6-2 Probability

A **probability model** is a description of some chance process that consists of two parts:

1. The **sample space S** (the set of all possible outcomes)
2. The probability for each outcome.
3. **Example #1:** You roll a single die. Give the probability model for this chance process.
4. S = { }.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Outcome |  |  |  |  |  |  |
| Probability |  |  |  |  |  |  |

An **event** is any outcome or a set of outcomes of a random phenomenon.

* An event is a subset of the sample space
* Events are usually designated by capital letters (*A, B, C, etc.)*

1. For the probability model above, we may define A = number less than 4. Find P(A).

**Basic Probability Rules:**

1. **The probability *P(A)* of any event *A* satisfies 0 ≤ P (*A*) ≤ 1**
2. **If *S* is the sample space in a probability model, then P(*S*) = 1**
   * Ex: What is the probability of being a boy or a girl?
3. ***Complement rule*: P(AC) = 1 - P (A).** 
   * The *complement* of any event A is the event that A does not occur, written as AC.

* **Example**: Distance learning courses are rapidly gaining popularity among college students. Below is a probability model showing the proportion of all distance learners in each age group

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Age Group (yr) | 18 to 23 | 24 to 29 | 30 to 39 | 40 or over |
| Probability | .57 | .17 | .14 | .12 |

P(18 to 23) =

Pc(18 to 23) =

P(at least 24) =

1. **Addition Rule of Mutually Exclusive Events:** If A and B are mutually exclusive, P(A or B) = P(A) + P(B)

* Two events A and B are ***Mutually Exclusive* (also called \_\_\_\_\_\_\_\_\_\_\_)**if they \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* In other words, P(A and B) = \_\_\_\_\_.
  + **Example:** You draw one card from a standard deck. Event A = drawing a king and Event B = Drawing a 2.
    1. The events are disjoint because: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
    2. Find P(King or 2) = P( ) =

**Other Probability Rules:**

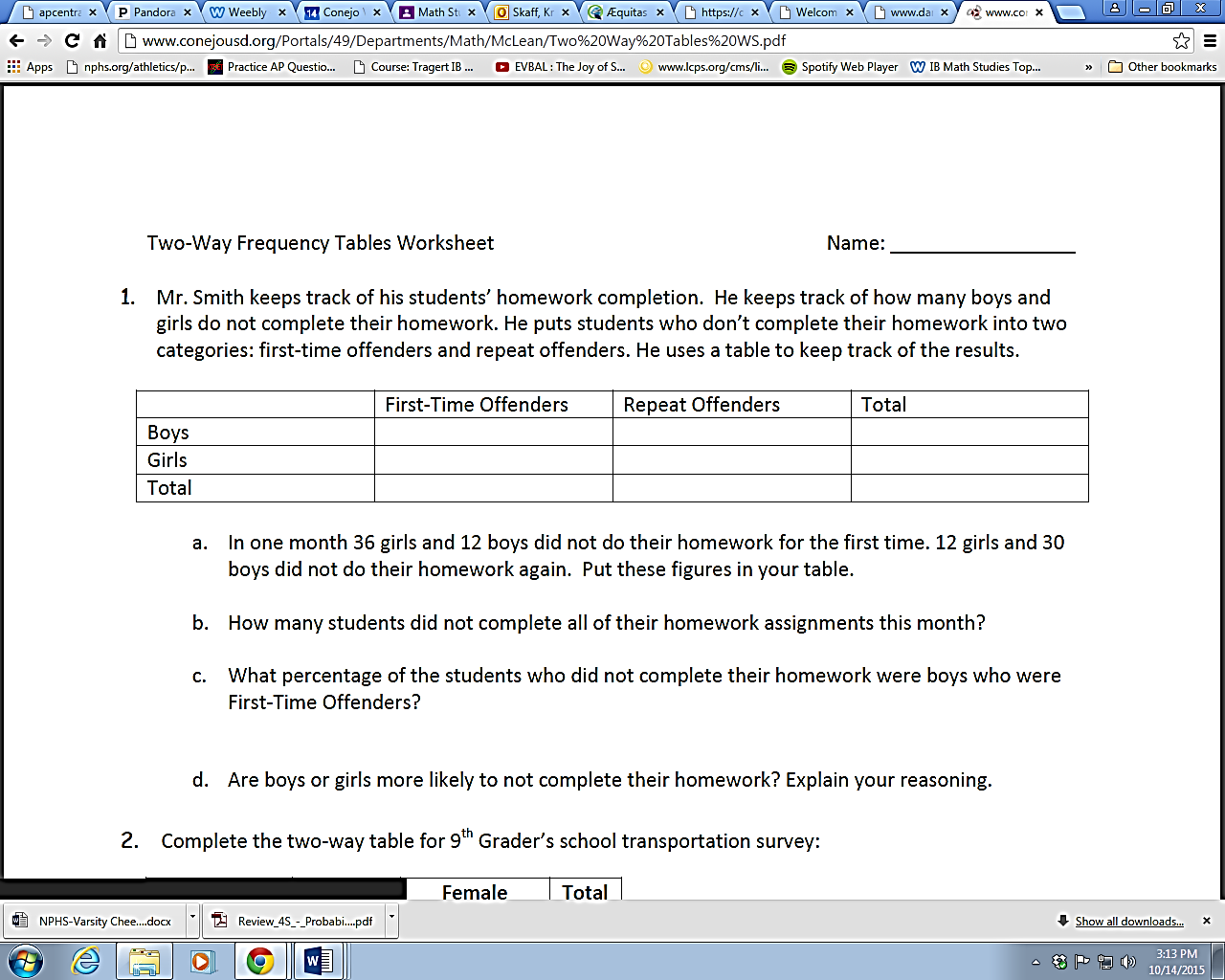
**The General Addition Rule:**  P (A or B) =

