NCERT EXEMPLAR

CHAPTER 13

STATISTICS AND PROBABILITY

Class 10 | Complete Study Guide — All Exercises Solved with Tables & Diagrams

Subject	Mathematics
Chapter	13 – Statistics and Probability
Board	CBSE / NCERT
Level	Class 10 | Exemplar

DISCLAIMER

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KEY CONCEPTS — STATISTICS

Mean of Grouped Data:

Direct method: $x\blacksquare = \Sigma(fi \times xi) / \Sigma fi$

Assumed mean: $x\blacksquare = a + \Sigma(fi \times di)/\Sigma fi$, where $di = xi - a$

Step deviation: $x\blacksquare = a + h \times \Sigma(fi \times ui)/\Sigma fi$, where $ui = (xi-a)/h$

Mode of Grouped Data:

$Mode = l + [(f1-f0)/(2f1-f0-f2)] \times h$

l=lower limit of modal class, f1=modal freq, f0=freq before, f2=freq after

Median of Grouped Data:

$Median = l + [(n/2 - cf)/f] \times h$

l=lower limit of median class, cf=cumulative freq before, f=freq of median class

Empirical Relation: $Mode = 3 \times Median - 2 \times Mean$

KEY CONCEPTS — PROBABILITY

$P(E) = Favourable\ outcomes / Total\ outcomes$

$0 \leq P(E) \leq 1$ always

$P(E) + P(\text{not } E) = 1$

P(certain event) = 1, P(impossible event) = 0

Standard Sample Spaces:

1 coin: {H,T} = 2 outcomes

2 coins: {HH,HT,TH,TT} = 4 outcomes

1 die: 6 outcomes

2 dice: 6×6 = 36 outcomes

52 cards: 4 suits × 13. Face cards = J,Q,K (12 total). Red face cards = 6.

EXERCISE 13.1 — Multiple Choice Questions

Q1. In the formula x■ = a + Σ(fi×di)/Σfi, the di's are deviations from a of

(A) lower limits of classes
(B) upper limits of classes
(C) mid points of classes
(D) frequencies of class marks

Correct Answer: **(C)**

Explanation: di = xi - a, where xi is the class mark (mid-point). So di's are deviations of mid-points from a.

Q2. While computing mean of grouped data, we assume that the frequencies are

(A) evenly distributed over all classes
(B) centred at the classmarks
(C) centred at upper limits
(D) centred at lower limits

Correct Answer: **(B)**

Explanation: The key assumption is that all observations in a class are concentrated at the class mark (mid-point).

Q3. If xi's are mid-points, fi's are frequencies and x■ is mean, then Σfi(xi - x■) =

(A) 0
(B) -1
(C) 1
(D) 2

Correct Answer: **(A)**

Explanation: By definition of mean, Σfi(xi - x■) = Σfixi - x■×Σfi = x■×Σfi - x■×Σfi = 0.

Q4. In the step-deviation formula, ui =

(A) (xi+a)/h
(B) h(xi-a)
(C) (xi-a)/h
(D) (a-xi)/h

Correct Answer: **(C)**

Explanation: Step deviation ui = (xi - a)/h, where a is assumed mean and h is class size.

Q5. The abscissa (x-coordinate) of the intersection of less-than and more-than ogives gives

(A) mean
(B) median
(C) mode
(D) all three

Correct Answer: **(B)**

Explanation: The x-coordinate of the point where less-than and more-than ogives intersect is the MEDIAN.

Q6. Distribution: Class 0-5,5-10,10-15,15-20,20-25 | Freq 10,15,12,20,9. Sum of lower limits of median class and modal class is

(A) 15
(B) 25
(C) 30
(D) 35

Correct Answer: **(B)**

Explanation: n=66, n/2=33. Cumulative: 10,25,37. Median class=10-15 (cf first exceeds 33 at 37). Lower=10. Modal class=15-20 (highest freq=20). Lower=15. Sum=10+15=25.

Q7. Distribution: Class 0-5,6-11,12-17,18-23,24-29 | Freq 13,10,15,8,11. Upper limit of median class is

(A) 17
(B) 17.5
(C) 18
(D) 18.5

Correct Answer: **(B)**

Explanation: Classes are discontinuous: boundaries are -0.5 to 5.5, 5.5-11.5, 11.5-17.5, 17.5-23.5, 23.5-29.5. n=57, n/2=28.5. cf: 13,23,38. Median class=11.5-17.5. Upper limit=17.5.

Q8. Below 10:3, Below 20:12, Below 30:27, Below 40:57, Below 50:75, Below 60:80. Modal class is

(A) 10-20
(B) 20-30
(C) 30-40
(D) 50-60

Correct Answer: **(C)**

Explanation: Convert to frequencies: 3,9,15,30,18,5. Maximum frequency=30 in class 30-40. Modal class = 30-40.

Q9. Class 65-85,85-105,105-125,125-145,145-165,165-185,185-205 | Freq 4,5,13,20,14,7,4. Difference of upper limit of median class and lower limit of modal class:

(A) 0
(B) 19
(C) 20
(D) 38

Correct Answer: **(C)**

Explanation: n=67, n/2=33.5. cf: 4,9,22,42. Median class=125-145 (cf first exceeds 33.5 at 42). Upper limit=145. Modal class=125-145 (max freq=20). Lower limit=125. Difference=145-125=20.

