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Autoregressive Modeling

```
clear all; clc;
```

Initial parameter

Sampling parameters

Samples quantity, N = 100

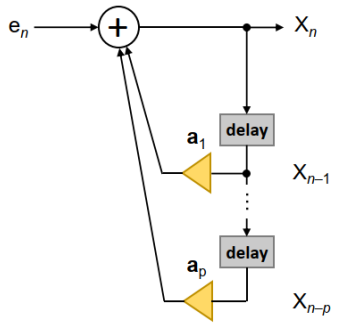
```
N = 100; % quantity of samples
```

Gaussian noise

$e_n = \text{randn}(N)$

```
e = randn(N);
e = e / max(e);
```

AR(p), Control lag



$$X_n = c + \sum_{i=1}^{p} a_i X_{n-i} + e_n$$

透過改變a_i增益來做，AR(1)，表示找前一個採樣 X_{n-i}與一個增益a_i乘得到結果, delay 1 sampe。

Autoregressive for forecast error: Youtube

delay 不能超過sample數量

Only for short-term forecasts

To forcast k-steps ahead(F_{t+k})

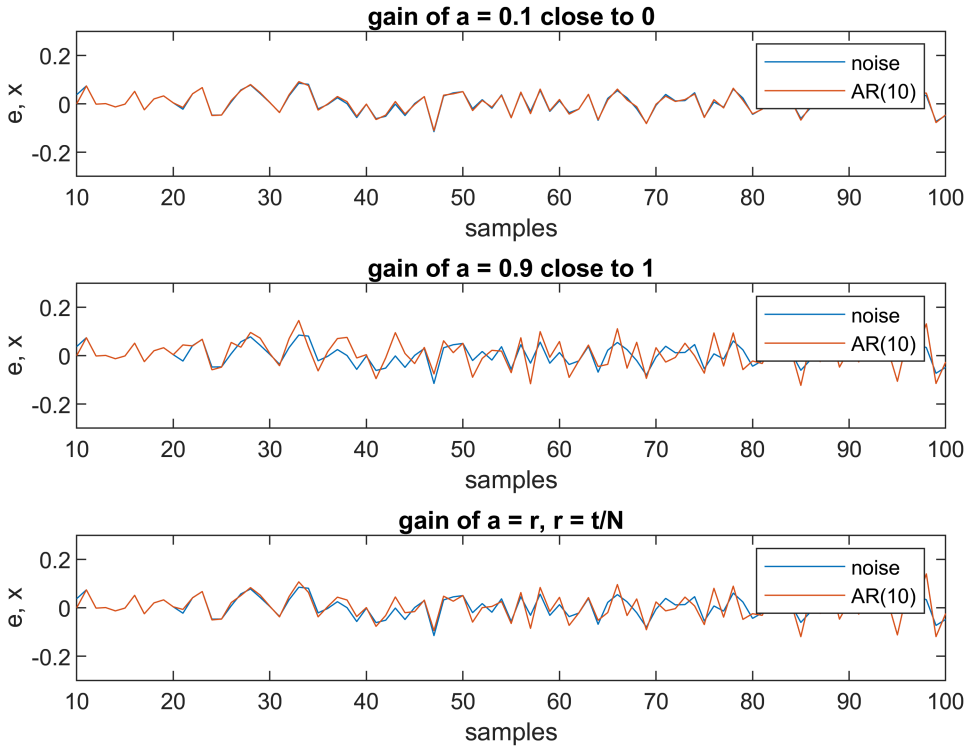
Use AR(p) model only if k>p, p lag p sequence, k is steps

```
a = [];
sets = 5; % test sets
lag = 10; % Control_lag

% Generate the a(r) AR is not able to linear regression but just test
% time varying a = t/N
for i = 1:N
    a(i) = (i/N);
end
ac = zeros(sets,1);
ac = [0.1, 0.9, -0.9 ,0.3, 0.5]; % with constant close to 0, 1...

x = zeros(N,sets);
xc = zeros(N,sets); % 初始化矩陣大小 constant

for j =1:lag % lag not calc
    for i = 1:5 % which data
        x(j,i) = 0; % a(i).*x(j,i)+e(j);
        xc(j,i) = 0; % ac(i).*x(j,i)+e(j);
    end
end

for j = 1:sets
    for i = (1+lag):N % calc start from AR(p->lag) --> lag+1
        xc(i,j) = ac(j).*x(i-lag,j)+e(i); % 對照組 constant a
        x(i,j) = a(i).*x(i-lag,j)+e(i);
    end
end
```

