| AP Statistics – 6.3N Activity | Name: |
|---|---|
| **Goal:** Understand Normal Model as an Approximation to the Binomial Model | Date: |

## I. Example: Teens and Debit Cards

In a survey of 506 teenagers ages 14-18, subjects were asked a variety of questions about personal finance. One question asked teens if they had a debit card. Suppose that exactly 10% of teens ages 14-18 have debit cards.

**Let X = the number of teens in a random sample of size 506 that have a debit card.**

(a) Show that the distribution of X is approximately binomial.

B - Yes. Teens either have a debit card or they don't

I - INDEPENDENT. SAMPLING WITHOUT REPLACEMENT AND THE 10% CONDITION IS MET. There are millions of teens and we are only sampling 506 TEENS.

N - FIXED Sample, $n = 506$

S - FIXED Probability $p = 10\%$

THIS IS A BINOMIAL DISTRIBUTION $B(506, .1)$

(b) Check the conditions for using a Normal approximation in this setting.

Since: $np = 506(.1) = 50.6 > 10$ and $n(1-p) = nq = 506(.9) = 455.4 > 10$

$np > 10$ and $nq > 10$, meet the conditions to use the normal approximation

(c) Use a Normal distribution to estimate the probability that 40 or fewer teens in the sample have debit cards.

These formulas are on the green sheet

$E(x) = \mu_x = np = 506(.1) = 50.6$

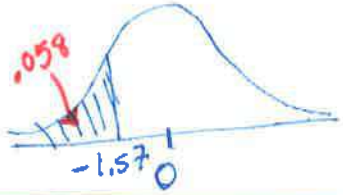
$SD(x) = \sigma_x = \sqrt{np(1-p)} = \sqrt{506(.1)(.9)} = 6.75$

$N(50.6, 6.75)$

$P(x \le 40) = P\left(z \le \frac{40 - 50.6}{6.75}\right)$

$= P(z \le -1.57) = .058$

normalcdf(-E99, -1.57, 0, 1)




THERE IS APPROXIMATELY A 6% CHANCE THAT 40 OR FEWER TEENS WILL HAVE A DEBIT CARD

Probability w/ BINOMIAL DISTR.

$B(506, .1) \rightarrow$ binomcdf(506, .1, 40) = .063

EITHER WOULD BE ACCEPTED

**II. Notes** –see definitions on page 395

The Normal Distribution can be used as an approximation for the binomial distribution

- if the number of successes and failures are at least ten. ($np \geq 10$ and $n(1-p) \geq 10$)
- In English that means – when the number of trials is large, this method is used.

$$\mu = np$$
$$\sigma = \sqrt{np(1-p)}$$

$$P(x \geq 4000) = P\left(z \geq \frac{x-\mu}{\sigma}\right)$$

In the above model, replace the inequality with less than, etc., whatever is appropriate for the problem you are solving. Additionally, replace the 4000 for your problem.

Steps:

1) Define the Random Variable
2) Check the conditions $np \geq 10$ and $n(1-p) \geq 10$
   ** You must show BOTH calculations to indicate you verified this condition.
3) Calculate the mean and the standard deviation with the formulas above.
4) Calculate the probability of interest
5) State your conclusion, in the context of the problem.