

EDA&Model

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```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##   filter, lag

## The following objects are masked from 'package:base':
##
##   intersect, setdiff, setequal, union

## Warning: package 'WDI' was built under R version 4.4.2

## Loading required package: Rcpp

## This is rstanarm version 2.32.1

## - See https://mc-stan.org/rstanarm/articles/priors for changes to default priors!

## - Default priors may change, so it's safest to specify priors, even if equivalent to the defaults.

## - For execution on a local, multicore CPU with excess RAM we recommend calling

##   options(mc.cores = parallel::detectCores())

#EDA
data clean GDP

gdp<- WDI(country = "NZ", indicator = "NY.GDP.MKTP.CD", start = 1983, end = 2022)
colnames(gdp) <- c("1","2","3", "year","gdp")
gdp1<-gdp%>% select(-1,-2,-3)
#reverse
gdp2<- gdp1[nrow(gdp1):1, ]
gdp_nz<-data.frame(gdp2)

income
```

```
income<- WDI(country = "NZ", indicator = "NY.GDP.PCAP.CD", start = 1983, end = 2022)
colnames(income) <- c("1","2","3", "4","income")
income1<-income%>% select(-1,-2,-3,-4)
#reverse
income2<-income1[nrow(income1):1, ]
income_nz<-data.frame(income2)
```

input&output

```
trade<- WDI(country = "NZ", indicator = c("NE.EXP.GNFS.CD", "NE.IMP.GNFS.CD"), start = 1983, end = 2022)
colnames(trade) <- c("1","2","3", "4","input","output")
trade1<-trade%>% select(-1,-2,-3,-4)
trade_nz<-data.frame(trade1)
```

population

```
#Get population data
population <- WDI(country = "NZ", indicator = "SP.POP.TOTL", start = 1983, end = 2022)
colnames(population) <- c("1","2","3", "4","population")
population1<-population%>% select(-1,-2,-3,-4)
#reverse
population2<- population1[nrow(population1):1, ]
population_nz<-data.frame(population2)
```

visitor

```
visitor<- WDI(country = "NZ", indicator = "ST.INT.ARVL", start = 1983, end = 2022)
colnames(visitor) <- c("1","2","3", "4","visitor")
visitor1<-visitor%>% select(-1,-2,-3,-4)
#reverse
visitor2<-visitor1[nrow(visitor1):1, ]
visitor_nz<-data.frame(visitor2)
```

inflation

```
inflation<- WDI(country = "NZ", indicator = "FP.CPI.TOTL.ZG", start = 1983, end = 2022)
colnames(inflation) <- c("1","2","3", "4","inflation")
inflation1<-inflation%>% select(-1,-2,-3,-4)
#reverse
inflation2<-inflation1[nrow(inflation1):1, ]
inflation_nz<-data.frame(inflation2)
```

dataframe

```
#combine all cleaned data
data_nz<-bind_cols(gdp_nz, income_nz,population_nz,trade_nz,visitor_nz,inflation_nz)

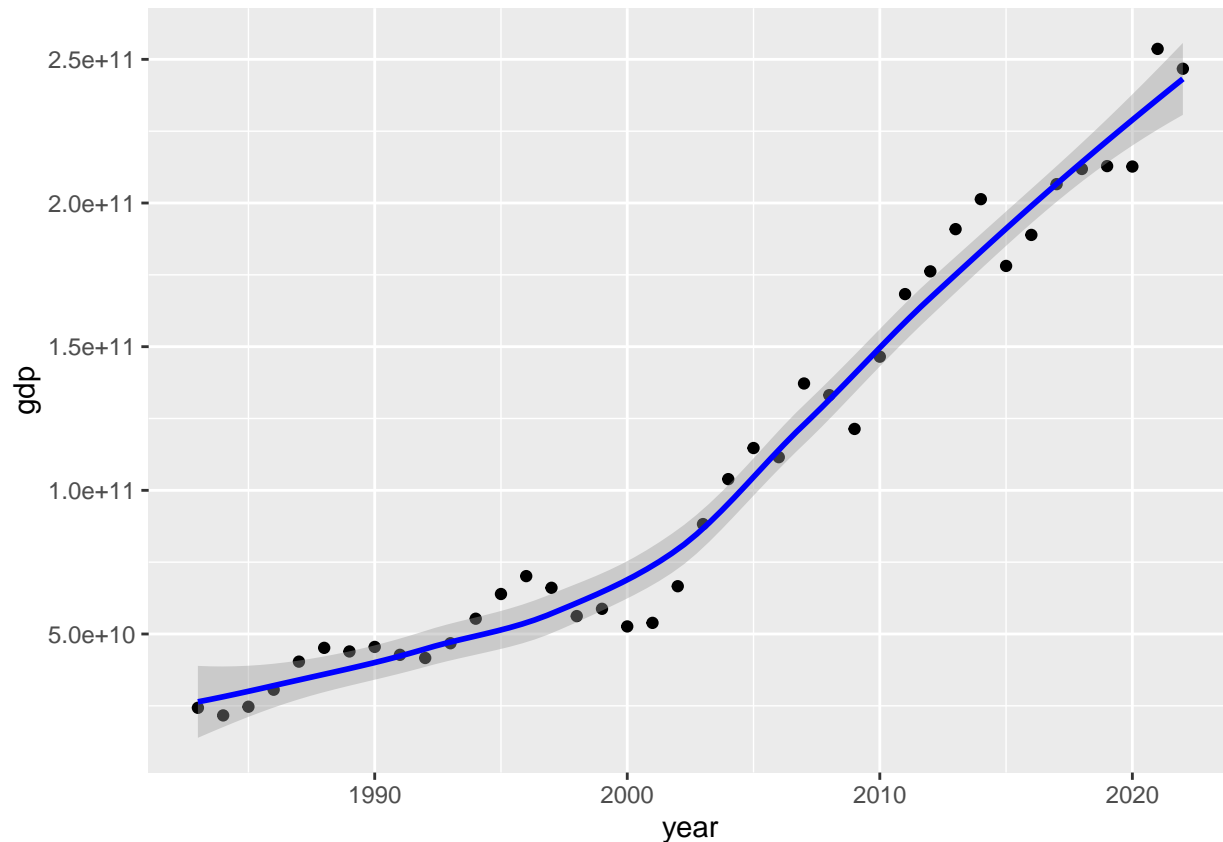
summary(data_nz)
```

```
##      year      gdp      income2      population2
## Min.   :1983   Min.   :2.167e+10   Min.    : 6714   Min.    :3199300
```

```
## 1st Qu.:1993    1st Qu.:4.646e+10    1st Qu.:13658    1st Qu.:3562075
## Median :2002    Median :7.920e+10    Median :20354    Median :3987850
## Mean   :2002    Mean   :1.089e+11    Mean   :25136    Mean   :4037638
## 3rd Qu.:2012    3rd Qu.:1.767e+11    3rd Qu.:38973    3rd Qu.:4416600
## Max.   :2022    Max.   :2.536e+11    Max.   :49624    Max.   :5117200
##
##      input          output          visitor2          inflation2
## Min.   :6.892e+09    Min.   :7.192e+09    Min.   : 996000    Min.   : -0.1143
## 1st Qu.:1.398e+10    1st Qu.:1.239e+10    1st Qu.:1817500    1st Qu.: 1.5208
## Median :2.411e+10    Median :2.232e+10    Median :2432000    Median : 2.3391
## Mean   :3.049e+10    Mean   :3.013e+10    Mean   :2394808    Mean   : 3.6627
## 3rd Qu.:4.992e+10    3rd Qu.:4.812e+10    3rd Qu.:2686750    3rd Qu.: 3.9762
## Max.   :6.019e+10    Max.   :7.326e+10    Max.   :3888000    Max.   :15.7443
##
##                                     NA's   :14
```

visualization

```
## 'geom_smooth()' using method = 'loess' and formula = 'y ~ x'
```



```
## List of 138
## $ line                                     :List of 6
## ..$ colour          : chr "black"
## ..$ linewidth       : num 0.5
## ..$ linetype        : num 1
## ..$ lineend         : chr "butt"
## ..$ arrow           : logi FALSE
```

```

## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_line" "element"
## $ rect :List of 5
## ..$ fill : chr "white"
## ..$ colour : chr "black"
## ..$ linewidth : num 0.5
## ..$ linetype : num 1
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_rect" "element"
## $ text :List of 11
## ..$ family : chr ""
## ..$ face : chr "plain"
## ..$ colour : chr "black"
## ..$ size : num 11
## ..$ hjust : num 0.5
## ..$ vjust : num 0.5
## ..$ angle : num 0
## ..$ lineheight : num 0.9
## ..$ margin : 'margin' num [1:4] 0points 0points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug : logi FALSE
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ title : chr "gdp change from1983-2023"
## $ aspect.ratio : NULL
## $ axis.title : NULL
## $ axis.title.x :List of 11
## ..$ family : NULL
## ..$ face : NULL
## ..$ colour : NULL
## ..$ size : NULL
## ..$ hjust : NULL
## ..$ vjust : num 1
## ..$ angle : NULL
## ..$ lineheight : NULL
## ..$ margin : 'margin' num [1:4] 2.75points 0points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.x.top :List of 11
## ..$ family : NULL
## ..$ face : NULL
## ..$ colour : NULL
## ..$ size : NULL
## ..$ hjust : NULL
## ..$ vjust : num 0
## ..$ angle : NULL
## ..$ lineheight : NULL
## ..$ margin : 'margin' num [1:4] 0points 0points 2.75points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"

```

```

## $ axis.title.x.bottom          : NULL
## $ axis.title.y                 :List of 11
## ..$ family                    : NULL
## ..$ face                      : NULL
## ..$ colour                    : NULL
## ..$ size                      : NULL
## ..$ hjust                     : NULL
## ..$ vjust                     : num 1
## ..$ angle                    : num 90
## ..$ lineheight                : NULL
## ..$ margin                    : 'margin' num [1:4] 0points 2.75points 0points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug                    : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.y.left            : NULL
## $ axis.title.y.right           :List of 11
## ..$ family                    : NULL
## ..$ face                      : NULL
## ..$ colour                    : NULL
## ..$ size                      : NULL
## ..$ hjust                     : NULL
## ..$ vjust                     : num 1
## ..$ angle                    : num -90
## ..$ lineheight                : NULL
## ..$ margin                    : 'margin' num [1:4] 0points 0points 0points 2.75points
## .. ..- attr(*, "unit")= int 8
## ..$ debug                    : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text                    :List of 11
## ..$ family                    : NULL
## ..$ face                      : NULL
## ..$ colour                    : chr "grey30"
## ..$ size                      : 'rel' num 0.8
## ..$ hjust                     : NULL
## ..$ vjust                     : NULL
## ..$ angle                    : NULL
## ..$ lineheight                : NULL
## ..$ margin                    : NULL
## ..$ debug                    : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x                 :List of 11
## ..$ family                    : NULL
## ..$ face                      : NULL
## ..$ colour                    : NULL
## ..$ size                      : NULL
## ..$ hjust                     : NULL
## ..$ vjust                     : num 1
## ..$ angle                    : NULL
## ..$ lineheight                : NULL
## ..$ margin                    : 'margin' num [1:4] 2.2points 0points 0points 0points
## .. ..- attr(*, "unit")= int 8

```

```

## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x.top           :List of 11
## ..$ family          : NULL
## ..$ face            : NULL
## ..$ colour          : NULL
## ..$ size            : NULL
## ..$ hjust           : NULL
## ..$ vjust           : num 0
## ..$ angle           : NULL
## ..$ lineheight      : NULL
## ..$ margin          : 'margin' num [1:4] 0points 0points 2.2points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x.bottom       : NULL
## $ axis.text.y              :List of 11
## ..$ family          : NULL
## ..$ face            : NULL
## ..$ colour          : NULL
## ..$ size            : NULL
## ..$ hjust           : num 1
## ..$ vjust           : NULL
## ..$ angle           : NULL
## ..$ lineheight      : NULL
## ..$ margin          : 'margin' num [1:4] 0points 2.2points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.y.left        : NULL
## $ axis.text.y.right       :List of 11
## ..$ family          : NULL
## ..$ face            : NULL
## ..$ colour          : NULL
## ..$ size            : NULL
## ..$ hjust           : num 0
## ..$ vjust           : NULL
## ..$ angle           : NULL
## ..$ lineheight      : NULL
## ..$ margin          : 'margin' num [1:4] 0points 0points 0points 2.2points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.theta         : NULL
## $ axis.text.r             :List of 11
## ..$ family          : NULL
## ..$ face            : NULL
## ..$ colour          : NULL
## ..$ size            : NULL
## ..$ hjust           : num 0.5

```

```

## ..$ vjust          : NULL
## ..$ angle          : NULL
## ..$ lineheight     : NULL
## ..$ margin         : 'margin' num [1:4] 0points 2.2points 0points 2.2points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.ticks        : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.ticks.x       : NULL
## $ axis.ticks.x.top   : NULL
## $ axis.ticks.x.bottom : NULL
## $ axis.ticks.y       : NULL
## $ axis.ticks.y.left  : NULL
## $ axis.ticks.y.right : NULL
## $ axis.ticks.theta   : NULL
## $ axis.ticks.r       : NULL
## $ axis.minor.ticks.x.top : NULL
## $ axis.minor.ticks.x.bottom : NULL
## $ axis.minor.ticks.y.left : NULL
## $ axis.minor.ticks.y.right : NULL
## $ axis.minor.ticks.theta : NULL
## $ axis.minor.ticks.r : NULL
## $ axis.ticks.length  : 'simpleUnit' num 2.75points
## ..- attr(*, "unit")= int 8
## $ axis.ticks.length.x : NULL
## $ axis.ticks.length.x.top : NULL
## $ axis.ticks.length.x.bottom : NULL
## $ axis.ticks.length.y : NULL
## $ axis.ticks.length.y.left : NULL
## $ axis.ticks.length.y.right : NULL
## $ axis.ticks.length.theta : NULL
## $ axis.ticks.length.r : NULL
## $ axis.minor.ticks.length : 'rel' num 0.75
## $ axis.minor.ticks.length.x : NULL
## $ axis.minor.ticks.length.x.top : NULL
## $ axis.minor.ticks.length.x.bottom : NULL
## $ axis.minor.ticks.length.y : NULL
## $ axis.minor.ticks.length.y.left : NULL
## $ axis.minor.ticks.length.y.right : NULL
## $ axis.minor.ticks.length.theta : NULL
## $ axis.minor.ticks.length.r : NULL
## $ axis.line          : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.line.x        : NULL
## $ axis.line.x.top    : NULL
## $ axis.line.x.bottom : NULL
## $ axis.line.y        : NULL
## $ axis.line.y.left   : NULL
## $ axis.line.y.right  : NULL
## $ axis.line.theta    : NULL
## $ axis.line.r        : NULL
## $ legend.background  : list()

```

