UNIVERSITI SAINS MALAYSIA

Kolej Legenda

First Semester Examination
2005/2006 Academic Session
November 2005

External Degree Programme
Bachelor of Computer Science (Hons.)

MAA161E - Statistics For Science Students
[Statistik Untuk Pelajar Sains]

Duration : 3 hours
[Masa: 3 jam]

INSTRUCTIONS TO CANDIDATE:

- Please ensure that this examination paper contains **FOUR** questions in **THIRTEEN** printed pages before you begin the examination.

  *[Sila pastikan bahawa kertas peperiksaan ini mengandungi **EMPAT** soalan di dalam **TIGA BELAS** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]*

- Answer **ALL** questions.

  *[Jawab **SEMUA** soalan.]*

- On each page, write *only your **Index Number**.*

  *[Dalam setiap muka surat, tulis **Angka Giliran** anda sahaja.]*

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1. (a) The distribution of lifespan for 100 light bulbs are shown in the table below:

Lifespan (hours)	Number of Light Bulbs
600 - 699	6
700 - 799	13
800 - 899	18
900 - 999	24
1000 - 1099	30
1100 - 1199	9

$$\sum x_i f_i = 93550 \; ; \quad \sum x_i^2 f_i = 89396425$$

(i) Calculate the mean, median and standard deviation of the bulbs' lifespan.

(ii) Describe the type of skewness for the above distribution.

(iii) Determine the interquartile range of the lifespan.

(iv) Find the value of k so that at least 65% of the lifespan are within k standard deviation of the mean.

(b) Out of 5 mathematicians and 7 physicists, a committee consisting of 2 mathematicians and 3 physicists is to be formed. How many ways can this be done if

(i) any mathematician and any physicist can be included?

(ii) one particular physicist must be in the committee?

(iii) two particular mathematicians cannot be in the committee?

(c) If A, B and C are three independent events, show that events A and $(B \cup C)$ are also independent.

(d) During an epidemic of a certain disease a doctor is consulted by 110 people, suffering from symptoms commonly associated with the disease. Of the 110 people, 45 are female of whom 20 actually have the disease. Fifteen males have the disease and the rest do not.

(i) A person is selected at random. The event that this person is female is denoted by F and the event that this person is suffering from the disease is denoted by D. Evaluate $P(F \cup D)$.

(ii) Of people with the disease, 96% react positively to a test for diagnosing the disease as do 8% of people without the disease. What is the probability of a person selected at random having the disease given that he or she reacted positively?

(100/100)

2. (a) 70% of the passengers who travel to Kuala Lumpur buy Berita Harian newspaper at the bookstall before boarding the train. The train is full and each carriage holds 10 passengers.

(i) What is the probability that at most three passengers in a carriage have bought Berita Harian?

(ii) If there are 40 carriage on the train, in how many of them would you expect there to be exactly three copies of Berita Harian?

(iii) If 8 people are standing in the corridor, what is the probability that the third passenger in the corridor of a carriage is the first who has bought Berita Harian?

(b) In a certain nation, men have heights distributed normally with mean 1.70 meter and standard deviation 10 cm. Meanwhile women have heights distributed normally with mean 1.60 meter and standard deviation 7.5 cm.

(i) Find the probability that a man chosen randomly has height not less than 1.83 meter.

(ii) What is the probability that the average height of 3 men chosen randomly is greater than 1.78 meter?

(iii) Find the probability that a husband and wife have less than 5 cm difference in heights.

(c) A news agent sells telephone cards at RM1, RM2, RM4, RM10 or RM20. The value of a telephone card sold may be regarded as a random variable, X, with the following probability distribution.

x	1	2	4	10	20
$P(X = x)$	p	$2p$	$2q$	q	0.07

(i) Given that $3P(X > 2) = 2P(X \leq 2)$, find the value of p and q.

(ii) Find the mean and variance of X.

(iii) Determine the value of median.

(iv) What is the probability that the value of the telephone card sold is less than RM5?

(100/100)

3\. (a) A study is made to determine if a cold climate results in more students being absent from school during a semester than for a warmer climate. Two groups of students are selected at random, one group from state A and the other group from state B. Of the 300 students from state A, 64 were absent at least one day during the semester and of the 400 students from state B, 51 were absent one or more days.

(i) What can we assert with 90% confidence about the possible size of our error if we estimate the fraction of the students who are absent in state A to be 0.15?

(ii) Construct a 95% confidence interval for the difference between the fractions of the students who are absent in the two states. Interpret your results.

