UNIVERSITI SAINS MALAYSIA

Second Semester Examination
2012/2013 Academic Session

June 2013

EEM421 – Quality Techniques
[Kaedah Kualiti]

Masa : 3 jam

Please check that this examination paper consists of **FIFTEEN (15)** pages of printed material before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **LIMA BELAS (15)** muka surat bercetak sebelum anda memulakan peperiksaan ini]*

Instructions: This question paper consists **FIVE (5)** questions. Answer **ALL** questions. All questions carry the same marks.

*[**Arahan:** Kertas soalan ini mengandungi **LIMA (5)** soalan. Jawab **SEMUA** soalan. Semua soalan membawa jumlah markah yang sama]*

Answer to any question must start on a new page.
[Mulakan jawapan anda untuk setiap soalan pada muka surat yang baru]

Answer question 1, 2 and 3 in the same booklet.
[Jawab soalan 1, 2 dan 3 di dalam buku jawapan yang sama].

Answer question 5 in another booklet. Use pages 12 and 15 in the examination paper to answer question 4. Attach the entire examination paper to the booklet.

[Jawab soalan 5 di dalam buku jawapan yang lain. Guna mukasurat 12 dan 15 dalam kertas soalan untuk menjawab soalan 4. Kepilkan seluruh kertas soalan kepada buku jawapan].

"In the event of any discrepancies, the English version shall be used".

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai]

…2/-

1. (a) Apakah faedah-faedah yang akan dilihat oleh syarikat daripada “Design for Manufacturability (DFM)”?
What benefits will the company see from Design for Manufacturability (DFM)?

(15 markah/marks)

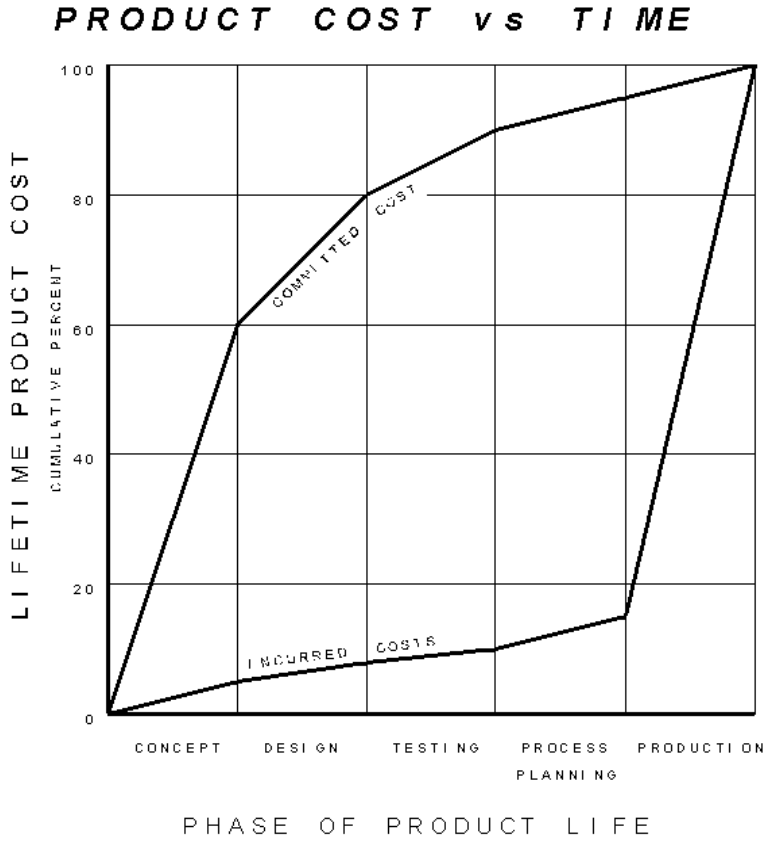
(b) Terangkan **SEPULUH** fakta prinsip umum dalam DFM yang menunjukkan bagaimana untuk merekabentuk produk pembuatan yang maksimum.
*Describe **TEN** points of the general principles/guidelines in DFM that indicate how to design a product for maximum manufacturability.*

(20 markah/marks)

(c) Daripada pemahaman anda, terangkan graf dalam Rajah 1, bagaimana ia dinilai dari segi kos pengeluaran.

