

ex2 facebook bus

Ex 2 Facebook Bus

First I create a dataset based on the seats on the bus. The connection rule is: communication is really possible with adjacent seats only, but any type of adjacency works: side, front, back, diagonal, even across the aisle.

Load the csv sheet

```
library(tidyverse)

## Attaching packages                                tidyverse 1.3.1

## ggplot2 3.3.5      purrr 0.3.4
## tibble 3.1.5       dplyr 1.0.7
## tidyr 1.1.4        stringr 1.4.0
## readr 2.0.2        forcats 0.5.1

## Conflicts                                         tidyverse_conflicts()
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()   masks stats::lag()

df = read_csv("~/Desktop/McGill/ORGB/2022-ona-assignments/ex2/facebook_bus.csv")

## Rows: 17 Columns: 2

## Column specification
## Delimiter: ","
## chr (2): node_1, node_2

##
## Use `spec()` to retrieve the full column specification for this data.
## Specify the column types or set `show_col_types = FALSE` to quiet this message.

library(dplyr)
## preprocessing
## change all the node type to character
df <- df %>%
  mutate(node_1 = as.character(node_1))
df <- df %>%
  mutate(node_2 = as.character(node_2))
```

Create a network based on the relationship

```
library("ggraph")
library("tidygraph")
```

```
## Warning: package 'tidygraph' was built under R version 4.1.2
```

```
##
```

```
## Attaching package: 'tidygraph'
```

```
## The following object is masked from 'package:stats':
```

```
##
```

```
## filter
```

```
nodes <- data.frame(nodes = c(1,2,3,4,5,6,"A","B","C","D"))
```

```
edges = df
```

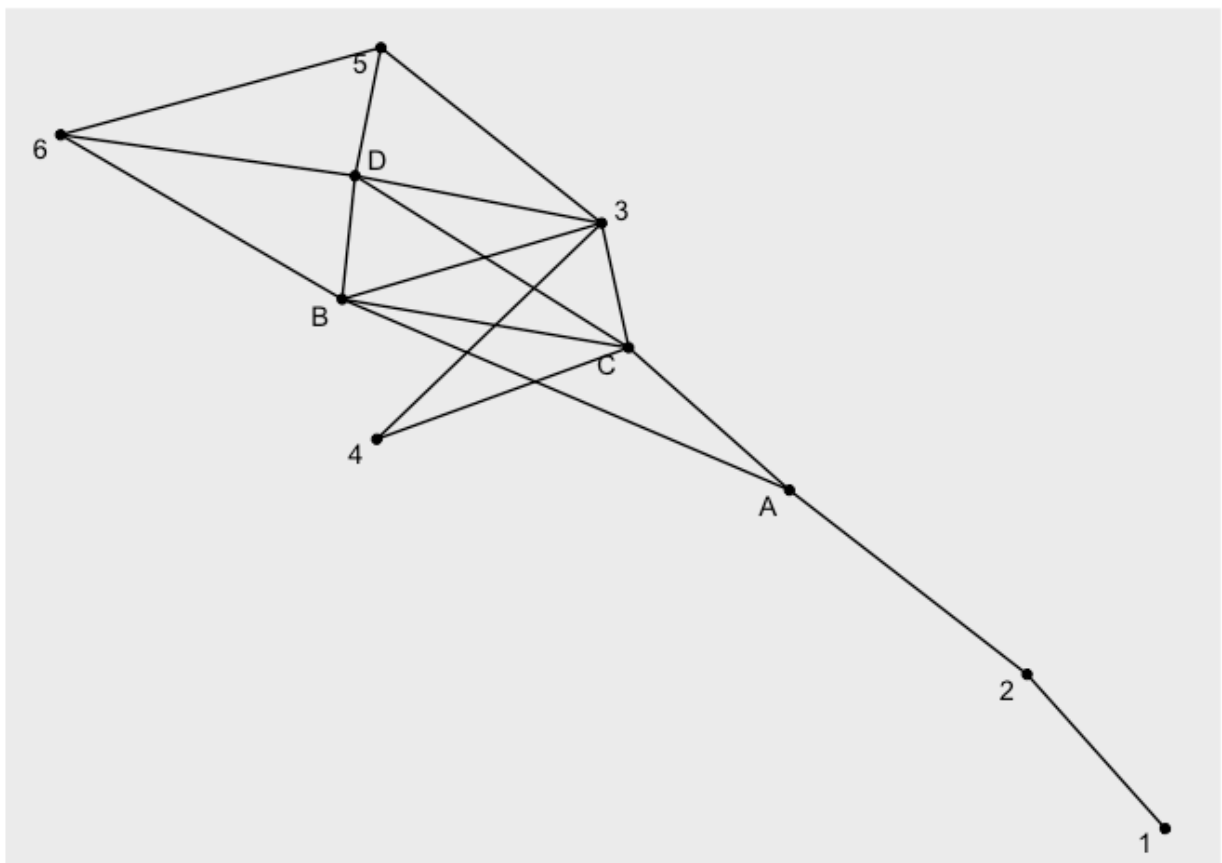
```
network <- tbl_graph(nodes=nodes, edges=edges, directed=FALSE)
```

```
## plotting
```

```
ggraph(network, layout = "graphopt") +
```

```
  geom_edge_link() +
```

```
  geom_node_point()+geom_node_text(aes(label = nodes),repel = TRUE)
```



```
theme_graph()
```

```
## List of 93
```

```
## $ line :List of 6
```

```
## ..$ colour : chr "black"
```

```
## ..$ size : num 0.5
```

```

## ..$ linetype      : num 1
## ..$ lineend       : chr "butt"
## ..$ arrow         : logi FALSE
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_line" "element"
## $ rect              :List of 5
## ..$ fill          : chr "white"
## ..$ colour        : chr "black"
## ..$ size          : num 0.5
## ..$ linetype      : num 1
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_rect" "element"
## $ text              :List of 11
## ..$ family        : chr "Arial Narrow"
## ..$ face          : chr "plain"
## ..$ colour        : chr "black"
## ..$ size          : num 11
## ..$ hjust         : num 0.5
## ..$ vjust         : num 0.5
## ..$ angle         : num 0
## ..$ lineheight    : num 0.9
## ..$ margin        : 'margin' num [1:4] 0points 0points 0points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug         : logi FALSE
## ..$ inherit.blank: logi FALSE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ title            : NULL
## $ aspect.ratio     : NULL
## $ axis.title       : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.title.x     :List of 11
## ..$ family        : NULL
## ..$ face          : NULL
## ..$ colour        : NULL
## ..$ size          : NULL
## ..$ hjust         : NULL
## ..$ vjust         : num 1
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 2.75points 0points 0points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.x.top :List of 11
## ..$ family        : NULL
## ..$ face          : NULL
## ..$ colour        : NULL
## ..$ size          : NULL
## ..$ hjust         : NULL
## ..$ vjust         : num 0
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 0points 2.75points 0points

