Homework 6

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Network Statistics

Let's summarise all of the transfers based on the incoming and outcoming leagues' of the teams. I will take the mean for all the numeric parameters of the transfers among all the teams from the leagues, and will take the most occuring position of the player as a summarising value for position attribute. Note that the fee of the transfers is expressed in terms of millions.

League_from	League_to	Count	Mean_Fee	Mean_Age	Position
Championship	Premier League	151	8	24	Centre-Forward
Ligue 1	Premier League	125	13	24	Centre-Back
LaLiga	Premier League	98	17	26	Centre-Back
Serie B	Serie A	74	7	24	Centre-Forward
Serie A	Premier League	73	17	25	Centre-Forward

Network Density

```
## [1] 0.04360084
```

As we can see the density of the network is very low, as we included all of the leagues from our data. Some of the transfers are very rare, and there are many leagues that had only a few or even one transfers with one of the leagues, and had no other transfers from our into. To see if this is the reason for low density let's filter out the network and include the leagues that had at least 5 transfers among themsleves.

```
## [1] 0.1208709
```

We can see significant improvement after this filtering. But in general it is again a low density. Nevertheless, we have about 150 leagues and usually only 20-25 of them make most of the transfers among themselves, so leagues other than that 20-25 make rare deals with famous leagues.

Reciprocity

Following the same pattern let's first calculate this metric for the summarised version of all leagues and then filter out the ones with more than 5 transfers

```
## [1] 0.3338684
```

In my opinion it is not a bad value taking into account that there are 665 unique League From League To compositions, and this is not the filtered one so there are many "one time" transfers among Leagues. So in general terms, We can assume that in around 33 percent of the trasnfers, from one League to another one it is expected that there will also be a transferm in opposite direction. Now let's remove "rare" leagues.

```
## [1] 0.4822695
```

Now the reciprocity is almost half of the highest possible number.

Relationships in Networks

Let's take the most obvious league for analyzing it's incoming and outcoming transfers.(England' Premier League)

```
## + 13/161 edges from 9d47c32 (vertex names):
##  [1] Premier League->1.Bundesliga   Premier League->Eredivisie
##  [3] Premier League->LaLiga         Premier League->Ligue 1
##  [5] Premier League->Premier League Premier League->Premier Liga
##  [7] Premier League-> Scotland      Premier League->Serie A
##  [9] Premier League->Super League   Premier League->Süper Lig
## [11] Premier League->Championship   Premier League->First Division
## [13] Premier League-> England
```

There are 13 leagues that had more than 5 transfers of players from English Premier League.

```
## + 26/161 edges from 9d47c32 (vertex names):
##  [1] 1.Bundesliga      ->Premier League Eredivisie        ->Premier League
##  [3] Jupiler Pro League->Premier League LaLiga            ->Premier League
##  [5] Liga NOS          ->Premier League Ligue 1           ->Premier League
##  [7] Premier League    ->Premier League Premier Liga      ->Premier League
##  [9]  Scotland         ->Premier League Serie A           ->Premier League
## [11] Série A           ->Premier League Super League      ->Premier League
## [13] Süper Lig         ->Premier League 1.HNL             ->Premier League
## [15] LaLiga2           ->Premier League Premiership       ->Premier League
## [17] Liga MX Clausura  ->Premier League  Argentina        ->Premier League
## [19]  Brazil           ->Premier League Ligue 2           ->Premier League
## + ... omitted several edges
```

And there are 26 leagues that had 5 or more transfers, in which the player left the leagues for EPL. I believe that this kind of measures can be used to identify the most desirable leagues to play for players. To see the opposite picture let's pick a not famous league. Let's pick the Turkish League

```
## + 6/161 edges from 9d47c32 (vertex names):
## [1] Süper Lig->LaLiga         Süper Lig->Ligue 1
## [3] Süper Lig->Premier League Süper Lig->Premier Liga
## [5] Süper Lig->Serie A        Süper Lig->Süper Lig
```

```
## + 9/161 edges from 9d47c32 (vertex names):
## [1] 1.Bundesliga  ->Süper Lig LaLiga        ->Süper Lig
## [3] Liga NOS      ->Süper Lig Ligue 1       ->Süper Lig
## [5] Premier League->Süper Lig Premier Liga  ->Süper Lig
## [7] Serie A       ->Süper Lig Série A       ->Süper Lig
## [9] Süper Lig     ->Süper Lig
```

