

```
In[1]:= (* Macierz dyskretnego laplasjanu na n-kacie *)  
n = 30;  
A = -IdentityMatrix[n];  
Do[A[[i, i + 1]] = 1 / 2; A[[i + 1, i]] = 1 / 2, {i, 1, n - 1}]  
A[[1, n]] = 1 / 2;  
A[[n, 1]] = 1 / 2;
```

```
In[5]:= MatrixForm[A]
```

Out[5]//MatrixForm=

-1	$\frac{1}{2}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$\frac{1}{2}$	-1	$\frac{1}{2}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	$\frac{1}{2}$	-1	$\frac{1}{2}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	$\frac{1}{2}$	-1	$\frac{1}{2}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	$\frac{1}{2}$	-1	$\frac{1}{2}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	$\frac{1}{2}$	-1	$\frac{1}{2}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	$\frac{1}{2}$	-1	$\frac{1}{2}$	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	$\frac{1}{2}$	-1	$\frac{1}{2}$	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	$\frac{1}{2}$	-1	$\frac{1}{2}$	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	$\frac{1}{2}$	-1	$\frac{1}{2}$	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	$\frac{1}{2}$	-1	$\frac{1}{2}$	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	$\frac{1}{2}$	-1	$\frac{1}{2}$	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	$\frac{1}{2}$	-1	$\frac{1}{2}$	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	$\frac{1}{2}$	-1	$\frac{1}{2}$	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	$\frac{1}{2}$	-1	$\frac{1}{2}$	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	$\frac{1}{2}$	-1	$\frac{1}{2}$	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$\frac{1}{2}$	-1	$\frac{1}{2}$	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$\frac{1}{2}$	-1	$\frac{1}{2}$	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$\frac{1}{2}$	-1	$\frac{1}{2}$	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$\frac{1}{2}$	-1	$\frac{1}{2}$
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$\frac{1}{2}$
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
$\frac{1}{2}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

```
In[7]:= (* lista wektorow wlasnych (numerycznie) *)  
alpha = Reverse[N[Eigenvalues[A]]];
```

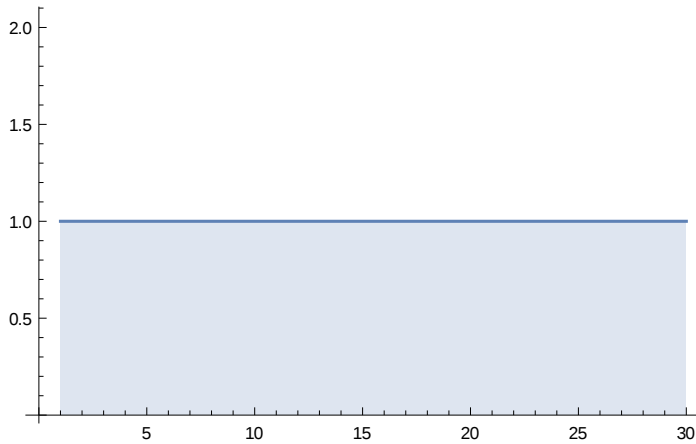
```
In[8]:= (* lista wartosci wlasnych *)
lambda = Reverse[N[Eigenvalues[A]]]
```

```
Out[8]:= {0., -0.0218524, -0.0218524, -0.0864545, -0.0864545, -0.190983, -0.190983,
-0.330869, -0.330869, -0.5, -0.5, -0.690983, -0.690983, -0.895472,
-0.895472, -1.10453, -1.10453, -1.30902, -1.30902, -1.5, -1.5, -1.66913,
-1.66913, -1.80902, -1.80902, -1.91355, -1.91355, -1.97815, -1.97815, -2.}
```

