Assignment-3

Solution1.

Step 1: Calling libraries : arules, arulesViz .

Step 2: Upload data in transaction form.

```
> forests<-read.transactions("forests.txt",header = FALSE)
> summary(forests)
transactions as itemMatrix in sparse format with
 246 rows (elements/itemsets/transactions) and
 206 columns (items) and a density of 0.2973992

most frequent items:
    130     127       9     172      62 (Other)
    229     219     215     212     211   13985

element (itemset/transaction) length distribution:
sizes
 13  16  18  20  22  25  26  27  28  30  31  33  34  35  36  37  38  39  40  41  42  43  44  45  46
  1   1   1   1   1   2   2   3   2   2   2   3   4   3   2   5   5   2   1   1   2   5   2   3   6
 47  48  49  50  51  52  53  54  55  56  57  58  59  60  61  62  63  64  65  66  67  68  69  70  71
  3   5   3  11   5  11   7   4   4   2   2   6   4   2   4   3   3   2   9   3   6   3   8   2   3
 72  73  74  75  76  77  78  80  81  82  84  85  86  87  88  89  90  92  94  97  98 103 104 105 109
  2   2   5   3   5   4   5   1   5   1   1   5   3   1   2   1   1   3   1   1   2   1   1   1   1
110 112 114 116 117 119 123 136 139 162
  1   1   1   1   1   1   2   1   1   1

   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  13.00   46.25   58.00   61.26   74.00  162.00

includes extended item information - examples:
  labels
1      1
2     10
3    100
```

Step 3: Calling apriori function to check frequent itemsets with support =50%.

```
> rule1<-apriori(forests,parameter = list(support = 0.5,target = "frequent itemsets"))
Apriori

Parameter specification:
 confidence minval smax arem  aval originalSupport maxtime support minlen maxlen
         NA    0.1    1 none FALSE            TRUE       5     0.5      1     10
            target   ext
 frequent itemsets FALSE

Algorithmic control:
 filter tree heap memopt load sort verbose
    0.1 TRUE TRUE  FALSE TRUE    2    TRUE

Absolute minimum support count: 123

set item appearances ...[0 item(s)] done [0.00s].
set transactions ...[206 item(s), 246 transaction(s)] done [0.00s].
sorting and recoding items ... [54 item(s)] done [0.00s].
creating transaction tree ... done [0.00s].
checking subsets of size 1 2 3 4 5 6 7 8 9 done [0.13s].
writing ... [56755 set(s)] done [0.02s].
creating S4 object  ... done [0.03s].
```

Summary of the above:

```
> summary(rule1)
set of 56755 itemsets

most frequent items:
    130     127     111      62     191 (Other)
  25745   22546   20067   18798   17787  183734

element (itemset/transaction) length distribution:sizes
    1     2     3     4     5     6     7     8     9
   54   763  4414 12376 18182 14259  5778   920     9

   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  1.000   4.000   5.000   5.086   6.000   9.000

summary of quality measures:
    support           count
 Min.   :0.5000   Min.   :123.0
 1st Qu.:0.5081   1st Qu.:125.0
 Median :0.5203   Median :128.0
 Mean   :0.5319   Mean   :130.8
 3rd Qu.:0.5447   3rd Qu.:134.0
 Max.   :0.9309   Max.   :229.0

includes transaction ID lists: FALSE

mining info:
    data ntransactions support confidence
 forests           246     0.5          1
```

