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MAIN EXAMINATION

MAY – JULY 2019 TRIMESTER

FACULTY OF COMMERCE

DEPARTMENT OF ACCOUNTING AND FINANCE

SPECIAL / SUPPMENETARY EXAMINATION

CMS 311: BUSINESS STATISTICS

Date: JULY 2019	Duration: 2 Hours
INSTRUCTIONS: Answer Question ONE and any other TWO Questions	

QUESTION ONE (30 MARKS) COMPULSARY

A population of 1,000 students spends an average of \$10.50 a day on dinner. The standard deviation of the expenditure is \$3. A simple random sample of 64 students is taken.

a) What are the expected value, standard deviation, and shape of the sampling distribution of the sample mean? **(10 MARKS)**

b) What is the probability that these 64 students will spend a combined total of more than \$715.21? **(10 MARKS)**

c) What is the probability that these 64 students will spend a combined total between \$703.59 and \$728.45? **(10 MARKS)**

ISO 9001:2008 Certified by the Kenya Bureau of Standards

QUESTION TWO (20 MARKS)

A. Two workers on the same job show the following results over a long period of time.

	Worker A	Worker B
Mean time of completing the job (minutes)	30	25
Standard deviation (minutes)	6	4

1. Which worker appears to be more consistent in the time he requires to complete the job? Explain. **(7 MARKS)**
2. Which worker appears to be faster in completing the job? Explain. **(6 MARKS)**

B. Suppose the manager of a plant is concerned with the total number of man-hours lost due to accidents for the past 12 months. The company statistician has reported the mean number of man-hours lost per month but did not keep a record of the total sum. Should the manager order the study repeated to obtain the desired information? Explain your answer clearly. **(7 MARKS)**

QUESTION THREE (20 MARKS)

A. The scores on an aptitude test required for entry into a certain job position have a mean of 500 and a standard deviation of 120. If a random sample of 36 applicants has a mean of 546, is there evidence that their mean score is different from the mean that is expected from all applicants? **(10 MARKS)**

B. The training department of a company wishes to determine if there is any difference in the performance between the workers that have completed a training program and those that have not completed the program. A sample of 100 trained workers reveals an average output of 74.3 parts per hour with a sample standard deviation of 16 parts per hour. A sample of 100 who have not been trained has an average output of 69.7 parts per hour with a standard deviation of 18 parts per hour. Is there evidence of a difference in output between the two groups? Write a 95% confidence interval estimate of the difference. **(10 MARKS)**

QUESTION FOUR (20 MARKS)

The price of the standard family saloon car and the company market share was recorded for a random sample of 12 car manufacturers.

Selling price $'00	137	138	125	142	168	145	135	145	160	146	136	160
Market share %	14	15	10	8	9	7	11	5	3	5	7	2

Required:

a) Plot the data on a scatter diagram and comment. **(4 MARKS)**

b) Calculate the product moment correlation coefficient. **(10 MARKS)**

c) Interpret the result obtain in (b) above **(6 MARKS)**

CMS 311 BUSINESS STATISTICS FORMULAE

PARAMETERS

- Population mean = $\mu = (\Sigma X_i) / N$
- Population standard deviation = $\sigma = \text{sqrt} [\Sigma (X_i - \mu)^2 / N]$
- Population variance = $\sigma^2 = \Sigma (X_i - \mu)^2 / N$
- Variance of population proportion = $\sigma_P^2 = PQ / n$
- Standardized score = $Z = (X - \mu) / \sigma$

Statistics

Unless otherwise noted, these formulas assume simple random sampling.

- Sample mean = $x = (\Sigma x_i) / n$

- Sample standard deviation = s = sqrt [$\Sigma (x_i - x)^2 / (n - 1)$]
- Sample variance = $s^2 = \Sigma (x_i - x)^2 / (n - 1)$
- Variance of sample proportion = $s_p^2 = pq / (n - 1)$

Counting

- n factorial: n! = n * (n-1) * (n - 2) * . . . * 3 * 2 * 1. By convention, 0! = 1.
- Permutations of *n* things, taken *r* at a time: $_nP_r = n! / (n - r)!$
- Combinations of *n* things, taken *r* at a time: $_nC_r = n! / r!(n - r)! = {_nP_r} / r!$

Probability

- Rule of addition: P(A ∪ B) = P(A) + P(B) - P(A ∩ B)
- Rule of multiplication: P(A ∩ B) = P(A) P(B|A)
- Rule of subtraction: P(A') = 1 - P(A)

Random Variables

In the following formulas, *X* and *Y* are random variables, and *a* and *b* are constants.

