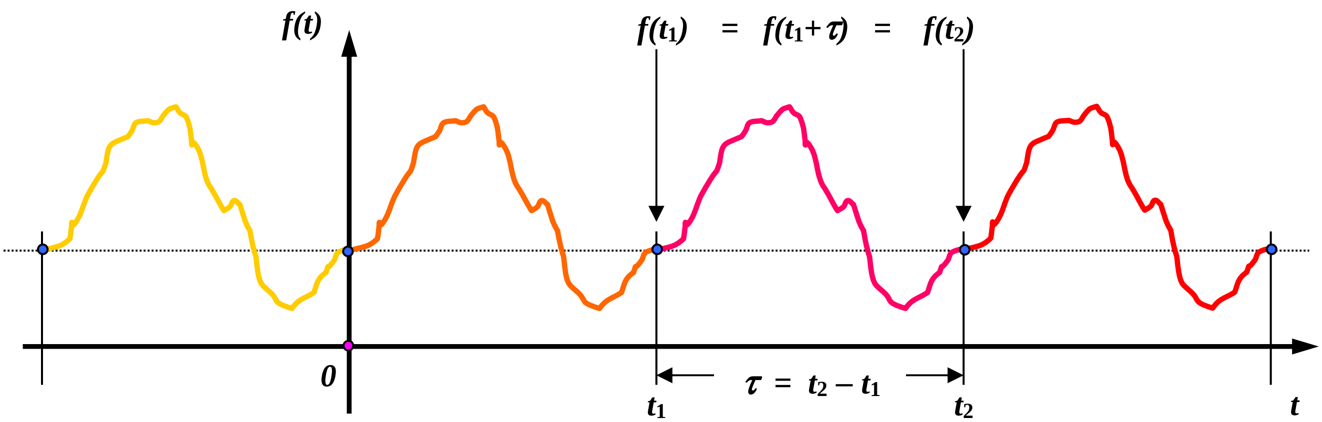
Note that we can also write the Fourier series expansion of *f(x)* in the time-domain, simply by changing the variable $x \to t$ and changing the spatial period, L to the temporal (i.e. time) period, τ, i.e. $L \to \tau$. Then since the frequency, $f = 1/\tau$, and $\omega = 2\pi f$, also with the relation $\omega / k = v$, we have:

$$f(t) = \frac{a_0}{2} + \sum_{n=1}^{n=\infty} a_n \cos\left(\tfrac{2\pi n t}{\tau}\right) + \sum_{n=1}^{n=\infty} b_n \sin\left(\tfrac{2\pi n t}{\tau}\right)$$

$$f(t) = \frac{a_0}{2} + \sum_{n=1}^{n=\infty} a_n \cos(2\pi n f t) + \sum_{n=1}^{n=\infty} b_n \sin(2\pi n f t)$$

$$f(t) = \frac{a_0}{2} + \sum_{n=1}^{n=\infty} a_n \cos(n\omega t) + \sum_{n=1}^{n=\infty} b_n \sin(n\omega t)$$

In the time-domain, the corresponding figure for the periodic temporal function, *f(t)* is:



Note further that since the *sine* and *cosine* functions, *sin (x)* and *cos (x)*, respectively, are linear combinations of powers of *x*,(i.e. their Taylor series expansions), then together with 1, they encompass ***all*** powers of *x*. Since the x^n form a complete set of basis vectors for the function "*space*" associated with the interval $x_1 \le x \le x_2$, then 1, and the Taylor series expansions for *sin(x)* and *cos(x)* also form a complete set of basis vectors for the function "*space*" associated with the interval $x_1 \le x \le x_2$. This is the reason that any mathematically well-behaved, periodic function, *f(x)* can be precisely replicated by an appropriate linear combination of 1, *sin(nkx)* and *cos(nkx)* - i.e. a Fourier series expansion, as defined above.