Preliminary report

1. Team member names:

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2. Project Status

Scope of update: Deliverable 1A | Deliverable 1B |Deliverable 1C

For 1A, we have completed the whole task. We have tested cases which have 50, 100, 500, 1000 vertices and each whose edges with probabilities from 0 to 1. And we have collected the statistics, see the attachment.

For 1B, we have implemented MST algorithm, and test it with some small, given cases. Next step, we will test it in a large scale.

Algorithmic approaches: Kruscal, DFS based on adjacent-list, union find.

Challenges encountered: Too much time to computer large scale test cases.

3. Preliminary Result

Plots and tables: see the attachment plots and tables.

Runtime: the time in the table is the time of executing one case for 500 times. We just record the time before the iteration begins, and get the running time after the iteration ends.

For Deliverable 1A, we are using the workstations in CSE, with CPU Intel Xeon® E31225, 3.10GHz.

For Deliverable 1B, we are using a pc with Intel Core i7-3630QM 2.40Ghz 2.40Ghz

Observations:

(1A) When the graph's scale is small, the run time almost doesn't change with the increase of p. But for large scale cases, the time significantly, and linearly increase the increase of p. This is because when V is small, V^2 does not surpass V a lot. But when V is large, the V^2 is much more larger and will have significant influence on performance. Also, the number of edges increase linearly with p, and the time increases linearly with p indicates that when E surpasses V, **the running time is linear with E.**

(1B) Average cost grows with the number of vertices. This is self-evident. Actually from the figure we see that the curve of the average cost became steady after p is beyond certain points. This became more apparent when n increase. For example when n=500, or n=1000, it looks like a pulse. That is probably because when P is larger, the number of connected component is smaller and later became 1. So the number of edges on MST will become steady to be n-1. That is why the cost became steady.

The running time is also linear with the increase of n. But for each n value, the computing time takes longer for a larger p. The largest computing time for a large p can be 3,4 times of that of a small p.

(1C) The average diameter also increases when value n increases. That is because more points lead to a larger average diameter value. But with different p values, the average diameter is quite even and small. So the variance between each P cases is very small.

Running time: The first a few p's compuations take longer time then than the larger p. In general it scales linear with the increasing of value n also.

4. Acknowledgements

- In approaching the Minimum spanning tree problem using Kruscal algorithm, we used the package provided by Robert Sedgewick and Kevin Wayne.

(http://algs4.cs.princeton.edu/15uf/UF.java.html)

Appendix

● Running Time For 1A

N = 20

probability	**0**	**0.02**	**0.04**	**0.06**	**0.08**	**0.1**	**0.12**	**0.14**	**0.16**	**0.18**	**0.2**
mean	20	16.108	12.586	9.068	6.358	4.398	2.984	2.388	1.812	1.512	1.324
deviation	0.000	1.991	2.418	2.724	2.467	2.128	1.554	1.356	0.992	0.752	0.592
time(ms)	796	187	188	203	187	203	187	203	188	203	187
probability	**0.2**	**0.22**	**0.24**	**0.26**	**0.28**	**0.3**	**0.32**	**0.34**	**0.36**	**0.38**	**0.4**
mean	1.324	1.188	1.122	1.066	1.038	1.018	1.01	1.008	1.002	1	1
deviation	0.592	0.461	0.362	0.264	0.211	0.133	0.099	0.089	0.045	0.000	0.000
time(ms)	187	203	187	203	189	202	188	202	203	187	204
probability	**0.4**	**0.42**	**0.44**	**0.46**	**0.48**	**0.5**	**0.52**	**0.54**	**0.56**	**0.58**	**0.6**
mean	1	1	1	1	1	1	1	1	1	1	1
deviation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
time(ms)	204	187	203	203	187	203	204	187	203	203	187
probability	**0.6**	**0.62**	**0.64**	**0.66**	**0.68**	**0.7**	**0.72**	**0.74**	**0.76**	**0.78**	**0.8**
mean	1	1	1	1	1	1	1	1	1	1	1
deviation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
time(ms)	187	203	188	203	187	203	187	203	203	188	202
probability	**0.8**	**0.82**	**0.84**	**0.86**	**0.88**	**0.9**	**0.92**	**0.94**	**0.96**	**0.98**	**1**
mean	1	1	1	1	1	1	1	1	1	1	1
deviation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
time(ms)	202	203	187	203	204	203	187	203	203	202	203

