

# Understanding the structure of an Econometrics study

FLORENCE

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## Part A: Structure of an Econometrics Study

### Microeconomics Research Question

How does an individual's income and credit history affect their probability of credit card approval?

#### General Structure

- **Type of Research:** Secondary
- **Variables:**
  - **Dependent:** Acc (Credit Card Application Accepted)
  - **Independent:** MDR, Age, Income, Avgexp, Ownrent, Selfempl
- **Econometric Model:** Logistic Regression

$$P(Acc = 1) = \frac{e^{\beta_0 + \beta_1 MDR + \beta_2 Age + \beta_3 Income + \beta_4 Avgexp + \beta_5 Ownrent + \beta_6 Selfempl}}{1 + e^{\beta_0 + \beta_1 MDR + \beta_2 Age + \beta_3 Income + \beta_4 Avgexp + \beta_5 Ownrent + \beta_6 Selfempl}}$$

### Macroeconomics Research Question

How does economic growth affect overall credit card approval rates in an economy?

#### General Structure

- **Type of Research:** Secondary
- **Variables:**
  - **Dependent:** Credit Card Approval Rate
  - **Independent:** GDP Growth, Unemployment Rate, Inflation Rate, Interest Rate
- **Econometric Model:** Multiple Linear Regression

$$CreditCardApprovalRate = \beta_0 + \beta_1 GDPGrowth + \beta_2 Unemployment + \beta_3 Inflation + \beta_4 InterestRate + \epsilon$$

## Part B: Modelling Econometric Data in R

### Step 1: Load Required Libraries and Dataset

```
library(tidyverse) # Data manipulation
library(dplyr)     # Data filtering
library(ggplot2)   # Visualization
library(caret)     # Machine Learning
library(stargazer) # Regression tables
library(MatchIt)   # Causal inference
library(broom)     # Tidying model output

# The dataset
df <- read.csv("dataset_for_assignment(2)(1).csv")

# First few rows
head(df)
```

```
##   MDR Acc Age Income Avgexp Ownrent Selfempl
## 1   0   1  38   4.52 124.98        1         0
## 2   0   1  33   2.42   9.85        0         0
## 3   0   1  34   4.50  15.00        1         0
## 4   0   1  31   2.54 137.87        0         0
## 5   0   1  32   9.79 546.50        1         0
## 6   0   1  23   2.50  92.00        0         0
```

```
# Any missing values?
colSums(is.na(df))
```

```
##      MDR      Acc      Age      Income      Avgexp      Ownrent      Selfempl
##      0        0        0        0        0        0        0
```

```
# Summary statistics
summary(df)
```

```
##      MDR      Acc      Age      Income
## Min.   :0.00   Min.   :0.00   Min.   :20.00   Min.   : 1.500
## 1st Qu.:0.00   1st Qu.:0.00   1st Qu.:26.00   1st Qu.: 2.365
## Median :0.00   Median :1.00   Median :31.00   Median : 3.000
## Mean   :0.36   Mean   :0.73   Mean   :32.08   Mean   : 3.369
## 3rd Qu.:0.00   3rd Qu.:1.00   3rd Qu.:37.00   3rd Qu.: 3.970
## Max.   :7.00   Max.   :1.00   Max.   :55.00   Max.   :10.000
##      Avgexp      Ownrent      Selfempl
## Min.    : 0.0   Min.    :0.00   Min.    :0.00
## 1st Qu.: 0.0   1st Qu.:0.00   1st Qu.:0.00
## Median : 81.3   Median :0.00   Median :0.00
## Mean    :189.0   Mean    :0.36   Mean    :0.05
## 3rd Qu.:252.8   3rd Qu.:1.00   3rd Qu.:0.00
## Max.    :1898.0   Max.    :1.00   Max.    :1.00
```

## Normalizing Income and Avgexp for better model performance

```
df$Income <- df$Income / max(df$Income)
df$Avgexp <- df$Avgexp / max(df$Avgexp)
```

### # Fitting a logistic regression model

```
logit_model <- glm(Acc ~ MDR + Age + Income + Avgexp + Ownrent, data = df, family = binomial)
```

```
## Warning: glm.fit: algorithm did not converge
```

```
## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
# Model summary
summary(logit_model)
```

```
##
## Call:
## glm(formula = Acc ~ MDR + Age + Income + Avgexp + Ownrent, family = binomial,
##      data = df)
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)   146.024    7073.890   0.021   0.984
## MDR           -20.068  298320.604   0.000   1.000
## Age            -3.749    256.517  -0.015   0.988
## Income        -310.956  24470.842  -0.013   0.990
## Avgexp        18517.566  809676.522   0.023   0.982
## Ownrent         2.078    5552.584   0.000   1.000
##
## (Dispersion parameter for binomial family taken to be 1)
##
##      Null deviance: 1.1665e+02  on 99  degrees of freedom
## Residual deviance: 1.8476e-06  on 94  degrees of freedom
## AIC: 12
##
## Number of Fisher Scoring iterations: 25
```

