Fall 2025 **Math F113X**

Exam 3

Name: _____ **Section:** ☐ **10:30 am (Leah Berman)**
☐ **11:45pm (Kevin Meek)**
☐ **online (Kevin Meek)**

Rules:

- Partial credit will be awarded, but you must show your work.
- You may have 1/2 of a standard page of paper ($8.5'' \times 5.5''$) of notes, both sides.
- Calculators are allowed.
- Place a box around your $\boxed{\text{FINAL ANSWER}}$ to each question where appropriate.
- Turn off anything that might go beep during the exam.
- A formula sheet (tabula recta, finance formulas) is included on the last page of the exam. You may tear it off if you need to.

Problem	Possible	Score
1	20	
2	18	
3	12	
4	5	
5	5	
6	20	
7	10	
8	10	
Extra Credit	(5)	
Total	100	

1. (20 points)

a. **Encrypt** the message GARBANZO using a **Caesar cipher** with shift 7 (mapping A to H).

b. **Decrypt** the message DXPQE using a **progressive Caesar cipher / sequential shift cipher** starting with a shift of 3 (mapping A to C).

c. **Encrypt** the message GOOSE using a **Vigenère cipher** with keyword BONK

2. (18 points)

a. **Encrypt** the message THE CAT IS OUT OF THE BAG using a **tabular transposition cipher** with no keyword and rows of length 5.

b. **Decrypt** the message

RTECZ WEOTE AULUY EOFTX

using a **tabular transposition cipher** with keyword CURB.

3. (12 points)

For each of the following encryption methods, list at least one advantage and at least one disadvantage of the encryption system.

a. Caesar cipher

- Advantage:

- Disadvantage:

b. Double transposition

- Advantage:

- Disadvantage:

4. (5 points)

What feature(s) of the word `ALMOST` make it be a bad keyword for a **transposition cipher**? Write your answer in a sentence or two.

5. (5 points)

Suppose you loan a friend \$1000 and they agree that they will pay back the entire amount they borrowed, plus 6% **simple interest**. How much interest will they pay you? Show your computation, and provide a numeric answer.

6. (20 points)

For each scenario below, **plug in numbers into the appropriate formula** needed to calculate the value. Do **not** actually calculate the the value.

a. You deposit \$1500 in an account with an APR of 2.4%. The interest is compounded quarterly. How much will the account be worth in 5 years?

b. You loan your friend \$600. They agree to pay an annual interest rate of 5% **simple interest**. Fifteen months later, they repay the loan. How much did they pay you in total?

c. You want to take out a loan to buy a \$250,000 home. The bank offers a 30-year mortgage with an interest rate of 6.2%. What will the monthly payments be? (Suppose the interest is compounded monthly.)

d. You deposit \$6000 in an account the earns 2.75% APR compounded **daily** for 5 years. How much **interest** did you earn?

e. If you have a mortgage and you pay exactly \$1200 a month for 30 years, how much did you pay over the life of the mortgage?

7. (10 points)

It is a fact that

$$185{,}078.84 = \frac{1500\left(1-\left(1+\frac{0.05375}{12}\right)^{-12\cdot 15}\right)}{\frac{0.05375}{12}}$$

Suppose this calculation is used to model a loan in which payments are made regularly. Explain what this calculation indicates about the account parameters.

a. What was the annual interest rate (as a percent)? _____

b. How long was the loan for? _____

c. How frequently are regular payments being made? _____

d. How much is each regular payment? _____

e. Explain, in your own words, what the number 185,078.84 represents.

8. (10 points)

Suppose you have $2500 in charges on a credit card with an annual percentage rate of 29.99%, compounded monthly. In order to pay down your balance, you plan to stop charging anything onto the card, and you plan to make monthly payments of $50.

a. How much do you owe at the end of the first month? (Show your computation, and actually compute it.)

b. Is this a reasonable payment plan? Why or why not?

Extra Credit (5 points)

Pick **one** of the two options. Indicate which one you want graded.

(a) (Grade this one: ☐)

Suppose you have the following part of a spreadsheet, where ### represents specific numbers that have been typed in (but which could be changed).

	A	B	C	D	E
1	P	r	n	t	A
2	###	###	1	1	
3				2	
4				3	
⋮				⋮	

i. Write a formula, using cell references (`A1`, `B2`, `C3`, etc.), to put into cell `E2` to compute the total amount of money you have at the end of the first year.

ii. If you want to compute the compound interest for year 2, what cell reference should you enter into cell `A3`?

iii. What should you enter into cell `E3` to be able to fill down row 3 to compute compound interest for subsequent years?

(b) (Grade this one: ☐)

Decrypt the text

EHACC LEOTP PAIOE CN

if it was encrypted using a double transposition cipher with first keyword `BLUE` and second keyword `HOUSE`.

Formulas

$$A = P + I \qquad A = P(1 + rt) \qquad A = P\left(1 + \frac{r}{n}\right)^{(nt)} \qquad P = \frac{A}{\left(1 + \frac{r}{n}\right)^{(nt)}}$$

$$P = \frac{d\left(1 - \left(1 + \frac{r}{n}\right)^{(-nt)}\right)}{\left(\frac{r}{n}\right)} \qquad d = \frac{P\left(\frac{r}{n}\right)}{\left(1 - \left(1 + \frac{r}{n}\right)^{(-nt)}\right)}$$

		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**V**	**W**	**X**	**Y**	**Z**
0	**A**	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	**B**	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A
2	**C**	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B
3	**D**	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C
4	**E**	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D
5	**F**	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E
6	**G**	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F
7	**H**	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G
8	**I**	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H
9	**J**	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I
10	**K**	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J
11	**L**	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K
12	**M**	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L
13	**N**	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M
14	**O**	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N
15	**P**	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
16	**Q**	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
17	**R**	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
18	**S**	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
19	**T**	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
20	**U**	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
21	**V**	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
22	**W**	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
23	**X**	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
24	**Y**	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
25	**Z**	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y