도수분포에서의 분산
(Variance of Frequency Distribution)

Start End

Start End

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n$$

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i$$

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

Variance :

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

Variance : σ^2

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

$$\text{Variance} \ : \sigma^2 \quad = \quad \frac{\sum_{i=1}^{n} (x_i - m)^2 f_i}{\sum_{i=1}^{n} f_i}$$

▸ Start ▸ End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

$$\text{Variance} \; : \sigma^2 = \frac{\sum_{i=1}^{n} (x_i - m)^2 f_i}{\sum_{i=1}^{n} f_i} = \frac{1}{N} \sum_{i=1}^{n} (x_i - m)^2 f_i$$

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

$$\text{Variance } : \sigma^2 = \frac{\sum_{i=1}^{n}(x_i - m)^2 f_i}{\sum_{i=1}^{n} f_i} = \frac{1}{N}\sum_{i=1}^{n}(x_i - m)^2 f_i = \frac{1}{N}\sum_{i=1}^{n}(x_i^2 - 2mx_i + m^2) f_i$$

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

$$\text{Variance} \ : \sigma^2 = \frac{\sum_{i=1}^{n}(x_i - m)^2 f_i}{\sum_{i=1}^{n} f_i} = \frac{1}{N}\sum_{i=1}^{n}(x_i - m)^2 f_i = \frac{1}{N}\sum_{i=1}^{n}(x_i^2 - 2mx_i + m^2) f_i$$

$$= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i$$

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

$$\text{Variance} \; : \sigma^2 = \frac{\sum_{i=1}^{n} (x_i - m)^2 f_i}{\sum_{i=1}^{n} f_i} = \frac{1}{N} \sum_{i=1}^{n} (x_i - m)^2 f_i = \frac{1}{N} \sum_{i=1}^{n} (x_i^2 - 2mx_i + m^2) f_i$$

$$= \frac{1}{N} \sum_{i=1}^{n} x_i^2 f_i - 2m$$

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

$$\text{Variance } : \sigma^2 = \frac{\sum_{i=1}^{n}(x_i - m)^2 f_i}{\sum_{i=1}^{n} f_i} = \frac{1}{N}\sum_{i=1}^{n}(x_i - m)^2 f_i = \frac{1}{N}\sum_{i=1}^{n}(x_i^2 - 2mx_i + m^2) f_i$$

$$= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m \times \frac{1}{N}\sum_{i=1}^{n} x_i f_i$$

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

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$$= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m \times \frac{1}{N}\sum_{i=1}^{n} x_i f_i + m^2$$

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

$$\text{Variance} \ : \sigma^2 = \frac{\sum_{i=1}^{n}(x_i - m)^2 f_i}{\sum_{i=1}^{n} f_i} = \frac{1}{N}\sum_{i=1}^{n}(x_i - m)^2 f_i = \frac{1}{N}\sum_{i=1}^{n}(x_i^2 - 2mx_i + m^2) f_i$$

$$= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m \times \frac{1}{N}\sum_{i=1}^{n} x_i f_i + m^2 \times \frac{1}{N}\sum_{i=1}^{n} f_i$$

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

$$\begin{aligned}
\text{Variance } : \sigma^2 &= \frac{\sum_{i=1}^{n} (x_i - m)^2 f_i}{\sum_{i=1}^{n} f_i} = \frac{1}{N} \sum_{i=1}^{n} (x_i - m)^2 f_i = \frac{1}{N} \sum_{i=1}^{n} (x_i^2 - 2mx_i + m^2) f_i \\
&= \frac{1}{N} \sum_{i=1}^{n} x_i^2 f_i - 2m \times \frac{1}{N} \sum_{i=1}^{n} x_i f_i + m^2 \times \frac{1}{N} \sum_{i=1}^{n} f_i \\
&= \frac{1}{N} \sum_{i=1}^{n} x_i^2 f_i
\end{aligned}$$