From your understanding, describe the graph in Figure 1 on how this it is viewed in terms of production costs.

(65 markah/marks)



Rajah 1
Figure 1

2. (a) Baca senario berikut dan tentukan dimanakah DFM dipraktik di dalam organisasi ini. Sebuah syarikat pengeluaran di Pulau Pinang baru-baru ini memutuskan untuk melakukan ujian pasaran ke atas produk cakera keras ABC. Klien mereka yang mempunyai garis komersial peralatan menghadapi jualan merosot dalam tempoh tiga tahun kebelakangan ini. Peralatan ini adalah produk berteknologi tinggi dan menjadi kesukaran kepada pelanggan untuk menentukan dasar kos yang berdaya saing.

…4/-

Read the following scenario and determine where this organization is implementing on DFM.

A local manufacturing company in Pulau Pinang recently decided to perform a market test on ABC hard disc product. Their client had a commercial line of equipment that was experiencing steadily declining sales over the past three years. The equipment line was a high end product that was becoming difficult for customers to justify on a competitive cost basis.

CABARAN

CHALLENGE

Klien perlu mengurangkan sebahagian besar kos mesin dan pada masa yang sama mengekalkan tahap kualiti yang tinggi. Klien juga dikehendaki untuk mengembangkan wilayah jualan mereka ke rantau Asia. Mesin tersebut perlu lulus semua piawaian SIRIM yang diguna pakai untuk membolehkan pengembangan ini.

The client needed to substantially reduce the cost of the machine while maintaining a high level of quality. The client also desired to expand their sales territory into Asia region. The machine would need to pass all applicable SIRIM standards to allow this expansion.

(50 markah/marks)

(b) Apakah perbezaan antara pembangunan produk jujukan dan pembangunan produk setemu.

What are the differences between the sequential product development and concurrent product development?

(50 markah/marks)

3. (a) Lukiskan turutan dalam penyelesaian masalah di dalam pusingan Rancang-Buat-Kaji-Bertindak (PDSA) Dr. Deming.
Draw the problems solving steps in Dr. Deming's Plan-Do-Study-Act (PDSA) cycle.

(30 markah/marks)

(b) Bincangkan pembinaan gambarajah sebab-dan-akibat atau gambarajah tulang-ikan dan gunakan satu contoh untuk membantu penerangan anda.

Describe the construction of the cause-and-effect diagram or the fish-bone diagram and use an example to help your explanation.

(30 markah/marks)

(c) (i) Bina Carta Pareto untuk kejadian kecacatan dan tuntutan jaminan bagi data berikut:

Construct Pareto Charts for defects occurrences and defects warranty claim for the following data:

Defects	**Occurrences**	**Warranty claim**
Electrical problems	110	$55,000
Noisy instrument panel components	200	$25,000
Loose instrument panel components	355	$155,000
Improper installation of the instrument panel or its components	80	$10,000

(ii) Analisa carta yang telah dibina dan cadangkan penyelesaian untuk mengurangkan kos

Analyze the constructed charts and propose your solution to minimize the cost

(40 markah/marks)

4. (a) Terangkan apa yang dimaksudkan dengan konsep subkumpulan rasional untuk carta kawalan.

Explain the meaning of the rational subgroup concept for control charts.

(20 markah/marks)

(b) Terangkan bila subkumpulan rasional bersaiz satu sesuai untuk digunakan.

Explain when it is appropriate to use a rational subgroup of size one.

