CDS-101 Checkpoint #2

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2024-06-02

#GHG = Greenhouse Gases #FJO = Female Job Occupation #YOY = Year-on-Year

#Outlier function

```r
find_outlier <- function(x) {
  return(x < quantile(x, .25) - 1.5*IQR(x) | x > quantile(x, .75) + 1.5*IQR(x))
}
```

Organizing Dataset (Hyunwoo Kang)

Summarize

```r
summary(Group_dataset)
```

```
##       Year      Birth_per_1000     Birth_YOY            FJO
##  Min.   :1991   Min.   : 7.036   Min.   :-5.870   Min.   : 7529000
##  1st Qu.:1998   1st Qu.: 8.795   1st Qu.:-3.555   1st Qu.: 8616500
##  Median :2006   Median : 9.786   Median :-2.450   Median : 9707000
##  Mean   :2006   Mean   :10.835   Mean   :-2.499   Mean   : 9649613
##  3rd Qu.:2014   3rd Qu.:13.431   3rd Qu.:-1.305   3rd Qu.:10697000
##  Max.   :2021   Max.   :16.002   Max.   : 1.080   Max.   :11725000
##     FJO_YOY            GHG            GHG_YOY            INF_Rate
##  Min.   :-7.000   Min.   :281.4   Min.   :-17.080   Min.   :0.383
##  1st Qu.: 1.000   1st Qu.:438.5   1st Qu.:  1.065   1st Qu.:1.710
##  Median : 2.000   Median :509.5   Median :  2.540   Median :2.756
##  Mean   : 1.581   Mean   :519.4   Mean   :  3.181   Mean   :3.232
##  3rd Qu.: 3.000   3rd Qu.:638.3   3rd Qu.:  6.940   3rd Qu.:4.460
##  Max.   : 5.000   Max.   :684.7   Max.   : 11.860   Max.   :9.333
##  Inflation_YOY
##  Min.   :-6.7000
##  1st Qu.:-0.9900
##  Median : 0.0800
##  Mean   :-0.1968
##  3rd Qu.: 0.8650
##  Max.   : 3.0700
```

Select

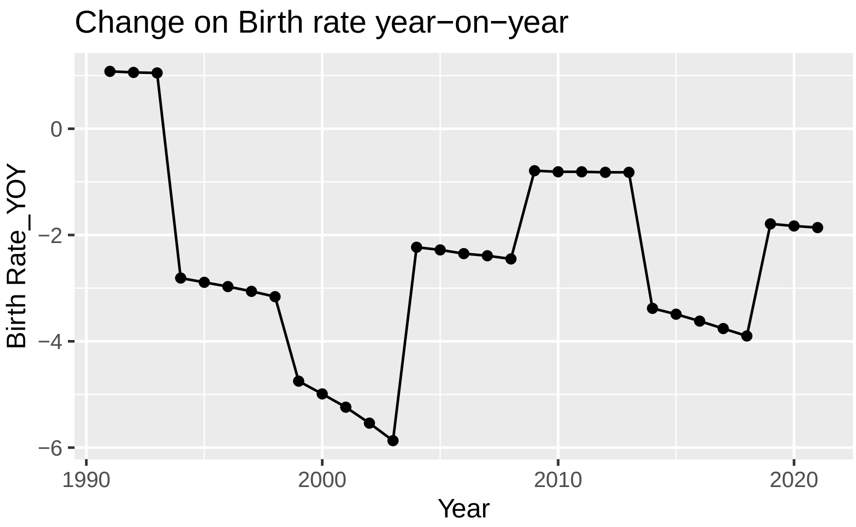
```
Envo_ft <- Group_dataset %>%
 select(Year, Birth_per_1000, Birth_YOY, GHG, GHG_YOY)
```

```
Econ_ft <- Group_dataset %>%
  select(Year, Birth_per_1000, Birth_YOY, INF_Rate, Inflation_YOY)
```

```
Soci_ft <- Group_dataset %>%
   select(Year, Birth_per_1000, Birth_YOY, FJO, FJO_YOY)
```

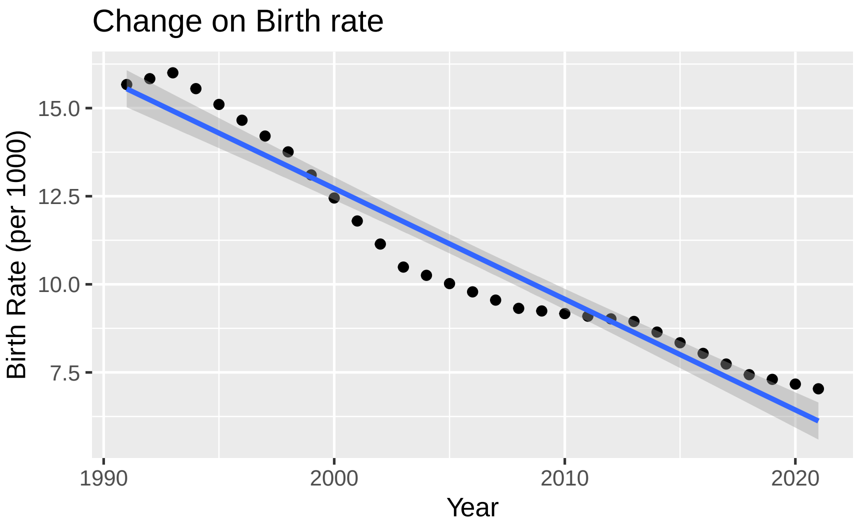
Variation of Birth Rate change Year-on-Year (Hyunwoo Kang)

```
 Group_dataset %>%
  ggplot() +
  geom_line(mapping = aes(y = Birth_YOY, x= Year)) +
  geom_point(mapping = aes(y = Birth_YOY, x= Year))+
  labs(title = "Change on Birth rate year-on-year",
       y = "Birth Rate_YOY",
       x = "Year")
```



```
 Group_dataset %>%
  ggplot() +
  geom_point(mapping = aes(y = Birth_per_1000, x= Year))+
  geom_smooth(mapping = aes(y = Birth_per_1000, x = Year), method = "lm") +
  labs(title = "Change on Birth rate",
       y = "Birth Rate (per 1000)",
       x = "Year")
```

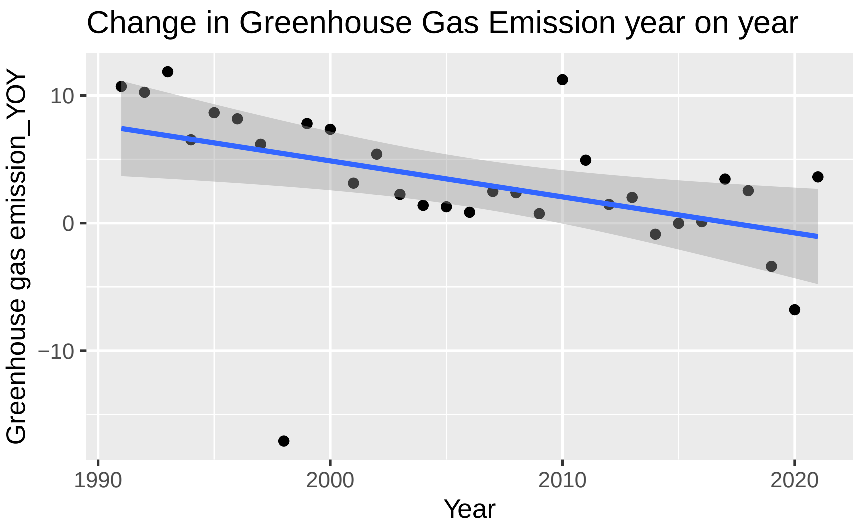
```
## ‘geom_smooth()‘ using formula = ’y ~ x’
```



Variation and Covariation - Envo_ft (Songlee Jun)

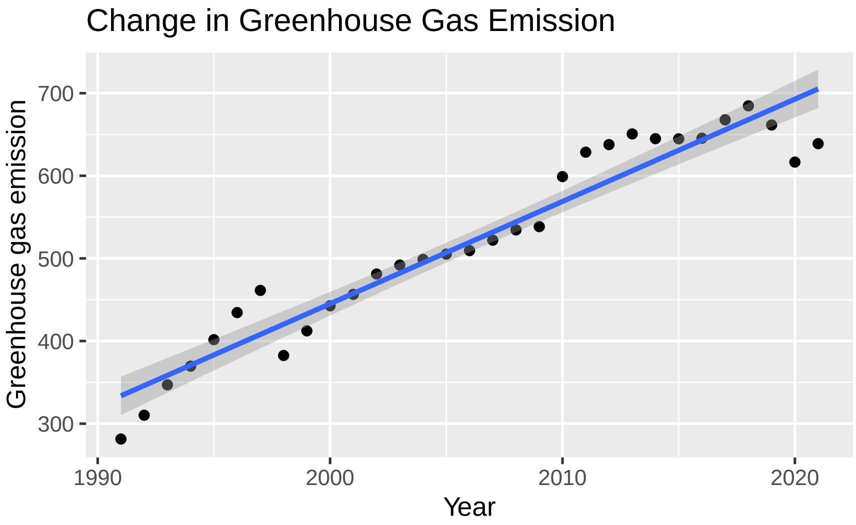
```
Envo_ft %>%
 ggplot() +
 geom_point(mapping = aes(x = Year, y = GHG_YOY)) +
 geom_smooth(mapping = aes(x = Year, y = GHG_YOY), method = "lm") +
  labs(title = "Change in Greenhouse Gas Emission year on year",
       x = "Year",
       y = "Greenhouse gas emission_YOY")
```

```
## ‘geom_smooth()‘ using formula = ’y ~ x’
```

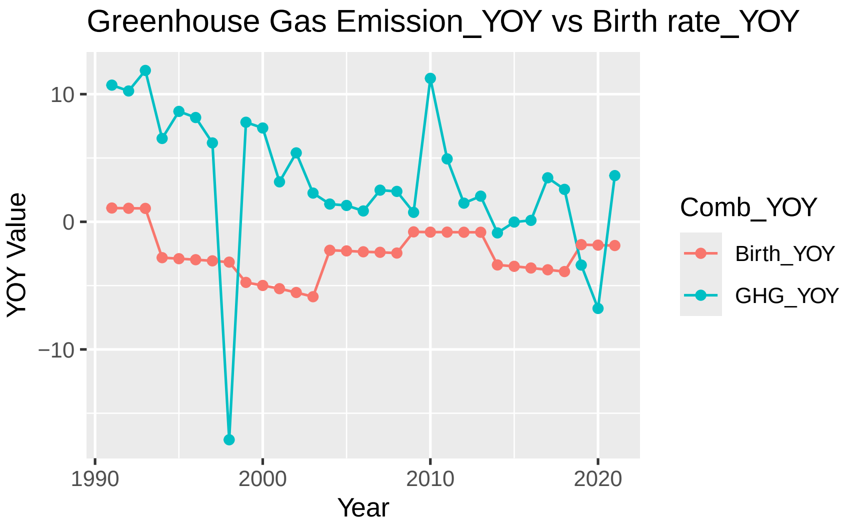


```
Envo_ft %>%
 ggplot() +
 geom_point(mapping = aes(x = Year, y = GHG)) +
 geom_smooth(mapping = aes(x = Year, y = GHG), method = "lm") +
  labs(title = "Change in Greenhouse Gas Emission",
       x = "Year",
       y = "Greenhouse gas emission")
```

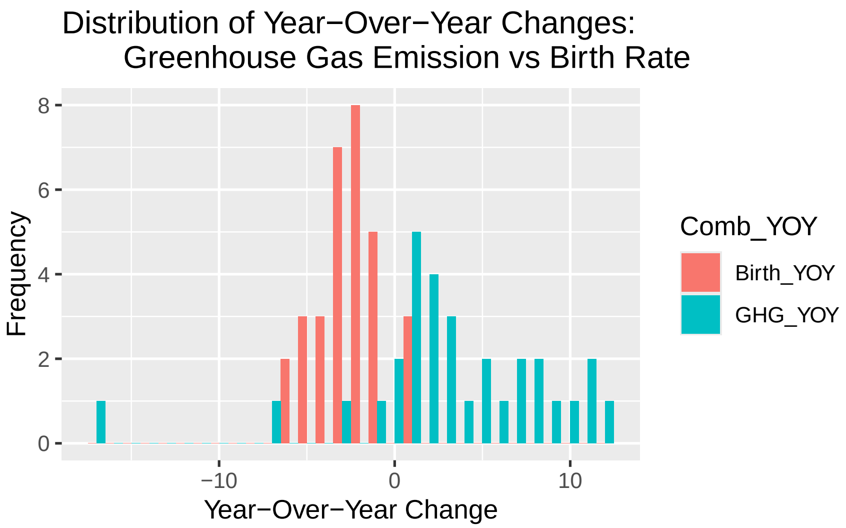
```
## ‘geom_smooth()‘ using formula = ’y ~ x’
```



```
Group_dataset%>%
  pivot_longer(cols = c('Birth_YOY', 'GHG_YOY'),
               names_to = 'Comb_YOY',
               values_to = 'Val_YOY')%>%
ggplot(aes(y = Val_YOY, x = Year)) +
  geom_line(aes(color = Comb_YOY))+
  geom_point(aes(color = Comb_YOY)) +
  labs(title = "Greenhouse Gas Emission_YOY vs Birth rate_YOY",
    x = "Year",
    y = "YOY Value")
```

