Price discrimination and bundling

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Firms with market power face a downward sloping demand curve

To sell an additional unit of output the firm must lower its price to the consumer who buys the additional unit as well as to all other consumers.

As in order to gain an additional consumer the monopolist has to lower price to all consumers it limits his incentive to serve more consumers

Hence monopolist undersupplies product relative to efficient outcome.

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- Identify who is who on the demand curve. Monopolist must know how consumers differ in their demand for its good. Only then can they identify consumer willingness to pay.

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- Problem of arbitrage

  Monopolist must be able to prevent those customers who are offered a low price from reselling their purchases at a higher price to other consumers.

First degree price discrimination -

This occurs when a monopolist is able to charge the maximum price each consumer is willing to pay for each unit sold.

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Suppose you have inherited **five** antique cars and are interested in selling them.

Two collectors have approached you and whilst talking to them you discover that the price they are willing to pay is as follows.

Willingness to pay to own	one car	Rs. 50 Lakh
" " " " "	second car	Rs. 40 Lakh
" " " " "	third car	Rs. 30 Lakh
" " " " "	fourth car	Rs. 20 Lakh
" " " " "	fifth car	Rs. 10 Lakh

First degree price discrimination means you are able to sell

First two cars at a price of	Rs. 50 Lakh,	one to each buyer
Two additional cars at	Rs. 40 Lakh,	again one to each buyer
Sell the fifth car at	Rs. 30 Lakh	to either one of the buyers.
Revenue from discriminatory pricing policy	Rs. 210 Lakh	

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Under uniform pricing policy

Price per car	No. sold	Revenue
Rs. 50 Lakh per car	2 cars sold	Rs. 100 Lakh
Rs. 40 Lakh per car	4 cars sold	Rs. 160 Lakh
Rs. 30 Lakh per car	5 cars sold	Rs. 150 Lakh

Under first degree price discrimination the monopolist extracts the entire surplus that the consumer is willing to pay.

Is this a theoretical curiosity? How does a monopolist have sufficient information and ability to prevent arbitrage so as to implement a pricing scheme in which a different price is charged to each buyer for each unit bought ?

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Problems of identification and arbitrage prevention are not insurmountable.

Two-part or nonlinear pricing schemes

1. A fee such as a membership fee that entitles the consumer to buy the good.
2. A price or usage fee charged for each unit the consumer actually buys.

E.g.: Clubs and theme parks

Consider a monopoly seller, say a jazz club, where people meet for drinks and music.

Let the club's customers be more or less the same in their demand for the club's services which consist mainly of selling drinks.

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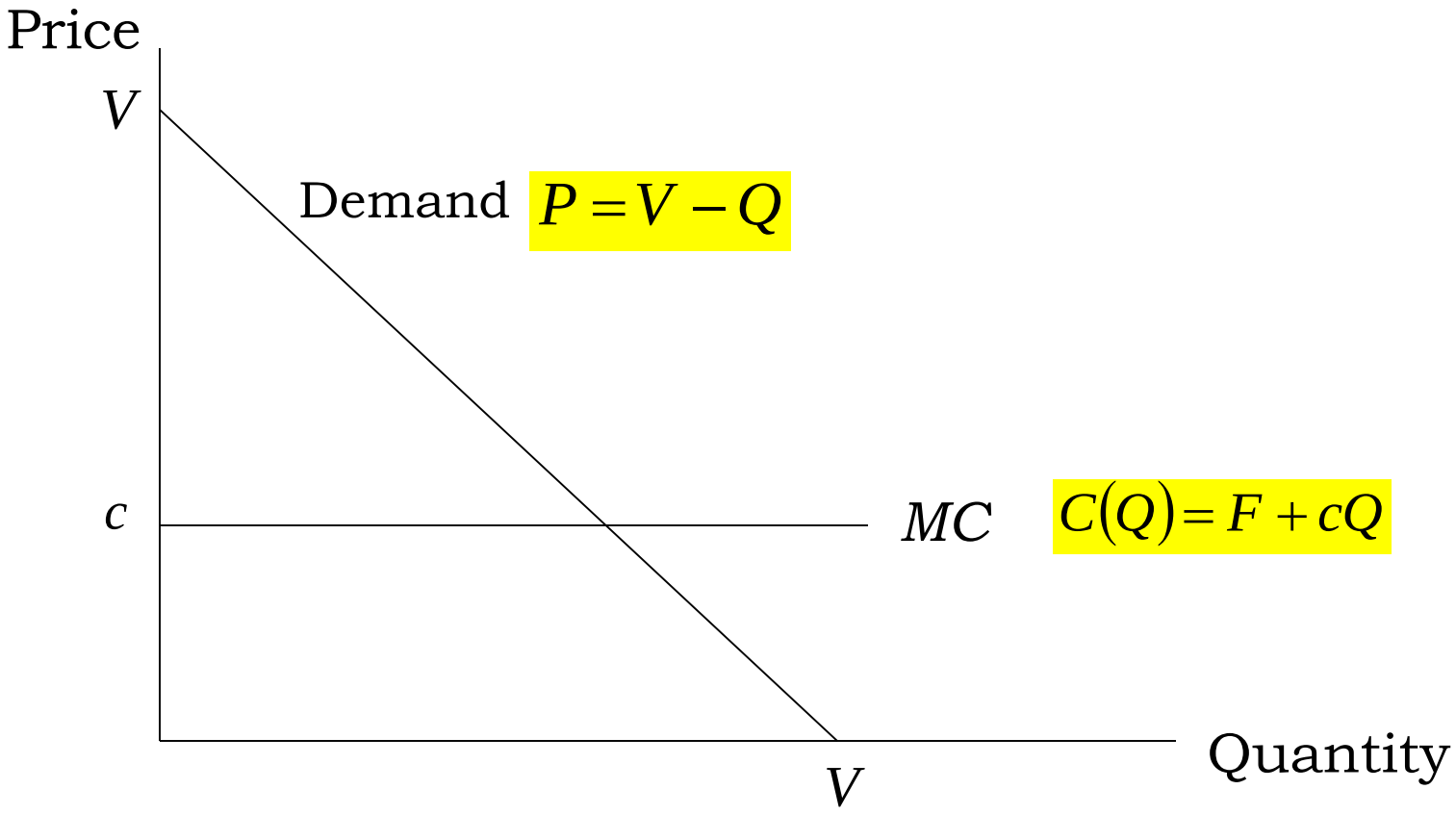
Q : number of drinks consumed in an evening
P : price per drink
V : maximum amount a consumer would be willing to pay for just one drink

$$P = V - Q$$

Cost function of the club

$$C(Q) = F + cQ$$

F : fixed cost of operating the club
c : cost per drink served


Price
V
Demand
P = V − Q
c
MC
C(Q) = F + cQ
V
Quantity

Note:

