Metoda nejmenších čtverců

1. Pomocí programu v Matlabu proložte zadanou sadu hodnot x, y, σ_y teoretickou lineární závislostí $y = ax + b$ a $y = mx$ pomocí lineární metody nejmenších čtverců.

   data `lindata.dat`

   Matlab `linfit.m`

$y = ax + b$

```
%% obecna primka y=theta2*x+theta1
fprintf(1,'\n');
fprintf(1,'obecna primka y=a*x+b\n');
%vytvoreni matice A
A0=ones(n,1);
A=[A0,x];
%vytvoreni matice B
B=inv(A'*inv(V)*A)*A'*inv(V);
%odhady parametru theta
theta=B*y;
%kovariancni matice parametru
U=B*V*B';
%% standardni odchylky
e_1=sqrt(U(1,1));       %odchylka konst. parametru
e_2=sqrt(U(2,2));       %odchylka lin. parametru
cor=U(1,2)/(e_1*e_2);   %korelace parametru
```

$y = mx$

```
%% primka prochazejici pocatkem y=m*x
fprintf(1,'\n');
fprintf(1,'primka prochazejici pocatkem y=m*x\n');
s1=x'*(y./(vp.*vp));
s2=x'*(x./(vp.*vp));
m=s1/s2;
%% standardni odchylka
e_m=sqrt(1/s2);
```

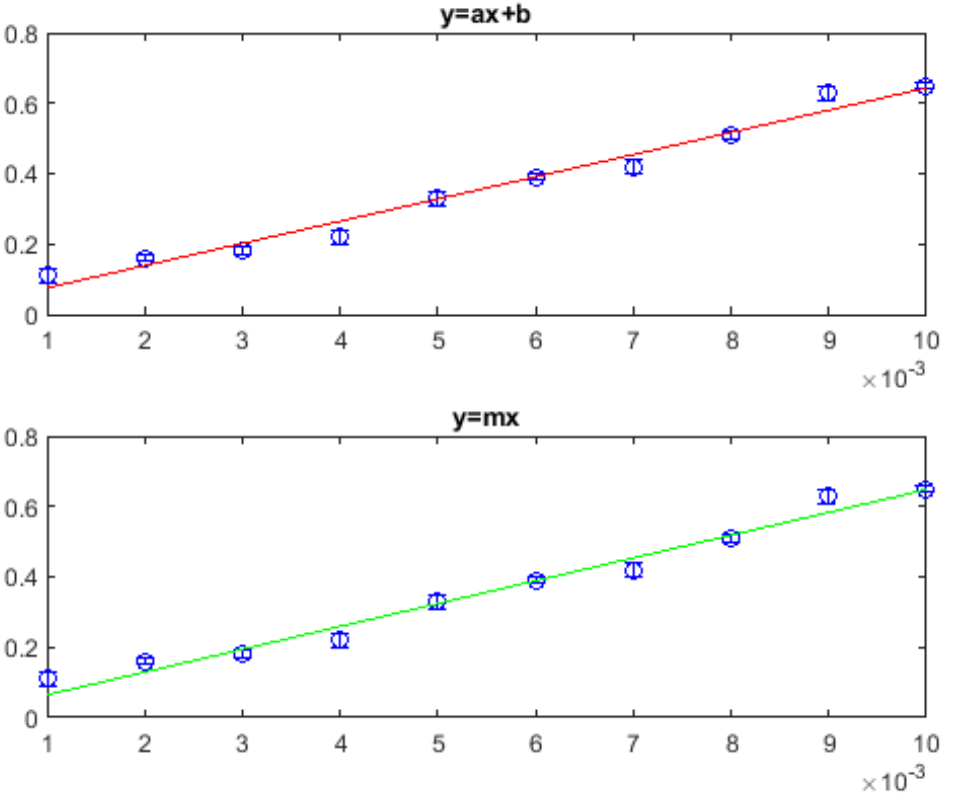
Metoda nejmenších čtverců

1. Pomocí programu v Matlabu proložte zadanou sadu hodnot x, y, σ_y teoretickou lineární závislostí $y = ax + b$ a $y = mx$ pomocí lineární metody nejmenších čtverců.

