mzhang25\_final

#load the packages that we need.  
library(caret)

## 载入需要的程辑包：lattice

## 载入需要的程辑包：ggplot2

library(class)  
library(dummies)

## Warning: 程辑包'dummies'是用R版本4.1.1 来建造的

## dummies-1.5.6 provided by Decision Patterns

library(tidyverse)

## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --

## v tibble 3.1.2 v dplyr 1.0.7  
## v tidyr 1.1.3 v stringr 1.4.0  
## v readr 1.4.0 v forcats 0.5.1  
## v purrr 0.3.4

## -- Conflicts ------------------------------------------ tidyverse\_conflicts() --  
## x dplyr::filter() masks stats::filter()  
## x dplyr::lag() masks stats::lag()  
## x purrr::lift() masks caret::lift()

library(factoextra)

## Warning: 程辑包'factoextra'是用R版本4.1.1 来建造的

## Welcome! Want to learn more? See two factoextra-related books at https://goo.gl/ve3WBa

library(ggplot2)  
library(cluster)  
library(GGally)

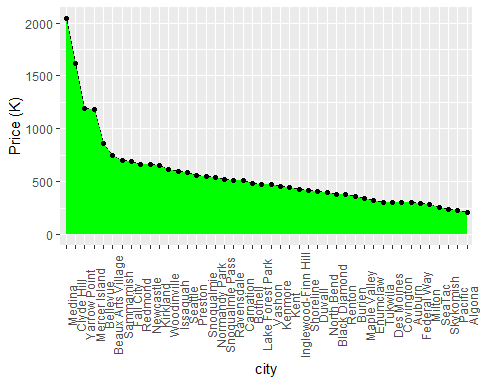
## Registered S3 method overwritten by 'GGally':  
## method from   
## +.gg ggplot2

#Load in the house data  
house <- read.csv("C:/Users/Administrator/Desktop/data.csv")  
#check and remove all missing data.  
house<-na.omit(house)  
#for the data 1(date)15(street)17(statezip)18(country)are useless for analyse.  
head(house)

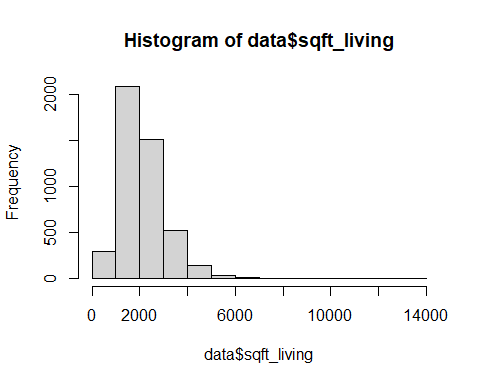
## date price bedrooms bathrooms sqft\_living sqft\_lot floors  
## 1 2014-05-02 00:00:00 313000 3 1.50 1340 7912 1.5  
## 2 2014-05-02 00:00:00 2384000 5 2.50 3650 9050 2.0  
## 3 2014-05-02 00:00:00 342000 3 2.00 1930 11947 1.0  
## 4 2014-05-02 00:00:00 420000 3 2.25 2000 8030 1.0  
## 5 2014-05-02 00:00:00 550000 4 2.50 1940 10500 1.0  
## 6 2014-05-02 00:00:00 490000 2 1.00 880 6380 1.0  
## waterfront view condition sqft\_above sqft\_basement yr\_built yr\_renovated  
## 1 0 0 3 1340 0 1955 2005  
## 2 0 4 5 3370 280 1921 0  
## 3 0 0 4 1930 0 1966 0  
## 4 0 0 4 1000 1000 1963 0  
## 5 0 0 4 1140 800 1976 1992  
## 6 0 0 3 880 0 1938 1994  
## street city statezip country  
## 1 18810 Densmore Ave N Shoreline WA 98133 USA  
## 2 709 W Blaine St Seattle WA 98119 USA  
## 3 26206-26214 143rd Ave SE Kent WA 98042 USA  
## 4 857 170th Pl NE Bellevue WA 98008 USA  
## 5 9105 170th Ave NE Redmond WA 98052 USA  
## 6 522 NE 88th St Seattle WA 98115 USA

data<-house[,c(-1,-15,-17,-18)]  
#Plot the graph shows the price change with city.  
data%>%filter(price!=0)%>%group\_by(city)%>%summarise(price=mean(price)/1000)%>%  
ggplot(aes(y = price,x = reorder(city, -price),group=1))+geom\_line(fill = 'green')+  
xlab('city')+ylab('Price (K)')+geom\_area(fill='green')+geom\_point()+  
theme(axis.text.x = element\_text(angle=90))

## Warning: Ignoring unknown parameters: fill



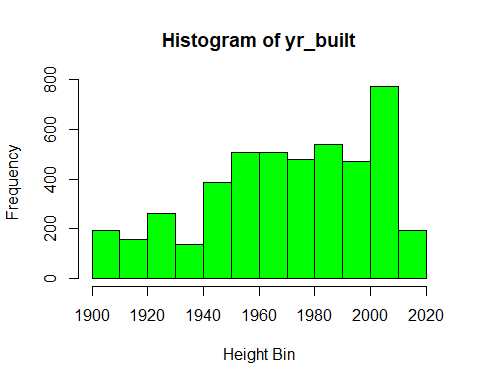
#shows the frequency of sqft house and check their percentage.   
hist(data$sqft\_living)



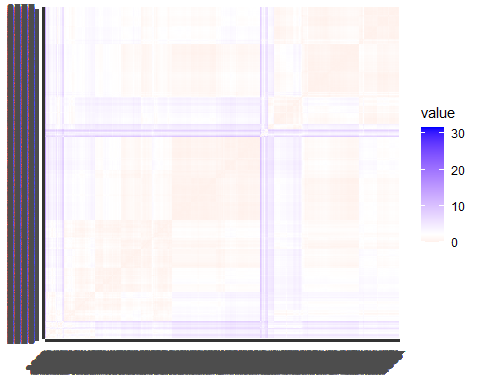
house\_sqft<-ifelse(data$sqft\_living<=2000,"small house",ifelse(data$sqft\_living<=4000,"medium house","large house"))  
freq<-data.frame(table(house\_sqft))  
freq$percentage<-paste(round(freq$Freq/nrow(norm)\*100,2),"%")  
freq

## house\_sqft Freq percentage  
## 1 large house 197 %  
## 2 medium house 2027 %  
## 3 small house 2376 %

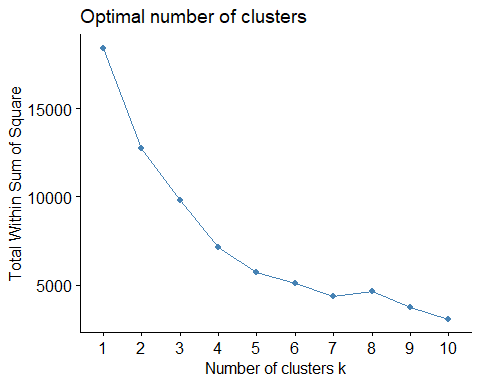
#plot histogram.  
hist(data$yr\_built, breaks = 10, col = "green", main = "Histogram of yr\_built", xlab = "Height Bin")



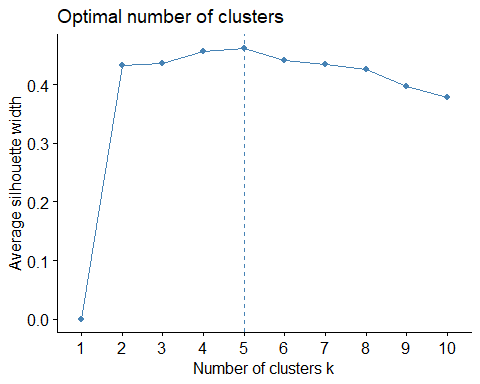
# We need to normalize all the continuous variables for later cluster.  
norm\_data<- preProcess(data, method=c("center", "scale"))  
norm<-predict(norm\_data,data)  
  
#First look at the sqft of living and other area.  
#I want to use sqft of living to do the cluster ( sqft\_living+sqft\_lot+sqft\_above+sqft\_basement)  
norm\_sqft<-norm[,c(4,5,10,11)]  
set.seed(1234)  
distance <- get\_dist(norm\_sqft)  
fviz\_dist(distance)



fviz\_nbclust(norm\_sqft, kmeans, method = "wss")



fviz\_nbclust(norm\_sqft, kmeans, method = "silhouette")



# BY using the elbow method, we get k = 5.  
kmodel\_sqft<- kmeans(norm\_sqft, centers = 5, nstart = 25)  
kmodel\_sqft$centers

## sqft\_living sqft\_lot sqft\_above sqft\_basement  
## 1 -0.7389339 -0.17575789 -0.5402241 -0.52997626  
## 2 2.2404095 0.09699146 1.3343840 2.17072313  
## 3 0.1225904 -0.11627557 -0.4867950 1.15866490  
## 4 0.7716269 0.02432924 1.1975790 -0.62326198  
## 5 1.1349840 6.46226515 1.2590575 0.01659895