(b) A manufacturer has developed a new fishing line, which he claims has a mean breaking strength of 15 kg. with a standard deviation of 0.5 kg. To test the hypothesis that $\mu = 15$ kg. against the alternative that $\mu < 15$ kg., a random sample of 50 lines will be tested. The critical region is defined to be $\bar{x} < 14.9$.

(i) Find the significance level of this test.

(ii) Find *P(Type II error)* if $\mu = 14.8$ kg.

(iii) Determine the power of the test. Explain your result.

(c) A researcher wishes to compare two different groups of students with respect to their mean time to complete a particular task using different technique. The time required is determined for each independent group. Using the following summary,

Technique	n	$\bar{x}$	s
1	11	23.5	2.7
2	8	20.4	5.2

(i) test whether group 1 and group 2 come from population with the same variance. Use a 5% significance level.

(ii) based on the results in part (i), test at the 2.5% significance level if the mean time to complete a particular task by group 1 is greater than group 2.

(iii) if the variable U is chi-square-distributed with $n = 8$, find χ_1^2 and χ_2^2 such that $P(\chi_1^2 \leq U \leq \chi_2^2) = 0.90$.

(100/100)

4. (a) Two different makes of stopwatches were used to time 12 different runners over a particular course. Using the times in second shown in the table.

	Runner											
Stopwatch	1	2	3	4	5	6	7	8	9	10	11	12
Type 1	59	49	64	60	54	47	49	58	66	76	70	66
Type 2	57	46	63	60	50	48	54	54	60	72	72	66

(i) Find the point estimate for the mean time difference where $d = type\ 1 - type\ 2$.

(ii) Construct a 95 % confidence interval for the mean time difference. Interpret your result based on the problem above.

(b) A sociologist recorded the number of years of school, x, and the number of hours of TV viewing per week, y, for a group of adults who were over 30 years of age. The results are given below.

Years of school, x	12	16	14	10	16	12	19	14
TV viewing hours, y	14	8	10	17	4	18	4	15

$\sum x = 113$; $\sum y = 90$; $\sum xy = 1172$; $\sum x^2 = 1653$; $\sum y^2 = 1230$

(i) Estimate the equation of the least square regression line.

(ii) Interpret the slope of the regression line.

(iii) Calculate the value of variation about the regression line.

(iv) Is there evidence at the 1% level that viewing hours and years of school are linearly related?

(c) (i) Suppose we have a multinomial experiment with the cells shown below. What observed frequencies a, b, c, d and e would results in $\chi^2 = 0$ if we were testing the hypothesis that I, II, III , IV and V occur in the ratio 10 : 7 : 5 : 4 : 2 with random sample of size 840?

	I	II	III	IV	V
	a	b	c	d	e

(ii) The following is the distribution of the number of bears spotted on 100 sightseeing tours in a National Park.

Number of bears	0	1	2	3
Number of tours	70	22	7	1

Test at the 0.05 level of significance whether the data on bear sightings is a random sample from a Poisson distribution with $\mu = 0.5$.

(100/100)

APPENDIX

FORMULA
MAA 161E –Statistics For Science Students

Confidence Interval:

$$\overline{X} \pm Z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}}$$

$$\overline{d} \pm t_{\frac{\alpha}{2}} \frac{s_d}{\sqrt{n_d}}$$

$$\overline{X} \pm t_{\frac{\alpha}{2}} \frac{s}{\sqrt{n}}$$

$$b \pm t_{\frac{\alpha}{2}} s_b$$

$$(\overline{X} - \overline{Y}) \pm t_{\alpha/2}\, S_p \sqrt{\frac{1}{n_x} + \frac{1}{n_y}}$$

$$\hat{p} \pm Z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

$$(\hat{p}_x - \hat{p}_y) \pm z_{\alpha/2} \cdot \sqrt{\frac{\hat{p}_x(1-\hat{p}_x)}{n_x} + \frac{\hat{p}_y(1-\hat{p}_y)}{n_y}}$$

$$(\overline{X} - \overline{Y}) \pm Z_{\alpha/2} \cdot \sqrt{\frac{\sigma_x^{\ 2}}{n_x} + \frac{\sigma_y^{\ 2}}{n_y}}$$

$$(\overline{X} - \overline{Y}) \pm t_{\alpha/2} \cdot \sqrt{\frac{s_x^{\ 2}}{n_x} + \frac{s_y^{\ 2}}{n_y}}$$

$$\left(\frac{(n-1)s^2}{\chi^2_{\frac{\alpha}{2}, n-1}}, \frac{(n-1)s^2}{\chi^2_{1-\frac{\alpha}{2}, n-1}} \right)$$

$$\left(\frac{s}{1 + \frac{Z_{\frac{\alpha}{2}}}{\sqrt{2n}}}, \frac{s}{1 - \frac{Z_{\frac{\alpha}{2}}}{\sqrt{2n}}} \right)$$

$$\left(\frac{s_1^2}{s_2^2} F_{1-\frac{\alpha}{2}, (v_2, v_1)}, \frac{s_1^2}{s_2^2} F_{\frac{\alpha}{2}, (v_2, v_1)} \right)$$