data `lindata.dat`

Matlab `linfit.m`

```
obecna primka y=a*x+b
b=0.012498 +/- 0.008680
a=63.081310 +/- 1.356314
korelace(a,b)=-0.887500

primka prochazejici pocatkem y=m*x
m=64.814453 +/- 0.625000
```



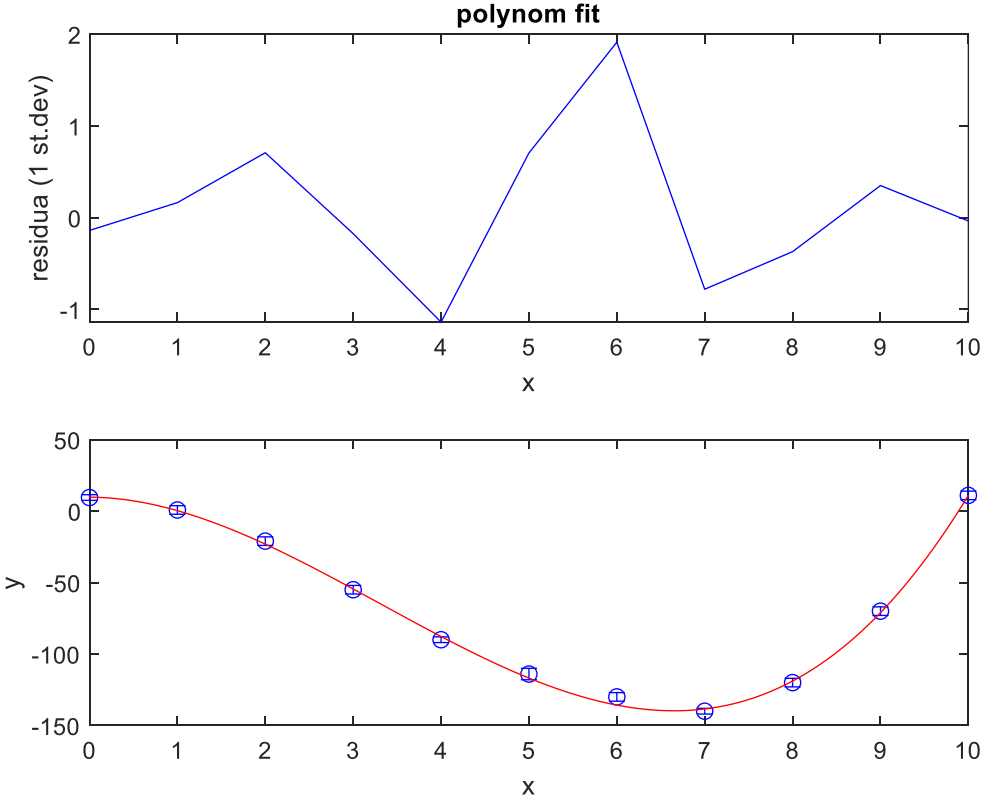
Metoda nejmenších čtverců

2. Pomocí programu v Matlabu proložte zadanou sadu hodnot x, y, σ_y teoretickým polynomem *m*-tého stupně $y = \sum_{i=0}^{m} \theta_i x^i$ pomocí lineární metody nejmenších čtverců.

