

```

Exit[];

c = {1 - 3 n^2 x^2 + 2 n^3 x^3, 3 n^2 x^2 - 2 n^3 x^3, x - 2 n x^2 + n^2 x^3, -n x^2 + n^2 x^3}
{1 - 3 n^2 x^2 + 2 n^3 x^3, 3 n^2 x^2 - 2 n^3 x^3, x - 2 n x^2 + n^2 x^3, -n x^2 + n^2 x^3}

b = 1 / n;

Y[i_, h_] := {Y[i], Y[i+1], m[i], m[i+1]}.c /. x -> h;
{Y[i, 0], Y[i, 1/n], D[Y[i, x], x] /. x -> 0, D[Y[i, x], x] /. x -> 1/n}
{Y[i], Y[1+i], m[i], m[1+i]}

Simplify[(D[Y[1, x], {x, 2}] / 4 / n /. x -> 0) == 0]
2 m[1] + m[2] + 3 n y[1] == 3 n y[2]

Simplify[(D[Y[n, x], {x, 2}] / 4 / n /. x -> b) == 0]
m[n] + 2 m[1+n] + 3 n y[n] == 3 n y[1+n]

Simplify[(D[Y[i, x], {x, 2}] / 4 / n /. x -> b) == (D[Y[i+1, x], {x, 2}] / 4 / n /. x -> 0)]
m[i] + 4 m[1+i] + m[2+i] + 3 n y[i] == 3 n y[2+i]

M[n_] := SparseArray[{{1, 1} -> -2, (n+1) {1, 1} -> 2,
  {n+1, n} -> -2, {1, 2} -> 2, {i_, j_} /; (i == j+1 && i < n+1 && i > 1) -> -1,
  {i_, j_} /; (i == j-1 && i < n+1 && i > 1) -> 1}, (n+1) {1, 1}];
M[5] // MatrixForm

$$\begin{pmatrix} -2 & 2 & 0 & 0 & 0 & 0 \\ -1 & 0 & 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 1 & 0 & 0 \\ 0 & 0 & -1 & 0 & 1 & 0 \\ 0 & 0 & 0 & -1 & 0 & 1 \\ 0 & 0 & 0 & 0 & -2 & 2 \end{pmatrix}$$


```

los:

```

y = Transpose[XY][[2]]; y = Table[y[[i]], {i, 1, Length[y], 20}];
If[y[[Length[y]]] != XY[[Length[XY], 2]], AppendTo[y, XY[[Length[XY], 2]]];
n = Length[y] - 1; m = M[n].y;

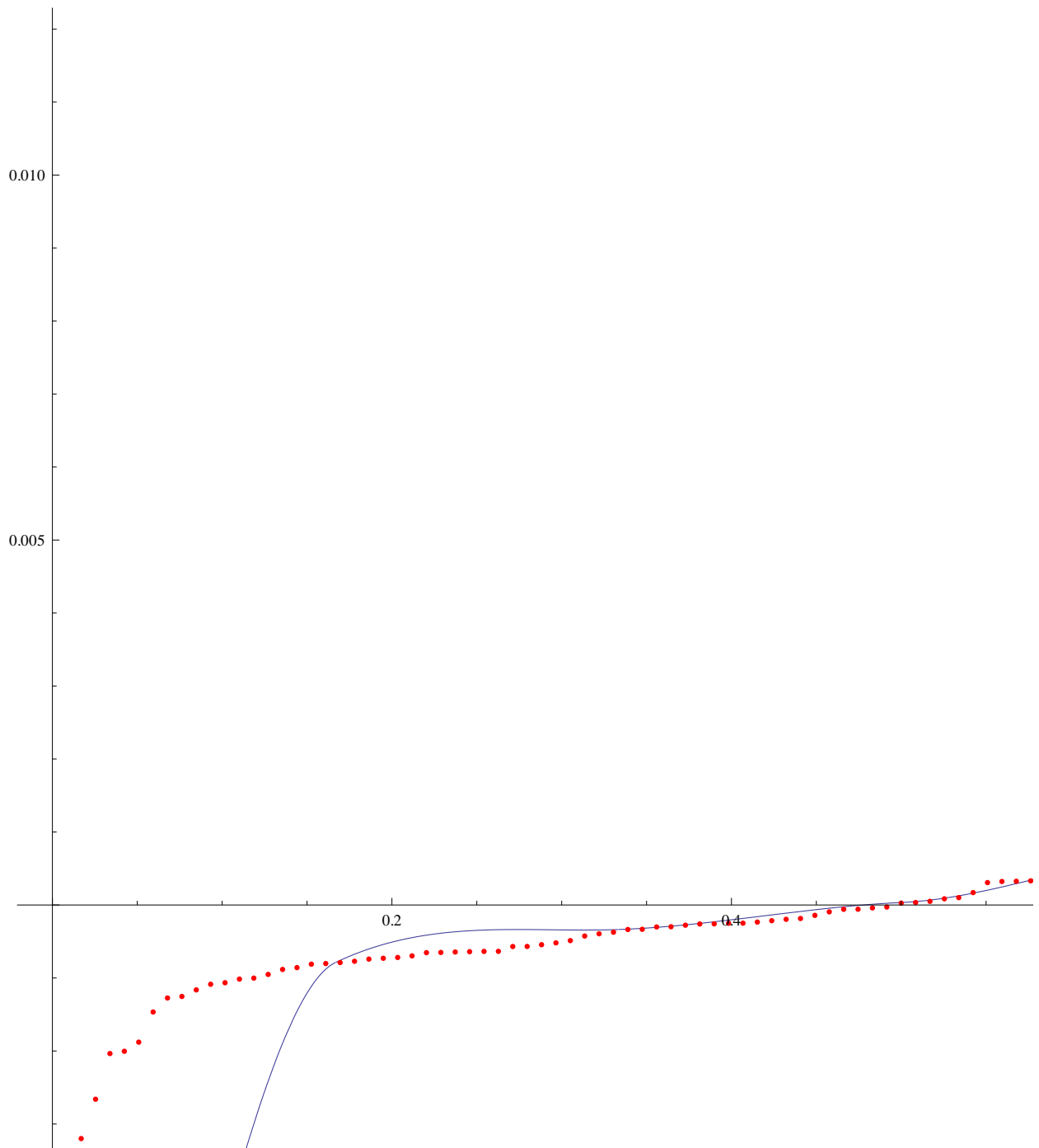
For[i = 1, i <= n, i++,
  delta = (y[[i+1]] - y[[i]]) n;
  If[delta == 0, m[[i]] = 0; m[[i+1]] = 0,
    a = m[[i]] / delta; b = m[[i+1]] / delta;
