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1. 1-001
Calculate the standard deviation of the following set of population data: 11, 7, 12, 10, and 8

a. 4.3
b. 2.2
*c. 1.9
d. 5.0

Incorrect Answer Reply:
the trick word here is "population" data therefore we divide by N and not n-1

2. 1-002
Given the following pairs of values of X and Y:

X, Y
2, 6
4, 7
5, 4
5, 2

What is the first step in determining if there is a linear association between X and Y?

*a. Draw a scatter diagram
b. Calculate sums of squares
c. Calculate correlation coefficient r
d. Do nothing. Get more data

Incorrect Answer Reply:
see pages VI-183 to 196

3. 1-003
When finding a confidence interval for the mean based on a sample size of n:

a. Increasing n increases the length of the confidence interval
b. Having to use Sx instead of n decreases the length of the interval

c. The longer the interval, the better the estimate of the mean
*d. Increasing n decreases the length of the interval

Correct Answer Reply:
ASQ CQE 1972 P-36

Incorrect Answer Reply:
see pages VI-87 to 89

4. 1-004
Estimate the biased variance of the population from which the following sample data came: 22, 18, 17, 20, and 21

a. 1.9
b. 5.4
*c. 3.4
d. 4.3

Correct Answer Reply:
ASQ CQE 1972 A-47

Incorrect Answer Reply:
Dividing by n-1 in the formula would created an unbiased estimate of variance.
If we divide by N we created a biased estimate of the variance and get 3.4.
The words biased and unbiased are seldom used in this context anymore.
See page 419 in the ASQ CQE Handbook.

5. 1-005
Given that random samples of process A produced 10 defectives and 30 good units, while process B produced 25 defectives out of 60 units. Using the chi-square test, what is the probability that the observed value of chi-square could result, under the hypothesis that both processes are operating at the same quality level?

a. Less than 5 percent
*b. Between 5 percent and 10 percent
c. Greater than 10 percent
d. 50 percent

Correct Answer Reply:

ASQ CQE 1972 A-1

Incorrect Answer Reply:

	Good O/E	Bad O/E	Total
Process A	30 / 26	10 / 14	40
Process B	35 / 39	25 / 21	60
	65	35	100

Good Exp in Process A = $\frac{40x65}{100} = 26$

Good Exp in Process B = $\frac{65x60}{100} = 39$

Bad Exp in Process A = $\frac{40x35}{100} = 14$

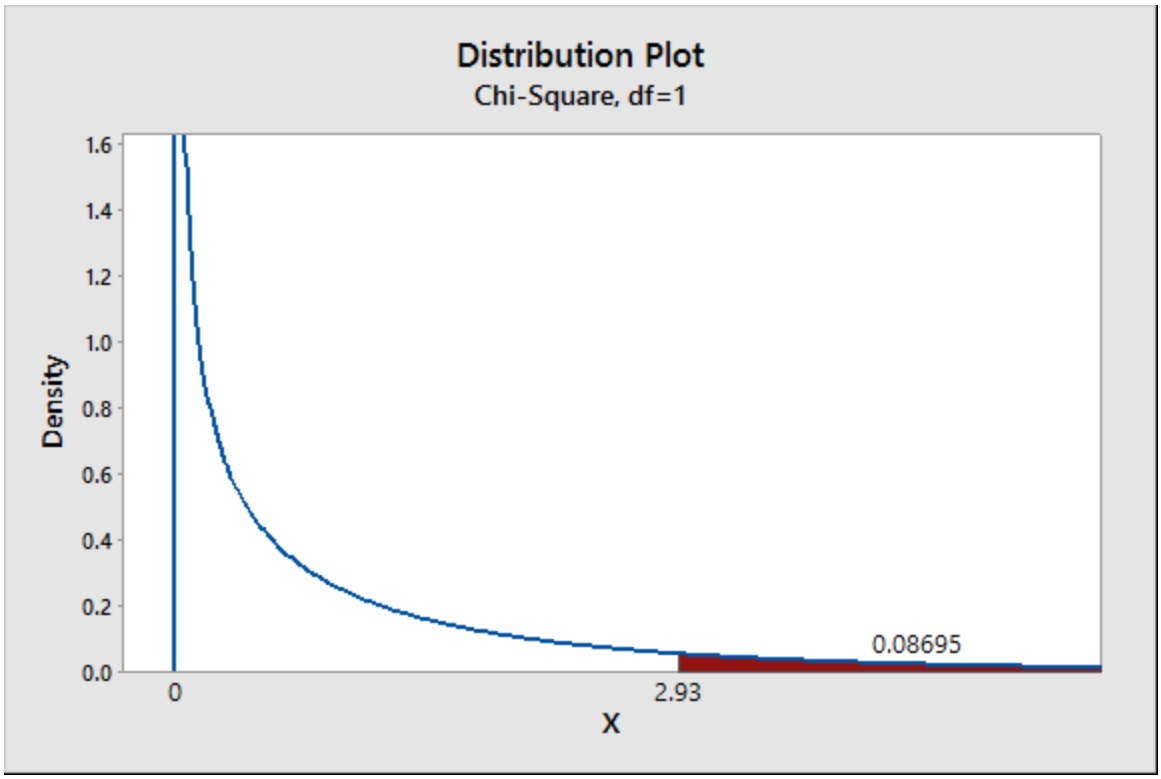
Bad Exp in Process B = $\frac{60x35}{100} = 21$

$$\chi^2_{calc} = \sum_{i=1}^{r}\sum_{j=1}^{c}\frac{(\text{Obs}_{ij} - Exp_{ij})^2}{E_{ij}} = \frac{(30-26)^2}{26} + \frac{(10-14)^2}{14} + \frac{(35-39)^2}{39} + \frac{(25-21)^2}{21} = 2.930$$

$\chi^2_{0.10,1df} = 3.84$

$\chi^2_{0.05,3df} = 2.71$

$2.71 \le 2.93 \le 3.84$



6. 1-006
How many degrees of freedom should you use in the above problem?
[Given that random samples of process A produced 10 defectives and 30 good units, while process B produced 25 defectives out of 60 units. Using the chi-square test, what is the probability that the observed value of chi-square could result, under the hypothesis that both processes are operating at the same quality level? }

*a. 1
b. 2
c. 3
d. 4

Correct Answer Reply:
ASQ CQE 1972 A-2

Incorrect Answer Reply:
This problem results in a chi-square contingency table problem with two rows and two columns.
The degrees of freedom would be (r-1)*(c-1) or in this case

1.
See page VI-173

7. 1-007
On the basis of the data in the previous problem what would you conclude?

*a. Nothing. The facts involving the consequences of a wrong decision are unknown
b. The two processes are comparable
c. The two processes are significantly different
d. Reject the null hypothesis

Correct Answer Reply:
ASQ CQE 1972 A-3

Incorrect Answer Reply:
Since the p value was between 0.05 and 0.10 and you have no information as to the risk you are willing to take in making an incorrect decision you must select answer a

8. 1-008
Three trainees were given the same lot of 50 pieces and asked to classify them as defective or non-defective, with the following results:

	Trainee #1	Trainee #2	Trainee #3	Trainee #4
Defective	17	30	25	72
Non-defective	33	20	25	78
Total	50	50	50	150

In determining whether or not there is a difference in the ability of the three trainees to properly classify the parts:

a. The value of chi-square is about 6.90
b. Using a level of significance of 0.05, the critical value of chi-square is 5.99
c. Since the obtained chi-square is greater than 5.99, we reject the null hypothesis
*d. All of the above
e. None of the above

Correct Answer Reply:
ASQ CQE 1974 A-60

Incorrect Answer Reply:

	Trainee #1	Trainee #2	Trainee #3	Total
Defective	17 / 24	30 / 24	25 / 24	72 / 72
Non-def	33 / 26	20 / 26	25 / 26	78 / 78
Total	50 / 50	50 / 50	50 / 50	150

$$\chi^2_{calculated} = \sum \frac{(obs - \exp)}{\exp}$$

$$= \frac{(17-24)^2}{24} + \frac{(30-24)^2}{24} + \frac{(25-24)^2}{24} + \frac{(33-26)^2}{26} + \frac{(20-26)^2}{26} + \frac{(25-26)^2}{26}$$

$$= \frac{49+36+1}{24} + \frac{49+36+1}{26} = 3.58 + 3.31 = 6.89$$

$$\chi^2_{critical} = \chi^2_{0.05,2} = 5.99$$

$$d.f. = (rows - 1)(columns - 1) = (2-1)*(3-1) = 1*2 = 2$$

9. 1-009
A process is producing material which is 40 percent defective. Four pieces are selected at random for inspection. What is the probability of exactly one defective being found in the sample?

a. 0.870
b. 0.575
*c. 0.346
d. 0.130

Correct Answer Reply:
ASQ CQE A-90

Incorrect Answer Reply:

$$P(x = 4 / p = 0.40, n = 4)$$
$$= {}_nC_x * (\mathrm{p})^x * (1-p)^{n-x}$$
$$= {}_4C_1 * (0.40)^1 * (0.60)^3$$
$$= 4 * 0.40 * 0.216$$
$$= 0.3456$$

10. 1-010
Given $Z_{0.95}$ = ± 1.96, the mean of a sample as 30 and the standard error of the mean as 5, the lower limit of the

interval that would include the population mean with probability 0.95 is:

*a. 20.20
b. 28.04
c. 15.31
d. 25.00
e. 24.00

Correct Answer Reply:
ASQ CQE A-74

Incorrect Answer Reply:
this question asks what is the 95% confidence interval given an x-bar equal to 30 and the "standard error of the mean" equal to 5. The standard error of the mean is defined as the standard deviation of the sample data divided by the square root of the sample size.

$$\bar{x} \pm Z_{0.95} \frac{s_x}{\sqrt{n}} = 30 \pm 1.96(5)$$

$$\bar{x} - Z_{0.95} \frac{s_x}{\sqrt{n}} = 30 - 1.96(5) = 20.20$$

11. 1-011
What is the best estimate of the variance of the population from which the following sample came? 17, 20, 18, 22, 21

a. 3.44
*b. 4.30
c. 5.00
d. 2.10

Correct Answer Reply:
ASQ CQE 1974 A-16

Incorrect Answer Reply:
did you compute variance or standard deviation?

12. 1-012
In the manufacture of airplane fuselage frame sections, thousands of rivets are used to join aluminum sheets and frames. A study of the number of oversize rivet holes and

the number of minor repairs on a unit yielded a correlation coefficient of +1.08. This means that:

a. The number of oversize rivet holes on a unit is a good predictor of the number of minor repairs that will have to be made
*b. You should hire a new statistician
c. The number of oversize rivet holes is a poor predictor of the number of minor repairs
d. A large number of oversize rivet holes means that a small number of minor repairs will have to be made
e. A large number of oversize rivet holes means that a large number of minor repairs will have to be made

Correct Answer Reply:
ASQ CQE 1974 A-78

Incorrect Answer Reply:
correlation coefficient r has a range of correct values from minus 1.0 to positive 1.0
see pages 183-196

13. 1-013
In order to test whether the outputs of two machines were yielding the same average value or one was larger than the other; a sample of ten pieces was taken from each. The t-value turned out to be 1.767. Using a level of significance of 0.05, one-tailed test, we conclude that:

a. The obtained t-ratio does not fall within the critical region
b. There was no significant difference between the means
*c. The null hypothesis was rejected
d. The null hypothesis was accepted
e. The question cannot be answered unless we know the standard deviations

Correct Answer Reply:
ASQ CQE 1974 A-45

Incorrect Answer Reply:

$H_0 : \mu_1 = \mu_2$

$H_1 : \mu_1 > \mu_2$

Reject H_0 if $t_{cal} > t_{\alpha,df}$

$df = n_1 + n_2 - 2 = 10 + 10 - 2 = 18$

$\alpha = 0.05$

$t_{\alpha,df} = 1.734$

$t_{cal} = 1.767$

see page VI-129

14. 1-014
The lengths of a certain bushing are normally distributed with mean '. How many standard deviation units, symmetrical about ', will include 70 percent of the lengths?