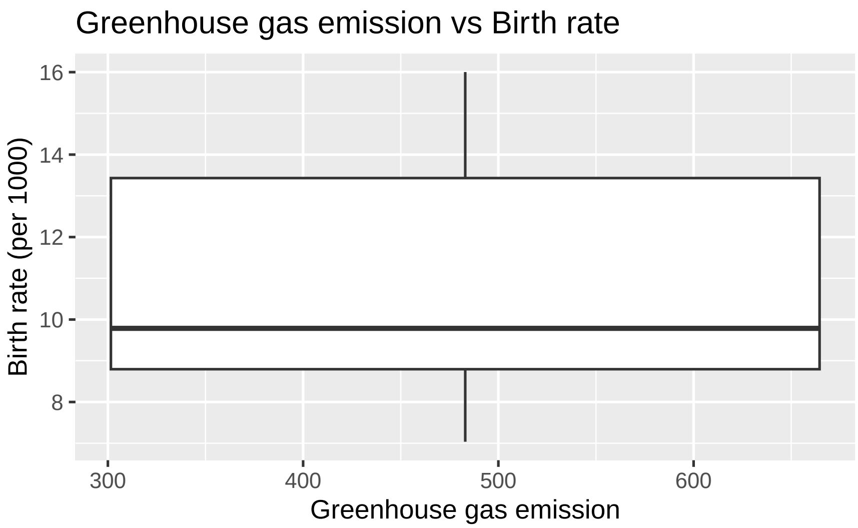


```
Group_dataset %>%
  pivot_longer(cols = c('Birth_YOY', 'GHG_YOY'),
               names_to = 'Comb_YOY',
               values_to = 'Val_YOY') %>%

ggplot(aes(x = Val_YOY, fill = Comb_YOY)) +
  geom_histogram(position = 'dodge', bins = 30) +
  labs(title = "Distribution of Year-Over-Year Changes:
       Greenhouse Gas Emission vs Birth Rate",
       x = "Year-Over-Year Change",
       y = "Frequency")
```



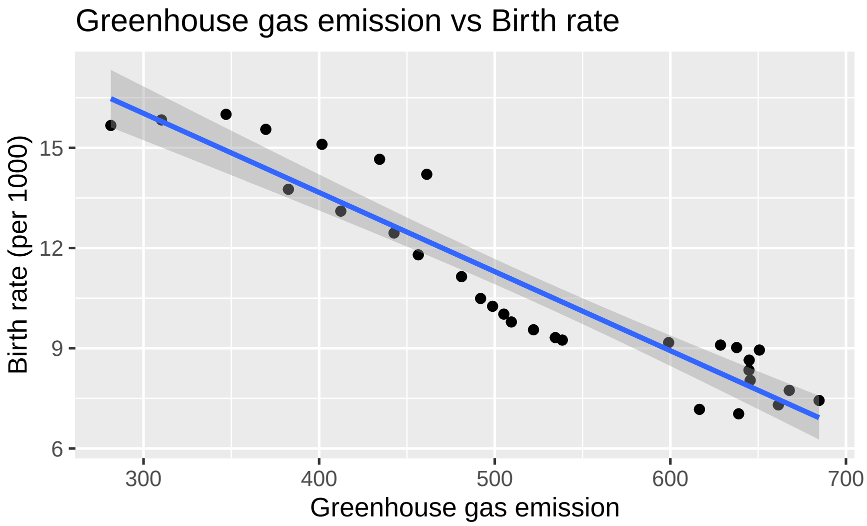
```
Envo_ft %>%
   ggplot(mapping = aes(x = GHG, y = Birth_per_1000)) +
   geom_boxplot(outlier.colour = "red", outlier.shape = 16) +
   stat_summary(
     aes(label = round(..y.., 1)),
     geom = "text",
     fun.data = function(y) {
       out <- boxplot.stats(y)$out
       if(length(out) == 0) return(NULL)
       data.frame(y = out)
     },
     hjust = -0.5
   ) +
   labs(
     title = "Greenhouse gas emission vs Birth rate",
     x = 'Greenhouse gas emission',
     y = "Birth rate (per 1000)"
   )
```

```
## Warning: The dot-dot notation (‘..y..‘) was deprecated in ggplot2 3.4.0.
## i Please use ‘after_stat(y)‘ instead.
## This warning is displayed once every 8 hours.
## Call ‘lifecycle::last_lifecycle_warnings()‘ to see where this warning was
## generated.

## Warning: Continuous x aesthetic
## i did you forget ‘aes(group = ...)‘?

## Warning: Computation failed in ‘stat_summary()‘.
## Caused by error in ‘fix.by()‘:
## ! ’by’ must specify uniquely valid columns
```

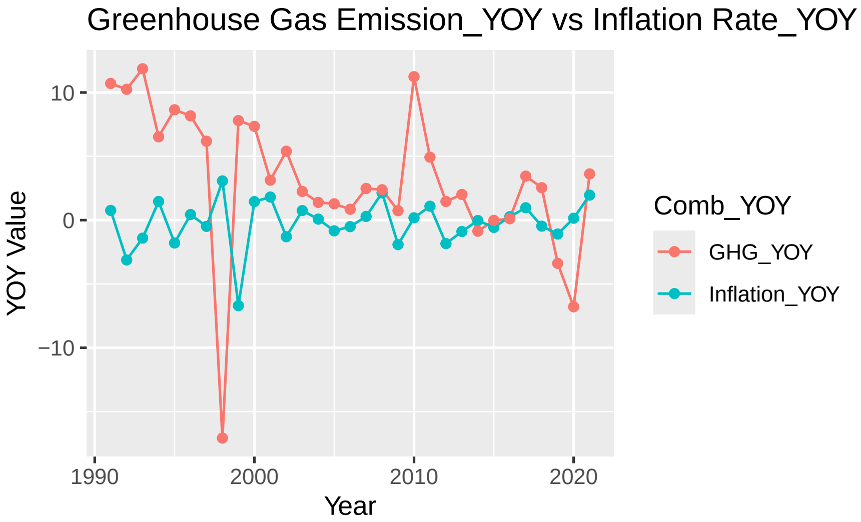


```
Envo_ft %>%
   ggplot()+
   geom_point(mapping = aes(x  = GHG, y = Birth_per_1000)) +
   geom_smooth(mapping = aes(x  = GHG, y  = Birth_per_1000), method="lm")+
  labs(
    title = "Greenhouse gas emission vs Birth rate",
    x = 'Greenhouse gas emission',
    y = "Birth rate (per 1000)")
```

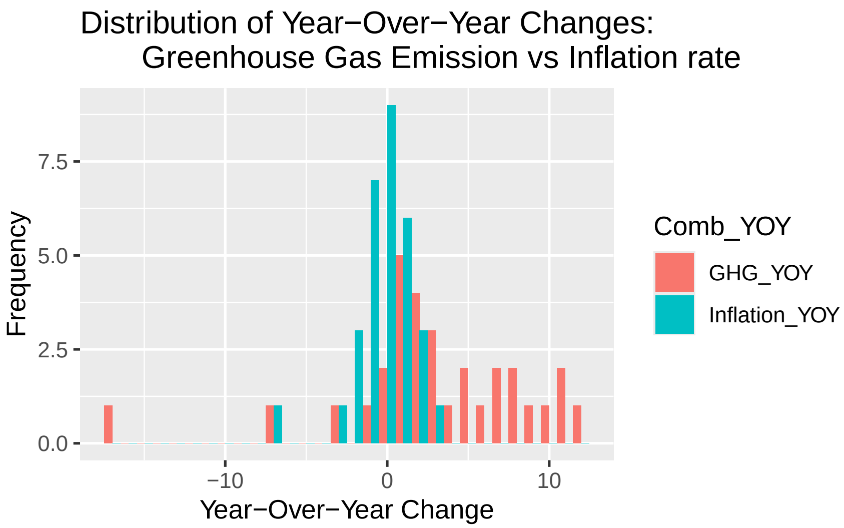
```
## `geom_smooth()` using formula = 'y ~ x'
```



```
Group_dataset%>%
  pivot_longer(cols = c('Inflation_YOY', 'GHG_YOY'),
               names_to = 'Comb_YOY',
                values_to = 'Val_YOY')%>%

ggplot(aes(y = Val_YOY, x = Year)) +
  geom_line(aes(color = Comb_YOY))+
  geom_point(aes(color = Comb_YOY)) +
  labs(title = "Greenhouse Gas Emission_YOY vs Inflation Rate_YOY",
    x = "Year",
    y = "YOY Value")
```

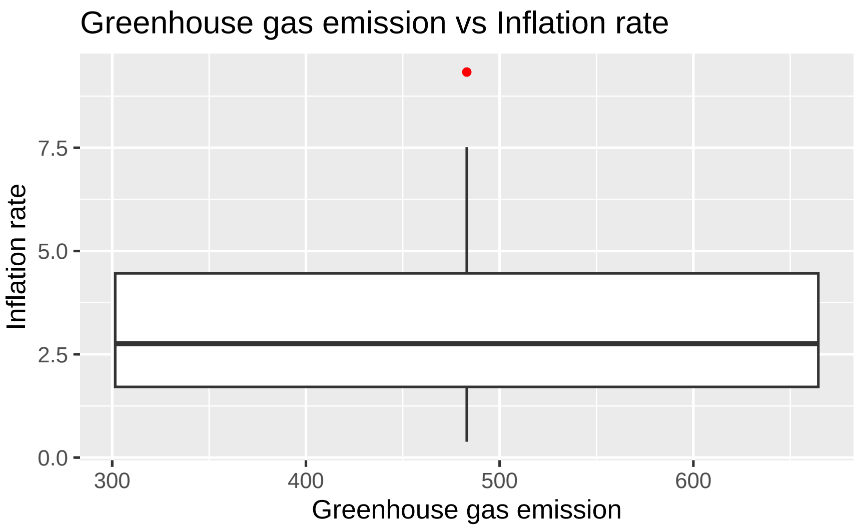


```
Group_dataset %>%
  pivot_longer(cols = c('Inflation_YOY', 'GHG_YOY'),
               names_to = 'Comb_YOY',
               values_to = 'Val_YOY') %>%

ggplot(aes(x = Val_YOY, fill = Comb_YOY)) +
  geom_histogram(position = 'dodge', bins = 30) +
  labs(title = "Distribution of Year-Over-Year Changes:
       Greenhouse Gas Emission vs Inflation rate",
       x = "Year-Over-Year Change",
       y = "Frequency")
```



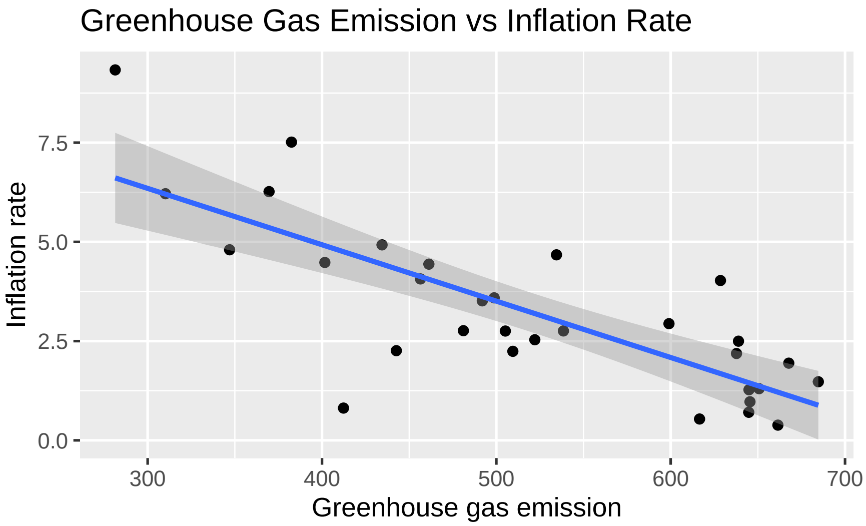
```r
Group_dataset %>%
   ggplot(mapping = aes(x = GHG, y = INF_Rate)) +
   geom_boxplot(outlier.colour = "red", outlier.shape = 16) +
   stat_summary(
     aes(label = round(..y.., 1)),
     geom = "text",
     fun.data = function(y) {
       out <- boxplot.stats(y)$out
       if (length(out) == 0) return(NULL)
       data.frame(y = out)
     },
     hjust = -0.5
   ) +
   labs(
     title = "Greenhouse gas emission vs Inflation rate",
     x = 'Greenhouse gas emission',
     y = "Inflation rate"
   )
```

```
## Warning: Continuous x aesthetic
## i did you forget ‘aes(group = ...)‘?

## Warning: Computation failed in ‘stat_summary()‘.
## Caused by error in ‘fix.by()‘:
## ! ’by’ must specify uniquely valid columns
```

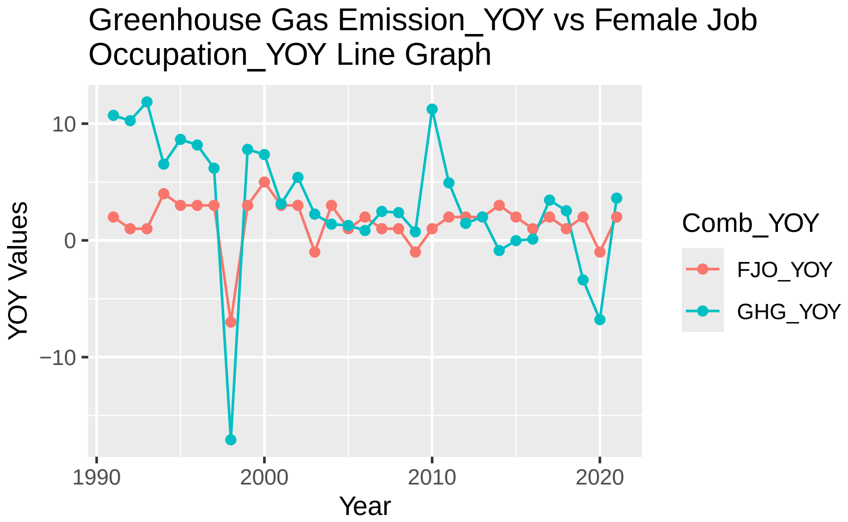


```
Group_dataset %>%
  ggplot() +
  geom_point(mapping = aes(x = GHG, y = INF_Rate))+
  geom_smooth(mapping = aes(x  = GHG, y  = INF_Rate), method="lm")+
  labs(
    title = "Greenhouse Gas Emission vs Inflation Rate",
    x = "Greenhouse gas emission",
    y = "Inflation rate")
```

