# Untitled

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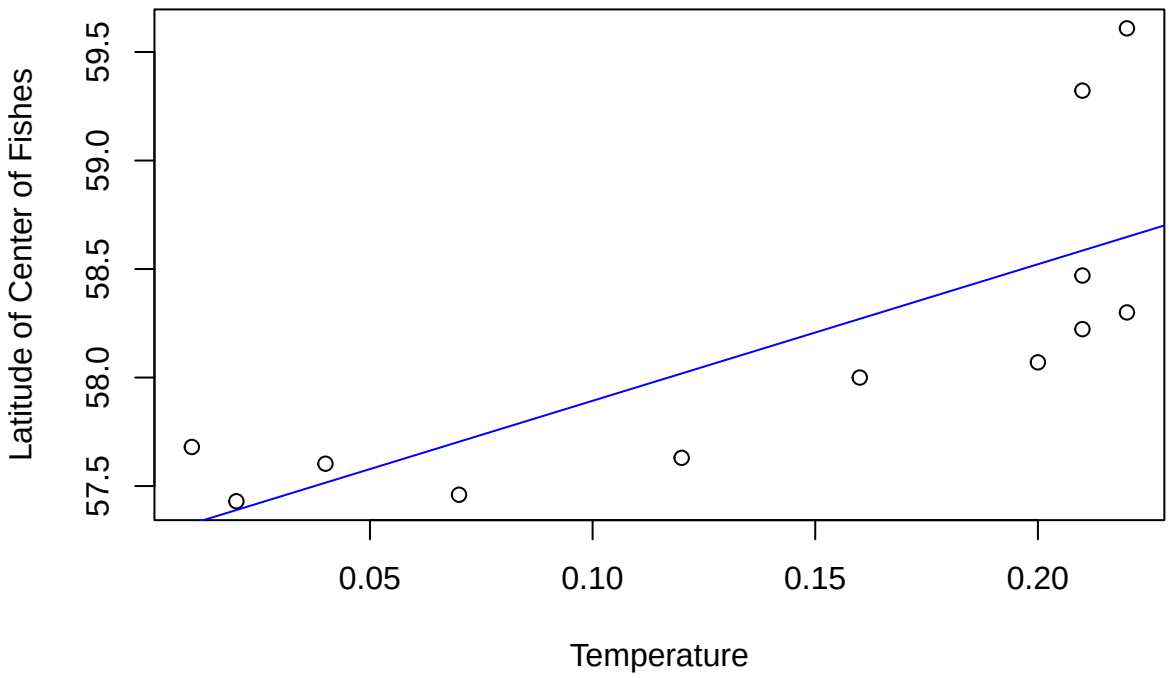
```
# import data of latitude of center of fish and temperature
year <- seq(from  = 1974, to = 1985)
north <- c(57.68, 57.43, 57.603, 57.460, 57.63, 58, 58.07, 58.223, 58.3, 58.47, 59.322, 59.609)
data <- cbind(year, north)
data <- data.frame(data)
temperature <- c(-0.42, -0.438, -0.366, -0.078, -0.186, 0.048, 0.066, -0.006, -0.006, 0.138, -0.042, -0
temperature <- temperature+0.438

temperature <- c(-0.07, -0.01, -0.1, 0.18, 0.07, 0.16, 0.26, 0.32, 0.14, 0.31, 0.16, 0.12)
temperature <- c(0.01, 0.02, 0.04, 0.07, 0.12, 0.16, 0.2, 0.21, 0.22, 0.21, 0.21, 0.22)
data <- cbind(data, temperature)
```

```
# Plot the scatter plot of temperature and the latitude of center of fish
plot(temperature, north, xlab = "Temperature", ylab = "Latitude of Center of Fishes")
abline(lm( north ~ temperature), col = "blue")
```



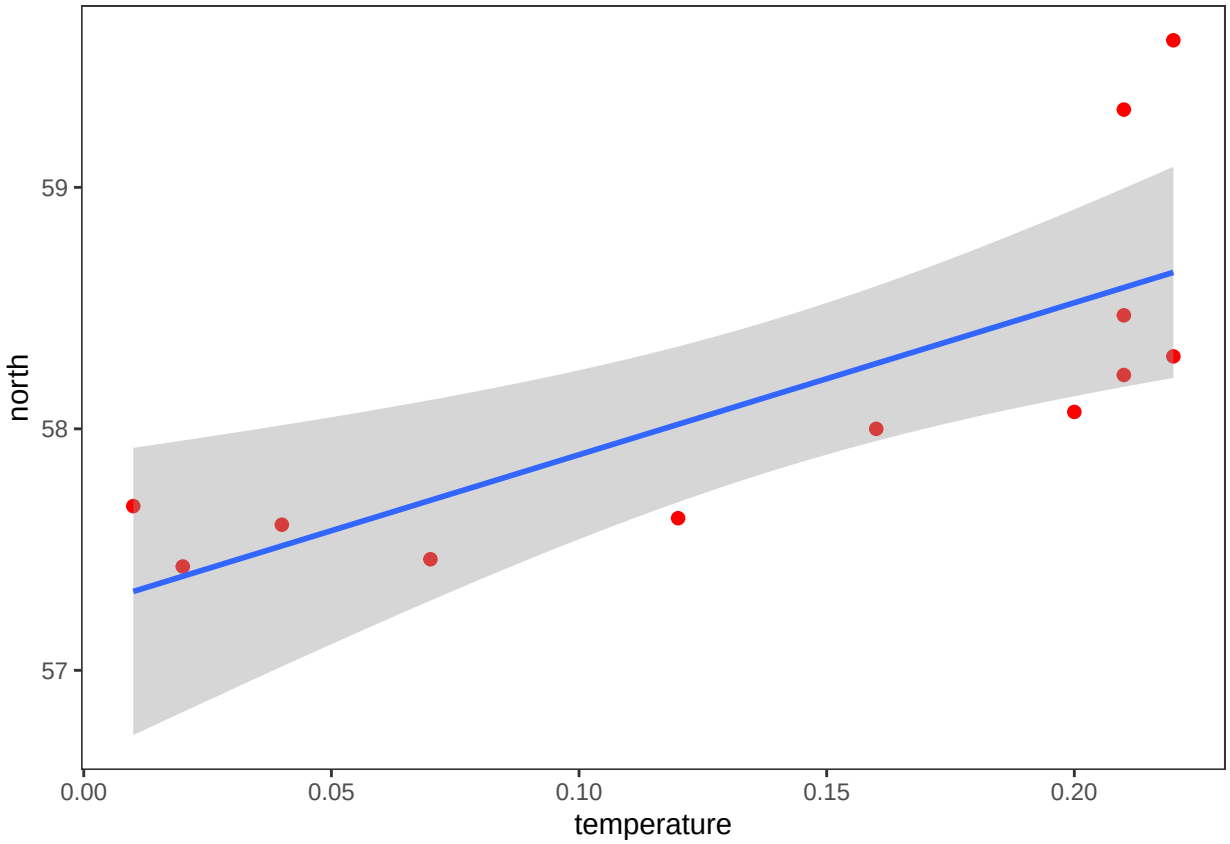

```
# Print the correlation between temperature and the latitude of center of fishes
cor(temperature, north)^2
```

```
## [1] 0.5676848
```

Since the result is 0.568, it shows that there's moderate positive correlation between temperature and latitude of center of fishes

