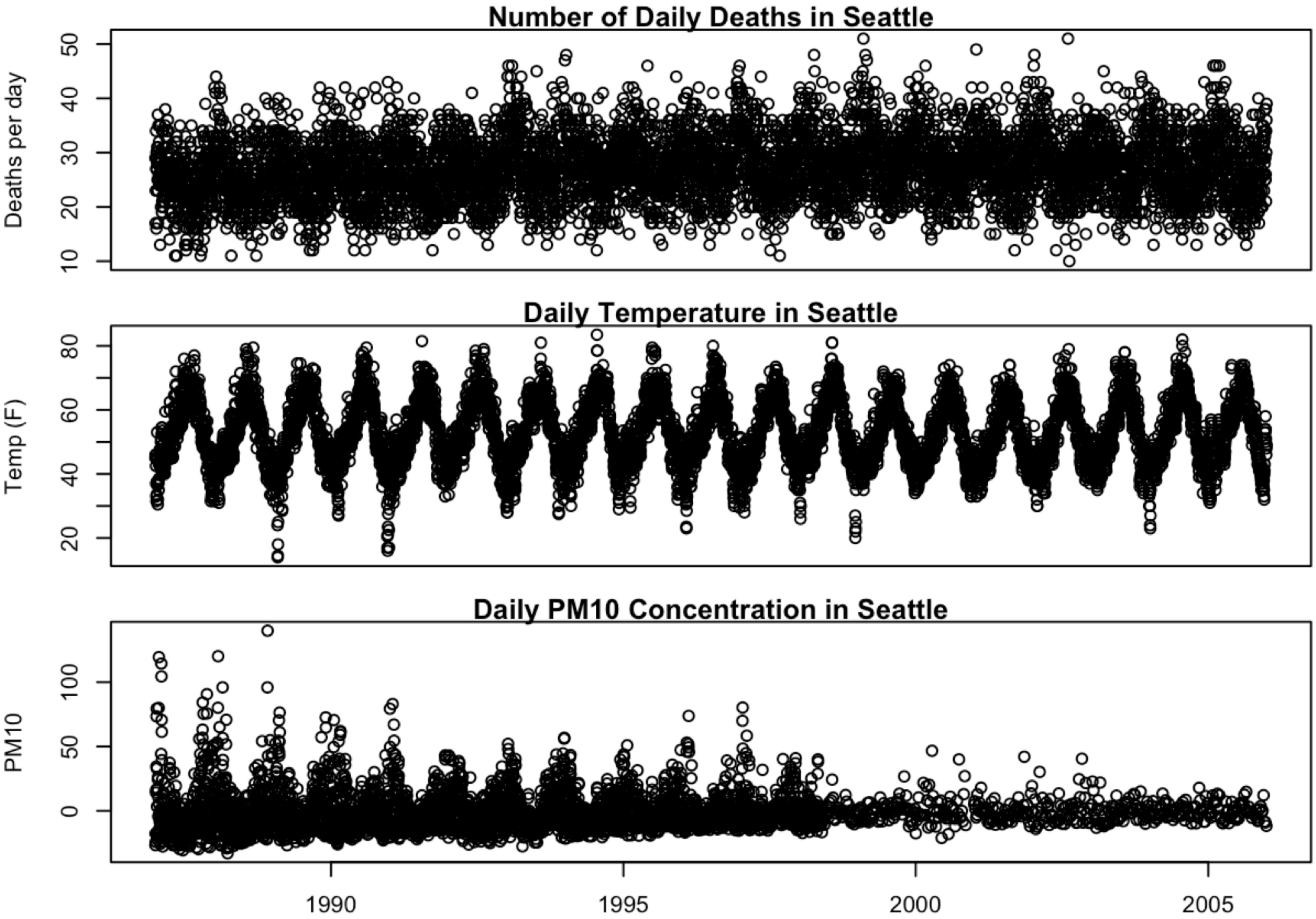
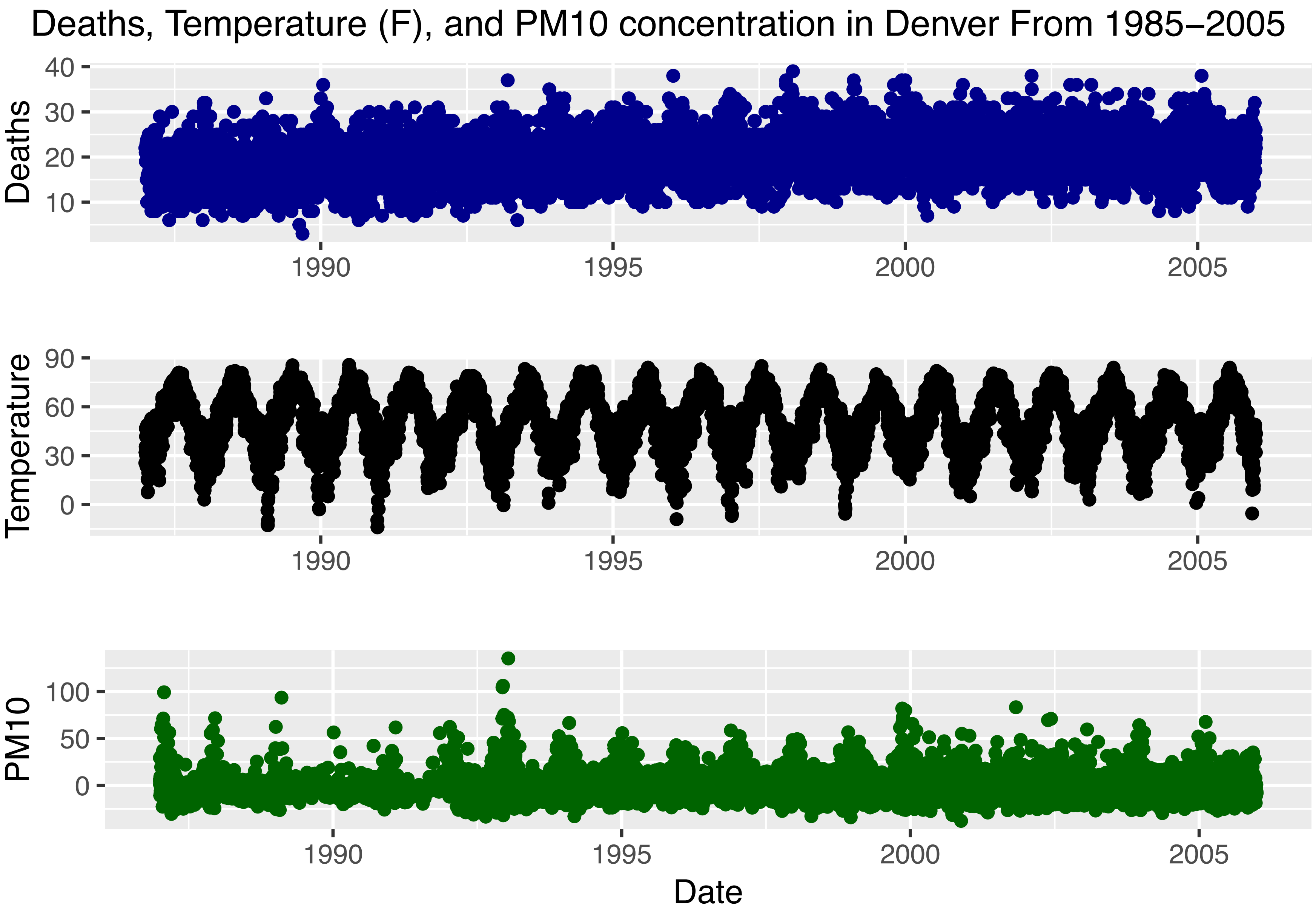
