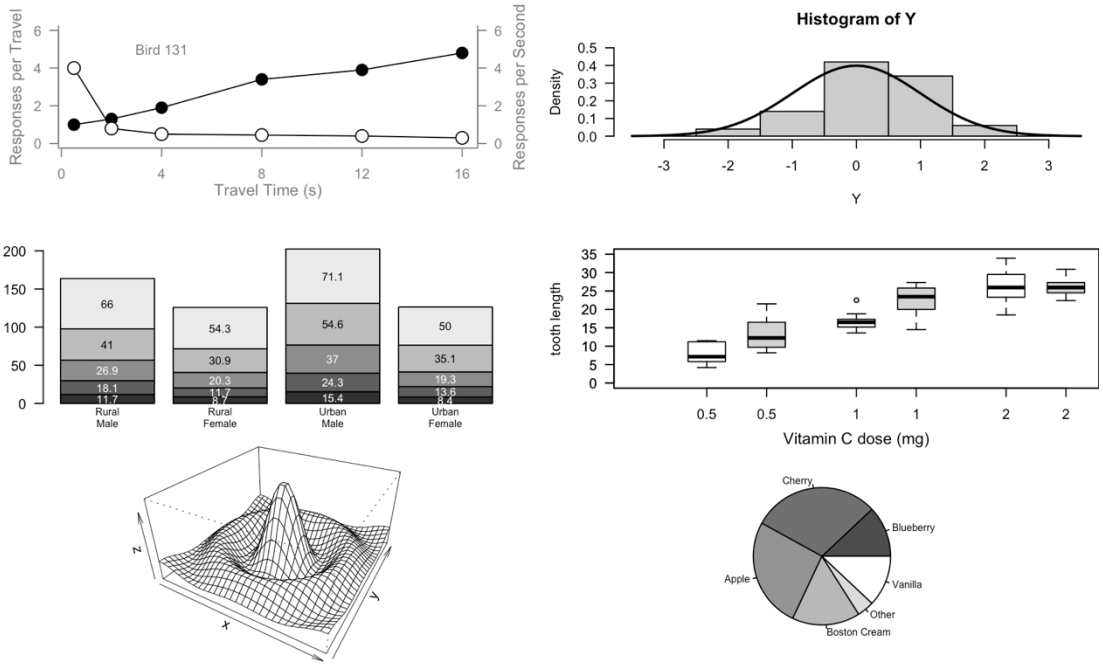
Assignment 2

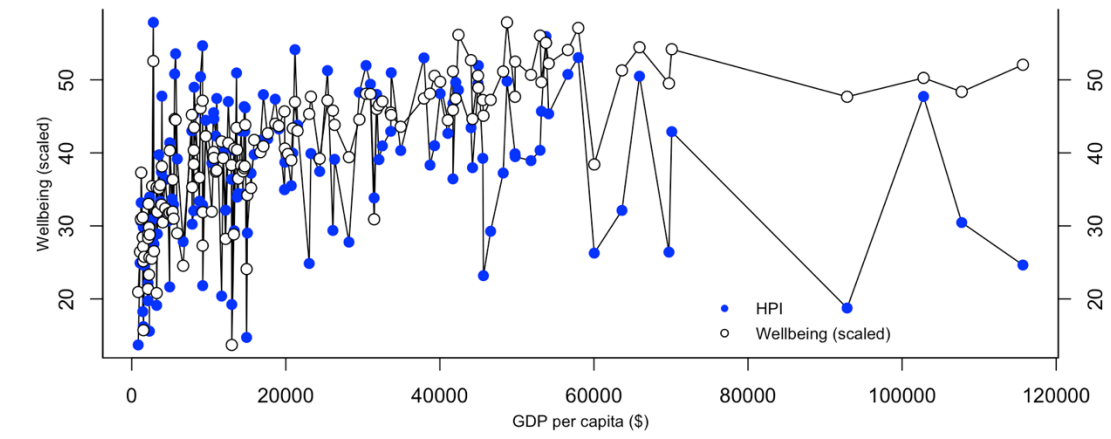
Plot from murrell01.R



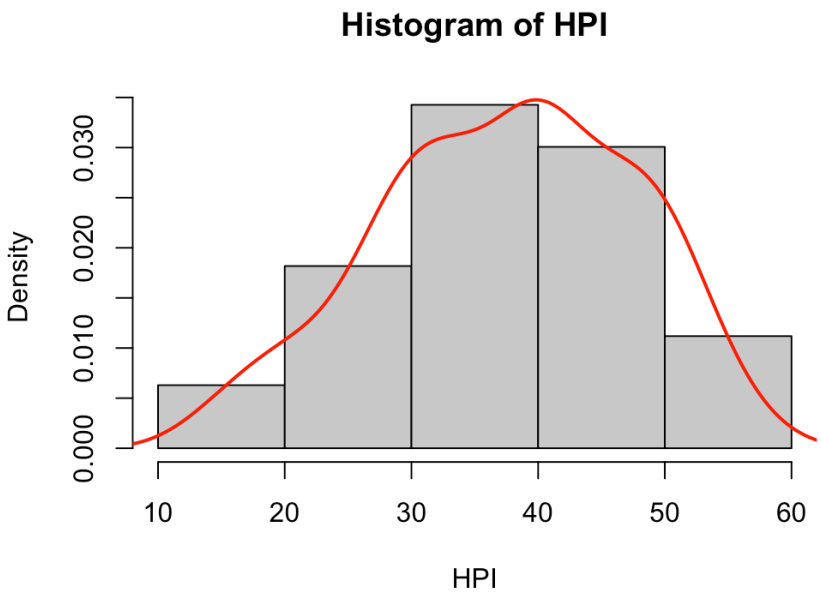

Exercise of murrell01.R

```
############################################################
# 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)
```

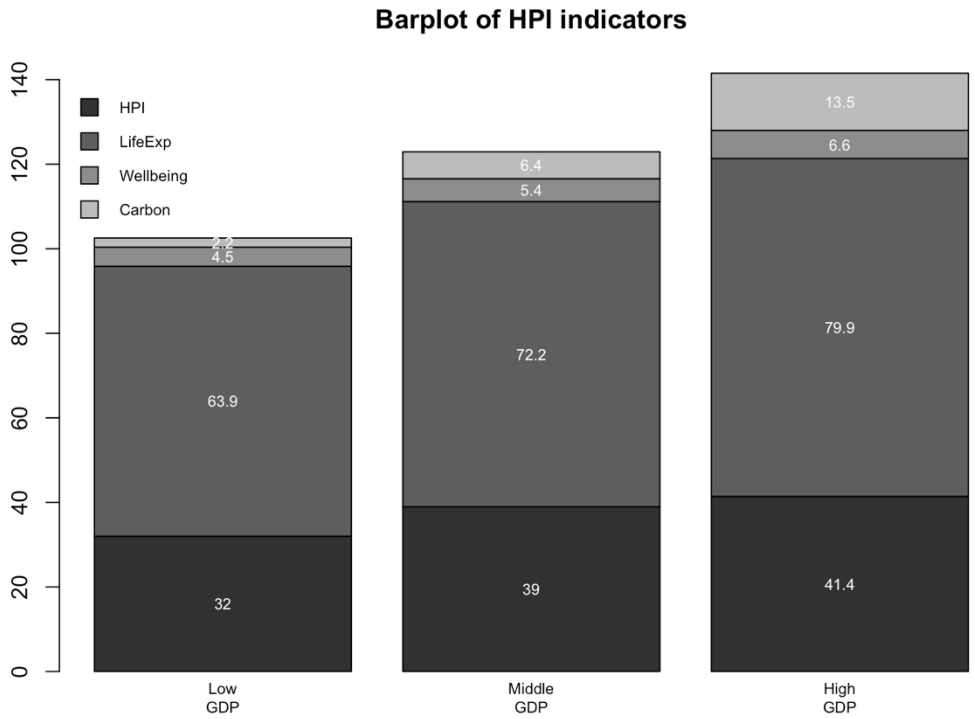
```
############################################################
