Probability-Show your Work in R

1. What is the probability of rolling a sum of 12 on three rolls of six-sided dice?
Express your answer as a decimal number only. Show your R code.

Answer: The probability is 0.1157407

```
> expand.grid(die_1 = 1:6,

              die_2 = 1:6,

              die_3 = 1:6)
```

die_1 die_2 die_3

	die_1	die_2	die_3
1	1	1	1
2	2	1	1
3	3	1	1
4	4	1	1
5	5	1	1
6	6	1	1
7	1	2	1
8	2	2	1
9	3	2	1
10	4	2	1
11	5	2	1
12	6	2	1
13	1	3	1
14	2	3	1
15	3	3	1
16	4	3	1
17	5	3	1
18	6	3	1

19	1	4	1
20	2	4	1
21	3	4	1
22	4	4	1
23	5	4	1
24	6	4	1
25	1	5	1
26	2	5	1
27	3	5	1
28	4	5	1
29	5	5	1
30	6	5	1
31	1	6	1
32	2	6	1
33	3	6	1
34	4	6	1
35	5	6	1
36	6	6	1
37	1	1	2
38	2	1	2
39	3	1	2
40	4	1	2
41	5	1	2
42	6	1	2
43	1	2	2

44	2	2	2
45	3	2	2
46	4	2	2
47	5	2	2
48	6	2	2
49	1	3	2
50	2	3	2
51	3	3	2
52	4	3	2
53	5	3	2
54	6	3	2
55	1	4	2
56	2	4	2
57	3	4	2
58	4	4	2
59	5	4	2
60	6	4	2
61	1	5	2
62	2	5	2
63	3	5	2
64	4	5	2
65	5	5	2
66	6	5	2
67	1	6	2
68	2	6	2

69	3	6	2
70	4	6	2
71	5	6	2
72	6	6	2
73	1	1	3
74	2	1	3
75	3	1	3
76	4	1	3
77	5	1	3
78	6	1	3
79	1	2	3
80	2	2	3
81	3	2	3
82	4	2	3
83	5	2	3
84	6	2	3
85	1	3	3
86	2	3	3
87	3	3	3
88	4	3	3
89	5	3	3
90	6	3	3
91	1	4	3
92	2	4	3
93	3	4	3

94	4	4	3
95	5	4	3
96	6	4	3
97	1	5	3
98	2	5	3
99	3	5	3
100	4	5	3
101	5	5	3
102	6	5	3
103	1	6	3
104	2	6	3
105	3	6	3
106	4	6	3
107	5	6	3
108	6	6	3
109	1	1	4
110	2	1	4
111	3	1	4
112	4	1	4
113	5	1	4
114	6	1	4
115	1	2	4
116	2	2	4
117	3	2	4
118	4	2	4

119	5	2	4
120	6	2	4
121	1	3	4
122	2	3	4
123	3	3	4
124	4	3	4
125	5	3	4
126	6	3	4
127	1	4	4
128	2	4	4
129	3	4	4
130	4	4	4
131	5	4	4
132	6	4	4
133	1	5	4
134	2	5	4
135	3	5	4
136	4	5	4
137	5	5	4
138	6	5	4
139	1	6	4
140	2	6	4
141	3	6	4
142	4	6	4
143	5	6	4

144	6	6	4
145	1	1	5
146	2	1	5
147	3	1	5
148	4	1	5
149	5	1	5
150	6	1	5
151	1	2	5
152	2	2	5
153	3	2	5
154	4	2	5
155	5	2	5
156	6	2	5
157	1	3	5
158	2	3	5
159	3	3	5
160	4	3	5
161	5	3	5
162	6	3	5
163	1	4	5
164	2	4	5
165	3	4	5
166	4	4	5
167	5	4	5
168	6	4	5

