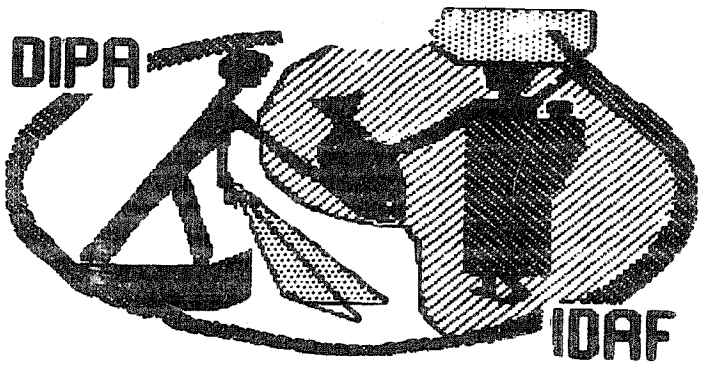
IDAF / WP / 33 February 1991

REPORT OF THE COURSE ON "QUANTITATIVE ANALYSIS OF SELECTED ASPECTS OF FISHERIES DEVELOPMENT"



FAO / DANIDA / NORWAY

IDAF/WP/33

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REPORT OF THE COURSE ON "QUANTITATIVE ANALYSIS OF SELECTED ASPECTS OF FISHERIES DEVELOPMENT"

Programme de Développement
Intégré des Pêches Artisanales
en Afrique de l'Ouest - DIPA

Programme for Integrated
Development of Artisanal
Fisheries in West Africa - IDAF

GCP/RAF/192/DEN

With financial assistance from Denmark and in collaboration with the Republic of Benin, the Fisheries Department of FAO is implementing in West Africa a programme of small scale fisheries development, commonly called the IDAF Project. This programme is based upon an integrated approach involving production, processing and marketing of fish, and related activities ; it also involves an active participation of the target fishing communities.

This report is a working paper and the conclusions and recommendations are those considered appropriate at the time of preparation. The working papers have not necessarily been cleared for publication by the government (s) concerned nor by FAO. They may be modified in the light of further knowledge gained at subsequent stages of the Project and issued later in other series.

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Report of the DIPA/IDAF course "Analyse Quantitative des Aspects Sélectionnés de Développement/Quantitative Analysis of Selected Aspects of Fisheries Development"

D.A. Palfreman, Consultant Economist, HIFI, Hull

1. Introduction and Acknowledgment

The following report reviews a course organised by DIPA/IDAF in Cotonou Benin from 3-12 December 1990. It followed an earlier visit to Cotonou by Mr. Palfreman.

The course was well-attended by people from throughout the region covered by the Programme.

Special thanks are due to Mr. C.T. Curr who prepared a number of detailed questions for the course on the basis of data from studies from the region. He also covered a number of the course topics when Mr. Palfreman's arrival in Cotonou was delayed.

Special thanks are also due to Mrs. Eva Callerholm Cassel, the Economist attached to the DIPA/IDAF Project in Cotonou. She also stood in in the absence of Mr. Palfreman to cover some of the topics and played a very valuable part in coaching course participants.

Thanks also to the course participants for making the course such an excellent and worthwhile event.

Thanks also to Mr. George Everett, the Project Coordinator, for initiating the course concept, enabling the course to take place and providing guidance throughout.

Background

The Programme for the Integrated Development of Artisanal Fisheries in West Africa was established "to help West African countries which wish to develop and manage their artisanal fisheries so as to draw from them the maximum economic and social advantages, thanks to an approach centred on the community and aimed at improving productivity and increasing the well-being and autonomy of the fishermen, those who are responsible for processing and distributing the fish and all those who work in the sector". (FAO Project Document for GCP/RAF/192/DEN).

From 13-16 March 1990, D.A. Palfreman, a Consultant Economist visited the headquarters of the Programme in Cotonou, Benin (a) to offer to the project some suggestions on future activities; (b) to prepare an outline for a short course for technical staff and others in the region on micro-economics and investment planning; (c) to review some cost and earnings studies already completed, and (d) to prepare terms of reference for a consultant to undertake detailed quantitative research into artisanal fishery operations in the region. The short course reported here was the outcome of objective (b).

A course programme with the title "Quantitative Analysis of Selected Aspects of Fisheries Development" was prepared. As indicated by its title, the intention was to prepare material for lectures, discussions and, questions and answers with a distinctly quantitative focus. It was also intended that the course participants would tackle the prepared questions by using a spreadsheet programme on micro-computers. The questions and answers prepared for the course are included as an appendix to this report.

3. Course Location

The course took place in Cotonou, Benin from 3 to 12 December at the offices of the DANIDA/Norway Programme for Integrated Development of Artisanal Fisheries in West Africa (IDAF). It is worth noting that the library at the IDAF office was an ideal location for the course. Course participants were able to work in an informal environment around a "boardroom" style table with the miro-computers in front of them. The room is also equipped with a blackboard and an overhead projector.

4. Course Participants

The course attracted participation from throughout the region. The following people attended :

Mr. C.T.Curr, FAO Consultant , Economist/Operations Analyst, Virginia Cottage, 9 Cherry Garth, Lund, Driffield YO25 9 TD England

Mr. D.A.Palfreman, Senior Lecturer, Humberside International Fisheries Institute, University of Hull, Hull HU6 7 RX, England

M. Ibrahima Seck, Fonctionnaire Principal, Direction de l'Océanographie et des Pêches Maritimes, Ministère des Ressources Animales, Dakar, Senegal

M. Moustapha Kebe, Economiste/Chercheur, Centre de Recherches Océanographiques de Dakar-Thiaroye, B.P. 2241, Dakar, Senegal

Mr. Alhaji M. Jallow, Senior Fisheries Officer, Department of Fisheries, Banjul, The Gambia

Mr. Momodou Koroma, Management Information Unit, Shenge Integrated Fisheries Project, Sierra Leone

Mr. H. Williams, Management Information Unit, Shenge Integrated Fisheries Project, Sierra Leone.

Mr. M. Okpanefe, Chief Economist, Nigerian Institute for Oceanography and Marine Research, Lagos, Nigeria.

Mr. A.R. Nkogho-Eyi, Fonctionnaire Principal, Direction des Pêches Maritimes et des Cultures Marines, Libreville, Gabon.

M. Mamadou Doumbia, Sous-Directeur des Pêches Artisanales, Direction des Pêches et de l'Aquaculture Maritimes et Lagunaires, Abidjan, Côte d'Ivoire.

M. Afian Joseph Bakouy, Chef Service Pêche Artisanale, Direction des Pêches, Yaoundé, Cameroun.

Mr. A. A. Sowunmi, Principal Planning Officer, Department of Fisheries, Agricultural Cooperatives and Fertilizer, Abuja, Nigeria.

Mr. Jan Haakonsen, Socio-Economsit/Anthropologist, FAO-IDAF, Cotonou, Benin.

Mr. G.V. Everett, Programme Coordinator, FAO- IDAF, Cotonou, Benin.

M. Luc Affoyon, Projet Modèle; Cotonou, Benin

M. Bonaventure Houndekon, Projet Modèle, Cotonou, Benin

Mrs. Eva Callerholm Cassel, Economist, FAO-IDAF, Cotonou, Benin

Mr. T.T. Meyizoun, Direction des Pêches, Cotonou, Benin

Mr. C.P. Tohouegnon, Direction des Pêches, Cotonou, Benin

M. Djramedo Teme, Port de pêche, Direction des Productions Animales, Lomé, Togo.

5. Instruction

Lectures and assistance to participants were by Messrs C. T. Curr, D.A. Palfreman and Mrs. Eva Callerholm Cassel. The lectures and seminars were conducted in English and French. The teaching staff felt that this had some positive effects because it ensured that the pace of the programme was such that there was a thorough understanding by all the course participants of the points made. In the course evaluation there was no criticism of the parallel use of both languages. It is also worth noting that the use of both languages in the same course ensured that this was a truly regional meeting in which ideas and experience from all parts of the region were shared.

The teaching staff also felt that the quality of the course was significantly enhanced by having lectures intersperssed with periods on the computers when a number of the various prepared questions were tackled. This ensured that the day was broken up and concentration maintained.

6. Course Timetable

An outline of the timetable followed is reproduced below :

Monday 3 December	: Supply and demand. Elasticity of supply and demand. Exercices.
Tuesday 4 December	: Discussion on supply and demand Introduction to the computers. Exercises.
Wednesday 5 December	: Opportunity costs Economic aspects of fisheries management. Exercises.
Thursday 6 December	: Marginal revenue and marginal cost Exercises.

Friday 7 December	: Introduction to investment appraisal. Exercices.
Saturday 8 December	: Economic analysis of projects Exercises.
Monday 10 December	: The economcis of management decisions and the project cycle. The example of environmental impact analysis . Exercises
Tuesday 11 December	: Risk and Uncertainty. Exercises
Wednesady 12 December	: The economic analysis of cooperatives Exercises Course evaluation

Sessions were from 8.00 to 12.00 and 15.00 to 18.00, except on Saturday 8 December and Wednesday 12 December when there were no afternoon session.

7. Course Content

One of the most positive features of the course was that those participants who had not yet been exposed to the use of micro-computers in project planning and for other analytical purposes were given an opportunity to work at a variety of problems with them. For those who already had some knowledge of the use of spreadsheets for planning purposes the course provided an opportunity for further practice and new applications.

The teaching participants felt that for future courses of a similar duration less emphasis on elementary supply and demand and more on practical investment appraisal would be a valuable shift of balance.

8. Evaluation

On the final day (Wednesday 12 December) a short period was set aside for an informal evaluation of the course. In general the participants were highly satisfied with the course. Mr. Okpanefe expressed the view that he would have appreciated a longer period for a more formal evaluation.

9. Conclusions and Recommendation

9.1. The document "Etude Préliminaire sur les Revenus des Unités de Pêche en République du Cap Vert" by . B. Horemans (Rapport Technique PNUD/FAO - CVI/82/003, Praia : FAO 1986) proved particularly useful in generating interesting questions for the course. This was a good demonstration of the insights that could emerge from a production and cost and earnings study. It was felt that this study was a useful model for similar work in the region. It concentrated on the collection and presentation of basic data rather than on the application of more elaborate analytical techniques.

9.2. It was very valuable to give hand on computer experience to the participants. It is inevitable that in time micro-computers will become widely used throughout the region. The teaching participants felt that it was worth emphasing the need to keep abreast of development in software and hardware. It is quite likely to be a false economy to fail to keep up with developments. It will, for the foreseable future, be an important role for IDAF to show people in fisheries in the region how to use micro-computers in courses such as this and to provide advice on the most suitable software and hardware.

9.3. If similar courses take place it may be useful if one or two course participants bring quantitative studies that they have completed for presentation, discussion and analysis. It is important to stress that such studies should be predominantly based on practical data which can be used, manipulated and analysed by course participants.

9.4. It is noted above that there may be some gains in shifting the balance of the course away from elementary supply and demand towards more planning and other practical problems.

9.5. The course gained by being conducted in English and French. It meant that it was a truly regional event.

Appendix

Questions and answers used in the course

Contents

1. Decision Making Under Risk and Uncertainty

1.1 Table 1.1 gives the average value of one share for one trip for a sample of 100 canoes without motors. The data come from a complete year of fishing for all the canoes, which all used the same fishing method, carried the same number of crew, and landed their carch at the same beach.

