**Chapter 7 Probability – (Study) Formula Sheet**

**7.1 – Introduction to Probability**

Probability:

Sample space:

* All possible outcomes
* Ex: Rolling a die, *S* = {1, 2, 3, 4, 5, 6}

**7.2 – Counting our Way to Probabilities**

Fundamental Counting Principle: Ex: Total # of ways to get dressed

* Total number of ways a job can be done with 3 pairs of socks, 4 pairs of
* Just multiply the number of ways to do each individual task) pants, 2 belts, and 3 ties

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Task 1 | Task 2 |  | Task *n* | Total Outcomes |
| *k1* | *k2* |  | *kn* |  |

\_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_

S. socks pants belts ties

Factorial**:**



Combinations and Permutations:

* How many ways to “select r objects from a total of n objects” (without replacement).
* Combinations: nCr 🡪 Order **does NOT** matter
  + Ex: Selecting a committee
* Permutations: nPr 🡪 Order **DOES** matter (meaning to the “slots”)
  + Ex: Selecting a President, Vice President and Secretary

**7.3 – Using Counting Methods to Find Probabilities**

Complements:

* EC 🡪 All outcomes in the sample space that are not in event E (think: NOT, opposite, take it out)
* **Diagram, venn diagram

  Description automatically generated**Complement rules of probability

1) *P(E) + P(EC) = 1*

2) *P(E) = 1 – P(EC)*

3) *P(EC) = 1 – P(E)*

Calculating (harder) probabilities:

* TWO Approaches: Ex: Select 3 Hearts 52 cards without replacement
  + Direct way \_\_\_\_\_\_ \_\_\_\_\_\_ \_\_\_\_\_\_
  + Counting methods \_\_\_\_\_\_\_\_\_ Solve numerator and denominator separately

**7.4 – Addition and Multiplication Rules of Probability**

Diagram

Description automatically generatedAddition rules:

* The probability of A or B occurring

*P(A or B) = P(A) + P(B) – P(A and B)*

* Shape, circle

  Description automatically generatedMutually Exclusive Events:
  + No outcomes in common (no overlap)
* Addition Rule for Mutually Exclusive Events:
  + *P(A or B) = P(A) + P(B)*

Conditional Probability:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Stats | Art | Total |
| Perfect | 100 | 40 |  |
| Good | 20 | 50 |  |
| Total |  |  |  |

* P(B | A) = The conditional probability of Event B, given that Event A has already occurred
* Event A is the “additional info” (GOES SECOND); then we are interested in Event B (GOES FIRST)

Ex) Find probability a student is a stats major given they have Good attendance

Multiplication Rules:

* Independent Events:
  + The result of one event does not influence the probability of the other
  + With replacement, unrelated experiments
* Dependent Events:
  + The result of one event does influence the probability of the other
  + Without replacement
* Multiplication Rule for Independent Events:
  + The probability of A and B occurring is:

*P(A and B) = P(A) x P(B)*

* Multiplication Rule for Dependent Events**:** 
  + The probability of A and B occurring is:

*P(A and B) = P(A) x P(B | A) “Both events occurred” = “A occurred, then B occurred later”*

**7.5 – Expected Value**

Expected value:

* Steps to find:

1) Make a table; 2) Think about X values first; 3) Then find probabilities; 4) Then calculate E(X)

Sum of Expected Values:

* To find the combined expected value of multiple events, just add the individual expected values.

Odds for Odds against

* To convert from probability to odds:, First write the probabilities as fractions
* To convert from odds to a probability: