Tema 7. Proyecto 2

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Modelo lineal para predicción de temperaturas

Cargar las biblioteces requeridas

```
library(sp)
library(maptools)
```

```
## Checking rgeos availability: TRUE
```

```
library(raster)
library(rgdal)
```

```
## rgdal: version: 1.4-4, (SVN revision 833)
##  Geospatial Data Abstraction Library extensions to R successfully loaded
##  Loaded GDAL runtime: GDAL 2.2.3, released 2017/11/20
##  Path to GDAL shared files: C:/Users/vshal/Documents/R/win-library/3.6/rgdal/gdal
##  GDAL binary built with GEOS: TRUE
##  Loaded PROJ.4 runtime: Rel. 4.9.3, 15 August 2016, [PJ_VERSION: 493]
##  Path to PROJ.4 shared files: C:/Users/vshal/Documents/R/win-library/3.6/rgdal/proj
##  Linking to sp version: 1.3-1
```

```
library(foreign)
```

Lectura de los archivos fuente

1. GeoTIFF
2. Shapefile de puntos (SHP)
3. Tabla DBF

```
mde <- raster("datos/ALT_MEXCAR.tif")
mde
```

```
## class      : RasterLayer
## dimensions : 1920, 4865, 9340800  (nrow, ncol, ncell)
## resolution : 0.008333333, 0.008333333  (x, y)
## extent     : -108.5249, -67.98321, 9.915776, 25.91578  (xmin, xmax, ymin, ymax)
## crs        : +proj=longlat +datum=WGS84 +no_defs +ellps=WGS84 +towgs84=0,0,0
## source     : C:/Users/vshal/GD/UdeG_Docencia/CUCSH_Curso_R/sources/datos/ALT_MEXCAR.tif
## names      : ALT_MEXCAR
## values     : -105, 5469  (min, max)
```

```
smn <- readOGR("datos/Estaciones_SMN_alt_ok.shp")
```

```
## OGR data source with driver: ESRI Shapefile
## Source: "C:\Users\vshal\GD\UdeG_Docencia\CUCSH_Curso_R\sources\datos\Estaciones_SMN_alt_o
k.shp", layer: "Estaciones_SMN_alt_ok"
## with 3089 features
## It has 10 fields
```

```
smn
```

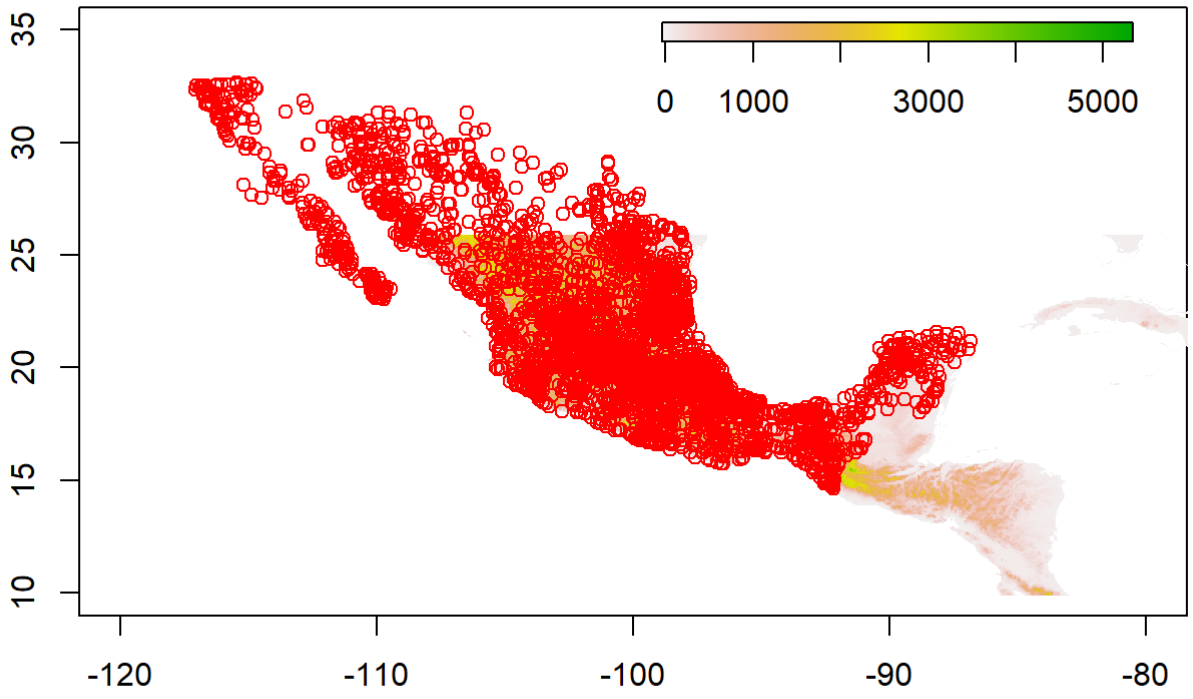
```
## class       : SpatialPointsDataFrame
## features    : 3089
## extent      : -117.0472, -86.82028, 14.61778, 32.665  (xmin, xmax, ymin, ymax)
## crs         : +proj=longlat +datum=WGS84 +no_defs +ellps=WGS84 +towgs84=0,0,0
## variables   : 10
## names       : OBJECTID, NUMERO_DE_,             NOMBRE_DE_,    Z, CVE_ENT,  Z_DELTA,   Z_M
DE,  Z_MDE1, Z_DELTA1,   Z_FIN
## min values  :        1,   00001003,          ?ADO - ACULCO,    0,      01, -382.393,     -
14,     -14, -382.393,     -14
## max values  :     3089,   00032187, ZUMPANGO DEL RIO (SMN), 4110,      32,  313.404, 4297.
51, 4297.51,  313.404, 4297.51
```

```
temp <- read.dbf("datos/Temp.dbf")
head(temp)
```

```
##   NUMERO_DE_ TENE TFEB TMAR TABR TMAY TJUN TJUL TAGO TSEP TOCT TNOV TDIC
## 1   00001003 15.4 16.7 19.2 21.7 23.7 24.0 22.0 22.1 22.2 21.0 18.5 16.3
## 2   00001004 11.8 13.1 15.6 18.0 19.9 20.7 19.4 19.2 18.6 16.7 14.2 12.5
## 3   00001005 13.4 14.7 17.2 19.5 21.9 22.6 21.0 20.7 20.2 18.6 16.2 14.2
## 4   00001006 12.6 13.8 16.7 19.5 21.7 22.0 20.5 20.3 19.8 18.0 15.1 13.4
## 5   00001007 12.2 13.4 16.4 18.8 21.0 21.4 20.0 19.6 19.5 17.5 14.8 13.1
## 6   00001008 13.0 13.8 16.0 18.1 20.0 19.5 18.3 18.3 17.6 16.4 14.9 13.4
##   TMEDIA
## 1   20.2
## 2   16.6
## 3   18.4
## 4   17.8
## 5   17.3
## 6   16.6
```

