

**Mathematical Concepts — Exam 1**  
**MAT 117, Spring 2011 — D. Ivanšić**

**Name:** \_\_\_\_\_  
*Show all your work!*

$$i = prt \quad A = p(1 + rt) \quad A = p \left(1 + \frac{r}{n}\right)^{nt} \quad A = p \frac{\left(1 + \frac{r}{n}\right)^{nt} - 1}{\frac{r}{n}} \quad P = m \frac{1 - \left(1 + \frac{r}{n}\right)^{-nt}}{\frac{r}{n}} \quad APY = \left(1 + \frac{r}{n}\right)^n - 1$$

1. (8pts) Sharon would like to buy a dinner table in the near future. How much should she deposit now, in an account bearing 5.4% simple interest, in order to have \$1500 in seven months?

2. (10pts) You borrowed \$300 from an uncle, and repaid him in 6 months with \$314. What simple annual interest rate did you pay on this loan?

3. (8pts) William Walker deposits \$30,000 into an account bearing 4% interest, compounded weekly. How much does he have in 3 years?

4. (14pts) On March 3rd, Ignacio paid \$890 for a spring break trip . He put 15% down, and the rest he financed with a 90-day loan with a simple interest rate of 7%.

a) When is the loan due?

b) If Ignacio makes a partial payment of \$200 on April 20th, how much does he owe on the due date?

5. (14pts) The Zhangs would like to save up to add a pool to their home.

a) How much should they deposit every quarter into an account with 3.5% interest, compounded quarterly, in order to have \$25,000 in five years?

b) How much of the final amount is from deposits and how much from interest?

**6.** (32pts) Wall-E, the trash-collecting robot, wishes to have more room to store his scavenged items and decides to have a warehouse built at a cost of \$430,000. He finances this with a 4.65% mortgage, compounded monthly, over 30 years.

a) What is his monthly payment on the loan?

b) What are his total payments over the course of the loan? How much of this amount is for interest?

c) How much does he owe after 10 years?

d) How much of his 121st payment (it's the next one after 10 years) goes toward interest, and how much towards the principal?

7. (14pts) Betty decided to buy new furniture for her home, for which she will need \$12,000. If she can deposit \$200 monthly into an account bearing 8.25%, compounded monthly, how long will it take until she has the desired amount?

**Bonus.** (10pts) George deposits \$135 every quarter into an account earning 3.4% interest, compounded quarterly. He does this for three years, then stops making deposits, leaving the accumulated money in the account. How much does he have five years after he started making deposits?

**Mathematical Concepts — Exam 2**  
**MAT 117, Spring 2011 — D. Ivanišić**

**Name:** \_\_\_\_\_  
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$$\frac{a}{b} = \frac{1-P(E)}{P(E)} \quad P(E) = \frac{b}{a+b} \text{ where odds against } E \text{ are } a : b \quad P(B|A) = \frac{n(A \text{ and } B)}{n(A)}$$

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) = P(A) + P(B) \text{ (if } A \text{ and } B \text{ are mutually exclusive)}$$

$$P(A \text{ and } B) = P(A) \cdot P(B|A) \quad P(A \text{ and } B) = P(A) \cdot P(B) \text{ if } A \text{ and } B \text{ are independent}$$

$$E = P_1 \cdot A_1 + P_2 \cdot A_2 + \cdots + P_n \cdot A_n$$

1. (8pts) The number and type of trees on a college campus are as follows:

Tree	oak	chestnut	cherry	magnolia
Number	31	22	25	12

A couple is looking to nail their shoes to a random tree on campus. What is the probability that the chosen tree is

- a) a chestnut?
- b) a cherry or an oak?
- c) not a magnolia?

