9.3 Using Simulations for Probability

Ex 1: Describe three different simulations that would represent a coin toss.

(a) Roll a die. If it's an even number, then assign it heads, if it's an odd roll, assign it tails.

(b) fill a hat w/ 10 papers of "0" and 10 papers of "1"
choose paper at random

(c) use 52-card deck
assign Red cards H
black cards T

This is an example of a random digit table.
How can this be used for simulations?

10480	15011	01536	02011	81647	91646	69179	14194	62590
22368	46573	25595	85393	30995	89198	27982	53402	93965
24130	48360	22527	97265	76393	64809	15179	24830	49340
42167	93093	06243	61680	07856	16376	39440	53537	71341
37570	39975	81837	16656	06121	91782	60468	81305	49684
77921	06907	11008	42751	27756	53498	18602	70659	90655
99562	72905	56420	69994	98872	31016	71194	18738	44013
96301	91977	05463	07972	18876	20922	94595	56869	69014
89579	14342	63661	10281	17453	18103	57740	84378	25331
85475	36857	53342	53988	53060	59533	38867	62300	08158
28918	69578	88231	33276	70997	79936	56865	05859	90106
63553	40961	48235	03427	49626	69445	18663	72695	52180
09429	93969	52636	92737	88974	33488	36320	17617	30015
10365	61129	87529	85689	48237	52267	67689	93394	01511
07119	97336	71048	08178	77233	13916	47564	81056	97735
51085	12765	51821	51259	77452	16308	60756	92144	49442
02368	21382	52404	60268	89368	19885	55322	44819	01188
01011	54092	33362	94904	31273	04146	18594	29852	71585
52162	53916	46369	58586	23216	14513	83149	98736	23495
07056	97628	33787	09998	42698	06691	76988	13602	51851
48663	91245	85828	14346	09172	30168	90229	04734	59193
54164	58492	22421	74103	47070	25306	76468	26384	58151
32639	32363	05597	24200	13363	38005	94342	28728	35806
29334	27001	87637	87308	58731	00256	45834	15398	46557
02488	33062	28834	07351	19731	92420	60952	61280	50001
81525	72295	04839	96423	24878	82651	66566	14778	76797
29676	20591	68086	26432	46901	20849	89768	81536	86645
00742	57392	39064	66432	84673	40027	32832	61362	98947
05366	04213	25669	26422	44407	44048	37937	63904	45766
91921	26418	64117	94305	26766	25940	39972	22209	71500
00582	04711	87917	77341	42206	35126	74087	99547	81817
00725	69884	62797	56170	86324	88072	76222	36086	84637
69011	65795	95876	55293	18988	27354	26575	08625	40801
25976	57948	29888	88604	67917	48708	18912	82271	65424
09763	83473	73577	12908	30883	18317	28290	35797	05998
91567	42595	27958	30134	04024	86385	29880	99730	55536
17955	56349	90999	49127	20044	59931	06115	20542	18059
46503	18584	18845	49618	02304	51038	20655	58727	28168
92157	89634	94824	78171	84610	82834	09922	25417	44137
14577	62765	35605	81263	39667	47358	56873	56307	61607
98427	07523	33362	64270	01638	92477	66969	98420	04880
34914	63976	88720	82765	34476	17032	87589	40836	32427
70060	28277	39475	46473	23219	53416	94970	25832	69975
53976	54914	06990	67245	68350	82948	11398	42878	80287
76072	29515	40980	07391	58745	25774	22987	80059	39911
90725	52210	83974	29992	65831	38857	50490	83765	55657
64364	67412	33339	31926	14883	24413	59744	92351	97473
08962	00358	31662	25388	61642	34072	81249	35648	56891
95012	68379	93526	70765	10592	04542	76463	54328	02349
15664	10493	20492	38391	91132	21999	59516	81652	27195

For example, describe a simulation, using this table, for a coin toss.

