



Oxford Cambridge and RSA

Thursday 23 May 2024 – Afternoon

Level 3 Certificate Core Maths B (MEI)

H869/02 Statistical Problem Solving

Formulae and Statistical Tables (ST1)

Time allowed: 2 hours



INSTRUCTIONS

- Do **not** send this Booklet for marking. Keep it in the centre or recycle it.

INFORMATION

- This document has **8** pages.

STATISTICS: HYPOTHESIS TESTS

Description	Test statistic
Spearman rank correlation test	$r_s = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}$
χ^2 test	$X^2 = \sum \frac{(f_o - f_e)^2}{f_e}$

CRITICAL VALUES FOR CORRELATION COEFFICIENTS

Critical values for the product moment correlation coefficient, r

	5%	2½%	1%	½%	1-Tail Test	5%	2½%	1%	½%
	10%	5%	2%	1%		10%	5%	2%	1%
<i>n</i>					<i>n</i>				
1	—	—	—	—	31	0.3009	0.3550	0.4158	0.4556
2	—	—	—	—	32	0.2960	0.3494	0.4093	0.4487
3	0.9877	0.9969	0.9995	0.9999	33	0.2913	0.3440	0.4032	0.4421
4	0.9000	0.9500	0.9800	0.9900	34	0.2869	0.3388	0.3972	0.4357
5	0.8054	0.8783	0.9343	0.9587	35	0.2826	0.3338	0.3916	0.4296
6	0.7293	0.8114	0.8822	0.9172	36	0.2785	0.3291	0.3862	0.4238
7	0.6694	0.7545	0.8329	0.8745	37	0.2746	0.3246	0.3810	0.4182
8	0.6215	0.7067	0.7887	0.8343	38	0.2709	0.3202	0.3760	0.4128
9	0.5822	0.6664	0.7498	0.7977	39	0.2673	0.3160	0.3712	0.4076
10	0.5494	0.6319	0.7155	0.7646	40	0.2638	0.3120	0.3665	0.4026
11	0.5214	0.6021	0.6851	0.7348	41	0.2605	0.3081	0.3621	0.3978
12	0.4973	0.5760	0.6581	0.7079	42	0.2573	0.3044	0.3578	0.3932
13	0.4762	0.5529	0.6339	0.6835	43	0.2542	0.3008	0.3536	0.3887
14	0.4575	0.5324	0.6120	0.6614	44	0.2512	0.2973	0.3496	0.3843
15	0.4409	0.5140	0.5923	0.6411	45	0.2483	0.2940	0.3457	0.3801
16	0.4259	0.4973	0.5742	0.6226	46	0.2455	0.2907	0.3420	0.3761
17	0.4124	0.4821	0.5577	0.6055	47	0.2429	0.2876	0.3384	0.3721
18	0.4000	0.4683	0.5425	0.5897	48	0.2403	0.2845	0.3348	0.3683
19	0.3887	0.4555	0.5285	0.5751	49	0.2377	0.2816	0.3314	0.3646
20	0.3783	0.4438	0.5155	0.5614	50	0.2353	0.2787	0.3281	0.3610
21	0.3687	0.4329	0.5034	0.5487	51	0.2329	0.2759	0.3249	0.3575
22	0.3598	0.4227	0.4921	0.5368	52	0.2306	0.2732	0.3218	0.3542
23	0.3515	0.4132	0.4815	0.5256	53	0.2284	0.2706	0.3188	0.3509
24	0.3438	0.4044	0.4716	0.5151	54	0.2262	0.2681	0.3158	0.3477
25	0.3365	0.3961	0.4622	0.5052	55	0.2241	0.2656	0.3129	0.3445
26	0.3297	0.3882	0.4534	0.4958	56	0.2221	0.2632	0.3102	0.3415
27	0.3233	0.3809	0.4451	0.4869	57	0.2201	0.2609	0.3074	0.3385
28	0.3172	0.3739	0.4372	0.4785	58	0.2181	0.2586	0.3048	0.3357
29	0.3115	0.3673	0.4297	0.4705	59	0.2162	0.2564	0.3022	0.3328
30	0.3061	0.3610	0.4226	0.4629	60	0.2144	0.2542	0.2997	0.3301

