Objective1\_Devyani

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# Load necessary libraries

# Load the dataset

# View first few rows

## # A tibble: 6 × 322  
## farmer\_id farmers\_name village taluka age gender marital\_status education  
## <chr> <chr> <chr> <chr> <dbl> <chr> <chr> <chr>   
## 1 <NA> नारायण रामलाल … वडगाव बु भडगाव 37 male married primary   
## 2 <NA> शिवाजी नथ्थू महा… कजगाव भडगाव 44 male married primary   
## 3 <NA> दीपक आत्माराम प… मळगाव भडगाव 48 male married secondary  
## 4 <NA> नरेंद्र भिकन पाटील कजगाव भडगाव 50 male married primary   
## 5 <NA> गजानन रामदास … केकतनिंभ… जामनेर 25 male unmarried secondary  
## 6 <NA> भावेश भगवान वाघ… गोंडखेल जामनेर 21 male unmarried secondary  
## # ℹ 314 more variables: religion <chr>, caste <chr>, subcaste <chr>,  
## # mother\_tongue <chr>, family\_type <chr>, head\_of\_family <chr>,  
## # relation\_with\_farmer <chr>, total\_family\_members <dbl>,  
## # income\_sources <chr>, `income\_sources/agriculture` <dbl>,  
## # `income\_sources/labour` <dbl>, `income\_sources/job` <dbl>,  
## # `income\_sources/business` <dbl>, `income\_sources/Privatejob` <dbl>,  
## # `income\_sources/GovernmentJob` <dbl>, `income\_sources/Pension` <dbl>, …