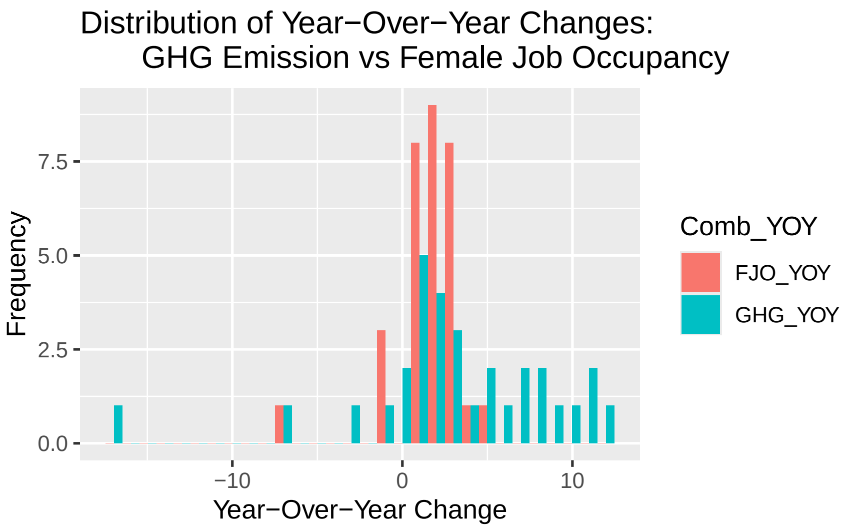
```
## `geom_smooth()` using formula = 'y ~ x'
```



```
Group_dataset%>%
  pivot_longer(cols = c('FJO_YOY', 'GHG_YOY'),
               names_to = 'Comb_YOY',
               values_to = 'Val_YOY')%>%

ggplot(aes(y = Val_YOY, x = Year)) +
  geom_line(aes(color = Comb_YOY))+
  geom_point(aes(color = Comb_YOY)) +
  labs(title = "Greenhouse Gas Emission_YOY vs Female Job
Occupation_YOY Line Graph",
    x = "Year",
    y = "YOY Values")
```



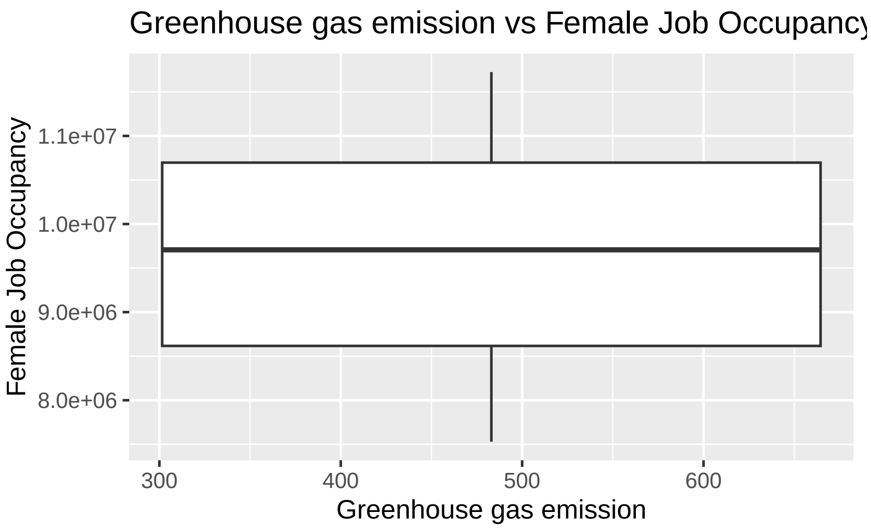
```
Group_dataset %>%
  pivot_longer(cols = c('FJO_YOY', 'GHG_YOY'),
               names_to = 'Comb_YOY',
               values_to = 'Val_YOY') %>%

ggplot(aes(x = Val_YOY, fill = Comb_YOY)) +
  geom_histogram(position = 'dodge', bins = 30) +
  labs(title = "Distribution of Year-Over-Year Changes:
       GHG Emission vs Female Job Occupancy",
       x = "Year-Over-Year Change",
       y = "Frequency")
```



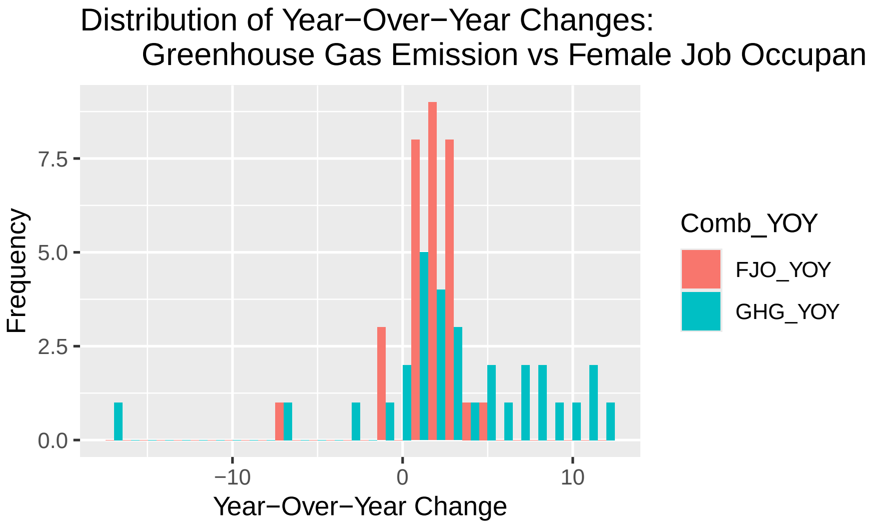
```
Group_dataset %>%
   ggplot(mapping = aes(x = GHG, y = FJO)) +
   geom_boxplot(outlier.colour = "red", outlier.shape = 16) +
   stat_summary(
     aes(label = round(..y.., 1)),
     geom = "text",
     fun.data = function(y) {
       out <- boxplot.stats(y)$out
       if (length(out) == 0) return(NULL)
       data.frame(y = out)
     },
     hjust = -0.5
   ) +
   labs(
     title = "Greenhouse gas emission vs Female Job Occupancy ",
     x = 'Greenhouse gas emission',
     y = "Female Job Occupancy"
   )
```

```
## Warning: Continuous x aesthetic
## i did you forget ‘aes(group = ...)‘?
```

```
## Warning: Computation failed in ‘stat_summary()‘.
## Caused by error in ‘fix.by()‘:
## ! ’by’ must specify uniquely valid columns
```



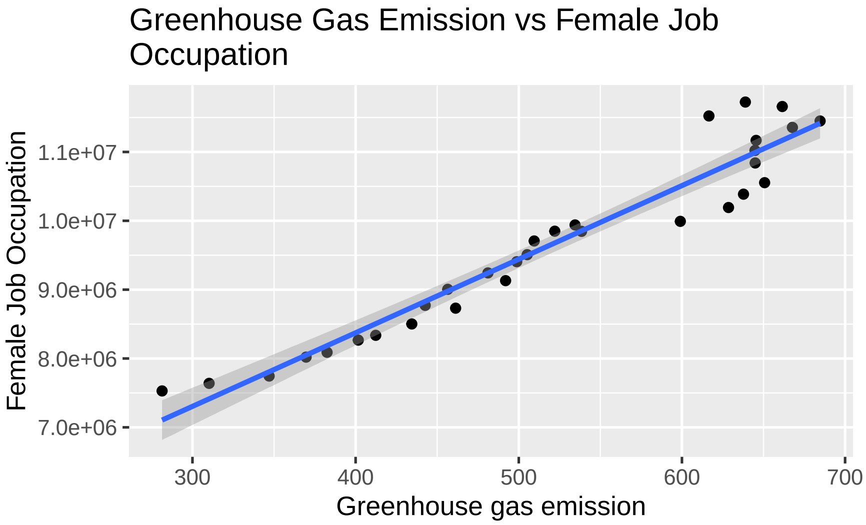
```
Group_dataset %>%
  pivot_longer(cols = c('FJO_YOY', 'GHG_YOY'),
               names_to = 'Comb_YOY',
               values_to = 'Val_YOY') %>%

ggplot(aes(x = Val_YOY, fill = Comb_YOY)) +
  geom_histogram(position = 'dodge', bins = 30) +
  labs(title = "Distribution of Year-Over-Year Changes:
      Greenhouse Gas Emission vs Female Job Occupancy",
      x = "Year-Over-Year Change",
      y = "Frequency")
```



```
Group_dataset%>%
  ggplot() +
  geom_point(mapping = aes(x = GHG, y = FJO)) +
```

```r
geom_smooth(mapping=aes(x = GHG, y = FJO), method="lm")+
  labs(
    title = "Greenhouse Gas Emission vs Female Job
Occupation",
    x = "Greenhouse gas emission",
    y = "Female Job Occupation")
```

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



Modeling & Hyphothesis test- Envo_ft year-on-year (Byungwook Oh)

```r
# Model
Envo_ft_model <- lm(Birth_YOY ~ GHG_YOY, data = Envo_ft)
```

```r
# Tidy model
Envo_ft_model %>%
  tidy()
```

term	estimate	std.error	statistic	p.value
(Intercept)	-2.7278213	0.3752186	-7.269953	0.0000001
GHG_YOY	0.0719243	0.0580149	1.239755	0.2250047

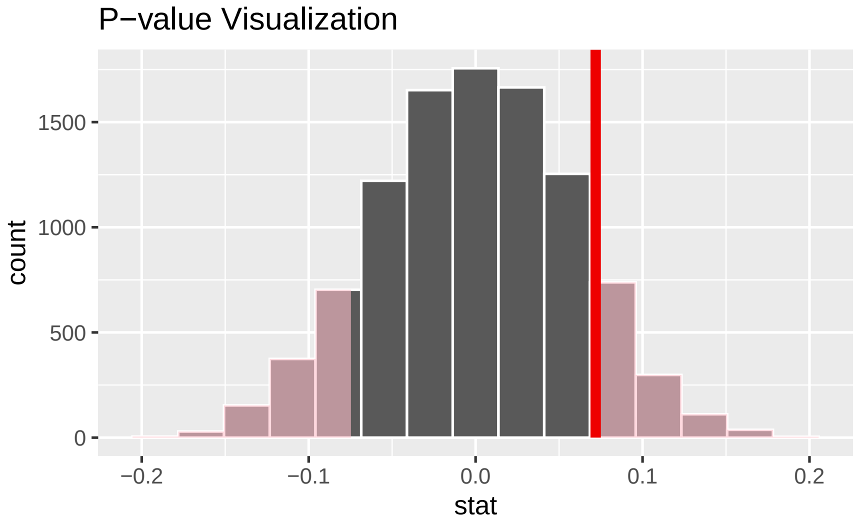
```r
# Null distribution
Envo_null_distribution <- Envo_ft %>%
  specify(Birth_YOY ~ GHG_YOY) %>%
  hypothesize(null="independence") %>%
  generate(reps=10000, type="permute") %>%
  calculate(stat="slope")
```

```
# Observed stat
Observed_stat <- Envo_ft %>%
  specify(Birth_YOY ~ GHG_YOY) %>%
  calculate(stat="slope")
```

```
# P-value
Envo_null_distribution %>%
  get_p_value(obs_stat=Observed_stat, direction="both")
```

p_value
0.2134

```
# P-value visualization
Envo_null_distribution %>%
  visualize() +
  shade_p_value(obs_stat=Observed_stat, direction= "both") +
  labs(title = "P-value Visualization")
```



Modeling & Hyphothesis test- Envo_ft with actual value (Byungwook Oh)

```r
# Model
Envo_ft_model <- lm(Birth_per_1000 ~ GHG, data = Envo_ft)
```

```r
# Null distribution
Envo_null_distribution_rv <- Envo_ft %>%
  specify(Birth_per_1000 ~ GHG) %>%
  hypothesize(null="independence") %>%
  generate(reps=10000, type="permute") %>%
  calculate(stat="slope")
```