    If[a^2 + b^2 > 3,
      t = 3 / Sqrt[a^2 + b^2]; m[[i]] = t a delta; m[[i+1]] = t b delta;
    ]];

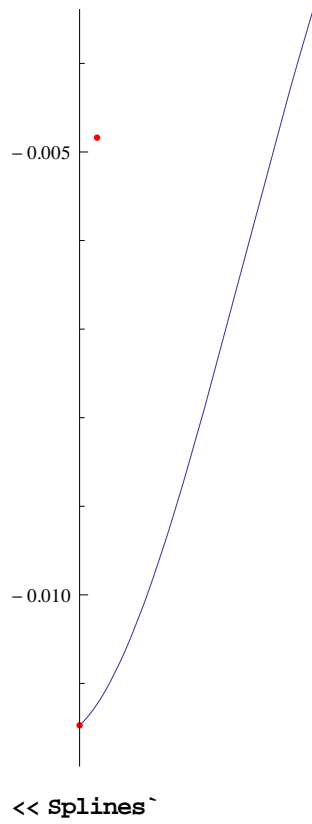
```

```

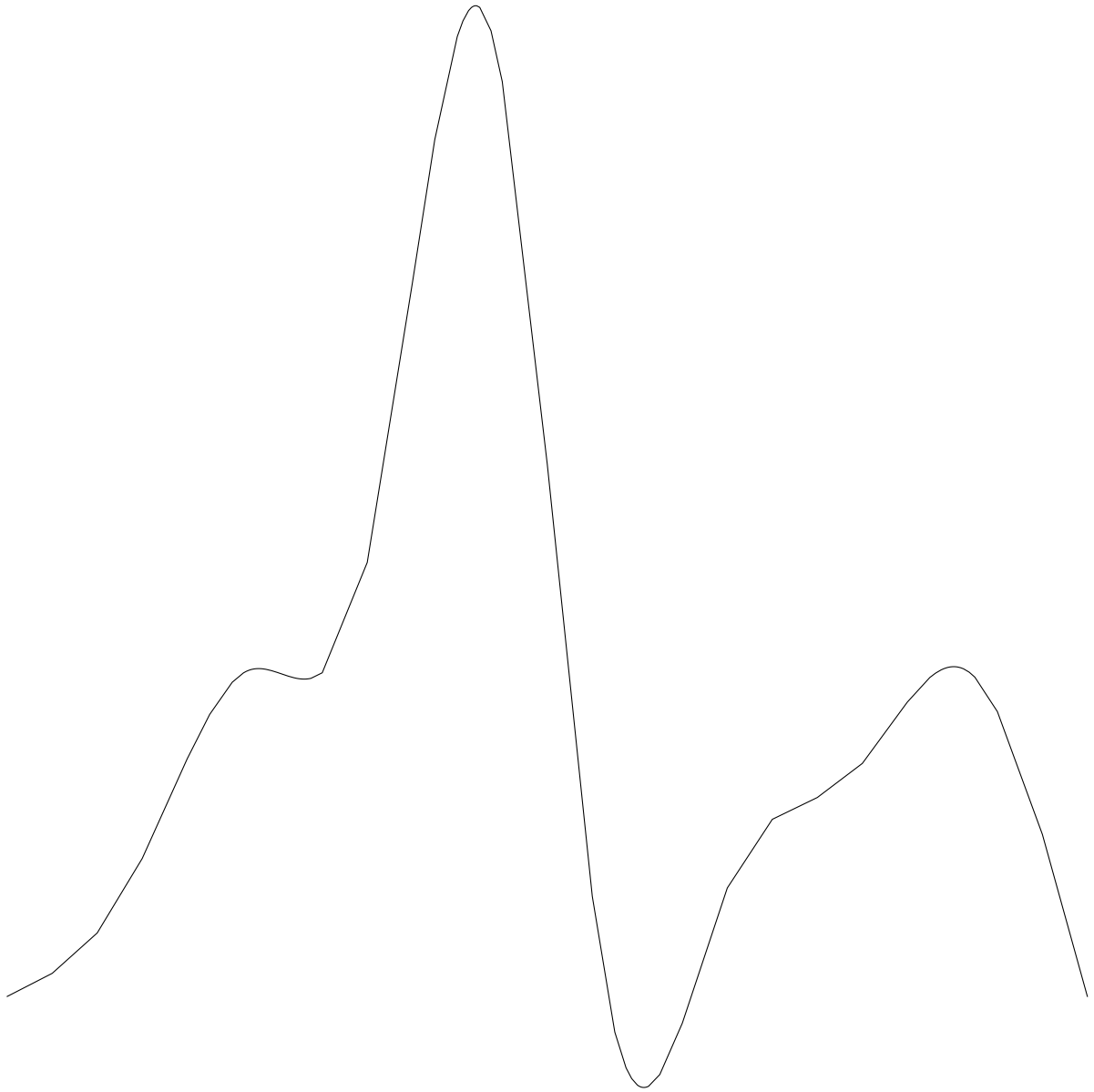
Y[x0_] := Module[{i, x = x0, y = y, m = m, c = c, n = n},
  i = Ceiling[x * n];
  x -= (i - 1) / n;
  {Y[[i]], Y[[i + 1]], m[[i]], m[[i + 1]]}.
  { $1 - 3 n^2 x^2 + 2 n^3 x^3$ ,  $3 n^2 x^2 - 2 n^3 x^3$ ,  $x - 2 n x^2 + n^2 x^3$ ,  $-n x^2 + n^2 x^3$ }
}
Show[Plot[Y[x], {x, 0, 1}, AspectRatio -> 1, PlotRange -> All],
ListPlot[XY, PlotStyle -> Red]]

```





```
Graphics[Spline[Table[{i / (Length[y] - 1), y[[i + 1]]}, {i, 0, Length[y] - 1}], Cubic],  
  AspectRatio -> 1]
```



```

Y[x0_] := Module[{i = n, x = x0, p = y, m = m, n = n, b, y},
  If[x == 0, i = 1,
    While[x ≤ (i - 1) / n, i--];];
  b = 1 / n;
  {p[[i]], p[[i + 1]], m[[i, 1]], m[[i, 2]], m[[n + i, 1]], m[[n + i, 2]]}.
  {1 -  $\frac{10 y^3}{b^3} + \frac{15 y^4}{b^4} - \frac{6 y^5}{b^5}$ ,  $\frac{10 y^3}{b^3} - \frac{15 y^4}{b^4} + \frac{6 y^5}{b^5}$ ,  $y - \frac{6 y^3}{b^2} + \frac{8 y^4}{b^3} - \frac{3 y^5}{b^4}$ ,
  -  $\frac{4 y^3}{b^2} + \frac{7 y^4}{b^3} - \frac{3 y^5}{b^4}$ ,  $\frac{y^2}{2} - \frac{3 y^3}{2 b} + \frac{3 y^4}{2 b^2} - \frac{y^5}{2 b^3}$ ,  $\frac{y^3}{2 b} - \frac{y^4}{b^2} + \frac{y^5}{2 b^3}$ } /. y → (x - (i - 1) / n)
]

```

```

y = {XY[[1, 2]], XY[[Length[XY], 2]]}; y = Transpose[XY][[2]];
y = Table[y[[i]], {i, 1, Length[y], 2}];
If[y[[Length[y]]] ≠ XY[[Length[XY], 2]], AppendTo[y, XY[[Length[XY], 2]]];

```

```
