

Impact

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This vignette demonstrates impact assessment with various lag choices

Reduce PM_{2.5} by 1 $\mu\text{g}/\text{m}^3$

For this example we will use the HRAPIE mean relative risk estimate $\text{RR} = 1.06$ per 10 $\mu\text{g}/\text{m}^3$ of PM_{2.5}.

No cessation lag

Functions in this package use demographic data in a standardised format stored in `demog_data`. For this example we will use the included `single_year_data` to create `demog_data`.

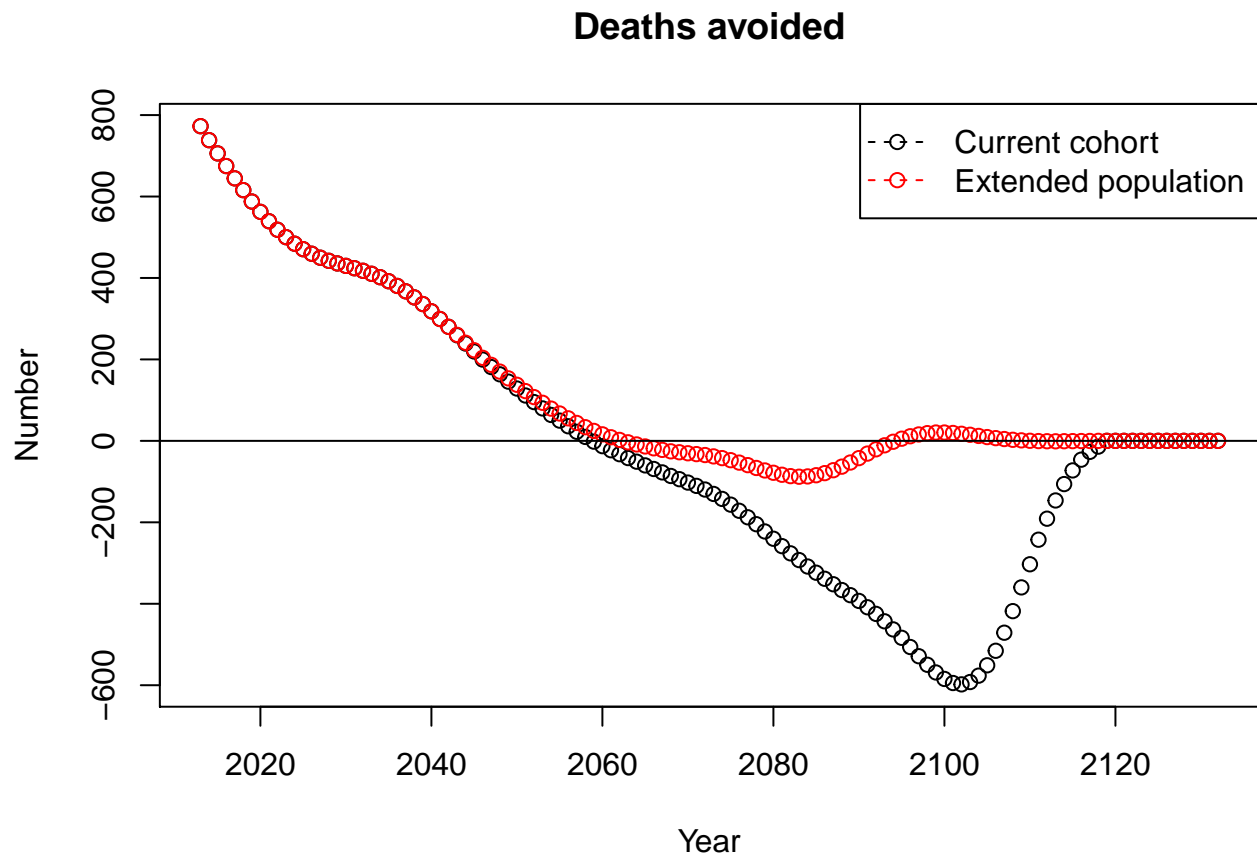
```
head(single_year_data)
#>      measure  sex age time  value
#> 1 Population Males  0 2005 132477
#> 2 Population Males  0 2006 136681
#> 3 Population Males  0 2007 145930
#> 4 Population Males  0 2008 149299
#> 5 Population Males  0 2009 151627
#> 6 Population Males  0 2010 152773
population <- subset(single_year_data,
                      time == 2011 & sex == "Persons" & measure == "Population")
population <- population[, c("age", "value")]
population$age <- as.numeric(gsub(" .+", "", population$age))
colnames(population)[2] <- "population"
deaths <- subset(single_year_data,
                  time == 2011 & sex == "Persons" & measure == "Deaths")
deaths <- deaths[, "value"]
demog_data <- data.frame(population, deaths = deaths)
```