# Check the structure of the dataset

## tibble [229 × 322] (S3: tbl\_df/tbl/data.frame)  
## $ farmer\_id : chr [1:229] NA NA NA NA ...  
## $ farmers\_name : chr [1:229] "नारायण रामलाल माळी" "शिवाजी नथ्थू महाजन" "दीपक आत्माराम पाटील" "नरेंद्र भिकन पाटील" ...  
## $ village : chr [1:229] "वडगाव बु" "कजगाव" "मळगाव" "कजगाव" ...  
## $ taluka : chr [1:229] "भडगाव" "भडगाव" "भडगाव" "भडगाव" ...  
## $ age : num [1:229] 37 44 48 50 25 21 40 36 69 43 ...  
## $ gender : chr [1:229] "male" "male" "male" "male" ...  
## $ marital\_status : chr [1:229] "married" "married" "married" "married" ...  
## $ education : chr [1:229] "primary" "primary" "secondary" "primary" ...  
## $ religion : chr [1:229] "हिंदू" "हिंदू" "हिंदू" "हिंदू" ...  
## $ caste : chr [1:229] "फुलमाळी" "माळी" "कुणबी" "राजपूत" ...  
## $ subcaste : chr [1:229] "ओबीसी" "OBC" "ओबीसी" "VJNT" ...  
## $ mother\_tongue : chr [1:229] "मराठी" "मराठी" "मराठी , अहिराणी" "मराठी" ...  
## $ family\_type : chr [1:229] "nuclear" "joint" "nuclear" "nuclear" ...  
## $ head\_of\_family : chr [1:229] "सोनाली नारायण माळी" "सरला शिवाजी महाजन" "सुनंदा दीपक पाटील" "छायाबाई नरेंद्र पाटील" ...  
## $ relation\_with\_farmer : chr [1:229] "पत्नी" "पत्नी" "पत्नी" "पत्नी" ...  
## $ total\_family\_members : num [1:229] 5 5 4 3 4 3 5 4 15 3 ...  
## $ income\_sources : chr [1:229] "agriculture labour" "agriculture labour" "agriculture" "agriculture labour" ...  
## $ income\_sources/agriculture : num [1:229] 1 1 1 1 1 0 1 0 1 1 ...  
## $ income\_sources/labour : num [1:229] 1 1 0 1 1 1 1 1 0 1 ...  
## $ income\_sources/job : num [1:229] NA NA NA NA NA NA NA NA NA NA ...  
## $ income\_sources/business : num [1:229] 0 0 0 0 0 0 0 0 0 0 ...  
## $ income\_sources/Privatejob : num [1:229] 0 0 0 0 0 0 0 0 0 0 ...  
## $ income\_sources/GovernmentJob : num [1:229] 0 0 0 0 0 0 0 0 0 0 ...  
## $ income\_sources/Pension : num [1:229] 0 0 0 0 0 0 0 0 0 0 ...  
## $ income\_sources/Other : num [1:229] 0 0 0 0 0 0 0 0 0 0 ...  
## $ otherincome : chr [1:229] NA NA NA NA ...  
## $ traditional\_business : chr [1:229] "शेती" "शेती" "शेती" "शेती" ...  
## $ annual\_income : chr [1:229] "below\_50k" "below\_50k" "below\_50k" "below\_50k" ...  
## $ bpl\_status : chr [1:229] "no" "no" "no" "yes" ...  
## $ ration\_card : chr [1:229] "orange" "orange" "orange" "yellow" ...  
## $ FarmersGroup : chr [1:229] NA NA NA NA ...  
## $ SHGroup : chr [1:229] NA NA NA NA ...  
## $ land\_type : chr [1:229] "own" "own" "own" "own" ...  
## $ irrigated\_land : chr [1:229] "0" "-" "0" "0" ...  
## $ dry\_land : chr [1:229] "3 बिघे" "02" "3" "1" ...  
## $ total\_land : chr [1:229] "0" "02" "0" "1" ...  
## $ SoilTesting : chr [1:229] NA NA NA NA ...  
## $ SoilTestedYear : num [1:229] NA NA NA NA NA NA NA NA NA NA ...  
## $ water\_sources : chr [1:229] "none" "neighbor\_water" "none" "none" ...  
## $ water\_sources/none : num [1:229] 1 0 1 1 1 1 1 1 1 1 ...  
## $ water\_sources/river : num [1:229] 0 0 0 0 0 0 0 0 0 0 ...  
## $ water\_sources/well : num [1:229] 0 0 0 0 0 0 0 0 0 0 ...  
## $ water\_sources/canal : num [1:229] 0 0 0 0 0 0 0 0 0 0 ...  
## $ water\_sources/borewell : num [1:229] 0 0 0 0 0 0 0 0 0 0 ...  
## $ water\_sources/farm\_pond : num [1:229] 0 0 0 0 0 0 0 0 0 0 ...  
## $ water\_sources/reservoir : num [1:229] 0 0 0 0 0 0 0 0 0 0 ...  
## $ water\_sources/dam : num [1:229] 0 0 0 0 0 0 0 0 0 0 ...  