Turkey was not a good choice for showing "unpopularity", as some famous but old players often move to Turkish teams for gaining CL practice. Nevertheless, we can see that the difference is only 3 leagues whereas for England the difference was almost double. Let's pick Brazilian league. The league is famous for rising stars from academies and selling them tou european teams.

```
## + 10/161 edges from 9d47c32 (vertex names):
##  [1] Série A->1.Bundesliga   Série A->LaLiga
```

```
##  [3] Série A->Liga NOS       Série A->Ligue 1
##  [5] Série A->Premier League Série A->Premier Liga
##  [7] Série A->Serie A        Série A->Série A
##  [9] Série A->Super League   Série A->Süper Lig
```

```
## + 5/161 edges from 9d47c32 (vertex names):
## [1] 1.Bundesliga->Série A Liga NOS    ->Série A Premier Liga->Série A
## [4] Serie A     ->Série A Série A     ->Série A
```

A hit ! There are 10 leagues that bought more than 5 players from Brazilian leagues, whereas there are only 5 leagues from which the Brazilian league teams bought more than 5 players

Degree Centrality

```
##     Premier League            Serie A             LaLiga
##                 39                 31                 26
##       Premier Liga       1.Bundesliga            Ligue 1
##                 26                 24                 24
##           Liga NOS            Série A          Süper Lig
##                 17                 15                 15
##       Super League         Eredivisie             Brazil
##                 14                 11                  9
## Jupiler Pro League       Championship          Argentina
##                  8                  7                  6
##       Torneo Final            Serie B            LaLiga2
##                  6                  5                  4
##   Liga MX Clausura     First Division            England
##                  4                  4                  4
##             Mexico           Scotland              1.HNL
##                  3                  2                  2
##           Ligue 2         League One   Primera División
##                  2                  2                  2
##       2.Bundesliga        Premiership        Allsvenskan
##                  1                  1                  1
##         Bundesliga              Qatar        Eliteserien
##                  1                  1                  1
##           HET Liga        Superligaen            Uruguay
##                  1                  1                  1
##             Serbia
##                  1
```

Using this method we can find the most "active" players of the market. England England England everywhere.

Closeness

```
##     Premier League            Serie A             LaLiga
##          0.7659574          0.6923077          0.6545455
##       1.Bundesliga       Premier Liga            Ligue 1
##          0.6428571          0.6428571          0.6315789
```

```
##           Liga NOS         Eredivisie            Série A
##          0.6000000          0.5538462          0.5538462
##       Super League          Süper Lig             Brazil
##          0.5538462          0.5454545          0.5373134
## Jupiler Pro League          Argentina            LaLiga2
##          0.5294118          0.5294118          0.4864865
##       Championship              1.HNL   Liga MX Clausura
##          0.4864865          0.4675325          0.4556962
##            Ligue 2       Torneo Final         League One
##          0.4500000          0.4444444          0.4444444
##           Scotland       Premiership     First Division
##          0.4390244          0.4390244          0.4390244
##        Eliteserien            England        Superligaen
##          0.4390244          0.4390244          0.4390244
##   Primera División            Serie B            Uruguay
##          0.4285714          0.4235294          0.4137931
##       2.Bundesliga         Bundesliga           HET Liga
##          0.3956044          0.3956044          0.3956044
##             Serbia              Qatar        Allsvenskan
##          0.3956044          0.3913043          0.3600000
##             Mexico
##          0.3495146
```

Nothing new about first place. We can see that in top 10 leagues England and Italy have high centrality whereas the other ones have more or less the same value.

Now let's consider the amount of transfers among the leagues as a "weight" for their edge. In our case the "weight" is not considered a cost, so we don't need to take it's inverse, when calculating the according metrics.

```
##     Premier League       Premier Liga            Serie A
##          0.07659574         0.07610994         0.07500000
##           Süper Lig         Eredivisie       Super League
##          0.07392197         0.07228916         0.07142857
##              Brazil            LaLiga2          Argentina
##          0.07031250         0.06909789         0.06728972
##             Ligue 1           Liga NOS       1.Bundesliga
##          0.06716418         0.06703911         0.06545455
##             Série A         League One              LaLiga
##          0.06360424         0.06185567         0.06122449
## Jupiler Pro League       Championship              1.HNL
##          0.06060606         0.05940594         0.05660377
##   Liga MX Clausura           Scotland     First Division
##          0.05598756         0.05555556         0.05294118
##               Qatar       Torneo Final        Eliteserien
##          0.05063291         0.05034965         0.05034965
##            HET Liga             Serbia            Uruguay
##          0.05013928         0.05013928         0.04965517
##         Allsvenskan            Ligue 2        Superligaen
##          0.04845222         0.04800000         0.04800000
##          Bundesliga            Serie B   Primera División
##          0.04736842         0.04675325         0.04675325
##              Mexico            England        Premiership
##          0.04615385         0.04390244         0.03076923
```

```
##       2.Bundesliga
##         0.02300319
```