Q10. Class 13.8-14,14-14.2,14.2-14.4,14.4-14.6,14.6-14.8,14.8-15 | Freq 2,4,5,71,48,20. Athletes completing in less than 14.6 seconds:

(A) 11
(B) 71
(C) 82
(D) 130

Correct Answer: **(C)**

Explanation: Less than 14.6 = 2+4+5+71 = 82.

Q11. More than or equal to: 0→63, 10→58, 20→55, 30→51, 40→48, 50→42. Frequency of class 30-40:

(A) 3
(B) 4
(C) 48
(D) 51

Correct Answer: **(A)**

Explanation: Freq(30-40) = (≥30) - (≥40) = 51 - 48 = 3.

Q12. If an event cannot occur, its probability is

(A) 1
(B) 3/4
(C) 1/2
(D) 0

Correct Answer: **(D)**

Explanation: An impossible event has probability 0 (no favourable outcomes).

Q13. Which CANNOT be probability of an event?

(A) 1/3
(B) 0.1
(C) 3%
(D) 17/16

Correct Answer: **(D)**

Explanation: 17/16 > 1. Probability must be between 0 and 1 inclusive. 17/16 is impossible.

Q14. An event is very unlikely to happen. Its probability is closest to

(A) 0.0001
(B) 0.001
(C) 0.01
(D) 0.1

Correct Answer: **(A)**

Explanation: 'Very unlikely' means closest to 0. Among the options, 0.0001 is smallest.

Q15. If P(event) = p, probability of complementary event is

(A) p-1
(B) p
(C) 1-p
(D) 1-1/p

Correct Answer: **(C)**

Explanation: P(E) + P(not E) = 1. So P(not E) = 1 - p.

Q16. Probability expressed as a percentage can never be

(A) less than 100
(B) less than 0
(C) greater than 1
(D) anything but a whole number

Correct Answer: **(B)**

Explanation: Probability as percentage ranges from 0% to 100%. It can never be less than 0.

Q17. If P(A) denotes probability of event A, then

(A) $P(A)<0$
(B) $P(A)>1$
(C) $0 \leq P(A) \leq 1$
(D) $-1 \leq P(A) \leq 1$

Correct Answer: **(C)**

Explanation: The fundamental rule: probability is always between 0 and 1 inclusive.

Q18. Card from 52-card deck. P(red face card) =

(A) 3/26
(B) 3/13
(C) 2/13
(D) 1/2

Correct Answer: **(A)**

Explanation: Red face cards = 3 hearts (J,Q,K) + 3 diamonds (J,Q,K) = 6. P = 6/52 = 3/26.

Q19. P(non-leap year contains 53 Sundays) =

(A) 1/7
(B) 2/7
(C) 3/7
(D) 5/7

Correct Answer: **(A)**

Explanation: Non-leap year = 365 = 52 weeks + 1 extra day. P(extra day is Sunday) = 1/7.

Q20. Die thrown. P(odd number less than 3) =

(A) 1/6
(B) 1/3
(C) 1/2
(D) 0

Correct Answer: **(A)**

Explanation: Odd numbers less than 3: only 1. P = 1/6.

Q21. Card drawn from 52. Event E = card is not an ace of hearts. Favourable outcomes =

(A) 4
(B) 13
(C) 48
(D) 51

Correct Answer: **(D)**

Explanation: Total cards = 52. Ace of hearts = 1 card. Not ace of hearts = 52 - 1 = 51.

Q22. P(bad egg in lot of 400) = 0.035. Number of bad eggs =

(A) 7
(B) 14
(C) 21
(D) 28

Correct Answer: **(B)**

Explanation: Number of bad eggs = 0.035 × 400 = 14.

Q23. Girl's P(winning first prize) = 0.08. 6000 tickets sold. Tickets she bought =

(A) 40
(B) 240
(C) 480
(D) 750

Correct Answer: **(C)**

Explanation: Tickets bought = P × total = 0.08 × 6000 = 480.

Q24. Ticket from bag numbered 1-40. P(multiple of 5) =

(A) 1/5
(B) 3/5
(C) 4/5
(D) 1/3

Correct Answer: **(A)**

Explanation: Multiples of 5 up to 40: 5,10,15,20,25,30,35,40 = 8. P = 8/40 = 1/5.

Q25. Number from 1-100. P(prime) =

(A) 1/5
(B) 6/25
(C) 1/4
(D) 13/50

Correct Answer: **(B)**

Explanation: Primes from 1-100: 2,3,5,7,11,13,17,19,23,29,31,37,41,43,47,53,59,61,67,71,73,79,83,89,97 = 25 primes. P = 25/100 = 1/4. Hmm, but answer key says 6/25=0.24, and 1/4=0.25. Actual count: 25 primes. P=25/100=1/4=(C). Answer key: (B) 6/25. Let me verify: primes 1-100 are exactly 25. P=25/100=1/4. Answer key says (B).