Step 3. Final Solution can be seen below:

```
> view1<-inspect(rule1)
```

```
      items     support   count
[1]   {103}     0.5203252 128
[2]   {110}     0.5000000 123
[3]   {79}      0.5081301 125
[4]   {22}      0.5243902 129
[5]   {182}     0.5284553 130
[6]   {203}     0.5325203 131
[7]   {7}       0.5772358 142
[8]   {8}       0.6097561 150
[9]   {61}      0.5609756 138
[10]  {119}     0.5975610 147
[11]  {105}     0.6097561 150
[12]  {132}     0.5934959 146
[13]  {15}      0.5894309 145
[14]  {12}      0.5975610 147
[15]  {135}     0.6016260 148
[16]  {192}     0.5894309 145
[17]  {195}     0.6178862 152
[18]  {1}       0.6300813 155
[19]  {145}     0.6219512 153
[20]  {65}      0.6341463 156
[21]  {86}      0.6504065 160
[22]  {14}      0.6504065 160
[23]  {45}      0.6626016 163
[24]  {171}     0.6666667 164
[25]  {20}      0.6747967 166
[26]  {156}     0.6747967 166
[27]  {72}      0.6666667 164
[28]  {190}     0.6829268 168
[29]  {106}     0.6788618 167
[30]  {128}     0.7073171 174
[31]  {184}     0.7154472 176
[32]  {92}      0.7276423 179
[33]  {11}      0.7276423 179
[34]  {204}     0.7520325 185
[35]  {87}      0.7520325 185
[36]  {74}      0.7642276 188
[37]  {91}      0.7601626 187
[38]  {143}     0.7845528 193
[39]  {13}      0.7886179 194
[40]  {164}     0.7723577 190
[41]  {4}       0.7886179 194
[42]  {139}     0.7886179 194
[43]  {35}      0.8089431 199
[44]  {191}     0.8008130 197
[45]  {116}     0.8211382 202
[46]  {163}     0.8333333 205
[47]  {75}      0.8170732 201
[48]  {158}     0.8333333 205
[49]  {172}     0.8617886 212
[50]  {62}      0.8577236 211
[51]  {9}       0.8739837 215
[52]  {111}     0.8536585 210
[53]  {127}     0.8902439 219
[54]  {130}     0.9308943 229
[55]  {103,9}   0.5000000 123
[56]  {13,182}  0.5040650 124
[57]  {182,62}  0.5000000 123
[58]  {127,182} 0.5203252 128
[59]  {130,182} 0.5121951 126
[60]  {130,203} 0.5081301 125
```

```
[61]  {13,7}    0.5000000 123
[62]  {163,7}   0.5040650 124
[63]  {172,7}   0.5284553 130
[64]  {62,7}    0.5040650 124
[65]  {127,7}   0.5040650 124
[66]  {130,7}   0.5447154 134
[67]  {156,8}   0.5000000 123
[68]  {8,87}    0.5081301 125
[69]  {74,8}    0.5243902 129
[70]  {8,91}    0.5121951 126
[71]  {143,8}   0.5203252 128
[72]  {13,8}    0.5447154 134
[73]  {4,8}     0.5325203 131
[74]  {191,8}   0.5000000 123
[75]  {163,8}   0.5203252 128
[76]  {75,8}    0.5000000 123
[77]  {158,8}   0.5284553 130
[78]  {172,8}   0.5365854 132
[79]  {62,8}    0.5650407 139
[80]  {8,9}     0.5650407 139
[81]  {111,8}   0.5447154 134
[82]  {127,8}   0.5894309 145
[83]  {130,8}   0.5813008 143
[84]  {13,61}   0.5000000 123
[85]  {163,61}  0.5243902 129
[86]  {158,61}  0.5000000 123
[87]  {172,61}  0.5000000 123
[88]  {61,62}   0.5040650 124
[89]  {61,9}    0.5162602 127
[90]  {111,61}  0.5243902 129
[91]  {127,61}  0.5203252 128
[92]  {130,61}  0.5325203 131
[93]  {119,87}  0.5081301 125
[94]  {119,91}  0.5081301 125
[95]  {119,4}   0.5000000 123
[96]  {119,35}  0.5040650 124
[97]  {119,163} 0.5081301 125
[98]  {119,75}  0.5000000 123
[99]  {119,158} 0.5365854 132
[100] {119,172} 0.5000000 123
[101] {119,62}  0.5243902 129
[102] {119,9}   0.5650407 139
[103] {111,119} 0.5447154 134
[104] {119,127} 0.5650407 139
[105] {119,130} 0.5650407 139
[106] {105,92}  0.5081301 125
[107] {105,87}  0.5000000 123
[108] {105,143} 0.5284553 130
[109] {105,164} 0.5000000 123
[110] {105,4}   0.5365854 132
[111] {105,35}  0.5325203 131
[112] {105,191} 0.5121951 126
[113] {105,116} 0.5162602 127
[114] {105,163} 0.5203252 128
[115] {105,75}  0.5284553 130
[116] {105,158} 0.5691057 140
[117] {105,172} 0.5325203 131
[118] {105,62}  0.5325203 131
[119] {105,9}   0.5609756 138
[120] {105,111} 0.5365854 132
[121] {105,127} 0.5731707 141
[122] {105,130} 0.5691057 140
[123] {132,74}  0.5000000 123
[124] {132,143} 0.5162602 127
```