N = 100

probability	**0**	**0.02**	**0.04**	**0.06**	**0.08**	**0.1**	**0.12**	**0.14**	**0.16**	**0.18**	**0.2**
mean	100	17.688	2.828	1.248	1.018	1.002	1	1	1	1	1
deviation	0	4.658	1.384	0.492	0.133	0.045	0	0	0	0	0
time(ms)	313	312	312	328	329	327	328	327	329	343	344
probability	**0.2**	**0.22**	**0.24**	**0.26**	**0.28**	**0.3**	**0.32**	**0.34**	**0.36**	**0.38**	**0.4**
mean	1	1	1	1	1	1	1	1	1	1	1
deviation	0	0	0	0	0	0	0	0	0	0	0
time(ms)	344	359	344	358	360	359	374	360	390	375	375
probability	**0.4**	**0.42**	**0.44**	**0.46**	**0.48**	**0.5**	**0.52**	**0.54**	**0.56**	**0.58**	**0.6**
mean	1	1	1	1	1	1	1	1	1	1	1
deviation	0	0	0	0	0	0	0	0	0	0	0
time(ms)	375	390	374	391	375	390	391	390	390	406	390
probability	**0.6**	**0.62**	**0.64**	**0.66**	**0.68**	**0.7**	**0.72**	**0.74**	**0.76**	**0.78**	**0.8**
mean	1	1	1	1	1	1	1	1	1	1	1
deviation	0	0	0	0	0	0	0	0	0	0	0

time(ms)	390	390	391	406	390	407	390	437	453	421	406
probability	**0.8**	**0.82**	**0.84**	**0.86**	**0.88**	**0.9**	**0.92**	**0.94**	**0.96**	**0.98**	**1**
mean	1	1	1	1	1	1	1	1	1	1	1
deviation	0	0	0	0	0	0	0	0	0	0	0
time(ms)	406	422	406	421	422	421	437	407	421	437	437

N = 500

probability	**0**	**0.02**	**0.04**	**0.06**	**0.08**	**0.1**	**0.12**	**0.14**	**0.16**	**0.18**	**0.2**
mean	500	1.028	1	1	1	1	1	1	1	1	1
deviation	0	0.164973	0	0	0	0	0	0	0	0	0
time(ms)	3355	3136	3246	3355	3465	6147	6319	6460	6615	6990	7224
probability	**0.2**	**0.22**	**0.24**	**0.26**	**0.28**	**0.3**	**0.32**	**0.34**	**0.36**	**0.38**	**0.4**
mean	1	1	1	1	1	1	1	1	1	1	1
deviation	0	0	0	0	0	0	0	0	0	0	0
time(ms)	7224	7333	7521	7660	7801	8160	8114	8269	8441	8627	8847
probability	**0.4**	**0.42**	**0.44**	**0.46**	**0.48**	**0.5**	**0.52**	**0.54**	**0.56**	**0.58**	**0.6**
mean	1	1	1	1	1	1	1	1	1	1	1
deviation	0	0	0	0	0	0	0	0	0	0	0
time(ms)	8847	8175	8303	8284	8425	8488	8643	8800	8815	8908	8940
probability	**0.6**	**0.62**	**0.64**	**0.66**	**0.68**	**0.7**	**0.72**	**0.74**	**0.76**	**0.78**	**0.8**
mean	1	1	1	1	1	1	1	1	1	1	1
deviation	0	0	0	0	0	0	0	0	0	0	0
time(ms)	8940	9049	9205	9159	9267	9424	11030	10937	11326	11483	11810
probability	**0.8**	**0.82**	**0.84**	**0.86**	**0.88**	**0.9**	**0.92**	**0.94**	**0.96**	**0.98**	**1**
mean	1	1	1	1	1	1	1	1	1	1	1
deviation	0	0	0	0	0	0	0	0	0	0	0
time(ms)	11810	11904	11982	12060	12169	12247	12341	12418	12513	12574	12590