Test Statistic:

$$Z = \frac{\overline{X} - \mu}{\sigma / \sqrt{n}}$$

$$T = \frac{\overline{X} - \mu}{s / \sqrt{n}}$$

$$T = \frac{\overline{d} - \mu_d}{s_d / \sqrt{n_d}}$$

$$T = \frac{b - \beta_1}{s_b}$$

$$T = r\sqrt{\frac{n-2}{1-r^2}}$$

$$\chi^2 = \frac{(n-1)s^2}{\sigma^2}$$

$$Z = \frac{s - \sigma}{\sigma / \sqrt{2n}}$$

$$Z = \frac{(\overline{X} - \overline{Y}) - (\mu_x - \mu_y)}{\sqrt{\frac{\sigma_x^{\ 2}}{n_x} + \frac{\sigma_y^{\ 2}}{n_y}}}$$

$$T = \frac{(\overline{X} - \overline{Y}) - (\mu_x - \mu_y)}{\sqrt{S_p^{\ 2}\left(\frac{1}{n_x} + \frac{1}{n_y}\right)}}$$

$$S_p^{\ 2} = \frac{(n_x - 1)s_x^{\ 2} + (n_y - 1)s_y^{\ 2}}{n_x + n_y - 2}$$

$$F = \frac{s_x^2}{s_y^2}$$

$$Z = \frac{(\hat{p}_x - \hat{p}_y) - (p_x - p_y)}{\sqrt{\hat{p}(1-\hat{p})\left(\frac{1}{n_x} + \frac{1}{n_y}\right)}}$$

$$T = \frac{(\overline{X} - \overline{Y}) - (\mu_x - \mu_y)}{\sqrt{\frac{s_x^2}{n_x} + \frac{s_y^2}{n_y}}}$$

$$dk = \frac{\left(\frac{s_x^2}{n_x} + \frac{s_y^2}{n_y}\right)^2}{\frac{\left(\frac{s_x^2}{n_x}\right)^2}{n_x - 1} + \frac{\left(\frac{s_y^2}{n_y}\right)^2}{n_y - 1}}$$

$$\chi^2 = \sum \frac{(O-E)^2}{E}, \quad E = np$$

Regression / Correlation Analysis

$$s_e = \sqrt{\frac{S_{YY} - bS_{XY}}{n-2}} \quad ; \quad s_b = \frac{s_e}{\sqrt{S_{XX}}} \quad ; \quad r = \frac{S_{XY}}{\sqrt{S_{XX} . S_{YY}}}$$

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KERTAS SOALAN DALAM VERSI BAHASA MALAYSIA

1. (a) Taburan masahayat bagi 100 mentol adalah seperti yang berikut:

Masahayat (jam)	Bilangan Mentol
600 - 699	6
700 - 799	13
800 - 899	18
900 - 999	24
1000 - 1099	30
1100 - 1199	9

$$\sum x_i f_i = 93550 \quad ; \quad \sum x_i^2 f_i = 89396425$$

(i) Hitung min, median dan sisihan piawai bagi masahayat mentol.

(ii) Huraikan bentuk pencongan bagi taburan data di atas.

(iii) Tentukan julat antara kuartil masahayat mentol.

(iv) Cari nilai k supaya sekurang-kurangnya 65% daripada masahayat mentol adalah dalam lingkungan k sisihan piawai daripada min.

(b) Satu jawatankuasa akan dibentuk daripada 5 orang ahli matematik dan 7 orang ahli fizik. Jawatankuasa tersebut akan terdiri daripada 2 ahli matematik dan 3 ahli fizik. Berapa carakah ini boleh dilakukan jika

(i) sesiapa jua ahli matematik dan ahli fizik boleh menyertainya?

(ii) seorang ahli fizik yang tertentu mesti menjadi ahli jawatankuasa?

