Assignment 1

Q1

Given a function $f(x)$ defined in an interval $x \in \{x_1, x_2\}, 0 < L = x_2 - x_1$, its Fourier series representation is given by

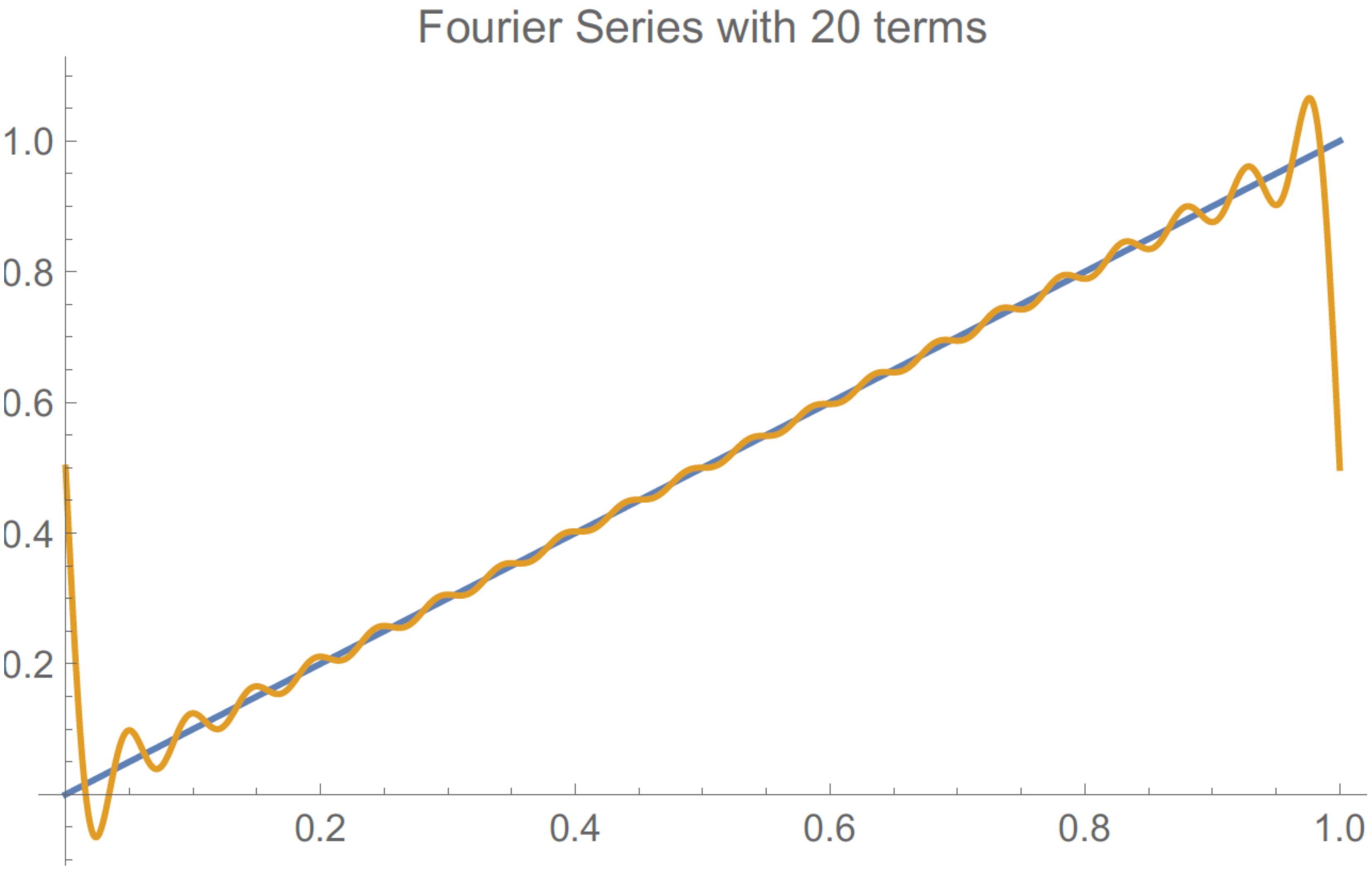
$$a_0 + \sum_{k=1}^{n} a_k \cos \frac{2\pi kx}{L} + b_k \sin \frac{2\pi kx}{L} x$$

Consider the function $f(x) = mx$, where m is the slope of the function, defined for $x \in \{0, L\}, L > 0$. The Fourier coefficients are given by

$$a_0 = \frac{mL}{2}, a_k = 0, b_k = -\frac{mL}{k\pi}$$

Plot the Fourier series with $n = 20$ terms, and overlap it with the function $f(x)$ on the same plot. The output should looks like Fig. 1 in the following page. Assume $L = m = 1$.