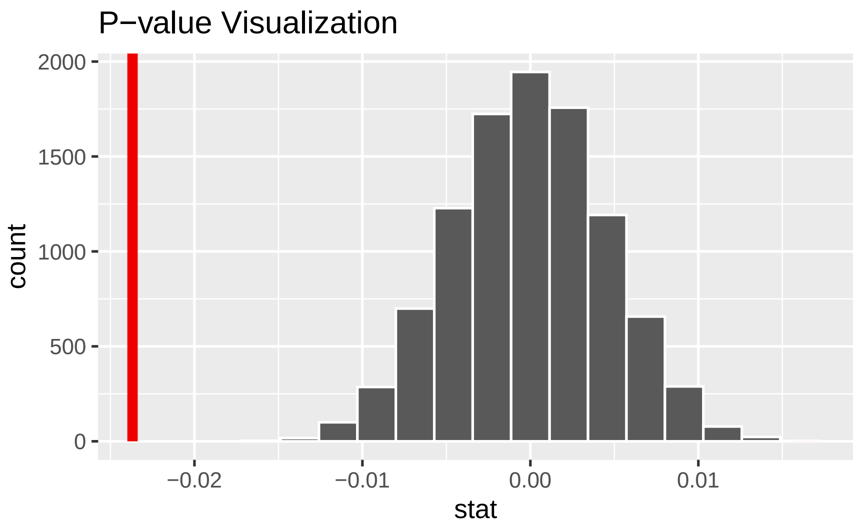
```r
# Observed stat
Observed_stat <- Envo_ft %>%
  specify(Birth_per_1000 ~ GHG) %>%
  calculate(stat="slope")
```

```r
# P-value
Envo_null_distribution_rv %>%
  get_p_value(obs_stat=Observed_stat, direction="both")
```

```
## Warning: Please be cautious in reporting a p-value of 0. This result is an approximation
## based on the number of ‘reps‘ chosen in the ‘generate()‘ step.
## i See ‘get_p_value()‘ (‘?infer::get_p_value()‘) for more information.
```

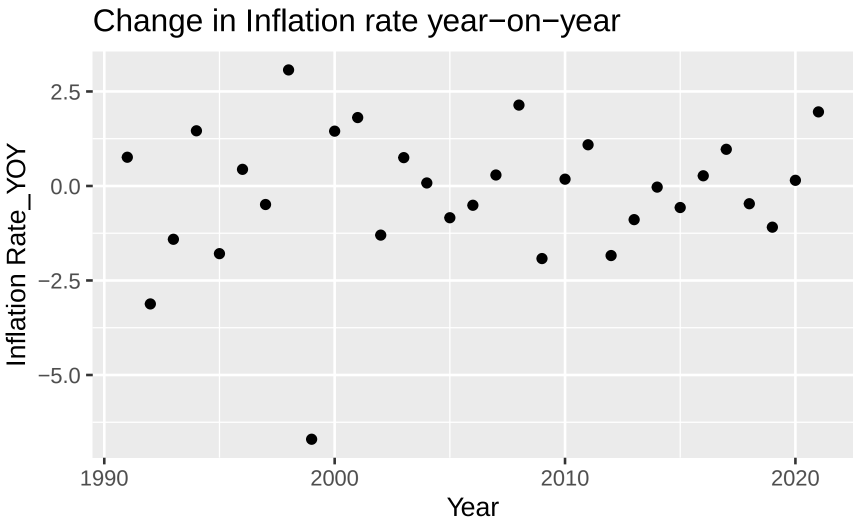
p_value
0

```r
# P-value visualization
Envo_null_distribution_rv %>%
  visualize() +
  shade_p_value(obs_stat=Observed_stat, direction= "both") +
  labs(title = "P-value Visualization")
```



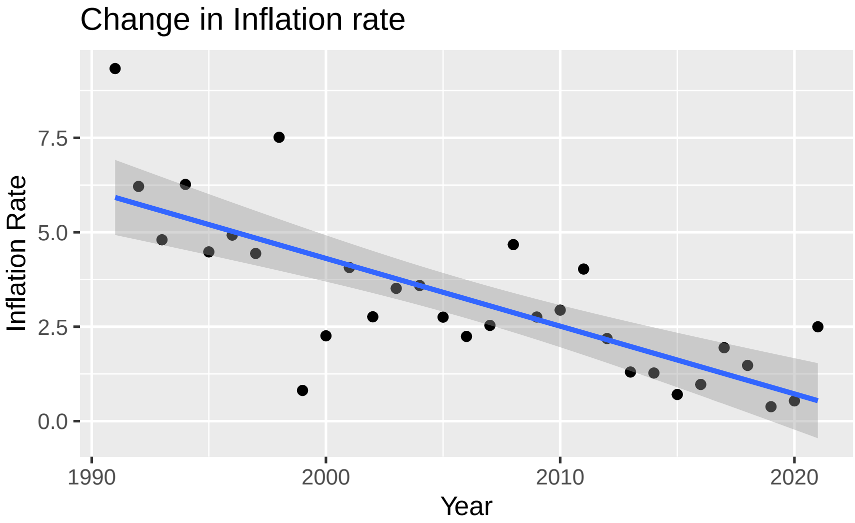
Variation and Covariation - Econ_ft (Dawon Kyoung)

```
Econ_ft %>%
 ggplot() +
 geom_point(mapping = aes(y = Inflation_YOY, x= Year))+
 labs(title = "Change in Inflation rate year-on-year",
      y = "Inflation Rate_YOY",
      x = "Year")
```

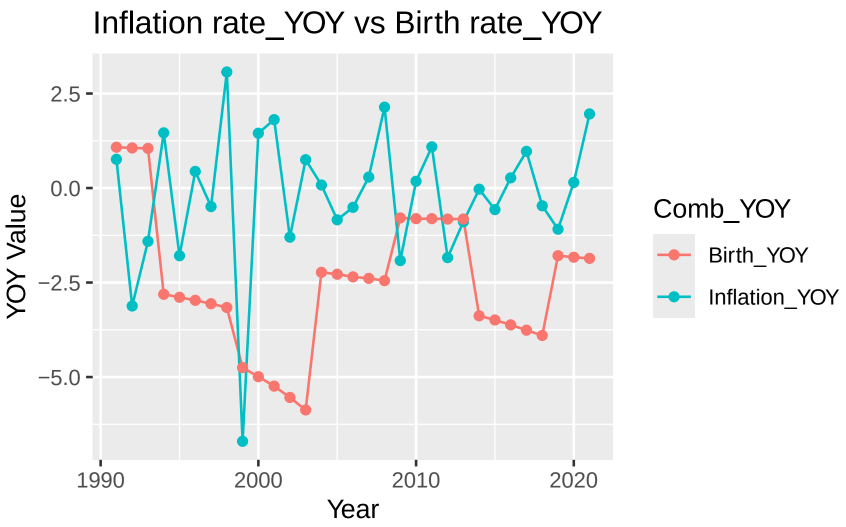


```
Econ_ft %>%
 ggplot() +
 geom_point(mapping = aes(y = INF_Rate, x= Year))+
 geom_smooth(mapping = (aes(y = INF_Rate, x = Year)), method ='lm') +
 labs(title = "Change in Inflation rate",
      y = "Inflation Rate",
      x = "Year")
```

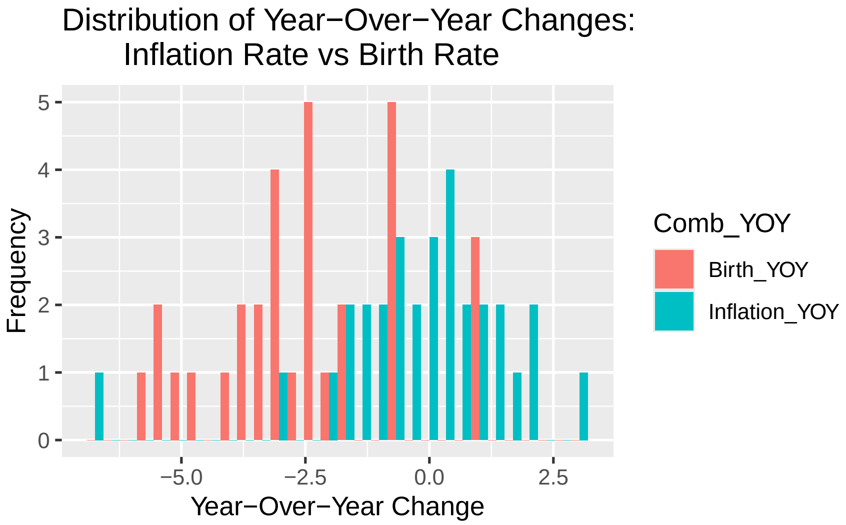
```
## `geom_smooth()` using formula = 'y ~ x'
```



```
Group_dataset%>%
  pivot_longer(cols = c('Inflation_YOY', 'Birth_YOY'),
               names_to = 'Comb_YOY',
               values_to = 'Val_YOY')%>%

ggplot(aes(y = Val_YOY, x = Year)) +
  geom_line(aes(color = Comb_YOY))+
  geom_point(aes(color = Comb_YOY)) +
  labs(
    title= 'Inflation rate_YOY vs Birth rate_YOY',
    x= 'Year',
    y= "YOY Value")
```

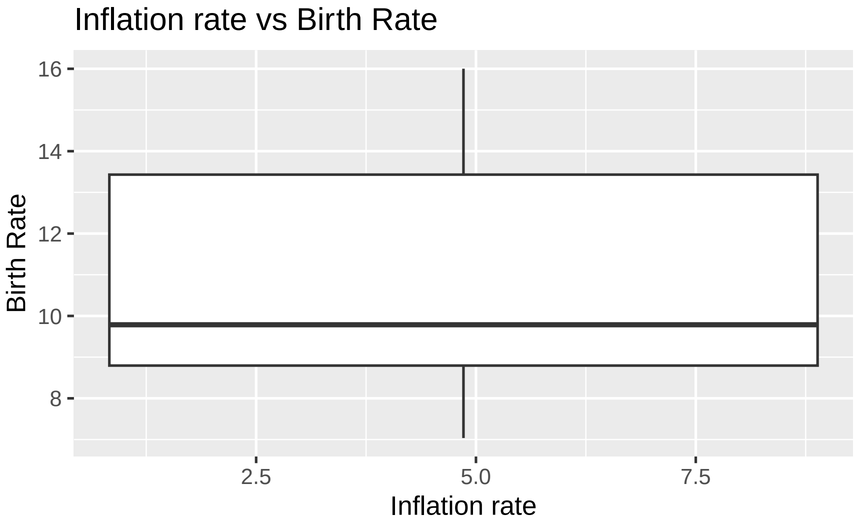


```
Group_dataset %>%
  pivot_longer(cols = c('Inflation_YOY', 'Birth_YOY'),
               names_to = 'Comb_YOY',
               values_to = 'Val_YOY') %>%

ggplot(aes(x = Val_YOY, fill = Comb_YOY)) +
  geom_histogram(position = 'dodge', bins = 30) +
  labs(title = "Distribution of Year-Over-Year Changes:
       Inflation Rate vs Birth Rate",
       x = "Year-Over-Year Change",
       y = "Frequency")
```



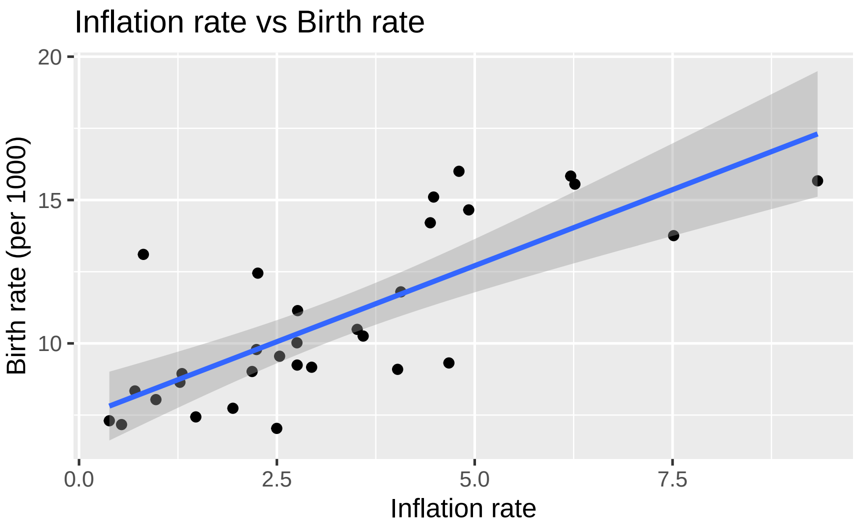
```
Econ_ft %>%
   ggplot(mapping = aes( x = INF_Rate, y = Birth_per_1000)) +
   geom_boxplot(outlier.colour = "red", outlier.shape = 16) +
   stat_summary(
     aes(label = round(..y.., 1)),
     geom = "text",
     fun.data = function(y) {
       out <- boxplot.stats(y)$out
       if (length(out) == 0) return(NULL)
       data.frame(y = out)
     },
     hjust = -0.5
   ) +
  labs(
    title = "Inflation rate vs Birth Rate",
    x = 'Inflation rate',
    y = "Birth Rate")
```

```
## Warning: Continuous x aesthetic
## i did you forget ‘aes(group = ...)‘?

## Warning: Computation failed in ‘stat_summary()‘.
## Caused by error in ‘fix.by()‘:
## ! ’by’ must specify uniquely valid columns
```

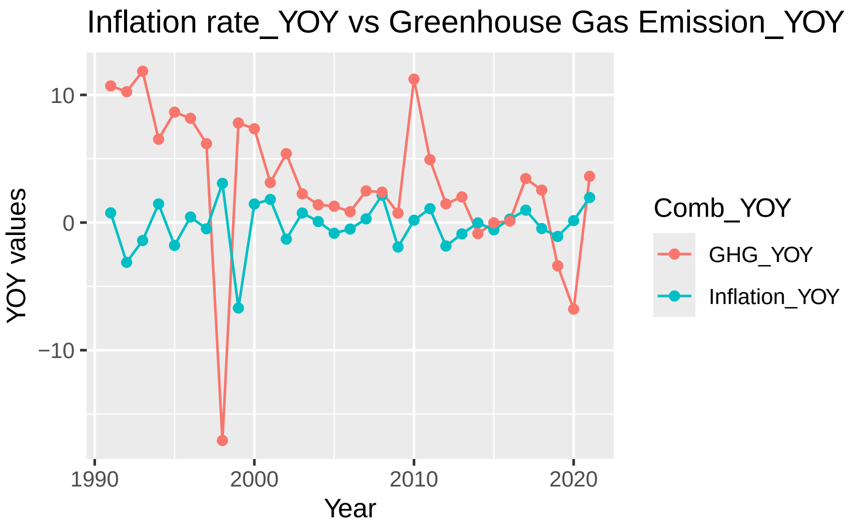


```
Econ_ft %>%
  ggplot() +
  geom_point(mapping=aes(x = INF_Rate, y = Birth_per_1000)) +
  geom_smooth(mapping = aes(x = INF_Rate, y = Birth_per_1000), method = 'lm') +
  labs(
    title= 'Inflation rate vs Birth rate',
    x= 'Inflation rate',
    y= "Birth rate (per 1000)")
```