n = Length[y] - 1;
```

```
n
```

```
6
```

```
m = Table[ts[i, j], {i, 2 n}, {j, 2}];
```

```
d = (Y[#[[1]]] - #[[2]])^2 & /@ XY; d = Sum[d[[i]], {i, Length[d]}];
```

```
g = Solve[Flatten[Table[D[d, ts[i, j]] == 0, {i, 2 n}, {j, 2}]], Flatten[m]][[1]]
```

```

{ts[1, 1] → 1.0823, ts[1, 2] → -3.6435 × 10-6, ts[2, 1] → -0.0151759,
ts[2, 2] → 2.77363 × 10-7, ts[3, 1] → -0.0113918, ts[3, 2] → 2.8026 × 10-6,
ts[4, 1] → 0.0193723, ts[4, 2] → 0., ts[5, 1] → -0.0000660752, ts[5, 2] → 0.571534,
ts[6, 1] → -8.38091 × 10-7, ts[6, 2] → -0.00384619, ts[7, 1] → 1.11775 × 10-6,
ts[7, 2] → 1.0304 × 10-6, ts[8, 1] → 0.00643999, ts[8, 2] → -1.97915 × 10-6,
ts[9, 1] → -0.0406935, ts[9, 2] → 1.06037 × 10-6, ts[10, 1] → -0.0002147,
ts[10, 2] → 0.000164586, ts[11, 1] → 3.53879 × 10-7, ts[11, 2] → 0.000792036,
ts[12, 1] → -2.59419 × 10-11, ts[12, 2] → 5.14753 × 10-7, ts[13, 1] → 4.53752 × 10-7,
ts[13, 2] → 0.0163343, ts[14, 1] → -8.31444 × 10-9, ts[14, 2] → -1.03083 × 10-7,
ts[15, 1] → 7.14926 × 10-9, ts[15, 2] → -7.28265 × 10-12, ts[16, 1] → -0.00837183,
ts[16, 2] → -4.2512 × 10-6, ts[17, 1] → -0.00985838, ts[17, 2] → -0.00375587,
ts[18, 1] → 1.29474 × 10-7, ts[18, 2] → 0.00153424, ts[19, 1] → -3.59751 × 10-7,
ts[19, 2] → -0.00155962, ts[20, 1] → 2.53477 × 10-8, ts[20, 2] → -3.25012 × 10-8,
ts[21, 1] → -0.00814505, ts[21, 2] → 1.77568 × 10-8, ts[22, 1] → 0.000612166,
ts[22, 2] → -3.55903 × 10-7, ts[23, 1] → 0.144097, ts[23, 2] → 0.137109,
ts[24, 1] → -6.39497 × 10-7, ts[24, 2] → -0.00327646, ts[25, 1] → 2.66831 × 10-7,