Visualización de datos fuente (raster de MDE y puntos SMN)

```
# dibujar el marco vacio
plot(1, axes = TRUE, type = 'n', xlim = c(-120, -80), ylim = c(10, 35), xlab = "", ylab = "")

# agregar MDE
plot(mde, add = TRUE, legend = FALSE)

# agregar leyenda de MDE
plot(mde, horizontal = TRUE, smallplot = c(.55, .9, .80, .82), legend.only = TRUE)

# agregar puntos SMN
plot(smn, add = TRUE, pch = 1, col = "red")
```



Vincular puntos SMN y datos de temperatura (JOIN)

```
smn_temp <- merge(smn, temp, by = "NUMERO_DE_")
head(smn_temp)
```

```
##   NUMERO_DE_ OBJECTID               NOMBRE_DE_    Z CVE_ENT    Z_DELTA
## 1   00001003        1       CALVILLO - CALVILLO 1702      01  -0.666382
## 2   00001004        2 CA?ADA HONDA - AGUASCALIE 1925      01   8.635380
## 3   00001005        3 PRESA EL NIAGARA - AGUASC 1828      01 -75.760100
## 4   00001006        4        EL TULE - ASIENTOS 1970      01 -30.881600
## 5   00001007        5 JESUS MARIA - JESUS MARIA 1800      01 -85.542100
## 6   00001008        6 PUERTO DE LA CONCEPCION - 2300      01 -22.656500
##     Z_MDE  Z_MDE1   Z_DELTA1   Z_FIN TENE TFEB TMAR TABR TMAY TJUN TJUL
## 1 1702.67 1702.67  -0.666382 1702.67 15.4 16.7 19.2 21.7 23.7 24.0 22.0
## 2 1916.36 1916.36   8.635380 1916.36 11.8 13.1 15.6 18.0 19.9 20.7 19.4
## 3 1903.76 1903.76 -75.760100 1903.76 13.4 14.7 17.2 19.5 21.9 22.6 21.0
## 4 2000.88 2000.88 -30.881600 2000.88 12.6 13.8 16.7 19.5 21.7 22.0 20.5
## 5 1885.54 1885.54 -85.542100 1885.54 12.2 13.4 16.4 18.8 21.0 21.4 20.0
## 6 2322.66 2322.66 -22.656500 2322.66 13.0 13.8 16.0 18.1 20.0 19.5 18.3
##   TAGO TSEP TOCT TNOV TDIC TMEDIA
## 1 22.1 22.2 21.0 18.5 16.3   20.2
## 2 19.2 18.6 16.7 14.2 12.5   16.6
## 3 20.7 20.2 18.6 16.2 14.2   18.4
## 4 20.3 19.8 18.0 15.1 13.4   17.8
## 5 19.6 19.5 17.5 14.8 13.1   17.3
## 6 18.3 17.6 16.4 14.9 13.4   16.6
```

