CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ

Semester 2 Examinations 2011

Module Title: Management Decision Making

Module Code: MATH6034

School: School of Computing & Mathematics

Programme Title: **Bachelor of Business in Accounting**
Bachelor of Business (Honours) in Accounting

Programme Code: **BACCT_7_Y2**
BACCT_8_Y2

External Examiner(s): **Mr. James Reilly**
Internal Examiner(s): **Dr. Shane O Rourke**

Instructions: **Do any FOUR out of 5 questions.**

Duration: 2 Hours

Sitting: Summer 2011

Requirements for this examination:

Note to Candidates: Please check the Programme Title and the Module Title to ensure that you have received the correct examination.
If in doubt please contact an Invigilator.

1. (a) A manufacturer of hardware produces components that have a mean diameter of 40mm with a standard deviation of 0.2mm. Find the percentage of components that have diameter less than 39.5mm.

   The components are fit for purpose only if the diameter is between 39.6mm and 40.4mm. Find the percentage of components that lie in this range. (9 marks)

   (b) On another production line it is found that 19 out of 20 components on average pass all quality control tests. Fifteen components are chosen at random. Find the probability that
   (i) they all pass; (ii) at most 13 components pass all quality control tests. (8 marks)

   (c) The machinery on another production line breaks down from time to time, requiring an engineer to service it. There are on average three breakdowns in an eight-hour shift. Find the probability that in a random *hour*, there are
   (i) no breakdowns; (ii) more than two breakdowns. (8 marks)

2. (a) The Department of Transport has conducted a study to estimate the mean distance travelled per week by car owners in Ireland. A sample of 100 motorists was randomly chosen, and the mean distance travelled by the motorists in this sample was found to be 140 miles. The standard deviation of the sample was 35 miles. Assuming that the standard deviation of the population of all car owners is also 35 miles, establish a 95% confidence interval for the mean distance travelled per week by car owners. Is it reasonable to assume that the population standard deviation is equal to the sample standard deviation? Briefly say why. (9 marks)

   (b) The following year, the Department of Transport decides that it wants to estimate the average distance travelled by motorists each week to within an error of 5 miles, and with a confidence level of 99%. Taking the standard deviation to be 40 miles, give the smallest sample size that could support such an estimate. (7 marks)

   (c) Emerald Fuels claims that its premium brand of petrol gives rise to greater fuel efficiency than one of its competitors, Oyster Oils. A sample of 20 motorists used Emerald Fuels' brand of petrol, and a mean of 48 miles per gallon was observed, with a sample standard deviation of 8 miles per gallon. A sample of 12 motorists used Oyster Oils' brand of petrol and a mean of 42 miles per gallon was observed, with a standard deviation of 3 miles per gallon. Test the hypothesis that Emerald Fuels have a higher average fuel efficiency (miles per gallon) than Oyster Oils. Use a 5% level of significance. (9 marks)

3. (a) Briefly describe three queueing situations each with a different queue discipline. (6 marks)

(b) State how the following are related:

(i). the average length of time spent by customers in a queue;

(ii). the average number of customers in a queue.

(6 marks)

(c) Callers phone a helpline at an average rate of one caller every two minutes. There is a single operator who takes an average of 1.8 minutes to deal with each call. An unlimited number of callers can be placed on hold, while the operator deals with each caller. Assuming that the inter-arrival and service times follow a negative exponential distribution, find

(i). the probability that a caller will have to wait to get through to the operator.

(ii). the average number of callers on hold at any given time.

(iii). the average length of time a caller spends on the line before being connected to the operator.

(iv). the probability that a caller will have to spend longer than 10 minutes on the line in total.

(13 marks)

4. (a) Convert the following linear programming problem to a standard minimum problem (there is no need to *solve* the problem).

