Assignment 1 SIO203B/MAE294B, 2025

Due by mid-night Wednesday April 9th
Submit by email to `wryoung@ucsd.edu`
with subject line `First asymptotolgy assignment`

Mermin's rant

As preparation for writing this assignment – and your thesis – read Mermin's rant (it's the Canvas module "Latex template"). Implement Mermin's advice in this assignment.

Back to high school

You can use the high school formula to exactly solve the quadratic equation

$$x^2 - \pi x + 2 = 0\,. \tag{1}$$

But if you replace π by the approximation 3 then you can solve the equation by inspection. Define ϵ by $\pi = 3 + \epsilon$ and use an regular perturbation series to solve (1) neglecting terms of order ϵ^3 and smaller. Assess the accuracy of this solution.

Keeping time

Read section **1.5 Example: Period of a pendulum** in the notes. You can use the result in equation (1.65) to solve this problem. A grandfather clock swings at a maximum angle $\theta_{\max} = 5^\circ$ to the vertical. How many seconds does the clock lose or gain each day if it is adjusted to keep perfect time when the swing is $\theta_{\max} = 2^\circ$?

There is another problem on the next page

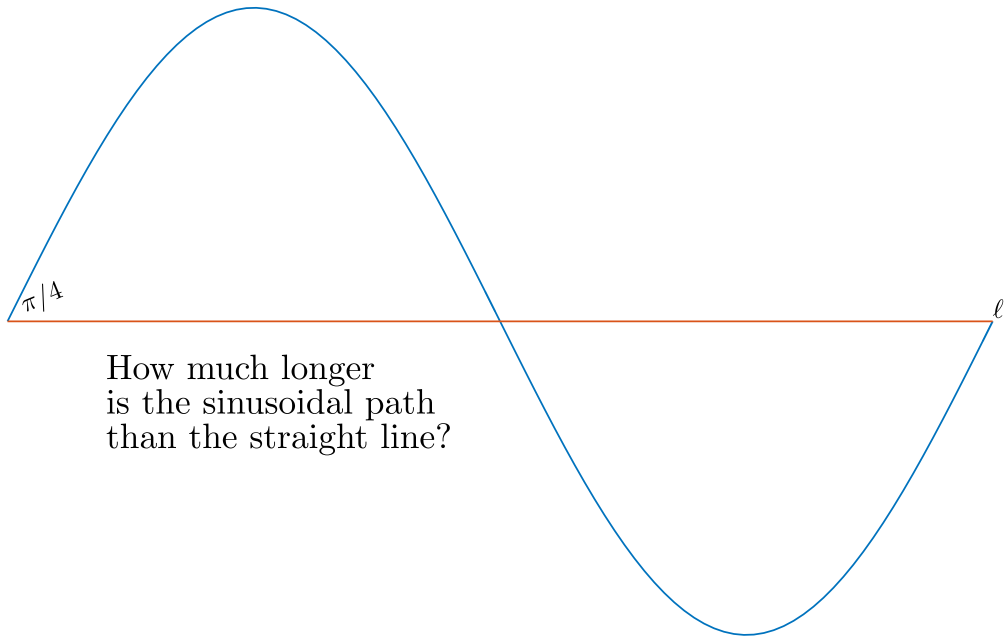

Figure 1: A tipsy walk.

Tipsy walk

The figure above shows the path followed by a tipsy sailor from a bar at the origin of the (x, y)-plane to home at $(x, y) = (\ell, 0)$. The path is a sinusoid leaving the bar at an angle α; in the figure 1 $\alpha = \pi/4$. How much longer is the sinusoidal path than the straight line? Answer this question by: *(i)* eyeballing the curve in figure 1 and guessing; *(ii)* constructing the integral that gives the arclength and evaluating it numerically with MATLAB; *(iii)* devising an approximation to the arc-length integral based on $\alpha \ll 1$, and then pressing your luck by using this approximation with $\alpha = \pi/4$.