



## SAMPLES

Population	Totality of objects, individuals, and events.
Sample	Part of population chosen for measurement and observation. • Number of sample values is $n$ .
Class	Subdivision of sample values $n$ .
Class mark, $x_i$	Midpoint value of a class.
Class size, $c$	Difference between successive lower or upper class limits.
Class frequency, $f$	Number of sample values in a class.
Relative frequency, $f/c$	Class frequency divided by total number of values $n$ .
Cumulative frequency	Total number of values less than given value.

## PROPERTIES OF SAMPLES

Parameter	Ungrouped Data	Data Grouped in $k$ Classes
Mean	$\bar{x} = \frac{\sum x_i}{n}$	$\bar{x} = \frac{\sum f_i x_i}{n}$
Variance	$\sigma^2 = \frac{\sum x_i^2}{n} - \bar{x}^2$	$\sigma^2 = \frac{\sum f_i x_i^2}{n} - \bar{x}^2$
Variance (alternates)	$\sigma^2 = \frac{\sum x_i^2}{n} - \frac{(\sum x_i)^2}{n^2}$	$\sigma^2 = \frac{\sum f_i x_i^2}{n} - \left(\frac{\sum f_i x_i}{n}\right)^2$

Note: Standard Deviation =  $\sigma = \sqrt{\text{variance}}$   
 Range of samples:  $x_{\max} - x_{\min}$   
 Mode: Most common value of  $x$   
 Median: Middle value or mean of two middle values.  
 Coefficient of variation:  $V = (\sigma/\bar{x}) \times 100$   
 Quartiles  $Q_1, Q_2, Q_3$ : Values that divide data set into 4 equal parts.  
 Interquartile range:  $Q_3 - Q_1$

## THE CODE METHOD

- Rationalize  $x_i$  by first subtracting a convenient number  $m$  (often the median or mode) followed by division by a suitable number  $c$  (often the class size).
- New data set  $u_i$  yields mean  $\bar{u}$  and standard deviation  $s_u$  of original set:  
 $\bar{x} = c\bar{u} + m$  and  $s_x = c s_u$

Example

Class	Frequency, $f_i$	$h_i = (x_i - m)/c$	$f_i h_i$	$f_i h_i^2$
60-62	5	-3	-15	45
63-65	18	-2	-36	72
66-68	42	-1	-42	42
69-71	27	0	0	0
72-74	8	1	8	8
		2	16	32

$\bar{u} = \frac{\sum f_i h_i}{n} = \frac{-15 + 16}{100} = 0.1$   
 $s_u^2 = \frac{\sum f_i h_i^2}{n} - \bar{u}^2 = \frac{127}{100} - 0.01 = 1.26$   
 $s_u = \sqrt{1.26} = 1.12$   
 $\bar{x} = c\bar{u} + m = 10(0.1) + 67 = 67.1$   
 $s_x = c s_u = 10(1.12) = 11.2$

Note:  $\bar{u}$  is the mean of the new set.  $\bar{x}$  is the mean of the original set.  
 $s_u$  is the standard deviation of original set.

## PROBABILITY THEORY

### FACTORS, FUNCTIONS

$n!$  (factorial)  
 $n! = n(n-1)(n-2) \dots (3)(2)(1)$

Stirling's Approximation  
 $n! \approx \sqrt{2\pi n} (n/e)^n$

### Binomial Coefficients

$\binom{n}{r} = \frac{n!}{r!(n-r)!} \quad \binom{n}{0} = \binom{n}{n} = 1$

Note:  $\binom{n}{r} = \binom{n}{n-r}$

### PROBABILITY THEORY

Probability  $P(A)$  of "success" = number of events considered successful ( $S$ )/total number of possible events ( $n$ )  
 Probability  $P(S)$  of "failure" =  $1 - P(S)$

- The probability  $P(A \cap B)$  that two independent events  $A$  and  $B$  will both occur, simultaneously or in succession, is:  $P(A \cap B) = P(A) \cdot P(B)$   
 Example: The probability of drawing a queen and a heart from two separate decks is:  $P(A \cap B) = \frac{1}{16} \cdot \frac{1}{4} = \frac{1}{64}$
- The combined probability  $P(A \cup B)$  that one or the other of two mutually exclusive events  $A$  and  $B$  will occur is:  $P(A \cup B) = P(A) + P(B)$   
 Example: The probability of drawing a queen or a jack from a single deck is:  $P(A \cup B) = \frac{1}{16} + \frac{1}{16} = \frac{1}{8}$
- The combined probability  $P(A \cup B)$  that one or the other or both of the two events  $A$  and  $B$  will occur is:  $P(A \cup B) = P(A) + P(B) - P(A \cap B)$   
 Example: The probability of drawing a queen or a heart from a single deck is:  $P(A \cup B) = \frac{1}{4} + \frac{1}{4} - \left(\frac{1}{16}\right) = \frac{7}{16}$
- The probability that event  $B$  occurs given that event  $A$  has already occurred is called the conditional probability  $P(B|A)$
- The probability of the sequence occurring is  $P(A \cap B) = P(A) \cdot P(B|A)$   
 Example: The probability of drawing a queen and a jack in succession from a single deck is:  $P(A \cap B) = \frac{1}{16} \cdot \frac{1}{15} = \frac{1}{240}$

### PERMUTATIONS & COMBINATIONS

- The number of permutations (= arrangements including changes in order) of  $n$  distinct objects taken all at a time is:  $n! = n \cdot (n-1) \dots 1$
- Number of permutations of  $n$  distinct objects taken  $r$  at a time is:  
 Without Repetition:  $P_r^n = \frac{n!}{(n-r)!}$   
 With Repetition of Objects:  $n^r = n \cdot n \dots n$
- Number of combinations (= arrangements consisting of changes in order) of  $n$  distinct objects taken  $r$  at a time is:  
 Without Repetition:  $C_r^n = \frac{n!}{r!(n-r)!}$   
 With Repetition of Objects:  $C_r^n = \frac{(n+r-1)!}{r!(n-1)!}$

Example: Given the following 3 objects (●, ○, △),  $n = 3$ ,  $r = 2$  (two taken at a time)

- Without Repetition:  $P_2^3 = \frac{3!}{(3-2)!} = 6$
- With Repetition of Objects:  $n^r = 3^2 = 9$
- add ●●, ○○, △△ to the outcome at left

# Practice Of Statistics Study Guide

**Sabine Zange**



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