1 Linear Interpolation

Property tables such as steam tables are tabulated at discrete values of the specific properties. When referring to the tables to find the specific properties, very often the property which we are interested in lies between the tabulated values. In such cases, interpolation is required to obtain the correct value. The easiest method is to use **Linear Interpolation** (Note: Interpolation is approximation)

Problem1 : Find values of P, h and v at
(a) T = 210
(b) T = 225.

T	P	h	v
200 (T_1)	100 (P_1)	3490	0.2150
220 (T_2)	140 (P_2)	3541	0.2340
240	190	3615	0.2453

SOLUTION: Part a)
For this, we are required to find the values at T = 210 which lies in between 200 (Smaller Value (T_1)) and 220 (Higher Value, (T_2))

Before we begin, lets use the following convention while finding the interpolated value:

Smaller value	-	The First value in the table (200 for part (a) for T)
Higher value	-	The second value in the table (220 for part (a) for T)
Given Value	-	The value at which properties are to be found (210 for part (a) for T))
Given Property	-	Property that is known (T for this problem)
Required Property	-	Properties to be found (P, h and v for this problem)

Adopt the following procedure:

1. Find the difference (T_2 - T_1) for the Given Property (Temperature) i.e. (Higher - Smaller)
2. Find the difference (T_3 - T_1) for Given property (Temperature) i.e. (Given Value - Smaller)
3. Find the difference (P_2 - P_1) for the Required Property (Pressure) i.e. (Higher - Smaller)

Then put the above values in the following equation

$$P_{req} = \frac{(T_3 - T_1)}{(T_2 - T_1)} * (P_2 - P_1) + P_1$$

In other words,

$$P_{req} = \frac{\text{(Given Value - Smaller, for T)}}{\text{(Higher - Smaller, for T)}} * \text{(Higher - Smaller, for P)} + \text{Smaller P}$$

For part (b) for P,
$T_1 = 220$, $T_2 = 240$, $T_3 = 225$
$P_1 = 140$, $P_2 = 190$

ANSWER:

T	P	h	v
200	100	3490	0.2150
210	120	3515.5	0.2245
220	140	3541	0.2340
225	152.5	3559.5	0.2368
240	190	3615	0.2453

Example: Find the values of ρ, ν and u at
(a) T = 330 K
(b) T = 335 K
(c) T = 347 K

Properties of Superheated Steam at P = 0.006 MPa

T (K)	ρ (kg/m^3)	ν (m^3/kg)	u (kJ/kg)
320	0.040708	24.565	2439.7
340	0.038291	26.116	2468.4
360	0.036151	27.662	2497.0

ANSWER:

T (K)	ρ (kg/m^3)	ν (m^3/kg)	u (kJ/kg)
320	0.040708	24.565	2439.7
330	0.039500	25.341	2454.1
335	0.038895	25.728	2461.2
340	0.038291	26.116	2468.4
343	0.037970	26.348	2472.7
360	0.036151	27.662	2497.0