UNIVERSITY OF RUHUNA

Faculty of Engineering

Semester 5 Examination in Engineering: October 2019

Module Number: CE5253 **Module Name: Infrastructure Planning**

[Three Hours]

[Answer **ALL** questions. Each question carries **EQUAL** marks]

Q1. The basic physical and organizational structures and facilities required for the operation of a society or enterprise can be regarded as "Infrastructure". Infrastructure can be broadly categorized into "economic infrastructure" and "social infrastructure".

a) Briefly describe what is meant by "economic infrastructure".

[2.0 Marks]

b) Identify an economic infrastructure from each of the following levels: household level, community level, metropolitan area, regional level and country level.

[5.0 Marks]

c) Major infrastructure development projects are expected to produce significant benefits to the society. Identify an example for such a major infrastructure development project in Sri Lanka, and discuss economic, social and environmental effects of the identified project. You are expected to consider both short-term and long-term impacts.

[5.0 Marks]

d) Applying commercial principles to infrastructure operations is a widely used technique in infrastructure improvements. Briefly discuss three strategies that can be used for incorporation of commercial principles.

[3.0 Marks]

Q2. Planning is carried out before implementation of any major infrastructure project. Infrastructure plan provides information about long-range economic, social and physical growth of a community, region or a country. While policy making and integrated planning are the main applications of infrastructure plan, there are many other applications.

a) Briefly explain three other applications of an infrastructure plan.

[3.0 Marks]

b) Identify different components that should be included in a comprehensive infrastructure plan.

[3.0 Marks]

c) Feasibility study is an important stage in an infrastructure project.

i. List different stages in an infrastructure project.

[2.0 Marks]

ii. Discuss in detail the aims, scope and the contents of a feasibility study.

[5.0 Marks]

d) Explain the importance of Public participation in planning an infrastructure project.

[2.0 Marks]

Q3. Colombo municipal council is considering development of a commercial building lot adjacent to a newly built residential area. The planning division has been requested to make a recommendation on the proposal. Preliminary investigation indicates that there is a need for both a retail facility and a supermarket. Further, the Table Q3.1 shows the projected revenues and expenses for each of these two alternatives.

Note: The common formulas involving discount rate calculations are provided in Appendix A.

a) Evaluate the two alternatives at 11% discount rate using Benefit to Cost Ratio (BCR) method, and using Net Present Value (NPV) method.

[6.0 Marks]

b) What is the best alternative for implementation considering your evaluation in Q3. a) above? Explain the reasons.

[2.0 Marks]

c) Due to external factors, some fluctuations in interest rate is expected over the next few years, before implementation of the project. Should your decision on investment change with the change of interest rate?
You may assume that the discount rate varies from 10% to 17%.

[7.0 Marks]

Q4. Colombo Port City (CPC) is a planned city to be built on a reclaimed 2.69 km^2 land in front of the Galle face green. CPC will be consisted of residential as well as financial zones. It is assumed that the trip production of the residential zones would be similar to that of Shivaji Park Residential Zone of Mumbai, India. The trip generation model developed for Shivaji Park Residential Zone with respect to average household income, and auto ownership are shown in Figures Q4.1 to Figure Q4.4.

a) Identify **five** other factors which influence the trip generation from a zone and briefly explain how they contribute to the trip generation.

[3.0 Marks]

b) It is estimated that a residential zone in the CPC will have 2500 households with an average income of 38,000 USD. Answer the below questions, using the information provided in Figure Q4.1 to Figure Q4.4.

i. Determine the household percentage of each economic category (low, medium, and high)
ii. Tabulate the distribution of auto ownership per household for each income category.
iii. Tabulate the number of trips per household per day for each income ownership category.
iv. Calculate the total number of trips per day generated in the zone.
v. Determine the percentage of trips by trip purpose.

[6.0 Marks]

c) At the initial stages of operation, CPC would have three transportation modes namely private vehicles, bus, and three-wheel taxi. Utility function for the system is given by below Equation 1.

$$U_{mode} = \beta_0 + \beta_1 \times Cost + \beta_2 \times Travel\ time + \beta_3 \times Comfort\ factor$$ **--Equation1**

Values of $\beta_0, \beta_1, \beta_2$, and β_3 are shown in the Table Q4.1. If there are 20,000 trips per hour, determine the modal share of private vehicles, buses, and three-wheel taxies using information in Table Q4.2.

