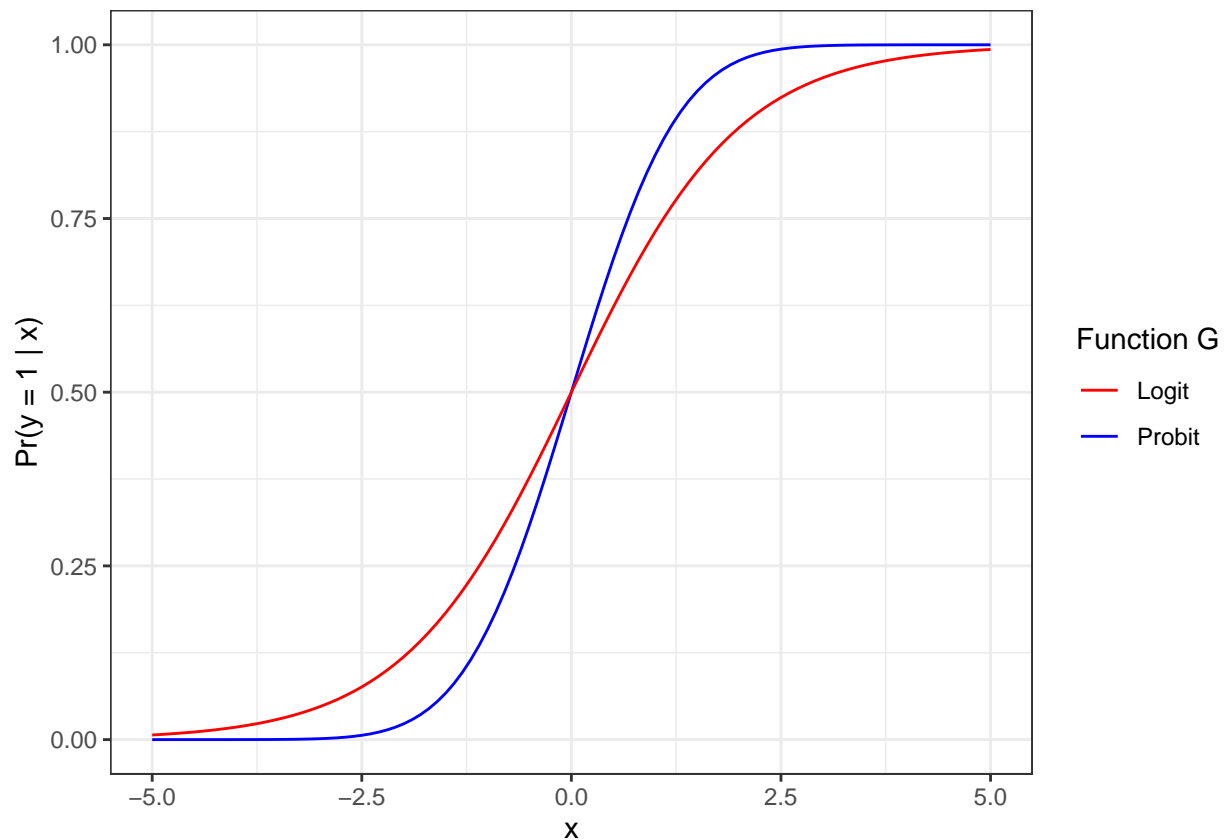


Modelos Logit e Probit

Inicialmente, compararemos o comportamento de ambas funções (logit e probit).

```
library(ggplot2)
ggplot(data.frame(x = c(-5,5)), aes(x=x)) +
  stat_function(fun = pnorm, aes(colour = "Probit")) +
  stat_function(fun = plogis, aes(colour = "Logit")) +
  theme_bw() +
  scale_colour_manual(name = "Function G", values = c("red", "blue")) +
  scale_y_continuous(name = "Pr(y = 1 | x)")
```



Participação da Mulher no Mercado de Trabalho

Neste exemplo, analisaremos um conjunto de dados conhecido como **mroz**. A base de dados contém 753 observações e é utilizada para investigar a participação de mulheres casadas na força de trabalho e renda.

Em nossa análise, utilizaremos a participação da mulher no mercado de trabalho (infl) como variável resposta e a relacionaremos com diferentes variáveis independentes através dos modelos logit e probit.

```
library(wooldridge)
data("mroz"); head(mroz)
```

```
##      infl  hours kidslt6 kidsge6 age educ  wage repwage hushrs husage huseduc
```

```
## 1 1 1610 1 0 32 12 3.3540 2.65 2708 34 12
## 2 1 1656 0 2 30 12 1.3889 2.65 2310 30 9
## 3 1 1980 1 3 35 12 4.5455 4.04 3072 40 12
## 4 1 456 0 3 34 12 1.0965 3.25 1920 53 10
## 5 1 1568 1 2 31 14 4.5918 3.60 2000 32 12
## 6 1 2032 0 0 54 12 4.7421 4.70 1040 57 11
## huswage faminc mtr motheduc fatheduc unem city exper nwifeinc lwage
## 1 4.0288 16310 0.7215 12 7 5.0 0 14 10.910060 1.21015370
## 2 8.4416 21800 0.6615 7 7 11.0 1 5 19.499981 0.32851210
## 3 3.5807 21040 0.6915 12 7 5.0 0 15 12.039910 1.51413774
## 4 3.5417 7300 0.7815 7 7 5.0 0 6 6.799996 0.09212332
## 5 10.0000 27300 0.6215 12 14 9.5 1 7 20.100058 1.52427220
## 6 6.7106 19495 0.6915 14 7 7.5 1 33 9.859054 1.55648005
## expersq
## 1 196
## 2 25
## 3 225
## 4 36
## 5 49
## 6 1089
```

Ajuste dos modelos

Em nossa análise, utilizaremos o *software* estatístico R. Para ajuste modelos logit e probit, aplicamos a função `glm`.

