Practice Exam-4-C1

The Pegasus Arcade

Herman is renovating his **video arcade**. The plan is to purchase new arcade machines, an advertising banner and a gumball machine to attract new customers.

Your task is to determine the minimum number of daily customers that are needed so that the arcade owner recovers all of his costs in the first year.

Here are the conditions to be respected when determining the average number of daily customers required:

- **The arcade is open 300 days of the year**
- **The average customer spends $5 a visit**

Use pi = 3.14 in your calculations

The Total Number of Machines to Purchase

To get an idea of how many arcade machines to purchase, Herman researched the number of machines at other arcades. The numbers are shown below.

4 9 10 12 15 19 19 24 26 30 30

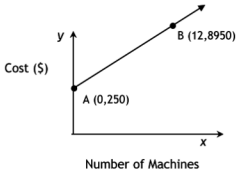
The number of machines used at the Pegasus Arcade will be which ever number is smaller; either the mean or the second quartile (Q2), from the above data.

Of the machines purchased, $\frac{1}{3}$ will be standard arcade machines, 10 will be pinball machines and the remainder will be dance machines.

The Cost to Purchase the Machines

The cost of all the machines is based on partial linear equations.

Standard Arcade Machines



Pinball Machines

Number of Machines	Cost ($)
0	150
5	2 075
12	4 770

Dance Machines

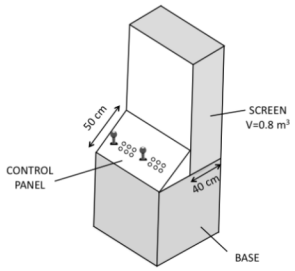
y= 625x + 250

where x is the number of machines
y is the cost in dollars

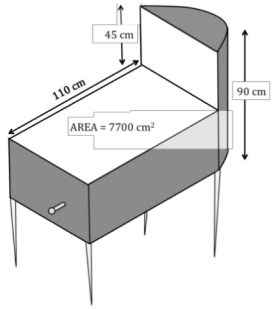
Transporting the Machines

Not only will the machines be purchased, but they will cost a certain amount to be transported to the Pegasus Arcade based on their total volume. Each dance machine (not shown below) has a volume of 1.5 m^3.

Standard Arcade Machines



Pinball Machines



A standard arcade machine is composed of three prisms:

- The base is a cube: the perimeter of one face is 3.2 m
- The control panel is a right triangular based prism
- The screen is a rectangular based prism and has a volume of 0.8 m^3

A pinball machine is composed of two solids: (The volume of the legs can be ignored)

- A rectangular based prism. The area of the base is 7 700 cm^2
- A half cylinder with height of 90 cm

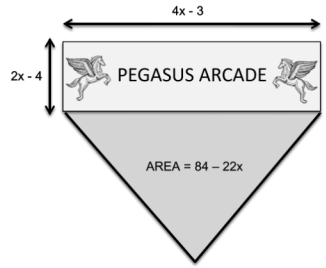
A freight train car must be rented to transport all of the purchased arcade machines. There are three options which depend on the total volume of the machines being transported.

	Total Volume to be Transported	Total Cost
Small Freight	Volume = 10 m^3	$ 3 000
Medium Freight	10 m^3 < Volume ≤ 14 m^3	$ 8 000
Large Freight	14 m^3 < Volume ≤ 18 m^3	$ 12 000

The Pegasus Arcade Banner

A large banner will be placed on the front of the building to attract customers.

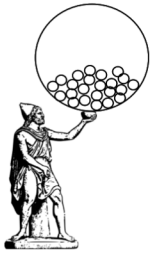
- The area of the triangular part of the banner is the same as the area of the rectangular part of the banner.
- The cost is $125 / m^2
- All measurements are in metres



The Gumball Machine

A gumball machine is made out of a ceramic Greek god statue and a spherical ball of glass.

- The glass sphere has a volume of 14.13 m^3
- The glass costs $50 / m^2
- The cost of the statue and gumballs, not including the glass sphere is $6 587



How many daily customers are needed so that the owner recovers all of his costs in the first year?

Conditions to be respected when determining the average number of daily customers required:

- **The arcade is open 300 days of the year**
- **The average customer spends $5 a visit**

Use pi = 3.14 in your calculations

[redacted] C1 solution

Marking Key

The number of machines to be purchased

$$mean = \frac{26+15+30+4+10+30+19+12+19+9+24}{11}$$
$$= \frac{198}{11}$$
$$= 18$$
$$Second\ Quartile\ (Median) = 19$$

Since the mean is less than the median, he will purchase a total of 18 machines

1/3 x 18 = 6 Standard Arcade Machines

10 Pinball Machines

18 – 6 – 10 = 2 Dance Machines

The cost to purchase the machines

a) Standard Arcade Machines

$$a = \frac{y_2 - y_1}{x_2 - x_1}$$
$$a = \frac{8950 - 250}{12 - 0}$$
$$a = \frac{8700}{12}$$
$$a = 725$$
$$b = 250 \quad from\ graph$$