- Expected value of X = E(X) = $\mu_x = \Sigma [x_i * P(x_i)]$
- Variance of X = Var(X) = $\sigma^2 = \Sigma [x_i - E(x)]^2 * P(x_i) = \Sigma [x_i - \mu_x]^2 * P(x_i)$
- Normal random variable = z-score = z = (X - μ)/σ
- Chi-square statistic = $X^2 = [(n - 1) * s^2] / \sigma^2$
- f statistic = $f = [s_1^2/\sigma_1^2] / [s_2^2/\sigma_2^2]$
- Expected value of sum of random variables = E(X + Y) = E(X) + E(Y)
- Expected value of difference between random variables = E(X - Y) = E(X) - E(Y)

Sampling Distributions

- Mean of sampling distribution of the mean = $\mu_x = \mu$
- Mean of sampling distribution of the proportion = $\mu_p = P$
- Standard deviation of proportion = σ_p = sqrt[P * (1 - P)/n] = sqrt(PQ / n)
- Standard deviation of the mean = σ_x = σ/sqrt(n)

- Standard deviation of difference of sample means = σ_d = sqrt[(σ_1^2 / n_1) + (σ_2^2 / n_2)]

Standard Error

- Standard error of proportion = SE_p = s_p = sqrt[p * (1 - p)/n] = sqrt(pq / n)
- Standard error of difference for proportions = SE_p = s_p = sqrt{ p * (1 - p) * [(1/n_1) + (1/n_2)] }
- Standard error of the mean = SE_x = s_x = s/sqrt(n)
- Standard error of difference of sample means = SE_d = s_d = sqrt[(s_1^2 / n_1) + (s_2^2 / n_2)]
- Standard error of difference of paired sample means = SE_d = s_d = { sqrt [($\Sigma(d_i$ - d)^2 / (n - 1)] } / sqrt(n)

Discrete Probability Distributions

- Binomial formula: P(X = x) = b(*x*; *n*, *P*) = ${}_nC_x$ * P^x * $(1 - P)^{n - x}$ = ${}_nC_x$ * P^x * $Q^{n - x}$
- Mean of binomial distribution = μ_x = n * P
- Variance of binomial distribution = σ_x^2 = *n* * *P* * (1 - *P*)
- Negative Binomial formula: P(X = x) = b*(*x*; *r*, *P*) = ${}_{x-1}C_{r-1}$ * P^r * $(1 - P)^{x - r}$
- Mean of negative binomial distribution = μ_x = rQ / P
- Variance of negative binomial distribution = σ_x^2 = r * Q / P^2
- Poisson formula: P(*x*; *μ*) = ($e^{-\mu}$) (μ^x) / x!
- Mean of Poisson distribution = μ_x = μ
- Variance of Poisson distribution = σ_x^2 = μ
- Multinomial formula: P = [n! / (n_1! * n_2! * ... n_k!)] * ($p_1^{n_1}$ * $p_2^{n_2}$ * . . . * $p_k^{n_k}$)

CORRELATION AND REGRESSION

Covariance ($cov_{(xy)}$ or S_{xy}) = $\frac{1}{N}\sum(x_i - \ddot{X})(y_i - \dot{Y})$

$cov_{(xy)}$ or S_{xy} = ($\frac{1}{N}\sum x_i y_i$) - $\ddot{X}\dot{Y}$

Coefficient of Correlation (r_{xy}) = $\frac{Sxy}{SxSy}$

$$r = \frac{n\sum xy - \left(\sum x\right)\left(\sum y\right)}{\sqrt{n\left(\sum x^2\right) - \left(\sum x\right)^2}\sqrt{n\left(\sum y^2\right) - \left(\sum y\right)^2}}$$

Rank correlation coefficient or spearman's rank correlation coefficient (r_s)

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2 - 1)}$$

Kendall Rank correlation

$$\tau = \frac{n_c - n_d}{\frac{1}{2}n(n-1)}$$

Pearson r correlation

$$r = \frac{N\sum xy - \sum (x)(y)}{\sqrt{N\sum x^2 - \sum (x^2)][N\sum y^2 - \sum (y^2)]}}$$

Method of least squares

$\sum y = na + b\sum x_i$

$\sum y_i x_i = a\sum x_i + b\sum x_i^2$

$\sum x_i = na + b\sum y_i$

$\sum x_i y_i = a\sum y_i + b\sum y_i^2$

$$b = \frac{n\left(\sum XY\right) - \left(\sum X\right)\left(\sum Y\right)}{n\left(\sum X^2\right) - \left(\sum X\right)^2}$$

$$a = \frac{\left(\sum Y\right) - b\left(\sum X\right)}{n}$$

$$LSMA = a + bX$$

b = r_{xy} - $\frac{Sy}{Sx}$

a = $\dot{Y}$ - b$\ddot{X}$

END