
UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2004/2005

March 2005

PLG 701E - Advanced Statistics in Educational Research
(Statistik Lanjutan dalam Penyelidikan Pendidikan)

Time : 3 hours
(Masa: 3 Jam)

Before you begin, please check that this question paper contains **THIRTEEN** printed page, including this page.

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

DIRECTION:

This question paper contains **FOUR (4)** questions. Answer **Question 1** in Section A and **TWO (2)** other questions in Section B.

ARAHAN:

*Kertas soalan ini mengandungi **EMPAT (4)** soalan. Jawab **Soalan 1** dalam Bahagian A dan **DUA (2)** soalan lain dalam Bahagian B*

SECTION A (40%)

Compulsory question.

1. The table below reports two separate 3-Way ANOVA results, one for each dependent variable: FIS (Frequency of Information-seeking) and VIS (Variety of Information-seeking).

Source	df	Frequency of Information-seeking		Variety of Information-seeking	
		MS	F	MS	F
Treatment (A)	5	155.81	11.93	60.70	18.44**
School Type (B)	2	53.08	4.08*	7.13	1.81
Gender (C)	1	164.69	12.61**	50.17	12.76**
A x B	10	8.65	0.66	1.70	0.43
A x C	5	7.14	0.54	2.60	0.66
B x C	2	28.77	2.20	5.67	1.44
A x B x C	10	4.87	0.37	3.08	0.78
Within Groups	108	13.06		3.93	
Total	143	18.81			

* $p > 0.05$; ** $p > 0.01$ (Source: *Journal of Counseling Psychology*, 1970, 17, 127-132)

Variable A is *Counseling treatments*, with five types of experimental treatment, namely C1, C2, C3, C4, and C5 against a control group. The classification variables include B (*School Types: rural-suburban-urban*) and C (*Gender: male-female*).

- (a) What do you mean by main effects and interaction effects? Explain. (5 marks)
- (b) Interpret the results of the two univariate ANOVA. What conclusions can you draw from the results with respect to the main effects and the interaction effects? (6 marks)
- (c) What additional information must be reported to enable a more complete interpretation of the results? (4 marks)
- (d) How many levels are present in variable A? (2 marks)
- (e) State the relationship between MS, df and SS. (2 marks)

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- (f) The correlation between frequency of Information-seeking and variety of Information-seeking was found to be 0.32 (significant at 0.01 level). Explain why MANOVA would be more appropriate than univariate ANOVA.
(4 marks)
- (g) State the MANOVA null hypothesis for counseling treatments with respect to the two dependent variables.
(4 marks)
- (h) Explain what is meant by *post hoc* analysis? Which independent variables should be analysed?
(4 marks)
- (i) State and explain two basic tests of assumptions that must be performed to assess model fit when a researcher uses MANOVA procedure.
(4 marks)
- (j) Briefly explain how a covariate functions in MANOVA or ANOVA. Under what circumstances should a covariate be used?
(5 marks)

SECTION B (60%)

Answer any **TWO (2)** questions.

2. The following table shows the results of a multiple regression analysis for 2 criterion variables and 6 predictor variables. Only the multiple correlation coefficient (R) and beta weights are reported.

Criterion Variable	Multiple R	Beta weights for Predictors					
		LM	NLM	RV	RC	AR	AF
Reading	0.598	0.044	0.094	0.292	0.472	-0.142	-0.016
Language	0.574	0.158	0.158	0.174	0.453	-0.166	-0.009

(Source: H.E. Anderson. The prediction of reading and language from the California tests. *Educational and Psychological Measurement*, 1961, 21, 1035-1036)

- (a) What is the relationship between regression coefficient and beta weight?
(5 marks)
- (b) How would you explain the relative importance of the independent variables in a regression equation?
(5 marks)
- (c) Interpret the multiple correlation coefficients in the above table. How many percent of the criterion variance is predictable by the sets of predictor variables? What is the single best predictor or combination of best predictors for each of the criterion variables? Justify your choice.
(10 marks)
- (d) Why is it important to examine the assumption of linearity when a researcher uses multiple regression analysis? Explain.
(5 marks)
- (e) Why is ethnicity generally not an appropriate independent variable for regression analysis? Under what circumstance would you use ethnicity in regression analysis?
(5 marks)

3. (a) Explain the differences between the objectives of data summarisation and data reduction. (4 marks)
- (b) What guidelines would you use to determine the number of factors to extract in factor analysis? Explain each briefly. (4 marks)
- (c) *The Depression Adjective Checklists (DCL)* is an instrument containing 17 adjectives that are used to measure the emotion state of a person. The respondents express their emotion using a 5-point Likert Scale. High value indicates *elated* mood and low values indicate *depressed* mood. The table below shows the result of a factor analysis (after rotation) of DCL conducted on a sample of subjects.

