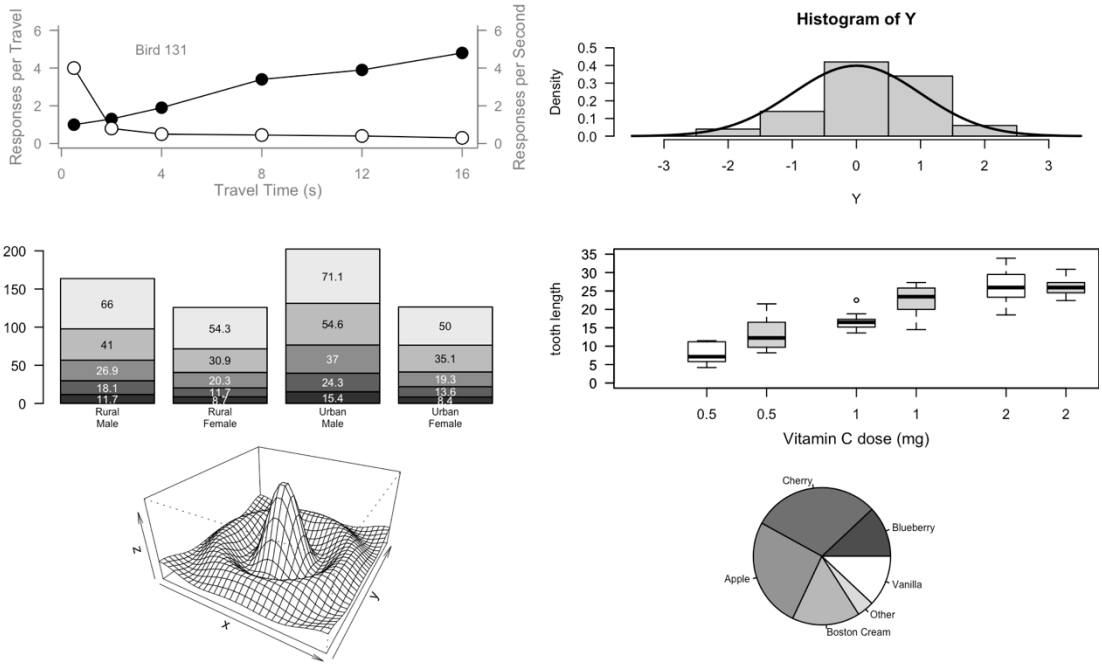
Assignment 2

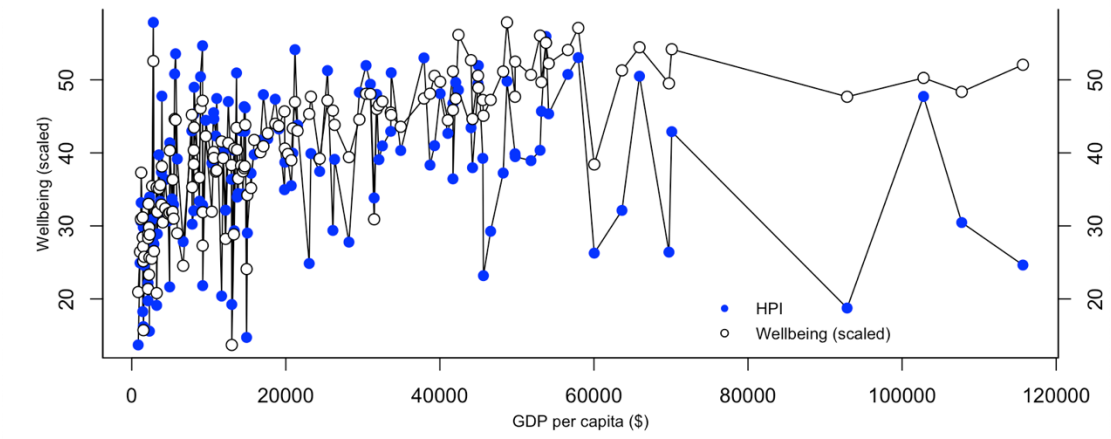
Plot from murrell01.R



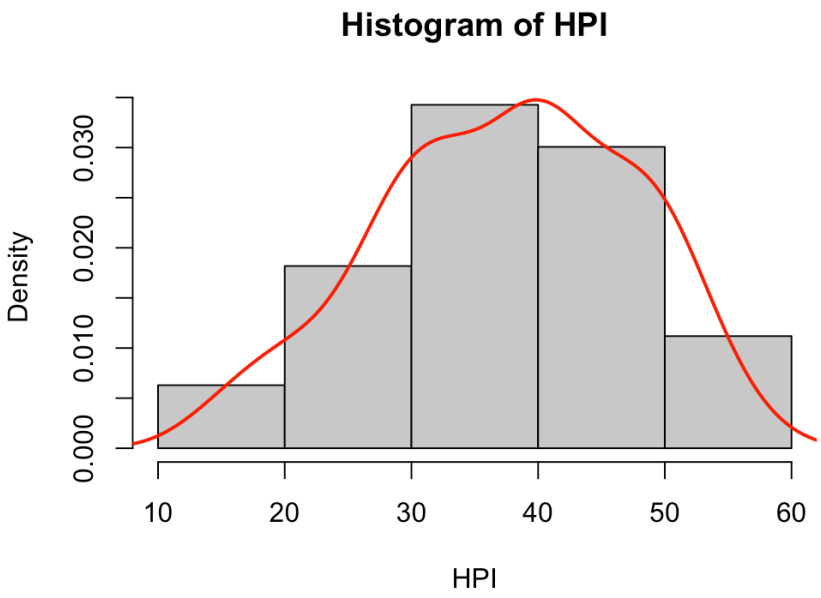
Exercise of murrell01.R

```
############################################################
# Assignment 2 (HPI-adapted Murrell examples, individual plots)
# Dataset: HPI 2024 ("1. All countries", skip=7)
# Variables:
#   - GDP per capita ($)
#   - HPI
#   - Ladder of life (Wellbeing) (0-10)
#   - Life Expectancy (years)
#   - Carbon Footprint (tCO2e)
############################################################

library(readxl)

hpi <- read_excel(
  "~/Desktop/UTD/DV/HPI_2024_public_dataset.xlsx",
  sheet = "1. All countries",
  skip = 7
)

keep <- complete.cases(hpi$`GDP per capita ($)`, hpi$HPI, hpi$`Ladder of life (Wellbeing) (0-10)`)
x_raw <- hpi$`GDP per capita ($)`[keep]
