UNIVERSITI UTARA MALAYSIA

PEPERIKSAAN AKHIR
SEMESTER PERTAMA SESI 2008/2009

KOD/NAMA KURSUS : JQP2013 / TEKNIK STATISTIK DALAM PEMBUATAN KEPUTUSAN
TARIKH : 8 NOVEMBER 2008
MASA : 9.00 – 11.30 PAGI
TEMPAT : DP 2/4

ARAHAN :
1. Buku soalan ini mengandungi LIMA (5) soalan dan ENAM (6) helai lampiran di dalam TIGA BELAS (13) mukasurat bercetak tidak termasuk kulit hadapan.
2. Sila jawab SEMUA soalan di dalam kertas jawapan yang disediakan.

INSTRUCTIONS:
1. This book script contains FIVE (5) questions and SIX (6) sheets of appendices in THIRTEEN (13) printed pages excluding the cover page.
2. Answer ALL questions in the answer sheet provided.

NO. MATRIK :

(dengan perkataan) (dengan angka)

NO. KAD PENGENALAN :

NAMA PENSYARAH :

KUMPULAN :

NOMBOR MEJA:

JANGAN BUKA KERTAS SOalan INI SEHINGGA DIBERI ARAHAN

SULIT
SOALAN 1 (20 MARKAH)

a. Bagaimanakah penganggar titik dan penganggar selang berbeza?

   How do point estimators and interval estimators differ?

   (4 markah/marks)

b. Apakah ciri penganggar yang dikehendaki? Terangkan salah satu daripada ciri penganggar tersebut?

   What are the desirable characteristics of estimators? Define one of the estimators’ characteristic?

   (5 markah/marks)

c. Terangkan konsep selang keyakinan apabila menganggar min populasi.

   Explain the concept of a confidence interval when estimating a population mean.

   (5 markah/marks)

d. Satu sampel rawak yang terdiri daripada 85 orang ketua kumpulan, penyelia, dan personel yang hampir serupa mendedahkan bahawa seseorang mengambil masa purata selama 6.5 tahun di dalam satu pekerjaan sebelum dapat dinaikkan pangkat. Sisihan piawai populasi ialah 1.7 tahun. Pada darjah keyakinan 0.95, apakah selang keyakinan bagi min populasi itu?

   A random sample of 85 group leaders, supervisors, and similar personnel revealed that a person spent an average 6.5 years on the job before being promoted. The population standard deviation was 1.7 years. Using the 0.95 degree of confidence, what is the confidence interval for the population mean?

   (6 markah/marks)
SOALAN 2 (20 MARKAH)

a. Formulasikan hipotesis kepada masalah berikut:

*Formulate the hypotheses for the following problems:*

i. Berdasarkan pemerikatan lalu, sebuah stesen penyiaran TV5 tempatan mendakwa bahawa penonton yang menonton siaran beritanya pada pukul 11:00 malam adalah mencecah purata 41% daripada 10,000 penonton di Bandar A. Di dalam satu tinjauan yang dijalankan ke atas 100 orang penonton, 36% menyatakan mereka menonton berita lewat mafam yang disiarkan oleh stesen TV5 tempatan.

*Based on the past ratings, the local broadcasting TV5 affiliate claims its 11:00 PM newscast reaches 41% of the 10,000 viewing audience in the B city. In a survey of 100 viewers, 36% indicated that they watch the late evening news on this local TV5 station.*

(3 markah/marks)

ii. Purata pendapatan kasar tahunan pengimpal yang diiktiraf adalah bertabur secara normal dengan min $20,000 dan sisihan piawai $2,000. Sebuah pertubuhan pembinaan kapal ingin mengetahui sama ada pengimpal mereka dapat memperolehi pendapatan tahunan lebih atau kurang daripada $20,000.

*The mean gross annual incomes of certified welders are normally distributed with the mean of $20,000 and a standard deviation of $2,000. The ship building association wishes to find out whether their welders earn more or less than $20,000 annually.*

(3 markah/marks)

iii. Purata kos tuisyen dan bilik di kolej-kolej swasta dilaporkan mencapai $8,500 setiap semester, tetapi seorang pentadbir kewangan percaya bahawa purata kos adalah lebih tinggi. Satu kajian yang dijalankan menggunakan 350 buah kolej swasta telah menunjukkan bahawa purata kos setiap semester ialah $8,745 dengan sisihan piawainya ialah $1,200.

