

## Chapter 3

### Descriptive Statistics: Numerical Methods



**“On Monday, I’m not really up to speed yet.  
By Wednesday, I’m totally exhausted. I’m at  
my peak on Tuesdays from 11:20 to 11:23 AM.”**

### Mean - Grouped Data

---

✓ Grouped Data - Frequency Distributions

- Measures of Location
- Mean
  - Population  $\mu = \frac{\sum f_i M_i}{N}, \quad N = \sum f_i$
  - Sample  $\bar{x} = \frac{\sum f_i M_i}{n}, \quad n = \sum f_i$

---

---

---

---

---

---

---

---

The 2000 Survey of population shows the following distribution of population by age for McPherson county, Nebraska

Age	Population $f_i$
1-10	90
11-20	100
21-30	82
31-40	92
41-50	73
51-60	65
61-70	57
71-80	50

$N = \sum f_i = 609$

---

---

---

---

---

---

---

---

The 2000 census of population shows the following distribution of population by age for McPherson county, Nebraska

Age	Population $f_i$	Class Mark $M_i$	True Lower Class Limit	cf	crf	$f_i M_i$	$f_i M_i^2$
1-10	90	5.5				$90 \times 5.5 = 495$	
11-20	100	15.5				$100 \times 15.5 = 1550$	
21-30	82	25.5				$82 \times 25.5 = 2091$	
31-40	92	35.5					
41-50	73	45.5					
51-60	65	55.5					
61-70	57	65.5					
71-80	50	75.5					

$N = \sum f_i = \boxed{\phantom{000}}$

---

---

---

---

---

---

---

---

---

---

The 2000 census of population shows the following distribution of population by age for McPherson county, Nebraska

Age	Population $f_i$	Class Mark $M_i$	True Lower Class Limit	cf	crf	$f_i M_i$	$f_i M_i^2$
1-10	90	5.5				495.0	
11-20	100	15.5				1550.0	
21-30	82	25.5				2091.0	
31-40	92	35.5				3266.0	
41-50	73	45.5				3321.5	
51-60	65	55.5				3607.5	
61-70	57	65.5				3733.5	
71-80	50	75.5				3775.0	

$N = \sum f_i = 609$        $\sum f_i M_i = 21839.5$

$\mu = \frac{\sum f_i M_i}{N} = \underline{\hspace{2cm}}$  years

---

---

---

---

---

---

---

---

---

---

✓ Grouped Data - Frequency Distributions

Measures of Variability

– Variance

- Population  $\sigma^2 = \frac{\sum f_i (M_i - \mu)^2}{N}$        $\sigma^2 = \frac{N \sum f_i M_i^2 - (\sum f_i M_i)^2}{N^2}$
- Sample  $s^2 = \frac{\sum f_i (M_i - \bar{x})^2}{n-1}$        $s^2 = \frac{n \sum f_i M_i^2 - (\sum f_i M_i)^2}{n(n-1)}$

---

---

---

---

---

---

---

---

---

---

✓ Grouped Data - Frequency Distributions

Measures of Variability

– Standard Deviation

• Population  $\sigma = \sqrt{\sigma^2}$

• Sample  $s = \sqrt{s^2}$

---

---

---

---

---

---

---

---

The 2000 census of population shows the following distribution of population by age for McPherson county, Nebraska

Age	Population $f_i$	Class Mark $M_i$	True Lower Class Limit	cf	crf	$f_i M_i$	$f_i M_i^2$
1-10	90	5.5				$90 \times 5.5^2 = 2722.5$	
11-20	100	15.5				$100 \times 15.5^2 = 24025.0$	
21-30	82	25.5				$82 \times 25.5^2 = 53320.5$	
31-40	92	35.5					
41-50	73	45.5					
51-60	65	55.5					
61-70	57	65.5					
71-80	50	75.5					

---

---

---

---

---

---

---

---

The 2000 census of population shows the following distribution of population by age for McPherson county, Nebraska

Age	Population $f_i$	Class Mark $M_i$	True Lower Class Limit	cf	crf	$f_i M_i$	$f_i M_i^2$
1-10	90	5.5					2722.50
11-20	100	15.5					24025.00
21-30	82	25.5					53320.50
31-40	92	35.5					115943.00
41-50	73	45.5					151128.25
51-60	65	55.5					200216.25
61-70	57	65.5					244544.25
71-80	50	75.5					285012.50

$$\sigma^2 = \frac{N \sum f_i M_i^2 - (\sum f_i M_i)^2}{N^2} \quad \sum f_i M_i^2 = 1076912.25$$

---

---

---

---

---

---

---

---

$$\sigma^2 = \frac{609 \cdot 1076912.25 - 21839.5^2}{609^2} = \text{_____ years}^2$$

The 2000 census of population shows the following distribution of population by age for McPherson county, Nebraska

Age	Population $f_i$	Class Mark $M_i$	True Lower Class Limit	cf	crf	$f_i M_i$	$f_i M_i^2$
1-10	90	5.5					2722.50
11-20	100	15.5					24025.00
21-30	82	25.5					53320.50
31-40	92	35.5					115943.00
41-50	73	45.5					151128.25
51-60	65	55.5					200216.25
61-70	57	65.5					244544.25
71-80	50	75.5					285012.50

---

---

---

---

---

---

---

---

$$\sigma = \sqrt{\sigma^2} =$$

The 2000 census of population shows the following distribution of population by age for McPherson county, Nebraska

Age	Population $f_i$	Class Mark $M_i$	True Lower Class Limit	cf	crf	$f_i M_i$	$f_i M_i^2$
1-10	90	5.5					2722.50
11-20	100	15.5					24025.00
21-30	82	25.5					53320.50
31-40	92	35.5					115943.00
41-50	73	45.5					151128.25
51-60	65	55.5					200216.25
61-70	57	65.5					244544.25
71-80	50	75.5					285012.50

---

---

---

---

---

---

---

---