0-4 H

5-9 T

H = 38

of outcomes in those 2 rows = 90

$P(H) = \frac{38}{90} \approx 0.42$ (from our simulation)

Ex 2: Use the random digit table to estimate the probability that two cards drawn from a standard deck of 52 cards (with replacement) will be of the same suit.

theoretical

$P(2 \text{ same suit})$

$= P(2\heartsuit \text{ or } 2\spadesuit \text{ or } 2\diamondsuit \text{ or } 2\clubsuit)$

$= \frac{1}{16} + \frac{1}{16} + \frac{1}{16} + \frac{1}{16} = \frac{1}{4}$

$= 0.25$

assign: 0-74 no

75-99 yes

start at $\underbrace{08}_{N}\underbrace{98}_{Y}\underbrace{54}_{N}\ \underbrace{49}_{N}\underbrace{99}_{Y}$

Count # of Y through end of row 15 on random digit table $\Rightarrow \frac{\#\text{ Yes}}{\#\text{ of simulations}}$

$= \frac{42}{145}$

≈ 0.2896

Question: Should the simulated probability match the theoretical probability? Why or why not?

it should be close

Ex 3: It is reported that 15% of people who come in contact with a person infected with strep throat will also get sick. How might we use the random digit table to simulate the probability that at least one child in a three-child family will catch the disease, given that all three children have been exposed to someone infected with strep throat?

08010 31233 $\boxed{53364}$ 67098

85674

Strategy

1. choose start pt in table.

   53364

2. assignments:

   0-14 yes

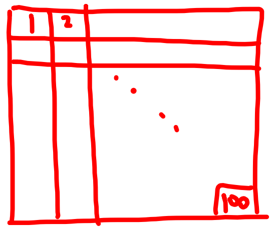
   15-99 no

$\underbrace{\_\ \_}_{\text{kid1}}\ \underbrace{\_\ \_}_{\text{kid2}}\ \underbrace{\_\ \_}_{\text{kid3}}$

kid 1	kid 2	kid 3
53	36	46
70	98	85
67	46	37
44	50	41
11 ✓	98	26
23	57	20
28	41	92
56	50	80
11 ✓	39	16
87	33	48

$$\frac{\#\text{ rows infected}}{\text{total }\#\text{ rows}} = \frac{2}{10} = 0.2$$

9.3B #7)



9.3B #5) T : 1,3,5,7,9

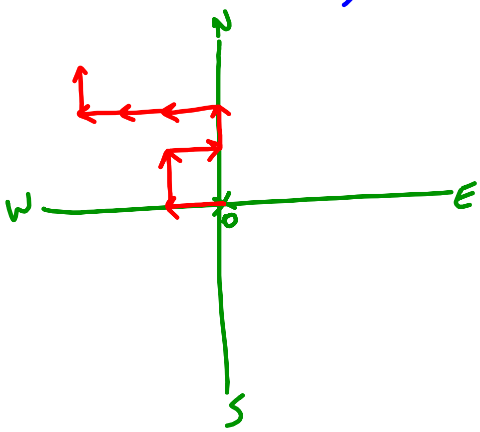
H : 0,2,4,6,8

in table, group #s in twos ex 01795 12367

HT TT TT HT HT

TT out of 25 $\approx P(TT)$

MC #2)



(2-d random walk)

$P(\text{left}) = \frac{1}{2}$

$P(\text{right}) = \frac{1}{6}$

$P(\text{straight}) = \frac{1}{3}$

Simulate w/ 6 sided die: left: 1,3,5

right: 2

straight: 4,6

MC #13) (b) $P(Q \text{ and } \spadesuit) = \frac{1}{52}$

(d) $P(\text{not } \heartsuit) = \frac{39}{52} = \frac{3}{4}$

(e) $P(\spadesuit \text{ or } \heartsuit) = \frac{1}{2}$

(g) $P(Q \text{ or } \spadesuit) = \frac{16}{52} = \frac{4}{13}$

(h) $P(\text{red or black}) = 1$