M118 SECTION 8.1 – SAMPLE SPACES, EVENTS, and PROBABILITY

1) **Sample Space** – set of all outcomes of an experiment

Each element in the sample space is called a **simple event**

each event is any subset of S

1) There is a wheel with 18 numbers around the edge, it is spun and allowed to rest so that a pointer points in a number section.
a) What are all the outcomes?

$$\text{Sample Space} = \{1, 2, 3, \ldots, 18\}$$

b) What is the event E that the out come is a prime number?

c) What is the event E that the outcome is a square of 4?

d) What is the event E that the out come is a number divisible by 12?

e) What is the event E that the out come is an even number greater than 15?

2) Different sample spaces
An experiment: A nickel and a dime are tossed
a) possible heads or tails =

b) Number of heads =

c) coins match or don't match

3) Roll two dice

a) Sample Space =

b) Event a 7 turns up

c) event an 11 turns up

d) event less than 4 turns up

e) event 12 turns up

f) event a 5 turns up

g) event a prime number greater than 7 turns up

PROBABILITY: Given a sample space $S = \{e_1, e_2, e_3, \dots e_n,\}$ with n simple events, to each e_i we assign a probability $P(e_i)$

e_i we assign a probability $P(e_i)$

1) $0 \le P(e_i) \le 1$
2) sum of all probabilities is 1
   $P(e_1) + P(e_2) + \ldots + P(e_n) = 1$

So flipping a coin, we get a head (H) or a tail (T), we assign

$P(H) = \frac{1}{2}$ and $P(T) = \frac{1}{2}$ (Obeys our laws of probabilities)

Given probabilities for each simple event then

a) If E is an empty set → P(E) = 0
b) If E is a simple event → already assigned
c) If E is a compound event → P(E) = sum of probabilities of all simple events
d) If E is the sample space →P(E) = P(S) = 1

THEORETICAL PROBABILITY:

Suppose S = {(HH), (HT), (TH), (TT)}

4 outcomes so P(any event) = 1/4

e_i	HH	HT	TH	TT
$P(e_i)$	1/4	1/4	1/4	1/4

a) P(one head) = {(HT, TH} = 1/4 + 1/4 = 1/2

b) P(at least 1 head) = {HT, TH, HH} = 1/4 + 1/4 + 1/4 = 3/4

c) P(at least 1 head or at least 1 tail) = 1

d) P(0 heads) = 1/4

EMPIRICAL PROBABILITY: Conduct an experiment n times and event E occurs with frequency f(E) times, then $\frac{f(E)}{n}$ = relative frequency

We flip a coin 1000 times and noted

e_i	HH	HT	TH	TT
$P(e_i)$	.273	.206	.312	.209

a) P(one head) = {(HT, TH} = .206 + .312 =

b) P(at least 1 head) = {HT, TH, HH} = .206 + .312 + .273 =

d) P(0 heads) = .209

EQUALLY LIKELY ASSUMPTION: Let S = a sample space with n elementsssss. We assume each simple event e_i is as likely to occur as any other, then we assign the probability 1/n to each simple event → $P(e_i) = 1/n$

Ex: If a single die is rolled $S = \{1, 2, 3, 4, 5, 6\}$ we assign a probability of 1/6 to each simple event.

Let E be the event that a prime number is rolled

$$E = \{2, 3, 5\} = 3/6$$

$$\text{Probability of event E} = \frac{\text{number of elements in E}}{\text{number of elements in S}}$$

Ex:

a) In drawing 5 cards from a 52 card deck w/o replacement, what is the probability of getting 5 spades?

b) 7 cards → P(7hearts) =

Ex: A group of 12 men and 16 women – a subcommittee of 6 is chosen– what is the probability of 3 men and 3 women?

Let E be the set of all 6–people committees with3 men and 3 women

O_1 → Select 3M from 12 M → ${}_{12}C_3$ → N_1

O_2 → Select 3W from 16 M → ${}_{16}C_3$ → N_2

$$\therefore n(E) = N_1 \cdot N_2 = {}_{12}C_3 \cdot {}_{16}C_3$$

$$\text{so } P(E) = \frac{n(E)}{n(S)} = \frac{{}_{12}C_3 \cdot {}_{16}C_3}{{}_{28}C_6}$$

#22

In a family with2 children, excluding multiple births, what is the probability of having 2 girls?

#30

A combination lock has 5 wheels each labeled with the digits 0 to 9. If an opening combination is a particular sequence of 5 digits with no repeats, what is the probability of a person guessing the right combination?

An experiment consists of tossing 3 coins:two fair but one that has a head on both sides. Compute the probability of:

a) 2 heads ___________ b) 0 heads _____________

c) 1 head ____________ d) 3 heads _____________

f) more than 1 head ____________ g) more than 1 tail _______

#92

A 4–person grievance committee is to be selected from 2 departments, A and B, with 15 and 20 people, respectively.
If the 4 people are selected at random from the 35 employees, what is the probability of selecting

a) 3 from A and 1 from B ?______________________

b) 2 from A and 2 from B? ______________________

c) All from A? _________________________________

d) At least 3 from A?__________________________