Math 111, section 7.1 Experiments, Sample Spaces, and Events

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In chapter 6, the question was, "How many ways...", and we counted the number of possible outcomes.

In chapter 7, we now move into probability, the realm of "What could happen?" and "How likely is it to happen?"

We won't be just counting the number of outcomes, we'll be specifying the nature of those outcomes and (eventually) working out whether a particular outcome has a high or low chance of occurring.

Vocabulary:
For a given situation, or **experiment**, observations are made and data is recorded.

Note that "experiment" in statistics and probability includes science done in a laboratory, but is larger than that as well, and includes social sciences (e.g. psychology, education) along with more informal settings (e.g. "How likely is it that I'll get an A on the first Exam, and what can I do to increase my chances?")

A **sample space** S must contain *all possible* outcomes for an experiment.

A sample space is a set. The elements in a sample space are the outcomes of the experiment, and are called **sample points**.

Using a concept from chapter 6, the sample space is the universe U for a given experiment.

Elements of a set (as we learned in chapter 6) must be distinct. In this case, we would say that the sample points in a sample space must be **mutually exclusive** outcomes.

An **event** (designated with a capital letter A, B, C, etc.) is a subset of the sample space, and will incorporate one or more of the outcomes.

Just as we did in chapter 6, we will talk about the **unions**, **intersections** and **complements** of various events. The notations for these will be the same as before.

Example A. You toss two coins. Describe the sample space, then define some events from this sample space.

tree diagram:

$S =$

$A =$

$B =$

Example A revisited. You toss two coins. List the possible outcomes, then define sample points for the sample space in terms of "number of heads".

possible outcomes:

number of heads	outcome(s)

$S =$

Example A – a new perspective (1). You toss ten coins. Describe the sample space.

$S =$

How many sample points would there be?

Example A – a new perspective (2). You toss ten coins and record the number of heads. Describe the sample space.

$S =$

In answering homework questions, carefully read the words so you know how your sample points are being defined.

Example B-1. You toss a standard six-sided die. Describe the sample space then define some events from this sample space.

$S =$

$A =$

$B =$

$C =$

$D =$

$E =$

Find the events $A \cup C$ and $A \cap C$.

verbal description of $A \cup C$:

$A \cup C =$

verbal description of $A \cap C$:

$A \cap C =$

Find the events D^c and $B \cap D^c$.

verbal description of D^c:

D^c =

verbal description of $B \cap D^c$:

$B \cap D^c$ =

Describe an event F such that E and F are complementary.

verbal description of F:

F =

List all events G_n such that E and G_n are mutually exclusive.

verbal description of events G_n:

G_1 =

G_2 =

G_3 =

G_4 =

Identify two events (among A through E) that are equal.

Example B-2. You toss two standard six-sided dice. Describe the sample space then define some events from this sample space.

Think one red die and one white die. The two dice are independent.
Using the multiplication principle, this sample space has how many sample points?

S = {							
							}

A =

B =

Note 1:

Note 2:

Example C. For text and class purposes, you need to be familiar with a standard deck of 52 cards.

Example D. Suppose that a box contains 3 blue blocks and 2 yellow blocks. You pick three blocks without replacement. Describe the sample space then define some events from this sample space.

tree diagram:

S =

A =

B =

C =

Example E. On their menu, Chili's offers "$20 Dinner for Two". Diners are asked to

"SELECT TWO FULL-SIZE ENTREES

- •FRIED SHRIMP
- •QUESADILLA EXPLOSION SALAD
- •CLASSIC BACON BURGER
- •CAJUN CHICKEN PASTA".

Describe a sample space of possible outcomes (combinations rather than permutations).

How many points in the sample space correspond to at least one of the diners ordering fried shrimp?

How many points in the sample space correspond to the two diners ordering fried shrimp and the classic bacon burger?

How many points in the sample space correspond to at least one of the diners ordering either fried shrimp or the classic bacon burger?

The examples so far are theoretical situations, the kind used by casinos and lotteries to determine prices and payouts. Often, however, situations are **empirical**, observations made about actual phenomena.

Example F. A hospital records the number of days each ICU patient stays in intensive care. Describe an appropriate sample space.

Each sample point and each event in a sample space will have a **probability** associated with it. We'll investigate more thoroughly in later sections.

things you should know for Exam 1

Be able to:

identify unions, intersections and complements of events for a given sample space

determine whether or not two events are mutually exclusive

list all of the events for a given sample space

describe a sample space for a given experiment

answer questions about specified events from a sample space