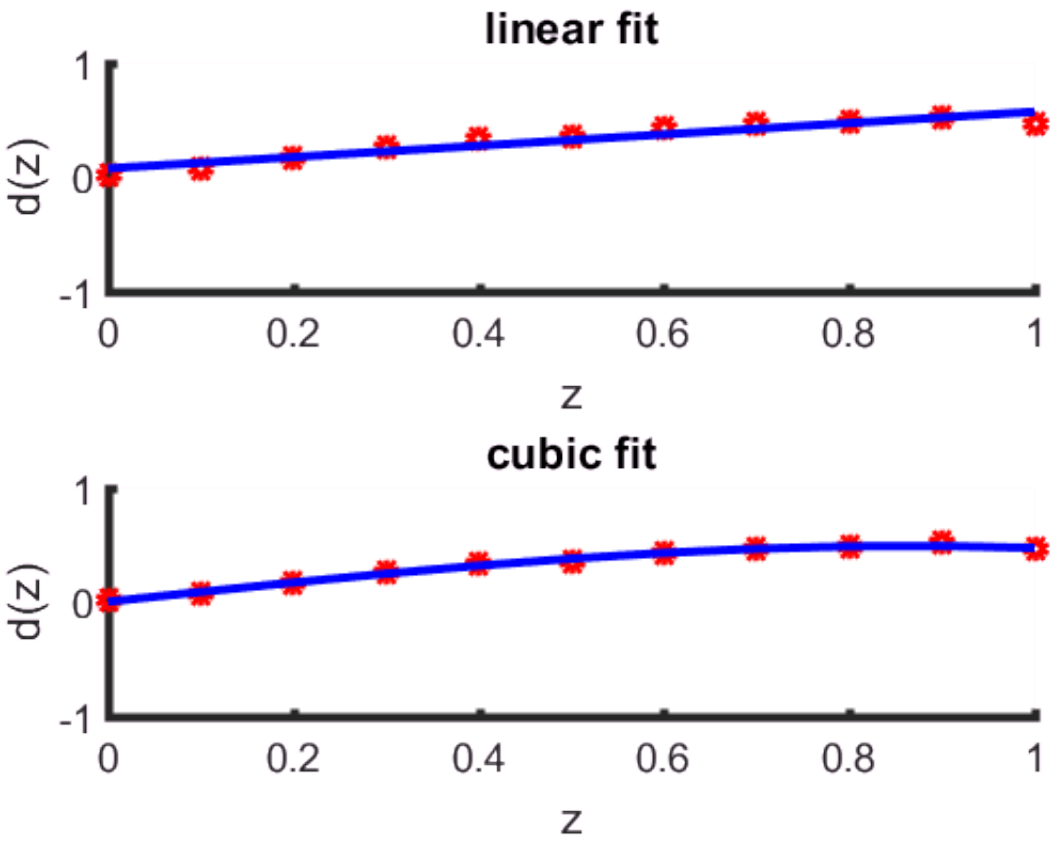
```
% gda05_18
% example F-test to assess difference in fit of two models
% the two models are linear and cubic fit of the same d(z)
% dataset
% supports Figure 5.18

clear all;

% auxially variable z
N = 11;
z = [0:N-1]'/(N-1);
dtrue = z - 0.5*z.*z;

% simulated data
sigmad=0.03;
dobs = dtrue + random('Normal', 0, sigmad, N, 1 );


figure(1);
clf;

% plot the observed data
subplot(2,1,1);
set(gca,'LineWidth',3);
set(gca,'FontSize',14);
hold on;
axis( [0, 1, -1, 1] );
plot(z,dobs,'ro','LineWidth',3);

% fit 1, straight line
M=2;
G=zeros(N,M);
G(:,1)=1;
G(:,2)=z;
mestA=(G'*G)\(G'*dobs);
dpreA = G*mestA;

% plot the predicted data for the linear fit
plot(z,dpreA,'b-','LineWidth',3);
title('linear fit');
xlabel('z');
ylabel('d(z)');

% linear error
EA = (dobs-dpreA)'*(dobs-dpreA);
vA = N-M; % degrees of freedom
disp(sprintf('linear error %f, degrees of freedom %d', EA, vA));
```

```
linear error 0.031057, degrees of freedom 9
```

```
% plot the observed data
subplot(2,1,2);
set(gca,'LineWidth',3);
set(gca,'FontSize',14);
hold on;
axis( [0, 1, -1, 1] );
plot(z,dobs,'ro','LineWidth',3);
```

```
% fit 2, cubic
M=4;
G=zeros(N,M);
G(:,1)=1;
G(:,2)=z;
G(:,3)=z.*z;
G(:,4)=z.^3;
mestB=(G'*G)\(G'*dobs);
dpreB = G*mestB;

% plot the predicted data for the cubic fit
plot(z,dpreB,'b-','LineWidth',3);
title('cubic fit');
xlabel('z');
ylabel('d(z)');
```




```
% 5.18 Hypothetical data set (red circles) fit (blue curve) with (A) a straight line
% and (B) a cubic polynomial. Although the cubic fit appears superior, an F-test
% reveals that this level of improvement of fit will be obtained 6.4% of the time under
% the Null Hypothesis that the improvement is due to random variation. The improvement of
% fit is not significant at the 95% level. MatLab script gda05_18.

% error of cubic fit
EB = (dobs-dpreB)'*(dobs-dpreB);
vB = N-M; % degrees of freedom
disp(sprintf('cubic error %f, degrees of freedom %d', EB, vB));
```

```
cubic error 0.002769, degrees of freedom 7
```

```
% F-value
```

```
Fobs = (EA/vA) / (EB/vB);
disp(sprintf('1/F %f F %f', 1/Fobs, Fobs));
```

```
1/F 0.114649 F 8.722297
```

```
% probabilty value associated with F-value
if( Fobs<1 )
    Fobs=1/Fobs;
end
P = 1 - (fcdf(Fobs,vA,vB)-fcdf(1/Fobs,vA,vB));
Pleft = fcdf(1/Fobs,vA,vB);
Pright = 1-fcdf(Fobs,vA,vB);
disp(sprintf('P(F<%f) = %f', 1/Fobs, Pleft));
```

```
P(F<0.114649) = 0.002145
```

```
disp(sprintf('P(F>%f) = %f', Fobs, Pright));
```

```
P(F>8.722297) = 0.004651
```

```
disp(sprintf('P(F<%f or F>%f) = %f', 1/Fobs, Fobs, P));
```

```
P(F<0.114649 or F>8.722297) = 0.006796
```

```
if( (Pleft+Pright)<0.05 )
    fprintf('Null Hypothesis can be rejected to 95%% confidence\n');
else
    fprintf('Null Hypothesis cannot be rejected to 95%% confidence\n');
end
```

```
Null Hypothesis can be rejected to 95% confidence
```