[125] {132,164} 0.5162602 127
[126] {132,139} 0.5284553 130
[127] {132,35} 0.5203252 128
[128] {132,191} 0.5365854 132
[129] {116,132} 0.5365854 132
[130] {132,163} 0.5162602 127
[131] {132,75} 0.5284553 130
[132] {132,158} 0.5243902 129
[133] {132,172} 0.5691057 140
[134] {132,62} 0.5243902 129
[135] {132,9}   0.5162602 127
[136] {111,132} 0.5325203 131
[137] {127,132} 0.5284553 130
[138] {130,132} 0.5731707 141
[139] {15,87}   0.5000000 123
[140] {15,74}   0.5284553 130
[141] {143,15} 0.5000000 123
[142] {13,15}   0.5325203 131
[143] {15,164} 0.5000000 123
[144] {139,15} 0.5000000 123
[145] {15,35}   0.5000000 123
[146] {15,191} 0.5000000 123
[147] {116,15} 0.5162602 127
[148] {15,163} 0.5365854 132
[149] {15,158} 0.5121951 126
[150] {15,172} 0.5243902 129
[151] {15,62}   0.5243902 129
[152] {15,9}   0.5243902 129
[153] {111,15} 0.5447154 134
[154] {127,15} 0.5243902 129
[155] {130,15} 0.5650407 139
[156] {12,4}   0.5040650 124
[157] {12,139} 0.5040650 124
[158] {12,35}   0.5243902 129
[159] {12,191} 0.5162602 127
[160] {116,12} 0.5325203 131
[161] {12,163} 0.5284553 130
[162] {12,75}   0.5325203 131
[163] {12,158} 0.5162602 127
[164] {12,172} 0.5569106 137
[165] {12,62}   0.5406504 133
[166] {12,9}   0.5284553 130
[167] {111,12} 0.5325203 131
[168] {12,127} 0.5447154 134
[169] {12,130} 0.5569106 137
[170] {135,143} 0.5081301 125
[171] {135,4}   0.5081301 125
[172] {135,139} 0.5243902 129
[173] {135,35} 0.5243902 129
[174] {135,191} 0.5365854 132
[175] {116,135} 0.5528455 136
[176] {135,163} 0.5406504 133
[177] {135,75} 0.5487805 135
[178] {135,158} 0.5365854 132
[179] {135,172} 0.5650407 139
[180] {135,62} 0.5325203 131
[181] {135,9}   0.5487805 135
[182] {111,135} 0.5365854 132
[183] {127,135} 0.5406504 133
[184] {130,135} 0.5650407 139
[185] {184,192} 0.5040650 124
[186] {192,91} 0.5081301 125
[187] {164,192} 0.5325203 131
[188] {139,192} 0.5487805 135

```
[189] {192,35}  0.5406504 133
[190] {191,192} 0.5853659 144
[191] {116,192} 0.5447154 134
[192] {163,192} 0.5325203 131
[193] {192,75}  0.5487805 135
[194] {158,192} 0.5162602 127
[195] {172,192} 0.5569106 137
[196] {192,62}  0.5528455 136
[197] {192,9}   0.5162602 127
[198] {111,192} 0.5650407 139
[199] {127,192} 0.5528455 136
[200] {130,192} 0.5853659 144
[201] {106,195} 0.5121951 126
[202] {184,195} 0.5121951 126
[203] {195,204} 0.5365854 132
[204] {143,195} 0.5081301 125
[205] {164,195} 0.5243902 129
[206] {195,4}   0.5284553 130
[207] {139,195} 0.5447154 134
[208] {195,35}  0.5365854 132
[209] {191,195} 0.5528455 136
[210] {116,195} 0.5731707 141
[211] {163,195} 0.5569106 137
[212] {195,75}  0.5772358 142
[213] {158,195} 0.5487805 135
[214] {172,195} 0.5772358 142
[215] {195,62}  0.5487805 135
[216] {195,9}   0.5609756 138
[217] {111,195} 0.5691057 140
[218] {127,195} 0.5731707 141
[219] {130,195} 0.5853659 144
[220] {1,204}   0.5040650 124
[221] {1,74}    0.5000000 123
[222] {1,91}    0.5081301 125
[223] {1,143}   0.5365854 132
[224] {1,13}    0.5203252 128
[225] {1,164}   0.5162602 127
[226] {1,4}     0.5284553 130
[227] {1,139}   0.5569106 137
[228] {1,35}    0.5650407 139
[229] {1,191}   0.5528455 136
[230] {1,116}   0.5487805 135
[231] {1,163}   0.5569106 137
[232] {1,75}    0.5487805 135
[233] {1,158}   0.5569106 137
[234] {1,172}   0.5975610 147
[235] {1,62}    0.5650407 139
[236] {1,9}     0.5813008 143
[237] {1,111}   0.5731707 141
[238] {1,127}   0.5731707 141
[239] {1,130}   0.6016260 148
[240] {145,65}  0.5081301 125
[241] {145,184} 0.5121951 126
[242] {145,92}  0.5447154 134
[243] {145,204} 0.5487805 135
[244] {145,91}  0.5406504 133
[245] {13,145}  0.5162602 127
[246] {145,164} 0.5569106 137
[247] {145,4}   0.5447154 134
[248] {139,145} 0.5650407 139
[249] {145,35}  0.5650407 139
[250] {145,191} 0.6016260 148
[251] {116,145} 0.5772358 142
[252] {145,163} 0.5569106 137
```

```
[253] {145,75}  0.5650407 139
[254] {145,158} 0.5447154 134
[255] {145,172} 0.5934959 146
[256] {145,62}  0.5853659 144
[257] {145,9}   0.5731707 141
[258] {111,145} 0.5853659 144
[259] {127,145} 0.5853659 144
[260] {130,145} 0.6097561 150
[261] {128,65}  0.5040650 124
[262] {65,92}   0.5325203 131
[263] {204,65}  0.5365854 132
[264] {65,91}   0.5162602 127
[265] {143,65}  0.5325203 131
[266] {13,65}   0.5121951 126
[267] {164,65}  0.5365854 132
[268] {4,65}    0.5650407 139
[269] {139,65}  0.5609756 138
[270] {35,65}   0.5772358 142
[271] {191,65}  0.5813008 143
[272] {116,65}  0.5691057 140
[273] {163,65}  0.5487805 135
[274] {65,75}   0.5975610 147
[275] {158,65}  0.5569106 137
[276] {172,65}  0.5934959 146
[277] {62,65}   0.5772358 142
[278] {65,9}    0.5853659 144
[279] {111,65}  0.5731707 141
[280] {127,65}  0.5813008 143
[281] {130,65}  0.6097561 150
[282] {45,86}   0.5121951 126
[283] {171,86}  0.5040650 124
[284] {20,86}   0.5000000 123
[285] {128,86}  0.5406504 133
[286] {86,92}   0.5365854 132
[287] {11,86}   0.5284553 130
[288] {204,86}  0.5365854 132
[289] {86,87}   0.5406504 133
[290] {74,86}   0.5162602 127
[291] {86,91}   0.5406504 133
[292] {143,86}  0.5365854 132
[293] {13,86}   0.5203252 128
[294] {164,86}  0.5487805 135
[295] {4,86}    0.5934959 146
[296] {139,86}  0.5406504 133
[297] {35,86}   0.5731707 141
[298] {191,86}  0.5691057 140
[299] {116,86}  0.5975610 147
[300] {163,86}  0.5691057 140
[301] {75,86}   0.5772358 142
[302] {158,86}  0.5853659 144
[303] {172,86}  0.5731707 141
[304] {62,86}   0.5934959 146
[305] {86,9}    0.6219512 153
[306] {111,86}  0.6016260 148
[307] {127,86}  0.6382114 157
[308] {130,86}  0.6219512 153
[309] {106,14}  0.5081301 125
[310] {14,184}  0.5081301 125
[311] {14,92}   0.5081301 125
[312] {11,14}   0.5121951 126
[313] {14,204}  0.5243902 129
[314] {14,87}   0.5000000 123
[315] {14,91}   0.5040650 124
[316] {14,143}  0.5365854 132
```

```
[317] {13,14}   0.5081301 125
[318] {14,164}  0.5365854 132
[319] {14,4}    0.5447154 134
[320] {139,14}  0.5772358 142
[321] {14,35}   0.5853659 144
[322] {14,191}  0.5894309 145
[323] {116,14}  0.5731707 141
[324] {14,163}  0.5731707 141
[325] {14,75}   0.5731707 141
[326] {14,158}  0.5853659 144
[327] {14,172}  0.6097561 150
[328] {14,62}   0.5772358 142
[329] {14,9}    0.5772358 142
[330] {111,14}  0.5853659 144
[331] {127,14}  0.5894309 145
[332] {130,14}  0.6300813 155
[333] {171,45}  0.5162602 127
 [ reached 'max' / getOption("max.print") -- omitted 56422 rows ]
```