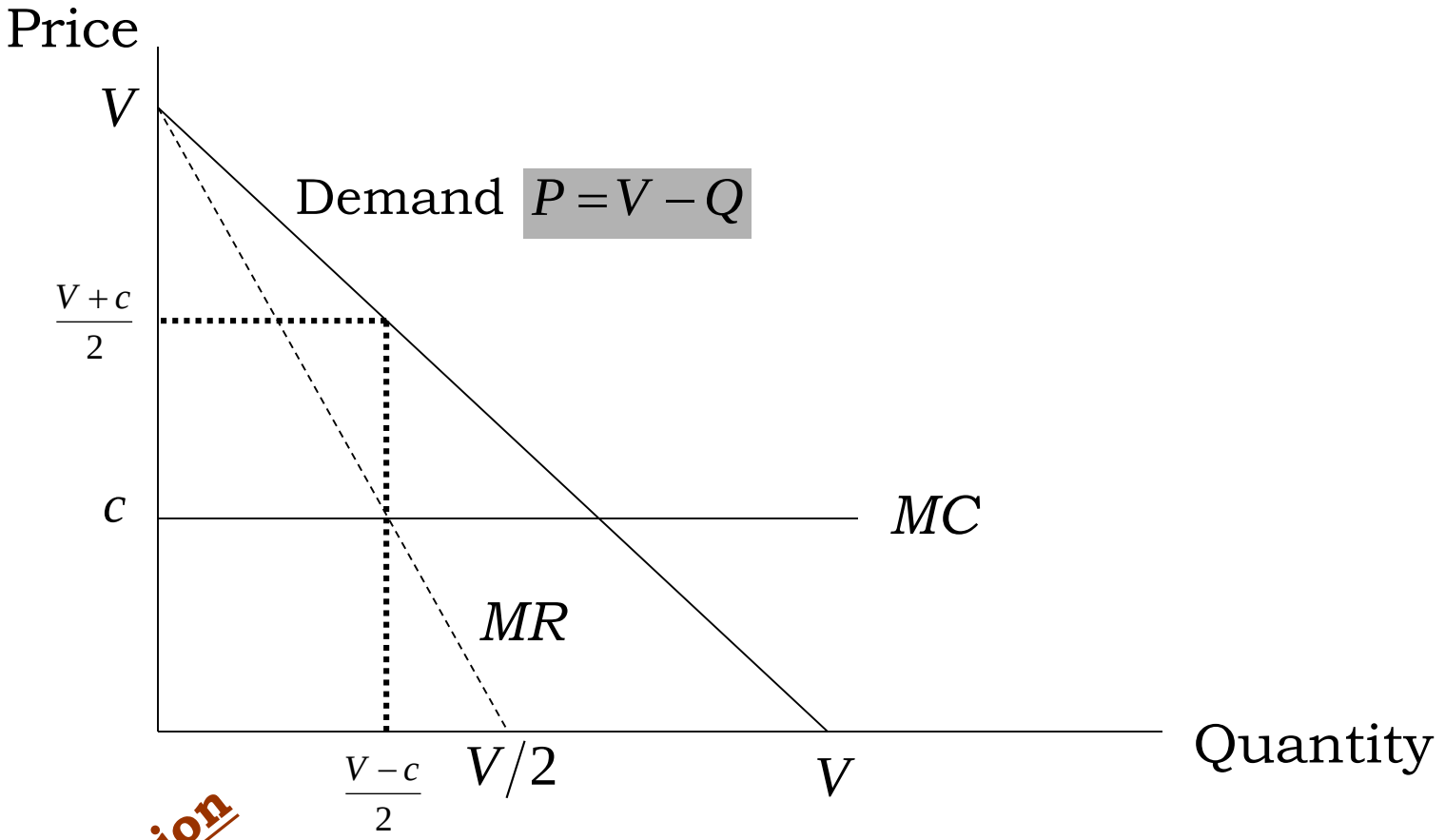
The marginal revenue (MR) associated with a demand curve is the change in total revenue when the sale of output changes by 1 unit.

The general formula for a linear demand curve is given by $P = a - bQ$ where a and b are positive numbers.

The corresponding marginal revenue curve for a linear demand curve is $MR = a - 2bQ$.

Hence when the demand is given by $P = V - Q$, the marginal revenue is $MR = V - 2Q$.

Profit maximization for firm is where marginal revenue equals to marginal cost, or, $MR = MC$.

