```
> restart:
  with(CurveFitting):
  with(plots):
```

Übungsaufgabe

Beschreibung der Situation

```
> Liste_t := [1 ,2 ,3 ,4 ,5 ,6 ,7 ,8 ,9 ,10,11,12,
              13,14,15,16,17,18,19,20,21,22,23,24,
              25,26,27,28,29,30,31,32,33,34,35,36];
  Liste_y := [1.2, 0.7, 2.0, 2.2, 3.2, 2.7, 3.8, 4.3, 3.6, 2.9,
  2.9, 7.7,
              1.4, 0.7, 2.2, 2.3, 3.5, 2.4, 4.0, 4.1, 3.3, 2.7,
  3.1, 6.9,
              1.3, 0.8, 1.9, 2.1, 2.9, 2.5, 4.1, 4.0, 3.2, 2.6,
  3.0, 7.6];

  n := nops(Liste_t):
  mittelwert_t := sum( Liste_t[i] ,i=1..n)/n;
  varianz_t_durch_n := sum( (Liste_t[i]- mittelwert_t)^2, i=1..
  n )/(n);
  varianz_t_durch_n_1 := sum( (Liste_t[i]- mittelwert_t)^2, i=
  1..n )/(n-1);



  mittelwert_Y := sum( Liste_y[i] ,i=1..n)/n;
  varianz_Y36 := sum( (Liste_y[i]- mittelwert_Y)^2, i=1..n )/
  (n);
  varianz_Y35 := sum( (Liste_y[i]- mittelwert_Y)^2, i=1..n )/
  (n-1);

  punkte := zip( (t,y) ->[t,y], Liste_t , Liste_y):

  p1 :=plot( punkte , style = point, color= black,view=[0..37,
  -3..8]):
  p2 :=plot( punkte , style = line , color= red, view=[0..37,
  -3..8], thickness=2):
  #display(p1);
  display(p1,p2);
```

$$Liste\_t := [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36]$$

$$Liste\_y := [1.2, 0.7, 2.0, 2.2, 3.2, 2.7, 3.8, 4.3, 3.6, 2.9, 2.9, 7.7, 1.4, 0.7, 2.2, 2.3, 3.5, 2.4, 4.0, 4.1, 3.3, 2.7, 3.1, 6.9, 1.3, 0.8, 1.9, 2.1, 2.9, 2.5, 4.1, 4.0, 3.2, 2.6, 3.0, 7.6]$$

$$mittelwert\_t := \frac{37}{2}$$

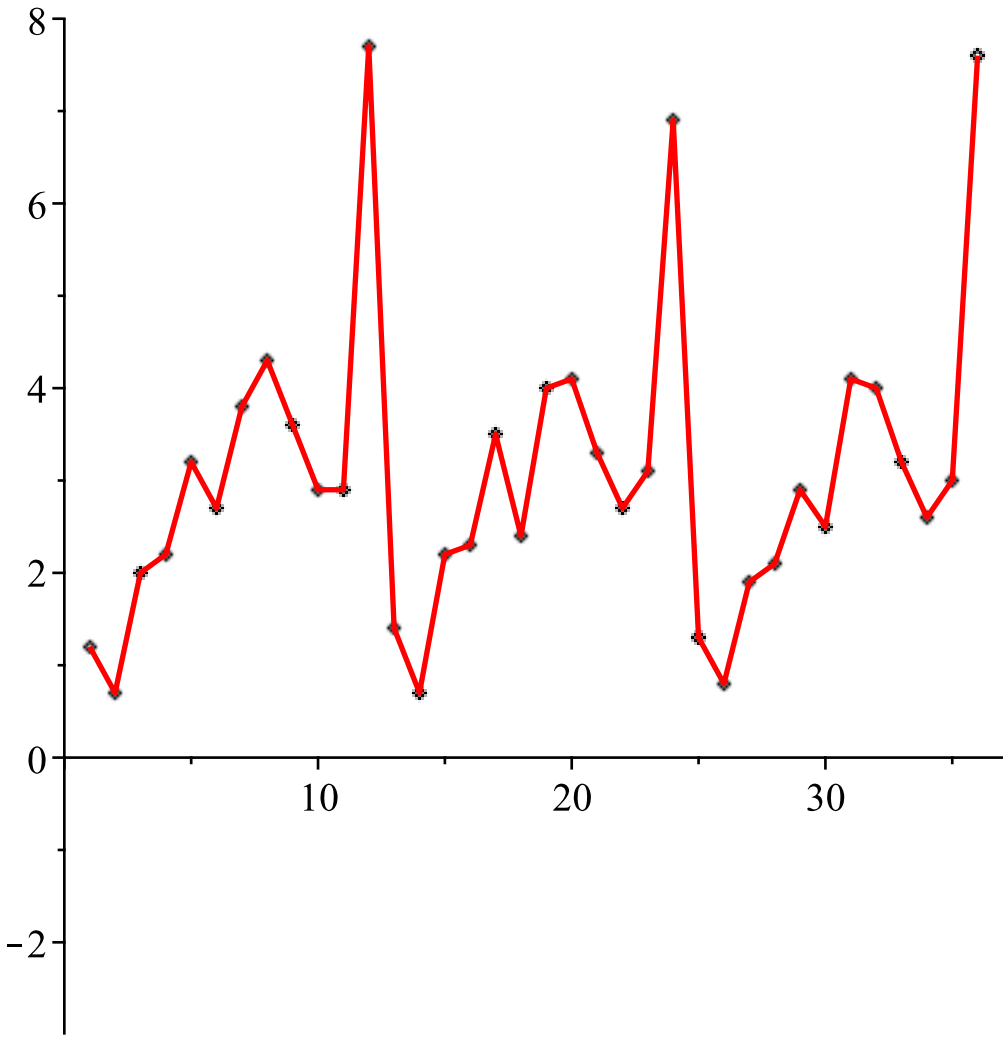
$$varianz\_t\_durch\_n := \frac{1295}{12}$$