y1_raw <- hpi$HPI[keep]
y2_wb <- hpi$`Ladder of life (Wellbeing) (0-10)`[keep]

ord <- order(x_raw, na.last = NA)
x  <- x_raw[ord]
y1 <- y1_raw[ord]
# Affine transformation(Wellbeing mapping to HPI)
y2 <- (y2_wb[ord] - min(y2_wb[ord])) / (max(y2_wb[ord]) - min(y2_wb[ord])) *
  (max(y1, na.rm=TRUE) - min(y1, na.rm=TRUE)) + min(y1, na.rm=TRUE)
```

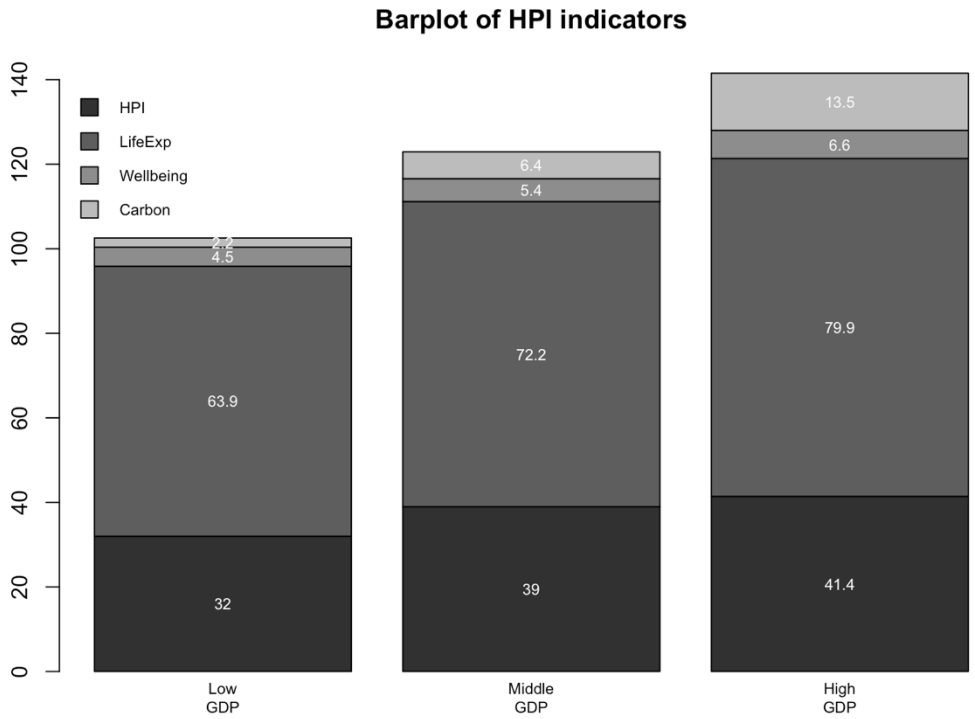
```
############################################################
# Scatterplot (HPI vs Wellbeing)
############################################################
plot.new()
plot.window(range(x, na.rm=TRUE), range(c(y1, y2), na.rm=TRUE))
lines(x, y1)
lines(x, y2)
points(x, y1, pch=16, cex=1.2, col="blue")      # HPI
points(x, y2, pch=21, bg="white", cex=1.2)      # Wellbeing (scaled)
axis(1, at=pretty(x))
axis(2, at=pretty(c(y1, y2)))
axis(4, at=pretty(c(y1, y2)))