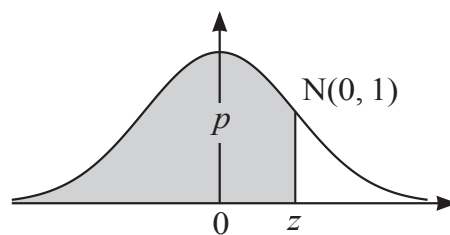
Critical values for Spearman's rank correlation coefficient, r_s

	5%	2½%	1%	½%	1-Tail Test	5%	2½%	1%	½%	2-Tail Test	10%	5%	2%	1%
	10%	5%	2%	1%		10%	5%	2%	1%		10%	5%	2%	1%
<i>n</i>						<i>n</i>								
1	—	—	—	—		31	0.3012	0.3560	0.4185	0.4593				
2	—	—	—	—		32	0.2962	0.3504	0.4117	0.4523				
3	—	—	—	—		33	0.2914	0.3449	0.4054	0.4455				
4	1.0000	—	—	—		34	0.2871	0.3396	0.3995	0.4390				
5	0.9000	1.0000	1.0000	—		35	0.2829	0.3347	0.3936	0.4328				
6	0.8286	0.8857	0.9429	1.0000		36	0.2788	0.3300	0.3882	0.4268				
7	0.7143	0.7857	0.8929	0.9286		37	0.2748	0.3253	0.3829	0.4211				
8	0.6429	0.7381	0.8333	0.8810		38	0.2710	0.3209	0.3778	0.4155				
9	0.6000	0.7000	0.7833	0.8333		39	0.2674	0.3168	0.3729	0.4103				
10	0.5636	0.6485	0.7455	0.7939		40	0.2640	0.3128	0.3681	0.4051				
11	0.5364	0.6182	0.7091	0.7545		41	0.2606	0.3087	0.3636	0.4002				
12	0.5035	0.5874	0.6783	0.7273		42	0.2574	0.3051	0.3594	0.3955				
13	0.4835	0.5604	0.6484	0.7033		43	0.2543	0.3014	0.3550	0.3908				
14	0.4637	0.5385	0.6264	0.6791		44	0.2513	0.2978	0.3511	0.3865				
15	0.4464	0.5214	0.6036	0.6536		45	0.2484	0.2945	0.3470	0.3822				
16	0.4294	0.5029	0.5824	0.6353		46	0.2456	0.2913	0.3433	0.3781				
17	0.4142	0.4877	0.5662	0.6176		47	0.2429	0.2880	0.3396	0.3741				
18	0.4014	0.4716	0.5501	0.5996		48	0.2403	0.2850	0.3361	0.3702				
19	0.3912	0.4596	0.5351	0.5842		49	0.2378	0.2820	0.3326	0.3664				
20	0.3805	0.4466	0.5218	0.5699		50	0.2353	0.2791	0.3293	0.3628				
21	0.3701	0.4364	0.5091	0.5558		51	0.2329	0.2764	0.3260	0.3592				
22	0.3608	0.4252	0.4975	0.5438		52	0.2307	0.2736	0.3228	0.3558				
23	0.3528	0.4160	0.4862	0.5316		53	0.2284	0.2710	0.3198	0.3524				
24	0.3443	0.4070	0.4757	0.5209		54	0.2262	0.2685	0.3168	0.3492				
25	0.3369	0.3977	0.4662	0.5108		55	0.2242	0.2659	0.3139	0.3460				
26	0.3306	0.3901	0.4571	0.5009		56	0.2221	0.2636	0.3111	0.3429				
27	0.3242	0.3828	0.4487	0.4915		57	0.2201	0.2612	0.3083	0.3400				
28	0.3180	0.3755	0.4401	0.4828		58	0.2181	0.2589	0.3057	0.3370				
29	0.3118	0.3685	0.4325	0.4749		59	0.2162	0.2567	0.3030	0.3342				
30	0.3063	0.3624	0.4251	0.4670		60	0.2144	0.2545	0.3005	0.3314				

THE NORMAL DISTRIBUTION AND ITS INVERSE

The Normal distribution: values of $\Phi(z) = p$

The table gives the probability, p , of a random variable distributed as $N(0, 1)$ being less than z .



