library(tidyverse)

## ── Attaching core tidyverse packages ──────────────────────── tidyverse 2.0.0 ──  
## ✔ dplyr 1.1.2 ✔ readr 2.1.4  
## ✔ forcats 1.0.0 ✔ stringr 1.5.0  
## ✔ ggplot2 3.4.2 ✔ tibble 3.2.1  
## ✔ lubridate 1.9.2 ✔ tidyr 1.3.0  
## ✔ purrr 1.0.1   
## ── Conflicts ────────────────────────────────────────── tidyverse\_conflicts() ──  
## ✖ dplyr::filter() masks stats::filter()  
## ✖ dplyr::lag() masks stats::lag()  
## ℹ Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors

library(ggplot2)  
library(RColorBrewer)  
library(gridExtra)

##   
## Attaching package: 'gridExtra'  
##   
## The following object is masked from 'package:dplyr':  
##   
## combine

Ames = read\_csv("ames\_student.csv")

## Rows: 2053 Columns: 81  
## ── Column specification ────────────────────────────────────────────────────────  
## Delimiter: ","  
## chr (47): MS\_SubClass, MS\_Zoning, Street, Alley, Lot\_Shape, Land\_Contour, Ut...  
## dbl (34): Lot\_Frontage, Lot\_Area, Year\_Built, Year\_Remod\_Add, Mas\_Vnr\_Area, ...  
##   
## ℹ Use `spec()` to retrieve the full column specification for this data.  
## ℹ Specify the column types or set `show\_col\_types = FALSE` to quiet this message.

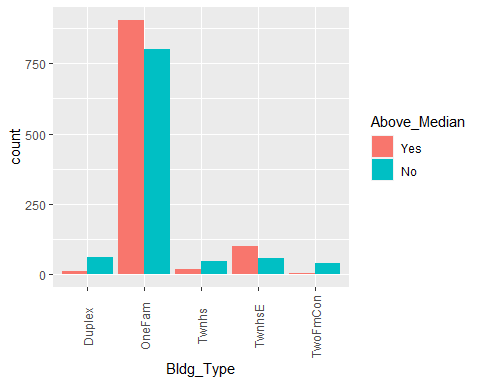
str(Ames)