*a. ± 1.04
b. ± 0.52
c. ± 1.28
d. ± 0.84

Correct Answer Reply:
ASQ CQE 1978 A-10

Incorrect Answer Reply:
form 2 of the normal table (A-11)

area under curve from 0.0 to 1.02 is 0.3508

2 times 0.3508 is about 70%

15. 1-015
Suppose that you are blindfolded and five items are placed before you, each of which is either a defective or non-defective. The probability that you will identify all items correctly is approximately:

a. 1.00
b. 0.17
c. 0.20
d. 0.50
*e. 0.03

Correct Answer Reply:
ASQ CQE 1974 A-49

Incorrect Answer Reply:

$(0.50)^5 = 0.03125$

or

$\Pr ob(x = 5 / \text{Binomial Distribution with } n = 5,\ p = 0.5)$

$= {}_5C_5 * (p)^5 (1-p)^5 = {}_5C_5 * (0.5)^5 * (0.5)^0 = 1 * 0.03125 * 1 = 0.03125$

16. 1-016
A supplier of cotton yarn claims that his product has an average breaking strength of 90 pounds. To test his claim, you select a random sample of 16 pieces of yarn. If the standard deviation of his process is unknown and you use normal curve theory instead of "t" distribution theory to test the null hypothesis, you would:

*a. Increase the risk of a Type I error
b. Decrease the risk of a Type I error
c. Increase the risk of a Type II error
d. Both 2 and 3
e. None of the above

Correct Answer Reply:
ASQ CQE 1974 A-32

Incorrect Answer Reply:
Using a z-table always results in a smaller criteria values for a given alpha. Since we reject the null when the calculated value is greater than the criteria value we see an increase in probablity space associated with the use of the smaller than correct criteria value

17. 1-017
Suppliers A and B have each sent us samples of 50 items to examine for us to choose between them to award a contract. The samples have the same mean and range. However, the standard deviation of A's product is 15 and of B's is 5. We may conclude that:

a. A's product is grouped closer to the mean than is B's
*b. B's product is grouped closer to the mean than is A's

c. there are three times as many measurements from -1 standard deviation to + 1 standard deviation in A's product as in B's .
d. There are one-third as many measurements from -1 standard deviation to + 1 standard deviation in A's product as in B's
e. Cannot say anything unless we know the value of the common mean

Correct Answer Reply:
ASQ CQE 1974 A-10

Incorrect Answer Reply:
less variation as measured by the standard deviation means less dispersion

18. 1-018
If the probability of success on a single trial is 0.3, and two trials are performed, what is the probability of at least one success?

a. 0.910
b. 0.410
*c. 0.510
d. 0.490
e. 0.030

Correct Answer Reply:
ASQ CQE 1974 A-3

Incorrect Answer Reply:
$1 - prob(\text{zero\_successes})$
$= 1 - (1 - 0.3)(1 - 0.3) = 1 - (0.7)(0.7) = 0.51$
or
$P(A + B) = P(A) + P(B) - P(A \text{ and B})$
$=0.3+0.3-(0.3)(0.3)=0.6-0.09=0.51$

19. 1-019
Select the incorrect statement from among the following: The IDs of a certain piece of tubing are normally distributed with mean 1.00". The proportion of tubing's with IDs less than 0.90 is:

a. Less than the proportion of IDs greater than 0.90"

b. Less than 50 percent
*c. Less than the proportion with IDs greater than 1.10"
d. Less than the proportion with IDs greater than 1.00"

Incorrect Answer Reply:
c is incorrect because the normal distribution is symetrical and the proportion less than 0.90 is EQUAL to the proportion greater than 1.10

20. 1-020
A test of significance using a given value of alpha is performed on the yield data from a process using a standard material and a proposed substitute. Which of the following conclusions is not possible from this test?

a. The standard material is better than the substitute material
*b. We have an interaction between the two materials
c. The probability of a Type I error is ?
d. The sample size is too small to detect the difference necessary to justify a material change
e. The proposed material is better than standard material

Incorrect Answer Reply:
interactions are best identified in a Designed Experiment

21. 1-021
Which of the following statements is correct?

*a. The higher the correlation, the better the regression equation estimate
b. The lower the correlation, the better the regression equation estimate
c. Regression estimates are better made with positive than with negative correlation
d. The lower the correlation, the greater is the likelihood that homoscedasticity exists with respect to the predicted variable
e. The better the regression estimate, the greater is the likelihood that homoscedasticity exists with respect to the predicted variable

Incorrect Answer Reply:
see pages VI-183 to 196

22. 1-022
If, in a t-test, alpha is 0.05:

*a. 5 percent of the time we will say that there is a real difference, when there really is not a difference
b. 5 percent of the time we will make a correct inference
c. 95 percent of the time we will make an incorrect inference
d. 5 percent of the time we will say that there is no real difference, but in reality there is a difference
e. 95 percent of the time the null hypothesis will be correct

Incorrect Answer Reply:
see pages VI-111 to 161

23. 1-023
A number resulting from the manipulation of some raw data according to certain specified procedures is called:

a. A sample
b. A population
c. A constant
*d. A statistic
e. A parameter

24. 1-024
The difference between setting alpha equal to 0.05 and alpha equal to 0.01 in hypothesis testing is:

*a. With alpha equal to 0.05 we are more willing to risk a Type I error
b. With alpha equal to 0.05 we are more willing to risk a Type II error
c. Alpha equal to 0.05 is a more "conservative" test of the null hypothesis (Ho)
d. With alpha equal to 0.05 we are less willing to risk a Type I error
e. None of the above

Incorrect Answer Reply:
see pages VI-111 to 161

25. 1-025
Suppose that, given $\bar{x} = 35$, and $z_{0.01} = \pm 2.58$, we established confidence limits for μ of 30 and 40. This means that:

a. The probability that μ = 35 is 0.01
b. The probability that μ = 35 is 0.99
c. The probability that the interval contains μ is 0.01
*d. The probability that the interval contains μ is 0.99
e. None of the above

Incorrect Answer Reply:
see pages VI-87 to 89

26. 1-026
Which of the following statements concerning the coefficient of simple linear correlation, r, is not true?

a. r = 0.00 represents the absence of a relationship
*b. The relationship between the two variables must be nonlinear
c. r = 0.76 has the same predictive power as r = -0.76
d. r = 1.00 represents a perfect relationship

Incorrect Answer Reply:
see pages VI-183 to 196

27. 1-027
Which of the following cannot be a null hypothesis?

a. The population means are equal
b. p' = 0.50
c. p' = 0.25
*d. The sample means are equal
e. The difference in the population means from which the samples were drawn is 3.85"

Incorrect Answer Reply:

a null hypothesis always has an equal sign and a parameter

28. 1-028
A process calls for the mean value of a dimension to be 2.02". Which of the following should be used as the null hypothesis to test whether or not the process is achieving this mean?

*a. The mean of the population is 2.02"
b. The mean of the sample is 2.02"
c. The mean of the population is not 2.02"
d. The mean of the sample is not 2.02"
e. All of the above are acceptable null hypotheses

Incorrect Answer Reply:
null hypothesis should always contain an equal sign and a parameter

29. 1-030
In determining a process average fraction defective using inductive or inferential statistics, we are making inferences about_____ based on_____ taken from the_____.

a. statistics, samples, populations
*b. populations, samples, populations
c. samples, statistics, populations
d. samples, populations, samples
e. statistics, populations, statistics

30. 1-031
For a given number of degrees of freedom, as the variability among means (groups, columns) increases relative to the variability within groups:

a. The F-ratio decreases
*b. The F-ratio increases
c. The F-ratio is unaffected
d. The risk of a Type 1 error increases
e. Cannot answer without knowing the number of observations

Incorrect Answer Reply:
see pages VI-269 to 329

31. 1-032
Let X be a random variable with mean of μ and standard deviation of σ_X . Take a random sample of size n. As n increases and as a result of the Central Limit Theorem:

a. The distribution of the sum $S_n = x_1 + x_2 + \ldots + x_n$ approaches a normal distribution with mean μ and standard deviation of $\sigma_X / \sqrt{n}$
b. The distribution of $S_n = x_1 + x_2 + \ldots + x_n$ approaches a normal distribution with mean $n\mu$ and standard deviation $\sigma_X / \sqrt{n}$
c. The distribution of $\bar{X}$ approaches a normal distribution with mean $n\mu$ and standard deviation of $\sigma_X \sqrt{n}$
*d. None of the above

32. 1-033
The standard deviation as a percent of the mean is called:

a. Relative precision
*b. Coefficient of variability
c. Standard deviation of the mean
d. Standard error

Incorrect Answer Reply:
see page VI-26

33. 1-035
This expression $\frac{n!}{x!(n-x)!} p'^{x}(1-p')^{n-x}$ is the following:

a. The general term for the Poisson distribution
b. The general term for the Pascal distribution
*c. The general term for the Binomial distribution
d. The general term for the Hypergeometric distribution

Incorrect Answer Reply:

see page VI-69 for Binomial formula

34. 1-036
The binomial distribution is a discrete distribution and may be used to describe:

a. Sampling without replacement from a finite population
*b. The case of n independent trials with probabilities constant from trial to trial
c. The case of n independent trials with several outcomes for each trial
d. Sampling without replacement from a finite population where there are several outcomes for each trial

35. 1-038
Ratios of two variances drawn from the same normal population are described by which one of the following distributions?

*a. F
b. Student "t"
c. Chi-square
d. Normal

Incorrect Answer Reply:
see pages VI-141 to 143

36. 1-039
The beta risk is the risk of:

a. Selecting the wrong hypothesis
*b. [Failing to reject a null] hypothesis when it is false
c. [Failing to reject a null] hypothesis when it is true
d. Rejecting a [null] hypothesis when it is true

Incorrect Answer Reply:
see page VI-114

37. 1-042
A statistic is:

a. The solution to a problem
b. A population value
c. A positive number between 0 and 1 inclusive
*d. A sample value [a value derived from the sample data]

38. 1-043
A parameter is:

a. A random variable
b. A sample value
*c. A population value
d. The solution to a statistical problem

39. 1-044
When finding a confidence interval for mean μ based on a sample size of n:

a. Increasing n increases the interval
b. Having to use Sx instead of σ_X decreases the interval
c. The larger the interval, the better the estimate of μ ?
*d. Increasing n decreases the interval

40. 1-045
Which one of the following is a true statement of probability?

a. P (E and F) = P (E) + P (F)
b. P (E or F) = P (E) x P (E/F)
*c. P (E or F) = P (E) + P (F) - P (E and F)
d. P (E and F) = P (E) + P (F) - P (E and F)

Incorrect Answer Reply:
see pages VI-37 to 40

41. 1-047
How many standard deviation units, symmetrical about the mean, will span an area around the mean of 40 percent of the total area under the normal curve?

a. ± 0.84
*b. ± 0.52
c. ± 1.28
d. ± 0.25

42. 1-049
Calculate the standard deviation of the following complete set of data: 52, 20, 24, 31, 35, 42

*a. 10.8
b. 11.8
c. 12.8
d. 13.8

Correct Answer Reply:
ASQ CQE 1972 P-52

Incorrect Answer Reply:
complete set of data implies population
therefore we divide by N and not n-1

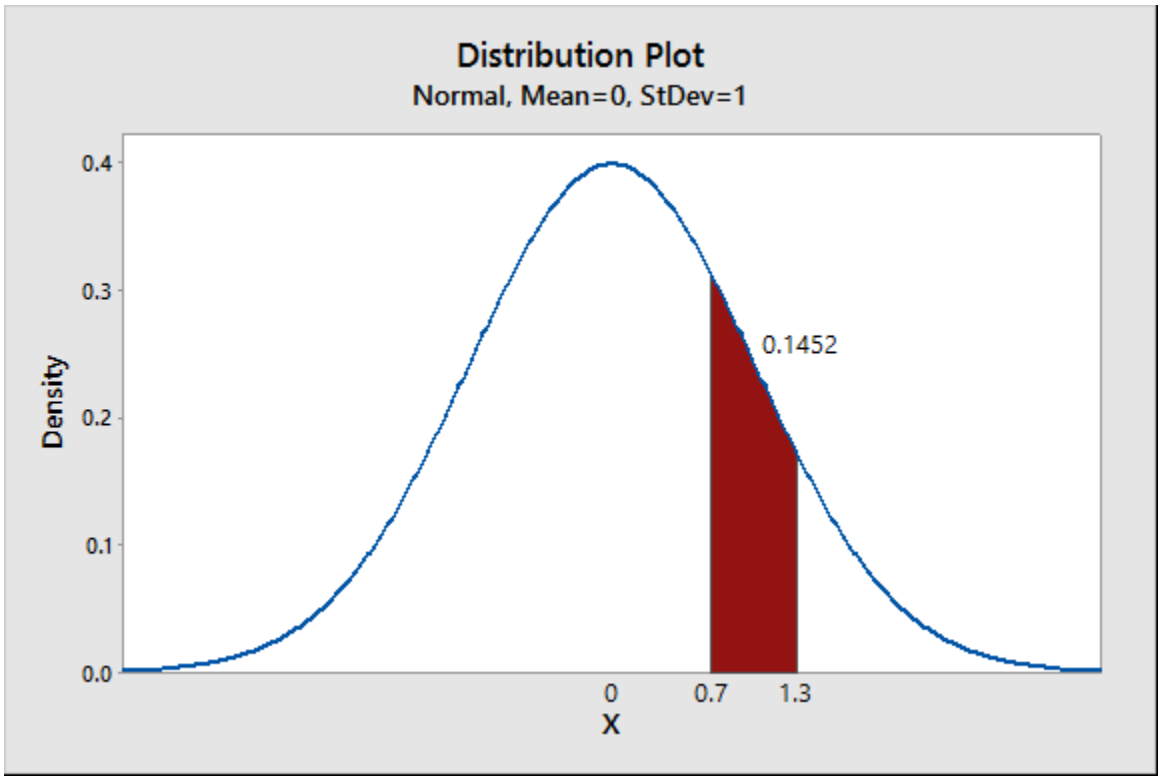
43. 1-050
In a normal distribution, what is the area under the curve between +0.7 and +1.3 standard deviation units?