Collect the data into groups with limits of : 370 to 379; 380 to 389, etc. Draw a frequency distribution of the data. What is the probability of an average share: a) above 450; b) below 420; c) between 430 and 449?

Table 1.1

485	411	447	407	432
452	413	451	442	415
430	427	529	419	470
432	405	461	499	442
442	416	463	436	531
439	490	467	503	413
493	443	420	499	437
464	507	420	455	408
393	460	452	409	486
464	422	457	430	445
424	374	483	441	448
440	483	464	452	477
400	493	459	452	395
447	493	428	387	447
419	445	441	438	482
512	484	467	441	422
467	435	438	493	441
434	428	390	441	476
429	434	469	470	433
454	443	463	436	458

1.2 Table 1.2 gives the average value of one share for one trip for a sample of 50 motorised canoes.
The data come from a complete year of fishing for all the canoes, which all used the same fishing method, carried the same number of crew, and landed their catch at the same beach as the non-motorised canoes in question 1.1.

Collect the data into groups with limits of : 2400 to 2499 ; 2500 to 2599, etc. Draw a frequency distribution of the data. What is the probability of an average share : a) above 3000; b) below 2600; c) between 2800 and 2999?

Table 1.2

2644	2901	3163	3108
3253	3497	2644	3068
2567	3200	2963	2916
3698	3658	2953	2762
2579	3086	2561	2978
2959	3302	2728	2477
3111	2536	2888	3247
3108	2573	2675	3003
2471	2814	2885	3089
3123	3293	3238	2582
2904	2808	2718	3278
3166	2814	2555	3197
3006	3871		

1.3 Show that for the non-motorised canoes, the given probabilities imply the average shares per trip shown:-

probability	average share per trip
26%	411
30%	439
21%	459
23%	492

An investor has just bought a non-motorised canoe, and expects the crew to make 30 fishing trips in the first year of operation and 40 trips in the second year. What is the owner's total expected revenue (one share): a) for the first year; b) for the second year? c) What is the Expected Present Value of the owner's total revenue for the two years if his Opportunity Discount Rate is 15%?

1.4 Show that for the motorised canoes, the given probability imply the average shares per trip shown:-

probability	average share per trip
30%	2596
24%	2907
24%	3107
22%	3404

An investor has just bought a motorised canoe, and expects the crew to make 25 fishing trips in the first year of operation and 35 trips in the second year. What is the owner's total expected revenue (two shares): a) for the first year; b) for the second

year? c) What is the Expected Present Value of the owner's total revenue for the two years if his Opportunity Discount Rate is 15%?

2. Supply and Demand Exercices

2.1 Suppose that the data of table 2.1 represent the market demand and supply schedules for fish over a range of prices.

Table 2.1

Price	Quantity Demanded	Quantity Supplied
F/kg	Kg/wk	Kg/wk
800	70	10
1600	60	30
2400	50	50
3200	40	70
4000	30	90

a) Using graph paper, plot in a single diagram the demand curve and supply curve.

b) What would be the excess demand or supply if price were set at 800 F/kg ?

c) What would be the excess demand or supply if price were set at 3200/kg F/kg ?

d) Find the equilibrium price and quantity.

e) Suppose that following an increase in consumer income the demand for fish rises to 15kg/wk at each price level. Find the new equilibrium price and quantity.

2.2 a) Hypothetical supply and demand data for fish are shown in Table 2.2. Plot the supply curve and the demand curve and find the equilibrium price.

Table 2.2

Price	Quantity Demanded	Quantity Supplied
$/kg	(tonnes)	(tonnes)
10	10	3
12	9	4
14	8	5
16	7	6
18	6	7
20	5	8

b) What is the excess demand or supply (a) when the price is $12? (b) when the price is $20?

c) Suppose the quantity supplied at each price rises by 1 tonne, what is the new equilibrium price and quantity? Does the equilibrium quantity sold rise by more or less than 1 tonne?

d) Suppose instead that a tax of $1 per tonne is imposed on firms supplying the fish. What happens to the quantity of fish sold and what happens to the price consumers pay?

2.3 You own a fish stall. You have 100 kg of fish that must be sold immediately, regardless of the price. Your supply curve is vertical. From past experience you know that the demand curve for fish slopes down and you can sell exactly 100 kg for F 1000/kg.

a) Draw a supply and demand diagram showing market equilibrium.

b) The elacticity of demand for fish at F 1000/kg is -0.5. You discover 10 kg are rotten and cannot be sold. What happens to the equilibrium price ?

2.4 Table 2.4 presents the quantity of fish demanded at various prices.

Table 2.4

price per Kg ($)	Quantity Demanded (tonnes)	Total Spending ($)	Price Elacticity of Demand
2.10	10		
1.80	20		
1.50	30		
1.20	40		
0.90	50		
0.60	60		
0.30	70		

a) Draw the demand curve on graph paper (price on vertical axis)

b) Suppose the price is $ 1.20. What is the change in quantity demanded (i) in tonnes (ii) in percentage terms if the prices falls by $0.30 ?

c) Calculate the total spending on fish at each price shown.

d) Calculate the price elasticity of demand for prices between $0.60 and $2.10.

e. Draw a graph showing total revenue against sales. Plot revenue on the vertical axis and quantity demanded on the horizontal axis.

f) At what price is revenue at its greatest?

g) At what price is the elasticity of demand equal to -1?

h) Within what range of prices is demand (i) elastic? (ii) inelastic ?

2.5 Table 2.5 presents the total spending and income of a household in 2 years.

a) Calculate the budget shares in each year for each good.

b) Calculate the income elasticity of demand for each good.

c) Classify each of the goods as either "normal" or "inferior".

d) Classify each of the good as either "luxury" or "necessity".

Table 2.5

	Year 1 $	Year 2 $
Income	$100	$200
Good A	30	50
Good B	30	70
Good C	25	20
Good D	15	60

2.6 The demand curve for Q is given by

$$P = 5000 - 10Q$$

Calculate the arc price elasticity of demand when:

i) The price changes from 4000 to 3000.

ii) The prices changes from 3000 to 2500.

iii) The price changes from 4000 to 3900.

iv) The price changes from 2000 to 1000.

2.7 There is a 3-person economy. The individual demand curves of each person are:

A		B		C	
P	Q	P	Q	P	Q
3	0	4	0	4	1
2	1	3	2	3	1
1	2	2	3	2	1
		1	4	1	1

Draw the market demand curve.

2.8 The following are the individual schedules for fish for four groups of consumers A, B, C, and D over the price range $20/tonne to $25/tonne. Assume that these schedules all relate to the same market and the same time period.

Table 2.8

Price $/tonne	Quantity demanded by			
	A	B	C	D
20	35	120	42	12
21	34	90	42	13
22	33	70	42	14
23	32	50	42	15
24	31	30	42	16
25	30	0	42	17

Which schedule is: -

i) perfectly price inelastic.

ii) elasticity between - 1 and zero.

iii) elasticity less than - 1.

iv) positively sloped.

2.9 Draw the market demand curve for the four consumer groups. Find the equilibrium price and quantity if the aggregate supply schedule is as follows.

Table 2.9

Price ($/tonne)	Supply (tonnes)
20	0
21	29
22	89
23	139
24	179
25	229

2.10 The following are the demand and supply schedules in a local market for fish.

Table 2.10

Price of fish	Quantity Demanded	Quantity Supplied
$/kg	kg	kg
0.70	920	705
0.75	830	710
0.80	770	715
0.85	720	720
0.90	680	725
0.95	655	730
1.00	635	735
1.05	625	740
1.10	620	745

Sketch the graphs.
A sales tax is imposed on fish. The price at which each quantity of fish is offered to buyers rises by the amount of the tax per kg.

If a subsidy is paid on fish sales, the price at which each quantity of fish is offered to the public falls by the amount of the subsidy per kg.
Estimate the following:

a) If fish sellers are required to pay a $0.15 per kg tax on the supply of fish:

   i) What is the new market price?

   ii) How much of this tax is paid by consumers and how much by suppliers?

b) If a $0.30 per kg subsidy is paid to suppliers :

   i) What is the new market price?

   ii) How much of the subsidy is passed on to consumers?

2.11 Table 2.11 gives monthly data of quantity of fish landed and average price for various locations in Cape Verde. Draw a scatter diagram to investigate the relationship between quantity landed and average price.

Is there any evidence of a relationship between quantity and average price?

Are there signs of differences between locations?

What kind of mathematical relationship would best represent the variation apparent in the data?

2.12 For the data given in questions 2.11 estimate the mathematical relationship between quantity landed and average price. Sketch a graph to show this relationship.

2.13 What is the estimated price elasticity of demand for the following quantities landed ?

5000; 10000; 15000; 20000; 25000.

2.14 Tables 2.14.1 & 2.14.2 give data on the amount landed and the average price obtained from individual fishing trips by motorised and non-motorised canoes. All the trips landed at Gamboa; the crew was 3 men in all cases, and the fishing method was the same throught (handlines).

Table 2.14.1 Non-motorised canoes

Kg	Price	Kg	Price	Kg	Price
28	82	72	55	157	51
33	89	50	50	35	40
6	108	15	70	31	41
5	174	22	75	124	56
19	109	19	79	41	45
15	123	28	54	177	51
15	107	13	77	103	47
10	103	18	70	30	50
9	108	25	66	35	51
16	76	8	71	3	83
18	90	7	90	34	51
6	103	11	86	42	60
9	89	18	80	17	71
11	73	60	76	31	48
4	133	40	74	34	79
24	55	21	73	18	68
11	135	48	73	14	78

Table 2.14.2 Motorised canoes

Kg	Price	kg	Price
151	109	45	57
210	79	178	58
60	80	42	73
204	89	45	54
173	91	74	68
134	94	14	55
255	76	35	70
181	97	64	53
250	80	55	50
256	80	3	80
136	122	50	60
97	142	119	63
494	75	306	54
327	80	584	60
339	80	142	50

393	80	250	93
42	90	203	60
72	90	399	58
60	90	310	73
43	87	88	81
124	66	205	83
215	66		

Is there any evidence of a relationship between quantity landed and average price ?

What differences are apparent between motorised and non-motorised canoes ?

3. Cost and the Theory of the Firm - Exercices

3.1 A fisheries specialist receives a salary of $20,000 per year. If he becomes self employed he will have to spend $12,000 on computing hardware and software, but he could increase his annual earnings to $30,000 per year. The rate of interest is 10 per cent per year.
Estimate his economic profit by becoming self-employed.

3.2 Table 3.2 gives details of 2 different production techniques for catching a given volume of fish.

Table 3.2

	Vessels	Total Crew	Rental per vessel	Total Wage cost
Technique A	4	16	100	50
Technique B	1	10	600	50

a) Which technique would you choose ?

b) If wage rates fall to $30/week which technique do you choose ?

c) If the wage rate is $50 per week what is the switching value of the capital rental for technique B?