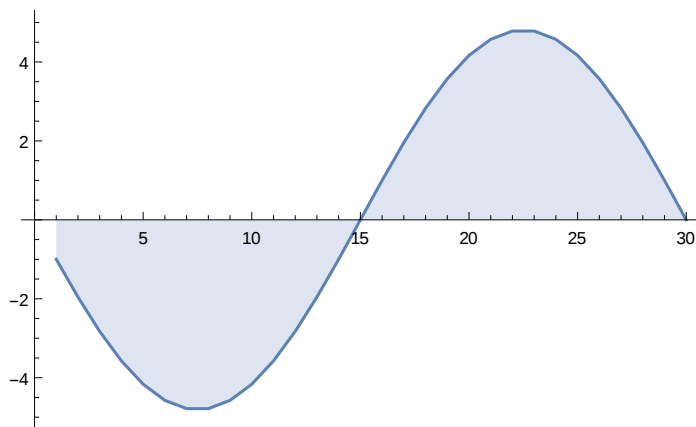
```
In[9]:= (* "wykresy" *)
```

```
Do[Print["wartosc wlasna = ", lambda[[k]]];
Print[ListLinePlot[Table[{i, alpha[[k, i]]}, {i, 1, n}], Filling -> Axis]], {k, 1, n}]
```

