

Fourier Cosine Series

Kurt Bryan and SIMIODE

A Mathematica notebook to compute the first few terms of the Fourier cosine expansion of a function $f(x)$ defined on an interval $0 \leq x \leq L$.

Define the interval and the function

```
In[5]:= L = 2  
f[x_] = x - x^2/3
```

Choose the number "n" of Fourier cosine coefficients to compute and set up an array "a" to hold coefficients

```
In[30]:= n = 5  
a = Table[(2/L)*Integrate[f[x]*Cos[k*Pi*x/L], {x, 0, L}], {k, 0, n}]
```

Form the Fourier cosine approximation. Note $a[[k+1]]$ is the coefficient of $\cos(k\pi x/L)$.

```
In[39]:= fcos = a[[1]]/2 + Sum[a[[k+1]]*Cos[k*Pi*x/L], {k, 1, n}]
```

Plot both $f(x)$ and the cosine approximation

```
In[40]:= plt1 = Plot[f[x], {x, 0, L}, PlotStyle -> {Red}];  
In[41]:= plt2 = Plot[fcos, {x, 0, L}, PlotStyle -> {Blue}];  
Show[plt1, plt2, AxesLabel -> {"x", " "}]
```