[3.0 Marks]

d) It is decided to introduce a BRT system to transportation system of the CPC at a later time. If BRT has the values of

$\beta_0 = 0.3, \quad \beta_1 = -0.2, \quad \beta_2 = -0.20, \quad$ and $\beta_3 = -0.15,$

Determine the market share of all modes in the transportation system of the CPC when cost of BRT is 20, travel time =4, and comfort factor is 4.

[3.0 Marks]

Table Q3.1: Projected Revenue and Expenses of two development alternatives

	Retail Facility	Supermarket
Size in square feet	85000	18000
Cost per square foot	Rs. 6700.00	Rs. 6000.00
Economic life	20 years	15 years
Projected yearly income	Rs. 100 million	Rs. 30 million

Table Q4.1 Coefficients of utility function for different modes

Mode	β_0	β_1	β_2	β_3
Private vehicles	0.40	-0.04	-0.15	-0.10
Bus	0.20	-0.25	-0.23	-0.47
Three-wheel taxies	0.30	-0.1	-0.20	-0.15

Table Q4.2 Cost, travel time and comfort for different modes in CPC area

Mode	Cost	Travel time	Comfort
Private vehicles	100	10	5
Bus	10	20	2
Three-wheel taxies	35	15	3

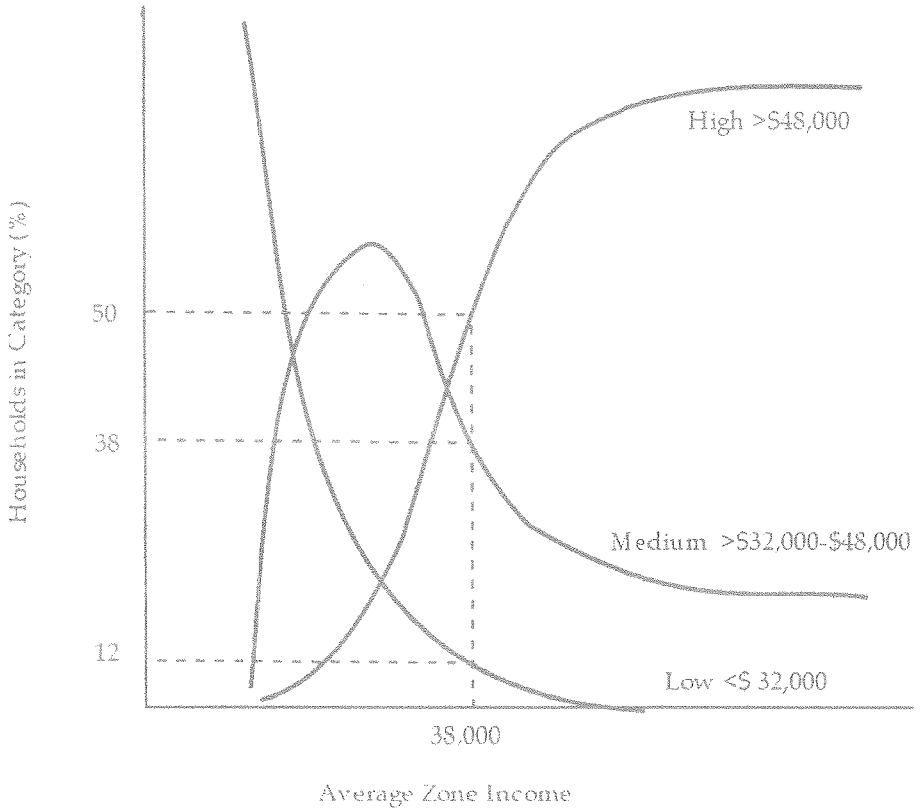

Figure Q4.1 Average zonal income versus households in income category

