EXAMINER'S REPORT

AUGUST 2001

LOGISTICS MANAGEMENT

General Comments

The results this autumn were quite good with most getting through. There were a few around 70% who may have been doing it for the first time.

The way this course and exam is structured requires one to really get into the theory, the techniques and how to apply the ideas in practice. This follows a learning cycle. Ideally people should look at the cases early on to get an idea of the types of problems which occur. These are mixtures of marketing, logistics, mathematics and strategy. Subsequently one should get into the theory, but not spend the year learning it off. Usually it is reasonably well done. Basically I expect a clear understanding of what is in the text and some practical illustrations from outside, such as from Irish applications. The middle part of the year should be spent on the quantitative techniques, hopefully linking them into the cases and the theory, and anecdotes about Irish companies where possible.

People can get through by focusing on one of the parts, but this year there were few instances of full marks for a question. Consequently, people who failed invariably did one of the sections very poorly and were not able to compensate from another section. It is safer to prepare all the sections.

Case Study

The case questions are geared at bringing one through a process of analysis, evaluation, diagnosis and prognosis. Most people tried all parts of the case section, and attempted all the sections in the exam. Consequently there were fewer than ever failures due to not attempting one or more sections. In the past this was the most common cause of failure and the reason for the high average failure rate. It should be understood that Logistics is important not just of itself but also because it requires one to put on one's quantitative thinking cap when addressing marketing problems.

When answering the case you should use the structure of the questions; it had four parts this Autumn. Within each part it is a good idea to make a statement, possibly using a headline or point form, and then justify it in a few sentences. You should refer to the text of the case, but do not quote it extensively or copy out tables. Where it is warranted you should make some simple calculations and show them. Do not get into too much accounting detail. However, in part (b) I asked for an evaluation of the profitability and performance of the Hollins and Parkway operations by product, region and distribution channel. And then in part (d) I asked that these evaluations be used to justify your proposals. So, answers were expected to refer to and summarise the quantitative data given in the question. The best answers offered practical solutions to getting some harmonisations of the Hollins and Parkway operations in the light of the market, and used the quantitative information in the case to justify these solutions.

Quantitative questions

There is no need to do roughwork and then write your answer out neatly. It wastes your precious time. Transcribing quantitative answers takes effort that would be better used on another question. Do your chosen questions as best you can. If you think you are making a mistake say so; then try to correct it. If you blank out, just leave two pages so that you can move onto other questions. Maybe later you will be able to do the rest of that question. Do not waste your time doing restarts.

The idea of having two different quantitative sections is to separate the less standard (C) question from the standard (D), the unstructured from the straightforward application of algorithms.

In **Section D** the **network with crashing** question is an example of a standard application of an algorithm that many people got mainly right.

The other such question in Section D was an application of **graphical linear programming**. This is not a simple procedure; one must develop an understanding of the technique. The basics are: 1. Develop the constraints. 2. Draw the graph. 3. Find the corners most likely to be best. 4. Put these into the objective function to get the best one. 5. Do some post-optimality analysis. Generally the few who did this did not do it well. Actually, it was possible to do this question in less than ten minutes. The main reason for having such questions on this course, and indeed having a subject such as Logistics on the Graduateship, is to stretch future marketing practitioners intellectually sufficiently to prepare them to address real marketing decision problems. A central issue in marketing is how to use your resources and plan your sales so as to get the best added value (usually profit) for your company. A linear programming question gets to the core of this issue. As long as this topic seems to be poorly addressed, or avoided altogether, it is likely to appear on future examinations.

Section C contained a **simulation** question. I include this kind of question occasionally because, whenever there is no obvious model, the rule is that you simulate. Not many got it fully right. The following is the question and the answer.

A petrol station sells one grade of petrol and has a single pump and one attendant. Cars arrive for petrol, wait in a single queue, and are served on a first-come, first-served basis. The interarrival-time probability distribution is given below. The next line contains the corresponding intervals that are used for the simulation of inter-arrival times.

IAT (minutes)	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Probability	0.07	0.14	0.26	0.22	0.16	0.10	0.05
Intervals	00-06	07-20	21-46	47-68	69-84	85-94	95-99

Part (a) required one to use the following random numbers to simulate 10 inter-arrival times between 11 customers. These are given on the next line.

87	73	51	30	05	10	45	80	13	41
7	6	5	4	2	3	4	6	3	4

The probability distribution of the time it takes to be served is given below. The next line contains the corresponding intervals that are used for the simulation of service times.