Calculate the impact assuming there is no lag between exposure reduction and health outcomes

```
no_lag <- impact(demog_data)
no_lag <- data.frame(lapply(no_lag, colSums))
```

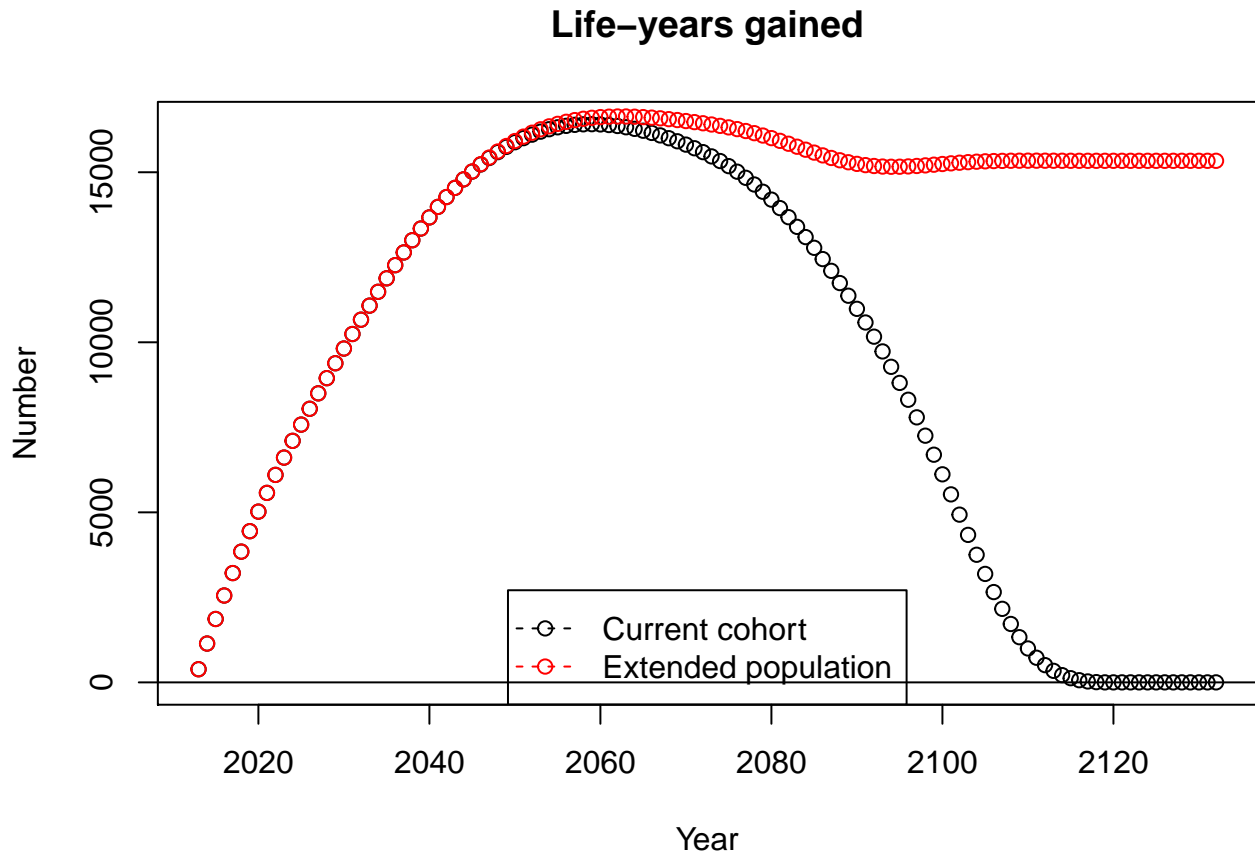
Compare deaths avoided

```
plot(rownames(no_lag), no_lag$deaths_current,
     xlab = "Year", ylab = "Number",
     main = "Deaths avoided", type = "b")
points(rownames(no_lag), no_lag$deaths_ext, col = "red")
abline(h = 0)
legend("topright", c("Current cohort", "Extended population"),
     col=c("black", "red"), pch = 21, lty=2)
```