▸ Start ▸ End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

$$\text{Variance } : \sigma^2 = \frac{\sum_{i=1}^{n}(x_i - m)^2 f_i}{\sum_{i=1}^{n} f_i} = \frac{1}{N}\sum_{i=1}^{n}(x_i - m)^2 f_i = \frac{1}{N}\sum_{i=1}^{n}(x_i^2 - 2mx_i + m^2) f_i$$

$$= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m \times \frac{1}{N}\sum_{i=1}^{n} x_i f_i + m^2 \times \frac{1}{N}\sum_{i=1}^{n} f_i$$

$$= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m$$

Variance of Frequency Distribution

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

$$\begin{aligned}\text{Variance} \; : \sigma^2 &= \frac{\sum_{i=1}^{n}(x_i - m)^2 f_i}{\sum_{i=1}^{n} f_i} = \frac{1}{N}\sum_{i=1}^{n}(x_i - m)^2 f_i = \frac{1}{N}\sum_{i=1}^{n}(x_i^2 - 2mx_i + m^2)f_i \\ &= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m \times \frac{1}{N}\sum_{i=1}^{n} x_i f_i + m^2 \times \frac{1}{N}\sum_{i=1}^{n} f_i \\ &= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m \times m\end{aligned}$$

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
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$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

$$\begin{aligned}
\text{Variance } : \sigma^2 &= \frac{\sum_{i=1}^{n}(x_i - m)^2 f_i}{\sum_{i=1}^{n} f_i} = \frac{1}{N}\sum_{i=1}^{n}(x_i - m)^2 f_i = \frac{1}{N}\sum_{i=1}^{n}(x_i^2 - 2mx_i + m^2) f_i \\
&= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m \times \frac{1}{N}\sum_{i=1}^{n} x_i f_i + m^2 \times \frac{1}{N}\sum_{i=1}^{n} f_i \\
&= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m \times m + m^2
\end{aligned}$$

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

$$\text{Variance } : \sigma^2 = \frac{\sum_{i=1}^{n}(x_i - m)^2 f_i}{\sum_{i=1}^{n} f_i} = \frac{1}{N}\sum_{i=1}^{n}(x_i - m)^2 f_i = \frac{1}{N}\sum_{i=1}^{n}(x_i^2 - 2mx_i + m^2) f_i$$

$$= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m \times \frac{1}{N}\sum_{i=1}^{n} x_i f_i + m^2 \times \frac{1}{N}\sum_{i=1}^{n} f_i$$

$$= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m \times m + m^2 \times \frac{1}{N} \times N$$

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

$$\begin{aligned}
\text{Variance} \ : \sigma^2 &= \frac{\sum_{i=1}^{n} (x_i - m)^2 f_i}{\sum_{i=1}^{n} f_i} = \frac{1}{N} \sum_{i=1}^{n} (x_i - m)^2 f_i = \frac{1}{N} \sum_{i=1}^{n} (x_i^2 - 2mx_i + m^2) f_i \\
&= \frac{1}{N} \sum_{i=1}^{n} x_i^2 f_i - 2m \times \frac{1}{N} \sum_{i=1}^{n} x_i f_i + m^2 \times \frac{1}{N} \sum_{i=1}^{n} f_i \\
&= \frac{1}{N} \sum_{i=1}^{n} x_i^2 f_i - 2m \times m + m^2 \times \frac{1}{N} \times N \\
&= \frac{1}{N} \sum_{i=1}^{n} x_i^2 f_i
\end{aligned}$$