# Scatterplot (HPI vs Wellbeing)
############################################################
plot.new()
plot.window(range(x, na.rm=TRUE), range(c(y1, y2), na.rm=TRUE))
lines(x, y1)
lines(x, y2)
points(x, y1, pch=16, cex=1.2, col="blue")      # 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)
```



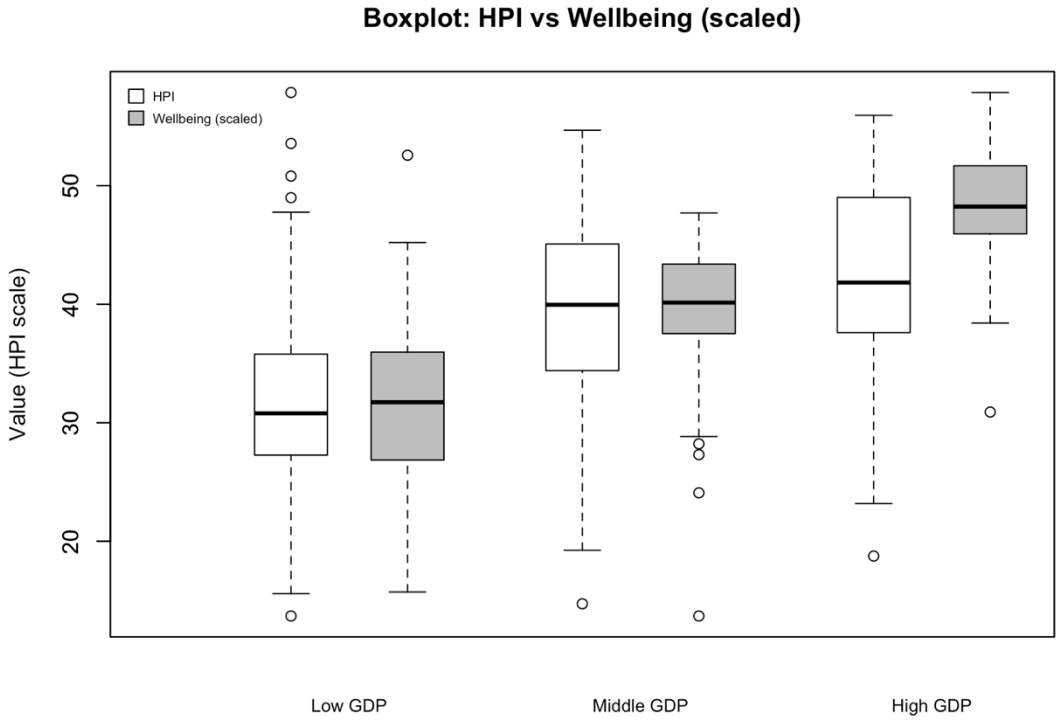
```r
#############################################################
# 2. Histogram
#############################################################
Y <- y1