```

```

## ..- attr(*, "unit")= int 8
## ..$ debug : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.x.bottom : NULL
## $ axis.title.y :List of 11
## ..$ family : NULL
## ..$ face : NULL
## ..$ colour : NULL
## ..$ size : NULL
## ..$ hjust : NULL
## ..$ vjust : num 1
## ..$ angle : num 90
## ..$ lineheight : NULL
## ..$ margin : 'margin' num [1:4] 0points 2.75points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.y.left : NULL
## $ axis.title.y.right :List of 11
## ..$ family : NULL
## ..$ face : NULL
## ..$ colour : NULL
## ..$ size : NULL
## ..$ hjust : NULL
## ..$ vjust : num 0
## ..$ angle : num -90
## ..$ lineheight : NULL
## ..$ margin : 'margin' num [1:4] 0points 0points 0points 2.75points
## ..- attr(*, "unit")= int 8
## ..$ debug : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.text.x :List of 11
## ..$ family : NULL
## ..$ face : NULL
## ..$ colour : NULL
## ..$ size : NULL
## ..$ hjust : NULL
## ..$ vjust : num 1
## ..$ angle : NULL
## ..$ lineheight : NULL
## ..$ margin : 'margin' num [1:4] 2.2points 0points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x.top :List of 11
## ..$ family : NULL
## ..$ face : NULL
## ..$ colour : NULL

```

```

## ..$ size          : NULL
## ..$ hjust         : NULL
## ..$ vjust         : num 0
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 0points 2.2points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x.bottom : NULL
## $ axis.text.y        :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust         : num 1
## ..$ vjust         : NULL
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 2.2points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.y.left   : NULL
## $ axis.text.y.right  :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust         : num 0
## ..$ vjust         : NULL
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 0points 0points 0points 2.2points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.ticks         : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.ticks.x        : NULL
## $ axis.ticks.x.top    : NULL
## $ axis.ticks.x.bottom : NULL
## $ axis.ticks.y        : NULL
## $ axis.ticks.y.left   : NULL
## $ axis.ticks.y.right  : NULL
## $ axis.ticks.length   : 'simpleUnit' num 2.75points
## ..- attr(*, "unit")= int 8
## $ axis.ticks.length.x : NULL
## $ axis.ticks.length.x.top : NULL
## $ axis.ticks.length.x.bottom: NULL
## $ axis.ticks.length.y : NULL

```

```

## $ axis.ticks.length.y.left : NULL
## $ axis.ticks.length.y.right : NULL
## $ axis.line : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.line.x : NULL
## $ axis.line.x.top : NULL
## $ axis.line.x.bottom : NULL
## $ axis.line.y : NULL
## $ axis.line.y.left : NULL
## $ axis.line.y.right : NULL
## $ legend.background : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.margin : 'margin' num [1:4] 5.5points 5.5points 5.5points 5.5points
## ..- attr(*, "unit")= int 8
## $ legend.spacing : 'simpleUnit' num 11points
## ..- attr(*, "unit")= int 8
## $ legend.spacing.x : NULL
## $ legend.spacing.y : NULL
## $ legend.key : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.key.size : 'simpleUnit' num 1.2lines
## ..- attr(*, "unit")= int 3
## $ legend.key.height : NULL
## $ legend.key.width : NULL
## $ legend.text :List of 11
## ..$ family : NULL
## ..$ face : NULL
## ..$ colour : NULL
## ..$ size : 'rel' num 0.8
## ..$ hjust : NULL
## ..$ vjust : NULL
## ..$ angle : NULL
## ..$ lineheight : NULL
## ..$ margin : NULL
## ..$ debug : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ legend.text.align : NULL
## $ legend.title :List of 11
## ..$ family : NULL
## ..$ face : NULL
## ..$ colour : NULL
## ..$ size : NULL
## ..$ hjust : num 0
## ..$ vjust : NULL
## ..$ angle : NULL
## ..$ lineheight : NULL
## ..$ margin : NULL
## ..$ debug : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ legend.title.align : NULL
## $ legend.position : chr "right"
## $ legend.direction : NULL

```

```

## $ legend.justification      : chr "center"
## $ legend.box                : NULL
## $ legend.box.just           : NULL
## $ legend.box.margin         : 'margin' num [1:4] 0cm 0cm 0cm 0cm
## ..- attr(*, "unit")= int 1
## $ legend.box.background     : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.box.spacing        : 'simpleUnit' num 11points
## ..- attr(*, "unit")= int 8
## $ panel.background          : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ panel.border              : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ panel.spacing             : 'simpleUnit' num 5.5points
## ..- attr(*, "unit")= int 8
## $ panel.spacing.x           : NULL
## $ panel.spacing.y           : NULL
## $ panel.grid                : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ panel.grid.major          : NULL
## $ panel.grid.minor          :List of 6
## ..$ colour                  : NULL
## ..$ size                    : 'rel' num 0.5
## ..$ linetype                : NULL
## ..$ lineend                 : NULL
## ..$ arrow                   : logi FALSE
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_line" "element"
## $ panel.grid.major.x        : NULL
## $ panel.grid.major.y        : NULL
## $ panel.grid.minor.x        : NULL
## $ panel.grid.minor.y        : NULL
## $ panel.ontop               : logi FALSE
## $ plot.background           :List of 5
## ..$ fill                    : chr "white"
## ..$ colour                  : logi NA
## ..$ size                    : NULL
## ..$ linetype                : NULL
## ..$ inherit.blank: logi FALSE
## ..- attr(*, "class")= chr [1:2] "element_rect" "element"
## $ plot.title                :List of 11
## ..$ family                  : chr "Arial Narrow"
## ..$ face                    : chr "bold"
## ..$ colour                  : chr "black"
## ..$ size                    : num 18
## ..$ hjust                   : num 0
## ..$ vjust                   : num 1
## ..$ angle                   : NULL
## ..$ lineheight              : NULL
## ..$ margin                  : 'margin' num [1:4] 0points 0points 10points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug                   : NULL
## ..$ inherit.blank: logi FALSE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"