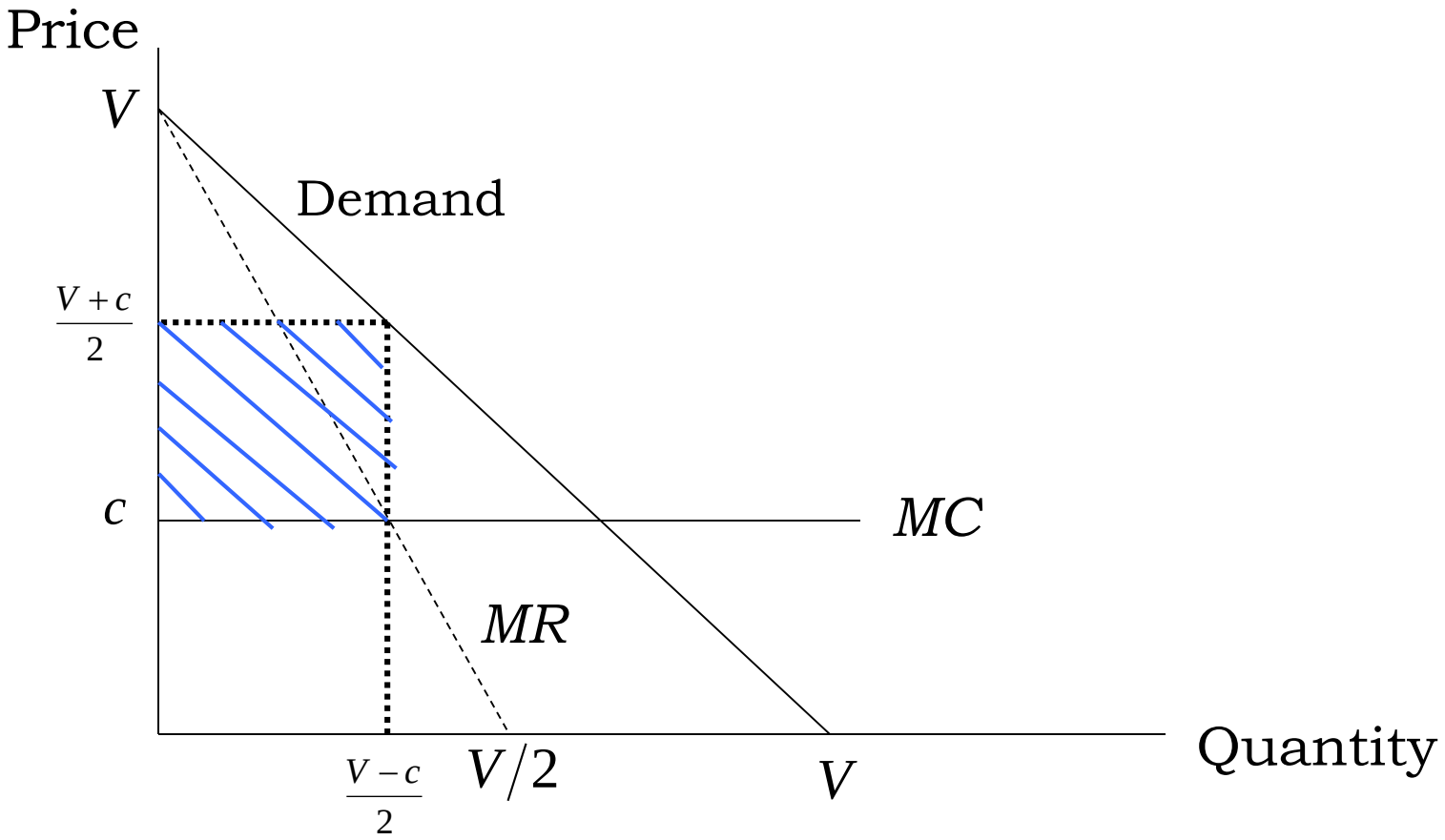


Profit Maximization

Total Revenue = $PQ = VQ - Q^2$

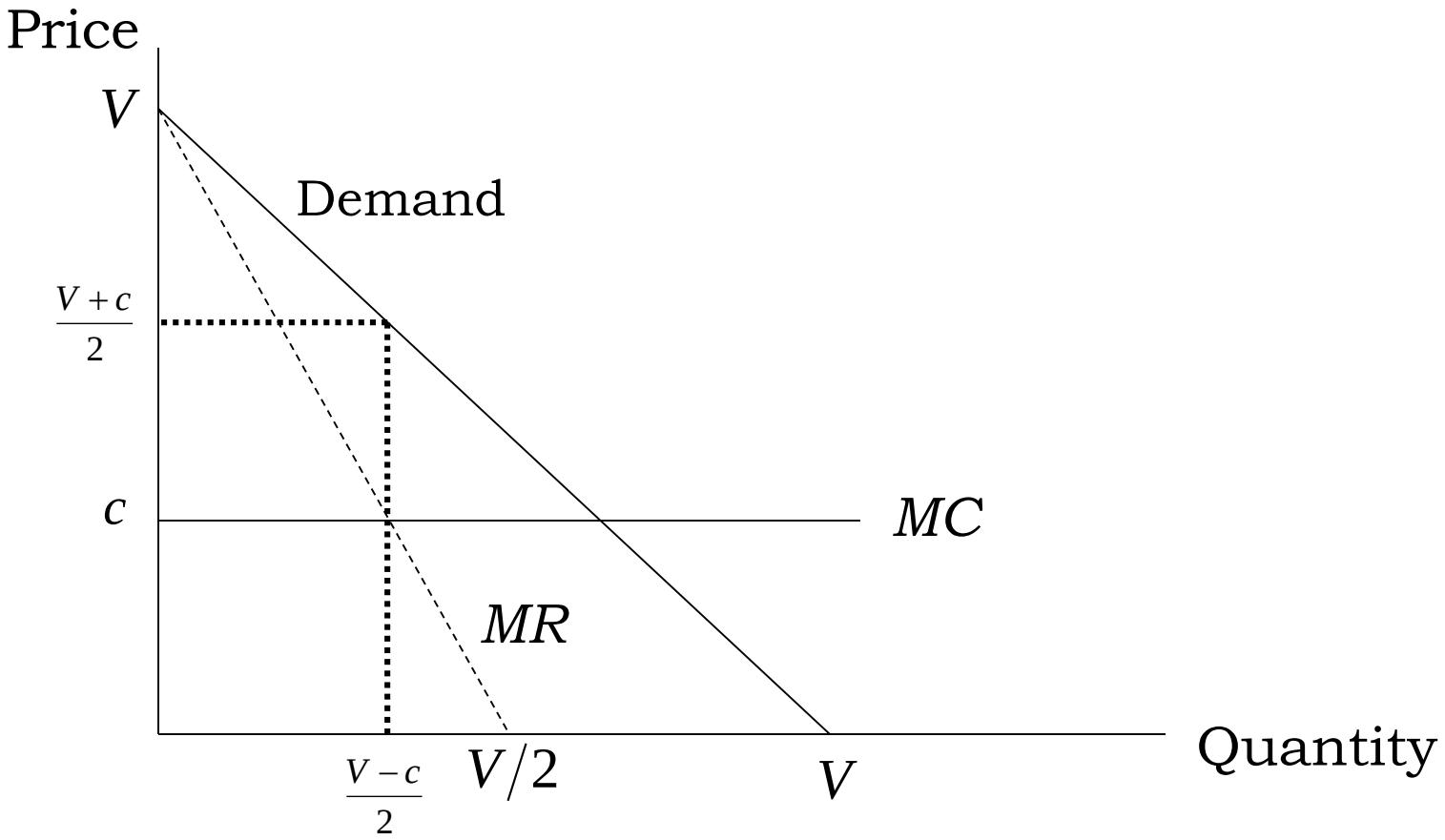
Marginal Revenue = $V - 2Q$

Setting $MR = MC$ gives us $Q = \frac{V-c}{2}$ and $P = \frac{V+c}{2}$



Setting $MR = MC$ gives us $Q = \frac{V-c}{2}$ and $P = \frac{V+c}{2}$

