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## Program code

```
public class Main {

	public static void main(String[] args) {

		//double p = 0.5;
		double[] p = {0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 0.95, 0.99};
		int m1 = 1000;
		int m2 = 10000;
		int[] terminals = {16, 12, 0};

		System.out.println("p\tM=1000\tM=10000");
		for (double pi : p) {
			System.out.print(pi + "\t");
			System.out.printf("%.4f\t",
Tools.calculateNetworkReliability(terminals, m1, pi));
			System.out.printf("%.4f\t",
Tools.calculateNetworkReliability(terminals, m2, pi));
			System.out.println();
		}



	}

}


public class Tools {

	/*
	 *    01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20
	 * 01  0  1  0  0  1  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0
	 * 02  1  0  1  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0
	 * 03  0  1  0  1  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0
	 * 04  0  0  1  0  1  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0
	 * 05  1  0  0  1  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0
	 * 06  0  0  0  0  1  0  1  0  0  0  0  0  0  0  1  0  0  0  0  0
	 * 07  0  0  0  0  0  1  0  1  0  0  0  0  0  0  0  0  1  0  0  0
	 * 08  1  0  0  0  0  0  1  0  1  0  0  0  0  0  0  0  0  0  0  0
	 * 09  0  0  0  0  0  0  0  1  0  1  0  0  0  0  0  0  0  1  0  0
	 * 10  0  1  0  0  0  0  0  0  1  0  1  0  0  0  0  0  0  0  0  0
	 * 11  0  0  0  0  0  0  0  0  0  1  0  1  0  0  0  0  0  0  1  0
	 * 12  0  0  1  0  0  0  0  0  0  0  1  0  1  0  0  0  0  0  0  0
	 * 13  0  0  0  0  0  0  0  0  0  0  0  1  0  1  0  0  0  0  0  1
```