N = 1000

probability	**0**	**0.02**	**0.04**	**0.06**	**0.08**	**0.1**	**0.12**	**0.14**	**0.16**	**0.18**	**0.2**
mean	1000	1	1	1	1	1	1	1	1	1	1
deviation	0	0	0	0	0	0	0	0	0	0	0
time(ms)	12745	11936	15242	16288	16835	17068	17161	17786	18472	20625	21405
probability	**0.2**	**0.22**	**0.24**	**0.26**	**0.28**	**0.3**	**0.32**	**0.34**	**0.36**	**0.38**	**0.4**
mean	1	1	1	1	1	1	1	1	1	1	1
deviation	0	0	0	0	0	0	0	0	0	0	0
time(ms)	21405	22185	22856	23558	24181	24743	25289	25835	26537	27224	26865
probability	**0.4**	**0.42**	**0.44**	**0.46**	**0.48**	**0.5**	**0.52**	**0.54**	**0.56**	**0.58**	**0.6**
mean	1	1	1	1	1	1	1	1	1	1	1
deviation	0	0	0	0	0	0	0	0	0	0	0
time(ms)	26865	27395	27894	28331	28737	29095	29454	30016	36256	37020	37286
probability	**0.6**	**0.62**	**0.64**	**0.66**	**0.68**	**0.7**	**0.72**	**0.74**	**0.76**	**0.78**	**0.8**
mean	1	1	1	1	1	1	1	1	1	1	1
deviation	0	0	0	0	0	0	0	0	0	0	0

time(ms)	37286	37566	37925	38222	36240	36286	36381	36459	36771	37130	37520
probability	**0.8**	**0.82**	**0.84**	**0.86**	**0.88**	**0.9**	**0.92**	**0.94**	**0.96**	**0.98**	**1**
mean	1	1	1	1	1	1	1	1	1	1	1
deviation	0	0	0	0	0	0	0	0	0	0	0
time(ms)	37520	38082	43479	44088	44976	43042	42839	41763	42122	42402	43324