Cost to purchase 6 standard arcade machines

$$y = 725x + 250$$
$$y = 725(6) + 250$$
$$y = 4600$$

Therefore the arcade machines cost $4 600.

b) Pinball Machines

$$a = \frac{y_2 - y_1}{x_2 - x_1}$$
$$a = \frac{2075 - 150}{5 - 0}$$
$$a = \frac{1925}{5}$$
$$a = 385$$
$$b = 150 \quad from\ table$$

The rule is: y = 385x + 150

Calculate the cost for 10 pinball machines→ x= 10

$$y = 385x + 150$$
$$y = 385(10) + 150$$
$$y = 4000$$

The cost to purchase the pinball machines is $4000

c) The Dance Machines

$$y = 625x + 250$$
$$y = 625(2) + 250$$
$$y = 1500$$

The cost to purchase the dance machines is $1500.

Transporting the Arcade Machines

a) Volume of a standard arcade machine

Find the side length of the cube give the perimeter of a face is 3.2 m

$$s = \frac{P}{4} = \frac{3.2}{4} = 0.8\ m$$

Find the volume of the cube

$$V = s^3 = (0.8m)^3 = 0.512\ m^3$$

Subtract 40 cm from 80 cm to get 40 cm for the triangular base's base.
The height of the triangle can be found using Pythagoras

$$b^2 = c^2 - a^2$$
$$b^2 = 50^2 - 40^2$$
$$b = 30\ cm$$

$$V = A_b h$$
$$V = \frac{(0.3)(0.4)}{2} \times 0.8$$
$$V = 0.048\ m^3$$

Total volume of an Arcade Machine = 0.512 m^3 + 0.8 m^3 + 0.048 m^3
= 1.36 m^3

b) Volume of a pinball machine

$$A_b = lw$$
$$\therefore w = \frac{A_b}{l}$$
$$= \frac{7700}{110}$$
$$= 70cm \leftarrow \text{diameter of cylinder}$$

$$r_{cylinder} = \frac{70}{2}$$
$$= 35cm$$
$$= 0.35m$$

$V_{cylinder}$

$V = \pi r^2 h/2$

$V = \pi(0.35)^2(0.9)/2$

$V = 0.17309 m^3$

V_{prism}

$V = A_b h$

$V = (0.77)(0.45)$

$V = 0.3465 m^3$

$V_T = V_{cylinder} + V_{prism}$

$V_T = 0.17309 + 0.3462$

$V_T = 0.52 m^3$

c) Total Volume of the Machines

Total Volume = Volume of Standard Arcade + Volume of Pinball Machines + Volume of Dance Machines

= 6 x 1.36 m^3 + 10 x 0.52 m^3 + 2 x 1.5 m^3

= 8.16 m^3 + 5.2 m^3 + 3 m^3

= 16.36 m^3

Since the volume is between 14 m^3 and 18 m^3 this is a large freight, so $12 000.

The Pegasus Arcade Banner

Area rectangle = Area triangle

$$(4x-3)(2x-4) = 84 - 22x$$
$$8x^2 - 16x - 6x + 12 = 84 - 22x$$
$$8x^2 - 22x + 12 = -22x + 84$$
$$+22x \quad -12 \quad +22x - 12$$
$$\frac{8x^2}{8} = \frac{72}{8}$$
$$x^2 = 9$$
$$x = \pm 3$$

Sub x = 3 back in to find the dimensions

Area = *l* x *w* = (4(3) - 3) x (2(3) - 4) = 18 m^2

Times the 18 m^2 by 2 to get total area = 36 m^2

So total cost is 36 m^2 x $125 = $4 500

Gumball Machine

Radius of the gumball machine

$V = \frac{4}{3}\pi r^3$

$r = \sqrt{\frac{3V}{4\pi}}$

$r = \sqrt{\frac{3 \cdot 14.13}{4 \cdot 3.14}}$

$r = \sqrt[3]{\frac{27}{8}}$

$r = 1.5 \ m$

The surface area and cost of the glass sphere

$A = 4\pi r^2$

$A = 4 \cdot 3.14 \cdot 1.5^2$

$A = 28.26 \ m^2$

$Cost = 28.26 \ m^2 \cdot \frac{\$50}{m^2} = \$1413$

Total cost with the statue and gumballs

$Cost = \$1413 + \$6587$

$= \$8000$

Total Cost

	Cost ($)
Arcade Machines	4 600
Pinball Machines	4 000
Dance Machines	1 500
Transportation Fees	12 000
Banner	4 500
Bubble gum Machine	8 000
Total Expenses	34 600

The number of customers per day

= The total expenses / ((# of days open a year)($spending per Customer)

= 34 600 / 300 / 5 = 23.1

Therefore, 24 people are needed.

Answer:

The minimum number of customers required per day is 24