

中央警察大學 102 學年度碩士班入學考試試題

所 別：消防科學研究所

科 目：火災科學

作答注意事項：

1. 本試題共 4 題，每題各占 25 分；共 2 頁。
2. 不用抄題，可不按題目次序作答，但應書寫題號。
3. 禁用鉛筆作答，違者不予計分。
4. 不需使用計算機，可用中文答題。

一、請回答下列問題：

- (一) Describe “moment generating function” and “pooled sample variance” of independent sample t-test.
- (二) With linear regression analysis, what does Least Square Method and Normal Equations mean ?
- (三) Specify a reasonable or suitable probability density function (not mass function) for describing possible fire risk (i. e. random variable or function) and its statistics (統計量). Also, describe the purposes of Chi-Square test.
- (四) With reference to simple random sampling, what does the distribution (if any applies) of the statistics $(\frac{\bar{x}-\mu}{\sigma})^2$ follow if the population is normal and n is small? What does “standard error” mean?
- (五) Define “significant level” and “power of test”.

二、火藥及炸藥均屬爆炸性物質，具有化學不穩定性，在一定外因的作用之下，能以極快的速度發生猛烈的化學反應，產生的大量氣體和熱量無法於短時間內逸散，致使周圍的溫度迅速升高，產生巨大壓力而引起爆炸。請說明一般爆炸性物質具有哪些特性？並請寫出下列兩種火（炸）藥受熱而分解爆炸之反應方程式：

- (一) 組成為 $\text{KNO}_3 : \text{S} : \text{C}$ 為 75 : 10 : 15 之黑色火藥
- (二) 成分為 $\text{C}_3\text{H}_5(\text{ONO}_2)_3$ 之硝化甘油

三、請回答下列問題：

- (一) An electrical firm manufactures light bulbs that have a length of life that is approximately normally distributed with a mean 40 weeks and standard deviation of 14 weeks. If 49 bulbs are randomly sampled from the firm, find the probability that the sample mean of 49 bulbs exceeds 42 weeks. (7 分)
- (二) Suppose that the five random variables X_1, X_2, \dots, X_5 , are i.i.d. and each has a standard normal distribution. Determine a constant c such that the random variable $c(X_1 + X_2) / \sqrt{X_3^2 + X_4^2 + X_5^2}$ will have a t distribution. (8 分)
- (三) A random sample of 8 cigarettes of a certain brand has an average nicotine content of 2.6 milligrams and a standard deviation of 0.9 milligram. Construct a 99% confidence interval for the true average nicotine content of this particular brand of cigarettes, assuming the distribution of nicotine contents to be approximately normal. (10 分)

Possibly useful data: ($z_{0.025} = 1.96$, $z_{0.005} = 2.58$, $P(Z \leq -1) = 0.1587$, $t_{8, 0.005} = 3.355$, $t_{7, 0.005} = 3.499$, $t_{8, 0.025} = 2.306$)

四、鈉 (Na)、過氧化鈉 (Na_2O_2)、磷化鋅 (Zn_3P_2)、碳化鈣 (CaC_2) 及碳化鋁 (Al_4C_3) 均屬禁水性之物質，其與水接觸即會發生化學反應，因而致生公共危險。試寫出此五種物質與水作用之化學反應方程式，並說明其危害性？