$$varianz\_t\_durch\_n\_1 := 111$$

$$mittelwert\_Y := 3.050000000$$

$$varianz\_Y36 := 2.660833333$$

$$varianz\_Y35 := 2.736857143$$



Bestimmung der Regressionsgerade y = at +b

```
>  s1  := n;                                          # Anzahl
   Wertepaare
    s2  := sum(  Liste_t[j]                 , j=1..n);   # Summe
```

```
aller t_i         Werte
 s3  := sum( (Liste_t[j])^2            , j=1..n);   # Summe
aller (t_i)^2     Werte
 s4  := sum(  Liste_y[j]               , j=1..n);   # Summe
aller y_i         Werte
 s5  := sum( (Liste_t[j])*(Liste_y[j]) , j=1..n);   # Summe
aller (t_i)*(y_i) Werte
```

$$s1 := 36$$

$$s2 := 666$$

$$s3 := 16206$$

$$s4 := 109.8$$

$$s5 := 2170.6$$

```
> regr := solve( {s5 = a * s3  + b* s2,
                  s4 = a * s2  + b* n  },  {a,b} );
  assign(regr);
```

$$regr := \{a = 0.03585585586,\ b = 2.386666667\}$$

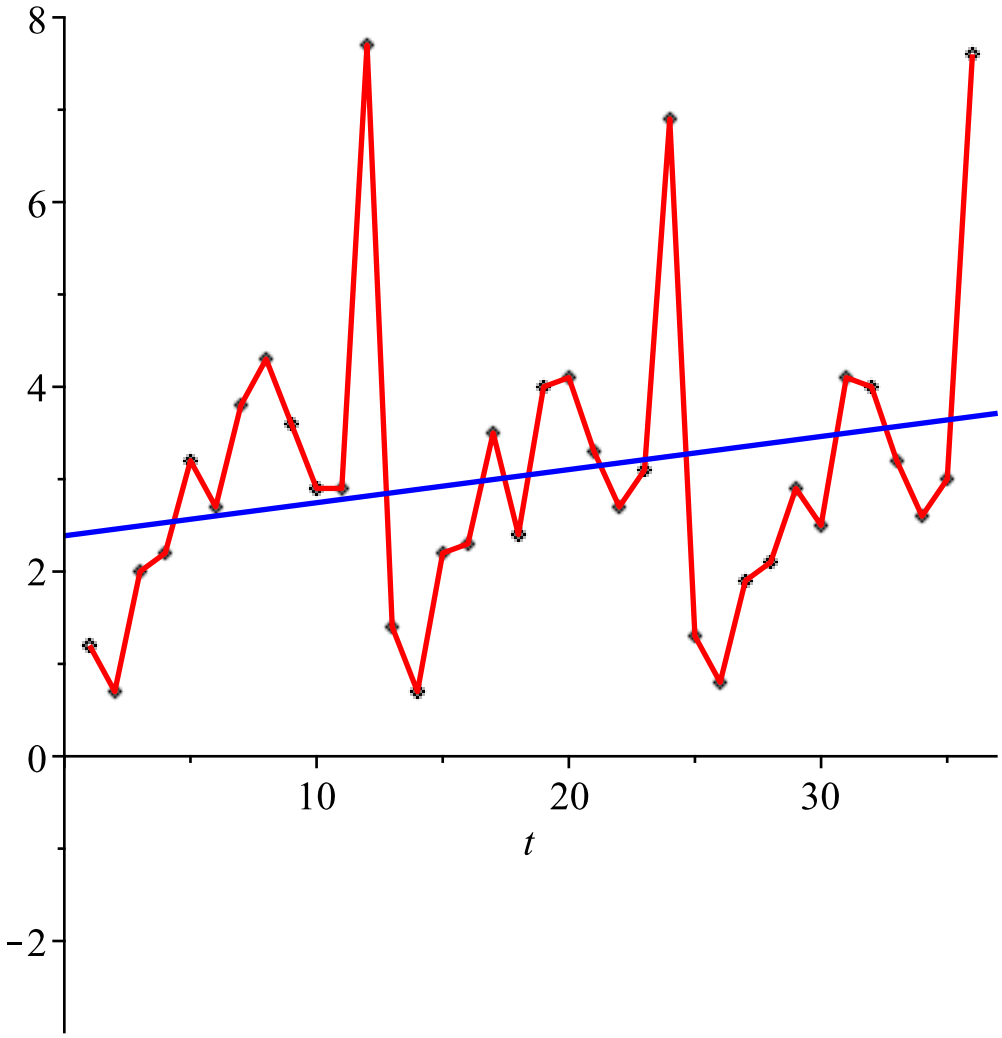
```
> g := t  ->  a*t + b:
  g(t);
```

$$0.03585585586\ t + 2.386666667$$

```
> g(10);
```

$$2.745225226$$

```
> p3 := plot(g(t), t=0..37, color= blue, thickness =2):
> display(p1,p2,p3);
```



Bestimmung der Trendbereinigten Zeitreihe

Von jedem Zeitreihenwert wird der zugehörige Werte der Trendfunktion subtrahiert.

```
> for i from 1 to n
    do
    y_stern[i] := Liste_y[i]  - g(Liste_t[i]);
    od;
  y_sternn := convert(y_stern,'list'):
```

