We used the third form of the pigeonhole principle to demonstrate the minimum quantities required in each mathematical word problem.

# Questions to Solve

1. Assume there is a standard deck of 52 cards
   1. How many cards must be selected to guarantee that at least three cards of the same suit are chosen?
   2. How many cards must be selected to guarantee that at least hearts are selected
   3. Use the pigeonhole third form.  
      Show you solution and submit your answer in the given link.
2. Assume that telephone numbers are of form NXX-NXX-XXXX where N is a digit from 2 to 9 and X can be any digit. What is the least number of area codes needed to guarantee that 25 million phone numbers can be assigned.  
   Use pigeonhole third form  
   Show you solution and submit your answer in the given link.

# Responses

## Standard Deck of 52 Cards

### Three Cards of the Same Suit Minimum

1. Analyze the given variables.
   1. There are 52 cards with 4 suits among them.
   2. Each suit has 13 cards.
2. We want to find the minimum number of cards that must be chosen to ensure at least 3 cards of the same suit.
3. We can select at most 2 cards from each suit.
   1. 2 cards per suit x 4 suits = 8 cards
   2. After selecting 8 cards — 2 from each suit — any additional card picked results in at least 3 cards of one suit.
4. Therefore, the minimum needed to guarantee at least three cards is:
   1. 8 cards of two suits + 1 more card = 9 cards minimum.

### Guarantee of Minimum One Heart

1. Analyze the given.
   1. 52 cards.
   2. 13 hearts
2. Determine worst-case scenario.
   1. 52 – 13 = 39 non-heart cards.
   2. After selecting 39 cards, any additional card must be a heart.
3. Therefore, the minimum needed is:
   1. 39 + 1 = 40 cards.

## Telephone Numbers

1. Analyze the given.
   1. The telephone number format is:
      1. NXX-NXX-XXXX
   2. N = digit from 2 to 9
   3. X = digit from 0 to 9.
2. Calculate total number of possible phone numbers.
   1. NXX-NXX-XXXX
   2. First three digits is the area code
   3. (8 x 10 x 10) x (10 x 10 x 10 x 10) = 8,000,000
3. Use Pigeonhole Principle.
4. Conclude.
   1. Therefore, the minimum number of phone numbers per area code is 4.

# Appendix

## Scans of Handwritten Copy



