```
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]
```

```
A [n_] := SparseArray[{{1, 1} → 2, (n + 1) {1, 1} → 2, {1, 2} → 1, {n + 1, n} → 1,
    {i_, j_} /; (i == j + 1 && i < n + 1 && i > 1) → 1, {i_, i_} /; (i < n + 1 && i > 1) → 4,
    {i_, j_} /; (i == j - 1 && i < n + 1 && i > 1) → 1}, (n + 1) {1, 1}];
A[5] // MatrixForm
B[n_] := SparseArray[
  {{1, 1} → -1, (n + 1) {1, 1} → 1, {1, 2} → 1, {i_, j_} /; (i == j + 1 && i > 1) → -1,
   {i_, j_} /; (i == j - 1 && i < n + 1 && i > 1) → 1}, (n + 1) {1, 1}]; B[5] // MatrixForm
```

$$\begin{pmatrix} 2 & 1 & 0 & 0 & 0 & 0 \\ 1 & 4 & 1 & 0 & 0 & 0 \\ 0 & 1 & 4 & 1 & 0 & 0 \\ 0 & 0 & 1 & 4 & 1 & 0 \\ 0 & 0 & 0 & 1 & 4 & 1 \\ 0 & 0 & 0 & 0 & 1 & 2 \end{pmatrix}$$

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

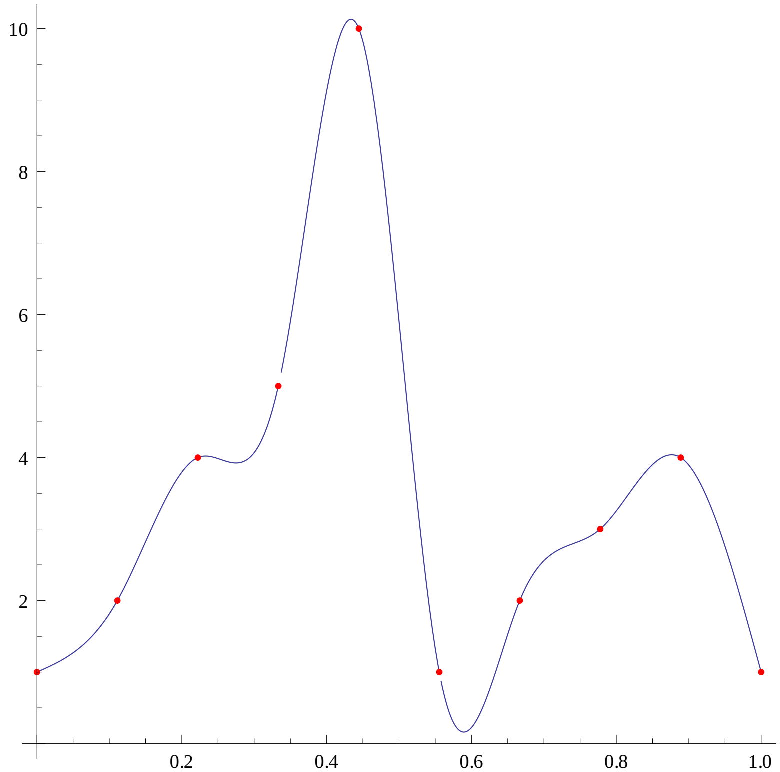
```
M[n_] := 3 n Inverse[A[n]].B[n];
```

los:

```
y = {1, 2, 4, 5, 10, 1, 2, 3, 4, 1}; m = M[Length[y] - 1].y; n = Length[y] - 1;
```

