Q. How do I find the value of a property between two values on a table?

A. The answer is that we interpolate between the values; that is, to estimate the value of a function between known points. The most common way to do this is through linear interpolation, although there are other, more complicated (and often more accurate) methods.

Let’s demonstrate linear interpolation by example:

Example: What is the specific volume of saturated R-134a vapor at \( T = 43.5 \, ^\circ\text{F} \)?

Solution: Let’s say we look up the specific volume of saturated R-134a vapor, we find the following data:

<table>
<thead>
<tr>
<th>( T ) (°F)</th>
<th>( v_g ) (ft(^3)/lbm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>0.9470</td>
</tr>
<tr>
<td>50</td>
<td>0.7871</td>
</tr>
</tbody>
</table>

The problem is that we are looking for the specific volume corresponding to \( T = 43.5 \, ^\circ\text{F} \), which is between 40 and 50 °F on the table. To solve this, let’s establish variables for the numbers on the table as follows: We’ll give the known values the variables \( T_1 \), \( T_2 \), \( v_1 \), and \( v_2 \).

And the “middle values” we’ll assign \( T \) and \( v \).

Now, the idea behind linear interpolation is to assume that the function \( v(T) \) is a straight line. Therefore the slope of the \( v \) vs. \( T \) line is the same for any two data points. Specifically,

\[
\frac{v_2 - v_1}{T_2 - T_1} = \frac{v - v_1}{T - T_1} = m,
\]

where \( m \) is the slope. We know every value on the left side of the equality, so we can solve for \( m \). Then we can solve for \( v \) using algebra:

\[
v = v_1 + m(T - T_1),
\]

and you can verify that, for this data, \( v(T=43.5 \, ^\circ\text{C}) \approx 0.891 \, \text{ft}^3/\text{lbm} \).