Introduction to Mathematical Modeling
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Semester: Fall 2025   Date: October 20, 2025

Encoding Data in Illinois Driver's License Numbers

The last 5 digits of Illinois driver's license numbers encode the driver's birth year and gender as follows:

- For a **man**, the last 5 digits consist of:
  - The last two digits of the birth year (e.g., 67 for 1967), followed by
  - The day of the year calculated assuming every month has 31 days.

- For a **woman**, 600 is added to the number calculated above.

Formula for Day of Year:
$$\text{Day of year} = 31 \times (\text{month} - 1) + d$$
where d is the day of the month.

Example: Month-day ranges assuming 31 days per month

$$\text{January} : 1 \text{ to } 31$$
$$\text{February} : 32 \text{ to } 62$$
$$\text{March} : 63 \text{ to } 93$$
$$...$$
$$\text{December} : 342 \text{ to } 372$$

(a) Find the last 5 digits for a man born on February 12, 1967

$$\text{Year (last two digits)} = 67$$
$$\text{Day of year} = 31 \times (2 - 1) + 12 = 31 + 12 = 43$$
$$\text{Last 5 digits} = 67 \times 1000 + 43 = 67043$$

(b) What do the last 5 digits 10642 tell you about the person?

Since the number is greater than 60000, it may indicate a woman (600 added):

$$10642 - 600 = 10042$$

This is not valid since the day part (last three digits) should be at most 372.
Instead, interpret the digits as:

$$\text{Year} = 10, \quad \text{Day} = 642$$

Since $642 > 372$, subtract 600 to check if it's a woman:

$$642 - 600 = 42$$

Thus:

$$\text{Year} = 10 \implies 2010, \quad \text{Day} = 42$$

Day 42 corresponds to February 11 (31 days in January + 11 days in February).

Since 600 was added, this person is **female**, born on **February 11, 2010**.

(c) What do the last 5 digits 90373 tell you about the person?

Split the digits:

$$\text{Year} = 90, \quad \text{Day} = 373$$

Since day 373 is just above the max day (372), assume no 600 added:

- The day is slightly off; it might be an error or represent December 31 + 1 (since this simplified model assumes all months have 31 days).

Hence, the person is likely a **male**, born in **1990**, with a day number 373 — likely indicating December 31 or a minor data inconsistency.

Encoding Data in a Hypothetical State's Driver's License Numbers

The last 5 digits of a driver's license number encode the driver's birth year and gender as follows:

- For a **man**, the last 5 digits consist of:

    - The last two digits of the birth year (e.g., 78 for 1978), followed by
    - The day of the year calculated assuming every month has 30 days.

- For a **woman**, 500 is added to the number calculated above.

Formula for Day of Year:
$$\text{Day of year} = 30 \times (\text{month} - 1) + d$$
where d is the day of the month.

Example: Month-day ranges assuming 30 days per month

$$\text{January} : 1 \text{ to } 30$$
$$\text{February} : 31 \text{ to } 60$$
$$\text{March} : 61 \text{ to } 90$$
$$\dots$$
$$\text{December} : 331 \text{ to } 360$$

(a) Find the last 5 digits for a man born on April 20, 1983

$$\text{Year (last two digits)} = 83$$
$$\text{Day of year} = 30 \times (4 - 1) + 20 = 90 + 20 = 110$$
$$\text{Last 5 digits} = 83 \times 1000 + 110 = 83110$$

(b) What do the last 5 digits 84525 tell you about the person?

Since the last 5 digits are greater than 50000, subtract 500 to check for a woman:

$$84525 - 500 = 84025$$

This is not valid since the day part (last three digits) should be at most 360. Instead, interpret as:

$$\text{Year} = 84, \quad \text{Day} = 525$$

Since $525 > 360$, subtract 500 for woman:

$$525 - 500 = 25$$

Thus:

$$\text{Year} = 84 \implies 1984, \quad \text{Day} = 25$$

Day 25 corresponds to January 25 (since January covers days 1 to 30).
Since 500 was added, this person is **female**, born on **January 25, 1984**.

(c) What do the last 5 digits 79270 tell you about the person?

Split the digits:

$$\text{Year} = 79, \quad \text{Day} = 270$$

Since $270 \leq 360$, assume no 500 added.
Calculate birth month and day:

$$\text{month} = \left\lfloor \frac{270 - 1}{30} \right\rfloor + 1 = \left\lfloor \frac{269}{30} \right\rfloor + 1 = 8 + 1 = 9$$

Day of month:

$$270 - 30 \times (9 - 1) = 270 - 240 = 30$$

Hence, this person is a **male**, born on **September 30, 1979**.

Encoding Birth Day in ID Numbers with 35-Day Months

The last three digits of a man's ID number represent the birth day of the year calculated assuming each month has 35 days. If the person is a woman, 500 is added to the birth day.

(a) What are the last three digits of a man's ID number if he was born on October 8th?

Calculate the day of the year assuming 35 days per month:

$$\text{Day of year} = 35 \times (\text{month} - 1) + d$$

For October 8:

$$\text{month} = 10$$
$$d = 8$$
$$\text{Day of year} = 35 \times (10 - 1) + 8 = 35 \times 9 + 8 = 315 + 8 = 323$$

Since the person is a man, no addition is made.

$$\boxed{323}$$

(b) What do you know about a person if the last three digits of the person's ID number are 503?

Since the number is greater than 500, subtract 500 to find the birth day:

$$503 - 500 = 3$$

This indicates a woman born on day 3 of the year.

Answer: The person is a **woman** born on **January 3**.

(c) What do you know about a person if the last three digits of the person's ID number is 420?

On December 31st, the day of the year is calculated as follows:

$$\text{Day of year} = 35 \times (12 - 1) + 12 = 416$$

Since the maximum value this formula can produce is 416, the last three digits of the person's ID number, 420, are considered invalid.

End of Lecture #11