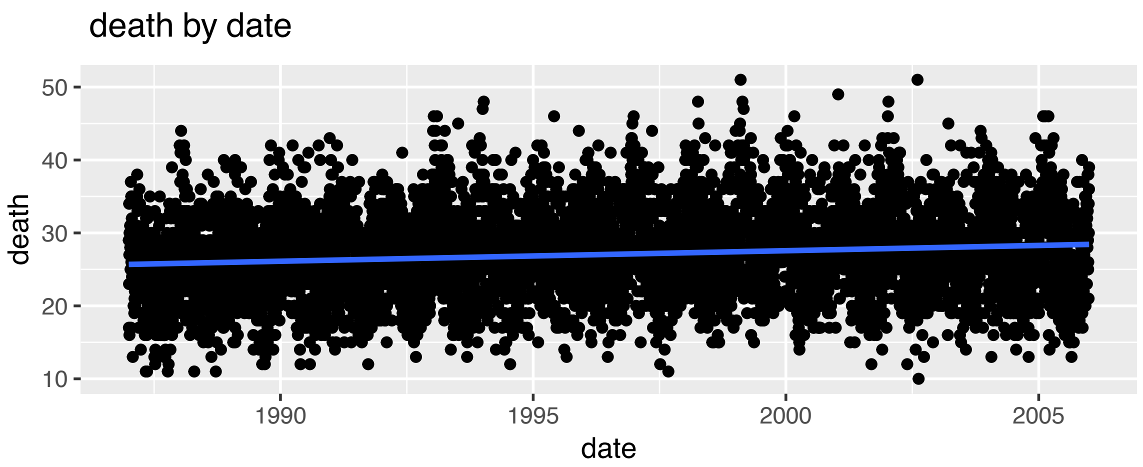