(20 markah/marks)

(c) Syarikat WT mengeluarkan aci engkol untuk 2-L engine 2 lejang kereta. Untuk menyambung aci engkol kepada roda pengawal kereta, enam lubang digerudi di hujung aci engkol yang mengunjur keluar (Rajah 4). Garispusat lubang perlu digerudi sebanyak 0.3750 inci . Kesemua enam lubang digerudi serentak. Setiap jam, operator akan memeriksa empat aci engkol yang dihasilkan dari empat kitaran mesin gerudi secara berturutan. Garispusat kesemua enam lubang diukur dan dicatat di dalam Jadual 4(a). Nilai X-bar dan R untuk jam 3 hingga 12 dihitungkan dengan cara yang sama seperti untuk jam 1 dan 2. Pengeluar ingin mengetahui bagaimana setiap gerudi sedang beroperasi. Dalam perkataan yang lain, pengeluar ingin menyiasat soalan yang berikut.

WT Corporation manufacturers crankshafts for 2-L automotive engines. In order to attach a crankshaft to a flywheel, six holes are drilled in the flange end of the crankshaft (Figure 4). The holes are to be drilled 0.3750 inch in diameter. All six holes are drilled simultaneously. Every hour, the operator inspects four crankshafts resulting from four consecutive cycles of the drill press. All six holes are measured and the values recorded in Table 4(a). The X-bar and range values for hours 3 to 12 are calculated in the same manner as for hours 1 and 2.The manufacturer is interested in investigating how each drill is operating. In other words, the manufacturer is interested in investigating the following questions.

- Adakah perlakuan setiap gerudi di bawah kawalan berstatistik?
  Is the performance for each drill under statistical control?

- Adakah garispusat purata bagi lubang sama untuk kesemua enam gerudi?
  Is the average diameter of the holes the same for all six drills?

- Adakah jumlah variasi untuk garispusat lubang sama untuk kesemua enam gerudi?
  Is the amount of variation in the hole diameters the same for all six drills?

Jawab soalan yang berikut.
Answer the following questions.

(i) Susun semula data dalam Jadual 4(a) supaya ia dapat digunakan untuk menyiasat soalan yang di atas. Beri jawapan anda dalam bentuk jadual. Beri justifikasi untuk jawapan anda. Hanya tunjuk data untuk subkumpulan pertama hingga tiga.

Re-organize the data in Table 4(a) so that it can be used for investigating the above questions. Present your answer in table form. Justify your answer. Only show the data for your first three subgroups.

(20 markah/marks)

(ii) Jenis carta kawalan yang manakah yang akan anda syorkan kepada sipengeluar? dan mengapa?

Which type of control charts would you recommend to the manufacturer? and why?

(10 markah/marks)

(iii) Apakah saiz baru untuk subkumpulan?
What would be the new subgroup size?

(5 markah/marks)

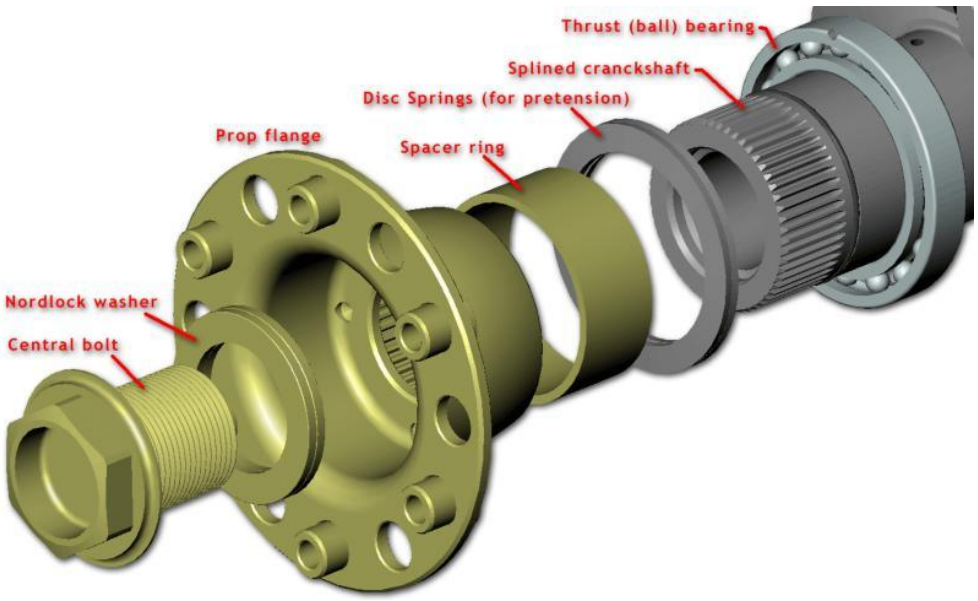
(iv) Berapakah bilangan subkumpulan selepas susunan data?
How many subgroups would there be after the re-organization of the data?