```

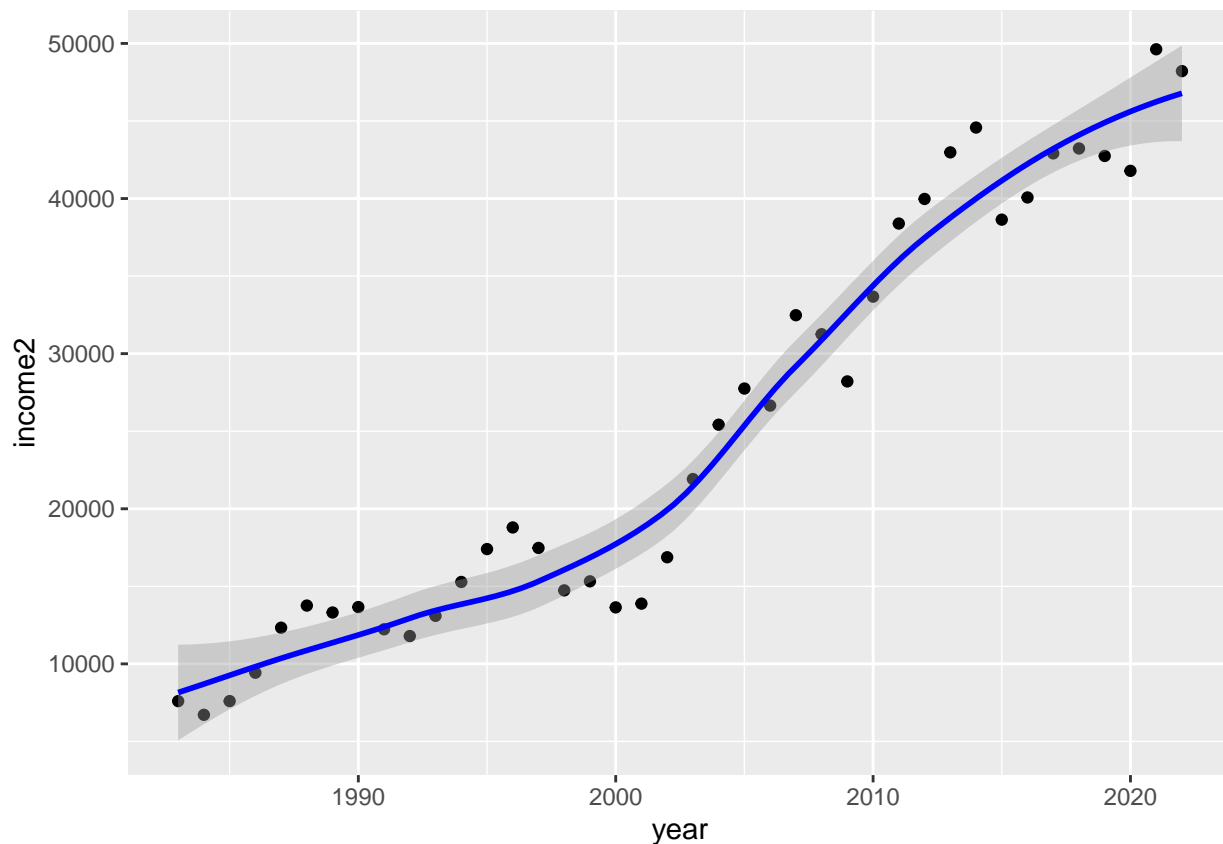
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##   $ legend.margin           : 'margin' num [1:4] 5.5points 5.5points 5.5points 5.5points
##   ..- attr(*, "unit")= int 8
##   $ legend.spacing         : 'simpleUnit' num 11points
##   ..- attr(*, "unit")= int 8
##   $ legend.spacing.x       : NULL
##   $ legend.spacing.y       : NULL
##   $ legend.key              : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##   $ legend.key.size         : 'simpleUnit' num 1.2lines
##   ..- attr(*, "unit")= int 3
##   $ legend.key.height       : NULL
##   $ legend.key.width        : NULL
##   $ legend.key.spacing      : 'simpleUnit' num 5.5points
##   ..- attr(*, "unit")= int 8
##   $ legend.key.spacing.x    : NULL
##   $ legend.key.spacing.y    : NULL
##   $ legend.frame            : NULL
##   $ legend.ticks            : NULL
##   $ legend.ticks.length     : 'rel' num 0.2
##   $ legend.axis.line        : NULL
##   $ legend.text              :List of 11
##   ..$ family                : NULL
##   ..$ face                   : NULL
##   ..$ colour                 : NULL
##   ..$ size                   : 'rel' num 0.8
##   ..$ hjust                  : NULL
##   ..$ vjust                  : NULL
##   ..$ angle                  : NULL
##   ..$ lineheight             : NULL
##   ..$ margin                 : NULL
##   ..$ debug                  : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##   $ legend.text.position     : NULL
##   $ legend.title             :List of 11
##   ..$ family                : NULL
##   ..$ face                   : NULL
##   ..$ colour                 : NULL
##   ..$ size                   : NULL
##   ..$ hjust                  : num 0
##   ..$ vjust                  : NULL
##   ..$ angle                  : NULL
##   ..$ lineheight             : NULL
##   ..$ margin                 : NULL
##   ..$ debug                  : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##   $ legend.title.position    : NULL
##   $ legend.position          : chr "right"
##   $ legend.position.inside   : NULL
##   $ legend.direction         : NULL
##   $ legend.byrow             : NULL
##   $ legend.justification     : chr "center"

```



```
## $ legend.justification.top      : NULL
## $ legend.justification.bottom  : NULL
## $ legend.justification.left    : NULL
## $ legend.justification.right   : NULL
## $ legend.justification.inside  : NULL
## $ legend.location              : NULL
## $ legend.box                   : NULL
## $ legend.box.just              : NULL
## $ legend.box.margin            : 'margin' num [1:4] 0cm 0cm 0cm 0cm
## .. attr(*, "unit")= int 1
## $ legend.box.background        : list()
## .. attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.box.spacing           : 'simpleUnit' num 11points
## .. attr(*, "unit")= int 8
## [list output truncated]
## - attr(*, "class")= chr [1:2] "theme" "gg"
## - attr(*, "complete")= logi TRUE
## - attr(*, "validate")= logi TRUE
```

```
## 'geom_smooth()' using method = 'loess' and formula = 'y ~ x'
```



```
## List of 138
## $ line                                :List of 6
## ..$ colour                          : chr "black"
## ..$ linewidth                       : num 0.5
## ..$ linetype                        : num 1
```

```

## ..$ lineend      : chr "butt"
## ..$ arrow        : logi FALSE
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_line" "element"
## $ rect           :List of 5
## ..$ fill          : chr "white"
## ..$ colour        : chr "black"
## ..$ linewidth     : num 0.5
## ..$ linetype       : num 1
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_rect" "element"
## $ text           :List of 11
## ..$ family        : chr ""
## ..$ face           : chr "plain"
## ..$ colour        : chr "black"
## ..$ size          : num 11
## ..$ hjust         : num 0.5
## ..$ vjust         : num 0.5
## ..$ angle         : num 0
## ..$ lineheight    : num 0.9
## ..$ margin        : 'margin' num [1:4] 0points 0points 0points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug         : logi FALSE
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ title           : chr "income change from1983-2023"
## $ aspect.ratio    : NULL
## $ axis.title       : NULL
## $ axis.title.x     :List of 11
## ..$ family        : NULL
## ..$ face           : NULL
## ..$ colour        : NULL
## ..$ size          : NULL
## ..$ hjust         : NULL
## ..$ vjust         : num 1
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 2.75points 0points 0points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.x.top :List of 11
## ..$ family        : NULL
## ..$ face           : NULL
## ..$ colour        : NULL
## ..$ size          : NULL
## ..$ hjust         : NULL
## ..$ vjust         : num 0
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 0points 2.75points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug         : NULL

```

```

## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.x.bottom : NULL
## $ axis.title.y :List of 11
## ..$ family : NULL
## ..$ face : NULL
## ..$ colour : NULL
## ..$ size : NULL
## ..$ hjust : NULL
## ..$ vjust : num 1
## ..$ angle : num 90
## ..$ lineheight : NULL
## ..$ margin : 'margin' num [1:4] 0points 2.75points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.y.left : NULL
## $ axis.title.y.right :List of 11
## ..$ family : NULL
## ..$ face : NULL
## ..$ colour : NULL
## ..$ size : NULL
## ..$ hjust : NULL
## ..$ vjust : num 1
## ..$ angle : num -90
## ..$ lineheight : NULL
## ..$ margin : 'margin' num [1:4] 0points 0points 0points 2.75points
## ..- attr(*, "unit")= int 8
## ..$ debug : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text :List of 11
## ..$ family : NULL
## ..$ face : NULL
## ..$ colour : chr "grey30"
## ..$ size : 'rel' num 0.8
## ..$ hjust : NULL
## ..$ vjust : NULL
## ..$ angle : NULL
## ..$ lineheight : NULL
## ..$ margin : NULL
## ..$ debug : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x :List of 11
## ..$ family : NULL
## ..$ face : NULL
## ..$ colour : NULL
## ..$ size : NULL
## ..$ hjust : NULL
## ..$ vjust : num 1
## ..$ angle : NULL
## ..$ lineheight : NULL

```

```

## ..$ margin      : 'margin' num [1:4] 2.2points 0points 0points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug       : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x.top      :List of 11
## ..$ family        : NULL
## ..$ face          : NULL
## ..$ colour        : NULL
## ..$ size          : NULL
## ..$ hjust         : NULL
## ..$ vjust         : num 0
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin      : 'margin' num [1:4] 0points 0points 2.2points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug       : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x.bottom : NULL
## $ axis.text.y        :List of 11
## ..$ family        : NULL
## ..$ face          : NULL
## ..$ colour        : NULL
## ..$ size          : NULL
## ..$ hjust         : num 1
## ..$ vjust         : NULL
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin      : 'margin' num [1:4] 0points 2.2points 0points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug       : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.y.left  : NULL
## $ axis.text.y.right :List of 11
## ..$ family        : NULL
## ..$ face          : NULL
## ..$ colour        : NULL
## ..$ size          : NULL
## ..$ hjust         : num 0
## ..$ vjust         : NULL
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin      : 'margin' num [1:4] 0points 0points 0points 2.2points
## .. ..- attr(*, "unit")= int 8
## ..$ debug       : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.theta   : NULL
## $ axis.text.r        :List of 11
## ..$ family        : NULL
## ..$ face          : NULL
## ..$ colour        : NULL

```

