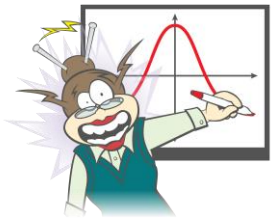
Mathematical Methods: Statistics



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Each of the questions included here can be solved using the TI-Nspire CX technology.

Question 1

People with blood type O negative are said to be 'universal donors'. In Australia, 9% of the population has this blood type.
On a given day, a random group of 45 people volunteer to donate blood.

a) Identify why this context is suitable for modelling as a binomial distribution.
b) Determine the mean and standard deviation of the number of people who are universal donors.
c) Determine the probability that no more than 3 of the donors are universal donors.

Response:

Question 2

Suppose the proportion of Australians who supported the removal of single-use plastic bags from supermarkets is 64%.
a) Using the normal approximation, determine the probability that, in a randomly selected sample of size 100, more than 70% of those surveyed supported the removal of the single-use plastic bags.
b) Determine the size of the sample required for the survey to achieve a margin of error of 4% in an approximate 95% confidence interval for this proportion.
c) Identify the effect that halving the margin of error has on the sample size obtained in b).
d) Determine the probability that in a randomly selected sample of size 25, the sample proportion is equal to the population proportion.

Response:

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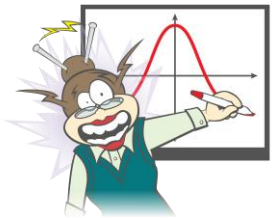

Question 3

Consider the following information when completing this question.

If X is normally distributed with mean μ and standard deviation σ then

$$X \sim N(\mu, \sigma^2)$$

If X and Y are two independent random normal variables such that

$$X \sim N(\mu_1, {\sigma_1}^2) \text{ and } Y \sim N(\mu_2, {\sigma_2}^2)$$

then

$$X - Y \sim N(\mu_1 - \mu_2, {\sigma_1}^2 + {\sigma_2}^2)$$

and

$$X + Y \sim N(\mu_1 + \mu_2, {\sigma_1}^2 + {\sigma_2}^2)$$

Contestant A and contestant B have trained to navigate an obstacle course.
The times for each contestant to run the obstacle course are independent of each other.
On any given day, the time to run the obstacle course for each contestant is normally distributed.
Let A be the run time (in minutes) for contestant A and B be the run time (in minutes) for contestant B with

$A \sim N(80, 10^2)$

$B \sim \mathrm{N}(78, 12^2)$

Determine the probability that contestant B runs the obstacle course faster than contestant A.

Response:

Question 4

When John serves during a tennis match, the probability of him hitting an ace is 0.32.

a) Determine the probability, that in 10 serves, John hits exactly 2 aces.
b) Determine the least number of serves he must attempt during a match to ensure that the probability of hitting at least one ace is 90% or greater.
c) Determine the least number serves he must attempt during a match to ensure that the probability of hitting at least 4 aces is 80% or greater.

Response:

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