Comapre life-years gained

```
plot(rownames(no_lag), no_lag$ly_current,
     xlab = "Year", ylab = "Number",
     main = "Life-years gained", type = "b")
points(rownames(no_lag), no_lag$ly_ext, col = "red")
abline(h = 0)
legend("bottom", c("Current cohort", "Extended population"),
      col=c("black", "red"), pch = 21, lty=2)
```

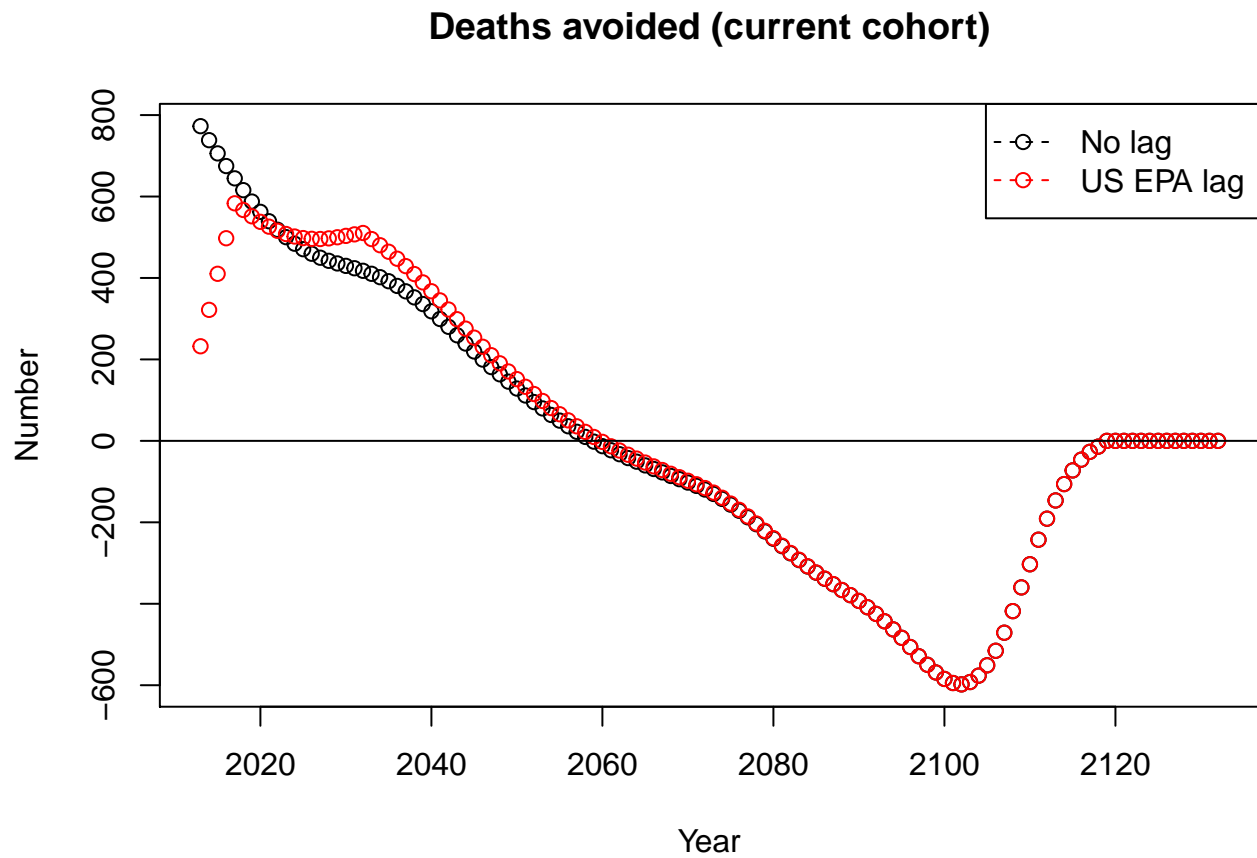


Calculate the impact assuming the US EPA lag between exposure reduction and health outcomes

```
lag <- cumsum(c(0.3, rep(0.5/4, 4), rep(0.2/15, 15)))
epa_lag <- impact(demog_data, lag_structure = lag)
epa_lag <- data.frame(lapply(epa_lag, colSums))
```

