

Ch. 7 Probability

7.1 Sample Spaces and Events

Def: An experiment is an occurrence, with a result, or outcome, that is uncertain before the experiment takes place.

The set of all possible outcomes is called the sample space for the experiment.

- 1) Experiment: Tossing a coin and observe the side facing up.

Outcomes: H, T

Sample space: $S = \{H, T\}$ $n(S) = 2$

- 2) Experiment: Toss two ^{indistinguishable} coins and observe the sides facing up.

Outcomes: (H, H), (T, T), (H, T) ~~(T, H)~~

Sample space: $S = \{(H, H), (T, T), (H, T)\}$

- 3) Experiment: Toss two distinguishable coins and observe the sides facing up.

Outcomes: (H, H), (T, T), (H, T), (T, H)

Sample space: $S = \{(H, H), (T, T), (H, T), (T, H)\}$

$$n(S) = 4$$

Experiment 1

5) Cast two distinguishable dice and observe the numbers facing up.

Outcomes: $(1,1), (1,2), \dots, (6,6)$ (36 outcomes) $6 \cdot 6 = n(D_1) \cdot n(D_2)$

Sample Space:

$$S = \left\{ \begin{array}{l} (1,1), (1,2), (1,3), (1,4), (1,5), (1,6), \\ (2,1), (2,2), (2,3), (2,4), (2,5), (2,6), \\ (3,1), (3,2), (3,3), (3,4), (3,5), (3,6), \\ (4,1), (4,2), (4,3), (4,4), (4,5), (4,6), \\ (5,1), (5,2), (5,3), (5,4), (5,5), (5,6), \\ (6,1), (6,2), (6,3), (6,4), (6,5), (6,6) \end{array} \right\}$$

$n(S)$ = the number of outcomes in $S = 36$

6) Experiment: Cast two indistinguishable dice and observe the numbers facing up.

Outcomes: $(1,1), (1,2), \dots, (6,6)$ (21 outcomes)

Sample Space:

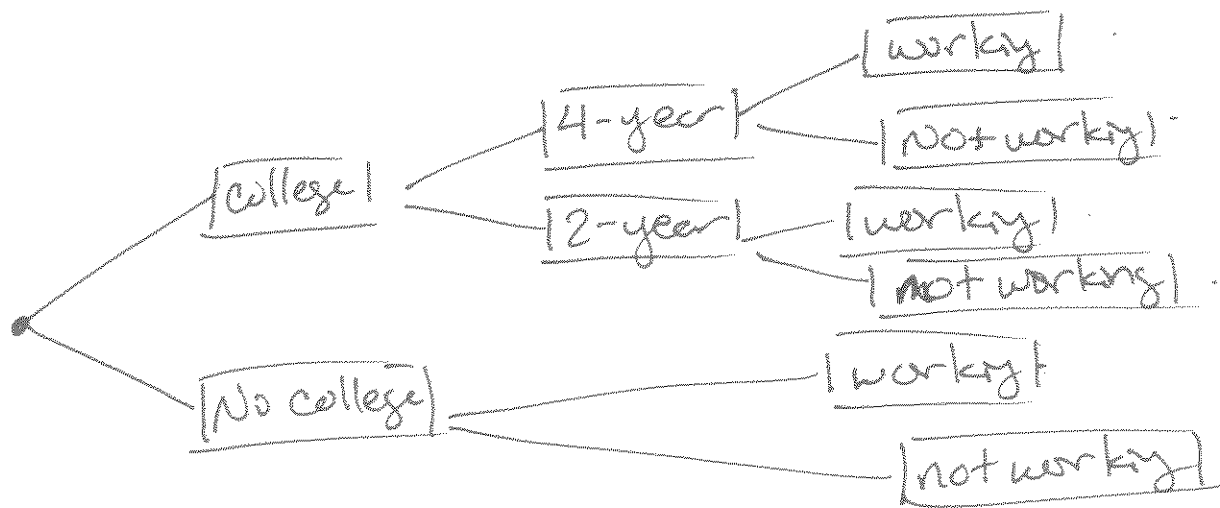
$$S = \left\{ \begin{array}{l} (1,1), (1,2), (1,3), (1,4), (1,5), (1,6), \\ (2,2), (2,3), (2,4), (2,5), (2,6), \\ (3,3), (3,4), (3,5), (3,6), \\ (4,4), (4,5), (4,6), \\ (5,5), (5,6), \\ (6,6) \end{array} \right\}$$

$$n(S) = 21 = 36 - \underline{15}$$

In Example 5, $n(S) = 36$. For this example, we don't want any duplicates. There are 6 outcomes on the diagonal leaving 30 duplicates, so we take away half of 30, i.e. 15.

Ex 1 *

In a survey conducted by the Bureau of Labor Statistics, the high school graduating class of 2010 was divided into those who went on to college and those who did not. Those who went on to college were further divided into those who went to 2-year colleges and those who went to 4-year colleges. All graduates were also asked whether they were working or not. Find the sample space for the experiment "Select a member of the high school graduating class of 2010 and classify his or her subsequent school and work activity."

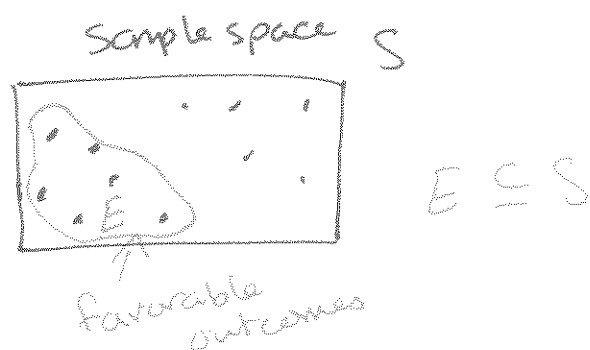


$$S = \left\{ \begin{array}{l} 4\text{-yr college working, } 4\text{-yr college not working,} \\ 2\text{-yr " " , } 2\text{-yr " " ,} \\ \text{no college " , no college " } \end{array} \right\}$$

Def: Given a sample space S , an event E is a subset of S .

The outcomes in E are called the favorable outcomes.

We say that E occurs in a particular experiment if the outcome of that experiment is one of the elements of E - that is, if the outcome of the experiment is favorable.



Ex: 1) Experiment: roll a die and observe the number facing up.

$$S = \{1, 2, 3, 4, 5, 6\}$$

Event E : the number rolled is 2

$$E = \{2\}$$

Event E : the number rolled is even

$$E = \{2, 4, 6\}$$

2) Experiment: Roll two distinguishable dice and observe the numbers facing up.

Event: The sum of the two numbers is 8.

$$E = \{(2, 6), (6, 2), (5, 3), (3, 5), (4, 4)\}$$

Event: The sum of the two numbers is 1.

$$E = \emptyset$$

Ex': Let S be the sample space in Ex 1*.

List the elements of the following events.

- a) The event that a 2010 high school graduate was working.

$$E = \{4\text{-yr college working}, 2\text{-yr working}, \text{none working}\}$$

- b) The event that a 2010 high school graduate went to a 2-yr college

$$E = \{2\text{-yr working}, 2\text{-yr not working}\}$$

$$E' = \{4\text{-yr } w, 4\text{-yr } nw, \text{none } w, \text{none } nw\}$$