Hence, monopolist earns a **surplus** of $\pi_U = (P-c)Q = \frac{(V-c)^2}{4}$



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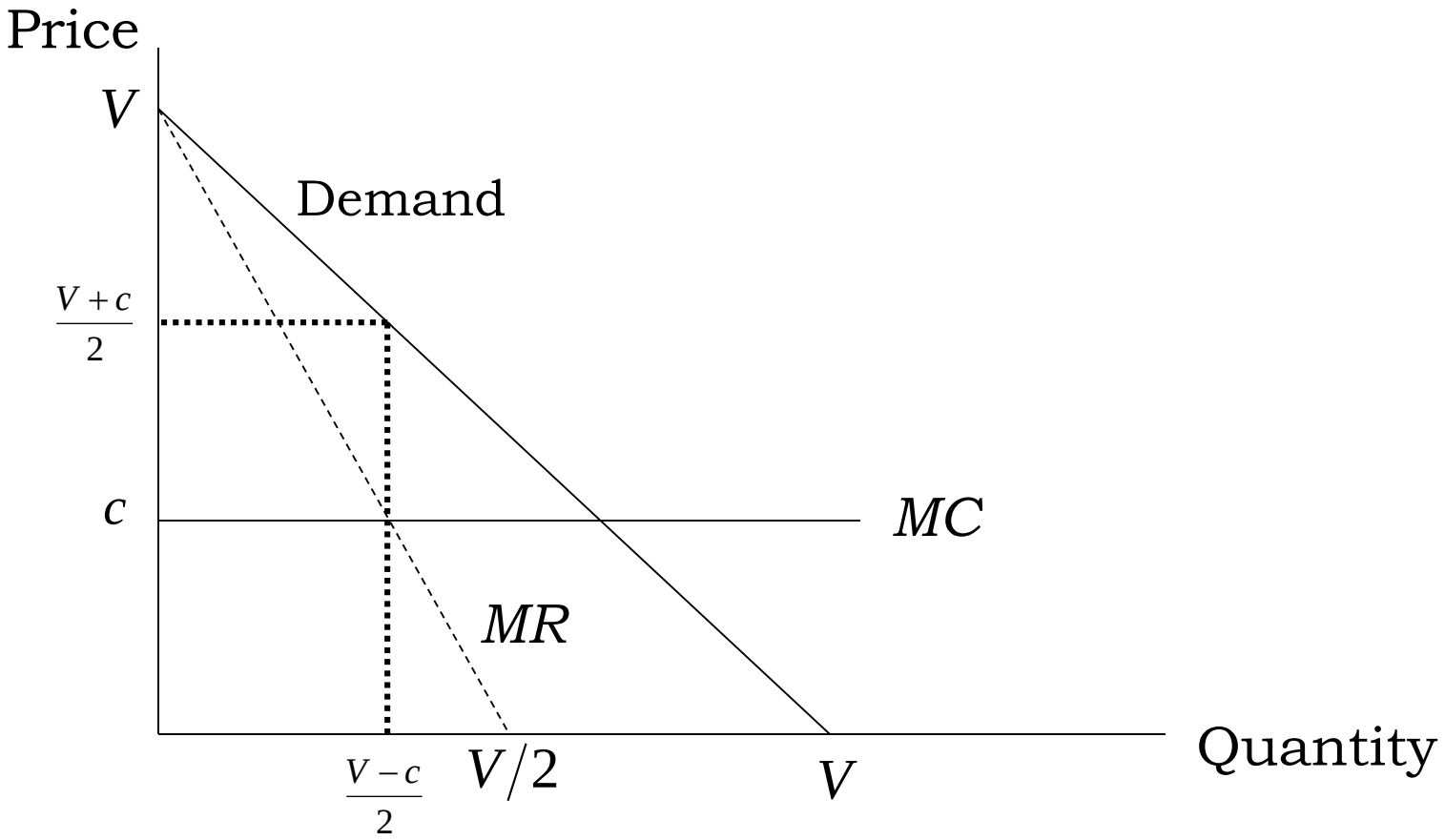
Monopoly profits if there are n customers will be given by

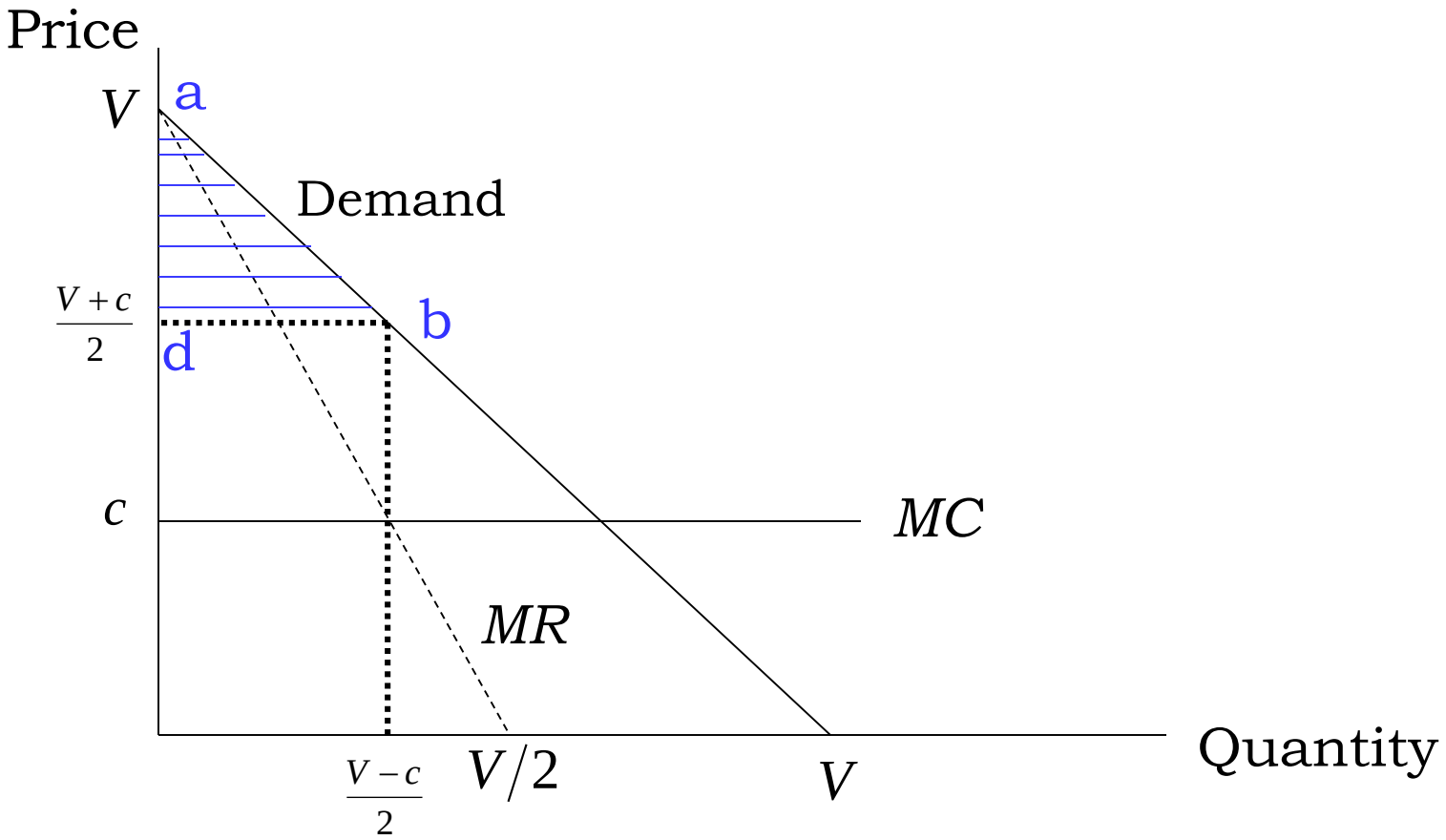
$$\Pi = n\pi_U - F = n\frac{(V-c)^2}{4} - F$$