Construir un modelo lineal de temperatura de junio

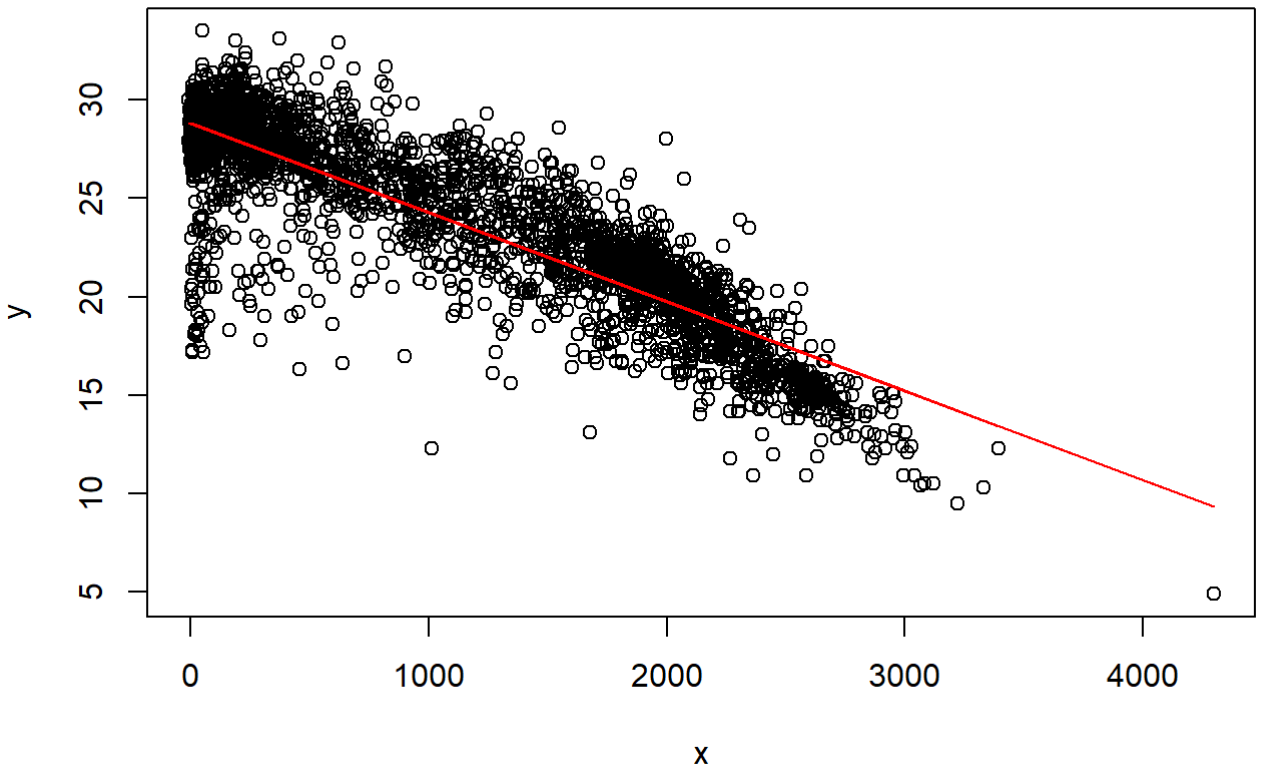
```
# obtener la tabla de atributos
smn_temp.df <- as.data.frame(smn_temp)

# mascara de buenos registros (T > 0)
temp_ok <- smn_temp.df[,"TJUN"] != 0

# seleccionar solo registros buenos y crear dos variables
x <- smn_temp.df[temp_ok,"Z_FIN"]
y <- smn_temp.df[temp_ok,"TJUN"]

#x
#y

# grafica de puntos de variables
plot(x,y)

modelo_tjunio <- glm(y ~ x)
modelo_tjunio
```

```
##
## Call:  glm(formula = y ~ x)
##
## Coefficients:
## (Intercept)            x
##   28.813753    -0.004531
##
## Degrees of Freedom: 2942 Total (i.e. Null);  2941 Residual
## Null Deviance:       64150
## Residual Deviance: 14750     AIC: 13100
```

```
summary(modelo_tjunio)
```

```
##
## Call:
## glm(formula = y ~ x)
##
## Deviance Residuals:
##      Min        1Q    Median        3Q       Max
## -11.9308   -1.0357    0.1106    1.3296    8.2309
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  2.881e+01  6.368e-02  452.46   <2e-16 ***
## x           -4.531e-03  4.564e-05  -99.27   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for gaussian family taken to be 5.013749)
##
##     Null deviance: 64154  on 2942  degrees of freedom
## Residual deviance: 14745  on 2941  degrees of freedom
## AIC: 13101
##
## Number of Fisher Scoring iterations: 2
```

```
# linea del modelo
prediction <- predict(modelo_tjunio, x = x)
lines(x, prediction, col = "red")
```



