Mathematical Concepts — Joysheet 5
MAT 117, Fall 2021 — D. Ivanšić

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Covers: 11.1, 11.4 *Show all your work!*

1. (15pts) Do this part on your own. Roll two dice 50 times.
a) Record how many times you get each of the possible sums on the dice in the first row.
b) In the second row, enter the empirical probabilities for each sum based on your 50 rolls. Then compute the theoretical probabilities for each sum and enter them in the third row of the table. Enter these numbers as fractions.
c) Find the difference between the rows P_E and P_T and write it in decimal form rounded to 4 decimal places, ignoring any minus signs (that is what | | stands for).

For example:
Sum = 7
(1,6) (2,5)
(3,4) (4,3)
(5,2) (6,1)
6 outcomes

Sum on roll	2	3	4	5	6	7	8	9	10	11	12
Times occured	2	2	5	5	4	10	8	3	3	7	1
Empirical prob. P_E	$\frac{2}{50}$	$\frac{2}{50}$	$\frac{5}{50}$	$\frac{5}{50}$	$\frac{4}{50}$	$\frac{10}{50}$	$\frac{8}{50}$	$\frac{3}{50}$	$\frac{3}{50}$	$\frac{2}{50}$	$\frac{1}{50}$
Theoretical prob. P_T	$\frac{1}{36}$	$\frac{2}{36}$	$\frac{3}{36}$	$\frac{4}{36}$	$\frac{5}{36}$	$\frac{6}{36}$	$\frac{5}{36}$	$\frac{4}{36}$	$\frac{3}{36}$	$\frac{2}{36}$	$\frac{1}{36}$
$\lvert P_E - P_T \rvert$	0.0122	0.0156	0.0167	0.0111	0.0589	0.0333	0.0211	0.0511	0.0233	0.0844	0.0078

2. (15pts) Do this part with 3 classmates. Write their names in the space provided. Each of you has to fill in the table independently, but the last three rows of this table should be the same for everyone in your group (check!).
a) Copy the "Times occured" line from above into row "You" and do the same for each of your classmates.
b) Sum by column and enter the sums in the row "Total times occured".
c) Write the empirical probability for each sum on the dice as a fraction. Keep in mind that your number of experiments is now larger.
d) Find $|P_E - P_T|$ and write it in decimal form rounded to 4 decimal places. Are the numbers smaller than in the table above? Mostly smaller, except for marked

Sum on roll	2	3	4	5	6	7	8	9	10	11	12
You	2	2	5	5	4	10	8	3	3	7	1
student 1	3	3	9	4	4	8	6	2	6	2	3
student 2	0	3	5	7	5	9	6	6	5	2	2
Total times occured	5	8	19	16	13	27	20	11	14	11	6
Empirical prob. P_E	$\frac{5}{150}$	$\frac{8}{150}$	$\frac{19}{150}$	$\frac{16}{150}$	$\frac{13}{150}$	$\frac{27}{150}$	$\frac{20}{150}$	$\frac{11}{150}$	$\frac{14}{150}$	$\frac{11}{150}$	$\frac{6}{150}$
$\lvert P_E - P_T \rvert$	0.0056	0.0022	0.0933	0.0094	0.0522	0.0133	0.0055	0.0378	0.01	0.0178	0.0122

↑ ↑
these two are bigger than in table above

3. (10pts) When choosing an outfit, a regional manager chooses among 4 pants or 7 skirts, 12 shirts, 5 jackets and 9 accessories. Assuming a top and a bottom are mandatory, and a jacket and an accessory optional, and all the outfit elements are independent of each other, how many different outfits can the manager select?

top bottom jacket accessory

11 · 12 · 6 · 10 = 7920 outfits.

11 (4+7) | 12 | 6 (5+1, not wearing one) | 10 (9+1, not wearing one)

4. (10pts) How many four-digit numbers are there whose sum of digits is a number ending with 3? (For example, 4586 is one such number, $4 + 5 + 8 + 6 = 23$, ends with 3.) Assume the leftmost digit of the four-digit number is not zero.

the last digit is determined by the first three digits, so there is only 1 choice for it.

9 (can't be 0) · 10 · 10 · 1 = 900

5. (10pts) A coin is tossed and two dice are rolled.
a) How many different outcomes are there to this experiment?
b) How many different outcomes has the sum on the dice equal to 8?

a) 2 · 6 · 6 = 72

b) 2 · 5 = 10

2 options for the coin; 5 options for these two slots are (2,6), (3,5), (4,4), (5,3), (6,2)