

BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE AND ENGINEERING

AEH 501

Department of Engineering and Physics

Bachelor of Science Honours Degree in Agricultural Engineering

Agricultural Machinery Management

3 hours (100 Marks)

JUN 2023

**Instructions:**

1. This paper contains 6 questions
2. Answer any **FOUR** questions, each of which carries 25 marks

Question 1

A small company manufactures two types of garden tools. Tool A requires 2 hours of machining and 5 hours of craftsman time. Type B requires 3 hours of machining and 5 hours of craftsman time. Each day there are 30 hours machine time available and 60 hours of craftsman time available. The profit on each type A tool is \$60 and each type B tool is \$84.

- i. Formulate a linear programming model for this problem. [10 marks]
- ii. Using the graphical methods calculate the number of tools of each type to be manufactured to maximize profit. [15 marks]

Question 2

- a) Explain some of the decisions to be made by a farm machinery operator running a farm machinery business. [5 marks]
- b) State the advice would you give to your machine operators to minimize machinery breakdowns. [10 marks]

c) A farmer wants to make a decision whether to buy a new tractor or sub-contract a neighboring tillage services provider. He has established the following details for the tractor he intends to buy.

- Ownership costs = \$15 547 /year
- Operating costs 23.80/hr
- Field capacity of tractor with plough = 2.4 ha/hr
- The Tillage service provider is charging = \$44.70 per ha for ploughing.

What advice should you give this farmer if his current scale of production is 350 ha?

[10 marks]

### Question 3

- a) Differentiate between an operating lease and a finance lease in farm machinery. [5 marks]
- b) State two advantages and two disadvantages of an operating lease. [4 marks]
- c) A grain storage company bought a new grain dryer for \$100 000.00, with all funds paid out when the machine is acquired. Over each of the next five years, the machine is expected to require \$10 000.00 annual operational costs and will generate \$ 50 000.00 of payments from customers. Calculate the payback period. [5 marks]
- d) Wadzanai and Matilda purchased a used S670 John Deere combine jointly, each paying half of the purchase cost of \$ 120 000. The combine is used for 900 ha. 600 ha by Wadzanai and 300 by Matilda . Both provide for their own fuel and labour, and repair costs are divided equally. The custom rate is at \$75/ha.
- A calculate the cost of using this combine for extra activities. [3 marks]
  - Calculate the extra ha that will be used by Wadzanai above his 50% share. [4 marks]
  - How much is Wadzanai expected to pay Matilda for the extra usage of his share. [4 Marks]

Question 4

- a) With the aid of a graph explain the effect of increasing machine size on the following costs of farm machinery.
- i. Ownership costs. [3 marks]
  - ii. Operating costs. [3 marks]
  - iii. Timeliness costs. [3 marks]
  - iv. Labour. [3 marks]
  - v. Total costs. [3 marks]
- b) 12-row conventional row-crop planter is to be used to plant 180 ha of soya beans with 75-cm row spacing. The soybeans have an anticipated yield of 2.7 t/ha and an anticipated selling price of \$250/t. Assuming a traveling speed of 7 km/hr, calculate:
- i. Calculate the field capacity, and [5 marks]
  - ii. Timeliness cost assuming the farmer works 10-hour days and wants to be assured of a 90% probability of having the required number of good working days. [5 marks]

Question 5

Given the information in Table 1 develop a contract rate for hiring out your new tractor.

<b>For the Tractor</b>		
Information required		
New price list	\$60 000	
Tractor Power	150 Hp	
Interest rate	10%	
Trade in Age	10 years	
Annual Usage (hours)	400	
<b>Ownership costs</b>	<b>Working</b>	<b>Answer</b>
Salvage value		
Average Value		
Depreciation cost (Straight line method)		
Interest cost		

Tax insurance and housing		
Total ownership costs		
Total ownership cost/hr		

**Variable costs for Tractor**

Variable costs for Tractor					
Item	Number	Costs	Rate/life	Variable costs summary	Variable costs/hr
Diesel		\$1.50	10l/hr		
Engine Oil		\$6.40/l	10 l/250 hrs		
Transmission oil		\$6.00/l	100l/1000hrs		
<b>Filters</b>					
Air filter		\$15	1500 hrs		
Fuel filter		\$25	500 hrs		
Oil filter		\$25	250 hrs		
Transmission oil filter		\$30	750 hrs		
<b>Tyres</b>					
Tyres (Large)	2	\$300	3500 hrs		
Tyres (small)	2	\$150	3500 hrs		
<b>Battery</b>	1	\$150	1000hrs		

Repair % Maintenance Other		11% of List Price/yea r				
Total operating cost/hr						

Question 6

- a) State and explain 5 ways for improving machine efficiency. [10 marks]
- b) Explain the following terms as related to machinery management
- I. Machine availability [4 marks]
  - II. Machine performance, [4 marks]
  - III. Quality. [4 marks]
  - IV. Overall equipment effectiveness. [3 marks]