range shift

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Chen et al. (2011) wanted to test the idea that organisms move to higher elevation as the climate warms. To test this, they collected data from 31 species, plotted below.

```
library(readxl)
library(BSDA)
library(dplyr)
library(ggplot2)
```

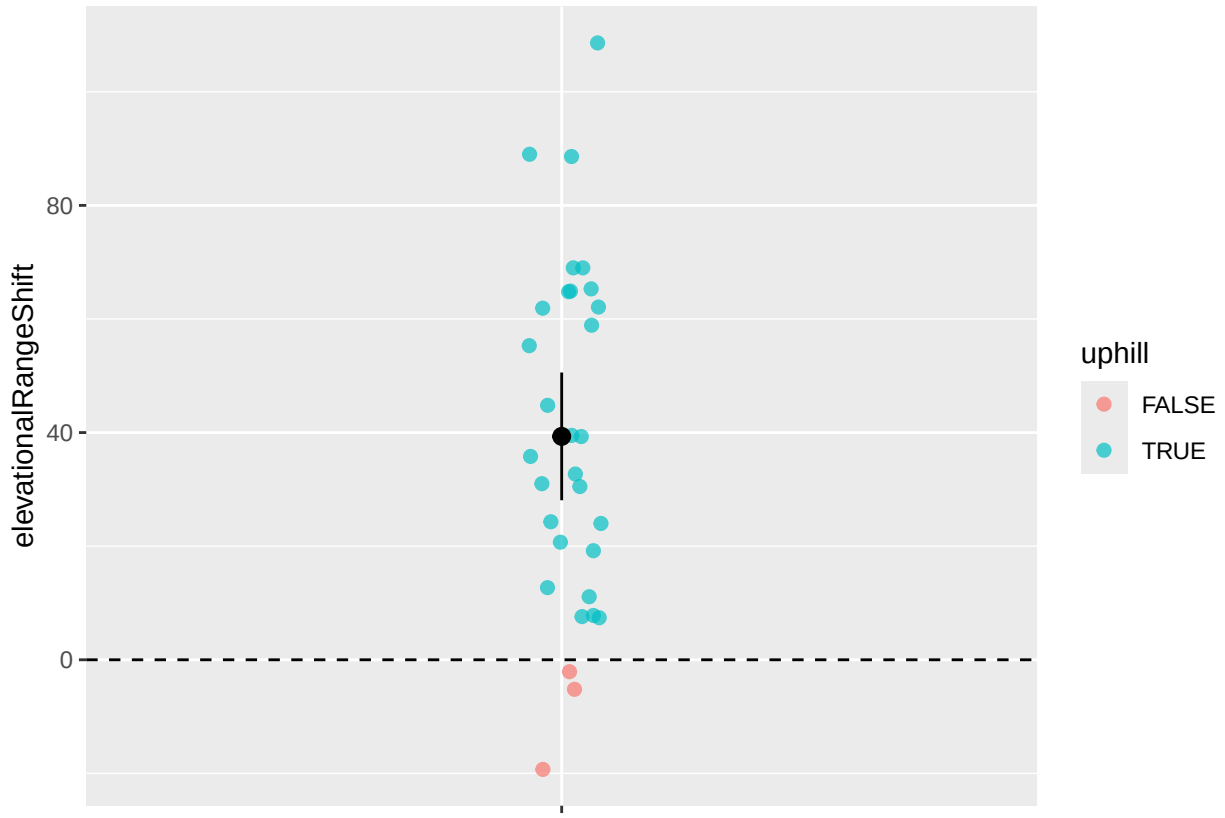
```
df <- read.csv('range_shift_data.csv')
head(df)
```

```
##   elevationalRangeShift  taxonAndLocation
## 1                  58.9    moths_Malaysia
## 2                   7.8 butterflies_Czech
## 3                 108.6 butterflies_Spain
## 4                  44.8    butterflies_UK
## 5                  11.1     butterfies_UK
## 6                  19.2   aquatic bugs_UK
```

Plot

```
range_shift <- df |>
  mutate(x = "", uphill = elevationalRangeShift > 0)

ggplot(range_shift, aes(x = x, y = elevationalRangeShift))+
  geom_jitter(aes(color = uphill), width = .05, height = 0, size = 2, alpha = .7)+
  geom_hline(yintercept = 0, lty= 2)+
  stat_summary(fun.data = "mean_cl_normal") +
  theme(axis.title.x = element_blank())
```



Normality test

```
shapiro.test(df$elevationalRangeShift)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  df$elevationalRangeShift
## W = 0.97755, p-value = 0.7416
```

Estimate population parameters

```
mean_pop <- 0
sd_pop <- sd(df$elevationalRangeShift)
```

Run z.test

```r
z.test(df$elevationalRangeShift,
       alternative='greater',
       mu=mean_pop,
       sigma.x=sd_pop)
```

```
##
##  One-sample z-Test
##
## data:  df$elevationalRangeShift
## z = 7.1413, p-value = 4.622e-13
## alternative hypothesis: true mean is greater than 0
## 95 percent confidence interval:
##  30.2704      NA
## sample estimates:
## mean of x
##  39.32903
```

Reference

Chen, I-Ching, Jane K. Hill, Ralf OhlemÃ¼ller, David B. Roy, and Chris D. Thomas. 2011. Rapid Range Shifts of Species Associated with High Levels of Climate Warming. Science 333 (6045): 1024 26. https://doi.org/10.1126/science.1206432.