q <- quantile(Y, c(.25,.75), na.rm=TRUE); IQRv <- q[2]-q[1]
Y[Y < q[1]-3*IQRv | Y > q[2]+3*IQRv] <- NA
hist(Y, breaks=pretty(Y), col="gray80", freq=FALSE,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



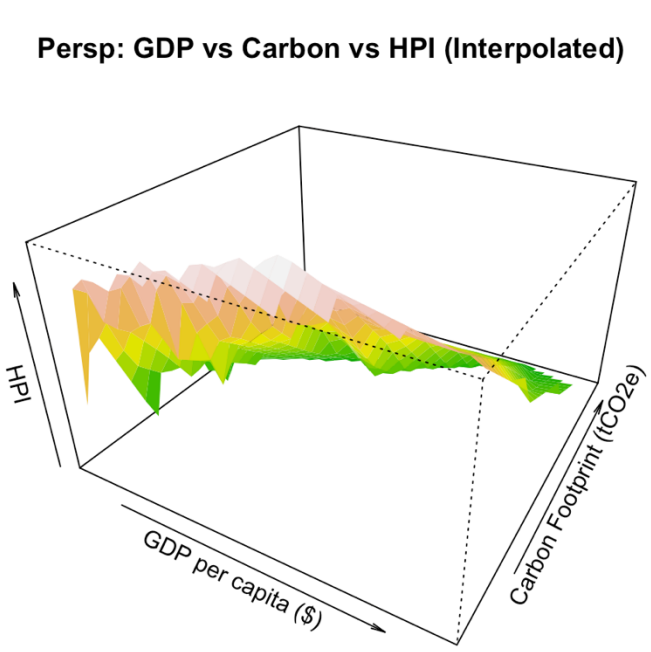
```r
############################################################
# 3. Barplot
############################################################
gdp_grp <- cut(x_raw,
               breaks = quantile(x_raw, probs=c(0,1/3,2/3,1), na.rm=TRUE),
