MTH 514: Multivariate Analysis

Problem Set *#2*

[1] Consider the "World economic development" dataset (source: International Monetary Fund) containing data on the following economic development indicators of 121 countries.

Indicator and abbreviation	**Aspect of Economic development**
GNP per capita at PPP (GNPPER)	Income level of economy
GDP growth rate (GDPGR)	Growth of economy
Gross domestic investment as percentage of GDP (DOMINV)	Level of investment
GDP deflator (GDPDFL)	Inflation
Agriculture value added as percentage of GDP (AGRVLAD)	Structure of output
Industry value added as percentage of GDP (INDVLAD)	Structure of output
Export of goods and services as percentage of GDP (EXP)	Openness of economy
General government consumption as percentage of GDP (GOVCON)	Role of government
Resource balance as percentage of GDP (RESBL)	Net borrowing/lending on account of merchandise trade
Domestic credit provided by the banking sector as percentage of GDP (DOMCRDT)	Private sector financing
Ratio of gross international reserve to imports (GRIIMP)	Strength of foreign exchange reserve
Number of months of import cover (IMPCOV)	Strength of foreign exchange reserve
Interest spread (INTSPRD)	Efficiency of financial market

(a) Detect multidimensional outliers using a principal component projection of the data.

(b) Detect rough clusters of world economies from the PCA projection.

(c) Obtain, if possible, a ranking of the world economies in terms of state of economic development using PCA.

(d) Obtain variable clustering using PCA.

[Standardize the data if you think it is required]

[2] Consider the banking performance dataset (source: Reserve Bank of India) containing the following observed financial ratios of public sector banks in India during the period from FY 1996-1997 to FY 1999-2000.

Financial Ratios	**Abbreviation**	**Variable type**
Return on Equity	ROE	Positive
Return on asset	ROA	Positive
Cost of deposit	COD	Negative
Cost of borrowing	COBR	Negative
Return on advances	ROAD	Positive
Return on Investment	ROI	Positive
Operating profit to total asset	OPTAST	Positive
Interest income to total income	INTINTOT	Structural
Other non-interest income to total income	OTHINTOT	Structural
Commission etc. to total income	COMINTOT	Structural
Net Interest income to total asset	NIITAST	Positive
Spread=Return on (advance+investment)-cost of deposits	SPRD	Positive
Staff expenses to total expenses	STEXTEX	Negative
Provisions and contingencies to total asset	PRVTAST	Negative
Intermediation cost (other operating expenses) to total asset	INTRMTAST	Negative
Net NPA to net advances	NET_NPA	Negative
Capital adequacy ratio	CAR	Structural
Business per employee	BUSEMP	Positive
Profit per employee	PFTEMP	Positive

** (i) "positive" indicates "higher the better"; (ii) "negative" indicates "lower the better"; (iii) "structural" indicates "pattern of business"

(a) Using a PCA obtain an appropriate projection of the financial ratios data and trace the significant trajectory movements on the projected plane over the years.

(b) Obtain PCA based clustering of variables.

(c) Obtain performance ranking of the banks for each year.

(d) Detect multidimensional outliers.

[Standardize the data if you think it is required]