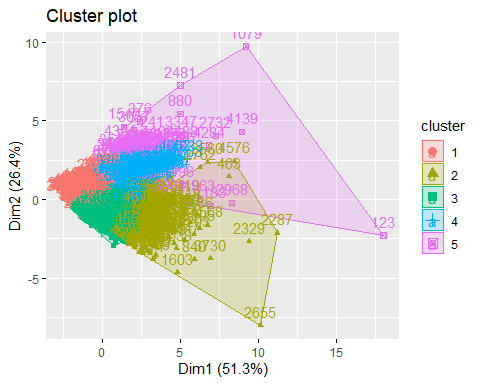
kmodel\_sqft$size

## [1] 2124 237 1101 1068 70

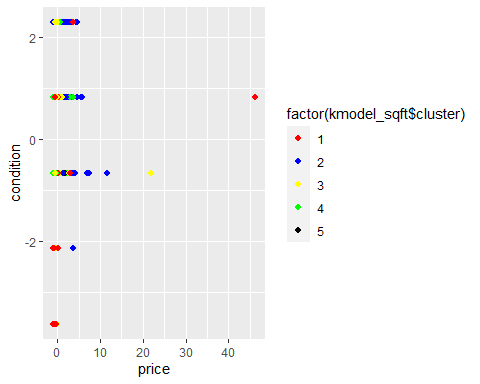
kmodel\_sqft

## K-means clustering with 5 clusters of sizes 2124, 237, 1101, 1068, 70  
##   
## Cluster means:  
## sqft\_living sqft\_lot sqft\_above sqft\_basement  
## 1 -0.7389339 -0.17575789 -0.5402241 -0.52997626  
## 2 2.2404095 0.09699146 1.3343840 2.17072313  
## 3 0.1225904 -0.11627557 -0.4867950 1.15866490  
## 4 0.7716269 0.02432924 1.1975790 -0.62326198  
## 5 1.1349840 6.46226515 1.2590575 0.01659895  
##   
## Clustering vector:  
## 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16   
## 1 4 1 3 3 1 1 4 3 1 1 3 3 1 4 1   
## 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32   
## 1 4 1 1 3 1 1 4 1 3 3 3 4 3 1 3   
## 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48   
## 1 4 2 4 1 3 1 3 1 1 1 1 1 1 1 1   
## 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64   
## 1 4 4 4 3 1 3 3 4 4 1 1 4 4 3 4   
## 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80   
## 4 1 3 1 4 3 3 3 3 1 1 1 3 4 3 4   
## 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96   
## 3 4 3 1 3 1 1 1 1 1 4 3 4 3 3 3   
## 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112   
## 1 3 1 2 4 3 1 4 1 4 3 5 1 1 1 4   
## 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128   
## 1 3 1 1 4 1 3 1 3 1 5 1 3 1 1 1   
## 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144   
## 3 4 4 1 3 4 1 3 3 3 1 4 1 1 4 2   
## 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160   
## 1 1 1 4 2 1 4 1 1 1 4 1 1 1 1 1   
## 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176   
## 1 1 1 1 2 3 1 1 1 1 4 4 3 1 1 1   
## 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192   
## 1 1 1 4 1 1 4 3 3 3 3 3 3 4 1 3   
## 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208   
## 3 2 1 1 1 3 4 1 4 2 4 3 3 1 4 4   
## 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224   
## 1 4 4 1 1 3 1 3 1 4 1 1 3 1 1 3   
## 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240   
## 4 4 1 2 4 1 3 1 4 4 1 1 1 1 3 3   
## 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256   
## 5 2 3 1 3 1 1 1 2 1 1 1 2 1 5 1   
## 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272   
## 1 3 1 3 1 3 4 3 1 1 3 1 1 3 2 3   
## 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288   
## 5 3 1 3 1 4 1 4 3 1 3 1 4 4 1 1   
## 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304   
## 1 1 1 4 4 1 1 1 1 3 1 1 1 3 3 3   
## 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320   
## 1 1 3 1 1 2 4 1 4 3 1 1 3 1 3 3   
## 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336   
## 1 4 3 1 1 4 1 3 1 1 1 3 1 3 1 3   
## 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352   
## 4 3 2 4 1 1 1 3 4 3 1 3 4 3 1 4   
## 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368   
## 3 1 3 1 4 1 4 3 4 3 1 1 1 1 3 1   
## 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384   
## 1 4 1 1 3 4 1 5 1 1 3 1 1 1 1 1   
## 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400   
## 1 4 1 1 4 1 2 4 3 1 1 1 3 4 4 1   
## 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416   
## 4 4 1 3 4 1 1 1 3 1 1 1 3 1 2 3   
## 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432   
## 1 1 2 3 4 2 4 1 3 1 4 3 1 1 4 3   
## 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448   
## 3 1 1 3 1 1 1 1 1 3 4 4 4 1 4 1   
## 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464   
## 1 1 1 1 2 1 4 1 4 4 4 1 1 5 2 1   
## 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480   
## 3 1 3 3 1 4 1 2 4 3 4 1 1 1 1 5   
## 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496   
## 2 1 2 3 5 1 4 3 2 3 4 3 3 1 4 5   
## 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512   
## 1 1 1 1 1 1 4 3 3 4 4 4 1 1 1 3   
## 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528   
## 1 4 2 1 3 1 3 1 3 1 1 3 4 2 3 1   
## 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544   
## 3 1 4 1 3 3 3 1 1 4 1 1 1 4 4 3   
## 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560   
## 4 4 1 4 2 4 3 3 1 3 1 4 4 2 3 1   
## 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576   
## 3 3 3 3 4 1 1 3 1 3 1 2 1 1 1 4   
## 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592   
## 1 2 4 1 4 2 1 1 1 1 1 3 1 2 4 4   
## 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608   
## 4 3 3 2 1 3 1 4 1 3 3 2 1 1 4 1   
## 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624   
## 3 3 1 2 3 1 1 1 1 4 1 4 3 4 2 4   
## 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640   
## 4 3 3 1 3 4 3 1 3 1 2 1 3 4 1 1   
## 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656   
## 3 1 1 3 1 1 1 3 1 1 4 1 3 4 4 4   
## 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672   
## 1 4 3 1 3 1 1 1 3 1 4 1 1 1 1 4   
## 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688   
## 1 4 3 4 3 4 1 5 1 4 1 3 1 3 4 3   
## 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704   
## 1 1 4 4 4 1 1 4 4 4 3 4 4 1 4 4   
## 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720   
## 2 1 4 1 4 1 1 3 1 3 1 1 1 3 1 1   
## 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736   
## 1 1 1 4 1 1 1 1 4 4 4 1 1 1 4 1   
## 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752   
## 2 1 4 1 4 3 3 3 1 4 1 5 2 1 1 4   
## 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768   
## 1 2 1 1 3 3 4 3 1 1 1 3 1 3 3 1   
## 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784   
## 3 1 1 3 4 4 4 1 2 1 1 5 4 4 1 4   
## 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800   
## 1 4 1 3 3 3 1 1 3 3 1 1 3 4 5 1   
## 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816   
## 1 4 1 1 3 4 1 4 3 3 1 3 4 4 1 1   
## 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832   
## 3 1 4 1 1 1 1 1 4 1 1 1 4 4 4 1   
## 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848   
## 1 3 4 4 1 1 1 2 1 4 4 1 4 1 1 2   
## 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864   
## 1 3 4 1 3 3 1 1 1 1 1 1 3 4 3 1   
## 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880   
## 1 1 1 3 1 1 3 1 1 1 1 4 1 2 5 5   
## 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896   
## 4 4 1 1 3 3 3 1 1 4 3 1 3 1 1 4   
## 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912   
## 1 1 3 1 1 1 2 1 4 1 1 1 1 4 1 3   
## 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928   
## 3 3 4 4 4 1 1 4 1 1 3 3 1 1 1 3   
## 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944   
## 1 4 4 1 3 4 4 4 1 4 1 3 4 3 3 1   
## 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960   
## 1 3 3 1 4 3 1 4 3 3 1 3 3 3 1 4   
## 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976   
## 1 1 1 1 1 4 1 1 1 3 2 4 1 1 1 1   
## 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992   
## 4 1 1 3 1 1 1 3 1 3 3 1 1 1 3 1   
## 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008   
## 3 1 4 2 1 4 4 5 1 4 1 4 4 3 3 1   
## 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024   
## 1 1 2 1 1 1 4 1 1 4 1 3 3 4 3 3   
## 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040   
## 1 3 1 2 4 1 4 5 1 1 1 4 1 4 4 1   
## 1041 1042 1043 1044 1045 1046 1047 1048 1049 1050 1051 1052 1053 1054 1055 1056   
## 4 1 2 1 3 1 1 1 1 1 1 1 4 1 1 1   
## 1057 1058 1059 1060 1061 1062 1063 1064 1065 1066 1067 1068 1069 1070 1071 1072   
## 4 1 3 4 3 1 1 4 3 3 1 1 1 1 3 4   
## 1073 1074 1075 1076 1077 1078 1079 1080 1081 1082 1083 1084 1085 1086 1087 1088   
## 1 1 1 1 3 4 5 1 4 1 4 3 1 3 1 3   
## 1089 1090 1091 1092 1093 1094 1095 1096 1097 1098 1099 1100 1101 1102 1103 1104   
## 1 4 1 3 4 1 3 3 3 1 1 1 3 1 4 5   
## 1105 1106 1107 1108 1109 1110 1111 1112 1113 1114 1115 1116 1117 1118 1119 1120   
## 1 4 1 3 1 4 4 4 1 1 3 4 4 1 1 1   
## 1121 1122 1123 1124 1125 1126 1127 1128 1129 1130 1131 1132 1133 1134 1135 1136   
## 4 1 1 1 4 4 3 4 4 1 2 4 2 4 2 1   
## 1137 1138 1139 1140 1141 1142 1143 1144 1145 1146 1147 1148 1149 1150 1151 1152   
## 1 4 1 4 1 1 4 3 1 4 1 3 3 3 1 3   
## 1153 1154 1155 1156 1157 1158 1159 1160 1161 1162 1163 1164 1165 1166 1167 1168   
## 3 4 3 1 1 1 1 1 1 1 3 3 1 3 1 4   
## 1169 1170 1171 1172 1173 1174 1175 1176 1177 1178 1179 1180 1181 1182 1183 1184   
## 1 3 3 2 3 1 1 1 4 1 1 1 1 2 5 3   
## 1185 1186 1187 1188 1189 1190 1191 1192 1193 1194 1195 1196 1197 1198 1199 1200   
## 3 3 1 3 3 1 3 1 4 3 1 4 4 1 3 3   
## 1201 1202 1203 1204 1205 1206 1207 1208 1209 1210 1211 1212 1213 1214 1215 1216   
## 4 1 4 1 1 4 1 1 4 4 1 4 4 4 1 1   
## 1217 1218 1219 1220 1221 1222 1223 1224 1225 1226 1227 1228 1229 1230 1231 1232   
## 1 1 1 1 4 1 3 2 3 4 1 1 4 1 1 3   
## 1233 1234 1235 1236 1237 1238 1239 1240 1241 1242 1243 1244 1245 1246 1247 1248   
## 4 1 3 4 1 3 1 4 4 4 3 3 3 4 1 4   
## 1249 1250 1251 1252 1253 1254 1255 1256 1257 1258 1259 1260 1261 1262 1263 1264   
## 4 3 1 1 1 1 3 1 1 2 2 4 1 5 1 3   
## 1265 1266 1267 1268 1269 1270 1271 1272 1273 1274 1275 1276 1277 1278 1279 1280   
## 3 5 1 1 2 3 1 3 5 3 1 5 1 1 1 1   
## 1281 1282 1283 1284 1285 1286 1287 1288 1289 1290 1291 1292 1293 1294 1295 1296   
## 4 1 3 1 1 1 1 1 4 1 3 1 1 3 1 1   
## 1297 1298 1299 1300 1301 1302 1303 1304 1305 1306 1307 1308 1309 1310 1311 1312   
## 1 1 1 3 1 4 4 1 1 1 4 1 4 4 3 1   
## 1313 1314 1315 1316 1317 1318 1319 1320 1321 1322 1323 1324 1325 1326 1327 1328   
## 3 1 1 1 3 4 1 1 1 3 1 1 1 1 1 1   
## 1329 1330 1331 1332 1333 1334 1335 1336 1337 1338 1339 1340 1341 1342 1343 1344   
## 1 1 3 3 1 1 1 1 1 3 4 1 3 4 3 4   
## 1345 1346 1347 1348 1349 1350 1351 1352 1353 1354 1355 1356 1357 1358 1359 1360   
## 3 4 1 1 1 3 3 3 4 3 3 3 1 1 3 1   
## 1361 1362 1363 1364 1365 1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376   
## 4 1 3 1 3 3 3 1 4 4 4 1 1 1 1 1   
## 1377 1378 1379 1380 1381 1382 1383 1384 1385 1386 1387 1388 1389 1390 1391 1392   
## 1 4 4 3 1 1 1 1 3 3 4 3 3 1 5 1   
## 1393 1394 1395 1396 1397 1398 1399 1400 1401 1402 1403 1404 1405 1406 1407 1408   
## 4 3 1 4 1 1 4 4 1 4 1 1 1 3 5 3   
## 1409 1410 1411 1412 1413 1414 1415 1416 1417 1418 1419 1420 1421 1422 1423 1424   
## 5 1 4 4 4 1 1 1 1 2 4 3 1 1 3 1   
## 1425 1426 1427 1428 1429 1430 1431 1432 1433 1434 1435 1436 1437 1438 1439 1440   
## 5 4 4 4 1 3 3 1 1 3 3 3 3 1 3 3   
## 1441 1442 1443 1444 1445 1446 1447 1448 1449 1450 1451 1452 1453 1454 1455 1456   
## 1 4 1 1 3 1 1 1 4 1 1 1 4 1 1 4   
## 1457 1458 1459 1460 1461 1462 1463 1464 1465 1466 1467 1468 1469 1470 1471 1472   
## 1 3 4 1 1 4 4 2 3 3 4 2 3 1 2 4   
## 1473 1474 1475 1476 1477 1478 1479 1480 1481 1482 1483 1484 1485 1486 1487 1488   
## 1 1 1 1 1 3 3 2 4 4 1 1 1 1 1 3   
## 1489 1490 1491 1492 1493 1494 1495 1496 1497 1498 1499 1500 1501 1502 1503 1504   
## 3 3 3 1 1 3 1 1 1 1 3 1 2 1 1 3   
## 1505 1506 1507 1508 1509 1510 1511 1512 1513 1514 1515 1516 1517 1518 1519 1520   
## 1 4 1 4 2 1 4 4 1 1 3 1 3 2 2 4   
## 1521 1522 1523 1524 1525 1526 1527 1528 1529 1530 1531 1532 1533 1534 1535 1536   
## 4 4 2 1 1 3 3 2 1 4 1 1 1 1 4 1   
## 1537 1538 1539 1540 1541 1542 1543 1544 1545 1546 1547 1548 1549 1550 1551 1552   
## 4 1 1 5 1 1 1 2 4 3 3 3 3 3 1 1   
## 1553 1554 1555 1556 1557 1558 1559 1560 1561 1562 1563 1564 1565 1566 1567 1568   
## 1 3 1 4 3 3 3 1 3 3 1 3 3 3 1 2   
## 1569 1570 1571 1572 1573 1574 1575 1576 1577 1578 1579 1580 1581 1582 1583 1584   
## 1 1 4 4 4 1 3 3 1 3 3 3 4 4 3 4   
## 1585 1586 1587 1588 1589 1590 1591 1592 1593 1594 1595 1596 1597 1598 1599 1600   
## 2 1 4 1 3 1 4 1 1 1 1 4 4 1 1 3   
## 1601 1602 1603 1604 1605 1606 1607 1608 1609 1610 1611 1612 1613 1614 1615 1616   
## 2 1 2 4 3 1 2 1 2 3 3 1 1 3 1 4   
## 1617 1618 1619 1620 1621 1622 1623 1624 1625 1626 1627 1628 1629 1630 1631 1632   
## 3 1 4 1 1 1 3 3 3 1 1 1 1 4 1 2   
## 1633 1634 1635 1636 1637 1638 1639 1640 1641 1642 1643 1644 1645 1646 1647 1648   
## 3 4 3 3 4 2 3 1 3 4 3 1 4 1 3 3   
## 1649 1650 1651 1652 1653 1654 1655 1656 1657 1658 1659 1660 1661 1662 1663 1664   
## 4 4 2 4 4 1 4 1 4 1 3 3 2 4 2 1   
## 1665 1666 1667 1668 1669 1670 1671 1672 1673 1674 1675 1676 1677 1678 1679 1680   
## 1 3 3 1 3 1 1 1 1 4 4 4 1 3 1 3   
## 1681 1682 1683 1684 1685 1686 1687 1688 1689 1690 1691 1692 1693 1694 1695 1696   
## 3 3 4 4 4 1 4 4 1 4 2 4 1 1 1 1   
## 1697 1698 1699 1700 1701 1702 1703 1704 1705 1706 1707 1708 1709 1710 1711 1712   
## 4 4 1 3 4 3 4 1 3 1 3 3 1 1 1 1   
## 1713 1714 1715 1716 1717 1718 1719 1720 1721 1722 1723 1724 1725 1726 1727 1728   
## 1 3 1 1 4 2 3 1 1 3 5 3 1 1 1 1   
## 1729 1730 1731 1732 1733 1734 1735 1736 1737 1738 1739 1740 1741 1742 1743 1744   
## 2 1 1 3 1 4 3 1 1 1 3 1 4 3 3 1   
## 1745 1746 1747 1748 1749 1750 1751 1752 1753 1754 1755 1756 1757 1758 1759 1760   
## 3 3 4 1 3 1 4 3 3 3 1 4 1 3 1 1   
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## 4113 4114 4115 4116 4117 4118 4119 4120 4121 4122 4123 4124 4125 4126 4127 4128   
## 1 1 3 4 1 1 3 1 2 1 4 1 3 4 1 4   
## 4129 4130 4131 4132 4133 4134 4135 4136 4137 4138 4139 4140 4141 4142 4143 4144   
## 1 1 1 1 4 3 1 2 4 1 5 3 3 4 2 2   
## 4145 4146 4147 4148 4149 4150 4151 4152 4153 4154 4155 4156 4157 4158 4159 4160   
## 1 4 1 1 2 1 1 3 4 4 4 4 1 3 4 4   
## 4161 4162 4163 4164 4165 4166 4167 4168 4169 4170 4171 4172 4173 4174 4175 4176   
## 4 4 1 4 4 3 3 1 3 2 4 3 4 3 4 1   
## 4177 4178 4179 4180 4181 4182 4183 4184 4185 4186 4187 4188 4189 4190 4191 4192   
## 1 3 4 3 1 1 1 2 1 1 4 1 1 4 1 4   
## 4193 4194 4195 4196 4197 4198 4199 4200 4201 4202 4203 4204 4205 4206 4207 4208   
## 1 1 2 3 3 3 1 1 4 1 4 1 2 3 1 1   
## 4209 4210 4211 4212 4213 4214 4215 4216 4217 4218 4219 4220 4221 4222 4223 4224   
## 4 3 1 1 1 3 3 4 1 4 3 1 3 1 1 1   
## 4225 4226 4227 4228 4229 4230 4231 4232 4233 4234 4235 4236 4237 4238 4239 4240   
## 1 3 4 4 3 4 4 1 1 4 5 1 3 1 1 1   
## 4241 4242 4243 4244 4245 4246 4247 4248 4249 4250 4251 4252 4253 4254 4255 4256   
## 3 4 1 3 3 3 2 1 1 1 4 1 2 1 2 1   
## 4257 4258 4259 4260 4261 4262 4263 4264 4265 4266 4267 4268 4269 4270 4271 4272   
## 1 1 1 1 3 4 3 3 3 2 5 1 4 4 4 1   
## 4273 4274 4275 4276 4277 4278 4279 4280 4281 4282 4283 4284 4285 4286 4287 4288   
## 3 2 2 4 4 2 4 1 1 4 4 5 1 3 3 4   
## 4289 4290 4291 4292 4293 4294 4295 4296 4297 4298 4299 4300 4301 4302 4303 4304   
## 3 3 1 1 3 1 1 3 4 1 1 1 1 3 4 4   
## 4305 4306 4307 4308 4309 4310 4311 4312 4313 4314 4315 4316 4317 4318 4319 4320   
## 4 1 4 3 4 1 4 1 1 1 3 1 4 1 1 1   
## 4321 4322 4323 4324 4325 4326 4327 4328 4329 4330 4331 4332 4333 4334 4335 4336   
## 1 4 1 3 1 3 3 3 3 1 1 1 1 1 1 1   
## 4337 4338 4339 4340 4341 4342 4343 4344 4345 4346 4347 4348 4349 4350 4351 4352   
## 4 3 1 3 4 4 1 1 4 4 3 3 1 3 1 1   
## 4353 4354 4355 4356 4357 4358 4359 4360 4361 4362 4363 4364 4365 4366 4367 4368   
## 4 5 1 3 3 3 2 3 3 3 4 1 3 1 1 1   
## 4369 4370 4371 4372 4373 4374 4375 4376 4377 4378 4379 4380 4381 4382 4383 4384   
## 1 5 3 4 4 1 5 4 3 3 1 4 3 4 2 4   
## 4385 4386 4387 4388 4389 4390 4391 4392 4393 4394 4395 4396 4397 4398 4399 4400   
## 1 2 3 1 1 4 1 1 1 1 4 1 1 3 2 3   
## 4401 4402 4403 4404 4405 4406 4407 4408 4409 4410 4411 4412 4413 4414 4415 4416   
## 4 1 4 4 3 4 1 1 4 1 1 3 3 1 1 1   
## 4417 4418 4419 4420 4421 4422 4423 4424 4425 4426 4427 4428 4429 4430 4431 4432   
## 2 1 3 4 1 1 1 4 1 1 1 1 4 1 3 3   
## 4433 4434 4435 4436 4437 4438 4439 4440 4441 4442 4443 4444 4445 4446 4447 4448   
## 2 1 4 1 1 4 1 1 1 4 1 3 3 4 4 1   
## 4449 4450 4451 4452 4453 4454 4455 4456 4457 4458 4459 4460 4461 4462 4463 4464   
## 3 4 3 1 1 1 1 4 1 4 1 1 3 1 4 1   
## 4465 4466 4467 4468 4469 4470 4471 4472 4473 4474 4475 4476 4477 4478 4479 4480   
## 3 1 1 4 4 1 4 1 4 3 4 1 2 1 3 3   
## 4481 4482 4483 4484 4485 4486 4487 4488 4489 4490 4491 4492 4493 4494 4495 4496   
## 3 4 3 2 4 4 1 3 3 3 1 3 3 3 3 1   
## 4497 4498 4499 4500 4501 4502 4503 4504 4505 4506 4507 4508 4509 4510 4511 4512   
## 1 4 1 4 3 1 1 3 1 4 1 4 1 4 4 4   
## 4513 4514 4515 4516 4517 4518 4519 4520 4521 4522 4523 4524 4525 4526 4527 4528   
## 1 4 4 4 1 1 3 3 3 1 1 2 2 1 3 4   
## 4529 4530 4531 4532 4533 4534 4535 4536 4537 4538 4539 4540 4541 4542 4543 4544   
## 2 4 1 4 4 1 1 1 1 1 3 1 4 4 4 1   
## 4545 4546 4547 4548 4549 4550 4551 4552 4553 4554 4555 4556 4557 4558 4559 4560   
## 4 4 1 1 4 3 1 1 1 4 1 1 1 3 2 1   
## 4561 4562 4563 4564 4565 4566 4567 4568 4569 4570 4571 4572 4573 4574 4575 4576   
## 1 1 3 3 4 1 1 4 1 1 3 1 2 1 1 2   
## 4577 4578 4579 4580 4581 4582 4583 4584 4585 4586 4587 4588 4589 4590 4591 4592   
## 3 1 1 3 3 1 1 3 1 3 1 1 4 1 4 3   
## 4593 4594 4595 4596 4597 4598 4599 4600   
## 4 4 1 1 1 4 3 1   
##   
## Within cluster sum of squares by cluster:  
## [1] 1103.5597 939.3008 876.6912 1291.8691 1534.2055  
## (between\_SS / total\_SS = 68.8 %)  
##   
## Available components:  
##   
## [1] "cluster" "centers" "totss" "withinss" "tot.withinss"  
## [6] "betweenss" "size" "iter" "ifault"