## Multicollinearity Check

```
correlation_matrix <- cor(df %>% select(-Acc))
print(correlation_matrix)
```

```
##              MDR      Age      Income      Avgexp      Ownrent
## MDR          1.000000000 0.08061585 0.03231663 -0.17266824 0.0008290335
## Age          0.080615850 1.00000000 0.26852063 0.05275400 0.2865031786
## Income       0.032316629 0.26852063 1.00000000 0.38536546 0.3482643154
```

```
## Avgexp    -0.1726682410  0.05275400 0.38536546  1.00000000  0.2108062397
## Ownrent   0.0008290335  0.28650318 0.34826432  0.21080624  1.0000000000
## Selfempl  -0.0821635190 -0.02002775 0.20646528 -0.01427031 -0.0764719113
##           Selfempl
## MDR        -0.08216352
## Age        -0.02002775
## Income      0.20646528
## Avgexp     -0.01427031
## Ownrent    -0.07647191
## Selfempl   1.00000000
```

### Average Treatment Effect (ATE) for Income

```
# Median income
median_income <- median(df$Income)

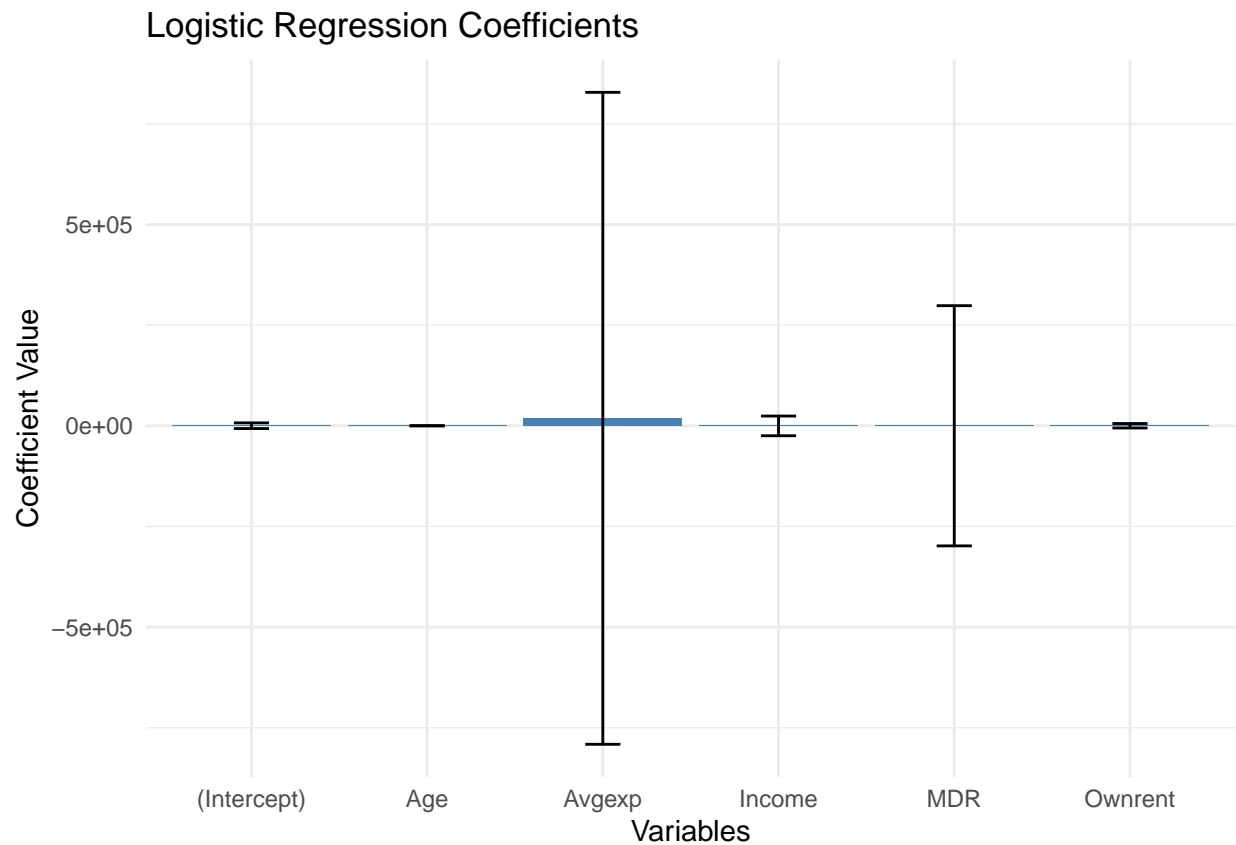
# Treatment and control groups
df$treatment <- ifelse(df$Income > median_income, 1, 0)

# Average approval rate
treatment_mean <- mean(df$Acc[df$treatment == 1])
control_mean <- mean(df$Acc[df$treatment == 0])

# Compute ATE
ATE <- treatment_mean - control_mean
ATE
```

```
## [1] -0.05258932
```

```
# Coefficients and plot
logit_coefs <- tidy(logit_model)
ggplot(logit_coefs, aes(x = term, y = estimate)) +
  geom_col(fill = "steelblue") +
  geom_errorbar(aes(ymin = estimate - std.error, ymax = estimate + std.error), width = 0.2) +
  labs(title = "Logistic Regression Coefficients", x = "Variables", y = "Coefficient Value") +
  theme_minimal()
```



```
# Approval rate for treatment and control groups plot
```

```
df |>
```

```
  group_by(treatment) |>
```

```
  summarise(approval_rate = mean(Acc)) |>
```

```
  ggplot(aes(x = factor(treatment), y = approval_rate, fill = factor(treatment))) +
```

```
  geom_bar(stat = "identity") +
```

```
  labs(title = "Approval Rate by Income Group", x = "Income Group (0 = Low, 1 = High)", y = "Approval Rate")
```

```
  scale_fill_manual(values = c("red", "blue")) +
```

```
  theme_minimal()
```