Number of Daily Deaths in Seattle
Deaths per day
10
20
30
40
50
Daily Temperature in Seattle
Temp (F)
20
40
60
80
Daily PM10 Concentration in Seattle
PM10
0
50
100
1990
1995
2000
2005

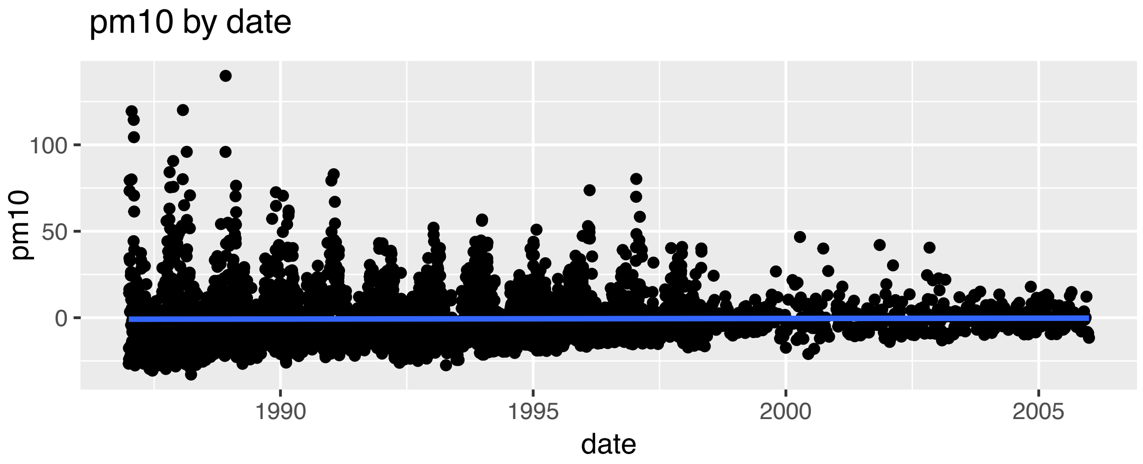
```
#seattle
par(mfrow=c(3,1))
par(mar=c(1,4,1,2), oma=c(4,2,2,2))
plot(death~date, data=seattle.data, xaxt="n", xlab="", ylab="Deaths per day", main="Number of Daily Deaths in Seattle")
plot(tempF~date, data=seattle.data, xaxt="n", xlab="", ylab="Temp (F)",main="Daily Temperature in Seattle")
plot(pm10~date, data=seattle.data, ylab="PM10", xlab="Date", main="Daily PM10 Concentration in Seattle")
```