## $ water\_sources/neighbor\_water : num [1:229] 0 1 0 0 0 0 0 0 0 0 ...  
## $ cotton : num [1:229] 0 1 0 1 133 5 3 NA 3 2 ...  
## $ maize : num [1:229] 3 1 3 NA 1 NA NA 7 0 0 ...  
## $ jowar : num [1:229] 0 NA 0 NA NA NA NA NA 0 0 ...  
## $ bajra : num [1:229] 0 NA 0 NA NA NA NA NA 0 0 ...  
## $ pulses : num [1:229] 0 NA 0 NA NA NA NA NA 0 0 ...  
## $ soybean : num [1:229] 0 NA 0 NA NA NA NA NA 0 0 ...  
## $ wheat : num [1:229] 0 NA 0 NA NA NA NA NA 0 0 ...  
## $ gram : num [1:229] 0 NA 0 NA NA NA NA NA 0 0 ...  
## $ sorghum : num [1:229] 0 NA 0 NA NA NA NA NA 0 0 ...  
## $ maize2 : num [1:229] 0 NA 0 NA NA NA NA NA 0 0 ...  
## $ groundnut : num [1:229] 0 NA 0 NA NA NA NA NA 0 0 ...  
## $ melon : num [1:229] 0 NA 0 NA NA NA NA NA 0 0 ...  
## $ sesame : num [1:229] 0 NA 0 NA NA NA NA NA 0 0 ...  
## $ banana : num [1:229] NA NA 0 NA NA NA NA NA 0 0 ...  
## $ pomegranate : num [1:229] NA NA 0 NA NA NA NA NA 0 0 ...  
## $ citrus : num [1:229] NA NA 0 NA NA NA NA NA 0 0 ...  
## $ vegetables : num [1:229] NA NA 0 NA NA NA NA NA 0 0 ...  
## $ other\_crops : chr [1:229] "0" "इतर पीक घेतलं नाही" "0" "नाही" ...  
## $ \_\_001 : chr [1:229] "No" "Yes" "No" "Yes" ...  
## $ text\_qi3tf85 : chr [1:229] NA NA NA NA ...  
## $ text\_pu6bd80 : chr [1:229] NA NA NA NA ...  
## $ bullocks : num [1:229] 0 0 0 0 0 0 1 1 1 0 ...  
## $ cow : num [1:229] 1 0 0 0 0 0 0 0 1 0 ...  
## $ buffalo : chr [1:229] "0" "0" "0" "0" ...  
## $ goat : chr [1:229] "0" "0" "0" "0" ...  
## $ sheep : chr [1:229] "0" "0" "0" "0" ...  
## $ poultry : num [1:229] 0 0 0 0 0 0 0 0 0 0 ...  
## $ text\_cu6dv88 : chr [1:229] NA NA NA NA ...  
## $ sprayer : num [1:229] 0 0 0 0 0 0 0 0 1 0 ...  
## $ motor : num [1:229] 0 1 0 0 0 0 0 0 0 0 ...  
## $ thresher : num [1:229] 0 0 0 0 0 0 0 0 0 0 ...  
## $ tractor : num [1:229] 0 0 0 0 0 0 0 1 0 0 ...  
## $ other\_001 : chr [1:229] NA "नाही" "0" NA ...  
## $ farm\_income : chr [1:229] "below\_50k" "below\_50k" "below\_50k" "below\_50k" ...  
## $ monthly\_expense : chr [1:229] "4500" "10000" "4500" "10000" ...  
## $ select\_one\_ld4vw19 : chr [1:229] NA NA NA NA ...  
## $ secondary\_business : chr [1:229] "no" "no" "no" "no" ...  
## $ business\_type : chr [1:229] "labor" "labor" "labor" "labor" ...  
## $ business\_type/labor : num [1:229] 1 1 1 1 1 1 1 1 0 1 ...  
## $ business\_type/dairy : num [1:229] 0 0 0 0 0 0 0 0 0 0 ...  
## $ business\_type/poultry : num [1:229] 0 0 0 0 0 0 0 0 0 0 ...  
## $ business\_type/job : num [1:229] 0 0 0 0 0 0 0 0 0 0 ...  
## $ business\_type/cottage : num [1:229] 0 0 0 0 0 0 0 0 0 0 ...  
## $ business\_type/goat\_farming : num [1:229] 0 0 0 0 0 0 0 0 0 0 ...  
## $ business\_type/other : num [1:229] 0 0 0 0 0 0 0 0 1 0 ...  
## $ text\_yx7ko73 : chr [1:229] NA NA NA NA ...  
## $ text\_cu8jm42 : chr [1:229] NA NA NA NA ...  
## $ loan\_status : chr [1:229] "yes" "yes" "yes" "yes" ...  
## $ loan\_amount : chr [1:229] "75k\_1lakh" "50k\_75k" "below\_50k" "below\_50k" ...  
## $ loan\_purpose : chr [1:229] "agriculture\_inputs debt\_repayment" "agriculture\_inputs debt\_repayment household\_needs" "agriculture\_inputs debt\_repayment" "agriculture\_inputs crop\_loss debt\_repayment household\_needs" ...  
## $ loan\_purpose/agriculture\_inputs : num [1:229] 1 1 1 1 1 1 1 1 1 NA ...  
## [list output truncated]