```

## ..$ size          : NULL
## ..$ hjust         : num 0.5
## ..$ vjust         : NULL
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 2.2points 0points 2.2points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.ticks      : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.ticks.x    : NULL
## $ axis.ticks.x.top : NULL
## $ axis.ticks.x.bottom : NULL
## $ axis.ticks.y    : NULL
## $ axis.ticks.y.left : NULL
## $ axis.ticks.y.right : NULL
## $ axis.ticks.theta : NULL
## $ axis.ticks.r    : NULL
## $ axis.minor.ticks.x.top : NULL
## $ axis.minor.ticks.x.bottom : NULL
## $ axis.minor.ticks.y.left : NULL
## $ axis.minor.ticks.y.right : NULL
## $ axis.minor.ticks.theta : NULL
## $ axis.minor.ticks.r    : NULL
## $ axis.ticks.length    : 'simpleUnit' num 2.75points
## ..- attr(*, "unit")= int 8
## $ axis.ticks.length.x : NULL
## $ axis.ticks.length.x.top : NULL
## $ axis.ticks.length.x.bottom : NULL
## $ axis.ticks.length.y : NULL
## $ axis.ticks.length.y.left : NULL
## $ axis.ticks.length.y.right : NULL
## $ axis.ticks.length.theta : NULL
## $ axis.ticks.length.r    : NULL
## $ axis.minor.ticks.length : 'rel' num 0.75
## $ axis.minor.ticks.length.x : NULL
## $ axis.minor.ticks.length.x.top : NULL
## $ axis.minor.ticks.length.x.bottom : NULL
## $ axis.minor.ticks.length.y : NULL
## $ axis.minor.ticks.length.y.left : NULL
## $ axis.minor.ticks.length.y.right : NULL
## $ axis.minor.ticks.length.theta : NULL
## $ axis.minor.ticks.length.r    : NULL
## $ axis.line                    : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.line.x    : NULL
## $ axis.line.x.top : NULL
## $ axis.line.x.bottom : NULL
## $ axis.line.y    : NULL
## $ axis.line.y.left : NULL
## $ axis.line.y.right : NULL
## $ axis.line.theta : NULL

```

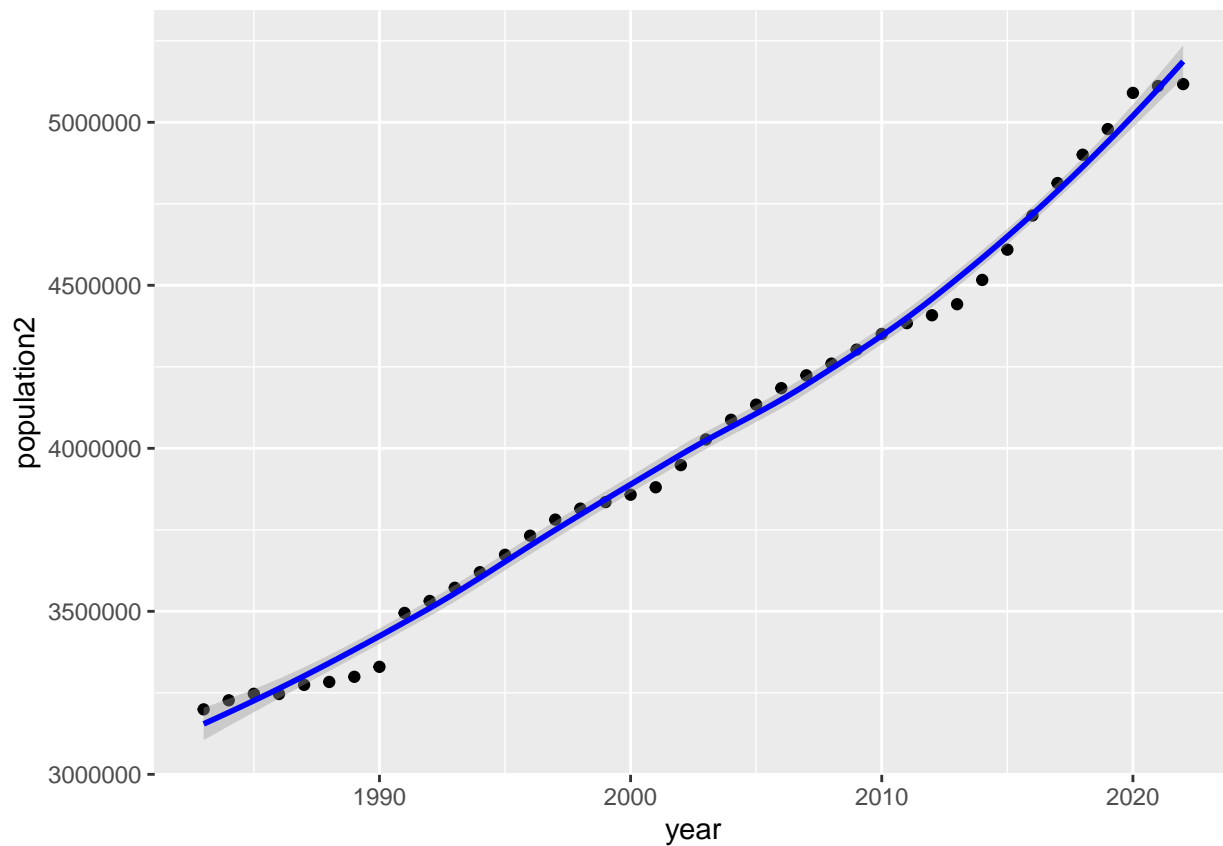
```

## $ axis.line.r : NULL
## $ legend.background : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.margin : 'margin' num [1:4] 5.5points 5.5points 5.5points 5.5points
## ..- attr(*, "unit")= int 8
## $ legend.spacing : 'simpleUnit' num 11points
## ..- attr(*, "unit")= int 8
## $ legend.spacing.x : NULL
## $ legend.spacing.y : NULL
## $ legend.key : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.key.size : 'simpleUnit' num 1.2lines
## ..- attr(*, "unit")= int 3
## $ legend.key.height : NULL
## $ legend.key.width : NULL
## $ legend.key.spacing : 'simpleUnit' num 5.5points
## ..- attr(*, "unit")= int 8
## $ legend.key.spacing.x : NULL
## $ legend.key.spacing.y : NULL
## $ legend.frame : NULL
## $ legend.ticks : NULL
## $ legend.ticks.length : 'rel' num 0.2
## $ legend.axis.line : NULL
## $ legend.text :List of 11
## ..$ family : NULL
## ..$ face : NULL
## ..$ colour : NULL
## ..$ size : 'rel' num 0.8
## ..$ hjust : NULL
## ..$ vjust : NULL
## ..$ angle : NULL
## ..$ lineheight : NULL
## ..$ margin : NULL
## ..$ debug : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ legend.text.position : NULL
## $ legend.title :List of 11
## ..$ family : NULL
## ..$ face : NULL
## ..$ colour : NULL
## ..$ size : NULL
## ..$ hjust : num 0
## ..$ vjust : NULL
## ..$ angle : NULL
## ..$ lineheight : NULL
## ..$ margin : NULL
## ..$ debug : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ legend.title.position : NULL
## $ legend.position : chr "right"
## $ legend.position.inside : NULL
## $ legend.direction : NULL

```

```
## $ legend.byrow           : NULL
## $ legend.justification   : chr "center"
## $ legend.justification.top : NULL
## $ legend.justification.bottom : NULL
## $ legend.justification.left : NULL
## $ legend.justification.right : NULL
## $ legend.justification.inside : NULL
## $ legend.location        : NULL
## $ legend.box             : NULL
## $ legend.box.just        : NULL
## $ legend.box.margin      : 'margin' num [1:4] 0cm 0cm 0cm 0cm
## .. attr(*, "unit")= int 1
## $ legend.box.background   : list()
## .. attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.box.spacing      : 'simpleUnit' num 11points
## .. attr(*, "unit")= int 8
## [list output truncated]
## - attr(*, "class")= chr [1:2] "theme" "gg"
## - attr(*, "complete")= logi TRUE
## - attr(*, "validate")= logi TRUE

## 'geom_smooth()' using method = 'loess' and formula = 'y ~ x'
```



```
## List of 138
## $ line           :List of 6
## ..$ colour       : chr "black"
```

```

## ..$ linewidth      : num 0.5
## ..$ linetype       : num 1
## ..$ lineend        : chr "butt"
## ..$ arrow          : logi FALSE
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_line" "element"
## $ rect              :List of 5
## ..$ fill           : chr "white"
## ..$ colour         : chr "black"
## ..$ linewidth      : num 0.5
## ..$ linetype       : num 1
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_rect" "element"
## $ text              :List of 11
## ..$ family         : chr ""
## ..$ face           : chr "plain"
## ..$ colour         : chr "black"
## ..$ size           : num 11
## ..$ hjust          : num 0.5
## ..$ vjust          : num 0.5
## ..$ angle          : num 0
## ..$ lineheight     : num 0.9
## ..$ margin         : 'margin' num [1:4] 0points 0points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug          : logi FALSE
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ title             : chr "population change from1983-2023"
## $ aspect.ratio      : NULL
## $ axis.title        : NULL
## $ axis.title.x      :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust          : NULL
## ..$ vjust          : num 1
## ..$ angle          : NULL
## ..$ lineheight     : NULL
## ..$ margin         : 'margin' num [1:4] 2.75points 0points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.x.top  :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust          : NULL
## ..$ vjust          : num 0
## ..$ angle          : NULL
## ..$ lineheight     : NULL
## ..$ margin         : 'margin' num [1:4] 0points 0points 2.75points 0points

```



```

## ..- attr(*, "unit")= int 8
## ..$ debug : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.x.bottom : NULL
## $ axis.title.y :List of 11
## ..$ family : NULL
## ..$ face : NULL
## ..$ colour : NULL
## ..$ size : NULL
## ..$ hjust : NULL
## ..$ vjust : num 1
## ..$ angle : num 90
## ..$ lineheight : NULL
## ..$ margin : 'margin' num [1:4] 0points 2.75points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.y.left : NULL
## $ axis.title.y.right :List of 11
## ..$ family : NULL
## ..$ face : NULL
## ..$ colour : NULL
## ..$ size : NULL
## ..$ hjust : NULL
## ..$ vjust : num 1
## ..$ angle : num -90
## ..$ lineheight : NULL
## ..$ margin : 'margin' num [1:4] 0points 0points 0points 2.75points
## ..- attr(*, "unit")= int 8
## ..$ debug : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text :List of 11
## ..$ family : NULL
## ..$ face : NULL
## ..$ colour : chr "grey30"
## ..$ size : 'rel' num 0.8
## ..$ hjust : NULL
## ..$ vjust : NULL
## ..$ angle : NULL
## ..$ lineheight : NULL
## ..$ margin : NULL
## ..$ debug : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x :List of 11
## ..$ family : NULL
## ..$ face : NULL
## ..$ colour : NULL
## ..$ size : NULL
## ..$ hjust : NULL
## ..$ vjust : num 1

```

```

## ..$ angle      : NULL
## ..$ lineheight : NULL
## ..$ margin     : 'margin' num [1:4] 2.2points 0points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug      : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x.top      :List of 11
## ..$ family           : NULL
## ..$ face             : NULL
## ..$ colour           : NULL
## ..$ size             : NULL
## ..$ hjust            : NULL
## ..$ vjust            : num 0
## ..$ angle            : NULL
## ..$ lineheight       : NULL
## ..$ margin           : 'margin' num [1:4] 0points 0points 2.2points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug            : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x.bottom   : NULL
## $ axis.text.y           :List of 11
## ..$ family           : NULL
## ..$ face             : NULL
## ..$ colour           : NULL
## ..$ size             : NULL
## ..$ hjust            : num 1
## ..$ vjust            : NULL
## ..$ angle            : NULL
## ..$ lineheight       : NULL
## ..$ margin           : 'margin' num [1:4] 0points 2.2points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug            : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.y.left     : NULL
## $ axis.text.y.right    :List of 11
## ..$ family           : NULL
## ..$ face             : NULL
## ..$ colour           : NULL
## ..$ size             : NULL
## ..$ hjust            : num 0
## ..$ vjust            : NULL
## ..$ angle            : NULL
## ..$ lineheight       : NULL
## ..$ margin           : 'margin' num [1:4] 0points 0points 0points 2.2points
## ..- attr(*, "unit")= int 8
## ..$ debug            : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.theta      : NULL
## $ axis.text.r           :List of 11
## ..$ family           : NULL

```

```

## ..$ face          : NULL
## ..$ colour        : NULL
## ..$ size           : NULL
## ..$ hjust          : num 0.5
## ..$ vjust          : NULL
## ..$ angle          : NULL
## ..$ lineheight     : NULL
## ..$ margin         : 'margin' num [1:4] 0points 2.2points 0points 2.2points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.ticks        : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.ticks.x       : NULL
## $ axis.ticks.x.top   : NULL
## $ axis.ticks.x.bottom : NULL
## $ axis.ticks.y       : NULL
## $ axis.ticks.y.left  : NULL
## $ axis.ticks.y.right : NULL
## $ axis.ticks.theta   : NULL
## $ axis.ticks.r       : NULL
## $ axis.minor.ticks.x.top : NULL
## $ axis.minor.ticks.x.bottom : NULL
## $ axis.minor.ticks.y.left : NULL
## $ axis.minor.ticks.y.right : NULL
## $ axis.minor.ticks.theta : NULL
## $ axis.minor.ticks.r   : NULL
## $ axis.ticks.length  : 'simpleUnit' num 2.75points
## ..- attr(*, "unit")= int 8
## $ axis.ticks.length.x : NULL
## $ axis.ticks.length.x.top : NULL
## $ axis.ticks.length.x.bottom : NULL
## $ axis.ticks.length.y : NULL
## $ axis.ticks.length.y.left : NULL
## $ axis.ticks.length.y.right : NULL
## $ axis.ticks.length.theta : NULL
## $ axis.ticks.length.r   : NULL
## $ axis.minor.ticks.length : 'rel' num 0.75
## $ axis.minor.ticks.length.x : NULL
## $ axis.minor.ticks.length.x.top : NULL
## $ axis.minor.ticks.length.x.bottom : NULL
## $ axis.minor.ticks.length.y : NULL
## $ axis.minor.ticks.length.y.left : NULL
## $ axis.minor.ticks.length.y.right : NULL
## $ axis.minor.ticks.length.theta : NULL
## $ axis.minor.ticks.length.r   : NULL
## $ axis.line                 : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.line.x               : NULL
## $ axis.line.x.top           : NULL
## $ axis.line.x.bottom        : NULL
## $ axis.line.y               : NULL
## $ axis.line.y.left          : NULL

```

```

## $ axis.line.y.right      : NULL
## $ axis.line.theta       : NULL
## $ axis.line.r           : NULL
## $ legend.background     : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.margin         : 'margin' num [1:4] 5.5points 5.5points 5.5points 5.5points
## ..- attr(*, "unit")= int 8
## $ legend.spacing        : 'simpleUnit' num 11points
## ..- attr(*, "unit")= int 8
## $ legend.spacing.x      : NULL
## $ legend.spacing.y      : NULL
## $ legend.key            : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.key.size       : 'simpleUnit' num 1.2lines
## ..- attr(*, "unit")= int 3
## $ legend.key.height     : NULL
## $ legend.key.width      : NULL
## $ legend.key.spacing    : 'simpleUnit' num 5.5points
## ..- attr(*, "unit")= int 8
## $ legend.key.spacing.x  : NULL
## $ legend.key.spacing.y  : NULL
## $ legend.frame          : NULL
## $ legend.ticks          : NULL
## $ legend.ticks.length   : 'rel' num 0.2
## $ legend.axis.line      : NULL
## $ legend.text           :List of 11
## ..$ family             : NULL
## ..$ face               : NULL
## ..$ colour            : NULL
## ..$ size               : 'rel' num 0.8
## ..$ hjust             : NULL
## ..$ vjust             : NULL
## ..$ angle             : NULL
## ..$ lineheight        : NULL
## ..$ margin            : NULL
## ..$ debug            : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ legend.text.position  : NULL
## $ legend.title         :List of 11
## ..$ family            : NULL
## ..$ face              : NULL
## ..$ colour           : NULL
## ..$ size             : NULL
## ..$ hjust            : num 0
## ..$ vjust           : NULL
## ..$ angle           : NULL
## ..$ lineheight      : NULL
## ..$ margin         : NULL
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ legend.title.position : NULL
## $ legend.position       : chr "right"

```