- **Figure .Deliverable. 1A**

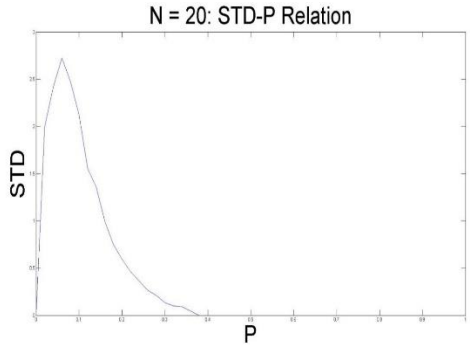

Figure 1

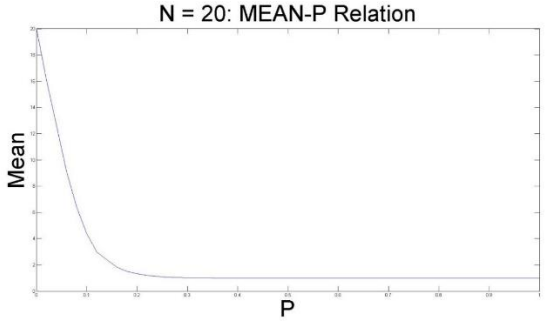

Figure 2

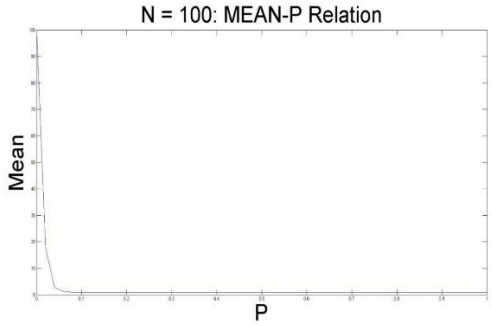

Figure 3

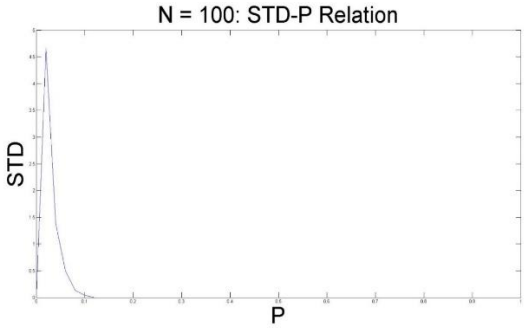

Figure 4

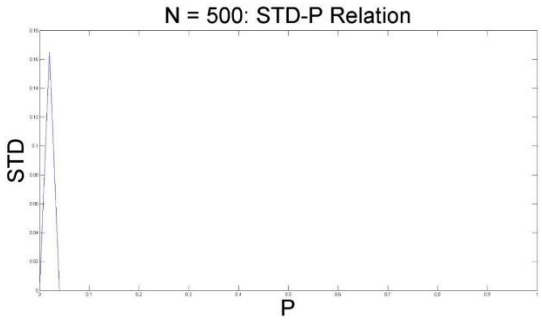

Figure 5

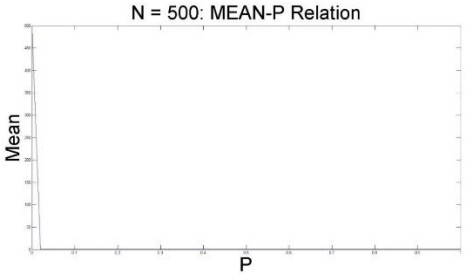

Figure 6

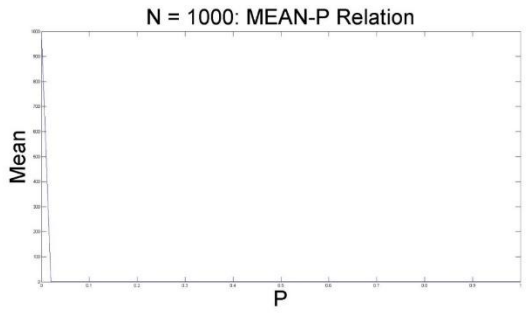

Figure 7

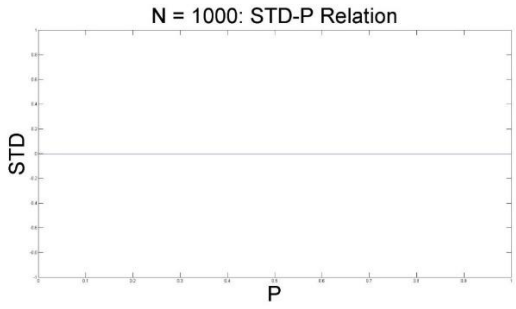

Figure 8

