

AP STATISTICS REVIEW III – PROBABILITY (~25%)

First, get out your AP formula sheet and check out the formulas in the probability section.

Here's the plan for any question that asks you to find a **probability**.

- Check to see if it's a **normal** problem. If it is, double check to see if it's a **sampling distribution** problem.
- Check to see if it's **binomial**. (Bi = success/failure, Nom = # trials fixed, I = independent trials, All = All probabilities the same for each trial)
- Are the events **independent**? If yes, then $P(A \cap B) = P(A) * P(B)$ and $P(A) = P(A|B)$
- Are the events **not independent**? For events that are **not independent** $P(A) \neq P(A|B)$
- Are the events **mutually exclusive (aka disjoint)**? What are some examples of events that are mutually exclusive? Are mutually exclusive events independent or not independent Y or N ? Why?
- Can I just **make a table** (make a total like 100 or 1000 and work backwards to get values) to solve?
- Can I make a tree diagram or venn diagram?
- **SHOULD I JUST THINK IT THROUGH?**
- $P(\text{at least one}) = 1 - P(\text{none})$
- Make sure to **1) write appropriate probability statement 2) show work/fraction 3) answer in context, if necessary.**

1) Suppose $P(A) = 0.35$, $P(B) = 0.6$ and $P(A \cap B) = 0.27$. Determine

- _____ $P(A^c)$ (A^c represents the complement of A)
- _____ $P(A \cup B)$
- _____ $P(A | B)$
- _____ are A and B independent events? (yes or no)... support your answer with probabilities.

2) Suppose the probability that a construction company will be awarded a certain contract is 0.35, the probability that it will be awarded second contract is 0.41, and the probability that it will get both contracts is 0.27. What is the probability that the company will win at least one of the two contracts?

- 3) A researcher interested in eye color versus success in a math program collected the following data from a random sample of 2000 high school students.

	brown	blue	total
fail	150	15	165
pass	1750	85	1835
total	1900	100	2000

- a) What is the probability that a student from this group fails the math program?
- b) What is the probability that a student from this group fails the math program given that they have blue eyes?
- c) Are blue eyes and failing the math program independent or dependent? Explain.
- 4) Of the 80 obese teenagers in a recent study, 25 had type II diabetes, 35 had high blood pressure, and 15 had both high blood pressure and type II diabetes. Suppose one of these 80 obese teenagers is randomly selected.
*Hint: make a table ☺
- a) Given that the teenager has type II diabetes, what is the probability that he or she also has high blood pressure?
- b) If the obese teenager does NOT have high blood pressure, what is the probability that he or she also does not have type II diabetes?

- 5) The probability that Lebron misses a free throw shot is 0.3. If he goes to the line to shoot three free throws (due to a foul on a three-point shot),
- What is the probability that Lebron misses all three shots? What assumptions did you make in order to calculate this probability?
 - What is the probability that he makes at least one of the three shots?
 - What is the probability that he makes the first shot but not the second or third?
- 6) Of the 12,000 freshman at the University of Texas, 9000 must take English, 8000 must take History, and 7000 must take both. Suppose that a student is randomly selected.
- What is the probability that the selected student must take English?
 - What is the probability that the selected student must take both English and History?
 - Suppose you learn that the selected student must take English, what is the probability that this student must take both English and History?
 - Are the outcomes *must take English* and *must take History* independent? Explain.
 - Answer the question posed in part **d** if only 6000 of the students must take both English and History.

- 7) Two office assistants at Podunk High School are responsible for getting the daily tardy list to the appropriate principals by 3:00pm daily. Rudy works on the lists 20% of the days and Fawn works on the tardy lists 80% of the days. Rudy fails to get the lists to the correct principals in time 30% of the time (which would make him tardy with the tardy lists). Fawn, not much better, manages to get the tardy lists to the correct principals 75% of the time. Let's say you are Principal Sac and the tardy list is late. What is the probability that today Rudy is responsible for the list?

Probability Distributions – Discrete Random Variables

- 8) Let x denote the number of broken eggs in a randomly selected carton of one dozen “store brand” eggs at a certain market. Suppose that the probability distribution of x is as follows.

x	0	1	2	3	4
$P(x)$	0.74	0.12	0.09	0.03	?

- a) Only values 0,1,2,3, and 4 have positive probabilities. What is $P(x = 4)$?
- b) Calculate $P(x \leq 2)$, the probability that the carton contains at most two broken eggs, and interpret this probability.
- c) Calculate $P(x < 2)$. Why is this smaller than the probability in part **b**?
- d) What is the probability that the carton contains exactly ten unbroken eggs?
- e) What is the probability that at least ten eggs are unbroken?
- f) What is the expected number of broken eggs per carton?
- g) What is the standard deviation of the probability distribution?

Binomial distributions (a special form of a discrete random variable)

- 9) Due to a typo on one problem, an AP Statistics exam has 39 multiple choice questions, each with 5 answer choices. Suppose you believe you have forgotten everything and must guess (randomly choose one of the five answers choices) on every question. Let x represent the number of correct responses on the test.
- What kind of probability distribution does x have? Explain.
 - What is your expected score on the exam?
 - Compute the standard deviation of x ?
 - What is the probability that you will get exactly 12 questions correct?
 - Overall, you believe you can do really well on the free response section. You did not study for the multiple choice section because you figured out that you would probably only need 12 questions correct to earn college credit in the course. What is the probability that you correctly answer at least 12 problems? (Oh my gosh! This could take all day!)

Normal Distribution

- 10) A machine that puts the center holes in blank CDs operates in such a way that the distribution of the diameter of the holes may be approximated by a normal distribution with a mean of 1.5 cm and a standard deviation of 0.06 cm. The specifications require the diameters of the holes to be between 1.38 and 1.62 cm. A CD not meeting the specifications is considered defective. (A center hole too small would not fit properly in a CD burner; a hole too large may cause the CD to slide during burning and ruin the quality of the music.) What proportion of CDs produced by this machine are defective due to an improperly sized center hole?

Sampling Distributions (make sure to check conditions, if necessary)

- 11) Every Saturday, The Full Deck music store has a draw your card day. A customer may choose to draw a card from a standard deck and buy a second CD for an amount in dollars equal to the value on the card with face cards counting as a 10. For example, if a customer draws a 3, his second CD will cost only \$3.00. If a customer draws a jack, the CD will cost \$10.00. Let X represent the amount paid for a second CD on draw a card day. The expected value of X is \$6.54 and the standard deviation of X is \$3.28.
- a) If a customer draws a card and buys a second CD every Saturday for 40 consecutive weeks, what is the total amount that the customer would expect to pay for these second CDs?
- b) If a customer draws a card and buys a second CD every Saturday for 40 consecutive weeks, what is the approximate probability that the total amount paid for these second CDs will exceed \$300.00?
- 12) A plane used to fly tourists in and out of the rain forest contains seating for 14 passengers. The total weight limit for the passengers is 2600 pounds. Assume the average weight of tourists is 160 pounds, the standard deviation 32 pounds, and that the distribution of tourist weights is approximately normal. If the weight limit is exceeded, the plane has difficulty taking off safely. (We're basically talking about crashing into very tall trees here. Not usually considered a vacation highlight!) If a random sample of 14 tourists has booked a flight, what is the chance that the weight limit will be exceeded?

- 13) A manufacturer of smartphones purchases computer chips from a vendor. When a large shipment is received, a random sample of 280 computer chips is selected, and each is inspected. If the sample proportion of defectives is more than 0.06, the entire shipment will be returned to the vendor. What is the approximate probability that the shipment will be returned if the true proportion of defectives in the shipment is 0.04?