               include.lowest = TRUE,
               labels = c("Low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



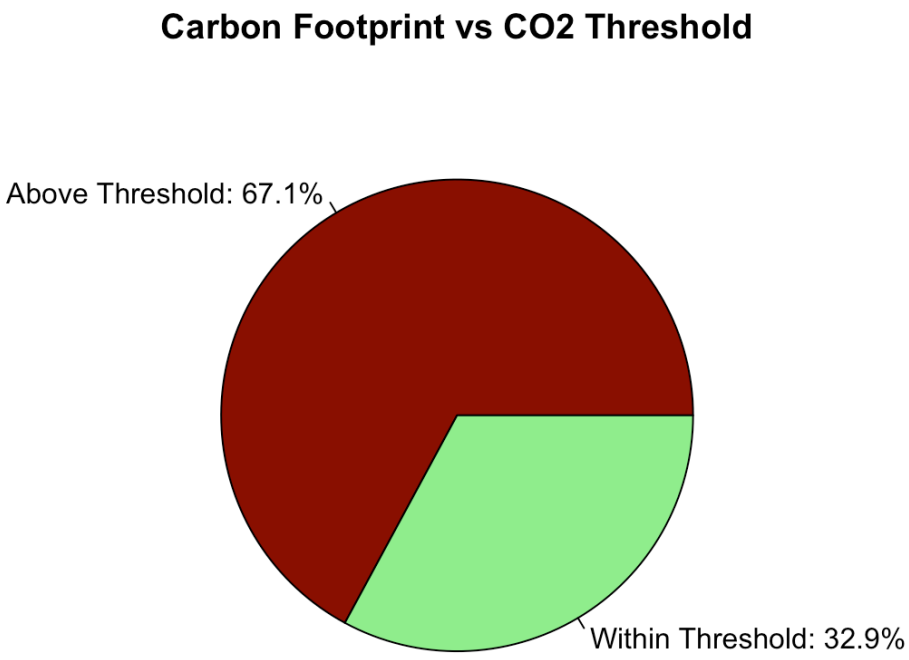
```r
#############################################################
# 4. Boxplot
#############################################################
boxplot(value ~ dose, data = DF,
        subset=supp=="HPI",
        boxwex=0.25, at=1:3-0.2,
        col="white", ylim=range(DF$value, na.rm=TRUE),