box(bty="u")
mtext("GDP per capita ($)", side=1, line=2, cex=0.8)
mtext("Wellbeing (scaled)", side=2, line=2, cex=0.8)
mtext("HPI", side=4, line=2, cex=0.8)

legend("bottomright",
       legend=c("HPI","Wellbeing (scaled)"),
       pch=c(16,21),
       pt.bg=c(NA,"white"),
       col=c("blue","black"),
       bty="n", cex=0.8)
```



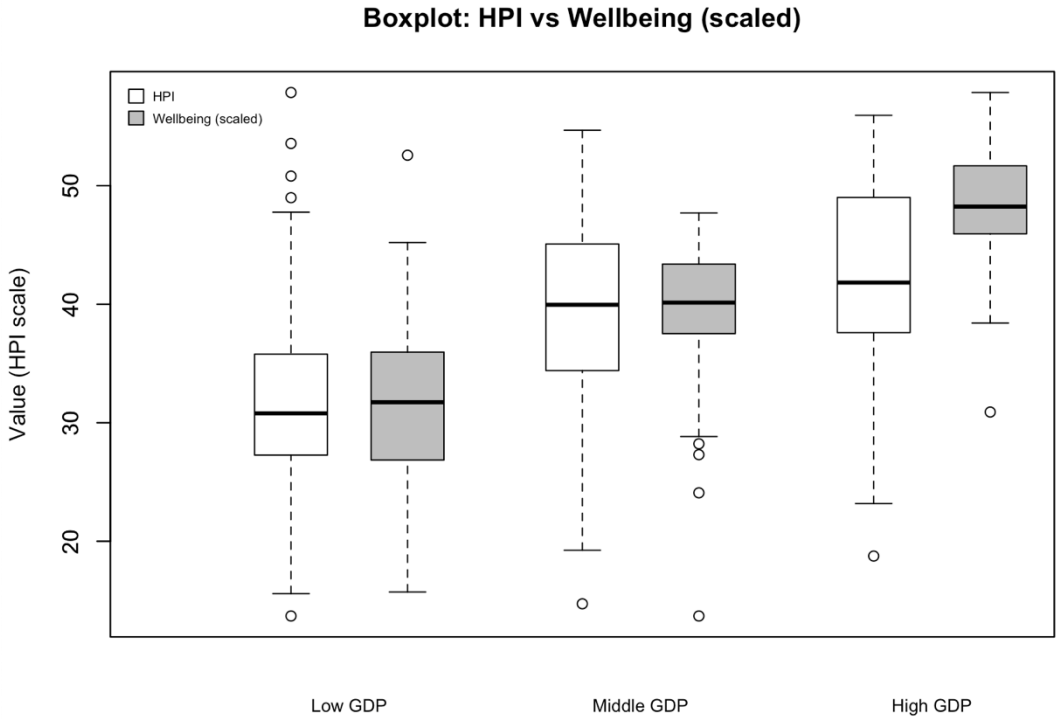
```r
#############################################################
# 2. Histogram
#############################################################
Y <- y1
q <- quantile(Y, c(.25,.75), na.rm=TRUE); IQRv <- q[2]-q[1]
Y[Y < q[1]-3*IQRv | Y > q[2]+3*IQRv] <- NA
hist(Y, breaks=pretty(Y), col="gray80", freq=FALSE,
     main="Histogram of HPI", xlab="HPI")
lines(density(na.omit(Y)), lwd=2, col="red")
```



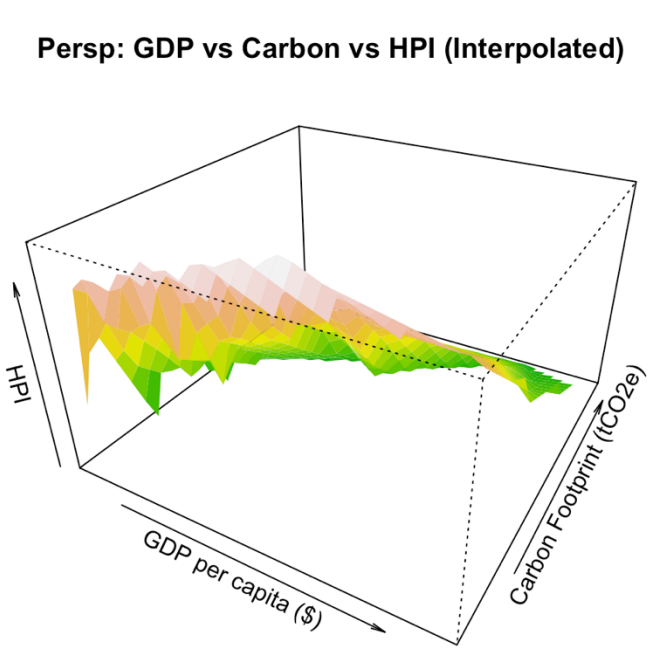
```r
