almost linear rise from 2000 till about 2010
% Not taking data points after 2014 because Gini Coeff stays constant
 after
% that (must be some error in the reported data)
time = time(1:end-5); gini = gini(1:end-5);
```




# Testing for integrating effects

```
[h1,p1] = adftest(gini);
% Hypothesis of unit root not rejected => Has integrating effects
diff_gini = diff(gini);
[h2,p2] = adftest(diff_gini);
% After differencing the series, the unit root hypothesis is rejected.
 So
% the series has I = 1 effect.
figure;
plot(time(2:end),diff(gini));
title("Differenced Gini Coeff");ylabel("Difference");xlabel("Time");
```




# Arima model

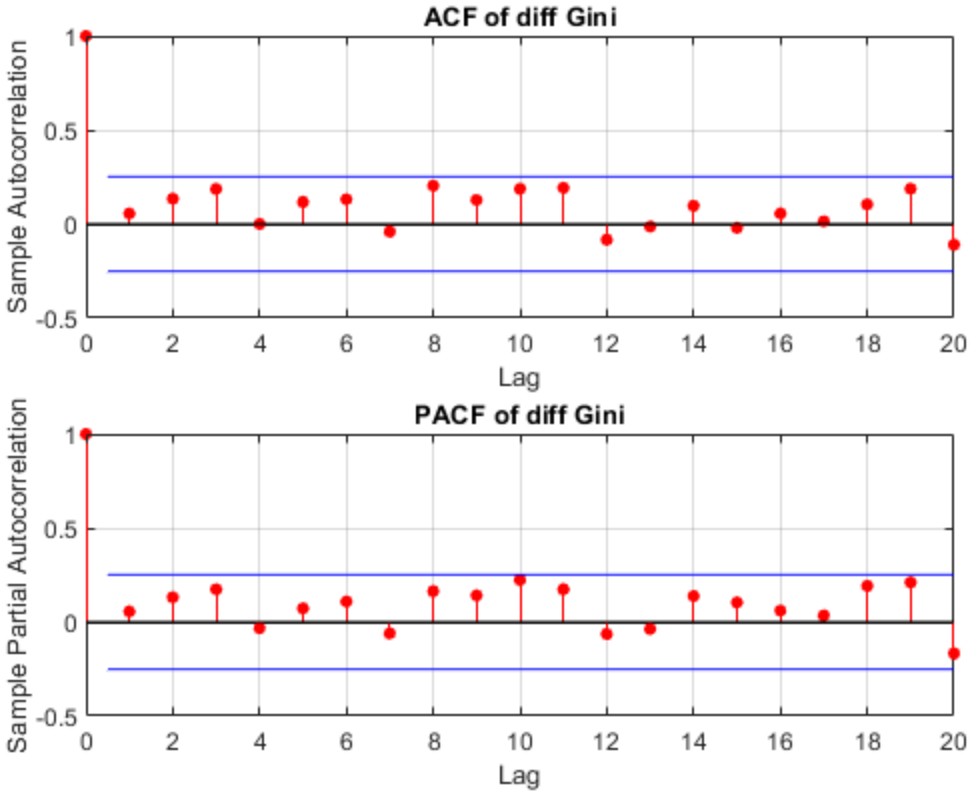
```
figure;
subplot(211); autocorr(diff_gini); title('ACF of diff Gini');
subplot(212); parcorr(diff_gini); title('PACF of diff Gini');
% Correlations indicate no significant AR or MA effects
[est_m1,res,uf,of] = f1([0,1,0],1,gini,0,0);
% No underfitting! (since residuals are white). Constant term is
% insignificant.
