

```

In[6]:= SetDirectory[
  "C:/Users/serha/OneDrive/Masaüstü/MyRepo/master_thesis_MMT003/210224_impacts_in_time_windows"];

(* data=Import["data_with_time_windows2.mx"]; *)

(* datafullmodified=Import["datafull_manipulated.mx"];
data=Table[Take[datafullmodified,UpTo@i],
  {i,{46497,91690,138440,183584,230005,275844,320350,367179,413106,459203}}]; *)

```

```

In[6]:= data = Import[
  "../data/ccm_manipulated_396096_partitioned_in_time_windows.mx", HeaderLines -> 1];

```

```

In[6]:= Get["../algorithm_packages/SingleNetworks-algorithm-package.wl"]
(* ?SingleNetworks` * *)

```

Thickness Feature

```

In[6]:= window = 10;
rawaim = data[[window]][[All, 10]];
pos = Partition[Flatten@Table[Position[rawaim, i], {i, {"NA", 0}}], 1];

In[6]:= aim = Delete[rawaim, pos];

In[6]:= campaign = Delete[data[[window]][[All, 2]], pos];

In[6]:= seri = Delete[data[[window]][[All, 1]], pos];

In[6]:= Print["unique aim data members: ", Dimensions@DeleteDuplicates@aim]
Print["aim data length: ", Dimensions@aim]
Print["sequence data groups amount: ", Dimensions@DeleteDuplicates@campaign]

unique aim data members: {35}
aim data length: {396096}
sequence data groups amount: {675}

In[6]:= Print["bucket size: ", bucketsize = Ceiling@N@Dimensions@aim / 50]
aimlabeled = Thread[Range@Length@aim -> aim];
aimpartitioned = Partition[Normal@Sort@Association@aimlabeled, UpTo@bucketsize];
bins = Table[MinMax[i], {i, Values@aimpartitioned}];
Print["node amount: ", Length@bins];

bucket size: {7922}
node amount: 50

In[6]:= Tally@bins

Out[6]:= {{{41, 56}, 1}, {{56, 56}, 1}, {{56, 57}, 1}, {{57, 63}, 1}, {{63, 65}, 1},
  {{65, 65}, 25}, {{65, 66}, 1}, {{66, 66}, 2}, {{66, 67}, 1}, {{67, 67}, 12},
  {{67, 74}, 1}, {{74, 76}, 1}, {{76, 77}, 1}, {{77, 87}, 1}, {{87, 87}, 1}}

In[6]:= repetitives

Out[6]:= {{65, 65}, {66, 66}, {67, 67}}