Taking the amount of the transfers as a "weight" changes the picture a little bit, and some not famous leagues have relatively higher values than in the previous calculation without "weight". #Betweenness

```
##     Premier League          Süper Lig         Eredivisie
##        0.185185185        0.086507937        0.067460317
##       Premier Liga           Serie A          Liga NOS
##        0.060978836        0.059523810        0.046693122
##       Super League           Ligue 1       1.Bundesliga
##        0.042989418        0.041137566        0.037301587
##            LaLiga       Championship            Serie B
##        0.019179894        0.004761905        0.003174603
##           Série A       2.Bundesliga Jupiler Pro League
##        0.002380952        0.000000000        0.000000000
##          Scotland              1.HNL            LaLiga2
##        0.000000000        0.000000000        0.000000000
##        Premiership   Liga MX Clausura        Allsvenskan
##        0.000000000        0.000000000        0.000000000
##          Argentina             Mexico             Brazil
##        0.000000000        0.000000000        0.000000000
##         Bundesliga              Qatar            Ligue 2
##        0.000000000        0.000000000        0.000000000
##     First Division       Torneo Final        Eliteserien
##        0.000000000        0.000000000        0.000000000
##            England           HET Liga         League One
##        0.000000000        0.000000000        0.000000000
##   Primera División        Superligaen            Uruguay
##        0.000000000        0.000000000        0.000000000
##             Serbia
##        0.000000000
```

In terms of betweeness the picture is almost the same as in closeness metrics. However we can see that there are some leauges having a value of 0. Nevertheless betweenness is not a decriptive statistics for this network as for example if there are two edges(transfers in our case) A -> B, B -> C, it is not always true that A and C have a special transfer connections, as our network's weight cannot be interpreted as the "cost" of making a transfer from one node to another.

Assortiavity Degree

```
## [1] -0.2170271
```

The low value here is logical, as the players from non popular leagues' teams are not likely to join a team from the popular leagues, and most of the time the same applies to the popular leagues' teams players.

Page rank

```
##     Premier League           Serie A       Premier Liga
##        0.137200024        0.101335277        0.086165269
```

```
##             LaLiga           Ligue 1       1.Bundesliga
##        0.080689720        0.080068328        0.077440295
##          Süper Lig       Super League            Série A
##        0.068313434        0.048305717        0.034482222
##             Mexico       Championship           Liga NOS
##        0.032934679        0.032239049        0.026408096
##     First Division            England         Eredivisie
##        0.023126878        0.023126878        0.018994195
##            Serie B           Scotland              Qatar
##        0.018056767        0.013297955        0.011889193
##   Liga MX Clausura       Torneo Final Jupiler Pro League
##        0.006037931        0.005213475        0.004925250
##             Brazil       2.Bundesliga              1.HNL
##        0.004841605        0.004327184        0.004327184
##            LaLiga2        Premiership        Allsvenskan
##        0.004327184        0.004327184        0.004327184
##          Argentina         Bundesliga            Ligue 2
##        0.004327184        0.004327184        0.004327184
##        Eliteserien           HET Liga         League One
##        0.004327184        0.004327184        0.004327184
##   Primera División        Superligaen            Uruguay
##        0.004327184        0.004327184        0.004327184
##             Serbia
##        0.004327184
```

Again a straight connection, the more popular the league the stronger links of transfers to it