2. (18pts) Write the probabilities and odds against and in favor of the following events (you can show any work needed below):

Event	probability	odds against	odds in favor
a) Getting heads on a coin toss			
b) Drawing a black ace or a jack from a deck of cards			
c) Getting exactly one head on three coin tosses			
d) Getting sum less than 5 on a roll of two dice			
e) Rolling a 5 and a 4 (not sum!) on a roll of two dice			

**3.** (14pts) A game of chance is set up like this: the player pays \$2 and tosses a raisin into a box with hamsters Gabe, Miles and Snoopy which scramble and get the raisin with likelihoods 30%, 10% and 50%, respectively. 10% of the time the hamsters ignore the raisin. Depending on whether Gabe, Miles or Snoopy get the raisin, the player wins \$3, \$5 or \$1, respectively, otherwise the player wins nothing.

- a) Find the expected value of this game.
- b) What is the fair price of this game?
- c) If a player played this game 200 times, how much would they expect to win or lose?

**4.** (18pts) A bag contains five tiles with the letters B, U, M, A, H . A tile is drawn from the bag and then replaced. This is done twice.

- |  |                                       |
|--|---------------------------------------|
| a) Determine the number of points in the sample space.                               | Determine the probability that:       |
| b) Construct a tree diagram and list the sample space. (You may do these partially.) | c) exactly one of the letters is a U. |
|  | d) both letters are consonants.       |
|  | e) both letters are vowels.           |
|  | f) at least one letter is B or M.     |

**5.** (10pts) The manager of a car repair shop notices that the probability that a car brought into the shop requires an oil change is 0.6. The probability that a car needs brake repair is 0.4, and the probability that it needs both brake repair and an oil change is 0.2. What is the probability that:

- a) a car brought in the shop needs an oil change or brake repair?
- b) a car brought in the shop needs neither an oil change nor brake repair?

**6.** (14pts) The probability that you can obtain a special kind of whole-wheat bread at a grocery store in the afternoon is 70% (it often sells out). Assume that availability of this bread on different days are independent events. What is the probability that:

- a) on two afternoon trips to the store you find the bread both times?
- b) on three afternoon trips to the store, you find the bread at least once?
- c) on three afternoon trips to the store, you find the bread the first and the third time, but not the second?

7. (18pts) From a group of 11 men and 17 women, two people are chosen at random. What is the probability that:

a) both are men?

b) at least one is a man?

c) exactly one person is a woman?

**Bonus.** (10pts) Suppose a precision-guided bomb hits a target with probability 0.8. A bridge is targeted by two bombs: whether one hits the target is independent of whether the other one hits. If a single bomb hits the bridge, it collapses with probability 0.3, and if both bombs hit, it collapses with probability 0.9. What is the probability that the bridge collapses after an attack by two bombs? *Hint:  $P(\text{collapse}) = P(\text{exactly one bomb hits AND collapses}) + P(\text{both bombs hit AND collapses})$*



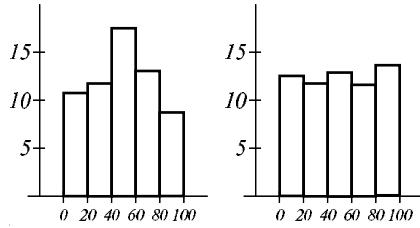
**Mathematical Concepts — Exam 3**  
**MAT 117, Spring 2011 — D. Ivanšić**

**Name:** \_\_\_\_\_  
*Show all your work!*

$$\begin{aligned} \text{angle} &= (\text{relative frequency}) \cdot 360^\circ & \text{midrange} &= \frac{\text{lowest value} + \text{highest value}}{2} \\ \bar{x} &= \frac{x_1 + x_2 + \cdots + x_n}{n} = \frac{\sum_i x_i}{n} & \text{range} &= \text{highest value} - \text{lowest value} \\ s &= \sqrt{\frac{(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + \cdots + (x_n - \bar{x})^2}{n - 1}} = \sqrt{\frac{\sum_i (x_i - \bar{x})^2}{n - 1}} & Z &= \frac{X - \mu}{\sigma} \end{aligned}$$

1. (18pts) Over the course of a week, a curious observer counts the number of people sitting at the computers in the main hall of Murray State's library at 4PM. She gets the following numbers: 14, 23, 32, 21, 11, 8, 11.
- Find the midrange.
  - Find the median.
  - Find the mean.
  - Find the range.
  - Find the standard deviation.