```
library(ggplot2)
ggplot(data, aes(x=temperature, y=north)) +
  geom_point(size=3, shape=20, color = "red") +
  theme_test() +
  geom_smooth(method = lm)
```

```
## `geom_smooth()` using formula 'y ~ x'
```




```
# get the equation of regression line
lm( north ~ temperature)
```

```
##
## Call:
## lm(formula = north ~ temperature)
##
## Coefficients:
## (Intercept)  temperature
##      57.264        6.292
```

```
temperature2016 <- 0.87
# predict using given temperature to predict north
tempPredict <- function(x){
  y = 57.264+6.292*x
  return(y)
```

```
}
# predict the latitude of the center of fish in 2016
tempPredict(temperature2016)
```

```
## [1] 62.73804
```

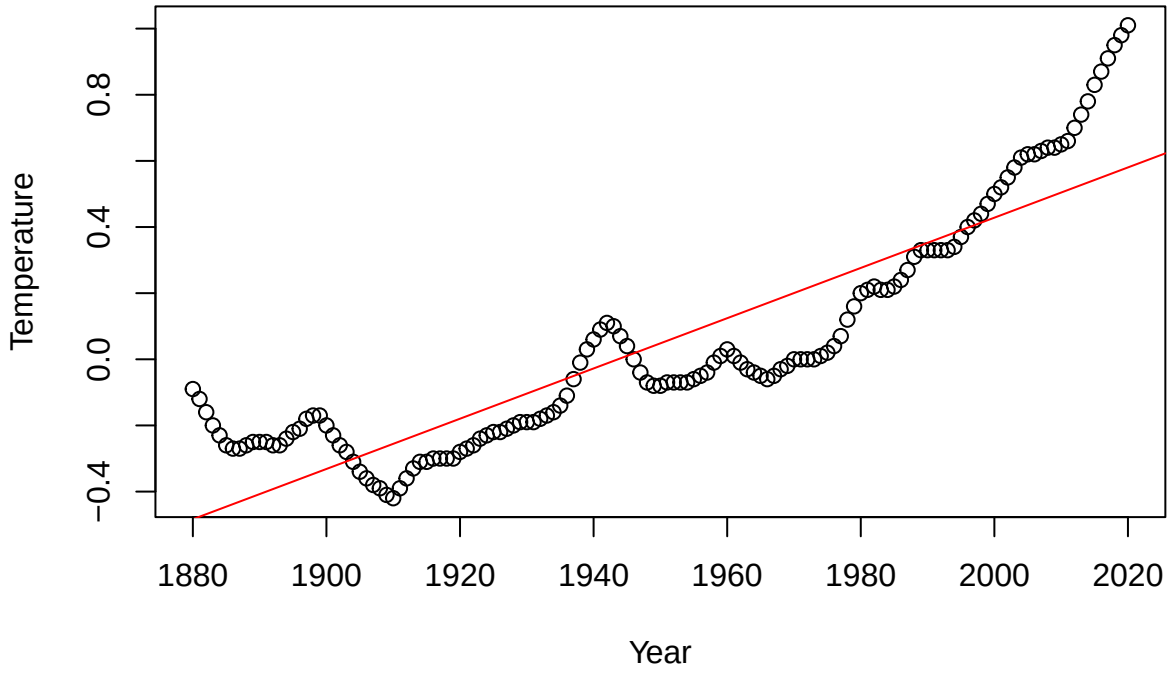
```
# input the temperature data from 1880 to 2020
allTemp <- read.csv("temperature.csv")
allTemp <- allTemp[,2:4]
colnames(allTemp) <- c("Year", "temp1", "temp2")
```

```
Temp <- allTemp[91:141,]
Temp
```

```
##     Year temp1 temp2
## 91  1970  0.03  0.00
## 92  1971 -0.08  0.00
## 93  1972  0.01  0.00
## 94  1973  0.16  0.00
## 95  1974 -0.07  0.01
## 96  1975 -0.01  0.02
## 97  1976 -0.10  0.04
## 98  1977  0.18  0.07
## 99  1978  