Math Methods (PHYS 320):13

Spring 2019

Reading: Boas on Fourier Series: Chapter 7 sections 1 - 3, 5 and 7 (Boas covers this in detail, more than we will in 320.)

(1) Boas pg 355 number 5

(2) Let's use the basis functions

$$\langle x \mid n \rangle = \frac{1}{\sqrt{\pi}} \cos(nx)$$

on $-\pi < x < \pi$. (n is an integer.) The inner product is

$$\langle u \mid v \rangle = \int_{-\pi}^{\pi} u^*(x) v(x) dx$$

so the weighting function is 1 and all these functions are real. Suppose you have a ket $\mid v\rangle$ which is the function

$$\langle x \mid v \rangle = 2 \cos x + \cos(2x).$$

(a) Find $\langle 1 \mid v \rangle$.
(b) Find $\langle n \mid v \rangle$ for any n.
Feel free to solve this by inspection.

(3) A very handy feature of Mathematica is the command BesselJZero, useful for instance on finding the modes of a circular drum head as Spencer mentioned.
(a) Plot $J_1(x)$ from 0 to 12.
(b) Find the first 4 zeros of $J_1(x)$. (Using N[BesselJZero ...] will give a numerical evaluation.)