data `polydata.dat`

Matlab `polyfit.m`

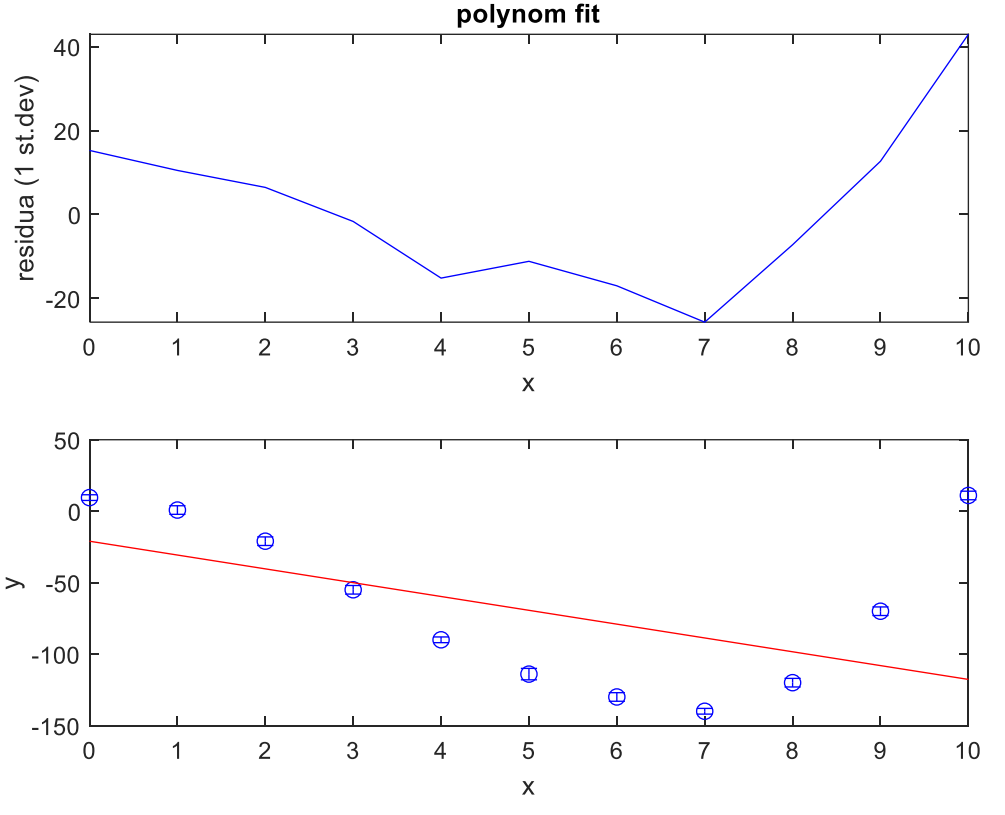
```
%% fit polynomu stupne m
%vytvoreni matice A
for i=1:n
   for j=1:m+1
      A(i,j)=x(i)^(j-1);
   end
end
%vytvoreni matice B
B=inv(A'*inv(V)*A)*A'*inv(V);
%odhady parametru theta
theta=B*y;
%kovariancni matice parametru theta
U=B*V*B';
R=U;
%korelacni matice parametru theta
for i=1:m+1
   for j=1:m+1
      R(i,j)=U(i,j)/sqrt(U(i,i)*U(j,j));
   end
end
```