```

```
In[ ]:= binsrearranged
```

```
Out[ ]:= { {41., 56.}, {56., 56.}, {56., 57.}, {57., 63.}, {63., 65.}, {65.0325, 65.0325},
  {65.065, 65.065}, {65.0975, 65.0975}, {65.13, 65.13}, {65.1625, 65.1625},
  {65.195, 65.195}, {65.2275, 65.2275}, {65.26, 65.26}, {65.2925, 65.2925},
  {65.325, 65.325}, {65.3575, 65.3575}, {65.39, 65.39}, {65.4225, 65.4225},
  {65.455, 65.455}, {65.4875, 65.4875}, {65.52, 65.52}, {65.5525, 65.5525},
  {65.585, 65.585}, {65.6175, 65.6175}, {65.65, 65.65}, {65.6825, 65.6825},
  {65.715, 65.715}, {65.7475, 65.7475}, {65.78, 65.78}, {65.8125, 65.8125}, {65., 66.},
  {66.033, 66.033}, {66.066, 66.066}, {66., 67.}, {67.0335, 67.0335}, {67.067, 67.067},
  {67.1005, 67.1005}, {67.134, 67.134}, {67.1675, 67.1675}, {67.201, 67.201},
  {67.2345, 67.2345}, {67.268, 67.268}, {67.3015, 67.3015}, {67.335, 67.335},
  {67.3685, 67.3685}, {67.402, 67.402}, {67., 74.}, {74., 76.}, {76., 77.}, {77., 87.}}
```

```
In[ ]:= repetitivesreport = DeleteCases[Tally@bins, x_ /; x[[2]] == 1];
repetitives = repetitivesreport[[All, 1]];
labelgeneration[x_] := Table[{repetitives[x]][[1]] +
  i * repetitives[x][[1]] / (2 * 10^(RealDigits@repetitives[x][[1]] + 1)[[2]]),
  repetitives[x][[2]] + i * repetitives[x][[2]] /
  (2 * 10^(RealDigits@repetitives[x][[2]] + 1)[[2]])},
  {i, Range@repetitivesreport[x][[2]]}]
binsrearranged = N@ReplacePart[bins,
  Flatten[Table[MapThread[#1 -> #2 &, {Flatten@Position[bins, repetitives[[g]]],
    labelgeneration[g]}], {g, Range@Length@repetitives}], 1]];
```

```
In[ ]:= aimbinned = Values@
  Sort[Flatten[Table[aimpartitioned[[i]] /. Table[Values@aimpartitioned[[i]][[j]] ->
    binsrearranged[[i]], {j, Length@aimpartitioned[[i]]}],
  {i, Length@aimpartitioned}], 1], #1[[1]] < #2[[1]] &];
Position[aimbinned, Null]
```

```
Out[ ]:= {}
```

```
In[ ]:= aim = aimbinned;
binningmembers = Sort[DeleteDuplicates[aim]];
Print["binning amount: ", Dimensions@DeleteDuplicates@aimbinned]
Print["dimension of binned data: ", Dimensions@aim]
Print["binning members dimension : ", Dimensions@binningmembers]

binning amount: {50, 2}
dimension of binned data: {396096, 2}
binning members dimension : {50, 2}
```

```

In[ ]:= binningmembers = Sort[N@DeleteDuplicates[aim]]

Out[ ]:= { {41., 56.}, {56., 56.}, {56., 57.}, {57., 63.}, {63., 65.}, {65., 66.}, {65.0325, 65.0325},
  {65.065, 65.065}, {65.0975, 65.0975}, {65.13, 65.13}, {65.1625, 65.1625},
  {65.195, 65.195}, {65.2275, 65.2275}, {65.26, 65.26}, {65.2925, 65.2925},
  {65.325, 65.325}, {65.3575, 65.3575}, {65.39, 65.39}, {65.4225, 65.4225},
  {65.455, 65.455}, {65.4875, 65.4875}, {65.52, 65.52}, {65.5525, 65.5525},
  {65.585, 65.585}, {65.6175, 65.6175}, {65.65, 65.65}, {65.6825, 65.6825},
  {65.715, 65.715}, {65.7475, 65.7475}, {65.78, 65.78}, {65.8125, 65.8125}, {66., 67.},
  {66.033, 66.033}, {66.066, 66.066}, {67., 74.}, {67.0335, 67.0335}, {67.067, 67.067},
  {67.1005, 67.1005}, {67.134, 67.134}, {67.1675, 67.1675}, {67.201, 67.201},
  {67.2345, 67.2345}, {67.268, 67.268}, {67.3015, 67.3015}, {67.335, 67.335},
  {67.3685, 67.3685}, {67.402, 67.402}, {74., 76.}, {76., 77.}, {77., 87.} }

In[ ]:= aimbaskets = Values@GroupBy[Thread[{aim, campaign}], Last → First];
aimbasketsrev = Table[DeleteDuplicates[i], {i, aimbaskets}];
Print["binning groups association to count of their total members: ",
  KeySort@Counts@aim]
Print["binning amount: ", Dimensions@DeleteDuplicates@aim]

binning groups association to count of their total members:
<| {41., 56.} → 7922, {56., 56.} → 7922, {56., 57.} → 7922, {57., 63.} → 7922,
  {63., 65.} → 7922, {65., 66.} → 7922, {65.0325, 65.0325} → 7922, {65.065, 65.065} → 7922,
  {65.0975, 65.0975} → 7922, {65.13, 65.13} → 7922, {65.1625, 65.1625} → 7922,
  {65.195, 65.195} → 7922, {65.2275, 65.2275} → 7922, {65.26, 65.26} → 7922,
  {65.2925, 65.2925} → 7922, {65.325, 65.325} → 7922, {65.3575, 65.3575} → 7922,
  {65.39, 65.39} → 7922, {65.4225, 65.4225} → 7922, {65.455, 65.455} → 7922,
  {65.4875, 65.4875} → 7922, {65.52, 65.52} → 7922, {65.5525, 65.5525} → 7922,
  {65.585, 65.585} → 7922, {65.6175, 65.6175} → 7922, {65.65, 65.65} → 7922,
  {65.6825, 65.6825} → 7922, {65.715, 65.715} → 7922, {65.7475, 65.7475} → 7922,
  {65.78, 65.78} → 7922, {65.8125, 65.8125} → 7922, {66., 67.} → 7922, {66.033, 66.033} → 7922,
  {66.066, 66.066} → 7922, {67., 74.} → 7922, {67.0335, 67.0335} → 7922, {67.067, 67.067} → 7922,
  {67.1005, 67.1005} → 7922, {67.134, 67.134} → 7922, {67.1675, 67.1675} → 7922,
  {67.201, 67.201} → 7922, {67.2345, 67.2345} → 7922, {67.268, 67.268} → 7922,
  {67.3015, 67.3015} → 7922, {67.335, 67.335} → 7922, {67.3685, 67.3685} → 7922,
  {67.402, 67.402} → 7922, {74., 76.} → 7922, {76., 77.} → 7922, {77., 87.} → 7918 |>

binning amount: {50, 2}