[est_m2,res2,uf2,of2] = f1([0,1,0],0,gini,1,0);
figure;
plot(time,res2);
```

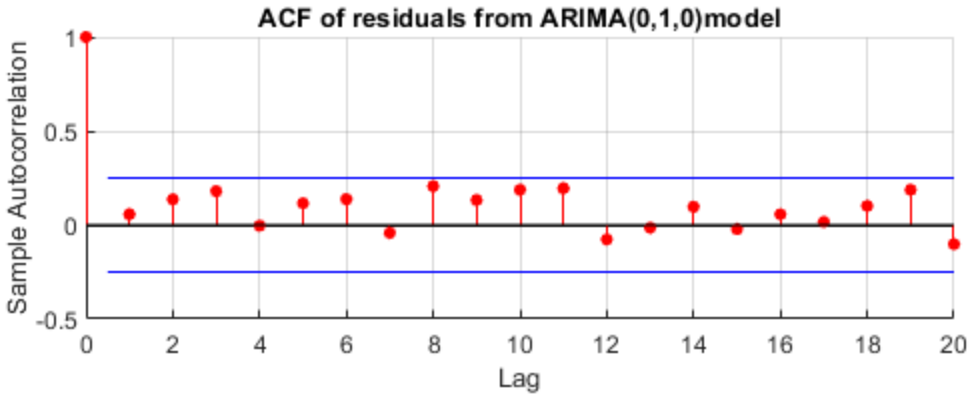
*ARIMA(0,1,0) Model (Gaussian Distribution):*

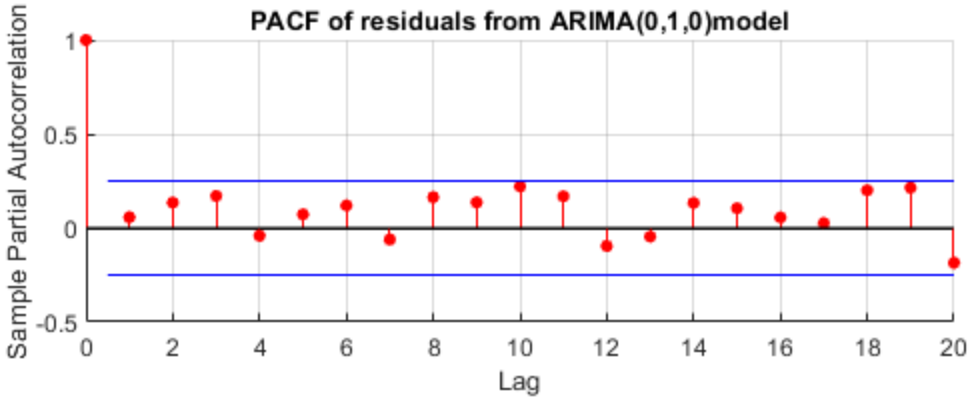
| | Value | StandardError | TStatistic | PValue |
|---|---|---|---|---|
| Constant | 0.0021799 | 0.0012314 | 1.7703 | 0.076678 |
| Variance | 8.6834e-05 | 9.6243e-06 | 9.0224 | 1.8395e-19 |

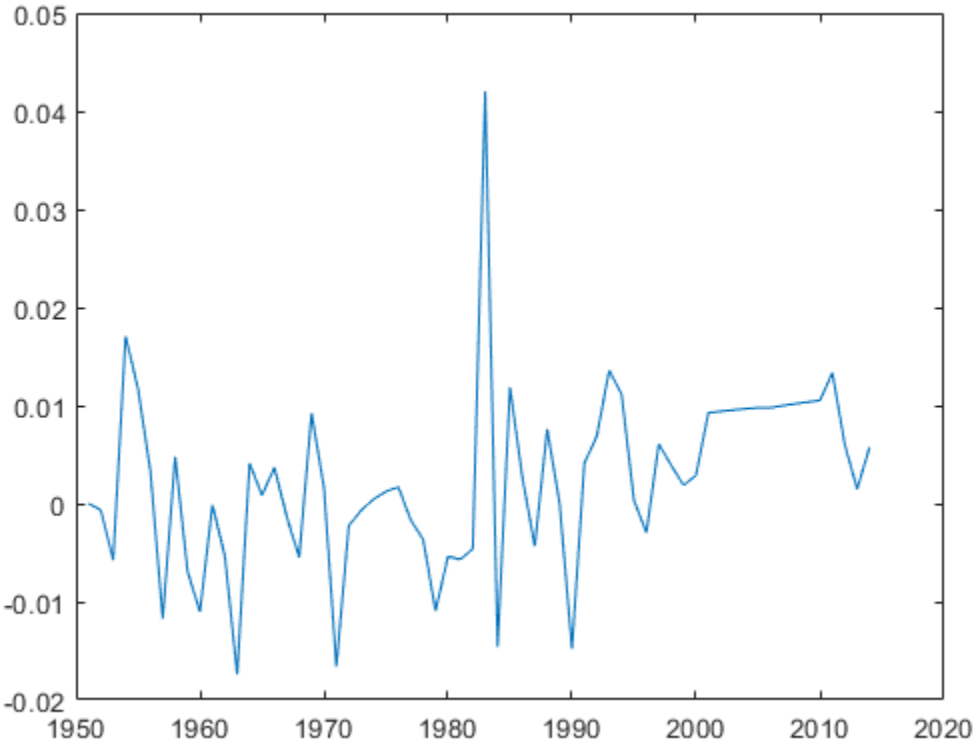
*ARIMA(0,1,0) Model (Gaussian Distribution):*

| | Value | StandardError | TStatistic | PValue |
|---|---|---|---|---|
| Constant | 0 | 0 | NaN | NaN |
| Variance | 9.1807e-05 | 9.3603e-06 | 9.8082 | 1.038e-22 |




ACF of residuals from ARIMA(0,1,0)model
Sample Autocorrelation
1
0.5
0
-0.5
0
2
4
6
8
10
12
14
16
18
20
Lag

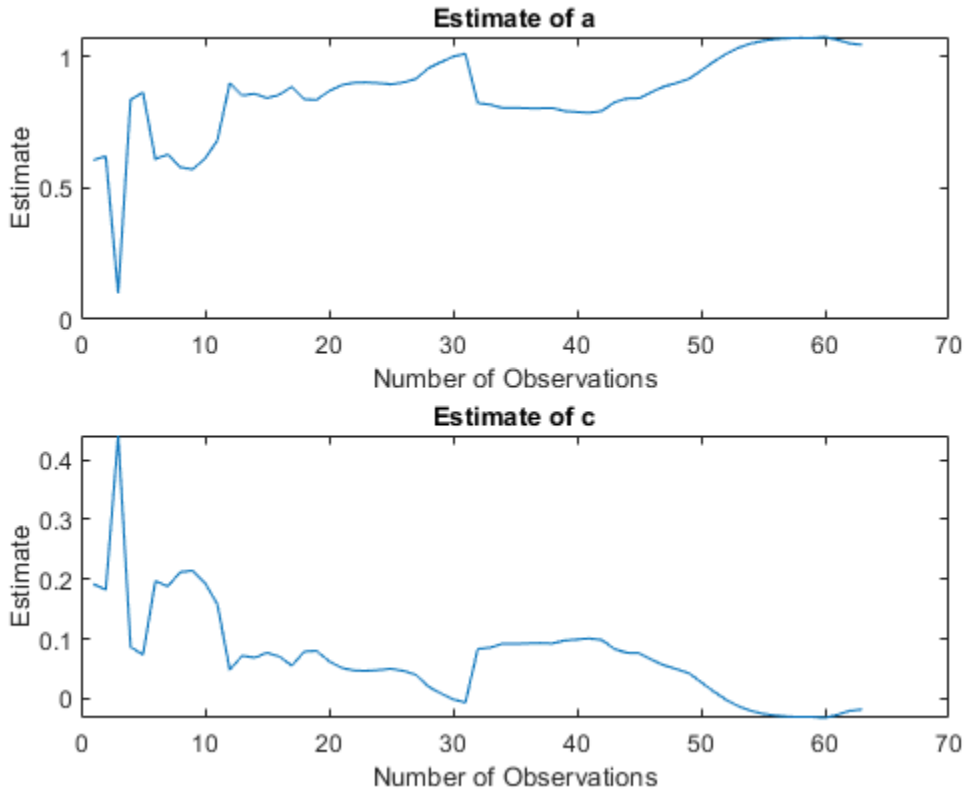

PACF of residuals from ARIMA(0,1,0)model
Sample Partial Autocorrelation
1
0.5
0
-0.5
0
2
4
6
8
10
12
14
16
18
20
Lag


0.05
0.04
0.03
0.02
0.01
0
-0.01
-0.02
1950
1960
1970
1980
1990
2000
2010
2020

# Second way: RLS

Modelling as gini[k] = a*gini[k-1] + c

```
N = length(gini);
H = [gini(1:N-1) ones(N-1,1)];
numParams = 2;
model1 = recursiveLS(numParams,'ForgettingFactor',0.97);
thetaest_vec = zeros(numParams,N-1);
cov_track = zeros(numParams,N-1);
for i = 2:N
    theta = model1(gini(i),H(i-1,:)');
    Ptheta1 = model1.ParameterCovariance;
    cov_track(1:numParams,i-1) = diag(Ptheta1);
    thetaest_vec(1:numParams,i-1) = theta;
end
figure;
subplot(211); plot(thetaest_vec(1,:));
title('Estimate of a');
xlabel('Number of Observations'); ylabel('Estimate')
subplot(212);plot(thetaest_vec(2,:));
title('Estimate of c');
xlabel('Number of Observations'); ylabel('Estimate');
% Comment your observations
```



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