(iii) dua orang ahli matematik yang tertentu tidak boleh menjadi ahli jawatankuasa?

(c) Jika A, B dan C adalah tiga peristiwa yang tak bersandar, tunjukkan bahawa peristiwa A dan $(B \cup C)$ adalah juga tak bersandar.

(d) Semasa suatu wabak sejenis penyakit tertentu, seorang doktor telah diminta memeriksa 110 orang yang menderita daripada gejala yang lazimnya berhubung dengan penyakit tersebut. Daripada 110 orang, 45 orang adalah wanita. Seramai 20 orang dalam kalangan wanita itu mengidap penyakit manakala seramai limabelas orang dalam kalangan lelaki mengidap penyakit tersebut.

(i) Seorang telah dipilih secara rawak. Peristiwa bahawa orang tersebut ialah wanita diwakili oleh F dan peristiwa bahawa orang tersebut sedang menanggung penderitaan daripada penyakit diwakili oleh D. Cari $P(F \cup D)$.

(ii) Bagi ujian menentukan penyakit, didapati daripada mereka yang mengidap penyakit tersebut, 96% bertindak balas positif. Manakala 8% daripada mereka tanpa penyakit bertindak balas positif. Apakah kebarangkalian bagi seorang yang dipilih secara rawak mempunyai penyakit diketahui bahawa dia bertindak balas positif?

(100/100)

2. (a) 70% daripada penumpang keretapi yang dalam perjalanan ke Kuala Lumpur membeli suratkhabar Berita Harian di sebuah kedai sebelum menaiki keretapi. Setiap gerabak dapat memuatkan 10 penumpang sahaja.

(i) Apakah kebarangkalian bahawa sebanyak-banyak tiga daripada penumpang telah membeli Berita Harian?

(ii) Jika keretapi tersebut mempunyai 40 gerabak, berapakah bilangan penumpang yang dijangkakan mempunyai tepat tiga naskah Berita Harian?

(iii) Jika 8 orang berdiri di koridor, apakah kebarangkalaian bahawa penumpang yang ketiga di koridor dalam sebarang gerabak adalah yang pertama membeli Berita Harian?

(b) Dalam suatu masyarakat tertentu, tinggi lelaki bertaburan normal dengan min 1.70 meter dan sisihan piawai 10 cm. Manakala tinggi wanita bertaburan normal dengan min 1.60 meter dan sisihan piawai 7.5 cm.

(i) Cari kebarangkalian bahawa seorang lelaki yang dipilih secara rawak mempunyai tinggi tidak kurang daripada 1.83 meter.

(ii) Cari kebarangkalian bahawa purata tinggi bagi 3 orang lelaki yang dipilih secara rawak adalah lebih daripada 1.78 meter.

(iii) Cari kebarangkalian bahawa seorang suami dan isterinya mempunyai perbezaan tinggi kurang daripada 5 cm.

(c) Sebuah agen berita menjual kad telefon pada harga RM1, RM2, RM4, RM10 atau RM20. Harga bagi satu kad telefon yang dijual boleh dianggap sebagai pembolehubah rawak, X, dengan taburan kebarangkalian seperti yang berikut.

x	1	2	4	10	20
$P(X = x)$	p	$2p$	$2q$	q	0.07

(i) Diketahui bahawa $3P(X > 2) = 2P(X \leq 2)$, cari nilai p dan q.

(ii) Cari min dan varians bagi X.

(iii) Tentukan nilai median.

(iv) Cari kebarangkalian bahawa nilai bagi kad telefon yang dijual ialah kurang daripada RM5?

(100/100)

3. (a) Suatu kajian telah dijalankan untuk menentukan sama ada pada musim sejuk berkesudahan dengan ramai pelajar tidak hadir ke sekolah sepanjang satu semester berbanding dengan musim panas. Dua kumpulan pelajar telah dipilih secara rawak; satu kunpulan dari negeri A dan kumpulan kedua dari negeri B. Daripada seramai 300 orang pelajar dari negeri A, 64 orang pelajar tidak hadir sekurang-kurangnya sehari sepanjang semester. Manakala daripada 400 orang pelajar dari negeri B, 51 orang pelajar tidak hadir sekurang-kurangnya sehari.

(i) Apakah yang boleh didakwa dengan 90% keyakinan mengenai saiz ralat yang mungkin, jika kita menganggar bahawa kadaran pelajar-pelajar yang tidak hadir dari negeri A ialah 0.15?