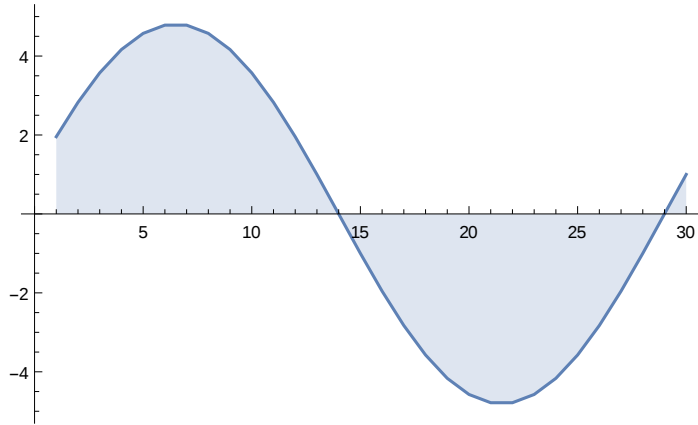
```
wartosc wlasna = 0.
```



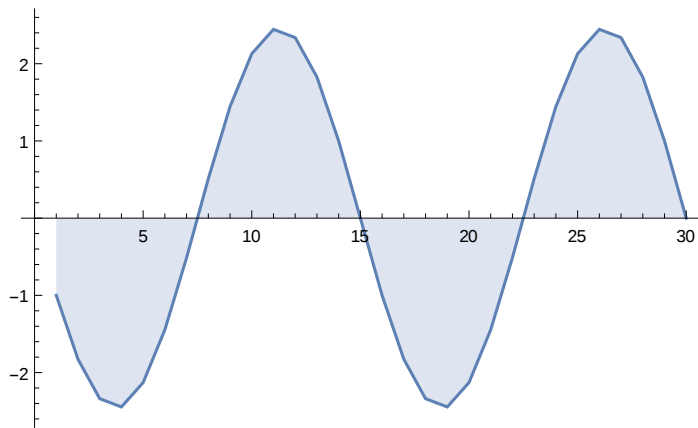
```
wartosc wlasna = -0.0218524
```



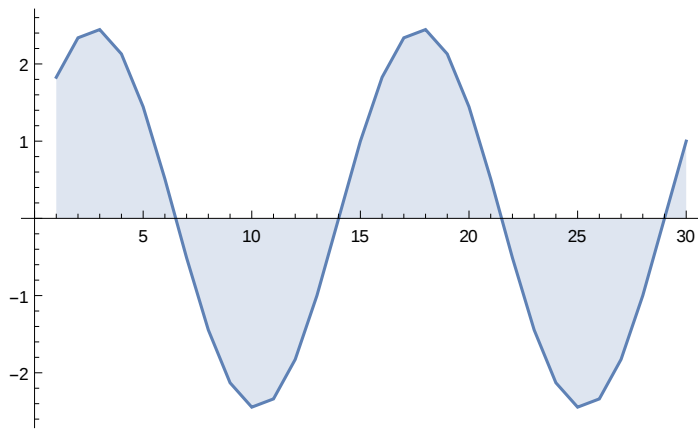
```
wartosc wlasna = -0.0218524
```



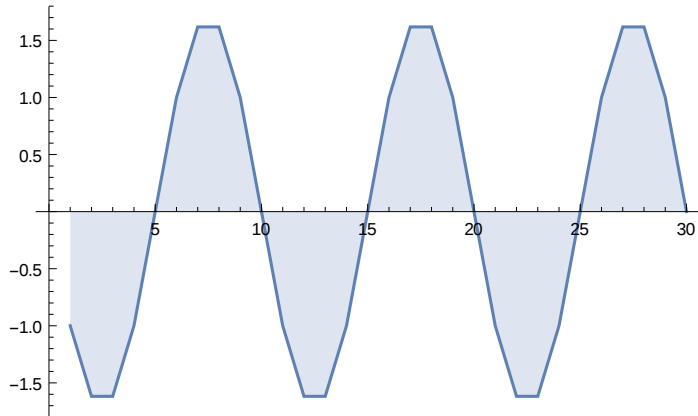
wartosc wlasna = -0.0864545



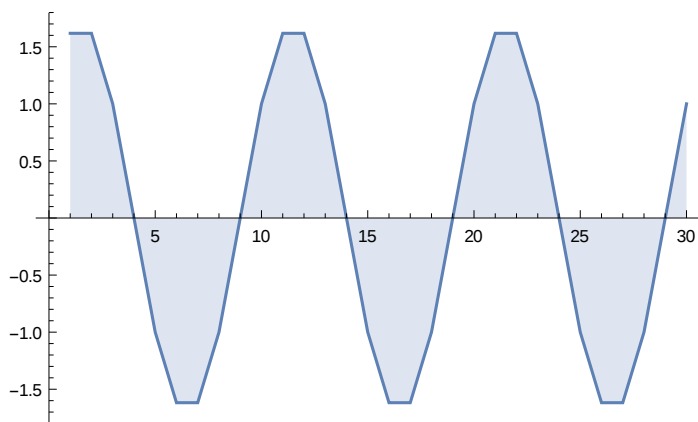