$$y\_stern_1 := -1.222522523$$

$$y\_stern_2 := -1.758378379$$

$$y\_stern_3 := -0.494234235$$

$$y\_stern_4 := -0.330090090$$

$$y\_stern_5 := 0.634054054$$

$$y\_stern_{6} := 0.098198198$$

$$y\_stern_{7} := 1.162342342$$

$$y\_stern_{8} := 1.626486486$$

$$y\_stern_{9} := 0.890630630$$

$$y\_stern_{10} := 0.154774774$$

$$y\_stern_{11} := 0.118918918$$

$$y\_stern_{12} := 4.883063063$$

$$y\_stern_{13} := -1.452792793$$

$$y\_stern_{14} := -2.188648649$$

$$y\_stern_{15} := -0.724504505$$

$$y\_stern_{16} := -0.660360361$$

$$y\_stern_{17} := 0.503783783$$

$$y\_stern_{18} := -0.632072072$$

$$y\_stern_{19} := 0.932072072$$

$$y\_stern_{20} := 0.996216216$$

$$y\_stern_{21} := 0.160360360$$

$$y\_stern_{22} := -0.475495496$$

$$y\_stern_{23} := -0.111351352$$

$$y\_stern_{24} := 3.652792792$$

$$y\_stern_{25} := -1.983063064$$

$$y\_stern_{26} := -2.518918919$$

$$y\_stern_{27} := -1.454774775$$

