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April 5th, 2024

Introduction to hypothesis testing

Introduction:

For each of the following problems,

(a) Write null and alternative hypotheses appropriate to this study.

(b) Compute the z-score of the sample mean.

(c) Compute the p-value of the sample mean.

(d) Are the results statistically significant at level $\alpha = 0.05$?

(e) What conclusions, if any, can be drawn from this study? Answer in ordinary human language.

Problem 1

A medical school advertises that the mean starting salary of its graduates is $\$89,000$. Concerned that it may actually be less, a group of first-years surveys 38 recent graduates, finding a sample mean of $\$85,500$. Assume $\sigma = \$8000$.

Answer:

```
populationMean <- 89000
sampleMean <- 85500
stndDev <- 8000
count <- 38

#PART A
cat("Null-hypotheses:"
    ,"N =",populationMean,"\n")
```

```
Null-hypotheses: N = 89000
```

```
cat("Alternative-hypotheses:",
    "N <",populationMean,"\n\n")
```

```
Alternative-hypotheses: N < 89000
```

```r
# PART B
z_score <- (sampleMean - populationMean) / (stndDev / sqrt(count))
cat("z-score:",z_score,"\n\n")
```

```
z-score: -2.696931
```

```r
# PART C
p_score <- pnorm(z_score)
cat("p-score:",p_score,"\n\n")
```

```
p-score: 0.003499087
```

```r
# PART D
if (p_score < 0.05){
  cat("The results are not statistically significant.")
} else if (p_score > 0.05){
  cat("The results are statistically significant.")
} else {
  cat("p-score is equal to 5%.")
}
```

```
The results are not statistically significant.
```

PART E:

That means there is **NOT** enough evidance to support us confidently saying the mean salary of graduates is 89000 dollars.

Problem 2

A laptop manufacturer claims that the mean life of the battery for a certain model of laptop is 6 hours. In a simple random sample of 80 laptops, the mean battery life is 5.9 hours. Assume $\sigma = 1.3$ hours. Is the company's claim reasonable?

Answer:

```r
populationMean <- 6
sampleMean <- 5.9
stndDev <- 1.3
count <- 80

#PART A
cat("Null-hypotheses:"
    ,"N =",populationMean,"\n")
```

```
Null-hypotheses: N = 6
```

```r
cat("Alternative-hypotheses:",
    "N <",populationMean,"\n\n")
```

```
Alternative-hypotheses: N < 6
```

```r
# PART B
z_score <- (sampleMean - populationMean) / (stndDev / sqrt(count))
cat("z-score:",z_score,"\n\n")
```

```
z-score: -0.6880209
```

```r
# PART C
p_score <- pnorm(z_score)
cat("p-score:",p_score,"\n\n")
```

```
p-score: 0.2457198
```

```r
# PART D
if (p_score < 0.05){
  cat("The results are not statistically significant.")
} else if (p_score > 0.05){
  cat("The results are statistically significant.")
} else {
  cat("p-score is equal to 5%.")
}
```

```
The results are statistically significant.
```

PART E:

That means there is enough evidance to support us confidently saying the mean battery life of a phone is 6 hours.

Problem 3

A soft drink manufacturer claims that the mean calorie content of one of its sports drinks is 150 calories per bottle. In a simple random sample of 95 bottles, the mean is 158 calories. Is there sufficient evidence to conclude that the mean is actually more than 150 calories/bottle? Assume $\sigma = 20$ calories.

Answer:

```r
populationMean <- 150
sampleMean <- 158
stndDev <- 20
count <- 95

#PART A
cat("Null-hypotheses:"
    ,"N =",populationMean,"\n")
```

```
Null-hypotheses: N = 150
```

```r
cat("Alternative-hypotheses:",
    "N >",populationMean,"\n\n")
```

```
Alternative-hypotheses: N > 150
```

```r
# PART B
z_score <- (sampleMean - populationMean) / (stndDev / sqrt(count))
cat("z-score:",z_score,"\n\n")
```

```
z-score: 3.898718
```

```r
# PART C
p_score <- 1 - pnorm(z_score)
cat("p-score:",p_score,"\n\n")
```

```
p-score: 4.835171e-05
```

```r
# PART D
if (p_score < 0.05){
  cat("The results are not statistically significant.")
} else if (p_score > 0.05){
  cat("The results are statistically significant.")
} else {
  cat("p-score is equal to 5%.")
}
```

```
The results are not statistically significant.
```

PART E:

That means there is **NOT** enough evidance to support us confidently saying the mean of calories in a drink is 150 calories.