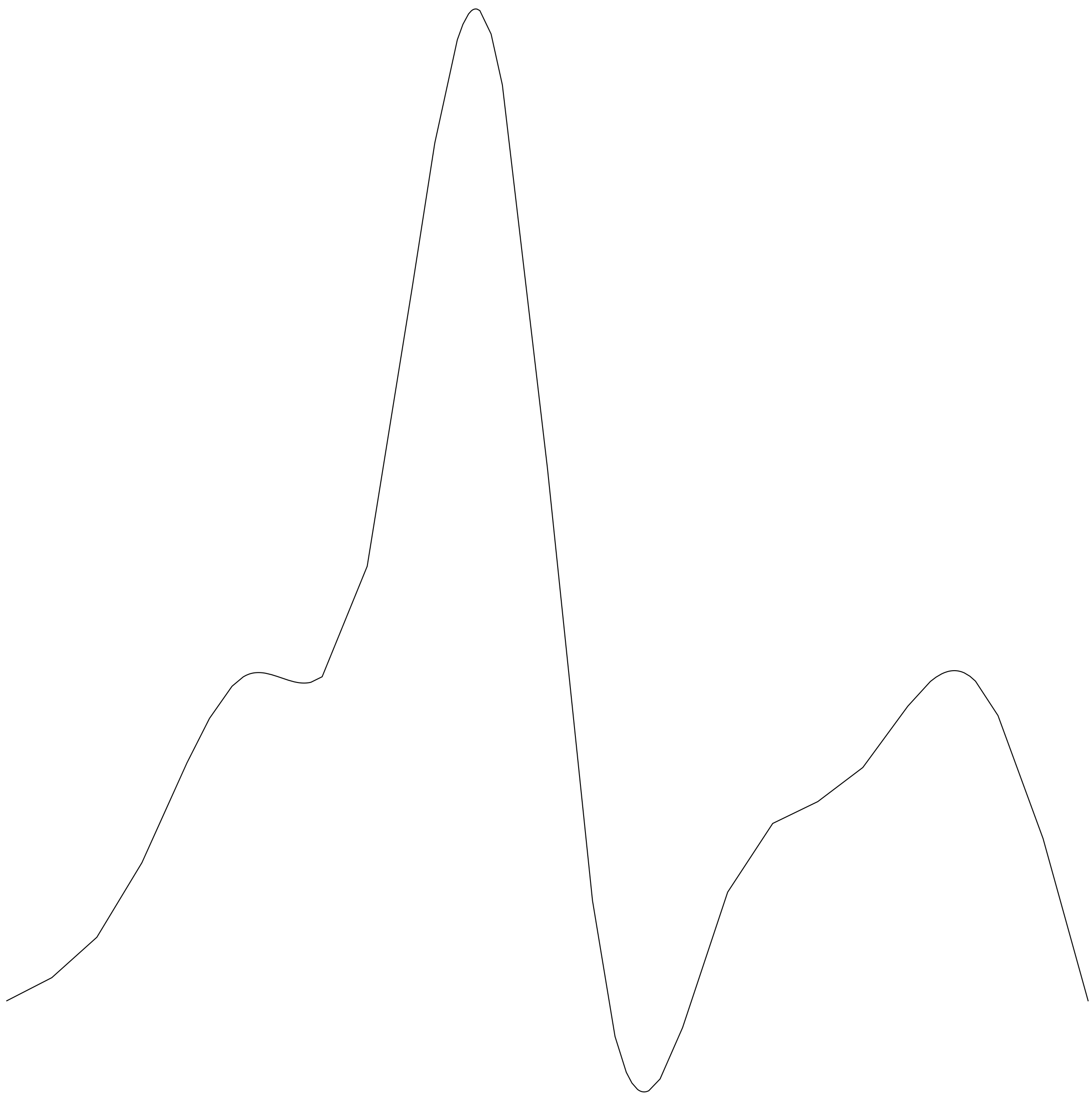
```
Y[x0_] := Module[{i, x = x0, y = y, m = m, c = c, n = n},
  i = Ceiling[x * n];
  x -= (i - 1) / n;
  {y[[i]], y[[i + 1]], m[[i]], m[[i + 1]]}.
   {1 - 3 n^2 x^2 + 2 n^3 x^3, 3 n^2 x^2 - 2 n^3 x^3, x - 2 n x^2 + n^2 x^3, -n x^2 + n^2 x^3}
 ]
```

```
Show[Plot[Y[x], {x, 0, 1}, AspectRatio → 1, PlotPoints → 250],
 ListPlot[Table[{i / (Length[y] - 1), y[[i + 1]]}, {i, 0, Length[y] - 1}], PlotStyle → Red]]
```




```
<< Splines`
```

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



```
ys =.
```

```
nN = 30; y = Table[ys[i], {i, nN}]; m = M[Length[y] - 1].y; n = Length[y] - 1
```