```

```

## $ plot.title.position      : chr "panel"
## $ plot.subtitle           :List of 11
## ..$ family                : chr "Arial Narrow"
## ..$ face                  : chr "plain"
## ..$ colour                : chr "black"
## ..$ size                  : num 12
## ..$ hjust                 : num 0
## ..$ vjust                 : num 1
## ..$ angle                 : NULL
## ..$ lineheight            : NULL
## ..$ margin                : 'margin' num [1:4] 0points 0points 15points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug                 : NULL
## ..$ inherit.blank: logi FALSE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ plot.caption            :List of 11
## ..$ family                : chr "Arial Narrow"
## ..$ face                  : chr "italic"
## ..$ colour                : chr "black"
## ..$ size                  : num 9
## ..$ hjust                 : num 1
## ..$ vjust                 : num 1
## ..$ angle                 : NULL
## ..$ lineheight            : NULL
## ..$ margin                : 'margin' num [1:4] 10points 0points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug                 : NULL
## ..$ inherit.blank: logi FALSE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ plot.caption.position   : chr "panel"
## $ plot.tag                 :List of 11
## ..$ family                : NULL
## ..$ face                  : NULL
## ..$ colour                : NULL
## ..$ size                  : 'rel' num 1.2
## ..$ hjust                 : num 0.5
## ..$ vjust                 : num 0.5
## ..$ angle                 : NULL
## ..$ lineheight            : NULL
## ..$ margin                : NULL
## ..$ debug                 : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ plot.tag.position       : chr "topleft"
## $ plot.margin             : 'margin' num [1:4] 30points 30points 30points 30points
## ..- attr(*, "unit")= int 8
## $ strip.background        : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ strip.background.x      : NULL
## $ strip.background.y      : NULL
## $ strip.placement         : chr "inside"
## $ strip.text               :List of 11
## ..$ family                : chr "Arial Narrow"
## ..$ face                  : chr "bold"

```



```

## ..$ colour      : chr "black"
## ..$ size        : num 10
## ..$ hjust       : NULL
## ..$ vjust       : NULL
## ..$ angle       : NULL
## ..$ lineheight  : NULL
## ..$ margin      : 'margin' num [1:4] 4.4points 4.4points 4.4points 4.4points
## ..- attr(*, "unit")= int 8
## ..$ debug       : NULL
## ..$ inherit.blank: logi FALSE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ strip.text.x   : NULL
## $ strip.text.y    :List of 11
## ..$ family      : NULL
## ..$ face        : NULL
## ..$ colour      : NULL
## ..$ size        : NULL
## ..$ hjust       : NULL
## ..$ vjust       : NULL
## ..$ angle       : num -90
## ..$ lineheight  : NULL
## ..$ margin      : NULL
## ..$ debug       : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ strip.switch.pad.grid : 'simpleUnit' num 2.75points
## ..- attr(*, "unit")= int 8
## $ strip.switch.pad.wrap : 'simpleUnit' num 2.75points
## ..- attr(*, "unit")= int 8
## $ strip.text.y.left    :List of 11
## ..$ family      : NULL
## ..$ face        : NULL
## ..$ colour      : NULL
## ..$ size        : NULL
## ..$ hjust       : NULL
## ..$ vjust       : NULL
## ..$ angle       : num 90
## ..$ lineheight  : NULL
## ..$ margin      : NULL
## ..$ debug       : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## - attr(*, "class")= chr [1:2] "theme" "gg"
## - attr(*, "complete")= logi TRUE
## - attr(*, "validate")= logi TRUE

```

Calculate various measures of centrality

```

## centrality degree
network centrality_degree = network %>%
  activate(nodes) %>%
  mutate(degree = centrality_degree()) %>%

```

```

as_tibble()

## centrality betweenness
network_betweenness centrality = network %>%
  activate(nodes) %>%
  mutate(betw = centrality_betweenness()) %>%
  arrange(desc(betw)) %>% as_tibble()

```

```

## Warning in betweenness(graph = graph, v = V(graph), directed = directed, :
## 'nobigint' is deprecated since igraph 1.3 and will be removed in igraph 1.4

```

```

network centrality degree

```

```

## # A tibble: 10 × 2
##   nodes degree
##   <chr>  <dbl>
## 1 1      1
## 2 2      2
## 3 3      5
## 4 4      2
## 5 5      3
## 6 6      3
## 7 A      3
## 8 B      5
## 9 C      5
## 10 D     5

```

```

network betweenness centrality

```

```

## # A tibble: 10 × 2
##   nodes betw
##   <chr> <dbl>
## 1 A    14
## 2 B    9.03
## 3 C    8.6
## 4 2     8
## 5 3    4.63
## 6 D    3.27
## 7 6    0.933
## 8 5    0.533
## 9 1     0
## 10 4    0

```

Choice of Seats

The of a node is simply its degree—the number of edges it has.

measures the extent to which a vertex lies on paths between other vertices. Vertices with high betweenness may have considerable influence within a network by virtue of their control over information passing between others.

In order to maximize the change of building a relationship between co-workers, I will need to pick a seat that can talk to as much people as possible, meaning a seats with high centrality degree. Also, I would like a seat with high betweenness centrality, because that seats will help me passing information to others.

If we calculate the “value” of a seats by adding the degree centrality and betweenness centrality. The seat that has the highest value will be B. This choice is beneficial if seats D,C and A will be filled. It will be even more beneficial if people who will seat at D,C or C are permanent worker at facebook. It is not so beneficial if people who seat at D,C or A are interns like me. It is even less beneficial if no one will seats at D,C and A.