# Check for missing values

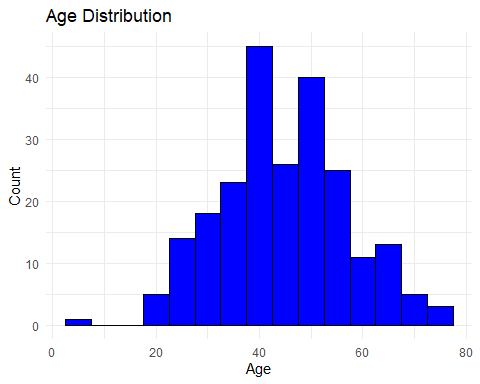
## farmer\_id   
## 56   
## farmers\_name   
## 0   
## village   
## 0   
## taluka   
## 0   
## age   
## 0   
## gender   
## 0   
## marital\_status   
## 0   
## education   
## 0   
## religion   
## 0   
## caste   
## 0   
## subcaste   
## 0   
## mother\_tongue   
## 0   
## family\_type   
## 0   
## head\_of\_family   
## 0   
## relation\_with\_farmer   
## 0   
## total\_family\_members   
## 0   
## income\_sources   
## 0   
## income\_sources/agriculture   
## 0   
## income\_sources/labour   
## 0   
## income\_sources/job   
## 145   
## income\_sources/business   
## 0   
## income\_sources/Privatejob   
## 3   
## income\_sources/GovernmentJob   
## 3   
## income\_sources/Pension   
## 3   
## income\_sources/Other   
## 3   
## otherincome   
## 228   
## traditional\_business   
## 0   
## annual\_income   
## 0   
## bpl\_status   
## 0   
## ration\_card   
## 0   
## FarmersGroup   
## 62   
## SHGroup   
## 62   
## land\_type   
## 0   
## irrigated\_land   
## 0   
## dry\_land   
## 0   
## total\_land   
## 0   
## SoilTesting   
## 67   
## SoilTestedYear   
## 226   
## water\_sources   
## 0   
## water\_sources/none   
## 0   
## water\_sources/river   
## 0   
## water\_sources/well   
## 0   
## water\_sources/canal   
## 0   
## water\_sources/borewell   
## 0   
## water\_sources/farm\_pond   
## 0   
## water\_sources/reservoir   
## 0   
## water\_sources/dam   
## 0   
## water\_sources/neighbor\_water   
## 0   
## cotton   
## 43   
## maize   
## 144   
## jowar   
## 179   
## bajra   
## 188   
## pulses   
## 187   
## soybean   
## 188   
## wheat   
## 174   
## gram   
## 170   
## sorghum   
## 188   
## maize2   
## 171   
## groundnut   
## 194   
## melon   
## 194   
## sesame   
## 196   
## banana   
## 191   
## pomegranate   
## 196   
## citrus   
## 196   
## vegetables   
## 196   
## other\_crops   
## 0   
## \_\_001   
## 30   
## text\_qi3tf85   
## 213   
## text\_pu6bd80   
## 102   
## bullocks   
## 0   
## cow   
## 0   
## buffalo   
## 0   
## goat   
## 0   
## sheep   
## 0   
## poultry   
## 0   
## text\_cu6dv88   
## 190   
## sprayer   
## 0   
## motor   
## 0   
## thresher   
## 0   
## tractor   
## 0   
## other\_001   
## 165   
## farm\_income   
## 0   
## monthly\_expense   
## 0   
## select\_one\_ld4vw19   
## 65   
## secondary\_business   
## 0   
## business\_type   
## 0   
## business\_type/labor   
## 0   
## business\_type/dairy   
## 0   
## business\_type/poultry   
## 0   
## business\_type/job   
## 0   
## business\_type/cottage   
## 0   
## business\_type/goat\_farming   
## 0   
## business\_type/other   
## 0   
## text\_yx7ko73   
## 181   
## text\_cu8jm42   
## 112   
## loan\_status   
## 0   
## loan\_amount   
## 31   
## loan\_purpose   
## 31   
## loan\_purpose/agriculture\_inputs   
## 31   
## loan\_purpose/agriculture\_machinery   
## 31   
## loan\_purpose/crop\_loss   
## 31   
## loan\_purpose/debt\_repayment   
## 31   
## loan\_purpose/household\_needs   
## 31   
## loan\_purpose/supplementary\_business   
## 31   
## loan\_purpose/other   
## 31   
## LoanOtherReason   
## 223   
## loan\_source   
## 31   
## loan\_source/bank   
## 31   
## loan\_source/private\_lender   
## 31   
## loan\_source/cooperative   
## 31   
## loan\_source/relatives\_friends   
## 31   
## loan\_source/self\_help\_group   
## 