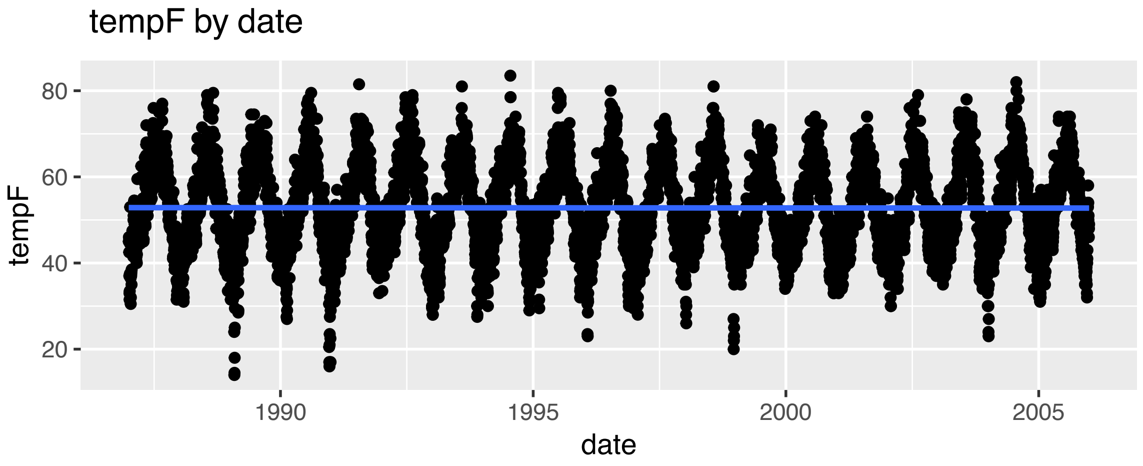


Deaths, Temperature (F), and PM10 concentration in Denver From 1985–2005
Deaths
40
30
20
10
1990
1995
2000
2005
Temperature
90
60
30
0
1990
1995
2000
2005
PM10
100
50
0
1990
1995
2000
2005
Date

```r
library(gridExtra)
Mortality<-den.data %>%
  ggplot(aes(x = date, y = death)) +
  geom_point(color="Dark Blue") +
  labs(y = "Deaths", x = "")
PM10<-den.data %>%
  ggplot(aes(x = date, y = pm10)) +
  geom_point(color="Dark Green") +
  labs(y = "PM10", x = "Date")
Temperature<-den.data %>%
  ggplot(aes(x = date, y = tempF)) +
  geom_point(color="black") +
  labs(y = "Temperature", x = "")
  labs(y = "Temperature", x = "")
grid.arrange(Mortality, Temperature, PM10,top="Deaths, Temperature (F), and PM10
concentration in Denver From 1985-2005", nrow=3)
```


death by date
death
50
40
30
20
10
1990
1995
2000
2005
date


pm10 by date
pm10
100
50
0
1990
1995
2000
2005
date


tempF by date
tempF
80
60
40
20
1990
1995
2000
2005
date

```r
PlotYvsX <-  function(dataframe,x,y) {
  aaa <- enquo(x)
  bbb <- enquo(y)
  dfname <- enquo(dataframe)
  dataframe %>%
    ggplot(aes_(y=bbb, x=aaa)) +
        geom_point() +
        ggtitle(bquote(.(bbb)~"by"*.(aaa)))+
        geom_smooth(method = "lm") -> p
  print(p)
}

Seattledeath <- PlotYvsX(seattle.data, date, death)
Seattlepm10 <- PlotYvsX(seattle.data, date, pm10)
Seattletemp <- PlotYvsX(seattle.data, date, tempF)
figure <- grid.draw(rbind(ggplotGrob(Seattledeath),
ggplotGrob(Seattlepm10), ggplotGrob(Seattletemp), size = "last"))
```