* + **Example:** What is the probability of drawing a red card or a king?

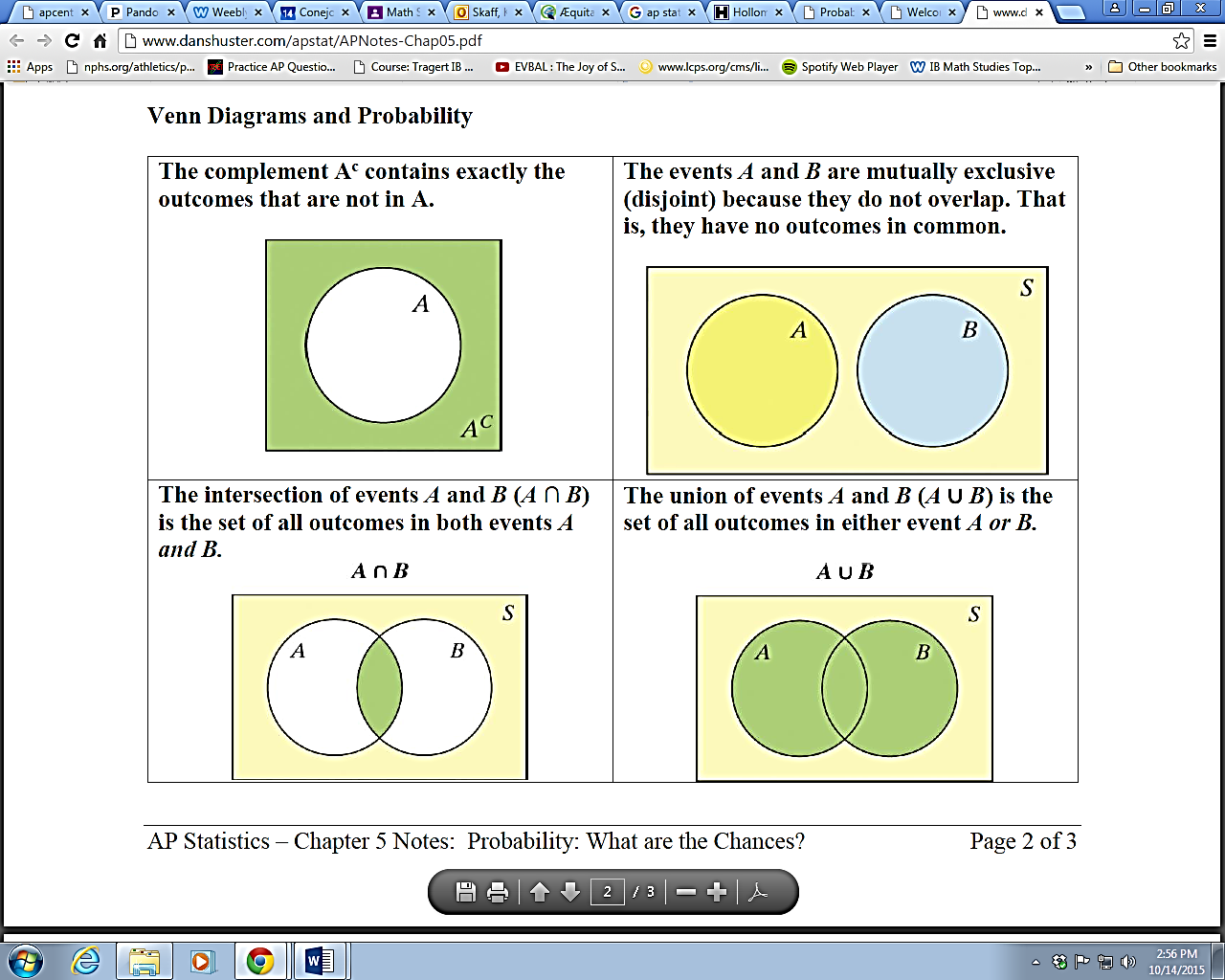
**Two-Way Tables:**

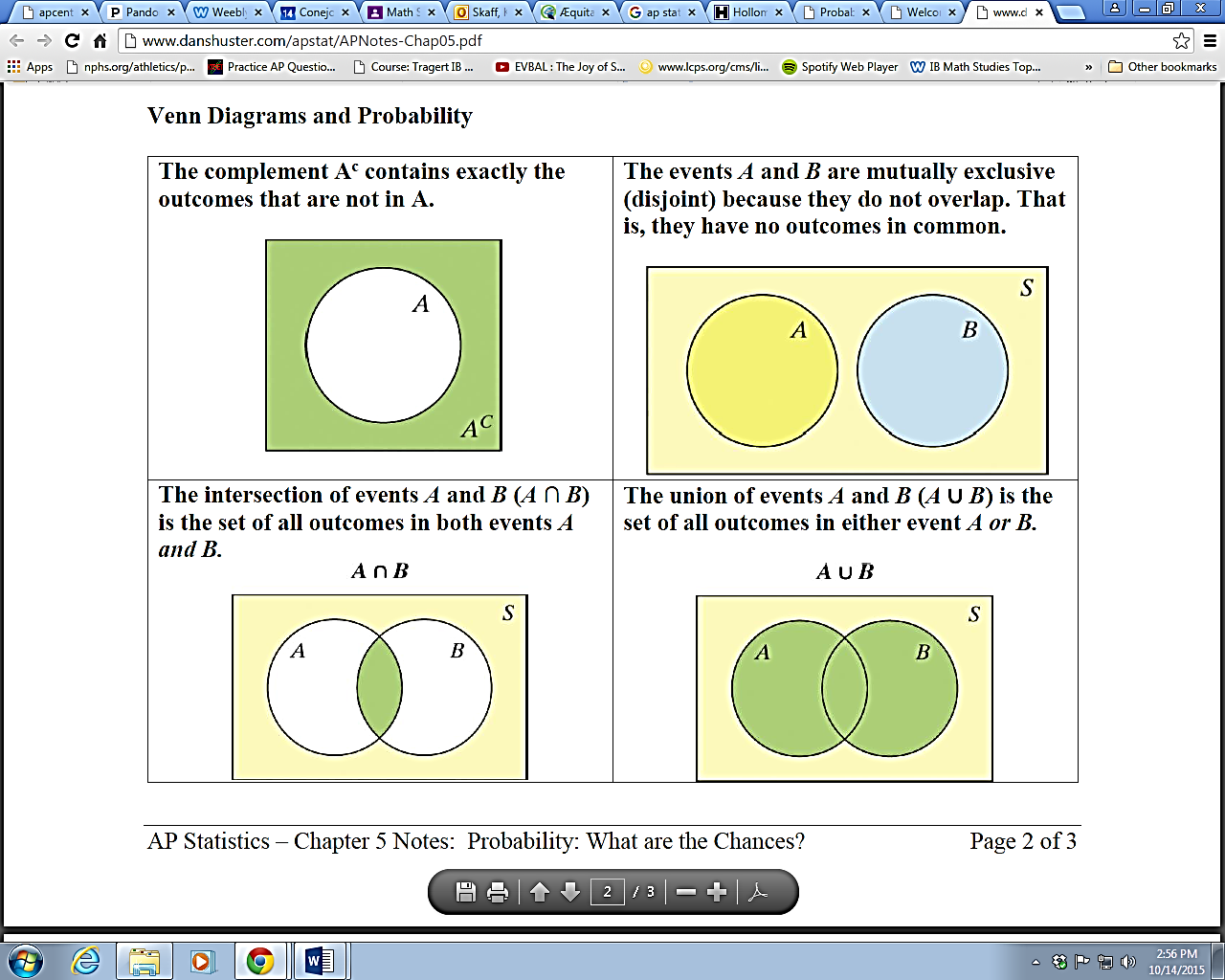
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | | Gender | |  |
| Male | Female | **Total** |
| Pierced Ears? | Yes | 19 | 84 | **103** |
| No | 71 | 4 | **75** |
| **Total** | | **90** | **86** | **178** |