Suppose $V = 10$ and $c = 2$

$$P = \frac{V + c}{2} = 6 \qquad Q = \frac{V - c}{2} = 4$$

Surplus earned per customer $= (P - c)Q$=(6 – 2)*4 = 16

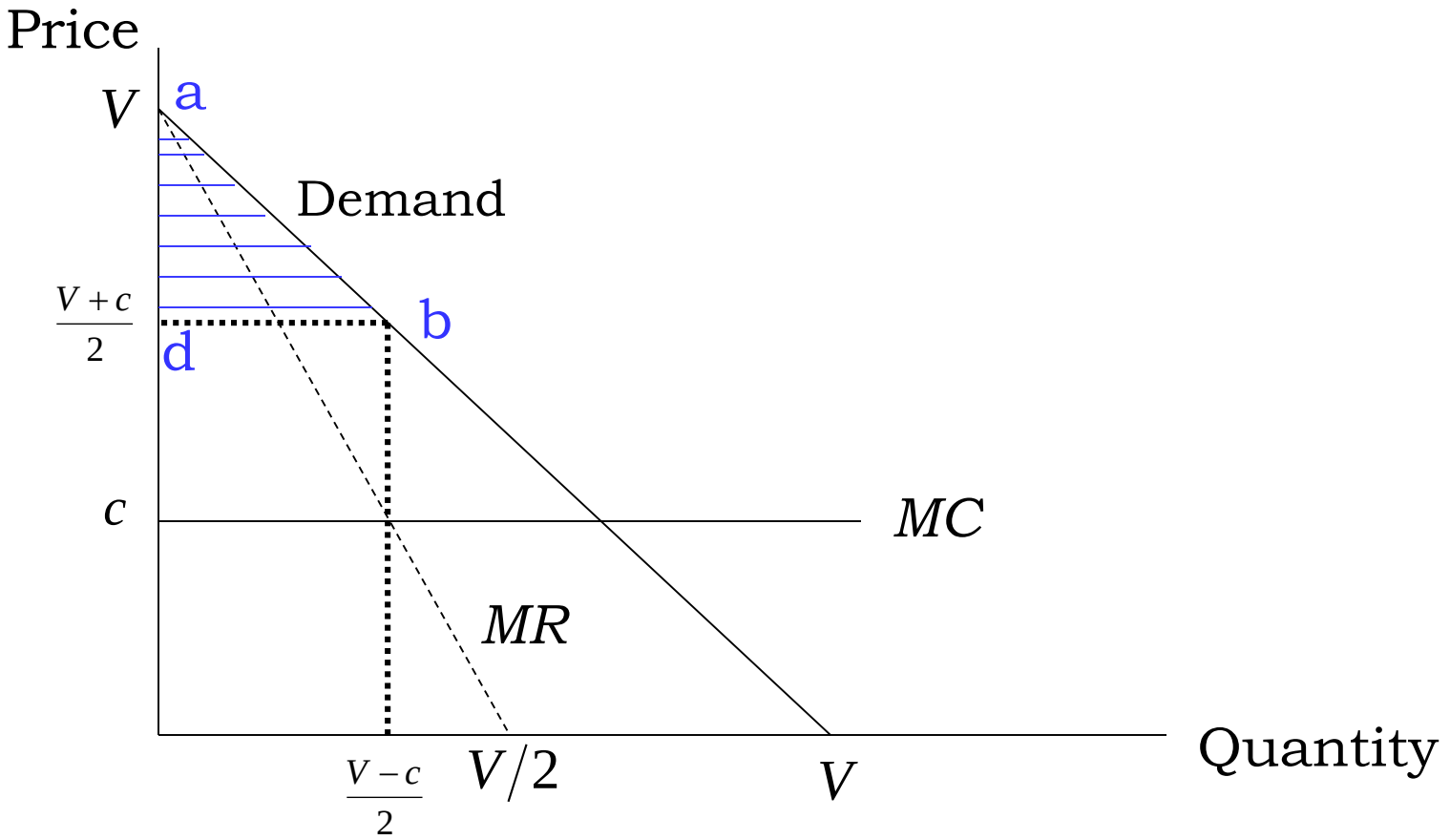


Suppose $V = 10$ and $c = 2$

$$P = \frac{V+c}{2} = 6 \qquad Q = \frac{V-c}{2} = 4$$

Surplus earned per customer = (6 – 2)*4 = 16

At uniform price of 6, customers of the club enjoy **consumers surplus** given by striped triangle abd



abd represents amount consumer was willing to pay for units of output up to $(V - c)/2$ but which the club does not extract as it charges a uniform price.

Consumer surplus = $\left(V - \frac{V+c}{2}\right)\frac{(V-c)}{2}\frac{1}{2} = \frac{(V-c)^2}{8}$

$V = 10$
$c = 2$

= 8 per customer

To appropriate some of the surplus the club owner can switch to a two-part tariff.

Charge an entry fee = $\frac{(V-c)^2}{8} = 8$

Consumers Surplus $= \frac{(V-c)^2}{8}$

Continue to charge a price per drink = $P = \frac{V+c}{2} = 6$

Since the entry fee is independent of the amount the customer actually drinks, each customer will continue to buy the same number of drinks as before.

However, entire consumer surplus is now transferred to the owner via the entry fee.