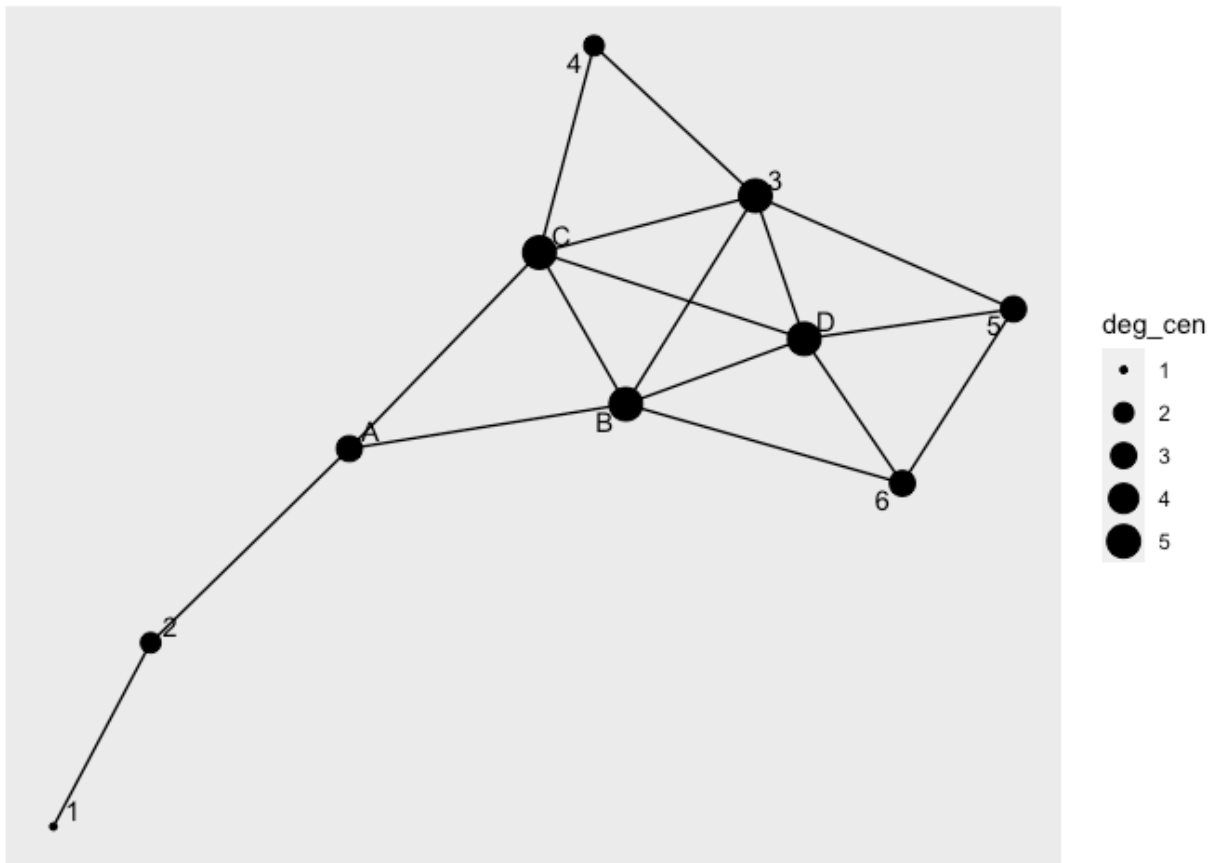
Plot the network graph with labels and centrality values

```
name <- c("1", "2", "3", "4", "5", "6", "A", "B", "C", "D")
deg_cen <- c(1, 2, 5, 2, 3, 3, 3, 5, 5, 5)
bwt_cen <- c(0, 8, 4.63, 0, 0.5333333, 0.9333333, 14, 9.0333333, 8.6000000, 3.2666667)
nodes <- data.frame(name, deg_cen, bwt_cen)

network_2 <- tbl_graph(nodes=nodes, edges=edges, directed=FALSE)
```

Plot based on degree centrality

```
ggraph(network, layout = "graphopt") +
  geom_edge_link() +
  geom_node_point(aes(size = deg_cen)) + geom_node_text(aes(label = nodes), repel = TRUE)
```



```
theme_graph()
```

```
## List of 93
## $ line                               :List of 6
## ..$ colour       : chr "black"
## ..$ size          : num 0.5
## ..$ linetype      : num 1
## ..$ lineend       : chr "butt"
## ..$ arrow         : logi FALSE
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_line" "element"
## $ rect                               :List of 5
## ..$ fill          : chr "white"
## ..$ colour        : chr "black"
## ..$ size          : num 0.5
## ..$ linetype      : num 1
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_rect" "element"
## $ text                               :List of 11
## ..$ family        : chr "Arial Narrow"
## ..$ face           : chr "plain"
## ..$ colour        : chr "black"
## ..$ size          : num 11
## ..$ hjust         : num 0.5
## ..$ vjust         : num 0.5
```

```

## ..$ angle          : num 0
## ..$ lineheight     : num 0.9
## ..$ margin         : 'margin' num [1:4] 0points 0points 0points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug          : logi FALSE
## ..$ inherit.blank: logi FALSE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ title            : NULL
## $ aspect.ratio     : NULL
## $ axis.title        : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.title.x      :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust          : NULL
## ..$ vjust          : num 1
## ..$ angle          : NULL
## ..$ lineheight     : NULL
## ..$ margin         : 'margin' num [1:4] 2.75points 0points 0points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.x.top  :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust          : NULL
## ..$ vjust          : num 0
## ..$ angle          : NULL
## ..$ lineheight     : NULL
## ..$ margin         : 'margin' num [1:4] 0points 0points 2.75points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.x.bottom : NULL
## $ axis.title.y      :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust          : NULL
## ..$ vjust          : num 1
## ..$ angle          : num 90
## ..$ lineheight     : NULL
## ..$ margin         : 'margin' num [1:4] 0points 2.75points 0points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"

```

```

## $ axis.title.y.left      : NULL
## $ axis.title.y.right    :List of 11
## ..$ family              : NULL
## ..$ face                 : NULL
## ..$ colour               : NULL
## ..$ size                 : NULL
## ..$ hjust                : NULL
## ..$ vjust                : num 0
## ..$ angle                : num -90
## ..$ lineheight           : NULL
## ..$ margin               : 'margin' num [1:4] 0points 0points 0points 2.75points
## .. ..- attr(*, "unit")= int 8
## ..$ debug                : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text              : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.text.x            :List of 11
## ..$ family              : NULL
## ..$ face                 : NULL
## ..$ colour               : NULL
## ..$ size                 : NULL
## ..$ hjust                : NULL
## ..$ vjust                : num 1
## ..$ angle                : NULL
## ..$ lineheight           : NULL
## ..$ margin               : 'margin' num [1:4] 2.2points 0points 0points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug                : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x.top        :List of 11
## ..$ family              : NULL
## ..$ face                 : NULL
## ..$ colour               : NULL
## ..$ size                 : NULL
## ..$ hjust                : NULL
## ..$ vjust                : num 0
## ..$ angle                : NULL
## ..$ lineheight           : NULL
## ..$ margin               : 'margin' num [1:4] 0points 0points 2.2points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug                : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x.bottom     : NULL
## $ axis.text.y            :List of 11
## ..$ family              : NULL
## ..$ face                 : NULL
## ..$ colour               : NULL
## ..$ size                 : NULL
## ..$ hjust                : num 1
## ..$ vjust                : NULL
## ..$ angle                : NULL