fviz\_cluster(kmodel\_sqft,data=norm\_sqft)



#The first cluster "single house".  
#The second cluster "luxury house".  
#the third cluster"general family".  
#the forth cluster"gengeral family with large garden".  
#the fifth cluster"large house".  
  
  
# plot the price and condition with cluster fill.  
fvizgg<-ggplot(data = norm, mapping = aes(x = price,y = condition, color = factor(kmodel\_sqft$cluster)))  
fvizgg <- fvizgg + geom\_point(pch = 20, size = 3)  
fvizgg+ scale\_colour\_manual(values = c("red","blue","yellow","green","black"))



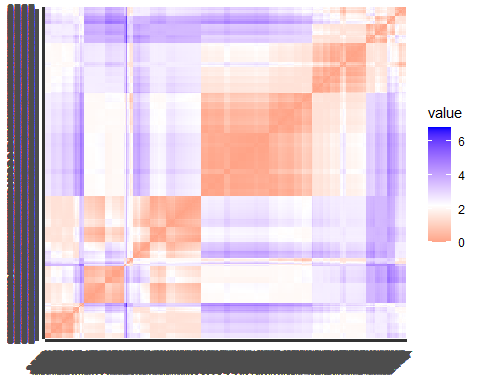
#table the price with cluster\_sqft.  
table(norm$city,kmodel\_sqft$cluster)

##   
## 1 2 3 4 5  
## Algona 4 0 0 1 0  
## Auburn 89 4 25 49 9  
## Beaux Arts Village 1 0 0 0 0  
## Bellevue 71 38 95 82 0  
## Black Diamond 6 0 0 3 0  
## Bothell 13 1 9 10 0  
## Burien 41 3 23 6 1  
## Carnation 11 2 1 4 4  
## Clyde Hill 0 4 4 3 0  
## Covington 28 0 5 10 0  
## Des Moines 39 2 13 4 0  
## Duvall 14 0 2 21 5  
## Enumclaw 18 0 1 2 7  
## Fall City 2 0 4 1 4  
## Federal Way 75 5 39 29 0  
## Inglewood-Finn Hill 1 0 0 0 0  
## Issaquah 78 21 32 53 3  
## Kenmore 29 2 19 16 0  
## Kent 102 2 37 43 1  
## Kirkland 80 10 47 50 0  
## Lake Forest Park 12 2 16 6 0  
## Maple Valley 53 0 4 38 1  
## Medina 0 3 2 6 0  
## Mercer Island 11 23 20 32 0  
## Milton 2 0 0 0 0  
## Newcastle 8 0 3 22 0  
## Normandy Park 7 1 6 4 0  
## North Bend 27 1 5 15 2  
## Pacific 5 0 0 1 0  
## Preston 1 0 0 0 1  
## Ravensdale 2 0 0 2 3  
## Redmond 64 6 42 115 8  
## Renton 129 7 56 96 5  
## Sammamish 34 7 18 115 1  
## SeaTac 18 0 8 3 0  
## Seattle 889 75 503 106 0  
## Shoreline 74 5 32 12 0  
## Skykomish 2 0 0 1 0  
## Snoqualmie 16 6 1 46 2  
## Snoqualmie Pass 0 0 1 0 0  
## Tukwila 20 0 7 2 0  
## Vashon 16 0 3 5 5  
## Woodinville 31 7 18 51 8  
## Yarrow Point 1 0 0 3 0

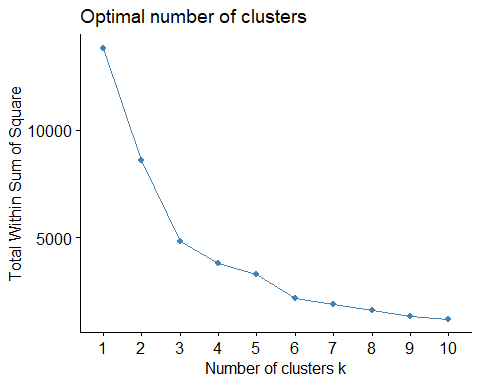
#calculate the mean sqft.  
aggregate(house$sqft\_living,list(kmodel\_sqft$cluster),mean)

## Group.1 x  
## 1 1 1427.601  
## 2 2 4297.325  
## 3 3 2257.427  
## 4 4 2882.583  
## 5 5 3232.571

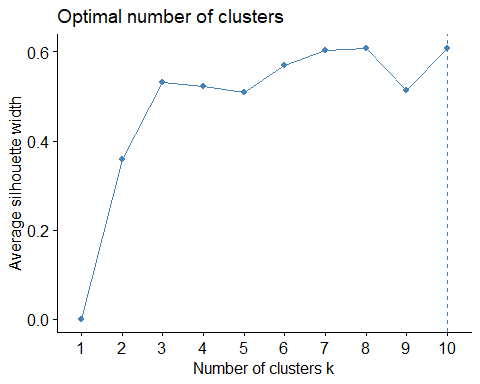
#Second look at house condition.   
#i will use condition and year od bulit and year of renovated to do cluster (condition+yr\_year+yr\_renovated)  
norm\_condition<-norm[,c(9,12,13)]  
set.seed(1234)  
distance <- get\_dist(norm\_condition)  
fviz\_dist(distance)



fviz\_nbclust(norm\_condition, kmeans, method = "wss")



fviz\_nbclust(norm\_condition, kmeans, method = "silhouette")



# using the elbow method, we get k = 10.  
kmodel\_condition<- kmeans(norm\_condition, centers = 10, nstart = 25)  
kmodel\_condition$centers

## condition yr\_built yr\_renovated  
## 1 -0.6670397 0.79257704 1.2064137  
## 2 2.2861678 -0.31108222 -0.8256037  
## 3 1.4580724 -1.65064897 1.1932389  
## 4 -0.6737515 -1.79712200 1.2153234  
## 5 0.8095640 0.05424527 -0.8256037  
## 6 -1.1721936 -1.14492345 -0.8256037  
## 7 -0.6670397 -0.50009439 1.2176616  
## 8 -0.6711729 0.94291310 -0.8256037  
## 9 0.8095640 -0.47163619 1.2087823  
## 10 1.4677401 -1.74947033 -0.8256037