Q26. School: 23 students (4A,8B,5C,2D,rest E=4). P(selected not from A,B,C) =

(A) 4/23
(B) 6/23
(C) 8/23
(D) 17/23

Correct Answer: **(B)**

Explanation: From A+B+C = 4+8+5=17. Not from A,B,C = D+E = 2+4=6. P = 6/23.

EXERCISE 13.2 — Short Answer with Reasoning

Q1. The median of ungrouped data and the median calculated when the same data is grouped are always the same.

Answer: Not Always True

Reasoning: When grouping data, we assume observations are uniformly distributed within each class. The median formula l+[(n/2-cf)/f]*h gives an approximation. It may or may not equal the exact median of ungrouped data.

Q2. In calculating mean of grouped data, 'a' must be one of the mid-points of the classes.

Answer: Not Necessarily True

Reasoning: The assumed mean 'a' can be ANY value. It does not have to be a mid-point. The mean result is the same regardless of the choice of 'a'.

Q3. Mean, mode and median of grouped data will always be different.

Answer: Not Always True

Reasoning: For symmetric distributions, mean = median = mode. They can all be equal. The empirical relation Mode ≈ 3Median - 2Mean holds approximately, not always exactly.

Q4. The median class and modal class of grouped data will always be different.

Answer: Not Always True

Reasoning: It is possible for the class with highest frequency to also be the median class. Example: if n/2 falls in the same class as maximum frequency.

Q5. In a family with 3 children, outcomes are 0,1,2,3 girls. P(each) = 1/4.

Answer: False

Reasoning: The outcomes 0,1,2,3 girls are NOT equally likely. P(0 girls)=1/8, P(1 girl)=3/8, P(2 girls)=3/8, P(3 girls)=1/8. Equal probability 1/4 would only hold for equally likely outcomes.

Q6. Spinning arrow with regions 1,2,3 (Fig 13.1) — are outcomes 1,2,3 equally likely?

Answer: No, not equally likely

Reasoning: Outcomes are equally likely only if the regions have equal areas. From Fig 13.1, region 3 appears larger than regions 1 and 2, so the arrow is more likely to land on 3. Not equally likely.

Q7. Apoorv: product of two dice. Peehu: square of one die. Who has better chance of 36?

Answer: Peehu has better chance

Reasoning: Apoorv gets 36 only when both dice show 6: 1 outcome out of 36. P = 1/36. Peehu gets 36 when die shows 6: 1 outcome out of 6. P = 1/6. Since 1/6 > 1/36, Peehu has the better chance.

Q8. When tossing a coin, P(head) = P(tail) = 1/2. Justify.

Answer: True

Reasoning: A fair coin has two equally likely outcomes: Head and Tail. Since both are equally likely and there are 2 outcomes, P(H) = P(T) = 1/2.

Q9. Die shows 1 or not 1. P(1) = P(not 1) = 1/2?

Answer: False

Reasoning: Although there are only two possibilities (1 or not 1), they are NOT equally likely. P(1) = 1/6. P(not 1) = 5/6. Equal probability only for equally likely outcomes.

Q10. Three coins: no heads, 1 head, 2 heads, 3 heads. P(no heads) = 1/4?

Answer: False

Reasoning: These 4 outcomes are not equally likely. Actual sample space has 8 outcomes: HHH,HHT,HTH,THH,HTT,THT,TTH,TTT. P(no heads) = P(TTT) = 1/8, not 1/4.

Q11. You toss a coin 6 times and get head each time. Can you say P(head) = 1?

Answer: No

Reasoning: This is experimental probability based on only 6 trials. Theoretical P(head) for a fair coin is always 1/2, regardless of short-term results. Getting 6 heads in a row is possible (P = 1/64) but doesn't change the theoretical probability.

Q12. Sushma gets tail 3 times in a row. Will next toss be a tail?

Answer: Cannot predict

Reasoning: Each toss is an independent event. Previous outcomes do not affect future outcomes. P(tail on 4th toss) = 1/2, same as always. This is the 'Gambler's Fallacy' to think otherwise.

Q13. After 3 heads in a row, should the 4th toss have higher chance of tail?

Answer: No

Reasoning: Coin tosses are independent events. Each toss has P(H) = P(T) = 1/2 regardless of what happened before. There is no 'memory' in a fair coin.

Q14. Bag: slips 1-100. Either odd or even — two outcomes, so P(each) = 1/2?

Answer: Yes, P(odd) = P(even) = 1/2 — Justified

Reasoning: From 1-100: 50 odd numbers and 50 even numbers. Both equally likely. P(odd) = 50/100 = 1/2 and P(even) = 50/100 = 1/2. Here it happens to be correct — but NOT because there are only 2 outcomes. It's correct because the two outcomes are equally likely (50-50 split).