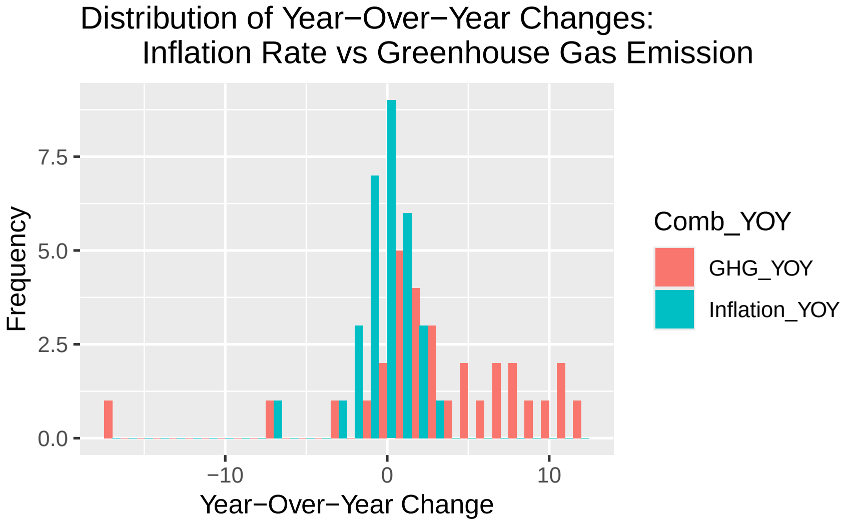
```
## `geom_smooth()` using formula = 'y ~ x'
```



```
Group_dataset%>%
  pivot_longer(cols = c('Inflation_YOY', 'GHG_YOY'),
               names_to = 'Comb_YOY',
               values_to = 'Val_YOY')%>%

ggplot(aes(y = Val_YOY, x = Year)) +
  geom_line(aes(color = Comb_YOY))+
  geom_point(aes(color = Comb_YOY)) +
   labs(
     title= 'Inflation rate_YOY vs Greenhouse Gas Emission_YOY',
     x= 'Year',
     y= 'YOY values')
```



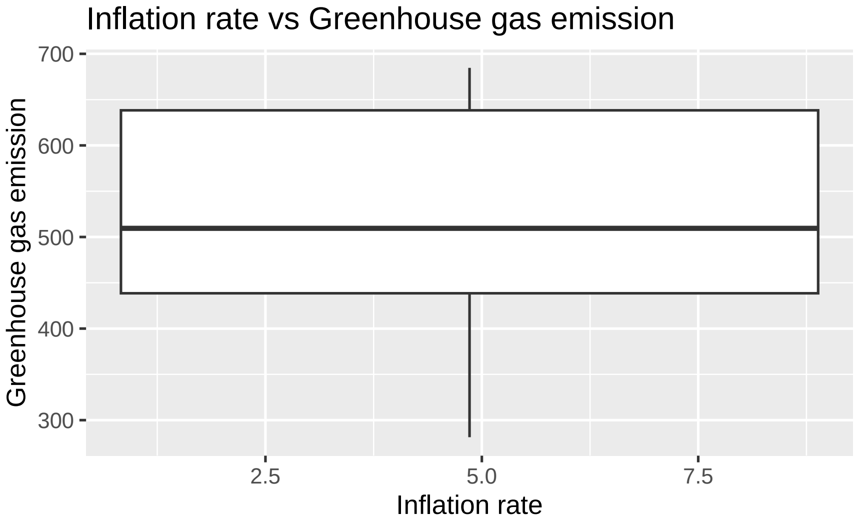
```
Group_dataset %>%
  pivot_longer(cols = c('Inflation_YOY', 'GHG_YOY'),
               names_to = 'Comb_YOY',
               values_to = 'Val_YOY') %>%

ggplot(aes(x = Val_YOY, fill = Comb_YOY)) +
  geom_histogram(position = 'dodge', bins = 30) +
  labs(title = "Distribution of Year-Over-Year Changes:
       Inflation Rate vs Greenhouse Gas Emission",
       x = "Year-Over-Year Change",
       y = "Frequency")
```



```
Group_dataset %>%
   ggplot(mapping = aes(x = INF_Rate, y = GHG)) +
   geom_boxplot(outlier.colour = "red", outlier.shape = 16) +
   stat_summary(
     aes(label = round(..y.., 1)),
     geom = "text",
     fun.data = function(y) {
       out <- boxplot.stats(y)$out
       if (length(out) == 0) return(NULL)
       data.frame(y = out)
     },
     hjust = -0.5
   ) +
  labs(
    title = "Inflation rate vs Greenhouse gas emission",
    x = 'Inflation rate',
    y = "Greenhouse gas emission")
```

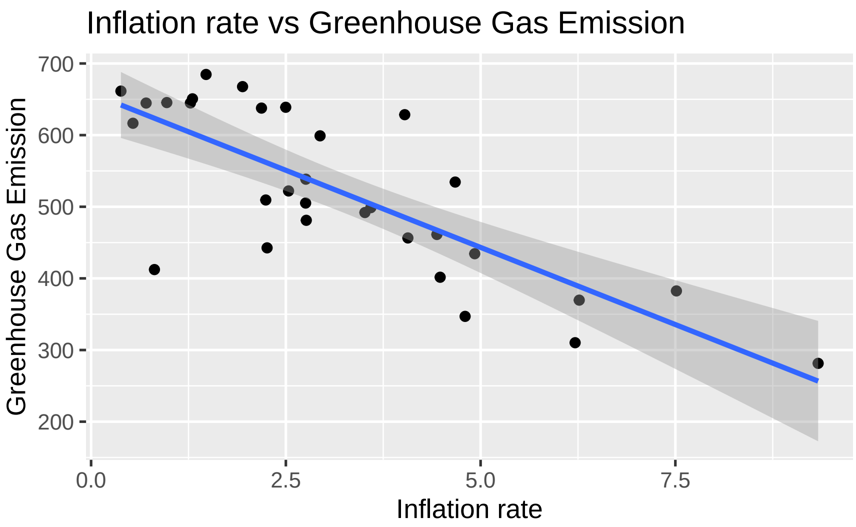
```
## Warning: Continuous x aesthetic
## i did you forget ‘aes(group = ...)‘?
```

```
## Warning: Computation failed in ‘stat_summary()‘.
## Caused by error in ‘fix.by()‘:
## ! ’by’ must specify uniquely valid columns
```

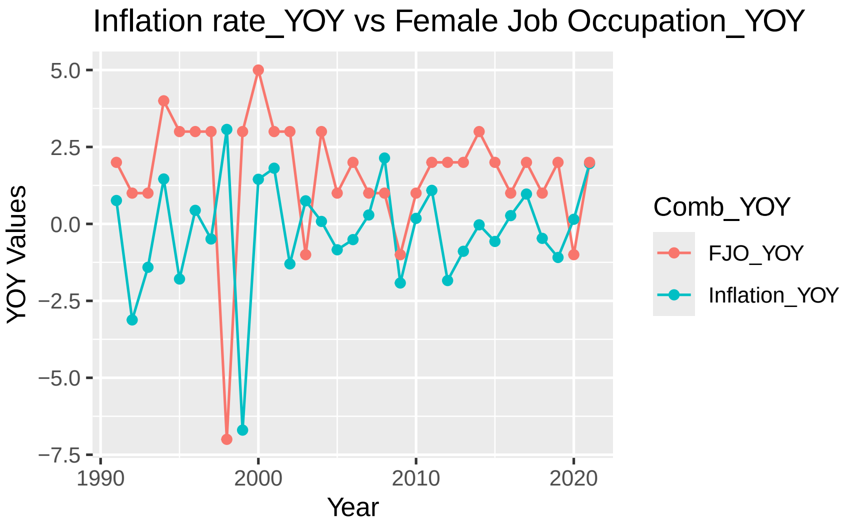


```
Group_dataset %>%
   ggplot() +
   geom_point(mapping= aes( x = INF_Rate, y = GHG))+
   geom_smooth(mapping=aes(x = INF_Rate, y = GHG),
method= 'lm')+
   labs(
     title= 'Inflation rate vs Greenhouse Gas Emission',
     x= 'Inflation rate',
     y= 'Greenhouse Gas Emission')
```

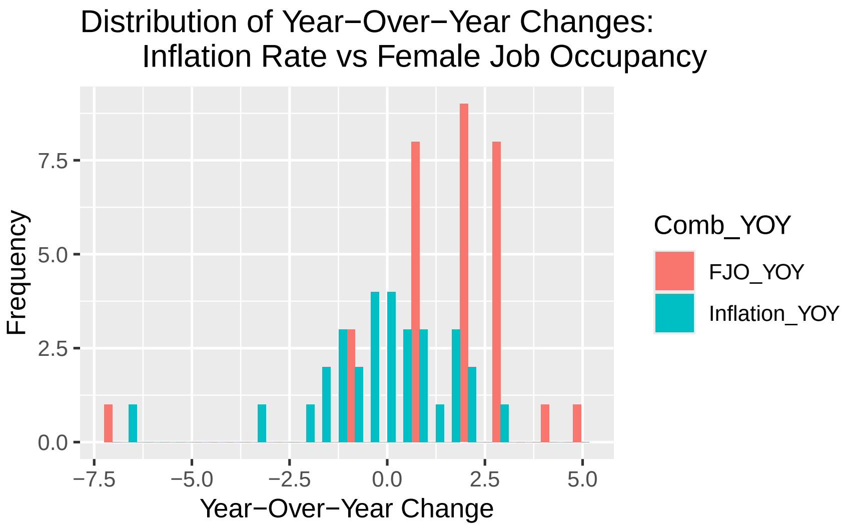
```
## ‘geom_smooth()‘ using formula = ’y ~ x’
```



```
Group_dataset %>%
  pivot_longer(cols = c('Inflation_YOY', 'FJO_YOY'),
               names_to = 'Comb_YOY',
               values_to = 'Val_YOY')%>%

ggplot(aes(x = Year, y = Val_YOY)) +
   geom_line(aes(color = Comb_YOY))+
   geom_point(aes(color = Comb_YOY)) +
   labs(
     title = 'Inflation rate_YOY vs Female Job Occupation_YOY',
     x = 'Year',
     y = 'YOY Values')
```



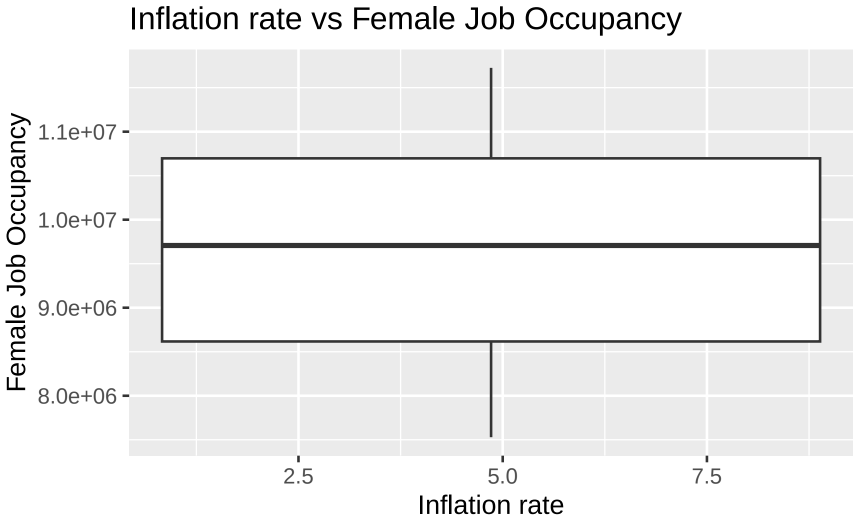
```r
Group_dataset %>%
  pivot_longer(cols = c('FJO_YOY', 'Inflation_YOY'),
               names_to = 'Comb_YOY',
               values_to = 'Val_YOY') %>%

ggplot(aes(x = Val_YOY, fill = Comb_YOY)) +
  geom_histogram(position = 'dodge', bins = 30) +
  labs(title = "Distribution of Year-Over-Year Changes:
       Inflation Rate vs Female Job Occupancy",
       x = "Year-Over-Year Change",
       y = "Frequency")
```



```r
Group_dataset %>%
   ggplot(mapping = aes(x = INF_Rate, y = FJO)) +
   geom_boxplot(outlier.colour = "red", outlier.shape = 16) +
   stat_summary(
     aes(label = round(..y.., 1)),
     geom = "text",
     fun.data = function(y) {
       out <- boxplot.stats(y)$out
       if (length(out) == 0) return(NULL)
       data.frame(y = out)
     },
     hjust = -0.5
   ) +
  labs(
    title = "Inflation rate vs Female Job Occupancy ",
    x = 'Inflation rate',
    y = "Female Job Occupancy")
```