ts[25, 2] → 9.11875 × 10-6, ts[26, 1] → -1.43491 × 10-7, ts[26, 2] → 0.00194979,
ts[27, 1] → 5.22883 × 10-10, ts[27, 2] → -3.14415 × 10-8, ts[28, 1] → -0.00253188,
ts[28, 2] → 7.16435 × 10-7, ts[29, 1] → 0.000761042, ts[29, 2] → 9.29119 × 10-8,
ts[30, 1] → 0.00727979, ts[30, 2] → 0.000626354, ts[31, 1] → 2.94519 × 10-7,
ts[31, 2] → -0.00319948, ts[32, 1] → -2.33249 × 10-7, ts[32, 2] → 0.00946658,
ts[33, 1] → -1.37021 × 10-7, ts[33, 2] → 1.83269 × 10-7, ts[34, 1] → -0.000435513,
ts[34, 2] → -6.99444 × 10-9, ts[35, 1] → 0.000559624, ts[35, 2] → 1.99426 × 10-7,

```

```

ts[36, 1] → 0.002977729, ts[36, 2] →  $5.79113 \times 10^{-7}$ , ts[37, 1] → -0.00305266,
ts[37, 2] → -0.00609373, ts[38, 1] →  $5.1309 \times 10^{-7}$ , ts[38, 2] → 0.00871657,
ts[39, 1] →  $2.00965 \times 10^{-8}$ , ts[39, 2] → -0.000350942, ts[40, 1] →  $-1.82019 \times 10^{-8}$ ,
ts[40, 2] →  $1.45694 \times 10^{-8}$ , ts[41, 1] → 0.000723568, ts[41, 2] →  $4.64264 \times 10^{-8}$ ,
ts[42, 1] →  $-2.39426 \times 10^{-7}$ , ts[42, 2] →  $-4.05992 \times 10^{-11}$ , ts[43, 1] → -0.00494753,
ts[43, 2] → -0.00506425, ts[44, 1] →  $1.46797 \times 10^{-7}$ , ts[44, 2] → -0.00465825,
ts[45, 1] →  $-8.14146 \times 10^{-8}$ , ts[45, 2] → -0.00227377, ts[46, 1] →  $7.18358 \times 10^{-8}$ ,
ts[46, 2] →  $3.72287 \times 10^{-9}$ , ts[47, 1] →  $1.37114 \times 10^{-7}$ , ts[47, 2] →  $8.42229 \times 10^{-12}$ ,
ts[48, 1] → 0.0125375, ts[48, 2] →  $-6.35024 \times 10^{-7}$ , ts[49, 1] → -0.0272504,