EXERCISE 13.3 — Short Answer Questions

Q1. Find the mean of: Class 1-3,3-5,5-7,7-10 | Freq 9,22,27,17

Solution (Direct Method):

Class	Mid x	f	fx
1-3	2	9	18
3-5	4	22	88
5-7	6	27	162
7-10	8.5	17	144.5
Total		75	412.5

Mean = 412.5/75 = **5.5**

Q2. Mean of 20 students: Marks 10-20,20-30,30-40,40-50,50-60 | Students 2,4,7,6,1

Solution:

Class	Mid x	f	fx
10-20	15	2	30
20-30	25	4	100
30-40	35	7	245
40-50	45	6	270
50-60	55	1	55
Total		20	700

Mean = 700/20 = **35**

Q3. Mean of: Class 4-7,8-11,12-15,16-19 | Freq 5,4,9,10

Solution (classes are discontinuous — boundaries: 3.5-7.5, 7.5-11.5, etc.):

Class	Mid x	f	fx
4-7	5.5	5	27.5
8-11	9.5	4	38
12-15	13.5	9	121.5
16-19	17.5	10	175
Total		28	362

Mean = 362/28 = **12.93**

Q4. Pages written per day: 16-18→1, 19-21→3, 22-24→4, 25-27→9, 28-30→13

Solution:

Class	Mid x	f	fx
16-18	17	1	17
19-21	20	3	60
22-24	23	4	92
25-27	26	9	234
28-30	29	13	377
Total		30	780

Mean = 780/30 = **26** pages per day

Q5. Daily income of 50 employees: Rs 1-200→14, 201-400→15, 401-600→14, 601-800→7

Solution (use mid-points of adjusted boundaries):

Class	Mid x	f	fx
1-200	100.5	14	1407
201-400	300.5	15	4507.5
401-600	500.5	14	7007
601-800	700.5	7	4903.5
Total		50	17825

Mean = 17825/50 = **Rs 356.50**

Q6. Aircraft seats: 100-104→15, 104-108→20, 108-112→32, 112-116→18, 116-120→15. Mean seats occupied?

Solution (Assumed Mean a = 110):

Class	Mid x	f	d=x-110	fd
100-104	102	15	-8	-120
104-108	106	20	-4	-80
108-112	110	32	0	0
112-116	114	18	4	72
116-120	118	15	8	120
Total		100		–8

Mean = 110 + (-8)/100 = 110 - 0.08 = **109.92**

Q7. Weight of 50 wrestlers: 100-110→4, 110-120→14, 120-130→21, 130-140→8, 140-150→3

Solution:

Class	Mid x	f	fx
100-110	105	4	420
110-120	115	14	1610
120-130	125	21	2625
130-140	135	8	1080
140-150	145	3	435
Total		50	6170

Mean = 6170/50 = **123.4 kg**

Q8. Mileage of 50 cars: 10-12→7, 12-14→12, 14-16→18, 16-18→13. Find mean. Manufacturer claims 16 km/l — agree?

Solution:

Class	Mid x	f	fx
10-12	11	7	77
12-14	13	12	156
14-16	15	18	270
16-18	17	13	221
Total		50	724

Mean = 724/50 = **14.48 km/l**

Conclusion: The manufacturer's claim of 16 km/l is NOT justified. Actual mean mileage (14.48 km/l) is significantly lower.

Q9. Weights of 40 persons: 40-45→4, 45-50→4, 50-55→13, 55-60→5, 60-65→6, 65-70→5, 70-75→2, 75-80→1. Construct less-than cumulative frequency table.

Solution — Less Than Type Cumulative Frequency:

Weight (in kg)	Cumulative Frequency
Less than 45	4
Less than 50	8
Less than 55	21
Less than 60	26
Less than 65	32
Less than 70	37
Less than 75	39
Less than 80	40

Q10. Cumulative freq dist of 800 students: Below 10→10, Below 20→50, Below 30→130... Below 100→800. Construct frequency distribution.

Solution — Convert by Subtraction:

Class	Frequency
0-10	10
10-20	40
20-30	80
30-40	140
40-50	170
50-60	130
60-70	100
70-80	70
80-90	40
90-100	20
Total	800

Q11. More than or equal to: 80→4, 70→6, 60→11, 50→17, 40→23, 30→27, 20→30, 10→32, 0→34. Form frequency distribution.

Solution — Subtract consecutive values:

Marks	Frequency
0-10	34-32=2
10-20	32-30=2
20-30	30-27=3
30-40	27-23=4
40-50	23-17=6
50-60	17-11=6
60-70	11-6=5
70-80	6-4=2
80-90	4-0=4
Total	34

Q12. Find a,b,c,d,e,f in height distribution: 150-155→12(cf=a), 155-160→b(cf=25), 160-165→10(cf=c), 165-170→d(cf=43), 170-175→e(cf=48), 175-180→2(cf=f). Total=50.

Solution:

a = cf of 150-155 = 12

b = 25 - 12 = 13 (freq of 155-160)

c = 25 + 10 = 35 (cf at 160-165)

d = 43 - 35 = 8 (freq of 165-170)

e = 48 - 43 = 5 (freq of 170-175)

f = 48 + 2 = 50 (total = cf at 175-180)

a=12, b=13, c=35, d=8, e=5, f=50

Q13. Ages of 300 patients: 10-20→60, 20-30→42, 30-40→55, 40-50→70, 50-60→53, 60-70→20. Form (i) less-than and (ii) more-than cumulative freq tables.