wartosc wlasna = -0.0864545



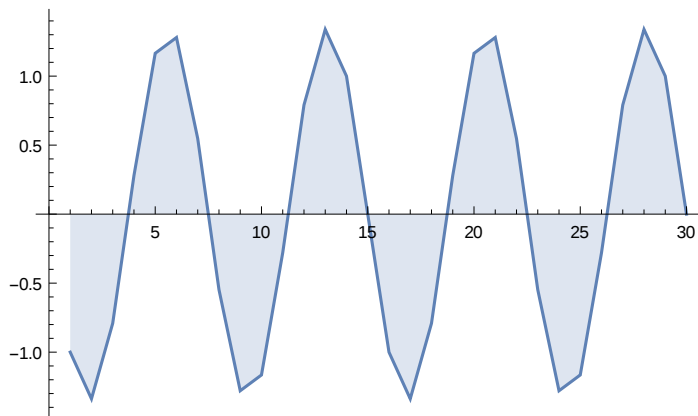
wartosc wlasna = -0.190983



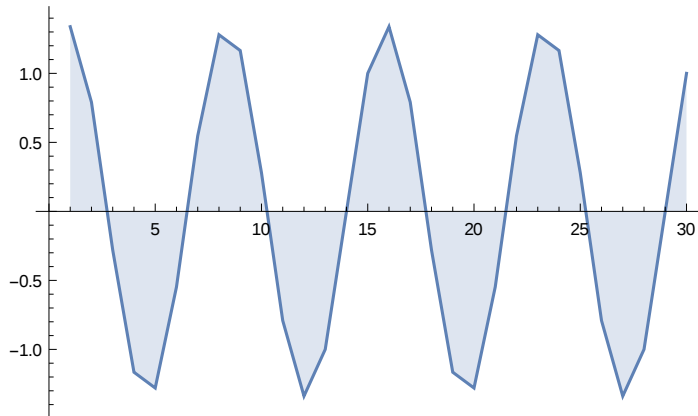
wartosc wlasna = -0.190983



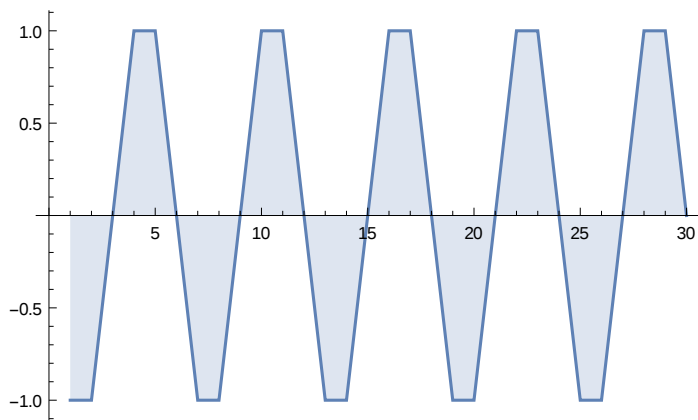
wartosc wlasna = -0.330869



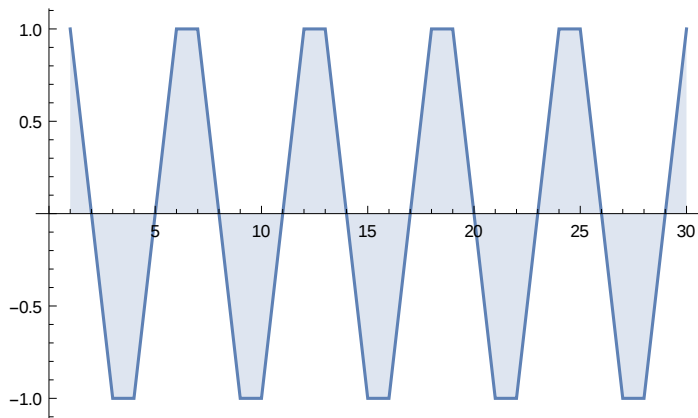
wartosc wlasna = -0.330869