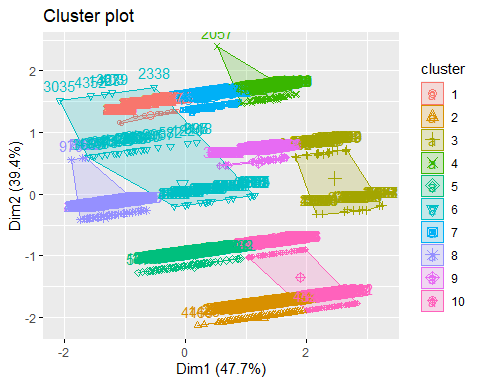
kmodel\_condition$size

## [1] 507 255 148 220 679 114 643 1429 347 258

kmodel\_condition

## K-means clustering with 10 clusters of sizes 507, 255, 148, 220, 679, 114, 643, 1429, 347, 258  
##   
## Cluster means:  
## condition yr\_built yr\_renovated  
## 1 -0.6670397 0.79257704 1.2064137  
## 2 2.2861678 -0.31108222 -0.8256037  
## 3 1.4580724 -1.65064897 1.1932389  
## 4 -0.6737515 -1.79712200 1.2153234  
## 5 0.8095640 0.05424527 -0.8256037  
## 6 -1.1721936 -1.14492345 -0.8256037  
## 7 -0.6670397 -0.50009439 1.2176616  
## 8 -0.6711729 0.94291310 -0.8256037  
## 9 0.8095640 -0.47163619 1.2087823  
## 10 1.4677401 -1.74947033 -0.8256037  
##   
## Clustering vector:  
## 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16   
## 7 10 5 5 9 7 8 8 5 7 7 3 8 9 7 5   
## 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32   
## 5 8 1 1 10 9 8 8 7 5 5 10 1 9 5 1   
## 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48   
## 7 8 1 8 5 5 2 9 9 5 9 1 6 7 5 8   
## 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64   
## 8 8 8 1 10 7 8 9 7 8 8 8 1 1 8 8   
## 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80   
## 1 6 5 5 1 2 1 8 4 1 4 8 9 8 9 8   
## 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96   
## 7 1 2 9 5 6 10 8 8 9 5 9 10 9 5 9   
## 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112   
## 4 7 8 2 8 8 7 1 9 8 7 8 7 8 4 8   
## 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128   
## 8 2 6 5 7 2 8 9 2 9 8 8 5 10 3 9   
## 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144   
## 8 8 8 9 7 8 7 5 9 1 8 8 8 8 8 8   
## 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160   
## 8 8 8 8 8 8 1 8 4 9 8 5 4 4 7 10   
## 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176   
## 5 1 7 7 7 8 2 7 7 5 4 5 7 1 5 8   
## 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192   
## 8 7 9 5 7 1 8 8 2 8 7 1 7 8 7 9   
## 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208   
## 7 10 5 8 8 5 8 7 1 2 8 5 8 7 1 2   
## 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224   
## 2 8 8 7 4 8 7 9 4 7 5 10 8 5 8 8   
## 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240   
## 8 1 8 1 8 8 7 7 8 8 8 2 5 7 5 9   
## 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256   
## 8 7 5 2 5 5 5 3 8 8 6 9 10 10 1 1   
## 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272   
## 5 2 1 6 6 9 5 5 3 4 8 1 8 10 3 8   
## 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288   
## 8 7 7 4 7 5 1 8 10 4 8 5 3 7 5 8   
## 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304   
## 5 5 7 7 5 8 9 4 8 10 10 7 1 2 7 9   
## 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320   
## 9 1 9 7 8 8 8 8 8 8 8 8 9 1 5 1   
## 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336   
## 7 8 2 3 8 8 4 5 7 8 8 7 8 7 10 8   
## 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352   
## 1 9 10 8 5 4 9 7 5 8 8 6 9 10 8 8   
## 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368   
## 7 5 7 5 3 10 1 5 8 10 7 7 8 9 3 5   
## 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384   
## 10 8 7 9 2 5 8 6 1 9 4 1 2 8 1 8   
## 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400   
## 8 8 8 8 8 5 1 8 10 5 8 5 9 8 1 3   
## 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416   
## 8 8 6 2 8 7 4 8 10 8 5 2 1 8 2 5   
## 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432   
## 5 5 5 10 8 9 1 10 4 5 8 8 5 5 8 5   
## 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448   
## 5 8 5 5 7 8 7 1 7 1 8 9 1 8 8 7   
## 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464   
## 5 5 5 5 1 4 9 7 8 8 1 1 8 8 8 8   
## 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480   
## 2 8 4 7 8 10 8 8 8 8 6 1 5 2 10 8   
## 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496   
## 8 4 5 3 1 3 8 7 1 1 1 2 9 5 8 5   
## 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512   
## 9 1 1 5 7 7 1 1 5 9 5 8 8 5 8 10   
## 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528   
## 9 5 8 7 3 7 10 7 10 8 6 5 6 5 6 8   
## 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544   
## 8 2 8 2 5 3 8 3 3 1 8 8 8 8 8 8   
## 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560   
## 8 1 5 8 8 8 1 5 8 9 2 8 8 8 2 9   
## 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576   
## 7 5 7 3 5 7 5 4 9 3 5 1 9 10 7 7   
## 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592   
## 5 5 8 1 5 6 7 7 7 7 10 7 7 8 8 8   
## 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608   
## 5 2 2 5 4 10 8 9 9 5 7 2 5 9 8 4   
## 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624   
## 7 4 1 5 7 5 8 10 7 8 1 8 8 1 8 1   
## 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640   
## 8 8 9 8 10 2 9 3 10 4 8 8 8 2 3 5   
## 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656   
## 5 1 7 7 7 2 7 8 6 10 1 1 10 5 1 5   
## 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672   
## 10 5 7 4 9 7 8 3 8 5 7 8 9 9 8 7   
## 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688   
## 8 8 2 1 9 8 5 8 8 8 7 8 9 5 8 4   
## 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704   
## 5 3 8 8 9 6 5 1 8 8 5 8 7 7 8 8   
## 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720   
## 8 8 1 1 1 7 6 8 5 5 4 9 8 7 7 7   
## 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736   
## 4 9 8 8 4 5 7 8 8 5 8 1 5 7 8 6   
## 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752   
## 1 10 8 7 8 8 9 7 5 7 7 9 5 5 2 8   
## 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768   
## 8 1 7 4 7 2 8 9 5 2 8 8 7 7 2 5   
## 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784   
## 1 4 7 7 8 8 1 8 1 8 8 8 1 1 8 8   
## 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800   
## 7 8 5 4 2 8 9 4 1 1 1 9 8 8 9 5   
## 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816   
## 7 5 6 7 4 8 3 8 10 2 1 9 8 7 9 7   
## 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832   
## 9 8 5 8 10 7 1 6 8 7 8 8 8 1 8 4   
## 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848   
## 5 9 1 8 9 10 8 5 8 8 8 1 8 8 8 8   
## 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864   
## 8 6 8 5 8 5 1 6 2 5 3 5 6 1 2 2   
## 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880   
## 6 8 10 2 4 7 9 8 7 2 5 7 5 10 9 8   
## 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896   
## 8 8 3 9 5 8 8 8 4 1 4 5 9 9 6 7   
## 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912   
## 5 8 5 4 8 6 5 7 8 8 1 1 7 7 5 9   
## 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928   
## 10 10 8 1 7 7 7 4 7 8 2 5 8 8 5 3   
## 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944   
## 7 8 8 8 8 1 1 8 6 7 8 7 8 9 5 4   
## 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960   
## 5 2 5 4 9 10 5 8 7 9 8 5 7 5 1 5   
## 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976   
## 5 8 5 10 6 8 9 5 6 8 8 8 5 5 5 4   
## 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992   
## 1 6 8 5 5 9 7 5 7 3 3 4 7 6 7 8   
## 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008   
## 7 8 8 7 9 8 2 5 8 8 10 5 1 9 9 7   
## 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024   
## 9 5 2 5 8 9 1 5 10 8 8 7 5 1 7 3   
## 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040   
## 8 9 9 10 4 10 8 8 8 8 8 8 8 8 8 8   
## 1041 1042 1043 1044 1045 1046 1047 1048 1049 1050 1051 1052 1053 1054 1055 1056   
## 1 8 1 8 8 8 9 8 8 9 8 2 1 1 7 1   
## 1057 1058 1059 1060 1061 1062 1063 1064 1065 1066 1067 1068 1069 1070 1071 1072   
## 4 8 5 5 5 10 1 8 1 3 8 2 7 7 5 1   
## 1073 1074 1075 1076 1077 1078 1079 1080 1081 1082 1083 1084 1085 1086 1087 1088   
## 7 2 5 7 8 8 10 7 3 3 8 7 5 5 3 7   
## 1089 1090 1091 1092 1093 1094 1095 1096 1097 1098 1099 1100 1101 1102 1103 1104   
## 8 1 7 8 1 7 7 8 7 1 6 7 7 10 8 8   
## 1105 1106 1107 1108 1109 1110 1111 1112 1113 1114 1115 1116 1117 1118 1119 1120   
## 7 8 5 8 8 8 5 8 7 8 4 1 8 9 1 8   
## 1121 1122 1123 1124 1125 1126 1127 1128 1129 1130 1131 1132 1133 1134 1135 1136   
## 8 7 2 7 8 1 8 2 8 8 8 8 8 8 8 8   
## 1137 1138 1139 1140 1141 1142 1143 1144 1145 1146 1147 1148 1149 1150 1151 1152   
## 8 5 8 1 2 7 1 5 6 5 1 5 10 7 4 10   
## 1153 1154 1155 1156 1157 1158 1159 1160 1161 1162 1163 1164 1165 1166 1167 1168   
## 1 8 1 6 8 8 5 10 5 2 2 7 6 7 5 8   
## 1169 1170 1171 1172 1173 1174 1175 1176 1177 1178 1179 1180 1181 1182 1183 1184   
## 7 1 5 9 7 2 2 4 5 7 4 7 2 7 8 8   
## 1185 1186 1187 1188 1189 1190 1191 1192 1193 1194 1195 1196 1197 1198 1199 1200   
## 7 10 7 1 8 1 2 1 8 5 4 8 8 8 9 8   
## 1201 1202 1203 1204 1205 1206 1207 1208 1209 1210 1211 1212 1213 1214 1215 1216   
## 5 1 8 8 8 8 5 8 8 8 8 8 1 8 8 8   
## 1217 1218 1219 1220 1221 1222 1223 1224 1225 1226 1227 1228 1229 1230 1231 1232   
## 8 8 9 6 5 2 7 7 2 8 10 5 8 2 9 7   
## 1233 1234 1235 1236 1237 1238 1239 1240 1241 1242 1243 1244 1245 1246 1247 1248   
## 4 4 9 8 7 8 8 2 8 8 9 7 9 8 4 7   
## 1249 1250 1251 1252 1253 1254 1255 1256 1257 1258 1259 1260 1261 1262 1263 1264   
## 5 10 5 4 7 8 5 1 1 7 1 8 9 5 1 2   
## 1265 1266 1267 1268 1269 1270 1271 1272 1273 1274 1275 1276 1277 1278 1279 1280   
## 7 8 7 7 1 10 9 5 8 5 3 8 7 7 3 7   
## 1281 1282 1283 1284 1285 1286 1287 1288 1289 1290 1291 1292 1293 1294 1295 1296   
## 8 1 9 7 6 4 7 3 8 8 5 2 7 5 8 8   
## 1297 1298 1299 1300 1301 1302 1303 1304 1305 1306 1307 1308 1309 1310 1311 1312   
## 8 8 8 2 4 1 1 3 8 5 8 2 8 8 8 8   
## 1313 1314 1315 1316 1317 1318 1319 1320 1321 1322 1323 1324 1325 1326 1327 1328   
## 1 8 2 7 9 5 8 8 7 5 9 8 10 1 7 7   
## 1329 1330 1331 1332 1333 1334 1335 1336 1337 1338 1339 1340 1341 1342 1343 1344   
## 9 7 4 4 5 5 7 7 6 10 1 6 7 8 9 1   
## 1345 1346 1347 1348 1349 1350 1351 1352 1353 1354 1355 1356 1357 1358 1359 1360   
## 2 8 8 6 5 9 10 5 8 1 7 7 7 7 10 1   
## 1361 1362 1363 1364 1365 1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376   
## 8 1 10 8 5 8 7 2 8 8 8 8 2 5 5 7   
## 1377 1378 1379 1380 1381 1382 1383 1384 1385 1386 1387 1388 1389 1390 1391 1392   
## 4 8 8 4 8 8 8 5 9 7 8 1 3 3 1 5   
## 1393 1394 1395 1396 1397 1398 1399 1400 1401 1402 1403 1404 1405 1406 1407 1408   
## 9 5 7 8 1 1 1 5 8 4 4 7 7 7 7 5   
## 1409 1410 1411 1412 1413 1414 1415 1416 1417 1418 1419 1420 1421 1422 1423 1424   
## 8 8 8 8 8 8 8 8 8 1 8 8 1 10 6 5   
## 1425 1426 1427 1428 1429 1430 1431 1432 1433 1434 1435 1436 1437 1438 1439 1440   
## 8 8 8 9 7 2 4 8 5 10 5 2 6 2 10 4   
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## 3793 3794 3795 3796 3797 3798 3799 3800 3801 3802 3803 3804 3805 3806 3807 3808   
## 5 4 10 5 7 5 2 8 8 8 8 8 8 8 1 1   
## 3809 3810 3811 3812 3813 3814 3815 3816 3817 3818 3819 3820 3821 3822 3823 3824   
## 8 8 4 3 7 7 8 1 5 9 5 8 5 7 7 1   
## 3825 3826 3827 3828 3829 3830 3831 3832 3833 3834 3835 3836 3837 3838 3839 3840   
## 8 7 4 5 2 8 8 5 8 8 8 8 7 9 4 5   
## 3841 3842 3843 3844 3845 3846 3847 3848 3849 3850 3851 3852 3853 3854 3855 3856   
## 5 8 8 8 1 2 8 5 5 10 10 5 2 1 7 3   
## 3857 3858 3859 3860 3861 3862 3863 3864 3865 3866 3867 3868 3869 3870 3871 3872   
## 10 1 2 5 7 8 4 9 1 6 8 2 5 5 5 10   
## 3873 3874 3875 3876 3877 3878 3879 3880 3881 3882 3883 3884 3885 3886 3887 3888   
## 7 3 8 2 6 7 7 8 8 8 1 8 8 8 8 8   
## 3889 3890 3891 3892 3893 3894 3895 3896 3897 3898 3899 3900 3901 3902 3903 3904   
## 1 8 8 5 2 5 8 7 5 8 8 5 7 5 7 9   
## 3905 3906 3907 3908 3909 3910 3911 3912 3913 3914 3915 3916 3917 3918 3919 3920   
## 2 8 8 7 5 5 7 1 8 8 2 8 1 8 8 2   
## 3921 3922 3923 3924 3925 3926 3927 3928 3929 3930 3931 3932 3933 3934 3935 3936   
## 8 3 2 4 5 7 2 7 4 5 7 7 7 2 4 8   
## 3937 3938 3939 3940 3941 3942 3943 3944 3945 3946 3947 3948 3949 3950 3951 3952   
## 8 1 7 9 7 8 8 7 1 3 8 5 2 8 7 7   
## 3953 3954 3955 3956 3957 3958 3959 3960 3961 3962 3963 3964 3965 3966 3967 3968   
## 8 8 8 8 8 8 8 8 8 2 8 1 10 6 8 8   
## 3969 3970 3971 3972 3973 3974 3975 3976 3977 3978 3979 3980 3981 3982 3983 3984   
## 4 8 8 1 9 6 10 5 7 4 4 10 1 5 8 7   
## 3985 3986 3987 3988 3989 3990 3991 3992 3993 3994 3995 3996 3997 3998 3999 4000   
## 5 3 6 1 5 5 1 2 2 8 7 3 10 5 6 3   
## 4001 4002 4003 4004 4005 4006 4007 4008 4009 4010 4011 4012 4013 4014 4015 4016   
## 6 1 4 8 8 5 9 5 8 8 7 8 10 8 5 5   
## 4017 4018 4019 4020 4021 4022 4023 4024 4025 4026 4027 4028 4029 4030 4031 4032   
## 8 9 2 5 5 1 10 10 5 1 5 1 8 1 10 8   
## 4033 4034 4035 4036 4037 4038 4039 4040 4041 4042 4043 4044 4045 4046 4047 4048   
## 5 1 8 8 8 8 8 8 8 8 1 8 8 8 5 8   
## 4049 4050 4051 4052 4053 4054 4055 4056 4057 4058 4059 4060 4061 4062 4063 4064   
## 9 8 8 3 1 1 5 5 5 1 10 8 5 5 9 8   
## 4065 4066 4067 4068 4069 4070 4071 4072 4073 4074 4075 4076 4077 4078 4079 4080   
## 7 8 4 8 7 5 6 5 1 6 5 1 8 8 5 8   
## 4081 4082 4083 4084 4085 4086 4087 4088 4089 4090 4091 4092 4093 4094 4095 4096   
## 7 7 8 7 9 7 8 5 1 8 5 1 5 8 7 7   
## 4097 4098 4099 4100 4101 4102 4103 4104 4105 4106 4107 4108 4109 4110 4111 4112   
## 7 1 10 1 7 5 7 4 4 5 5 8 5 10 8 7   
## 4113 4114 4115 4116 4117 4118 4119 4120 4121 4122 4123 4124 4125 4126 4127 4128   
## 5 5 9 8 1 6 2 7 8 4 8 6 8 8 8 2   
## 4129 4130 4131 4132 4133 4134 4135 4136 4137 4138 4139 4140 4141 4142 4143 4144   
## 5 8 8 2 4 1 10 8 8 9 8 7 3 8 9 6   
## 4145 4146 4147 4148 4149 4150 4151 4152 4153 4154 4155 4156 4157 4158 4159 4160   
## 6 2 5 4 9 2 8 8 8 8 1 1 8 7 8 8   
## 4161 4162 4163 4164 4165 4166 4167 4168 4169 4170 4171 4172 4173 4174 4175 4176   
## 8 8 1 1 8 8 10 5 5 8 1 7 5 2 8 5   
## 4177 4178 4179 4180 4181 4182 4183 4184 4185 4186 4187 4188 4189 4190 4191 4192   
## 7 7 4 10 10 10 6 1 5 8 8 8 7 8 9 8   
## 4193 4194 4195 4196 4197 4198 4199 4200 4201 4202 4203 4204 4205 4206 4207 4208   
## 9 5 5 7 9 8 9 9 1 5 8 10 10 8 7 10   
## 4209 4210 4211 4212 4213 4214 4215 4216 4217 4218 4219 4220 4221 4222 4223 4224   
## 8 7 5 7 7 2 5 1 5 4 5 5 2 8 8 5   
## 4225 4226 4227 4228 4229 4230 4231 4232 4233 4234 4235 4236 4237 4238 4239 4240   
## 8 1 8 8 10 8 8 4 9 8 3 5 9 8 5 9   
## 4241 4242 4243 4244 4245 4246 4247 4248 4249 4250 4251 4252 4253 4254 4255 4256   
## 1 8 9 10 8 3 3 8 10 9 1 7 8 9 8 6   
## 4257 4258 4259 4260 4261 4262 4263 4264 4265 4266 4267 4268 4269 4270 4271 4272   
## 9 5 9 9 2 5 9 4 5 1 5 5 8 8 8 8   
## 4273 4274 4275 4276 4277 4278 4279 4280 4281 4282 4283 4284 4285 4286 4287 4288   
## 10 8 1 8 8 8 8 8 8 8 8 8 7 5 3 4   
## 4289 4290 4291 4292 4293 4294 4295 4296 4297 4298 4299 4300 4301 4302 4303 4304   
## 3 2 7 9 9 5 5 4 8 2 1 5 8 3 1 1   
## 4305 4306 4307 4308 4309 4310 4311 4312 4313 4314 4315 4316 4317 4318 4319 4320   
## 8 5 1 7 5 8 8 7 7 7 9 5 1 7 8 1   
## 4321 4322 4323 4324 4325 4326 4327 4328 4329 4330 4331 4332 4333 4334 4335 4336   
## 8 1 5 7 8 9 5 1 8 5 5 8 1 5 9 8   
## 4337 4338 4339 4340 4341 4342 4343 4344 4345 4346 4347 4348 4349 4350 4351 4352   
## 8 8 3 7 1 1 7 9 1 9 7 7 7 5 5 6   
## 4353 4354 4355 4356 4357 4358 4359 4360 4361 4362 4363 4364 4365 4366 4367 4368   
## 1 6 5 7 9 9 5 7 5 10 1 5 8 1 8 2   
## 4369 4370 4371 4372 4373 4374 4375 4376 4377 4378 4379 4380 4381 4382 4383 4384   
## 6 1 2 8 8 3 8 8 9 7 7 5 7 8 8 1   
## 4385 4386 4387 4388 4389 4390 4391 4392 4393 4394 4395 4396 4397 4398 4399 4400   
## 1 8 9 5 7 8 5 1 7 9 2 7 8 7 3 1   
## 4401 4402 4403 4404 4405 4406 4407 4408 4409 4410 4411 4412 4413 4414 4415 4416   
## 1 5 6 1 5 4 5 5 5 7 1 5 2 1 5 2   
## 4417 4418 4419 4420 4421 4422 4423 4424 4425 4426 4427 4428 4429 4430 4431 4432   
## 8 8 7 5 7 8 9 8 9 5 6 8 8 9 8 4   
## 4433 4434 4435 4436 4437 4438 4439 4440 4441 4442 4443 4444 4445 4446 4447 4448   
## 8 4 1 9 9 8 7 8 8 1 7 4 1 8 8 5   
## 4449 4450 4451 4452 4453 4454 4455 4456 4457 4458 4459 4460 4461 4462 4463 4464   
## 10 9 2 3 7 5 1 8 10 8 2 8 10 5 8 9   
## 4465 4466 4467 4468 4469 4470 4471 4472 4473 4474 4475 4476 4477 4478 4479 4480   
## 10 2 4 8 1 5 8 9 8 5 8 7 1 6 2 9   
## 4481 4482 4483 4484 4485 4486 4487 4488 4489 4490 4491 4492 4493 4494 4495 4496   
## 2 1 2 8 8 5 9 10 5 3 8 4 5 9 4 7   
## 4497 4498 4499 4500 4501 4502 4503 4504 4505 4506 4507 4508 4509 4510 4511 4512   
## 7 8 2 1 2 5 9 5 1 8 4 5 7 7 8 8   
## 4513 4514 4515 4516 4517 4518 4519 4520 4521 4522 4523 4524 4525 4526 4527 4528   
## 5 8 8 5 7 8 8 10 10 6 4 8 2 7 9 2   
## 4529 4530 4531 4532 4533 4534 4535 4536 4537 4538 4539 4540 4541 4542 4543 4544   
## 8 7 4 8 5 2 7 9 7 8 5 6 8 8 8 8   
## 4545 4546 4547 4548 4549 4550 4551 4552 4553 4554 4555 4556 4557 4558 4559 4560   
## 8 5 7 8 8 5 7 4 7 1 5 2 4 10 2 10   
## 4561 4562 4563 4564 4565 4566 4567 4568 4569 4570 4571 4572 4573 4574 4575 4576   
## 5 8 9 9 8 1 3 5 7 8 10 4 4 8 7 8   
## 4577 4578 4579 4580 4581 4582 4583 4584 4585 4586 4587 4588 4589 4590 4591 4592   
## 2 9 5 3 5 10 3 7 5 10 8 7 8 9 8 5   
## 4593 4594 4595 4596 4597 4598 4599 4600   
## 8 1 8 9 1 8 8 5   
##   
## Within cluster sum of squares by cluster:  
## [1] 82.93708 57.81040 108.23107 23.76521 135.61445 126.37512 65.43835  
## [8] 175.43572 60.50012 168.60571  
## (between\_SS / total\_SS = 92.7 %)  
##   
## Available components:  
##   
## [1] "cluster" "centers" "totss" "withinss" "tot.withinss"  
## [6] "betweenss" "size" "iter" "ifault"