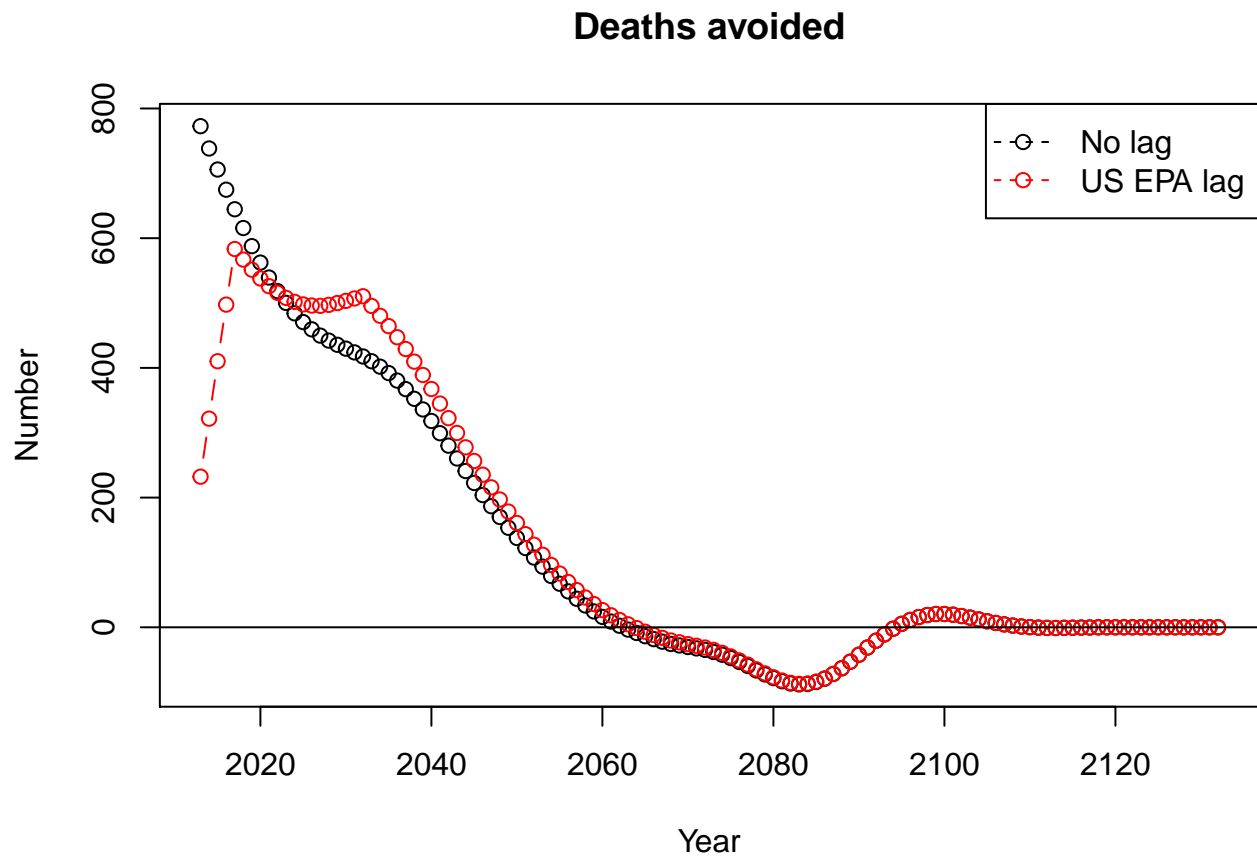
Plot a comparison of no lag and US EPA lag (Current cohort)

```
plot(rownames(no_lag), no_lag$deaths_current,
     xlab = "Year", ylab = "Number",
     main = "Deaths avoided (current cohort)", type = "b")
points(rownames(epa_lag), epa_lag$deaths_current, col = "red", type = "b")
abline(h = 0)
legend("topright", c("No lag", "US EPA lag"),
     col=c("black", "red"), pch = 21, lty=2)
```