a. 0.2903
b. 0.7580
c. 0.2580
*d. 0.1452

Correct Answer Reply:
ASQ CQE 1972 P-50

Incorrect Answer Reply:
Using Form 1 the z-table
P(z<=1.3)=0.9032
P(z<=0.9)=0.7580
0.9032 - 0.7580 = 0.1452

Using Form 2 of the z-table
Prob(z<1.3)=0.4032
Prob(z<0.7)=0.2580
0.4032 - 0.2580 = 0.1452



44. 1-051
Two balance scales are to be compared by weighing the same five items on each scale, yielding the following results:

	Item #1	Item #2	Item #3	Item #4	Item #5
Scale A	110	99	112	85	99
Scale B	112	101	113	88	101

The sharpest test comparing mean effects is obtained by using which one of the following:

*a. Paired data test of significance with 4 degrees of freedom

b. $t = \dfrac{\bar{x}_A - \bar{x}_B}{S_p / \sqrt{n}}$ for 8 degrees of freedom

c. Analysis of variance for randomized blocks

d. Determining the correlation coefficient r

Incorrect Answer Reply:

the items are being measured on two different scales
see pages VI-165 to 169

45. 1-052
Estimate the variance of the population from which the following sample data came:
22, 18, 17, 20, and 21

*a. 4.3
b. 2.1
c. 1.9
d. 5.0

Correct Answer Reply:
ASQ CQE 1972 A-47

Incorrect Answer Reply:
sample variance is the sample standard deviation squared

46. 1-053
If the probability of a success on a single trial is 0.2, and 3 trials are performed, what is the probability of at least one success?

a. 0.008
b. 0.384
*c. 0.488
d. 0.600

Correct Answer Reply:
ASQ CQE 1972 A-28

Incorrect Answer Reply:
$1-(0.8)(0.8)(0.8)=1-0.512=0.488$

47. 1-054
A process is acceptable if its standard deviation is not greater than 1.0. A sample of four items yields the values 52, 56, 53, 55. In order to determine if the process be accepted or rejected, the following statistical test should be used:

a. t-test

*b. Chi-square test
c. z-test
d. None of the above

Correct Answer Reply:
ASQ CQE 1972 A-29

Incorrect Answer Reply:

$H_0 : \sigma^2 = 1.0$

$H_1 : \sigma^2 > 1.0$

Reject H_0 if $\chi^2_{cal} > \chi^2_{critical}$

$$\chi^2_{cal} = \frac{(n-1)(s^2)}{\sigma_0^2} = \frac{(4-1)(1.826)^2}{(1.0)^2} = 10.00$$

48. 1-055
If a distribution is skewed to the left, the median will always be:

a. less than the mean
*b. between the mean and the mode
c. greater than the mode
d. Equal to the mean
e. Equal to the mode

Incorrect Answer Reply:
see pages VI-50 and 51

49. 1-056
The sum of the squared deviations of a group of measurements from their mean divided by the number of measurement equals:

a. σ [Sigma]
*b. σ^2 [Sigma squared]
c. Zero
d. X
e. The mean deviation

Correct Answer Reply:
ASQ CQE P-8

Incorrect Answer Reply:

see page VI-19 formula population variance or sigma squared

50. 1-057
In determining a process average fraction defective using inductive or inferential statistics, we use _____ computed from _____ to make inferences about _____.

*a. statistics, samples, populations
b. populations, samples, populations
c. samples, statistics, populations
d. samples, populations, samples
e. statistics, populations, statistics

51. 1-058
Which of the following statistical measures of variability is not dependent on the exact value of every measurement?

a. Interquartile range
b. Variance
*c. Range
d. Coefficient of variation
e. None of the above.

Incorrect Answer Reply:
see page VI-17

52. 1-059
The expression $\frac{\mu^x e^{-\mu}}{x!}$ is the general term for the:

a. Hypergeometric distribution
b. Pascal distribution
*c. Poisson distribution
d. Binomial distribution
e. None of the above

Incorrect Answer Reply:
see page VI-75

53. 1-060
If, in a t-test, alpha is .01:

*a. 1% of the time we will say that there is a real difference when there really is not a difference
b. 1% of the time we will make a correct inference
c. 1% of the time we will say that there is no real difference but in reality there is a difference
d. 99% of the time we will make an incorrect inference
e. 99% of the time the null hypothesis will be correct

Incorrect Answer Reply:
see page VI-114

54. 1-061
Suppose that, given $\bar{X} = 50.0$, and z = ±1.96, we established 95% confidence limits for μ of 30 and 70. This means that:

a. The probability that μ = 50 is 0.05
b. The probability that μ = 50 is 0.95
c. The probability that the interval contains μ is .05
*d. The probability that the interval contains μ is .95
e. None of the above

Incorrect Answer Reply:
see pages VI-87 to 89

55. 1-064
A null hypothesis requires several assumptions, a basic one of which is:

a. That the variables are dependent
*b. That the variables are independent
c. That the sample size is adequate
d. That the confidence interval is ± 2 standard deviations
e. That the correlation coefficient is -0.95.

Incorrect Answer Reply:
see pages VI-111 to 119

56. 1-065
One use for a Student t-test is to determine whether or not differences exist in:

a. Variability
b. Quality costs
c. Correlation coefficients
*d. Averages
e. None of these

Incorrect Answer Reply:
see pages VI-123-125

57. 1-068
Given 6 books how many sets can be arranged in lots of 3 but always in a different order?

a. 18 sets
b. 54 sets
c. 108 sets
*d. 120 sets

Incorrect Answer Reply:
${}_6P_3 = 120$

58. 1-069
The probability of observing at least one defective in a random sample of size ten drawn from a population that has been producing, on the average, ten percent defective unit is:

a. $(0.10)^{10}$
b. $(0.90)^{10}$
c. $1-(0.10)^{10}$
*d. $1-(0.90)^{10}$
e. $(0.10)^{1}(0.90)^{9}$

Incorrect Answer Reply:
$1- prob(x=0, p=0.1, n=10)$
$=1-{}_{10}C_0(0.1)^0(0.9)^{10}$
$=1-(0.9)^{10}$

59. 1-070
Determine the coefficient of variation for the last 500 pilot plant test runs of high temperature film having a mean of 900° Kelvin with a standard deviation of 54°;

*a. 6%
b. 16.7%
c. 0.06%
d. 31%
e. The reciprocal of the relative standard deviation

Incorrect Answer Reply:
CV = standard deviation/mean = 54/900 = 0.06

60. 1-072
A lot of 50 pieces contains 5 defectives. A sample of two is drawn without replacement. The probability that both will be defective is approximately:

a. 0.4000
b. 0.0100
c. 0.0010
*d. 0.0082
e. 0.0093

Incorrect Answer Reply:
$\frac{5}{50} x \frac{4}{49} = 0.0082$

61. 1-073
Suppose that 5 bad electron tubes get mixed up with 8 good tubes. If 2 tubes are drawn simultaneously, what is the probability that both are good?

a. 8/13
*b. 14/39
c. 7/12
d. 7/13
e. 36/91

Incorrect Answer Reply:
8/13 x 7/12 = 14/39

62. 1-074
The lengths of a certain bushing are normally distributed with a mean $\bar{x}'[\mu]$ How many standard deviation units, symmetric, about $\bar{x}'[\mu]$, will include 80% of the lengths?

a. ±1.04
b. ±0.52
*c. ±1.28
d. ±0.84

Incorrect Answer Reply:
Using Table A-11, we find that the area from 0 to z [1.28] is 0.40. 2 x 0.40 or 80%

63. 1-076
A process is producing material which is 40% defective. Four pieces are selected at random for inspection. What is the probability of exactly one good piece being found in the sample?

a. 0.870
b. 0.575
c. 0.346
d. 0.130
*e. 0.154

Incorrect Answer Reply:
$P(\mathrm{x}=1, \mathrm{p}=0.60, \mathrm{n}=4)$
$= {}_{n}C_{x}(p)^{x}(1-p)^{n-x}$
$= {}_{4}\mathrm{C}_{1} * (0.60)^{1}(0.40)^{3}$

64. 1-077
An inspection plan is set up to randomly sample 3' of a 100' cable and accept the cables if no flaws are found in the 3' length. What is the probability that a cable with an average of one flaw per foot will be rejected by the plan?

a. 0.05
*b. 0.95
c. 0.72
d. 0.03
e. 0.10

Incorrect Answer Reply:
$1-P(x=0, \lambda=3.0)=1-0.05=0.95$

65. 1-078
A process is turning out end-items which have defects of Type A or Type B or both in them. If the probability of a Type "A" defect is .10 and of a Type "B" defect is .20, the probability that an end item will have no defects is:

a. 0.02
b. 0.28
c. 0.30
*d. 0.72
e. 0.68

Incorrect Answer Reply:
Prob(Type A defect) = 0.1

Prob(No Type A defect) = 1- Prob(Type A defect)=0.9

Prob(Type B defect) = 0.2

Prob(No Type B defect) = 1- Prob(Type B defect)=0.8

Prob(no defects of either Type A or B)

= (Prob(No Type A defect) * Prob(No Type B defect))

=(0.9)(0.8)=0.72

= 1- (0.8)(0.9) = 0.72

66. 1-080
If it was known that a population of 30,000 parts had a standard deviation of .05 seconds, what size sample would be required to maintain an error no greater than .01 seconds with a confidence level of 95%?

a. 235
b. 487
c. 123
*d. 96
e. 78

Correct Answer Reply:
ASQ CQE 1978 A-16

Incorrect Answer Reply:
see pages VI-100 and 101

$$n = \frac{z_{\alpha/2}\sigma_X}{E} = [\frac{1.96(0.05)}{0.01}]^2 = (9.8)^2 = 96.04$$

67. 1-081
Determine whether the following two types of rockets have significantly different variances at the 5% level. [10% level]

Rocket 1	Rocket 2
61 readings	31 readings
1,346.89 miles^2	2,237.29 miles^2

a. Significant difference because F calc < F table
b. No significant difference because F calc < F table
*c. Significant difference because Fca1c > F table
d. No significant difference because F calc > F table

Correct Answer Reply:
ASQ CQE 1978 A-20

Incorrect Answer Reply:

$$Ho: \sigma_2^2 = \sigma_1^2$$

$$Ha: \sigma_2^2 > \sigma_1^2$$

$$F_{calculated} = \frac{s_2^2}{s_1^2} = \frac{2237.29}{1346.89} = 1.66$$

$$F_{table} = F_{0.05,30,60} = 1.65$$

$$F_{table} = F_{0.10,30,60} = 1.48$$

you might consider an alterantive hypothesis $\sigma_A^2 \neq \sigma_B^2$

68. 1-082
When small samples are used to estimate the standard deviation through use of the range statistic, sample subgroup sizes larger than 20 should not be used because:

a. The number 20 causes calculation difficulties

*b. The efficiency of the range as an estimator of the standard deviation falls to 70%
c. The distribution for n=20 is skewed
d. The n=20 adversely affects the location of the mean
e. The variance is a biased estimate

Correct Answer Reply:
ASQ CQE 1978 A-21

Incorrect Answer Reply:
none of the other answers are correct
and it is true that the efficiency of using the range to estimate standard deviation decreases as the sample size increases

69. 1-083
The distribution of a characteristic is negatively skewed. The sampling distribution of the mean for large samples is:

a. Negatively skewed
*b. Approximately normal
c. Positively skewed
d. Bimodal
e. Poisson

Correct Answer Reply:
ASQ CQE 1978 A-24

Incorrect Answer Reply:
see page VI-51

70. 1-084
When using the Poisson as an approximation to the binomial the following conditions apply for the best approximation:

a. Larger sample size and larger fraction defective
*b. Larger sample size and smaller fraction defective
c. Smaller sample size and larger fraction defective
d. Smaller sample size and smaller fraction defective

Correct Answer Reply:
ASQ CQE 1978 A-28

Incorrect Answer Reply:
see page VI-76

71. 1-085
A null hypothesis assumes that a process is producing no more than the maximum allowable rate of defective items. The Type II error is to conclude that the process

a. Is producing too many defectives when it actually isn't.
*b. Is not producing too many defectives when it actually is.
c. Is not producing too many defectives when it is not.
d. Is producing too many defectives when it is.