Utilizaremos idade (age), número de crianças com menos de 6 anos no domicílio (kidslt6) e rendimento familiar subtraído da renda oriunda do trabalho (nwifeinc).

Probit

```
probit <- glm(formula = inlf ~ age + kidslt6 + nwifeinc,
              data = mroz,
              family = binomial(link = "probit"))

summary(probit)

##
## Call:
## glm(formula = inlf ~ age + kidslt6 + nwifeinc, family = binomial(link = "probit"),
##      data = mroz)
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)  2.080225   0.308677   6.739 1.59e-11 ***
## age         -0.034819   0.006649  -5.236 1.64e-07 ***
## kidslt6     -0.799504   0.110531  -7.233 4.71e-13 ***
## nwifeinc    -0.011450   0.004192  -2.732  0.0063 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## (Dispersion parameter for binomial family taken to be 1)
##
## Null deviance: 1029.75 on 752 degrees of freedom
## Residual deviance: 956.79 on 749 degrees of freedom
## AIC: 964.79
##
## Number of Fisher Scoring iterations: 4
```

Logit

```
logit <- glm(formula = inlf ~ age + kidslt6 + nwifeinc,
             data = mroz,
             family = binomial(link = "logit"))

summary(logit)
```

```
##
## Call:
## glm(formula = inlf ~ age + kidslt6 + nwifeinc, family = binomial(link = "logit"),
##      data = mroz)
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)  3.394399   0.515576   6.584 4.59e-11 ***
## age          -0.056855   0.010991  -5.173 2.31e-07 ***
## kidslt6      -1.313316   0.187535  -7.003 2.50e-12 ***
## nwifeinc     -0.018751   0.006889  -2.722 0.00649 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
## Null deviance: 1029.75 on 752 degrees of freedom
## Residual deviance: 956.75 on 749 degrees of freedom
## AIC: 964.75
##
## Number of Fisher Scoring iterations: 4
```

Efeito Parcial na Média (PEA)

Probit

```
probitMean <- mfx::probitmfx(formula = inlf ~ age + kidslt6 + nwifeinc,
                             data = mroz, atmean = TRUE)

probitMean
```

```
## Call:
## mfx::probitmfx(formula = inlf ~ age + kidslt6 + nwifeinc, data = mroz,
```

```
##      atmean = TRUE)
##
## Marginal Effects:
##           dF/dx  Std. Err.      z    P>|z|
## age      -0.0136710  0.0026087 -5.2406 1.601e-07 ***
## kidslt6  -0.3139105  0.0435115 -7.2144 5.416e-13 ***
## nwifeinc -0.0044957  0.0016463 -2.7308 0.006317 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Logit

```
logitMean <- mfx::logitmfx(formula = inlf ~ age + kidslt6 + nwifeinc,
                           data = mroz, atmean = TRUE)

logitMean
```

```
## Call:
## mfx::logitmfx(formula = inlf ~ age + kidslt6 + nwifeinc, data = mroz,
##      atmean = TRUE)
##
## Marginal Effects:
##           dF/dx  Std. Err.      z    P>|z|
## age      -0.0139264  0.0026861 -5.1846 2.165e-07 ***
## kidslt6  -0.3216922  0.0460995 -6.9782 2.989e-12 ***
## nwifeinc -0.0045930  0.0016880 -2.7209 0.00651 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Efeito Parcial Médio (APE)

Probit

```
probitAvg <- mfx::probitmfx(formula = inlf ~ age + kidslt6 + nwifeinc,
                             data = mroz, atmean = FALSE)

probitAvg
```

```
## Call:
## mfx::probitmfx(formula = inlf ~ age + kidslt6 + nwifeinc, data = mroz,
##      atmean = FALSE)
##
## Marginal Effects:
##           dF/dx  Std. Err.      z    P>|z|
## age      -0.0126459  0.0022822 -5.5412 3.005e-08 ***
## kidslt6  -0.2903722  0.0358252 -8.1053 5.264e-16 ***
## nwifeinc -0.0041586  0.0015000 -2.7724 0.005564 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Logit

```
LogitAvg <- mfx::logitmfx(formula = inlf ~ age + kidslt6 + nwifeinc,  
                          data = mroz, atmean = FALSE)
```

LogitAvg

```
## Call:  
## mfx::logitmfx(formula = inlf ~ age + kidslt6 + nwifeinc, data = mroz,  
##      atmean = FALSE)  
##  
## Marginal Effects:  
##           dF/dx  Std. Err.      z    P>|z|  
## age          -0.0126521  0.0026322 -4.8066 1.535e-06 ***  
## kidslt6      -0.2922576  0.0473994 -6.1659 7.010e-10 ***  
## nwifeinc     -0.0041727  0.0015666 -2.6635 0.007733 **  
## ---  
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```