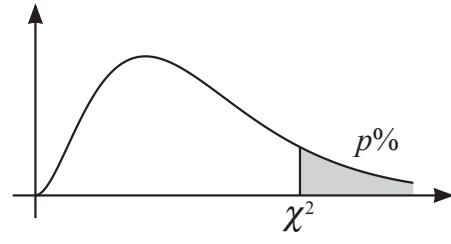
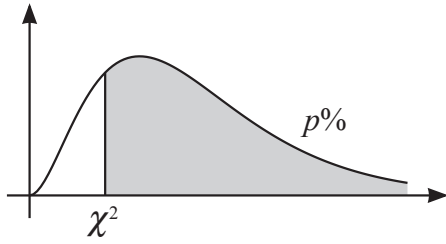
(add)

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	1	2	3	4	5	6	7	8	9
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359	4	8	12	16	20	24	28	32	36
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753	4	8	12	16	20	24	28	32	35
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141	4	8	12	15	19	23	27	31	35
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517	4	8	11	15	19	23	26	30	34
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879	4	7	11	14	18	22	25	29	32
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224	3	7	10	14	17	21	24	27	31
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549	3	6	10	13	16	19	23	26	29
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852	3	6	9	12	15	18	21	24	27
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133	3	6	8	11	14	17	19	22	25
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389	3	5	8	10	13	15	18	20	23
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621	2	5	7	9	12	14	16	18	21
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830	2	4	6	8	10	12	14	16	19
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015	2	4	6	7	9	11	13	15	16
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177	2	3	5	6	8	10	11	13	14
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319	1	3	4	6	7	8	10	11	13
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441	1	2	4	5	6	7	8	10	11
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545	1	2	3	4	5	6	7	8	9
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633	1	2	3	3	4	5	6	7	8
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706	1	1	2	3	4	4	5	6	6
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767	1	1	2	2	3	4	4	5	5
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817	0	1	1	2	2	3	3	4	4
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857	0	1	1	2	2	2	3	3	4
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890	0	1	1	1	2	2	2	3	3
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916	0	1	1	1	1	2	2	2	2
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936	0	0	1	1	1	1	1	2	2
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952	differences untrustworthy								
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964									
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974									
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981									
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986									
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990	differences untrustworthy								
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993									
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995									
3.3	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9996	.9997									
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998									