DCL Item	Factor 1	Factor 2
Unhappy	.63	
Dispirited	.58	
Blue	.56	
Downcast	.56	
Distressed	.51	
Lost	.47	
Forlorn	.45	
Lonely	.42	
Broken	.39	
Burdened	.39	.48
Cheerless	.34	
Active		.47
Composed		.48
Good		.48
Peaceful		.49
Free		.53
Vigorous		.47

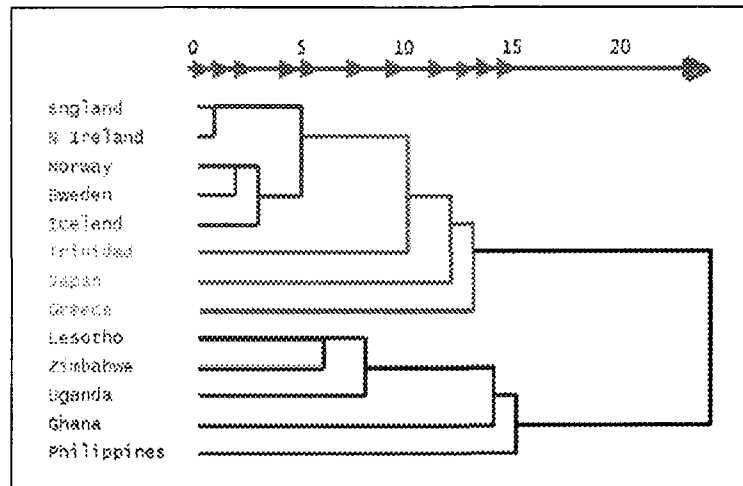
Eigenvalues	3.117	2.710
% of Variance	44.519	38.727
Cumulative %	44.519	83.246

Interpret the results of the factor loadings by:

- (i) explaining the significance of the eigenvalue statistics (5 marks)
- (ii) giving an appropriate label to each of the factors (5 marks)
- (d) Based on the results shown in the table, would you expect a depressed person to score high, medium or low on factor 1 and factor 2, respectively? Justify your answer. (4 marks)

- (e) What is the limitation of factor analysis with respect to sample size question?
(4 marks)
- (f) How does the measure of sampling adequacy (MSA) index inform us with regards to the appropriateness of factor analysis?
(4 marks)
4. (a) What is the purpose of cluster analysis? In what way is the procedure different from factor analysis?
(5 marks)
- (b) What should one consider when selecting a similarity measure to use in cluster analysis?
(4 marks)
- (c) Differentiate between *single linkage*, *complete linkage*, and *average linkage* procedures in hierarchical cluster analysis.
(5 marks)
- (d) Under what circumstances should hierarchical or non-hierarchical cluster analysis be appropriately used? Explain.
(4 marks)
- (e) How does a researcher decide on the number of clusters to have in the solution?
(4 marks)

- (f) A international study was conducted to study grade 8 students' interest towards learning science and technological topics. Based on the students' responses in 13 countries, a Hierarchical Cluster Analysis was performed and the following dendrogram was obtained:



- (i) Interpret the dendrogram.
- (ii) What conclusion would you draw regarding the pattern of students' interests in these countries.

(8 marks)

TERJEMAHAN
BAHAGIAN A (40%)

Jawab **Soalan 1** yang **diWAJIBKAN**.

1. Jadual berikut melaporkan keputusan ANOVA tiga-hala untuk dua variabel bebas: Kekekapan mencari maklumat, FIS (Frequency of Information-seeking) dan Kepelbagaian mencari maklumat, VIS (Variety of Information-seeking).