▸ Start ▸ End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

$$\text{Variance} \ : \sigma^2 = \frac{\sum_{i=1}^{n} (x_i - m)^2 f_i}{\sum_{i=1}^{n} f_i} = \frac{1}{N}\sum_{i=1}^{n}(x_i - m)^2 f_i = \frac{1}{N}\sum_{i=1}^{n}(x_i^2 - 2mx_i + m^2) f_i$$

$$= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m \times \frac{1}{N}\sum_{i=1}^{n} x_i f_i + m^2 \times \frac{1}{N}\sum_{i=1}^{n} f_i$$

$$= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m \times m + m^2 \times \frac{1}{N} \times N$$

$$= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m^2 +$$

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

$$\begin{aligned}
\text{Variance } : \sigma^2 &= \frac{\sum_{i=1}^{n}(x_i - m)^2 f_i}{\sum_{i=1}^{n} f_i} = \frac{1}{N}\sum_{i=1}^{n}(x_i - m)^2 f_i = \frac{1}{N}\sum_{i=1}^{n}(x_i^2 - 2mx_i + m^2) f_i \\
&= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m \times \frac{1}{N}\sum_{i=1}^{n} x_i f_i + m^2 \times \frac{1}{N}\sum_{i=1}^{n} f_i \\
&= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m \times m + m^2 \times \frac{1}{N} \times N \\
&= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m^2 + m^2
\end{aligned}$$

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

$$\text{Variance} : \sigma^2 = \frac{\sum_{i=1}^{n} (x_i - m)^2 f_i}{\sum_{i=1}^{n} f_i} = \frac{1}{N} \sum_{i=1}^{n} (x_i - m)^2 f_i = \frac{1}{N} \sum_{i=1}^{n} (x_i^2 - 2mx_i + m^2) f_i$$

$$= \frac{1}{N} \sum_{i=1}^{n} x_i^2 f_i - 2m \times \frac{1}{N} \sum_{i=1}^{n} x_i f_i + m^2 \times \frac{1}{N} \sum_{i=1}^{n} f_i$$

$$= \frac{1}{N} \sum_{i=1}^{n} x_i^2 f_i - 2m \times m + m^2 \times \frac{1}{N} \times N$$

$$= \frac{1}{N} \sum_{i=1}^{n} x_i^2 f_i - 2m^2 + m^2 = \frac{1}{N} \sum_{i=1}^{n} x_i^2 f_i$$

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

$$\text{Variance } : \sigma^2 = \frac{\sum_{i=1}^{n}(x_i - m)^2 f_i}{\sum_{i=1}^{n} f_i} = \frac{1}{N}\sum_{i=1}^{n}(x_i - m)^2 f_i = \frac{1}{N}\sum_{i=1}^{n}(x_i^2 - 2mx_i + m^2) f_i$$

$$= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m \times \frac{1}{N}\sum_{i=1}^{n} x_i f_i + m^2 \times \frac{1}{N}\sum_{i=1}^{n} f_i$$

$$= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m \times m + m^2 \times \frac{1}{N} \times N$$

$$= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m^2 + m^2 = \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - m^2$$

Start End

x_i	f_i	$x_i f_i$
x_1	f_1	$x_1 f_1$
$\vdots$	$\vdots$	$\vdots$
x_n	f_n	$x_n f_n$

$$f_1 + f_2 + f_3 + \cdots + f_n = \sum_{i=1}^{n} f_i = N$$

$$\begin{aligned}
\text{Variance } : \sigma^2 &= \frac{\sum_{i=1}^{n}(x_i - m)^2 f_i}{\sum_{i=1}^{n} f_i} = \frac{1}{N}\sum_{i=1}^{n}(x_i - m)^2 f_i = \frac{1}{N}\sum_{i=1}^{n}(x_i^2 - 2mx_i + m^2) f_i \\
&= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m \times \frac{1}{N}\sum_{i=1}^{n} x_i f_i + m^2 \times \frac{1}{N}\sum_{i=1}^{n} f_i \\
&= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m \times m + m^2 \times \frac{1}{N} \times N \\
&= \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - 2m^2 + m^2 = \frac{1}{N}\sum_{i=1}^{n} x_i^2 f_i - m^2
\end{aligned}$$

Github:
https://min7014.github.io/math20230524001.html

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