## spc\_tbl\_ [2,053 × 81] (S3: spec\_tbl\_df/tbl\_df/tbl/data.frame)  
## $ MS\_SubClass : chr [1:2053] "One\_Story\_1946\_and\_Newer\_All\_Styles" "One\_Story\_1946\_and\_Newer\_All\_Styles" "One\_Story\_1946\_and\_Newer\_All\_Styles" "One\_Story\_1946\_and\_Newer\_All\_Styles" ...  
## $ MS\_Zoning : chr [1:2053] "Residential\_Low\_Density" "Residential\_High\_Density" "Residential\_Low\_Density" "Residential\_Low\_Density" ...  
## $ Lot\_Frontage : num [1:2053] 141 80 81 93 74 78 43 39 0 85 ...  
## $ Lot\_Area : num [1:2053] 31770 11622 14267 11160 13830 ...  
## $ Street : chr [1:2053] "Pave" "Pave" "Pave" "Pave" ...  
## $ Alley : chr [1:2053] "No\_Alley\_Access" "No\_Alley\_Access" "No\_Alley\_Access" "No\_Alley\_Access" ...  
## $ Lot\_Shape : chr [1:2053] "Slightly\_Irregular" "Regular" "Slightly\_Irregular" "Regular" ...  
## $ Land\_Contour : chr [1:2053] "Lvl" "Lvl" "Lvl" "Lvl" ...  
## $ Utilities : chr [1:2053] "AllPub" "AllPub" "AllPub" "AllPub" ...  
## $ Lot\_Config : chr [1:2053] "Corner" "Inside" "Corner" "Corner" ...  
## $ Land\_Slope : chr [1:2053] "Gtl" "Gtl" "Gtl" "Gtl" ...  
## $ Neighborhood : chr [1:2053] "North\_Ames" "North\_Ames" "North\_Ames" "North\_Ames" ...  
## $ Condition\_1 : chr [1:2053] "Norm" "Feedr" "Norm" "Norm" ...  
## $ Condition\_2 : chr [1:2053] "Norm" "Norm" "Norm" "Norm" ...  
## $ Bldg\_Type : chr [1:2053] "OneFam" "OneFam" "OneFam" "OneFam" ...  
## $ House\_Style : chr [1:2053] "One\_Story" "One\_Story" "One\_Story" "One\_Story" ...  
## $ Overall\_Qual : chr [1:2053] "Above\_Average" "Average" "Above\_Average" "Good" ...  
## $ Overall\_Cond : chr [1:2053] "Average" "Above\_Average" "Above\_Average" "Average" ...  
## $ Year\_Built : num [1:2053] 1960 1961 1958 1968 1997 ...  
## $ Year\_Remod\_Add : num [1:2053] 1960 1961 1958 1968 1998 ...  
## $ Roof\_Style : chr [1:2053] "Hip" "Gable" "Hip" "Hip" ...  
## $ Roof\_Matl : chr [1:2053] "CompShg" "CompShg" "CompShg" "CompShg" ...  
## $ Exterior\_1st : chr [1:2053] "BrkFace" "VinylSd" "Wd Sdng" "BrkFace" ...  
## $ Exterior\_2nd : chr [1:2053] "Plywood" "VinylSd" "Wd Sdng" "BrkFace" ...  
## $ Mas\_Vnr\_Type : chr [1:2053] "Stone" "None" "BrkFace" "None" ...  
## $ Mas\_Vnr\_Area : num [1:2053] 112 0 108 0 0 20 0 0 0 0 ...  
## $ Exter\_Qual : chr [1:2053] "Typical" "Typical" "Typical" "Good" ...  
## $ Exter\_Cond : chr [1:2053] "Typical" "Typical" "Typical" "Typical" ...  
## $ Foundation : chr [1:2053] "CBlock" "CBlock" "CBlock" "CBlock" ...  
## $ Bsmt\_Qual : chr [1:2053] "Typical" "Typical" "Typical" "Typical" ...  
## $ Bsmt\_Cond : chr [1:2053] "Good" "Typical" "Typical" "Typical" ...  
## $ Bsmt\_Exposure : chr [1:2053] "Gd" "No" "No" "No" ...  
## $ BsmtFin\_Type\_1 : chr [1:2053] "BLQ" "Rec" "ALQ" "ALQ" ...  
## $ BsmtFin\_SF\_1 : num [1:2053] 2 6 1 1 3 3 1 3 1 3 ...  
## $ BsmtFin\_Type\_2 : chr [1:2053] "Unf" "LwQ" "Unf" "Unf" ...  
## $ BsmtFin\_SF\_2 : num [1:2053] 0 144 0 0 0 0 0 0 0 0 ...  
## $ Bsmt\_Unf\_SF : num [1:2053] 441 270 406 1045 137 ...  
## $ Total\_Bsmt\_SF : num [1:2053] 1080 882 1329 2110 928 ...  