```

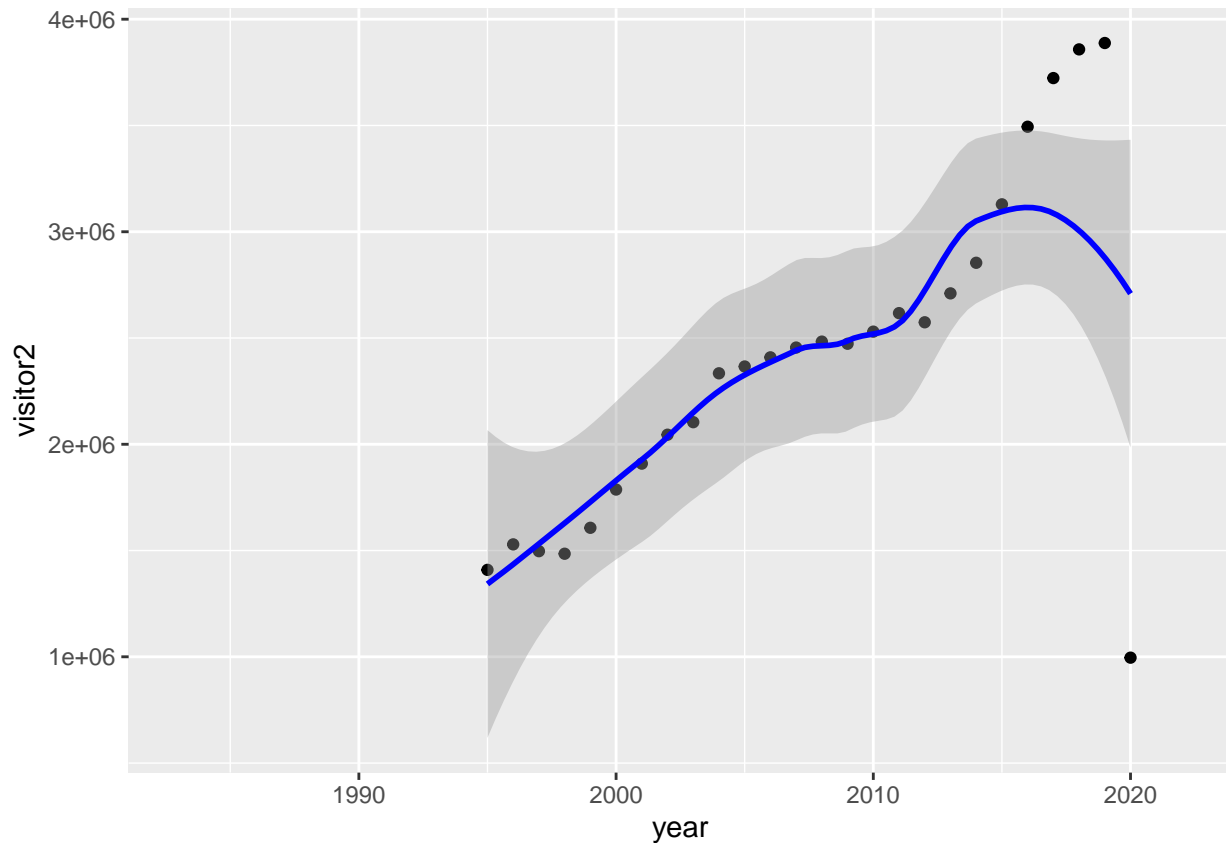
## $ legend.position.inside      : NULL
## $ legend.direction           : NULL
## $ legend.byrow               : NULL
## $ legend.justification       : chr "center"
## $ legend.justification.top   : NULL
## $ legend.justification.bottom : NULL
## $ legend.justification.left  : NULL
## $ legend.justification.right : NULL
## $ legend.justification.inside : NULL
## $ legend.location            : NULL
## $ legend.box                 : NULL
## $ legend.box.just            : NULL
## $ legend.box.margin          : 'margin' num [1:4] 0cm 0cm 0cm 0cm
##   .. attr(*, "unit")= int 1
## $ legend.box.background      : list()
##   .. attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.box.spacing         : 'simpleUnit' num 11points
##   .. attr(*, "unit")= int 8
## [list output truncated]
## - attr(*, "class")= chr [1:2] "theme" "gg"
## - attr(*, "complete")= logi TRUE
## - attr(*, "validate")= logi TRUE

## 'geom_smooth()' using method = 'loess' and formula = 'y ~ x'

## Warning: Removed 14 rows containing non-finite outside the scale range
## ('stat_smooth()').

## Warning: Removed 14 rows containing missing values or values outside the scale range
## ('geom_point()').

```



```
## List of 138
## $ line                                     :List of 6
##   ..$ colour      : chr "black"
##   ..$ linewidth    : num 0.5
##   ..$ linetype     : num 1
##   ..$ lineend      : chr "butt"
##   ..$ arrow        : logi FALSE
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_line" "element"
## $ rect                                       :List of 5
##   ..$ fill         : chr "white"
##   ..$ colour       : chr "black"
##   ..$ linewidth    : num 0.5
##   ..$ linetype     : num 1
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_rect" "element"
## $ text                                       :List of 11
##   ..$ family       : chr ""
##   ..$ face         : chr "plain"
##   ..$ colour       : chr "black"
##   ..$ size         : num 11
##   ..$ hjust        : num 0.5
##   ..$ vjust        : num 0.5
##   ..$ angle        : num 0
##   ..$ lineheight   : num 0.9
##   ..$ margin       : 'margin' num [1:4] 0points 0points 0points 0points
##   ..- attr(*, "unit")= int 8
```

```

## ..$ debug          : logi FALSE
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ title              : chr "number of visitor change from1983-2023"
## $ aspect.ratio       : NULL
## $ axis.title         : NULL
## $ axis.title.x       :List of 11
## ..$ family          : NULL
## ..$ face             : NULL
## ..$ colour          : NULL
## ..$ size            : NULL
## ..$ hjust           : NULL
## ..$ vjust           : num 1
## ..$ angle           : NULL
## ..$ lineheight      : NULL
## ..$ margin          : 'margin' num [1:4] 2.75points 0points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.x.top   :List of 11
## ..$ family          : NULL
## ..$ face             : NULL
## ..$ colour          : NULL
## ..$ size            : NULL
## ..$ hjust           : NULL
## ..$ vjust           : num 0
## ..$ angle           : NULL
## ..$ lineheight      : NULL
## ..$ margin          : 'margin' num [1:4] 0points 0points 2.75points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.x.bottom : NULL
## $ axis.title.y       :List of 11
## ..$ family          : NULL
## ..$ face             : NULL
## ..$ colour          : NULL
## ..$ size            : NULL
## ..$ hjust           : NULL
## ..$ vjust           : num 1
## ..$ angle           : num 90
## ..$ lineheight      : NULL
## ..$ margin          : 'margin' num [1:4] 0points 2.75points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.y.left  : NULL
## $ axis.title.y.right :List of 11
## ..$ family          : NULL
## ..$ face             : NULL
## ..$ colour          : NULL

```

```

## ..$ size          : NULL
## ..$ hjust         : NULL
## ..$ vjust         : num 1
## ..$ angle         : num -90
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 0points 0points 2.75points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text              :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : chr "grey30"
## ..$ size           : 'rel' num 0.8
## ..$ hjust         : NULL
## ..$ vjust         : NULL
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : NULL
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x          :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust         : NULL
## ..$ vjust         : num 1
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 2.2points 0points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x.top      :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust         : NULL
## ..$ vjust         : num 0
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 0points 2.2points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x.bottom   : NULL
## $ axis.text.y          :List of 11
## ..$ family         : NULL

```



```

## ..$ face          : NULL
## ..$ colour        : NULL
## ..$ size          : NULL
## ..$ hjust         : num 1
## ..$ vjust         : NULL
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 2.2points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.y.left : NULL
## $ axis.text.y.right :List of 11
## ..$ family        : NULL
## ..$ face          : NULL
## ..$ colour        : NULL
## ..$ size          : NULL
## ..$ hjust         : num 0
## ..$ vjust         : NULL
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 0points 0points 2.2points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.theta  : NULL
## $ axis.text.r      :List of 11
## ..$ family        : NULL
## ..$ face          : NULL
## ..$ colour        : NULL
## ..$ size          : NULL
## ..$ hjust         : num 0.5
## ..$ vjust         : NULL
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 2.2points 0points 2.2points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.ticks       : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.ticks.x      : NULL
## $ axis.ticks.x.top  : NULL
## $ axis.ticks.x.bottom : NULL
## $ axis.ticks.y      : NULL
## $ axis.ticks.y.left : NULL
## $ axis.ticks.y.right : NULL
## $ axis.ticks.theta  : NULL
## $ axis.ticks.r      : NULL
## $ axis.minor.ticks.x.top : NULL
## $ axis.minor.ticks.x.bottom : NULL

```

```

## $ axis.minor.ticks.y.left      : NULL
## $ axis.minor.ticks.y.right    : NULL
## $ axis.minor.ticks.theta      : NULL
## $ axis.minor.ticks.r          : NULL
## $ axis.ticks.length           : 'simpleUnit' num 2.75points
##   .. attr(*, "unit")= int 8
## $ axis.ticks.length.x         : NULL
## $ axis.ticks.length.x.top     : NULL
## $ axis.ticks.length.x.bottom  : NULL
## $ axis.ticks.length.y         : NULL
## $ axis.ticks.length.y.left    : NULL
## $ axis.ticks.length.y.right   : NULL
## $ axis.ticks.length.theta     : NULL
## $ axis.ticks.length.r         : NULL
## $ axis.minor.ticks.length     : 'rel' num 0.75
## $ axis.minor.ticks.length.x   : NULL
## $ axis.minor.ticks.length.x.top : NULL
## $ axis.minor.ticks.length.x.bottom : NULL
## $ axis.minor.ticks.length.y   : NULL
## $ axis.minor.ticks.length.y.left : NULL
## $ axis.minor.ticks.length.y.right : NULL
## $ axis.minor.ticks.length.theta : NULL
## $ axis.minor.ticks.length.r   : NULL
## $ axis.line                   : list()
##   .. attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.line.x                 : NULL
## $ axis.line.x.top             : NULL
## $ axis.line.x.bottom          : NULL
## $ axis.line.y                 : NULL
## $ axis.line.y.left            : NULL
## $ axis.line.y.right           : NULL
## $ axis.line.theta             : NULL
## $ axis.line.r                 : NULL
## $ legend.background           : list()
##   .. attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.margin               : 'margin' num [1:4] 5.5points 5.5points 5.5points 5.5points
##   .. attr(*, "unit")= int 8
## $ legend.spacing              : 'simpleUnit' num 11points
##   .. attr(*, "unit")= int 8
## $ legend.spacing.x            : NULL
## $ legend.spacing.y            : NULL
## $ legend.key                  : list()
##   .. attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.key.size             : 'simpleUnit' num 1.2lines
##   .. attr(*, "unit")= int 3
## $ legend.key.height           : NULL
## $ legend.key.width            : NULL
## $ legend.key.spacing          : 'simpleUnit' num 5.5points
##   .. attr(*, "unit")= int 8
## $ legend.key.spacing.x        : NULL
## $ legend.key.spacing.y        : NULL
## $ legend.frame                : NULL
## $ legend.ticks                : NULL
## $ legend.ticks.length         : 'rel' num 0.2

