Chapter 1 Wave Function

Problem 1.1: For the distribution of ages in Section 1.3.1:

Number of people	Ages
1	14
1	15
3	16
2	22
2	24
5	25
No. 14	

(a) Compute $\langle j^2 \rangle$ and $\langle j \rangle^2$

(b) Determine Δj for each j, and use Equation 1.11 to compute the standard deviation

Solution: $\sum Ni = 14$

$$P(j) = \frac{Ni}{\sum Ni}$$

(a) $\langle j \rangle = \sum jP(j) = 14 \times \frac{1}{14} + 15 \times \frac{1}{14} + 16 \times \frac{3}{14} + 22 \times \frac{2}{14} + 24 \times \frac{2}{14} + 25 \times \frac{5}{14}$

$$= \frac{1}{14}(14 + 15 + 48 + 44 + 48 + 125)$$

$$= \frac{294}{14} = 21$$

$$\langle j \rangle^2 = (21)^2 = 441$$

$$\langle j^2 \rangle = \sum j^2 P(j) = (14)^2 \times \frac{1}{14} + (15)^2 \times \frac{1}{14} + (16)^2 \times \frac{3}{14} + (22)^2 \times \frac{2}{14} + (24)^2 \times \frac{2}{14} + (25)^2 \times \frac{5}{14}$$

$$= \frac{1}{14}(196 + 225 + 768 + 968 + 1152 + 3125)$$

$$= \frac{1}{14}(6434) = 459.57$$

(b)

Number of people	$\langle j \rangle$	$(j - \langle j \rangle)$	$(j - \langle j \rangle)^2$
14	21	–7	49
15	21	–6	36
16	21	–5	25
22	21	1	1
24	21	3	9
25	21	4	16

$$\sigma^2 = \frac{\sum_j (\Delta j)^2 Ni}{\sum Ni} = \frac{49\times1}{14} + \frac{36\times1}{14} + \frac{25\times3}{14} + \frac{1\times2}{14} + \frac{9\times2}{14} + \frac{11\times5}{14}$$

$$= \frac{260}{14} = 18.5$$