Incorrect Answer Reply:
see page VI-114

		THE "TRUTH"	
		The null hypothesis (H_0) is "true" (H_a is false)	**The null hypothesis (H_0) is "not true"** (H_a is true)
THE DECISION THE ANALYST MAKES	**Reject H_0** (support H_a)	**TYPE I (α) error / Alpha Risk / p – value** "Over-reacting" **(1 - α) = the "Confidence level" of the test**	**Correct Decision (1 - β)** "Power" of the test
	Fail to Reject H_0 (do not support H_a)	**Correct Decision**	**TYPE II (β) error / Beta Risk** "Under-reacting"

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72. 1-086
A number derived from sample data, which describes the data in some useful way, is called a:

a. Constant.
*b. Statistic.
c. Parameter.
d. Critical value.

73. 1-089
For the Normal Probability Distribution the relationships among the median, mean and mode are that

*a. They are all equal to the same value.
b. The mean and mode have the same value but the median is different.
c. Each has a value different from the other two.
d. The mean and median are the same but the mode is different.

Incorrect Answer Reply:
see pages VI-55 to 58

74. 1-090
A sample of n observations has a mean of $\bar{X}$ and a standard deviation $s_x > 0$. If a single observation, which equals the value of the sample mean, is removed from the sample, which of the following is true?

a. The $\bar{x}$ and s_x both change.
b. The $\bar{x}$ and s_x remain the same.
*c. The $\bar{x}$ remains same but s_x increases.
d. The $\bar{x}$ remains the same but s_x decreases.

Incorrect Answer Reply:
in the formula $s = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}}$ the numberator would remain the same and the denomiator would decrease by one

75. 1-091
For two events, A and B one of the following is a true probability statement.

a. P (A or B) = P (A) + P (B) if A and B are independent.
*b. P (A or B) = P (A) + P (B) if A and B are mutually exclusive.
c. P (A and B) = P (A) x P (B) if A and B are mutually exclusive.
d. P (A or B) = P (A) x P (B) if A and B are independent.

Incorrect Answer Reply:
see page VI-38

76. 1-092
Which of the following cannot be a null hypothesis?

a. The population means are equal.
b. Proportion p = 0.5
*c. The sample means are equal.
d. The difference in the population means is 3.85

Incorrect Answer Reply:
null hypothesis always contain equal signs and parameters

77. 1-094
If, in a t-test, alpha is .05,

a. 5% of the time we will say that there is no real difference, but in reality there is a difference.
b. 5% of the time we will make a correct inference.
*c. 5% of the time we will say that there is a real difference when there really is not a difference.
d. 95% of the time we will make an incorrect inference.
e. 95% of the time the null hypothesis will be correct.

Incorrect Answer Reply:
see page VI-114

78. 1-095
The expression $P(x) = \frac{\mu^x e^{-\mu}}{x!}$ is the general term for the:

*a. Poisson distribution.
b. Pascal distribution.
c. Hypergeometric distribution.
d. Binomial distribution.

Incorrect Answer Reply:
see page VI-75

79. 1-096
How many outcomes are possible when performing a single trial of a binomial experiment?

a. One
*b. Two
c. Three
d. Four

Incorrect Answer Reply:
see page VI-68

80. 1-098
For a certain make of car, the factory-installed brake linings have a mean lifetime of 40,000 miles with a 5,000 mile standard deviation. A sample of 100 cars has been selected for testing. Assuming that the finite population correction may be ignored, the standard error of is:

a. 50 miles.
*b. 500 miles.
c. 400 miles.
d. 4,000 miles.

Incorrect Answer Reply:
$$\frac{5000}{\sqrt{100}} = \frac{5000}{10} = 500$$

81. 1-099
What is the standard deviation of the following sample; 3.2, 3.1, 3.3, 3.3, 3.1?

a. 3.2000
b. 0.0894
*c. 0.1000

d. 0.0498
e. 0.2000

Incorrect Answer Reply:
this problem was orignally on an exam before the invention of the electronic calculator and was meant to be completed in less than 2 minutes

$$\bar{x} = \frac{3.2+3.1+3.3+3.3+3.1}{5} = 3.2$$

$$s = \sqrt{\frac{(3.2-3.2)^2+(3.2-3.1)^2+(3.2-3.3)^2+(3.2-3.3)^2+(3.2-3.1)^2}{5-1}}$$

$$s = \sqrt{\frac{0+(0.1)^2+(0.1)^2+(0.1)^2+).1)^2}{4}} = \sqrt{\frac{0.04}{4}} = \sqrt{0.01} = 0.1$$

82. 1-100
What value of z in the normal tables had 5% of the area in the beyond it?

a. 1.960
*b. 1.645
c. 2.576
d. 1.282

83. 1-101
A purchaser wants to determine whether or not there is any difference between the means of the convolute paperboard cans supplied by two different vendors, A and B. A random sample of 100 cans is selected from the output of each vendor. The sample from A yielded a mean of 13.59 with a standard deviation of 5.94. The sample from B yielded a mean of 14.43 with a standard deviation of 5.61. Which of the following would be a suitable null hypothesis to test?

*a. Ho: $\mu_A = \mu_B$
b. Ho: $\mu_A > \mu_B$
c. Ho: $\mu_A < \mu_B$
d. Ho: $\mu_A \neq \mu_B$

Incorrect Answer Reply:
a null hypothesis should always contain an equal sign and a parameter

84. 2-001
A process is checked at random by inspection of samples of four shafts after a polishing operation, and x-bar and R charts are maintained. A person making a spot check picks out two shafts, measures them accurately, and plots the value of each on the x-bar chart. Both points fall just outside the control limits. He advises the department foreman to stop the process. This decision indicates that:

a. The process level is out of control
b. Both the level and dispersion are out of control
c. The process level is out of control but not the dispersion
*d. The person is misusing the chart

Incorrect Answer Reply:
This x-bar chart requires a sample of four units and the sample mean of the four units to be plotted. The person has plotted the individual values of each of the two units sample and therefore is mis-using the chart.

85. 2-003
ANSI/ASQ Z1.4 sampling tables and procedures have the fundamental principle of providing:

a. Low probability of acceptance of poor product
*b. High probability of acceptance of good product
c. Low probability of acceptance of good product
d. High probability of acceptance of poor product

Incorrect Answer Reply:
see page IV-13

86. 2-004
The best way to evaluate a sampling plan for risk protection is to:

a. Evaluate the ? risk
b. Evaluate the ? risk
*c. Examine the OC curve
d. Determine how well it conforms to ANSI/ASQ Z1.4

Incorrect Answer Reply:
see pages IV-5 to 12

87. 2-005
The average number of defects found in the periodic inspection of five sub-assemblies is 55.72. Assume that a c chart is to be used for future production. Calculate the preliminary three-sigma control limits:

a. 82.5, 28.9
b. 15.6, 6.6
c. 65.7, 45.7
*d. 78.2, 33.2

Incorrect Answer Reply:

$$\bar{c} = \frac{\sum c}{25} = \frac{1393}{25} = 55.72$$

$$\bar{c} \pm 3\sqrt{\bar{c}} = 55.72 \pm 3\sqrt{55.72} = 55.72 \pm 22 = 78.2, 33.2$$

88. 2-006
Referring to the data in the preceding question (25 samples of five units collected for the computation of the prelimnary control limits on a c-chart), if points are outside of the control limits and we wish to set up a control chart for future production:

a. More data are needed
*b. Discard those points falling outside the control limits, for which you can identify an assignable cause, and revise the limits
c. Check with production to determine the true process capability
d. Discard those points falling outside the control limits and revise the limits

89. 2-007
The Dodge-Romig tables for AOQL protection are designed to provide:

a. Minimum average sampling costs
b. Maximum protection against poor material
c. Maximum risk of accepting good lots
*d. Minimum average total inspection for a given process average

Incorrect Answer Reply:
See tab IV, page 13

90. 2-008
The AOQL for the single sampling plan with sample size of 200 acceptance number of 14 and rejection number of 15 for a lot size of 4000 is approximately:

a. 10.0%
*b. 4.5%
c. 4.0%
d. 7.2%

Incorrect Answer Reply:
See note on bottom of page 23 of Z1.4 standard
4.7% from Table II-A and V-A

$$4.7(1-\frac{200}{4000}) = 4.5$$

91. 2-009
A value of 0.9973 refers to the probability that:

a. The process is in control
b. A correct decision will be made as to control or lack of control of the process
c. The process is unstable
*d. A point will fall inside three-sigma limits for an chart if process is in control

Incorrect Answer Reply:
the probability space between = and - 3 standard deviations

92. 2-010
A chart for number of defects is called:

a. The np chart
b. The p chart
c. The x-bar chart
*d. The c chart

Incorrect Answer Reply:
see page VI-207

93. 2-011
Each value below is the number of defects found in 25 groups of eight subassemblies inspected.

77	61	59	22	54
64	49	54	92	22
75	65	41	89	49
93	45	87	55	33
45	77	40	25	20

Assume that a "c" chart is to be used for future protection
Calculate the preliminary three-sigma control limits from the above data.

a. 65.7, 45.7
*b. 78.2, 33.2
c. 15.6, 6.6
d. 82.5, 28.9

Incorrect Answer Reply:

$$\bar{c} = \frac{\sum c}{25} = \frac{1393}{25} = 55.72$$

$$\bar{c} \pm 3\sqrt{\bar{c}} = 55.72 \pm 3\sqrt{55.72} = 55.7 \pm 22.4 = 78.2, 33.2$$

94. 2-012
You have just been put in charge of incoming inspection and have decided to institute a sampling plan on a small gear which your company uses in considerable quantity. The vendor ships them to you in lots of 1000. You have decided to use ANSI/ASQ Z1.4, inspection level II, and an AQL = 4.0 percent. Naturally, your inspectors, never having used scientific sampling, are interested in seeing how it works. The first lot is inspected and accepted. One of the inspectors says: "This means that the lot is not more" than four percent defective." Assuming the sample was randomly taken and no inspection errors were made, which one of the following would, you accept:

a. The inspector's statement is correct
b. The probability of accepting the lot is about 0.99
c. You should go to reduced sampling
*d. The lot may be ten percent defective
e. All of the above are correct

Incorrect Answer Reply:

Acceptance or rejection of a single lot will not tell you what the overall per cent defective is or is not. Answer c is not correct because you can not go to reduced sampling based on one sample lot. Answers a and b are not correct. Answer d is correct because the lot could be 10% defective(it might be 20% defective or it might be 2% defective).

95. 2-013
The controlled process has a mean of 50 and a standard deviation of 5.0 What is the probability that a random sample of 16 items will yield a mean greater than 53?

a. 0.99
*b. 0.01
c. 0.49
d. 0.58
e. 0.42

Incorrect Answer Reply:

$P(\bar{x}_{16} > 53 \text{ given ND } 50,5)$

$$P(\frac{\bar{x}_{16} - \mu}{\sigma_{\bar{x}}}) = P(\frac{53-50}{\frac{5}{\sqrt{16}}}) = P(Z > 2.5) = 0.01$$

96. 2-014
The operating characteristic (OC) curve of an acceptance sampling plan:

a. Demonstrates the advantages of double sampling over single sampling
b. Demonstrates how the plan will reject all of the lots worse than the AQL
c. Shows the relative cost of sampling for various levels of quality
*d. Shows the ability of the plan to distinguish between good and bad lots

Incorrect Answer Reply:
see pages IV-5 to 12

97. 2-016
Your quality control manager has asked you to make a study

of the costs of using variables sampling as against attribute sampling for a pipe fitting. After searching the literature you find that the following sampling plans will give equal protection over the range of quality levels in which you are interested:

Type of Plans	Sample Size	Acceptance Criteria
Attributes	450	Ac=10, Re=11
Variables, sigma unknown	100	k=2.0
Variables, sigma known	33	k=2.0

Upon investigating the possible costs involved in each type of sampling with your accounting, production and inspection departments, you arrive at the following figures:

	Attributes	Variables, Sigma unknown	Variables, Sigma known
Unit Sampling Cost	0.05	0.05	0.05
Unit Inspection Cost	0.05	0.35	0.35
Unit Computation Cost	0.00	0.02	0.01
Lot Overhead Cost	6.00	8.00	40.00

Which type of sampling would you advise your quality control manager to use based on the above information?

a. Use attributes sampling
b. Since they all give equal protection, it doesn't make any difference
c. Use continuous sampling
*d. Use variables sampling sigma unknown
e. Use variables sampling sigma known

Incorrect Answer Reply:

since all three plans give equal protections we simply need to cost out each of the plans
Attributes
((0.05+0.05)*450)+6.00=$51.00
Variables, Sigma unknown
(0.05+0.35+0.02)*100+8.00=$50.00
Variables, Sigma known
(0.05+0.35+0.01)*33+40=$53.53
choose "Variables, Sigma unknown" because it has the lowest cost

98. 2-018
You have just returned from a two-week vacation and are going over the control charts that have been maintained during your absence with your quality control manager. He calls your attention to the fact that one of the -charts shows the last 50 points to be very near the center line. In fact, they all seem to be within about one sigma of the center line. What explanation would you offer him?

