

# R Spatial Assignment

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## set paths

```
rm(list = ls())

user_path <- function() {
  # Return a hardcoded path that depends on the current user, or the current
  # working directory for an unrecognized user. If the path isn't readable,
  # stop.

  user <- Sys.info()["user"]
  if (user == "zachkuloszewski") {
    path = "/Users/zachkuloszewski/Library/CloudStorage/Dropbox/My Mac (Zachs-MBP.lan)/Documents/Gi
  } else if (user == "") {
    path = ""
  } else {
    warning("No path found for current user (", user, ")")
    path = getwd()
  }
  stopifnot(file.exists(path))
  return(path)
}
```

## Problem 1: Mapping Dell (2010)

### Part 1.i, load necessary libraries

```
library(tidyverse)
library(sf)
library(raster)
library(rgdal)
library(exactextractr)
```

### Part 1.ii-iv, importing raw files

```
mita_shape <- st_read(paste0(user_path(), "data/Dell_raw_data_files/MitaBoundary.shp"))

## Reading layer `MitaBoundary' from data source
##   `/Users/zachkuloszewski/Library/CloudStorage/Dropbox/My Mac (Zachs-MBP.lan)/Documents/GitHub/phd_p
##   using driver `ESRI Shapefile'
## Simple feature collection with 2 features and 4 fields
## Geometry type: LINESTRING
```

```
## Dimension:      XY
## Bounding box:   xmin: 646480 ymin: 8232697 xmax: 945874 ymax: 8516450
## Projected CRS: WGS 84 / UTM zone 18S

peru_border <- st_read(paste0(user_path(), "data/Dell_raw_data_files/peru_nw.shp"))

## Reading layer `peru_nw' from data source
##   `/Users/zachkuloszewski/Library/CloudStorage/Dropbox/My Mac (Zachs-MBP.lan)/Documents/GitHub/phd_p
##   using driver `ESRI Shapefile'
## Simple feature collection with 1 feature and 4 fields
## Geometry type: MULTIPOLYGON
## Dimension:      XY
## Bounding box:   xmin: -203278.5 ymin: 7964797 xmax: 1190929 ymax: 9995858
## Projected CRS: WGS 84 / UTM zone 18S

capitals <- st_read(paste0(user_path(), "data/Dell_raw_data_files/locations.shp"))

## Reading layer `locations' from data source
##   `/Users/zachkuloszewski/Library/CloudStorage/Dropbox/My Mac (Zachs-MBP.lan)/Documents/GitHub/phd_p
##   using driver `ESRI Shapefile'
## Simple feature collection with 407 features and 3 fields
## Geometry type: POINT
## Dimension:      XY
## Bounding box:   xmin: -74.91666 ymin: -17.18333 xmax: -68.51 ymax: -12.58333
## Geodetic CRS:   WGS 84
```

#### Part 1.v, recast district capitals

```
capitals <- st_transform(capitals, crs(mita_shape))
```

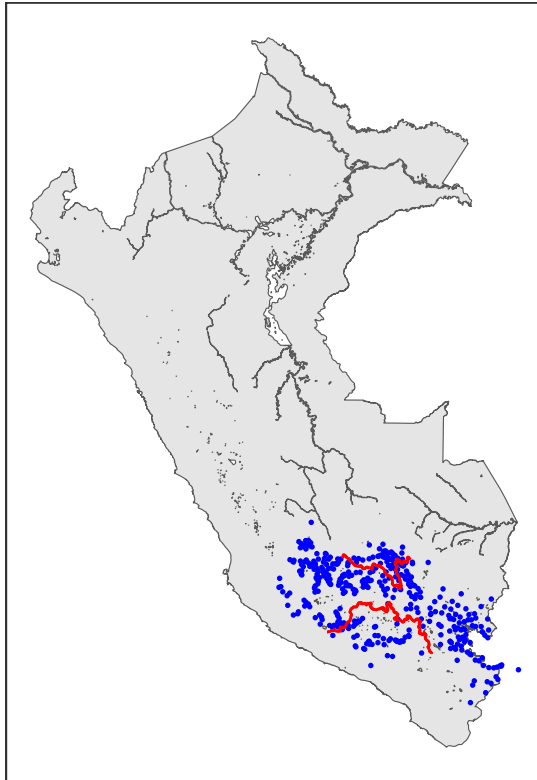
#### Part 1.vi, plot a map!

```
# define map theme
map_theme <- list(theme_bw(),
  theme(line = element_blank(),
    panel.grid.minor=element_blank(), # blank background
    panel.grid.major=element_blank(),
    axis.text.x = element_blank(),
    axis.text.y = element_blank(),
    axis.ticks = element_blank(), # turn off ticks
    axis.title.x = element_blank(), # turn off titles
    axis.title.y = element_blank()))

# plot map
peru_map <- ggplot() +
  geom_sf(data=peru_border) +
  geom_sf(data=capitals, color="blue", size=0.3) +
  geom_sf(data=mita_shape, color = "red") +
  map_theme +
  ggtitle("Peru, Mitas, and Capital Locations")

peru_map
```