        xaxt="n",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



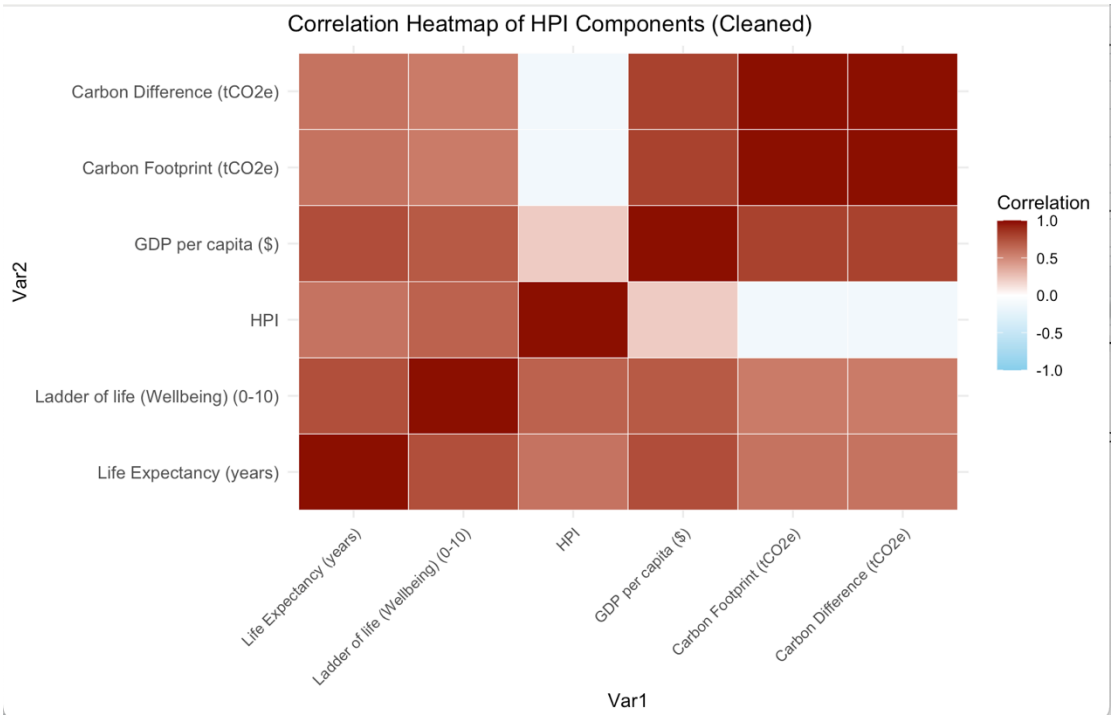
```r
############################################################
# 5. Persp
############################################################
library(akima)

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")
```

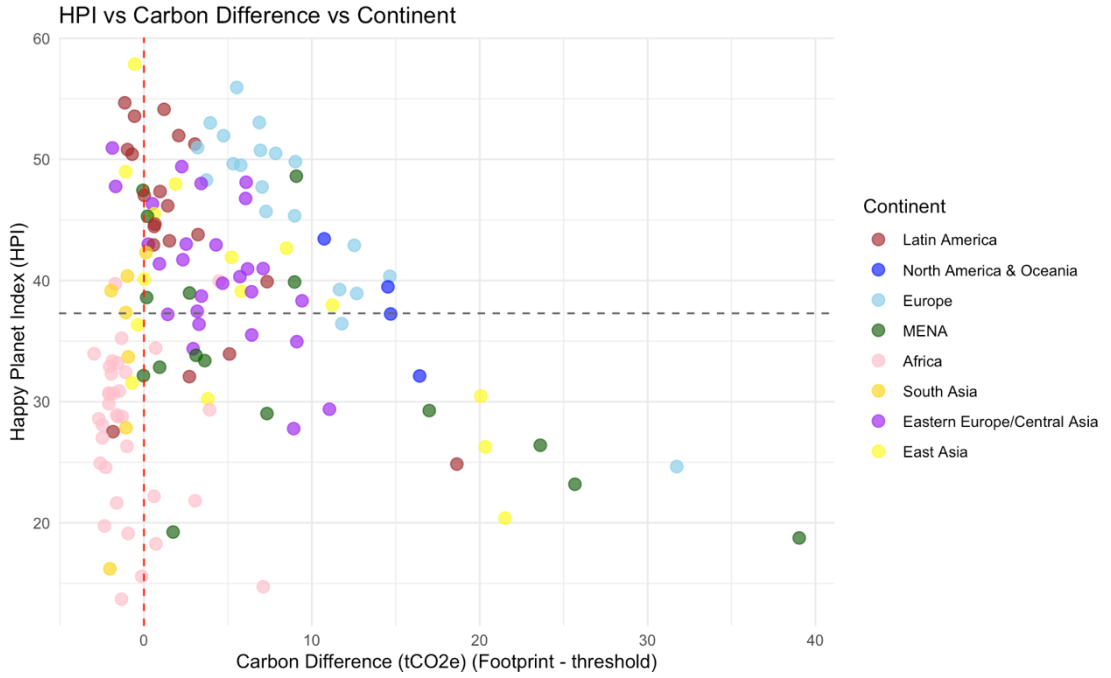


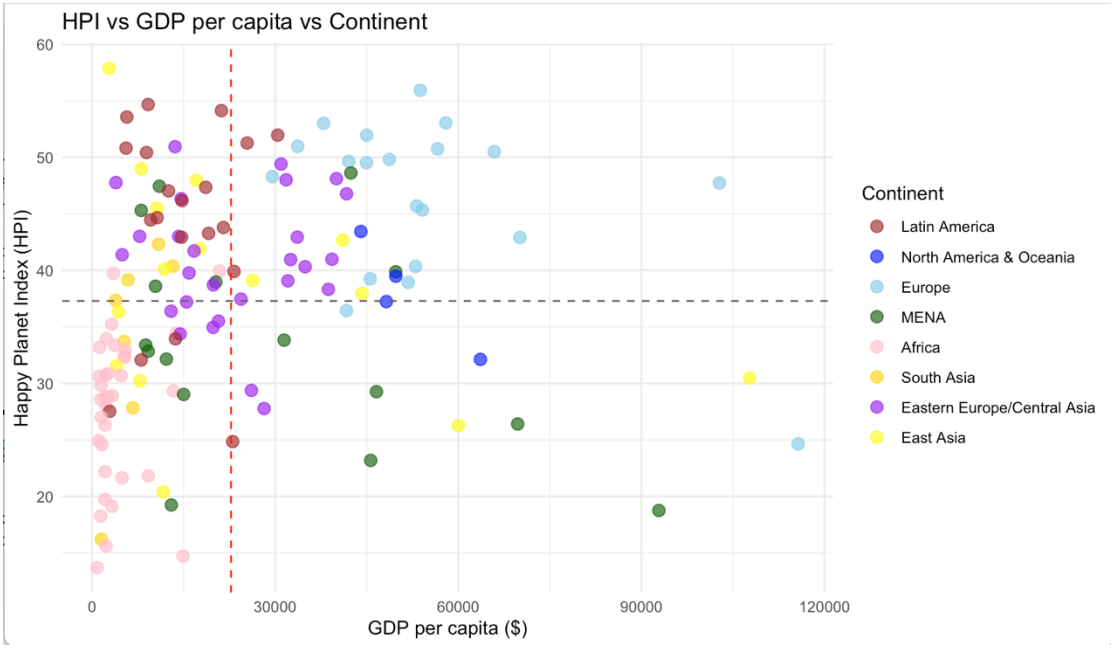

Some more HPI data graph by using ggplot