Maximise $x_1 - x_2 + 4x_3$ subject to

$$\begin{array}{rrcl} & x_1 & \geq & 0 \\ & x_2 & \leq & 0 \\ 7x_2 & -4x_3 & = & 0 \\ -x_1 & +8x_2 & \leq & 19 \\ x_2 & +5x_3 & \geq & 4. \end{array}$$

(10 marks)

(b) Use the simplex method to minimise $-2y_2 + y_3$ subject to the constraints $y_i \geq 0$ for all i and

$$\begin{array}{rrrcl} -y_1 & -2y_2 & & \geq & 3 \\ 4y_1 & +y_2 & +7y_3 & \geq & 1 \\ 2y_1 & -3y_2 & +y_3 & \geq & 5. \end{array}$$

(15 marks)

5. (a) A company anticipates that it will need to pay for a new fleet of delivery vans in eight years' time. It intends to put regular annual deposits in a sinking fund between now and then, and wants to have €180,000 in the account at the end of this time. Find how much the annual deposits should be if the deposit interest rate is 3.5% per annum. (8 marks)

(b) Calculate the monthly repayments on a mortgage of €350000 over a 25 year period where monthly interest is fixed at 0.45%. (7 marks)

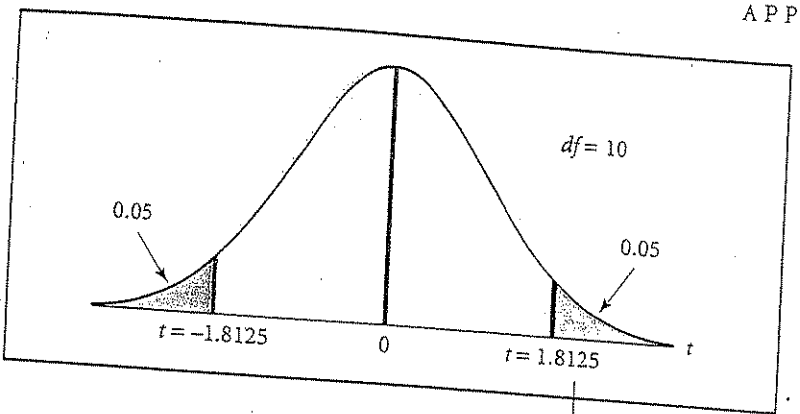
(c) A company is considering whether to invest in a new form of technology for use in its production lines. This investment would entail an initial payment of €35000 to cover the cost of the equipment and staff training, It is anticipated that the investment will not lead to any savings in the cost of production in the first year of its operation, but should save €20000 in the second year and a further €20000 in the third year. Calculate the Internal Rate of Return of the investment. (Note: the IRR is less than 10%.) (10 marks)

PROBABILITIES (OR AREAS UNDER *t*-DISTRIBUTION CURVE)

