

Mathematical Concepts — Joysheet 1
MAT 117, Fall 2022 — D. Ivanišić

Name: _____

Covers: Calc. practice Show all your work!

Use your calculator to compute each expression to 6 significant digits accuracy or six decimal places, whichever is more accurate. Write down the sequence of keys you entered in order to compute each expression. Do not round numbers in mid-computation.

1. (4pts) $\sqrt[8]{17} =$

2. (6pts) $13(\sqrt[4]{6.4} - 1) =$

3. (8pts) $980 \left(1 + \frac{0.0375}{4}\right)^{20} =$

4. (9pts) $\frac{1500}{\left(1 + \frac{0.0425}{12}\right)^{18}} =$

5. (9pts) $25 \left(\sqrt[8]{\frac{4000}{1500}} - 1\right) =$

6. (12pts) $\frac{\left(1 + \frac{0.0415}{4}\right)^{16} - 1}{\frac{0.0415}{4}} =$

7. (12pts) $\frac{1 - \left(1 + \frac{0.0475}{12}\right)^{-36}}{\frac{0.475}{12}} =$

Mathematical Concepts — Joysheet 2
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Name: _____

Covers: 8.1–8.3

Show all your work!

1. (8pts) a) 52 is what percent of 196? b) 42% of what number is 20?

2. (6pts) A dress was originally priced at \$149, but is now on sale at 30% off. What is the current price of the dress?

3. (13pts) Harriett, a single woman with two children, is filing a single tax return. She earned \$70,960 in wages and \$1,200 in interest; she deposited \$7000 into a retirement account; she paid \$5,100 in mortgage interest, \$1,800 in property taxes and \$3250 in state income taxes, and donated \$300 to charity.

a) Find Harriett's gross income and adjusted gross income.

b) Use the table 8.1 (2016 marginal tax rates, standard deductions and exemptions) on page 507 of our book to first determine Harriett's taxable income (don't forget the exemptions) and then find the tax on this income.

4. (13pts) You made a \$2,000 investment in 2019. During the first year, it increased in value by 25%. Then, during the next two years, it decreased in value by 18%. Overall, during the three years you held the investment, did the value increase or decrease, and by how many percent?

5. (10pts) How much money should you deposit in a simple-interest account bearing 4% if you would like to have \$5,000 in a year-and-a-half? How much of the final \$5,000 is from interest?

6. (10pts) A business borrowed \$24,000 from a bank at 12% simple annual interest, and repaid the loan with \$31,920. How many months did the business hold this loan?

4. (10pts) To save for a garage addition to their home in seven years (approximate cost \$40,000), a family makes monthly deposits into an account bearing 5.1%, compounded monthly.

- a) How much should the family deposit every month to reach their goal?
- b) How much would they earn in interest over the seven years?

5. (16pts) At age 24, Serena got a good job and started contributing \$300 a month to a retirement account. After 8 years, she left this job for a better-paying one, so she was able to contribute \$500 a month to a retirement account. Suppose the account grew all the time at rate 8%, compounded monthly.

- a) How much is in the account when Serena is 43?
- b) How much of it was from deposits, and how much from interest?

6. (10pts) You bought a home for \$140,000, and fifteen years later, you sold it for \$223,000. Assuming annual compounding, at what annual rate did this investment grow?

This is an exercise in computing the payment on a hypothetical loan and comparing it with the numbers that financial services websites give you. Do the following:

1. (4pts) Decide on an amount and purpose for a hypothetical loan (e.g. buying a car, house, starting a business, etc.) Choose over how many years it should be repaid. Standard choices for each category are suggested: 15, 20, 30 years for a home, 3, 4, 5 years for a car, etc.

2. (14pts) Find a financial services website (bank, mortgage originator) that gives you interest rate quotes for the kind of loan that you chose in problem 1 and computes the monthly payment based on a loan amount. Use their computation to find the monthly payment on your hypothetical loan. **Don't use a website with a "generic" calculator such as bankrate.com, rather, find one that offers actual loans with current interest rates.** Print out the webpage, showing loan amount, term, interest rate and payment and attach it to this one. Try to keep it to just one sheet.

(Attachment)

3. (12pts) Using our loan formula from 8.6, compute (write the computation here) the monthly payment on your hypothetical loan. Use the interest rate that you found on the website. The frequency of compounding is typically monthly. Does your number agree with the information on the website you found?

4. (14pts) Find the balance of the hypothetical loan after two thirds of all payments have been made.

5. (16pts) Write an amortization schedule for the four payments after two thirds of all payments have been made. (For example, if it's a 60-month loan, consider payments 41, 42, 43 and 44.)

3. (10pts) License plates for the state of Thumbia consist of 8 characters. The first two are letters, the second two are numbers, the fifth is an emoji, the sixth is either an emoji or a letter, the seventh is a number and the eighth can be a letter, number or emoji. If there are 49 emojis to choose from and letters are only uppercase, how many different license plates are possible in this state?