New York

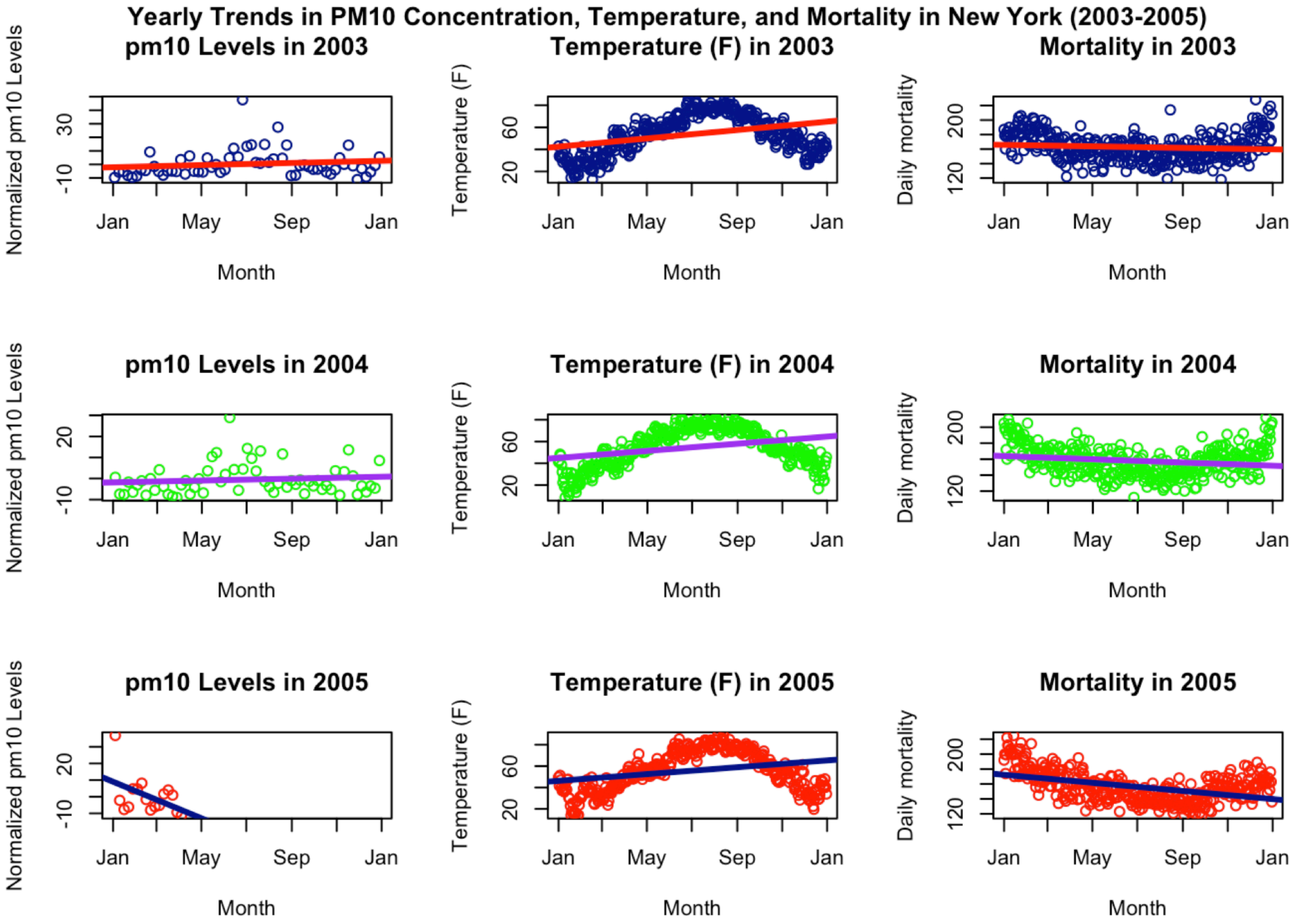


Figure 1: Each plot displays the trend in a given variable over the course of a selected year in New York. PM10 data was incomplete for 2005 and was often only available in week-long intervals for all other years.

```{r, echo=FALSE, include=FALSE}
yearpm10tempFdeathcalculator<-function(dataSub, yearselected, pointColor, lineColor){
  ## make a scatter plot with all data points of pm10 against date
  plot(pm10 ~ date, data=dataSub, ylab="Normalized pm10 Levels", xlab="Month", main=paste0("pm10 Levels in ", yearselected), col="gray")
  ## add colored points to specific data subset for pm10 against date
  points(pm10 ~ date, data=dataSub, col=pointColor)
  ## add best fit line for specific data subset for pm10 against date
  abline(lm(pm10 ~ date, data=dataSub), col=lineColor, lwd=3)
  ## make a scatter plot with all data points of tempF against date
  plot(tempF ~ date, data=dataSub, ylab="Temperature (F)", xlab="Month", main=paste0("Temperature (F) in ", yearselected), col="gray")
  ## add colored points to specific data subset for tempF against date
  points(tempF ~ date, data=dataSub, col=pointColor)
  ## add best fit line for specific data subset for tempF against date
  abline(lm(tempF ~ date, data=dataSub), col=lineColor, lwd=3)
  ## make a scatter plot with all data points of death against date
  plot(death ~ date, data=dataSub, ylab="Daily mortality", xlab="Month", main=paste0("Mortality in ", yearselected), col="gray")
  ## add colored points to specific data subset for death against date
  points(death ~ date, data=dataSub, col=pointColor)
  ## add best fit line for specific data subset for death against date
  abline(lm(death ~ date, data=dataSub), col=lineColor, lwd=3)
  ## return a summary of the linear model outputs
}

