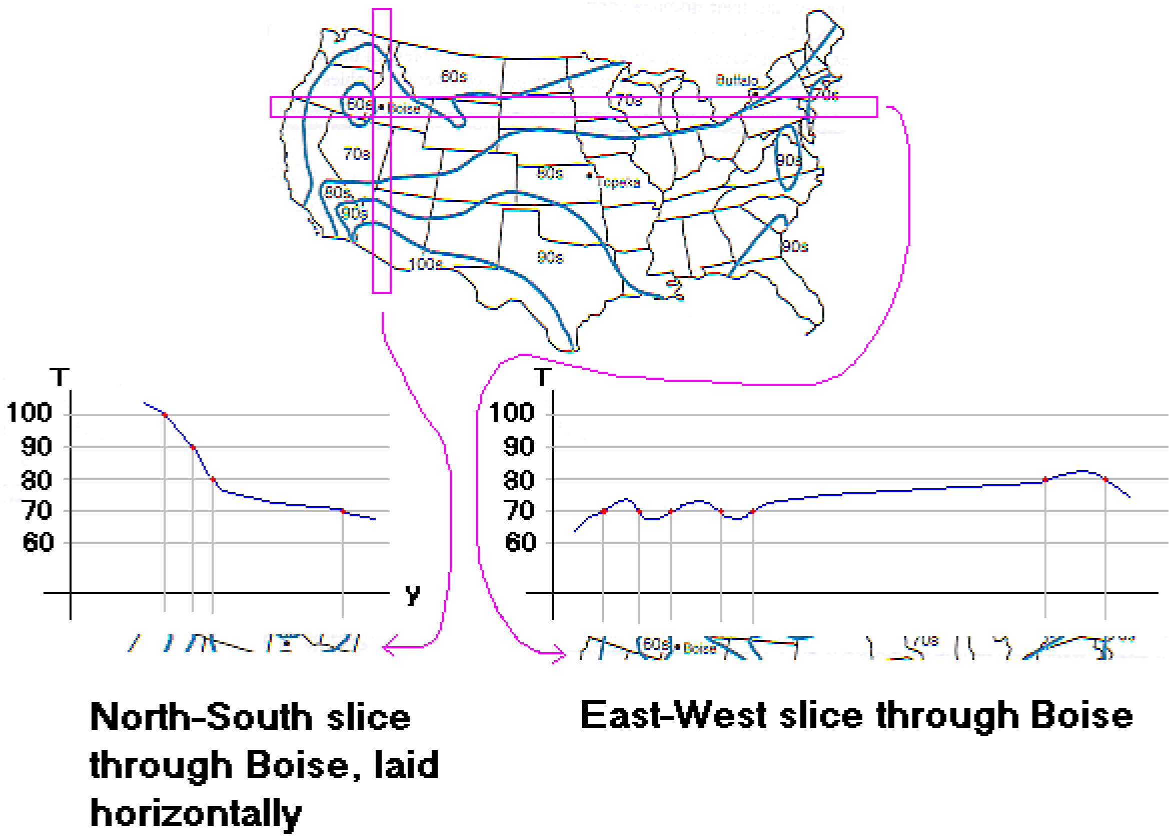
Problems 11.1, Page 7

3. We take slices of the map in a north-south line and in an east-west line through Boise, lay them along the horizontal axes, and every time the line through Boise crosses an isotherm, we mark that point on the graph in red, because we know the temperature exactly at that point. Then we sketch a curve connecting the red points.



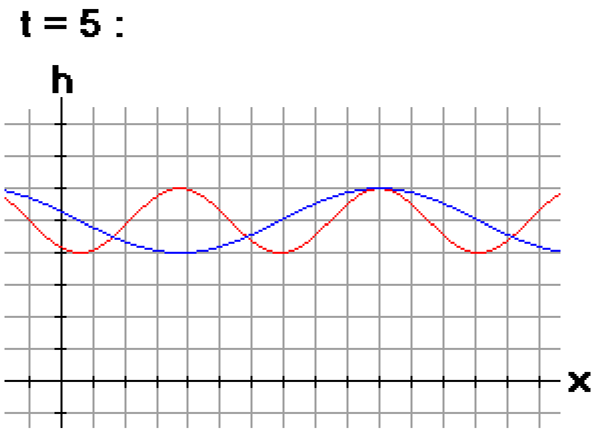
4. By Table 11.1 on page 3, when the price of beef is \$3.50/lb, a household with an income of 20 (thousand dollars), for example, will buy 2.59 lbs, so they will spend $\$3.5(2.59) = \$9.065$ for it. Computing similar products throughout the table gives the values for M (dollars/household/week):

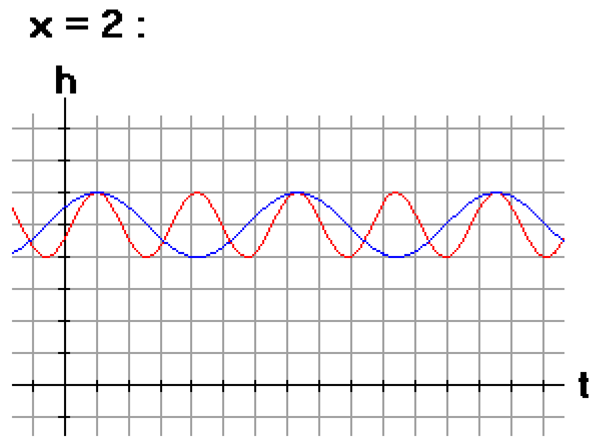
Household income per year, I (\$1000)	Price of beef, p (\$/lb)			
M	3.00	3.50	4.00	4.50
20	7.95	9.065	10.04	10.935
40	12.42	14.175	15.76	17.46
60	15.33	17.5	19.88	21.78
80	16.05	18.515	20.76	22.815
100	17.37	20.195	22.4	24.885

6. With the price of beef held constant, i.e., looking at each particular column of Table 11.1, we see that beef consumption increases with household income.

12. (a) Like $-31°$ F. (b) 10 mph. (c) About 6 mph. (d) About 23° F.

15. Adding to the graphs in Figures 11.2 and 11.3 the curves (in red) for the new height function,





we see that the standing fans are twice as dense in the new wave as in the old (at least at the instant $t = 5$), and that the fans stand and sit in half the time with the new compared with the old (at least the fan in seat number 2 does). So the new wave is apparently traveling twice as fast as the old.

But the speed of the wave in seats per second is computed by looking at the crests. If we consider the seat number x where the crest appears at time t, then because the crest corresponds to an h-value of 6, we get an equation relating x and t: $6 = 5 + \cos(x - 2t)$, or equivalently, with some algebra, $x = 2t + 2\pi k$ for any integer k. Thus, in a plane with t on the horizontal axis and x on the vertical, the graph is a set of lines, all with slope 2, and $dx/dt = 2$ seats/sec on any one of them. In other words, the wave is traveling the same speed as the one in Example 4.