169	1	5	5
170	2	5	5
171	3	5	5
172	4	5	5
173	5	5	5
174	6	5	5
175	1	6	5
176	2	6	5
177	3	6	5
178	4	6	5
179	5	6	5
180	6	6	5
181	1	1	6
182	2	1	6
183	3	1	6
184	4	1	6
185	5	1	6
186	6	1	6
187	1	2	6
188	2	2	6
189	3	2	6
190	4	2	6
191	5	2	6
192	6	2	6
193	1	3	6

```
194   2   3   6

195   3   3   6

196   4   3   6

197   5   3   6

198   6   3   6

199   1   4   6

200   2   4   6

201   3   4   6

202   4   4   6

203   5   4   6

204   6   4   6

205   1   5   6

206   2   5   6

207   3   5   6

208   4   5   6

209   5   5   6

210   6   5   6

211   1   6   6

212   2   6   6

213   3   6   6

214   4   6   6

215   5   6   6

216   6   6   6

>

> total_each_row <-rowSums(expand.grid(die_1 = 1:6,die_2 = 1:6,die_3 = 1:6))
```

```
> total_each_row

[1]  3  4  5  6  7  8  4  5  6  7  8  9  5  6  7  8  9 10  6  7  8  9 10 11  7  8  9 10 11 12  8  9
10

[34] 11 12 13  4  5  6  7  8  9  5  6  7  8  9 10  6  7  8  9 10 11  7  8  9 10 11 12  8  9 10
11 12 13

[67]  9 10 11 12 13 14  5  6  7  8  9 10  6  7  8  9 10 11  7  8  9 10 11 12  8  9 10 11 12
13  9 10 11

[100] 12 13 14 10 11 12 13 14 15  6  7  8  9 10 11  7  8  9 10 11 12  8  9 10 11 12 13  9
10 11 12 13 14

[133] 10 11 12 13 14 15 11 12 13 14 15 16  7  8  9 10 11 12  8  9 10 11 12 13  9 10 11
12 13 14 10 11 12

[166] 13 14 15 11 12 13 14 15 16 12 13 14 15 16 17  8  9 10 11 12 13  9 10 11 12 13
14 10 11 12 13 14 15

[199] 11 12 13 14 15 16 12 13 14 15 16 17 13 14 15 16 17 18

>

> F <- length(total_each_row[total_each_row == 12])

> total <- length(total_each_row)

> probability <- F/total

> probability

[1] 0.1157407
```

2. A newspaper company classifies its customers by gender and location of residence. The research department has gathered data from a random sample of customers. The data is summarized in the table below.

Gender and Residence of Customers		
Residence		s les

Apartment	200	300
Dorm	200	100
With Parent(s)	100	200
Sorority/Fraternity House	200	100
Other	200	100

What is the probability that a customer is male and lives in 'Other' or is female and lives in 'Other'? Express your answer as a decimal number only. Show your R code.

Answer: The probability is 0.1764706
Code:
> male_other <- 200
> female_other <- 100
> total <- 1700
> probability <- (male_other/total) + (female_other/total)
> probability
[1] 0.1764706

3. Two cards are drawn without replacement from a standard deck of52 playing cards. What is the probability of choosing a diamond for the second card drawn, if the first card, drawn without replacement, was a diamond? Express your answer as a decimal number only. Show your R code.

Answer: The probability is 0.2352941

Code:

 > cardsleft <-51

> diamondleft <-12

> probability_diamond <- diamondleft/cardsleft
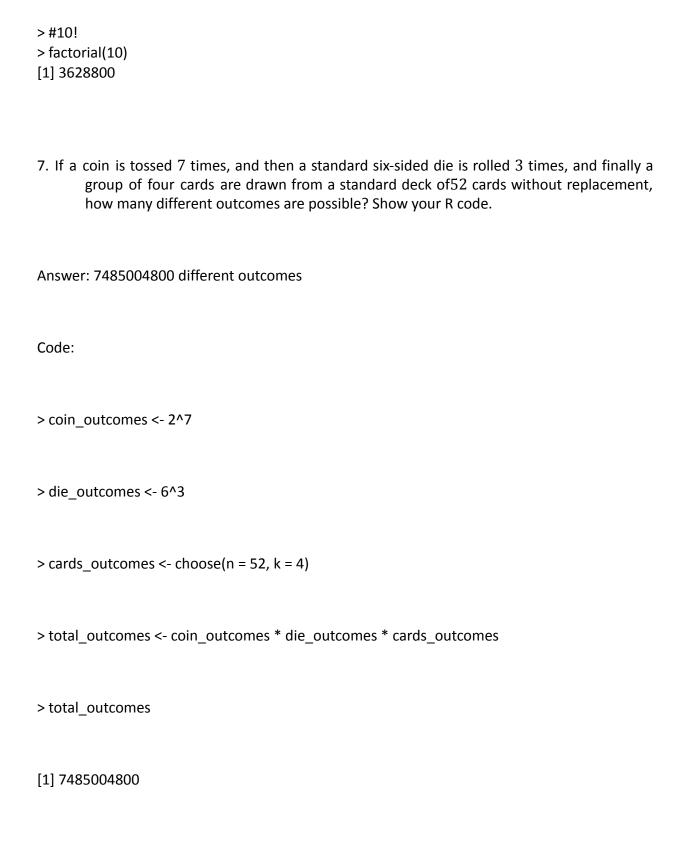
> probability_diamond

[1] 0.2352941

4. A coordinator will select 10 songs from a list of 20 songs to compose an event's musical entertainment lineup. How many different lineups are possible? Show your R code.

Answer: 670442572800 lineups

Code:

```
> #P(n,r) = C(n, r) * r!

> n <- 20

> r <- 10

> choose(n,r) * factorial(r)

[1] 670442572800
```

5. You are ordering a new home theater system that consists of a TV, surround sound system, and DVD player. You can choose from 20 different TVs, 20 types of surround sound systems, and 18 types of DVD players. How many different home theater systems can you build? Show your R code.

Answer: 7200 different home theater systems

Code:

```
> choose(20,1)*choose(20,1)*choose(18,1)

[1] 7200
```

6. A doctor visits her patients during morning rounds. In how many ways can the doctor visit 10 patients during the morning rounds? Show your R code.
Answer: 3628800 ways

```
> #10!
> factorial(10)
[1] 3628800
```

7. If a coin is tossed 7 times, and then a standard six-sided die is rolled 3 times, and finally a group of four cards are drawn from a standard deck of52 cards without replacement, how many different outcomes are possible? Show your R code.

Answer: 7485004800 different outcomes

Code:

```
> coin_outcomes <- 2^7
```

```
> die_outcomes <- 6^3
```

```
> cards_outcomes <- choose(n = 52, k = 4)
```

```
> total_outcomes <- coin_outcomes * die_outcomes * cards_outcomes
```

```
> total_outcomes
```

```
[1] 7485004800
```

8. In how many ways may a party of four women and four men be seated at a round table if the women and men are to occupy alternate seats. Show your R code.

Answer: 144 ways

Code:

```
> # 3!*4!

> factorial(3)*factorial(4)

[1] 144
```

9. An opioid urinalysis test is 95% sensitive for a 30-day period, meaning that if a person has actually used opioids within 30 days, they will test positive 95% of the time P(+ | User) =.95. The same test is 99% specific, meaning that if they did not use opioids within 30 days, they will test negative P(- | Not User) = .99. Assume that 3% of the population are users. Then what is the probability that a person who tests positive is actually a user P(User | +)? Show your R code. You may use a tree, table, or Bayes to answer this problem.

Answer:

Code:

```
> a <- 0.03

> nota <- 1- 0.03

> bgivena <- 0.95

> bgivennota <- 1-0.99

> agivenb <- (a*bgivena) / ((bgivennota*nota) + (a*bgivena))

> agivenb
```

[1] 0.7460733

10. You have a hat in which there are three pancakes. One is golden on both sides, one is brown on both sides, and one is golden on one side and brown on the other. You withdraw one pancake and see that one side is brown. What is the probability that the other side is brown?

Answer: The probability that the other side is brown is 0.6666667

Code:

> prob_bothside_Brown <- 2/6

> prob_Brown <- 3/6

> prob_the_other_side_Brown_given_one_side_is_brown <-
        prob_bothside_Brown/prob_Brown

> prob_the_other_side_Brown_given_one_side_is_brown

[1] 0.6666667