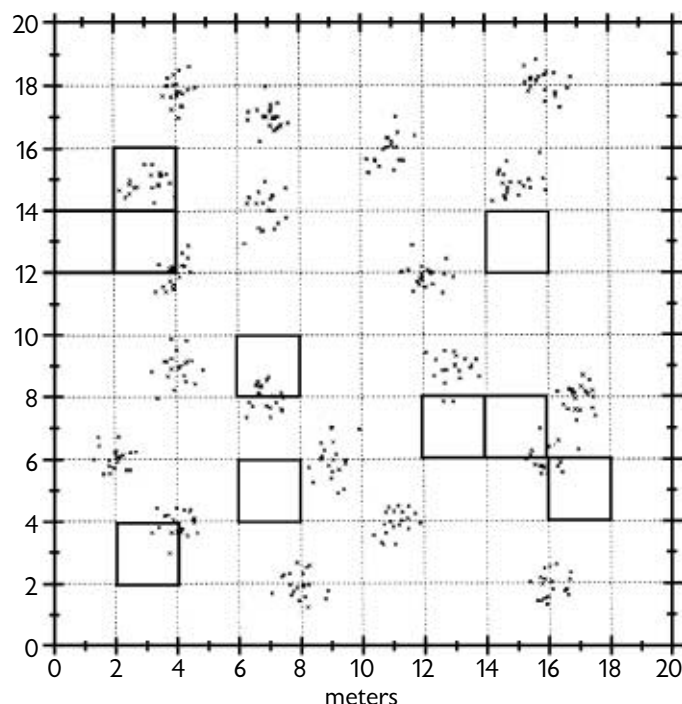


# Homework 1

ESM 211

Due 17 Jan. 2020

Plants and animals are often distributed unevenly across space, even at a local. This figure, which maps a hypothetical population, shows a type of pattern we often see:



1. Give three reasons why a plant or animal might be patchily distributed like this. For each, describe whether you would expect the location of the high-density patches to be consistent from year to year (1 point).

## Eureka dune grass

Eureka dune grass (*Swallenia alexandrae*) is a rare bunchgrass that only grows on three sand dunes in Death Valley National Park. You are going to evaluate the population change on one of those dunes (Saline Dune) from 2009 to 2010.

Plants were counted in 11 quadrats across the dune. The data are in the file **Swallenia.csv**.

2. Read in the data, and use a two-sample t-test (e.g., using `t.test()` in R) to assess whether and how mean abundance changed from 2009 to 2010. Choose a level for  $\alpha$ , and justify your choice. On the basis of this analysis, what do you conclude about the change in the grass's abundance? (1 point)
3. Because the plant was counted in the same plots each year, you can also do a paired t-test (R hint: use `paired = TRUE` in `t.test()`). On the basis of this analysis, what do you conclude about the change in the grass's abundance? (1 point)
4. Which of these analyses is more appropriate? Why? (Hint: think about your answers to question 1, and whether any apply here) (1 point)

5. Write a short paragraph to the park superintendent describing your finding about the changes (if any) to the dune grass population. (1 point)

## Yellowstone grizzly bears

The grizzly population in and around Yellowstone National Park has been increasing recently, to the point where delisting has been attempted. But not so long ago, the population seemed to be declining, and was in fact the subject of the first quantitative Population Viability Analysis (PVA), which concluded that the population was at a high risk of going extinct.

In this section you will analyze trends in both the early data and in more recent times.

The easiest bears to observe in aerial and ground-based surveys are adult females with cubs. Since females give birth every three years, on average, an approximate index of the number of adult females (reproductively mature individuals; females reach this stage between ages 4 and 9) in the population in a given year is the sum of females-with-cubs in the current year, the previous year, and the year before that. These are the estimates tabulated in the file `grizzlydata.csv`, in the column labeled `N`.

6. Open the file, and look at the data from 1959 to 1968. Did the grizzly bear population decline over this period? Support your conclusion with graphs, statistics, and logical reasoning. (2 points)

In the late 1960s, the park undertook a major management change. Prior to this time, all garbage generated by park staff and visitors was disposed of in dumps within the park boundaries (generally close to the tourist attractions that generated them). Both grizzly and black bears congregated on these dumps, to the point where some of them became tourist attractions in their own right, with bleachers, lights, and ranger talks (Fig. 1). Due both to concerns of conflict with habituated bears, and an increasing mandate to promote natural processes, the park closed the dumps between 1968 and 1971, shipping garbage off-site.



Figure 1: ‘“Lunch Counter - For Bears Only” at Old Faithful, southeast of the upper Hamilton Store, and Ranger Naturalist Walter Phillip Martindale; (Photographer unknown; 1921- mid 1930s; courtesy of NPS)’

The closures were initially controversial among bear biologists, as garbage feeding appears to improve bear fecundity (Stringham 1986) and there was evidence that bears responded to abrupt dump closures by seeking out food at campgrounds, increasing the potential for dangerous interactions with humans and the need for killing “problem” bears (Craighead and Craighead 1971).

7. Select the data from 1969 to 1978. Did the population continue to decline? Was the decline faster than the period prior to the dump closures? (1 point)
8. Finally look at the data after 1978. Did population size continue to change? What was the direction and magnitude of the trend? (1 point)
9. Write a short paragraph to the park superintendent describing your conclusions on the effects (if any) of the dump closures on the grizzly bear population. (1 point)

## References

- Craighead, J. J., and F. C. Craighead Jr. 1971. Grizzly bear-man relationships in Yellowstone National Park. *BioScience* 21:845-857. <https://doi.org/10.2307/1295811>
- Stringham, S. F. 1986. Effects of Climate, Dump Closure, and Other Factors on Yellowstone Grizzly Bear Litter Size. *Bears: Their Biology and Management* 6:33-39. <https://www.jstor.org/stable/3872803>