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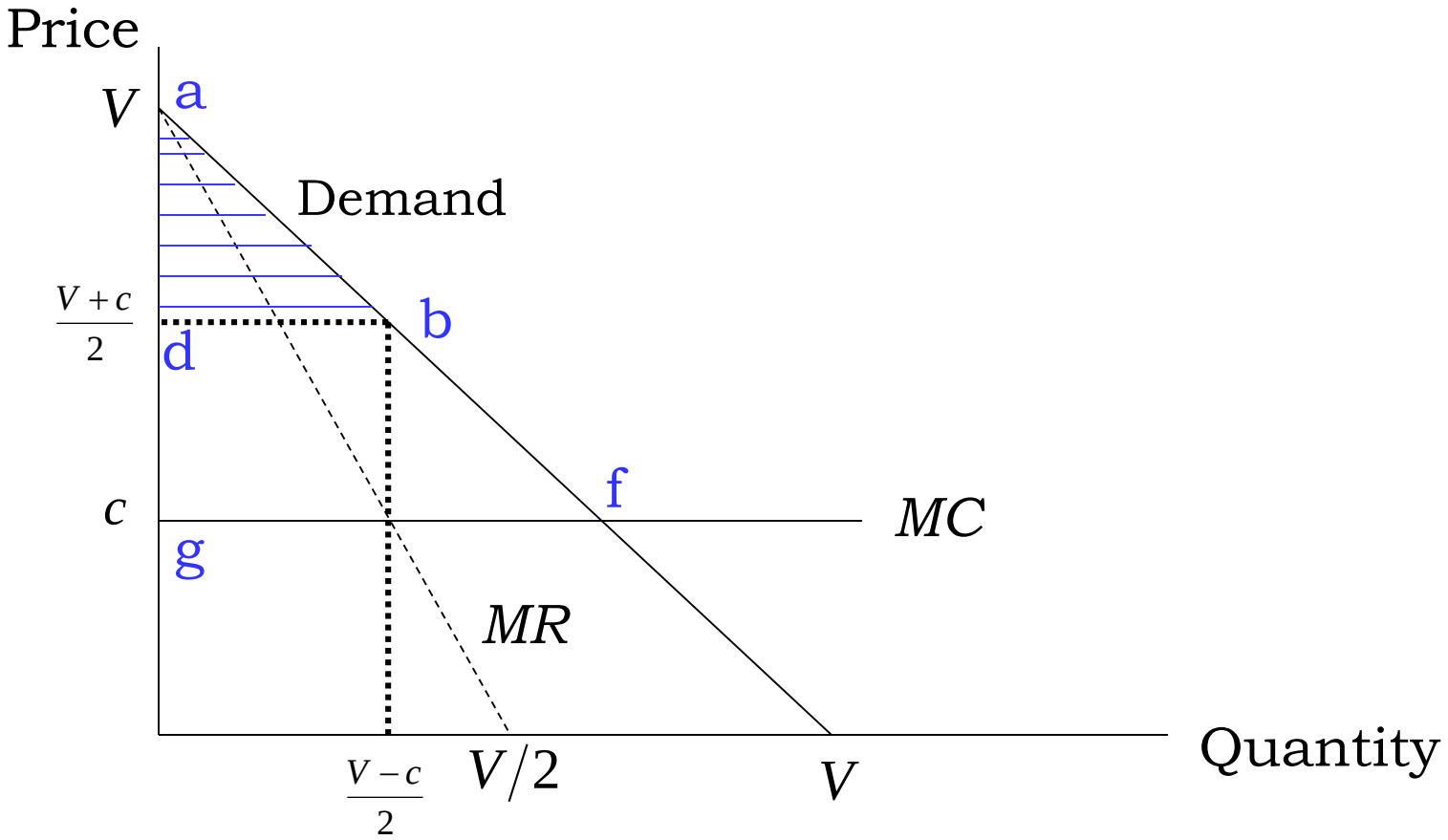
Club owner can do better still.

Reducing the price per drink permits him to increase consumer surplus and in turns permits him to increase the entry fee and increase profit.



1. Set the price per drink equal to marginal cost

2. At this price consumer surplus is area of triangle afg

Consumer surplus = $(V-c)(V-c)\frac{1}{2} = \frac{(V-c)^2}{2} = \frac{(10-2)^2}{2} = 32$

Charge an entry fee equal to this consumer surplus of 32

With drinks sold at costs there is no profit to be earned from selling drinks.

However, entry fee paid by each customer is profit.

Total profit has increased to 32 > 16 earned under uniform pricing

Also, each customer is buying the quantity of drinks that would have been bought had the drinks been priced competitively. The monopoly now offers the **competitive level of output** and the average price per drink is none other than the profit maximizing uniform price.

Second Degree Price Discrimination

Two phenomena made first degree price discrimination possible -

1. Customers are more or less identical or are distinguishable by means of a simple mechanism.

2. Club has ability to deny access to those not paying the cover charge.

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2. Club has ability to deny access to those not paying the cover charge.

Not all services can be marketed in this way -

E.g. – monopoly seller is a refreshment stand located within a campus. – This makes limiting entry by means of a cover charge impossible.

Block pricing or second degree price discrimination possible in such a situation

Monopolist knows the market contains consumers of different types but does not know which type of consumer is which.

Problem is to devise a pricing scheme that will result in consumers revealing their type through their actual purchases.

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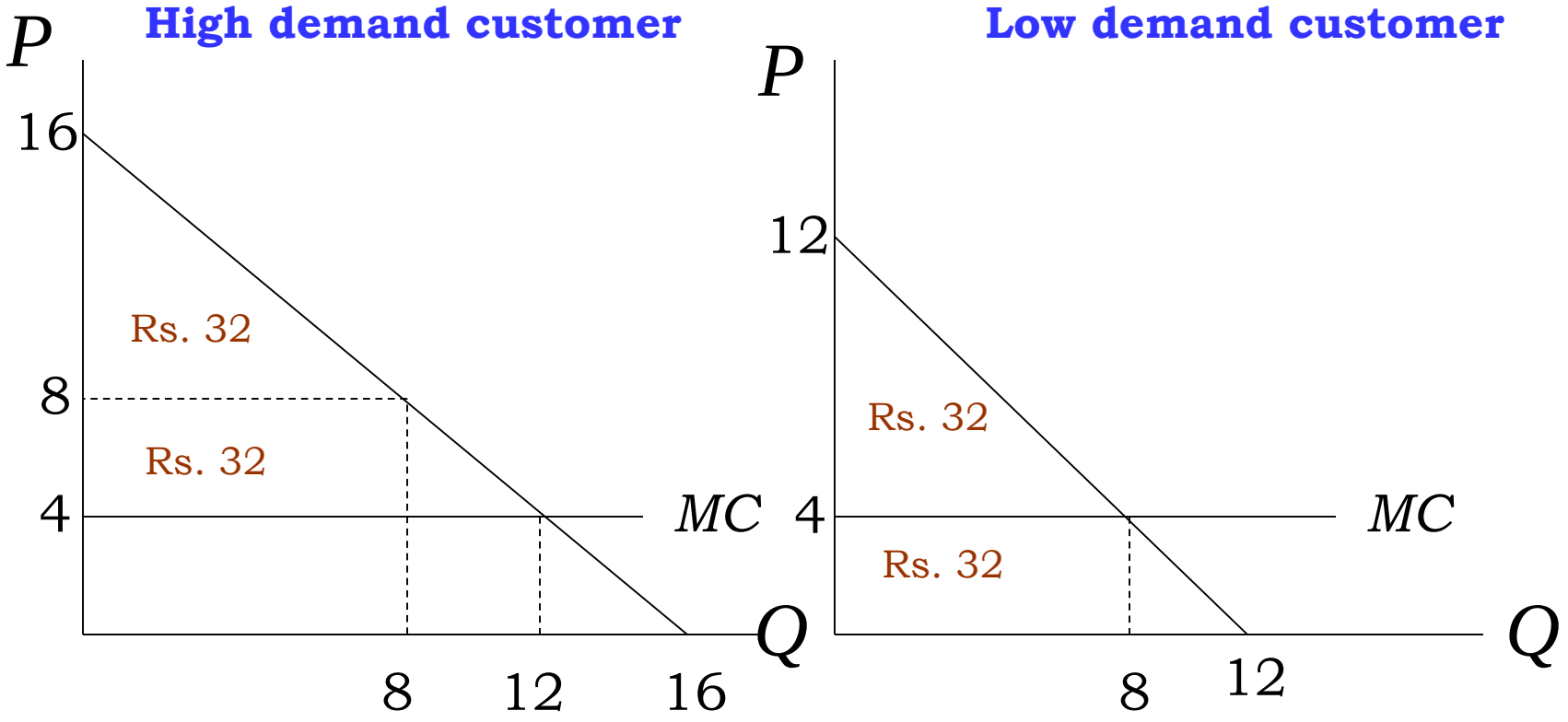
Let there be 2 types of customers -