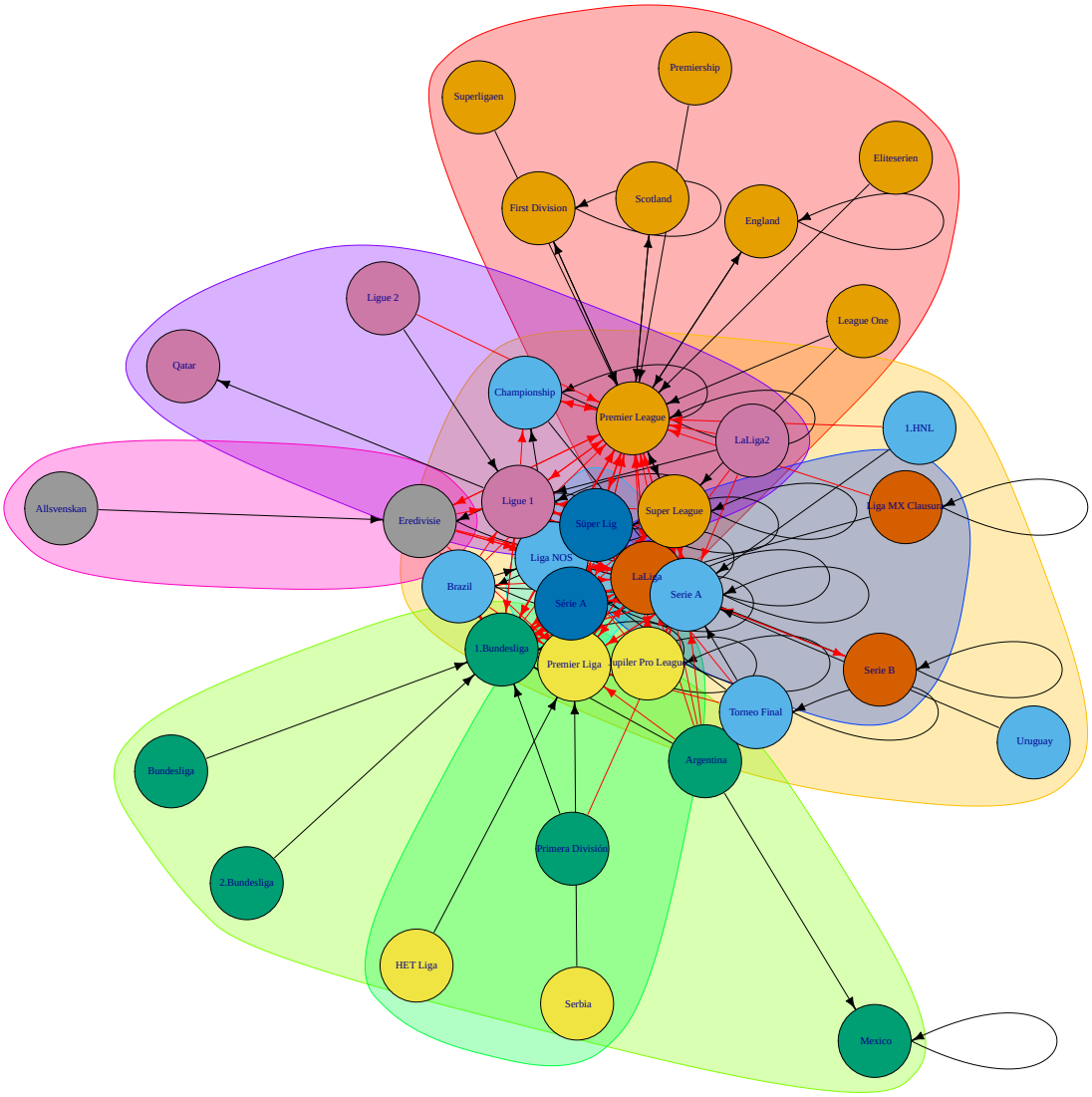
```
## + 6/37 vertices, named, from 9d47c32:
## [1] Süper Lig      LaLiga         Ligue 1        Premier League
## [5] Premier Liga   Serie A
```

```
## + 10/37 vertices, named, from 9d47c32:
##  [1] Série A        1.Bundesliga   LaLiga         Liga NOS
##  [5] Ligue 1        Premier League Premier Liga   Serie A
##  [9] Super League   Süper Lig
```

As we can see Turkish and Brazilian leagues sell players mainly to top leagues.

Community Detection

```
## Community sizes
## 1 2 3 4 5 6 7 8
## 9 7 6 4 2 3 4 2
```



As we can see most of the communities are built based on the continents and geographic locations of the league's countries. Also the second divisions of the leagues are most of the time in the same community. Clear example is Premier League's community. The community includes the leagues from Britain countries , leagues from second divisions and geographicaly close countries.