```

```

## ..$ lineheight      : NULL
## ..$ margin          : 'margin' num [1:4] 0points 2.2points 0points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug           : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.y.left   : NULL
## $ axis.text.y.right  :List of 11
## ..$ family          : NULL
## ..$ face            : NULL
## ..$ colour          : NULL
## ..$ size            : NULL
## ..$ hjust           : num 0
## ..$ vjust           : NULL
## ..$ angle           : NULL
## ..$ lineheight      : NULL
## ..$ margin          : 'margin' num [1:4] 0points 0points 0points 2.2points
## .. ..- attr(*, "unit")= int 8
## ..$ debug           : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.ticks         : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.ticks.x       : NULL
## $ axis.ticks.x.top   : NULL
## $ axis.ticks.x.bottom : NULL
## $ axis.ticks.y       : NULL
## $ axis.ticks.y.left  : NULL
## $ axis.ticks.y.right : NULL
## $ axis.ticks.length  : 'simpleUnit' num 2.75points
## ..- attr(*, "unit")= int 8
## $ axis.ticks.length.x : NULL
## $ axis.ticks.length.x.top : NULL
## $ axis.ticks.length.x.bottom: NULL
## $ axis.ticks.length.y : NULL
## $ axis.ticks.length.y.left : NULL
## $ axis.ticks.length.y.right : NULL
## $ axis.line          : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.line.x        : NULL
## $ axis.line.x.top    : NULL
## $ axis.line.x.bottom : NULL
## $ axis.line.y        : NULL
## $ axis.line.y.left   : NULL
## $ axis.line.y.right  : NULL
## $ legend.background  : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.margin      : 'margin' num [1:4] 5.5points 5.5points 5.5points 5.5points
## ..- attr(*, "unit")= int 8
## $ legend.spacing     : 'simpleUnit' num 11points
## ..- attr(*, "unit")= int 8
## $ legend.spacing.x   : NULL
## $ legend.spacing.y   : NULL
## $ legend.key         : list()

```

```

##   .- attr(*, "class")= chr [1:2] "element_blank" "element"
##   $ legend.key.size      : 'simpleUnit' num 1.2lines
##   .- attr(*, "unit")= int 3
##   $ legend.key.height    : NULL
##   $ legend.key.width     : NULL
##   $ legend.text          :List of 11
##   ..$ family            : NULL
##   ..$ face              : NULL
##   ..$ colour            : NULL
##   ..$ size              : 'rel' num 0.8
##   ..$ hjust             : NULL
##   ..$ vjust             : NULL
##   ..$ angle             : NULL
##   ..$ lineheight        : NULL
##   ..$ margin            : NULL
##   ..$ debug             : NULL
##   ..$ inherit.blank: logi TRUE
##   .- attr(*, "class")= chr [1:2] "element_text" "element"
##   $ legend.text.align    : NULL
##   $ legend.title         :List of 11
##   ..$ family            : NULL
##   ..$ face              : NULL
##   ..$ colour            : NULL
##   ..$ size              : NULL
##   ..$ hjust             : num 0
##   ..$ vjust             : NULL
##   ..$ angle             : NULL
##   ..$ lineheight        : NULL
##   ..$ margin            : NULL
##   ..$ debug             : NULL
##   ..$ inherit.blank: logi TRUE
##   .- attr(*, "class")= chr [1:2] "element_text" "element"
##   $ legend.title.align   : NULL
##   $ legend.position      : chr "right"
##   $ legend.direction     : NULL
##   $ legend.justification : chr "center"
##   $ legend.box           : NULL
##   $ legend.box.just      : NULL
##   $ legend.box.margin    : 'margin' num [1:4] 0cm 0cm 0cm 0cm
##   .- attr(*, "unit")= int 1
##   $ legend.box.background : list()
##   .- attr(*, "class")= chr [1:2] "element_blank" "element"
##   $ legend.box.spacing   : 'simpleUnit' num 11points
##   .- attr(*, "unit")= int 8
##   $ panel.background     : list()
##   .- attr(*, "class")= chr [1:2] "element_blank" "element"
##   $ panel.border         : list()
##   .- attr(*, "class")= chr [1:2] "element_blank" "element"
##   $ panel.spacing        : 'simpleUnit' num 5.5points
##   .- attr(*, "unit")= int 8
##   $ panel.spacing.x      : NULL
##   $ panel.spacing.y      : NULL
##   $ panel.grid           : list()
##   .- attr(*, "class")= chr [1:2] "element_blank" "element"

```



```

## $ panel.grid.major          : NULL
## $ panel.grid.minor         :List of 6
## ..$ colour                 : NULL
## ..$ size                   : 'rel' num 0.5
## ..$ linetype               : NULL
## ..$ lineend                : NULL
## ..$ arrow                  : logi FALSE
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_line" "element"
## $ panel.grid.major.x       : NULL
## $ panel.grid.major.y       : NULL
## $ panel.grid.minor.x       : NULL
## $ panel.grid.minor.y       : NULL
## $ panel.ontop               : logi FALSE
## $ plot.background          :List of 5
## ..$ fill                   : chr "white"
## ..$ colour                 : logi NA
## ..$ size                   : NULL
## ..$ linetype               : NULL
## ..$ inherit.blank: logi FALSE
## ..- attr(*, "class")= chr [1:2] "element_rect" "element"
## $ plot.title                :List of 11
## ..$ family                 : chr "Arial Narrow"
## ..$ face                   : chr "bold"
## ..$ colour                 : chr "black"
## ..$ size                   : num 18
## ..$ hjust                  : num 0
## ..$ vjust                  : num 1
## ..$ angle                  : NULL
## ..$ lineheight             : NULL
## ..$ margin                 : 'margin' num [1:4] 0points 0points 10points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug                  : NULL
## ..$ inherit.blank: logi FALSE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ plot.title.position       : chr "panel"
## $ plot.subtitle             :List of 11
## ..$ family                 : chr "Arial Narrow"
## ..$ face                   : chr "plain"
## ..$ colour                 : chr "black"
## ..$ size                   : num 12
## ..$ hjust                  : num 0
## ..$ vjust                  : num 1
## ..$ angle                  : NULL
## ..$ lineheight             : NULL
## ..$ margin                 : 'margin' num [1:4] 0points 0points 15points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug                  : NULL
## ..$ inherit.blank: logi FALSE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ plot.caption              :List of 11
## ..$ family                 : chr "Arial Narrow"
## ..$ face                   : chr "italic"
## ..$ colour                 : chr "black"