```

```

In[ ]:= AbsoluteTiming[
  singlesupportvalues = Table[N[Count[Table[MemberQ[i, j], {i, aimbasketsrev}], True] /
    Length[aimbasketsrev]], {j, binningmembers}];]
pairs = Subsets[binningmembers, {2}];
Dimensions[binningmembers]
Dimensions[pairs]
Dimensions[aimbasketsrev]
AbsoluteTiming[
  pairsupportvalues = Table[N[Count[Table[SubsetQ[i, j], {i, aimbasketsrev}], True] /
    Length[aimbasketsrev]], {j, pairs}];]

Out[ ]:= {0.0719329, Null}

Out[ ]:= {50, 2}

Out[ ]:= {1225, 2, 2}

Out[ ]:= {675}

Out[ ]:= {6.22806, Null}

In[ ]:= AbsoluteTiming[liftvalues = pairsupportvalues / (DeleteCases[Flatten@
  UpperTriangularize[Table[singlesupportvalues[[j]] * singlesupportvalues[[k]],
    {j, Length[binningmembers]}, {k, Length[binningmembers]}], 1], 0.));]

Out[ ]:= {0.0051813, Null}

In[ ]:= allmatricelements =
  Sort[Join[pairs, Reverse[pairs, 2], Table[{i, i}, {i, binningmembers}]]];

```

```
labeledPairs := Extract[pairs, Position[liftvalues, x_ /; x > 1]];
Dimensions@labeledPairs
AbsoluteTiming[
  binarymatrix = ArrayReshape[Table[If[j == True, 1, 0], {j, Table[MemberQ[labeledPairs, i],
    {i, allmatrixelements}]}], {Length@binningmembers, Length@binningmembers}];
  graph = AdjacencyGraph[binarymatrix, {GraphLayout -> Automatic, DirectedEdges -> False,
    EdgeShapeFunction -> "Line", VertexSize -> 1.5, VertexStyle -> Green,
    VertexLabelStyle -> Directive[Black, Italic, 7.5], VertexLabels -> Flatten[
      MapThread[{#1 -> Placed[#2, Center]} &, {Range[1, Dimensions[binarymatrix][[1]]},
      Table[StringRiffle[i, "\n"], {i, binningmembers}]}]}], ImageSize -> 600]
```

$$Out[•]= \{172, 2, 2\}$$

```
Out[•]= {0.0424732, Null}
```