Generar raster de temperaturas esperadas de junio

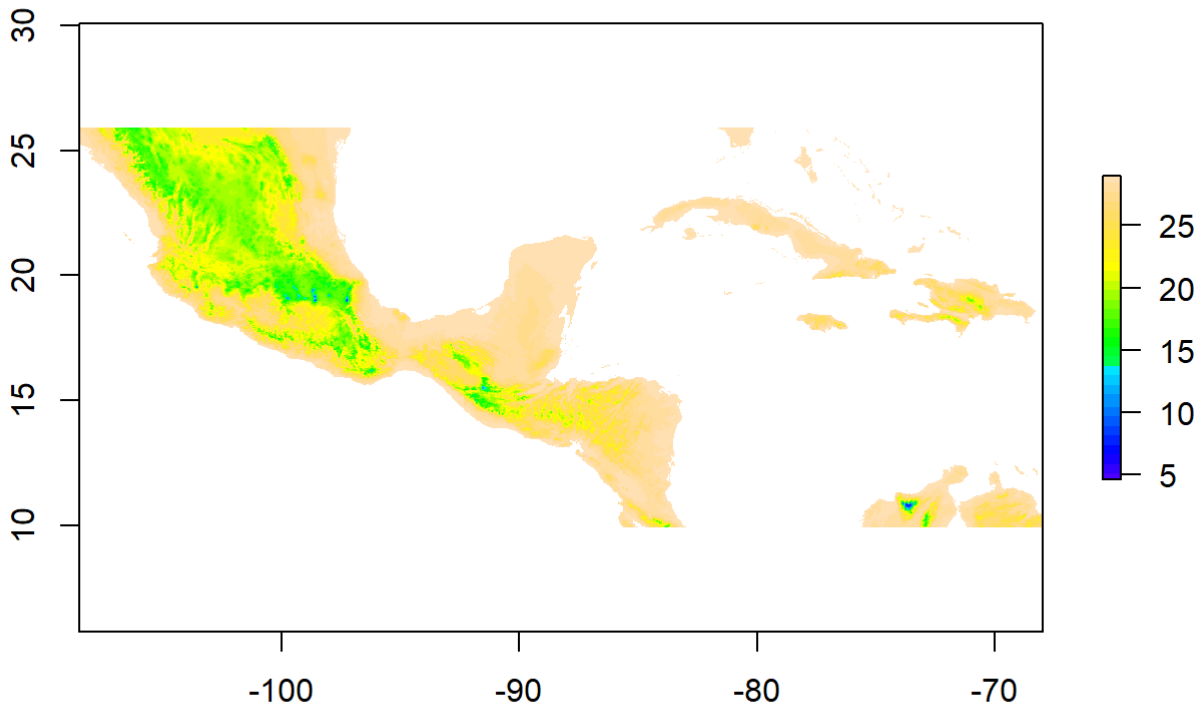
```
names(mde) <- "x"
mde
```

```
## class      : RasterLayer
## dimensions : 1920, 4865, 9340800  (nrow, ncol, ncell)
## resolution : 0.008333333, 0.008333333  (x, y)
## extent     : -108.5249, -67.98321, 9.915776, 25.91578  (xmin, xmax, ymin, ymax)
## crs        : +proj=longlat +datum=WGS84 +no_defs +ellps=WGS84 +towgs84=0,0,0
## source     : C:/Users/vshal/GD/UdeG_Docencia/CUCSH_Curso_R/sources/datos/ALT_MEXCAR.tif
## names      : x
## values     : -105, 5469  (min, max)
```

```
prediction_mde <- predict(mde, modelo_tjunio)
prediction_mde
```

```
## class      : RasterLayer
## dimensions : 1920, 4865, 9340800  (nrow, ncol, ncell)
## resolution : 0.008333333, 0.008333333  (x, y)
## extent     : -108.5249, -67.98321, 9.915776, 25.91578  (xmin, xmax, ymin, ymax)
## crs        : +proj=longlat +datum=WGS84 +no_defs +ellps=WGS84 +towgs84=0,0,0
## source     : memory
## names      : layer
## values     : 4.033294, 29.28952  (min, max)
```

```
plot(prediction_mde, col = topo.colors(32))
```



Guardar raster en GeoTIFF (Float 32 bits)

```
writeRaster(prediction_mde, filename = "datos/prediccion_tjunio_32bits.tif",
            format="GTiff", datatype = "FLT4S", overwrite = TRUE)
```