Metoda nejmenších čtverců

$m = 1$

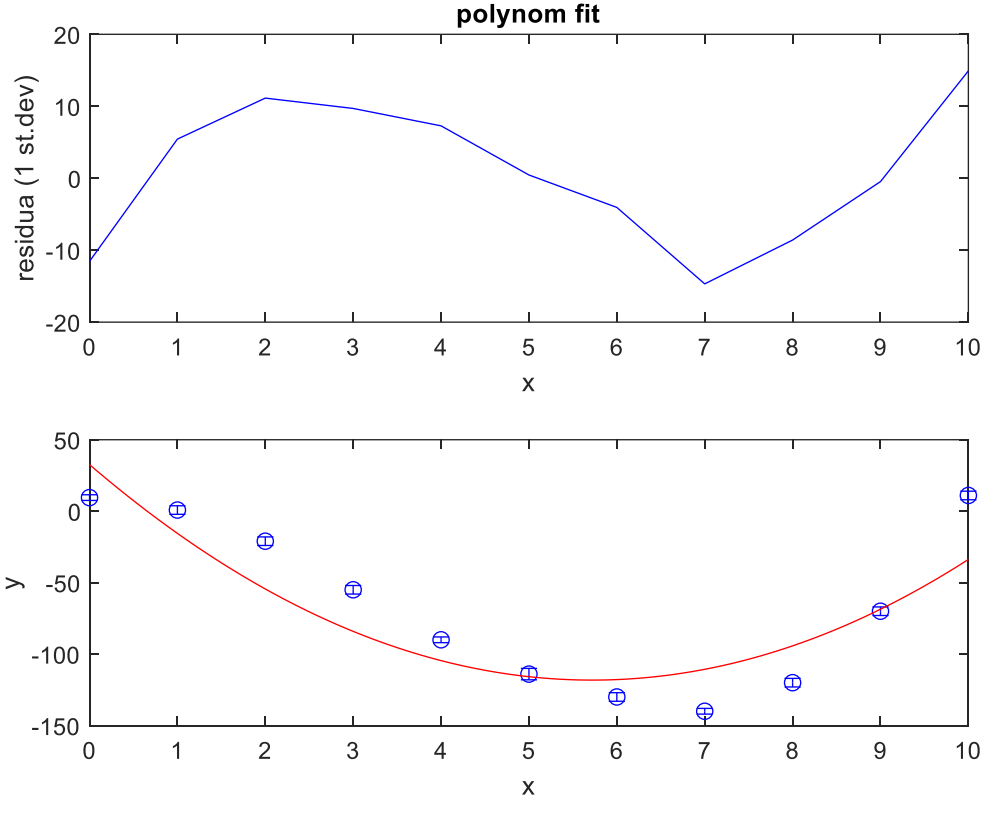
```
stupen polynomu: 1
theta0: -21.013396 +/- 1.401552
theta1: -9.670547 +/- 0.248492

kovariancni matice:

U =

    1.9643   -0.2872
   -0.2872    0.0617

korelacni matice:

R =

    1.0000   -0.8246
   -0.8246    1.0000

pocet stupnu volnosti: 9
chisq = 3741.447845 +/- 4.242641
chisq/deg.freedom  = 415.716427 +/- 1.414214
```