4. (10pts) How many even four-digit numbers are there whose sum of digits is a number ending with 0? (For example, 6356 is one such number, $6 + 3 + 5 + 6 = 20$, and 20 ends with 0.) Assume the leftmost digit of the four-digit number is not zero.

5. (10pts) A die is rolled and a coin is tossed twice.

a) How many different outcomes are there to this experiment?

b) How many different outcomes have an even number on the die and exactly one head? List all the outcomes.

Mathematical Concepts — Joysheet 6
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Name: _____
Covers: 11.4, 11.6 Show all your work!

1. (10pts) A car manufacturer's offerings have been classified into groups in the table according to their starting MSRP price and type.

| Type/price | <\$24K | \$24-34K | >\$34K |
|------------|--------|----------|--------|
| Car | 3 | 1 | 2 |
| SUV | 2 | 8 | 4 |

If a random vehicle is chosen, what is the probability that it

- a) is an SUV?
- b) has a price under \$24K?
- c) is an SUV priced between \$24K and \$34K?
- d) is a car priced above \$24K?

2. (20pts) Write the probabilities and odds against and in favor of the following events (show any work needed below):

| Event | probability | odds against | odds in favor |
|---|-------------|--------------|---------------|
| a) Getting a number less than 3 on a roll of one die | | | |
| b) Picking a bag of corn chips without looking from a shelf holding 5 bags of corn chips and 9 bags of potato chips | | | |
| c) Getting a 5 on exactly one die when rolling two dice | | | |
| d) Getting sum 3 or 9 on a roll of two dice | | | |
| e) On one draw, getting a picture card or a club | | | |

- 3.** (4pts) The odds in favor of Fred going bowling next week are 9-to-4.
- What is the probability Fred goes bowling next week?
 - What is the probability Fred doesn't go bowling next week?
- 4.** (4pts) In a household, there is a 15% chance that an appliance breaks down in a year.
- What are the odds in favor of an appliance breaking down in a year?
 - What are the odds against an appliance breaking down in a year?
- 5.** (8pts) Among 457 outfits in a clothing store, 145 have lime color and 238 have pockets, while 315 have at least one of those features. What is the probability that a randomly chosen outfit from the store
- has lime color and pockets?
 - has neither pockets nor lime color?
- 6.** (14pts) A bag contains 8 white socks, 4 red socks and 6 blue socks. Without looking, we draw a sock from the bag twice, returning the sock after the first draw. Write the number of outcomes of this experiment and then compute the probability that
- The first sock is red and the second sock is blue.
 - At least one of the socks is white.
 - The second sock is blue or the two socks have different colors.

1. (14pts) Motorcycle racer Whelan knows that racing is not without risks of bodily injury. Surveying data, he finds that in one race, the likelihood that a rider emerges unscathed is 81%, lightly injured 15%, severely injured 4%. Assume Whelan goes to two races, whose injury outcomes are independent of each other. What is the probability that
- Whelan is unscathed in the first race and severely injured in the second?
 - Whelan is lightly injured in one race and unscathed in the other?
 - Whelan is injured in at least one race?

2. (14pts) Three Coke cans are picked at random in succession from a trunk with 9 regular Cokes, 6 diet Cokes, 4 vanilla Cokes and 5 cherry Cokes. What is the probability that:
- The second can is a cherry Coke, given that the first one was diet Coke?
 - The first two cans are regular Cokes and the third is a cherry Coke?
 - All three are not regular Cokes?
 - At least one is a vanilla Coke?

3. (10pts) The table shows the styles and gender of recording artists managed by an agent. What is the probability that a random artist from this agent:

- a) is an R&B singing woman?
- b) is a rock artist?
- c) is a woman, given they are a country artist?
- d) is a pop artist, given they are a man?
- e) is not a country artist, given they are a woman?

| Style | Man | Woman | Total |
|---------|-----|-------|-------|
| Pop | 3 | 8 | |
| R&B | 6 | 7 | |
| Rock | 5 | 3 | |
| Country | 5 | 6 | |
| Total | | | |

4. (11pts) A multiple choice test has 5 answers on every question, one of which is correct, one is acceptable, and three are incorrect. You are to select only one answer, and you get 5 points for a correct answer, 3 points for an acceptable answer, 0 points for not attempting a question, and 3 points are subtracted for an incorrect answer.

- a) What is the expected value of a random guess?
- b) If you can rule out one answer as incorrect, what is the expected value of a random guess?
- c) If you can always rule out one answer as incorrect and randomly choose an answer among the remaining four, how many points can you expect to have on a 20-question test?

5. (11pts) A game of chance is set up as follows: A player pays \$2 and two dice are rolled. The player collects \$12 if the sum on the dice is 2, \$7 if the sum is 3 or 9, and nothing if the sum is any other number.

- a) Find the expected value of this game.
- b) If you play this game 40 times, how much do you expect to win or lose?
- c) What is the fair price of this game?

3. (10pts) A hardware store manager examines over two weeks how many customers per day buy electrical equipment. The numbers are listed below.