ts[49, 2] →  $4.56494 \times 10^{-6}$ , ts[50, 1] → 0.0373004, ts[50, 2] → 0.0249767,
ts[51, 1] →  $6.50168 \times 10^{-6}$ , ts[51, 2] → -0.071426, ts[52, 1] →  $-4.84526 \times 10^{-7}$ ,
ts[52, 2] → 0.00557458, ts[53, 1] →  $-3.751 \times 10^{-7}$ , ts[53, 2] →  $-2.28261 \times 10^{-7}$ ,
ts[54, 1] → 0.010349, ts[54, 2] →  $2.39079 \times 10^{-7}$ , ts[55, 1] → -0.00449078,
ts[55, 2] →  $-1.97346 \times 10^{-7}$ , ts[56, 1] → 0.000709043, ts[56, 2] → -0.00386641,
ts[57, 1] →  $3.52967 \times 10^{-6}$ , ts[57, 2] → -0.0270599, ts[58, 1] →  $-3.8275 \times 10^{-7}$ ,
ts[58, 2] → 0.0196661, ts[59, 1] → -0.00018142, ts[59, 2] → 6.67817, ts[60, 1] → -34.345,
ts[60, 2] → -47.6272, ts[61, 1] → -2.56596, ts[61, 2] → 1.82046, ts[62, 1] → -16.,
ts[62, 2] → 12.251, ts[63, 1] → -18.8114, ts[63, 2] → 32., ts[64, 1] → 339.047,
ts[64, 2] → -9.50602, ts[65, 1] → 7.0635, ts[65, 2] → -3.09377, ts[66, 1] → -26.3816,
ts[66, 2] → 30.5071, ts[67, 1] → 12.2701, ts[67, 2] → -17.964, ts[68, 1] → 15.8686,
ts[68, 2] → 5.68961, ts[69, 1] → 0.084268, ts[69, 2] → -0.306083, ts[70, 1] → -1.49157,
ts[70, 2] → 0.622097, ts[71, 1] → 0.000131837, ts[71, 2] → 0.000309723,
ts[72, 1] → -5.35569, ts[72, 2] → 12.5429, ts[73, 1] → 1.18473, ts[73, 2] → -1.51892,
ts[74, 1] → -0.0000209261, ts[74, 2] → -0.0000401053, ts[75, 1] → 16.9927,
ts[75, 2] → -19.296, ts[76, 1] → 1.0385, ts[76, 2] →  $4.33681 \times 10^{-19}$ ,
ts[77, 1] → -0.6367, ts[77, 2] → 0.873711, ts[78, 1] → 2.8305, ts[78, 2] → -0.185246,
ts[79, 1] → -0.495827, ts[79, 2] → -1.28585, ts[80, 1] → 1.39899, ts[80, 2] → 0.175671,