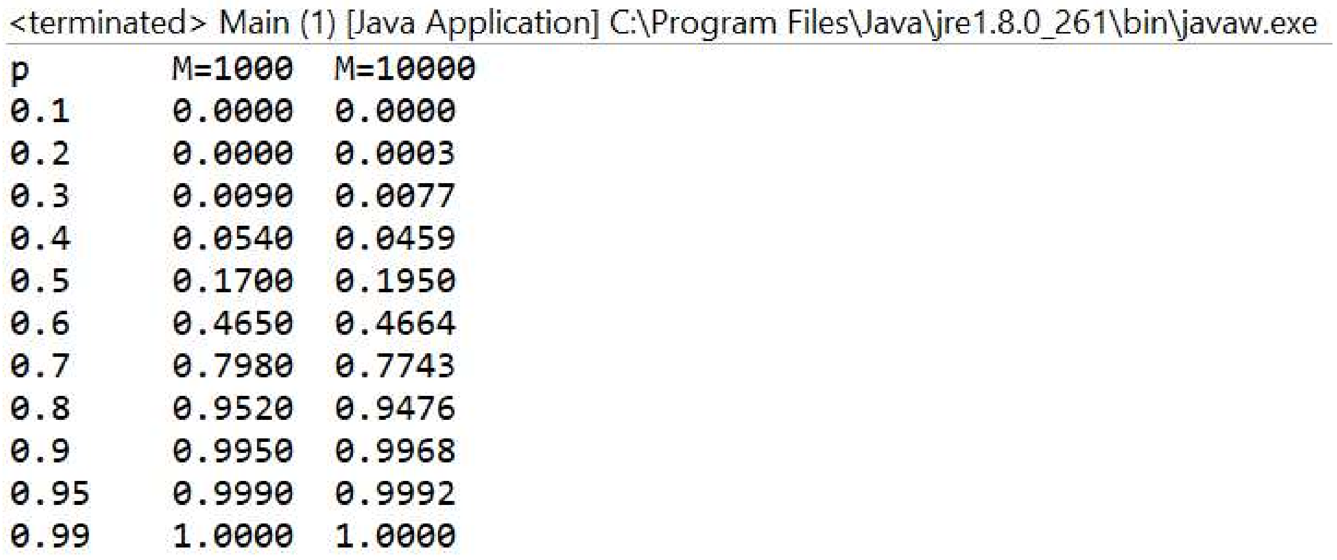
```
         * 14  0  0  0  1  0  0  0  0  0  0  0  0  1  0  1  0  0  0  0  0
         * 15  0  0  0  0  0  1  0  0  0  0  0  0  0  1  0  1  0  0  0  0
         * 16  0  0  0  0  0  0  0  0  0  0  0  0  0  0  1  0  1  0  0  1
         * 17  0  0  0  0  0  0  1  0  0  0  0  0  0  0  0  1  0  1  0  0
         * 18  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0  1  0  1  0
         * 19  0  0  0  0  0  0  0  0  0  0  1  0  0  0  0  0  0  1  0  1
         * 20  0  0  0  0  0  0  0  0  0  0  0  0  1  0  0  1  0  0  1  0
         */

        static private double[] p = {0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 0.95,
0.99};
        static private int[][] connections = {
                        /*00*/{0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
                        /*01*/{1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
                        /*02*/{0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0},
                        /*03*/{0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0},
                        /*04*/{1, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
                        /*05*/{0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0},
                        /*06*/{0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0},
                        /*07*/{1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0},
                        /*08*/{0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0},
                        /*09*/{0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0},
                        /*10*/{0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0},
                        /*11*/{0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0},
                        /*12*/{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1},
                        /*13*/{0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0},
                        /*14*/{0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0},
                        /*15*/{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1},
                        /*16*/{0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0},
                        /*17*/{0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0},
                        /*18*/{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 1},
                        /*19*/{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0}
        };
        static private int[][] stateVector = new int[connections.length]
[connections[0].length];

        static public double calculateNetworkReliability(int[] terminals, int m, double p) {

                double r = 0;

                for (int i = 0; i < m; i++) {
                        calculateNetworkStateVector(p);
                        if (checkTerminalsConnection(terminals))
                                r++;
                }

                //System.out.println(r); //print count of "UP" results (for tests)

                return r / m;
        }

        static private void calculateNetworkStateVector(double p) {

                if (connections == null || connections.length <= 0 || connections[0].length !
= connections.length ) {
                        System.out.println("Incorrect connections array");
                        return;
                }
```

```
		int length = connections.length;
		//int[][] stateVector = new int[length][length];

		for (int i = 0; i < length; i++) {
			for (int j = i; j < length; j++) {
				if (connections[i][j] == 1)
					stateVector[i][j] = Math.random() <= p ? 1 : 0;
				else
					stateVector[i][j] = 0;
			}
		}

		for (int i = 0; i < length; i++) {
			for (int j = 0; j < i; j++) {
				stateVector[i][j] = stateVector[j][i];
			}
		}

		//print transition matrix (for tests)
		/*
		int r = 0;
		for (int i = 0; i < length; i++) {
			System.out.print((i < 10 ? "0" + i : i) + "|  ");
			for (int j = 0; j < length; j++) {
				if (stateVector[i][j] == 1 && i < j)
					r++;
				System.out.print(stateVector[i][j] + "  ");
			}
			System.out.println();
		}
		*/
		//System.out.println(r); //print count of "UP" results (for tests)
	}

	static private boolean checkRoute(int x, int y) {
		if (x > y) {
			int tmp = x;
			x = y;
			y = tmp;
		}

		return checkRoute(x, y, " " + x + " ");
	}

	static private boolean checkRoute(int x, int y, String route) {

		if (x == y) {
			//System.out.println(route.substring(1)); //print route if exists (for
tests)
			return true;
		}

		for (int i = 0; i < stateVector.length; i++) {
			if (stateVector[x][i] == 1
					&& !route.contains(" " + i + " ")
					&& checkRoute(i, y, route + i + " "))
				return true;
```

```
                }

                return false;
        }

        static private boolean checkTerminalsConnection(int[] terminals) {
                for (int i = 0; i < terminals.length; i++)
                        for (int j = i + 1; j < terminals.length; j++)
                                if (!checkRoute(terminals[i], terminals[j]))
                                        return false;

                //System.out.println("true"); //true - network is UP (for tests)
                return true;
        }

}
```