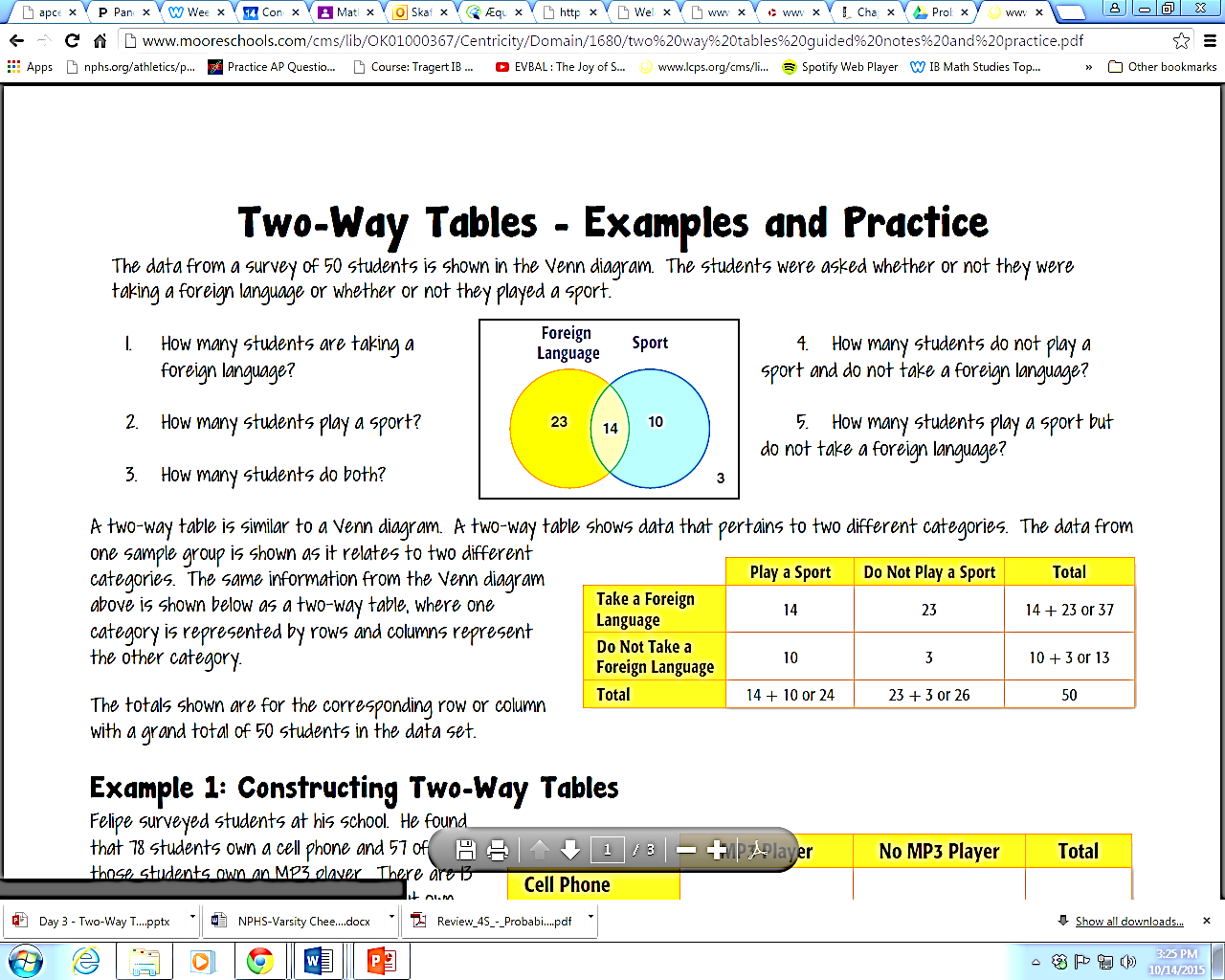
* + **Example 1:** An AP Statistics class wants to know how common it is for teenagers to have their ears pierced. They collected data – gender and whether the student had a pierced ear – for 178 NPHS students. The two-way table below displays the data.
* Suppose we choose a student form the sample at random. Find the probability that a student
  1. has pierced ears
  2. is male and has pierced ears
  3. is male or has pierced ears
  4. is female or doesn’t have pierced ears
  + **Example 2:** Making two-way tables.



**Venn Diagrams:**





* + **Example 1:** The data from a survey of 50 students is shown in the Venn Diagram. The students were asked whether or not they were taking a foreign language and whether or not they played a sport. The Venn diagram below displays the results. Event F = Foreign Language and Event S = Sport.
    1. P(F) =
    2. P(S) =
    3. P(F S) =
    4. P(Sc) =
    5. P(F
  + **Example 2:** Real estate ads in the North Pole claim that 64% of polar bear caves have only one entrance, 21% of caves contain hieroglyphics, and 17% have both features. What is the probability that a polar bear cave has…
    1. Only one entrance or hieroglyphics?
    2. Neither only one entrance nor hieroglyphics?
    3. Only one entrance and no hieroglyphics?

**Bring it Together!**

* **Example:** According to the National Center for Health Statistics (<http://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless201306.pdf>), in December 2012, 60% of U.S. households had a traditional landline telephone, 89% of households had cell phones, and 51% had both. Suppose we randomly selected a household in December 2012.
  1. Make a two-way table that displays the sample space of this chance process.
  2. Construct a Venn diagram to represent the outcomes of this chance process.
  3. Find the probability that the household has at least one of the two types of phones.
  4. Find the probability that the household has a cell phone only.