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CIT Semester 1 Examinations 2018/19

Note to Candidates:	Check the Programme Title and the Module Description to ensure that you have received the correct examination. If in doubt please contact an Invigilator.
Module Title:	**Statistical Inference**
Module Code:	**STAT7008**
Programme Title(s):	BBus Hons Information Sys Y2
Block Code(s):	**BBISY_8_Y2**
External Examiner(s):	**Dr. Katarina Domijan**
Internal Examiner(s):	Mr. Declan O Connor, Dr. Catherine Palmer, Dr. Mark Hartnett
Instructions:	Answer Question 1 and Two Other Questions Note Question 1 is allocated 40 Marks, all other questions allocated 30 Marks.
Duration:	2 Hours
Required Items:	Calculator

Q1

a) A box contains 40 identical items 16 of which are red, 12 blue, 4 yellow and the rest orange. Three items are randomly selected without replacement. What is the probability that none of the three items are blue?

b) 2 people are chosen for position out of 9 men and 7 women what is probability that it will be one man and one woman chosen.

c) One card is drawn from a standard 52 card deck. In describing the occurrence of two possible events, an Ace and a King, these two events are said to be:
   (1) independent
   (2) mutually exclusive
   (3) random variables
   (4) randomly independent
   (5) none of these

d) There are 2,500 workers in a factory. The table shows the number of each type of worker in the factory

Managers	Craftsmen	Labourers	Administrators
250	1,000	750	500

A stratified sample of size 160 is required. Calculate the number of each type of worker that should be chosen.

e) What is meant by the term "Sampling error"?

f) What is meant by a sampling frame?

g) Which of the following are discrete random variables?

I. the weight of a fish
II. the number of calls in a car park
III. the number of guests at a wedding
IV. the area of an apartment
V. the attendance at a football match

a) I and II only
b) II and III only
c) I and IV
d) II, III, and V

h) The time taken to complete a task is normally distributed with a mean of 220 seconds and a standard deviation of 30 seconds. What is the probability that the next person who completes the task requires more than 280 seconds?

i) In an office, on average a phone rings 2 times every half hour. What is the probability it will ring on exactly 3 occasions in the next hour?

j) A card is drawn from a pack, a coin is tossed and a dice is rolled. What is the probability of getting a queen, a head and a number less than 5 on the dice?

(10 x 4 = 40 Marks)

Q2 (a) In a company with 2,000 employees, 10% of the staff are managers, 20% are administrators and 30% are involved with sales. The remaining staff are involved in production. If 2 employees are taken at random from the staff list, find the probability that:

i) neither are sales staff

ii) only one is involved with production

iii) both are managers (9 Marks)

(b) A machine malfunctions 18 times on average per year. During a given month what is the probability that the machine will malfunction,

i) on exactly two occasions,

ii) on at least two occasions. (9 Marks)

(c) The weights of bags of sugar from a production line are normally distributed with a mean of 500g and standard deviation of 2.5g.

i) What is the probability that a bag selected at random will have a weight between 498.5g and 502.5g?

ii) Calculate the value above which 90% of the bags will weigh.

iii) What is the probability that a bag selected at random will have a weight of more than 505g? (12 marks)

Q3 (a) We wish to survey 120 CIT BBIS students regarding their preference in music. The following table shows the number of male and female students in each year.

Year	Male	Female	Total
1	50	35	85
2	40	45	85
3	40	40	80
4	30	20	50
Total	160	140	300

Calculate the numbers from each group for a stratified sample. (6 marks)

(b) Write a brief note on the following;

(i) Census
(ii) Snowball sampling
(iii) Simple random sampling (9 Marks)

(c) A random sample of 200 visitors to a webpage reveals that on average they spend 45 seconds per visit with a standard deviation of 10 seconds.

(i) Find a 99% confidence interval for the mean time per visit of all visitors.
(ii) How large a sample would be required to be necessary to estimate the population mean to within ± 5 seconds with a 95% confidence level? (15 Marks)

Q4 (a) Write a brief note on the following;

(i) The Central Limits Theorem
(ii) Type I Error
(iii) Alternative hypotheses (12 Marks)

(b) List four ways of improving the response rate to a survey (8 marks)

(c) 20 smokers were questioned about the number of hours they sleep each day. The sample mean was calculated as 7.5 hours with a standard deviation is 0.5 Test the hypothesis that the smokers need less sleep than the general public which needs an average of 7.7 hours of sleep. Assume a significance level of 0.10 (10%). (10 Marks)

Useful Formulae

Binomial $P(r) = \binom{n}{r} p^r q^{n-r}$

Poisson $p(r) = e^{-\lambda} \frac{\lambda^r}{r!}$

Standard Normal units $Z = \frac{x-\mu}{\sigma}$ **or** $Z = \frac{x-\bar{x}}{s}$