The Inverse Normal function: values of $\Phi^{-1}(p) = z$

p	.000	.001	.002	.003	.004	.005	.006	.007	.008	.009
.50	.0000	.0025	.0050	.0075	.0100	.0125	.0150	.0175	.0201	.0226
.51	.0251	.0276	.0301	.0326	.0351	.0376	.0401	.0426	.0451	.0476
.52	.0502	.0527	.0552	.0577	.0602	.0627	.0652	.0677	.0702	.0728
.53	.0753	.0778	.0803	.0828	.0853	.0878	.0904	.0929	.0954	.0979
.54	.1004	.1030	.1055	.1080	.1105	.1130	.1156	.1181	.1206	.1231
.55	.1257	.1282	.1307	.1332	.1358	.1383	.1408	.1434	.1459	.1484
.56	.1510	.1535	.1560	.1586	.1611	.1637	.1662	.1687	.1713	.1738
.57	.1764	.1789	.1815	.1840	.1866	.1891	.1917	.1942	.1968	.1993
.58	.2019	.2045	.2070	.2096	.2121	.2147	.2173	.2198	.2224	.2250
.59	.2275	.2301	.2327	.2353	.2378	.2404	.2430	.2456	.2482	.2508
.60	.2533	.2559	.2585	.2611	.2637	.2663	.2689	.2715	.2741	.2767
.61	.2793	.2819	.2845	.2871	.2898	.2924	.2950	.2976	.3002	.3029
.62	.3055	.3081	.3107	.3134	.3160	.3186	.3213	.3239	.3266	.3292
.63	.3319	.3345	.3372	.3398	.3425	.3451	.3478	.3505	.3531	.3558
.64	.3585	.3611	.3638	.3665	.3692	.3719	.3745	.3772	.3799	.3826
.65	.3853	.3880	.3907	.3934	.3961	.3989	.4016	.4043	.4070	.4097
.66	.4125	.4152	.4179	.4207	.4234	.4261	.4289	.4316	.4344	.4372
.67	.4399	.4427	.4454	.4482	.4510	.4538	.4565	.4593	.4621	.4649
.68	.4677	.4705	.4733	.4761	.4789	.4817	.4845	.4874	.4902	.4930
.69	.4959	.4987	.5015	.5044	.5072	.5101	.5129	.5158	.5187	.5215
.70	.5244	.5273	.5302	.5330	.5359	.5388	.5417	.5446	.5476	.5505
.71	.5534	.5563	.5592	.5622	.5651	.5681	.5710	.5740	.5769	.5799
.72	.5828	.5858	.5888	.5918	.5948	.5978	.6008	.6038	.6068	.6098
.73	.6128	.6158	.6189	.6219	.6250	.6280	.6311	.6341	.6372	.6403
.74	.6433	.6464	.6495	.6526	.6557	.6588	.6620	.6651	.6682	.6713
.75	.6745	.6776	.6808	.6840	.6871	.6903	.6935	.6967	.6999	.7031
.76	.7063	.7095	.7128	.7160	.7192	.7225	.7257	.7290	.7323	.7356
.77	.7388	.7421	.7454	.7488	.7521	.7554	.7588	.7621	.7655	.7688
.78	.7722	.7756	.7790	.7824	.7858	.7892	.7926	.7961	.7995	.8030
.79	.8064	.8099	.8134	.8169	.8204	.8239	.8274	.8310	.8345	.8381
.80	.8416	.8452	.8488	.8524	.8560	.8596	.8633	.8669	.8705	.8742
.81	.8779	.8816	.8853	.8890	.8927	.8965	.9002	.9040	.9078	.9116
.82	.9154	.9192	.9230	.9269	.9307	.9346	.9385	.9424	.9463	.9502
.83	.9542	.9581	.9621	.9661	.9701	.9741	.9782	.9822	.9863	.9904
.84	.9945	.9986	1.003	1.007	1.011	1.015	1.019	1.024	1.028	1.032
.85	1.036	1.041	1.045	1.049	1.054	1.058	1.063	1.067	1.071	1.076
.86	1.080	1.085	1.089	1.094	1.099	1.103	1.108	1.112	1.117	1.122
.87	1.126	1.131	1.136	1.141	1.146	1.150	1.155	1.160	1.165	1.170
.88	1.175	1.180	1.185	1.190	1.195	1.200	1.206	1.211	1.216	1.221
.89	1.227	1.232	1.237	1.243	1.248	1.254	1.259	1.265	1.270	1.276
.90	1.282	1.287	1.293	1.299	1.305	1.311	1.317	1.323	1.329	1.335
.91	1.341	1.347	1.353	1.360	1.366	1.372	1.379	1.385	1.392	1.398
.92	1.405	1.412	1.419	1.426	1.433	1.440	1.447	1.454	1.461	1.468
.93	1.476	1.483	1.491	1.499	1.506	1.514	1.522	1.530	1.538	1.546
.94	1.555	1.563	1.572	1.581	1.589	1.598	1.607	1.616	1.626	1.635
.95	1.645	1.655	1.665	1.675	1.685	1.695	1.706	1.717	1.728	1.739
.96	1.751	1.762	1.774	1.787	1.799	1.812	1.825	1.838	1.852	1.866
.97	1.881	1.896	1.911	1.927	1.943	1.960	1.977	1.995	2.014	2.034
.98	2.054	2.075	2.097	2.120	2.144	2.170	2.197	2.226	2.257	2.290
.99	2.326	2.366	2.409	2.457	2.512	2.576	2.652	2.748	2.878	3.090