3.3 The economics of operating a canoe are assumed to be :

Cost of input (E) 33000 per day
price of fish 400 per kg

Table 2.11

1. Quantity landed (kg)

	Palmeira	Tarrafal	R. de Barca	Gamboa	Cidade Velha	Pedra Badejo	Chao Bon	Fonte Vila	Furna
June					3582			6135	
July								7482	
August			25988	15018	2722			9042	
September	5202		6178	8842	1436			7693	
October	2830	6687	10333	8332	2835		261	8042	
November	2614	4485	12017	4762	1485	2920	536	9704	8743
December	2313		11435	7765	2082	4834		12194	6388
January	2113	17094	18454	2318	898	1179	528	3675	195
February	2270	7647	16558	4586			411	2939	1617
March		4483	5792	5726				4595	5099
April		6790	8125	8187				4941	

2. Average price (escudos capverdiens/kg)

	Palmeira	Tarrafal	R. de Barca	Gamboa	Cidade Velha	Pedra Badejo	Chao Bon	Fonte Vila	Furna
June					80.7			81.6	
July								66.8	
August			35.7	57.3	71.8			78.5	
September	109.0		43.3	60.4	103.0			84.7	
October	99.1	75.0	41.9	72.3	93.1		96.5	76.2	
November	99.8	72.0	33.2	67.9	105.7	90.5	94.3	64.1	26.1
December	111.8		49.7	61.6	87.3	77.1		40.1	28.8
January	101.2	70.6	52.6	90.1	95.6	111.2	94.2	86.1	34.1
February	103.2	78.7	59.9	84.0			80.9	89.8	40.9
March		88.2	75.1	92.4				82.9	42.6
April		91.7	76.8	81.5				97.6	

Effort (days)	Catch (=100 E-0.05 E^2) (kg)
50	4875
60	5820
70	6755
80	7680
90	8590
100	9500
110	10395
120	11280
130	12155
140	13020
150	13875
160	14720
170	15555
180	16380
190	17195
200	18000

(1 variable E is assumed to include all inputs)

a) calculate total earnings
total costs
marginal revenue
marginal cost.

b) What is the level of fishing effort chosen by the operator?

3.4 You are the economist to a government. You have been given the following sustained yield function by your biologist colleagues for single species fishery in the maritime zone of your country.

$Y = 10\ E - 0.0001\ E^2$
Y = sustainable yield per year (tonnes)
E = fleet fishing effort in days at sea per year.

a) Draw the sustainable yield curve.

i) What is the MSY?

ii) What is the level of fishing effort corresponding to extinction of the stock?

b) The price of fish is $2000 per tonne at all levels of supply.

Draw the total revenue curve (either by changing the axis on the first diagram or drawing a new diagram).

c) Total cost is given by the following equation.

TC = $4000 E

Draw the TC curve on the same diagram as the total revenue (TR) curve.
Calculate:

i) The level of fishing effort corresponding to free access equilibrium.

ii) The level of fishing effort corresponding to maximum economic yield.

iii) The maximum rent the fishery can yield.

d) The fleet consists of similar small fishing vessels. Each one operates for 150 days per year. How many vessels should be in the fleet?

4. Investment Appraisal

4.1 Evaluate a proposal to construct and operate an ice plant.

		CFA Francs
Capital cost		40 milion
Annual fixed cost (incurred from year 0)		2 milion
Annual variable cost		70% of sales revenue
		Tonnes
Sales	Year 0	0
	Year 1	150
	Year 2	300
	Year 3 - 9	500

Price of ice F 80,000/tonne. The plant is expected to be constructed in Year 0 and have an operating life for a further 9 years with a negligeable salvage value.

Calculate the Net Present Value (NPV) at discount rates 0%, 5%, 10% and the Internal Rate of Return (IRR).

4.2 Rework question 4.1 assuming a salvage value in year 10 of F 2 milion

4.3 Assume that there are 2 economic benefits of the project. The first is fish saved that would otherwise have spoiled. The second is an increase in the price of fish by 1 per cent reflecting greater consumer confidence.

The first benefit, the fish saved, is exactly equal to the sum the users of ice are willing to pay for ice and is therefore, identical to the value of ice sales. In this case the value of the economic benefit resulting from the ice factory is already

fully valued in the financial cash flow.

The second benefit arises because the economy's consumers now place a higher value on fish. Fish is worth 1% more to them than before so the price of fish rises from F 900 to F 909 thousand per tonne and the volume of fish sold is identical to the volume of ice sold because it is use on a 1 : 1 radio.

What are the net present values of the economic benefits at discount rate 0%, 5%, 10% and 20%?
What is the economic IRR?

4.4 A fisherman has worked for several years on board a very successful motorised canoe. He has saved enough money to buy a canoe and outboard motor of his own. Further details of his present situation and estimated costs earnings are given below;-

Present situation:
annual earnings from fishing aboard one of top motorised canoes

Value of one share	6500 per trip
number of trips	35 per year
total earnings	227500 per year

Investment costs and expected performance of new canoe without motor:

capital costs		
canoe	55000	3 years expected life
recurrent costs paid by owner		
canoe repairs	8% of capital cost per year	
number of trips		
year 1	35	
year 2	40	
average value of 1 share	500 per trip	
(divided revenue from fish sales less shared expenses)		

Investment costs an expected performance of new motorised canoe :

capital costs		
canoe	55000	3 years expected life
motor	100000	2 years expected life
recurrent costs paid by owner		
canoe repairs	8% of capital cost per year	
motor repairs	30% of capital cost per year	
number of trips		
year 1	20	
year 2	30	
average value of 1 share	5000 per trip	
(divided revenue from fish sales less shared expenses)		

Owner's income; number of shares:

	non-motorised	motorised
a) owner continues to fish	2	3
b) owner gives up fishing	1	2

(there is no gear share, as the crew provide their own hand lines)

Construct financial profit and loss accounts to represent two year's expected operation of a non-motorised vessel if the owner decides: a) to continue fishing, but aboard his new canoe; b) to give up fishing. Calculate the Net Present Values (at 20% discount rate) and Financial Internal Rates of Return. Assume the boat is bought at the end of Year 0, and that fishing takes places in Years 1 and 2.

4.5 Construct financial profit and loss accounts to represent two years' expected operation of a motorised vessel if the owner decides: a) to continue fishing, but aboard his new canoe; b) to give up fishing. Calculate the Net Present Values (at 20% discount rate) and Financial Internal Rates of Return. Assume the boat is bought at the end of Year 0, and that fishing takes place in Years 1 and 2.

4.6 The fisherman could alternatively invest his savings in a non-fishing entreprise which would require no other input from him and would yield an estimated 22% per year. He is unaware of any better alternative investment opportunity.

If the fisherman gave up fishing altogether, the only possible employment open to him would pay him a salary of 50000 per year.

Construct economic profit and loss accounts to represent two years' expected operation of a non-motorised vessel if the owner decides: a) to continue fishing, but aboard his new canoe; b)to give up fishing. Calculate the Net Present Values (at 20% discount rate) and Economic Internal Rates of Return.

4.7 Construct economic profit and loss accounts to represent two years' expected operation of a motorised vessel if the owner decides: a) to continue fishing, but aboard his new canoe; b) to gived up fishing. Calculate the Net Present Values (at 20% discount rate) and Economic Internal Rates of Return.

5. Economic and Financial Analysis

5.1 The data below show the observed performance of fishing vessels operating from the same landing beach. The vessels are identical in all respects except for their outboard motors. One motor is 40 hp and the other is 25 hp

The majority of the catch, 80 percent, is sold. The remaining 20 percent is given away and therefore has no financial value to the owner or crew of the vessel.

Some of the fishing trips about 12 per cent of the total, are organised for the benefit of the fishermen; the entire product of the fish from these special trips (except the 20 per cent noted above which is given away) are paid to the crew. These special trips are the means by which the crew earn their wages.

Their is no profit tax but there is a sales tax of 1 per cent of the value of fish sales.
From the data given calculate the fixed and variable costs for the two cases and prepare financial profit and loss accounts.

General data	40hp	25hp
number of crew	16	16
number of fishing trips/year	250	240
normal commercial trips	220	211
trips for benefit of crew	30	29
fuel consumption per trip :		
petrol	39.22	44.72 litres
oil	2.42	2.80 litres
Cost of maintenance :		
boat; per year, % of capital cost	8%	8%
nets; per trip	258	258
outboard motor; per trip	88	100
average catch/trip	750	750 kg
disposal of catch :		
given to fishermen	15%	15%
given to others	5%	5%
sold	80%	80%
average selling price of fish	6.00	6.00/kg
fuel price :		
petrol	15.40/litre (15% tax included)	
oil	57.19/litre (15% tax included)	
cost of meals for crew	8100/Man/year	

Investment costs	40hp	25hp	life, years
boat	116000	116000	3
nets	430000	430000	3
outboard motor	88000	64000	2

import duty on motor	25%	22000	16000
total		656000	626000

Profit tax	0%
Sales tax	1% of the value of sales.

5.2 An investor wishes to buy a boat with 40hp motor, using 300000 of his own capital and borrowing the remainder over a period of 2 years at 20% per year interest. Prepare a financial cash flow forecast for the two year period, showing income, expenses, financing arrangements, repayment of capital, interest payments and the balance expected at the end of each year. Assume the boat is bought at the end of Year 0, and that fishing takes place in Years 1 and 2.

5.3 Set up a financial discounted cash flow analysis for the vessel with the 40 hp motor to find the Net Present Value of the investment at an assumed discount rate of 20 per cent. Also find the Financial Internal Rate of Return.
Assume that the boat is bought at the end of Year 0 and that fishing takes place in Year 1 and 2.
Prepare a graph to show the sensitivity of the FRR to the following :

- capital cost
- variable costs
- the price of fish
- the price of fuel
- fishing effort
- fish given away.

5.4 Set up a financial discounted cash flow analysis for the vessel with the 25 hp motor to find the Net Present Value of the investment at an assumed discount rate of 20 per cent. Also find the Financial Internal Rate of Return. Assume that the boat is bought at the end of Year 0 and that fishing takes place in Years 1 and 2.

5.5 From the data used in questions 5.3 and 5.4 set up an incremental (marginal) financial analysis to calculate the incremental Net Present Value and the incremental Financial Internal Rate of Return gained from an incremental investment in the more efficient 40 hp vessel.

5.6 List the economic benefits from operating the 40 hp vessel including the economic value of fish given away.

It has been estimated from a separate study that the introduction of an additional boat to the fishery will reduce the profits of the existing fleet by an amount equivalent to 18% of the economic revenue of the additional boat. List the economic costs from

operating the 40 hp boat, including external costs; make appropriate allowances for taxes.

Set up an economic discounted cash flow analysis for the 40 hp boat to find the Net Present Value of this investment at an assumed discount rate of 10%. Find the Economic Internal Rate of Return.

5.7 Repeat the analysis in question 5.6 for the 25 hp boat.

5.8 From the data used in questions 5.6 and 5.7 set up an incremental (marginal) economic analysis to calculate the incremental Net Present Value and incremental Economic Internal Rate of Return gained from the investment in the more efficient 40 hp boat.

