Unit 15 · Probability & Expected Value Cheat Sheet

Unit 15 focus: find probabilities, count outcomes and use complements

1 PROBABILITY WORDS

Term	Meaning / quick example
Probability	0 to 1 (0% to 100%) chance.
Complement	P(not A) = 1 − P(A).
Independent	One does not affect the other.
Experimental	From trials: frequency ÷ trials.

2 BASIC PROBABILITY

$P(A) = \frac{\text{favorable}}{\text{total}}$ for equally likely outcomes.

Example: 6 red, 9 blue, 5 green tickets; draw one.
Total: 20
Green: $5 \div 20 = 0.25$

Answer: 25%

3 EXPERIMENTAL ESTIMATE

Use the sample rate to predict.

Example: 12 defective of 400 tested; shipment of 5,000.
Rate: $12 \div 400 = 0.03$
Expect: $0.03(5{,}000) = 150$

Answer: About 150 defective

4 "AND" AND "OR"

Independent "and": $P(A \text{ and } B) = P(A)P(B)$
"Or": $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

Bus late 30%, train late 10%: both $0.3(0.1) = 0.03$.

5 COUNTING

Situation	Count
4 shirts, 3 pants, 2 shoes	$4 \cdot 3 \cdot 2 = 24$ outfits
3-digit lock, 0–9	$10^3 = 1{,}000$ codes
2 of 8 toppings	$\binom{8}{2} = 28$ pizzas

Multiply choices; for "order does not matter," use combinations.

6 TWO-WAY TABLE

For "given B," use only the B row or column.

Example: 80 seniors, 24 have jobs.
P(job | senior): $24 \div 80 = 0.30$

Answer: 30%

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More practice: decide with expected value: games, warranties and lotteries

1 EXPECTED VALUE

$E = \sum(\text{outcome})(\text{probability})$ — include the cost as a negative.

$2 to play; win $10 on a 6:
$\frac{1}{6}(10) - 2 \approx -0.33$ per play.

A long-run average, not a guarantee.

2 FAIR PRICE

Fair price = expected winnings (EV = 0).

Example: Win $24 if a 10-section spinner lands on 1 of 2 sections.
Expected winnings: $\frac{2}{10}(24) = 4.80$

Answer: A fair price is $4.80

3 EXTENDED WARRANTY

EV = P(repair) × repair cost − price.

Example: $129 plan; 10% chance of a $450 repair.
Expected repair: $0.10(450) = 45$
EV: $45 - 129 = -84$

Answer: −$84: costs more than it saves on average

4 LOTTERY TICKET

Add prize ÷ odds for each prize, then subtract the price.

Example: $2 ticket; $1,000 at 1 in 2,500; $4 at 1 in 20.
Prizes: $0.40 + 0.20 = 0.60$
EV: $0.60 - 2 = -1.40$

Answer: −$1.40 per ticket

5 BEYOND EXPECTED VALUE

- Can I afford the worst case?
- Do I need the money for sure (rent, tuition)?
- Is a single play likely to match the average?
- Independent events have no memory: no “due” wins.

6 REMINDERS & MISTAKES

✔ Do remember

- EV is a long-run average.
- Count each outcome once.

✘ Common mistakes

- A losing streak means a win is due: the gambler’s fallacy.
- Add probabilities for “and”: multiply for independent events.
- Positive EV = sure profit: single plays can still lose.
- More tickets = better odds of profit: more tickets = bigger expected loss.