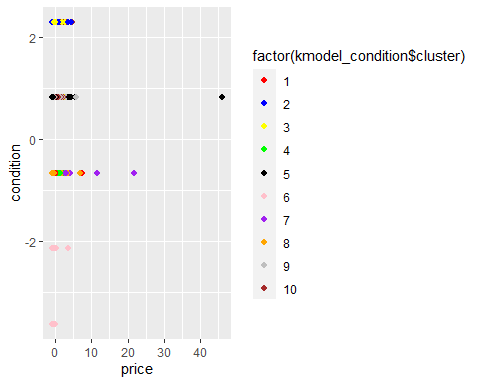
fviz\_cluster(kmodel\_condition,data=norm\_condition)



table(data$city,kmodel\_condition$cluster)

##   
## 1 2 3 4 5 6 7 8 9 10  
## Algona 0 0 0 0 0 0 1 3 1 0  
## Auburn 35 6 0 1 38 0 17 60 11 8  
## Beaux Arts Village 0 0 0 0 0 0 0 0 1 0  
## Bellevue 30 27 2 0 73 2 46 65 40 1  
## Black Diamond 3 0 0 1 1 0 0 3 1 0  
## Bothell 7 1 0 1 3 0 4 17 0 0  
## Burien 3 6 2 1 11 5 25 6 13 2  
## Carnation 4 1 0 0 1 1 4 11 0 0  
## Clyde Hill 1 1 0 0 3 1 4 0 1 0  
## Covington 7 5 0 0 16 0 3 10 2 0  
## Des Moines 4 1 0 2 13 1 17 8 10 2  
## Duvall 7 0 0 0 2 1 2 28 2 0  
## Enumclaw 1 4 3 0 8 0 1 7 0 4  
## Fall City 0 0 1 1 1 0 2 5 1 0  
## Federal Way 22 4 0 0 47 1 18 45 11 0  
## Inglewood-Finn Hill 0 1 0 0 0 0 0 0 0 0  
## Issaquah 27 8 0 0 32 0 4 107 7 2  
## Kenmore 8 5 0 1 9 1 9 27 5 1  
## Kent 14 7 1 0 62 1 14 67 17 2  
## Kirkland 25 18 1 2 41 1 27 62 7 3  
## Lake Forest Park 3 2 2 0 3 1 13 7 5 0  
## Maple Valley 21 2 1 0 11 0 0 61 0 0  
## Medina 1 0 0 0 3 0 3 2 2 0  
## Mercer Island 6 13 4 1 26 1 10 16 8 1  
## Milton 0 0 0 0 2 0 0 0 0 0  
## Newcastle 4 8 0 0 7 0 0 14 0 0  
## Normandy Park 0 3 0 0 3 1 3 1 7 0  
## North Bend 14 4 1 2 5 0 5 17 1 1  
## Pacific 1 0 0 0 1 0 0 4 0 0  
## Preston 0 0 1 0 1 0 0 0 0 0  
## Ravensdale 1 0 0 0 1 0 1 4 0 0  
## Redmond 42 2 0 0 47 2 12 122 8 0  
## Renton 46 20 4 3 59 2 36 101 19 3  
## Sammamish 52 4 0 1 15 0 2 95 6 0  
## SeaTac 1 0 0 0 5 2 12 8 0 1  
## Seattle 71 80 119 195 74 78 281 334 117 224  
## Shoreline 3 14 4 1 17 2 40 14 27 1  
## Skykomish 0 0 0 1 1 0 0 1 0 0  
## Snoqualmie 16 1 0 0 4 3 0 47 0 0  
## Snoqualmie Pass 1 0 0 0 0 0 0 0 0 0  
## Tukwila 0 0 0 4 1 4 12 6 2 0  
## Vashon 3 3 1 2 5 1 3 5 4 2  
## Woodinville 23 4 1 0 26 2 12 38 9 0  
## Yarrow Point 0 0 0 0 1 0 0 1 2 0

#cluster1-good condition,new house and no renovated recent.  
#cluster2-good condition,old house and have renovated recent.  
#cluster3-bad condition,new house and no renovated recent.  
#cluster4-bad condition,old house and have renovated recent.  
#cluster5-good condition,old house and have renovated recent.  
#cluster6-bad condition,old house and have renovated recent.  
#cluster7-good condition,new house and have renovated recent.  
#cluster8-good condition,old house and no renovated recent.  
#cluster9-good condition,old house and no renovated recent.  
#cluster10-bad condition,new house and have renovated recent.  
#plot the price with condition.  
fvizgg<-ggplot(data = norm, mapping = aes(x = price,y = condition, color = factor(kmodel\_condition$cluster)))  
fvizgg <- fvizgg + geom\_point(pch = 20, size = 3)  
fvizgg+ scale\_colour\_manual(values = c("red","blue","yellow","green","black","pink","purple","orange","grey","brown"))



#Third cluster by using linear model and k-means,to assign a certain supervised performance to the unsupervised model.  
#linear model can be a good way to filter important variables. A linear regression model was fitted to the data and l selection of the significant features with high scores.  
house <- house%>%filter(price!=0)%>%mutate(price=log(price))  
data\_predict<-house[,c(-1,-15,-16,-17,-18)]  
#separate to train and test to do linear model.  
samp<-sample(1:nrow(data\_predict),0.8\*nrow(data\_predict))  
train<-data\_predict[samp,]  
test<-data\_predict[-samp,]  
#linear model   
fit.lm<-lm(price~.,data=train)  
summary(fit.lm)