## $ Heating : chr [1:2053] "GasA" "GasA" "GasA" "GasA" ...  
## $ Heating\_QC : chr [1:2053] "Fair" "Typical" "Typical" "Excellent" ...  
## $ Central\_Air : chr [1:2053] "Y" "Y" "Y" "Y" ...  
## $ Electrical : chr [1:2053] "SBrkr" "SBrkr" "SBrkr" "SBrkr" ...  
## $ First\_Flr\_SF : num [1:2053] 1656 896 1329 2110 928 ...  
## $ Second\_Flr\_SF : num [1:2053] 0 0 0 0 701 678 0 0 0 0 ...  
## $ Low\_Qual\_Fin\_SF : num [1:2053] 0 0 0 0 0 0 0 0 0 0 ...  
## $ Gr\_Liv\_Area : num [1:2053] 1656 896 1329 2110 1629 ...  
## $ Bsmt\_Full\_Bath : num [1:2053] 1 0 0 1 0 0 0 1 1 1 ...  
## $ Bsmt\_Half\_Bath : num [1:2053] 0 0 0 0 0 0 0 0 0 0 ...  
## $ Full\_Bath : num [1:2053] 1 1 1 2 2 2 2 2 2 1 ...  
## $ Half\_Bath : num [1:2053] 0 0 1 1 1 1 0 0 0 1 ...  
## $ Bedroom\_AbvGr : num [1:2053] 3 2 3 3 3 3 2 2 3 2 ...  
## $ Kitchen\_AbvGr : num [1:2053] 1 1 1 1 1 1 1 1 1 1 ...  
## $ Kitchen\_Qual : chr [1:2053] "Typical" "Typical" "Good" "Excellent" ...  
## $ TotRms\_AbvGrd : num [1:2053] 7 5 6 8 6 7 5 5 6 5 ...  
## $ Functional : chr [1:2053] "Typ" "Typ" "Typ" "Typ" ...  
## $ Fireplaces : num [1:2053] 2 0 0 2 1 1 0 1 0 1 ...  
## $ Fireplace\_Qu : chr [1:2053] "Good" "No\_Fireplace" "No\_Fireplace" "Typical" ...  
## $ Garage\_Type : chr [1:2053] "Attchd" "Attchd" "Attchd" "Attchd" ...  
## $ Garage\_Finish : chr [1:2053] "Fin" "Unf" "Unf" "Fin" ...  
## $ Garage\_Cars : num [1:2053] 2 1 1 2 2 2 2 2 2 2 ...  
## $ Garage\_Area : num [1:2053] 528 730 312 522 482 470 506 608 420 506 ...  
## $ Garage\_Qual : chr [1:2053] "Typical" "Typical" "Typical" "Typical" ...  
## $ Garage\_Cond : chr [1:2053] "Typical" "Typical" "Typical" "Typical" ...  
## $ Paved\_Drive : chr [1:2053] "Partial\_Pavement" "Paved" "Paved" "Paved" ...  
## $ Wood\_Deck\_SF : num [1:2053] 210 140 393 0 212 360 0 237 483 192 ...  
## $ Open\_Porch\_SF : num [1:2053] 62 0 36 0 34 36 82 152 21 0 ...  
## $ Enclosed\_Porch : num [1:2053] 0 0 0 0 0 0 0 0 0 0 ...  
## $ Three\_season\_porch: num [1:2053] 0 0 0 0 0 0 0 0 0 0 ...  
## $ Screen\_Porch : num [1:2053] 0 120 0 0 0 0 144 0 0 0 ...  
## $ Pool\_Area : num [1:2053] 0 0 0 0 0 0 0 0 0 0 ...  
## $ Pool\_QC : chr [1:2053] "No\_Pool" "No\_Pool" "No\_Pool" "No\_Pool" ...  
## $ Fence : chr [1:2053] "No\_Fence" "Minimum\_Privacy" "No\_Fence" "No\_Fence" ...  
## $ Misc\_Feature : chr [1:2053] "None" "None" "Gar2" "None" ...  
## $ Misc\_Val : num [1:2053] 0 0 12500 0 0 0 0 0 500 0 ...  
## $ Mo\_Sold : num [1:2053] 5 6 6 4 3 6 1 3 3 2 ...  
## $ Year\_Sold : num [1:2053] 2010 2010 2010 2010 2010 2010 2010 2010 2010 2010 ...  
## $ Sale\_Type : chr [1:2053] "WD" "WD" "WD" "WD" ...  
## $ Sale\_Condition : chr [1:2053] "Normal" "Normal" "Normal" "Normal" ...  
## $ Longitude : num [1:2053] -93.6 -93.6 -93.6 -93.6 -93.6 ...  
## $ Latitude : num [1:2053] 42.1 42.1 42.1 42.1 42.1 ...  
## $ Above\_Median : chr [1:2053] "Yes" "No" "Yes" "Yes" ...  