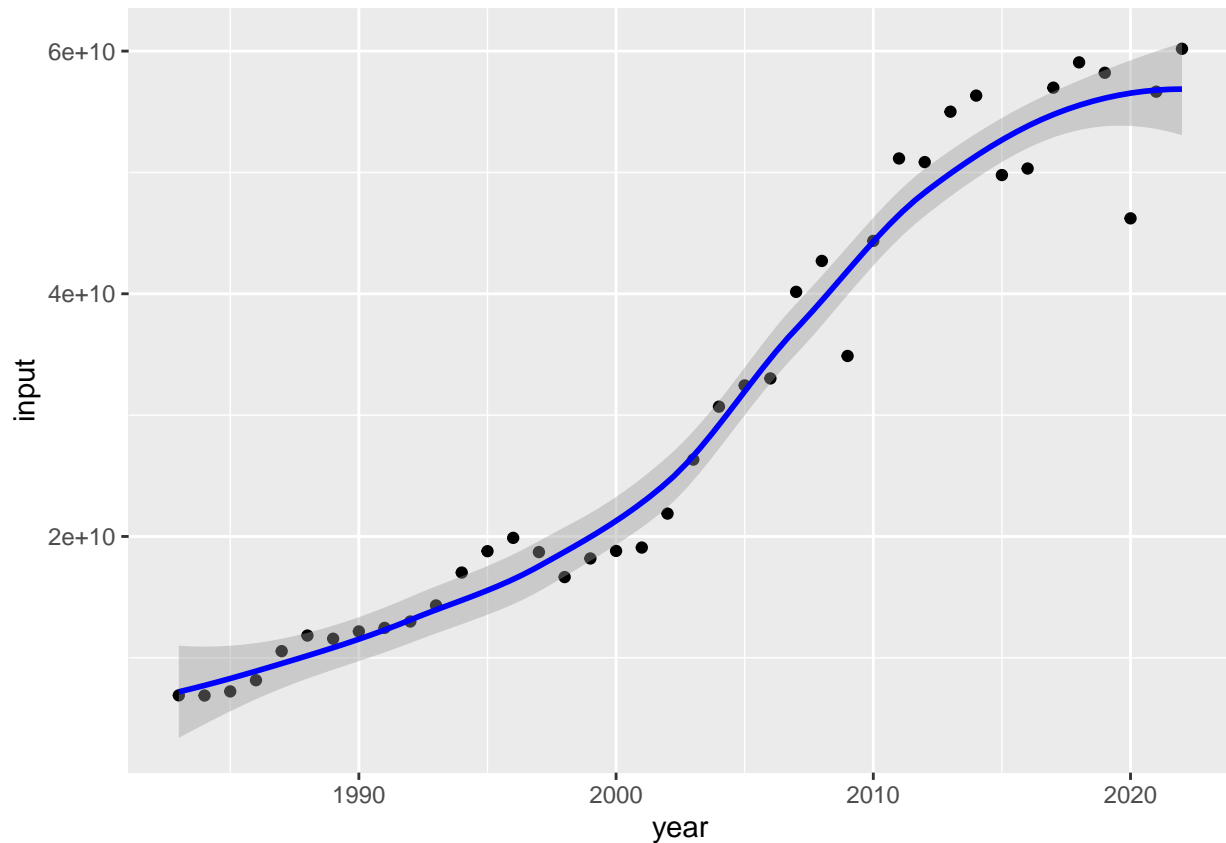
```

```

## $ legend.axis.line           : NULL
## $ legend.text                :List of 11
##   ..$ family                : NULL
##   ..$ face                   : NULL
##   ..$ colour                 : NULL
##   ..$ size                   : 'rel' num 0.8
##   ..$ hjust                  : NULL
##   ..$ vjust                  : NULL
##   ..$ angle                  : NULL
##   ..$ lineheight             : NULL
##   ..$ margin                 : NULL
##   ..$ debug                  : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ legend.text.position       : NULL
## $ legend.title               :List of 11
##   ..$ family                : NULL
##   ..$ face                   : NULL
##   ..$ colour                 : NULL
##   ..$ size                   : NULL
##   ..$ hjust                  : num 0
##   ..$ vjust                  : NULL
##   ..$ angle                  : NULL
##   ..$ lineheight             : NULL
##   ..$ margin                 : NULL
##   ..$ debug                  : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ legend.title.position      : NULL
## $ legend.position            : chr "right"
## $ legend.position.inside     : NULL
## $ legend.direction           : NULL
## $ legend.byrow               : NULL
## $ legend.justification       : chr "center"
## $ legend.justification.top    : NULL
## $ legend.justification.bottom : NULL
## $ legend.justification.left   : NULL
## $ legend.justification.right  : NULL
## $ legend.justification.inside : NULL
## $ legend.location            : NULL
## $ legend.box                 : NULL
## $ legend.box.just            : NULL
## $ legend.box.margin          : 'margin' num [1:4] 0cm 0cm 0cm 0cm
##   ..- attr(*, "unit")= int 1
## $ legend.box.background      : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.box.spacing         : 'simpleUnit' num 11points
##   ..- attr(*, "unit")= int 8
## [list output truncated]
## - attr(*, "class")= chr [1:2] "theme" "gg"
## - attr(*, "complete")= logi TRUE
## - attr(*, "validate")= logi TRUE

## 'geom_smooth()' using method = 'loess' and formula = 'y ~ x'

```



```
## List of 138
## $ line                                     :List of 6
##   ..$ colour      : chr "black"
##   ..$ linewidth    : num 0.5
##   ..$ linetype     : num 1
##   ..$ lineend      : chr "butt"
##   ..$ arrow        : logi FALSE
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_line" "element"
## $ rect                                     :List of 5
##   ..$ fill         : chr "white"
##   ..$ colour       : chr "black"
##   ..$ linewidth    : num 0.5
##   ..$ linetype     : num 1
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_rect" "element"
## $ text                                    :List of 11
##   ..$ family       : chr ""
##   ..$ face         : chr "plain"
##   ..$ colour       : chr "black"
##   ..$ size         : num 11
##   ..$ hjust        : num 0.5
##   ..$ vjust        : num 0.5
##   ..$ angle        : num 0
##   ..$ lineheight    : num 0.9
##   ..$ margin       : 'margin' num [1:4] 0points 0points 0points 0points
##   ..- attr(*, "unit")= int 8
```

```

## ..$ debug          : logi FALSE
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ title              : chr "input change from1983-2023"
## $ aspect.ratio       : NULL
## $ axis.title         : NULL
## $ axis.title.x       :List of 11
## ..$ family          : NULL
## ..$ face             : NULL
## ..$ colour          : NULL
## ..$ size            : NULL
## ..$ hjust           : NULL
## ..$ vjust           : num 1
## ..$ angle           : NULL
## ..$ lineheight      : NULL
## ..$ margin          : 'margin' num [1:4] 2.75points 0points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.x.top   :List of 11
## ..$ family          : NULL
## ..$ face             : NULL
## ..$ colour          : NULL
## ..$ size            : NULL
## ..$ hjust           : NULL
## ..$ vjust           : num 0
## ..$ angle           : NULL
## ..$ lineheight      : NULL
## ..$ margin          : 'margin' num [1:4] 0points 0points 2.75points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.x.bottom : NULL
## $ axis.title.y       :List of 11
## ..$ family          : NULL
## ..$ face             : NULL
## ..$ colour          : NULL
## ..$ size            : NULL
## ..$ hjust           : NULL
## ..$ vjust           : num 1
## ..$ angle           : num 90
## ..$ lineheight      : NULL
## ..$ margin          : 'margin' num [1:4] 0points 2.75points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.y.left  : NULL
## $ axis.title.y.right :List of 11
## ..$ family          : NULL
## ..$ face             : NULL
## ..$ colour          : NULL

```

```

## ..$ size          : NULL
## ..$ hjust         : NULL
## ..$ vjust         : num 1
## ..$ angle         : num -90
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 0points 0points 2.75points
## .. ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text              :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : chr "grey30"
## ..$ size           : 'rel' num 0.8
## ..$ hjust         : NULL
## ..$ vjust         : NULL
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : NULL
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x          :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust         : NULL
## ..$ vjust         : num 1
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 2.2points 0points 0points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x.top      :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust         : NULL
## ..$ vjust         : num 0
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 0points 2.2points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x.bottom   : NULL
## $ axis.text.y          :List of 11
## ..$ family         : NULL

```

```

## ..$ face          : NULL
## ..$ colour        : NULL
## ..$ size          : NULL
## ..$ hjust         : num 1
## ..$ vjust         : NULL
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 2.2points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.y.left : NULL
## $ axis.text.y.right :List of 11
## ..$ family        : NULL
## ..$ face          : NULL
## ..$ colour        : NULL
## ..$ size          : NULL
## ..$ hjust         : num 0
## ..$ vjust         : NULL
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 0points 0points 2.2points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.theta  : NULL
## $ axis.text.r      :List of 11
## ..$ family        : NULL
## ..$ face          : NULL
## ..$ colour        : NULL
## ..$ size          : NULL
## ..$ hjust         : num 0.5
## ..$ vjust         : NULL
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 2.2points 0points 2.2points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.ticks       : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.ticks.x      : NULL
## $ axis.ticks.x.top  : NULL
## $ axis.ticks.x.bottom : NULL
## $ axis.ticks.y      : NULL
## $ axis.ticks.y.left : NULL
## $ axis.ticks.y.right : NULL
## $ axis.ticks.theta  : NULL
## $ axis.ticks.r      : NULL
## $ axis.minor.ticks.x.top : NULL
## $ axis.minor.ticks.x.bottom : NULL

```

```

## $ axis.minor.ticks.y.left      : NULL
## $ axis.minor.ticks.y.right    : NULL
## $ axis.minor.ticks.theta      : NULL
## $ axis.minor.ticks.r          : NULL
## $ axis.ticks.length           : 'simpleUnit' num 2.75points
##   .- attr(*, "unit")= int 8
## $ axis.ticks.length.x         : NULL
## $ axis.ticks.length.x.top     : NULL
## $ axis.ticks.length.x.bottom  : NULL
## $ axis.ticks.length.y        : NULL
## $ axis.ticks.length.y.left    : NULL
## $ axis.ticks.length.y.right   : NULL
## $ axis.ticks.length.theta     : NULL
## $ axis.ticks.length.r        : NULL
## $ axis.minor.ticks.length     : 'rel' num 0.75
## $ axis.minor.ticks.length.x   : NULL
## $ axis.minor.ticks.length.x.top : NULL
## $ axis.minor.ticks.length.x.bottom: NULL
## $ axis.minor.ticks.length.y   : NULL
## $ axis.minor.ticks.length.y.left : NULL
## $ axis.minor.ticks.length.y.right : NULL
## $ axis.minor.ticks.length.theta : NULL
## $ axis.minor.ticks.length.r   : NULL
## $ axis.line                   : list()
##   .- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.line.x                 : NULL
## $ axis.line.x.top             : NULL
## $ axis.line.x.bottom          : NULL
## $ axis.line.y                 : NULL
## $ axis.line.y.left            : NULL
## $ axis.line.y.right           : NULL
## $ axis.line.theta             : NULL
## $ axis.line.r                 : NULL
## $ legend.background           : list()
##   .- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.margin               : 'margin' num [1:4] 5.5points 5.5points 5.5points 5.5points
##   .- attr(*, "unit")= int 8
## $ legend.spacing              : 'simpleUnit' num 11points
##   .- attr(*, "unit")= int 8
## $ legend.spacing.x            : NULL
## $ legend.spacing.y            : NULL
## $ legend.key                  : list()
##   .- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.key.size             : 'simpleUnit' num 1.2lines
##   .- attr(*, "unit")= int 3
## $ legend.key.height           : NULL
## $ legend.key.width            : NULL
## $ legend.key.spacing          : 'simpleUnit' num 5.5points
##   .- attr(*, "unit")= int 8
## $ legend.key.spacing.x        : NULL
## $ legend.key.spacing.y        : NULL
## $ legend.frame                : NULL
## $ legend.ticks                : NULL
## $ legend.ticks.length         : 'rel' num 0.2

```

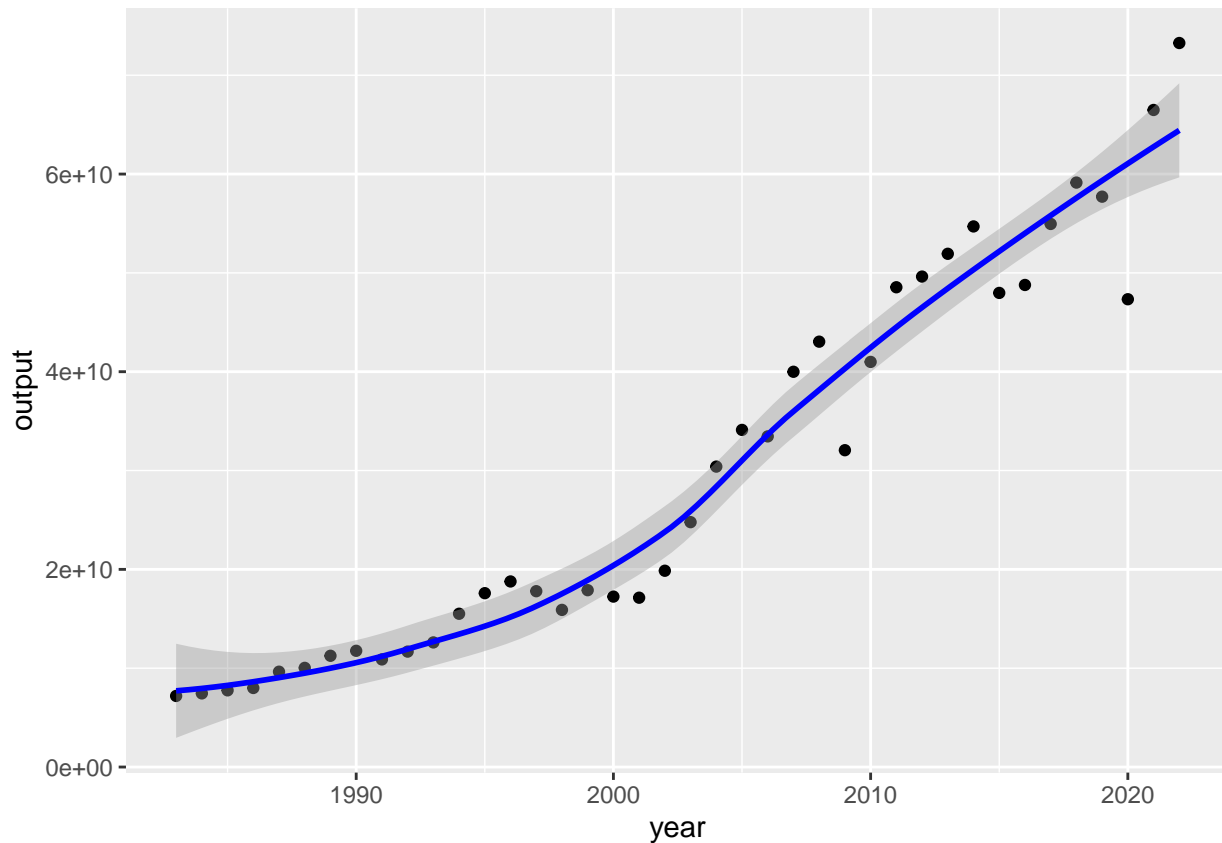