(ii) Binakan selang keyakinan 95% bagi perbezaan antara kadaran pelajar yang tidak hadir dari kedua-dua negeri. Ulaskan jawapan anda.

(b) Pengusaha kilang tertentu telah mencipta tali memancing yang baru, iaitu mereka mendakwa bahawa min ketahanan untuk putus ialah 15 kg. dengan sisihan piawai 0.5 kg. Untuk menguji hipotesis bahawa $\mu = 15$ kg. berlawanan alternatif $\mu < 15$ kg., suatu sampel rawak dengan 50 tali akan diuji. Kawasan kritikal ditakrifkan sebagai $\bar{x} < 14.9$.

(i) Cari aras keertian bagi ujian tersebut.

(ii) Cari *P(Ralat Jenis II)* jika $\mu = 14.8$ kg.

(iii) Tentukan nilai kuasa ujian. Jelaskan jawapan anda.

(c) Seorang penyelidik ingin membandingkan dua kumpulan pelajar yang berbeza terhadap purata masa untuk menyelesaikan tugas tertentu. Masa yang diperlukan telah diperoleh untuk setiap kumpulan. Dengan menggunakan ringkasan yang berikut,

Teknik	n	$\bar{x}$	s
1	11	23.5	2.7
2	8	20.4	5.2

(i) uji sama ada kumpulan 1 dan kumpulan 2 adalah dari populasi dengan varians yang sama. Gunakan aras keertian 5%.

(ii) berdasarkan daripada keputusan di bahagian (i), uji pada aras keertian 2.5% jika min masa untuk menyelesaikan tugas tertentu oleh kumpulan 1 lebih besar daripada kumpulan 2.

(iii) jika pemboleh ubah U bertaburan khi-kuasa-dua dengan $n = 8$, cari χ_1^2 dan χ_2^2 yang sedemikian $P(\chi_1^2 \leq U \leq \chi_2^2) = 0.90$.

(100/100)

4. (a) Dua jenis jam randik telah digunakan untuk menyukat masa 12 orang pelari yang berlainan terhadap larian tertentu. Dengan menggunakan masa dalam saat yang ditunjukkan dalam jadual di bawah.

	Pelari											
Jam Randik	1	2	3	4	5	6	7	8	9	10	11	12
Jenis 1	59	49	64	60	54	47	49	58	66	76	70	66
Jenis 2	57	46	63	60	50	48	54	54	60	72	72	66

(i) Cari anggaran titik bagi min perbezaan masa iaitu $d = jenis\ 1 - jenis\ 2$.

(ii) Binakan selang keyakinan 95% untuk min perbezaan masa. Ulaskan jawapan anda berdasarkan masalah di atas.

(b) Seorang pakar ilmu sosiologi mencatatkan bilangan tahun persekolahan, x, dan bilangan jam menonton televisyen dalam seminggu, y, bagi sekumpulan orang dewasa yang berumur lebih daripada 30 tahun. Keputusan adalah seperti berikut.

Bilangan tahun persekolahan, x	12	16	14	10	16	12	19	14
Jam menonton TV, y	14	8	10	17	4	18	4	15

$\sum x = 113$; $\sum y = 90$; $\sum xy = 1172$; $\sum x^2 = 1653$; $\sum y^2 = 1230$

(i) Cari anggaran persamaan garis regresi kuasa dua terkecil.

(ii) Tafsirkan kecerunan garis regresi.

(iii) Kira nilai variasi di sekitar garis regresi.

(iv) Adakah terdapat bukti pada aras keertian 1% bahawa bilangan jam menonton televisyen dan bilangan tahun persekolahan mempunyai hubungan linear?

(c) (i) Andaikan terdapat suatu ujikaji multinomial dengan sel-sel seperti yang ditunjukkan di bawah. Apakah nilai kekerapan yang diamati a, b, c, d dan e yang akan menghasilkan $\chi^2 = 0$ jika kita menguji hipotesis bahawa I, II, III, IV dan V berlaku dalam nisbah 10 : 7 : 5 : 4 : 2 dengan sampel rawak bersaiz 840?

	I	II	III	IV	V
	a	b	c	d	e

(ii) Yang berikut ialah taburan bilangan beruang yang dikesan pada 100 lawatan bersiar-siar di tempat yang indah di sebuah Taman Nasional.

Bilangan beruang	0	1	2	3
Bilangan lawatan	70	22	7	1

Uji pada aras keertian 0.05 sama ada data terhadap beruang yang dikesan ialah suatu sampel rawak daripada taburan Poisson dengan $\mu = 0.5$.