0.07  0.12
## 100 1979  0.16  0.16
## 101 1980  0.26  0.20
## 102 1981  0.32  0.21
## 103 1982  0.14  0.22
## 104 1983  0.31  0.21
## 105 1984  0.16  0.21
## 106 1985  0.12  0.22
## 107 1986  0.18  0.24
## 108 1987  0.32  0.27
## 109 1988  0.39  0.31
## 110 1989  0.27  0.33
## 111 1990  0.45  0.33
## 112 1991  0.40  0.33
## 113 1992  0.22  0.33
## 114 1993  0.23  0.33
## 115 1994  0.32  0.34
## 116 1995  0.45  0.37
## 117 1996  0.33  0.40
## 118 1997  0.46  0.42
## 119 1998  0.61  0.44
## 120 1999  0.38  0.47
## 121 2000  0.39  0.50
## 122 2001  0.54  0.52
## 123 2002  0.63  0.55
## 124 2003  0.62  0.58
## 125 2004  0.53  0.61
## 126 2005  0.68  0.62
## 127 2006  0.64  0.62
```

```
## 128 2007  0.66  0.63
## 129 2008  0.54  0.64
## 130 2009  0.66  0.64
## 131 2010  0.72  0.65
## 132 2011  0.61  0.66
## 133 2012  0.65  0.70
## 134 2013  0.68  0.74
## 135 2014  0.74  0.78
## 136 2015  0.90  0.83
## 137 2016  1.01  0.87
## 138 2017  0.92  0.91
## 139 2018  0.85  0.95
## 140 2019  0.98  0.98
## 141 2020  1.02  1.01
```

```r
# Plot the scatter plot of temperature and year
plot(allTemp$Year, allTemp$temp2, xlab = "Year", ylab = "Temperature")
abline(lm(allTemp$temp2 ~ allTemp$Year), col = "red")