*The average cost of tuition and room at private colleges is reported to be $8,500 per term, but a financial administrator believes that the average cost is higher. A study conducted using 350 private colleges showed that the average cost per term is $8,745 with a standard deviation of $1,200.*

(3 markah/marks)

*Mubin’s Eletric Company produces one type of bulb which had a capacity that approximately normal distributed with a standard deviation of 40 hours. In one executive meeting, one of the members raises his anxiety towards the decreasing of their bulb capacity. All this while, Mubin’s company is very grateful of their average capacity of 783 hours. If a random sample of 30 bulbs indicate average capacity of 780.*

i. Adakah kebimbangan ahli mesyuarat itu berasas pada aras kecertian 5%?

*Is the anxiety of one of the meeting members is reasonable at 5% significance level? (6 markah/marks)*

ii. Adakah kebimbangan ahli mesyuarat itu berasas pada aras kecertian 4%?

*Is the anxiety of one of the meeting members is reasonable at 4% significance level? (2 markah/marks)*

iii. Apakah kesilapan yang mungkin berlaku dalam pengujian ini yang boleh dikelaskan sebagai ralat jenis I?

*What is the error that might happen in this test which can be concluded as type I error? (1.5 markah/marks)*

iv. Apakah kesilapan yang mungkin berlaku dalam pengujian ini yang boleh dikelaskan sebagai ralat jenis II?

*What is the error that might happen in this test which can be concluded as type II error? (1.5 markah/marks)*
SOALAN 3 (20 MARKAH)

a. Data berikut diperolehi daripada tiga shif satu restoran yang populasi bertabur secara normal:

*Given the following data drawn from three shift of a restaurant that their population is normally distributed:*

<table>
<thead>
<tr>
<th></th>
<th>Pagi</th>
<th>Tengahari</th>
<th>Petang</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>morning</em></td>
<td>8</td>
<td>11</td>
<td>16</td>
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<td>16</td>
<td>13</td>
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<tr>
<td>9</td>
<td>10</td>
<td></td>
<td>11</td>
</tr>
</tbody>
</table>

Bentukkan jadual ANOVA dan uji pada aras keertian 5% untuk menentukan sama ada terdapat perbezaan di antara min tiga shif tersebut.

*Set up the ANOVA table and test at the 5% level of significance to determine whether differences exist among the means of three shift.*

(15 markah/marks)

b. Apakah andaian bagi menggunakan ANOVA?

*What are the assumptions for using ANOVA?*

(2 markah/marks)

c. Melalui ujian F, dua penganggaran berbeza yang berasaskan varian populasi telah diperolehi. Sila terangkan DUA (2) penganggaran berbeza tersebut.

*With the F test, two different estimates of the population variance are made. Please define these TWO(2) different estimates.*

(3 markah/marks)
SOALAN 4 (20 MARKAH)

a. Seorang penyelidik ingin mengetahui adakah bilangan orang dewasa yang tidak mempunyai insuran kesihatan bertubur secara sama rata di antara tiga kategori (tahap pendidikan kurang daripada 12 tahun, tahap pendidikan adalah 12 tahun, tahap pendidikan lebih daripada 12 tahun). Satu sampel yang terdiri daripada 60 orang dewasa yang tidak mempunyai insuran kesihatan telah dipilih, dan keputusannya adalah seperti yang ditunjukkan. Pada $\alpha = 0.05$, adakah dapat disimpulkan bahawa frekuensinya tidak sama rata? Gunakan kaedah nilai-P. Jika hipotesis nol ditolak, berikan alasan yang munasabah.

A researcher wishes to see if the number of adults who do not have health insurance is equally distributed among three categories (less than 12 years of education, 12 years of education, more than 12 years education). A sample of 60 adults who do not have health insurance is selected, and the results are shown. At $\alpha = 0.05$ can it be concluded that the frequencies are not equal? Use the P-value method. If the null hypothesis is rejected, give a possible reason for this.