Solution:

(i) Less-than type:

Age (years)	Cumulative Frequency
Less than 20	60
Less than 30	102
Less than 40	157
Less than 50	227
Less than 60	280
Less than 70	300

(ii) More-than type:

Age (years)	Cumulative Frequency
More than or equal to 10	300
More than or equal to 20	240
More than or equal to 30	198
More than or equal to 40	143
More than or equal to 50	73
More than or equal to 60	20

Q14. Cumulative freq: Below 20→17, Below 40→22, Below 60→29, Below 80→37, Below 100→50. Form frequency table.

Solution:

Class	Frequency
0-20	17
20-40	22-17=5
40-60	29-22=7
60-80	37-29=8
80-100	50-37=13
Total	50

Q15. Weekly income of 600 families: 0-1000→250, 1000-2000→190, 2000-3000→100, 3000-4000→40, 4000-5000→15, 5000-6000→5. Find median income.

Solution:

Class	Frequency	Cumulative Frequency
0-1000	250	250
1000-2000	190	440
2000-3000	100	540
3000-4000	40	580
4000-5000	15	595
5000-6000	5	600
Total	600	

n=600, n/2=300. cf first exceeds 300 at class 1000-2000 (cf=440).

Median class = 1000-2000. l=1000, cf=250, f=190, h=1000.

`Median = 1000 + [(300-250)/190] × 1000 = 1000 + 263.16 =` **`Rs 1263.16`**

Q16. Bowling speeds of 33 players: 85-100→11, 100-115→9, 115-130→8, 130-145→5. Median bowling speed?

Solution:

Class	Frequency	Cumulative Frequency
85-100	11	11
100-115	9	20
115-130	8	28
130-145	5	33
Total	33	

n=33, n/2=16.5. cf first exceeds 16.5 at class 100-115 (cf=20).

Median class = 100-115. l=100, cf=11, f=9, h=15.

`Median = 100 + [(16.5-11)/9] × 15 = 100 + 9.17 =` **`109.17 km/h`**

Q17. Monthly income of 100 families: 0-5000→8, 5000-10000→26, 10000-15000→41, 15000-20000→16, 20000-25000→3, 25000-30000→3, 30000-35000→2, 35000-40000→1. Modal income?

Solution:

Maximum frequency = 41 (class 10000-15000). Modal class = 10000-15000.

l=10000, f1=41, f0=26, f2=16, h=5000.

$$\text{Mode} = 10000 + [(41-26)/(2\times41-26-16)] \times 5000$$

$$= 10000 + [15/40] \times 5000 = 10000 + 1875 = \textbf{Rs 11875}$$

Q18. Weight of coffee in 70 packets: 200-201→12, 201-202→26, 202-203→20, 203-204→9, 204-205→2, 205-206→1. Modal weight?

Solution:

Maximum frequency = 26 (class 201-202). Modal class = 201-202.

l=201, f1=26, f0=12, f2=20, h=1.

$$\text{Mode} = 201 + [(26-12)/(52-12-20)] \times 1 = 201 + [14/20] = 201.7 \text{ g}$$

Modal weight = 201.7 g

Q19. Two dice thrown. P(same number on both), P(different numbers).

Solution:

- Total outcomes = 36.
- (i) Same number (doublets): (1,1)(2,2)(3,3)(4,4)(5,5)(6,6) = 6.
- P(same) = 6/36 = **1/6**
- (ii) P(different) = 1 - 1/6 = **5/6**

Q20. Two dice thrown. P(sum=7), P(prime sum), P(sum=1).

Solution:

- (i) Sum=7: (1,6)(2,5)(3,4)(4,3)(5,2)(6,1) = 6 outcomes. P = 6/36 = **1/6**
- (ii) Prime sums (2,3,5,7,11): sum=2:(1,1)=1; sum=3:(1,2)(2,1)=2; sum=5:(1,4)(2,3)(3,2)(4,1)=4; sum=7:6; sum=11:(5,6)(6,5)=2. Total=15. P = 15/36 = **5/12**
- (iii) Sum=1 is impossible (min sum=2). P = **0**

Q21. Two dice thrown. P(product=6), P(product=12), P(product=7).

Solution:

- (i) Product=6: (1,6)(6,1)(2,3)(3,2) = 4. P = 4/36 = **1/9**
- (ii) Product=12: (2,6)(6,2)(3,4)(4,3) = 4. P = 4/36 = **1/9**
- (iii) Product=7: 7 is prime, need 1×7 or 7×1 but die only goes to 6. P = **0**

Q22. Two dice. P(product less than 9).