##   
## Call:  
## lm(formula = price ~ ., data = train)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -3.4339 -0.2406 0.0398 0.2473 4.4766   
##   
## Coefficients: (1 not defined because of singularities)  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 1.889e+01 5.773e-01 32.731 < 2e-16 \*\*\*  
## bedrooms -5.173e-02 8.862e-03 -5.838 5.76e-09 \*\*\*  
## bathrooms 1.365e-01 1.454e-02 9.389 < 2e-16 \*\*\*  
## sqft\_living 3.000e-04 1.824e-05 16.453 < 2e-16 \*\*\*  
## sqft\_lot -5.389e-07 1.750e-07 -3.080 0.00209 \*\*   
## floors 1.421e-01 1.589e-02 8.944 < 2e-16 \*\*\*  
## waterfront 1.918e-01 8.702e-02 2.204 0.02761 \*   
## view 6.903e-02 9.278e-03 7.440 1.25e-13 \*\*\*  
## condition 6.156e-02 1.110e-02 5.544 3.17e-08 \*\*\*  
## sqft\_above 2.315e-05 1.839e-05 1.259 0.20803   
## sqft\_basement NA NA NA NA   
## yr\_built -3.594e-03 2.876e-04 -12.496 < 2e-16 \*\*\*  
## yr\_renovated 1.417e-05 7.332e-06 1.932 0.05342 .   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.3749 on 3628 degrees of freedom  
## Multiple R-squared: 0.5218, Adjusted R-squared: 0.5203   
## F-statistic: 359.8 on 11 and 3628 DF, p-value: < 2.2e-16

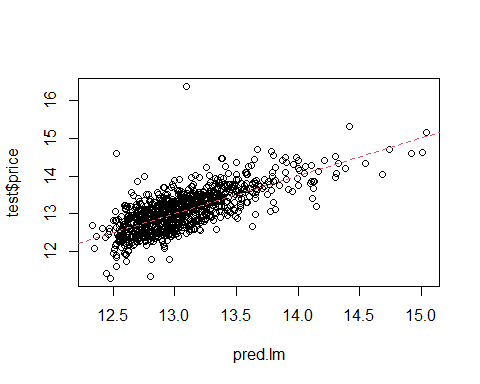
# use step to do better linear model.  
fit.lm2<-step(fit.lm)

## Start: AIC=-7130.63  
## price ~ bedrooms + bathrooms + sqft\_living + sqft\_lot + floors +   
## waterfront + view + condition + sqft\_above + sqft\_basement +   
## yr\_built + yr\_renovated  
##   
##   
## Step: AIC=-7130.63  
## price ~ bedrooms + bathrooms + sqft\_living + sqft\_lot + floors +   
## waterfront + view + condition + sqft\_above + yr\_built + yr\_renovated  
##   
## Df Sum of Sq RSS AIC  
## - sqft\_above 1 0.223 510.11 -7131.0  
## <none> 509.88 -7130.6  
## - yr\_renovated 1 0.525 510.41 -7128.9  
## - waterfront 1 0.683 510.56 -7127.8  
## - sqft\_lot 1 1.333 511.22 -7123.1  
## - condition 1 4.319 514.20 -7101.9  
## - bedrooms 1 4.789 514.67 -7098.6  
## - view 1 7.779 517.66 -7077.5  
## - floors 1 11.244 521.13 -7053.2  
## - bathrooms 1 12.388 522.27 -7045.3  
## - yr\_built 1 21.945 531.83 -6979.2  
## - sqft\_living 1 38.044 547.93 -6870.7  
##   
## Step: AIC=-7131.04  
## price ~ bedrooms + bathrooms + sqft\_living + sqft\_lot + floors +   
## waterfront + view + condition + yr\_built + yr\_renovated  
##   
## Df Sum of Sq RSS AIC  
## <none> 510.11 -7131.0  
## - yr\_renovated 1 0.516 510.62 -7129.4  
## - waterfront 1 0.691 510.80 -7128.1  
## - sqft\_lot 1 1.233 511.34 -7124.3  
## - condition 1 4.193 514.30 -7103.2  
## - bedrooms 1 4.881 514.99 -7098.4  
## - view 1 7.558 517.66 -7079.5  
## - bathrooms 1 12.176 522.28 -7047.2  
## - floors 1 15.643 525.75 -7023.1  
## - yr\_built 1 21.759 531.86 -6981.0  
## - sqft\_living 1 113.971 624.08 -6399.0

summary(fit.lm2)

##   
## Call:  
## lm(formula = price ~ bedrooms + bathrooms + sqft\_living + sqft\_lot +   
## floors + waterfront + view + condition + yr\_built + yr\_renovated,   
## data = train)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -3.4349 -0.2403 0.0380 0.2460 4.4820   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 1.880e+01 5.720e-01 32.861 < 2e-16 \*\*\*  
## bedrooms -5.218e-02 8.855e-03 -5.893 4.14e-09 \*\*\*  
## bathrooms 1.335e-01 1.435e-02 9.307 < 2e-16 \*\*\*  
## sqft\_living 3.182e-04 1.117e-05 28.475 < 2e-16 \*\*\*  
## sqft\_lot -5.154e-07 1.740e-07 -2.962 0.00307 \*\*   
## floors 1.508e-01 1.430e-02 10.549 < 2e-16 \*\*\*  
## waterfront 1.929e-01 8.702e-02 2.217 0.02667 \*   
## view 6.719e-02 9.163e-03 7.333 2.77e-13 \*\*\*  
## condition 6.046e-02 1.107e-02 5.461 5.04e-08 \*\*\*  
## yr\_built -3.543e-03 2.847e-04 -12.442 < 2e-16 \*\*\*  
## yr\_renovated 1.405e-05 7.332e-06 1.916 0.05545 .   
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.3749 on 3629 degrees of freedom  
## Multiple R-squared: 0.5216, Adjusted R-squared: 0.5202   
## F-statistic: 395.6 on 10 and 3629 DF, p-value: < 2.2e-16

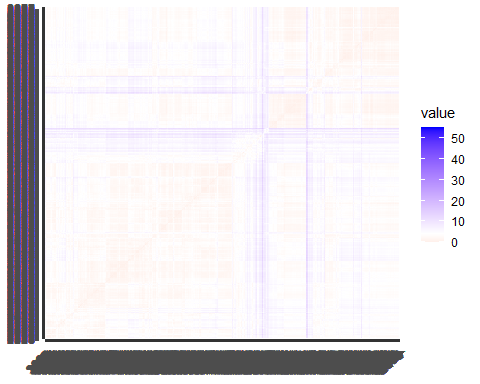
# prediction  
pred.lm<-predict(fit.lm2,test)  
plot(pred.lm,test$price)  
abline(a=0,b=1,col=2,lty=2)



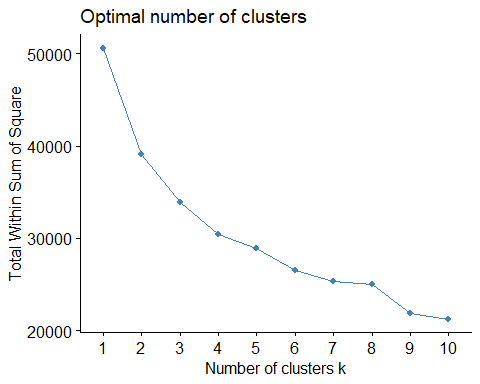
#greatest impact on the house price are bedrooms, bathrooms and sqft\_ living,sqft\_lot, floors, view ,yr\_built and condition.  
#MSE  
sum((pred.lm-test$price)^2)

## [1] 130.3922

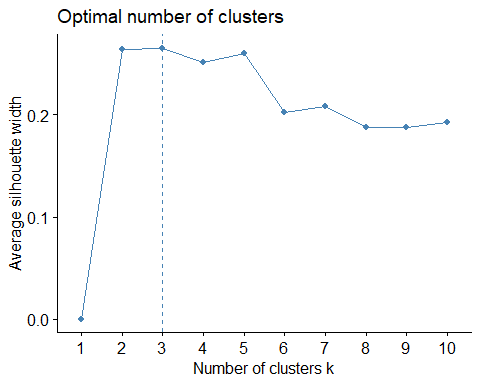
#use important variable from linear model to do the cluster.   
norm\_total<-norm[,c(-7,-13,-14)]  
set.seed(1234)  
distance <- get\_dist(norm\_total)  
fviz\_dist(distance)



fviz\_nbclust(norm\_total, kmeans, method = "wss")



fviz\_nbclust(norm\_total, kmeans, method = "silhouette")



# By using the elbow method, we get k = 3  
kmodel\_total<- kmeans(norm\_total, centers = 3, nstart = 25)  
kmodel\_total$centers

## price bedrooms bathrooms sqft\_living sqft\_lot floors  
## 1 -0.24165714 -0.3602250 -0.6562848 -0.5590645 -0.09325398 -0.7127905  
## 2 0.95228241 1.0425108 1.2061242 1.5150282 0.35266513 0.1466178  
## 3 0.01376264 0.1519542 0.5185189 0.2717181 0.01047592 0.9687549  
## view condition sqft\_above sqft\_basement yr\_built  
## 1 -0.1784143 0.2751682 -0.6283319 0.006966716 -0.5761801  
## 2 1.4363993 0.2363245 0.8917633 1.487566394 -0.1179053  
## 3 -0.2455090 -0.4761072 0.5881224 -0.528593953 0.8655141