<table>
<thead>
<tr>
<th>Kategori (Category)</th>
<th>Kurang daripada 12 tahun (Less than 12 years)</th>
<th>12 tahun (12 years)</th>
<th>Lebih daripada 12 tahun (More than 12 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frekuensi (Frequency)</td>
<td>29</td>
<td>20</td>
<td>11</td>
</tr>
</tbody>
</table>

(15 markah/marks)

b. Sila berikan LIMA (5) kegunaan taburan khi-kuadrua?

Please give FIVE (5) uses of the chi-square distribution?

(5 markah/marks)
SOALAN 5 (20 MARKAH)

a. Apakah DUA (2) tujuan penggunaan garisan regresi?

*What are the TWO (2) purposes of regression line?*  
(2 markah/marks)

b. Apakah yang dimaksudkan dengan garisan penyuaian terbaik?

*What is meant by the line of best fit?*  
(4 markah/marks)

c. Data berikut menggambarkan jumlah jualan tahunan dan perbelanjaan pengiklanan sebuah syarikat selama 8 tahun.

*The following data represent a company's yearly sales volume and its advertising expenditure over a period of 8 years.*

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<tr>
<th>(Y)</th>
<th></th>
<th>(X)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Jualan di dalam</td>
<td>Pengiklanan di dalam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales in</td>
<td>Advertising in</td>
<td></td>
<td></td>
</tr>
<tr>
<td>($1,000,000)</td>
<td>($10,000)</td>
<td></td>
<td></td>
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<td>32</td>
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</tbody>
</table>

i. Bina satu gambarajah serakan jualan melawan pengiklanan, dan terangkan apa yang ditunjukkan oleh hubungan jualan dan pengiklanan.

*Develop a scatter diagram of sales versus advertising, and explain what it shows regarding the relationship between sales and advertising.*  
(3 markah/marks)

ii. Gunakan kaedah kuasa dua terkecil untuk mengira garisan regresi anggaran di antara jualan dan pengiklanan.

*Use the method of least squares to compute an estimated regression line between sales and advertising.*  
(7 markah/marks)
iii. If the company's advertising expenditure is $400,000, what are the predicted sales? Give the answer in dollars.

(2 markah/marks)

iv. What does the slope of the estimated regression line indicate?

(2 markah/marks)
Jadual Taburan Normal
Normal Probability Table

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8
# The Chi-Square Distribution

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Chapter 3: Important Formulas

Mean for individual data: \( \bar{X} = \frac{\sum X}{n} \)

Mean for grouped data: \( \bar{X} = \frac{\sum f \cdot X}{n} \)

Standard deviation for a sample:
\( s = \sqrt{\frac{\sum X^2 - (\sum X)^2/n}{n-1}} \)

Standard deviation for grouped data:
\( s = \sqrt{\frac{\sum f \cdot X^2 - (\sum f \cdot X)^2/n}{n-1}} \)

Range rule of thumb: \( s = \frac{\text{range}}{4} \)

Chapter 4: Probability and Counting Rules

Addition rule 1 (mutually exclusive events):
\( P(A \text{ or } B) = P(A) + P(B) \)

Addition rule 2 (events not mutually exclusive):
\( P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) \)

Multiplication rule 1 (independent events):
\( P(A \text{ and } B) = P(A) \cdot P(B) \)

Multiplication rule 2 (dependent events):
\( P(A \text{ and } B) = P(A) \cdot P(B \text{ | } A) \)

Conditional probability: \( P(B \text{ | } A) = \frac{P(A \text{ and } B)}{P(A)} \)

Complementary events: \( P(E^c) = 1 - P(E) \)

Fundamental counting rule: Total number of outcomes of a sequence when each event has a different number of possibilities: \( k_1 \cdot k_2 \cdot k_3 \cdot \ldots \cdot k_n \)

Permutation rule: Number of permutations of \( n \) objects taking \( r \) at a time is \( P_r = \frac{n!}{(n-r)!} \)

Combination rule: Number of combinations of \( r \) objects selected from \( n \) objects is \( C_r = \frac{n!}{(n-r)!r!} \)

Chapter 5: Normal Distribution

Standard score: \( z = \frac{X - \mu}{\sigma} \) or \( z = \frac{X - \bar{X}}{s} \)