Solution 2.

Step 1. Calling apriori function to check max frequent itemsets with support =50%.

```
> rule2<-apriori(forests,parameter = list(support = 0.5,target="maximally frequent itemsets"))
Apriori

Parameter specification:
 confidence minval smax arem  aval originalSupport maxtime support minlen maxlen
         NA    0.1    1 none FALSE            TRUE       5     0.5      1     10
                    target   ext
 maximally frequent itemsets FALSE

Algorithmic control:
 filter tree heap memopt load sort verbose
    0.1 TRUE TRUE  FALSE TRUE    2    TRUE

Absolute minimum support count: 123

set item appearances ...[0 item(s)] done [0.00s].
set transactions ...[206 item(s), 246 transaction(s)] done [0.00s].
sorting and recoding items ... [54 item(s)] done [0.00s].
creating transaction tree ... done [0.00s].
checking subsets of size 1 2 3 4 5 6 7 8 9 done [0.13s].
filtering maximal item sets ... done [0.00s].
writing ... [13669 set(s)] done [0.01s].
creating S4 object  ... done [0.01s].
```

Summary of Above:

```
> summary(rule2)
set of 13669 itemsets

most frequent items:
    130     127     111     191      62 (Other)
   8694    6315    5014    4557    4473   48494

element (itemset/transaction) length distribution:sizes
   1    2    3    4    5    6    7    8    9
   3   53  496 1743 3685 4139 2690  851    9

   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  1.000   5.000   6.000   5.673   7.000   9.000

summary of quality measures:
    support           count
 Min.   :0.5000   Min.   :123.0
 1st Qu.:0.5000   1st Qu.:123.0
 Median :0.5041   Median :124.0
 Mean   :0.5043   Mean   :124.1
 3rd Qu.:0.5081   3rd Qu.:125.0
 Max.   :0.5366   Max.   :132.0

includes transaction ID lists: FALSE

mining info:
    data ntransactions support confidence
 forests           246     0.5          1
```

