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(ex): roll a die.

$t = 6, \quad \varepsilon_i = i, \quad x = e^{-\beta}$

$$q \equiv \sum_i e^{-\beta\varepsilon_i} = \sum_i x^i = x + x^2 + x^3 + \cdots + x^6$$

$$p_i = \frac{x^i}{\sum_i x^i}$$

$$\langle \varepsilon \rangle = \sum_i (i p_i) = \frac{x + 2x^2 + 3x^3 + 4x^4 + \cdots + 6x^6}{x + x^2 + x^3 + \cdots + x^6}$$

random distribution of outcomes: $\langle \varepsilon \rangle = \frac{1+2+3+4+5+6}{6} = 3.5$

If we know $\langle \varepsilon \rangle = 3.5$:

then. $\frac{x + 2x^2 + 3x^3 + \cdots + 6x^6}{x + x^2 + \cdots + x^6} = 3.5 \quad \Rightarrow \quad x = 1.$

and $p_1 = p_2 \cdots = p_6 = \frac{x^i}{\sum_i x^i} = \frac{1}{6}$

—— all possible outcomes are equally probable.

If we know $\langle \varepsilon \rangle = 3.0$.

then. $\frac{x + 2x^2 + 3x^3 + \cdots + 6x^6}{x + x^2 + \cdots + x^6} = 3.0 \quad \Rightarrow \quad x = 0.84$

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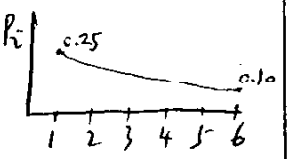
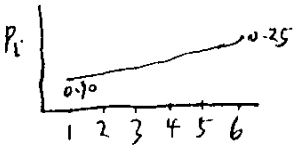
$P_i = \frac{X^i}{\sum_i X^i}$, different for different i.



If $\langle \varepsilon \rangle = 4.0$.



In general.

If $\langle \varepsilon \rangle$ is a randome distribution value $\Rightarrow$ flat distribution

$\langle \varepsilon \rangle <$ " " $\Rightarrow$ exponentially decaying

$\langle \varepsilon \rangle >$ " " $\Rightarrow$ exponentially rising

(ex): coin flipping case.

H/T. $t = 2$. $\varepsilon_i = i$. $e^{-\beta} = X$. let H ≡ 1, T ≡ 2

$q = X + X^2$; $P_H = \frac{X}{X+X^2}$; $P_T = \frac{X^2}{X+X^2}$

$\langle \varepsilon \rangle = \frac{X + 2X^2}{X+X^2} \Rightarrow X = \frac{\langle \varepsilon \rangle - 1}{2 - \langle \varepsilon \rangle}$

For flat distribution: $\langle \varepsilon \rangle = 1.5$

If $\langle \varepsilon \rangle = 1.5$, $X = 1$. $P_H = P_T = \frac{1}{2}$

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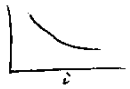
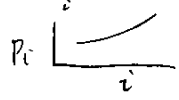
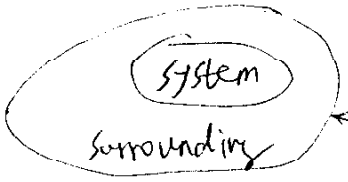
If $\langle \varepsilon \rangle \lesssim 1.5$ P_i 

$\langle \varepsilon \rangle > 1.5$ P_i 

ch7. Thermodynamic Functions



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