

DEPARTMENT OF STATISTICS AND DEMOGRAPHY

MAIN EXAMINATION, 2016/17

**COURSE TITLE:** INTRODUCTION TO STATISTICS

**COURSE CODE:** STA 141

**TIME ALLOWED:** TWO (2) HOURS

**INSTRUCTION:** ANSWER ALL QUESTIONS IN SECTION A AND ANY TWO QUESTIONS IN SECTION B

**SPECIAL REQUIREMENTS:** SCIENTIFIC CALCULATORS AND STATISTICAL TABLES

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## SECTION A

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### Question 1

A study of the effects of smoking on sleep patterns is conducted. The measure observed is the time, in minutes, that it takes to fall asleep. These data are obtained:

Smokers:	69.3	56.0	22.1	47.6	53.2	48.1
	52.7	34.4	60.2	43.8	23.2	13.8
Non-smokers:	28.6	25.1	26.4	34.9	29.8	28.4
	38.5	30.2	30.6	31.8	41.6	21.1
	36.0	37.9	13.9			

- (a) Find the sample mean for each group  
(b) Find the sample standard deviation for each group  
(c) Comment on what kind of impact smoking appears to have on the time required to fall asleep. (3+6+1 marks)

### Question 2

- (a) Several measurements of the diameter of a ball bearing made with one micrometer had a mean of 2.49 mm and a standard deviation of 0.012 mm and several measurements of the unstretched length of a spring made with another micrometer had a mean of 0.75 inch with a standard deviation of 0.002 inch. Which of the two micrometers is relatively more precise?  
(b) If five specimens of hard yellow brass had shearing strengths of 49, 52, 51, 53 and 55 thousand psi and on four Sundays the rainfall at a marina amounted to 0.22, 0.18, 0.16 and 0.24 inches. Which of these two sets of data is relatively more variable? (5+5 marks)

### Question 3

- (a) In a large metropolitan area, the probabilities are 0.86, 0.35 and 0.29 that a family (randomly selected for a survey) owns a colour television, a HDTV set, or both kinds of sets respectively. What is the probability that a family owns either or both kinds of sets?  
(b) Near a certain exit of a Highway, the probabilities are 0.23 and 0.24 that a truck stopped at a roadblock will have faulty brakes or badly worn tyres. Also the probability is 0.38 that a truck stopped at a road block will have faulty brakes and/or badly worn tyres. What is the probability that a truck stopped at this roadblock will have faulty brakes as well as badly worn tyres? (5+5 marks)

### Question 4

- (a) An experiment consists of flipping a coin and then flipping a second time if a head occurs. If a tail occurs on the first flip, then a die is tossed once. Construct a tree diagram and list the elements of the sample space. What is the probability of getting an even number?  
(b) A coin is biased so that a head is twice as likely to occur as a tail. If the coin is tossed 3 times, what is the probability of getting two tails and one head? (5+5 marks)

**Question 5**

- (a) An automobile safety engineer claims that 1 in 10 automobile accidents is due to driver fatigue. What is the probability that at least 3 of 5 automobile accidents are due to driver fatigue?
- (b) In a certain city, incompatibility is given as the legal reason in 70 percent of all divorce cases. Find the probability that five of the next six divorce cases filed in this city will claim incompatibility as the reason?
- (c) The average number of trucks arriving on any one day at a truck depot in a certain city is known to be 12. What is the probability that on a given day fewer than nine trucks will arrive at this depot?  
(3+3+4 marks)

**Question 6**

A shop has 11 video games to choose, 4 of them contain extreme violence. A customer picks 3 of these games at random. What is the probability that the number of extremely violent games among the three selected games is:

- (a) Exactly two?  
 (b) More than one?  
 (c) None?

(10 marks)

**SECTION B****Question 7**

The following are the amounts of sulphur oxides (in tons) emitted by an industrial plant on 80 days:

15	26	17	11	23	24	19	14	9	13
23	10	6	15	18	26	13	29	18	24
27	23	18	21	11	21	16	19	17	11
19	15	23	27	20	21	19	22	17	19
19	23	25	20	16	18	8	14	24	15
14	30	19	17	21	24	23	25	18	18
8	22	12	22	13	12	19	20	26	32
26	11	16	28	18	18	9	24	20	29

- (a) Group these data into the classes 5-9, 10-14, 15-19, 20-24, 25-29, 30-34.  
 (b) Draw a bar graph of this distribution and judge whether it can be described as bell shaped.  
 (c) Determine the values of the sample mean and standard deviation  
 (d) Use the result in (c) to determine what percentage of the original data falls within one standard deviation of the mean, what percentage of the original data falls within two standard deviations of the mean and what percentage of the original data falls within three standard deviations of the mean.  
 (e) Compare the percentages obtained in (d) with the 68, 95 and 99.7% claimed by the empirical rule.  
 (5+4+6+3+2 marks)

**Question 8**

(a) A mail-order house employs three stock clerks, U, V and W, who pull items from shelves and assemble them for subsequent verification and packaging. U makes a mistake in an order (gets a wrong item or the wrong quantity) one time in a hundred, V makes a mistake in an order five times in a hundred, and W makes a mistake in an order three times in a hundred. If U, V and W fill respectively, 30, 40 and 30 percent of all orders, what are the probabilities that:

- (i) a mistake will be made in an order;  
 (ii) if a mistake is made in an order, the order was filled by V? (10 marks)

(b) Suppose that during periods of transcendental meditation the reduction of a person's oxygen consumption is a random variable having a normal distribution with  $\mu = 37.6$  cc per minute and  $\sigma = 4.6$  cc per minute. Find the probability that during a period of transcendental meditation a person's oxygen consumption will be reduced by:

- (i) At least 44.5 cc per minute  
 (ii) At most 35.0 cc per minute  
 (iii) Anywhere between 30.0 and 40.0 cc per minute. (3+3+4 marks)

**Question 9**

The following is the distribution of grades that 500 students received in a geography test:

Grade	Number of students
10-24	44
25-39	70
40-54	92
55-69	147
70-84	115
85-99	32

Calculate:

- (a) The mean and the standard deviation  
 (b) IQR. (5+7+8 marks)

**Question 10**

The following data on the number of hours that 10 students studied for a French test and their scores on the test:

<u>Hours studied (x)</u>	<u>Test score (y)</u>
4	31
9	58
10	65
14	73
4	37
7	44
12	60
22	91
1	21
17	84

- (a) Find the equation of the least squares line that approximates the regression of the test scores on the number of hours studied.
- (b) Predict the average test score of a person who studied 14 hours for the test.

(15+5 marks)

**END OF EXAM!!**



## Standard Normal Probabilities

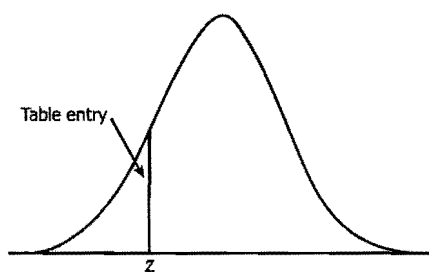


Table entry for  $z$  is the area under the standard normal curve to the left of  $z$ .

$z$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
-3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
-3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
-3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
-3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
-3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
-2.9	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
-2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
-2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
-2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
-2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
-2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
-2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
-2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
-2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
-2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
-1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
-1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
-1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
-1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
-1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
-1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
-1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
-1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
-1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
-1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
-0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
-0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
-0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
-0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
-0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
-0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
-0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
-0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
-0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
-0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641