31   
## loan\_source/microfinance   
## 31   
## loan\_source/other   
## 31   
## bank\_name   
## 112   
## bank\_name\_001   
## 226   
## loan\_duration   
## 31   
## overdue\_loan   
## 31   
## overdue\_duration   
## 31   
## subsidized\_loan   
## 31   
## health\_conditions\_other   
## 178   
## low\_market\_price   
## 0   
## climate\_change   
## 0   
## irrigation\_problem   
## 0   
## high\_fertilizer\_cost   
## 0   
## lack\_of\_govt\_support   
## 0   
## labour\_cost   
## 0   
## middleman\_exploitation   
## 0   
## high\_production\_cost   
## 0   
## inflation\_stress   
## 0   
## lack\_of\_processing\_units   
## 0   
## electricity\_issue   
## 0   
## no\_minimum\_price   
## 0   
## no\_farm\_loan   
## 0   
## pest\_disease   
## 0   
## disaster\_damage   
## 0   
## no\_compensation   
## 0   
## storage\_marketing\_issue   
## 0   
## lack\_of\_family\_support   
## 0   
## tech\_resistance   
## 0   
## aadhar\_card   
## 0   
## voter\_id   
## 0   
## ayushman\_bharat\_card   
## 0   
## pm\_kisan\_card   
## 0   
## JobCard   
## 57   
## PMLIfeInsurance   
## 58   
## caste\_validity   
## 0   
## caste\_validity\_001   
## 3   
## caste\_validity\_001\_001   
## 3   
## caste\_certificate   
## 0   
## age\_nationality\_certificate   
## 0   
## pan\_card   
## 0   
## bank\_account   
## 0   
## ration\_card\_001   
## 0   
## driving\_license   
## 0   
## pm\_kisan   
## 0   
## pm\_kisan\_mandhan   
## 0   
## pm\_kisan\_mandhan\_001   
## 3   
## pm\_kisan\_mandhan\_001\_001   
## 3   
## pm\_kisan\_mandhan\_001\_001\_001   
## 3   
## pmksy   
## 0   
## pmfby   
## 0   
## kisan\_credit   
## 0   
## loan\_waiver   
## 0   
## organic\_farming   
## 0   
## organic\_farming\_001   
## 3   
## aif\_funding   
## 0   
## agri\_tech   
## 0   
## farm\_pond   
## 0   
## community\_pond   
## 0   
## tractor\_scheme   
## 0   
## accident\_insurance   
## 0   
## farmer\_training   
## 0   
## tree\_plantation   
## 0   
## solar\_pump   
## 0   
## water\_conservation   
## 0   
## market\_facility   
## 0   
## agri\_dev   
## 0   
## rupee\_insurance   
## 0   
## atma   
## 0   
## Difficulties   
## 58   
## Difficulties/1   
## 58   
## Difficulties/2   
## 58   
## Difficulties/3   
## 58   
## Difficulties/4   
## 58   
## Difficulties/5   
## 58   
## other\_difficulties   
## 201   
## scheme\_info\_sources   
## 0   
## scheme\_info\_sources/local\_agriculture\_office   
## 0   
## scheme\_info\_sources/cooperative   
## 0   
## scheme\_info\_sources/tv\_radio   
## 0   
## scheme\_info\_sources/internet\_apps   
## 0   
## scheme\_info\_sources/ngo   
## 0   
## scheme\_info\_sources/\_   
## 3   
## other\_info\_sources   
## 216   
## scheme\_improvements   
## 0   
## scheme\_improvements/more\_info\_training   
## 0   
## scheme\_improvements/simplified\_process   
## 0   
## scheme\_improvements/local\_help\_centers   
## 0   
## scheme\_improvements/other   
## 3   
## other\_improvements   
## 226   
## family\_problems   
## 0   
## suicide\_causes   
## 0   
## suicide\_prevention   
## 0   
## govt\_initiatives   
## 0   
## farming\_training   
## 0   
## alternate\_income   
## 0   
## informant\_name   
## 0   
## informant\_mobile   
## 0   
## surveyor\_name   
## 0   
## depression\_1   
## 0   
## depression\_2   
## 0   
## depression\_3   
## 0   
## depression\_4   
## 0   
## depression\_5   
## 0   
## anxiety\_1   
## 0   