(100/100)

LAMPIRAN

FORMULA
MAA 161E – Statistik Untuk Pelajar Sains

Confidence Interval:

$\overline{X} \pm Z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}}$ $\overline{d} \pm t_{\frac{\alpha}{2}} \frac{s_d}{\sqrt{n_d}}$	$\overline{X} \pm t_{\frac{\alpha}{2}} \frac{s}{\sqrt{n}}$ $b \pm t_{\frac{\alpha}{2}} s_b$	$(\overline{X}-\overline{Y}) \pm t_{\alpha/2}\, S_p \sqrt{\frac{1}{n_x}+\frac{1}{n_y}}$
$\hat{p} \pm Z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$ $(\hat{p}_x - \hat{p}_y) \pm z_{\alpha/2} \cdot \sqrt{\frac{\hat{p}_x(1-\hat{p}_x)}{n_x} + \frac{\hat{p}_y(1-\hat{p}_y)}{n_y}}$ $(\overline{X}-\overline{Y}) \pm Z_{\alpha/2} \cdot \sqrt{\frac{\sigma_x^{\,2}}{n_x} + \frac{\sigma_y^{\,2}}{n_y}}$ $(\overline{X}-\overline{Y}) \pm t_{\alpha/2} \cdot \sqrt{\frac{s_x^{\,2}}{n_x} + \frac{s_y^{\,2}}{n_y}}$		$\left(\frac{(n-1)s^2}{\chi^2_{\frac{\alpha}{2},n-1}}, \frac{(n-1)s^2}{\chi^2_{1-\frac{\alpha}{2},n-1}}\right)$ $\left(\frac{s}{1+\frac{Z_{\frac{\alpha}{2}}}{\sqrt{2n}}}, \frac{s}{1-\frac{Z_{\frac{\alpha}{2}}}{\sqrt{2n}}}\right)$ $\left(\frac{s_1^2}{s_2^2} F_{1-\frac{\alpha}{2},(v_2,v_1)}, \frac{s_1^2}{s_2^2} F_{\frac{\alpha}{2},(v_2,v_1)}\right)$

Test Statistic:

$Z = \frac{\overline{X}-\mu}{\sigma/\sqrt{n}}$ $T = \frac{\overline{X}-\mu}{s/\sqrt{n}}$ $T = \frac{\overline{d}-\mu_d}{s_d/\sqrt{n_d}}$ $T = \frac{b-\beta_1}{s_b}$ $T = r\sqrt{\frac{n-2}{1-r^2}}$ $\chi^2 = \frac{(n-1)s^2}{\sigma^2}$	$Z = \frac{s-\sigma}{\sigma/\sqrt{2n}}$ $Z = \frac{(\overline{X}-\overline{Y})-(\mu_x-\mu_y)}{\sqrt{\frac{\sigma_x^{\,2}}{n_x}+\frac{\sigma_y^{\,2}}{n_y}}}$ $T = \frac{(\overline{X}-\overline{Y})-(\mu_x-\mu_y)}{\sqrt{S_p^{\,2}\left(\frac{1}{n_x}+\frac{1}{n_y}\right)}}$ $S_p^{\,2} = \frac{(n_x-1)s_x^{\,2}+(n_y-1)s_y^{\,2}}{n_x+n_y-2}$ $F = \frac{s_x^2}{s_y^2}$	$Z = \frac{(\hat{p}_x-\hat{p}_y)-(p_x-p_y)}{\sqrt{\hat{p}(1-\hat{p})\left(\frac{1}{n_x}+\frac{1}{n_y}\right)}}$ $T = \frac{(\overline{X}-\overline{Y})-(\mu_x-\mu_y)}{\sqrt{\frac{s_x^2}{n_x}+\frac{s_y^2}{n_y}}}$ $dk = \frac{\left(\frac{s_x^2}{n_x}+\frac{s_y^2}{n_y}\right)^2}{\frac{\left(\frac{s_x^2}{n_x}\right)^2}{n_x-1}+\frac{\left(\frac{s_y^2}{n_y}\right)^2}{n_y-1}}$ $\chi^2 = \sum \frac{(O-E)^2}{E}, \quad E = np$

Regression / Correlation Analysis

$$s_e = \sqrt{\frac{S_{YY} - bS_{XY}}{n-2}} \quad ; \quad s_b = \frac{s_e}{\sqrt{S_{XX}}} \quad ; \quad r = \frac{S_{XY}}{\sqrt{S_{XX}.S_{YY}}}$$

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