```

```

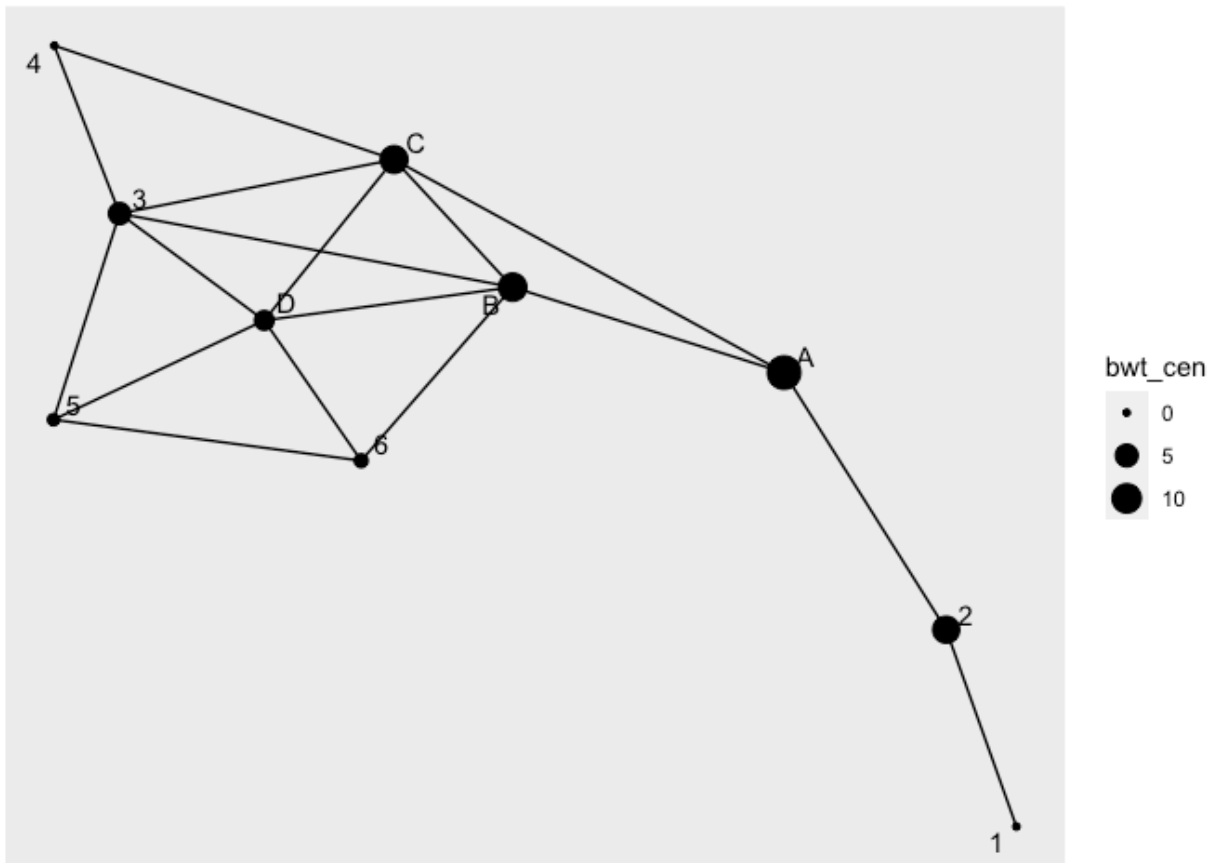
## ..$ size          : num 9
## ..$ hjust         : num 1
## ..$ vjust         : num 1
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 10points 0points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi FALSE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ plot.caption.position : chr "panel"
## $ plot.tag           :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : 'rel' num 1.2
## ..$ hjust         : num 0.5
## ..$ vjust         : num 0.5
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : NULL
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ plot.tag.position   : chr "topleft"
## $ plot.margin         : 'margin' num [1:4] 30points 30points 30points 30points
## ..- attr(*, "unit")= int 8
## $ strip.background    : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ strip.background.x  : NULL
## $ strip.background.y  : NULL
## $ strip.placement     : chr "inside"
## $ strip.text          :List of 11
## ..$ family          : chr "Arial Narrow"
## ..$ face            : chr "bold"
## ..$ colour          : chr "black"
## ..$ size            : num 10
## ..$ hjust          : NULL
## ..$ vjust          : NULL
## ..$ angle          : NULL
## ..$ lineheight     : NULL
## ..$ margin         : 'margin' num [1:4] 4.4points 4.4points 4.4points 4.4points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi FALSE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ strip.text.x       : NULL
## $ strip.text.y       :List of 11
## ..$ family          : NULL
## ..$ face            : NULL
## ..$ colour          : NULL
## ..$ size            : NULL
## ..$ hjust          : NULL
## ..$ vjust          : NULL

```

```
## ..$ angle      : num -90
## ..$ lineheight  : NULL
## ..$ margin      : NULL
## ..$ debug       : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ strip.switch.pad.grid : 'simpleUnit' num 2.75points
## ..- attr(*, "unit")= int 8
## $ strip.switch.pad.wrap : 'simpleUnit' num 2.75points
## ..- attr(*, "unit")= int 8
## $ strip.text.y.left     :List of 11
## ..$ family          : NULL
## ..$ face            : NULL
## ..$ colour          : NULL
## ..$ size            : NULL
## ..$ hjust           : NULL
## ..$ vjust           : NULL
## ..$ angle           : num 90
## ..$ lineheight      : NULL
## ..$ margin          : NULL
## ..$ debug           : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## - attr(*, "class")= chr [1:2] "theme" "gg"
## - attr(*, "complete")= logi TRUE
## - attr(*, "validate")= logi TRUE
```