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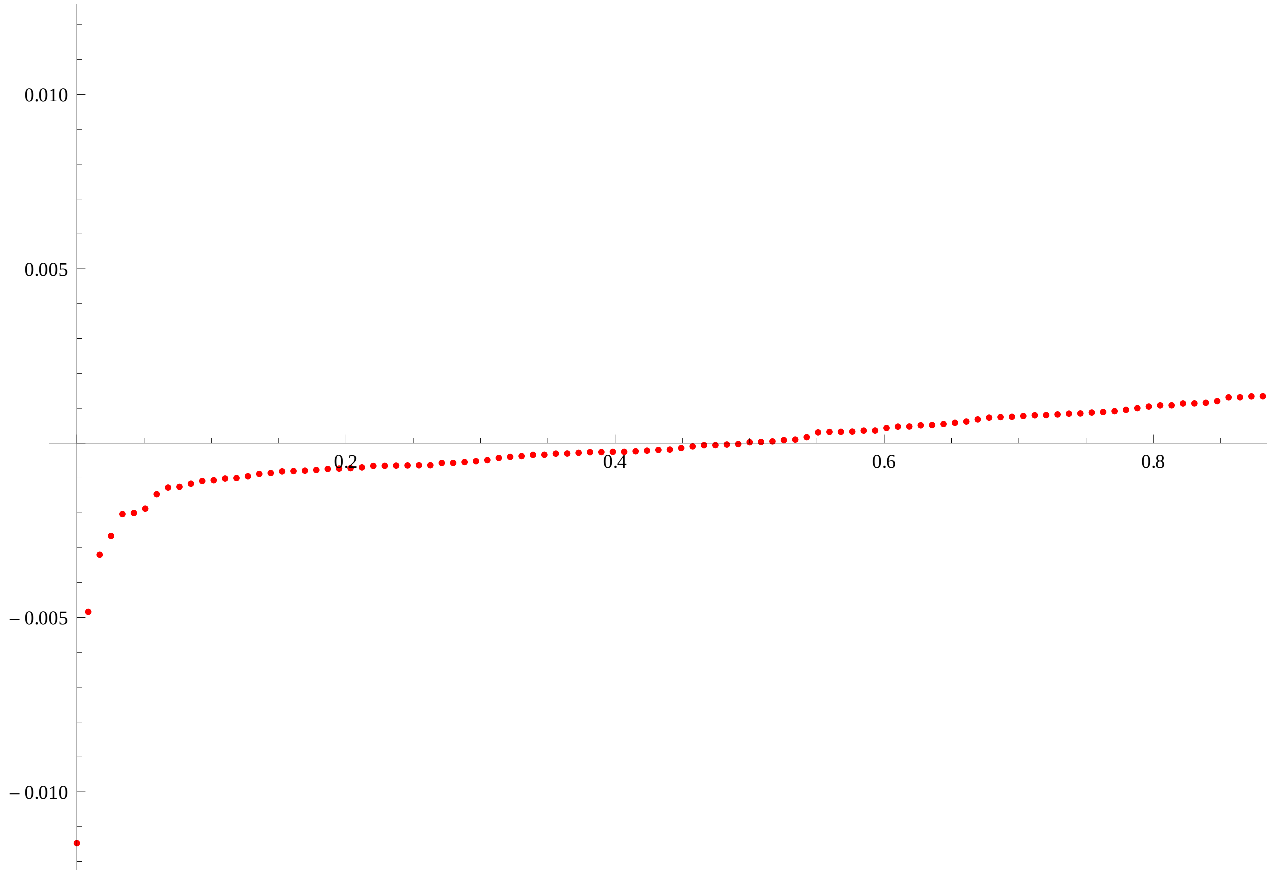
```
d = (Y[#[[1]]] - #[[2]]) ^ 2 & /@ XY; d = Sum[d[[i]], {i, Length[d]}];
g = Solve[Table[D[d, ys[i]] == 0, {i, nN}], y][[1]];
```

```
y = Table[ys[i], {i, nN}] /. g; m = M[Length[y] - 1].y; d /. g
Show[ListPlot[XY, PlotStyle → Red, PlotRange → All],
 Plot[Y[x], {x, 0, 1}, PlotRange → All]]
```

```
0.0000460665
```




```
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.}}
```