2.1.2 Use data to estimate patients heart rate in beats/min with the given values of t

(a) $t = 36, t = 42$

Let $h(t) =$ # of heart beats after t minutes

$$\frac{\Delta h}{\Delta t} = \frac{h(42) - h(36)}{42 - 36} = \frac{2948 - 2530}{6} = \frac{418}{6} = 69.67 \text{ beats/min}$$

(b) $t = 38, t = 42$

$$\frac{\Delta h}{\Delta t} = \frac{h(42) - h(38)}{42 - 38} = \frac{2948 - 2661}{42 - 38} = \frac{287}{4} = 71.71 \text{ beats/min}$$

2.1.5 A ball thrown with velocity of 40 ft/sec has height t seconds after thrown of $y = 40t - 16t^2$ (ft).

(a) Find average velocity for time period beginning at $t = 2$ sec and lasting

(i) .5 sec.

$$\frac{\Delta y}{\Delta t} = \frac{y(2.5) - y(2)}{.5} = \frac{0 - (16)}{.5} = -32 \text{ ft/sec}$$

(ii) .1 sec

$$\frac{\Delta y}{\Delta t} = \frac{y(2.1) - y(2)}{.1} = \frac{13.44 - 16}{.1} = -25.6 \text{ ft/sec}$$

(iii) .05 sec

$$\frac{\Delta y}{\Delta t} = \frac{y(2.05) - y(2)}{.05} = \frac{14.76 - 16}{.05} = -24.8 \text{ ft/sec}$$

(iv) .01 sec

$$\frac{\Delta y}{\Delta t} = \frac{y(2.01) - y(2)}{.01} = \frac{15.7584 - 16}{.01} \approx -24.2 \text{ ft/sec}$$

[(v) .001 sec

$$\frac{\Delta y}{\Delta t} = \frac{y(2.001) - y(2)}{.001} = \frac{15.975984 - 16}{.001} \approx -24.02 \text{ ft/sec}$$

(b) As we use smaller time increments (.0001, .00001, ...) it appear the average velocity is stabilizing to -24 ft/sec.

2.1.8 Displacement given by $s = 2\sin(\pi t) + 3\cos(\pi t)$

(a) Find average velocity on given intervals

(i) $[1,2]$ $\quad \frac{s(2)-s(1)}{2-1} = \frac{3-(-3)}{1} = 6$

(ii) $[1,1.1]$ $\quad \frac{s(1.1)-s(1)}{1.1-1} = \frac{-3.47-(-3)}{.1} = -4.712$

(iii) $[1,1.01]$ $\quad \frac{-3.061-(-3)}{.01} = -6.134$

(iv) $[1,1.001]$ $\quad \frac{-3.006-(-3)}{.001} = -6.268$

(b) Given our calculations so far, the best estimate for instantaneous velocity is ≈ -6 cm/s. If we take even smaller intervals, it stabilizes to $\approx -2\pi$.