ts[81, 1] → -0.366519, ts[81, 2] → -2., ts[82, 1] → -0.487093, ts[82, 2] → -1.96284,
ts[83, 1] → 2.60241, ts[83, 2] → -3.75542, ts[84, 1] → -1.57432, ts[84, 2] → 1.13425,
ts[85, 1] → 1.53906, ts[85, 2] → 0.502709, ts[86, 1] → -0.0296981, ts[86, 2] → -0.52828,
ts[87, 1] → -0.00306103, ts[87, 2] → 5.28408, ts[88, 1] → -0.219279,
ts[88, 2] → 0.438558, ts[89, 1] → 1.1985, ts[89, 2] → 0., ts[90, 1] → -1.39025,
ts[90, 2] → -2.61385, ts[91, 1] → 1.72055, ts[91, 2] → -2.03868, ts[92, 1] → 2.32895,
ts[92, 2] → 11.2633, ts[93, 1] → -0.00243271, ts[93, 2] → -0.0748942,
ts[94, 1] → 1.38933, ts[94, 2] → 1.17664, ts[95, 1] → -0.437468, ts[95, 2] → 2.3569,
ts[96, 1] → -1.7784, ts[96, 2] → -3.35749, ts[97, 1] → -2.88359, ts[97, 2] → 5.46428,
ts[98, 1] → -0.197677, ts[98, 2] → 0.214086, ts[99, 1] → 0.71371, ts[99, 2] → 0.28754,
ts[100, 1] → -0.346736, ts[100, 2] → 0.365231, ts[101, 1] → 0.0000959718,
ts[101, 2] → -0.000130176, ts[102, 1] → -0.205296, ts[102, 2] → -1.53448,
ts[103, 1] → -0.666426, ts[103, 2] → -0.0768087, ts[104, 1] → 0.565089,
ts[104, 2] → -0.569554, ts[105, 1] → -1.05936, ts[105, 2] → -0.499442,
ts[106, 1] → -0.0011975, ts[106, 2] → 0.000174175, ts[107, 1] → -0.000325132,
ts[107, 2] → -3.94381, ts[108, 1] → 2.52051, ts[108, 2] → 19.2403, ts[109, 1] → -10.2788,
ts[109, 2] →  $-6.80745 \times 10^{-19}$ , ts[110, 1] → -34.8736, ts[110, 2] → 4.76171,
ts[111, 1] → 4.3992, ts[111, 2] → 1.56344, ts[112, 1] → 11.2038, ts[112, 2] → -5.41162,
ts[113, 1] → -4., ts[113, 2] → 2.01487, ts[114, 1] → 0.319386, ts[114, 2] → -1.01247,