```

## $ legend.axis.line           : NULL
## $ legend.text                :List of 11
##   ..$ family                : NULL
##   ..$ face                   : NULL
##   ..$ colour                 : NULL
##   ..$ size                   : 'rel' num 0.8
##   ..$ hjust                  : NULL
##   ..$ vjust                  : NULL
##   ..$ angle                  : NULL
##   ..$ lineheight             : NULL
##   ..$ margin                 : NULL
##   ..$ debug                  : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ legend.text.position       : NULL
## $ legend.title               :List of 11
##   ..$ family                : NULL
##   ..$ face                   : NULL
##   ..$ colour                 : NULL
##   ..$ size                   : NULL
##   ..$ hjust                  : num 0
##   ..$ vjust                  : NULL
##   ..$ angle                  : NULL
##   ..$ lineheight             : NULL
##   ..$ margin                 : NULL
##   ..$ debug                  : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ legend.title.position      : NULL
## $ legend.position            : chr "right"
## $ legend.position.inside     : NULL
## $ legend.direction           : NULL
## $ legend.byrow               : NULL
## $ legend.justification       : chr "center"
## $ legend.justification.top   : NULL
## $ legend.justification.bottom : NULL
## $ legend.justification.left  : NULL
## $ legend.justification.right  : NULL
## $ legend.justification.inside : NULL
## $ legend.location            : NULL
## $ legend.box                 : NULL
## $ legend.box.just            : NULL
## $ legend.box.margin          : 'margin' num [1:4] 0cm 0cm 0cm 0cm
##   ..- attr(*, "unit")= int 1
## $ legend.box.background      : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.box.spacing         : 'simpleUnit' num 11points
##   ..- attr(*, "unit")= int 8
## [list output truncated]
## - attr(*, "class")= chr [1:2] "theme" "gg"
## - attr(*, "complete")= logi TRUE
## - attr(*, "validate")= logi TRUE

## 'geom_smooth()' using method = 'loess' and formula = 'y ~ x'

```



```
## List of 138
## $ line                                     :List of 6
##   ..$ colour      : chr "black"
##   ..$ linewidth    : num 0.5
##   ..$ linetype     : num 1
##   ..$ lineend      : chr "butt"
##   ..$ arrow        : logi FALSE
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_line" "element"
## $ rect                                     :List of 5
##   ..$ fill         : chr "white"
##   ..$ colour       : chr "black"
##   ..$ linewidth    : num 0.5
##   ..$ linetype     : num 1
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_rect" "element"
## $ text                                    :List of 11
##   ..$ family       : chr ""
##   ..$ face         : chr "plain"
##   ..$ colour       : chr "black"
##   ..$ size         : num 11
##   ..$ hjust        : num 0.5
##   ..$ vjust        : num 0.5
##   ..$ angle        : num 0
##   ..$ lineheight   : num 0.9
##   ..$ margin       : 'margin' num [1:4] 0points 0points 0points 0points
##   ..- attr(*, "unit")= int 8
```

```

## ..$ debug          : logi FALSE
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ title              : chr "input change from1983-2023"
## $ aspect.ratio       : NULL
## $ axis.title         : NULL
## $ axis.title.x       :List of 11
## ..$ family          : NULL
## ..$ face             : NULL
## ..$ colour          : NULL
## ..$ size            : NULL
## ..$ hjust           : NULL
## ..$ vjust           : num 1
## ..$ angle           : NULL
## ..$ lineheight      : NULL
## ..$ margin          : 'margin' num [1:4] 2.75points 0points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.x.top   :List of 11
## ..$ family          : NULL
## ..$ face             : NULL
## ..$ colour          : NULL
## ..$ size            : NULL
## ..$ hjust           : NULL
## ..$ vjust           : num 0
## ..$ angle           : NULL
## ..$ lineheight      : NULL
## ..$ margin          : 'margin' num [1:4] 0points 0points 2.75points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.x.bottom : NULL
## $ axis.title.y       :List of 11
## ..$ family          : NULL
## ..$ face             : NULL
## ..$ colour          : NULL
## ..$ size            : NULL
## ..$ hjust           : NULL
## ..$ vjust           : num 1
## ..$ angle           : num 90
## ..$ lineheight      : NULL
## ..$ margin          : 'margin' num [1:4] 0points 2.75points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.y.left  : NULL
## $ axis.title.y.right :List of 11
## ..$ family          : NULL
## ..$ face             : NULL
## ..$ colour          : NULL

```

```

## ..$ size      : NULL
## ..$ hjust     : NULL
## ..$ vjust     : num 1
## ..$ angle     : num -90
## ..$ lineheight : NULL
## ..$ margin    : 'margin' num [1:4] 0points 0points 0points 2.75points
## ..- attr(*, "unit")= int 8
## ..$ debug     : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text           :List of 11
## ..$ family          : NULL
## ..$ face            : NULL
## ..$ colour         : chr "grey30"
## ..$ size           : 'rel' num 0.8
## ..$ hjust         : NULL
## ..$ vjust         : NULL
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : NULL
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x         :List of 11
## ..$ family          : NULL
## ..$ face            : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust         : NULL
## ..$ vjust         : num 1
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 2.2points 0points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x.top     :List of 11
## ..$ family          : NULL
## ..$ face            : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust         : NULL
## ..$ vjust         : num 0
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 0points 2.2points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x.bottom  : NULL
## $ axis.text.y         :List of 11
## ..$ family          : NULL

```

```

## ..$ face          : NULL
## ..$ colour        : NULL
## ..$ size           : NULL
## ..$ hjust          : num 1
## ..$ vjust          : NULL
## ..$ angle          : NULL
## ..$ lineheight     : NULL
## ..$ margin         : 'margin' num [1:4] 0points 2.2points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.y.left  : NULL
## $ axis.text.y.right :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust          : num 0
## ..$ vjust          : NULL
## ..$ angle          : NULL
## ..$ lineheight     : NULL
## ..$ margin         : 'margin' num [1:4] 0points 0points 0points 2.2points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.theta   : NULL
## $ axis.text.r        :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust          : num 0.5
## ..$ vjust          : NULL
## ..$ angle          : NULL
## ..$ lineheight     : NULL
## ..$ margin         : 'margin' num [1:4] 0points 2.2points 0points 2.2points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.ticks         : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.ticks.x       : NULL
## $ axis.ticks.x.top    : NULL
## $ axis.ticks.x.bottom : NULL
## $ axis.ticks.y       : NULL
## $ axis.ticks.y.left   : NULL
## $ axis.ticks.y.right  : NULL
## $ axis.ticks.theta    : NULL
## $ axis.ticks.r        : NULL
## $ axis.minor.ticks.x.top : NULL
## $ axis.minor.ticks.x.bottom : NULL

```

```

## $ axis.minor.ticks.y.left      : NULL
## $ axis.minor.ticks.y.right    : NULL
## $ axis.minor.ticks.theta      : NULL
## $ axis.minor.ticks.r          : NULL
## $ axis.ticks.length           : 'simpleUnit' num 2.75points
##   .. attr(*, "unit")= int 8
## $ axis.ticks.length.x         : NULL
## $ axis.ticks.length.x.top     : NULL
## $ axis.ticks.length.x.bottom  : NULL
## $ axis.ticks.length.y        : NULL
## $ axis.ticks.length.y.left   : NULL
## $ axis.ticks.length.y.right  : NULL
## $ axis.ticks.length.theta    : NULL
## $ axis.ticks.length.r        : NULL
## $ axis.minor.ticks.length     : 'rel' num 0.75
## $ axis.minor.ticks.length.x   : NULL
## $ axis.minor.ticks.length.x.top : NULL
## $ axis.minor.ticks.length.x.bottom: NULL
## $ axis.minor.ticks.length.y   : NULL
## $ axis.minor.ticks.length.y.left : NULL
## $ axis.minor.ticks.length.y.right : NULL
## $ axis.minor.ticks.length.theta : NULL
## $ axis.minor.ticks.length.r   : NULL
## $ axis.line                   : list()
##   .. attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.line.x                 : NULL
## $ axis.line.x.top             : NULL
## $ axis.line.x.bottom          : NULL
## $ axis.line.y                 : NULL
## $ axis.line.y.left            : NULL
## $ axis.line.y.right           : NULL
## $ axis.line.theta             : NULL
## $ axis.line.r                 : NULL
## $ legend.background           : list()
##   .. attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.margin               : 'margin' num [1:4] 5.5points 5.5points 5.5points 5.5points
##   .. attr(*, "unit")= int 8
## $ legend.spacing              : 'simpleUnit' num 11points
##   .. attr(*, "unit")= int 8
## $ legend.spacing.x            : NULL
## $ legend.spacing.y            : NULL
## $ legend.key                  : list()
##   .. attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.key.size             : 'simpleUnit' num 1.2lines
##   .. attr(*, "unit")= int 3
## $ legend.key.height           : NULL
## $ legend.key.width            : NULL
## $ legend.key.spacing          : 'simpleUnit' num 5.5points
##   .. attr(*, "unit")= int 8
## $ legend.key.spacing.x        : NULL
## $ legend.key.spacing.y        : NULL
## $ legend.frame                : NULL
## $ legend.ticks                : NULL
## $ legend.ticks.length         : 'rel' num 0.2

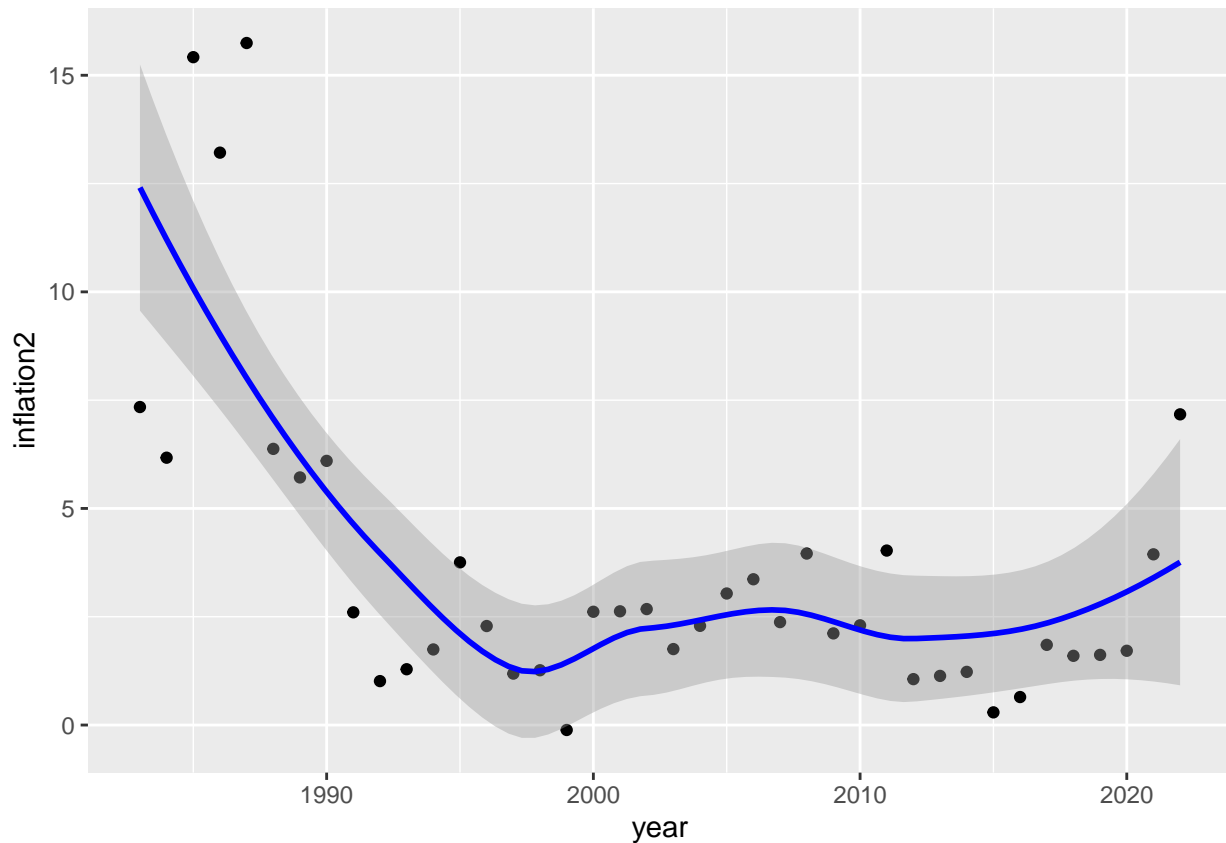
```

```

## $ legend.axis.line          : NULL
## $ legend.text               :List of 11
##   ..$ family               : NULL
##   ..$ face                  : NULL
##   ..$ colour                : NULL
##   ..$ size                   : 'rel' num 0.8
##   ..$ hjust                  : NULL
##   ..$ vjust                  : NULL
##   ..$ angle                  : NULL
##   ..$ lineheight            : NULL
##   ..$ margin                 : NULL
##   ..$ debug                  : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ legend.text.position      : NULL
## $ legend.title              :List of 11
##   ..$ family               : NULL
##   ..$ face                  : NULL
##   ..$ colour                : NULL
##   ..$ size                   : NULL
##   ..$ hjust                  : num 0
##   ..$ vjust                  : NULL
##   ..$ angle                  : NULL
##   ..$ lineheight            : NULL
##   ..$ margin                 : NULL
##   ..$ debug                  : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ legend.title.position     : NULL
## $ legend.position           : chr "right"
## $ legend.position.inside    : NULL
## $ legend.direction          : NULL
## $ legend.byrow               : NULL
## $ legend.justification      : chr "center"
## $ legend.justification.top   : NULL
## $ legend.justification.bottom : NULL
## $ legend.justification.left  : NULL
## $ legend.justification.right  : NULL
## $ legend.justification.inside : NULL
## $ legend.location           : NULL
## $ legend.box                 : NULL
## $ legend.box.just            : NULL
## $ legend.box.margin          : 'margin' num [1:4] 0cm 0cm 0cm 0cm
##   ..- attr(*, "unit")= int 1
## $ legend.box.background      : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.box.spacing         : 'simpleUnit' num 11points
##   ..- attr(*, "unit")= int 8
## [list output truncated]
## - attr(*, "class")= chr [1:2] "theme" "gg"
## - attr(*, "complete")= logi TRUE
## - attr(*, "validate")= logi TRUE