$$y\_stern_{28} := -1.290630631$$

$$y\_stern_{29} := -0.526486487$$

$$y\_stern_{30} := -0.962342343$$

$$y\_stern_{31} := 0.601801801$$

$$y\_stern_{32} := 0.465945945$$

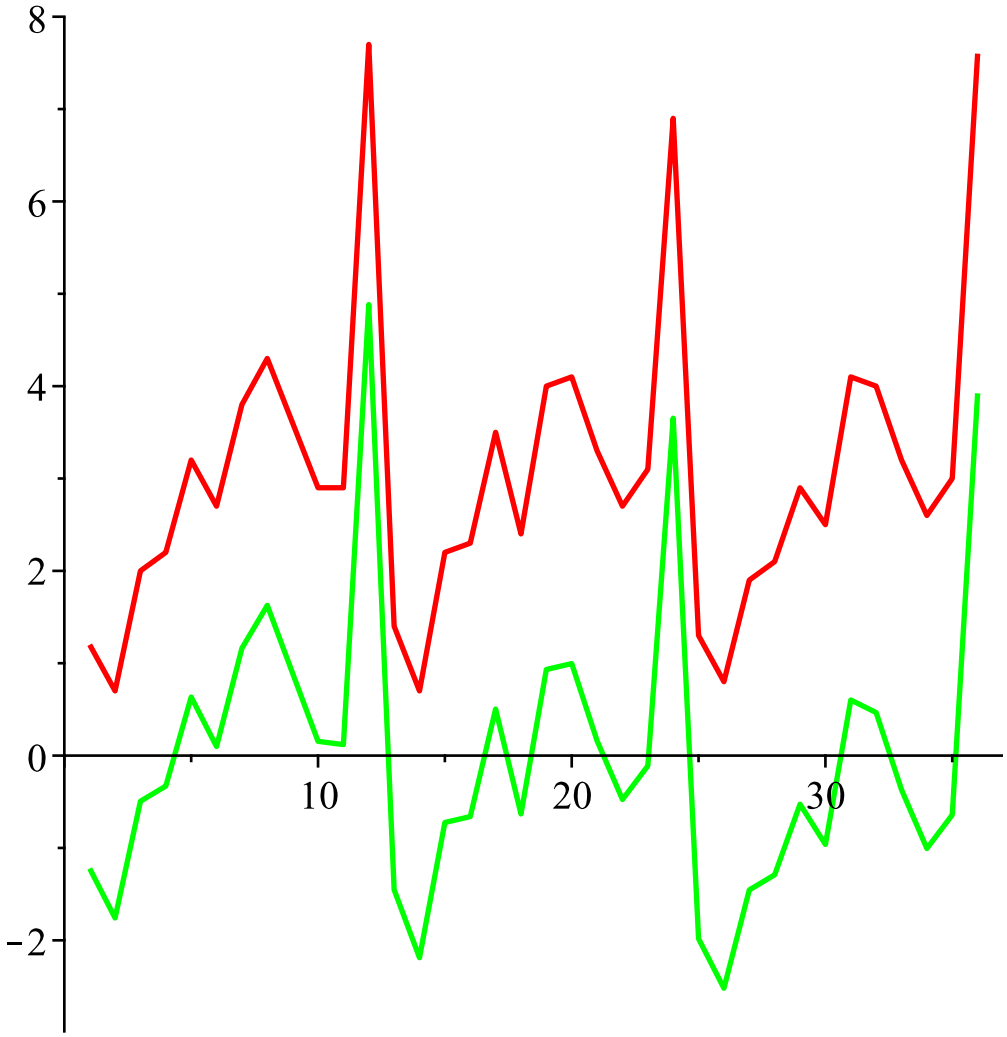
$$y\_stern_{33} := -0.369909910$$

$$y\_stern_{34} := -1.005765766$$

$$y\_stern_{35} := -0.641621622$$

$$y\_stern_{36} := 3.922522522$$

```
> punkte_stern := zip( (t,y) ->[t,y], Liste_t , y_sternn):
> p4 :=plot( punkte_stern , style = point, color= green):
  p5 :=plot( punkte_stern , style = line , color= green,
  thickness=2):
> #display(p1, p4);
  display(p2, p5);
```



Bestimmung der zyklischen Komponente

```
>  k := 12;
   m := n/k;
```

$$k := 12$$

$$m := 3$$

```
> for i from 1 to k
    do
```

```
   SS[i] := (1/m)*sum( y_stern[ i + j*k], j=0..m-1):
      for ii from 1 to m-1 do
          SS[i + k*ii] := SS[i]:
          od:
  od:

for i from 1 to n do
 S[i] := SS[i];
od;
```