Metoda nejmenších čtverců

$m = 2$

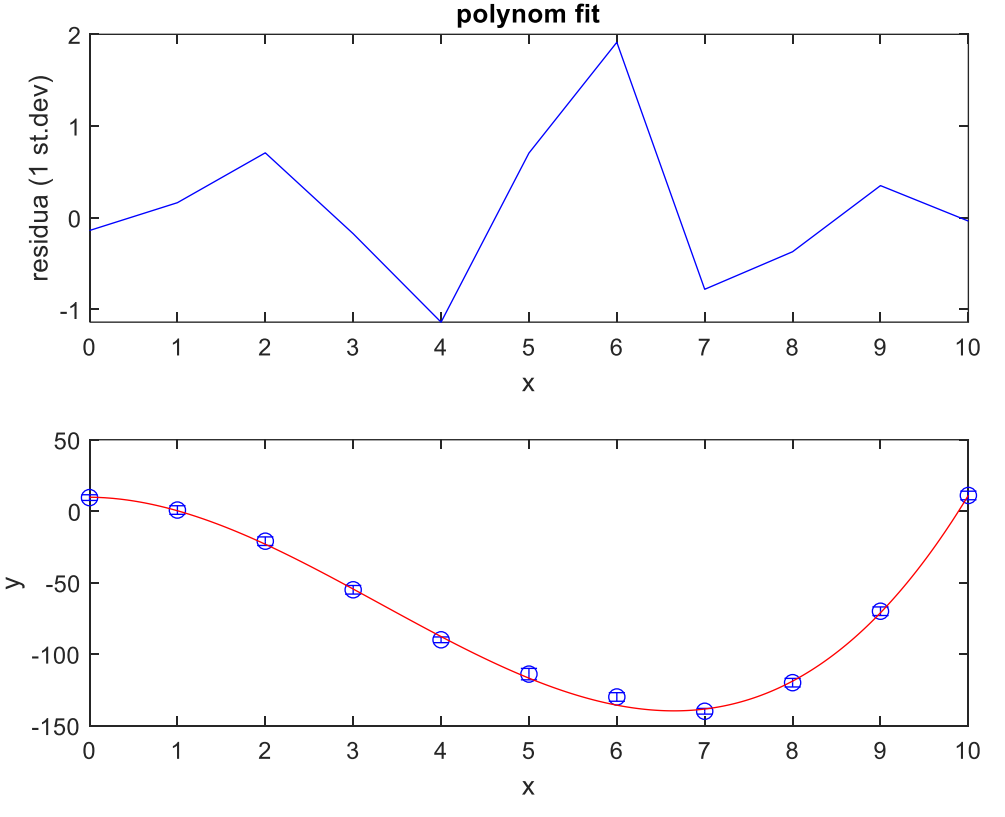
```
stupen polynomu: 2
theta0: 32.598569 +/- 1.731697
theta1: -52.725477 +/- 0.853755
theta2: 4.608972 +/- 0.087436

kovariancni matice:

U =

    2.9988   -1.1179    0.0889
   -1.1179    0.7289   -0.0714
    0.0889   -0.0714    0.0076

korelacni matice:

R =

    1.0000   -0.7561    0.5873
   -0.7561    1.0000   -0.9567
    0.5873   -0.9567    1.0000

pocet stupnu volnosti: 8
chisq = 962.865871 +/- 4.000000
chisq/deg.freedom  = 120.358234 +/- 1.414214
```



Metoda nejmenších čtverců

$m = 3$

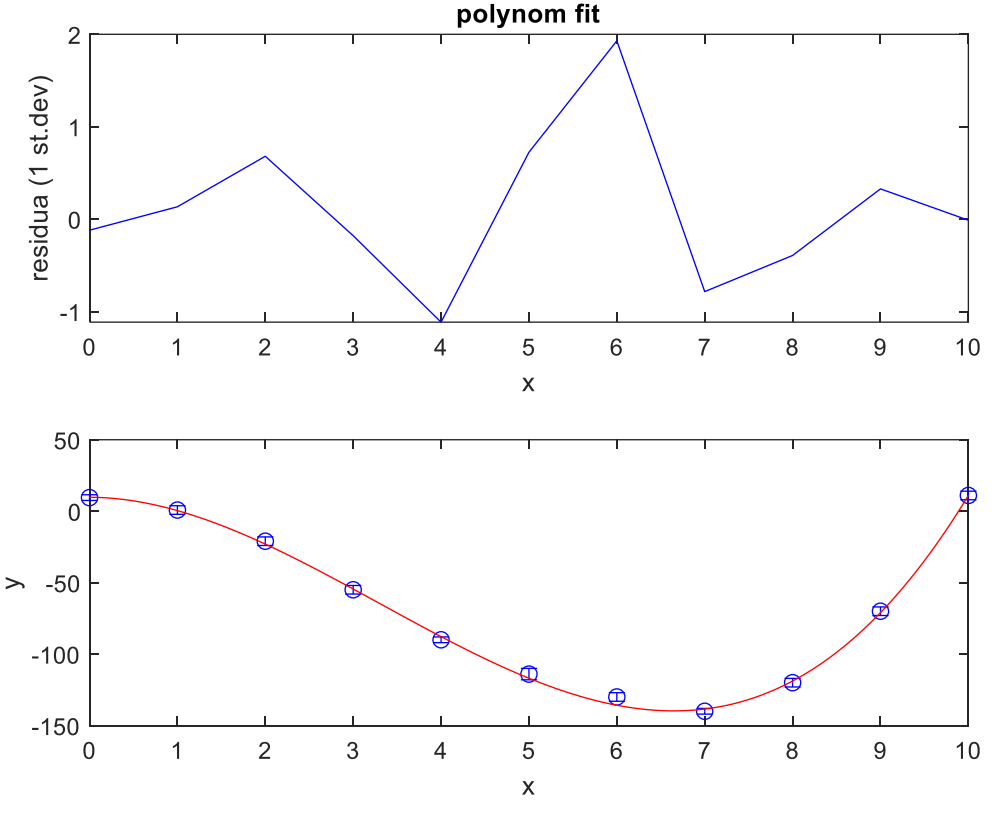
```
stupen polynomu: 3
theta0: 9.777893 +/- 1.882431
theta1: -0.479484 +/- 1.893218
theta2: -9.997465 +/- 0.480438
theta3: 1.005872 +/- 0.032533

kovariancni matice:

U =

    3.5435   -2.3651    0.4376   -0.0240
   -2.3651    3.5843   -0.8697    0.0550
    0.4376   -0.8697    0.2308   -0.0154
   -0.0240    0.0550   -0.0154    0.0011

korelacni matice:

R =

    1.0000   -0.6636    0.4839   -0.3921
   -0.6636    1.0000   -0.9562    0.8925
    0.4839   -0.9562    1.0000   -0.9833
   -0.3921    0.8925   -0.9833    1.0000

pocet stupnu volnosti: 7
chisq = 6.900470 +/- 3.741657
chisq/deg.freedom  = 0.985781 +/- 1.414214
```