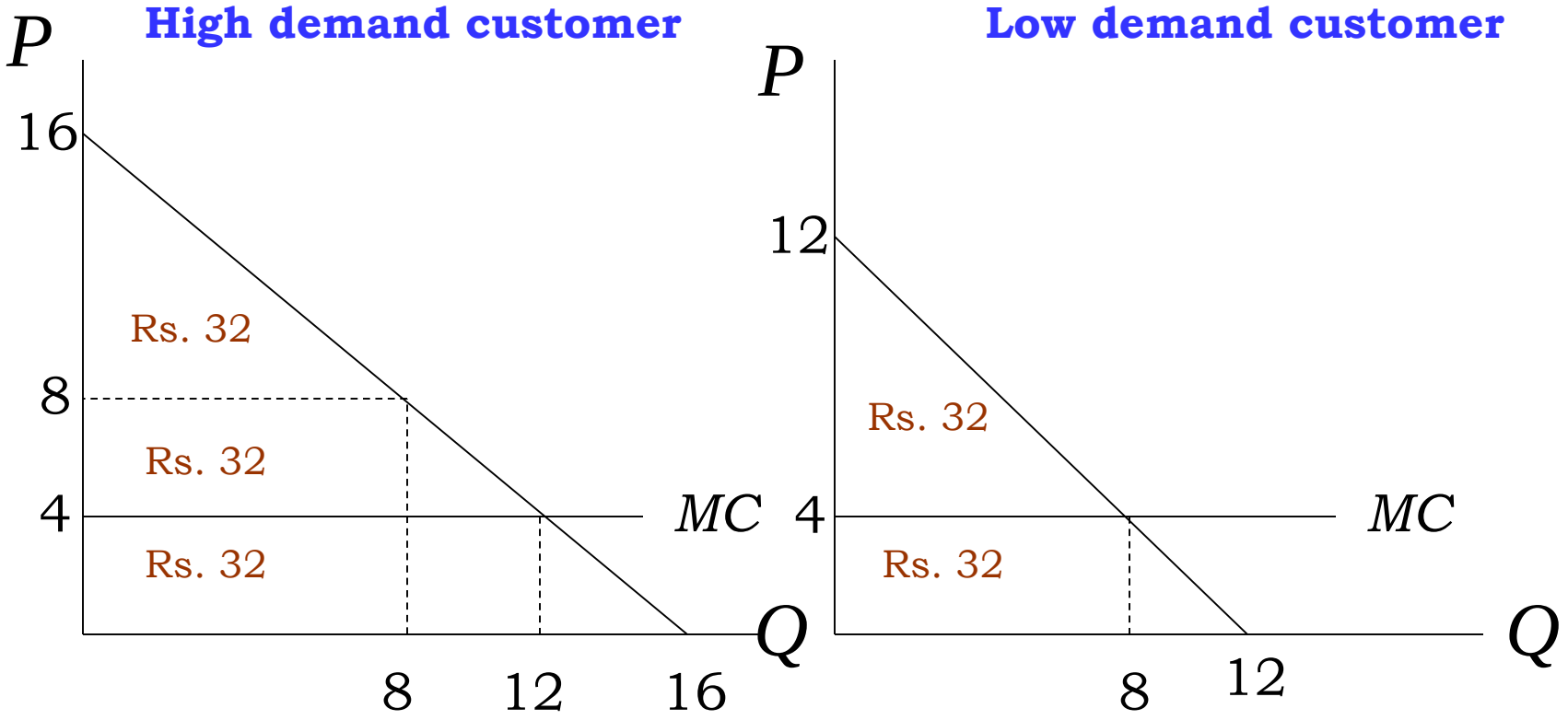
High demand customers $P_h = 16 - Q_h$

Low demand customers $P_l = 12 - Q_l$

Differentiated two part tariff does not work as both types of customers will claim to be low demand types when entering the club so as to pay lower entry fee.