a. Somebody "goofed" in the original calculation of the control limits
*b. The process standard deviation has decreased during the time the last 50 samples were taken and nobody thought to recomputed the control limits
c. This is a terrible situation. I'll get on it right away and see what the trouble is. I hope we haven't produced too much scrap
d. This is fine. The closer the points are to the center line the better our control

99. 2-019
A single sampling plan calls for a sample size of 80 with an acceptance number of 5 and a rejection number of 6. If the quality of the submitted lots is ten percent defective, then the percent of lots expected to be accepted in the long run is approximately:

a. 6%
b. 10%
c. 30%
d. 0%
*e. 20%

Incorrect Answer Reply:

$$\lambda = np = (80)(0.10) = 8.0$$

$$P(x \le 5 / \lambda = 8.0) = 0.191$$

100. 2-020
Select one single sampling plan from ANSI/ASQ Z1.4 that meets the following requirements: lot size = 1000; AQL = 0.65 percent; inspection level II; tightened inspection

*a. Sample size = 125; Ac = 1; Re = 2
b. Sample size = 200; Ac = 1; Re = 2

c. Sample size = 80; Ac = 1; Re = 2
d. Sample size = 50; Ac = 0; Re = 2
e. Sample size = 80; Ac = 8; Re = 9

Incorrect Answer Reply:
Table I - Sample Size Code Letter J
Table II-B Single sampling plans for tightened Sample code J and 0.65 AQL

101. 2-021
Double sampling is better than single sampling because:

a. It is more economical regardless of lot quality
b. It is easier to administer
c. It gives the lot a second chance
d. If the first sample rejects the lot, the second will accept it
*e. It involves less inspection when the lots are of very good or very bad quality

Incorrect Answer Reply:
see page IV-13

102. 2-022
A very useful attribute control chart for plotting the actual number of defects found during an inspection is known as:

a. The and R chart
b. The np chart
c. The p chart
*d. The c chart
e. The u chart

Correct Answer Reply:
ASQ CQE 1974 P-48

Incorrect Answer Reply:
see page VI-207

103. 2-026
Classification of defects is most essential as a prior step to a valid establishment of:

a. Design characteristics

b. Vendor specifications of critical parts
c. Process control points
*d. Economical sampling inspection
e. A product audit check list

Correct Answer Reply:
ASQ CQE 1974 P-65

Incorrect Answer Reply:
see page IV-1

104. 2-028
The expression $\frac{x!}{x!(n-x)!}p'^{x}(1-p')^{n-x}$ is the general term for the:

a. Poisson distribution
b. Pascal distribution
c. Hypergeometric distribution
d. Binomial distribution
*e. None of the above

Incorrect Answer Reply:
the first term of the expression $\frac{x!}{x!(\mathrm{n}-\mathrm{x})!}$ is incorrect. It should be $\frac{n!}{x!(n-x)!}$ for the Binomial probability

105. 2-029
The two quantities that uniquely determine a single attributes sampling plan are:

a. AQL and LTPD
*b. Sample size and rejection number
c. AQL and producer's risk
d. LTPD and consumer's risk

Incorrect Answer Reply:
see page IV-3

106. 2-030
Your operation requires infrequent vendor shipments of a relatively small number of parts for a critical assembly. Desiring the best protection for the lowest cost, you

advise the chief inspector that the most appropriate sampling plan for receiving inspection should be one developed from:

a. The Poisson distribution
*b. The Hypergeometric distribution
c. The Binomial distribution
d. The Log normal distribution
e. The Gaussian (normal) distribution

Incorrect Answer Reply:
the key word here is "small number of parts" which results in sample sizes that are usually greater than 10% of the lot

107. 2-031
Selection of a sampling plan from the Dodge-Romig LTPD sampling tables:

a. Requires knowledge of the AOQ
*b. Requires knowledge of the process average
c. Requires sorting of rejected lots
d. Requires larger samples than ANSI/ASQ Z1.4 for equivalent quality assurance

108. 2-033
In acceptance sampling, the probability of accepting an undesirable lot is the same as (or may be called):

a. Alpha
*b. Beta
c. AQL
d. LTPD
e. None of these

Incorrect Answer Reply:
see page IV-4

109. 2-035
The acronym "AQL" as used in sampling inspection means:

a. That level of lot quality for which there is a small risk of rejecting the lot
b. The same as the limiting quality (LQ) or LTPD
c. The same as the rejectable quality level (RQL)

*d. The maximum percent defective that can be considered satisfactory as a process average
e. The average outgoing quality level

Incorrect Answer Reply:
see page IV-4

110. 2-037
If we drew a large number of samples from a controlled process, we would not be surprised to discover:

a. Some differences among the values of the sample means
b. A distribution of sample means around some central value
c. That many sample means differ from the process average
*d. All of the above
e. None of the above

Incorrect Answer Reply:
see pages VI-87 to 89

111. 2-038
The terms "critical," "major," "minor" or "incidental" may be used in planning for:

a. Classification of defects
b. Classification of characteristics
c. Acceptance sampling
*d. All of the above
e. None of the above

Incorrect Answer Reply:
see page IV-13

112. 2-039
Double sampling is better than single sampling because:

a. It involves less inspection regardless of lot quality
b. If the first sample rejects the lot the second sample will accept it
*c. It is more economical except when lots are of borderline quality

d. It is easier to administer

Incorrect Answer Reply:
see page IV-13

113. 2-040
One defective is:

a. An item that is unacceptable to the inspector
b. The same as one defect
c. A characteristic that may be unacceptable for more than one reason
*d. An item that fails to meet quality standards and specifications

Incorrect Answer Reply:
see page VI-207

114. 2-041
Random selection of a sample:

*a. Theoretically means that each item in the lot had an equal chance to be selected in the sample
b. Assures that the sample average will equal the population average
c. Means that a table of random numbers was used to dictate the selection
d. is a meaningless theoretical requirement

115. 2-042
The factor D_4 used in x-bar and R control charts is [used to compute]:

*a. The distance between the mean and the upper control limit of a range chart
b. The number of defects in a second sample
c. The constant which corrects the bias in estimating the population standard deviation from the average range of randomly drawn samples
d. The probability that is in control

Incorrect Answer Reply:
see page VI-213

116. 2-043
100 percent inspection is:

*a. Used to sort items
b. At best only 60 percent effective
c. Assures a satisfactory outgoing quality level
d. Is theoretically unsound but is an excellent practice

117. 2-044
The two factors that have the most to do with determining an attributes sampling plan (assuming "a binomial distribution?) are:

*a. Sample size and rejection number
b. Lot size and sample size
c. Lot size and acceptance number
d. None of the above

Incorrect Answer Reply:
see pages IV-3 to 12

118. 2-047
The basic reason for randomness in sampling is to:

a. Make certain that the sample represents the population
*b. Eliminate personal bias
c. Guarantee to reduce the cost of inspection
d. Guarantee correct lot inferences

Incorrect Answer Reply:
see page VI-4

119. 2-048
A "p" chart:

a. Can be used for only one type of defect per chart
b. Plots the number of defects in a sample
*c. Plots either the fraction or percent defective in order of time
d. Plots variations in dimensions

Incorrect Answer Reply:

see page VI-207

120. 2-049
The assumed probability distribution for the control chart for number of defects is the:

a. Binomial distribution
*b. Poisson distribution
c. Normal distribution
d. Student "t" distribution

Incorrect Answer Reply:
see page VI-75

121. 2-050
A process is in control with $\bar{p} = 0.10$ and n = 100. The three sigma limits of the np-control chart are:

*a. 1 and 19
b. 9.1 and 10.9
c. 0.01 and 0.19
d. 0.07 and 0.13

Incorrect Answer Reply:
$$n\bar{p} \pm 3\sqrt{n\bar{p}(1-\bar{p})} = 100(0.1) \pm 3\sqrt{100(0.1)(0.9)} = 10 \pm 3\sqrt{9} = 1,19$$

122. 2-051
The control chart that is most sensitive to variations in a measurement is:

a. The p chart
b. The np chart
c. The c chart
*d. The x-bar and R chart

Incorrect Answer Reply:
The x-bar is actually the only chart here that measures variations in a measurement, the rest only delineate product as good or bad or count defects.

123. 2-052
A process is checked at random [every hour] by inspection of samples of four shafts after a polishing operation, and

x-bar and R charts are maintained. A person making a spot check measures two shafts accurately, and plots their range on the R chart. The point falls just outside the control limit. He advises the department foreman to stop the process. This decision indicates that:

a. The process level is out of control
b. The process level is out of control but not the dispersion
c. The person is misusing the chart
*d. The process dispersion is out of control

Incorrect Answer Reply:
the person is mis-using the chart because four shafts should have been measured but the process is also out of control based on the sample of two units minimally required to compute a Range statistic

124. 2-054
A useful tool to determine when to investigate excessive variation in a process is:

a. ANSI/ASQ Z1.4
*b. Control chart
c. Dodge-Romig AOQL sampling table
d. Process capability study

Incorrect Answer Reply:
the key word here is "when"
a control chart monitors a process over time

125. 2-055
The operating characteristic (OC) curve of an acceptance sampling plan:

a. Demonstrates how the plan will reject all of the lots worse than the AQL
*b. Shows the ability of the plan to distinguish between good and bad lots
c. Shows the relative cost of sampling for various levels of quality
d. Demonstrates the advantages of double sampling over single

Incorrect Answer Reply:
see pages IV-3 to 12

126. 2-056
Using a 10 percent sample of each lot, with an acceptance number of zero, regardless of lot size:

a. Results in a constant level of protection against bad product
b. Assures a constant producer's risk
*c. Abdicates the responsibility for pre-determining quality requirements
d. Provides an AQL of zero and an LTPD of 10 percent

Incorrect Answer Reply:
see pages IV-3 to 12

127. 2-057
If the distribution of defectives among various lots is found to follow the laws of chance, we can conclude that:

*a. The product was well mixed before dividing into lots
b. The manufacturing process is not predictable
c. All lots should be accepted
d. None of the above is true

128. 2-058
Shewhart $\bar{X}$ control charts are designed with which one of the following objectives?

a. Reduce sample size
b. Fix risk of accepting poor product
*c. Decide when to hunt for causes of variation
d. Establish an acceptable quality level

129. 2-059
In which one of the following is the use of an x-bar and R chart liable to be helpful as a tool to control a process?

a. The machine capability is wider than the specification
b. The machine capability is equal to the specification

*c. The machine capability is somewhat smaller than the specification
d. The machine capability is very small compared to the specification

Incorrect Answer Reply:
answers a and b you already have product outside specification
answer d you have no product outside specification and are likely not to have any outside soon
answer c only takes a slight shift in the process mean and you begin to have product outside of specification

130. 2-060
The basic concept of ANSI/ASQ Z1.4 sampling tables and procedures is that:

a. Poor product is accepted infrequently
b. Good product is accepted rarely
c. Poor product is accepted consistently
*d. Good product is accepted most of the time

Incorrect Answer Reply:
see page IV-13

131. 2-061
In acceptance sampling, the probability of accepting a rejectable lot is called:

*a. Beta
b. AQL
c. Alpha
d. LTPD

Incorrect Answer Reply:
see page IV-4

132. 2-063
The Dodge-Romig sampling tables for AOQL protection:

*a. Require sorting of rejected lots
b. Are the same in principle as the ANSI/ASQ Z1.4 tables?
c. Do not depend upon the process average

d. Require larger samples than ANSI/ASQ Z1.4 for equivalent quality assurances

133. 2-064
If a process is out of control, the theoretical probability that four consecutive points on an X chart will fall on the same side of the mean is:

*a. Unknown
b. $(1/2)^4$
c. $2*\left(\frac{1}{2}\right)^4$
d. $\left(\frac{1}{2}\right)*\left(\frac{1}{2}\right)^4$

Incorrect Answer Reply:
without knowing how far out of control you can not make any calculations

134. 2-066
Assume a large lot contains exactly 4 percent defective items. Using the Poisson distribution, what is the probability that a random sample of 50 items will not reflect the true lot quality?

a. 27%
*b. 73%
c. 82%
d. 67%

Incorrect Answer Reply:
to reflect the true quality the sample of 50 items must find 2 defects $\frac{2}{50} = 0.04$
Prob(of not refelecting true quality)=
$1 - P(x = 2/\lambda = 2.0) = 1 - \frac{e^{-\lambda}\lambda^x}{x!} = 1 - \frac{e^{-2.0}2.0^2}{2!} = 1 - 0.27 = 0.73$

135. 2-067
You have been given the job of straightening out the Incoming Inspection Department. A certain type of bolt has been purchased in lots of 800 for some time. Your

predecessor was of the "10% school" and used the following sampling plan: Take a sample of 80 bolts. If none are defective, accept the lot, otherwise screen (100% inspect). Having had a course in Statistical Quality Control a new QC Engineer feels that a better plan would be the following: Take a sample of 25 bolts. Accept the lots if 0 or 1 is defective, otherwise screen it. If, in the past, lots have turned out to be about 1% defective and the AOQL is 0.8%, which of the two plans would you accept and why, if in fact this is the incoming quality of future lots?

