Due: April 5th, 2024 5pm
You may use your phone calculator and tables on page 2,3

1. A B.Math (Honours) first year student ask the institute to try a new, energy-efficient lawn mower engine from their hometown. They claim that the engine will run continuously for more than 8 hours (480 minutes) on a single litre of diesel. To check the institute selects a simple random sample of 50 protoype engines for testing. The engines run for an average of 485 minutes. The B.Math (Honours) first year class declare that the true standard deviation is known and is equal to 30 minutes, and the run times of the engines are normally distributed.

   Test the hypothesis that the mean run time is more than 480 minutes. Use a 0.05 level of significance.

2. The Brinell scale is a measure of how hard a material is. At ICTS, two Ph.d. students measure hardness of 10 pieces of ductile iron in the lab and they are listed below:

   $$170, 167, 174, 179, 179, 187, 179, 183, 179156, 163$$

   They hypothesized that the mean Brinell hardness of all Icts ductile iron pieces is greater than 170. Test this hypothesis.

3. Natural cork in wine bottles is subject to deterioration, and as a result wine in such bottles may experience contamination. Superfisher (a beer brewing) company recently reported that in a tasting of commercial pulawines, 16 of 91 bottles were considered spoiled to some extent by cork-associated characteristics. Does this data provide strong evidence for concluding that more than 15% of all such bottles are contaminated in this way? Use a significance level equal to 0.10.

4. Weights of twenty students of 4 standard from school A had a sample average strength of 29.8. A second random sample of 25 students from school B gave a sample average strength of 34.7. Assuming that the two weight distributions are normal with $\sigma_1 = 4$ and $\sigma_2 = 5$, does the data indicate that the corresponding true average weights μ_1, μ_2 are different? Perform a test at level of significance level $\alpha = 0.05$.

Table 1 : in (i, j)-th entry provides $\mathbb{P}(t_i \leq j)$, with $t_i \sim$ t-distribution with i degrees of freedom.

	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2
2	0.570	0.604	0.636	0.667	0.695	0.722	0.746	0.768	0.789	0.807	0.823
3	0.573	0.608	0.642	0.674	0.705	0.733	0.759	0.783	0.804	0.824	0.842
4	0.574	0.610	0.645	0.678	0.710	0.739	0.766	0.790	0.813	0.833	0.852
5	0.575	0.612	0.647	0.681	0.713	0.742	0.770	0.795	0.818	0.839	0.858
6	0.576	0.613	0.648	0.683	0.715	0.745	0.773	0.799	0.822	0.843	0.862
7	0.576	0.614	0.649	0.684	0.716	0.747	0.775	0.801	0.825	0.846	0.865
8	0.577	0.614	0.650	0.685	0.717	0.748	0.777	0.803	0.827	0.848	0.868
9	0.577	0.615	0.651	0.685	0.718	0.749	0.778	0.804	0.828	0.850	0.870

Table 2 : in (i, j)-th entry provides $\mathbb{P}(t_i \leq j)$, with $t_i \sim$ t-distribution with i degrees of freedom.

	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
1	0.750	0.765	0.779	0.791	0.803	0.813	0.822	0.831	0.839	0.846	0.852
2	0.789	0.807	0.823	0.838	0.852	0.864	0.875	0.884	0.893	0.901	0.908
3	0.804	0.824	0.842	0.858	0.872	0.885	0.896	0.906	0.915	0.923	0.930
4	0.813	0.833	0.852	0.868	0.883	0.896	0.908	0.918	0.927	0.935	0.942
5	0.818	0.839	0.858	0.875	0.890	0.903	0.915	0.925	0.934	0.942	0.949
6	0.822	0.843	0.862	0.879	0.894	0.908	0.920	0.930	0.939	0.947	0.954
7	0.825	0.846	0.865	0.883	0.898	0.911	0.923	0.934	0.943	0.950	0.957
8	0.827	0.848	0.868	0.885	0.900	0.914	0.926	0.936	0.945	0.953	0.960
9	0.828	0.850	0.870	0.887	0.902	0.916	0.928	0.938	0.947	0.955	0.962
10	0.830	0.851	0.871	0.889	0.904	0.918	0.930	0.940	0.949	0.957	0.963

Table 3 : in (i, j)-th entry provides $\mathbb{P}(t_i \leq j)$, with $t_i \sim$ t-distribution with i degrees of freedom.

	2.20	2.22	2.24	2.26	2.28	2.30	2.32	2.34	2.36	2.38	2.40
2	0.921	0.922	0.923	0.924	0.925	0.926	0.927	0.928	0.929	0.930	0.931
3	0.942	0.943	0.945	0.946	0.947	0.948	0.948	0.949	0.950	0.951	0.952
4	0.954	0.955	0.956	0.957	0.958	0.959	0.959	0.960	0.961	0.962	0.963
5	0.960	0.961	0.962	0.963	0.964	0.965	0.966	0.967	0.968	0.968	0.969
6	0.965	0.966	0.967	0.968	0.969	0.969	0.970	0.971	0.972	0.973	0.973
7	0.968	0.969	0.970	0.971	0.972	0.973	0.973	0.974	0.975	0.976	0.976
8	0.971	0.971	0.972	0.973	0.974	0.975	0.976	0.976	0.977	0.978	0.978
9	0.972	0.973	0.974	0.975	0.976	0.977	0.977	0.978	0.979	0.979	0.980

Table 4: in (i, j)-th entry provides $\mathbb{P}(Z \leq i + j)$, with $Z \sim \text{Normal}(0, 1)$

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359	0.5398
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753	0.5793
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141	0.6179
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517	0.6554
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879	0.6915
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224	0.7257
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549	0.7580
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852	0.7881
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133	0.8159
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389	0.8413
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621	0.8643
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830	0.8849
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015	0.9032
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177	0.9192
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319	0.9332
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441	0.9452
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545	0.9554
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633	0.9641
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706	0.9713
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767	0.9772
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817	0.9821
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857	0.9861
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890	0.9893
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916	0.9918
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936	0.9938
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952	0.9953
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964	0.9965
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986	0.9987
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998	0.9998