2. (6pts) Histograms for two data sets, which have the same mean  $\mu = 59$ , are shown. Which of the data sets will have a greater standard deviation and why?



3. (28pts) A thrift store has a selection of cheaply priced items. The table below indicates the prices that appear in the store and how many items have them.

- Draw a histogram for the data.
- Find the mode price.
- Find the median price.
- Find the mean price.
- Find the standard deviation.

Price	Frequency
\$1	25
\$2	13
\$4	11
\$7	8
\$9	12
\$10	7

4. (19pts) The distribution of scores on our exam 2 is shown below. Do the following:
- Find the relative frequencies.
  - Draw a pie chart (find angles first).
  - Enter a representative value for each interval.
  - Use the representative values to estimate the mean of data. How does it compare to the actual mean of 65.1?

Range of Scores	Number of Students	Relative Frequency	Angle	Representative Value
90–100	5			
80–89	5			
70–79	6			
60–69	7			
0–59	16			

5. (13pts) Compute the following areas under a standard normal distribution curve. Draw a picture showing which area you are computing.

a)  $A(-0.33 \leq Z < 0.4) =$

b)  $A(Z > -0.65) =$

6. (16pts) The weight of a box of chocolate-milk powder is normally distributed with mean 610 grams and standard deviation 7 grams. The declared weight on the package is 600 grams. Draw a picture showing which area you are computing as you answer:
- What percentage of boxes have weight lower than declared weight?
  - What percentage of boxes have weight between 605 and 635 grams?

**Bonus.** (10pts) Over the course of many years, the organizers of the 10K race “Find Your Fast” have noticed that participants’ running times are normally distributed with mean 53 minutes and standard deviation 7 minutes. As the number of participants has risen, the organizers have decided to make the race more competitive by demanding that an applicant’s time on some 10K race they have run in the past be better than the times of the slowest 10% of the “Find Your Fast” participants. What is the highest qualifying time for the race? (*Hint: this problem is the reverse of what we usually do with a normal distribution. Here, the area is given: you have to find the number on the axis that this area corresponds to. You will also need to apply conversion to the standard normal distribution.*)

**Mathematical Concepts — Exam 4**  
**MAT 117, Spring 2011 — D. Ivanšić**

**Name:** \_\_\_\_\_  
*Show all your work!*

1. (26pts) Murray's Lady Gaga fan club wishes to put up a poster that highlights her best feature. To decide what this is, they survey the members to rank her following prominent features: clothes, hair, or nose.

Votes:	3	5	1	4	6	1
1st	C	C	H	H	N	N
2nd	H	N	C	N	C	H
3rd	N	H	N	C	H	C

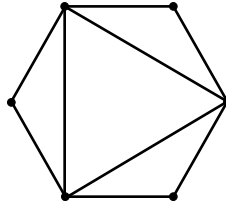
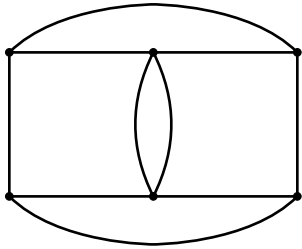
- Which choice wins the vote in a plurality election?
- Which choice wins the vote in a plurality election with a runoff?
- Which choice is the pairwise comparison winner?
- Which choice is the winner using Borda's method? Perform the check on the sum of Borda points.

2. (28pts) A town is trying to decide which community project to fund next. The choices are a fountain, a museum, a pool, or sidewalks. The preference rankings of the townspeople broke down into the following percentages.

Votes	18	15	9	17	11	16	14
1st	F	M	M	P	P	S	S
2nd	M	S	P	M	F	P	F
3rd	S	F	S	F	S	M	M
4th	P	P	F	S	M	F	P

- Which choice wins the vote in a plurality election?
- Which choice wins the vote in a plurality election with elimination?
- Which choice wins the vote in a plurality election with a runoff? (Is it the same as b?)
- Which choice is the winner using Borda's method? Perform the check on the sum of Borda points.