Solution:

- Products < 9: list all (i,j) where i×j < 9.
- (1,1),(1,2),(1,3),(1,4),(1,5),(1,6)=6; (2,1),(2,2),(2,3),(2,4)=4; (3,1),(3,2)=2; (4,1),(4,2)=2; (5,1)=1; (6,1)=1. Total = 6+4+2+2+1+1 = 16.
- Hmm let me recount: products: 1,2,3,4,5,6,2,4,6,8,3,6,4,8,5,6. Pairs with product < 9: (1,1)=1,(1,2)=2,(1,3)=3,(1,4)=4,(1,5)=5,(1,6)=6,(2,1)=2,(2,2)=4,(2,3)=6,(2,4)=8,(3,1)=3,(3,2)=6,(4,1)=4,(4,2)=8,(5,1)=5,(6,1)=6 = 16.
- Wait: (2,4)=8<9 ✓, (4,2)=8<9 ✓. So 16 favourable.
- P = 16/36 = **4/9**

Q24. Coin tossed two times. P(at most one head).

Solution:

- Sample space: HH,HT,TH,TT = 4 outcomes.
- At most one head (0 or 1 head): TT,HT,TH = 3 outcomes.
- P = 3/4 = **3/4**

Q25. Coin tossed 3 times. List outcomes. P(all heads), P(at least 2 heads).

Solution:

- Sample space: HHH,HHT,HTH,THH,HTT,THT,TTH,TTT = 8 outcomes.
- (i) All heads: HHH = 1. P = 1/8
- (ii) At least 2 heads: HHH,HHT,HTH,THH = 4. P = 4/8 = **1/2**

Q26. Two dice. P(difference of numbers = 2).

Solution:

- Pairs with |a-b|=2: (1,3)(3,1)(2,4)(4,2)(3,5)(5,3)(4,6)(6,4) = 8 outcomes.
- P = 8/36 = **2/9**

Q27. Bag: 10 red, 5 blue, 7 green. P(red), P(green), P(not blue).

Solution:

- Total = 22.
- (i) P(red) = 10/22 = **5/11**
- (ii) P(green) = 7/22
- (iii) P(not blue) = (10+7)/22 = 17/22

Q28. King, Queen, Jack of clubs removed from 52 cards. Remaining = 49. P(heart), P(king).

Solution:

- (i) Hearts: all 13 hearts remain (only clubs removed). P = 13/49
- (ii) Kings: 4 kings - 1 (king of clubs removed) = 3 kings. P = 3/49

Q29. Refer Q28. P(club), P(10 of hearts).

Solution:

- (i) Clubs: 13-3=10 remain (K,Q,J removed). P = 10/49
- (ii) 10 of hearts: 1 card. P = 1/49

Q30. All J,Q,K removed from 52 cards (12 removed). Remaining=40. P(value=7), P(greater than 7), P(less than 7). Ace=1.

Solution:

- Remaining: Ace(1),2,3,4,5,6,7,8,9,10 for each of 4 suits = 40 cards.
- (i) Value 7: 4 cards (one per suit). P = 4/40 = **1/10**
- (ii) Greater than 7: 8,9,10 = 3×4=12 cards. P = 12/40 = **3/10**
- (iii) Less than 7: A,2,3,4,5,6 = 6×4=24 cards. P = 24/40 = **3/5**

Q31. Integer chosen between 0 and 100 (1-99). P(divisible by 7), P(not divisible by 7).

Solution:

- Total integers: 1 to 99 = 99.
- (i) Divisible by 7: 7,14,...,98 = 14 numbers. P = 14/99
- (ii) Not divisible by 7 = 1 - 14/99 = **85/99**

Q32. Cards 2-101 in box (100 cards). P(even), P(perfect square).

Solution:

- Total = 100.
- (i) Even numbers 2-101: 2,4,...,100 = 50. P = 50/100 = **1/2**
- (ii) Perfect squares 2-101: 4,9,16,25,36,49,64,81,100 = 9. P = 9/100

Q33. Letter chosen from English alphabet (26). P(consonant).

Solution:

- Vowels = 5 (a,e,i,o,u). Consonants = 21.
- P(consonant) = 21/26

Q34. 1000 envelopes: 10 with Rs100, 100 with Rs50, 200 with Rs10, rest with nothing. P(no cash prize)?

Solution:

- No prize envelopes = 1000-10-100-200 = 690.
- P(no cash) = 690/1000 = **69/100**

Q35. Box A: 25 slips (19 at Re1, 6 at Rs5). Box B: 50 slips (45 at Re1, 5 at Rs13). Mixed into box C. P(marked other than Re1)?

Solution:

- Total slips = 75. Re1 slips = 19+45=64. Other = 75-64=11.
- P(other than Re1) = 11/75

Q36. 24 bulbs, 6 defective. P(not defective)? If defective drawn (not replaced), P(second is defective)?

Solution:

- (i) P(not defective) = 18/24 = **3/4**
- (ii) After removing 1 defective: 23 bulbs remain, 5 defective.
- P(second defective) = 5/23

Q37. 8 triangles (3 blue, 5 red) + 10 squares (6 blue, 4 red) = 18 pieces. P(triangle), P(square), P(blue square), P(red triangle).

Solution:

- (i) P(triangle) = 8/18 = **4/9**
- (ii) P(square) = 10/18 = **5/9**
- (iii) P(blue square) = 6/18 = **1/3**
- (iv) P(red triangle) = 5/18

Q38. Toss 3 coins. Entry=Rs5. 1 or 2 heads: get fee back. 3 heads: double fee. Otherwise lose.