- a) Find the midrange of the data. 4, 7, 9, 3, 11, 8, 8, 9, 6, 7, 6, 4, 5, 9
b) Find the median of the data.
c) Find the mean of the data.

4. (20pts) Over a semester, a student tracks how many homeworks are due every week. The numbers are shown below. Do the following:

- a) Draw a histogram for the data.
b) Find the midrange of the data.
c) Find the mode of the data.
d) Find the median of the data.
e) Find the mean of the data.

| Weekly homeworks | Frequency (weeks) |
|------------------|-------------------|
| 0 | 2 |
| 1 | 3 |
| 2 | 2 |
| 3 | 5 |
| 4 | 4 |

5. (6pts) Construct an example with six numbers 0–10, which satisfies the conditions below. Verify by stating the mean, median and mode for your example.

$$\text{mean} < \text{mode} < \text{median}$$

Mathematical Concepts — Joysheet 9
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Name: _____

Covers: 12.3–12.5 Show all your work!

Final answers should have accuracy to 6 decimal places (or 4 decimal places for table-derived answers). Show some work how the mean and standard deviation are computed. *Giving only the answer will bring you few points.*

1. (15pts) A meteorologist tracks the weekly amount of rainfall in a certain location. The rounded results are below.

- a) Find the range of the data.
- b) Find the mean of the data.
- c) Find the standard deviation of the data.

| Rainfall (millimeters) | Frequency (weeks) |
|---------------------------|----------------------|
| 10 | 7 |
| 20 | 12 |
| 30 | 16 |
| 40 | 13 |
| 50 | 4 |

2. (15pts) The weights of inhabitants of a certain country have been found to have mean 172 lbs, with standard deviation of 6 lbs. Use the 68-95-99.7 rule (draw a picture) to find the percentage of inhabitants whose weight is:

- a) between 160 and 184 lbs

- b) under 166 lbs

- c) over 160 lbs

- d) between 154 and 178 lbs.

3. (5pts) A survey of 927 adults found that 62% of them agree with continued US support for Ukraine. Find the margin of error of this survey and explain what it means.

4. (5pts) On product satisfaction surveys where a higher score means a better product, product A scored 30 on a survey with mean 31 and standard deviation 1.5, and product B scored 45 on a survey with mean 47 and standard deviation 2.5. Use z -scores to determine which product is worse.

5. (20pts) The lifespan of a certain insect is normally distributed with mean 41 days and standard deviation 4 days. Draw a picture showing which area you are computing as you answer:

- a) What percentage of insects live up to 46 days?
- b) What percentage of insects live longer than 50 days?
- c) What is the percentile of an insect that lived 30 days? What does this mean?
- d) What is the probability that a random insect lives between 40 and 48 days?

Mathematical Concepts — Joysheet 10
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Name: _____

Covers: 14.1, 14.2 Show all your work!

1. (30pts) According to betting websites, currently the teams most favored to win the soccer World Cup are Argentina, Brazil, France, and Spain, A number of fans ranked these teams' prospects, where a 1st place ranking means the fans think this team is most likely to win. The rankings are listed below, where votes are percentages. Suppose someone wants to place a bet on a winning team based on these fans' rankings.

| Votes | 15 | 21 | 7 | 19 | 9 | 11 | 13 | 5 |
|-------|----|----|---|----|---|----|----|---|
| 1st | A | B | B | F | F | S | S | S |
| 2nd | F | A | F | S | B | B | A | F |
| 3rd | S | F | S | B | A | F | B | B |
| 4th | B | S | A | A | S | A | F | A |

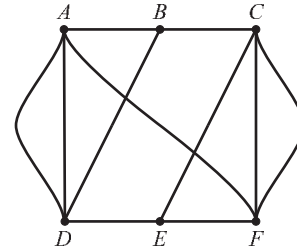
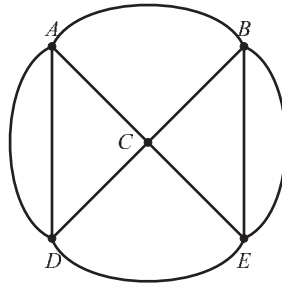
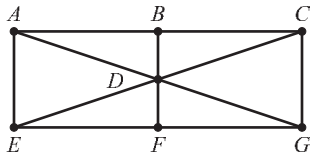
- a) Which choice wins the vote in a plurality election?
- b) Which choice wins the vote in a plurality election with elimination?
- c) Which choice is the pairwise comparison winner?
- d) Which choice is the winner using Borda's method? Perform the check on the sum of Borda points.

2. (16pts) For each of the following graphs:

a) State and justify whether it has an Euler path.

b) State and justify whether it has an Euler circuit.

c) If it has either an Euler path or a circuit, indicate it on the graph. Use arrows and number the edges to indicate how the Euler path or circuit goes around the graph.



3. (14pts) Consider the selection of central US states in the picture.

a) Draw a graph that models the bordering relationship between these states.

b) Is there a trip around these states that crosses every common state border exactly once? If so, display the route.

c) Is there a trip as in b) that starts and ends in the same state? If so, display the route.