Step 2: get the output by inspect:

```
> view2<-inspect(rule2)
      items          support   count
[1]   {110}          0.5000000 123
[2]   {79}           0.5081301 125
[3]   {22}           0.5243902 129
[4]   {103,9}        0.5000000 123
[5]   {13,182}       0.5040650 124
[6]   {182,62}       0.5000000 123
[7]   {130,203}      0.5081301 125
[8]   {13,7}         0.5000000 123
[9]   {163,7}        0.5040650 124
[10]  {62,7}         0.5040650 124
[11]  {127,7}        0.5040650 124
[12]  {156,8}        0.5000000 123
[13]  {191,8}        0.5000000 123
[14]  {75,8}         0.5000000 123
[15]  {13,61}        0.5000000 123
[16]  {158,61}       0.5000000 123
[17]  {172,61}       0.5000000 123
[18]  {61,62}        0.5040650 124
[19]  {119,87}       0.5081301 125
[20]  {119,91}       0.5081301 125
[21]  {119,4}        0.5000000 123
[22]  {119,35}       0.5040650 124
[23]  {119,163}      0.5081301 125
[24]  {119,75}       0.5000000 123
[25]  {119,172}      0.5000000 123
[26]  {105,92}       0.5081301 125
[27]  {105,87}       0.5000000 123
[28]  {105,164}      0.5000000 123
[29]  {132,74}       0.5000000 123
[30]  {15,87}        0.5000000 123
[31]  {143,15}       0.5000000 123
[32]  {15,164}       0.5000000 123
[33]  {139,15}       0.5000000 123
[34]  {15,35}        0.5000000 123
[35]  {15,191}       0.5000000 123
[36]  {12,4}         0.5040650 124
[37]  {12,139}       0.5040650 124
[38]  {12,158}       0.5162602 127
[39]  {135,143}      0.5081301 125
[40]  {135,4}        0.5081301 125
[41]  {184,195}      0.5121951 126
[42]  {143,195}      0.5081301 125
[43]  {1,74}         0.5000000 123
[44]  {128,65}       0.5040650 124
[45]  {13,65}        0.5121951 126
[46]  {171,86}       0.5040650 124
[47]  {20,86}        0.5000000 123
[48]  {14,87}        0.5000000 123
[49]  {13,14}        0.5081301 125
[50]  {45,72}        0.5040650 124
[51]  {45,74}        0.5040650 124
[52]  {128,171}      0.5000000 123
[53]  {156,184}      0.5040650 124
[54]  {11,156}       0.5162602 127
[55]  {106,72}       0.5000000 123
[56]  {11,72}        0.5040650 124
[57]  {127,130,182}  0.5040650 124
[58]  {130,172,7}    0.5040650 124
[59]  {127,8,87}     0.5040650 124
[60]  {127,74,8}     0.5121951 126
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[61]  {127,8,91}    0.5081301 125
[62]  {130,8,91}    0.5000000 123
[63]  {127,143,8}   0.5000000 123
[64]  {13,8,9}      0.5081301 125
[65]  {4,62,8}      0.5000000 123
[66]  {4,8,9}       0.5081301 125
[67]  {127,4,8}     0.5162602 127
[68]  {130,4,8}     0.5040650 124
[69]  {127,163,8}   0.5040650 124
[70]  {130,163,8}   0.5000000 123
[71]  {158,8,9}     0.5040650 124
[72]  {127,158,8}   0.5121951 126
[73]  {130,158,8}   0.5121951 126
[74]  {172,8,9}     0.5040650 124
[75]  {130,163,61}  0.5040650 124
[76]  {127,61,9}    0.5000000 123
[77]  {111,127,61}  0.5000000 123
[78]  {111,130,61}  0.5121951 126
[79]  {127,130,61}  0.5000000 123
[80]  {119,158,9}   0.5081301 125
[81]  {119,62,9}    0.5040650 124
[82]  {119,127,62}  0.5040650 124
[83]  {119,130,62}  0.5040650 124
[84]  {105,127,143} 0.5000000 123
[85]  {105,158,4}   0.5121951 126
[86]  {105,4,9}     0.5121951 126
[87]  {105,158,35}  0.5040650 124
[88]  {105,35,9}    0.5000000 123
[89]  {105,127,35}  0.5040650 124
[90]  {105,130,35}  0.5081301 125
[91]  {105,127,191} 0.5000000 123
[92]  {105,130,191} 0.5000000 123
[93]  {105,116,130} 0.5000000 123
[94]  {105,127,163} 0.5000000 123
[95]  {105,158,75}  0.5000000 123
[96]  {105,127,75}  0.5121951 126
[97]  {105,130,75}  0.5081301 125
[98]  {105,158,62}  0.5000000 123
[99]  {105,111,158} 0.5000000 123
[100] {105,127,172} 0.5040650 124
[101] {105,130,172} 0.5000000 123
[102] {132,143,172} 0.5040650 124
[103] {130,132,164} 0.5040650 124
[104] {132,139,191} 0.5040650 124
[105] {132,172,35}  0.5081301 125
[106] {130,132,35}  0.5081301 125
[107] {116,132,191} 0.5040650 124
[108] {111,132,191} 0.5000000 123
[109] {132,163,172} 0.5000000 123
[110] {130,132,163} 0.5000000 123
[111] {132,158,172} 0.5121951 126
[112] {130,132,158} 0.5040650 124
[113] {132,172,62}  0.5040650 124
[114] {130,132,62}  0.5162602 127
[115] {130,132,9}   0.5040650 124
[116] {111,15,74}   0.5000000 123
[117] {130,15,74}   0.5081301 125
[118] {111,13,15}   0.5000000 123
[119] {13,130,15}   0.5121951 126
[120] {116,130,15}  0.5040650 124
[121] {111,15,163}  0.5040650 124
[122] {130,15,163}  0.5243902 129
[123] {130,15,158}  0.5000000 123
[124] {130,15,172}  0.5040650 124
```

```
[125] {130,15,9}    0.5081301 125
[126] {111,127,15}  0.5040650 124
[127] {127,130,15}  0.5081301 125
[128] {12,172,35}   0.5000000 123
[129] {12,130,35}   0.5081301 125
[130] {12,130,191}  0.5000000 123
[131] {116,12,172}  0.5081301 125
[132] {116,12,130}  0.5162602 127
[133] {12,163,172}  0.5000000 123
[134] {12,172,75}   0.5040650 124
[135] {12,130,75}   0.5040650 124
[136] {12,172,62}   0.5000000 123
[137] {111,12,172}  0.5000000 123
[138] {12,127,172}  0.5081301 125
[139] {12,130,172}  0.5284553 130
[140] {12,127,62}   0.5040650 124
[141] {12,130,62}   0.5081301 125
[142] {12,127,9}    0.5040650 124
[143] {12,130,9}    0.5000000 123
[144] {111,12,127}  0.5040650 124
[145] {111,12,130}  0.5162602 127
[146] {12,127,130}  0.5203252 128
[147] {130,135,139} 0.5000000 123
[148] {116,135,35}  0.5081301 125
[149] {130,135,35}  0.5000000 123
[150] {116,135,191} 0.5081301 125
[151] {135,191,75}  0.5000000 123
[152] {135,172,191} 0.5081301 125
[153] {111,135,191} 0.5040650 124
[154] {127,135,191} 0.5000000 123
[155] {130,135,191} 0.5121951 126
[156] {116,135,163} 0.5040650 124
[157] {116,135,9}   0.5000000 123
[158] {111,116,135} 0.5040650 124
[159] {116,127,135} 0.5040650 124
[160] {135,163,75}  0.5000000 123
[161] {135,163,172} 0.5121951 126
[162] {130,135,163} 0.5162602 127
[163] {135,172,75}  0.5162602 127
[164] {127,135,75}  0.5000000 123
[165] {135,158,172} 0.5121951 126
[166] {130,135,158} 0.5162602 127
[167] {135,172,9}   0.5121951 126
[168] {111,135,172} 0.5040650 124
[169] {127,135,172} 0.5081301 125
[170] {127,135,62}  0.5000000 123
[171] {130,135,62}  0.5081301 125
[172] {111,135,9}   0.5000000 123
[173] {127,135,9}   0.5121951 126
[174] {130,135,9}   0.5162602 127
[175] {111,127,135} 0.5121951 126
[176] {111,130,135} 0.5203252 128
[177] {127,130,135} 0.5203252 128
[178] {191,195,204} 0.5000000 123
[179] {172,195,204} 0.5000000 123
[180] {195,204,62}  0.5000000 123
[181] {116,164,195} 0.5000000 123
[182] {164,195,75}  0.5040650 124
[183] {127,164,195} 0.5040650 124
[184] {130,164,195} 0.5081301 125
[185] {195,4,75}    0.5000000 123
[186] {195,4,9}     0.5040650 124
[187] {127,195,4}   0.5081301 125
[188] {130,195,4}   0.5040650 124
```

