# The Project Network Generator

To test and compare performances of the abovementioned algorithms on different kinds of networks a random network generator application (PNGEN/BRoyGen) has been developed in Delphi 10.3 that can be used to construct mathematical equivalents of schedule-typed networks (Fig. 05).

To provide variety of the generated networks a set of numerical options and switches (See Table X) have been built in the software. These controls provide tools to adjust characteristics of the network such as: involving or excluding loops; guaranteeing integrity of the graph (connected or not); setting restrictions on number of starting and terminating nodes (single or multiple Critical Paths); specifying extent (%) and number ("cut up") of main branches ("trunk") of the initial spanning tree (thus effecting indicator I3 of the network); limiting random mixing of nodes (to control orderliness of the data set – I4), etc. A logical switch together with numerical parameters facilitate controlling the extent of the graph structure in topological and in numerical meaning such as involving or excluding negative weights; setting number of nodes and that of edges thus controlling the relation/activity ratio – I1; occurrence ("rate") of negative weights; range of weights in absolute value together with setting expected distribution of them; range of overweighting ("tightening") negative weights (to preclude positive loops if circular references and negative weights were allowed in the model) that are interpreted as potential maximum-typed relationships – I2.

The seed of the random generator can be fixed and/or set manually to provide means for gradual development or reproduction of previously generated random networks.

Table X. Controls of the Project Network Generator

|  |  |  |  |
| --- | --- | --- | --- |
| **Ref.** | **Parameter** | **Type** | **Range** |
| 1 | GTM Scheme Features | Boolean | Yes / No |
| 2 | Upper Triangle Coding | Boolean | Yes / No |
| 3 | No Negative Weight | Boolean | Yes / No |
| 4 | Connected for Sure | Boolean | Yes / No |
| 5 | Single Critical Path | Boolean | Yes / No |
| 6 | Keep Random Seed | Boolean | Yes / No |
| 7 | Random Seed | Integer | ± 2.147.483.647 |
| 8 | Number of Nodes | Integer | 100 - 2.000.000 |
| 9 | Number of Edges \* | Integer | 100 - 10.000.000 |
| 10 | Rate of Negative | Integer | 5 - 10.000.000 |
| 11 | Range of Weight | Integer | 1 - 10.000 |
| 12 | Tightening ... [%] | Integer | 0 - 1.000 |
| 13 | Trunk [%] | Integer | 0 - 100 |
| 14 | Cut Up | Integer | 0 - 100 |
| 15 | No Mix [%] | Integer | 0 - 100 |
| 16 | Distribution of Weights | Graphics  (100x100) | Beta / Constant / Fuzzy / Normal |

\* Maximum 16 successors per Node

After constructing the network built-in routines attempt to calculate the early and late times along the "schedule". In case of success (no positive loop identified) elaborated tabular display provides deep insight into the generated logical structure. The paths of the network can be walked through either in forward or backward direction. After each run a verbal summary report is also displayed together with a short statistical overview of different features and results.

For communicating other applications various data formats (different data structures in pure "txt" text format) are available to export the data into different applications (such as the one developed and used to test the Modified Floyd-Warshall algorithm to schedule open network – Vattai 2016). The application and the respective user manual have been made publicly available for the research community through the [www.ekt.bme.hu/PNGEN.shtml](http://www.ekt.bme.hu/PNGEN.shtml) link.