## Sampling Distributions — Math 121 - Workshop

In a simple random sample of size $n$ from a large population, the sample mean $\bar{x}$ has a probability distribution called the **sampling distribution**. You need to know these three things about the sampling distribution for $\bar{x}$.

1. **Shape**. It gets more normal as $n$ increases.
2. **Center**. Same as the population mean $\mu$ for individuals.
3. **Spread**. Smaller than the population standard deviation $\sigma$:

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}.$$

The numbers racket was an illegal lottery run by mobsters that was popular in big cities before states started running their own lotteries. It cost \$1 to play and players could pick any three digit number from 000 to 999. The winning number was selected the next day, and a player who picked the right number would win \$600.

1. Make a table showing the (two) possible outcomes and their probabilities if you buy one numbers ticket.

2. What is the theoretical average payoff for one numbers game?

3. Some people played the numbers game every day. If someone played 350 games a year for 40 years, that would be 14,000 games. The theoretical standard deviation in the return from one game is $\sigma = \$18.964$. Use this to describe the **shape**, **center**, and **spread** of the sampling distribution for the average winnings (per game) over this person's lifetime.

4. Could someone win more money playing numbers than they lost? What is the probability of that happening if they played numbers 14,000 times? Use the normal distribution to find out.

5. Some mobsters took around 350,000 numbers bets every week. For the people running the numbers racket, the theoretical average profit per bet was $\mu = \$0.40$ with a standard deviation of $\sigma = \$18.964$. Draw and label a graph of the sampling distribution for their weekly average profit.

6. A mobster taking 350,000 bets per week can be 95% sure that they will have a weekly average profit (per bet) between what two numbers?

NUMBERS RACKET

By "BILL"

Boy, there was plenty of excitement when that "611" came out Monday.

M, my, my! ! They tell me that some of the bankers haven't stopped running yet. However the "big fish" survived the storm and their ability to pay off will mea increased business for them, mind you.

I turned that cartoon every way but loose before the figger was announced, and could't see it, but as soon as it came out, the number was as plain as day. I am still $22.60 ahead. Watch 732. Maybe Santa Claus'll bring it.

| Inning Number | | My Guess |
|---|---|---|
| 059 | December 5 | 333 |
| 765 | December 6 | 883 |
| 011 | December 7 | 234 |
| 611 | December 9 | 576 |
| 470 | December 10 | 450 |
| 689 | December 11 | 854 |

A typical newspaper article about the numbers racket. From the *Baltimore Afro-American*, Dec. 14, 1929.