## anxiety\_2   
## 0   
## anxiety\_3   
## 0   
## anxiety\_4   
## 0   
## social\_support\_1   
## 0   
## social\_support\_2   
## 0   
## social\_support\_3   
## 0   
## social\_support\_4   
## 0   
## suicidal\_ideation\_1   
## 0   
## suicidal\_ideation\_2   
## 0   
## suicidal\_ideation\_3   
## 0   
## financial\_stress\_1   
## 0   
## financial\_stress\_2   
## 0   
## financial\_stress\_3   
## 0   
## financial\_stress\_4   
## 0   
## coping\_1   
## 0   
## coping\_2   
## 0   
## coping\_3   
## 0   
## coping\_4   
## 0   
## life\_satisfaction\_1   
## 0   
## life\_satisfaction\_2   
## 0   
## life\_satisfaction\_3   
## 0   
## life\_satisfaction\_4   
## 0   
## member\_depressed   
## 0   
## mental\_support   
## 0   
## medical\_need   
## 0   
## govt\_schemes\_awareness   
## 0   
## positive\_mental\_state   
## 0   
## social\_participation   
## 0   
## govt\_support\_needed   
## 0   
## education\_continuity   
## 0   
## housing\_type   
## 0   
## housing\_condition   
## 0   
## additional\_observations   
## 0   
## Point\_and\_shoot\_Use\_mera\_to\_take\_a\_photo   
## 4   
## Point\_and\_shoot\_Use\_mera\_to\_take\_a\_photo\_URL   
## 4   
## \_\_003   
## 176   
## text\_ye0iz81   
## 226   
## \_\_005   
## 229   
## life\_insurance   
## 226   
## \_\_006   
## 178   
## agri\_insurance   
## 226   
## \_\_007   
## 176   
## cropping\_pattern   
## 226   
## \_   
## 179   
## crops\_kharif   
## 226   
## crops\_kharif/jowar   
## 226   
## crops\_kharif/bajra   
## 226   
## crops\_kharif/maize   
## 226   
## crops\_kharif/urad\_moong   
## 226   
## crops\_kharif/soybean   
## 226   
## crops\_kharif/\_\_\_\_   
## 226   
## \_\_008   
## 228   
## crops\_rabi   
## 226   
## crops\_rabi/wheat   
## 226   
## crops\_rabi/gram   
## 226   
## crops\_rabi/jowar\_late   
## 226   
## crops\_rabi/\_\_\_\_   
## 226   
## crops\_summer   
## 226   
## crops\_summer/maize   
## 226   
## crops\_summer/sugarcane   
## 226   
## crops\_summer/groundnut   
## 226   
## crops\_summer/cucumber\_melon   
## 226   
## crops\_summer/\_\_\_\_   
## 226   
## crops\_horticulture   
## 226   
## crops\_horticulture/banana   
## 226   
## crops\_horticulture/pomegranate   
## 226   
## crops\_horticulture/citrus   
## 226   
## crops\_horticulture/\_\_\_\_   
## 226   
## other   
## 226   
## \_\_009   
## 225   
## \_\_010   
## 186   
## text\_lo1xd85   
## 229   
## \_\_011   
## 200   
## health\_conditions   
## 229   
## health\_conditions/heart\_disease   
## 229   
## health\_conditions/diabetes   
## 229   
## health\_conditions/respiratory\_disease   
## 229   
## health\_conditions/mental\_stress   
## 229   
## health\_conditions/other   
## 229   
## \_\_012   
## 177   
## \_\_013   
## 204   
## \_\_014   
## 184   
## \_\_015   
## 229   
## other\_farming\_issues   
## 226   
## job\_card   
## 226   
## \_\_017   
## 176   
## balasaheb\_project   
## 226   
## \_\_018   
## 177   
## ahilyadevi\_nursery   
## 226   
## other\_schemes   
## 226   
## \_\_002   
## 176   
## \_\_002/1   
## 176   
## \_\_002/2   
## 176   
## \_\_002/3   
## 176   
## \_\_002/4   
## 176   
## \_\_002/5   
## 176   
## \_id   
## 0   
## \_uuid   
## 0   
## \_submission\_time   
## 0   
## \_validation\_status   
## 216   
## \_notes   
## 229   
## \_status   
## 0   
## \_submitted\_by   
## 229   
## \_\_version\_\_   
## 0   
## \_tags   
## 229   
## \_index   
## 0

