Question 1:

Solution: P(non-satisfactory result) = 1/5 (given).

P(satisfactory result) = 4/5

P(at most 3 drugs give non-satisfactory result) =

~~P(non-satisfactory result ≤ 3) = Solution in Part B)~~

A) For given problem statement proposed type of probability distribution is binomial distribution.

3 conditions that binomial distribution follows:

1) Total number of trials is fixed as n. i.e Sample size which is 10 in given problem statement.

2) Each trial is binary i.e has only 2 possible outcomes - success or failure. i.e for given problem statement in each trial drug can either give satisfactory result or non satisfactory result.

3) Probability of success is same in all trial i.e 4/5 in given scenario.

B) Let X be number of ~~non-satisfactory~~ non-satisfactory result.

We have to find probability for $P(X \leq 3)$

$$P(X \leq 3) = {}^{10}C_3 (1/5)^3 (4/5)^7 + {}^{10}C_2 (1/5)^2 (4/5)^8 + {}^{10}C_1 (1/5)^1 (4/5)^9 + {}^{10}C_0 (1/5)^0 (4/5)^{9}$$

$= 120 \times 0.2097 \times 0.008 + 45 \times 0.1678 \times 0.04 +$
$+ 10 \times 0.13422 \times 0.2 + 0.1073$

$= 0.201312 + 0.30204 + 0.26844 + 0.1073$

$= 0.879092$.

∴ 0.8791 is probability that at most 3 drugs are not able to do satisfactory ~~result~~ job.

Question 2:

Solution 2:

$n = 100$
$\bar{x} = 207$ sec
$\sigma_x = 65$ sec
95% confidence level (Given)

A) According to scenario of problem there given sample mean & its confidence value & one have to find interval in which population mean lies.

Methadology used will be — Confidence interval

Properties of confidence interval method:

~~1) Validity~~:

1) Sample size should be greater than 30, i.e 100 in our case.
2) population Standard deviation known ($\sigma = \frac{\sigma_x}{\sqrt{n}}$)
3) each datum must be independent of other data
4) Data must be approximately normally distribut

B) Margin of error $= 2 \times \frac{\sigma_x}{\sqrt{n}}$

$2 = 1.96$ for 95% confidence level

Margin of error $= 1.96 \times \frac{65}{\sqrt{100}} = 1.96 \times 6.5$
$= 12.74$

Mean range (μ) = $207 - \text{Margin of error} < \mu < 207 + \text{Margin of error}$
$= 194.26 < \mu < 219.74$

∴ range [194.26, 219.74]

Question 3:

Solution 3: 1st method - Z test

A) $n = 100$, $\bar{X} = 207$ sec $\sigma_{\bar{x}} = 65$ sec (Given)

$\alpha = 0.05$ (significant level).

(1) Based on problem, the hypothesis can be defined as

~~Ho: $\mu > 200$: Ha~~

Ho: $\mu \leq 200$ (claim) : the mean effective response time of ~~drug~~ painkiller is less than equal to 200 sec. i.e satisfactory

H1: $\mu > 200$: the mean effective response time of painkiller is greater than 200 sec. i.e not-satisfactory

Right-tailed test -

(2) test statistic for Z-test is defined as

$$Z = \frac{\bar{x} - \mu}{\sigma_x / \sqrt{n}}$$

$\bar{X}$ is 207 sec i.e Sample mean,
μ is population mean i.e 200 sec,
σ_x is standard deviation i.e 65 sec, n is sample size i.e 100.

$$= \frac{207 - 200}{65/\sqrt{100}} = 1.0769.$$

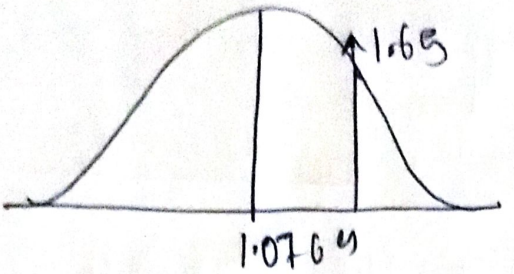
(3) for alpha level $= 1 - 0.05 = 0.95$

Z value corresponding to 0.95 is

$Z = \pm 1.65$

(4) Make the decision: Since the test value, + 1.0769 is less than critical value, +1.65, is not in critical value region, fail to reject null hypothesis

Hence, tut will claim for given evidences that Painkiller response time is less than equal to 200 sec.



Step 5: Summarize the results. There is enough evidence to support claim that the newer batch produces a satisfactory result & passes the assurance test.

2nd method (P-value method)

(1) State the hypothesis & identify the claim according to statement

$H_0: \mu \leq 200$ (claim): the mean effective response time of painkiller is less than equal to 200 sec i.e. satisfactory.

$H_1: \mu > 200$: the mean effective response time of painkiller is greater than 200 sec i.e non-satisfactory

(2) z-score for sample point

$$z = \frac{\bar{x} - \mu}{\sigma x / \sqrt{n}} = \frac{207 - 200}{65/\sqrt{100}} = 1.076 g \cong 1.08$$

cumulative probability of sample point = .8599

(3) too one-tailed test → p = 1 − .8599 = .1401

(4) p value > 0.05, fail to reject null hypothesis that newer batch produces satisfactory result to passed the quality assurance test.

B) Case 1:

$\alpha = 0.05 \quad \beta = 0.45$

Case 2: $\alpha = 0.15 \quad \beta = 0.15$

Case 1 prefer over case 2 → when painkiller have some sideeffects when it's response time is not less than equal to 200 sec. ie when we have more cost to do experiments on test cases to get effectiveness over population as power is only .55 (1−β)

Case 2 prefer over case 1 ⇒ when painkiller don't have any negative effects when it's response time exceed 200 sec. i.e Type 1 error is not much critical. while we don't want to miss effective painkiller ∴ power is increased upto .85 (1−β).

Question 4:

Solution 4:

A/B testing is used in this case to know which tagline is attracting more users. In our case we have to compare 2 taglines and by A/B testing we can test which one is better

Steps involved –

(1) As we know the given campign is for existing users. therefore, we will divide them into 2 groups i.e control group and variable group.

(2) To control group tagline 1 would be made visible while to variable group tagline 2

(3) Now we will collect sample for both taglines. value 0 will be assign to users who visited the page, seen the tagline but didn't bought the medicine, while value 1 will be assign to user who visited the page and bought the medicine, for both control & variable group.

(4) Now with collected sample 2 proportion test can be used with tools like XLstat, optimizely.

(5) In using XLstat we have to put frequency of value 1 for both the group with respective sample size.

(6) Then have to mention H_1: proportion1 - portion2 < 0
(control group) (variable group)

(7) Set $\alpha = 5\%$.

(8) After running test we got P value, which will decide whether we are rejecting the null hypothesis or fail to reject null hypothesis

(9) Finally, after making decision we are able to conclude which tagline is better.