Service Time (minutes)	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Probability	0.08	0.17	0.28	0.20	0.14	0.09	0.04
Intervals	00-07	08-24	25-52	53-72	73-86	87-95	96-99

Part (b) required one to use the following random numbers to simulate 11 customers' service times. These are given on the next line.

23	71	68	85	30	80	26	55	59	72	20
3	5	5	6	4	6	4	5	5	5	3

Part (c) asked what is the average waiting time and average time spent in the petrol station. This required the simulation of 11 customer times. The first confusion arose because 10 inter-arrival times were available. This is because the arrival time for the first customer is zero. The 11 customers' times are presented below. In the fourth line any time that the next customer is delayed is given. The service time for customer one (3) is compared with the inter-arrival time between customers one and two (7), indicating that there will be a four minute delay before the second arrives.

Cust.	1	2	3	4	5	6	7	8	9	10	11
Arrive	0	7	6	5	4	2	3	4	6	3	4
Service	3	5	5	6	4	6	4	5	5	5	3
Delay	0	0	0	0	2	4	7	7	6	8	9

The first delay occurs when the fourth customer takes 6 minutes and the fifth customer arrives after 4 minutes. The same problem occurs with the next two customers.
The waiting time builds up to 43 over the 10 or 11 customers or about 4 each.
The time in service is 51 plus 43 queueing or 94 minutes, which is about 8.5 each.

Part (d) asks you to discuss how to resolve any weaknesses in the procedure you used. The simulation was over too short a period. It was affected by the build-up in the middle. There was no account taken of the start of the simulation. Was this the start of the day?

Part (e) asked what practical advice would you offer the manager. Get a second server? Speed up the service time, at the pump or paying in the shop? Check the simulation.

The other Section C question was on **stock (inventory) control**. This is a long section in the text and likely to occur every year.

A company that holds the franchise for a particular brand of computer game has made the following estimates. It costs £500 delivery costs each time it gets a delivery of computer games from the manufacturer. The cost of carrying one of these computer games in stock for a year has been estimated to be £208, mainly coming from insurance and estimates of decline in price due to changes in popularity. The estimated annual demand for this type of computer game is 520 units. Assume that orders are received instantaneously and that no shortages are allowed.

Part (a) asked for the optimum order quantity and the minimum inventory cost.
I was very surprised that some people did not get the economic order quantity of 50 units, and reorders 10.4 times a year. With each delivery costing £500, and delivery costs equal storage costs at optimum, the total costs are £10,400.

Part (b) asked what level of stock should the manager re-order if the following changes occur in the assumptions? There is a three week delivery lead-time during which demand averages at thirty (30) computer games with a standard deviation of five (5). It is estimated that the shortage cost of not having one of the computer games in stock when it is demanded is £24.

The shortages are converted into z-scores using z = (shortage – 30) / 5
These z-scores are converted into probabilities of exceeding the figure using the tables.
The probability of 30 to 32 is 0.1554, 32 to 34 is 0.1327, 34 to 36 is 0.0608 and over 36 is 0.1511.

The estimated shortage cost is got by multiplying the probabilities of shortage for each chosen level of safety stock by the average usage during lead-time by the number of orders per year 10.4 by the shortage cost per order £24 = £249.60. Sample re-order levels can then be checked. In this case intervals of width two are used: 30-32, 32-34, etc.

Re-order Level	Safety Stock	Annual Stock Holding Costs x £208	Possible Shortages (mid points)	Probability of shortages	Shortage Cost (x £249.60)	Total Cost
30	**0**	**0**	**1**	**0.1554**	38.79	£478.03
			3	**0.1327**	99.37	
			5	**0.0608**	75.88	
			7	**0.1511**	264.00	
32	**2**	**£416**	**1**	**0.1327**	33.12	£683.22
			3	**0.0608**	45.53	
			5	**0.1511**	188.57	
34	**4**	**£832**	**1**	**0.0608**	15.18	£960.32
			3	**0.1511**	113.14	
36	**6**	**£1248**	**1**	**0.1511**	37.71	£1285.71

The minimum cost of £478.03 indicates that the safety stock should be about 1 unit.

Part (c) asked on what assumptions have you based your calculations and to comment on them. These were that demand using lead time follows a normal distribution pattern. Also, the usual EOQ assumptions apply. Both are reasonable.