Midterm Exam

2025-03-05

1-You wonder if you have a world record on your hands (pun intended), so you call Pablo and find out that the mean weight of a dobsonfly is 11 grams, with a standard deviation of 2.3 grams. Your fly weighs 12.4 grams.

What percentage of dobsonflies are at least this heavy?

Do you conclude that a dobsonfly of this size is rare, if we use a threshold of rareness as the top 5% of heavy dobsonflies?

Include a graph of your output.

```
# Given values
mean_weight <- 11
sd_weight <- 2.3
observed_weight <- 12.4

# Calculate the probability of a dobsonfly weighing at least 12.4 grams
p_value <- pnorm(observed_weight,
                 mean = mean_weight,
                 sd = sd_weight,
                 lower.tail = FALSE)
percentage <- p_value * 100
percentage
```

```
## [1] 27.13631
```

```
# another way
mean_weight <- 11
sd_weight <- 2.3
observed_weight <- 12.4

# Calculate Z-score
z_score <- (observed_weight - mean_weight) / sd_weight

# Find the probability of being at least this heavy
p_value <- pnorm(z_score,
                 lower.tail = FALSE)
p_value
```

```
## [1] 0.2713631
```

2- Using our same information about the dobsonflies (mean = 11g, sd = 2.3g), how heavy would a dobsonfly need to be to be in the top 5% of heaviest dobsonflies?

```r
mean_weight <- 11
sd_weight <- 2.3

# Find the 95th percentile
top_5_weight <- qnorm(0.95, mean = mean_weight, sd = sd_weight)
top_5_weight
```

```
## [1] 14.78316
```

```r
mean_weight <- 11
sd_weight <- 2.3

# Use qnorm for the bottom 5% and flip the sign
z_95 <- qnorm(1-0.05)

# Compute the weight for the top 5%
top_5_weight <- mean_weight + (z_95 * sd_weight)
top_5_weight
```

```
## [1] 14.78316
```

3- We want to know if the trend in permafrost thaw depth deviates significantly from zero. A test of a hypothesized mean = 0 against this one sample data will tell us if any trend is significant.

Conduct a one-sample z-test on the data to see if our sample mean differs significantly from a hypothesized mean of 0. Note that the true standard deviation for this hypothesized population is 0.27.

```r
library(readxl)
```

```
## Warning: package 'readxl' was built under R version 4.3.1
```

```r
library(BSDA)  # Load the BSDA package
```

```
## Warning: package 'BSDA' was built under R version 4.3.2

## Loading required package: lattice

##
## Attaching package: 'BSDA'

## The following object is masked from 'package:datasets':
##
##     Orange
```

```r
df <- read_excel('AnnualEOSThawDepthForR.xlsx')

z.test(df$TrendSlope1996to2017,
       mu=0,
       sigma.x=0.27,
       alternative='two.side'
      )
```

```
##
##  One-sample z-Test
##
## data:  df$TrendSlope1996to2017
## z = 15.016, p-value < 2.2e-16
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  0.6231577 0.8102548
## sample estimates:
## mean of x
## 0.7167062
```