############################################################
# 3. Barplot
############################################################
gdp_grp <- cut(x_raw,
               breaks = quantile(x_raw, probs=c(0,1/3,2/3,1), na.rm=TRUE),
               include.lowest = TRUE,
               labels = c("Low GDP","Middle GDP","High GDP"))

bar_df <- data.frame(
  HPI       = tapply(hpi$HPI[keep], gdp_grp, mean, na.rm=TRUE),
  LifeExp   = tapply(hpi$`Life Expectancy (years)`[keep], gdp_grp, mean, na.rm=TRUE),
  Wellbeing = tapply(hpi$`Ladder of life (Wellbeing) (0-10)`[keep], gdp_grp, mean, na.rm=TRUE),
  Carbon    = tapply(hpi$`Carbon Footprint (tCO2e)`[keep], gdp_grp, mean, na.rm=TRUE)
)
HPIStack <- as.matrix(t(bar_df))

cols <- gray(0.1 + seq(1, 9, 2)/11)

midpts <- barplot(HPIStack,
                  col=cols,
                  names=rep("", ncol(HPIStack)),
                  main="Barplot of HPI indicators")

mtext(sub(" ", "\n", colnames(HPIStack)),
      at=midpts, side=1, line=0.5, cex=0.7)

text(rep(midpts, each=nrow(HPIStack)),
     apply(HPIStack, 2, cumsum) - HPIStack/2,
     round(HPIStack,1), cex=0.7, col="white")

legend("topright",
       inset=c(-0.235,0),
       legend=rownames(bar_df),
       fill=cols,
       bty="n", cex=0.7, xpd=TRUE)
```



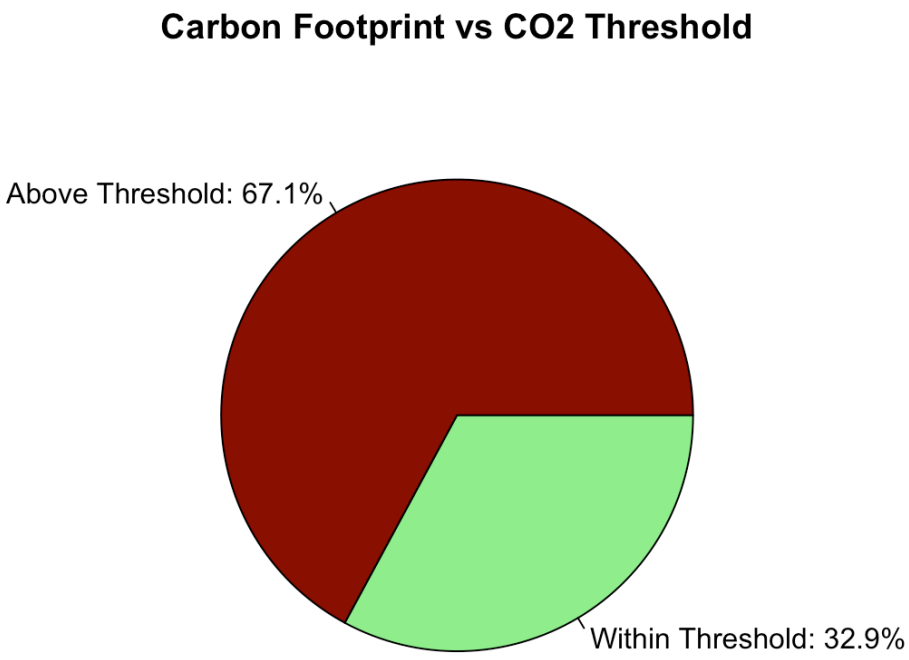
```r
#############################################################
# 4. Boxplot
#############################################################
boxplot(value ~ dose, data = DF,
        subset=supp=="HPI",
        boxwex=0.25, at=1:3-0.2,
        col="white", ylim=range(DF$value, na.rm=TRUE),
        xaxt="n", xlab = "", main="Boxplot: HPI vs Wellbeing (scaled)",
        ylab="Value (HPI scale)")