## - attr(\*, "spec")=  
## .. cols(  
## .. MS\_SubClass = col\_character(),  
## .. MS\_Zoning = col\_character(),  
## .. Lot\_Frontage = col\_double(),  
## .. Lot\_Area = col\_double(),  
## .. Street = col\_character(),  
## .. Alley = col\_character(),  
## .. Lot\_Shape = col\_character(),  
## .. Land\_Contour = col\_character(),  
## .. Utilities = col\_character(),  
## .. Lot\_Config = col\_character(),  
## .. Land\_Slope = col\_character(),  
## .. Neighborhood = col\_character(),  
## .. Condition\_1 = col\_character(),  
## .. Condition\_2 = col\_character(),  
## .. Bldg\_Type = col\_character(),  
## .. House\_Style = col\_character(),  
## .. Overall\_Qual = col\_character(),  
## .. Overall\_Cond = col\_character(),  
## .. Year\_Built = col\_double(),  
## .. Year\_Remod\_Add = col\_double(),  
## .. Roof\_Style = col\_character(),  
## .. Roof\_Matl = col\_character(),  
## .. Exterior\_1st = col\_character(),  
## .. Exterior\_2nd = col\_character(),  
## .. Mas\_Vnr\_Type = col\_character(),  
## .. Mas\_Vnr\_Area = col\_double(),  
## .. Exter\_Qual = col\_character(),  
## .. Exter\_Cond = col\_character(),  
## .. Foundation = col\_character(),  
## .. Bsmt\_Qual = col\_character(),  
## .. Bsmt\_Cond = col\_character(),  
## .. Bsmt\_Exposure = col\_character(),  
## .. BsmtFin\_Type\_1 = col\_character(),  
## .. BsmtFin\_SF\_1 = col\_double(),  
## .. BsmtFin\_Type\_2 = col\_character(),  
## .. BsmtFin\_SF\_2 = col\_double(),  
## .. Bsmt\_Unf\_SF = col\_double(),  
## .. Total\_Bsmt\_SF = col\_double(),  
## .. Heating = col\_character(),  
## .. Heating\_QC = col\_character(),  
## .. Central\_Air = col\_character(),  
## .. Electrical = col\_character(),  
## .. First\_Flr\_SF = col\_double(),  
## .. Second\_Flr\_SF = col\_double(),  
## .. Low\_Qual\_Fin\_SF = col\_double(),  
## .. Gr\_Liv\_Area = col\_double(),  
## .. Bsmt\_Full\_Bath = col\_double(),  
## .. Bsmt\_Half\_Bath = col\_double(),  
## .. Full\_Bath = col\_double(),  
## .. Half\_Bath = col\_double(),  
## .. Bedroom\_AbvGr = col\_double(),  
## .. Kitchen\_AbvGr = col\_double(),  
## .. Kitchen\_Qual = col\_character(),  
## .. TotRms\_AbvGrd = col\_double(),  
## .. Functional = col\_character(),  
## .. Fireplaces = col\_double(),  
## .. Fireplace\_Qu = col\_character(),  
## .. Garage\_Type = col\_character(),  
## .. Garage\_Finish = col\_character(),  
## .. Garage\_Cars = col\_double(),  
## .. Garage\_Area = col\_double(),  
## .. Garage\_Qual = col\_character(),  
## .. Garage\_Cond = col\_character(),  
## .. Paved\_Drive = col\_character(),  
## .. Wood\_Deck\_SF = col\_double(),  
## .. Open\_Porch\_SF = col\_double(),  
## .. Enclosed\_Porch = col\_double(),  
## .. Three\_season\_porch = col\_double(),  
## .. Screen\_Porch = col\_double(),  
## .. Pool\_Area = col\_double(),  
## .. Pool\_QC = col\_character(),  
## .. Fence = col\_character(),  
## .. Misc\_Feature = col\_character(),  
## .. Misc\_Val = col\_double(),  
## .. Mo\_Sold = col\_double(),  
## .. Year\_Sold = col\_double(),  
## .. Sale\_Type = col\_character(),  
## .. Sale\_Condition = col\_character(),  
## .. Longitude = col\_double(),  
## .. Latitude = col\_double(),  
## .. Above\_Median = col\_character()  
## .. )  
## - attr(\*, "problems")=<externalptr>

