# Loan Analysis

**Assignment What’s due:**

For this assignment, you will enter your answers on BlackBoard. The assignment is due no later than 8:00 AM Tuesday December 12, 2023.

The following instructions will step you through problems and list the questions that you will be asked on BlackBoard. Each problem will include several questions for that problem. Each question is worth 2 points. There are 50 questions for a total of 100 points.

This is a group assignment but will be scored individually. You may work with your group on the assignment, but each student must enter your answers into BlackBoard. Scores will be automatically posted after the deadline. Assignments that are submitted late will receive a score of zero. Note: you must enter answers exactly as requested. Misspelled answers or errors in numbers will be scored as wrong.

# Background

Customers enter a bank and consider taking out a loan. Determine the factors that influence whether a customer takes out a loan.

# Definitions:

PersonalLoan: 0 if did not take out a loan, 1 if took out a loan Age: age of customer (years)

CCAvg: average monthly credit card spending (in $1,000)

Education: three categories (undergraduate-1, graduate-2, professional-3) Experience: professional experience of customer (years)

Family: family size of customer

Income: income of customer (in $1,000)

Mortgage: size of mortgage (in $1,000)

CDAccount: No/Yes (0,1)

CreditCard: No/Yes (0,1)

Online: No/Yes (0,1)

SecuritiesAccount: No/Yes (0,1)

# Resources

Use the dataset UniversalBank.csv from BlackBoard.

Use Rcmdr for this analysis. If you run other software and get different answers, the answers will be marked as incorrect.

# Questions:

**Problem #1: Significant Variables in Logit**

Run a logit regression with PersonalLoan as the dependent variable (Y) and all non-binary variables as independent (X) variables. Do not use CDAccount, CreditCard, Online, or Securities Account for this problem.

1. How many of the coefficients (intercept and variables) are significant at the 0.05 level?

**5**

1. What is the coefficient of Education? (x.xx)

**1.69**

1. Is the coefficient of Education significant at the 0.05 level? (Yes or No)

**Yes**

1. What is the coefficient of Experience? (x.xx)

**0.08**

1. Is the coefficient of Experience significant at the 0.05 level? (Yes or No)

**No**

1. What effect does Age have on the probability of taking out a loan? (Increases probability, Decreases probability, Cannot make any conclusion)

**Cannot make any conclusion**

# Problem #2: Significant Variables in Probit

Run a probit regression with PersonalLoan as the dependent variable (Y) and all non-binary variables as independent (X) variables. Do not use CDAccount, CreditCard, Online, or Securities Account for this problem.

1. How many of the coefficients (intercept and variables) are significant at the 0.05 level?

**5**

1. What is the coefficient of Family? (x.xx)

**0.34**

1. Is the coefficient of Family significant at the 0.05 level? (Yes or No)

**Yes**

1. What is the coefficient of Income? (x.xx)

**0.03**

1. Is the coefficient of Income significant at the 0.05 level? (Yes or No)

**Yes**

1. What effect does Mortgage have on the probability of taking out a loan? (Increases probability, Decreases probability, Cannot make any conclusion)

**Cannot make any conclusion**

# Problem #3: Reduced Model Logit

Run a logit regression with PersonalLoan as the dependent variable (Y) and Education, Family, and Income as independent (X) variables.

1. What is the coefficient of Education? (x.xx)

**1.62**

1. Is the coefficient of Education significant at the 0.05 level? (Yes or No)

**Yes**

1. What is the coefficient of Family? (x.xx)

**0.68**

1. Is the coefficient of Family significant at the 0.05 level? (Yes or No)

**Yes**

1. What is the coefficient of Income? (x.xx)

**0.06**

1. Is the coefficient of Income significant at the 0.05 level? (Yes or No)

**Yes**

# Problem #4: Reduced Model Probit

Run a probit regression with PersonalLoan as the dependent variable (Y) and Education, Family, and Income as independent (X) variables.

1. What is the coefficient of Education? (x.xx)

**0.78**

1. Is the coefficient of Education significant at the 0.05 level? (Yes or No)

**Yes**

1. What is the coefficient of Family? (x.xx)

**0.33**

1. Is the coefficient of Family significant at the 0.05 level? (Yes or No)

**Yes**

1. What is the coefficient of Income? (x.xx)

**0.03**

1. Is the coefficient of Income significant at the 0.05 level? (Yes or No)

**Yes**

# Problem #5: Logit Predictions and Sensitivity Analysis

The results below are from a logit regression with PersonalLoan as the dependent variable (Y) and Education and Income as independent (X) variables.

Coefficients:

Estimate Std. Error z value Pr(>|z|)

(Intercept) -11.277354 0.421381 -26.76 <2e-16 \*\*\*

Education 1.724336 0.099339 17.36 <2e-16 \*\*\*

Income 0.052255 0.002034 25.69 <2e-16 \*\*\*

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Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Create a prediction model for this logit regression. After creating a prediction model, create a sensitivity analysis on PersonalLoan probability by varying Education (1 to 3 by increments of 1) and Income (20 to 200 by increments of 20) as the two dimensions of the sensitivity analysis.

1. What is the probability of taking out a PersonalLoan when Education = Professional and Income = $80,000 per year? (x.xx) (probabilities are between 0.00 and 1.00)

**0.13**

1. What is the probability of taking out a PersonalLoan when Education = Graduate and Income = $120,000? (x.xx) (probabilities are between 0.00 and 1.00)

**0.17**

1. What is the probability of taking out a PersonalLoan when Education = Undergraduate and Income = $160,000? (x.xx) (probabilities are between 0.00 and 1.00)

**0.23**

# Problem #6: Probit Predictions and Sensitivity Analysis

The results below are from a probit regression with PersonalLoan as the dependent variable (Y) and Education and Income as independent (X) variables.