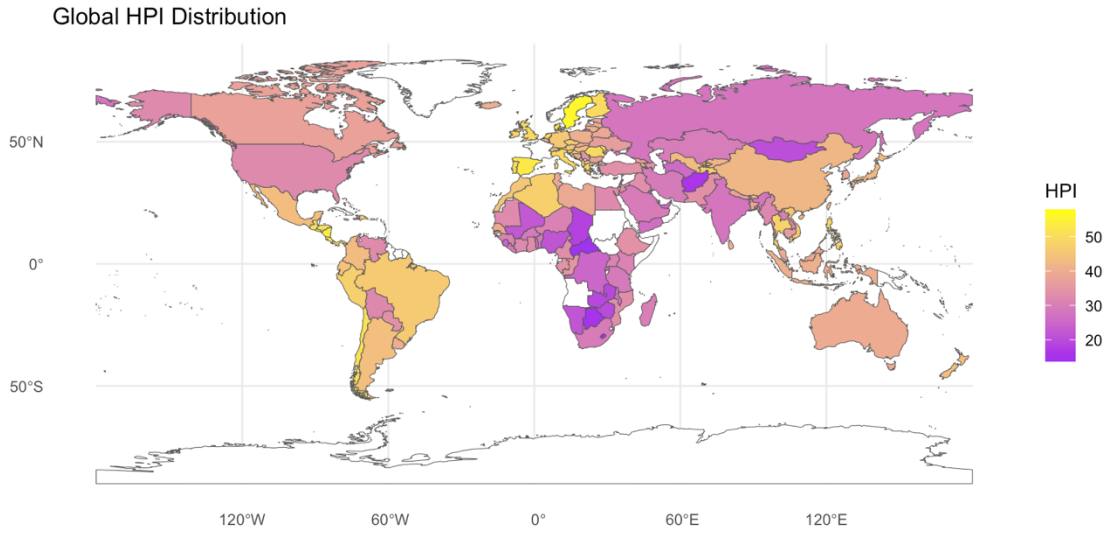



Heatmap shows carbon Footprint has no relation with HPI

*Carbon Difference = Carbon Footprint - CO2 threshold for year






**AI Disclosure**: Parts of the codes in this report were developed with assistance from an AI tool (ChatGPT, OpenAI). The AI was used for debugging, code suggestions, and in some cases partial rewriting. The author is responsible for reviewing, modifying, and integrating all code into the final work.