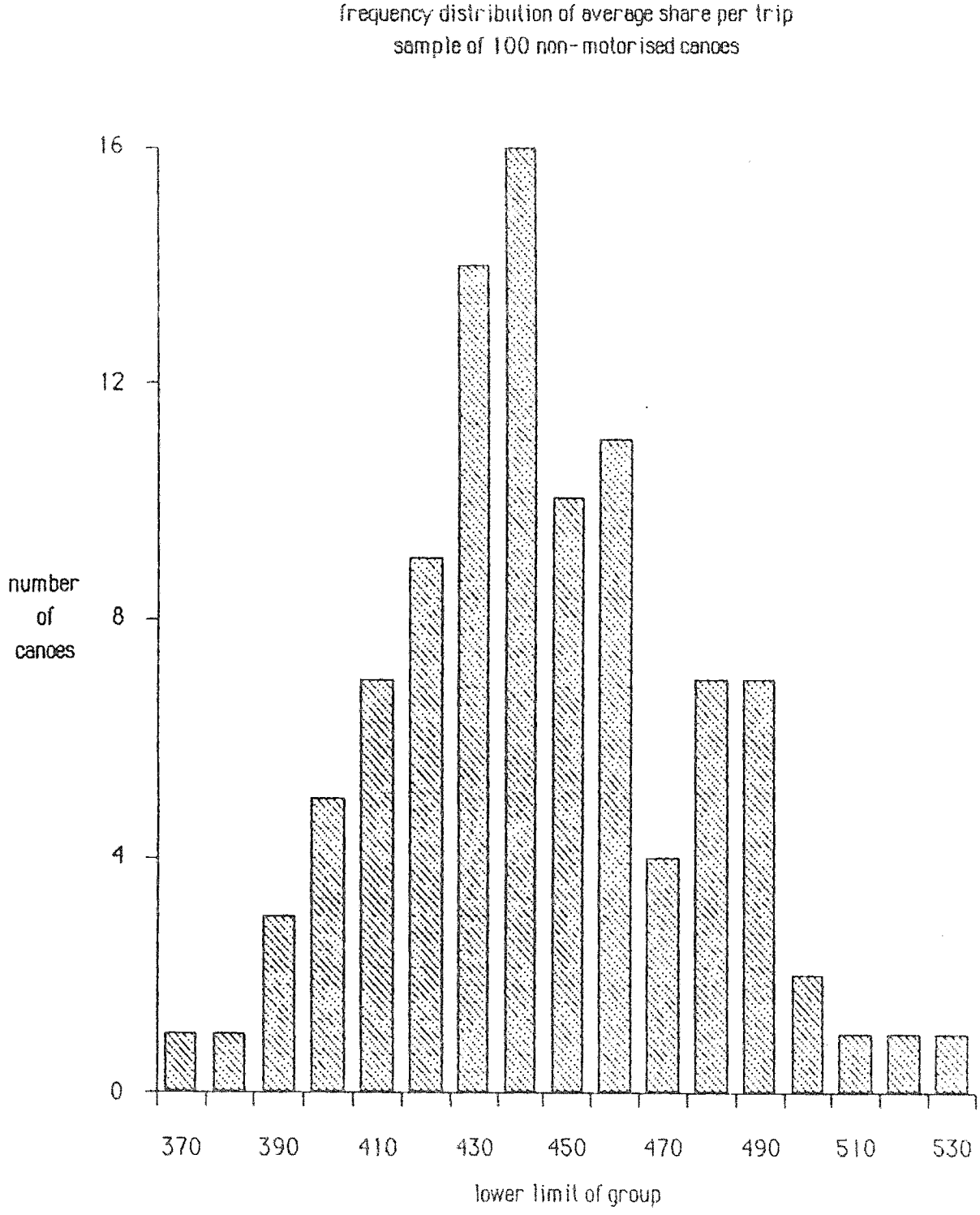
Appendix : II

ANSWERS

1.1	a) probability of average share above 450	44%
	b) probability of average share below 420	17%
	c) probability of average share between 430 and 449	30%
1.2	a) probability of average share above 3000	46%
	b) probability of average share below 2600	18%
	c) probability of average share between 2800 and 2999	24%

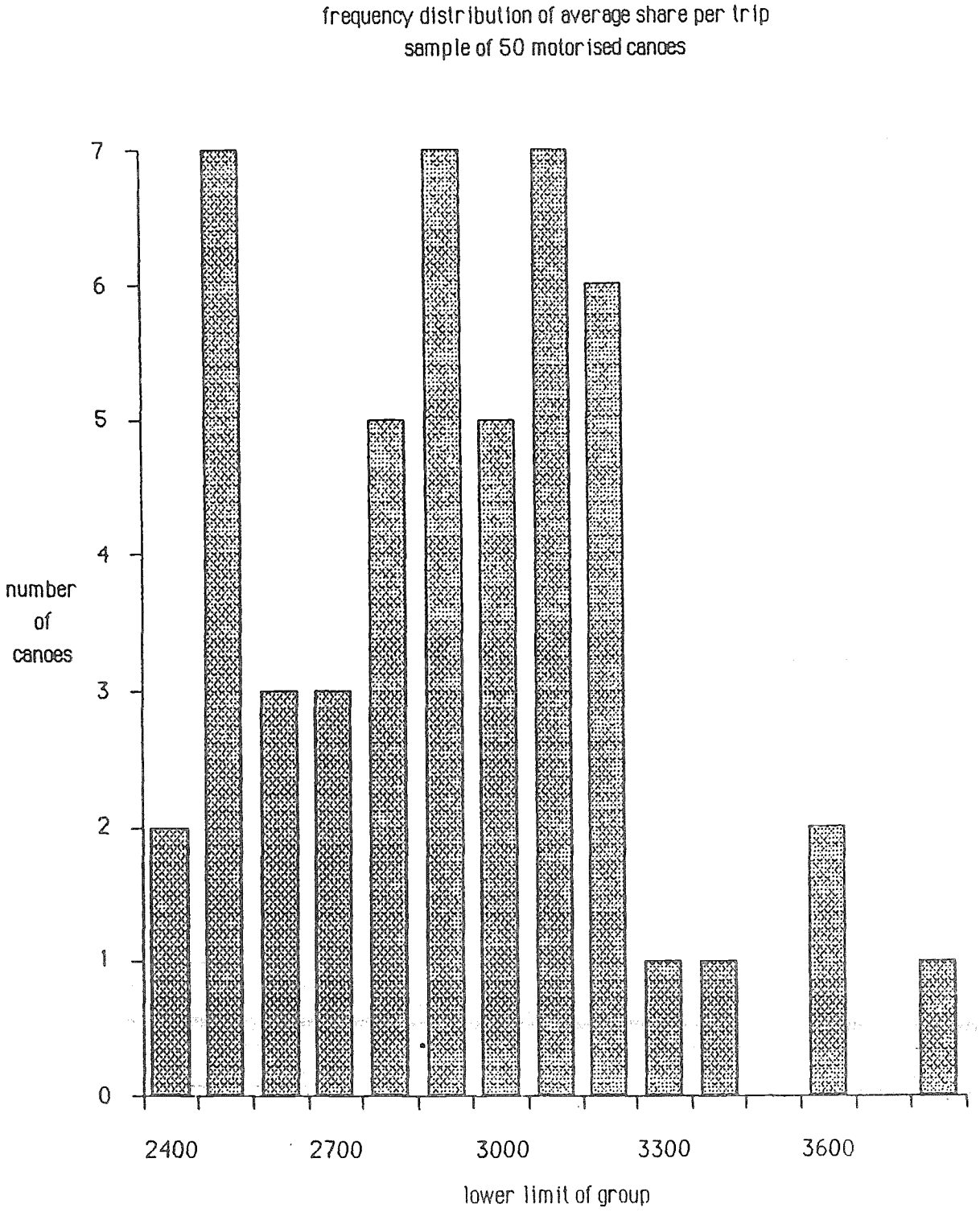
ANSWERS

1.1


frequency distribution of average share per trip
sample of 100 non-motorised canoes
number of canoes
16
12
8
4
0
370
390
410
430
450
470
490
510
530
lower limit of group

ANSWERS

1.2


frequency distribution of average share per trip
sample of 50 motorised canoes
number of canoes
0
1
2
3
4
5
6
7
2400
2700
3000
3300
3600
lower limit of group

1.3

15% annual discount rate

YEAR 1		30 trips		YEAR 2		40 trips				
Prob	Value of 1 Share	owner Share	PV	Prob	Value of 1 Share	owner Share	PV	Joint probability	Total PV	weighted PV
26%	411	12330	10722	26%	411	16440	12431	6.76%	23153	1565
				30%	439	17560	13278	7.80%	24000	1872
				21%	459	18360	13883	5.46%	24605	1343
				23%	492	19680	14881	5.98%	25603	1531
30%	439	13170	11452	26%	411	16640	12431	7.80%	23883	1863
				30%	439	17560	13278	9.00%	24730	2226
				21%	459	18360	13883	6.30%	25335	1596
				23%	492	19680	14881	6.90%	26333	1817
21%	459	13770	11974	26%	411	16440	12431	5.46%	24405	1333
				30%	439	17560	13278	6.30%	25252	1591
				21%	459	18360	13883	4.41%	25857	1140
				23%	492	19680	14881	4.83%	26855	1297
23%	492	14760	12835	26%	411	16440	12431	5.98%	25266	1511
				30%	439	17560	13278	6.90%	26113	1802
				21%	459	18360	13883	4.83%	26718	1290
				23%	492	19680	14881	5.29%	27716	1466
Totals		13443				17924	Total Expected Present Value			25243