3. (12pts) Determine whether each of the following graphs has an Euler path or an Euler circuit. If it does, find it, if not, explain why not.

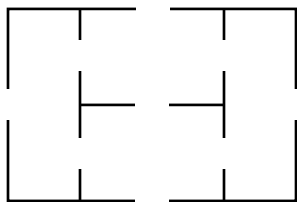


4. (15pts) Below is a floor plan of a building, with doors joining rooms indicated.

a) Represent the floor plan as a graph (don't forget to include an "outside").

b) Use the graph to determine if it is possible to walk around the building, passing through every door exactly once. If it is, draw the route.

c) Is it possible to do the same as in b), and start and finish outside?



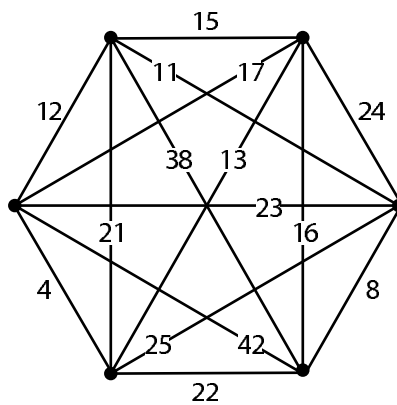
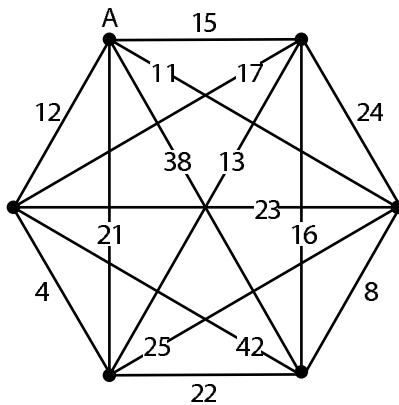
5. (19pts) A weary tourist would like to visit Lexington, Louisville, Bowling Green and Paducah, while trying to minimize the distance traveled. The table below has the distances between the cities.

- Draw a weighted graph that corresponds to this problem.
- Use the brute force method to find the route that minimizes the distance traveled. First list all the possible orders of visits with Paducah the starting city.
- Use the nearest neighbor algorithm to find an approximate solution to the problem. Is it the same as in c)?

	BG	Le	Lo
Le	154		
Lo	112	74	
P	151	262	220

**Bonus.** (10pts) Find an approximate solution to the traveling salesman problem. Show the weight of the found circuits. Use (one on each picture)

- the nearest neighbor algorithm starting at A.
- the greedy algorithm.





**Mathematical Concepts — Final Exam**  
**MAT 117, Spring 2011 — D. Ivanišić**

**Name:** \_\_\_\_\_  
*Show all your work!*

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$$\frac{a}{b} = \frac{1 - P(E)}{P(E)} \quad P(E) = \frac{b}{a+b} \text{ where odds against } E \text{ are } a : b \quad P(B|A) = \frac{n(A \text{ and } B)}{n(A)}$$

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) = P(A) + P(B) \text{ (if } A \text{ and } B \text{ are mutually exclusive)}$$

$$P(A \text{ and } B) = P(A) \cdot P(B|A) \quad P(A \text{ and } B) = P(A) \cdot P(B) \text{ if } A \text{ and } B \text{ are independent}$$

$$E = P_1 \cdot A_1 + P_2 \cdot A_2 + \dots + P_n \cdot A_n$$

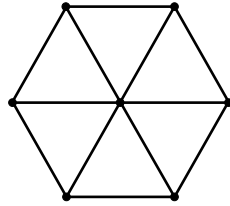
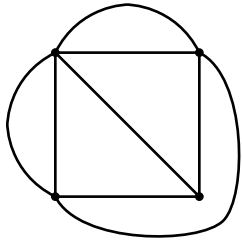
$$\text{angle} = (\text{relative frequency}) \cdot 360^\circ \quad \text{midrange} = \frac{\text{lowest value} + \text{highest value}}{2}$$

$$\bar{x} = \frac{x_1 + x_2 + \dots + x_n}{n} = \frac{\sum_i x_i}{n} \quad \text{range} = \text{highest value} - \text{lowest value}$$

$$s = \sqrt{\frac{(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + \dots + (x_n - \bar{x})^2}{n - 1}} = \sqrt{\frac{\sum_i (x_i - \bar{x})^2}{n - 1}} \quad Z = \frac{X - \mu}{\sigma}$$

