Probability and Statistics

Topic 11 - Putting It Together: Which Method Do I Use?

Aamir Alaud Din, PhD

November 12, 2024

TABLE OF CONTENTS

TABLE OF CONTENTS

RECAP

Table 10

	Description	Formula
Combination	The selection of r objects from a set of n different objects when the order in which the objects are selected does not matter (so AB is the same as BA) and an object cannot be selected more than once (repetition is not allowed)	$${}_nC_r = \frac{n!}{r!(n-r)!}$$
Permutation of Distinct Items with Replacement	The selection of r objects from a set of n different objects when the order in which the objects are selected matters (so AB is different from BA) and an object may be selected more than once (repetition is allowed)	$$n^r$$
Permutation of Distinct Items without Replacement	The selection of r objects from a set of n different objects when the order in which the objects are selected matters (so AB is different from BA) and an object cannot be selected more than once (repetition is not allowed)	$${}_nP_r = \frac{n!}{(n-r)!}$$
Permutation of Nondistinct Items without Replacement	The number of ways n objects can be arranged (order matters) in which there are n_1 of one kind, n_2 of a second kind, . . . , and n_k of a kth kind, where $n = n_1 + n_2 + \cdots + n_k$	$$\frac{n!}{n_1!n_2!\cdots n_k!}$$

TABLE OF CONTENTS

OBJECTIVES

After learning this topic and studying, you should be able to:

1. Determine the appropriate probability rule to use
2. Determine the appropriate counting technique to use

TABLE OF CONTENTS

THE WHY SECTION

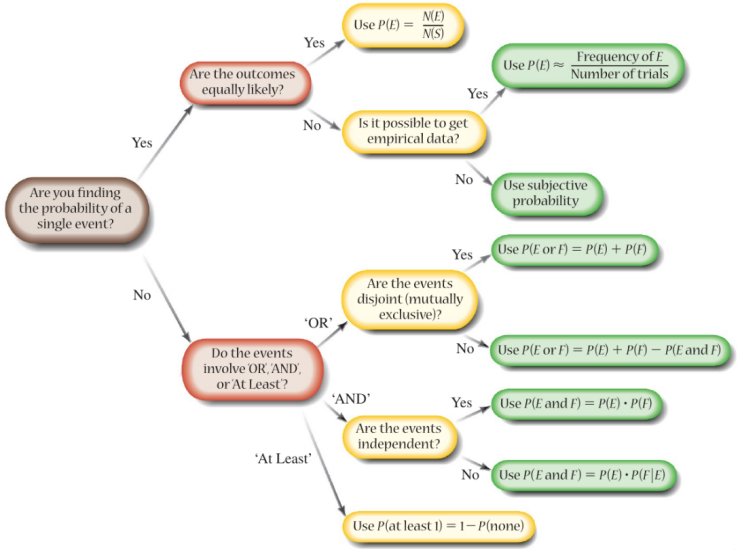
- In a problem involving probability, we need to be very careful in counting the outcomes in the sample space as well as the outcomes in the probability experiment.
- We already studied the methods to count the events in the sample space and for the probability experiment.
- We studied 1) multiplication rule, 2) permutation, 3) combination, 4) permuttion with nondistinct items, and 5) simultaneous use of permutation and combination to count the outcomes.
- The problem is to understand which method should we use in a particular problem.
- Our goal to study this topic is to understand which method should we use to solve the probability problem.

TABLE OF CONTENTS

DETERMINE APPROPRIATE PROBABILITY RULE

- This section will help you learn when to use a particular rule.
- To aid you, consider the flowchart in figure below.
- While not all situations can be handled directly with the formulas provided, they can be combined and expanded to many more situations.
- The first step is to determine whether we are finding the probability of a single event.
- If we are dealing with a single event, we must decide whether to use the classical method (equally likely outcomes), the empirical method (relative frequencies), or subjective probability.
- For experiments involving more than one event, we first decide which type of statement we have.