Coefficients:

Estimate Std. Error z value Pr(>|z|)

(Intercept) -5.7865341 0.1966486 -29.43 <2e-16 \*\*\*

Education 0.8290666 0.0487247 17.02 <2e-16 \*\*\*

Income 0.0273955 0.0009865 27.77 <2e-16 \*\*\*

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Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Create a prediction model for this probit regression. After creating a prediction model, create a sensitivity analysis on PersonalLoan probability by varying Education (1 to 3 by increments of 1) and Income (20 to 200 by increments of 20) as the two dimensions of the sensitivity analysis.

1. What is the probability of taking out a PersonalLoan when Education = Professional and Income = $80,000 per year? (x.xx) (probabilities are between 0.00 and 1.00)

**0.13**

1. What is the probability of taking out a PersonalLoan when Education = Graduate and Income = $120,000? (x.xx) (probabilities are between 0.00 and 1.00)

**0.20**

1. What is the probability of taking out a PersonalLoan when Education = Undergraduate and Income = $160,000? (x.xx) (probabilities are between 0.00 and 1.00)Problem

**0.28**

# Problem #7: Logit Moderating Effect

Run a logit regression with PersonalLoan as the dependent variable (Y) and Family, Income, and Family\*Income as independent (X) variables.

1. What is the coefficient of Family? (x.xx)

**-1.49**

1. Is the coefficient of Family significant at the 0.05 level? (Yes or No)

**Yes**

1. What is the coefficient of Income? (x.xx)

**0.00**

1. Is the coefficient of Income significant at the 0.05 level? (Yes or No)

**No**

1. What is the coefficient of Family\*Income? (x.xx)

**0.02**

1. Is the coefficient of Family\*Income significant at the 0.05 level? (Yes or No)

**Yes**

# Problem #8: Probit Moderating Effect

Run a probit regression with PersonalLoan as the dependent variable (Y) and Family, Income, and Family\*Income as independent (X) variables.

1. What is the coefficient of Family? (x.xx)

**-0.87**

1. Is the coefficient of Familty significant at the 0.05 level? (Yes or No)

**Yes**

1. What is the coefficient of Income? (x.xx)

**-0.00**

1. Is the coefficient of Income significant at the 0.05 level? (Yes or No)

**No**

1. What is the coefficient of Family\*Income? (x.xx)

**0.01**

1. Is the coefficient of Family\*Income significant at the 0.05 level? (Yes or No)

**Yes**

# Problem #9: Logit Moderating Effect Predictions and Sensitivity Analysis

The results below are from a logit regression with PersonalLoan as the dependent variable (Y) and Education, Income and Education\*Income as independent (X) variables.

Coefficients:

Estimate Std. Error z value Pr(>|z|)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| (Intercept) | 1.905818 | 0.805047 | 2.367 | 0.0179 \* |
| Education | -7.043853 | 0.676857 | -10.407 | <2e-16 \*\*\* |
| Income | -0.058799 | 0.007082 | -8.303 | <2e-16 \*\*\* |
| Education:Income | 0.079411 | 0.006280 | 12.646 | <2e-16 \*\*\* |
| --- |  |  |  |  |

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Create a prediction model for this logit regression. After creating a prediction model, create a sensitivity analysis on PersonalLoan probability by varying Education (1 to 3 by increments of 1) and Income (20 to 200 by increments of 20) as the two dimensions of the sensitivity analysis.

1. What is the probability of taking out a PersonalLoan when Education = Professional and Income = $80,000 per year? (x.xx) (probabilities are between 0.00 and 1.00

**0.01**

1. What is the probability of taking out a PersonalLoan when Education = Graduate and Income = $120,000? (x.xx) (probabilities are between 0.00 and 1.00)

**0.46**

1. What is the probability of taking out a PersonalLoan when Education = Undergraduate and Income = $160,000? (x.xx) (probabilities are between 0.00 and 1.00)

**0.14**

# Problem #10: Probit Moderating Effect Predictions and Sensitivity Analysis

The results below are from a probit regression with PersonalLoan as the dependent variable (Y) and Education, Income and Education\*Income as independent (X) variables.

Coefficients:

Estimate Std. Error z value Pr(>|z|)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| (Intercept) | 0.688135 | 0.365103 | 1.885 | 0.0595 . |
| Education | -3.468733 | 0.301614 | -11.501 | <2e-16 \*\*\* |
| Income | -0.029574 | 0.003300 | -8.963 | <2e-16 \*\*\* |
| Education:Income | 0.040270 | 0.002863 | 14.065 | <2e-16 \*\*\* |
| --- |  |  |  |  |

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Create a prediction model for this probit regression. After creating a prediction model, create a sensitivity analysis on PersonalLoan probability by varying Education (1 to 3 by increments of 1) and Income (20 to 200 by increments of 20) as the two dimensions of the sensitivity analysis.

1. What is the probability of taking out a PersonalLoan when Education = Professional and Income = $80,000 per year? (x.xx) (probabilities are between 0.00 and 1.00)

**0.01**

1. What is the probability of taking out a PersonalLoan when Education = Graduate and Income = $120,000? (x.xx) (probabilities are between 0.00 and 1.00)

**0.45**

1. What is the probability of taking out a PersonalLoan when Education = Undergraduate and Income = $160,000? (x.xx) (probabilities are between 0.00 and 1.00)

**0.14**

# Problem #11: Concepts

1. Which model, logit or probit, is more sensitive to the prediction taking out a loan for a customer with a graduate degree and an income of $75,000?

**probit**

1. Which model, logit or probit, is more sensitive to the prediction taking out a loan for a customer with an undergraduate degree and an income of $25,000?

**logit**