ts[115, 1] → -0.6678, ts[115, 2] → -1.02936, ts[116, 1] → -15.4272, ts[116, 2] → -22.929,
ts[117, 1] → 2.50975, ts[117, 2] → 14.2177, ts[118, 1] → 2380.09, ts[118, 2] → 493.507}

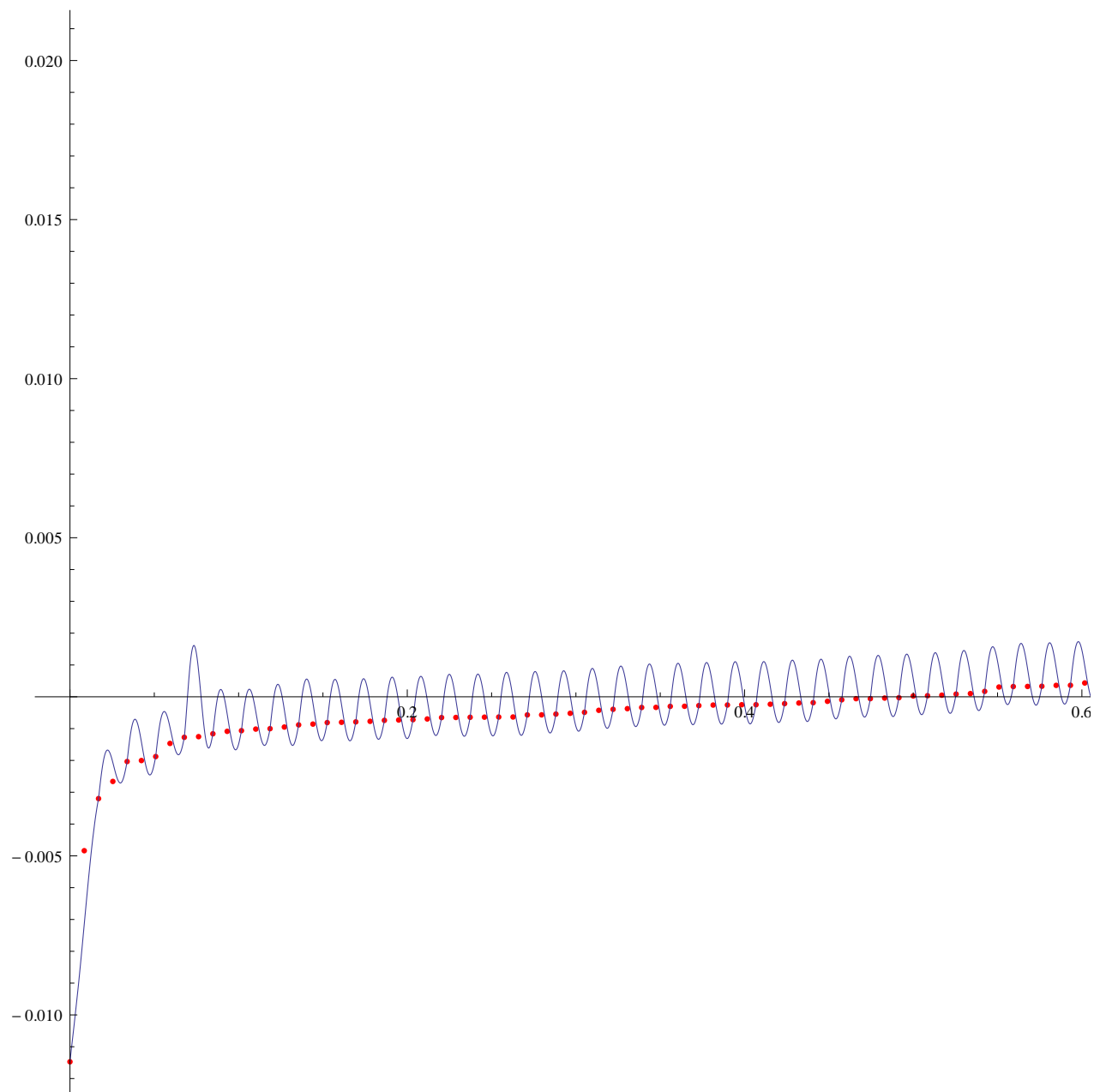
```

```

m = Table[ts[i, j], {i, 2 n}, {j, 2}] /. g;
m[[1 ;; n]] = n / 2 M[n].y;
m = Table[ts[i, j], {i, n}, {j, 2}] /. g;
For[i = 1, i ≤ n, i++,
  delta = (P[[i + 1, 2]] - P[[i, 2]]) / (P[[i + 1, 1]] - P[[i, 1]]);
  a = m[[i]] / delta; b = m[[i + 1]] / delta;
  If[a ^ 2 + b ^ 2 > 3,
    t = 3 / Sqrt[a ^ 2 + b ^ 2]; m[[i]] = t a delta; m[[i + 1]] = t b delta;]
]; m

```

```
Show[ListPlot[{XY}, PlotRange -> All, PlotStyle -> Red],
Plot[Y[x], {x, 0, 1}, PlotRange -> All]]
```

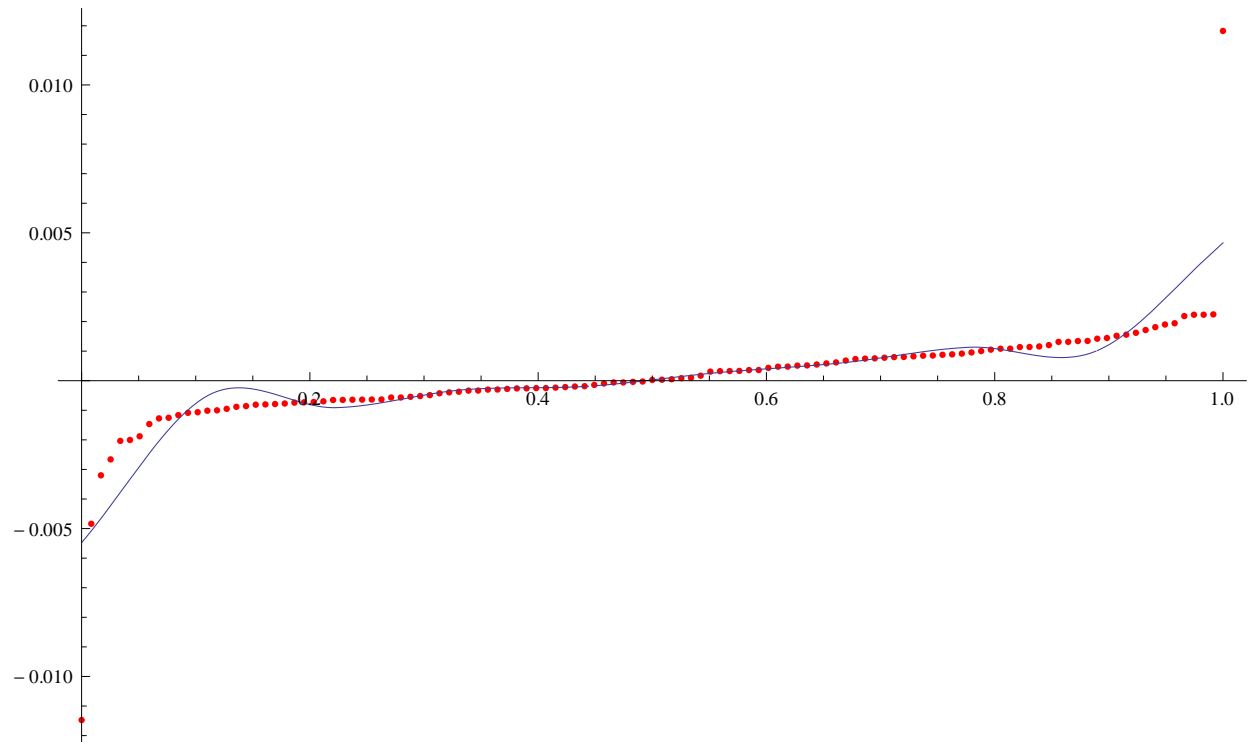


```
Solve[Table[D[d, ys[i]] == 0, {i, nN}], Table[ys[i], {i, nN}]]
{{ys[1] -> -0.00547464, ys[2] -> -0.000492335, ys[3] -> -0.000911088,
  ys[4] -> -0.00031071, ys[5] -> -0.000185091, ys[6] -> 0.000265952,
  ys[7] -> 0.00060474, ys[8] -> 0.00113058, ys[9] -> 0.00100276, ys[10] -> 0.0046597}}
y = Table[ys[i], {i, nN}] /. %[[1]];
nN = 10; y = Table[ys[i], {i, nN}];
```

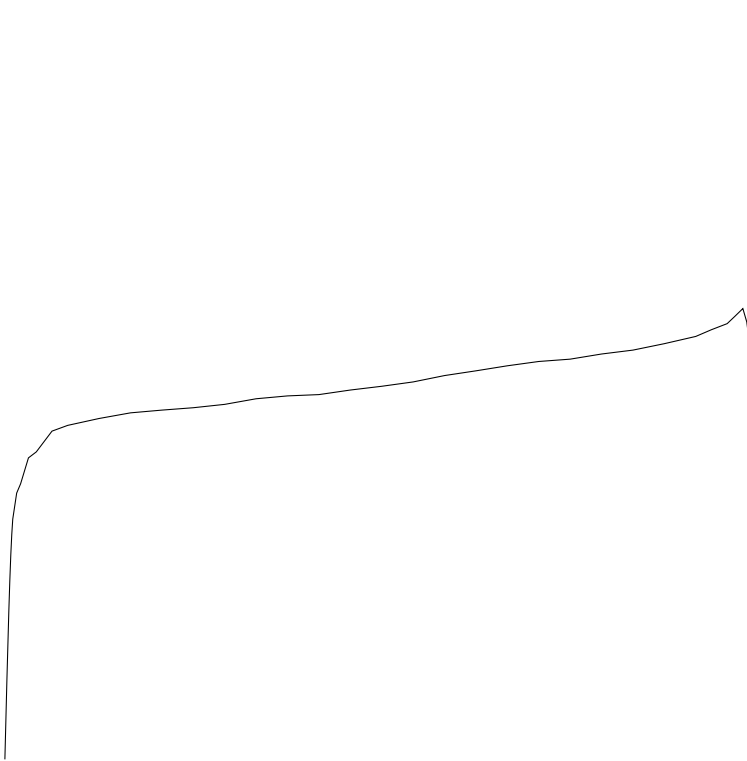


```
m = n / 2 M[n].y; n = Length[y] - 1;
d = (Y[#[[1]]] - #[[2]]) ^ 2 & /@ XY; d = Sum[d[[i]], {i, Length[d]}]
Show[ListPlot[XY, PlotStyle -> Red, PlotRange -> All],
Plot[Y[x], {x, 0, 1}, PlotRange -> All]]
```

0.000118941



```
Graphics[Spline[XY, Cubic], AspectRatio -> 1]
```



```
Y[0]
```

```
0.01
```

```
{#[[1]]} & /@ XY