(a) 13443

(b) 17924

(c) 25243

1.4

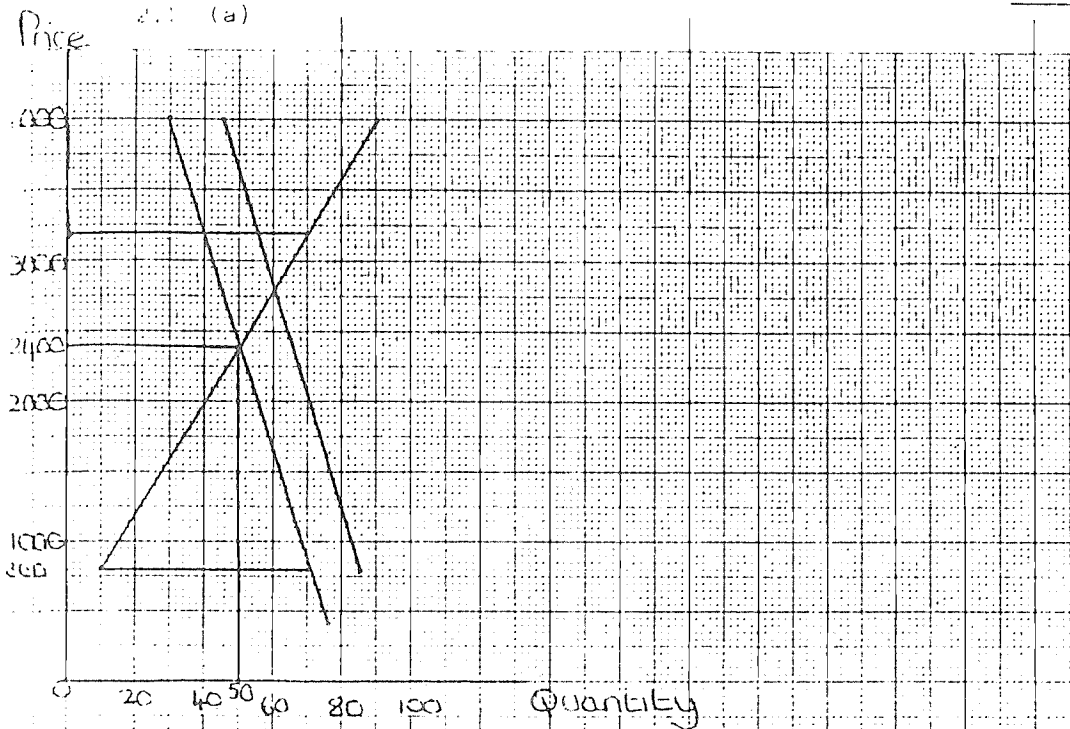
15% annual discount rate

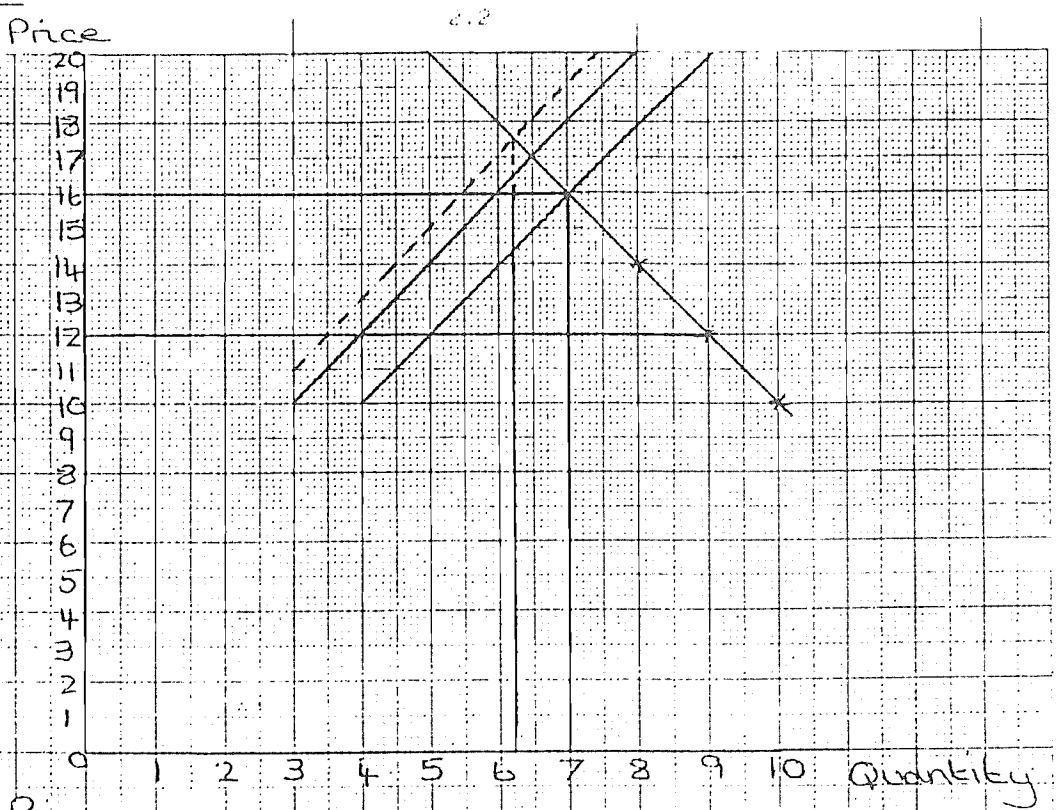
YEAR 1		25 trips		YEAR 2		35 trips				
prob	value of 1 share	owner share	PV	prob	value of 1 share	owner share	PV	joint probability	total PV	weighted PV
30%	2596	155760	135443	30%	2596	207680	157036	9.00%	292479	26323
				24%	2907	232560	175849	7.20%	311292	22413
				24%	3107	248560	187947	7.20%	323391	23284
				22%	3404	272320	205913	6.60%	341357	22530
24%	2907	174420	151670	30%	2596	207680	157036	7.20%	308705	22227
				24%	2907	232560	175849	5.76%	327518	18865
				24%	3107	248560	187947	5.76%	339617	19562
24%	3107	186420	162104	30%	2596	207680	157036	7.20%	319140	22978
				24%	2907	232560	175849	5.76%	337953	19466
				24%	3107	248560	187947	5.76%	350051	20163
				22%	3404	272320	205903	5.28%	368017	19431
22%	3404	204240	177600	30%	2596	207680	157036	6.60%	334636	22086
				24%	2907	232560	175849	5.28%	353449	18662
				24%	3107	248560	187947	5.28%	365547	19301
				22%	3404	272320	205913	4.84%	383513	18562
Totals		178262		237683 Total Expected Present Valuen					334733	

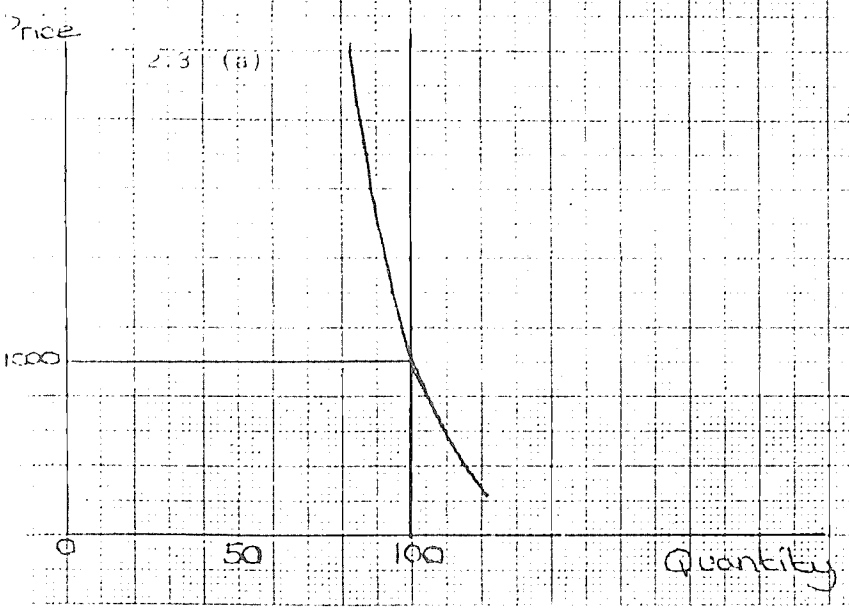
(a) 178262

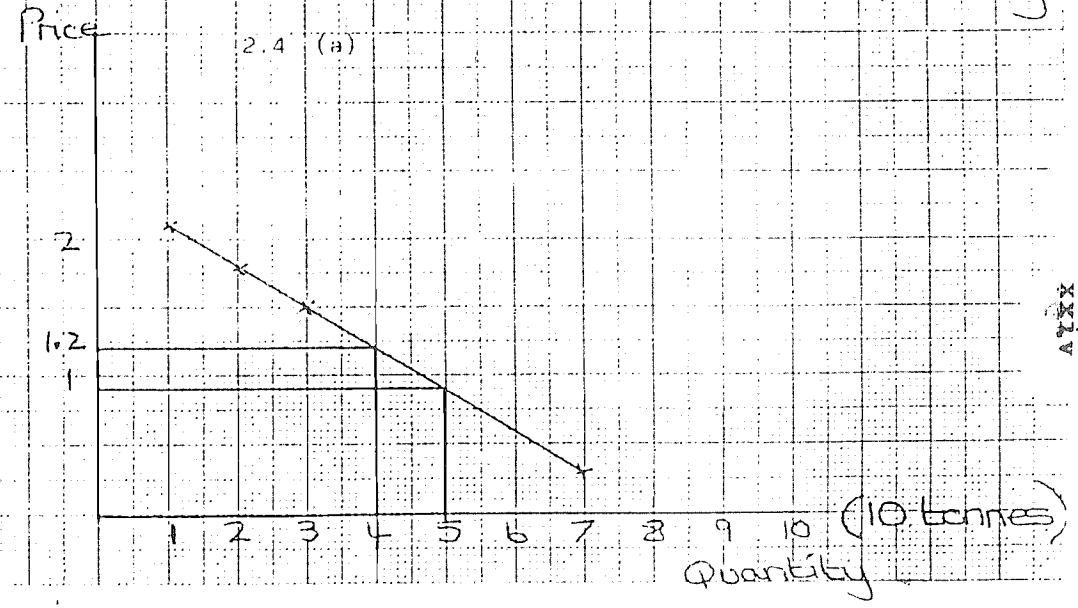
(b) 237683

(c) 334733


2.1 (a)
Price
4000
3000
2400
2000
1000
800
0
20
40
50
60
80
100
Quantity


2.2
Price
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
8
9
10
Quantity


Price
2.3 (a)
1500
0
50
100
Quantity


Price
2.4 (a)
2
1.2
1
1
2
3
4
5
6
7
8
9
10
(10 tonnes)
Quantity

2.1 a) graph
b) 60 kg/wk excess demand.
c) 30 kg/wk excess supply
d) 2400 F/kg, 50 kg/wk.
e) 2800 F/lg, 60 kg/wk

2.2 a) 5 tonnes excess demand.
b) 3 tonnes excess supply.
c) $16/kg, 7 tonne.
d) Consumers pay $17.5/kg. Quantity of fish sold falls from 6.5 tonnes to 6.25 tonnes.

2.3 a) graph.
b) Quantity = $\frac{\%\text{ change in quantity demanded}}{\%\text{ change in price}} = -0.5$

$$= \frac{-10 \times 100}{\frac{100}{X}} = -0.5$$

$$X = \frac{10}{0.5} = 20\%$$

.. new price = F 1200/KG

2.4 a) graph
b) (i) 10 tonnes (ii) 25%
c) -h)

Price per kg	Quantity demanded	Total spending	Price elasticity of demand
2.10	10	21	
1.80	20	36	-3.00
1.50	30	45	-1.67
1.20	40	48	-1.0
0.90	50	45	-0.60
0.60	60	36	-0.33
0.30	70	21	

2.5	Year 1		Year 2		Ye	Normal/Inf.	Lux/Nec
	$	Share	$	Share			
Income	100	%	200	%			
Good A	30	30	50	25	0.67	N	Nec
Good B	30	30	70	35	1.33	N	Lux
Good C	25	25	20	10	-0.20	I	Nec
Good D	15	15	60	30	3.00	N	Lux

2.6. i)

$$P = 5000 - 10Q$$

$$10Q = 5000 - P$$

$$Q = 500 - \frac{P}{10}$$

if $P = 4000$

$$Q = 500 - \frac{4000}{10}$$

$$= 100.$$

if $P = 3000$

$$Q = 500 - \frac{3000}{10}$$

$$= 200.$$

$$\text{Elasticity} = \frac{Q_2 - Q_1}{Q_1} \Big/ \frac{P_2 - P_1}{P_1}$$

$$= \frac{Q}{Q} \Big/ \frac{P}{P}$$

$$= \frac{200 - 100}{100} \Big/ \frac{3000 - 4000}{4000}$$

$$= \frac{1}{\frac{-1}{4}} = -4$$

2.6 ii) -1.5
iii) -4
iv) -0.67

2.7 horizontal summation on graph (not show).