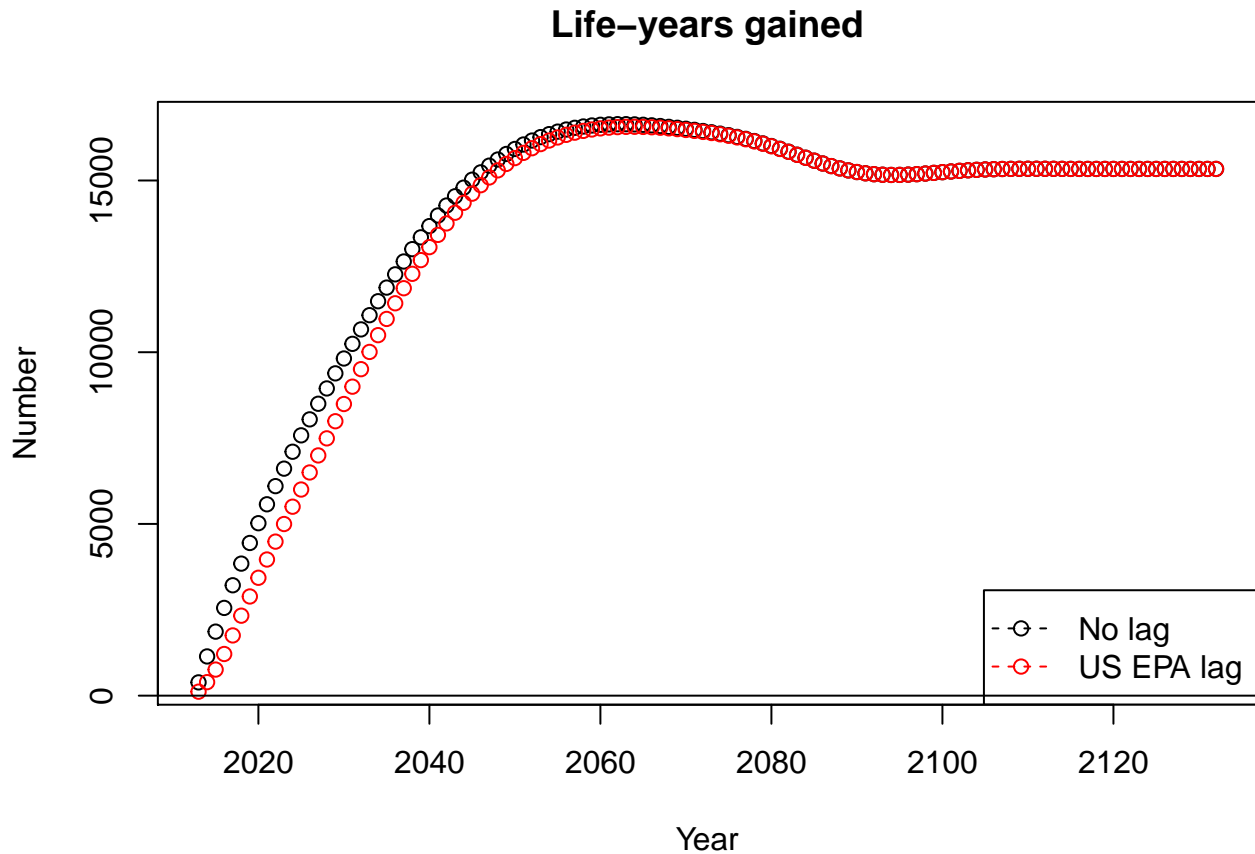
Plot a comparison of no lag and US EPA lag (Extended cohort)

```
plot(rownames(no_lag), no_lag$deaths_ext,
     xlab = "Year", ylab = "Number",
     main = "Deaths avoided", type = "b")
points(rownames(epa_lag), epa_lag$deaths_ext, col = "red", type = "b")
abline(h = 0)
legend("topright", c("No lag", "US EPA lag"),
     col=c("black", "red"), pch = 21, lty=2)
```



Compare total life-years gained

```
plot(rownames(no_lag), no_lag$ly_ext,
     xlab = "Year", ylab = "Number",
     main = "Life-years gained", type = "b")
points(rownames(epa_lag), epa_lag$ly_ext, col = "red", type = "b")
abline(h = 0)
legend("bottomright", c("No lag", "US EPA lag"),
     col=c("black", "red"), pch = 21, lty=2)
```



Assuming $\text{PM}_{2.5}$ takes 10 years to fall by $1 \mu\text{g}/\text{m}^3$ and US EPA cessation lag