# Summary statistics for numerical variables

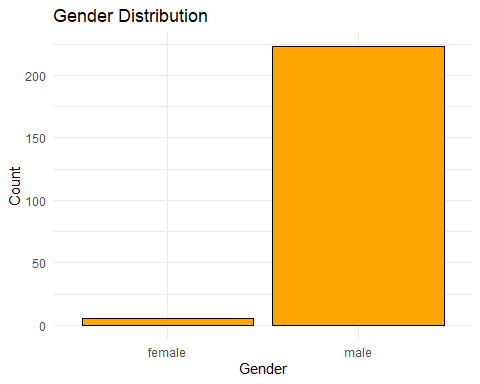
## age total\_family\_members monthly\_expense   
## Min. : 5.00 Min. : 1.000 Length:229   
## 1st Qu.:37.00 1st Qu.: 3.000 Class :character   
## Median :44.00 Median : 4.000 Mode :character   
## Mean :44.79 Mean : 4.568   
## 3rd Qu.:52.00 3rd Qu.: 5.000   
## Max. :76.00 Max. :32.000

# Visualizations

## Histogram for Age



## Bar plot for Gender



# Factor Analysis

## Define the recoding scheme

## Select columns to recode (update column numbers or names as needed)

## Apply recoding & Recode the selected columns

## low\_market\_price climate\_change irrigation\_problem high\_fertilizer\_cost  
## Min. :1.00 Min. :1.000 Min. :1.00 Min. :1.00   
## 1st Qu.:4.00 1st Qu.:4.000 1st Qu.:4.00 1st Qu.:4.00   
## Median :5.00 Median :5.000 Median :5.00 Median :5.00   
## Mean :4.62 Mean :4.498 Mean :4.45 Mean :4.59   
## 3rd Qu.:5.00 3rd Qu.:5.000 3rd Qu.:5.00 3rd Qu.:5.00   
## Max. :5.00 Max. :5.000 Max. :5.00 Max. :5.00   
## lack\_of\_govt\_support labour\_cost middleman\_exploitation  
## Min. :1.000 Min. :1.000 Min. :1.000   
## 1st Qu.:4.000 1st Qu.:4.000 1st Qu.:4.000   
## Median :4.000 Median :5.000 Median :4.000   
## Mean :4.266 Mean :4.402 Mean :4.131   
## 3rd Qu.:5.000 3rd Qu.:5.000 3rd Qu.:5.000   
## Max. :5.000 Max. :5.000 Max. :5.000   
## high\_production\_cost inflation\_stress lack\_of\_processing\_units  
## Min. :2.000 Min. :2.000 Min. :2.000   
## 1st Qu.:4.000 1st Qu.:4.000 1st Qu.:4.000   
## Median :5.000 Median :5.000 Median :4.000   
## Mean :4.537 Mean :4.585 Mean :4.231   
## 3rd Qu.:5.000 3rd Qu.:5.000 3rd Qu.:5.000   
## Max. :5.000 Max. :5.000 Max. :5.000   
## electricity\_issue no\_minimum\_price no\_farm\_loan pest\_disease   
## Min. :1.000 Min. :1.000 Min. :1.000 Min. :1.000   
## 1st Qu.:3.000 1st Qu.:4.000 1st Qu.:3.000 1st Qu.:4.000   
## Median :4.000 Median :5.000 Median :4.000 Median :5.000   
## Mean :3.904 Mean :4.659 Mean :3.878 Mean :4.445   
## 3rd Qu.:5.000 3rd Qu.:5.000 3rd Qu.:5.000 3rd Qu.:5.000   
## Max. :5.000 Max. :5.000 Max. :5.000 Max. :5.000   
## disaster\_damage no\_compensation storage\_marketing\_issue lack\_of\_family\_support  
## Min. :1.000 Min. :1.00 Min. :1.000 Min. :1.000   
## 1st Qu.:4.000 1st Qu.:3.00 1st Qu.:4.000 1st Qu.:1.000   
## Median :5.000 Median :4.00 Median :4.000 Median :2.000   
## Mean :4.472 Mean :3.93 Mean :4.223 Mean :2.638   
## 3rd Qu.:5.000 3rd Qu.:5.00 3rd Qu.:5.000 3rd Qu.:4.000   
## Max. :5.000 Max. :5.00 Max. :5.000 Max. :5.000   
## tech\_resistance  
## Min. :1.000   
## 1st Qu.:3.000   
## Median :4.000   
## Mean :3.493   
## 3rd Qu.:4.000   
## Max. :5.000

## Select columns for factor analysis (columns 122 to 140)

## # A tibble: 6 × 19  
## low\_market\_price climate\_change irrigation\_problem high\_fertilizer\_cost  
## <dbl> <dbl> <dbl> <dbl>  
## 1 5 5 5 5  
## 2 5 5 5 5  
## 3 5 5 5 5  
## 4 5 5 5 5  
## 5 5 5 5 5  
## 6 1 5 5 5  
## # ℹ 15 more variables: lack\_of\_govt\_support <dbl>, labour\_cost <dbl>,  
## # middleman\_exploitation <dbl>, high\_production\_cost <dbl>,  
## # inflation\_stress <dbl>, lack\_of\_processing\_units <dbl>,  
## # electricity\_issue <dbl>, no\_minimum\_price <dbl>, no\_farm\_loan <dbl>,  
## # pest\_disease <dbl>, disaster\_damage <dbl>, no\_compensation <dbl>,  
## # storage\_marketing\_issue <dbl>, lack\_of\_family\_support <dbl>,  
## # tech\_resistance <dbl>

## Perform Bartlett’s test of sphericity

##   
## Bartlett test of homogeneity of variances  
##   
## data: factor\_data  
## Bartlett's K-squared = 691.34, df = 18, p-value < 2.2e-16

# Conclusions:

Bartlett’s test of sphericity was conducted to assess whether the correlation matrix significantly differs from an identity matrix, indicating the suitability of the data for factor analysis. The test yielded a value of 691.34 with 18 degrees of freedom and a p-value 2.2e-16.

Since the p-value is highly significant (), we reject the null hypothesis, which assumes that the variables are uncorrelated. This suggests that the dataset contains sufficient intercorrelations to justify the application of Factor Analysis. Thus, the data is suitable for dimensionality reduction and latent factor extraction.

## Perform Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy

## Kaiser-Meyer-Olkin factor adequacy  
## Call: KMO(r = factor\_data)  
## Overall MSA = 0.8  
## MSA for each item =   
## low\_market\_price climate\_change irrigation\_problem   
## 0.77 0.88 0.78   
## high\_fertilizer\_cost lack\_of\_govt\_support labour\_cost   
## 0.83 0.86 0.80   
## middleman\_exploitation high\_production\_cost inflation\_stress   
## 0.76 0.85 0.79   
## lack\_of\_processing\_units electricity\_issue no\_minimum\_price   
## 0.74 0.48 0.80   
## no\_farm\_loan pest\_disease disaster\_damage   
## 0.81 0.83 0.85   
## no\_compensation storage\_marketing\_issue lack\_of\_family\_support   
## 0.86 0.81 0.64   
## tech\_resistance   
## 0.74

# Conclusions:

## Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy

The **Kaiser-Meyer-Olkin (KMO) test** was conducted to evaluate the suitability of the dataset for **factor analysis**. The **overall KMO measure** was found to be **0.80**, indicating **good adequacy** for factor analysis.