Mean of sample means: \( \mu_x = \mu \)

Standard deviation of the mean: \( \sigma_x = \frac{\sigma}{\sqrt{n}} \)

Central limit theorem formula: \( z = \frac{\bar{X} - \mu}{\sigma / \sqrt{n}} \)

Chapter 6: Confidence Intervals and Sample Size

Confidence interval for means:
\( \bar{X} - t_{\alpha/2} \left( \frac{\sigma}{\sqrt{n}} \right) < \mu < \bar{X} + t_{\alpha/2} \left( \frac{\sigma}{\sqrt{n}} \right) \)

Confidence interval for means:
\( \bar{X} - t_{\alpha/2} \left( \frac{s}{\sqrt{n}} \right) < \mu < \bar{X} + t_{\alpha/2} \left( \frac{s}{\sqrt{n}} \right) \)

Sample size for means: \( n = \left( \frac{z_{\alpha/2} \cdot \sigma}{\delta} \right)^2 \) where \( E \) is the maximum error of estimate

Confidence interval for a proportion:
\( \hat{p} - \left( z_{\alpha/2} \right) \sqrt{\frac{\hat{p} \cdot \hat{q}}{n}} < p < \hat{p} + \left( z_{\alpha/2} \right) \sqrt{\frac{\hat{p} \cdot \hat{q}}{n}} \)
Sample size for a proportion: \( n = \frac{d^2 q}{\hat{p} (1-\hat{p})} \)

where \( \hat{p} = \frac{\bar{X}}{n} \) and \( q = 1 - \hat{p} \)

Confidence interval for variance:
\[
\frac{(n - 1)s^2}{\chi^2_{1 - \alpha/2}} < \sigma^2 < \frac{(n - 1)s^2}{\chi^2_{\alpha/2}}
\]

Confidence interval for standard deviation:
\[
\sqrt{\frac{(n - 1)s^2}{\chi^2_{1 - \alpha/2}}} < \sigma < \sqrt{\frac{(n - 1)s^2}{\chi^2_{\alpha/2}}}
\]

\[
\text{z test: } z = \frac{\bar{X} - \mu}{\sigma/\sqrt{n}} \quad \text{for any value } n. \text{ If } n < 30, \text{ population must be normally distributed.}
\]

\[
z = \frac{\bar{X} - \mu}{s/\sqrt{n}} \quad \text{for } \sigma \text{ unknown and } n \geq 30
\]

\[
t \text{ test: } t = \frac{\bar{X} - \mu}{s/\sqrt{n}} \quad \text{for } n < 30 \text{ (d.f. } n - 1)\]

\[
z \text{ test for proportions: } z = \frac{\hat{p} - p}{\sqrt{pq/n}}
\]

Chi-square test for a single variance:
\[
\chi^2 = \frac{(n - 1)s^2}{\sigma^2} \quad \text{(d.f. } n - 1\text{)}
\]

Chapter 5: Testing the Difference between Two Means, Two Variances, and Two Proportions

z test for comparing two means (independent samples):
\[
z = \frac{\bar{X}_1 - \bar{X}_2 - (\mu_1 - \mu_2)}{s^2/\sqrt{n_1} + s^2/\sqrt{n_2}}
\]

Formula for the confidence interval for difference of two means (large samples):
\[
(\bar{X}_1 - \bar{X}_2) - z_{\alpha/2} \sqrt{\frac{s^2}{n_1} + \frac{s^2}{n_2}} < \mu_1 - \mu_2
\]
\[
< (\bar{X}_1 - \bar{X}_2) + z_{\alpha/2} \sqrt{\frac{s^2}{n_1} + \frac{s^2}{n_2}}
\]

Note: \( s^2 \) and \( \sigma^2 \) can be used when \( n_1 \geq 30 \) and \( n_2 \geq 30 \).

F test for comparing two variances: \( F = \frac{s^2_1}{s^2_2} \)

where \( s^2_1 \) is the larger variance and \( n_1 - 1 \) d.f.