(5 markah/marks)

(v) Apakah yang harus dilakukan jika gerudi tidak berada dalam kawalan berstatistik?

What should be done if the drills are not under statistical control?

(20 markah/marks)



Rajah 4
Figure 4

Jadual 4(a)
Table 4(a)

HOUR 1

Hole	Crank 1	2	3	4
1	3751	3752	3750	3750
2	3752	3751	3750	3752
3	3747	3752	3752	3749
4	3745	3745	3741	3745
5	3752	3751	3750	3752
6	3753	3750	3752	3750
$\bar{X}$-bar	3750	3750	3749	3750
Range	8	7	11	7

HOUR 2

Hole	Crank 1	2	3	4
1	3750	3751	3752	3753
2	3749	3752	3754	3752
3	3748	3748	3753	3751
4	3745	3744	3745	3746
5	3750	3754	3753	3750
6	3751	3750	3752	3753
	3749	3750	3752	3751
	6	10	9	7

HOUR 3

Hole	Crank 1	2	3	4
1	3751	3749	3752	3753
2	3748	3752	3751	3753
3	3749	3749	3753	3752
4	3745	3744	3744	3743
5	3750	3751	3752	3750
6	3752	3749	3750	3753

HOUR 4

Hole	Crank 1	2	3	4
1	3751	3753	3752	3750
2	3750	3751	3751	3751
3	3749	3750	3751	3752
4	3741	3745	3744	3745
5	3752	3755	3751	3750
6	3753	3752	3754	3753

HOUR 5

Hole	Crank 1	2	3	4
1	3751	3752	3754	3753
2	3754	3750	3751	3752
3	3752	3753	3752	3751
4	3745	3746	3747	3746
5	3751	3751	3753	3754
6	3750	3752	3753	3751

HOUR 6

Hole	Crank 1	2	3	4
1	3752	3750	3751	3750
2	3751	3750	3752	3750
3	3753	3750	3753	3750
4	3744	3745	3746	3744
5	3751	3750	3751	3751
6	3750	3751	3750	3750

HOUR 7

Hole	Crank 1	2	3	4
1	3751	3749	3751	3750
2	3752	3750	3754	3751
3	3753	3750	3752	3750
4	3744	3742	3754	3745
5	3750	3750	3750	3750
6	3751	3749	3751	3750

HOUR 8

Hole	Crank 1	2	3	4
1	3752	3751	3753	3750
2	3751	3752	3753	3750
3	3753	3753	3750	3751
4	3744	3746	3745	3744
5	3751	3751	3752	3750
6	3750	3750	3752	3750

HOUR 9

Hole	Crank 1	2	3	4
1	3750	3752	3751	3750
2	3751	3750	3751	3750
3	3752	3750	3750	3749
4	3741	3742	3740	3742
5	3751	3752	3750	3750
6	3752	3754	3750	3754

HOUR 10

Hole	Crank 1	2	3	4
1	3750	3752	3751	3750
2	3750	3751	3752	3750
3	3750	3752	3751	3750
4	3745	3744	3746	3745
5	3750	3752	3752	3751
6	3750	3751	3752	3751