2.8 i) C
ii) A
iii) B
iv) D

2.9 P = 23 Q = 139

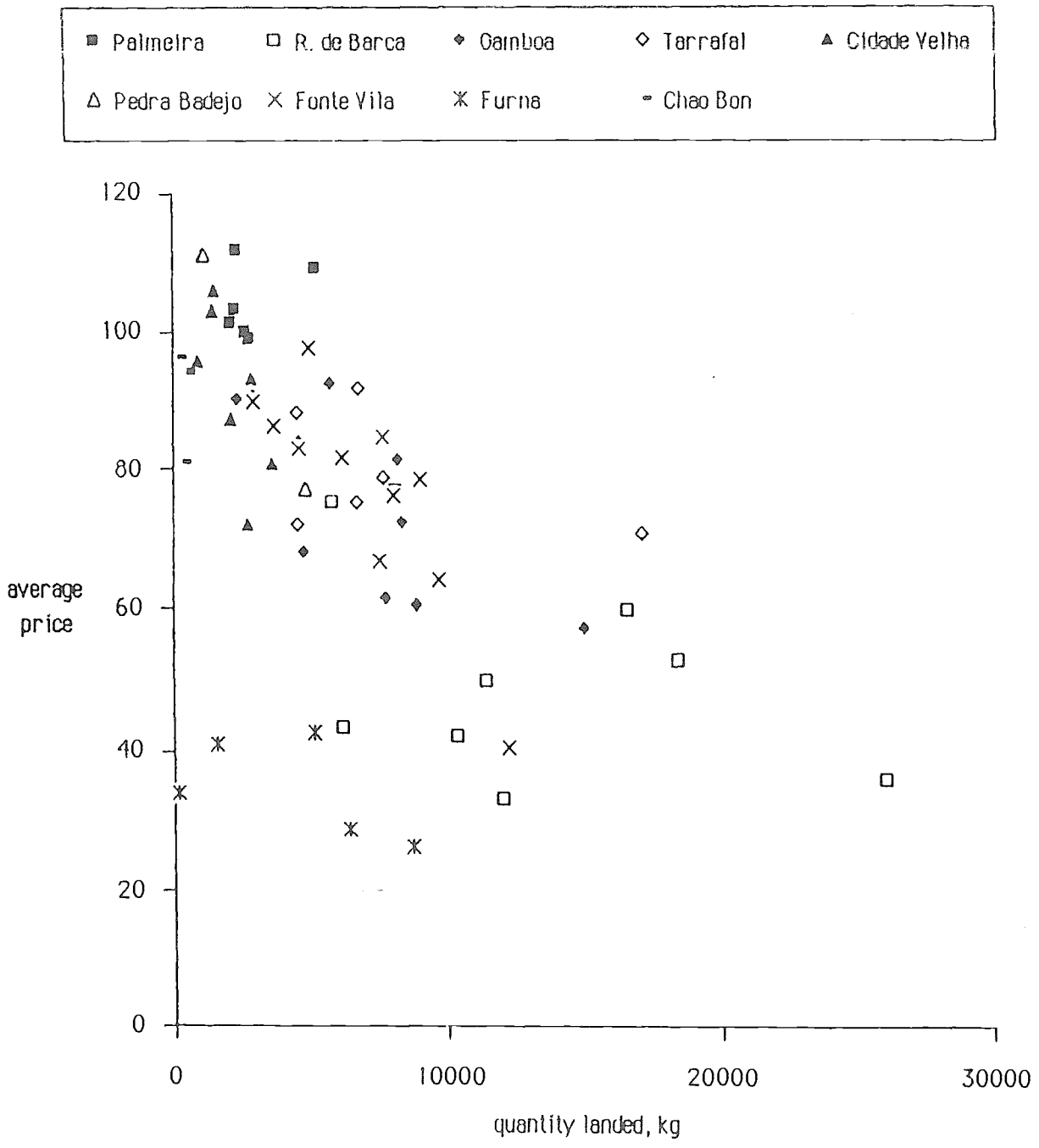
2.10 a) (i) 0.867
(ii) 0.017 by consumers
0.133 by producers

b) (i) 0.822
(ii) 0.028 to consumers
0.272 to producers

ANSWERS

2.11

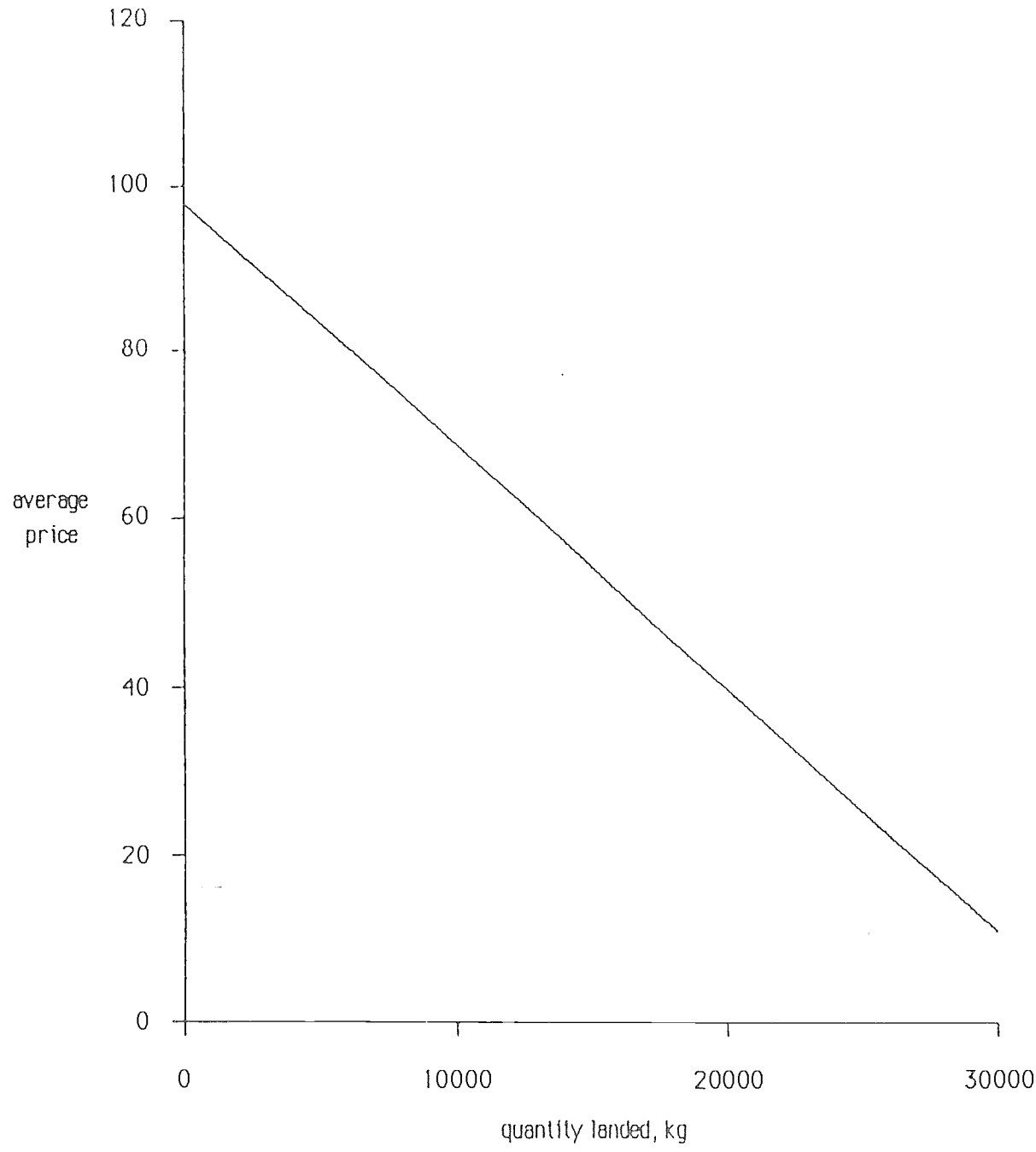
scatter diagram of
average price per kg v quantity landed



ANSWERS

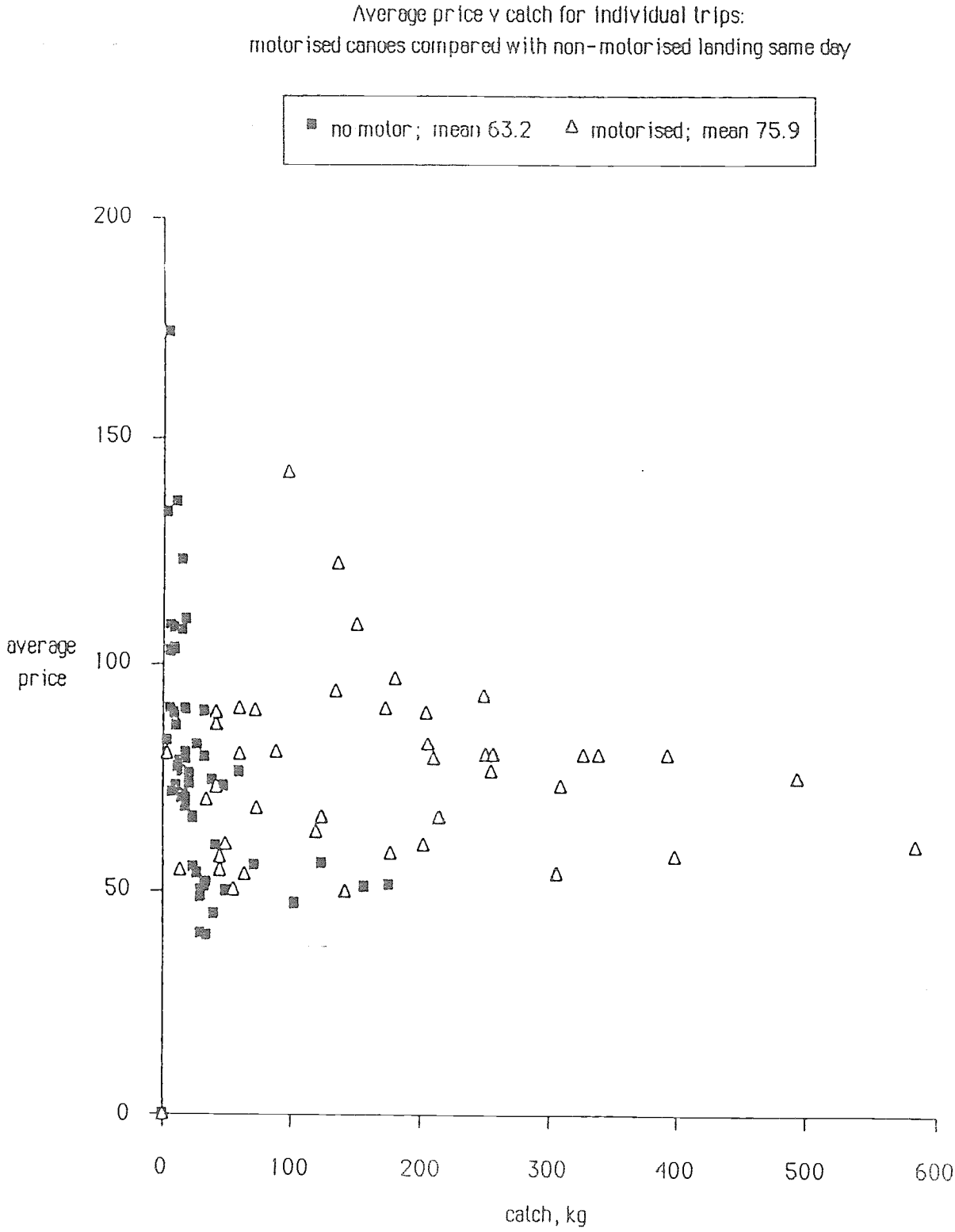
2.12

Regression relationship between average price and quantity landed: data from Furna not included (slope = -0.00289; intercept = 97.6).