Conf. Level	*0.1*	*0.3*	*0.5*	*0.7*	*0.8*	*0.9*	*0.95*	*0.98*	*0.9*
One Tail	*0.45*	*0.35*	*0.25*	*0.15*	*0.1*	*0.05*	*0.025*	*0.01*	*0.0*
Two Tails	*0.9*	*0.7*	*0.5*	*0.3*	*0.2*	*0.1*	*0.05*	*0.02*	*0.0*
df					*Values of t*				
38	0.1265	0.3882	0.6810	1.0508	1.3042	1.6860	2.0244	2.4286	2.71
39	0.1265	0.3882	0.6808	1.0504	1.3036	1.6849	2.0227	2.4258	2.70
40	0.1265	0.3881	0.6807	1.0500	1.3031	1.6839	2.0211	2.4233	2.70
41	0.1264	0.3880	0.6805	1.0497	1.3025	1.6829	2.0195	2.4208	2.70
42	0.1264	0.3880	0.6804	1.0494	1.3020	1.6820	2.0181	2.4185	2.69
43	0.1264	0.3879	0.6802	1.0491	1.3016	1.6811	2.0167	2.4163	2.69
44	0.1264	0.3878	0.6801	1.0488	1.3011	1.6802	2.0154	2.4141	2.69
45	0.1264	0.3878	0.6800	1.0485	1.3007	1.6794	2.0141	2.4121	2.68
46	0.1264	0.3877	0.6799	1.0482	1.3002	1.6787	2.0129	2.4102	2.68
47	0.1263	0.3877	0.6797	1.0480	1.2998	1.6779	2.0117	2.4083	2.68
48	0.1263	0.3876	0.6796	1.0478	1.2994	1.6772	2.0106	2.4066	2.68
49	0.1263	0.3876	0.6795	1.0475	1.2991	1.6766	2.0096	2.4049	2.680
50	0.1263	0.3875	0.6794	1.0473	1.2987	1.6759	2.0086	2.4033	2.677
51	0.1263	0.3875	0.6793	1.0471	1.2984	1.6753	2.0076	2.4017	2.675
52	0.1263	0.3875	0.6792	1.0469	1.2980	1.6747	2.0066	2.4002	2.673
53	0.1263	0.3874	0.6791	1.0467	1.2977	1.6741	2.0057	2.3988	2.671
54	0.1263	0.3874	0.6791	1.0465	1.2974	1.6736	2.0049	2.3974	2.670
55	0.1262	0.3873	0.6790	1.0463	1.2971	1.6730	2.0040	2.3961	2.668
56	0.1262	0.3873	0.6789	1.0461	1.2969	1.6725	2.0032	2.3948	2.666
57	0.1262	0.3873	0.6788	1.0459	1.2966	1.6720	2.0025	2.3936	2.664
58	0.1262	0.3872	0.6787	1.0458	1.2963	1.6716	2.0017	2.3924	2.663
59	0.1262	0.3872	0.6787	1.0456	1.2961	1.6711	2.0010	2.3912	2.6618
60	0.1262	0.3872	0.6786	1.0455	1.2958	1.6706	2.0003	2.3901	2.6603
61	0.1262	0.3871	0.6785	1.0453	1.2956	1.6702	1.9996	2.3890	2.6589
62	0.1262	0.3871	0.6785	1.0452	1.2954	1.6698	1.9990	2.3880	2.6575
63	0.1262	0.3871	0.6784	1.0450	1.2951	1.6694	1.9983	2.3870	2.6561
64	0.1262	0.3871	0.6783	1.0449	1.2949	1.6690	1.9977	2.3860	2.6549
65	0.1262	0.3870	0.6783	1.0448	1.2947	1.6686	1.9971	2.3851	2.6536
66	0.1261	0.3870	0.6782	1.0446	1.2945	1.6683	1.9966	2.3842	2.6524
67	0.1261	0.3870	0.6782	1.0445	1.2943	1.6679	1.9960	2.3833	2.6512
68	0.1261	0.3870	0.6781	1.0444	1.2941	1.6676	1.9955	2.3824	2.6501
69	0.1261	0.3869	0.6781	1.0443	1.2939	1.6672	1.9949	2.3816	2.6490
70	0.1261	0.3869	0.6780	1.0442	1.2938	1.6669	1.9944	2.3808	2.6479
71	0.1261	0.3869	0.6780	1.0441	1.2936	1.6666	1.9939	2.3800	2.6469
72	0.1261	0.3869	0.6779	1.0440	1.2934	1.6663	1.9935	2.3793	2.6458
73	0.1261	0.3868	0.6779	1.0438	1.2933	1.6660	1.9930	2.3785	2.6449
74	0.1261	0.3868	0.6778	1.0437	1.2931	1.6657	1.9925	2.3778	2.6439
75	0.1261	0.3868	0.6778	1.0436	1.2929	1.6654	1.9921	2.3771	2.6430
76	0.1261	0.3868	0.6777	1.0436	1.2928	1.6652	1.9917	2.3764	2.6421
77	0.1261	0.3868	0.6777	1.0435	1.2926	1.6649	1.9913	2.3758	2.6412
78	0.1261	0.3867	0.6776	1.0434	1.2925	1.6646	1.9908	2.3751	2.6403
79	0.1261	0.3867	0.6776	1.0433	1.2924	1.6644	1.9905	2.3745	2.6395
80	0.1261	0.3867	0.6776	1.0432	1.2922	1.6641	1.9901	2.3739	2.6387
81	0.1261	0.3867	0.6775	1.0431	1.2921	1.6639	1.9897	2.3733	2.6379
82	0.1261	0.3867	0.6775	1.0430	1.2920	1.6636	1.9893	2.3727	2.6371
83	0.1260	0.3867	0.6775	1.0429	1.2918	1.6634	1.9890	2.3721	2.6364
84	0.1260	0.3866	0.6774	1.0429	1.2917	1.6632	1.9886	2.3716	2.6356
85	0.1260	0.3866	0.6774	1.0428	1.2916	1.6630	1.9883	2.3710	2.6349
86	0.1260	0.3866	0.6774	1.0427	1.2915	1.6628	1.9879	2.3705	2.6342
87	0.1260	0.3866	0.6773	1.0426	1.2914	1.6626	1.9876	2.3700	2.6335
88	0.1260	0.3866	0.6773	1.0426	1.2912	1.6624	1.9873	2.3695	2.6329
89	0.1260	0.3866	0.6773	1.0425	1.2911	1.6622	1.9870	2.3690	2.6322