boxplot(value ~ dose, data = DF,
        subset=supp=="Wellbeing",
        add=TRUE, boxwex=0.25, at=1:3+0.2, col="gray", xaxt="n")

mtext(c("Low GDP","Middle GDP","High GDP"),
      side=1, at=1:3, line=2, cex=0.8)

legend("topleft",
       legend=c("HPI","Wellbeing (scaled)"),
       fill=c("white","gray"),
       bty="n", cex=0.6,
       x.intersp=0.5,
       y.intersp=0.8)
```



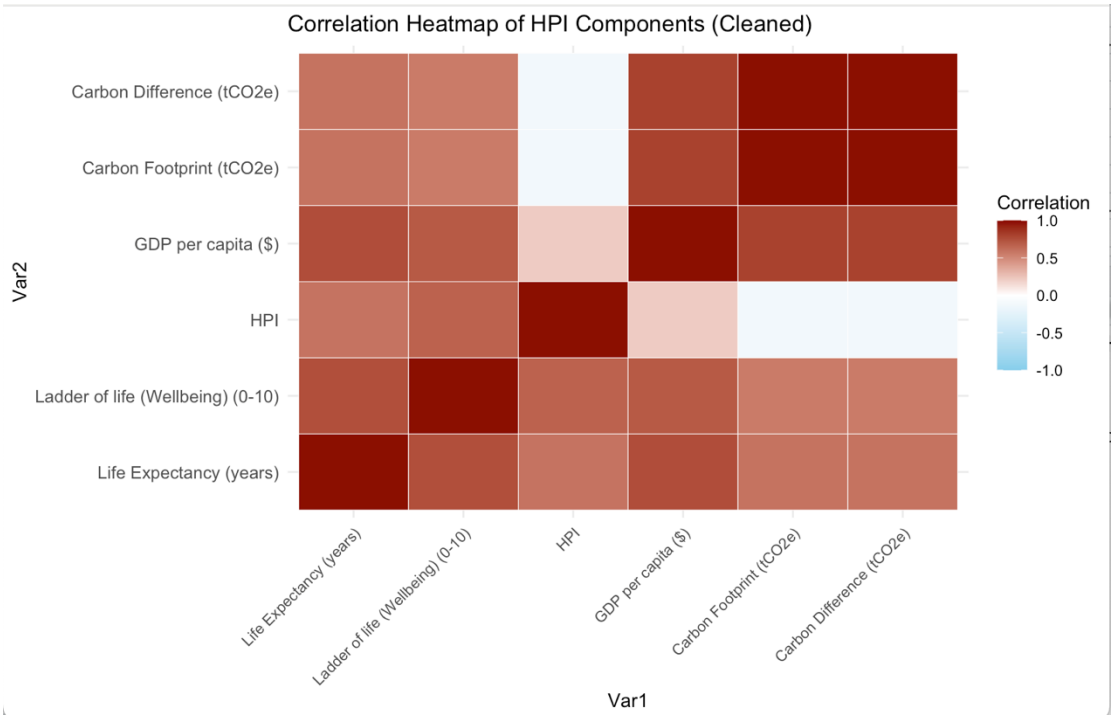
```r
############################################################
# 5. Persp
############################################################
library(akima)

df_persp <- data.frame(
  gdp    = hpi$`GDP per capita ($)`,
  carbon = hpi$`Carbon Footprint (tCO2e)`,
  hpi    = hpi$HPI
)
df_persp <- na.omit(df_persp)

interp_res <- interp(
  x = df_persp$gdp,
  y = df_persp$carbon,
  z = df_persp$hpi,
  nx = 30, ny = 30
)