a. The old plan because it will accept more of the submitted lots
*b. The new plan because it requires less screening
c. The new plan because it will accept more of the submitted lots
d. They are both about the same since they require about the same average total inspection

Incorrect Answer Reply:

Old plan is n=80, c=0 and
$P_a = P(x = 0 / \lambda = 80 * 0.01 = 0.8) = 0.449$
New plan is n=25, c=1 and $P_a = P(x \le 1 / \lambda = 25 * (0.01) = 0.25) = 0.974$
More product at proportion defective of 0.01 is accepted by the new plan

136. 2-068
Which of the following sampling plans gives the greatest protection against accepting lots of poor quality?

a. Sample size = 200; Ac = 14; Re = 15
b. Sample size = 100; Ac = 7; Re = 8
c. Sample size = 200; Ac = 21; Re = 22
*d. Sample size = 200; AC = 12; Re = 13
e. First sample size 125; Ac = 7; Re = 11; cumulative sample=250; Ac = 18; Re = 19

Incorrect Answer Reply:

First I assumed a "poor quality" level. Since the first plan had an AQL of 4.0% I used a 5.0% as a "poor level" and evaluated each plan for its protection (Pa), looking for the lowest.
plan a $P_a = P(\mathrm{x} \le 14 / \lambda = (0.05)(200) = 10.0) = 0.917$
plan b $P_a = P(x \le 7 / \lambda = (0.05)100 = 5.0) = 0.867$
plan c $P_a = P(x \le 21 / \lambda = (0.05)200 = 10.0) = 0.999$

plan d $P_a = P(x \le 12 / \lambda = (0.05)200 = 10.0) = 0.792$

plan e $P_a = P(x \le 18 / \lambda = 0.05 * 250 = 12.5) = 0.948$

137. 2-069
100% inspection is:

a. At best only 60% effective
b. Effective for detecting minor defects
*c. Generally used to sort bad items from good
d. All of the above

138. 2-070
A p-chart is a type of control chart for:

a. Plotting bar-stock lengths from receiving inspection samples
*b. Plotting fraction defective results from shipping inspection samples
c. Plotting defects per unit from in-process inspection samples
d. Answers 1, 2, and 3 above
e. answers 1 and 3 only

Incorrect Answer Reply:
see page VI-207

139. 2-071
The sensitivity of a p-chart to changes in quality is:

a. Equal to that of a range chart
b. Equal to that of a chart for averages
c. Equal to that of a c-chart
d. Equal to that of a u-chart
*e. None of the above

Incorrect Answer Reply:
see pages VI-197 to 243

140. 2-072
A p-chart has exhibited statistical control over a period of time. However, the average fraction defective is too high to be satisfactory. Improvement can be obtained by:

a. A change in the basic design of the product
b. Instituting 100% inspection
c. A change in the production process through substitution new tooling or machinery
*d. All of the above answers are correct except number 2
e. All of the above answers are correct except number 3

Incorrect Answer Reply:
100% inspection will only sort the good and bad product but will not change the process of production

141. 2-073
Consumer's risk is defined as:

*a. Accepting an unsatisfactory lot as satisfactory.
b. Passing a satisfactory lot as satisfactory.
c. An alpha risk.
d. A 5% risk of accepting an unsatisfactory lot.

Incorrect Answer Reply:
see page IV-4

142. 2-075
The steeper the OC-curve, the:

a. Less protection for both producer and consumer
*b. More protection for both producer and consumer
c. The lower the AQL
d. The smaller the sample size

Incorrect Answer Reply:
see pages IV-5 to 12

143. 2-076
When used together for variables data, which of the following is the most useful pair of quantities in Quality Control?

*a. x-bar and R
b. x-bar and n
c. R and sigma
d. p-bar and n
e. AQL and p prime

Correct Answer Reply:
ASQ CQE 1978 P-11

Incorrect Answer Reply:
the x-bar and R because x-bar is a statistical measure of central tendency and R is a statisitical measure of variation

144. 2-082
In control chart theory, the distribution of the number of defects per unit follows very closely the:

a. Normal distribution
b. Binomial distribution
c. Chi-square distribution
*d. Poisson distribution

Incorrect Answer Reply:
see page VI-75

145. 2-083
A consideration to be made prior to the use of any sampling plan is (are):

a. The consumer's and producer's risks must be specified
b. The method of selecting samples must be specified
c. The characteristics to be inspected must be specified
d. The conditions must be specified (material accumulated in lots or inspected by continuous sampling)
*e. All of the above

Incorrect Answer Reply:
see pages IV-5 to 12

146. 2-084
The probability of accepting material produced at an acceptable quality level is defined as:

a. α
b. β

c. AQL
*d. $1-\alpha$
e. $1-\beta$

Incorrect Answer Reply:
see pages IV-3 to 12

147. 2-085
AOQL means:

a. Average outgoing quality level
*b. Average outgoing quality limit
c. Average outside quality limit
d. Anticipated optimum quality level

Incorrect Answer Reply:
see Z1.4 page 7

148. 2-087
ANSI/ASQ Z1.4 is to be used to select a single sampling plan for lots of 8,000 under normal inspection, Level II and an AQL of 2.5%. The exact AOQL for the plan is:

a. 2.50%
b. 3.00%
*c. 3.22%
d. 3.30%
e. 2.60%

Incorrect Answer Reply:
From Table I - sample code letter is L
From Table II-A - plan is n=200, c=10
From Table V-A - unadjusted AOQL is 3.3
using note adjusted value is $1-\frac{sample\_size}{Lot\_size}(3.3)=(1-\frac{200}{8000})*3.3=3.22$

149. 2-088
Large panes of plate glass contain on the average 0.25 flaws per pane. The standard deviation of the distribution of flaws is:

a. 0.25
b. 0.05
*c. 0.50

d. 0.75
e. None of the above

150. 2-089
You have just returned from a two-week vacation and are going over with your QC manager, the control charts which have been maintained during your absence. He calls your attention to the fact that one of the X-charts shows the last 50 points to be very near the center line. In fact, they seem to be within about one sigma of the center line. What explanation would you offer him?

a. Somebody "goofed" in the original calculation of the control limits.
*b. The process standard deviation has decreased during the time the last 50 samples were taken and nobody thought to re-compute the control limits.
c. This is a terrible situation. I'll get on it right away and see what the trouble is. I hope we haven't produced too much scrap.
d. This is fine. The closer the points are to the center line the better our control.

Incorrect Answer Reply:
none of the the other three answers is correct

151. 2-090
Your quality control manager has asked you to make a study of the costs of using variables sampling as against attribute sampling for a pipe fitting. After searching the literature you find that the following sampling plans will give equal protection over the range of quality levels in which you are interested:

Type of Plan	Sample Size	Acceptance Criteria
Attributes	450	Ac=10, Re=11
Variables, sigma unknown	100	k=2.0
Variables, sigma known	33	k=2.0

Upon investigating the possible costs involved in each type of sampling with your accounting, production and inspection departments, you arrive at the following figures:

	Attributes	Variables, Sigma	Variables, Sigma

		unknown	known
Unit Sampling Cost	0.05	0.05	0.05
Unit Inspection Cost	0.05	0.35	0.35
Unit Computation Cost	0.00	0.02	0.01
Lot Overhead Cost	6.00	18.00	40.00

Based on the above information, which sampling plan would you advise your inspector to use?

a. Since they all give equal protection, it doesn't make any difference.
*b. Use attributes sampling.
c. Use continuous sampling.
d. Use variable sampling, sigma unknown.
e. Use variable sampling, sigma known.

Incorrect Answer Reply:
since all three plans give equal protections we simply need to cost out each of the plans
Attributes
((0.05+0.05)*450)+6.00=$51.00
Sigma unknown
(0.05+0.35+0.02)*100+18.00=$60.00
Sigma known
(0.05+0.35+0.01)*33+40=$53.53

choose Attribute plan because it has the lowest cost

152. 2-091
An x-bar and R chart was prepared for an operation using twenty samples with five pieces in each sample. $\bar{\bar{x}}$ was found to be 33.6 and $\bar{R}$ was 6.2. During production a sample of five was taken and the pieces measured 36, 43, 37, 34, and 38. At the time this sample was taken:

a. Both average and range were within control limits
b. Neither average nor range was within control limits
*c. Only the average was outside control limits
d. Only the range was outside control limits
e. The information given is not sufficient to construct an and R chart using tables usually available.

Incorrect Answer Reply:

the control limits would be:

$UCL_{\bar{x}} = \bar{\bar{x}} \pm A_2 \bar{R} = 33.6 \pm (0.58)(6.2) = 33.6 \pm 3.6 = 30.0, 37.2$

and

$UCL_R = D_4 \bar{R} = 2.11(6.2) = 13$

the x-bar of the sample is 37.6 and the R is 9
only the x-bar is outside the control limits

153. 2-092
You are to construct an OC curve. Which of the following cannot be used as an abscissa value?

a. AOQL
*b. ASN
c. AQL
d. LTPD
e. All of these can be abscissa values.

154. 2-093
A large lot of parts is rejected by your customer and found to be 20% defective. What is the probability that the lot would have been accepted by the following sampling plan; sample size=10; accept if no defectives; reject if one or more defectives?

a. .89
b. .63
c. .01
d. .80
*e. .11

Incorrect Answer Reply:

This a a simple Binomial problem with a Table A-12 look-up $P_a = P(x = 0 / \mathrm{n} = 10, \mathrm{p} = 0.20) = 0.107$

155. 2-095
You look at a process and note that the chart for averages has been in control. If the range suddenly and significantly increases, the mean will:

a. Always increase
b. Stay the same
c. Always decrease

*d. Occasionally show out of control of either limit
e. None of the above

Incorrect Answer Reply:
if the Range chart shows an increase in variablility, then the mean will vary as well.

156. 2-096
Your major product cannot be fully inspected without destruction. You have been requested to plan the inspection program, including some product testing, in the most cost-effective manner. You most probably will recommend that samples selected for the product verification be based upon:

a. ANSI/ASQ Z1.4, latest issue: attribute sampling
*b. ANSI/ASQ Z1.9, latest issue; variables sampling
c. Either answers 1 or 2 above will meet your criteria
d. Neither answers 1 nor 2 above will meet your criteria

Incorrect Answer Reply:
Variables sample always a smaller sample since this is destructive testing you want to minimize your sample size

157. 2-097
On the production floor, parts being produced measure .992 to 1.010. The specification requires the parts to be .995-1.005. Which of the following techniques would not be particularly useful in trying to improve and control the process?

a. Pre-control
*b. ANSI/ASQ Z1.4 charts
c. Multi-variable charts
d. x-bar and R charts
e. Machine capability analysis

Incorrect Answer Reply:
the key words here are "improve and control" Z1.4 is an acceptance sampling plan

158. 2-098
The Dodge-Romig Tables are designed to minimize which parameter?

a. AOQL
b. AQL
*c. ATI
d. AOQ

Incorrect Answer Reply:
see page IV-13

159. 2-099
When used together for variables data, which of the following pair of quantities is the most useful in preparing control charts?

a. AQL and p
b. p and n
*c. x-bar and R
d. R and sigma

Incorrect Answer Reply:
the x-bar and R chart is the most powerful of all control charts

160. 2-100
An operation requires shipments from your vendor of small lots of fixed size. The attribute sampling plan used for receiving inspection should have its OC curve developed using:

a. The Binomial distributions
b. The Gaussian (normal) distribution
c. The Poisson distribution
*d. The Hypergeometric distribution

Incorrect Answer Reply:
the key word is "small" lots
attribute sampling plans are based on the Binomial distribution
often we approximate the Binomial distribution with the Poisson when we have large lot sizes
but when we have small lot sizes the Hypergeometric distribution applies
see page VI-72

161. 2-101
The acronym "AQL", as used in sampling inspection, means

a. that level of lot quality for which there is a small risk of rejecting the lot
b. the Average Quality Limit
*c. the maximum percent defective that can be considered satisfactory as process average
d. the quality level

162. 2-102
An operating characteristic curve shows

*a. The probability of accepting lots of various quality levels by sampling methods
b. The operating characteristic curve of the machine
c. How to operate a machine for best quality results
d. The probability that a lot contains a certain number of rejectable parts

Incorrect Answer Reply:
see page VI-5

163. 2-103
Two quantities which uniquely determine a single sampling attributes plan are:

a. AQL and LTPD
*b. Sample size and rejection number
c. AQL and producer's risk
d. LTPD and consumer's risk

Incorrect Answer Reply:
see page IV-3

164. 2-106
In comparison with attributes sampling plans, variables sampling plans

a. Have the advantage of greater simplicity.
b. Usually require a larger sample size for comparable assurance as to the correctness of decisions in judging a single quality characteristic.

c. Have the advantage of being applicable to either single or multiple quality characteristics.
*d. Provide greater assurance, for the same sample size, as to the correctness of decisions in judging a single quality characteristic

Incorrect Answer Reply:
see CQE Handbook page 215-216

165. 2-107
Under acceptance sampling, with screening, average outgoing quality will not be worse, in the long run, than the

a. ATI
b. AQL
*c. AOQL
d. AOQ

Incorrect Answer Reply:
see page 7 of Z1.4

166. 2-108
Which of the following does not generate product-quality characteristics?

a. Designer
*b. Inspector
c. Machinist
d. Equipment engineer

Incorrect Answer Reply:
the inspector on checks to see if the product conform to specification or not - all the others affect the product outcome

167. 2-109
A comparison of variable and attribute sampling systems will show that equal protection (as determined by the OC curves) can be obtained

a. When the variable and attribute sample sizes are equal
b. When the attribute sample is smaller than the variable sample

*c. When the variable sample is smaller than the attribute sample
d. None of these.