Plotting based on betweenness centrality

```
ggraph(network, layout = "graphopt") +
  geom_edge_link() +
  geom_node_point(aes(size = bwt_cen))+geom_node_text(aes(label = nodes),repel = TRUE)
```



```
theme_graph()
```

```
## List of 93
## $ line                               :List of 6
## ..$ colour                          : chr "black"
## ..$ size                            : num 0.5
## ..$ linetype                        : num 1
## ..$ lineend                        : chr "butt"
## ..$ arrow                          : logi FALSE
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_line" "element"
## $ rect                               :List of 5
## ..$ fill                            : chr "white"
## ..$ colour                          : chr "black"
## ..$ size                            : num 0.5
## ..$ linetype                        : num 1
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_rect" "element"
## $ text                               :List of 11
## ..$ family                          : chr "Arial Narrow"
## ..$ face                            : chr "plain"
## ..$ colour                          : chr "black"
## ..$ size                            : num 11
## ..$ hjust                          : num 0.5
## ..$ vjust                          : num 0.5
```

```

## ..$ angle          : num 0
## ..$ lineheight     : num 0.9
## ..$ margin         : 'margin' num [1:4] 0points 0points 0points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug          : logi FALSE
## ..$ inherit.blank: logi FALSE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ title             : NULL
## $ aspect.ratio      : NULL
## $ axis.title        : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.title.x       :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust          : NULL
## ..$ vjust          : num 1
## ..$ angle          : NULL
## ..$ lineheight     : NULL
## ..$ margin         : 'margin' num [1:4] 2.75points 0points 0points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.x.top   :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust          : NULL
## ..$ vjust          : num 0
## ..$ angle          : NULL
## ..$ lineheight     : NULL
## ..$ margin         : 'margin' num [1:4] 0points 0points 2.75points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.title.x.bottom : NULL
## $ axis.title.y       :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust          : NULL
## ..$ vjust          : num 1
## ..$ angle          : num 90
## ..$ lineheight     : NULL
## ..$ margin         : 'margin' num [1:4] 0points 2.75points 0points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug          : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"

```

```

## $ axis.title.y.left      : NULL
## $ axis.title.y.right    :List of 11
## ..$ family              : NULL
## ..$ face                 : NULL
## ..$ colour               : NULL
## ..$ size                 : NULL
## ..$ hjust                : NULL
## ..$ vjust                : num 0
## ..$ angle                : num -90
## ..$ lineheight           : NULL
## ..$ margin               : 'margin' num [1:4] 0points 0points 0points 2.75points
## .. ..- attr(*, "unit")= int 8
## ..$ debug                : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text              : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.text.x            :List of 11
## ..$ family              : NULL
## ..$ face                 : NULL
## ..$ colour               : NULL
## ..$ size                 : NULL
## ..$ hjust                : NULL
## ..$ vjust                : num 1
## ..$ angle                : NULL
## ..$ lineheight           : NULL
## ..$ margin               : 'margin' num [1:4] 2.2points 0points 0points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug                : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x.top        :List of 11
## ..$ family              : NULL
## ..$ face                 : NULL
## ..$ colour               : NULL
## ..$ size                 : NULL
## ..$ hjust                : NULL
## ..$ vjust                : num 0
## ..$ angle                : NULL
## ..$ lineheight           : NULL
## ..$ margin               : 'margin' num [1:4] 0points 0points 2.2points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug                : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.x.bottom     : NULL
## $ axis.text.y            :List of 11
## ..$ family              : NULL
## ..$ face                 : NULL
## ..$ colour               : NULL
## ..$ size                 : NULL
## ..$ hjust                : num 1
## ..$ vjust                : NULL
## ..$ angle                : NULL

```

```

## ..$ lineheight      : NULL
## ..$ margin          : 'margin' num [1:4] 0points 2.2points 0points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug           : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.text.y.left   : NULL
## $ axis.text.y.right  :List of 11
## ..$ family          : NULL
## ..$ face             : NULL
## ..$ colour          : NULL
## ..$ size             : NULL
## ..$ hjust            : num 0
## ..$ vjust           : NULL
## ..$ angle            : NULL
## ..$ lineheight       : NULL
## ..$ margin          : 'margin' num [1:4] 0points 0points 0points 2.2points
## .. ..- attr(*, "unit")= int 8
## ..$ debug           : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ axis.ticks         : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.ticks.x       : NULL
## $ axis.ticks.x.top   : NULL
## $ axis.ticks.x.bottom : NULL
## $ axis.ticks.y       : NULL
## $ axis.ticks.y.left  : NULL
## $ axis.ticks.y.right : NULL
## $ axis.ticks.length  : 'simpleUnit' num 2.75points
## ..- attr(*, "unit")= int 8
## $ axis.ticks.length.x : NULL
## $ axis.ticks.length.x.top : NULL
## $ axis.ticks.length.x.bottom: NULL
## $ axis.ticks.length.y : NULL
## $ axis.ticks.length.y.left : NULL
## $ axis.ticks.length.y.right : NULL
## $ axis.line          : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ axis.line.x        : NULL
## $ axis.line.x.top    : NULL
## $ axis.line.x.bottom : NULL
## $ axis.line.y        : NULL
## $ axis.line.y.left   : NULL
## $ axis.line.y.right  : NULL
## $ legend.background  : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ legend.margin      : 'margin' num [1:4] 5.5points 5.5points 5.5points 5.5points
## ..- attr(*, "unit")= int 8
## $ legend.spacing     : 'simpleUnit' num 11points
## ..- attr(*, "unit")= int 8
## $ legend.spacing.x   : NULL
## $ legend.spacing.y   : NULL
## $ legend.key         : list()