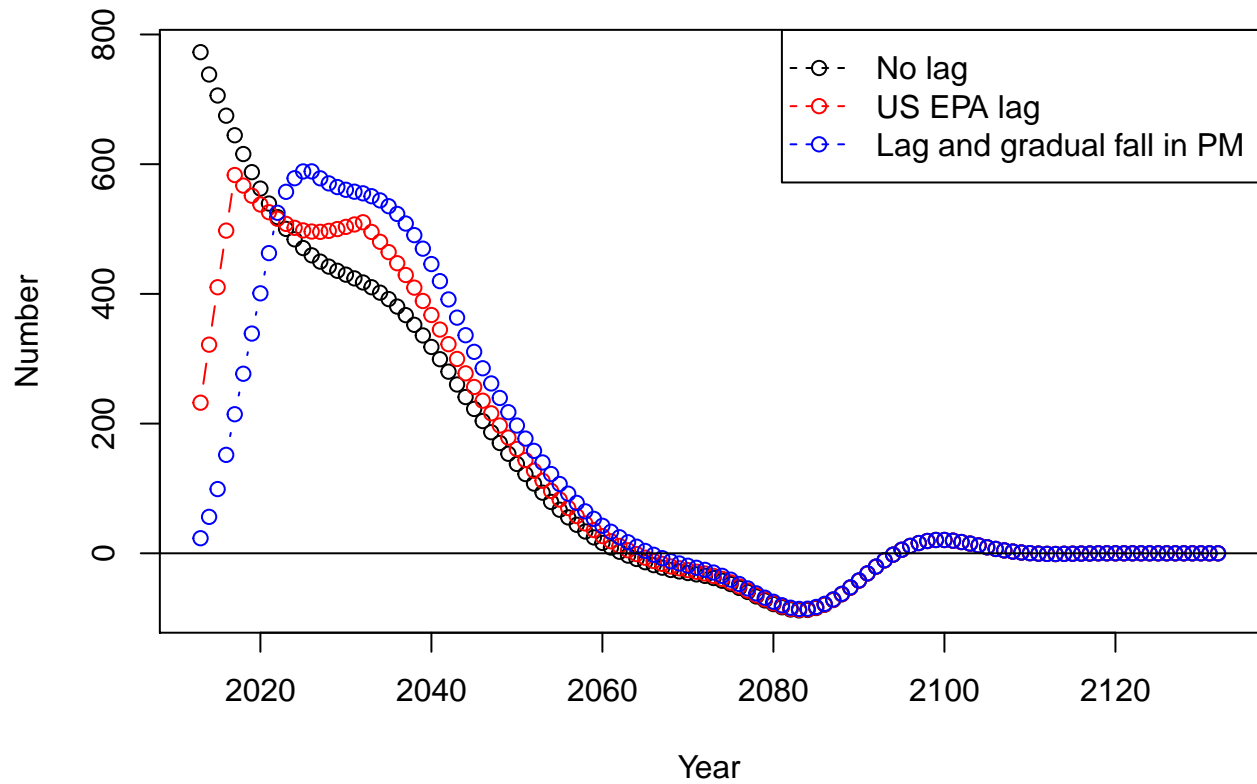
Calculate results

```
pm <- seq(0.1, 1, 0.1)
slow_pm <- impact(demog_data, delta_pm = pm, lag_structure = lag)
slow_pm <- data.frame(lapply(slow_pm, colSums))
```

Compare deaths avoided

```
plot(rownames(no_lag), no_lag$deaths_ext,
     xlab = "Year", ylab = "Number",
     main = "Deaths avoided", type = "b")
points(rownames(epa_lag), epa_lag$deaths_ext, col = "red", type = "b")
points(rownames(slow_pm), slow_pm$deaths_ext, col = "blue", type = "b")
abline(h = 0)
legend("topright", c("No lag", "US EPA lag", "Lag and gradual fall in PM"),
     col=c("black", "red", "blue"), pch = 21, lty=2)
```

Deaths avoided



Compare life years gained

```
plot(rownames(no_lag), no_lag$ly_ext,
     xlab = "Year", ylab = "Number",
     main = "Life-years gained", type = "b")
points(rownames(epa_lag), epa_lag$ly_ext, col = "red", type = "b")
points(rownames(slow_pm), slow_pm$ly_ext, col = "blue", type = "b")
abline(h = 0)
legend("bottomright", c("No lag", "US EPA lag", "Lag and gradual fall in PM"),
     col=c("black", "red", "blue"), pch = 21, lty=2)
```

Life-years gained