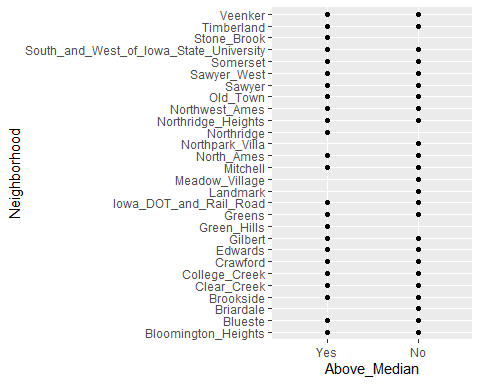
Ames = Ames %>% select (Neighborhood, Overall\_Cond, Year\_Built, Exterior\_1st, Kitchen\_Qual, TotRms\_AbvGrd ,Above\_Median, Bldg\_Type,Full\_Bath,Pool\_QC,Fence,Year\_Remod\_Add,Roof\_Style,Roof\_Matl,Year\_Sold,Roof\_Matl,Roof\_Style,Foundation,Lot\_Area,Longitude,Latitude,Exter\_Cond,Overall\_Cond,Bsmt\_Cond,Garage\_Cond)  
  
Ames = Ames %>% mutate(Above\_Median = as\_factor(Above\_Median))  
Ames

## # A tibble: 2,053 × 22  
## Neighborhood Overall\_Cond Year\_Built Exterior\_1st Kitchen\_Qual TotRms\_AbvGrd  
## <chr> <chr> <dbl> <chr> <chr> <dbl>  
## 1 North\_Ames Average 1960 BrkFace Typical 7  
## 2 North\_Ames Above\_Average 1961 VinylSd Typical 5  
## 3 North\_Ames Above\_Average 1958 Wd Sdng Good 6  
## 4 North\_Ames Average 1968 BrkFace Excellent 8  
## 5 Gilbert Average 1997 VinylSd Typical 6  
## 6 Gilbert Above\_Average 1998 VinylSd Good 7  
## 7 Stone\_Brook Average 1992 HdBoard Good 5  
## 8 Stone\_Brook Average 1995 CemntBd Good 5  
## 9 Gilbert Good 1992 HdBoard Typical 6  
## 10 Gilbert Average 1990 HdBoard Good 5  
## # ℹ 2,043 more rows  
## # ℹ 16 more variables: Above\_Median <fct>, Bldg\_Type <chr>, Full\_Bath <dbl>,  
## # Pool\_QC <chr>, Fence <chr>, Year\_Remod\_Add <dbl>, Roof\_Style <chr>,  
## # Roof\_Matl <chr>, Year\_Sold <dbl>, Foundation <chr>, Lot\_Area <dbl>,  
## # Longitude <dbl>, Latitude <dbl>, Exter\_Cond <chr>, Bsmt\_Cond <chr>,  
## # Garage\_Cond <chr>

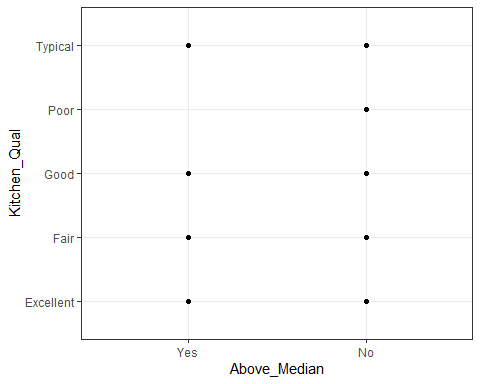
ggplot(Ames, aes(x=Bldg\_Type, fill = Above\_Median)) + geom\_bar(position=position\_dodge()) + theme(axis.text.x = element\_text(angle = 90, vjust=0.5))