### Individual Measure of Sampling Adequacy (MSA)

The **MSA values** for each variable are as follows:

| Variable | MSA |
| --- | --- |
| low\_market\_price | 0.77 |
| climate\_change | 0.88 |
| irrigation\_problem | 0.78 |
| high\_fertilizer\_cost | 0.83 |
| lack\_of\_govt\_support | 0.86 |
| labour\_cost | 0.80 |
| middleman\_exploitation | 0.76 |
| high\_production\_cost | 0.85 |
| inflation\_stress | 0.79 |
| lack\_of\_processing\_units | 0.74 |
| electricity\_issue | 0.48 |
| no\_minimum\_price | 0.80 |
| no\_farm\_loan | 0.81 |
| pest\_disease | 0.83 |
| disaster\_damage | 0.85 |
| no\_compensation | 0.86 |
| storage\_marketing\_issue | 0.81 |
| lack\_of\_family\_support | 0.64 |
| tech\_resistance | 0.74 |

### Interpretation of KMO Results

* A **KMO value above 0.80** is considered **very good** for factor analysis.
* **Most variables have MSA values above 0.75**, supporting their inclusion in factor analysis.
* The variable *electricity\_issue* has a lower MSA (0.48), indicating that it may not contribute significantly to a strong factor structure.

### Conclusion

The **overall KMO value of 0.80** confirms that the dataset is **suitable for factor analysis**. However, careful consideration should be given to variables with lower MSA scores, as they may not contribute well to the factor model.

## Perform Factor Analysis using Principal Axis Factoring

## Print factor loadings

##   
## Loadings:  
## MR1 MR2 MR3   
## low\_market\_price 0.216   
## climate\_change 0.652   
## irrigation\_problem 0.373 0.122  
## high\_fertilizer\_cost 0.631   
## lack\_of\_govt\_support 0.422 0.244   
## labour\_cost 0.599 0.122   
## middleman\_exploitation 0.262 0.260   
## high\_production\_cost 0.595 0.251   
## inflation\_stress 0.520 0.151  
## lack\_of\_processing\_units 0.223 0.113 0.846  
## electricity\_issue 0.218 0.337  
## no\_minimum\_price 0.395 0.127  
## no\_farm\_loan 0.215 0.548 0.173  
## pest\_disease 0.548 0.189 0.142  
## disaster\_damage 0.599 0.302   
## no\_compensation 0.266 0.441   
## storage\_marketing\_issue 0.278 0.323 0.207  
## lack\_of\_family\_support 0.514   
## tech\_resistance 0.108 0.542   
##   
## MR1 MR2 MR3  
## SS loadings 3.316 1.587 1.007  
## Proportion Var 0.175 0.084 0.053  
## Cumulative Var 0.175 0.258 0.311

# Conclusions for factor loadings:

The **factor analysis results** reveal the underlying structure of the dataset with three extracted factors (**MR1, MR2, and MR3**). The interpretation of these factors is based on the **factor loadings**, which indicate the strength of each variable’s association with a particular factor.

* **Factor MR1** has high loadings on *climate\_change* (0.652), *high\_fertilizer\_cost* (0.631), *labour\_cost* (0.599), *high\_production\_cost* (0.595), *disaster\_damage* (0.599), and *pest\_disease* (0.548).
  + This suggests that **MR1 represents economic and environmental challenges** faced by the respondents.
* **Factor MR2** is mainly associated with *no\_farm\_loan* (0.548), *lack\_of\_family\_support* (0.514), and *tech\_resistance* (0.542).
  + This factor reflects **financial constraints and social support issues**.
* **Factor MR3** has its highest loading on *lack\_of\_processing\_units* (0.846) and moderate loadings on *electricity\_issue* (0.337).
  + This factor represents **infrastructure and resource-related issues**.

### Factor Variance Explained

The **SS loadings** indicate the relative importance of each factor:

* **MR1 explains 17.5% of the variance**
* **MR2 explains 8.4% of the variance**
* **MR3 explains 5.3% of the variance**

The **cumulative variance explained by the three factors is 31.1%**, suggesting that these factors capture a meaningful portion of the dataset’s variability but may not fully account for all underlying structures.

### Summary of Key Dimensions

Based on these findings, the dataset can be grouped into three key dimensions:

1. **Economic and Environmental Challenges (MR1)**
2. **Financial and Social Constraints (MR2)**
3. **Infrastructure and Resource Limitations (MR3)**

These factors provide valuable insights into the major challenges present in the dataset, supporting the use of factor analysis for dimensionality reduction.

## Visualize factor loadings

