

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (5%) State the Chebyshev's Inequality. What is the probability that an observation deviates from the mean less than 4 times the standard deviation according to this inequality?
2. An experiment is conducted in the following way. Flip a fair coin. If head, roll a fair dice. Twice the number of point(s) on the upward face is recorded. If tail, draw a card from a deck of cards consisting of 52 cards. The point of the drawn card is recorded (J=11, Q=12, K=13.)
 - a. (5%) If the recorded number is 7 what is the probability of getting head?
 - b. (5%) If the recorded number is 6 what is the probability of getting tail?
3. The weight of newborn babies in NCKU Hospital is normally distributed with a mean of 3.6 kg and a standard deviation of 0.6 kg.
 - a. (5%) What is the probability that a baby is 4.2 kg or more?
 - b. (5%) What would be the 90th percentile for birth weight?
 - c. (5%) Within what range would the middle 95% of birth weights lie?
 - d. (5%) If a baby weighing 2.8 kg or less then the baby is called under-weighting. Among 1000 newborns, what is the probability that over 50 (excluding 50) newborns are under-weighting?
4. (10%) Please write down the definition of *type I error rate* and *power* of a statistical hypothesis test. Suppose, regardless the data, we reject the null hypothesis (H_0) by tossing a fair coin (i.e. reject H_0 with probability 0.5). What is the type I error rate and power of this test.
5. Suppose the walking distance (measure in meter) per day of a NCKU student follows normal distribution with some mean and standard deviation 100m. An experiment is conducted as follows. Following the simple random sample scheme, 121 students were sampled with sample mean 2140 m. We are going to examine the hypotheses $H_0 : \mu \leq 2000$ v.s. $H_a : \mu > 2000$
 - a. (5%) If the true mean is 2030, what is the power of this test?
 - b. (5%) If you increase the number of samples to 144 and the sample mean remains 2140m, what is the power of this test?
 - c. (5%) According to a. and b., when we increase the sample size, the type II error is increased or decreased?

6. In one completely randomized design, there are 4 treatments and five experimental units per treatment. The resulting ANOVA table is as follows

Source	Degrees of freedom	Sum of Squares	Mean Squares	F-Statistic
Treatment	(1)	300	(4)	4
Error	(2)	(3)	(5)	
Total				

- a. (5%) Please provide the null hypothesis of the F-statistic.
- b. (5%) What is the sampling distribution of the F-statistic under the null hypothesis?
- c. (10%) Please specify the value of (1) – (5). (請於答案卷上作答)

7. (10%) An analyst in the soft drink industry wants to conduct a statistical test to determine whether there is a relationship between a person’s preferences for one of the four popular soft drinks – Soda, Black Tea, Green Tea, and Coffee – and whether the person drinks sweetened or unsweetened drinks. A random sample of 330 people is selected and their responses are as follows.

	Soda	Black Tea	Green Tea	Coffee	Total
Unsweetened	55	32	47	21	155
Sweeten	60	43	35	37	175
Total	115	75	82	58	330

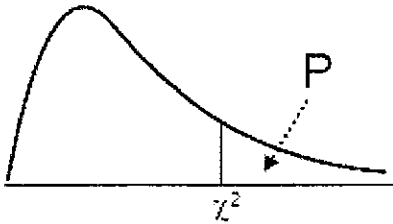
Please conduct the test and state your hypothesis, type I error rate, the name of the test you used, and your conclusion.

8. (10%) A researcher attempted to determine if a drug has an effect on relieving chronic headaches. In the experiment, 160 patients were recruited from NCKU hospital. At the first time period of the experiment, all patients were asked to take placebo (sugar) and then checked whether their headaches were relieved. At the second time period, patients were asked to take the drug and then checked whether their headaches were relieved. The researcher summarized the experiment result in the following table and want to know whether the drug is effective.

	Not Relief	Relief
taking placebo	100	60
taking drug	20	140

Please provide your comment on this experiment and find a best way, if possible, to answer this researcher’s question.

Values of the Chi-squared distribution



DF	P										
	0.995	0.975	0.200	0.100	0.050	0.025	0.020	0.010	0.005	0.002	0.001
1	0.000	0.000	1.642	2.706	3.841	5.024	5.412	6.635	7.879	9.550	10.828
2	0.010	0.0506	3.219	4.605	5.991	7.378	7.824	9.210	10.597	12.429	13.816
3	0.072	0.216	4.642	6.251	7.815	9.348	9.837	11.345	12.838	14.796	16.266
4	0.207	0.484	5.989	7.779	9.488	11.143	11.668	13.277	14.860	16.924	18.467
5	0.412	0.831	7.289	9.236	11.070	12.833	13.388	15.086	16.750	18.907	20.515
6	0.676	1.237	8.558	10.645	12.592	14.449	15.033	16.812	18.548	20.791	22.458
7	0.989	1.690	9.803	12.017	14.067	16.013	16.622	18.475	20.278	22.601	24.322
8	1.344	2.180	11.030	13.362	15.507	17.535	18.168	20.090	21.955	24.352	26.124
9	1.735	2.700	12.242	14.684	16.919	19.023	19.679	21.666	23.589	26.056	27.877
10	2.156	3.247	13.442	15.987	18.307	20.483	21.161	23.209	25.188	27.722	29.588