Source	df	Frequency of Information-seeking		Variety of Information-seeking	
		MS	F	MS	F
Treatment (A)	5	155.81	11.93	60.70	18.44**
Type School (B)	2	53.08	4.08*	7.13	1.81
Sex (C)	1	164.69	12.61**	50.17	12.76**
A x B	10	8.65	0.66	1.70	0.43
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* $p > 0.05$; ** $p > 0.01$ (Source: *Journal of Counseling Psychology*, 1970, 17, 127-132)

Variabel A ialah *Rawatan Kaunseling*. Terdapat 5 jenis rawatan eksperimen, C1, C2, C3, C4, and C5 berbanding dengan satu kumpulan kawalan. Variabel terdiri daripada B (*Jenis Sekolah*: desa-pinggir bandar-bandar) dan C (*Jantina*: lelaki-perempuan).

- (a) Apakah yang dimaksudkan dengan kesan-kesan utama dan kesan-kesan interaksi? Jelaskan. (5 markah)
- (b) Tafsirkan keputusan kedua-dua ANOVA univariat tersebut. Apakah kesimpulan yang boleh diperolehi terhadap kesan-kesan utama dan kesan-kesan interaksi? (6 markah)
- (c) Apakah maklumat tambahan yang perlu dilaporkan supaya gambaran tafsiran keputusan yang lebih lengkap diperolehi? (4 markah)
- (d) Berapakah paras yang wujud dalam variabel A? (2 markah)
- (e) Sebutkan hubungan antara MS, df and SS. (2 markah)

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- (f) Korelasi antara kekerapan mencari maklumat, FIS dan kepelbagaian mencari maklumat, VIS ialah 0.32 (signifikan pada paras 0.01). Jelaskan mengapa MANOVA adalah lebih sesuai digunakan berbanding dengan ANOVA univariat.
(4 markah)
- (g) Sebutkan hipotesis nol MANOVA untuk Rawatan Kaunseling dengan merujuk kepada kedua-dua variabel bebas.
(4 markah)
- (h) Jelaskan maksud analisis *post hoc*? Manakah variabel bebas di atas patut dianalisis?
(4 markah)
- (i) Sebut dan jelaskan dua ujian andaian asas yang perlu dilaksanakan untuk menilai kesesuaian model (*model fit*) apabila penyelidik mengguna prosedur MANOVA.
(4 markah)
- (j) Jelaskan dengan ringkas bagaimana kovariat berfungsi dalam ANOVA atau MANOVA. Dalam keadaan manakah kovariat patut digunakan?
(5 markah)

BAHAGIAN B (60%)

Jawab **DUA (2)** soalan lain.

2. Jadual berikut menunjukkan keputusan analisis pelbagai regresi untuk 2 variabel kriteria dan 6 variabel peramal. Hanya nilai pekali pelbagai regresi dan keberatan beta dilaporkan.

Variabel Kriteria	Multiple R	Keberatan Beta untuk Peramal					
		LM	NLM	RV	RC	AR	AF
Membaca	0.598	0.044	0.094	0.292	0.472	-0.142	-0.016
Bahasa	0.574	0.158	0.158	0.174	0.453	-0.166	-0.009

(Source: H.E. Anderson. The prediction of reading and language from the California tests. *Educational and Psychological Measurement*, 1961, 21, 1035-1036)

- (a) Apakah hubungan di antara pekali regresi dengan keberatan beta (*beta weight*)?
(5 markah)
- (b) Bagaimanakah anda hendak menjelaskan kepentingan relatif variabel bebas dalam persamaan regresi?
(5 markah)
- (c) Tafsirkan pekali-pekali pelbagai regresi dalam jadual di atas. Berapa peratuskah varian peramal dapat diramal oleh set variabel peramal tertentu? Apakah variabel peramal tunggal atau kombinasi variabel peramal yang dapat meramal variabel kriteria dengan paling baik? Nyatakan hujah untuk menyokong jawapan anda.
(10 markah)
- (d) Mengapa penelitian andaian lineariti begitu penting apabila penyelidik mengguna analisis pelbagai regresi? Jelaskan.
(5 markah)
- (e) Mengapa variabel *keetnik* tidak sesuai digunakan sebagai variabel bebas untuk analisis regresi? Dalam keadaan bagaimanakah anda boleh mengguna variabel *keetnik* dalam analisis regresi.
(5 markah)