PERCENTAGE POINTS OF THE χ^2 DISTRIBUTION



$p\%$	99	97.5	95	90		10	5	2.5	1	0.5
$v = 1$	.0001	.0010	.0039	.0158		2.706	3.841	5.024	6.635	7.879
2	.0201	.0506	0.103	0.211		4.605	5.991	7.378	9.210	10.60
3	0.115	0.216	0.352	0.584		6.251	7.815	9.348	11.34	12.84
4	0.297	0.484	0.711	1.064		7.779	9.488	11.14	13.28	14.86
5	0.554	0.831	1.145	1.610		9.236	11.07	12.83	15.09	16.75
6	0.872	1.237	1.635	2.204		10.64	12.59	14.45	16.81	18.55
7	1.239	1.690	2.167	2.833		12.02	14.07	16.01	18.48	20.28
8	1.646	2.180	2.733	3.490		13.36	15.51	17.53	20.09	21.95
9	2.088	2.700	3.325	4.168		14.68	16.92	19.02	21.67	23.59
10	2.558	3.247	3.940	4.865		15.99	18.31	20.48	23.21	25.19
11	3.053	3.816	4.575	5.578		17.28	19.68	21.92	24.72	26.76
12	3.571	4.404	5.226	6.304		18.55	21.03	23.34	26.22	28.30
13	4.107	5.009	5.892	7.042		19.81	22.36	24.74	27.69	29.82
14	4.660	5.629	6.571	7.790		21.06	23.68	26.12	29.14	31.32
15	5.229	6.262	7.261	8.547		22.31	25.00	27.49	30.58	32.80
16	5.812	6.908	7.962	9.312		23.54	26.30	28.85	32.00	34.27
17	6.408	7.564	8.672	10.09		24.77	27.59	30.19	33.41	35.72
18	7.015	8.231	9.390	10.86		25.99	28.87	31.53	34.81	37.16
19	7.633	8.907	10.12	11.65		27.20	30.14	32.85	36.19	38.58
20	8.260	9.591	10.85	12.44		28.41	31.41	34.17	37.57	40.00
21	8.897	10.28	11.59	13.24		29.62	32.67	35.48	38.93	41.40
22	9.542	10.98	12.34	14.04		30.81	33.92	36.78	40.29	42.80
23	10.20	11.69	13.09	14.85		32.01	35.17	38.08	41.64	44.18
24	10.86	12.40	13.85	15.66		33.20	36.42	39.36	42.98	45.56
25	11.52	13.12	14.61	16.47		34.38	37.65	40.65	44.31	46.93
26	12.20	13.84	15.38	17.29		35.56	38.89	41.92	45.64	48.29
27	12.88	14.57	16.15	18.11		36.74	40.11	43.19	46.96	49.64
28	13.56	15.31	16.93	18.94		37.92	41.34	44.46	48.28	50.99
29	14.26	16.05	17.71	19.77		39.09	42.56	45.72	49.59	52.34
30	14.95	16.79	18.49	20.60		40.26	43.77	46.98	50.89	53.67
35	18.51	20.57	22.47	24.80		46.06	49.80	53.20	57.34	60.27
40	22.16	24.43	26.51	29.05		51.81	55.76	59.34	63.69	66.77
50	29.71	32.36	34.76	37.69		63.17	67.50	71.42	76.15	79.49
100	70.06	74.22	77.93	82.36		118.5	124.3	129.6	135.8	140.2

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