HOUR 11

Hole	Crank 1	2	3	4
1	3750	3750	3751	3750
2	3750	3749	3751	3750
3	3751	3752	3750	3751
4	3742	3744	3743	3744
5	3750	3750	3751	3752
6	3750	3749	3750	3751

HOUR 12

Hole	Crank 1	2	3	4
1	3750	3750	3749	3750
2	3750	3751	3750	3749
3	3750	3750	3751	3751
4	3741	3746	3745	3744
5	3751	3750	3749	3750
6	3750	3750	3751	3750

5. (a) Seorang jurutera ingin memahami kegagalan pengayun semasa unit tersebut diperiksa semasa analisis kegagalan. Beliau ingin memahami korelasi antara ralat kedudukan dan kepekaan FM. Selepas mengumpul data, beliau menjalankan Analisis Korelasi Pearson. Lengkapkan analisis tersebut dan buat kesimpulan.

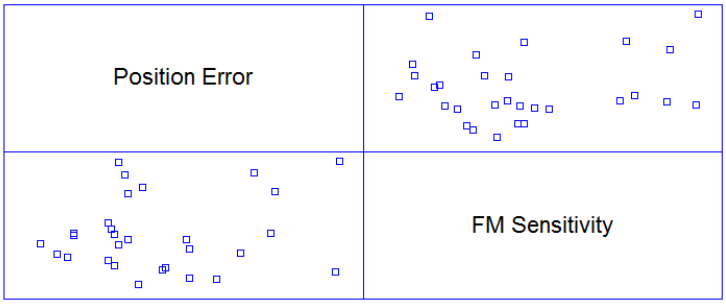
An Engineer would like to understand the failure of an oscillator when he examines the unit during Failure Analysis. The latter would like to comprehend the correlation between Positioning Error and FM Sensitivity. After collecting data, he performed Pearson Correlation Analysis. Complete the analysis and draw conclusions.

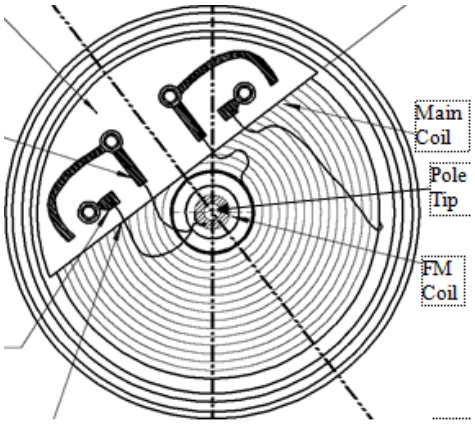
(50 markah/marks)

Correlations

	Position Error	FM Sensitivity
Position Error		0.1574 (29) 0.4149
FM Sensitivity	0.1574 (29) 0.4149	

Correlation
(Sample Size)
P-Value





Hypothesis Statement:

H_o : Position Error and FM Sensitivity _____

H_A : Position Error and FM Sensitivity _____

Correlation : ___

Sample Size : _____

P value : ___

Hence, Accept __ , Reject __

Results:

Since the P-value in the ANOVA table is less than 0.05, statistically there __ significant relationship between Position Error and FM Sensitivity.

Conclusions:

_____ correlation between Position Error and FM Sensitivity .

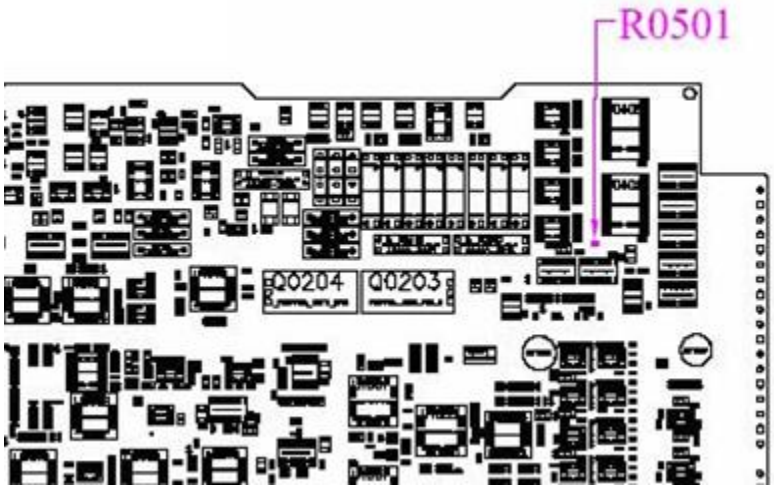
(b) Seorang jurutera ingin menjalankan kajian keatas sejenis perintang (R0501) daripada dua pembekal; Synton-Tech Corporation (S) dan B2B Freezone (B). Jurutera tersebut mempunyai 30 buah perintang daripada setiap pembekal. Beliau kemudian menjalankan ujikaji mengguna perintang daripada kedua-dua pembekal keatas susunatur PCB.

Hasil daripada ujikaji mengguna perisian Statgraphic diberi di bawah. Lengkapkan bahagian yang dikosongkan.

An Engineer would like to perform a study on a type of resistor (R0501) from two suppliers; Synton - Tech Corporation (S) and B2B Freezone (B). The engineer had a sample of 30 pieces of the resistors from each supplier. He then ran an experiment with both suppliers' resistors on the PCB layout.

Results from the experiment using Statgraphic software are given below. Fill in the blanks.

(50 markah/marks)



Tests for Normality for Synton
Computed Chi-Square goodness-of-fit statistic = 14.0
P-Value = 0.300708
Shapiro-Wilks W statistic = 0.969682
P-Value = 0.575956
Z score for skewness = 0.207516
P-Value = 0.835603
Z score for kurtosis = 0.967661
P-Value = 0.333212
Tests for Normality for B2B Freezone
Computed Chi-Square goodness-of-fit statistic = 14.0
P-Value = 0.300708
Shapiro-Wilks W statistic = 0.970065
P-Value = 0.586068
Z score for skewness = 0.884435
P-Value = 0.37646
Z score for kurtosis = 0.611344
P-Value = 0.540969
Comparison of Means (assuming equal variances)
95.0% confidence interval for mean of Synton:
6.92833 +/- 0.331474 [6.59686,7.25981]
95.0% confidence interval for mean of B2B Freezone:
6.60567 +/- 0.22193 [6.38374,6.8276]
95.0% confidence interval for the difference between the means
assuming equal variances: 0.322667 +/- 0.390422 [-0.0677552,0.713088]
t test to compare means
Null hypothesis: mean1 = mean2
Alt. hypothesis: mean1 NE mean2
assuming equal variances: t = 1.65434 P-value = 0.103462
Comparison of Means (not assuming equal variances)
95.0% confidence interval for mean of Synton:
6.92833 +/- 0.331474 [6.59686,7.25981]
95.0% confidence interval for mean of B2B Freezone:
6.60567 +/- 0.22193 [6.38374,6.8276]
95.0% confidence interval for the difference between the means
not assuming equal variances: 0.322667 +/- 0.391632 [-0.0689652,0.714299]
t test to compare means
Null hypothesis: mean1 = mean2
Alt. hypothesis: mean1 NE mean2
not assuming equal variances: t = 1.65434 P-value = 0.104244

Variance Check
Cochran's C test: 0.690481 P-Value = 0.0344795
Bartlett's test: 1.08156 P-Value = 0.034484
Hartley's test: 2.23082
Levene's test: 1.81821 P-Value = 0.182769
Comparison of Medians
Median of sample 1: 7.01
Median of sample 2: 6.59
Mann-Whitney (Wilcoxon) W test to compare medians
Null hypothesis: median1 = median2
Alt. hypothesis: median1 NE median2
Average rank of sample 1: 34.75
Average rank of sample 2: 26.25
W = 322.5 P-value = 0.0600863