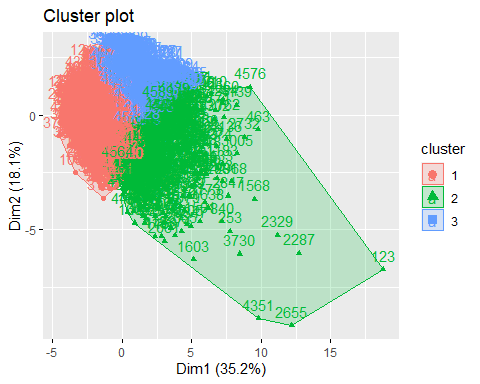
kmodel\_total$size

## [1] 2368 577 1655

kmodel\_total

## K-means clustering with 3 clusters of sizes 2368, 577, 1655  
##   
## Cluster means:  
## price bedrooms bathrooms sqft\_living sqft\_lot floors  
## 1 -0.24165714 -0.3602250 -0.6562848 -0.5590645 -0.09325398 -0.7127905  
## 2 0.95228241 1.0425108 1.2061242 1.5150282 0.35266513 0.1466178  
## 3 0.01376264 0.1519542 0.5185189 0.2717181 0.01047592 0.9687549  
## view condition sqft\_above sqft\_basement yr\_built  
## 1 -0.1784143 0.2751682 -0.6283319 0.006966716 -0.5761801  
## 2 1.4363993 0.2363245 0.8917633 1.487566394 -0.1179053  
## 3 -0.2455090 -0.4761072 0.5881224 -0.528593953 0.8655141  
##   
## Clustering vector:  
## 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16   
## 1 2 1 1 1 1 1 3 1 1 1 2 1 1 3 1   
## 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32   
## 1 3 1 1 1 1 3 3 1 1 1 1 3 1 1 3   
## 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48   
## 1 3 2 3 1 1 1 2 1 1 1 3 1 1 3 3   
## 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64   
## 3 3 3 3 1 1 1 1 1 2 3 3 3 3 2 3   
## 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80   
## 3 1 1 1 3 1 3 3 1 3 1 3 3 3 1 3   
## 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96   
## 1 3 1 1 1 1 1 3 3 1 3 1 3 1 1 2   
## 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112   
## 3 2 3 2 2 1 1 3 1 3 1 3 1 1 1 3   
## 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128   
## 1 1 1 1 3 1 2 1 1 1 2 3 1 1 1 1   
## 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144   
## 1 3 3 1 1 3 1 1 1 1 3 3 3 1 3 2   
## 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160   
## 3 3 3 3 2 3 3 1 1 1 3 1 1 1 1 1   
## 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176   
## 1 3 1 1 2 1 1 1 1 1 2 3 2 3 1 3   
## 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192   
## 3 1 1 3 1 3 3 1 1 3 1 1 1 3 1 1   
## 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208   
## 1 2 1 3 3 3 3 1 3 2 3 2 1 1 3 1   
## 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224   
## 1 3 3 1 1 1 1 1 1 2 1 1 3 1 3 2   
## 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240   
## 3 3 3 2 3 3 1 1 3 3 1 1 3 1 1 1   
## 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256   
## 3 2 1 1 1 3 1 1 2 3 1 1 2 1 3 1   
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## 2737 2738 2739 2740 2741 2742 2743 2744 2745 2746 2747 2748 2749 2750 2751 2752   
## 1 1 3 1 1 2 2 1 3 2 1 3 2 1 1 1   
## 2753 2754 2755 2756 2757 2758 2759 2760 2761 2762 2763 2764 2765 2766 2767 2768   
## 1 3 1 3 1 1 1 3 3 2 1 1 1 1 3 2   
## 2769 2770 2771 2772 2773 2774 2775 2776 2777 2778 2779 2780 2781 2782 2783 2784   
## 1 1 1 1 2 1 1 1 2 1 3 1 1 2 3 1   
## 2785 2786 2787 2788 2789 2790 2791 2792 2793 2794 2795 2796 2797 2798 2799 2800   
## 3 3 2 3 3 1 1 3 1 1 3 1 3 1 3 1   
## 2801 2802 2803 2804 2805 2806 2807 2808 2809 2810 2811 2812 2813 2814 2815 2816   
## 3 1 3 1 1 1 3 1 3 3 3 3 3 3 3 3   
## 2817 2818 2819 2820 2821 2822 2823 2824 2825 2826 2827 2828 2829 2830 2831 2832   
## 3 3 3 3 1 1 1 1 3 2 3 1 1 1 3 1   
## 2833 2834 2835 2836 2837 2838 2839 2840 2841 2842 2843 2844 2845 2846 2847 2848   
## 1 3 1 1 1 3 1 1 3 2 1 3 1 1 2 2   
## 2849 2850 2851 2852 2853 2854 2855 2856 2857 2858 2859 2860 2861 2862 2863 2864   
## 1 1 1 1 1 1 1 1 1 1 2 1 1 1 1 3   
## 2865 2866 2867 2868 2869 2870 2871 2872 2873 2874 2875 2876 2877 2878 2879 2880   
## 1 3 1 1 2 3 1 1 3 3 1 1 1 3 1 3   
## 2881 2882 2883 2884 2885 2886 2887 2888 2889 2890 2891 2892 2893 2894 2895 2896   
## 1 1 1 2 2 2 1 3 3 3 1 1 3 1 2 1   
## 2897 2898 2899 2900 2901 2902 2903 2904 2905 2906 2907 2908 2909 2910 2911 2912   
## 3 1 3 3 1 1 3 3 1 3 3 1 3 3 3 3   
## 2913 2914 2915 2916 2917 2918 2919 2920 2921 2922 2923 2924 2925 2926 2927 2928   
## 3 3 3 1 3 2 1 1 3 3 1 1 3 1 3 1   
## 2929 2930 2931 2932 2933 2934 2935 2936 2937 2938 2939 2940 2941 2942 2943 2944   
## 3 1 2 1 3 2 1 1 1 2 3 1 1 1 1 1   
## 2945 2946 2947 2948 2949 2950 2951 2952 2953 2954 2955 2956 2957 2958 2959 2960   
## 1 2 3 3 1 3 1 1 1 3 3 1 1 1 3 3   
## 2961 2962 2963 2964 2965 2966 2967 2968 2969 2970 2971 2972 2973 2974 2975 2976   
## 3 3 2 3 2 3 1 2 2 2 1 2 2 2 3 1   
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## 3 3 3 2 2 1 3 1 3 1 1 3 3 1 1 3   
## 2993 2994 2995 2996 2997 2998 2999 3000 3001 3002 3003 3004 3005 3006 3007 3008   
## 1 1 1 3 3 3 3 1 1 1 3 1 2 3 1 2   
## 3009 3010 3011 3012 3013 3014 3015 3016 3017 3018 3019 3020 3021 3022 3023 3024   
## 3 3 3 3 3 3 3 1 1 3 1 1 1 1 3 1   
## 3025 3026 3027 3028 3029 3030 3031 3032 3033 3034 3035 3036 3037 3038 3039 3040   
## 2 3 1 3 3 1 1 1 3 3 3 1 1 1 3 1   
## 3041 3042 3043 3044 3045 3046 3047 3048 3049 3050 3051 3052 3053 3054 3055 3056   
## 1 1 1 1 1 3 2 1 3 3 1 1 1 3 3 2   
## 3057 3058 3059 3060 3061 3062 3063 3064 3065 3066 3067 3068 3069 3070 3071 3072   
## 1 1 3 1 1 1 3 3 1 1 1 3 3 1 3 1   
## 3073 3074 3075 3076 3077 3078 3079 3080 3081 3082 3083 3084 3085 3086 3087 3088   
## 1 3 3 3 3 1 1 1 3 1 1 1 1 1 1 1   
## 3089 3090 3091 3092 3093 3094 3095 3096 3097 3098 3099 3100 3101 3102 3103 3104   
## 1 1 1 3 1 1 3 1 1 3 3 3 3 3 1 1   
## 3105 3106 3107 3108 3109 3110 3111 3112 3113 3114 3115 3116 3117 3118 3119 3120   
## 1 1 3 3 1 2 1 1 2 3 1 3 3 2 3 1   
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## 1 1 3 2 1 3 1 3 1 1 1 3 3 2 3 1   
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## 1 1 1 1 1 1 2 1 1 3 1 3 1 2 1 3   
## 3153 3154 3155 3156 3157 3158 3159 3160 3161 3162 3163 3164 3165 3166 3167 3168   
## 3 2 3 1 3 3 3 3 3 3 2 3 3 3 2 1   
## 3169 3170 3171 3172 3173 3174 3175 3176 3177 3178 3179 3180 3181 3182 3183 3184   
## 1 1 1 1 1 3 3 3 3 2 1 1 1 1 1 1   
## 3185 3186 3187 3188 3189 3190 3191 3192 3193 3194 3195 3196 3197 3198 3199 3200   
## 3 1 1 3 1 1 1 3 1 3 3 1 1 3 2 3   
## 3201 3202 3203 3204 3205 3206 3207 3208 3209 3210 3211 3212 3213 3214 3215 3216   
## 2 3 2 1 1 3 1 1 3 3 1 1 1 1 3 1   
## 3217 3218 3219 3220 3221 3222 3223 3224 3225 3226 3227 3228 3229 3230 3231 3232   
## 1 1 3 1 1 3 1 1 1 1 1 3 1 3 1 1   
## 3233 3234 3235 3236 3237 3238 3239 3240 3241 3242 3243 3244 3245 3246 3247 3248   
## 1 3 2 3 1 1 2 3 3 1 1 2 1 1 3 1   
## 3249 3250 3251 3252 3253 3254 3255 3256 3257 3258 3259 3260 3261 3262 3263 3264   
## 3 1 1 1 2 1 3 1 1 1 3 1 3 2 1 1   
## 3265 3266 3267 3268 3269 3270 3271 3272 3273 3274 3275 3276 3277 3278 3279 3280   
## 1 1 1 1 3 2 3 1 3 3 3 1 1 1 1 3   
## 3281 3282 3283 3284 3285 3286 3287 3288 3289 3290 3291 3292 3293 3294 3295 3296   
## 1 3 1 2 3 3 2 1 3 1 1 3 3 3 3 1   
## 3297 3298 3299 3300 3301 3302 3303 3304 3305 3306 3307 3308 3309 3310 3311 3312   
## 1 3 1 2 3 1 1 1 1 3 1 1 3 1 3 2   
## 3313 3314 3315 3316 3317 3318 3319 3320 3321 3322 3323 3324 3325 3326 3327 3328   
## 1 3 2 1 1 2 1 1 2 3 1 1 1 1 1 3   
## 3329 3330 3331 3332 3333 3334 3335 3336 3337 3338 3339 3340 3341 3342 3343 3344   
## 1 3 1 1 2 1 1 1 1 2 3 1 3 1 1 1   
## 3345 3346 3347 3348 3349 3350 3351 3352 3353 3354 3355 3356 3357 3358 3359 3360   
## 1 1 2 1 3 2 1 1 1 2 3 3 3 3 3 3   
## 3361 3362 3363 3364 3365 3366 3367 3368 3369 3370 3371 3372 3373 3374 3375 3376   
## 2 2 3 2 1 1 1 1 1 1 3 1 2 2 1 1   
## 3377 3378 3379 3380 3381 3382 3383 3384 3385 3386 3387 3388 3389 3390 3391 3392   
## 3 3 1 1 1 1 1 1 2 1 1 1 3 2 3 3   
## 3393 3394 3395 3396 3397 3398 3399 3400 3401 3402 3403 3404 3405 3406 3407 3408   
## 3 3 3 3 3 3 3 3 1 3 1 3 3 3 1 1   
## 3409 3410 3411 3412 3413 3414 3415 3416 3417 3418 3419 3420 3421 3422 3423 3424   
## 3 1 1 1 1 1 1 1 1 1 3 2 1 1 2 1   
## 3425 3426 3427 3428 3429 3430 3431 3432 3433 3434 3435 3436 3437 3438 3439 3440   
## 3 3 3 3 2 2 1 1 3 1 2 1 1 2 1 1   
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## 3 1 1 3 1 1 1 3 1 2 1 3 1 1 2 3   
## 3457 3458 3459 3460 3461 3462 3463 3464 3465 3466 3467 3468 3469 3470 3471 3472   
## 3 1 1 1 2 1 1 3 1 1 3 1 1 2 3 2   
## 3473 3474 3475 3476 3477 3478 3479 3480 3481 3482 3483 3484 3485 3486 3487 3488   
## 1 1 1 1 3 1 1 1 1 3 1 1 1 1 1 2   
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## 1 3 3 2 1 3 1 2 2 3 1 2 3 1 3 1   
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## 3 1 3 1 3 1 3 1 1 1 1 1 2 3 2 1   
## 3537 3538 3539 3540 3541 3542 3543 3544 3545 3546 3547 3548 3549 3550 3551 3552   
## 1 1 3 1 1 3 1 1 1 3 1 1 1 1 3 3   
## 3553 3554 3555 3556 3557 3558 3559 3560 3561 3562 3563 3564 3565 3566 3567 3568   
## 1 1 1 3 1 2 3 2 1 3 3 2 1 2 1 1   
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## 1 2 3 3 3 1 3 1 3 2 1 1 3 1 1 1   
## 3585 3586 3587 3588 3589 3590 3591 3592 3593 3594 3595 3596 3597 3598 3599 3600   
## 1 3 1 1 1 1 1 1 1 3 1 3 3 3 3 3   
## 3601 3602 3603 3604 3605 3606 3607 3608 3609 3610 3611 3612 3613 3614 3615 3616   
## 3 3 3 3 3 1 3 3 3 2 1 3 1 1 1 1   
## 3617 3618 3619 3620 3621 3622 3623 3624 3625 3626 3627 3628 3629 3630 3631 3632   
## 2 1 3 1 1 3 1 1 1 2 3 3 1 1 1 1   
## 3633 3634 3635 3636 3637 3638 3639 3640 3641 3642 3643 3644 3645 3646 3647 3648   
## 1 1 2 2 1 1 1 1 1 1 1 1 1 3 3 1   
## 3649 3650 3651 3652 3653 3654 3655 3656 3657 3658 3659 3660 3661 3662 3663 3664   
## 1 3 3 1 1 3 3 1 1 1 1 3 3 2 2 3   
## 3665 3666 3667 3668 3669 3670 3671 3672 3673 3674 3675 3676 3677 3678 3679 3680   
## 1 1 2 2 1 3 3 1 1 3 1 1 1 1 1 3   
## 3681 3682 3683 3684 3685 3686 3687 3688 3689 3690 3691 3692 3693 3694 3695 3696   
## 3 1 2 3 2 3 3 3 3 1 2 1 3 3 3 3   
## 3697 3698 3699 3700 3701 3702 3703 3704 3705 3706 3707 3708 3709 3710 3711 3712   
## 3 3 3 3 3 1 2 3 1 3 1 3 1 3 1 3   
## 3713 3714 3715 3716 3717 3718 3719 3720 3721 3722 3723 3724 3725 3726 3727 3728   
## 3 1 3 1 1 1 1 1 3 2 3 1 2 1 1 3   
## 3729 3730 3731 3732 3733 3734 3735 3736 3737 3738 3739 3740 3741 3742 3743 3744   
## 1 2 1 3 3 3 1 1 1 3 1 3 3 1 2 1   
## 3745 3746 3747 3748 3749 3750 3751 3752 3753 3754 3755 3756 3757 3758 3759 3760   
## 1 2 3 1 2 1 1 1 1 3 1 1 2 1 3 2   
## 3761 3762 3763 3764 3765 3766 3767 3768 3769 3770 3771 3772 3773 3774 3775 3776   
## 3 1 1 2 1 1 3 3 2 1 2 1 1 1 1 2   
## 3777 3778 3779 3780 3781 3782 3783 3784 3785 3786 3787 3788 3789 3790 3791 3792   
## 1 1 1 2 1 2 1 2 3 3 1 3 3 3 1 2   
## 3793 3794 3795 3796 3797 3798 3799 3800 3801 3802 3803 3804 3805 3806 3807 3808   
## 1 1 1 3 2 1 2 3 3 3 3 3 3 3 3 3   
## 3809 3810 3811 3812 3813 3814 3815 3816 3817 3818 3819 3820 3821 3822 3823 3824   
## 3 2 1 1 2 1 3 1 3 1 1 2 1 1 2 1   
## 3825 3826 3827 3828 3829 3830 3831 3832 3833 3834 3835 3836 3837 3838 3839 3840   
## 3 1 1 1 2 3 3 1 3 1 3 3 1 3 1 1   
## 3841 3842 3843 3844 3845 3846 3847 3848 3849 3850 3851 3852 3853 3854 3855 3856   
## 2 3 3 3 3 1 1 3 2 1 1 1 3 1 1 1   
## 3857 3858 3859 3860 3861 3862 3863 3864 3865 3866 3867 3868 3869 3870 3871 3872   
## 1 3 1 1 1 3 1 2 3 1 3 1 3 1 1 2   
## 3873 3874 3875 3876 3877 3878 3879 3880 3881 3882 3883 3884 3885 3886 3887 3888   
## 1 2 1 2 1 1 1 3 3 1 3 3 3 3 1 3   
## 3889 3890 3891 3892 3893 3894 3895 3896 3897 3898 3899 3900 3901 3902 3903 3904   
## 2 3 3 1 3 3 3 1 1 3 3 1 1 1 1 1   
## 3905 3906 3907 3908 3909 3910 3911 3912 3913 3914 3915 3916 3917 3918 3919 3920   
## 2 3 2 1 1 1 2 2 3 3 2 3 3 3 3 1   
## 3921 3922 3923 3924 3925 3926 3927 3928 3929 3930 3931 3932 3933 3934 3935 3936   
## 2 1 1 3 2 1 1 1 1 1 3 1 1 1 1 3   
## 3937 3938 3939 3940 3941 3942 3943 3944 3945 3946 3947 3948 3949 3950 3951 3952   
## 3 2 1 2 2 1 3 1 3 1 3 3 2 3 2 3   
## 3953 3954 3955 3956 3957 3958 3959 3960 3961 3962 3963 3964 3965 3966 3967 3968   
## 3 3 3 3 3 1 3 2 3 1 3 3 2 2 1 3   
## 3969 3970 3971 3972 3973 3974 3975 3976 3977 3978 3979 3980 3981 3982 3983 3984   
## 2 1 3 1 3 1 1 3 1 1 2 1 2 2 3 3   
## 3985 3986 3987 3988 3989 3990 3991 3992 3993 3994 3995 3996 3997 3998 3999 4000   
## 1 1 1 2 1 3 3 1 1 3 1 1 1 1 2 1   
## 4001 4002 4003 4004 4005 4006 4007 4008 4009 4010 4011 4012 4013 4014 4015 4016   
## 1 3 1 3 1 3 1 1 3 2 1 3 1 3 1 1   
## 4017 4018 4019 4020 4021 4022 4023 4024 4025 4026 4027 4028 4029 4030 4031 4032   
## 3 2 3 1 2 3 1 1 1 3 1 1 3 3 2 3   
## 4033 4034 4035 4036 4037 4038 4039 4040 4041 4042 4043 4044 4045 4046 4047 4048   
## 2 3 3 3 3 3 3 3 3 3 3 3 3 3 2 3   
## 4049 4050 4051 4052 4053 4054 4055 4056 4057 4058 4059 4060 4061 4062 4063 4064   
## 3 2 3 1 3 1 1 3 1 3 1 3 2 2 1 1   
## 4065 4066 4067 4068 4069 4070 4071 4072 4073 4074 4075 4076 4077 4078 4079 4080   
## 1 3 1 1 1 2 3 1 3 1 1 3 3 3 2 3   
## 4081 4082 4083 4084 4085 4086 4087 4088 4089 4090 4091 4092 4093 4094 4095 4096   
## 3 1 3 1 1 1 2 3 3 3 1 2 3 3 1 1   
## 4097 4098 4099 4100 4101 4102 4103 4104 4105 4106 4107 4108 4109 4110 4111 4112   
## 1 1 1 1 1 3 1 1 1 1 1 2 2 1 1 1   
## 4113 4114 4115 4116 4117 4118 4119 4120 4121 4122 4123 4124 4125 4126 4127 4128   
## 1 1 2 3 1 1 1 1 2 1 3 1 1 3 3 3   
## 4129 4130 4131 4132 4133 4134 4135 4136 4137 4138 4139 4140 4141 4142 4143 4144   
## 3 1 3 1 2 1 1 2 3 1 2 2 1 3 2 2   
## 4145 4146 4147 4148 4149 4150 4151 4152 4153 4154 4155 4156 4157 4158 4159 4160   
## 1 3 1 1 2 1 3 3 3 3 3 3 1 1 3 3   
## 4161 4162 4163 4164 4165 4166 4167 4168 4169 4170 4171 4172 4173 4174 4175 4176   
## 3 3 3 3 3 1 2 1 1 2 3 2 3 1 3 3   
## 4177 4178 4179 4180 4181 4182 4183 4184 4185 4186 4187 4188 4189 4190 4191 4192   
## 1 1 3 1 1 1 3 2 1 3 3 1 1 3 1 3   
## 4193 4194 4195 4196 4197 4198 4199 4200 4201 4202 4203 4204 4205 4206 4207 4208   
## 1 1 2 1 2 2 1 1 3 1 3 1 2 1 1 1   
## 4209 4210 4211 4212 4213 4214 4215 4216 4217 4218 4219 4220 4221 4222 4223 4224   
## 3 2 1 1 1 2 1 3 1 3 1 1 1 3 3 1   
## 4225 4226 4227 4228 4229 4230 4231 4232 4233 4234 4235 4236 4237 4238 4239 4240   
## 3 1 3 3 1 3 3 1 1 3 2 3 1 1 3 1   
## 4241 4242 4243 4244 4245 4246 4247 4248 4249 4250 4251 4252 4253 4254 4255 4256   
## 3 3 1 2 1 1 2 1 1 1 3 1 2 1 2 1   
## 4257 4258 4259 4260 4261 4262 4263 4264 4265 4266 4267 4268 4269 4270 4271 4272   
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## 4353 4354 4355 4356 4357 4358 4359 4360 4361 4362 4363 4364 4365 4366 4367 4368   
## 3 1 1 2 1 2 2 3 1 1 3 1 3 3 3 1   
## 4369 4370 4371 4372 4373 4374 4375 4376 4377 4378 4379 4380 4381 4382 4383 4384   
## 1 3 2 3 3 1 3 3 1 1 1 3 1 3 2 3   
## 4385 4386 4387 4388 4389 4390 4391 4392 4393 4394 4395 4396 4397 4398 4399 4400   
## 3 2 1 1 1 3 1 3 1 1 3 1 3 1 2 1   
## 4401 4402 4403 4404 4405 4406 4407 4408 4409 4410 4411 4412 4413 4414 4415 4416   
## 3 1 1 3 1 2 1 1 3 1 3 1 1 3 1 1   
## 4417 4418 4419 4420 4421 4422 4423 4424 4425 4426 4427 4428 4429 4430 4431 4432   
## 2 3 1 3 1 3 1 3 1 1 1 1 2 1 1 1   
## 4433 4434 4435 4436 4437 4438 4439 4440 4441 4442 4443 4444 4445 4446 4447 4448   
## 2 1 3 1 1 3 1 1 3 3 1 1 2 3 3 1   
## 4449 4450 4451 4452 4453 4454 4455 4456 4457 4458 4459 4460 4461 4462 4463 4464   
## 2 3 1 1 1 1 3 3 1 3 1 3 2 1 3 3   
## 4465 4466 4467 4468 4469 4470 4471 4472 4473 4474 4475 4476 4477 4478 4479 4480   
## 1 3 1 3 3 3 3 1 3 1 3 1 2 1 2 1   
## 4481 4482 4483 4484 4485 4486 4487 4488 4489 4490 4491 4492 4493 4494 4495 4496   
## 2 3 1 2 3 3 1 1 1 1 3 1 1 1 2 1   
## 4497 4498 4499 4500 4501 4502 4503 4504 4505 4506 4507 4508 4509 4510 4511 4512   
## 1 3 1 3 2 1 1 1 3 3 1 3 1 3 3 3   
## 4513 4514 4515 4516 4517 4518 4519 4520 4521 4522 4523 4524 4525 4526 4527 4528   
## 1 3 3 2 1 3 1 1 1 1 1 2 2 1 1 3   
## 4529 4530 4531 4532 4533 4534 4535 4536 4537 4538 4539 4540 4541 4542 4543 4544   
## 2 2 1 3 3 1 1 1 1 1 1 1 3 3 3 3   
## 4545 4546 4547 4548 4549 4550 4551 4552 4553 4554 4555 4556 4557 4558 4559 4560   
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## 4561 4562 4563 4564 4565 4566 4567 4568 4569 4570 4571 4572 4573 4574 4575 4576   
## 3 3 2 2 3 3 1 2 1 3 1 1 2 3 1 2   
## 4577 4578 4579 4580 4581 4582 4583 4584 4585 4586 4587 4588 4589 4590 4591 4592   
## 3 1 3 1 1 1 1 1 1 1 3 1 2 1 3 1   
## 4593 4594 4595 4596 4597 4598 4599 4600   
## 3 3 3 1 3 3 1 3   
##   
## Within cluster sum of squares by cluster:  
## [1] 12625.972 13207.112 8077.464  
## (between\_SS / total\_SS = 33.0 %)  
##   
## Available components:  
##   
## [1] "cluster" "centers" "totss" "withinss" "tot.withinss"  
## [6] "betweenss" "size" "iter" "ifault"