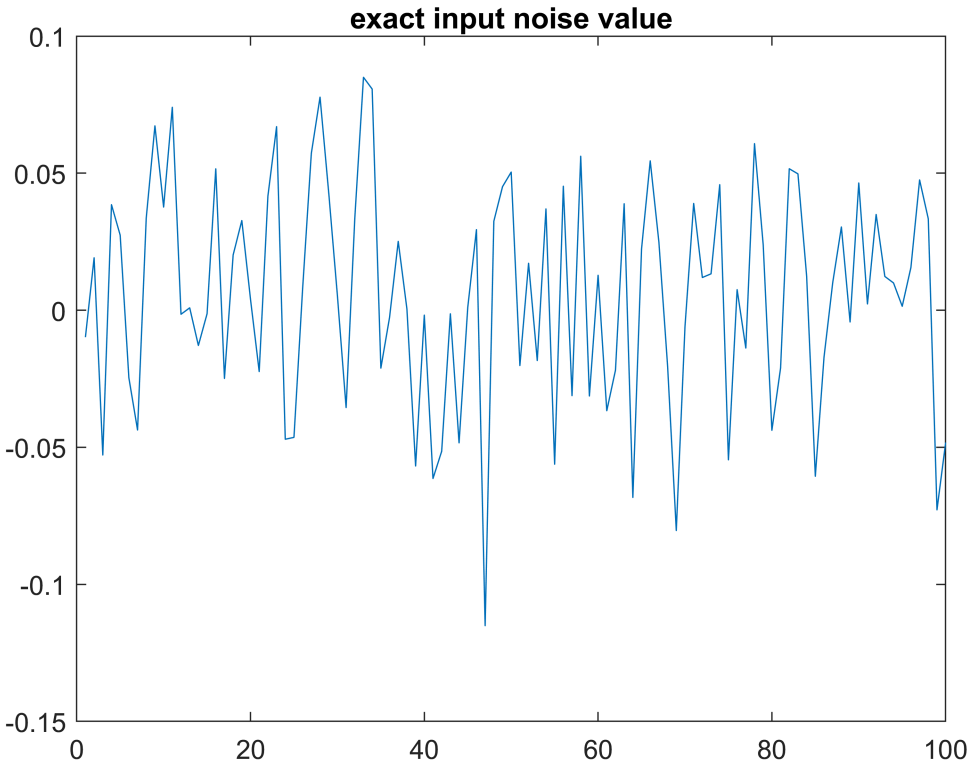
Plot

```
% calc end
str1 = ['AR', '(', string(lag), ')' ];
t = linspace(1,N,N);
ylimit_const = [-0.3, 0.3];
AR = sprintf( str1(1)+str1(2)+str1(3)+str1(4));

figure();
subplot(3, 1, 1);
plot(t(lag:end),e(lag:end));
hold on;
plot(t(lag:end),xc(lag:end,1));
title('gain of a = 0.1 close to 0');
xlim([lag, N]); %xlim(0, N);
ylim(ylimit_const); %ylim(-2, 2);
xlabel('samples');
ylabel('e, x') ;
% legend(['noise', 'AR(2)'], loc='best');
% tight_layout(pad=0.5, w_pad=0.5, h_pad=1.0);
legend('noise', AR)
subplot(3, 1, 2);
plot(t(lag:end),e(lag:end));
hold on;
```

```
plot(t(lag:end),xc(lag:end,2));
title('gain of a = 0.9 close to 1')
xlim([lag, N]); %xlim(0, N);
ylim(ylimit_const); %ylim(-2, 2);
xlabel('samples');
ylabel('e, x') ;
% legend(['noise', 'AR(2)'], loc='best');
% tight_layout(pad=0.5, w_pad=0.5, h_pad=1.0);
legend('noise', AR)
subplot(3, 1, 3);
plot(t(lag:end),e(lag:end));
hold on;
plot(t(lag:end),x(lag:end,1));
title('gain of a = r, r = t/N')
xlim([lag, N]); %xlim(0, N);
ylim(ylimit_const); %ylim(-2, 2);
xlabel('samples');
ylabel('e, x') ;
% legend(['noise', 'AR(2)'], loc='best');
% tight_layout(pad=0.5, w_pad=0.5, h_pad=1.0);
legend('noise', AR)
```




```
figure(); plot(t,e);title('exact input noise value')
```


exact input noise value
0.1
0.05
0
-0.05
-0.1
-0.15
0
20
40
60
80
100