```

```
###*New York*

```{r, echo=FALSE, fig.cap="Figure 1: Each plot displays the trend in a given variable over the course of a selected year in New York. PM10 data was incomplete for 2005 and was often only available in week-long intervals for all other years.", fig.align='center'}
par(mfrow=c(3,3))
yearpm10tempFdeathcalculator(NY.data[NY.data$date >= "2003-01-01" & NY.data$date <= "2003-12-31",],
            "2003", "dark blue","red")
yearpm10tempFdeathcalculator(NY.data[NY.data$date >= "2004-01-01" & NY.data$date <= "2004-12-31",],
            "2004", "green","purple")
yearpm10tempFdeathcalculator(NY.data[NY.data$date >= "2005-01-01" & NY.data$date <= "2005-12-31",],
            "2005", "red","dark blue")
title("Yearly Trends in PM10 Concentration, Temperature, and Mortality in New York (2003-2005)", outer = TRUE, line=-1.25)
```
```

```r
#seattle
glm.sea <- list() #this stores all the models into one variable
glm.sea$base <- glm(death ~ pm10, data=seattle.data, family=poisson)
glm.sea$season <- glm(death ~ pm10 + as.factor(season), data=seattle.data, family=poisson)
glm.sea$month <- glm(death ~ pm10 + as.factor(month), data=seattle.data, family=poisson)
```

```r
#seattle
tab.sea <- do.call(data.frame, lapply(glm.sea, function(z) summary(z)$coefficients["pm10",
])) # this calls the coefficient labeled "pm10" from each model inside glm.sea
```

```r
tab.sea
```

```
##                     base       season        month
## Estimate    8.708022e-04 0.0001492494 0.0001054039
## Std. Error  1.841743e-04 0.0001916113 0.0001940727
## z value     4.728141e+00 0.7789174419 0.5431155735
## Pr(>|z|)    2.265851e-06 0.4360283487 0.5870502307
```

```
unadjusted <- c(coef(glm.model1)["pm10"], coef(glm.model4)["pm10"], coef(glm.model7)["pm10
"], coef(glm.model10)["pm10"])
byseason <- c(coef(glm.model2)["pm10"], coef(glm.model5)["pm10"], coef(glm.model8)["pm10"]
,coef(glm.model11)["pm10"])
bymonth <- c(coef(glm.model3)["pm10"], coef(glm.model6)["pm10"], coef(glm.model9)["pm10"],
coef(glm.model12)["pm10"])
city <- c("Chicago", "LA", "Seattle","Denver")

myCoef <- data.frame(city, unadjusted, byseason, bymonth)
myCoef
```

```
##      city    unadjusted     byseason      bymonth
## 1 Chicago -4.590244e-05 0.0005035420 0.0006432855
## 2      LA -3.462817e-04 0.0001690600 0.0003187338
## 3 Seattle  8.708022e-04 0.0001492494 0.0001054039
## 4  Denver  1.126783e-03 0.0006260010 0.0004543116
```

```
kable(myCoef)
```

city	unadjusted	byseason	bymonth
Chicago	-0.0000459	0.0005035	0.0006433
LA	-0.0003463	0.0001691	0.0003187
Seattle	0.0008708	0.0001492	0.0001054
Denver	0.0011268	0.0006260	0.0004543

```r
PM10models <- function(dataframe){
  A <- glm(death ~ pm10, data= dataframe, family=poisson)
  B <- glm(death ~ pm10 + as.factor(season), data= dataframe, family=poisson)
  C <- glm(death ~ pm10 + as.factor(month(date)), data= dataframe, family=poisson)
  x <- c(A$coefficients[2],B$coefficients[2], C$coefficients[2])
  y <- c("Model A", "Model B", "Model C")
  z <- cbind(y,x)
  colnames(z) <- c("Models", "Log Relative Rates")
  rownames(z) <- c()
        return(z)
}
PM10models(la.data)
```

```
##       Models    Log Relative Rates
## [1,] "Model A" "-0.000346281698162812"
## [2,] "Model B" "0.00016906003984161 4"
## [3,] "Model C" "0.000318733839864906"
```

Table 1: This table displays the Beta 1 values (equivalent to a log relative relative rate) and P values (P = > 0.05 when results are statistically significant) obtained in each of the nine analyses performed. Three models were applied to the data from each city, with the first model (Model A) examining solely the effect of PM10, the second model (Model B) examining the effects of PM10 with seasons as a covariate, and the third model (Model C) examining the effects of PM10 with months as a covariate.