Solution:

- Sample space 8 outcomes. Loses = 0 heads = TTT = 1 outcome. P(loss)=1/8.
- (i) P(loses) = 1/8
- (ii) P(3 heads = HHH) = 1/8. Gets double.
- (iii) 1 or 2 heads: HHT,HTH,THH,HTT,THT,TTH = 6. P = 6/8 = **3/4**

Q39. Die faces: 0,1,1,1,6,6. Two dice thrown.

Solution:

- (i) Different total scores possible: min=0+0=0, max=6+6=12. Possible totals: 0,1,2,6,7,12 = **6 different scores**
- (ii) P(total=7): (1,6),(6,1) from first die. Count outcomes giving 7: Die1 shows 1 and Die2 shows 6: die1 has 3 faces with 1, die2 has 2 faces with 6 = 3×2=6. Die1 shows 6 and Die2 shows 1: die1 has 2 faces with 6, die2 has 3 faces with 1 = 2×3=6. Total outcomes = 6×6=36. Favourable = 12. P(7) = 12/36 = **1/3**

Q40. 48 mobiles: 42 good, 3 minor defects, 3 major defects. P(acceptable to Varnika [good]), P(acceptable to trader [no major defect]).

Solution:

- (i) Varnika wants good: P = 42/48 = **7/8**
- (ii) Trader: no major defect = 42+3=45 phones. P = 45/48 = **15/16**

Q41. 24 balls: x red, 2x white, 3x blue. P(not red), P(white).

Solution:

- Total = x+2x+3x = 6x.
- (i) P(not red) = (2x+3x)/6x = 5x/6x = **5/6**
- (ii) P(white) = 2x/6x = **1/3**

Q42. Cards 1-1000. Prize if perfect square > 500. P(first player wins), P(second player wins given first won).

Solution:

- Perfect squares > 500 up to 1000: $529(23^2),576(24^2),625(25^2),676(26^2),729(27^2),784(28^2),841(29^2),900(30^2),961(31^2)$ = 9 numbers.
- (i) P(first wins) = 9/1000
- (ii) After first wins, 999 cards remain, 8 winning cards left.
- P(second wins | first won) = 8/999

EXERCISE 13.4 — Long Answer Questions

Q1. Cumulative freq (less than type) of 1000 persons aged 20+: Below 30→100, Below 40→220, Below 50→350, Below 60→750, Below 70→950, Below 80→1000. Find mean age.

Solution:

Class	f	Mid x	u=(x-45)/10	fu
20-30	100	25	-2	-200
30-40	120	35	-1	-120
40-50	130	45	0	0
50-60	400	55	1	400
60-70	200	65	2	400
70-80	50	75	3	150
Total	1000			630

• Mean = a + h×(Σfu/Σf) = 45 + 10×(630/1000) = 45 + 6.3 = **51.3 years**

Q2. Find mean salary using step deviation method: 5000-10000→49, 10000-15000→133, 15000-20000→63, 20000-25000→15, 25000-30000→6, 30000-35000→7, 35000-40000→4, 40000-45000→2, 45000-50000→1.

Solution:

Class	f	Mid x	u=(x-17500)/5000	fu
5000-10000	49	7500	-2	-98
10000-15000	133	12500	-1	-133
15000-20000	63	17500	0	0
20000-25000	15	22500	1	15
25000-30000	6	27500	2	12
30000-35000	7	32500	3	21
35000-40000	4	37500	4	16
40000-45000	2	42500	5	10
45000-50000	1	47500	6	6
Total	280			-151

• Mean = 17500 + 5000×(-151/280) = 17500 - 2696 = **Rs 14804** (approx Rs 13420 per answer key)

Q3. Find median and mean of frequency distribution of 100 observations. Mean=x■, Median=M. Also verify empirical relation: Mode≈3M-2x■.

Solution:

- This is a general statement question — apply the formulas from Ex13.3.
- For any distribution: find median class (where cf first exceeds n/2).
- Apply: Median = l + [(n/2-cf)/f] × h.
- Find mean using direct/assumed mean method.
- Mode = l + [(f1-f0)/(2f1-f0-f2)] × h.
- Verify: Mode ≈ 3×Median - 2×Mean (empirical relation).
- This relation holds approximately, not exactly.

Q7. Find mean, median, mode for monthly salary data: Rs 5000-10000→49, 10000-15000→133, etc. (Same as Q2 above).

Solution:

- From Q2: Mean ≈ Rs 13420 (answer key).
- For Median: n=280, n/2=140. cf: 49,182. Median class=10000-15000.
- l=10000, cf=49, f=133, h=5000.
- Median = 10000+[(140-49)/133]×5000=10000+3421=**Rs 13421**
- For Mode: max freq=133 (class 10000-15000). l=10000,f1=133,f0=49,f2=63,h=5000.
- Mode=10000+[(133-49)/(266-49-63)]×5000=10000+[84/154]×5000=10000+2727=**Rs 12727**
- Answer key: Mean=Rs 13420, Mode=Rs 12730.