```

```
{0.}, {0.008475}, {0.016949}, {0.025424}, {0.033898}, {0.042373}, {0.050847},
{0.059322}, {0.067797}, {0.076271}, {0.084746}, {0.09322}, {0.101695}, {0.110169},
{0.118644}, {0.127119}, {0.135593}, {0.144068}, {0.152542}, {0.161017}, {0.169492},
{0.177966}, {0.186441}, {0.194915}, {0.20339}, {0.211864}, {0.220339}, {0.228814},
{0.237288}, {0.245763}, {0.254237}, {0.262712}, {0.271186}, {0.279661}, {0.288136},
{0.29661}, {0.305085}, {0.313559}, {0.322034}, {0.330508}, {0.338983}, {0.347458},
{0.355932}, {0.364407}, {0.372881}, {0.381356}, {0.389831}, {0.398305}, {0.40678},
{0.415254}, {0.423729}, {0.432203}, {0.440678}, {0.449153}, {0.457627}, {0.466102},
{0.474576}, {0.483051}, {0.491525}, {0.5}, {0.508475}, {0.516949}, {0.525424},
{0.533898}, {0.542373}, {0.550847}, {0.559322}, {0.567797}, {0.576271}, {0.584746},
{0.59322}, {0.601695}, {0.610169}, {0.618644}, {0.627119}, {0.635593}, {0.644068},
{0.652542}, {0.661017}, {0.669492}, {0.677966}, {0.686441}, {0.694915}, {0.70339},
{0.711864}, {0.720339}, {0.728814}, {0.737288}, {0.745763}, {0.754237}, {0.762712},
{0.771186}, {0.779661}, {0.788136}, {0.79661}, {0.805085}, {0.813559}, {0.822034},
{0.830508}, {0.838983}, {0.847458}, {0.855932}, {0.864407}, {0.872881}, {0.881356},
{0.889831}, {0.898305}, {0.90678}, {0.915254}, {0.923729}, {0.932203}, {0.940678},
{0.949153}, {0.957627}, {0.966102}, {0.974576}, {0.983051}, {0.991525}, {1.}]
```

```
Export["c:\\sdasd.txt", {Round[#[[1]]], #[[2]]} & /@ (XY * (Length[XY] - 1))]
```

c:\\sdasd.txt