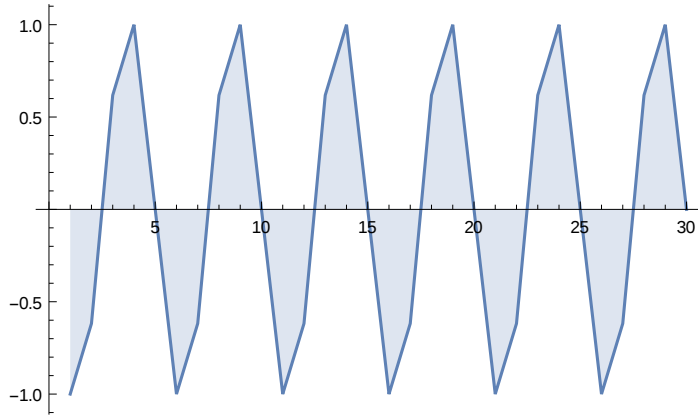
wartosc wlasna = -0.5



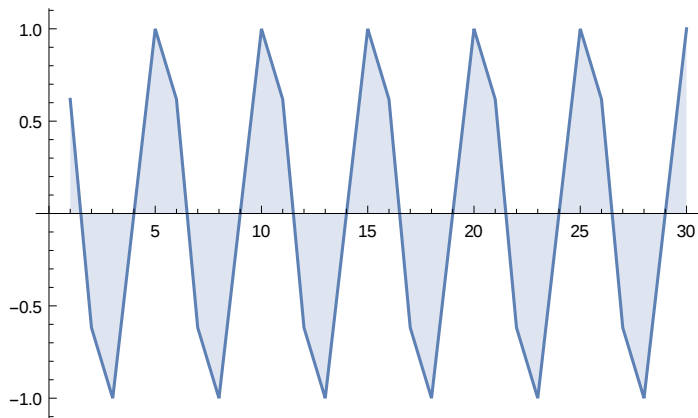
wartosc wlasna = -0.5



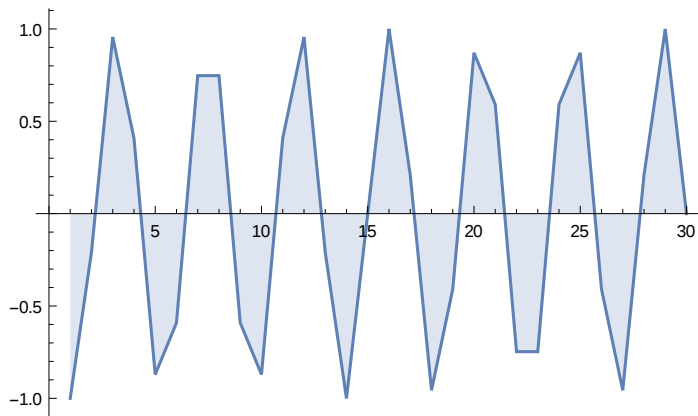
wartosc wlasna = -0.690983



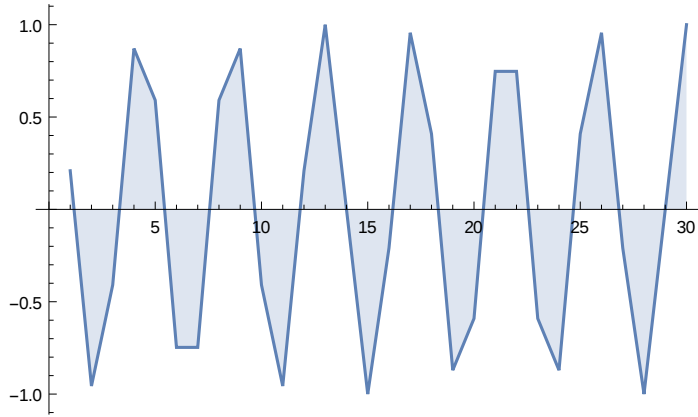
wartosc wlasna = -0.690983



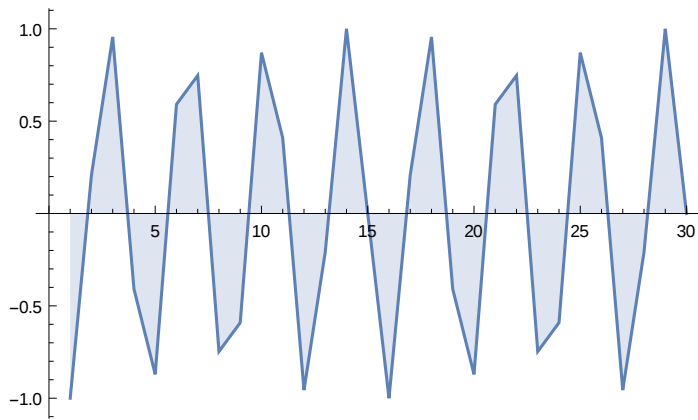
wartosc wlasna = -0.895472