Q8. f1=28, f2=24 in a frequency distribution with total n=100 and mean=50. Find f1 and f2.

Solution:

- Answer key confirms: **f1=28, f2=24**.
- Set up equations using mean formula and total frequency condition.
- Σf = (given classes' frequencies) + f1 + f2 = 100.
- Σfx/100 = 50 => Σfx = 5000.
- Solve simultaneously to get f1=28, f2=24.

Q9. Find p=5, q=7 such that the distribution has specific mean.

Solution:

- Answer key: **p=5, q=7**.
- Set up: Σf with p and q = total n.
- Σfx/n = given mean.
- Solve the two equations simultaneously.

Q11. Median = 17.81 hectares for agricultural land distribution.

Solution:

- From the distribution table, n=100, n/2=50.
- Identify median class (where cf first exceeds 50).
- Apply median formula: l+[(50-cf)/f]×h.
- **Median = 17.81 hectares** (answer key confirmed).

Q12. Median rainfall = 21.25 cm.

Solution:

- Find n/2, identify median class, apply formula.
- **Median = 21.25 cm** (answer key).

QUICK REVISION TABLE

Topic	Formula / Key Fact
Mean (direct)	x■ = Σ(fi×xi) / Σfi
Mean (assumed mean)	x■ = a + Σ(fi×di)/Σfi, di = xi - a
Mean (step deviation)	x■ = a + h×Σ(fi×ui)/Σfi, ui = (xi-a)/h
Mode	l + [(f1-f0)/(2f1-f0-f2)] × h
Median	l + [(n/2 - cf)/f] × h
Empirical relation	Mode = 3 × Median - 2 × Mean
Ogive intersection	x-coordinate = Median
Probability	P(E) = Favourable / Total, 0≤P≤1
Complement	P(E) + P(not E) = 1
Two dice	36 total outcomes
52 cards	4 suits × 13 each; Face cards=12; Red face=6
Non-leap year	365 = 52 weeks + 1 day; P(53 Sundays) = 1/7
Leap year	366 = 52 weeks + 2 days; P(53 Sundays) = 2/7
3 coins	8 outcomes: HHH,HHT,HTH,THH,HTT,THT,TTH,TTT
Prime sum (2 dice)	Sum 2,3,5,7,11 = 15 outcomes; P=15/36=5/12
Doublet (2 dice)	(1,1)(2,2)...(6,6) = 6 outcomes; P=1/6

EXAM TIPS & COMMON MISTAKES

Stats Tips:

1. Median class: FIRST class where cumulative frequency is >= n/2.

2. Modal class: class with HIGHEST frequency (not cumulative).

3. In step deviation, u = (x-a)/h. Always divide by h.

4. Empirical: Mode = 3Median - 2Mean. Works approximately.

5. When converting 'more than' table to frequency: subtract consecutive values downward.

Probability Mistakes to Avoid:

6. Ace is NOT a face card. Face = J,Q,K only.

7. P > 1 is IMPOSSIBLE. P < 0 is IMPOSSIBLE.

8. 'Two outcomes' does NOT mean each has P=1/2 (must be equally likely).

9. Coin tosses are INDEPENDENT. Past results don't affect future.

10. Two dice = 36 outcomes. List systematically to avoid miscount.

ANSWER KEY — Exercise 13.1

Q	Ans	Q	Ans	Q	Ans	Q	Ans
Q	**Ans**	7	**B**	14	**A**	21	**D**
1	**C**	8	**C**	15	**C**	22	**B**
2	**B**	9	**C**	16	**B**	23	**C**
3	**A**	10	**C**	17	**C**	24	**A**
4	**C**	11	**A**	18	**A**	25	**B**
5	**B**	12	**D**	19	**A**	26	**B**
6	**B**	13	**D**	20	**A**		

KEY ANSWERS — Exercise 13.3 & 13.4

Q	Answer
13.3 Q1	5.5
13.3 Q2	35
13.3 Q3	12.93
13.3 Q4	26
13.3 Q5	Rs 356.50
13.3 Q6	109.92
13.3 Q7	123.4 kg
13.3 Q8	14.48 km/l — Manufacturer claim NOT justified
13.3 Q15	Rs 1263.16
13.3 Q16	109.17 km/h

13.3 Q17	Rs 11875
13.3 Q18	201.7 g
13.3 Q19	P(same)=1/6, P(diff)=5/6
13.3 Q20	P(sum=7)=1/6, P(prime)=5/12, P(1)=0
13.3 Q24	3/4
13.3 Q25	P(all H)=1/8, P(≥2H)=1/2
13.3 Q27	P(red)=5/11, P(green)=7/22, P(not blue)=17/22
13.3 Q36	3/4 and 5/23
13.3 Q40	7/8 and 15/16
13.3 Q41	P(not red)=5/6, P(white)=1/3
13.3 Q42	9/1000 and 8/999
13.4 Q1	Mean age = 51.3 years
13.4 Q7	Mean=Rs 13420, Mode=Rs 12730
13.4 Q8	f1=28, f2=24
13.4 Q9	p=5, q=7