168. 2-111
Incoming-material inspection is based most directly on

a. Design requirements
*b. Purchase order requirements
c. Manufacturing requirements
d. Customer use of the end product

Incorrect Answer Reply:
supplier is under contract to supply per the purchase order contract

169. 2-112
You have been asked to sample a lot of 300 units from a vendor whose past quality has been about 2% defective. A sample of 40 pieces is drawn from the lot and you have been told to reject the lot if you find two or more parts defective. What is the probability of finding two or more parts defective?

a. 0.953
b. 0.809
*c. 0.191
d. 0.047

Incorrect Answer Reply:
this is a Poisson approximation to a Binomial problem (defective versus non-defectives).
$\lambda = 40(0.02) = 0.8$
$1 - \mathrm{P(x=0 \text{ or } x=1 \text{ given } } \lambda = 0.8) = 1 - 0.809 = 0.191$
this problem might be considered a hypergeometric problem because the sample (40) is more than 10% of the lot size and the probability would be about 0.184

170. 2-113
What is the probability of finding no defective items in a random sample of 100 items taken from the output of a continuous process which averages 0.7% defective items?

*a. 0.49

b. 1.74
c. 0.10
d. 0.74
e. 0.33

Incorrect Answer Reply:

$\lambda = 100(0.007) = 0.7$

$P(x = 0 / \lambda = 0.7)$ Table lookup

0.497

171. 2-114
Lots of 75 pieces each are inspected to an AQL of 0.25% using normal inspection, single sampling. A single lower specification limit, denoted by L is used. The standazrd level (Level II in Z1.4 and Level IV in Z1.9) is used. The sample size for ANSI/ASQ Z1.4 is

a. 13
b. 32
*c. 50
d. 75

Incorrect Answer Reply:

Lot size of 75 in Table I gives a sample size code letter of E
In Table II-A AQL of 0.25% and code letter E you must follow downward arrow to code letter H and sample size 50

172. 2-117
A process is producing material which is 30% defective. Five pieces are selected at random for inspection. What is the probability of exactly two good pieces being found in the sample?

a. 0.868
b. 0.309
c. 0.436
*d. 0.132

Incorrect Answer Reply:

this is a Binomial Table look-up

$P(\mathrm{x} = 2 / \mathrm{p} = 0.70, \mathrm{n} = 5) = \mathrm{P}(\mathrm{x} \le 2) - P(x \le 1) = 0.163 - 0.031 = 0.132$

173. 2-118
An inspection plan is set up to randomly sample 3 square feet of a 1,000 square foot carpet and to accept the carpets only if no flaws are found in the 3 square foot sample. What is the probability that a roll of carpet with an average of one (1) flaw per square foot will be rejected by the plan?

a. .05
b. .72
c. .90
*d. .95

Incorrect Answer Reply:
Poisson distribution as mean is expressed as a rate
$1-P(x=0/\lambda=3.0)=1-0.05=0.95$

174. 2-119
A process is in control at $\bar{\bar{x}}=100$ and $\bar{R}=7.3$ with n = 4. If the process level shifts to 101.5, with the same $\bar{R}$, what is the probability that the next point will fall outside the old control limits?

*a. 0.016
b. 0.029
c. 0.122
d. 0.360

Incorrect Answer Reply:
the upper control limit on x-bar is:
$UCL_{\bar{x}}=100+A_2\bar{R}=100+(0.73)(7.3)=105.329$

$$P(\bar{x}\geq 105.329)=P(z\geq\frac{UCL-\mu}{\sigma_{\bar{X}}})=P(z\geq\frac{105.329-101.5}{\bar{R}/d_2\sqrt{n}})=P(z\geq\frac{3.829}{7.3/2.059\sqrt{4}})$$

$$=P(z\geq\frac{3.829}{1.773})=P(z\geq 2.16)=1-P(z\leq 2.16)=1-0.984=0.016$$

175. 2-120
An x-bar and R chart was prepared for an operation using twenty samples with five pieces in each sample. x- double bar was found to be 33.6 and R-bar was found to be 6.20. During production a sample of five was taken and the pieces

measured 36, 43, 37, 25, and 38. At the time this sample was taken

a. Both average and range were within control limits
b. Neither average nor range were within control limits
c. Only the average was outside control limits
*d. Only the range was outside control limits

Incorrect Answer Reply:
the control limits on x-bar are

$$UCL_{\bar{x}} = \bar{\bar{x}} \pm A_2 \bar{R} = 33.6 \pm (0.58)(6.2) = 33.6 \pm 3.6 = 30.0, 37.2$$

the control limits on R are

$$UCL_R = D_4 * \bar{R} = 2.11 * 6.2 = 13.08$$

$$LCL_R = D_3 * \bar{R} = 0 * 6.2 = 0$$

the x-bar and R for the sample are

$$\bar{x} = \frac{\sum_{n=1}^{n=5} x}{5} = \frac{(36 + 43 + 37 + 25 + 38)}{5} = 35.8$$

$$R = (43 - 25) = 18$$

only the R value is beyond the upper control limit

176. 2-121
A comparison of known sigma and unknown sigma variables plans will show that equal protection is obtained (as determined by the OC curves)

a. When the unknown sigma sample size is smaller than the known sigma sample size
b. When the known sigma sample size is larger than the unknown sigma sample size
c. When the known sigma and unknown sigma sample sizes are equal
*d. None of these.

177. 2-122
An electronics firm was experiencing high rejections in their multiple connector manufacturing departments. "P" charts were introduced as part of a program to reduce defectives. Control limits were based on prior history using the formula:

$$p \pm 3\sqrt{\frac{p(1-p)}{n}}$$

Where p is the historical value of percent defective and n is the number of pieces inspected each week. After six weeks, the following record was accumulated.

Dept	p	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
104	9	8	11	6	13	12	10
105	16	13	19	20	12	15	17
106	15	18	19	16	11	13	16

1000 pieces were inspected each week in each department. Which department(s) exhibited a point or points out of control during this period?

a. Department 104
b. Department 105
c. Department 106
*d. All of the Departments
e. None of the Departments

Incorrect Answer Reply:

the control limits for dept 104 chart are

$$p \pm 3\sqrt{\frac{(p)(1-p)}{n}} = 0.09 \pm 3\sqrt{\frac{(0.09)(0.91)}{1000}} = 6.29, 11.71$$

the control limits for dept 105 chart are

$$p \pm 3\sqrt{\frac{(p)(1-p)}{n}} = 0.16 \pm 3\sqrt{\frac{(0.16)(0.84)}{1000}} = 12.52, 19.48$$

the control limits for dept 106 chart are

$$p \pm 3\sqrt{\frac{(p)(1-p)}{n}} = 0.15 \pm 3\sqrt{\frac{(0.15)(0.85)}{1000}} = 11.61, 18.39$$

178. 2-123
A large lot of parts is rejected by your customer and found, upon screening, to be 20% defective. What is the probability that the lot would have been accepted by the following sampling plan: sample size = 10; accept if no defectives; reject if one or more defectives?

a. 0.89
b. 0.20
c. 0.80
*d. 0.11
e. None of the above

Incorrect Answer Reply:

$P(x = 0 / n = 10, p = 0.20) = 0.107$

does not meet Poisson approxiamtion criteria of p <0.1, n large

179. 2-124
Which table should be used to determine a confidence interval on the mean when sigma is not known and the sample size is 10?

a. z-table
*b. t-table
c. F-table
d. Chi-squared table

Incorrect Answer Reply:
see page VI-92 to 93

180. 2-125
Using ANSI/ASQ Z1.4, what sample size should be taken from a lot of 1000 pieces for inspection level II with normal inspection?

a. 32
b. 50
*c. 80
d. 100
e. 125

Incorrect Answer Reply:
Table I sample size code letter J
assume single sampling, normal
Table II-A sample size 80

181. 2-127
The prime use of a control chart is to

*a. Detect assignable causes of variation in the process.
b. Detect nonconforming product.
c. Measure the performance of all quality characteristics of a process.
d. Detect the presence of random variation in the process.

Incorrect Answer Reply:
answer b is incorrect because you are sampling product
answer c is incorrect because you only look at a single quality characteristic per chart
answer d is incorrect because we know there is random variation in the process

182. 3-01
The main objective of designed experimentation in an industrial environment is:

*a. To obtain more information for less cost than can be obtained by traditional experimentation
b. To verify that one factor at a time is most economical
c. To obtain data and then decide what to do with it
d. To improve the design of equipment for more effective experimentation

Incorrect Answer Reply:
see pages VI-269 to 329

183. 3-02
The fundamental equation of analysis of variance may express the idea that:

*a. The total sum of squares of deviations from the grand mean is equal to the sum of squares of deviations between treatment means and the grand mean plus the sum of squares of deviation within treatments
b. The total standard deviation is equal to the sum of the standard deviation for the treatment effect plus the standard deviation of the random error
c. The degrees of freedom are not additive
d. A basic population model can be constructed to represent the behavior of the experimentation

Incorrect Answer Reply:
see pages VI-269 to 329

184. 3-03
Given the following results obtained from a fixed factor randomized block designed experiment in which the production outputs of three machines A, B, C are compared:

A	4	8	5	7	6
B	2	0	1	-2	4
C	-3	1	-2	-1	0

How many degrees of freedom are used to compute the error variance?

a. 2
b. 3
*c. 12
d. 14

Incorrect Answer Reply:
15 responses - 3 factors = 12 d.f.

185. 3-04
What is the critical value of F with a risk of 0.05 for the previous problem?

*a. 3.89
b. 4.75
c. 3.49
d. 4.60

Incorrect Answer Reply:
$F_{0.05,2,12} = 3.89$

186. 3-07
You have just conducted a designed experiment at three levels A, B and C yielding the following "coded" data:

A	B	C
6	5	3
3	9	4
5	1	2
2		

As a major step in your analysis you calculate the degrees of freedom for the "error" sum of squares to be:

*a. 7
b. 9
c. 3
d. 2
e. 10

Incorrect Answer Reply:

10 data values - 3 factors = 7 d.f.

187. 3-08
If, in a designed experiment, you obtained an F-ratio of 0.68 with 2 and 20 degrees of freedom, you would conclude that:

*a. There were no significant differences among the means
b. You had made an error
c. The variances were equal
d. The null hypothesis was rejected
e. All of the above

Correct Answer Reply:
ASQ CQE 1974 A-14

Incorrect Answer Reply:
The F test in DOE is used with ANOVA, and ANOVA is used to test the differences between more than 2 means. F test as a test of hypothesis on the ratio of two sample variances.

188. 3-09
In an experiment designed to compare two different ways of measuring a given quantity, it was desired to test the null hypothesis that the means were equal at the 0.05 level of significance. A sample of five parts was measured by method I and a sample of seven parts with method II. A t-ratio [calculated] of 2.179 was obtained. We should:

a. Reject the null hypothesis
*b. Fail to reject the null hypothesis
c. Assert that there is no difference between the two methods
d. Conclude that is significantly greater than
e. Conclude that we must know the sample means in order to answer the question

Correct Answer Reply:
ASQ CQE 1974 A-13

Incorrect Answer Reply:
see pages VI-129 to 131
the t critical for this test would be based on n1 + n2 -2 degrees of freedom (5 + 7 -2) or 10 and because we are testing for equality we have a two tailed test

$t_{critical} = t_{0.05/2,10} = t_{0.025,10} = 2.228$
and the t-calculated is less than the t-critical

189. 3-12
In every experiment there is experimental error. Which of the following statements is true?

*a. This error is due to lack of uniformity of the material used in the experiment and to inherent. variability in the experimental technique
b. This error can be changed statistically by increasing the degrees of freedom.
c. The error can be reduced only by improving the material.
d. In a well-designed experiment there is no interaction effect.