$$S_1 := -1.552792793$$

$$S_2 := -2.155315316$$

$$S_3 := -0.8911711717$$

$$S_4 := -0.7603603607$$

$$S_5 := 0.2037837833$$

$$S_6 := -0.4987387390$$

$$S_7 := 0.8987387383$$

$$S_8 := 1.029549549$$

$$S_9 := 0.2270270267$$

$$S_{10} := -0.4421621627$$

$$S_{11} := -0.2113513520$$

$$S_{12} := 4.152792793$$

$$S_{13} := -1.552792793$$

$$S_{14} := -2.155315316$$

$$S_{15} := -0.8911711717$$

$$S_{16} := -0.7603603607$$

$$S_{17} := 0.2037837833$$

$$S_{18} := -0.4987387390$$

$$S_{19} := 0.8987387383$$

$$S_{20} := 1.029549549$$

$$S_{21} := 0.2270270267$$

$$S_{22} := -0.4421621627$$

$$S_{23} := -0.2113513520$$

$$S_{24} := 4.152792793$$

$$S_{25} := -1.552792793$$

$$S_{26} := -2.155315316$$

$$S_{27} := -0.8911711717$$

$$S_{28} := -0.7603603607$$

$$S_{29} := 0.2037837833$$

$$S_{30} := -0.4987387390$$

$$S_{31} := 0.8987387383$$

$$S_{32} := 1.029549549$$

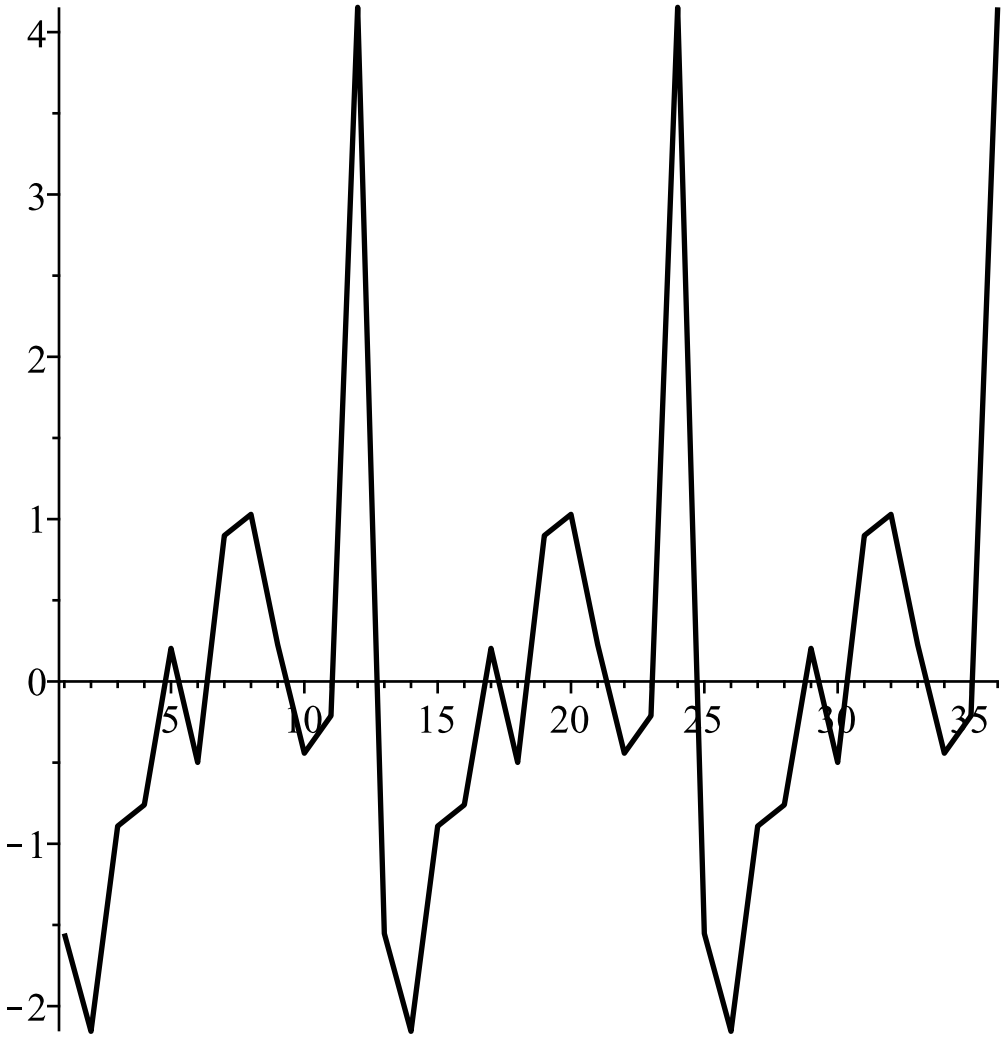
$$S_{33} := 0.2270270267$$

$$S_{34} := -0.4421621627$$

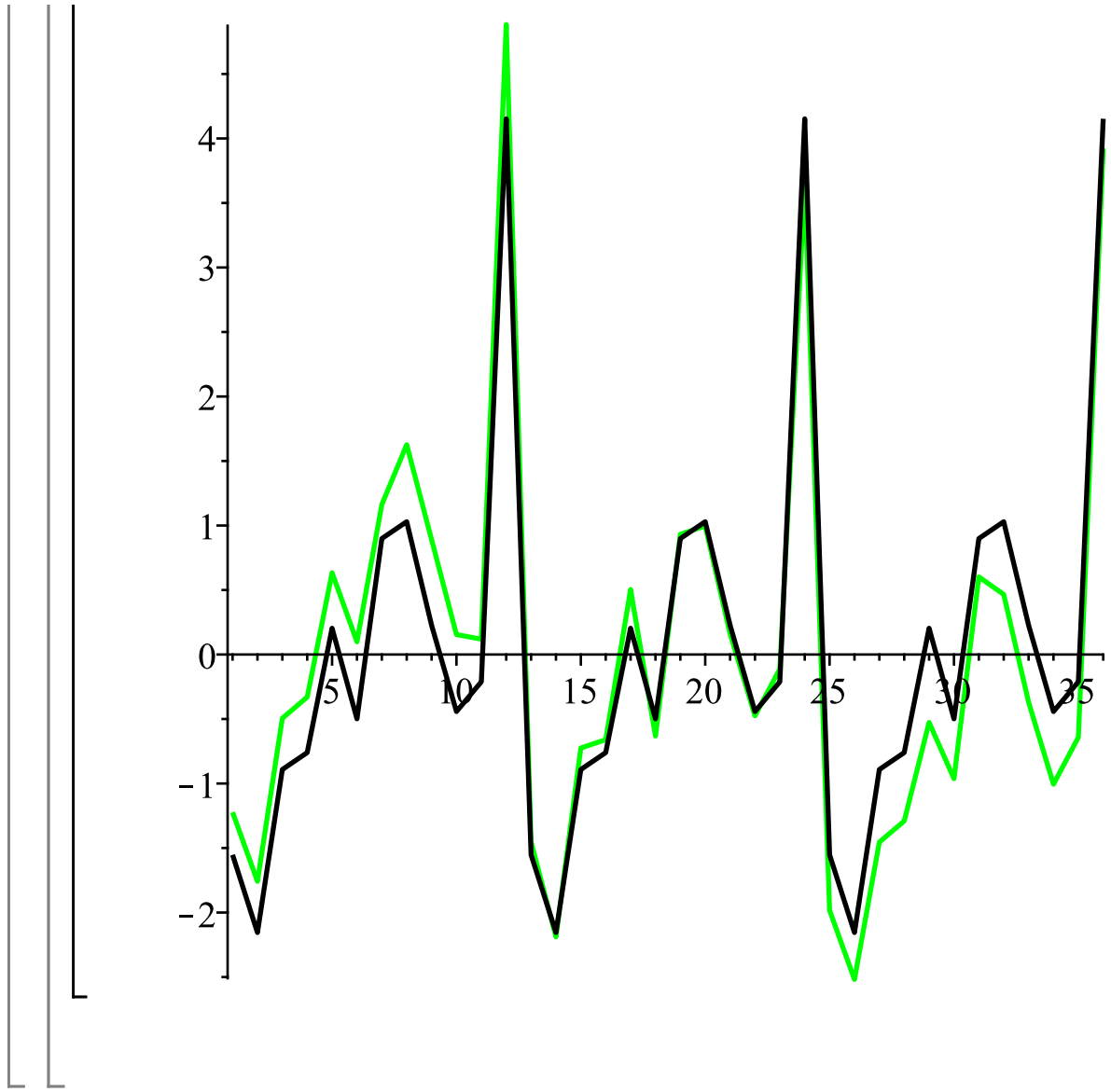
$$S_{35} := -0.2113513520$$

$$S_{36} := 4.152792793$$

```
> S_hut := convert(S,'list'):
> punkte_S := zip( (t,y) ->[t,y], Liste_t , S_hut):
> p6 :=plot( punkte_S , style = point, color= black):
  p7 :=plot( punkte_S , style = line , color= black, thickness=
  2):
> #display(p6);
  display(p7);
```




```
> display(p5,p7);
```


4
3
2
1
0
−1
−2
5
10
15
20
25
30
35