Metoda nejmenších čtverců

$m = 4$

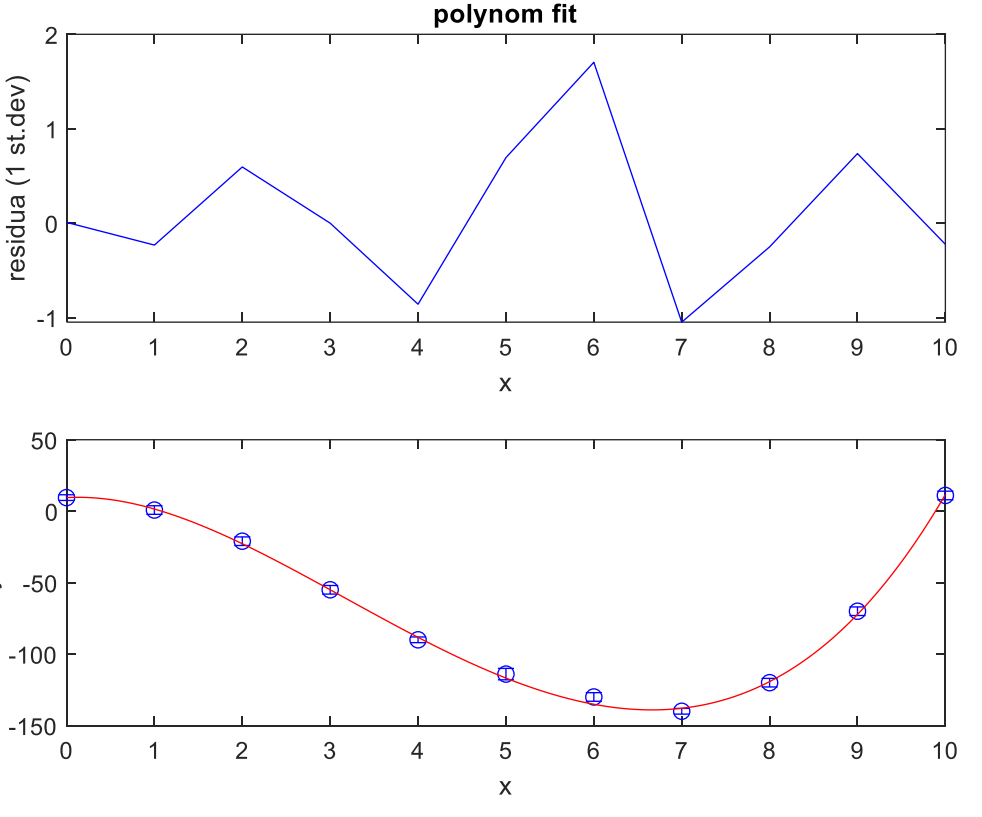
```
stupen polynomu: 4
theta0: 9.739719 +/- 1.959859
theta1: -0.246522 +/- 3.829354
theta2: -10.119055 +/- 1.802518
theta3: 1.025531 +/- 0.282775
theta4: -0.000986 +/- 0.014094

kovariancni matice:

U =

    3.8410   -4.1807    1.3852   -0.1772    0.0077
   -4.1807   14.6640   -6.6525    0.9900   -0.0469
    1.3852   -6.6525    3.2491   -0.5034    0.0245
   -0.1772    0.9900   -0.5034    0.0800   -0.0040
    0.0077   -0.0469    0.0245   -0.0040    0.0002

korelacni matice:

R =

    1.0000   -0.5570    0.3921   -0.3198    0.2783
   -0.5570    1.0000   -0.9638    0.9142   -0.8692
    0.3921   -0.9638    1.0000   -0.9876    0.9638
   -0.3198    0.9142   -0.9876    1.0000   -0.9934
    0.2783   -0.8692    0.9638   -0.9934    1.0000

pocet stupnu volnosti: 6
chisq = 6.895572 +/- 3.464102
chisq/deg.freedom  = 1.149262 +/- 1.414214
```