DETERMINE APPROPRIATE PROBABILITY RULE



DETERMINE APPROPRIATE PROBABILITY RULE

- For events involving "AND," we must know if the events are independent.
- For events involving "OR," we need to know if the events are disjoint (mutually exclusive).

EXAMPLE 1

In the game show Deal or No Deal?, a contestant is presented with 26 suitcases that contain amounts ranging from \$0.01 to \$1,000,000. The contestant must pick an initial case that is set aside as the game progresses. The amounts are randomly distributed among the suitcases prior to the game as shown in Table 11. What is the probability that the contestant picks a case worth at least \$100,000?

EXAMPLE 2

According to a Harris poll, 14% of adult Americans have one or more tattoos, 50% have pierced ears, and 65% of those with one or more tattoos also have pierced ears. What is the probability that a randomly selected adult American has one or more tattoos and pierced ears?

Table 11

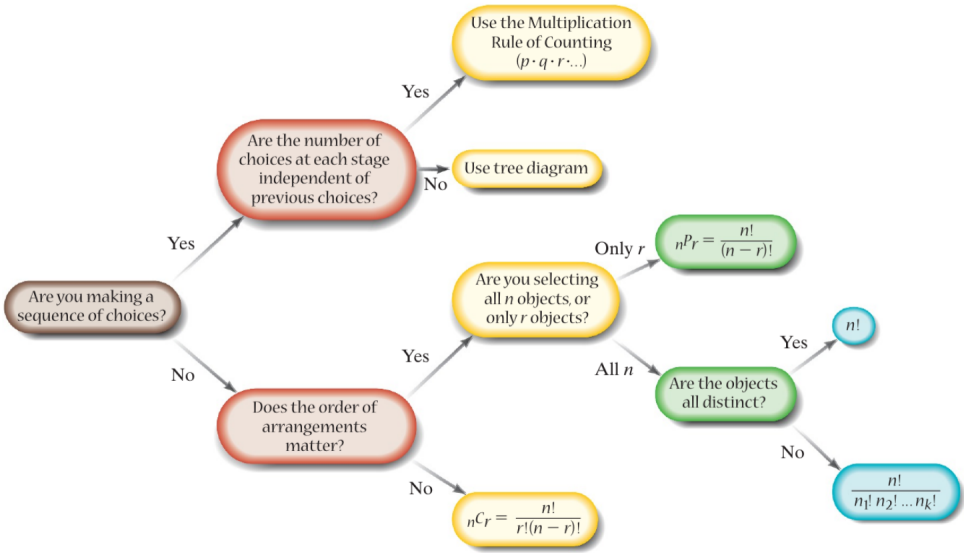
Prize	Number of Suitcases
\$0.01–\$100	8
\$200–\$1000	6
\$5,000–\$50,000	5
\$100,000–\$1,000,000	7

TABLE OF CONTENTS

DETERMINE APPROPRIATE COUNTING TECHNIQUE

- To determine the appropriate counting technique to use, we need the ability to distinguish between a sequence of choices and an arrangement of items.
- We also need to determine whether order matters in the arrangements.
- See figure below on the following slide.
- Keep in mind that one problem may require several counting rules.
- We first must decide whether we have a sequence of choices or an arrangement of items.
- For a sequence of choices, we use the Multiplication Rule of Counting if the number of choices at each stage is independent of previous choices.
- If the number of choices at each stage is not independent of previous choices, we use a tree diagram.

DETERMINE APPROPRIATE PROBABILITY RULE



DETERMINE APPROPRIATE COUNTING TECHNIQUE

- When determining the number of arrangements of items, we want to know whether the order of selection matters.
- If order matters, we also want to know whether we are arranging all the items available or a subset of the items.

EXAMPLE 3

The Hazelwood city council consists of five men and four women. How many different subcommittees can be formed that consist of three men and two women?

EXAMPLE 4

The Daytona 500, the season opening NASCAR event, has 43 drivers in the race. In how many different ways could the top four finishers (first, second, third, and fourth place) occur?


Thank You!