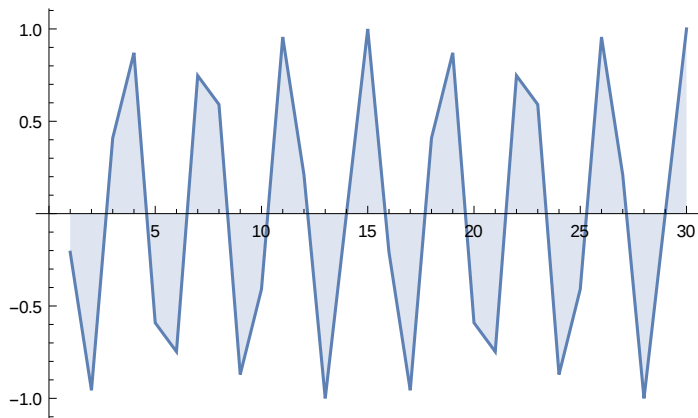
wartosc wlasna = -0.895472



wartosc wlasna = -1.10453

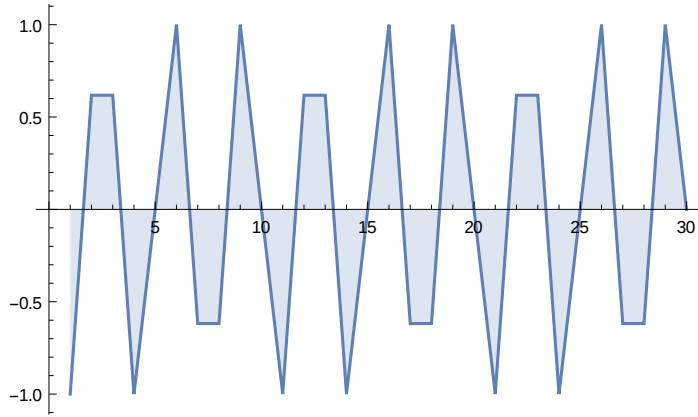


wartosc wlasna = -1.10453

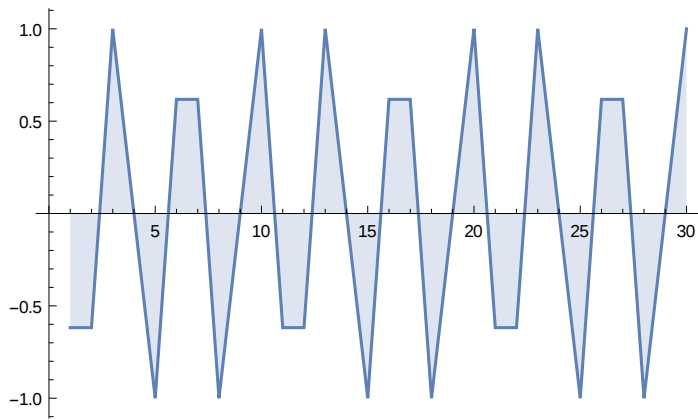


wartosc wlasna = -1.30902

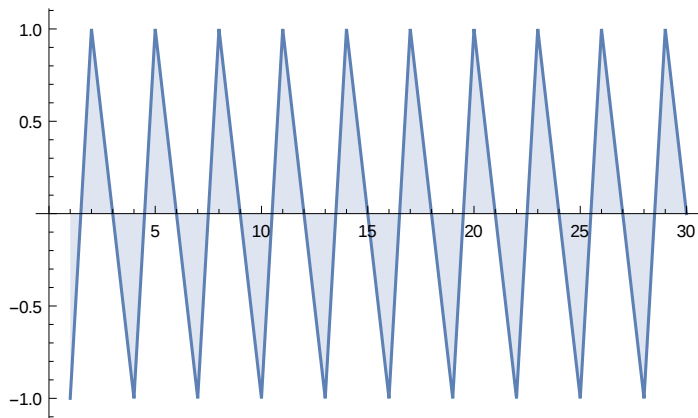




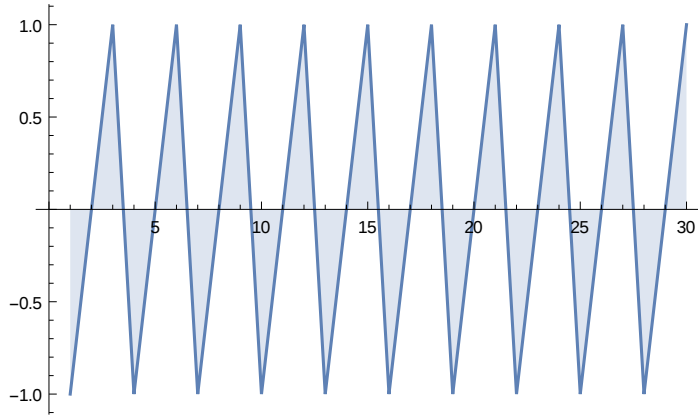
