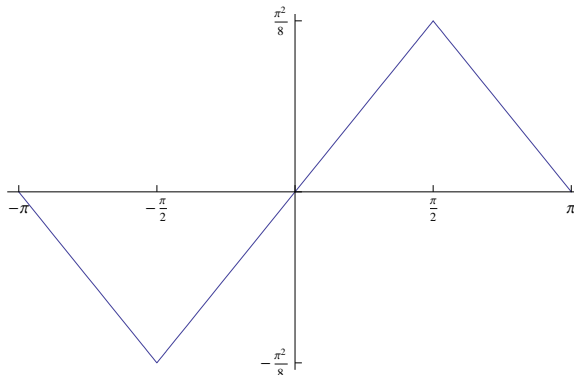### Approximating a function with a series of sines

Use *Mathematica* (or something equivalent) to do the following.

1. Plot the function $f(x)$ shown below.



2. Use `Manipulate` to build a plot showing both $f(x)$ and $a_1 \sin(x)$ with $a_1$ as the manipulation variable. Experiment to find the value of $a_1$ for which $a_1 \sin(x)$ best approximates $f(x)$.

   $a_1 =$

3. Use `Manipulate` to build a plot showing both $f(x)$ and $a_1 \sin(x) + a_2 \sin(2x)$ with $a_1$ fixed at the optimal value you found in Part 2 and $a_2$ as the manipulation variable. Experiment to find the value of $a_2$ for which $a_1 \sin(x) + a_2 \sin(2x)$ best approximates $f(x)$.

   $a_2 =$

4. Extend this idea to get values for $a_k$ for as many values of $k$ as you have time.

   $a_3 =$

   $a_4 =$

   $a_5 =$

   $a_6 =$

   $a_7 =$

5. In making your choices above, you had in mind some criterion for "best approximates". Write a description of that criterion. Then, try to come up with one or two other reasonable criteria for "best approximates".