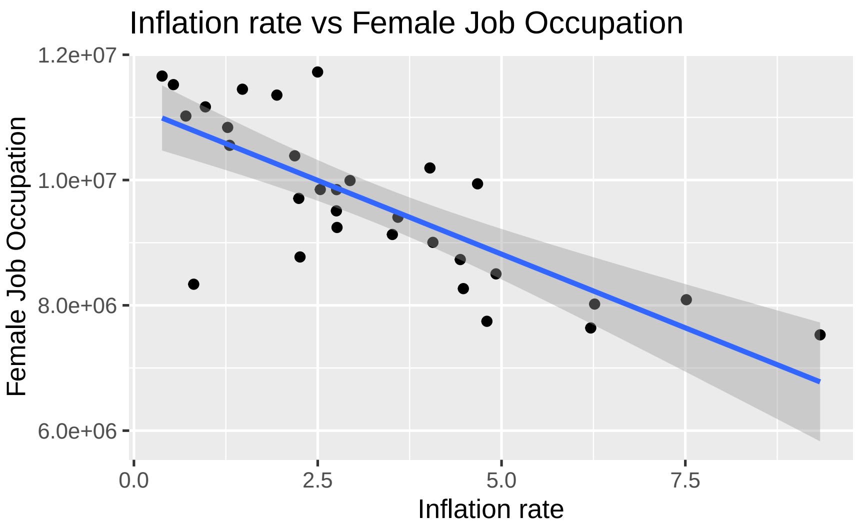
```
## Warning: Continuous x aesthetic
## i did you forget ‘aes(group = ...)‘?
```

```
## Warning: Computation failed in ‘stat_summary()‘.
## Caused by error in ‘fix.by()‘:
## ! ’by’ must specify uniquely valid columns
```



```
Group_dataset %>%
   ggplot() +
   geom_point(mapping = aes(x= INF_Rate, y= FJO))+
   geom_smooth(mapping=aes(x= INF_Rate, y= FJO),
method= 'lm')+
   labs(
     title= 'Inflation rate vs Female Job Occupation',
     x= 'Inflation rate',
     y= 'Female Job Occupation')
```

```
## ‘geom_smooth()‘ using formula = ’y ~ x’
```



Modeling & Hyphothesis test- Econ_ft year on year (Daeun Choi)

```r
# Model
Econ_ft_model <- lm(Birth_YOY ~ Inflation_YOY, data=Econ_ft)
```

```r
# Tidy model
Econ_ft_model %>%
  tidy()
```

term	estimate	std.error	statistic	p.value
(Intercept)	-2.5239630	0.3345546	-7.5442476	0.0000000
Inflation_YOY	-0.1266971	0.1850287	-0.6847431	0.4989426

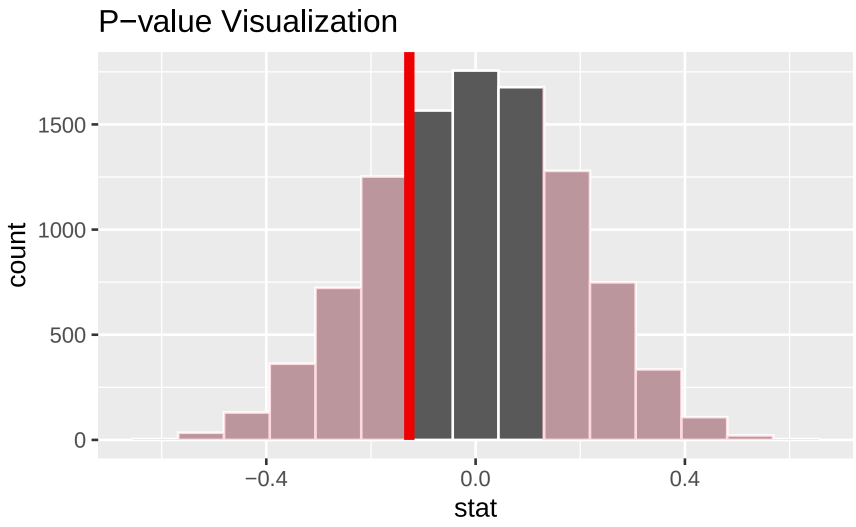
```r
# Null distribution
Econ_null_distribution <- Econ_ft %>%
  specify(Birth_YOY ~ Inflation_YOY) %>%
  hypothesize(null="independence") %>%
  generate(reps=10000, type="permute") %>%
  calculate(stat="slope")
```

```r
# Observed stat
Observed_stat <- Econ_ft %>%
  specify(Birth_YOY ~ Inflation_YOY) %>%
  calculate(stat="slope")
```

```
# P-value
Econ_null_distribution %>%
  get_p_value(obs_stat=Observed_stat, direction="both")
```

p_value
0.513

```
# P-value visualization
Econ_null_distribution %>%
  visualize() +
  shade_p_value(obs_stat=Observed_stat, direction= "both") +
  labs(title = "P-value Visualization")
```



Modeling & Hypothesis test - Econ_ft with actual value (Daeun Choi)

```
# Model
Econ_ft_model <- lm(Birth_per_1000 ~ INF_Rate, data = Econ_ft)
```

```
# Null distribution
Econ_null_distribution_rv <- Econ_ft %>%
  specify(Birth_per_1000 ~ INF_Rate) %>%
  hypothesize(null="independence") %>%
  generate(reps=10000, type="permute") %>%
  calculate(stat="slope")
```

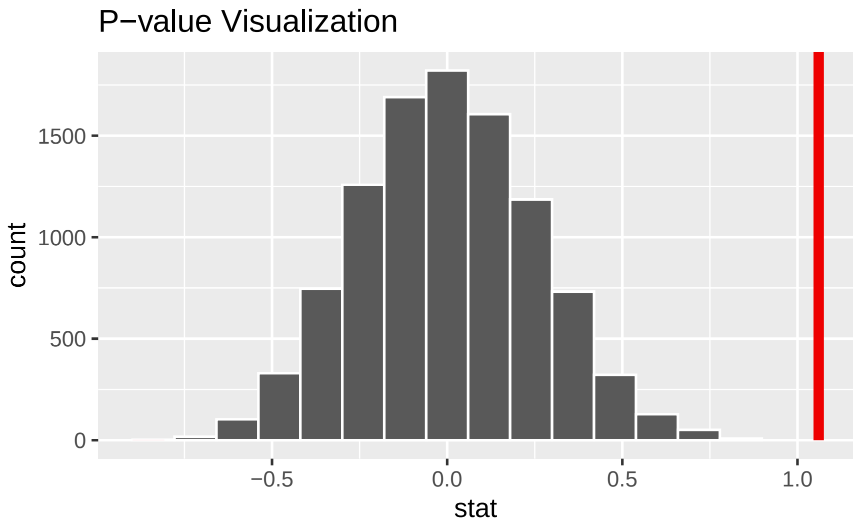
```
# Observed stat
Observed_stat <- Econ_ft %>%
  specify(Birth_per_1000 ~ INF_Rate) %>%
  calculate(stat="slope")
```

```
# P-value
Econ_null_distribution_rv %>%
  get_p_value(obs_stat=Observed_stat, direction="both")
```

```
## Warning: Please be cautious in reporting a p-value of 0. This result is an approximation
## based on the number of `reps` chosen in the `generate()` step.
## i See `get_p_value()` (`?infer::get_p_value()`) for more information.
```

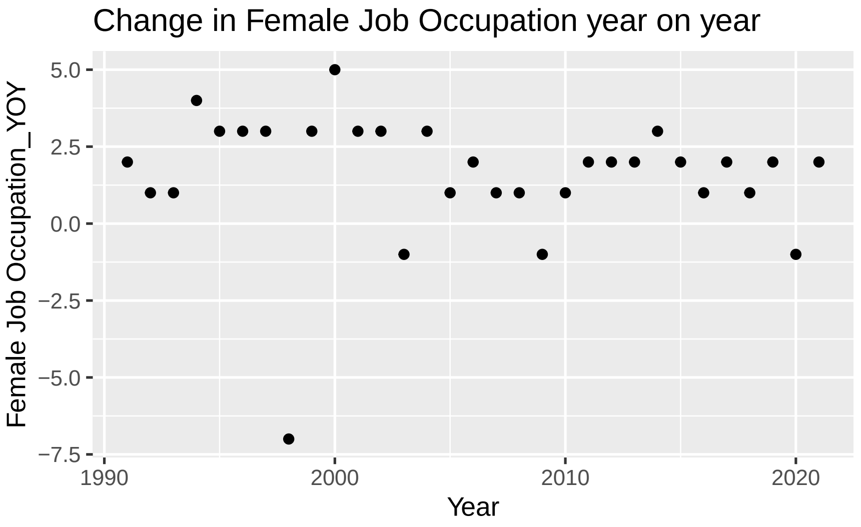
p_value
0

```
# P-value visualization
Econ_null_distribution_rv %>%
  visualize() +
  shade_p_value(obs_stat=Observed_stat, direction= "both") +
  labs(title = "P-value Visualization")
```



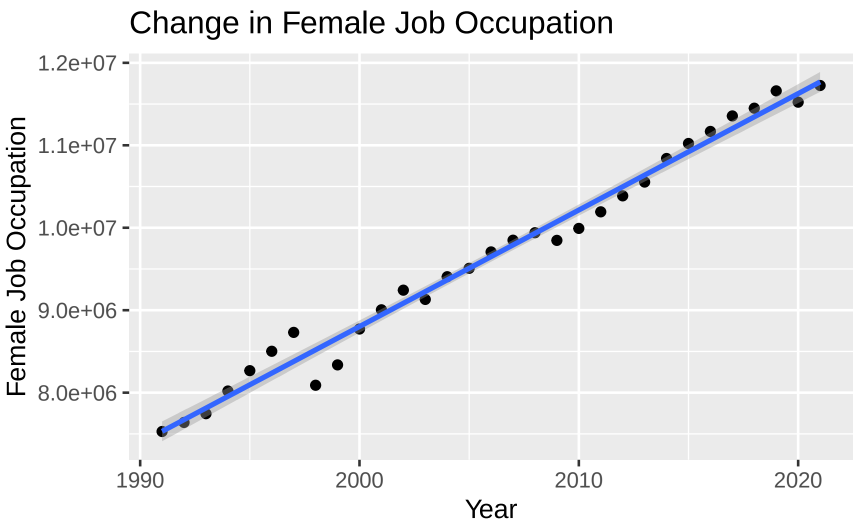
Variation and Covariation - Soci_ft (Eunho Cha)

```r
Soci_ft %>%
  ggplot() +
  geom_point(mapping = aes(y = FJO_YOY, x = Year)) +
  labs(title = "Change in Female Job Occupation year on year",
       y  = "Female Job Occupation_YOY",
       x = "Year")
```

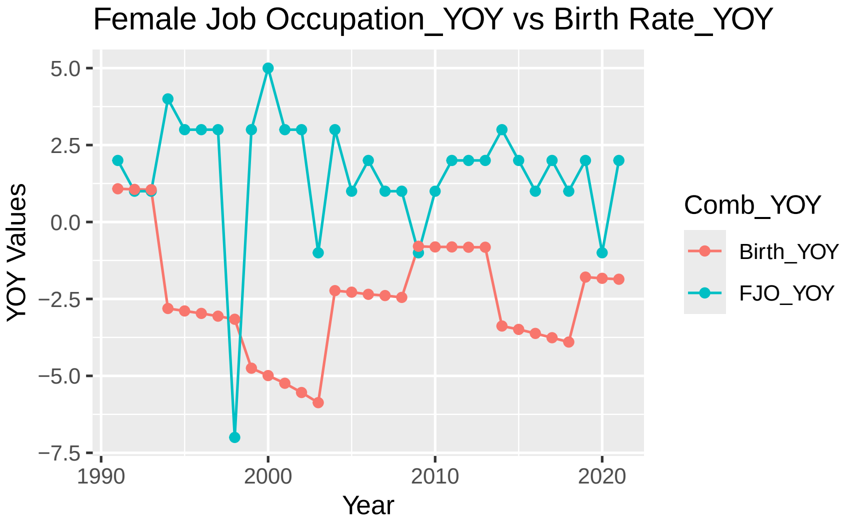


```r
Soci_ft %>%
  ggplot() +
  geom_point(mapping = aes(y = FJO, x = Year)) +
  geom_smooth(mapping = aes(y = FJO, x = Year), method = 'lm') +
  labs(title = "Change in Female Job Occupation",
       y  = "Female Job Occupation",
       x = "Year")
```

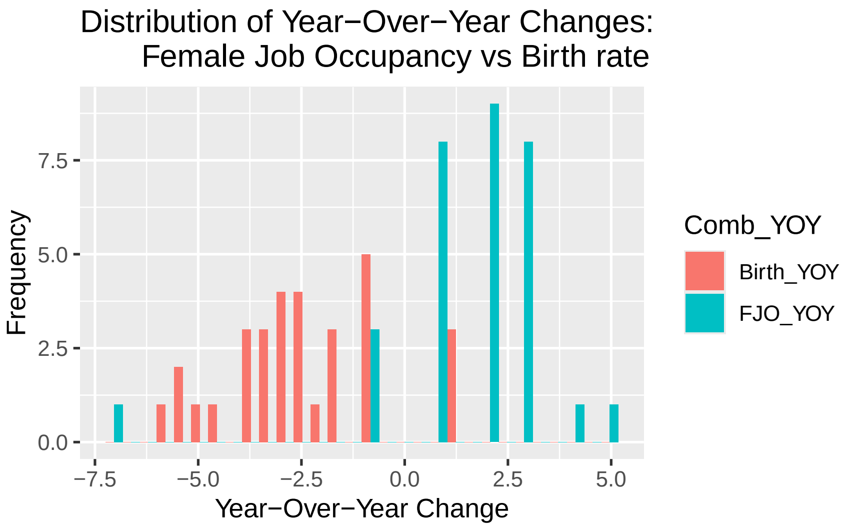
```
## ‘geom_smooth()‘ using formula = ’y ~ x’
```



```
Group_dataset%>%
  pivot_longer(cols = c('FJO_YOY', 'Birth_YOY'),
               names_to = 'Comb_YOY',
               values_to = 'Val_YOY')%>%

ggplot(aes(y = Val_YOY, x = Year)) +
  geom_line(aes(color = Comb_YOY))+
  geom_point(aes(color = Comb_YOY)) +
   labs(
     title="Female Job Occupation_YOY vs Birth Rate_YOY",
     x= "Year",
     y= "YOY Values"
   )
```