## Peru, Mitas, and Capital Locations



### Part 1.vii, distance to border

```
# calculate distance to both borders
capitals$border_dist <- st_distance(capitals$geometry, mita_shape$geometry)

# take minimum of two distances
capitals <- capitals %>%
  rowwise() %>%
  mutate(border_dist = min(border_dist[, 1], border_dist[, 2]))
```

### Part 1.viii, import raster of nightlights

```
nightlights <- raster(paste0(user_path(), "data/per_viirs_100m_2012.tif"))
```

### Part 1.ix, nightlights within 5km of capitals

```
# calculate buffer objects
capital_buffer <- st_buffer(capitals$geometry, dist = 5000)

# mean within each buffer
capitals$mean_nightlights <- exact_extract(nightlights, capital_buffer, "mean")
```

```
## Warning in .local(x, y, ...): Polygons transformed to raster CRS (EPSG:NA)
```

```
## |
```

|

### Part 1.x, mean nightlights in mita capitals

```
# within the mita
mean(capitals$mean_nightlights[capitals$mita == 1 & !is.na(capitals$mita)])

## [1] 0.2036325

# outside the mita
mean(capitals$mean_nightlights[capitals$mita == 0 | is.na(capitals$mita)], na.rm = T)

## [1] 0.5855151
```

### Part 1.xi, map everything now

```
# define bounds in latitude and longitude to zoom in on study area
disp_win_wgs84 <- st_sfc(st_point(c(-74.5, -16.5)), st_point(c(-70.5, -13)), crs = 4326)

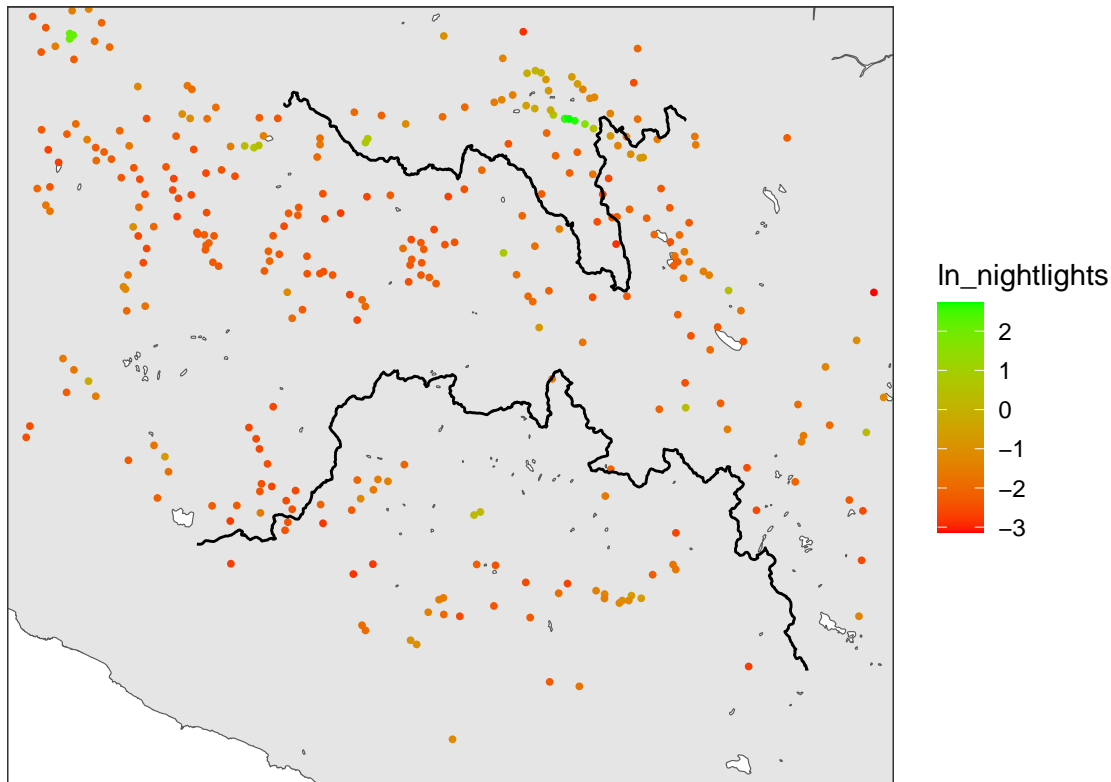
# switch to right CRS
disp_win_wgs84 <- st_transform(disp_win_wgs84, crs = crs(capitals))
disp_win_coord <- st_coordinates(disp_win_wgs84)

capitals$ln_nightlights <- log(0.1 + capitals$mean_nightlights)

# plot map
nightlight_map <- ggplot() + geom_sf(data = peru_border) + geom_sf(data = capitals,
  aes(color = ln_nightlights), size = 0.7) + geom_sf(data = mita_shape, color = "black") +
  map_theme + ggtitle("Capitals and Nightlights") + coord_sf(xlim = disp_win_coord[,
    "X"], ylim = disp_win_coord[, "Y"], datum = crs(capitals), expand = FALSE) +
  scale_color_gradient(low = "red", high = "green")

nightlight_map
```

