35. **John Wayne.** Like a lot of other Americans, John Wayne died of cancer. But is there more to this story? In 1955 Wayne was in Utah shooting the film *The Conqueror*. Across the state line, in Nevada, the United States military was testing atomic bombs. Radioactive fallout from those tests drifted across the filming location. A total of 46 of the 220 people working on the film eventually died of cancer. Cancer experts estimate that one would expect only about 30 cancer deaths in a group this size.

a) Is the death rate observed in the movie crew unusually high? **YES - IF 30/220 APPLIES.**

b) Does this prove that exposure to radiation increases the risk of cancer?

\[ H_0 : p = \frac{30}{220} \quad H_1 : p > \frac{30}{220} \]

\[ \text{OBSERVED STAT} \]

\[ \frac{46}{220} - \frac{30}{220} \]

\[ \sqrt{\frac{30}{220} \left(1 - \frac{30}{220}\right) / 220} = 3.14 \]

\[ 1 - .9992 = 0.0008 \]

\[ 50 \ P-VALUE \]

\[ 1 - .9992 = .0008 \]
1. Hypotheses. Write the null and alternative hypotheses you would use to test each of the following situations:

a) A governor is concerned about his "negatives"—the percentage of state residents who express disapproval of his job performance. His political committee pays for a series of TV ads, hoping that they can keep the negatives below 30%. They will use follow-up polling to assess the ads' effectiveness.

\[ H_0 : \ p = 0.3 \quad \text{H}_1 : \ p > 0.3 \]

\[
\frac{145/400 - 0.3}{\sqrt{0.3 \cdot 0.7 / 400}} = 2.73
\]

\[ 1 - 0.9968 = 0.0032 \]

REALLY TRY TO SHOW ADS INCREASE DISAPPROVAL RATING

\[ p = 0.03 \]

P VALUE

SHOULD USE H1: p < .3 "ADS EFFECTIVE" 2.73 NOT SUPPORTED BY DATA REQUIRED
1. Hypotheses. Write the null and alternative hypotheses you would use to test each of the following situations:

b) Is a coin fair?

\[ p = \text{fraction of heads in large number of tosses} \]

\[ H_0 : p = 0.5 \]

\[ H_1 : p \neq 0.5 \text{ (two-sided alternative)} \]

Suppose we toss a coin 100 times finding 57 heads.

\[ \frac{57 - 50}{\sqrt{50 \times 0.5 \times 0.5}} = 1.40 \]

\[ 2 \times (1 - 0.9192) = 0.1616 \]

\[ \text{Just some in this case as finding 43 is in 100} \]
1. **Hypotheses.** Write the null and alternative hypotheses you would use to test each of the following situations:

c) Only about 20% of people who try to quit smoking succeed. Sellers of a motivational tape claim that listening to the recorded messages can help people quit.

\[ p = \text{fraction of smokers who try to quit and succeed.} \]

**H0:** \[ p = 0.2 \text{ (historic).} \]

**H1:** \[ p > 0.2 \text{ (w/ motivational tape) ONE-SIDED.} \]

Suppose we sample 500 smokers w/ tape, finding 121 quit.

\[
\frac{121/500 - 0.2}{\sqrt{0.2 \times 0.8 / 500}} = 2.35
\]

Applicable if \( p = 2 \)

\[ (1 - 0.9906) = 0.0096 \]

\[ z = 2.3 \]

\[ p < 0.05 \]
19. 1960 data: fraction of smokers in adult population = 0.44.

In 2004 sample of 881 adults there were 54.6% smokers.

H0: $p = 0.44$ (no change from past). 

\[
\frac{0.546 - 0.44}{\sqrt{0.44 \cdot 0.56/881}} = 6.34
\]

Theoretical if $p = 0.49$

\[2(1 - 1.0000) = 0.0000 \text{ (largest table entry)}\]

Test is like smoke detector with lots of data you are sure to get $p = 0$. 
4. Dice. The seller of a loaded die claims that it will favor the outcome 6. We don’t believe that claim, and roll the die 200 times to test an appropriate hypothesis. Our P-value turns out to be 0.03. Which conclusion is appropriate? Explain.

a) There’s a 3% chance that the die is fair.
b) There’s a 97% chance that the die is fair.
c) There’s a 3% chance that a loaded die could randomly produce the results we observed, so it’s reasonable to conclude that the die is fair.
d) There’s a 3% chance that a fair die could randomly produce the results we observed, so it’s reasonable to conclude that the die is not fair.

H0: \( p = \frac{1}{6} \). H1: \( p > \frac{1}{6} \).

Suppose we toss die 200 times finding 42 "sixes."

\[
\frac{43/200 - 1/6}{\sqrt{1/6 \cdot 5/6/200}} = 1.83
\]

\[ (1 - 0.9664) = 0.0336 \]
24. Company wants at most 2% of appliances to be damaged. Inspectors find 5 of 60 appliances damaged.

\[ H_0: p = 0.05 \ (p = \text{chance of damage}), \quad H_1: p > 0.05. \]

\[ \frac{\hat{p} - p_0}{\sqrt{p_0(1-p_0)/n}} = \frac{0.05 - 0.02}{\sqrt{0.02 \times 0.98/60}} = 3.50 \]

**TROUBLE, PHAT = 5/60 IS TOO SMALL. N = 60 IS NOT LARGE.**

We don't trust the result of a naive test.

**NOTE:** MENDEL'S LIFE LONG DATA

\[ p\text{-value} \quad H_0: \text{all Mendel's models correct} \quad H_1: \text{not} \]

0 MENDELS P