# Quiz2

Ciphertext:
ECDTM ECAER AUOOL
EDSAM MERNE NASSO
DYTNR VBNLC RLTIQ
LAETR IGAWE BAAEI
HOR

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 2 | 3 | 3 | 9 | 0 | 1 | 1 | 3 | 0 | 0 | 4 | 3 | 4 | 4 | 0 | 1 | 6 | 3 | 4 | 1 | 1 | 1 | 0 | 1 | 0 |

## How to determine the dimension of the rectangle?

- In this case we have 63 letters.
- Vowel Frequencies can help us to determine the dimensions of the rectangle.
- In English approximately 40% of plaintext consists of vowels. Therefore, for the correct dimension, each row of the rectangle should be approximately 40% vowels.
- For example, there are 21 letters in the ciphertext.
- Because we know that the message completely fills the rectangle, this suggests either a 3X7 or a 7X3 array.
- Consider our choice between 3X7 and 7X3 as an example.
- For a 3X7 rectangle, each row should contain approximately 2.8 vowels.
- Let us note the difference between this estimate and the actual count to find the right dimension.

## Example:

Either

| | | | | | | |
|---|---|---|---|---|---|---|
| A | I | T | M | T | S | E |
| S | R | F | I | K | O | E |
| A | I | N | M | L | I | M |

or

| | | |
|---|---|---|
| A | F | L |
| S | N | S |
| A | M | O |
| I | I | I |
| R | M | E |
| I | T | E |
| T | K | M |

40% vowels. Consider our choice between $3 \times 7$ and $7 \times 3$.

For a $3 \times 7$ rectangle, each row should contain approximately 2.8 vowels.
Let us note the difference between this estimate and the actual count:

| | | | | | | | Number of vowels | Difference |
|---|---|---|---|---|---|---|---|---|
| A | I | T | M | T | S | E | 3 | 0.2 |
| S | R | F | I | K | O | E | 3 | 0.2 |
| A | I | N | M | L | I | M | 3 | 0.2 |

The sum of the differences is 0.6.

For a $7 \times 3$ rectangle:

| | | | Number of vowels | Difference |
|---|---|---|---|---|
| A | F | L | 1 | 0.2 |
| S | N | S | 0 | 1.2 |
| A | M | O | 2 | 0.8 |
| I | I | I | 3 | 1.8 |
| R | M | E | 1 | 0.2 |
| I | T | E | 2 | 0.8 |
| T | K | M | 0 | 1.2 |

The sum of the differences is 6.2. It appears that the $3 \times 7$ rectangle is more likely.

## Practice:

Transposition - Columnar Transposition

| E | R | A |
|---|---|---|
| C | A | M |
| D | U | M |
| T | O | E |
| M | O | R |
| E | L | N |
| C | E | E |
| A | D | N |
| E | S | A |