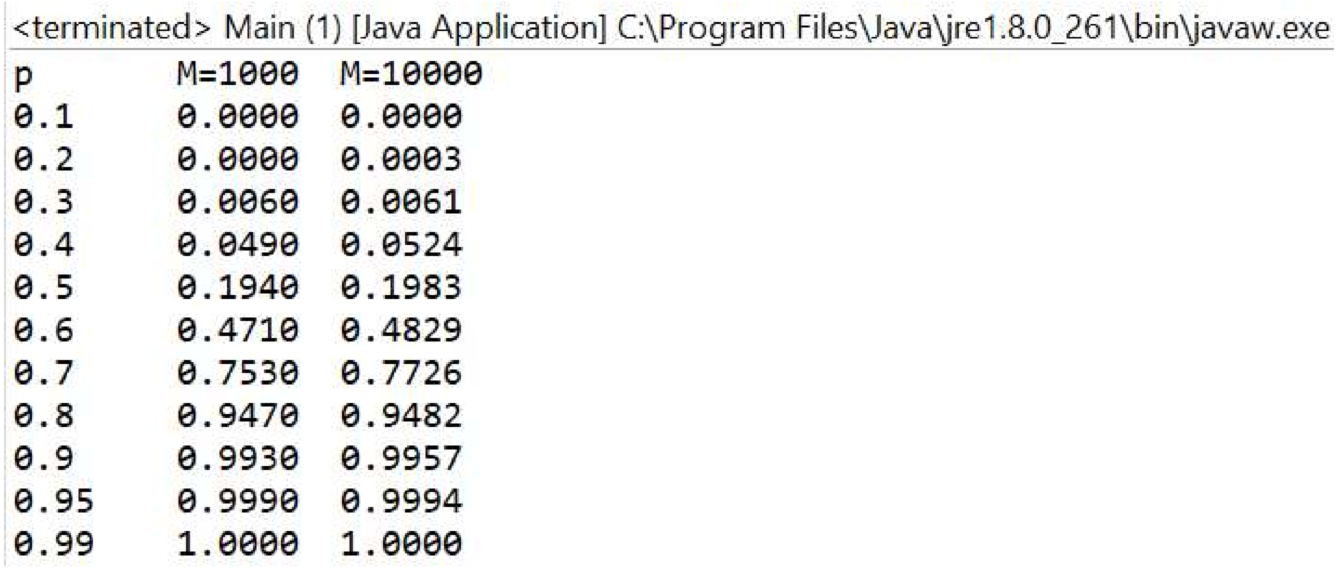
## Program result

Run 1:



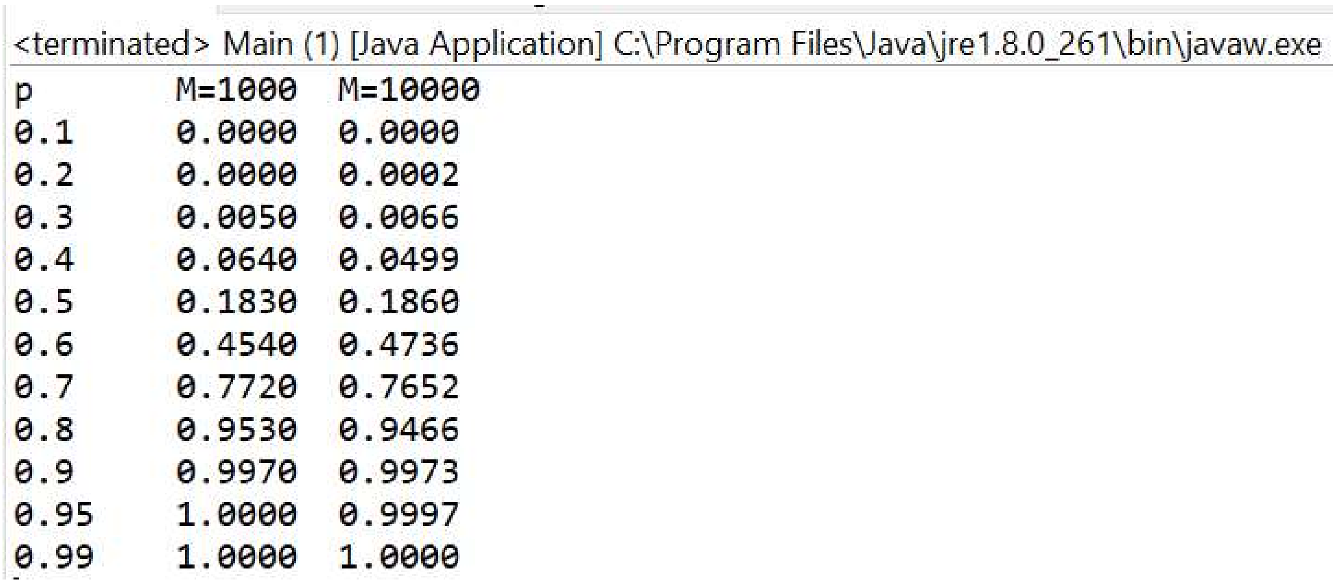
```
<terminated> Main (1) [Java Application] C:\Program Files\Java\jre1.8.0_261\bin\javaw.exe
p       M=1000  M=10000
0.1     0.0000  0.0000
0.2     0.0000  0.0003
0.3     0.0090  0.0077
0.4     0.0540  0.0459
0.5     0.1700  0.1950
0.6     0.4650  0.4664
0.7     0.7980  0.7743
0.8     0.9520  0.9476
0.9     0.9950  0.9968
0.95    0.9990  0.9992
0.99    1.0000  1.0000
```

Run 2:



```
<terminated> Main (1) [Java Application] C:\Program Files\Java\jre1.8.0_261\bin\javaw.exe
p         M=1000   M=10000
0.1       0.0000   0.0000
0.2       0.0000   0.0003
0.3       0.0060   0.0061
0.4       0.0490   0.0524
0.5       0.1940   0.1983
0.6       0.4710   0.4829
0.7       0.7530   0.7726
0.8       0.9470   0.9482
0.9       0.9930   0.9957
0.95      0.9990   0.9994
0.99      1.0000   1.0000
```

Run 3:



```
<terminated> Main (1) [Java Application] C:\Program Files\Java\jre1.8.0_261\bin\javaw.exe
p         M=1000   M=10000
0.1       0.0000   0.0000
0.2       0.0000   0.0002
0.3       0.0050   0.0066
0.4       0.0640   0.0499
0.5       0.1830   0.1860
0.6       0.4540   0.4736
0.7       0.7720   0.7652
0.8       0.9530   0.9466
0.9       0.9970   0.9973
0.95      1.0000   0.9997
0.99      1.0000   1.0000
```