● Figure Deliverable 1B

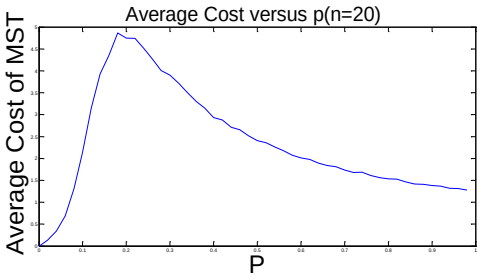

Figure 1

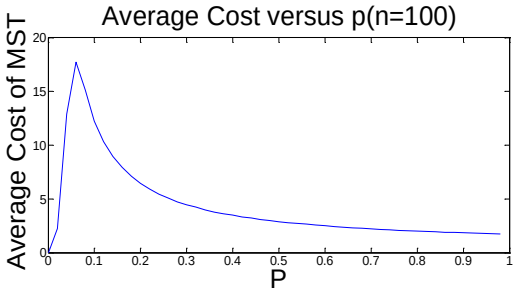

Figure 2

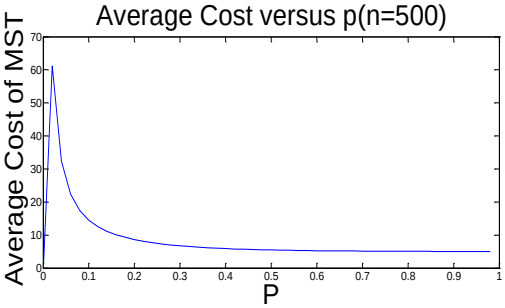

Figure 3

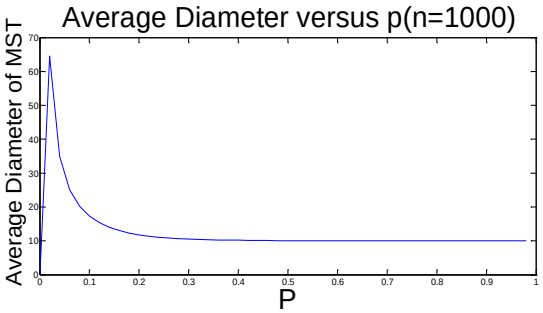

Figure 4

● Figure Deliverable 1C

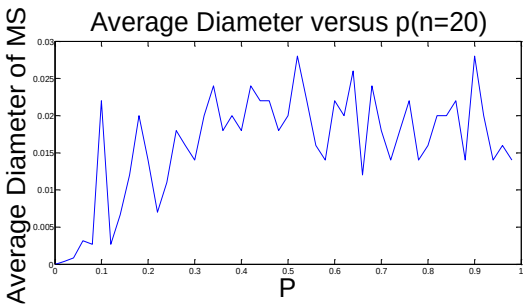

Figure 1

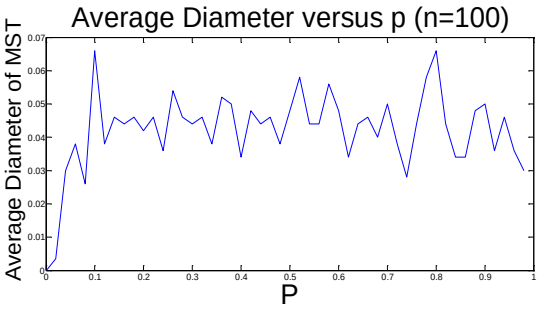

Figure 2

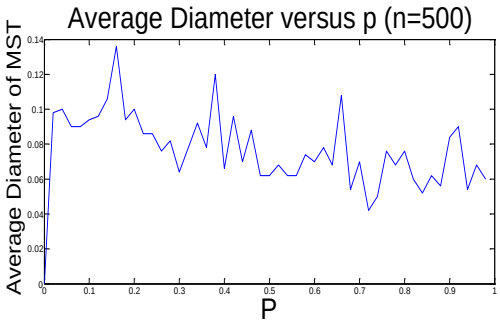

Figure 3

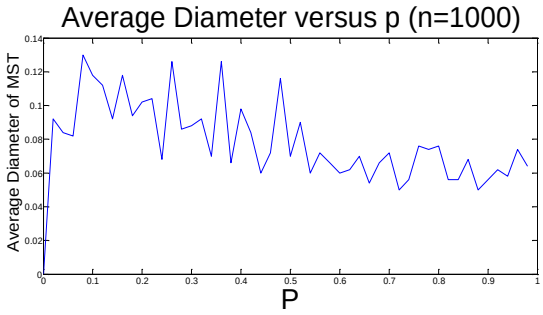

Figure 4