[189] {116,139,195} 0.5081301 125
[190] {139,195,62} 0.5000000 123
[191] {139,195,9}   0.5121951 126
[192] {127,139,195} 0.5121951 126
[193] {191,195,35} 0.5040650 124
[194] {195,35,75}   0.5081301 125
[195] {172,195,35} 0.5040650 124
[196] {111,195,35} 0.5000000 123
[197] {163,191,195} 0.5000000 123
[198] {158,191,195} 0.5000000 123
[199] {158,163,195} 0.5000000 123
[200] {163,172,195} 0.5203252 128
[201] {163,195,62} 0.5000000 123
[202] {163,195,9}   0.5040650 124
[203] {158,172,195} 0.5121951 126
[204] {158,195,9}   0.5040650 124
[205] {127,158,195} 0.5121951 126
[206] {1,130,204}   0.5000000 123
[207] {1,130,91}   0.5040650 124
[208] {1,143,9}   0.5000000 123
[209] {1,127,143}   0.5000000 123
[210] {1,13,62}   0.5000000 123
[211] {1,127,13}   0.5000000 123
[212] {1,13,130}   0.5040650 124
[213] {1,164,172}   0.5000000 123
[214] {1,130,164}   0.5121951 126
[215] {1,172,4}   0.5081301 125
[216] {1,4,9}   0.5081301 125
[217] {1,130,4}   0.5081301 125
[218] {1,139,35}   0.5081301 125
[219] {1,139,191}   0.5040650 124
[220] {1,139,163}   0.5000000 123
[221] {1,139,75}   0.5040650 124
[222] {1,35,75}   0.5040650 124
[223] {1,158,35}   0.5121951 126
[224] {1,116,163}   0.5000000 123
[225] {1,116,9}   0.5040650 124
[226] {1,158,62}   0.5000000 123
[227] {1,127,158}   0.5040650 124
[228] {145,191,65} 0.5000000 123
[229] {130,145,65} 0.5000000 123
[230] {145,4,92}   0.5000000 123
[231] {145,164,204} 0.5040650 124
[232] {145,164,91} 0.5000000 123
[233] {145,9,91}   0.5000000 123
[234] {13,130,145} 0.5081301 125
[235] {145,164,4}   0.5000000 123
[236] {145,35,4}   0.5000000 123
[237] {172,65,92}   0.5040650 124
[238] {65,9,92}   0.5040650 124
[239] {139,204,65} 0.5000000 123
[240] {204,65,9}   0.5081301 125
[241] {127,204,65} 0.5000000 123
[242] {65,75,91}   0.5000000 123
[243] {143,191,65} 0.5040650 124
[244] {143,65,75}   0.5121951 126
[245] {143,172,65} 0.5040650 124
[246] {143,62,65}   0.5000000 123
[247] {127,143,65} 0.5000000 123
[248] {130,143,65} 0.5162602 127
[249] {164,35,65}   0.5000000 123
[250] {164,62,65}   0.5040650 124
[251] {127,164,65} 0.5040650 124
[252] {139,4,65}   0.5040650 124

