

Probability and Statistics: practice solutions, Grade 11 – download the PDF

Written solutions to the chapter problems. Check each step, then correct yourself.

1 Lunch combinations



Three stages, so we multiply: $5 \times 4 \times 3 = 60$.

Answer: 60 different lunches.

2 Factorial arithmetic



$$6! = 720.$$

$$\frac{8!}{6!} = 8 \times 7 = 56.$$

$$P(7, 2) = 7 \times 6 = 42.$$

$$C(7, 2) = \frac{42}{2!} = 21.$$

3 Bike lock



(a) $10 \times 10 \times 10 \times 10 = 10,000$.

(b) $10 \times 9 \times 8 \times 7 = 5,040$.

4 Pizza toppings



Order does not matter (the same toppings give the same pizza), so we use a combination:

$$C(9, 3) = \frac{9 \times 8 \times 7}{3 \times 2 \times 1} = 84.$$

Answer: 84 pizzas.

5 Coin and die



The coin and the die do not influence each other, so the events are independent:

$$\frac{1}{2} \times \frac{3}{6} = \frac{1}{4}.$$

Answer: $\frac{1}{4} = 0.25$.

6 Tea or coffee



(a) There are $9 + 21 = 30$ people under 30: $P = \frac{21}{30} = 0.7$.

(b) There are $11 + 19 = 30$ people 30 or older: $P = \frac{11}{30} \approx 0.367$.

7 Heights and the empirical rule



(a) 66 ± 3 : between 63 and 69 inches.

(b) 66 ± 6 : between 60 and 72 inches.

(c) 72 inches is 2 standard deviations above the mean. About 95% lie within, so the two tails share 5%, and the upper tail is about **2.5%**.

8 Books on a shelf



Glue the two books into one block. Then we arrange 4 objects: $4! = 24$ ways. Inside the block the two books can be swapped: $2! = 2$ ways.

Total: $24 \times 2 = 48$.

9 Choosing a committee



Choose the girls: $C(4, 2) = 6$. Choose the boys: $C(5, 2) = 10$. Multiply the two stages: $6 \times 10 = 60$.

10 Two aces



The draws are dependent: $\frac{4}{52} \times \frac{3}{51} = \frac{12}{2652} = \frac{1}{221}$.

Answer: $\frac{1}{221} \approx 0.0045$.

11 Exactly one red



Two ways: red then green, or green then red.

$$\frac{6}{10} \times \frac{4}{9} + \frac{4}{10} \times \frac{6}{9} = \frac{24}{90} + \frac{24}{90} = \frac{48}{90} = \frac{8}{15}.$$

12 Guessing on a quiz



Binomial with $n = 8, p = 0.5$: $P(X = 6) = C(8, 6)(0.5)^6(0.5)^2 = \frac{28}{256} = \frac{7}{64} \approx 0.109$.

13 Expanding a binomial



Row 4 of Pascal's triangle: 1, 4, 6, 4, 1. Powers of -3 : 1, -3 , 9, -27 , 81.

$$(x - 3)^4 = x^4 - 12x^3 + 54x^2 - 108x + 81.$$

14 Standard deviation by hand



Mean: $\frac{32}{8} = 4.$

Squared deviations: 9, 1, 1, 1, 0, 0, 4, 16, sum 32.

$$\sigma = \sqrt{32/8} = \sqrt{4} = 2.$$

15 Which test was better?



Maya: $z = \frac{82 - 70}{8} = 1.5.$

Brother: $z = \frac{31 - 25}{3} = 2.$

His score is 2 standard deviations above the mean, Maya's is 1.5. Relative to his class, the brother did better.

16 Stratified sample



Total: $240 + 220 + 200 + 140 = 800$, so the sampling fraction is $\frac{80}{800} = 10\%.$

9th: 24; 10th: 22; 11th: 20; 12th: 14. Check: $24 + 22 + 20 + 14 = 80.$

17 Letters of STATISTICS



There are 10 letters: S three times, T three times, I twice, A once, C once.

$$\frac{10!}{3!3!2!} = \frac{3,628,800}{72} = 50,400.$$

18 A screening test



Sick: $0.02 \times 1000 = 20$ people, of whom $0.9 \times 20 = 18$ test positive.

Healthy: 980 people, of whom $0.05 \times 980 = 49$ test positive.

$$P(\text{sick} \mid \text{positive}) = \frac{18}{18 + 49} = \frac{18}{67} \approx 0.269.$$

Only about 27%: because the condition is rare, most positives are false alarms.

19 Defective parts



(a) Complement: $1 - 0.9^{10} \approx 1 - 0.3487 = 0.6513$.

(b) $C(10, 2)(0.1)^2(0.9)^8 = 45 \times 0.01 \times 0.4305 \approx 0.1937$.

(c) Mean = $10 \times 0.1 = 1$. Standard deviation = $\sqrt{10 \times 0.1 \times 0.9} = \sqrt{0.9} \approx 0.949$.

20 Coefficients



(a) The term with x^3 is $C(6, 3)(2x)^3(1)^3 = 20 \times 8x^3 = 160x^3$. The coefficient is 160.

(b) Replace x by 1: $(2 + 1)^6 = 3^6 = 729$.

21 Polling margin of error



(a) $\sqrt{\frac{0.64 \times 0.36}{625}} = \frac{0.48}{25} = 0.0192$, so $ME = 1.96 \times 0.0192 \approx 0.0376$, about 3.8%.

(b) 0.64 ± 0.0376 : from about 60.2% to 67.8%.

(c) $1.96 \times \frac{0.5}{\sqrt{n}} \leq 0.03$ gives $\sqrt{n} \geq 32.67$, so $n \geq 1067.1$. A sample of 1,068 residents is needed.

22

Battery life

- (a) 30 and 50 are $\mu \pm 2\sigma$: about 95%.
- (b) 45 is $\mu + \sigma$. Outside $\pm\sigma$ lies 32%, half of it above: about 16%.
- (c) From -1σ to $+2\sigma$: $34\% + 47.5\% = 81.5\%$. Then $0.815 \times 2500 = 2037.5$, about 2,038 batteries.

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