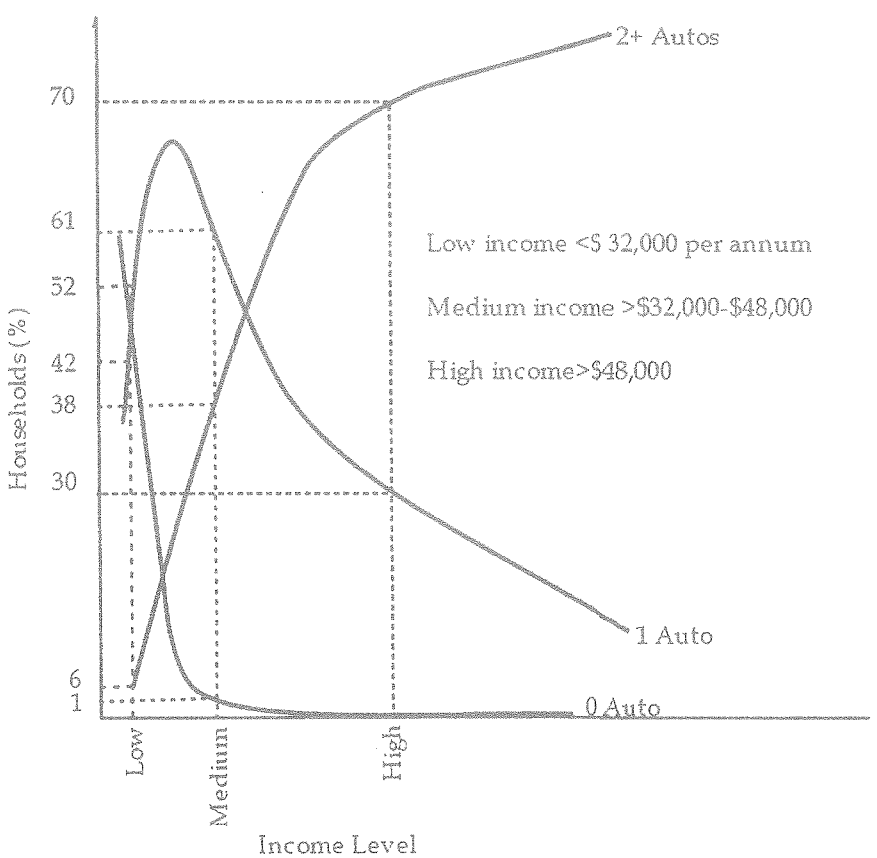

Figure Q4.2 Households by automobile ownership and income category

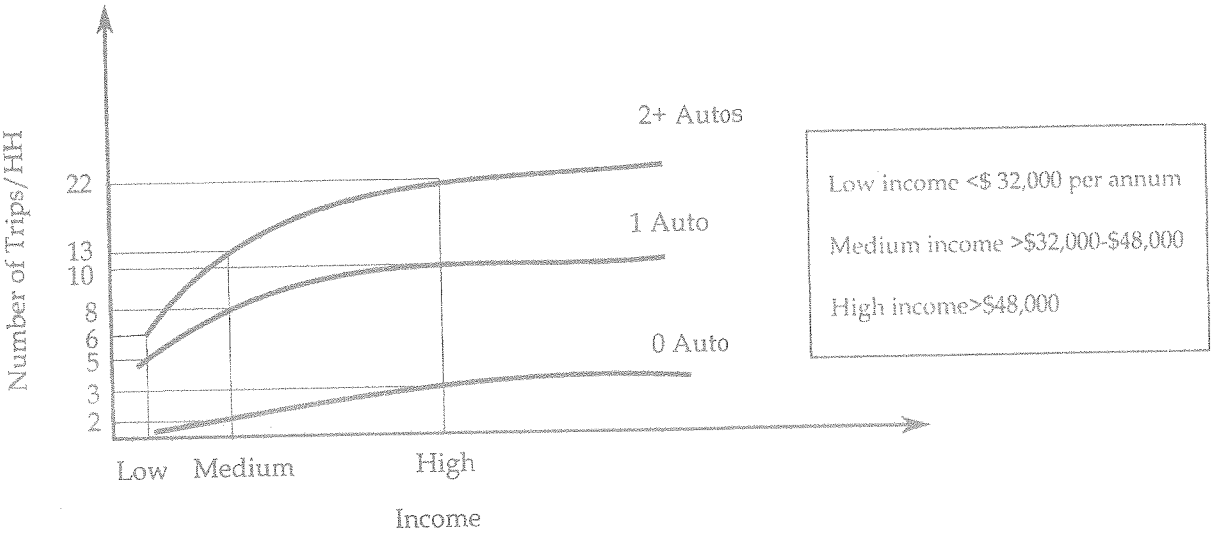

Figure Q4.3 Trips per households per day by auto ownership and income category

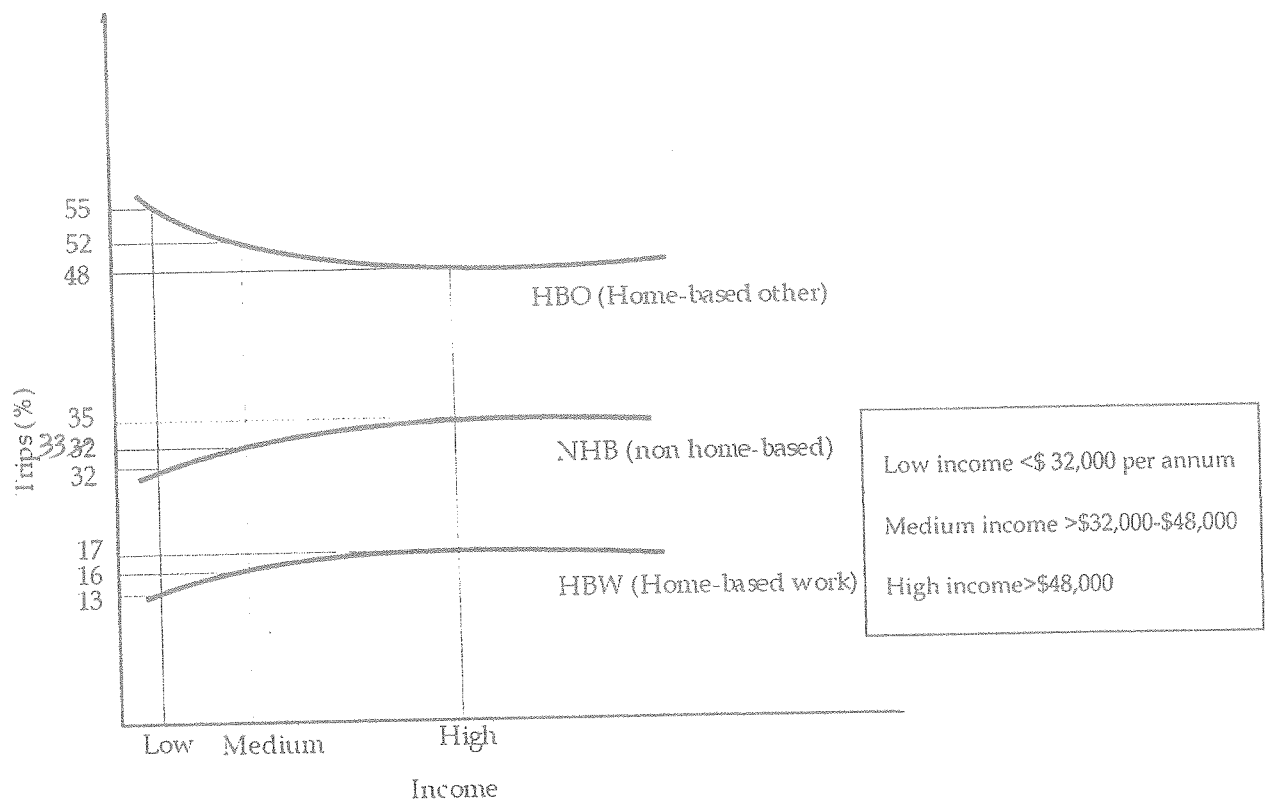

Figure Q4.4 Trips by purpose and income category

Appendix A: Common Formulas involving discount rate calculations with usual notations.

$$P = A\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$$

$$P = F\left[\frac{1}{(1+i)^n}\right]$$