Question Based on Variance

Data Science and A.I. Lecture Series

Bindeshwar Singh Kushwaha

PostNetwork Academy

Reach PostNetwork Academy

Website

PostNetwork Academy | www.postnetwork.co

YouTube Channel

www.youtube.com/@postnetworkacademy

PostNetwork Academy Facebook Page

www.facebook.com/postnetworkacademy

LinkedIn

www.linkedin.com/company/postnetworkacademy

GitHub

GitHub| www.github.com/postnetworkacademy

GeoGebra

GeoGebra| www.geogebra.org/u/postnetworkacademy

Telegram

Telegram Channel| www.t.me/postnetworkacademy

Whatsapp Channel

www.whatsapp.com/channel/0029VaEbbm97tkj9WCh8C03d

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

If x_i are observations and f_i are frequencies of observations then variance is $Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$$

$$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$$

$$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$$

$$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$$

$$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$$

$$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$$

$$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$$

$$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4				
4	4				
6	5				
8	15				
10	8				
12	5				
14	4				
16	5				

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4				
4	4				
6	5				
8	15				
10	8				
12	5				
14	4				
16	5				
	N=50				

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8			
4	4				
6	5				
8	15				
10	8				
12	5				
14	4				
16	5				
	N=50				

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8			
4	4	16			
6	5				
8	15				
10	8				
12	5				
14	4				
16	5				
	N=50				

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8			
4	4	16			
6	5	30			
8	15				
10	8				
12	5				
14	4				
16	5				
	N=50				

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8			
4	4	16			
6	5	30			
8	15	120			
10	8				
12	5				
14	4				
16	5				
	N=50				

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8			
4	4	16			
6	5	30			
8	15	120			
10	8	80			
12	5				
14	4				
16	5				
	N=50				

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8			
4	4	16			
6	5	30			
8	15	120			
10	8	80			
12	5	60			
14	4	56			
16	5				
	N=50				

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8			
4	4	16			
6	5	30			
8	15	120			
10	8	80			
12	5	60			
14	4	56			
16	5	80			
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8			
4	4	16			
6	5	30			
8	15	120			
10	8	80			
12	5	60			
14	4	56			
16	5	80			
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7		
4	4	16			
6	5	30			
8	15	120			
10	8	80			
12	5	60			
14	4	56			
16	5	80			
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is