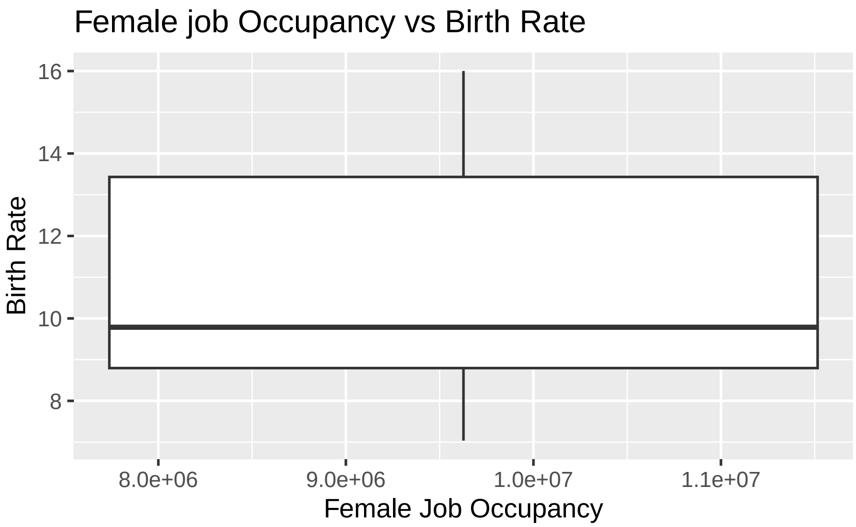
```
Group_dataset %>%
  pivot_longer(cols = c('FJO_YOY', 'Birth_YOY'),
               names_to = 'Comb_YOY',
               values_to = 'Val_YOY') %>%

ggplot(aes(x = Val_YOY, fill = Comb_YOY)) +
  geom_histogram(position = 'dodge', bins = 30) +
  labs(title = "Distribution of Year-Over-Year Changes:
       Female Job Occupancy vs Birth rate",
       x = "Year-Over-Year Change",
       y = "Frequency")
```



```
Group_dataset %>%
   ggplot(mapping = aes(x = FJO, y = Birth_per_1000)) +
   geom_boxplot(outlier.colour = "red", outlier.shape = 16) +
   stat_summary(
     aes(label = round(..y.., 1)),
     geom = "text",
     fun.data = function(y) {
       out <- boxplot.stats(y)$out
       if (length(out) == 0) return(NULL)
       data.frame(y = out)
     },
     hjust = -0.5
   ) +
  labs(
    title = "Female job Occupancy vs Birth Rate",
    x = 'Female Job Occupancy',
    y = "Birth Rate")
```

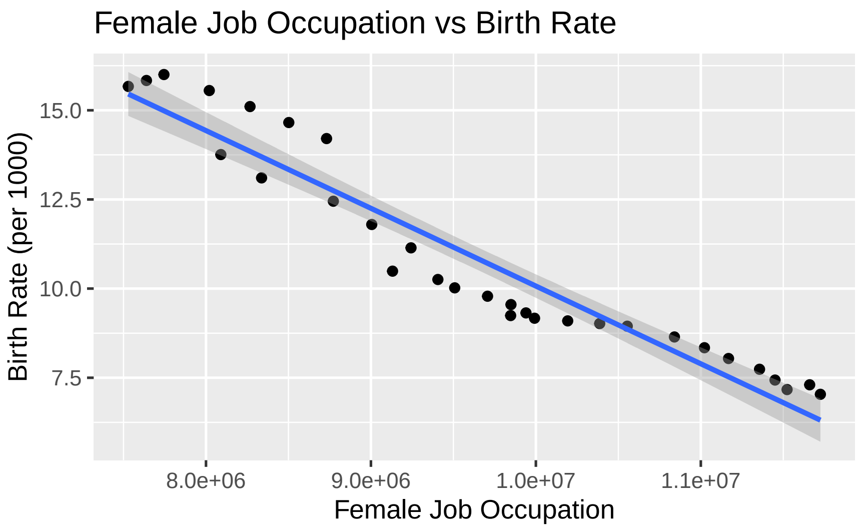
```
## Warning: Continuous x aesthetic
## i did you forget 'aes(group = ...)'?
```

```
## Warning: Computation failed in 'stat_summary()'.
## Caused by error in 'fix.by()':
## ! 'by' must specify uniquely valid columns
```

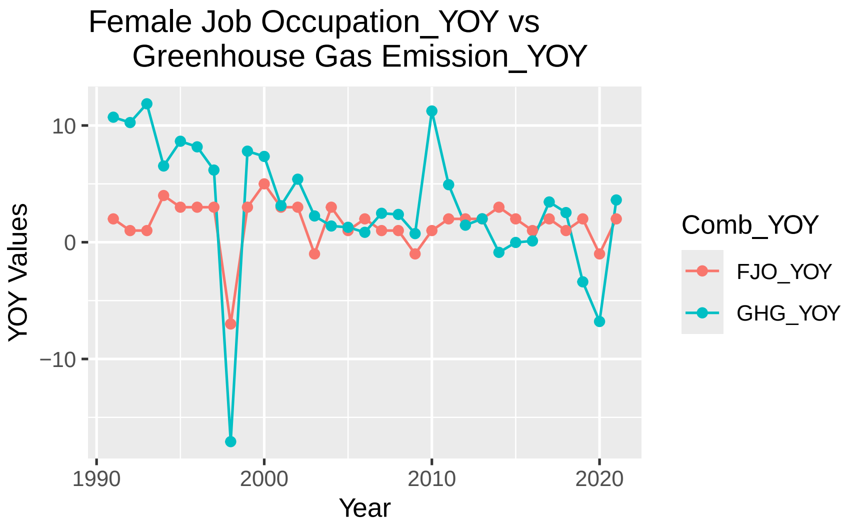


```
Soci_ft %>%
   ggplot() +
   geom_point(mapping = aes(x= FJO, y= Birth_per_1000))+
   geom_smooth(mapping=aes(x = FJO, y = Birth_per_1000), method="lm")+
   labs(
     title="Female Job Occupation vs Birth Rate",
     x= "Female Job Occupation",
     y= "Birth Rate (per 1000)"
   )
```

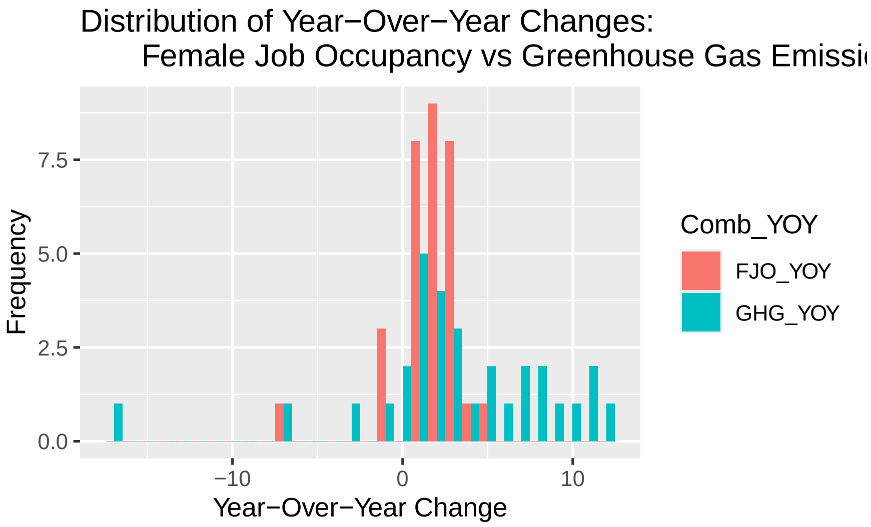
```
## 'geom_smooth()' using formula = 'y ~ x'
```



```
Group_dataset%>%
  pivot_longer(cols = c('FJO_YOY', 'GHG_YOY'),
               names_to = 'Comb_YOY',
               values_to = 'Val_YOY')%>%

ggplot(aes(y = Val_YOY, x = Year)) +
  geom_line(aes(color = Comb_YOY))+
  geom_point(aes(color = Comb_YOY)) +
   labs(
     title= "Female Job Occupation_YOY vs
     Greenhouse Gas Emission_YOY",
     x= "Year",
     y= "YOY Values"
   )
```

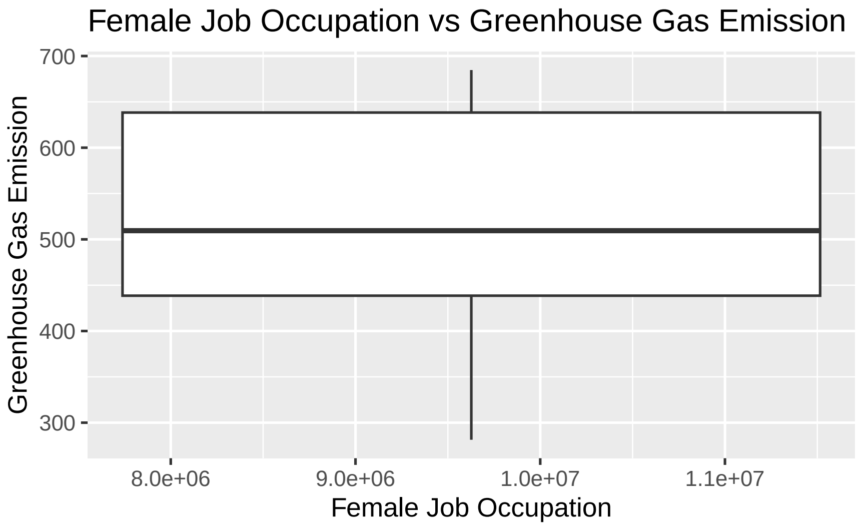


```r
Group_dataset %>%
  pivot_longer(cols = c('FJO_YOY', 'GHG_YOY'),
               names_to = 'Comb_YOY',
               values_to = 'Val_YOY') %>%

ggplot(aes(x = Val_YOY, fill = Comb_YOY)) +
  geom_histogram(position = 'dodge', bins = 30) +
  labs(title = "Distribution of Year-Over-Year Changes:
       Female Job Occupancy vs Greenhouse Gas Emission",
       x = "Year-Over-Year Change",
       y = "Frequency")
```



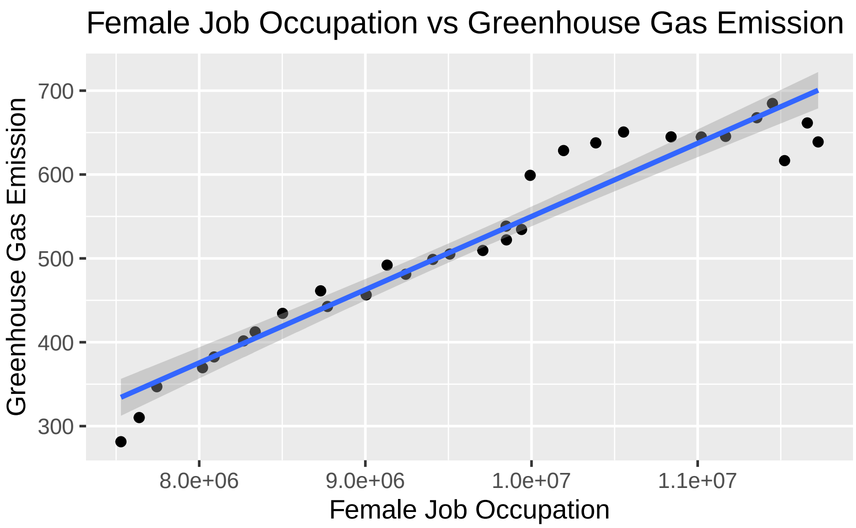
```r
Group_dataset %>%
   ggplot(mapping = aes(x = FJO, y = GHG)) +
   geom_boxplot(outlier.colour = "red", outlier.shape = 16) +
   stat_summary(
     aes(label = round(..y.., 1)),
     geom = "text",
     fun.data = function(y) {
       out <- boxplot.stats(y)$out
       if (length(out) == 0) return(NULL)
       data.frame(y = out)
     },
     hjust = -0.5
   ) +
    labs(
     title= "Female Job Occupation vs Greenhouse Gas Emission",
     x= "Female Job Occupation",
     y= "Greenhouse Gas Emission"
    )
```

```
## Warning: Continuous x aesthetic
## i did you forget ‘aes(group = ...)‘?

## Warning: Computation failed in ‘stat_summary()‘.
## Caused by error in ‘fix.by()‘:
## ! ’by’ must specify uniquely valid columns
```