wartosc wlasna = -1.30902



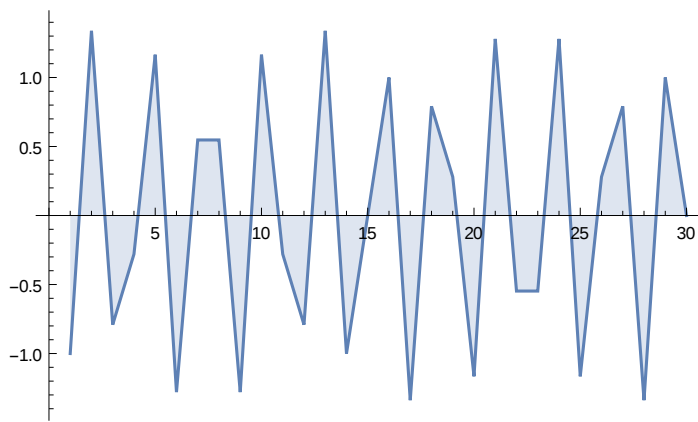
wartosc wlasna = -1.5



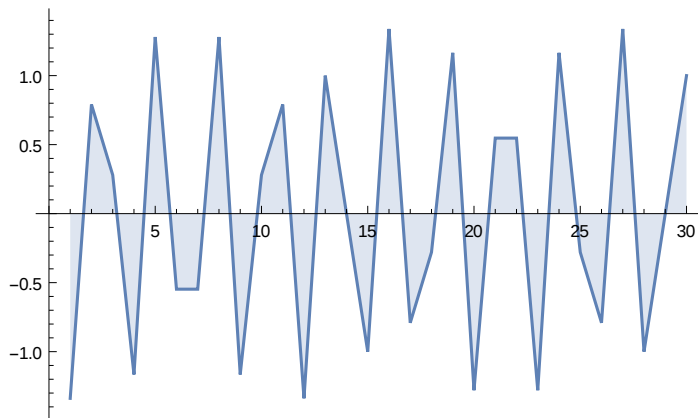
wartosc wlasna = -1.5



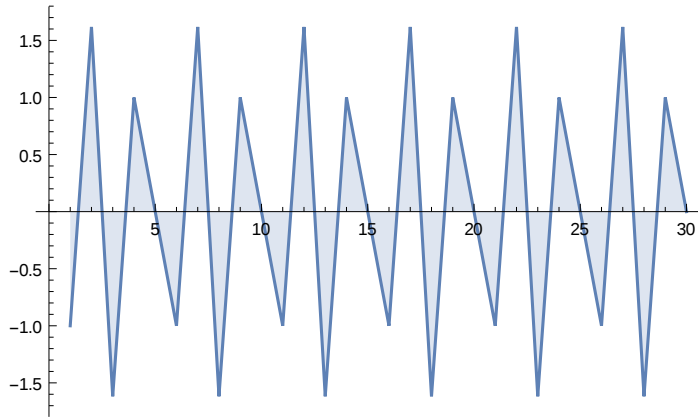
wartosc wlasna = -1.66913



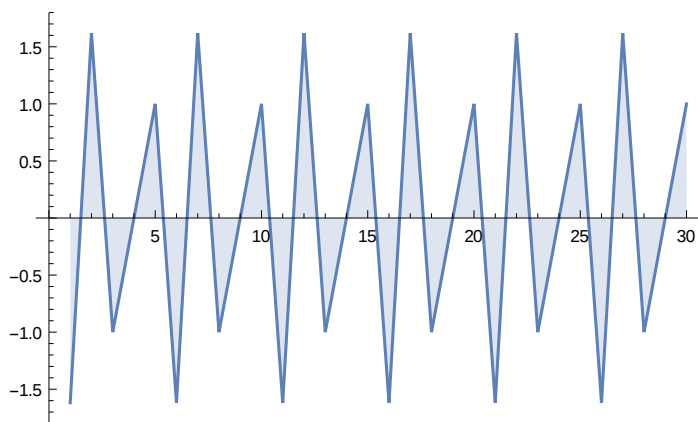
wartosc wlasna = -1.66913



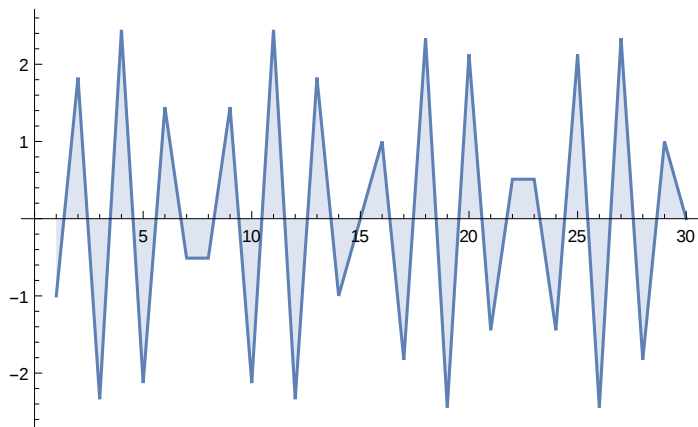