APPENDIX F

Values of t for Selected Probabilities



PROBABILITIES (OR AREAS UNDER t-DISTRIBUTION CURVE)

Conf. Level	*0.1*	*0.3*	*0.5*	*0.7*	*0.8*	*0.9*	*0.95*	*0.98*	*0.99*
One Tail	*0.45*	*0.35*	*0.25*	*0.15*	*0.1*	*0.05*	*0.025*	*0.01*	*0.005*
Two Tails	*0.9*	*0.7*	*0.5*	*0.3*	*0.2*	*0.1*	*0.05*	*0.02*	*0.01*
df	*Values of t*								
1	0.1584	0.5095	1.0000	1.9626	3.0777	6.3137	12.7062	31.8210	63.6559
2	0.1421	0.4447	0.8165	1.3862	1.8856	2.9200	4.3027	6.9645	9.9250
3	0.1366	0.4242	0.7649	1.2498	1.6377	2.3534	3.1824	4.5407	5.8408
4	0.1338	0.4142	0.7407	1.1896	1.5332	2.1318	2.7765	3.7469	4.6041
5	0.1322	0.4082	0.7267	1.1558	1.4759	2.0150	2.5706	3.3649	4.0321
6	0.1311	0.4043	0.7176	1.1342	1.4398	1.9432	2.4469	3.1427	3.7074
7	0.1303	0.4015	0.7111	1.1192	1.4149	1.8946	2.3646	2.9979	3.4995
8	0.1297	0.3995	0.7064	1.1081	1.3968	1.8595	2.3060	2.8965	3.3554
9	0.1293	0.3979	0.7027	1.0997	1.3830	1.8331	2.2622	2.8214	3.2498
10	0.1289	0.3966	0.6998	1.0931	1.3722	1.8125	2.2281	2.7638	3.1693
11	0.1286	0.3956	0.6974	1.0877	1.3634	1.7959	2.2010	2.7181	3.1058
12	0.1283	0.3947	0.6955	1.0832	1.3562	1.7823	2.1788	2.6810	3.0545
13	0.1281	0.3940	0.6938	1.0795	1.3502	1.7709	2.1604	2.6503	3.0123
14	0.1280	0.3933	0.6924	1.0763	1.3450	1.7613	2.1448	2.6245	2.9768
15	0.1278	0.3928	0.6912	1.0735	1.3406	1.7531	2.1315	2.6025	2.9467
16	0.1277	0.3923	0.6901	1.0711	1.3368	1.7459	2.1199	2.5835	2.9208
17	0.1276	0.3919	0.6892	1.0690	1.3334	1.7396	2.1098	2.5669	2.8982
18	0.1274	0.3915	0.6884	1.0672	1.3304	1.7341	2.1009	2.5524	2.8784
19	0.1274	0.3912	0.6876	1.0655	1.3277	1.7291	2.0930	2.5395	2.8609
20	0.1273	0.3909	0.6870	1.0640	1.3253	1.7247	2.0860	2.5280	2.8453
21	0.1272	0.3906	0.6864	1.0627	1.3232	1.7207	2.0796	2.5176	2.8314
22	0.1271	0.3904	0.6858	1.0614	1.3212	1.7171	2.0739	2.5083	2.8188
23	0.1271	0.3902	0.6853	1.0603	1.3195	1.7139	2.0687	2.4999	2.8073
24	0.1270	0.3900	0.6848	1.0593	1.3178	1.7109	2.0639	2.4922	2.7970
25	0.1269	0.3898	0.6844	1.0584	1.3163	1.7081	2.0595	2.4851	2.7874
26	0.1269	0.3896	0.6840	1.0575	1.3150	1.7056	2.0555	2.4786	2.7787
27	0.1268	0.3894	0.6837	1.0567	1.3137	1.7033	2.0518	2.4727	2.7707
28	0.1268	0.3893	0.6834	1.0560	1.3125	1.7011	2.0484	2.4671	2.7633
29	0.1268	0.3892	0.6830	1.0553	1.3114	1.6991	2.0452	2.4620	2.7564
30	0.1267	0.3890	0.6828	1.0547	1.3104	1.6973	2.0423	2.4573	2.7500
31	0.1267	0.3889	0.6825	1.0541	1.3095	1.6955	2.0395	2.4528	2.7440
32	0.1267	0.3888	0.6822	1.0535	1.3086	1.6939	2.0369	2.4487	2.7385
33	0.1266	0.3887	0.6820	1.0530	1.3077	1.6924	2.0345	2.4448	2.7333
34	0.1266	0.3886	0.6818	1.0525	1.3070	1.6909	2.0322	2.4411	2.7284
35	0.1266	0.3885	0.6816	1.0520	1.3062	1.6896	2.0301	2.4377	2.7238
36	0.1266	0.3884	0.6814	1.0516	1.3055	1.6883	2.0281	2.4345	2.7195
37	0.1265	0.3883	0.6812	1.0512	1.3049	1.6871	2.0262	2.4314	2.7154