```

```

##   .- attr(*, "class")= chr [1:2] "element_blank" "element"
##   $ legend.key.size      : 'simpleUnit' num 1.2lines
##   .- attr(*, "unit")= int 3
##   $ legend.key.height    : NULL
##   $ legend.key.width     : NULL
##   $ legend.text          :List of 11
##   ..$ family            : NULL
##   ..$ face              : NULL
##   ..$ colour            : NULL
##   ..$ size              : 'rel' num 0.8
##   ..$ hjust             : NULL
##   ..$ vjust             : NULL
##   ..$ angle             : NULL
##   ..$ lineheight        : NULL
##   ..$ margin            : NULL
##   ..$ debug             : NULL
##   ..$ inherit.blank: logi TRUE
##   .- attr(*, "class")= chr [1:2] "element_text" "element"
##   $ legend.text.align    : NULL
##   $ legend.title         :List of 11
##   ..$ family            : NULL
##   ..$ face              : NULL
##   ..$ colour            : NULL
##   ..$ size              : NULL
##   ..$ hjust             : num 0
##   ..$ vjust             : NULL
##   ..$ angle             : NULL
##   ..$ lineheight        : NULL
##   ..$ margin            : NULL
##   ..$ debug             : NULL
##   ..$ inherit.blank: logi TRUE
##   .- attr(*, "class")= chr [1:2] "element_text" "element"
##   $ legend.title.align   : NULL
##   $ legend.position      : chr "right"
##   $ legend.direction     : NULL
##   $ legend.justification : chr "center"
##   $ legend.box           : NULL
##   $ legend.box.just      : NULL
##   $ legend.box.margin    : 'margin' num [1:4] 0cm 0cm 0cm 0cm
##   .- attr(*, "unit")= int 1
##   $ legend.box.background : list()
##   .- attr(*, "class")= chr [1:2] "element_blank" "element"
##   $ legend.box.spacing   : 'simpleUnit' num 11points
##   .- attr(*, "unit")= int 8
##   $ panel.background     : list()
##   .- attr(*, "class")= chr [1:2] "element_blank" "element"
##   $ panel.border         : list()
##   .- attr(*, "class")= chr [1:2] "element_blank" "element"
##   $ panel.spacing        : 'simpleUnit' num 5.5points
##   .- attr(*, "unit")= int 8
##   $ panel.spacing.x      : NULL
##   $ panel.spacing.y      : NULL
##   $ panel.grid           : list()
##   .- attr(*, "class")= chr [1:2] "element_blank" "element"

```



```

## $ panel.grid.major          : NULL
## $ panel.grid.minor         :List of 6
## ..$ colour                 : NULL
## ..$ size                   : 'rel' num 0.5
## ..$ linetype               : NULL
## ..$ lineend                : NULL
## ..$ arrow                  : logi FALSE
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_line" "element"
## $ panel.grid.major.x       : NULL
## $ panel.grid.major.y       : NULL
## $ panel.grid.minor.x       : NULL
## $ panel.grid.minor.y       : NULL
## $ panel.ontop               : logi FALSE
## $ plot.background          :List of 5
## ..$ fill                   : chr "white"
## ..$ colour                 : logi NA
## ..$ size                   : NULL
## ..$ linetype               : NULL
## ..$ inherit.blank: logi FALSE
## ..- attr(*, "class")= chr [1:2] "element_rect" "element"
## $ plot.title                :List of 11
## ..$ family                 : chr "Arial Narrow"
## ..$ face                   : chr "bold"
## ..$ colour                 : chr "black"
## ..$ size                   : num 18
## ..$ hjust                  : num 0
## ..$ vjust                  : num 1
## ..$ angle                  : NULL
## ..$ lineheight             : NULL
## ..$ margin                 : 'margin' num [1:4] 0points 0points 10points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug                  : NULL
## ..$ inherit.blank: logi FALSE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ plot.title.position       : chr "panel"
## $ plot.subtitle             :List of 11
## ..$ family                 : chr "Arial Narrow"
## ..$ face                   : chr "plain"
## ..$ colour                 : chr "black"
## ..$ size                   : num 12
## ..$ hjust                  : num 0
## ..$ vjust                  : num 1
## ..$ angle                  : NULL
## ..$ lineheight             : NULL
## ..$ margin                 : 'margin' num [1:4] 0points 0points 15points 0points
## .. ..- attr(*, "unit")= int 8
## ..$ debug                  : NULL
## ..$ inherit.blank: logi FALSE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ plot.caption              :List of 11
## ..$ family                 : chr "Arial Narrow"
## ..$ face                   : chr "italic"
## ..$ colour                 : chr "black"

```

```

## ..$ size          : num 9
## ..$ hjust         : num 1
## ..$ vjust         : num 1
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 10points 0points 0points 0points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi FALSE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ plot.caption.position : chr "panel"
## $ plot.tag           :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : 'rel' num 1.2
## ..$ hjust         : num 0.5
## ..$ vjust         : num 0.5
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : NULL
## ..$ debug         : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ plot.tag.position   : chr "topleft"
## $ plot.margin         : 'margin' num [1:4] 30points 30points 30points 30points
## ..- attr(*, "unit")= int 8
## $ strip.background    : list()
## ..- attr(*, "class")= chr [1:2] "element_blank" "element"
## $ strip.background.x  : NULL
## $ strip.background.y  : NULL
## $ strip.placement     : chr "inside"
## $ strip.text          :List of 11
## ..$ family         : chr "Arial Narrow"
## ..$ face           : chr "bold"
## ..$ colour         : chr "black"
## ..$ size           : num 10
## ..$ hjust         : NULL
## ..$ vjust         : NULL
## ..$ angle         : NULL
## ..$ lineheight    : NULL
## ..$ margin        : 'margin' num [1:4] 4.4points 4.4points 4.4points 4.4points
## ..- attr(*, "unit")= int 8
## ..$ debug         : NULL
## ..$ inherit.blank: logi FALSE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ strip.text.x        : NULL
## $ strip.text.y        :List of 11
## ..$ family         : NULL
## ..$ face           : NULL
## ..$ colour         : NULL
## ..$ size           : NULL
## ..$ hjust         : NULL
## ..$ vjust         : NULL

```

```

## ..$ angle      : num -90
## ..$ lineheight : NULL
## ..$ margin     : NULL
## ..$ debug      : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## $ strip.switch.pad.grid : 'simpleUnit' num 2.75points
## ..- attr(*, "unit")= int 8
## $ strip.switch.pad.wrap : 'simpleUnit' num 2.75points
## ..- attr(*, "unit")= int 8
## $ strip.text.y.left     :List of 11
## ..$ family            : NULL
## ..$ face              : NULL
## ..$ colour            : NULL
## ..$ size              : NULL
## ..$ hjust             : NULL
## ..$ vjust             : NULL
## ..$ angle            : num 90
## ..$ lineheight       : NULL
## ..$ margin           : NULL
## ..$ debug            : NULL
## ..$ inherit.blank: logi TRUE
## ..- attr(*, "class")= chr [1:2] "element_text" "element"
## - attr(*, "class")= chr [1:2] "theme" "gg"
## - attr(*, "complete")= logi TRUE
## - attr(*, "validate")= logi TRUE

```