## Capitals and Nightlights



## Problem 2: African Ethnic Groups

### Part 2.i-ii, load data

```
# murdock map
tribal_borders <- st_read(paste0(user_path(), "data/Africa/borders_tribes.shp"))

## Reading layer `borders_tribes' from data source
##   `/Users/zachkuloszewski/Library/CloudStorage/Dropbox/My Mac (Zachs-MBP.lan)/Documents/GitHub/phd_p
##   using driver `ESRI Shapefile'
## Simple feature collection with 843 features and 5 fields
## Geometry type: MULTIPOLYGON
## Dimension:      XY
## Bounding box:   xmin: -25.35875 ymin: -34.82223 xmax: 63.50018 ymax: 37.53944
## Geodetic CRS:   WGS 84

# explorer routes
explorer_rtes <- st_read(paste0(user_path(), "data/Africa/Explorer_Routes_Final.shp"))

## Reading layer `Explorer_Routes_Final' from data source
##   `/Users/zachkuloszewski/Library/CloudStorage/Dropbox/My Mac (Zachs-MBP.lan)/Documents/GitHub/phd_p
##   using driver `ESRI Shapefile'
## Simple feature collection with 25 features and 4 fields
## Geometry type: MULTILINESTRING
## Dimension:      XY
## Bounding box:   xmin: -15.17746 ymin: -33.81254 xmax: 45.24822 ymax: 33.86637
## Geodetic CRS:   WGS 84
```

### Part 2.iii, selecting pre-colonial voyages

```
explorer_rtes_pre_col <- filter(explorer_rtes, Year_End <= 1885 & !is.na(Year_End))
```

### Part 2.iv, identify ethnic groups with pre-colonial contact

```
# first identify the intersections
tribal_borders$explorers_contacted <- st_intersects(tribal_borders$geometry, explorer_rtes_pre_col$geom)

# then create binary based on length of intersection list
tribal_borders <- tribal_borders %>%
  rowwise() %>%
  mutate(contacted = as.numeric(length(explorers_contacted) > 0))
```

### Part 2.v, map contacted groups

```
# factorise contact variable for legend
tribal_borders$contacted <- as.factor(tribal_borders$contacted)

contact_map <- ggplot() + geom_sf(data = tribal_borders, aes(fill = contacted)) +
  geom_sf(data = explorer_rtes_pre_col) + map_theme + ggtitle("Pre-Colonial Exploration and Ethnic Gr

contact_map
```

## Pre-Colonial Exploration and Ethnic Group Contact