Incorrect Answer Reply:
see pages VI-269 to 279

190. 3-13
When considering a factorial experiment, observe that:

a. This experiment cannot be used when complete randomization is necessary
*b. A main effect may be confounded
c. This type of design is not encountered often in industrial experiments
d. One of the advantages is that úan exact test always exists for all effects

Incorrect Answer Reply:
see pages VI-269 to 279

191. 3-14
Sensitivity in experimentation is:

a. Getting the true result
b. Extreme care in data analysis
c. Using the best measuring device
*d. Ability to distinguish differences in the response variable

Incorrect Answer Reply:

see pages VI-269 to 279

192. 3-15
A 3^2 experiment indicates:

a. Two levels of three factors
b. Three independent variables and two dependent variables
*c. Three levels of two factors
d. Two go-no-go variables and three continuous variables

Incorrect Answer Reply:
see page VI-276

193. 3-18
Information generated in a designed experiment:

a. Always results in an analysis of variance table
b. Is based on the fact that "the variance of the sum is the sum of the variances"
c. Must always be quantitative
*d. May be based on values which are not necessarily numerical

Incorrect Answer Reply:
see page VI-280 for example (Flux type)
either A19 or A880

194. 3-21
When constructing a factorial experiment, one of the following is true:

a. Factorial experiments may not contain any number of levels per factor. They must be the same for each factor
*b. Confounding takes place in factorials when we run a fractional part of the complete experiment
c. Contrasts and treatment combinations are the same
d. In factorials, the factors must be quantitative

Incorrect Answer Reply:
see pages VI-318 to 324

195. 3-23
To state that the levels of a factor are fixed indicates that:

*a. The levels are to be set at certain fixed values
b. The equipment from which the data are collected must not be moved
c. The factors under consideration are qualitative
d. The levels were chosen from a finite population

Incorrect Answer Reply:
see pages VI-269 to 279

196. 3-30
In the analysis of variance:

a. The total sum of squares of deviations from the grand mean is equal to the sum of squares of deviations between treatment means and the grand mean minus the sum of squares of deviations within treatments
b. The total standard deviation is equal to the sum of the standard deviation for the treatment effect plus the standard deviation of the random error
*c. The degrees of freedom are additive
d. A basic population model can be constructed to represent the behavior of the experimentation

Incorrect Answer Reply:
see pages VI-269 to 279

197. 3-33
When you perform "one experiment" with "forty-nine repetitions,' what are the fifty experiments called?

a. Randomization
*b. Replications
c. Planned grouping
d. Experimental pattern
e. Sequential

Incorrect Answer Reply:
see pages VI-269 to 279

198. 3-35
A factorial experiment has been performed to determine the effect of Factor A and Factor B on the strength of a part. An "F" test shows a significant interaction effect. This means that:

a. Either Factor A or Factor B has a significant effect on strength.
b. Both Factor A and Factor B effect strength.
*c. The effect of changing Factor B can be estimated only if the level of Factor A is known.
d. Neither Factor A nor Factor B effect strength.
e. That strength will increase if Factor A is increased while Factor B is held at a low level.

Incorrect Answer Reply:
see pages VI-269 to 279

199. 3-36
The test used for testing significance in an Analysis of Variance table is:

a. The z test
b. The t test
*c. The F test
d. The Chi-square test

200. 3-38
An 3^2 experiment means that we are considering:

a. Two levels of three factors.
b. Two dependent variables and three independent variables.
c. Two go/no-go variables and three continuous variables.
*d. Three levels of two factors.

Incorrect Answer Reply:
see page VI-276

201. 3-42
An experiment with two factors, in which all levels of one variable are run at each level of the second variable, is called a

a. One-way experiment.
b. Latin square experiment.
*c. Factorial experiment.
d. Fractional factorial experiment.

Incorrect Answer Reply:
see pages VI-269 to 279

202. 3-43
A two-way Analysis of Variance has r levels for the one variable and c levels for the second variable with 2 observations per cell. The degrees of freedom for interaction is

a. 2 (r x c)
*b. (r - 1) (c - 1)
c. r c - 1
d. 2 (r - 1) (c - 1)

Incorrect Answer Reply:
see VI-174 to 176

203. 3-45
Consider the SS and MS columns of an Analysis of Variance A table for a single factor design. The appropriate ratio for testing the null hypothesis of no treatment effect is

a. SS treatments divided by SS residual.
*b. MS treatments divided by MS residual.
c. SS treatments divided by MS residual.
d. MS treatments divided by SS residual.

Incorrect Answer Reply:
see pages VI-269 to 279

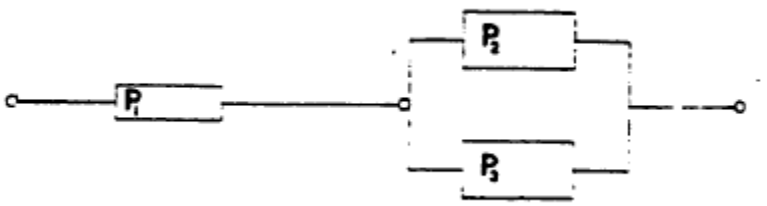
204. 3-48
Which of the following purposes are served by replicating an experiment?
A-Provide a means for estimating the experimental error.
B-Increase the number of treatments included in the experiment.
C-Improve the precision of estimates of treatment effects.

a. A and B only

*b. A and C only
c. B and C only
d. A, B and C

Incorrect Answer Reply:
see pages VI-269 to 279

205. 8-02
Find the predicted system reliability for the three parts shown if the individual part reliability is 90 percent each for a specified mission time and mission conditions:



a. 72.9%
b. 70.0%
c. 99.9%
*d. 89.1%
e. 90.0%

Correct Answer Reply:
Correct

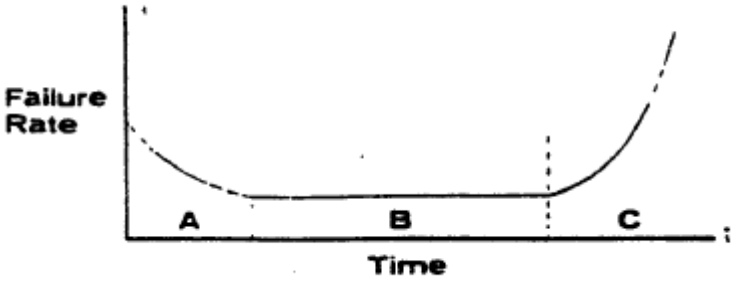
Incorrect Answer Reply:
0.90 x (1-(.1)(.1)) =0.90 x 0.99 = 0.891
0.891 x 100 = 89.1 %

206. 8-03
Failure mode effects analysis is primarily for the purpose of:

a. Learning as much about the item as possible after qualification test
b. Determining, by extensive analysis, the reliability of an item.
*c. Determining the way an item will most likely fail, to help obtain design and procedural safeguards against such failure
d. Determining the cause of a failure, by dissecting the item, to help obtain corrective action

Incorrect Answer Reply:
see pages III-20 to 29

207. 8-08



Where: $\lambda =$ failure rate (failures per unit of time)
t = time in service
The failure rate model above is used to show a typical relationship of many parts between their failure rate and the time in service. The reliability function for the period "B' is best represented by:

a. $R(t) = e^{\lambda t}$
b. $\lambda = at^2 + bt + R$
c. $R(t) = e^{-\lambda t \alpha}$
*d. $R(t) = e^{-\lambda t}$
e. None of these

Incorrect Answer Reply:
see pages III-6 to 9

208. 8-09
A maintainability group is primarily concerned with:

a. Determining the probability of survival of a system for a given period of time
*b. Establishing the probability of a system being restored to functional operation within a given period of time
c. Performing adequate maintenance on a system
d. Administration of maintenance supplies inventory
e. None of these

Incorrect Answer Reply:

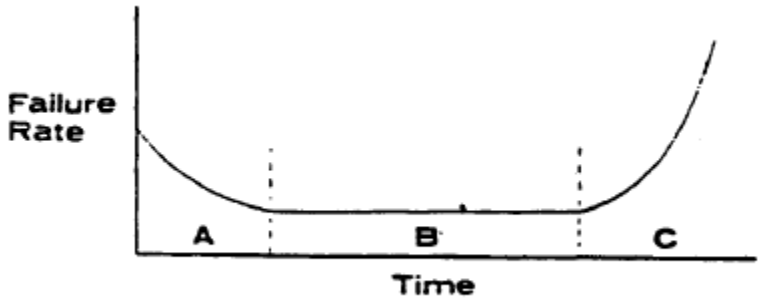
see page III-11

209. 8-10
Parts in use during the random failure or normal [useful life] portion of the part life cycle curve will exhibit:

*a. A constant failure rate
b. A decreasing failure rate
c. A low failure rate
d. An increasing failure rate

Incorrect Answer Reply:
see page III-6

210. 8-12
In the failure rate model shown below, the part of the curve identified as "A" represents:



a. The "bath tub" curve
b. Random and independent failures fitting a Poisson model
*c. The debugging period for complex equipment
d. The wear-out period

Incorrect Answer Reply:
see page III-6

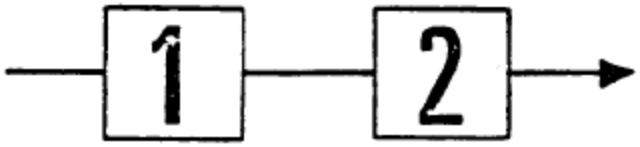
211. 8-14
"Maintainability" is:

a. The probability that a system will not fail
b. The process by which a system is restored to operation after failure
*c. A characteristic of design and installation

d. The time required to restore a system to operation after failure

Incorrect Answer Reply:
see page III-11

212. 8-19
Component 1 has an exponential failure rate of 3 X 10-4 failures per hour.
Component 2 is normally distributed with a mean of 600 hours and standard deviation of 200 hours.
Assuming independence, calculate the reliability of the system after 200 hours.



a. 0.878
*b. 0.920
c. 0.940
d. 0.977

Correct Answer Reply:
correct!

Incorrect Answer Reply:
$R_1 = e^{-\lambda t} = e^{-(0.0003)(200)} = e^{-0.06} = 0.9418$ and

$R_2 = 1 - P(-\infty \le z \le \frac{200-600}{200})$

$= 1 - P(-\infty \le z \le -2.0) = 1 - 0.0228 = 0.9772$ and

System Reliability $= R_s = R_1 * R_2 = 0.9418 * 0.9772 = 0.920$

213. 8-20
Reliability predictions are often expressed in terms of MTBF (Mean Time between Failure) or its reciprocal the:

a. Failure mode
*b. Failure rate (percent per 1000 hours, units per 100 Cycles
c. MTTF (Mean Time to Failure)
d. Service life

e. None of these

Incorrect Answer Reply:
see pages III-7 to 9

214. 8-22
Maintainability is:

*a. The probability of a system being restored to functional operation within a given period of time.
b. Performing adequate maintenance on a system
c. Probability of survival of a system for a given period of time
d. Maintaining a machine in satisfactory working condition
e. None of the above.

Incorrect Answer Reply:
see page III-11

215. 8-25
Parts in use during the "wear out" portion of the part life cycle curve will exhibit:

a. A constant failure rate
b. A decreasing failure rate
c. A low failure rate
*d. An increasing failure rate

Incorrect Answer Reply:
see page III-6

216. 8-26
Reliability, maintainability, and product safety improvements are most often economically accomplished during the phase of a program.

*a. Design and development
b. Prototype test
c. Production
d. Field operation
e. Redesign and retrofit

Incorrect Answer Reply:
see pages III-6 to 11

217. 8-30
For a high compression aircraft air conditioning system, the MTBF is 100 hours. This means life is allocated to four serial units comprising the total system. The unit failure rates are then weighted as follows:
W1 = 0.1250
W2 = 0.2500
W3 = 0.1875
W4 = 0.4375
Based upon the above data, indicate which of the following the correct calculation for one of the units is:

*a. $\lambda 3 = 0.001875$
b. $\lambda 4 = 0.043570$
c. $\lambda 1 = 0.012500$
d. $\lambda 3 = 0.0001875$
e. $\lambda 2 = 0.002510$

Incorrect Answer Reply:
since the MTBF is 100 hours, the failure ratre is 0.01 failures per hour
multiplying each of the weights by 0.01, the only correct one is W3 beacuse (0.01)*(0.1875)=0.001875

218. 8-41
What is the reliability of a system at 850 hours, if the average usage on the system was 400 hours for 1650 items and the total number of failures was 145? Assume an exponential distribution.

a. 0%
b. 36%
c. 18%
*d. 83%

Incorrect Answer Reply:

$$MTTF = \frac{total - operating - time}{total - number - of - failures} = \frac{400 * 1650}{145}$$

$$\lambda = \frac{1}{MTTF} = \frac{145}{400 * 1650} = 0.00022$$

$$R_s(850) = e^{-\lambda t} = e^{-0.00022(850)} = 0.83$$