國立中央大學八十四學年度碩士班研究生入學試題卷

(10%) 1. Please give three and four measures, respectively, for central tendency and dispersion in regard to a measured vehicular speed distribution.

(20%) 2. Estimating population means and sample sizes.

(7%)a. A traffic engineer wants to estimate the vehicular speed population mean within ±1 kilometer per hour with 99 percent confidence and based on previous studies the standard deviation is expected to be 4 kilometers per hour. What is the minimum sample size required for the study?

(7%)b. Suppose 200 speeds are observed and the standard deviation is found to be 6.3 kilometers per hour. Assuming a 95 percent confidence level, what statement can be made about the maximum error of the vehicular speed means?

(6%)c. Consider the example of 152 vehicular speed observations. Suppose the population mean is to be estimated within ± 1 kilometer per hour with 95 percent confidence level. Please indicate the standard deviation.

(20%) 3. Evaluating methematical distributions and testing significant differences between means and between variances.

(7%)a. Two speed studies are taken under situations that are considered identical and the results are summarized in Table 1. Suppose the difference between means is assumed to be normally distributed, please check, with 90 percent confidence level, whether this assumption is in fact true or if in fact the situations were not identical.

(7%)b. Two speed studies utilized in 3a. are again used to test significant differences betweeen variances. The hypothesis to be tested is that there is no difference between two sample variances. Please check, with 95 percent confidence level, whether this assumption is in fact true or not.

(6%)c. Given the number of the measured time headways and the theoretical frequencies of the negative exponential distribution in Table 2. Assuming a 95 percent confidence level, what can be concluded about the hypothesis?

(15%) 4. The frequency of chirping of a cricket is thought to be related to temperature. This suggests the possibility that temperature can be estimated (predicted) from the chirp frequency. Table 3 gives frequency-temperature pairs observed for the striped ground cricket.

(10%)a. Find the best straight-line of temperature, given chirp frequency.

(5%)b. Given the obtained empirical regression line in 4a., predict the temperature with a chirp frequency of 19 per second.

(20%) 5. A given set of origin-destination (O-D) flows $\{q_{rs}\}$ that satisfies the flow conservation constraints is the aggregate result of many individual travel decisions. There can be many combinations of individual decisions (each such combination is called "a state" of the system) which result in the same set of O-D flows $\mathbf{q} = (..., q_{rs}, ...)$. The basic assumption of the approach discussed here is that all states are equally likely to occur and thus the likelihood of a given distribution pattern, $\mathbf{q}$, occurring is proportional to the number of states that result in this pattern while satisfying the constraints.

(10%)a. Show the number of states associated with a particular distribution, $N(\mathbf{q})$, by an equation. (Note that the total number of trips in the system is Q, and $Q = \sum_r \sum_s q_{rs}$, where r is an origin designation and s is a destination designation).

(10%)b. Derive the set of O-D flows with the highest likelihood of occurring, using Stirling's formula, i.e $log\ x! \simeq x log x - x$.

(15%) 6. Consider the probability statement: $prob[\tilde{z}(x) \geq d] \geq 1 - \alpha$. Where $\tilde{z}(x) = \tilde{c}_1 x_1 + \tilde{c}_2 x_2 + ... + \tilde{c}_n x_n$, $\alpha \in R[0,1]$, $d \in R$, and the $\tilde{c}'s$ are normal random variables, that is, $\tilde{c}_i \sim N[E(\tilde{c}_i), var(\tilde{c}_i)]$. What the deterministic equivalent statement should be for the above probability statement?

Table 1

	Study 1	Study 2
Mean	30.8	32.0
Standard deviation	6.2	5.4
Sample size	100	200

Table 2

Time Headway Group	f_o (觀察值)	f_i (理論值)
0.0–0.5	80	125
0.5–1.0	87	114
1.0–1.5	90	103
1.5–2.0	102	94
2.0–2.5	87	83
2.5–3.0	102	77
3.0–3.5	83	69
3.5–4.0	80	63
4.0–4.5	65	55
4.5–5.0	36	51
5.0–5.5	40	46
5.5–6.0	41	42
6.0–6.5	33	37
6.5–7.0	32	34
7.0–7.5	26	32
7.5–8.0	20	28
8.0–8.5	22	25
8.5–9.0	24	24
9.0–9.5	17	20
> 9.5	253	198
	1320	1320

Table 3

Chirps/sec. (x)	20	16	20	18	17	16	15	17	15	16
Temperature, °F (y)	89	72	93	84	81	75	70	82	69	83

The following information is for your reference:

$$z_{0.005} = 2.575,\ z_{0.025} = 1.96,\ z_{0.05} = 1.645,\ z_{0.1} = 1.28$$

$$F_{0.05}(100, 200) = 1.32,\ F_{0.05}(200, 100) = 1.31$$

$$\chi^2_{0.05}(18) = 28.9,\ \chi^2_{0.05}(19) = 30.1,\ \chi^2_{0.05}(20) = 31.4$$