1. (13pts) Assume the number of hours college students spend working per week is normally distributed with a mean of 15 hours and standard deviation 4 hours. Draw pictures showing which area you are computing as you answer:
- What percentage of students work fewer than 8 hours per week?
  - What percentage of students work between 13 and 17 hours per week?

2. (12pts) Determine whether each of the following graphs has an Euler path or an Euler circuit. If it does, find it, if not, explain why not.



3. (23pts) Fans of the “Star Wars” saga were asked to elect their favorite episode of the original series (1977-1983). The rankings of the group are below.

Votes:	12	4	11	7	6	3
1st	IV	IV	V	V	VI	VI
2nd	V	VI	IV	VI	IV	V
3rd	VI	V	VI	IV	V	IV

- Which choice wins the vote in a plurality election?
- Which choice wins the vote in a plurality election with a runoff?
- Which choice is the pairwise comparison winner?
- Which choice is the winner using Borda’s method? Perform the check on the sum of Borda points.

4. (25pts) The number of movie theaters in cities with populations greater than 10,000 across a US state is shown in the table below.

- Draw a histogram for the data.
- Find the mode number of movie theaters.
- Find the median number of movie theaters.
- Find the mean number of movie theaters.
- Find the standard deviation.

Movie Theaters	Frequency (cities)
0	11
1	24
2	15
3	9
4	7
5	5

5. (13pts) Write the probabilities and odds against and in favor of the following events (you can show any work needed below):

Event	probability	odds against	odds in favor
a) Drawing a queen from a deck of cards			
b) Getting exactly one head on three coin tosses			
c) Getting sum more than 8 on a roll of two dice			

**6.** (12pts) A game of chance is set up like this: the player pays \$10 and rolls a die. If the numbers 1 or 6 come up, the player wins \$21, if 4 comes up, the player wins \$15, otherwise the player wins nothing.

a) Find the expected value of this game.

b) What is the fair price of this game?

c) If a player played this game 100 times, how much would they expect to win or lose?

**7.** (5pts) In a subdivision of 43 houses, 13 have a pool, 21 have a three-car garage and 6 have both a pool and a three-car garage. If a home is randomly selected from the subdivision, what is the probability that it has a pool or a three-car garage?

**8.** (10pts) The probability that a student gets a job within a year after graduating is 75%. Assuming that different students getting jobs are independent events. What is the probability that:

a) Two students will get jobs after graduating?

b) At least one from a group of three will not get a job after graduating?

**9.** (7pts) If \$2,000 is deposited into an account bearing 2.55%, compounded daily, how much is in the account after two-and-a-half years?

**10.** (14pts) The Swokowskis would like to save up for a luxury car.

a) How much should they deposit every quarter into an account with 3.75% interest, compounded quarterly, in order to have \$35,000 in five years?

b) How much of the final amount is from deposits and how much from interest?

**11.** (16pts) The Middletons need to borrow \$650,000 to help cover the cost of the wedding of their daughter. Suppose they can get a 10-year loan with interest rate 6%, compounded monthly.

- a) What is their monthly payment?
- b) What is the balance on the loan after 8 years?

**Bonus.** (15pts) Below is a floor plan of a building, with doors joining rooms indicated.

- a) Represent the floor plan as a graph (don't forget to include an "outside").
- b) Use the graph to determine if it is possible to walk around the building, passing through every door exactly once. If it is, draw the route.
- c) Is it possible to do the same as in b), and start and finish outside?