Metoda nejmenších čtverců

$m = 5$

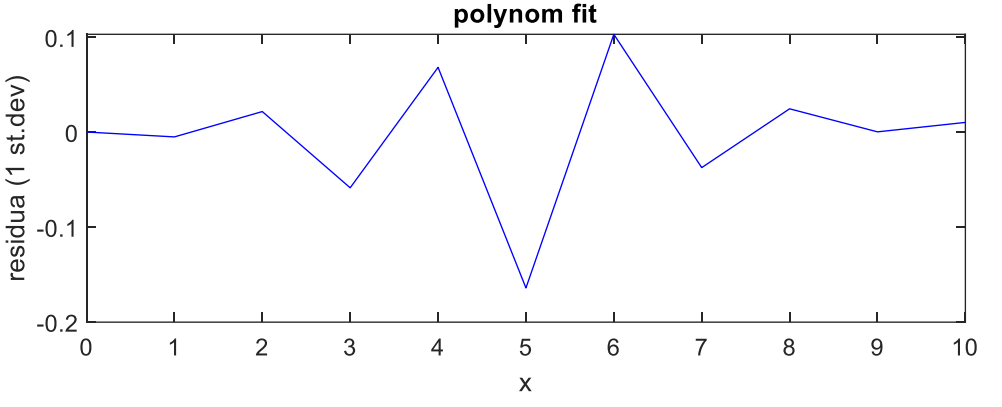
```
stupen polynomu: 5
theta0: 9.483401 +/- 1.987158
theta1: 3.426614 +/- 6.065604
theta2: -13.230846 +/- 4.373807
theta3: 1.918074 +/- 1.177492
theta4: -0.104913 +/- 0.133838
theta5: 0.004221 +/- 0.005405

kovariancni matice:

U =

    3.9488   -5.7248    2.6933   -0.5524    0.0514   -0.0018
   -5.7248   36.7916  -25.3985    6.3668   -0.6730    0.0254
    2.6933  -25.3985   19.1302   -5.0585    0.5549   -0.0215
   -0.5524    6.3668   -5.0585    1.3865   -0.1561    0.0062
    0.0514   -0.6730    0.5549   -0.1561    0.0179   -0.0007
   -0.0018    0.0254   -0.0215    0.0062   -0.0007    0.0000

korelacni matice:

R =

    1.0000   -0.4750    0.3099   -0.2361    0.1932   -0.1652
   -0.4750    1.0000   -0.9574    0.8914   -0.8290    0.7755
    0.3099   -0.9574    1.0000   -0.9822    0.9479   -0.9111
   -0.2361    0.8914   -0.9822    1.0000   -0.9905    0.9707
    0.1932   -0.8290    0.9479   -0.9905    1.0000   -0.9944
   -0.1652    0.7755   -0.9111    0.9707   -0.9944    1.0000

pocet stupnu volnosti: 5
chisq = 6.285838 +/- 3.162278
chisq/deg.freedom  = 1.257168 +/- 1.414214
```