## 'geom_smooth()' using method = 'loess' and formula = 'y ~ x'

```



```
## List of 138
## $ line                                     :List of 6
##   ..$ colour      : chr "black"
##   ..$ linewidth    : num 0.5
##   ..$ linetype     : num 1
##   ..$ lineend      : chr "butt"
##   ..$ arrow        : logi FALSE
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_line" "element"
## $ rect                                     :List of 5
##   ..$ fill         : chr "white"
##   ..$ colour       : chr "black"
##   ..$ linewidth    : num 0.5
##   ..$ linetype     : num 1
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_rect" "element"
## $ text                                     :List of 11
##   ..$ family       : chr ""
##   ..$ face         : chr "plain"
##   ..$ colour       : chr "black"
##   ..$ size         : num 11
##   ..$ hjust        : num 0.5
##   ..$ vjust        : num 0.5
##   ..$ angle        : num 0
##   ..$ lineheight   : num 0.9
##   ..$ margin       : 'margin' num [1:4] 0points 0points 0points 0points
##   ..- attr(*, "unit")= int 8
```



```

## ..$ debug          : logi FALSE
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ title              : chr "inflation from1983-2023"
## $ aspect.ratio        : NULL
## $ axis.title          : NULL
## $ axis.title.x        :List of 11
## ..$ family          : NULL
## ..$ face             : NULL
## ..$ colour          : NULL
## ..$ size            : NULL
## ..$ hjust           : NULL
## ..$ vjust           : num 1
## ..$ angle           : NULL
## ..$ lineheight      : NULL
## ..$ margin          : 'margin' num [1:4] 2.75points 0points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.x.top    :List of 11
## ..$ family          : NULL
## ..$ face             : NULL
## ..$ colour          : NULL
## ..$ size            : NULL
## ..$ hjust           : NULL
## ..$ vjust           : num 0
## ..$ angle           : NULL
## ..$ lineheight      : NULL
## ..$ margin          : 'margin' num [1:4] 0points 0points 2.75points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.x.bottom : NULL
## $ axis.title.y        :List of 11
## ..$ family          : NULL
## ..$ face             : NULL
## ..$ colour          : NULL
## ..$ size            : NULL
## ..$ hjust           : NULL
## ..$ vjust           : num 1
## ..$ angle           : num 90
## ..$ lineheight      : NULL
## ..$ margin          : 'margin' num [1:4] 0points 2.75points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.y.left   : NULL
## $ axis.title.y.right  :List of 11
## ..$ family          : NULL
## ..$ face             : NULL
## ..$ colour          : NULL

```

```

## ..$ size          : NULL
## ..$ hjust         : NULL
## ..$ vjust         : num 1
## ..$ angle         : num -90
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 0points 0points 2.75points
## .. ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text              :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : chr "grey30"
## ..$ size           : 'rel' num 0.8
## ..$ hjust         : NULL
## ..$ vjust         : NULL
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : NULL
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x          :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust         : NULL
## ..$ vjust         : num 1
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 2.2points 0points 0points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x.top      :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust         : NULL
## ..$ vjust         : num 0
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 0points 2.2points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x.bottom   : NULL
## $ axis.text.y          :List of 11
## ..$ family         : NULL

```

```

## ..$ face          : NULL
## ..$ colour        : NULL
## ..$ size          : NULL
## ..$ hjust         : num 1
## ..$ vjust         : NULL
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 2.2points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.y.left : NULL
## $ axis.text.y.right :List of 11
## ..$ family        : NULL
## ..$ face          : NULL
## ..$ colour        : NULL
## ..$ size          : NULL
## ..$ hjust         : num 0
## ..$ vjust         : NULL
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 0points 0points 2.2points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.theta  : NULL
## $ axis.text.r      :List of 11
## ..$ family        : NULL
## ..$ face          : NULL
## ..$ colour        : NULL
## ..$ size          : NULL
## ..$ hjust         : num 0.5
## ..$ vjust         : NULL
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 2.2points 0points 2.2points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.ticks       : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.ticks.x      : NULL
## $ axis.ticks.x.top   : NULL
## $ axis.ticks.x.bottom : NULL
## $ axis.ticks.y      : NULL
## $ axis.ticks.y.left  : NULL
## $ axis.ticks.y.right : NULL
## $ axis.ticks.theta   : NULL
## $ axis.ticks.r       : NULL
## $ axis.minor.ticks.x.top : NULL
## $ axis.minor.ticks.x.bottom : NULL

```

```

## $ axis.minor.ticks.y.left      : NULL
## $ axis.minor.ticks.y.right    : NULL
## $ axis.minor.ticks.theta      : NULL
## $ axis.minor.ticks.r          : NULL
## $ axis.ticks.length           : 'simpleUnit' num 2.75points
##   .- attr(*, "unit")= int 8
## $ axis.ticks.length.x         : NULL
## $ axis.ticks.length.x.top     : NULL
## $ axis.ticks.length.x.bottom  : NULL
## $ axis.ticks.length.y        : NULL
## $ axis.ticks.length.y.left    : NULL
## $ axis.ticks.length.y.right   : NULL
## $ axis.ticks.length.theta     : NULL
## $ axis.ticks.length.r        : NULL
## $ axis.minor.ticks.length     : 'rel' num 0.75
## $ axis.minor.ticks.length.x   : NULL
## $ axis.minor.ticks.length.x.top : NULL
## $ axis.minor.ticks.length.x.bottom: NULL
## $ axis.minor.ticks.length.y   : NULL
## $ axis.minor.ticks.length.y.left : NULL
## $ axis.minor.ticks.length.y.right : NULL
## $ axis.minor.ticks.length.theta : NULL
## $ axis.minor.ticks.length.r   : NULL
## $ axis.line                   : list()
##   .- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.line.x                 : NULL
## $ axis.line.x.top             : NULL
## $ axis.line.x.bottom          : NULL
## $ axis.line.y                 : NULL
## $ axis.line.y.left            : NULL
## $ axis.line.y.right           : NULL
## $ axis.line.theta             : NULL
## $ axis.line.r                 : NULL
## $ legend.background           : list()
##   .- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.margin               : 'margin' num [1:4] 5.5points 5.5points 5.5points 5.5points
##   .- attr(*, "unit")= int 8
## $ legend.spacing              : 'simpleUnit' num 11points
##   .- attr(*, "unit")= int 8
## $ legend.spacing.x            : NULL
## $ legend.spacing.y            : NULL
## $ legend.key                  : list()
##   .- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.key.size             : 'simpleUnit' num 1.2lines
##   .- attr(*, "unit")= int 3
## $ legend.key.height           : NULL
## $ legend.key.width            : NULL
## $ legend.key.spacing          : 'simpleUnit' num 5.5points
##   .- attr(*, "unit")= int 8
## $ legend.key.spacing.x        : NULL
## $ legend.key.spacing.y        : NULL
## $ legend.frame                : NULL
## $ legend.ticks                : NULL
## $ legend.ticks.length         : 'rel' num 0.2

```

```

## $ legend.axis.line          : NULL
## $ legend.text               :List of 11
##   ..$ family               : NULL
##   ..$ face                  : NULL
##   ..$ colour                : NULL
##   ..$ size                  : 'rel' num 0.8
##   ..$ hjust                 : NULL
##   ..$ vjust                 : NULL
##   ..$ angle                 : NULL
##   ..$ lineheight            : NULL
##   ..$ margin                : NULL
##   ..$ debug                 : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ legend.text.position      : NULL
## $ legend.title              :List of 11
##   ..$ family               : NULL
##   ..$ face                  : NULL
##   ..$ colour                : NULL
##   ..$ size                  : NULL
##   ..$ hjust                 : num 0
##   ..$ vjust                 : NULL
##   ..$ angle                 : NULL
##   ..$ lineheight            : NULL
##   ..$ margin                : NULL
##   ..$ debug                 : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ legend.title.position     : NULL
## $ legend.position           : chr "right"
## $ legend.position.inside    : NULL
## $ legend.direction          : NULL
## $ legend.byrow               : NULL
## $ legend.justification      : chr "center"
## $ legend.justification.top   : NULL
## $ legend.justification.bottom : NULL
## $ legend.justification.left  : NULL
## $ legend.justification.right : NULL
## $ legend.justification.inside : NULL
## $ legend.location           : NULL
## $ legend.box                 : NULL
## $ legend.box.just            : NULL
## $ legend.box.margin         : 'margin' num [1:4] 0cm 0cm 0cm 0cm
##   ..- attr(*, "unit")= int 1
## $ legend.box.background     : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.box.spacing        : 'simpleUnit' num 11points
##   ..- attr(*, "unit")= int 8
## [list output truncated]
## - attr(*, "class")= chr [1:2] "theme" "gg"
## - attr(*, "complete")= logi TRUE
## - attr(*, "validate")= logi TRUE

```

As we can see from the graphs,GDP,income,population,input,output are linear,which are upwards,and in-

flation show downwards trend. For visitor, standard error is too big, there are a lot of missing data, especially there is an outlier 2020 (because of Covid) makes the curve downwards. These may affect the analysis, we will see in regression part.

Model

This should be a linear problem, so I will consider linear model.

linear model

```
regression1<-lm(gdp~income2+population2+input+output+visitor2+inflation2,data_nz)
summary(regression1)
```

```
##
## Call:
## lm(formula = gdp ~ income2 + population2 + input + output + visitor2 +
##      inflation2, data = data_nz)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -4.394e+09 -2.268e+09  5.914e+07  1.511e+09  6.183e+09
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) -1.516e+11  1.401e+10 -10.823  1.45e-09 ***
## income2      3.713e+06  5.079e+05   7.310  6.23e-07 ***
## population2  3.989e+04  3.849e+03  10.362  2.96e-09 ***
## input        9.429e-02  5.452e-01   0.173   0.865
## output       9.026e-02  5.456e-01   0.165   0.870
## visitor2     -1.338e+03  1.775e+03  -0.754   0.460
## inflation2   -8.582e+08  6.176e+08  -1.390   0.181
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.895e+09 on 19 degrees of freedom
## (14 observations deleted due to missingness)
## Multiple R-squared:  0.9982, Adjusted R-squared:  0.9976
## F-statistic: 1711 on 6 and 19 DF, p-value: < 2.2e-16
```

From T test we can see intercept, GDP, income is small enough to indicate strong effect, for but rest of them might not enough, I might choose another model.

Then I use GLM and I remove visitor

```
##
## SAMPLING FOR MODEL 'continuous' NOW (CHAIN 1).
## Chain 1:
## Chain 1: Gradient evaluation took 0.000102 seconds
## Chain 1: 1000 transitions using 10 leapfrog steps per transition would take 1.02 seconds.
## Chain 1: Adjust your expectations accordingly!
## Chain 1:
## Chain 1:
## Chain 1: Iteration:    1 / 2000 [ 0%] (Warmup)
## Chain 1: Iteration:   200 / 2000 [10%] (Warmup)
## Chain 1: Iteration:   400 / 2000 [20%] (Warmup)
```

```

## Chain 1: Iteration: 600 / 2000 [ 30%] (Warmup)
## Chain 1: Iteration: 800 / 2000 [ 40%] (Warmup)
## Chain 1: Iteration: 1000 / 2000 [ 50%] (Warmup)
## Chain 1: Iteration: 1001 / 2000 [ 50%] (Sampling)
## Chain 1: Iteration: 1200 / 2000 [ 60%] (Sampling)
## Chain 1: Iteration: 1400 / 2000 [ 70%] (Sampling)
## Chain 1: Iteration: 1600 / 2000 [ 80%] (Sampling)
## Chain 1: Iteration: 1800 / 2000 [ 90%] (Sampling)
## Chain 1: Iteration: 2000 / 2000 [100%] (Sampling)
## Chain 1:
## Chain 1: Elapsed Time: 4.167 seconds (Warm-up)
## Chain 1: 0.39 seconds (Sampling)
## Chain 1: 4.557 seconds (Total)
## Chain 1:
##
## SAMPLING FOR MODEL 'continuous' NOW (CHAIN 2).
## Chain 2:
## Chain 2: Gradient evaluation took 1.1e-05 seconds
## Chain 2: 1000 transitions using 10 leapfrog steps per transition would take 0.11 seconds.
## Chain 2: Adjust your expectations accordingly!
## Chain 2:
## Chain 2:
## Chain 2: Iteration: 1 / 2000 [ 0%] (Warmup)
## Chain 2: Iteration: 200 / 2000 [ 10%] (Warmup)
## Chain 2: Iteration: 400 / 2000 [ 20%] (Warmup)
## Chain 2: Iteration: 600 / 2000 [ 30%] (Warmup)
## Chain 2: Iteration: 800 / 2000 [ 40%] (Warmup)
## Chain 2: Iteration: 1000 / 2000 [ 50%] (Warmup)
## Chain 2: Iteration: 1001 / 2000 [ 50%] (Sampling)
## Chain 2: Iteration: 1200 / 2000 [ 60%] (Sampling)
## Chain 2: Iteration: 1400 / 2000 [ 70%] (Sampling)
## Chain 2: Iteration: 1600 / 2000 [ 80%] (Sampling)
## Chain 2: Iteration: 1800 / 2000 [ 90%] (Sampling)
## Chain 2: Iteration: 2000 / 2000 [100%] (Sampling)
## Chain 2:
## Chain 2: Elapsed Time: 6.641 seconds (Warm-up)
## Chain 2: 0.512 seconds (Sampling)
## Chain 2: 7.153 seconds (Total)
## Chain 2:
##
## SAMPLING FOR MODEL 'continuous' NOW (CHAIN 3).
## Chain 3:
## Chain 3: Gradient evaluation took 9e-06 seconds
## Chain 3: 1000 transitions using 10 leapfrog steps per transition would take 0.09 seconds.
## Chain 3: Adjust your expectations accordingly!
## Chain 3:
## Chain 3:
## Chain 3: Iteration: 1 / 2000 [ 0%] (Warmup)
## Chain 3: Iteration: 200 / 2000 [ 10%] (Warmup)
## Chain 3: Iteration: 400 / 2000 [ 20%] (Warmup)
## Chain 3: Iteration: 600 / 2000 [ 30%] (Warmup)
## Chain 3: Iteration: 800 / 2000 [ 40%] (Warmup)
## Chain 3: Iteration: 1000 / 2000 [ 50%] (Warmup)
## Chain 3: Iteration: 1001 / 2000 [ 50%] (Sampling)

```