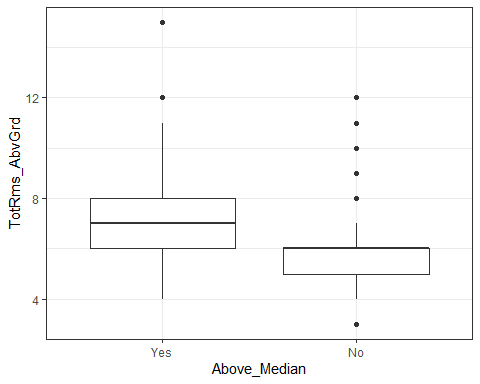
ggplot(Ames, aes(x = Above\_Median, y = Neighborhood)) + geom\_point()



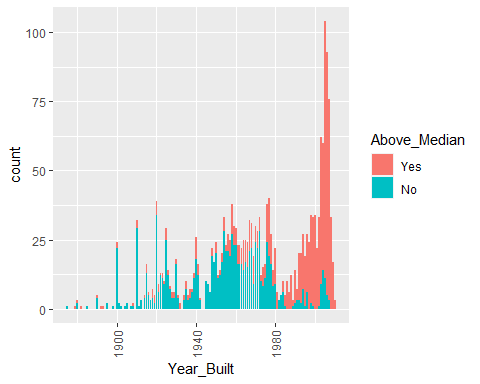
ggplot(Ames, aes(x = Above\_Median, y = Kitchen\_Qual)) + geom\_point() + theme\_bw()



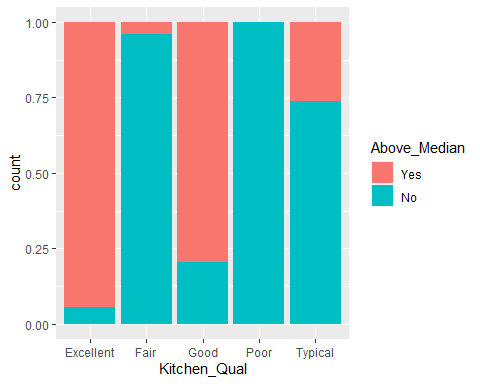
ggplot(Ames, aes(x = Above\_Median, y = TotRms\_AbvGrd)) + geom\_boxplot() + theme\_bw()



ggplot(Ames, aes(x=Year\_Built, fill = Above\_Median)) + geom\_bar() + theme(axis.text.x = element\_text(angle = 90, vjust=0.5))



ggplot(Ames, aes(x = Kitchen\_Qual, fill = Above\_Median)) + geom\_bar(position = "fill")



p1 = ggplot(Ames, aes(x = Overall\_Cond, fill = Above\_Median)) + geom\_bar(position = "fill")+theme(axis.text.x = element\_text(angle = 90, vjust=0.5))  
p2 = ggplot(Ames, aes(x = Exter\_Cond, fill = Above\_Median)) + geom\_bar(position = "fill")+theme(axis.text.x = element\_text(angle = 90, vjust=0.5))  
p3 = ggplot(Ames, aes(x = Bsmt\_Cond, fill = Above\_Median)) + geom\_bar(position = "fill")+theme(axis.text.x = element\_text(angle = 90, vjust=0.5))  
p4 = ggplot(Ames, aes(x = Garage\_Cond, fill = Above\_Median)) + geom\_bar(position = "fill")+theme(axis.text.x = element\_text(angle = 90, vjust=0.5))  
grid.arrange(p1,p2,p3,p4)

