

1. In Boston, the number of hours of daylight $D(t)$ at a particular time of the year may be approximated by

$$D(t) = 3 \sin\left(\frac{2\pi}{365}(t - 79)\right) + 12,$$

with t in days and $t = 0$ corresponding to January 1.

- (a) What is the maximum number of hours of daylight Boston receives during the year?
- (b) What is the minimum number of hours of daylight Boston receives during the year?
- (c) What is the average number of hours of daylight Boston receives during the year?
- (d) Sketch the graph of $D(t)$. You may use your calculator to assist you, but the graph you sketch here should make clear the amplitude, balance value, and period of $D(t)$.
- (e) How many days of the year have more than 10.5 hours of daylight?

2. When an earthquake occurs along a fault line, *slip* is the relative displacement of formerly adjacent points on opposite sides of a fault, measured along the fault line. After the 1906 San Francisco earthquake, the slip $S(d)$ in meters of a point d kilometers from the earthquake's fault line could be approximated by

$$S(d) = 2 \left(1 - \frac{2}{\pi} \tan^{-1} \left(\frac{d}{3.5} \right) \right).$$

- (a) Estimate the slip of a point 1 kilometer from the earthquake's fault line.
- (b) According to this model, how far did a point on the earthquake's fault line slip?
- (c) If it is determined that a point slipped approximately 0.92 meters during the earthquake, approximately how far from the earthquake's fault line was the point?
- (d) Find $\lim_{d \rightarrow \infty} S(d)$ and interpret your answer in words.
3. Stonehenge in Salisbury Plains, England, was constructed using solid stone blocks weighing over 99,000 pounds each. Lifting a single stone required 550 people, who pulled the stone up a ramp inclined at an angle of 9° . Approximate the distance that a stone was moved in order to raise it to a height of 30 feet.