3. (a) Jelaskan perbezaan antara objektif pemerumusan data (*data summarisation*) dan objektif pengecilan data (*data reduction*). (4 markah)
- (b) Apakah garis panduan yang anda akan guna untuk menentu bilangan faktor yang dapat diekstrakkan dalam analisis faktor? Jelaskan setiapnya dengan ringkas. (4 markah)
- (c) *Depression Adjective Cheklists (DCL)* yang mengandungi 17 perkataan adalah satu alat ukur yang direka untuk mengukur keadaan emosi seseorang. Seorang responden menjelaskan emosinya berdasarkan skala Likert 5 titik. Nilai tinggi menunjukkan keadaan fikiran gembira (*elated mood*), dan nilai rendah menunjukkan keadaan fikiran tertekan (*depressed mood*). Jadual berikut menunjukkan keputusan muatan faktor (*faktor loading*) yang diperolehi menerusi analisis faktor (selepas putaran) ke atas DCL untuk satu sampel subjek:

DCL Item	Factor 1	Factor 2
Unhappy	.63	
Dispirited	.58	
Blue	.56	
Downcast	.56	
Distressed	.51	
Lost	.47	
Forlorn	.45	
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Eigenvalues	3.117	2.710
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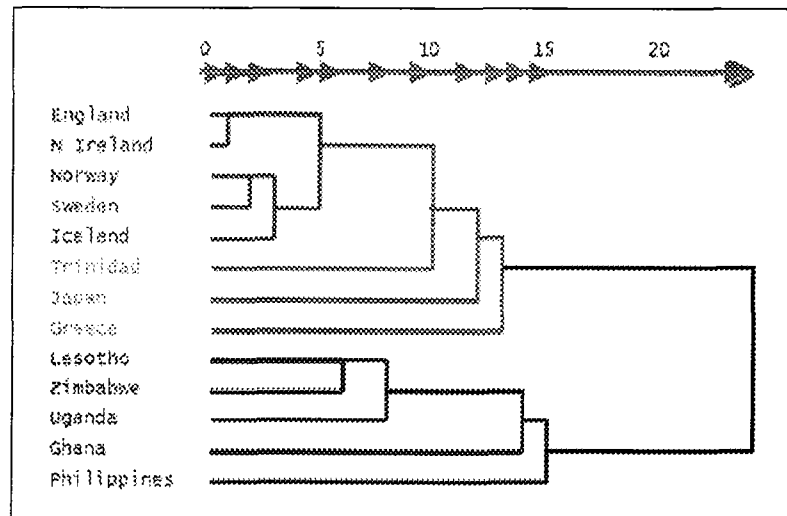
Tafsirkan keputusan muatan faktor dengan:

- (i) menjelaskan kesignifikan statistik nilai eigen (5 markah)
- (ii) memberi label yang sesuai kepada setiap faktor. (5 markah)
- (d) Berdasarkan jadual di atas, adakah seseorang yang merasa tertekan mendapat markah tinggi, sederhana atau rendah dalam faktor 1 dan faktor 2? Jelaskan jawapan anda. (4 markah)

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- (e) Apakah had-had analisis faktor dari perspektif saiz sampel?
(4 markah)
- (f) Bagaimanakah ukuran kecukupan persampelan (*measure of sampling adequacy* atau *MSA*) memberi maklumat tentang kesesuaian analisis faktor?
(4 markah)
4. (a) Apakah tujuan analisis pengumpulan? Apakah bezanya dengan analisis faktor dari segi prosedur?
(5 markah)
- (b) Apakah yang perlu dipertimbangkan semasa memilih satu ukuran kesamaan (*similarity measure*) dalam analisis pengumpulan?
(4 markah)
- (c) Bezakan antara kaedah *single linkage*, kaedah *complete linkage*, dan kaedah *average linkage* dalam analisis pengumpulan berhirarki (*hierarchical cluster analysis*).
(5 markah)
- (d) Dalam keadaan apakah analisis pengumpulan berhirarki atau analisis pengumpulan bukan berhirarki sesuai digunakan? Jelaskan.
(4 markah)
- (e) Bagaimanakah seseorang penyelidik memutuskan bilangan kumpulan (*cluster*) yang diperlukan dalam analisis?
(4 markah)

- (f) Satu kajian antarabangsa dijalankan untuk mengkaji sejauh manakah pelajar gred 8 berminat mempelajari tajuk sains dan teknologi. Berdasarkan respon daripada pelajar di 13 negara, analisis pengumpulan berhirarki dijalankan dan menghasilkan *dendogram* berikut:



- (i) Tafsirkan dendogram tersebut.
- (ii) Apakah kesimpulan yang anda boleh buat tentang pola-pola minat pelajar daripada negara-negara tersebut?
- (8 markah)