ANSWERS

2.14


Average price v catch for individual trips:
motorised canoes compared with non-motorised landing same day
no motor; mean 63.2
motorised; mean 75.9
average price
200
150
100
50
0
0
100
200
300
400
500
600
catch, kg

3.1

Benefits	30,000
Costs	20,000
Interests	1,200
Costs	21,200
Net benefit	8,800

(The value of independence)

3.2 a) B
b) A
c $700/wk

3.3

Effort	Total catch	Catch per unit of Effort	Total Cost	Earnings	Profit	MR (1)	MC (2)
50	4,875	97.50	1650000	1950000	300000		0.00
60	5,820	97.00	1980000	2328000	348000	400	349
70	6,755	96.50	2310000	2702000	392000	400	353
80	7,680	96.00	2640000	3072000	432000	400	357
90	8,595	95.50	2970000	3438000	468000	400	361
100	9,500	95.00	3300000	3800000	500000	400	365
110	10,395	94.50	3630000	4158000	528000	400	369
120	11,280	94.00	3960000	4512000	552000	400	373
130	12,155	93.50	4290000	4862000	572000	400	377
140	13,020	93.00	4620000	5208000	588000	400	382
150	13,875	92.50	4950000	5550000	600000	400	386
160	14,720	92.00	5280000	5888000	608000	400	391
170	15,555	91.50	5610000	6222000	612000	400	395
180	16,380	91.00	5940000	6552000	612000	400	400
190	17,195	90.50	6270000	6878000	608000	400	405
200	18,000	90.00	6600000	7200000	600000	400	410
210	18,795	89.50	6930000	7518000	588000	400	415
220	19,580	89.00	7260000	7832000	572000	400	420
230	20,355	88.50	7590000	8142000	552000	400	426
240	21,120	88.00	7920000	8448000	528000	400	431
250	21,875	87.50	8250000	8750000	500000	400	437
260	22,620	87.00	8580000	9048000	468000	400	443
270	23,355	86.50	8910000	9342000	432000	400	449
280	24,080	86.00	9240000	9632000	392000	400	455

(1) Marginal revenue
(2) Marginal cost

(a) catch per unit effort $= \frac{\text{catch}}{\text{effort}}$

Total cost = 33,000 x effort
earnings = 400 x catch
Profit = earnings - total cost
Marginal revenue = MR =
(2328000 - 1950000) / (5820 - 4875) = 400
(270200 - 2328000) / (6755 - 5820) = 400 etc

Marginal Cost = MC = (1980000 - 1650000) / 5820 - 4875) = 349
(2310000 - 1980000) / (6755 - 5820) = 353 etc

(b) Profit are maximised where MR = MC (E = 180)

3.4 (a) (i) $Y = 10E - 0.0001E^2$
To find the maximum value of Y
differentiate the function and set equal to zero.

$$\frac{dY}{dE} = 10 - 0.0002E = 0$$

$$E = 50,000$$

substitute E = 50,000 into
$Y = 10E - 0.0001E^2$ to give :

Y = 250,000.

(ii) Extinction of the stock occurs when one of the solutions to $10E - 0.0001E^2 = 0$ One of the solution is when E = 0.
The other is given by :-

$E(10 - 0.0001E) = 0$

$$E = \frac{10}{0.0001} = 100,000$$

b) To find the total revenue curve, multiply the yield curve by the price. Therefore :

Total revenue = PY
$= 2000 (10E - 0.0001E^2)$

(i) At free access equilibrium.
TR = TC, therefore:

$2000E(10 - 0.0001E) = 4000E$
$10 - 0.0001E = 2$
$0.0001E = 8$
$E = 80,000$ days.

(ii) and (iii) At maximum economic yield TR - TC is at its

maximum.
Set π = TR - TC. To find the maximum differentiate and set equal to zero.

π = TR - TC = 20,000E - 0.2E^2-4000E
= 16,000E - 0,2E^2

$\frac{d\pi}{dE}$ = 16,000 - 0.4E = 0
E = 40,000

therefor π = 20,000 x 40,000 - 0.2(40,000)^2 - 4,000 x 40,000
= 320 million.

(d) each vessel fishes for 150 days per year.
Optimal effort = 40,000. Optimal fleet size = 40,000/150 = 267

Effort days '000	Yield tonnes '000	Costs millions $	Revenues millions $	Economic yield
0	0	0	0	0
5	48	20	95	75
10	90	40	180	140
15	128	60	255	195
20	160	80	320	240
25	188	100	375	275
30	210	120	420	300
35	228	140	455	315
40	240	160	480	320
45	248	180	495	315
50	250	200	500	300
55	247	220	495	275
60	240	240	480	240
65	227	260	455	195
70	210	280	420	140
75	188	300	375	75
80	160	320	320	0
85	128	340	255	-85
90	90	360	180	-180
95	48	380	95	-285
100	0	400	0	-400

Price of ice
80000 FCFA/tonne

Year									
0	1	2	3	4	5	6	7	8	9
production									
0	150	300	500	500	500	500	500	500	500
Earnings millions FCFA									
Sales of ice									
0,0	12,0	24,0	40,0	40,0	40,0	40,0	40,0	40,0	40,0
Total earnings									
0,0	12,0	24,0	40,0	40,0	40,0	40,0	40,0	40,0	40,0
Costs									

Capital									
40,0									
Fix									
2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
Variable									
0,0	8,41	6,8	28,0	28,0	28,0	28,0	28,0	28,0	28,0
Totals costs									
42,0	10,4	18,8	30,0	30,0	30,0	30,0	30,0	30,0	30,0
Cash Flow									
-42,0	1,6	5,2	10,0	10,0	10,0	10,0	10,0	10,0	10,0

Net Present Value

0%	34,80
5%	16,72
10%	3,99
20%	-12,02

Internal Rate of Return 11,98%

4.2 Residual value of the plant in the end of year 9 :
2,00 millions FCFA

Year

0	1	2	3	4	5	6	7	8	9
Production									
tonne of ice									
0	150	300	500	500	500	500	500	500	500
Earnings; millions FCFA									
Sales of ice									
0,0	12,0	24,0	40,0	40,0	40,0	40,0	40,0	40,0	40,0
Residual Value of Capital									2,00
Totals earnings									
0,0	12,0	24,0	40,0	40,0	40,0	40,0	40,0	40,0	42,0
Costs									
Capital									
40,0									
fixes									
2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,00
variable									
0,0	8,4	16,8	28,0	28,0	28,0	28,0	28,0	28,0	28,0
Totals costs									
42,0	10,4	18,8	30,0	30,0	30,0	30,0	30,0	30,0	30,0
Cash Flow									
-42,0	1,6	5,2	10,0	10,0	10,0	10,0	10,0	10,0	12,0

Net Present Value

0%	36,80
5%	18,01
10%	4,84
20%	-11,64

Internal Rate of Return 12,35 %

Question 4.3

Residual Value of the Plant in the end of Year 9:
2,0 FCFA milion
Increase in the price of fish sold by the buyers of ice :
9000 FCFA/tonne

Year	0	1	2	3	4	5	6	7	8	9
Production tonnes of ice	0	150	300	500	500	500	500	500	500	500
Economic benefices										
Saved fish*	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	
Increase in fish price		1,35	2,70	4,50	4,50	4,50	4,50	4,50	4,50	4,50
Total advantages		1,35	2,70	4,50	4,50	4,50	4,50	4,50	4,50	4,50
Earnings; FCFA milions										
Sales of ice	0,0	12,0	24,0	40,0	40,0	40,0	40,0	40,0	40,0	40,0
Residual Value of Capital										2,0
Total Revenue	0,00	12,0	24,0	40,0	40,0	40,0	40,0	40,0	40,0	40,0
Costs										
Capital	40,0									
fixe	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
variable	0,0	8,40	16,8	28,0	28,0	28,0	28,0	28,0	28,0	28,0
Total costs	42,0	10,4	18,8	30,0	30,0	30,0	30,0	30,0	30,0	30,0
Cash Flow	-42,0	2,95	7,9	14,5	14,5	14,50	14,5	14,5	14,5	16,5

Net present Value

0%	72,35
5%	45,37
10%	26,40
20%	2,63

Internal Rate of Return 21,58%

*The value of the fish saved is already included in the value of sold ice.

4.4 Financial appraisal of new canoe without motor

a) Financial profit and loss statement

Year	0	1	2
Number of trips		35	40
net earnings (sales less shared running costs)			
2 shares; owner fishes with crew		35000	40000
1 share; owner ceases fishing		17500	20000
recurrent costs paid owner			
repairs			
canoe		4400	4400
total recurrent costs		4400	4400
profit before depreciation			
owner fishes with crew		30600	35600
owner ceases fishing		13100	15600
depreciation			
canoe		18333	18333
net profit			
owner fishes crew		12267	17267
owner ceases fishing		-5233	-2733

b) FINANCIAL DCF APPRAISAL

Year	0	1	2
number of trips		35	40
net earnings (sales less shared running costs)			
2 shares; owner fishes with crew		35000	40000
1 share; owner ceases fishing		17500	20000
capital costs and capital recovery			
investment			
canoe	55000		-18333
recurrent costs paid by owner			
repairs			
canoe		4400	4400
total costs	55000	4400	-13933
financial cash flow			
owner fishes with crew	-55000	30600	53933
owner ceases fishing	-55000	13100	33933

net present value	20% discount factor
owner fishes with crew	7954
owner ceases fishing	-20519

financial internal rate of return	
owner fishes with crew	31%
owner ceases fishing	-9%

4.5 Financial appraisal of new motorised canoe

a) Financial profit and loss statement

Year	0	1	2
number of trips		20	30
net earnings (sales less shared running costs)			
3 shares; owner fishes with crew		300000	450000
2 shares; owner ceases fishing		200000	300000
recurrent costs paid owner			
repairs			
canoe		4400	4400
motor		30000	30000
total recurrent costs		34400	34400
profit before depreciation			
owner fishes with crew		265600	415600
owner ceases fishing		165600	265600
depreciation			
canoe		18333	18333
motor		50000	50000
total		68333	68333
net profit			
owner fishes with crew		197267	347267
owner ceases fishing		97267	197267

b) Financial DCF appraisal

Year	0	1	2
number of trips		20	30
net earnings (sales less shared running costs)			
3 shares; owner fishes with crew		300000	450000
2 shares; owner ceases fishing		200000	300000
capital costs and capital recovery			
investment			
canoe	55000		-18333
motor	100000		
total investment costs	155000	0	-18333
recurrent costs paid by owner			
repairs			
canoe		4400	4400
motor		30000	30000
total recurrent costs		34400	34400
total costs	155000	34400	16067

financial cash flow			
owner fishes with crew	-155000	265600	433933
owner ceases fishing	-155000	165600	283933
net present value		20% discount factor	
owner fishes with crew	367676		
owner ceases fishing	180176		
financial internal rate of return			
owner fishes with crew	174%		
owner ceases fishing	99%		

4.6 Economic appraisal of new canoe without motor

a) Economic profit and loss statement

Year	0	1	2
number of trips		35	40
net earnings (sales less shared running costs)			
2 shares; owner fishes with crew		35000	40000
1 share; owner ceases fishing		17500	20000
recurrent costs paid by owner			
repairs			
canoe		4400	4400
opportunity costs			
labour			
owner fishes crew		227500	227500
owner ceases fishing		50000	50000
capital		12100	12100
total costs			
owner fishes with crew		244000	244000
owner ceases fishing		66500	66500
economic profit			
owner fishes with crew		-209000	-204000
owner ceases fishing		- 49000	- 46500

b) Economic DCF appraisal

Year	0	1	2
number of trips		35	40
net earnings (sales less shared running costs)			
2 shares; owner fishes with crew		35000	40000
1 share; owner ceases fishing		17500	20000
capital costs and capital recovery			
investment			
canoe	55000		-18333
recurrent costs paid by owner			
repairs			
canoe		4400	4400
opportunity costs			

labour			
owner fishes with crew		227500	227500
owner ceases fishing		50000	50000
capital		12100	12100
total costs			
owner fishes with crew	55000	231900	231567
owner ceases fishing	55000	54400	36067
economic cash flow			
owner fishes with crew	-55000	-196900	-173567
owner ceases fishing	-55000	- 36900	- 16067
net present value		20% discount factor	
owner fishes with crew	-339616		
owner ceases fishing	- 96907		
economic internal rate of return			
owner fishes with crew	none		
owner ceases fishing	none		