Appendix 3b

\[ t \text{ test for comparing two means (independent samples, variances not equal):}
\]
\[
t = \frac{\bar{X}_1 - \bar{X}_2 - (\mu_1 - \mu_2)}{\sqrt{\frac{s^2_1}{n_1} + \frac{s^2_2}{n_2}}}
\]

(d.f. = the smaller of \( n_1 - 1 \) or \( n_2 - 1 \))

Formula for the confidence interval for difference of two means (small independent samples, variance unequal):
\[
(\bar{X}_1 - \bar{X}_2) - t_{\alpha/2} \sqrt{\frac{s^2_1}{n_1} + \frac{s^2_2}{n_2}} < \mu_1 - \mu_2
\]
\[
< (\bar{X}_1 - \bar{X}_2) + t_{\alpha/2} \sqrt{\frac{s^2_1}{n_1} + \frac{s^2_2}{n_2}}
\]

(d.f. = smaller of \( n_1 - 1 \) and \( n_2 - 1 \))

\[ t \text{ test for comparing two means (independent samples, variances equal):}
\]
\[
t = \frac{\bar{X}_1 - \bar{X}_2 - (\mu_1 - \mu_2)}{\sqrt{\frac{(n_1 - 1)s^2_1 + (n_2 - 1)s^2_2}{n_1 + n_2 - 2}} \cdot \frac{1}{\sqrt{n_1/n_2}}}
\]

(d.f. = \( n_1 + n_2 - 2 \))

Formula for the confidence interval for difference of two means (small independent samples, variances equal):
\[
(\bar{X}_1 - \bar{X}_2) - t_{\alpha/2} \sqrt{\frac{(n_1 - 1)s^2_1 + (n_2 - 1)s^2_2}{n_1 + n_2 - 2}} \cdot \frac{1}{\sqrt{n_1/n_2}} \quad < \mu_1 - \mu_2
\]
\[
< (\bar{X}_1 - \bar{X}_2) + t_{\alpha/2} \sqrt{\frac{(n_1 - 1)s^2_1 + (n_2 - 1)s^2_2}{n_1 + n_2 - 2}} \cdot \frac{1}{\sqrt{n_1/n_2}}
\]

and d.f. = \( n_1 + n_2 - 2 \).

\[ t \text{ test for comparing two means for dependent samples:}
\]
\[
t = \frac{\bar{D} - \mu_D}{s_d/\sqrt{n}} \quad \text{where } \bar{D} = \frac{\Sigma D}{n} \text{ and }
\]
\[
s_D = \sqrt{\frac{\Sigma D^2 - (\Sigma D)^2/n}{n - 1}}
\]

(d.f. = \( n - 1 \))

Formula for confidence interval for the mean of the difference for dependent samples:
\[
\bar{D} - t_{\alpha/2} s_D < \mu_D < \bar{D} + t_{\alpha/2} s_D
\]

(d.f. = \( n - 1 \))
z test for comparing two proportions:

$$z = \frac{(\hat{p}_1 - \hat{p}_2) - (p_1 - p_2)}{\sqrt{\frac{\hat{p}(1 - \hat{p})}{n_1} + \frac{\hat{p}(1 - \hat{p})}{n_2}}}$$

where

$$\hat{p} = \frac{X_1 + X_2}{n_1 + n_2} \quad \hat{p}_1 = \frac{X_1}{n_1}$$

$$q = 1 - \hat{p} \quad \hat{p}_2 = \frac{X_2}{n_2}$$

Formula for the confidence interval for the difference of two proportions:

$$(\hat{p}_1 - \hat{p}_2) - z_{a/2} \sqrt{\frac{\hat{p}_1 \hat{q}_1}{n_1} + \frac{\hat{p}_2 \hat{q}_2}{n_2}} < p_1 - p_2$$

$$< (\hat{p}_1 - \hat{p}_2) + z_{a/2} \sqrt{\frac{\hat{p}_1 \hat{q}_1}{n_1} + \frac{\hat{p}_2 \hat{q}_2}{n_2}}$$

Chapter 5: Correlation and Regression

Correlation coefficient:

$$r = \frac{n \sum xy - (\sum x)(\sum y)}{\sqrt{[n \sum x^2 - (\sum x)^2][n \sum y^2 - (\sum y)^2]}}$$

t test for correlation coefficient: $t = r \sqrt{n - 2}$

(d.f. = $n - 2$)