wartosc wlasna = -1.80902



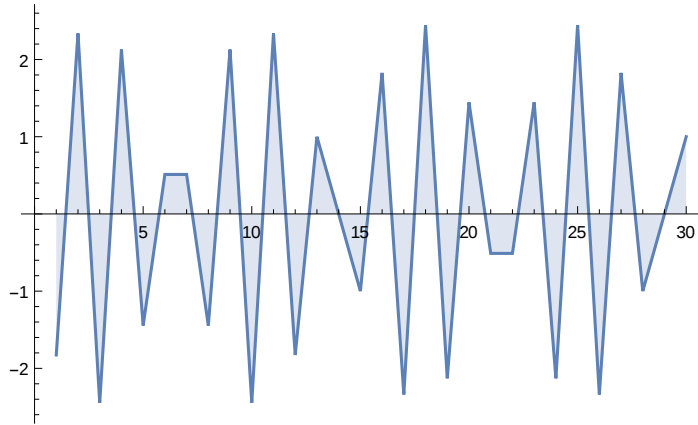
wartosc wlasna = -1.80902



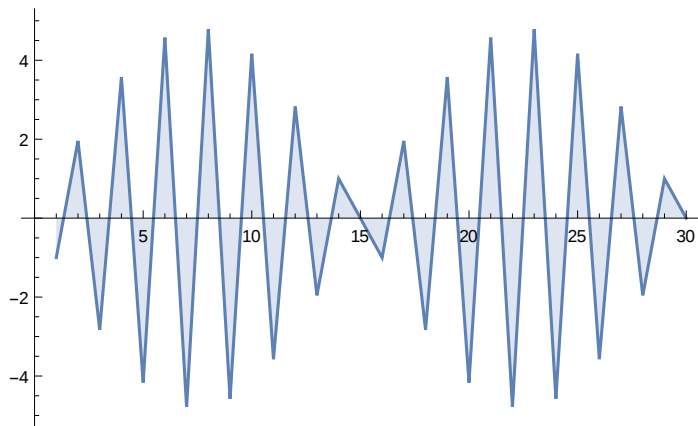
wartosc wlasna = -1.91355



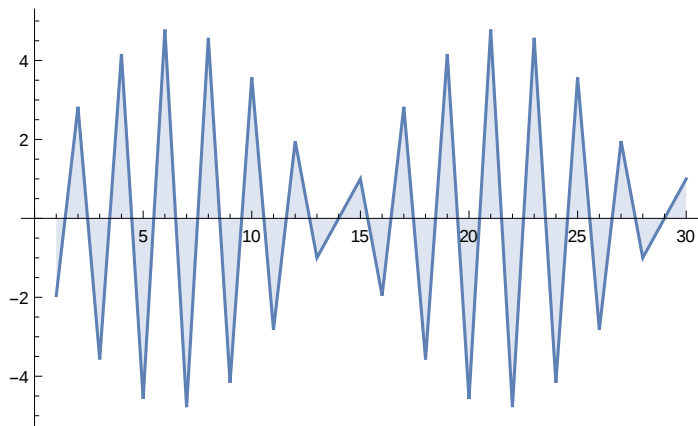
wartosc wlasna = -1.91355



wartosc wlasna = -1.97815



wartosc wlasna = -1.97815



wartosc wlasna = -2.