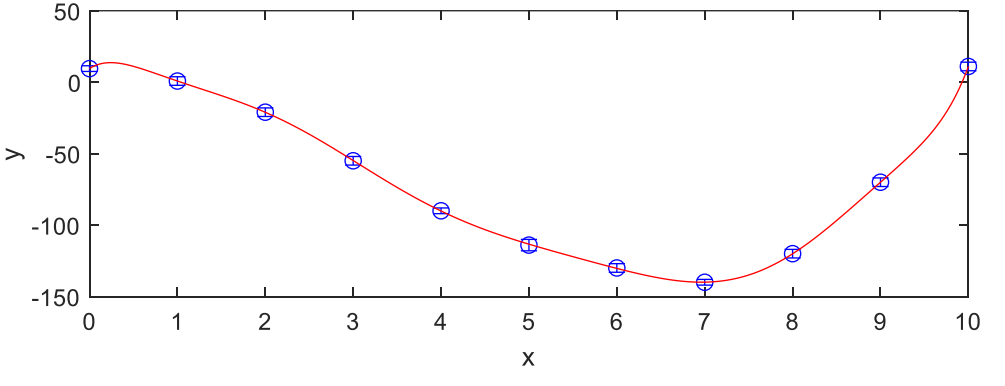


Metoda nejmenších čtverců

$m = 9$

```
stupen polynomu: 9
theta0: 9.499356 +/- 1.999998
theta1: 39.613446 +/- 74.930638
theta2: -116.317282 +/- 173.815397
theta3: 112.494059 +/- 156.210567
theta4: -59.528511 +/- 72.899603
theta5: 17.901582 +/- 19.694182
theta6: -3.153088 +/- 3.197009
theta7: 0.322257 +/- 0.307574
theta8: -0.017684 +/- 0.016154
theta9: 0.000403 +/- 0.000357
```






```
korelacni matice:

R =

    1.0000   -0.0726    0.0340   -0.0219    0.0162   -0.0130
   -0.0726    1.0000   -0.9946    0.9844   -0.9722    0.9587
    0.0340   -0.9946    1.0000   -0.9971    0.9900   -0.9806
   -0.0219    0.9844   -0.9971    1.0000   -0.9978    0.9923
    0.0162   -0.9722    0.9900   -0.9978    1.0000   -0.9983
   -0.0130    0.9587   -0.9806    0.9923   -0.9983    1.0000
    0.0110   -0.9446    0.9695   -0.9846    0.9938   -0.9986    1.0000   -0.9988    0.9958   -0.9915
   -0.0096    0.9303   -0.9576    0.9754   -0.9874    0.9949   -0.9988    1.0000   -0.9991    0.9966
    0.0086   -0.9161    0.9453   -0.9654    0.9797   -0.9896    0.9958   -0.9991    1.0000   -0.9992
   -0.0078    0.9024   -0.9330    0.9550   -0.9714    0.9833   -0.9915    0.9966   -0.9992    1.0000

pocet stupnu volnosti: 1
chisq = 0.048254 +/- 1.414214
chisq/deg.freedom  = 0.048254 +/- 1.414214
```