$SE(p) = \sqrt{\frac{\pi(1-\pi)}{n}}$ *or* $\sqrt{\frac{p(1-p)}{n}}$

$SE\ (\bar{x}) = \frac{\sigma}{\sqrt{n}}$ *or* $\frac{s}{\sqrt{n}}$

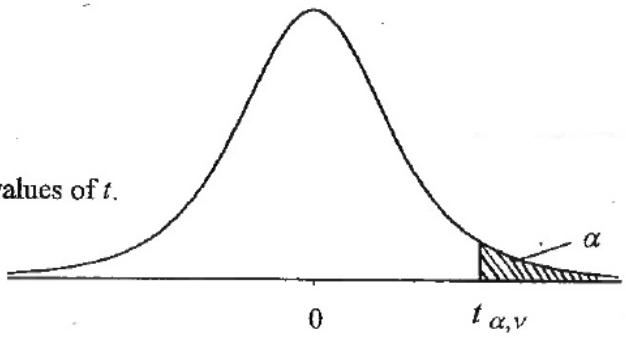
$n = \frac{Z^2 s^2}{E^2}$

Table 7 Percentage Points of the *t* Distribution

The table gives the value of $t_{\alpha\nu}$ – the 100α percentage point of the t distribution for ν degrees of freedom.

The values of t are obtained by solution of the equation:

$$\alpha = \Gamma[\tfrac{1}{2}(\nu+1)][\Gamma(\tfrac{1}{2}\nu)]^{-1}(\nu\pi)^{-1/2}\int_t^\infty (1+x^2/\nu)^{-(\nu+1)/2}\,dx$$



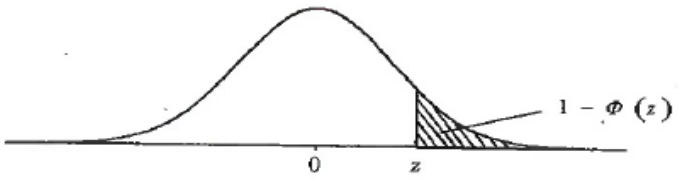
Note: The tabulation is for one tail only, that is, for positive values of t.
For $|t|$ the column headings for α should be doubled.

$\alpha =$	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
$\nu = 1$	3.078	6.314	12.706	31.821	63.657	318.31	636.62
2	1.886	2.920	4.303	6.965	9.925	22.326	31.598
3	1.638	2.353	3.182	4.541	5.841	10.213	12.924
4	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	1.319	1.714	2.069	2.500	2.807	3.485	3.767
24	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	1.296	1.671	2.000	2.390	2.660	3.232	3.460
120	1.289	1.658	1.980	2.358	2.617	3.160	3.373
∞	1.282	1.645	1.960	2.326	2.576	3.090	3.291

Table 3 Areas in Upper Tail of the Normal Distribution

The function tabulated is $1 - \Phi(z)$ where $\Phi(z)$ is the cumulative distribution function of a standardised Normal variable, z.

Thus $1 - \Phi(z) = \frac{1}{\sqrt{2\pi}} \int_z^\infty e^{-z^2/2}$ is the probability that a standardised Normal variate selected at random will be greater than a value of $z \left(= \frac{x - \mu}{\sigma} \right)$



$\frac{x-\mu}{\sigma}$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641
0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
2.0	.02275	.02222	.02169	.02118	.02068	.02018	.01970	.01923	.01876	.01831
2.1	.01786	.01743	.01700	.01659	.01618	.01578	.01539	.01500	.01463	.01426
2.2	.01390	.01355	.01321	.01287	.01255	.01222	.01191	.01160	.01130	.01101
2.3	.01072	.01044	.01017	.00990	.00964	.00939	.00914	.00889	.00866	.00842
2.4	.00820	.00798	.00776	.00755	.00734	.00714	.00695	.00676	.00657	.00639
2.5	.00621	.00604	.00587	.00570	.00554	.00539	.00523	.00508	.00494	.00480
2.6	.00466	.00453	.00440	.00427	.00415	.00402	.00391	.00379	.00368	.00357
2.7	.00347	.00336	.00326	.00317	.00307	.00298	.00289	.00280	.00272	.00264
2.8	.00256	.00248	.00240	.00233	.00226	.00219	.00212	.00205	.00199	.00193
2.9	.00187	.00181	.00175	.00169	.00164	.00159	.00154	.00149	.00144	.00139
3.0	.00135	.00131	.00126	.00122	.00118	.00114	.00111	.00107	.00104	.00100
3.1	.00097	.00094	.00090	.00087	.00084	.00082	.00079	.00076	.00074	.00071
3.2	.00069	.00066	.00064	.00062	.00060	.00058	.00056	.00054	.00052	.00050
3.3	.00048	.00047	.00045	.00043	.00042	.00040	.00039	.00038	.00036	.00035
3.4	.00034	.00032	.00031	.00030	.00029	.00028	.00027	.00026	.00025	.00024
3.5	.00023	.00022	.00022	.00021	.00020	.00019	.00019	.00018	.00017	.00017
3.6	.00016	.00015	.00015	.00014	.00014	.00013	.00013	.00012	.00012	.00011
3.7	.000108	.000104	.000100	.000096	.000092	.000088	.000085	.000082	.000078	.000075
3.8	.000072	.000069	.000067	.000064	.000062	.000059	.000057	.000054	.000052	.000050
3.9	.000048	.000046	.000044	.000042	.000041	.000039	.000037	.000036	.000034	.000033
4.0	.000032									

$5.0 \rightarrow 0.000\,000\,286\,7$ $5.5 \rightarrow 0.000\,000\,019\,0$ $6.0 \rightarrow 0.000\,000\,001\,0$