12. [10 points] Again suppose that \( C = h(T) \) is the daily cost, in dollars, to heat a certain house if the average outside temperature that day is \( T \) degrees Fahrenheit (°F). Some values of \( h(T) \) and its derivative \( h'(T) \) are given in the table below.

<table>
<thead>
<tr>
<th>( T )</th>
<th>5</th>
<th>8</th>
<th>18</th>
<th>30</th>
<th>55</th>
</tr>
</thead>
<tbody>
<tr>
<td>( h(T) )</td>
<td>8</td>
<td>7.2</td>
<td>5</td>
<td>3.3</td>
<td>1.4</td>
</tr>
<tr>
<td>( h'(T) )</td>
<td>0.3</td>
<td>0.25</td>
<td>0.2</td>
<td>0.11</td>
<td>0.05</td>
</tr>
</tbody>
</table>

The function \( h(T) \) is invertible and differentiable. Also, \( h''(T) \) exists and is positive for all \( T \).

a. [2 points] Find the linear approximation \( L(T) \) of \( h(T) \) near \( T = 8 \).

\[ Solution: \quad L(T) = 7.2 - 0.25(T - 8) \]

b. [1 point] Use your formula for \( L(T) \) to approximate \( h(10) \).

\[ Solution: \quad h(10) \approx 7.2 - 0.25 \cdot 2 = 6.7 \]

c. [2 points] Is your answer in part b. an overestimate or underestimate of the actual value, or is there not enough information to decide? Briefly explain.

\[ Solution: \quad \text{The approximation is an underestimate since } h''(T) \text{ is positive, so } h(T) \text{ is concave up.} \]

d. [3 points] Suppose that the quadratic approximation \( Q(T) \) of \( h(T) \) near \( T = 25 \) is given by

\[ Q(T) = 3.9 - 0.15(T - 25) + 0.003(T - 25)^2. \]

Find the values of \( h(25) \), \( h'(25) \), and \( h''(25) \).

\[ Solution: \quad h(25) = 3.9 \]
\[ h'(25) = -0.15 \]
\[ h''(25) = 0.003 \cdot 2 = 0.006 \]

e. [2 points] Use the table to compute \( (h^{-1})'(5) \).

\[ Solution: \quad (h^{-1})'(5) = \frac{1}{h'(18)} = -5 \]