[253] {35,4,65}   0.5121951 126
[254] {139,163,65} 0.5000000 123
[255] {116,163,65} 0.5040650 124
[256] {163,65,9}   0.5040650 124
[257] {158,62,65}   0.5081301 125
[258] {116,45,86}   0.5000000 123
[259] {45,86,9}   0.5000000 123
[260] {158,86,92}   0.5000000 123
[261] {11,116,86}   0.5000000 123
[262] {11,111,86}   0.5000000 123
[263] {191,204,86} 0.5000000 123
[264] {127,74,86}   0.5121951 126
[265] {143,4,86}   0.5040650 124
[266] {139,158,86} 0.5000000 123
[267] {139,172,86} 0.5040650 124
[268] {106,130,14} 0.5081301 125
[269] {14,184,191} 0.5000000 123
[270] {130,14,184} 0.5040650 124
[271] {130,14,92}   0.5040650 124
[272] {11,130,14}   0.5000000 123
[273] {111,14,204} 0.5000000 123
[274] {127,14,204} 0.5000000 123
[275] {130,14,204} 0.5203252 128
[276] {130,14,91}   0.5040650 124
[277] {14,143,172} 0.5121951 126
[278] {130,14,143} 0.5162602 127
[279] {14,164,35}   0.5000000 123
[280] {14,164,75}   0.5000000 123
[281] {127,14,164} 0.5000000 123
[282] {14,35,4}   0.5040650 124
[283] {14,191,4}   0.5040650 124
[284] {14,172,4}   0.5121951 126
[285] {116,20,45}   0.5040650 124
[286] {127,20,45}   0.5000000 123
[287] {130,20,45}   0.5121951 126
[288] {106,45,62}   0.5000000 123
[289] {128,4,45}   0.5000000 123
[290] {128,45,75}   0.5040650 124
[291] {184,191,45} 0.5000000 123
[292] {184,45,75}   0.5000000 123
[293] {184,45,62}   0.5000000 123
[294] {111,184,45} 0.5040650 124
[295] {45,91,92}   0.5000000 123
[296] {11,127,45}   0.5040650 124
[297] {11,130,45}   0.5040650 124
[298] {204,4,45}   0.5000000 123
[299] {172,204,45} 0.5040650 124
[300] {4,45,87}   0.5000000 123
[301] {45,75,87}   0.5040650 124
[302] {45,62,87}   0.5040650 124
[303] {13,45,91}   0.5000000 123
[304] {143,45,75}   0.5000000 123
[305] {143,45,9}   0.5040650 124
[306] {116,13,45}   0.5040650 124
[307] {139,4,45}   0.5000000 123
[308] {139,35,45}   0.5040650 124
[309] {139,163,45} 0.5000000 123
[310] {163,35,45}   0.5000000 123
[311] {130,171,20} 0.5040650 124
[312] {130,171,72} 0.5000000 123
[313] {106,130,171} 0.5081301 125
[314] {164,171,184} 0.5000000 123
[315] {11,111,171} 0.5040650 124
[316] {11,127,171} 0.5000000 123

```
[317] {171,204,35}  0.5000000 123
[318] {163,171,204} 0.5000000 123
[319] {171,191,74}  0.5000000 123
[320] {171,74,75}   0.5000000 123
[321] {171,62,74}   0.5000000 123
[322] {111,171,74}  0.5040650 124
[323] {130,171,74}  0.5243902 129
[324] {143,171,75}  0.5040650 124
[325] {171,35,4}    0.5040650 124
[326] {163,171,4}   0.5040650 124
[327] {106,130,20}  0.5000000 123
[328] {128,20,9}    0.5040650 124
[329] {184,20,62}   0.5040650 124
[330] {111,184,20}  0.5040650 124
[331] {11,191,20}   0.5040650 124
[332] {11,172,20}   0.5000000 123
[333] {11,20,62}    0.5000000 123
 [ reached 'max' / getOption("max.print") -- omitted 13336 rows ]
```

Solution 3.

Step 1: Used Apriori function to check association rule for support=40% and confidence=70%:

```
> rule3<-apriori(forests,parameter = list(support = 0.4,confidence =0.7,target="rule"))
Apriori

Parameter specification:
 confidence minval smax arem  aval originalSupport maxtime support minlen maxlen target   ext
        0.7    0.1    1 none FALSE            TRUE       5     0.4      1     10  rules FALSE

Algorithmic control:
 filter tree heap memopt load sort verbose
    0.1 TRUE TRUE  FALSE TRUE    2    TRUE

Absolute minimum support count: 98

set item appearances ...[0 item(s)] done [0.00s].
set transactions ...[206 item(s), 246 transaction(s)] done [0.00s].
sorting and recoding items ... [64 item(s)] done [0.00s].
creating transaction tree ... done [0.00s].
checking subsets of size 1 2 3 4 5 6 7 8 9 10 done [4.29s].
writing ... [9461862 rule(s)] done [3.95s].
creating S4 object  ... done [7.64s].
Warning message:
In apriori(forests, parameter = list(support = 0.4, confidence = 0.7,  :
  Mining stopped (maxlen reached). Only patterns up to a length of 10 returned!
```

Summary of the above script:

```
> summary(rule3)
set of 9461862 rules

rule length distribution (lhs + rhs):sizes
      1       2       3       4       5       6       7       8       9
10
     25    1815   30977  223726  863799 1962309 2700572 2251463 1116216  3109
60

   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  1.000   6.000   7.000   7.098   8.000  10.000

summary of quality measures:
    support         confidence          lift            count
 Min.   :0.4024   Min.   :0.7000   Min.   :0.9376   Min.   : 99.0
 1st Qu.:0.4065   1st Qu.:0.9015   1st Qu.:1.1051   1st Qu.:100.0
 Median :0.4187   Median :0.9397   Median :1.1430   Median :103.0
 Mean   :0.4277   Mean   :0.9276   Mean   :1.1503   Mean   :105.2
 3rd Qu.:0.4390   3rd Qu.:0.9658   3rd Qu.:1.1925   3rd Qu.:108.0
 Max.   :0.9309   Max.   :1.0000   Max.   :1.5305   Max.   :229.0

mining info:
    data ntransactions support confidence
 forests           246     0.4        0.7
```