```




```r
# Get the equation of the regression line
lm(allTemp$temp2 ~ allTemp$Year)
```

```
##
## Call:
## lm(formula = allTemp$temp2 ~ allTemp$Year)
```

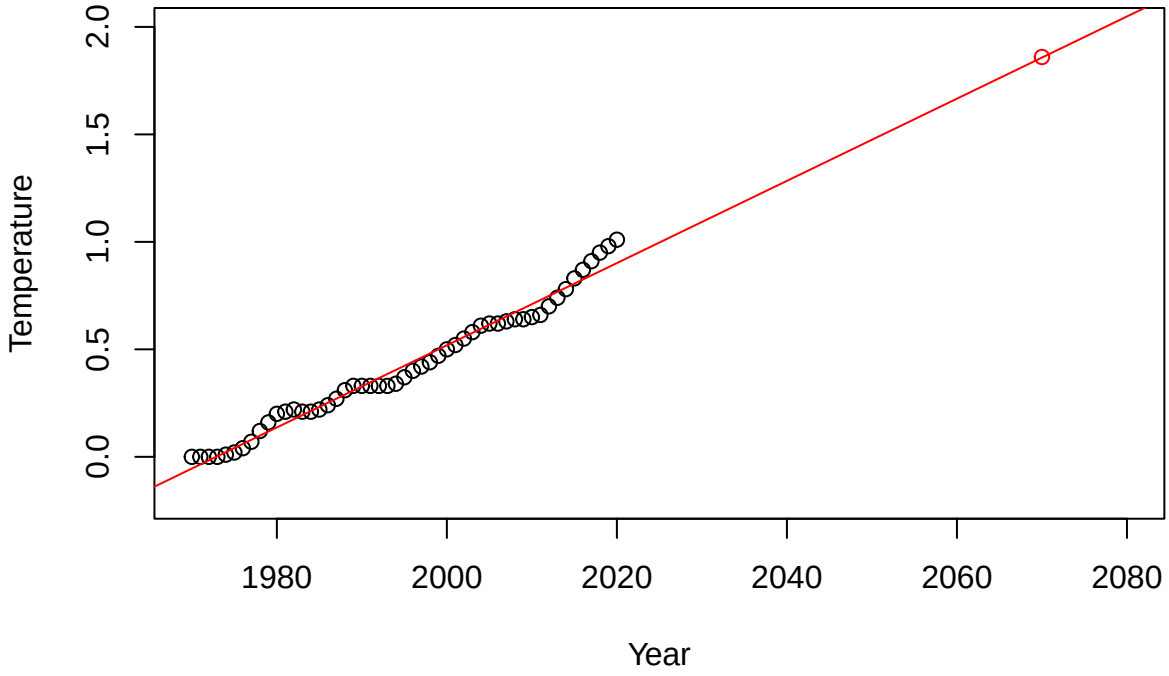
```
##
## Coefficients:
##  (Intercept)  allTemp$Year
##   -14.769749      0.007599
```

```
# Using the regression line to predict the temperature in 2072
temperature2072 <- 0.007599*2072-14.769749
```

```
# Using the regression found above the predict the lattitude of center of fish in 2072
tempPredict(temperature2072)
```

```
## [1] 63.40108
```

```
plot(allTemp$Year[91:141], allTemp$temp2[91:141], xlim = c(1970, 2080), ylim = c(-0.2, 2), xlab = "Year
abline(lm(allTemp$temp2[91:141] ~ allTemp$Year[91:141]), col = "red")
points(2070, 1.86, col = "red")
```




```
temperature <- allTemp$temp2[70:141]
year <- allTemp$Year[70:141]
models <- lm(temperature ~ year)
models
```

```
##
## Call:
## lm(formula = temperature ~ year)
##
## Coefficients:
## (Intercept)         year
##   -29.15034      0.01483
```

```
0.01483*2072-29.15034
```

```
## [1] 1.57742
```

```
tempPredict(1.57742)
```

```
## [1] 67.18913
```

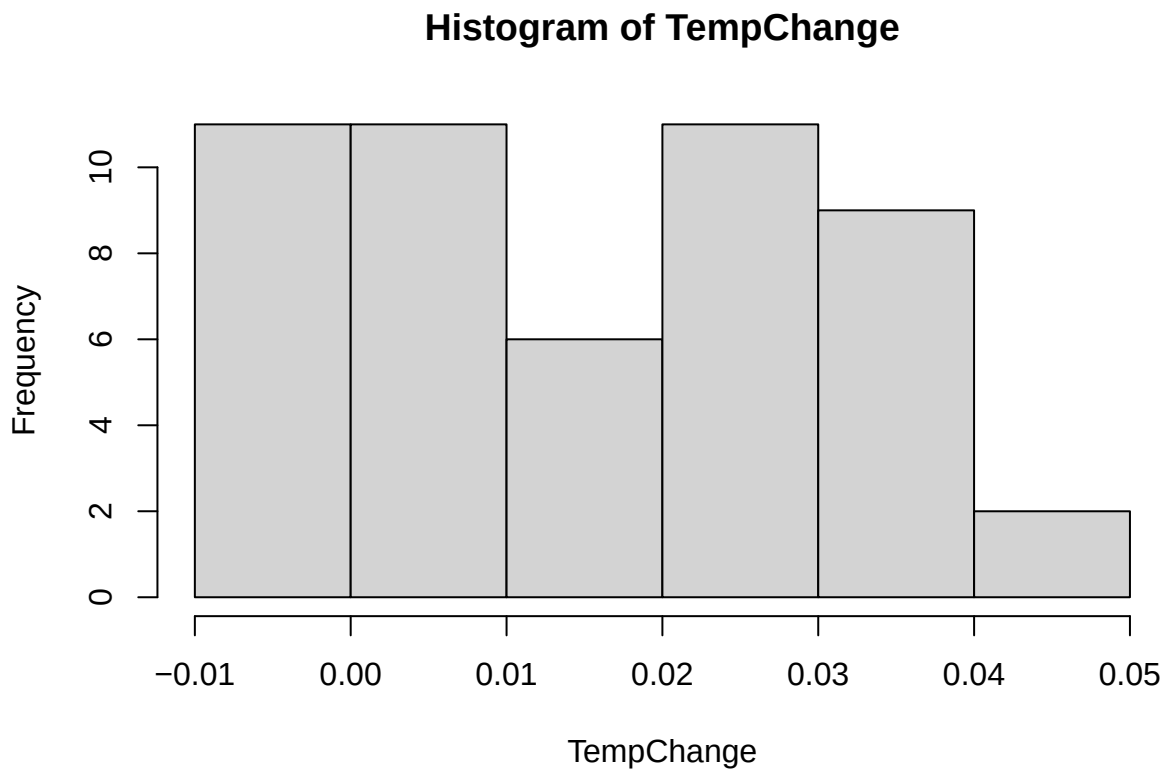
```r
new.year <-  data.frame(