$$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$$

$$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$$

$$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$$

$$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$$

$$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$$

$$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7		
4	4	16	-5		
6	5	30			
8	15	120			
10	8	80			
12	5	60			
14	4	56			
16	5	80			
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7		
4	4	16	-5		
6	5	30	-3		
8	15	120			
10	8	80			
12	5	60			
14	4	56			
16	5	80			
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7		
4	4	16	-5		
6	5	30	-3		
8	15	120	-1		
10	8	80			
12	5	60			
14	4	56			
16	5	80			
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7		
4	4	16	-5		
6	5	30	-3		
8	15	120	-1		
10	8	80	1		
12	5	60			
14	4	56			
16	5	80			
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7		
4	4	16	-5		
6	5	30	-3		
8	15	120	-1		
10	8	80	1		
12	5	60	3		
14	4	56			
16	5	80			
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7		
4	4	16	-5		
6	5	30	-3		
8	15	120	-1		
10	8	80	1		
12	5	60	3		
14	4	56	5		
16	5	80			
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7		
4	4	16	-5		
6	5	30	-3		
8	15	120	-1		
10	8	80	1		
12	5	60	3		
14	4	56	5		
16	5	80	7		
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7	49	
4	4	16	-5		
6	5	30	-3		
8	15	120	-1		
10	8	80	1		
12	5	60	3		
14	4	56	5		
16	5	80	7		
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7	49	
4	4	16	-5	25	
6	5	30	-3		
8	15	120	-1		
10	8	80	1		
12	5	60	3		
14	4	56	5		
16	5	80	7		
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7	49	
4	4	16	-5	25	
6	5	30	-3	9	
8	15	120	-1		
10	8	80	1		
12	5	60	3		
14	4	56	5		
16	5	80	7		
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7	49	
4	4	16	-5	25	
6	5	30	-3	9	
8	15	120	-1	1	
10	8	80	1		
12	5	60	3		
14	4	56	5		
16	5	80	7		
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7	49	
4	4	16	-5	25	
6	5	30	-3	9	
8	15	120	-1	1	
10	8	80	1	1	
12	5	60	3		
14	4	56	5		
16	5	80	7		
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7	49	
4	4	16	-5	25	
6	5	30	-3	9	
8	15	120	-1	1	
10	8	80	1	1	
12	5	60	3	9	
14	4	56	5		
16	5	80	7		
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7	49	
4	4	16	-5	25	
6	5	30	-3	9	
8	15	120	-1	1	
10	8	80	1	1	
12	5	60	3	9	
14	4	56	5	25	
16	5	80	7		
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7	49	
4	4	16	-5	25	
6	5	30	-3	9	
8	15	120	-1	1	
10	8	80	1	1	
12	5	60	3	9	
14	4	56	5	25	
16	5	80	7	49	
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7	49	196
4	4	16	-5	25	
6	5	30	-3	9	
8	15	120	-1	1	
10	8	80	1	1	
12	5	60	3	9	
14	4	56	5	25	
16	5	80	7	49	
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7	49	196
4	4	16	-5	25	100
6	5	30	-3	9	
8	15	120	-1	1	
10	8	80	1	1	
12	5	60	3	9	
14	4	56	5	25	
16	5	80	7	49	
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7	49	196
4	4	16	-5	25	100
6	5	30	-3	9	45
8	15	120	-1	1	
10	8	80	1	1	
12	5	60	3	9	
14	4	56	5	25	
16	5	80	7	49	
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7	49	196
4	4	16	-5	25	100
6	5	30	-3	9	45
8	15	120	-1	1	15
10	8	80	1	1	
12	5	60	3	9	
14	4	56	5	25	
16	5	80	7	49	
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7	49	196
4	4	16	-5	25	100
6	5	30	-3	9	45
8	15	120	-1	1	15
10	8	80	1	1	8
12	5	60	3	9	
14	4	56	5	25	
16	5	80	7	49	
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7	49	196
4	4	16	-5	25	100
6	5	30	-3	9	45
8	15	120	-1	1	15
10	8	80	1	1	8
12	5	60	3	9	45
14	4	56	5	25	
16	5	80	7	49	
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7	49	196
4	4	16	-5	25	100
6	5	30	-3	9	45
8	15	120	-1	1	15
10	8	80	1	1	8
12	5	60	3	9	45
14	4	56	5	25	100
16	5	80	7	49	
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7	49	196
4	4	16	-5	25	100
6	5	30	-3	9	45
8	15	120	-1	1	15
10	8	80	1	1	8
12	5	60	3	9	45
14	4	56	5	25	100
16	5	80	7	49	245
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7	49	196
4	4	16	-5	25	100
6	5	30	-3	9	45
8	15	120	-1	1	15
10	8	80	1	1	8
12	5	60	3	9	45
14	4	56	5	25	100
16	5	80	7	49	245
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			$\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = 754$

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7	49	196
4	4	16	-5	25	100
6	5	30	-3	9	45
8	15	120	-1	1	15
10	8	80	1	1	8
12	5	60	3	9	45
14	4	56	5	25	100
16	5	80	7	49	245
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			$\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = 754$

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$

If x_i are observations and f_i are frequencies of observations then variance is
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

$Var(X) =$
$\frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2$

$= \frac{1}{N}\sum_{i=1}^{n} f_i(x_i^2 + \bar{X}^2 - 2x_i\bar{X})$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) -$
$2\bar{X}(\frac{1}{N}\sum_{i=1}^{n} f_i x_i) + \frac{N\bar{X}^2}{N}$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - 2\bar{X}^2 + \bar{X}^2$

$= \frac{1}{N}(\sum_{i=1}^{n} f_i x_i^2) - \bar{X}^2$

x_i	f_i	$f_i x_i$	$x_i - \bar{X}$	$(x_i - \bar{X})^2$	$f_i(x_i - \bar{X})^2$
2	4	8	-7	49	196
4	4	16	-5	25	100
6	5	30	-3	9	45
8	15	120	-1	1	15
10	8	80	1	1	8
12	5	60	3	9	45
14	4	56	5	25	100
16	5	80	7	49	245
	N=50	$\sum_{i=1}^{n} f_i x_i = 450$			$\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = 754$

$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} f_i x_i = \frac{450}{50} = 9$
$Var(X) = \frac{1}{N}\sum_{i=1}^{n} f_i(x_i - \bar{X})^2 = \frac{754}{50} = 15.5$