continued

	Means		Proportions
	Large Sample	**Small Sample**	**Always Large**
Confidence intervals	$\bar{x} \pm Z\frac{s}{\sqrt{n}}$ $\bar{x} \pm z\frac{s}{\sqrt{n}}\sqrt{\frac{N-n}{N-1}}$ $n = \frac{z^2 s^2}{E^2}$ $n = \frac{n_0}{1+\frac{n_0}{N}}$	$\bar{x} \pm t_{n-1}\frac{s}{\sqrt{n}}$	$p \pm Z\sqrt{\frac{p(1-p)}{n}}$ $p \pm z\sqrt{\frac{p(1-p)}{n}}\sqrt{\frac{N-n}{N-1}}$ $n = \frac{1}{4}\frac{z^2}{E^2}$ $n = p_L(1-p_L)\frac{z^2}{E^2}$ $n = \frac{n_0}{1+\frac{n_0}{N}}$
One Sample Test	$Z = \frac{\bar{x}-\mu_0}{\frac{s}{\sqrt{n}}}$	$t_{n-1} = \frac{\bar{x}-\mu_0}{\frac{s}{\sqrt{n}}}$	$z = \frac{p-\pi_0}{\sqrt{\frac{\pi_0(1-\pi_0)}{n}}}$
Two Sample Test	$Z = \frac{\bar{x}_1-\bar{x}_2-(\mu_1-\mu_2)}{\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}}$	$t_{n_1+n_2-2} = \frac{\bar{x}_1-\bar{x}_2-(\mu_1-\mu_2)}{s_p\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}}$ $s_p^2 = \frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2}$	$z = \frac{p_1-p_2}{\sqrt{\bar{p}(1-\bar{p})}\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}}$ $\bar{p} = \frac{n_1p_1+n_2p_2}{n_1+n_2}$

ADCA 2 – Examination Formulae 2010 – Semester 2

Compound Interest

$$A = P(1+i)^n$$

$$P = A(1+i)^{-n} \quad \left[= \frac{A}{(1+i)^n} \right]$$

A = Amount

P = Present Value

Depreciation $B = C(1-i)^n$

Annuity Formulae (Payment Interval = Interest Period)

$$A = R\left[\frac{(1+i)^n - 1}{i}\right] \qquad P = R\left[\frac{1-(1+i)^{-n}}{i}\right]$$

Binomial Distribution $P(r,n) = {}^nC_r p^r q^{n-r}$

Poisson Distribution $P(x) = \dfrac{\lambda^x . e^{-\lambda}}{x!}$ $\lambda = np$

Standard Units $Z = \dfrac{x - \bar{x}}{\sigma}$

Single Server Queue: (M/M/1)

$$\mathrm{L_s} = \frac{\lambda}{\mu - \lambda} \qquad \mathrm{W_s} = \frac{1}{\mu - \lambda} \qquad \mathrm{L_q} = \frac{\lambda^2}{\mu(\mu - \lambda)} \qquad \mathrm{W_q} = \frac{\lambda}{\mu(\mu - \lambda)}$$

$$P_n = \left(1 - \frac{\lambda}{\mu}\right)\left(\frac{\lambda}{\mu}\right)^n \qquad P(\mathrm{S} > \mathrm{t}) = e^{-\mu\left(1-\frac{\lambda}{\mu}\right)\mathrm{t}} \qquad P(Q > t) = \frac{\lambda}{\mu} e^{-\mu\left(1-\frac{\lambda}{\mu}\right)\mathrm{t}}$$

