Name: KEY Date: _____ Period: _____

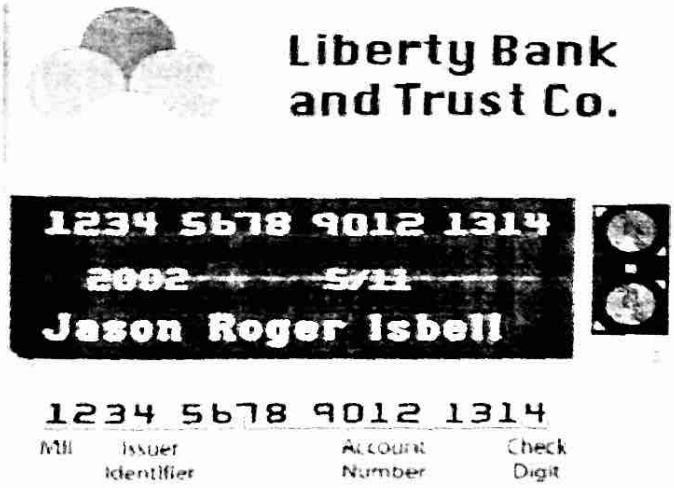
Analyzing Numerical Data: Validating Identification Numbers

ID Student Activity Sheet 13: Credit Card Numbers

Identification numbers are present everywhere in society. Today's identification numbers are more sophisticated than those introduced years earlier (for example, Social Security numbers). Today's numbers have a check digit to partially ensure that they have been correctly scanned or entered into a computer.

Credit cards have 16-digit numbers, of which the first 15 digits identify the credit card and the sixteenth digit is the check digit.

The following figure shows the significance of the digits:



MII stands for *major industry identifier*; *4* and *5* indicate "Banking and Financial." VISA cards begin with *4* and MasterCard cards with *5*.

1. MasterCard numbers begin with 51, 52, 53, 54, or 55. What is the maximum number of credit cards that MasterCard can issue?

$5 \times 10^{13} \times 1 = 5 \times 10^{13}$ credit cards

check digit determined by the previous #'s

A **check digit** is used to help validate credit card numbers. The credit card companies use the Codabar method to determine the check digit. This method consists of the following steps:

- Add the digits in the odd-numbered positions and double this total.
- Add the number of odd-position digits that are more than 4 to the total.
- Add the even-position digits.
- Choose a check digit that makes this calculation total a number whose final digit is 0.

(How exactly is it more?)

Libraries, shipping/receiving companies, and blood banks also use the Codabar method.

2. Show that the check digit (**d**) for the VISA card 4162 0012 3456 789**d** is 3.

add position digits

$2(4+6+0+1+3+5+7+9)+4+(1+2+0+2+4+6+8+d)$

$2(35)+4+(23+d) = 97+d \rightarrow \boxed{d=3}$ since $97+3=100$ ✓

3. What is the check digit (**d**) for the MasterCard number 5424 9813 2720 008**d**? add

$2(5+2+9+1+2+2+0+8)+3+(4+4+8+3+7+0+0+d)$

$2(29)+3+26+d = 58+29+d = 87+d \rightarrow \boxed{d=3}$ since $87+3=90$ ✓

4. Show that 4128 0012 4389 0110 is an invalid VISA credit card number.

$2(4+2+0+1+4+8+0+1)+1+(1+8+0+2+3+9+1+0)$

$2(20)+1+24 = 40+25 = 65$, not a multiple of 10 so it's not valid.

If someone made a single-digit error when entering this invalid number, can you tell which digit is incorrect? Why or why not?

No. Any single digit can be increased or decreased by an amount that causes the sum of the resulting 16 digits to end in "0".

Change one digit in this invalid number so the resulting number is valid.

ex. change 3 to 8.

ex. change check digit to 5

5. The following is another way to explain the Codabar method:

- If a digit is in an even-numbered position, add it to the total.
- If a digit is in an odd-numbered position, multiply it by 2. If the product is equal to or greater than 10, subtract 9 from the product. Add this difference to the total.
- After the first 15 digits have been processed, choose the check digit so that the sum of the 16 digits ends in 0.

Explain why both methods yield the same check digit.

compare the first three steps in the original method and the second step in this method. If "d" is an odd numbered position greater than 9 ex. d = u+5, then 2d = 2u+10 2u+10 −9 = 2u+1. Both 2d+1 and 2u+1 have the same units digit 3 thus, the same effect on the check digit.