  year = c(2070)
)
predict(models, newdata = new.year, interval = "prediction")
```

```
##        fit      lwr    upr
## 1 1.556521 1.368443 1.7446
```

```
TempChange <- rep(NA,50)
for (i in 91:140) {
  TempChange[i-90] <- allTemp[i+1,3] - allTemp[i,3]
}
TempChange
```

```
##  [1]  0.00  0.00  0.00  0.01  0.01  0.02  0.03  0.05  0.04  0.04  0.01  0.01
## [13] -0.01  0.00  0.01  0.02  0.03  0.04  0.02  0.00  0.00  0.00  0.00  0.01
## [25]  0.03  0.03  0.02  0.02  0.03  0.03  0.02  0.03  0.03  0.03  0.01  0.00
## [37]  0.01  0.01  0.00  0.01  0.01  0.04  0.04  0.04  0.05  0.04  0.04  0.04
## [49]  0.03  0.03
```

```
hist(TempChange)
```




```
TempChange
```

```
##  [1]  0.00  0.00  0.00  0.01  0.01  0.02  0.03  0.05  0.04  0.04  0.01  0.01
## [13] -0.01  0.00  0.01  0.02  0.03  0.04  0.02  0.00  0.00  0.00  0.00  0.01
## [25]  0.03  0.03  0.02  0.02  0.03  0.03  0.02  0.03  0.03  0.03  0.01  0.00
## [37]  0.01  0.01  0.00  0.01  0.01  0.04  0.04  0.04  0.05  0.04  0.04  0.04
## [49]  0.03  0.03
```

```
summary(TempChange)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## -0.0100  0.0100  0.0200  0.0202  0.0300  0.0500
```

```
sd(TempChange)
```

```
## [1] 0.01597064
```