4.7 Economic appraisal of new motorised canoe

a) Economic profit and loss statement

Year	0	1	2
number of trips		20	30
net earnings (sales less shared running costs)			
3 shares; owner fishes with crew		300000	450000
2 shares; owner ceases fishing		200000	300000
recurrent costs paid by owner			
repairs			
canoe		4400	4400
motor		30000	30000
total recurrent costs		34400	34400
opportunity costs			
labour			
owner fishes with crew		227500	227500
owner ceases fishing		50000	50000
capital		34100	34100
total costs			
owner fishes with crew		296000	296000
owner ceases fishing		118500	118500
economic profit			
owner fishes with crew		4000	154000
owner ceases fishing		81500	181500

b) Economic DCF appraisal

Year	0	1	2
number of trips		20	30
net earnings (sales less shared runnings costs)			
3 shares; owner fishes with crew		300000	450000
2 shares; ceases fishing		200000	300000
capital costs and capital recovery			
investment			
canoe	55000		-18333

motor	100000		
total investment costs	155000	0	-18333
recurrent costs paid by owner			
repairs			
canoe		4400	4400
motor		30000	30000
total recurrent costs		34400	34400
opportunity costs			
labour			
owner fishes with crew		227500	227500
owner ceases fishing		50000	50000
capital		34100	34100
total costs			
owner fishes with crew	155000	296000	277667
owner ceases fishing	155000	118500	100167
economic cash flow			
owner fishes with crew	-155000	4000	172333
owner ceases fishing	-155000	81500	199833
net present value		20% discount factor	
owner fishes with crew	- 31991		
owner ceases fishing	51690		
economic internal rate of return			
owner fishes with crew	7%		
owner ceases fishing	43%		

5.1 Annual profit and loss accounts

	40hp boat	25hp boat
revenue		
sales of fish		
normal commercial trips	792000	759600
trips for benefit of crew	108000	104400
total sales of fishes	900000	864000
operating expenses		
fixed costs;		
maintenance; boat	9280	9280
meals for crew	129600	129600
total fixed costs	138880	138880
variable costs;		
fuel;		
petrol	150980	165268
oil	34667	38400
maintenance;		
nets	64500	61920
outboard motor	22000	24000
crew payments:		
cash from fish sales	108000	104400
total variable costs	380147	393988
total operating expenses	519027	532868

profit before depreciation and taxes		380973	331132
depreciation:			
boat		38667	38667
nets		143333	143333
outboard motor		44000	32000
total depreciation		226000	214000
profit after depreciation before taxes		154973	117132
sales tax	1%	9000	8640
profit tax	0%	0	0
total taxes		9000	8640
net profit		145973	108492

5.2 Financial and cash flow forecast for 40hp boat

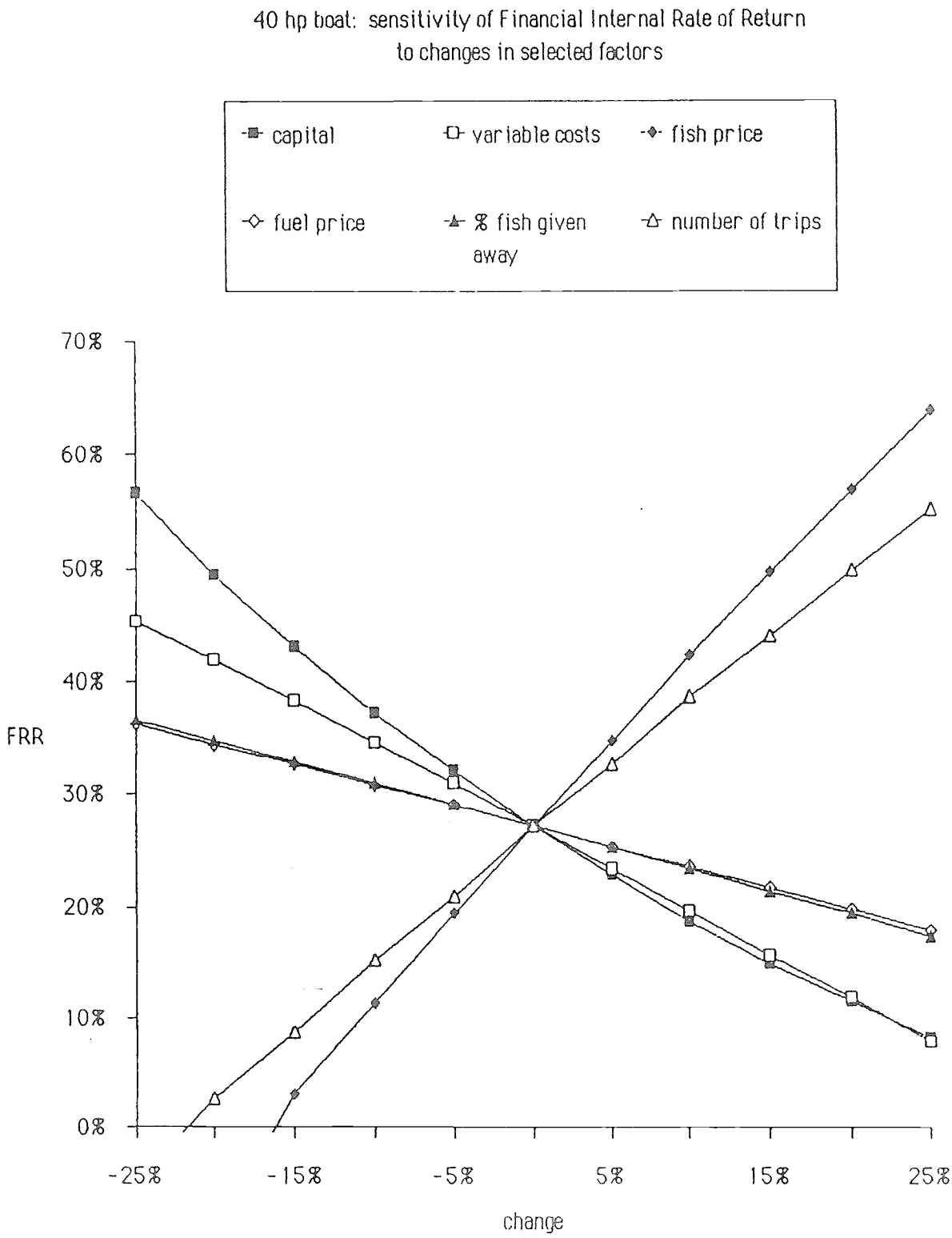
loan period 2 years
loan interest 20% per year

Year	0	1	2	3
Revenue				
sales		900000	900000	900000
expenses				
investment costs				
capital	634000		88000	
import duty	22000		22000	
operating costs	0	519027	519027	519027
taxes	0	9000	9000	9000
total expenses	656000	528027	638027	528027
opening balance	-656000	71973	583146	1168719
financing:				
proprietor's capital	300000			
loans				
investments	356000	0	0	0
working capital				
total loans	356000	0	0	0
repayment of capital	0	178000	178000	0
balance owed	356000	178000	0	0
interest on loans	0	71200	35600	0
closing balance	-300000	321173	796746	1168719

5.3 Discounted financial cash flow analysis for 40hp boat

Year	0	1	2	3
cash inflow				
total sales of fish		900000	900000	900000
capital recovery				44000
total cash inflow	0	900000	900000	944000
cash outflow				

5.3


40 hp boat: sensitivity of Financial Internal Rate of Return
to changes in selected factors
capital
variable costs
fish price
fuel price
% fish given away
number of trips
70%
60%
50%
40%
30%
20%
10%
0%
FRR
-25%
-15%
-5%
5%
15%
25%
change

investment costs				
capital	634000		88000	
import duty	22000		22000	
operating costs		519027	519027	519027
taxes		9000	9000	9000
total cash outflow	656000	528027	638027	528027
Net cash flow	-656000	371973	261973	415973

Net Present Value 76628 (20% discount rate)
Financial Internal Rate of Return 27%

5.4 Discounted financial cash flow analysis for 25hp boat

Year	0	1	2	3
Cash inflow				
total sales of fish		864000	864000	864000
capital recovery				32000
total cash inflow	0	864000	864000	896000
Cash outflow				
investment costs				
capital	610000		64000	
import duty	16000		16000	
operating costs		532868	532868	532868
taxes		8640	8640	8640
total cash outflow	626000	541508	621508	541508
Net cash flow	-626000	322492	242492	354492

Net Present Value 16286 (20% discount rate)
Financial Internal Rate of Return 22%

5.5 Incremental financial analysis; 40hp v 25hp boat

Year	0	1	2	3
Incremental cash inflow:				
total sales of fish	0	36000	36000	36000
capital recovery	0	0	0	12000
total cash inflow	0	36000	36000	48000
Incremental cash outflow:				
investment costs				
capital	24000	0	24000	0
import duty	6000	0	6000	0
operating costs	0	-13841	-13841	-13841
taxes	0	360	360	360
total cash outflow	30000	-13841	16519	-13841

Incremental net cash flow	-30000	49481	19481	61481
Incremental NPV	60342	(20% discount rate)		
Incremental FRR	131%			

5.6 **Economic analysis of costs and benefits for 40hp boat**

Year	0	1	2	3
Benefits				
Sales of fish		900000	900000	900000
capital recovery				44000
opportunity revenue (value of fish given away)		225000	225000	225000
total benefits	0	1125000	1125000	1169000
Costs				
Capital costs	634000		88000	
operating costs (nett of fuel tax)		494812	494812	494812
external costs (reduction in other fishermen's profit)		202500	202500	202500
total costs	634000	697312	785312	697312
Net benefit	-634000	427688	339688	471688
Net Present Value	389927	(10% discount rate)		
Economic Internal Rate of Return	42%			

5.7 **Economic analysis of costs and benefits for 25hp boat**

Year	0	1	2	3
Benefits				
sales of fish		864000	864000	864000
capital recovery				32000
opportunity revenue (value of fish given away)		216000	216000	216000
Total benefits	0	1080000	1080000	1112000
costs				
capital costs	610000		64000	
operating costs (nett of fuel tax)		506303	506303	506303
external costs (reduction in other fishermen's profits)		194400	194400	194400
total costs	610000	700703	764703	700703
Net benefit	-610000	379297	315297	411297
Net Present Value	304405	(10% discount rate)		

Economic Internal Rate of Return 36%

5.8 Incremental economic analysis; 40hp V 25hp boat

Year	0	1	2	3
Incremental benefits				
sales of fish		36000	36000	36000
capital recovery		0	0	12000
opportunity revenue (value of fish given away)		9000	9000	9000
total benefits		45000	45000	57000
Costs				
capital costs	24000	0	24000	0
operating costs (nett of fuel tax)		-11491	-11491	-11491
external costs (reduction in other fishermen's profits)		8100	8100	8100
total incremental costs	24000	- 3391	20609	- 3391
Incremental net benefit	-634000	427688	339688	471688

Incremental NPV 389927 (10% discount rate)

Incremental ERR 42%

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