	Log RMR (pm10)	p
Mortality ~ pm10 (NY)	-0.00002	0.90870
Mortality ~ pm10 (LA)	-0.00035	0.01004
Mortality ~ pm10 (SEA)	0.00087	0.00000
Mortality ~ pm10 + season (NY)	0.00119	0.00000
Mortality ~ pm10 + season (LA)	0.00017	0.22028
Mortality ~ pm10 + season (SEA)	0.00015	0.43603
Mortality ~ pm10 + month (NY)	0.00123	0.00000
Mortality ~ pm10 + month (LA)	0.00032	0.02268
Mortality ~ pm10 + month (SEA)	0.00032	0.02268

```
```{r, echo=FALSE, include=FALSE}
#Make intended rows as columns
#Code models of form: glm(death ~ pm10, family = poisson)
Column1 <- c(summary(Model_A_NY)$coefficient["pm10", "Estimate"],
             summary(Model_A_NY)$coefficient["pm10", "Pr(>|z|)"])
Column2 <- c(summary(Model_A_LA)$coefficient["pm10", "Estimate"],
             summary(Model_A_LA)$coefficient["pm10", "Pr(>|z|)"])
Column3 <- c(summary(Model_A_SEA)$coefficient["pm10", "Estimate"],
             summary(Model_A_SEA)$coefficient["pm10", "Pr(>|z|)"])

#Code models of form: glm(death ~ pm10 + as.factor(season), family = poisson)
Column4 <- c(summary(Model_B_NY)$coefficient["pm10", "Estimate"],
             summary(Model_B_NY)$coefficient["pm10", "Pr(>|z|)"])
Column5 <- c(summary(Model_B_LA)$coefficient["pm10", "Estimate"],
             summary(Model_B_LA)$coefficient["pm10", "Pr(>|z|)"])
Column6 <- c(summary(Model_B_SEA)$coefficient["pm10", "Estimate"],
             summary(Model_B_SEA)$coefficient["pm10", "Pr(>|z|)"])

#Code models of form: glm(death ~ pm10 + as.factor(month), family = poisson)
Column7 <- c(summary(Model_C_NY)$coefficient["pm10", "Estimate"],
             summary(Model_C_NY)$coefficient["pm10", "Pr(>|z|)"])

Column8 <- c(summary(Model_C_LA)$coefficient["pm10", "Estimate"],
             summary(Model_C_LA)$coefficient["pm10", "Pr(>|z|)"])

Column9 <- c(summary(Model_C_SEA)$coefficient["pm10", "Estimate"],
             summary(Model_C_SEA)$coefficient["pm10", "Pr(>|z|)"])
```
```

```{r, echo=FALSE}
#Bind columns
TabularDisplay1 <- data.frame(cbind(Column1, Column2, Column3, Column4, Column5, Column6, Column7, Column8, Column9))
#Make intended rows as rows and intended columns as columns
TabularDisplay1 <- t(TabularDisplay1)
#Name rows and columns
rownames(TabularDisplay1) <- c("Mortality ~ pm10 (NY)",
                               "Mortality ~ pm10 (LA)",
                               "Mortality ~ pm10 (SEA)",
                               "Mortality ~ pm10 + season (NY)",
                               "Mortality ~ pm10 + season (LA)",
                               "Mortality ~ pm10 + season (SEA)",
                               "Mortality ~ pm10 + month (NY)",
                               "Mortality ~ pm10 + month (LA)",
                               "Mortality ~ pm10 + month (SEA)")
colnames(TabularDisplay1) <- c("Log RMR (pm10)", "p")
#Format digits
TabularDisplay1 <- round(TabularDisplay1, digits = 5)
TabularDisplay1 <- format(TabularDisplay1, nsmall = 5)
#Plot tabular display
```

```{r, echo=FALSE, fig.align='center'}
pander(TabularDisplay1, style='multiline', justify=c("right", "right","right"), caption = "Table 1: This table displays the Beta 1 values (equivalent to a log relative relative rate) and P values (P = > 0.05 when results are statistically significant) obtained in each of the nine analyses performed. Three models were applied to the data from each city, with the first model (Model A) examining solely the effect of PM10, the second model (Model B) examining the effects of PM10 with seasons as a covariate, and the third model (Model C) examining the effects of PM10 with months as a covariate.")

```