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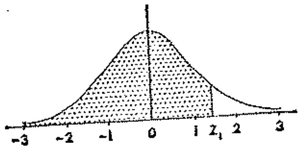
Area under the Normal Curve

$$P(z \leqslant z_1) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{z_1} e^{-\frac{1}{2}z^2} \, dz .$$



z	0·00	0·01	0·02	0·03	0·04	0·05	0·06	0·07	0·08	0·09
0·0	0·5000	5040	5080	5120	5160	5199	5239	5279	5319	5359
0·1	0·5398	5438	5478	5517	5557	5596	5636	5675	5714	5753
0·2	0·5793	5832	5871	5910	5948	5987	6026	6064	6103	6141
0·3	0·6179	6217	6255	6293	6331	6368	6406	6443	6480	6517
0·4	0·6554	6591	6628	6664	6700	6736	6772	6808	6844	6879
0·5	0·6915	6950	6985	7019	7054	7088	7123	7157	7190	7224
0·6	0·7257	7291	7324	7357	7389	7422	7454	7486	7517	7549
0·7	0·7580	7611	7642	7673	7704	7734	7764	7794	7823	7852
0·8	0·7881	7910	7939	7967	7995	8023	8051	8078	8106	8133
0·9	0·8159	8186	8212	8238	8264	8289	8315	8340	8365	8389
1·0	0·8413	8438	8461	8485	8508	8531	8554	8577	8599	8621
1·1	0·8643	8665	8686	8708	8729	8749	8770	8790	8810	8830
1·2	0·8849	8869	8888	8907	8925	8944	8962	8980	8997	9015
1·3	0·9032	9049	9066	9082	9099	9115	9131	9147	9162	9177
1·4	0·9192	9207	9222	9236	9251	9265	9279	9292	9306	9319
1·5	0·9332	9345	9357	9370	9382	9394	9406	9418	9429	9441
1·6	0·9452	9463	9474	9484	9495	9505	9515	9525	9535	9545
1·7	0·9554	9564	9573	9582	9591	9599	9608	9616	9625	9633
1·8	0·9641	9649	9656	9664	9671	9678	9686	9693	9699	9706
1·9	0·9713	9719	9726	9732	9738	9744	9750	9756	9761	9767
2·0	0·9772	9778	9783	9788	9793	9798	9803	9808	9812	9817
2·1	0·9821	9826	9830	9834	9838	9842	9846	9850	9854	9857
2·2	0·9861	9864	9868	9871	9875	9878	9881	9884	9887	9890
2·3	0·9893	9896	9898	9901	9904	9906	9909	9911	9913	9916
2·4	0·9918	9920	9922	9925	9927	9929	9931	9932	9934	9936
2·5	0·99379	99396	99413	99430	99446	99461	99477	99492	99506	99520
2·6	0·99534	99547	99560	99573	99585	99598	99609	99621	99632	99643
2·7	0·99653	99664	99674	99683	99693	99702	99711	99720	99728	99736
2·8	0·99744	99752	99760	99767	99774	99781	99788	99795	99801	99807
2·9	0·99813	99819	99825	99831	99836	99841	99846	99851	99856	99861
3·0	0·99865	99869	99874	99878	99882	99886	99889	99893	99897	99900
3·1	0·99903	99906	99910	99913	99916	99918	99921	99924	99926	99929
3·2	0·99931	99934	99936	99938	99940	99942	99944	99946	99948	99950
3·3	0·99952	99953	99955	99957	99958	99960	99961	99962	99964	99965
3·4	0·99966	99968	99969	99970	99971	99972	99973	99974	99975	99976
3·5	0·99977	99978	99978	99979	99980	99981	99981	99982	99983	99983
3·6	0·99984	99985	99985	99986	99986	99987	99987	99988	99988	99989
3·7	0·99989	99990	99990	99990	99991	99991	99992	99992	99992	99992
3·8	0·99993	99993	99993	99994	99994	99994	99994	99995	99995	99995
3·9	0·99995	99995	99996	99996	99996	99996	99996	99996	99997	99997

Do not turn over this question paper until advised to do so by the invigilator.

Then check that it is the correct course code and title for the examination that you are sitting.