

Homework 2

Problem 1:

Let $g(t) = t$ on $(0 \leq t \leq 1)$. Then $T = 1$, and $f = 1/T = 1$ Hz.

$$\text{Thus } a(n) = 2 \int_0^1 \sin(2\pi t) dt = -\frac{1}{\pi}$$

$$b(n) = 2 \int_0^1 \cos(2\pi t) dt = 0$$

$$c(n) = 2 \int_0^1 t dt = 1$$

Problem 3:

$$\text{Per Nyquist, max data rate} = 2(6 \times 10^6) \log_2(4) \text{ bps} = \mathbf{24 \text{ Mbps}}$$

Problem 4:

$$\text{Per Shannon, max data rate} = (3 \times 10^3) \log_2(1 + 100) \text{ bps} = \mathbf{20 \text{ Kbps}}$$

Problem 5:

The T1 carrier moves data at 1.544 Mbps. The line bandwidth is 50 KHz.

Per Shannon,

$$1.544 \times 10^6 = 50 \times 10^3 \log_2(1 + SN)$$

$$2e^{(1.544/50) \times 10^3} = 1 + SN$$

$$SN = \mathbf{93 \text{ dB}}$$