Fig. 1



Q2.

- Consider the triangular function as defined as in Fig.2.

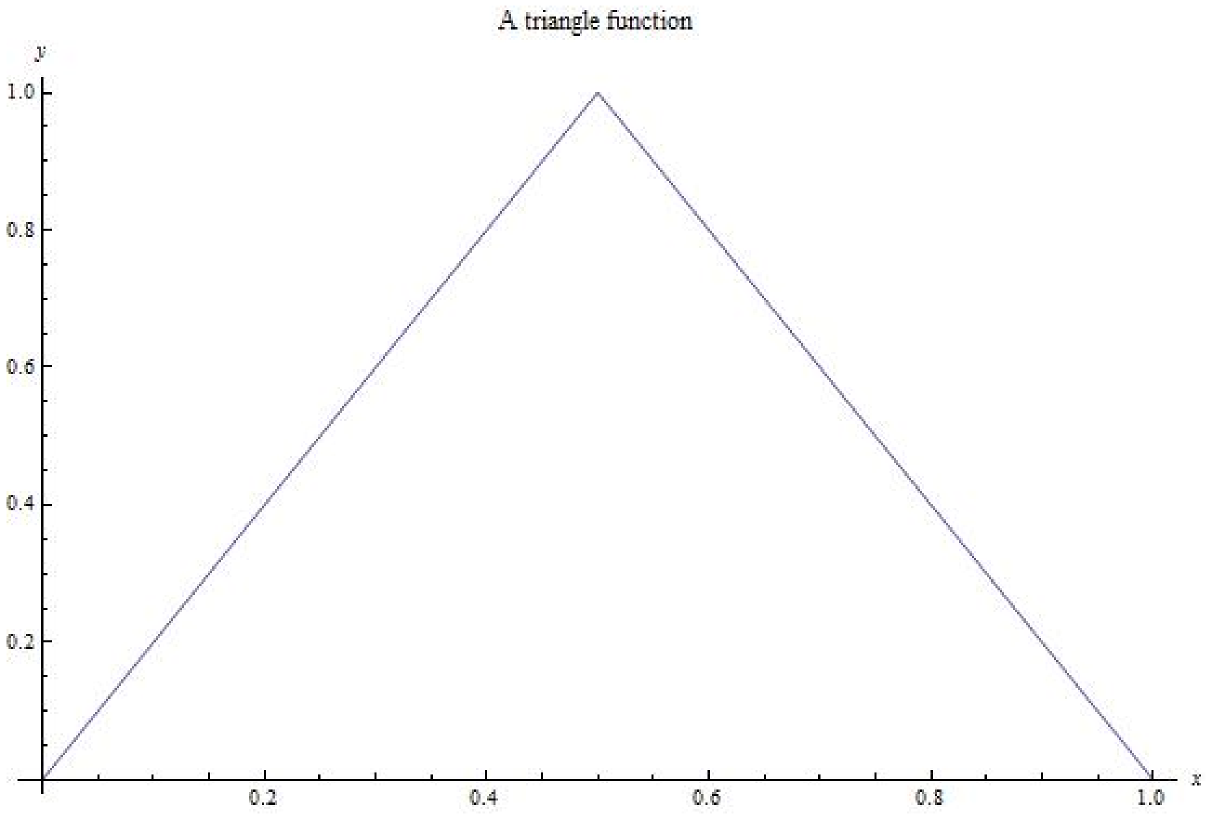


Fig.2

- Find out the Fourier series coefficients for this function, i.e., a_0, a_k and b_k.
- Generate the Fourier series for the triangular function using Mathematica.
- Plot the Fourier series (using only *n*=5 terms, along with the triangular function, on the same plot.
- Your code should be robust enough to allow user to control the number of terms in the Fourier series defined. Your plot should look something like Fig.3.

Fig. 3. Fourier series representation of the triangular function using only 5 terms.