zfacet <- interp_res$z[-1, -1] + interp_res$z[-1, -(ncol(interp_res$z))] +
  interp_res$z[-(nrow(interp_res$z)), -1] + interp_res$z[-(nrow(interp_res$z)), -(ncol(interp_res$z))]
zfacet <- zfacet / 4
facetcol <- terrain.colors(100)[cut(zfacet, 100)]

persp(interp_res$x, interp_res$y, interp_res$z,
      theta=30, phi=30, expand=0.6,
      col=facetcol, border=NA,
      main="Persp: GDP vs Carbon vs HPI (Interpolated)",
      xlab="GDP per capita ($)",
      ylab="Carbon Footprint (tCO2e)",
      zlab="HPI")
```



```r
############################################################
# 6. Piechart
############################################################
carbon_diff <- hpi$`Carbon Footprint (tCO2e)` -
  hpi$`CO2 threshold for year  (tCO2e)`

carbon_status <- ifelse(carbon_diff > 0,
                        "Above Threshold", "Within Threshold")

pie_sales <- prop.table(table(carbon_status))

pie(pie_sales,
    col=c("darkred","lightgreen"),
    labels=paste0(names(pie_sales), ": ",
                  round(100*pie_sales,1), "%"),
    main="Carbon Footprint vs CO2 Threshold")
```

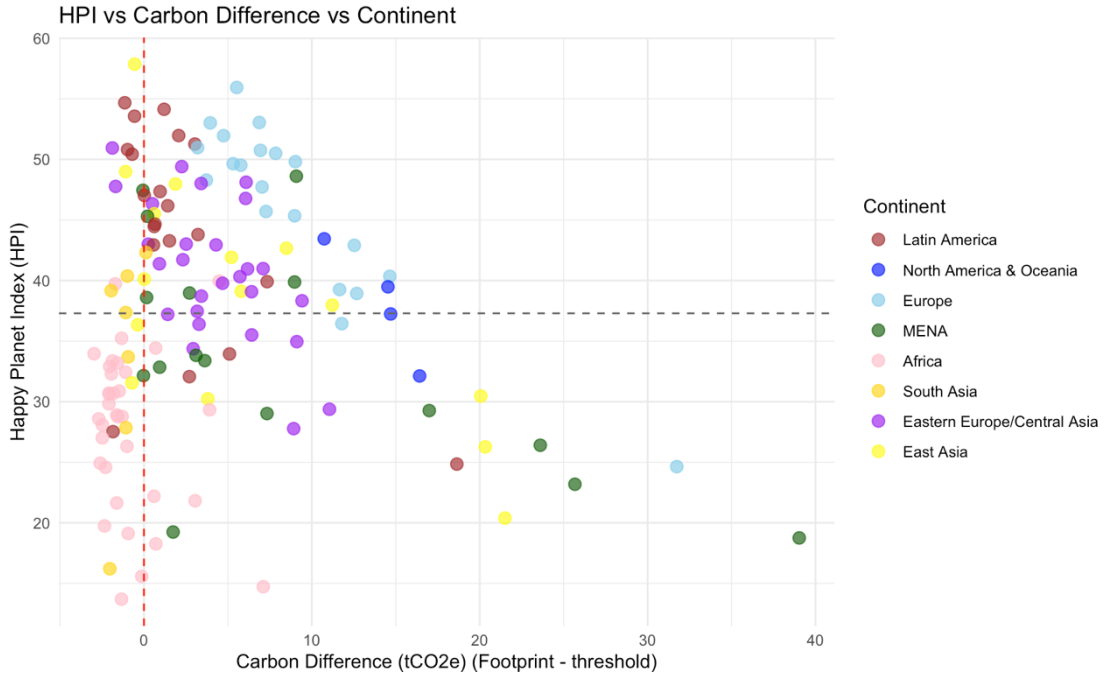


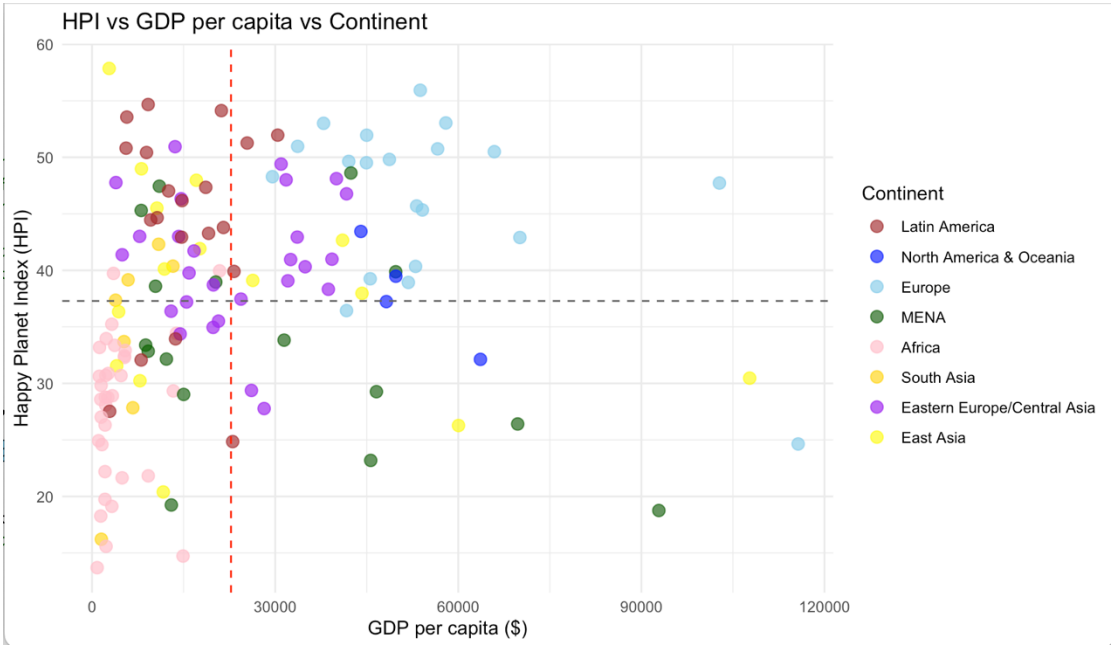
Some more HPI data graph by using ggplot

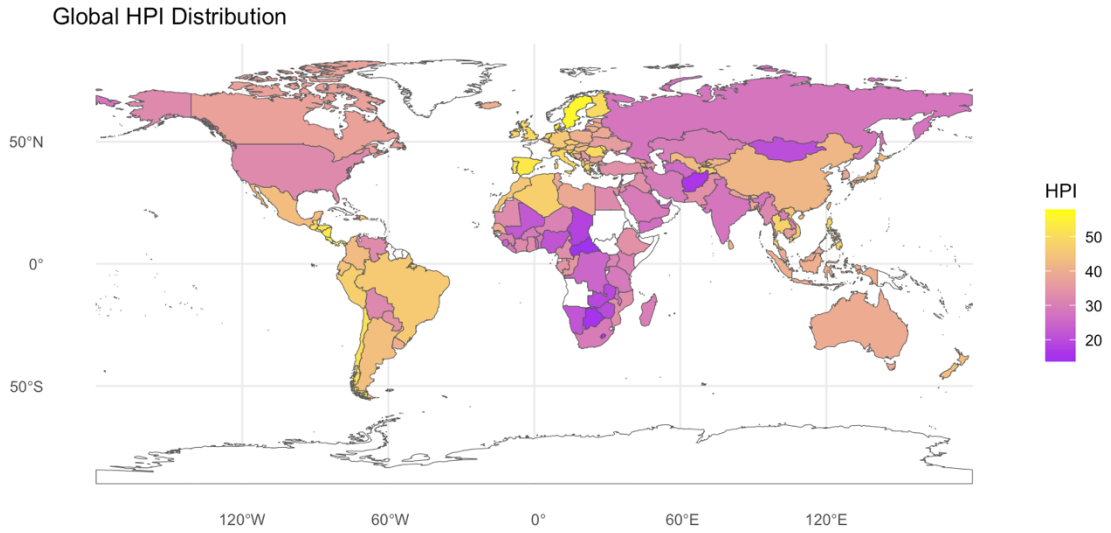


Heatmap shows carbon Footprint has no relation with HPI

*Carbon Difference = Carbon Footprint - CO2 threshold for year




HPI vs GDP per capita vs Continent
Happy Planet Index (HPI)
60
50
40
30
20
0
30000
60000
90000
120000
GDP per capita ($)
Continent
Latin America
North America & Oceania
Europe
MENA
Africa
South Asia
Eastern Europe/Central Asia
East Asia


Global HPI Distribution
50°N
0°
50°S
120°W
60°W
0°
60°E
120°E
HPI
50
40
30
20