fviz\_cluster(kmodel\_total,data=norm\_total)



#plot the city and price with cluster 3.  
table(data$city,kmodel\_total$cluster)

##   
## 1 2 3  
## Algona 3 0 2  
## Auburn 93 8 75  
## Beaux Arts Village 1 0 0  
## Bellevue 127 85 74  
## Black Diamond 6 0 3  
## Bothell 12 4 17  
## Burien 57 11 6  
## Carnation 8 4 10  
## Clyde Hill 3 7 1  
## Covington 28 0 15  
## Des Moines 41 8 9  
## Duvall 13 2 27  
## Enumclaw 18 3 7  
## Fall City 7 2 2  
## Federal Way 87 9 52  
## Inglewood-Finn Hill 1 0 0  
## Issaquah 37 25 125  
## Kenmore 30 5 31  
## Kent 93 8 84  
## Kirkland 101 20 66  
## Lake Forest Park 23 7 6  
## Maple Valley 18 0 78  
## Medina 0 8 3  
## Mercer Island 23 38 25  
## Milton 2 0 0  
## Newcastle 8 1 24  
## Normandy Park 12 4 2  
## North Bend 24 3 23  
## Pacific 4 0 2  
## Preston 1 0 1  
## Ravensdale 3 0 4  
## Redmond 85 18 132  
## Renton 146 18 129  
## Sammamish 31 18 126  
## SeaTac 24 1 4  
## Seattle 1010 219 344  
## Shoreline 95 13 15  
## Skykomish 2 0 1  
## Snoqualmie 8 8 55  
## Snoqualmie Pass 0 0 1  
## Tukwila 22 1 6  
## Vashon 16 6 7  
## Woodinville 44 13 58  
## Yarrow Point 1 0 3

table(data$price,kmodel\_total$cluster)

##   
## 1 2 3  
## 0 19 15 15  
## 7800 1 0 0  
## 80000 1 0 0  
## 83000 1 0 0  
## 83300 2 0 0  
## 84350 0 0 1  
## 87500 1 0 0  
## 90000 2 0 0  
## 1e+05 4 0 0  
## 102500 1 0 0  
## 107500 1 0 0  
## 108333.333333 1 0 0  
## 110000 2 0 0  
## 110700 1 0 0  
## 115000 1 0 0  
## 117833.333333 1 0 0  
## 119500 1 0 0  
## 120000 1 0 0  
## 120750 1 0 0  
## 124740 1 0 0  
## 127160 1 0 0  
## 129000 2 0 0  
## 132250 0 0 2  
## 132500 2 0 0  
## 134000 1 0 0  
## 135000 1 0 0  
## 135333.333333 2 0 0  
## 136500 1 0 0  
## 137000 1 0 0  
## 137124 1 0 0  
## 139000 2 0 0  
## 140000 1 0 0  
## 141800 1 0 0  
## 142500 1 0 0  
## 145000 1 0 0  
## 148000 2 0 0  
## 148226 1 0 0  
## 148612.5 2 0 0  
## 149000 1 0 0  
## 149500 1 0 0  
## 150000 8 0 0  
## 152000 1 0 0  
## 153000 1 0 0  
## 154950 1 0 0  
## 155000 3 0 0  
## 156000 1 0 0  
## 156766.666667 1 0 0  
## 157500 1 0 0  
## 160000 7 0 0  
## 160797 0 0 1  
## 161700 1 0 0  
## 163785.714286 1 0 0  
## 165000 4 0 0  
## 165050 1 0 0  
## 167500 1 0 0  
## 168000 1 0 1  
## 168333.333333 1 0 0  
## 168500 1 0 0  
## 170000 3 0 0  
## 170500 1 0 0  
## 171000 1 0 0  
## 171224.8 1 0 0  
## 171758.333333 1 0 0  
## 172500 1 0 0  
## 173000 1 0 0  
## 173666.666667 1 0 0  
## 174000 1 0 0  
## 174500 1 0 1  
## 174950 1 0 0  
## 175000 11 0 1  
## 176225 1 0 0  
## 176400 1 0 0  
## 177500 1 0 0  
## 178650 1 0 0  
## 180000 4 0 1  
## 180785.714286 1 0 0  
## 182805 1 0 0  
## 183000 2 0 0  
## 185000 5 0 0  
## 186000 1 0 0  
## 186950 0 0 1  
## 187000 1 0 0  
## 187500 1 0 0  
## 188000 0 1 0  
## 189000 2 0 0  
## 189650 1 0 0  
## 190000 6 0 0  
## 190368.75 1 0 0  
## 191000 2 0 0  
## 192000 1 0 0  
## 192500 2 0 0  
## 193000 2 0 0  
## 194000 2 0 0  
## 195000 6 1 0  
## 196440 1 0 0  
## 196500 1 0 0  
## 197000 1 0 0  
## 197500 2 0 0  
## 198000 2 0 0  
## 198995 1 0 0  
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## 622500 0 1 1  
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## 661500 0 1 0  
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## 831500 0 0 1  
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## 842500 0 0 1  
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## 849900 0 0 1  
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## 852600 0 1 0  
## 852880 0 0 1  
## 854000 0 1 0  
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## 859000 0 1 0  
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## 2075000 0 0 1  
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## 2200000 0 1 0  
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## 2680000 0 1 0  
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## 2750000 0 1 0  
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## 3710000 0 1 0  
## 3800000 0 1 0  
## 4489000 0 1 0  
## 4668000 0 1 0  
## 7062500 0 1 0  
## 12899000 0 1 0  
## 26590000 0 1 0

#cluster1-high price,lot of bedroom and bathroom,large sqft of living and lot,more floor and view,good condition,large sqft\_above,samll sqft\_basement,old build.  
#cluster2-regular price, large amount bedroom and bathroom,big sqft of living and lot,large amount floor,bad view,bad condition,small sqft\_above,small sqft\_basement,new build.  
#cluster3-low price,small amount bedroom and bathroom,small sqft of living and lot,more floor waterfront and view,bad condition,small sqft\_above,large sqft\_basement,old build.

#use silhouette to check the result of total cluster sil<-silhouette(kmodel\_totalclus.avg.widths #cluster2 better than cluster 3 and cluster 1.

#check the cluster3 relation with price and sqft. p<-ggplot(data = norm, mapping = aes(x = price,y = sqft\_living, color = factor(kmodel\_total$cluster))) p <- p + geom\_point(pch = 20, size = 3) p + scale\_colour\_manual(values = c(“red”,“blue”,“yellow”))