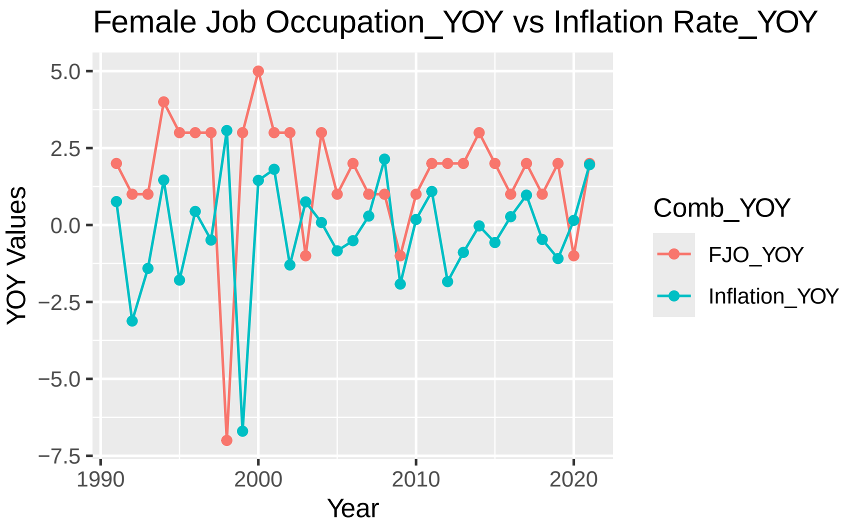


```
Group_dataset %>%
   ggplot() +
   geom_point(mapping= aes (x= FJO, y= GHG)) +
   geom_smooth(mapping=aes (x= FJO, y=GHG), method="lm")+
   labs(
     title= "Female Job Occupation vs Greenhouse Gas Emission",
     x= "Female Job Occupation",
     y= "Greenhouse Gas Emission"
   )
```

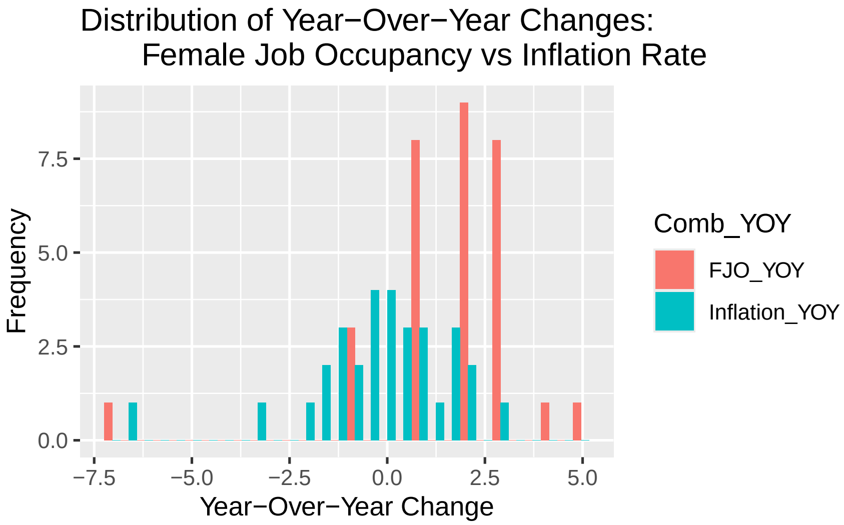
```
## ‘geom_smooth()‘ using formula = ’y ~ x’
```



```
Group_dataset%>%
  pivot_longer(cols = c('FJO_YOY', 'Inflation_YOY'),
               names_to = 'Comb_YOY',
               values_to = 'Val_YOY')%>%

ggplot(aes(y = Val_YOY, x = Year)) +
  geom_line(aes(color = Comb_YOY))+
  geom_point(aes(color = Comb_YOY)) +
   labs(
     title= "Female Job Occupation_YOY vs Inflation Rate_YOY",
     x= "Year",
     y= "YOY Values"
   )
```

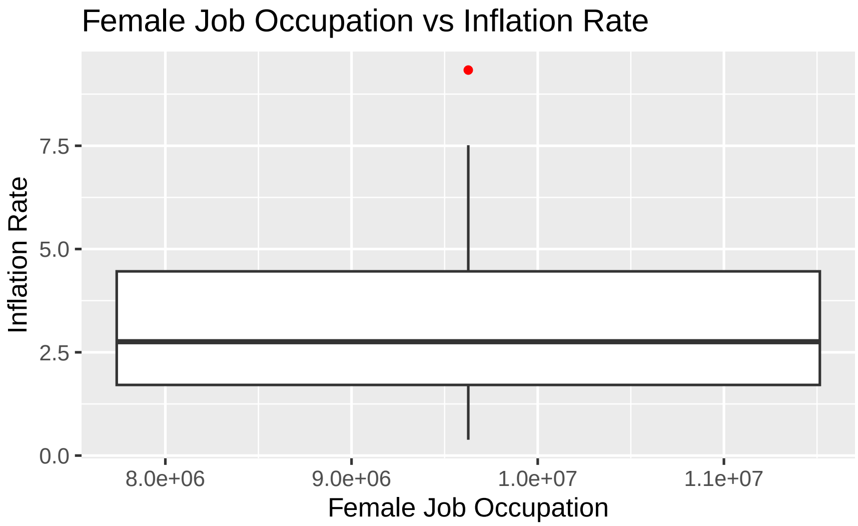


```
Group_dataset %>%
  pivot_longer(cols = c('FJO_YOY', 'Inflation_YOY'),
               names_to = 'Comb_YOY',
               values_to = 'Val_YOY') %>%

ggplot(aes(x = Val_YOY, fill = Comb_YOY)) +
  geom_histogram(position = 'dodge', bins = 30) +
  labs(title = "Distribution of Year-Over-Year Changes:
       Female Job Occupancy vs Inflation Rate",
       x = "Year-Over-Year Change",
       y = "Frequency")
```



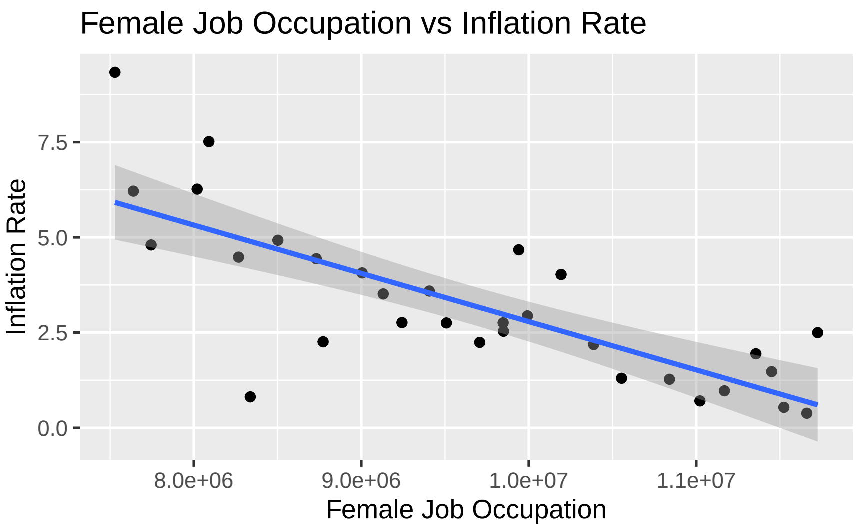
```
Group_dataset %>%
   ggplot(mapping = aes(x = FJO, y = INF_Rate)) +
   geom_boxplot(outlier.colour = "red", outlier.shape = 16) +
   stat_summary(
     aes(label = round(..y.., 1)),
     geom = "text",
     fun.data = function(y) {
       out <- boxplot.stats(y)$out
       if (length(out) == 0) return(NULL)
       data.frame(y = out)
     },
     hjust = -0.5
   ) +
    labs(
     title= "Female Job Occupation vs Inflation Rate",
     x= "Female Job Occupation",
     y= "Inflation Rate"
    )
```

```
## Warning: Continuous x aesthetic
## i did you forget ‘aes(group = ...)‘?

## Warning: Computation failed in ‘stat_summary()‘.
## Caused by error in ‘fix.by()‘:
## ! ’by’ must specify uniquely valid columns
```



```
Group_dataset %>%
  ggplot() +
  geom_point(mapping= aes (x= FJO, y=INF_Rate)) +
  geom_smooth(mapping=aes (x= FJO, y=INF_Rate), method="lm")+
  labs(
    title= "Female Job Occupation vs Inflation Rate",
    x= "Female Job Occupation",
    y= "Inflation Rate"
  )
```

```
## ‘geom_smooth()‘ using formula = ’y ~ x’
```



Modeling & Hypothesis test - Soci_ft year on year (Duy Tran)

```
# Model
Soci_ft_model <- lm(Birth_YOY ~ FJO_YOY, data = Soci_ft)
```

```
# Tidy model
Soci_ft_model %>%
  tidy()
```

term	estimate	std.error	statistic	p.value
(Intercept)	-2.3081339	0.4185330	-5.5148199	0.0000061
FJO_YOY	-0.1207724	0.1611897	-0.7492564	0.4597376

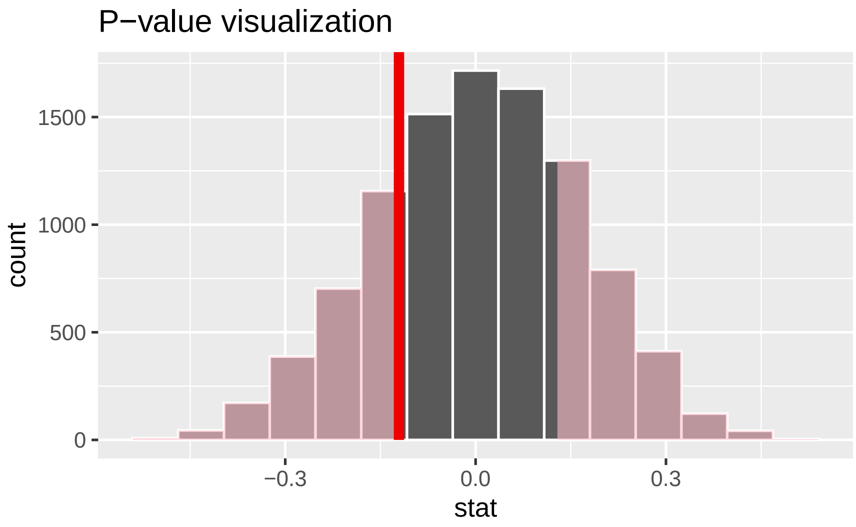
```
# Null distribution
Soci_null_distribution <- Soci_ft %>%
  specify(Birth_YOY ~ FJO_YOY) %>%
  hypothesize(null="independence") %>%
  generate(reps=10000, type="permute") %>%
  calculate(stat="slope")
```

```
# Observed stat
Observed_stat <- Soci_ft %>%
  specify(Birth_YOY ~ FJO_YOY) %>%
  calculate(stat="slope")
```

```r
# P-value
Soci_null_distribution %>%
  get_p_value(obs_stat=Observed_stat, direction="both")
```

p_value
0.447

```r
# P-value visualization
Soci_null_distribution %>%
  visualize() +
  shade_p_value(obs_stat=Observed_stat, direction="both") +
  labs(title ="P-value visualization")
```



Modeling & Hyphothesis test- Soci_ft with actual value (Duy Tran)

```r
# Model
Soci_ft_model <- lm(Birth_per_1000 ~ FJO, data = Soci_ft)
```

```r
# Null distribution
Soci_null_distribution_rv <- Soci_ft %>%
  specify(Birth_per_1000 ~ FJO) %>%
  hypothesize(null="independence") %>%
  generate(reps=10000, type="permute") %>%
  calculate(stat="slope")
```

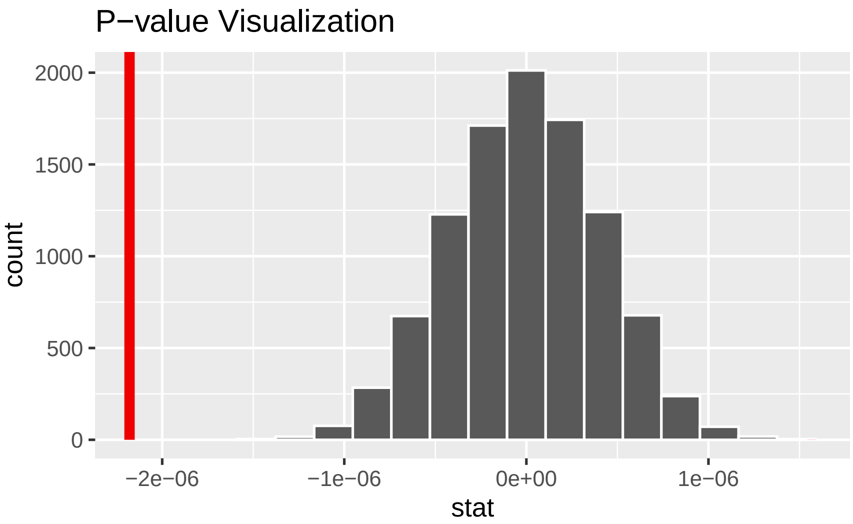
```r
# Observed stat
Observed_stat <- Soci_ft %>%
  specify(Birth_per_1000 ~ FJO) %>%
  calculate(stat="slope")
```

```r
# P-value
Soci_null_distribution_rv %>%
  get_p_value(obs_stat=Observed_stat, direction="both")
```

```
## Warning: Please be cautious in reporting a p-value of 0. This result is an approximation
## based on the number of `reps` chosen in the `generate()` step.
## i See `get_p_value()` (`?infer::get_p_value()`) for more information.
```

p_value
0

```r
# P-value visualization
Soci_null_distribution_rv %>%
  visualize() +
  shade_p_value(obs_stat=Observed_stat, direction= "both") +
  labs(title = "P-value Visualization")
```


P−value Visualization
count
−2e−06
−1e−06
0e+00
1e−06
stat