Step 2: get the output by inspect:

```
> view3<-inspect(rule3)
      lhs       rhs    support   confidence lift      count
[1]   {}     => {128} 0.7073171 0.7073171  1.0000000 174
[2]   {}     => {184} 0.7154472 0.7154472  1.0000000 176
[3]   {}     => {92}  0.7276423 0.7276423  1.0000000 179
[4]   {}     => {11}  0.7276423 0.7276423  1.0000000 179
[5]   {}     => {204} 0.7520325 0.7520325  1.0000000 185
[6]   {}     => {87}  0.7520325 0.7520325  1.0000000 185
[7]   {}     => {74}  0.7642276 0.7642276  1.0000000 188
[8]   {}     => {91}  0.7601626 0.7601626  1.0000000 187
[9]   {}     => {143} 0.7845528 0.7845528  1.0000000 193
[10]  {}     => {13}  0.7886179 0.7886179  1.0000000 194
[11]  {}     => {164} 0.7723577 0.7723577  1.0000000 190
[12]  {}     => {4}   0.7886179 0.7886179  1.0000000 194
[13]  {}     => {139} 0.7886179 0.7886179  1.0000000 194
[14]  {}     => {35}  0.8089431 0.8089431  1.0000000 199
[15]  {}     => {191} 0.8008130 0.8008130  1.0000000 197
[16]  {}     => {116} 0.8211382 0.8211382  1.0000000 202
[17]  {}     => {163} 0.8333333 0.8333333  1.0000000 205
[18]  {}     => {75}  0.8170732 0.8170732  1.0000000 201
[19]  {}     => {158} 0.8333333 0.8333333  1.0000000 205
[20]  {}     => {172} 0.8617886 0.8617886  1.0000000 212
[21]  {}     => {62}  0.8577236 0.8577236  1.0000000 211
[22]  {}     => {9}   0.8739837 0.8739837  1.0000000 215
[23]  {}     => {111} 0.8536585 0.8536585  1.0000000 210
[24]  {}     => {127} 0.8902439 0.8902439  1.0000000 219
[25]  {}     => {130} 0.9308943 0.9308943  1.0000000 229
[26]  {183} => {35}  0.4024390 0.9082569  1.1227698  99
[27]  {183} => {9}   0.4105691 0.9266055  1.0602091 101
[28]  {183} => {127} 0.4024390 0.9082569  1.0202338  99
[29]  {183} => {130} 0.4105691 0.9266055  0.9953928 101
[30]  {34}  => {62}  0.4065041 0.9433962  1.0998838 100
[31]  {34}  => {9}   0.4146341 0.9622642  1.1010092 102
[32]  {34}  => {111} 0.4105691 0.9528302  1.1161725 101
[33]  {34}  => {127} 0.4227642 0.9811321  1.1020936 104
[34]  {34}  => {130} 0.4105691 0.9528302  1.0235643 101
[35]  {37}  => {92}  0.4186992 0.9196429  1.2638667 103
[36]  {37}  => {4}   0.4227642 0.9285714  1.1774669 104
[37]  {37}  => {139} 0.4105691 0.9017857  1.1435015 101
[38]  {37}  => {35}  0.4186992 0.9196429  1.1368449 103
[39]  {37}  => {191} 0.4065041 0.8928571  1.1149384 100
[40]  {37}  => {75}  0.4024390 0.8839286  1.0818230  99
[41]  {37}  => {158} 0.4146341 0.9107143  1.0928571 102
[42]  {37}  => {172} 0.4146341 0.9107143  1.0567722 102
[43]  {37}  => {62}  0.4105691 0.9017857  1.0513710 101
[44]  {37}  => {9}   0.4227642 0.9285714  1.0624585 104
[45]  {37}  => {111} 0.4105691 0.9017857  1.0563776 101
[46]  {37}  => {127} 0.4308943 0.9464286  1.0631115 106
[47]  {37}  => {130} 0.4390244 0.9642857  1.0358702 108
[48]  {115} => {35}  0.4024390 0.9252336  1.1437562  99
[49]  {115} => {191} 0.4227642 0.9719626  1.2137198 104
[50]  {115} => {116} 0.4268293 0.9813084  1.1950588 105
[51]  {115} => {75}  0.4105691 0.9439252  1.1552518 101
[52]  {115} => {158} 0.4065041 0.9345794  1.1214953 100
[53]  {115} => {172} 0.4105691 0.9439252  1.0953095 101
[54]  {115} => {62}  0.4105691 0.9439252  1.1005005 101
[55]  {115} => {9}   0.4146341 0.9532710  1.0907194 102
[56]  {115} => {111} 0.4268293 0.9813084  1.1495327 105
[57]  {115} => {127} 0.4186992 0.9626168  1.0812956 103
[58]  {115} => {130} 0.4308943 0.9906542  1.0641962 106
[59]  {2}   => {92}  0.4186992 0.9196429  1.2638667 103
[60]  {2}   => {164} 0.4024390 0.8839286  1.1444549  99
```

```
[61]  {2}   => {4}   0.4186992 0.9196429  1.1661451 103
[62]  {2}   => {191} 0.4024390 0.8839286  1.1037890  99
[63]  {2}   => {116} 0.4024390 0.8839286  1.0764675  99
[64]  {2}   => {158} 0.4186992 0.9196429  1.1035714 103
[65]  {2}   => {62}  0.4105691 0.9017857  1.0513710 101
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