The regression line equation: $y' = a + bx$

where

$$a = \frac{\sum (y - \bar{y})(x - \bar{x})}{\sum (x - \bar{x})^2}$$

$$b = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sum (x - \bar{x})^2}$$

Coefficient of determination: $r^2 = \frac{\text{explained variation}}{\text{total variation}}$

Standard error of estimate:

$$s_{xy} = \sqrt{\frac{\sum x^2 - a \sum x - b \sum xy}{n - 2}}$$

Prediction interval for $y'$:

$$y' - t_{a/2}s_{xy} \sqrt{1 + \frac{1}{n} + \frac{(x - \bar{x})^2}{\sum x^2 - (\sum x)^2}}$$

$$< y < y' + t_{a/2}s_{xy} \sqrt{1 + \frac{1}{n} + \frac{(x - \bar{x})^2}{\sum x^2 - (\sum x)^2}}$$

(d.f. = $n - 2$)

Formula for the multiple correlation coefficient:

$$R = \sqrt{\frac{\sum y^2 - \sum r_{y,j}^2}{1 - \sum r_{y,j}^2}}$$

Formula for the $F$ test for the multiple correlation coefficient:

$$F = \frac{R^2/k}{(1 - R^2)(n - k - 1)}$$

(d.f. = $n - k$ and d.f. D. = $n - k - 1$)

Formula for the adjusted $R^2$:

$$R_{adj}^2 = 1 - \frac{\left[1 - R^2(n - 1)\right]}{n - k}$$

Chi-square test for goodness-of-fit:

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

(d.f. = no. of categories - 1)

Chi-square test for independence and homogeneity of proportions:

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

[d.f. = (rows - 1)(cols. - 1)]

Chapter 6: Analysis of Variance

ANOVA test:

$$F = \frac{s_{A}^2}{s_B^2}$$

where $\bar{X}_{om} = \frac{\sum X}{N}$

d.f. N. = $k - 1$ where $N = n_1 + n_2 + \cdots + n_k$

d.f. D. = $N - k$ where $k$ = number of groups

$$s_A^2 = \frac{\sum (X_{om} - \bar{X}_{om})^2}{k - 1}$$

$$s_B^2 = \frac{\sum (X_{om} - \bar{X}_{om})^2}{\Sigma (n_i - 1)}$$

Scheffé test: $F_{S} = \frac{(\bar{X} - \bar{X}_{om})^2}{s_B^2(1/n_i + 1/n_j)}$

and $F' = (k - 1)(C.V.)$

Tukey test: $q = \frac{\bar{X} - \bar{X}_{om}}{\sqrt{s_B/n}}$

Formulas for two-way ANOVA:

$$MS_A = \frac{SS_A}{a - 1} \quad F_A = \frac{MS_A}{MS_w}$$

$$MS_B = \frac{SS_B}{b - 1} \quad F_B = \frac{MS_B}{MS_w}$$

$$MS_{A\times B} = \frac{SS_{A\times B}}{(a - 1)(b - 1)} \quad F_{A\times B} = \frac{MS_{A\times B}}{MS_w}$$

$$MS_w = \frac{SS_w}{abn - 1}$$
Alternatives Formula

Estimated Simple Linear Regression

\[ \hat{y} = b_0 + b_1 x \]

Slope and y-Intercept for the Estimated Regression Equation

\[ b_1 = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sum (x_i - \bar{x})^2} \]

\[ b_0 = \bar{y} - b_1 \bar{x} \]

Sum of Squares Due to Error

\[ SSE = \sum (y_i - \hat{y}_i)^2 \]

Total Sum of Squares

\[ SST = \sum (y_i - \bar{y})^2 \]

Sum of Squares Due to Regression

\[ SSR = \sum (\hat{y}_i - \bar{y})^2 \]

Relationship among SST, SSR, and SSE

\[ SST = SSR + SSE \]

Coefficient of Determination

\[ r^2 = \frac{SSR}{SST} \]

Sample Correlation Coefficient

\[ r_{xy} = (\text{sign of } b_1) \sqrt{\text{coefficient of determination}} \]

\[ = (\text{sign of } b_1) \sqrt{r^2} \]