Hypothesis Statement:
Ho : Synton - Tech Corporation (S) and B2B Freezone (B) resistors are similar.
H_A : _____

Normality Test;
- Synton (S) _____ (p =_____),
- B2B Freezone (B) _____(p = _____)
Since data _____

Variance Check
Data Not Normal *Or* Normal; -Ho : $\sigma_S = \sigma_B$; H_A: $\sigma_S \neq \sigma_B$
_____ Test, p = _____, therefore σ between Synton (S) and B2B Freezone (B) resistors is _____.

Test for _____;_____,
-Ho : $_S =$ $_B$; H_A : $_S \neq$ $_B$
-P = _____, therefore _____ is _____ significantly different for Resistor value.

Results:
Since _____ Test and _____ show _____ difference; thus Accept _____.

Conclusions:
_____

ANSWERS:

5a. What is Normal Distribution (Gauss Distribution)?

A theoretical frequency distribution for a set of variable data, usually represented by a bell-shaped curve symmetrical about the mean.

b. List 4 Characteristics of Normal Distribution (Any 4)

1) Continuous Random Variable.
2) Mound or Bell-shaped curve.
3) The normal curve extends indefinitely in both directions, approaching, but never touching, the horizontal axis as it does so.
4) Unimodal
5) Mean = Median = Mode
6) Symmetrical with respect to the mean
That is, 50% of the area (data) under the curve lies to the left of the mean and 50% of the area (data) under the curve lies to the right of the mean.
7) (a) 68% of the area (data) under the curve is within one standard deviation of the mean
(b) 95% of the area (data) under the curve is within two standard deviations of the mean
(c) 99.7% of the area (data) under the curve is within three standard deviations of the mean
8) The total area under the normal curve is equal to 1.

c. What is importance of central limit theorem?

The importance is that the sum of a large number of independent random variables is always approximately normally distributed as long as each random variable has the same distribution and that distribution has a finite mean and variance. The point is that it DOES NOT matter what the particular distribution is. So whatever distribution you start with, you always end up with normal.

d. Answers

Hypothesis Statement:

H_o : Position Error and FM Sensitivity have no correlations.

H_A : Position Error and FM Sensitivity have correlations.

Correlation : 0.1574

Sample Size : 29

P value : 0.4149

Hence, Accept H_o, Reject H_A

Results:

Since the P-value in the ANOVA table is less than 0.05, statistically there is No significant relationship between Position Error and FM Sensitivity.

Conclusions:

No correlation between Position Error and FM Sensitivity.

e. Answers

Hypothesis Statement:

Ho : Synton - Tech Corporation (S) and B2B Freezone (B) resistors are similar.

H_A : **Synton - Tech Corporation (S) and B2B Freezone (B) resistors are different**.

Normality Test;

- Synton (S) _**Normal**___ (p =_**0.575956**_),
- B2B Freezone (B) __**Normal** __(p = _**0.586068**)

Since data __**Normal** _,

Variance Check

Data Not Normal *Or* Normal; -Ho : $\sigma_S = \sigma_B$; H_A: $\sigma_S \neq \sigma_B$

_ **Bartlett's** __ Test, p = _**0.034484**___, therefore σ between Synton (S) and B2B Freezone (B)
resistors is ___**significantly different**_____.

Test for ___Mean(not assuming equal variances); t- test or 2 Sample T-Test __,

-Ho : $\mu_S = \mu_B$; H_A : $\mu_S \neq \mu_B$

-P = __**0.104244**__, therefore _**Mean**_ is _**not**__ significantly different for Resistor value.

Results:

Since __ **Bartlett's** _ Test and _**t- test or 2 Sample T-Test** _____ show __**significant**_ difference; thus Accept _ **H_A**__.

Conclusions:

_____**Synton - Tech Corporation (S) and B2B Freezone (B) resistors are different**