```

## Chain 3: Iteration: 1200 / 2000 [ 60%] (Sampling)
## Chain 3: Iteration: 1400 / 2000 [ 70%] (Sampling)
## Chain 3: Iteration: 1600 / 2000 [ 80%] (Sampling)
## Chain 3: Iteration: 1800 / 2000 [ 90%] (Sampling)
## Chain 3: Iteration: 2000 / 2000 [100%] (Sampling)
## Chain 3:
## Chain 3: Elapsed Time: 5.896 seconds (Warm-up)
## Chain 3: 0.415 seconds (Sampling)
## Chain 3: 6.311 seconds (Total)
## Chain 3:
##
## SAMPLING FOR MODEL 'continuous' NOW (CHAIN 4).
## Chain 4:
## Chain 4: Gradient evaluation took 9e-06 seconds
## Chain 4: 1000 transitions using 10 leapfrog steps per transition would take 0.09 seconds.
## Chain 4: Adjust your expectations accordingly!
## Chain 4:
## Chain 4:
## Chain 4: Iteration: 1 / 2000 [ 0%] (Warmup)
## Chain 4: Iteration: 200 / 2000 [ 10%] (Warmup)
## Chain 4: Iteration: 400 / 2000 [ 20%] (Warmup)
## Chain 4: Iteration: 600 / 2000 [ 30%] (Warmup)
## Chain 4: Iteration: 800 / 2000 [ 40%] (Warmup)
## Chain 4: Iteration: 1000 / 2000 [ 50%] (Warmup)
## Chain 4: Iteration: 1001 / 2000 [ 50%] (Sampling)
## Chain 4: Iteration: 1200 / 2000 [ 60%] (Sampling)
## Chain 4: Iteration: 1400 / 2000 [ 70%] (Sampling)
## Chain 4: Iteration: 1600 / 2000 [ 80%] (Sampling)
## Chain 4: Iteration: 1800 / 2000 [ 90%] (Sampling)
## Chain 4: Iteration: 2000 / 2000 [100%] (Sampling)
## Chain 4:
## Chain 4: Elapsed Time: 6.351 seconds (Warm-up)
## Chain 4: 0.405 seconds (Sampling)
## Chain 4: 6.756 seconds (Total)
## Chain 4:
##
## Model Info:
## function: stan_glm
## family: gaussian [identity]
## formula: gdp ~ income2 + population2 + input + output + inflation2
## algorithm: sampling
## sample: 4000 (posterior sample size)
## priors: see help('prior_summary')
## observations: 40
## predictors: 6
##
## Estimates:
##          mean          sd      10%      50%
## (Intercept) -1.091511e+11 1.857811e+10 -1.330394e+11 -1.091691e+11
## income2      4.494546e+06 4.871513e+05 3.884112e+06 4.496467e+06
## population2 2.741360e+04 5.586700e+03 2.033090e+04 2.737750e+04
## input        -1.100000e+00 4.000000e-01 -1.600000e+00 -1.100000e+00
## output        9.000000e-01 4.000000e-01 4.000000e-01 9.000000e-01

```



```
## inflation2 7.326454e+08 2.953906e+08 3.739691e+08 7.268049e+08
## sigma 4.955297e+09 6.257158e+08 4.225478e+09 4.895046e+09
## 90%
## (Intercept) -8.575680e+10
## income2 5.104279e+06
## population2 3.451760e+04
## input -6.000000e-01
## output 1.300000e+00
## inflation2 1.117294e+09
## sigma 5.780916e+09
##
## Fit Diagnostics:
## mean sd 10% 50%
## mean_PPD 108877635886.5 1092597238.2 107515231224.2 108876345344.7
## 90%
## mean_PPD 110270343336.9
##
## The mean_ppd is the sample average posterior predictive distribution of the outcome variable (for de
##
## MCMC diagnostics
## mcse Rhat n_eff
## (Intercept) 392330257.2 1.0 2242
## income2 10367.6 1.0 2208
## population2 113.3 1.0 2429
## input 0.0 1.0 1966
## output 0.0 1.0 1975
## inflation2 6122769.2 1.0 2328
## sigma 13218378.4 1.0 2241
## mean_PPD 18634889.1 1.0 3438
## log-posterior 0.1 1.0 1345
##
## For each parameter, mcse is Monte Carlo standard error, n_eff is a crude measure of effective sample
```

Since $Rhat = 1.0$, it indicates that the model has converged and the model's stability is good.

Prediction First I get 2023 economic informations

```
data_2023_nz<-data.frame(income2=48527.83,population2=5223100,input=5077000000,output=4221000000,infl
```

```
## [1] 235808941598
```

Seem its not close,maybe input and output are too much partial in this model,and in 2023,input and out put decreased a lot,made the model not accuracy.I try to remove input and out put

```
##
## SAMPLING FOR MODEL 'continuous' NOW (CHAIN 1).
## Chain 1:
## Chain 1: Gradient evaluation took 1.4e-05 seconds
## Chain 1: 1000 transitions using 10 leapfrog steps per transition would take 0.14 seconds.
## Chain 1: Adjust your expectations accordingly!
## Chain 1:
## Chain 1:
## Chain 1: Iteration: 1 / 2000 [ 0%] (Warmup)
```

```

## Chain 1: Iteration: 200 / 2000 [ 10%] (Warmup)
## Chain 1: Iteration: 400 / 2000 [ 20%] (Warmup)
## Chain 1: Iteration: 600 / 2000 [ 30%] (Warmup)
## Chain 1: Iteration: 800 / 2000 [ 40%] (Warmup)
## Chain 1: Iteration: 1000 / 2000 [ 50%] (Warmup)
## Chain 1: Iteration: 1001 / 2000 [ 50%] (Sampling)
## Chain 1: Iteration: 1200 / 2000 [ 60%] (Sampling)
## Chain 1: Iteration: 1400 / 2000 [ 70%] (Sampling)
## Chain 1: Iteration: 1600 / 2000 [ 80%] (Sampling)
## Chain 1: Iteration: 1800 / 2000 [ 90%] (Sampling)
## Chain 1: Iteration: 2000 / 2000 [100%] (Sampling)
## Chain 1:
## Chain 1: Elapsed Time: 12.064 seconds (Warm-up)
## Chain 1: 0.17 seconds (Sampling)
## Chain 1: 12.234 seconds (Total)
## Chain 1:
##
## SAMPLING FOR MODEL 'continuous' NOW (CHAIN 2).
## Chain 2:
## Chain 2: Gradient evaluation took 1.6e-05 seconds
## Chain 2: 1000 transitions using 10 leapfrog steps per transition would take 0.16 seconds.
## Chain 2: Adjust your expectations accordingly!
## Chain 2:
## Chain 2:
## Chain 2: Iteration: 1 / 2000 [ 0%] (Warmup)
## Chain 2: Iteration: 200 / 2000 [ 10%] (Warmup)
## Chain 2: Iteration: 400 / 2000 [ 20%] (Warmup)
## Chain 2: Iteration: 600 / 2000 [ 30%] (Warmup)
## Chain 2: Iteration: 800 / 2000 [ 40%] (Warmup)
## Chain 2: Iteration: 1000 / 2000 [ 50%] (Warmup)
## Chain 2: Iteration: 1001 / 2000 [ 50%] (Sampling)
## Chain 2: Iteration: 1200 / 2000 [ 60%] (Sampling)
## Chain 2: Iteration: 1400 / 2000 [ 70%] (Sampling)
## Chain 2: Iteration: 1600 / 2000 [ 80%] (Sampling)
## Chain 2: Iteration: 1800 / 2000 [ 90%] (Sampling)
## Chain 2: Iteration: 2000 / 2000 [100%] (Sampling)
## Chain 2:
## Chain 2: Elapsed Time: 8.04 seconds (Warm-up)
## Chain 2: 0.208 seconds (Sampling)
## Chain 2: 8.248 seconds (Total)
## Chain 2:
## Chain 2:
##
## SAMPLING FOR MODEL 'continuous' NOW (CHAIN 3).
## Chain 3:
## Chain 3: Gradient evaluation took 1.2e-05 seconds
## Chain 3: 1000 transitions using 10 leapfrog steps per transition would take 0.12 seconds.
## Chain 3: Adjust your expectations accordingly!
## Chain 3:
## Chain 3:
## Chain 3: Iteration: 1 / 2000 [ 0%] (Warmup)
## Chain 3: Iteration: 200 / 2000 [ 10%] (Warmup)
## Chain 3: Iteration: 400 / 2000 [ 20%] (Warmup)
## Chain 3: Iteration: 600 / 2000 [ 30%] (Warmup)
## Chain 3: Iteration: 800 / 2000 [ 40%] (Warmup)

```

```

## Chain 3: Iteration: 1000 / 2000 [ 50%] (Warmup)
## Chain 3: Iteration: 1001 / 2000 [ 50%] (Sampling)
## Chain 3: Iteration: 1200 / 2000 [ 60%] (Sampling)
## Chain 3: Iteration: 1400 / 2000 [ 70%] (Sampling)
## Chain 3: Iteration: 1600 / 2000 [ 80%] (Sampling)
## Chain 3: Iteration: 1800 / 2000 [ 90%] (Sampling)
## Chain 3: Iteration: 2000 / 2000 [100%] (Sampling)
## Chain 3:
## Chain 3: Elapsed Time: 9.323 seconds (Warm-up)
## Chain 3: 0.203 seconds (Sampling)
## Chain 3: 9.526 seconds (Total)
## Chain 3:
##
## SAMPLING FOR MODEL 'continuous' NOW (CHAIN 4).
## Chain 4:
## Chain 4: Gradient evaluation took 1.4e-05 seconds
## Chain 4: 1000 transitions using 10 leapfrog steps per transition would take 0.14 seconds.
## Chain 4: Adjust your expectations accordingly!
## Chain 4:
## Chain 4:
## Chain 4: Iteration: 1 / 2000 [ 0%] (Warmup)
## Chain 4: Iteration: 200 / 2000 [ 10%] (Warmup)
## Chain 4: Iteration: 400 / 2000 [ 20%] (Warmup)
## Chain 4: Iteration: 600 / 2000 [ 30%] (Warmup)
## Chain 4: Iteration: 800 / 2000 [ 40%] (Warmup)
## Chain 4: Iteration: 1000 / 2000 [ 50%] (Warmup)
## Chain 4: Iteration: 1001 / 2000 [ 50%] (Sampling)
## Chain 4: Iteration: 1200 / 2000 [ 60%] (Sampling)
## Chain 4: Iteration: 1400 / 2000 [ 70%] (Sampling)
## Chain 4: Iteration: 1600 / 2000 [ 80%] (Sampling)
## Chain 4: Iteration: 1800 / 2000 [ 90%] (Sampling)
## Chain 4: Iteration: 2000 / 2000 [100%] (Sampling)
## Chain 4:
## Chain 4: Elapsed Time: 7.133 seconds (Warm-up)
## Chain 4: 0.117 seconds (Sampling)
## Chain 4: 7.25 seconds (Total)
## Chain 4:
##
## Model Info:
## function: stan_glm
## family: gaussian [identity]
## formula: gdp ~ income2 + population2 + input + output + inflation2
## algorithm: sampling
## sample: 4000 (posterior sample size)
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## population2 2.741360e+04 5.586700e+03 2.033090e+04 2.737750e+04

```

```
## input      -1.100000e+00  4.000000e-01 -1.600000e+00 -1.100000e+00
## output      9.000000e-01  4.000000e-01  4.000000e-01  9.000000e-01
## inflation2  7.326454e+08  2.953906e+08  3.739691e+08  7.268049e+08
## sigma      4.955297e+09  6.257158e+08  4.225478e+09  4.895046e+09
##           90%
## (Intercept) -8.575680e+10
## income2      5.104279e+06
## population2  3.451760e+04
## input      -6.000000e-01
## output      1.300000e+00
## inflation2  1.117294e+09
## sigma      5.780916e+09
##
## Fit Diagnostics:
##           mean          sd          10%          50%
## mean_PPD 108877635886.5  1092597238.2 107515231224.2 108876345344.7
##           90%
## mean_PPD 110270343336.9
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## The mean_ppd is the sample average posterior predictive distribution of the outcome variable (for de
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##           mcse          Rhat          n_eff
## (Intercept) 392330257.2          1.0 2242
## income2      10367.6          1.0 2208
## population2   113.3          1.0 2429
## input         0.0          1.0 1966
## output         0.0          1.0 1975
## inflation2   6122769.2          1.0 2328
## sigma      13218378.4          1.0 2241
## mean_PPD    18634889.1          1.0 3438
## log-posterior 0.1          1.0 1345
##
## For each parameter, mcse is Monte Carlo standard error, n_eff is a crude measure of effective sample
```

```
predicted_gdp_2023<- posterior_predict(regression2, newdata = data_2023_nz)
GDP_2023<-mean(predicted_gdp_2023)
GDP_2023
```

```
## [1] 244033263726
```

This model is better

Prediction of 2024 GDP

```
data_2024_nz<-data.frame(income2=47549.65,population2=5338500,inflation2=5.756)
```

```
predicted_gdp_2024<- posterior_predict(regression2, newdata = data_2024_nz)
GDP_2024<-mean(predicted_gdp_2024)
GDP_2024
```

```
## [1] 243930143788
```