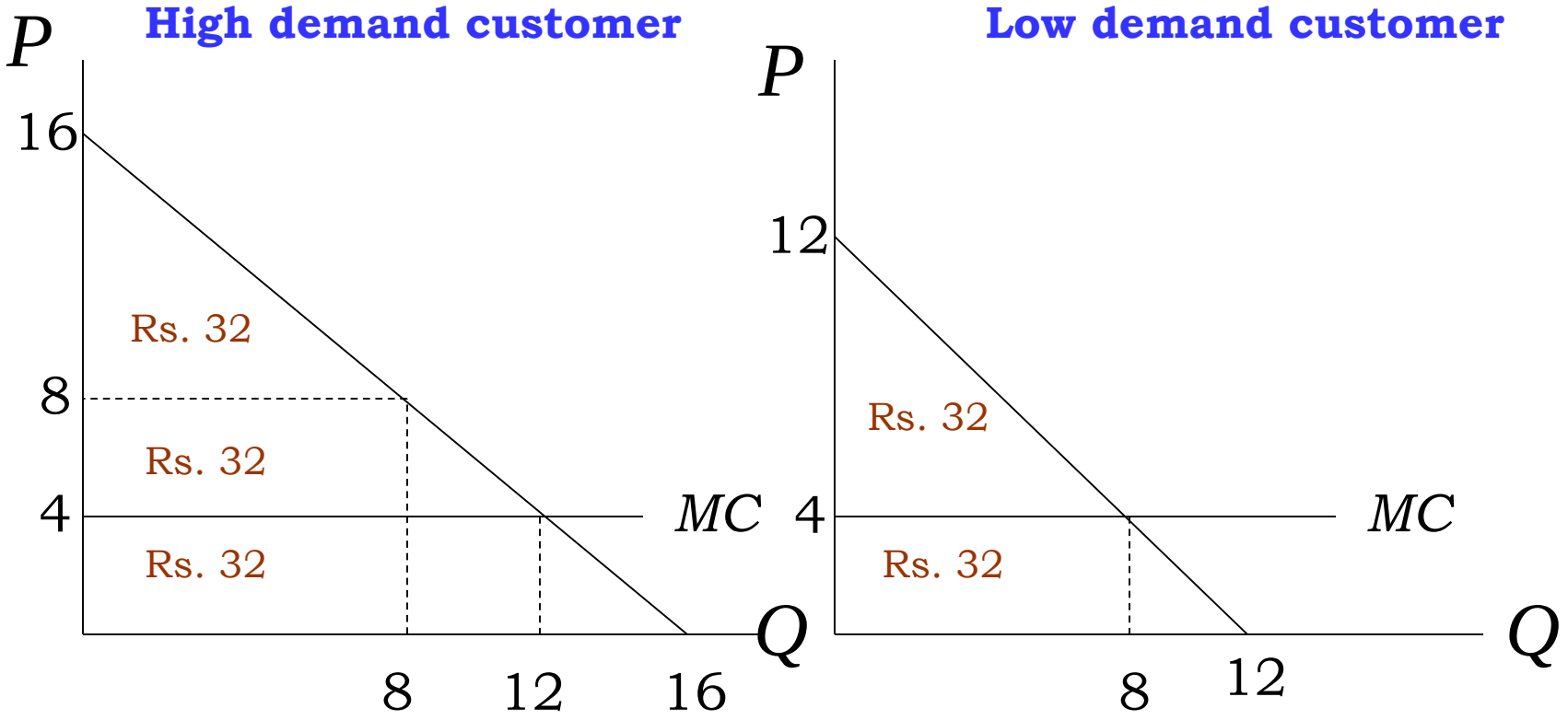
Club owner knows that low demand customers are willing to pay a total of Rs. 64 for eight drinks.



Club owner knows that low demand customers are willing to pay a total of Rs. 64 for eight drinks.

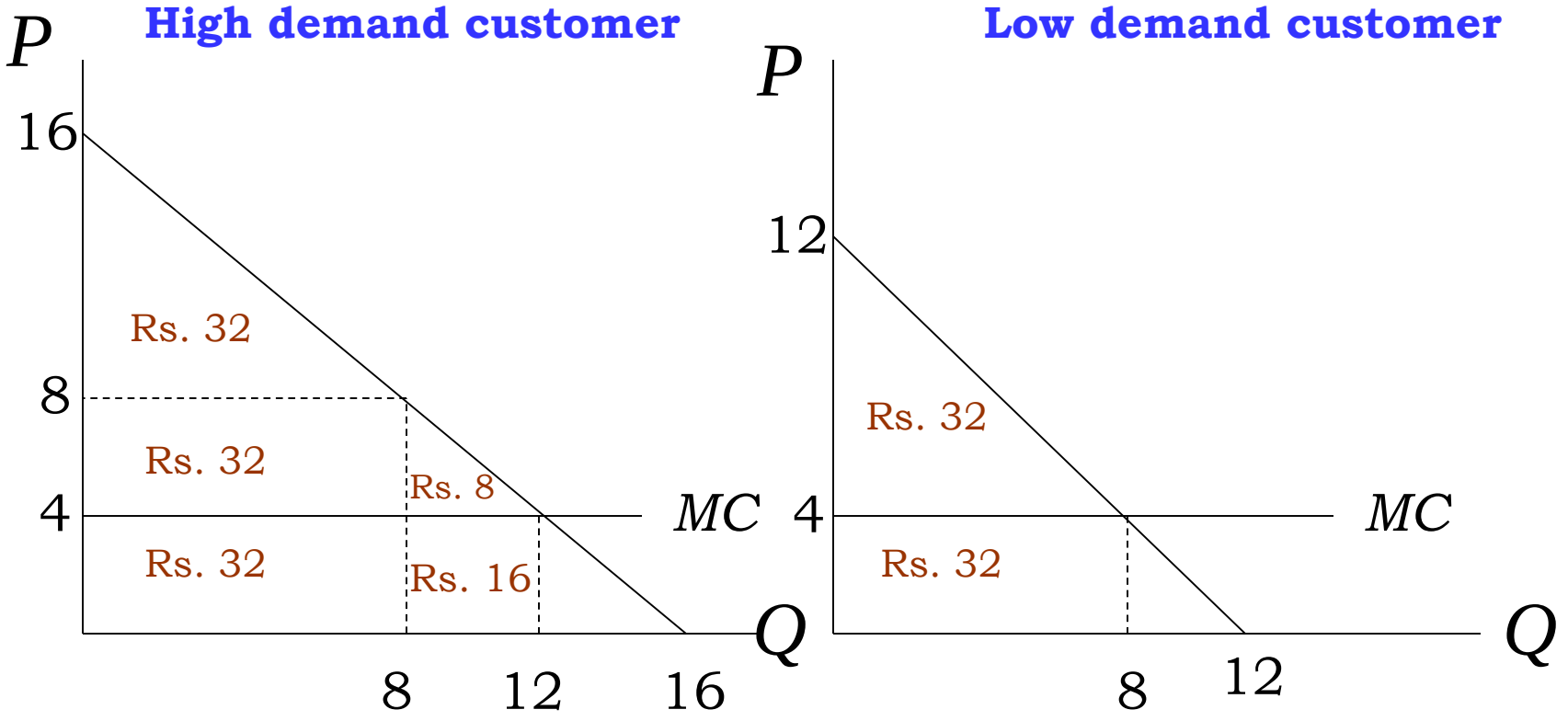
Rather than charging this amount through a two part tariff entry is offered plus the right to consume 8 drinks for a total charge of Rs. 64

Low demand customers will accept the charge as it is equals their willingness to pay



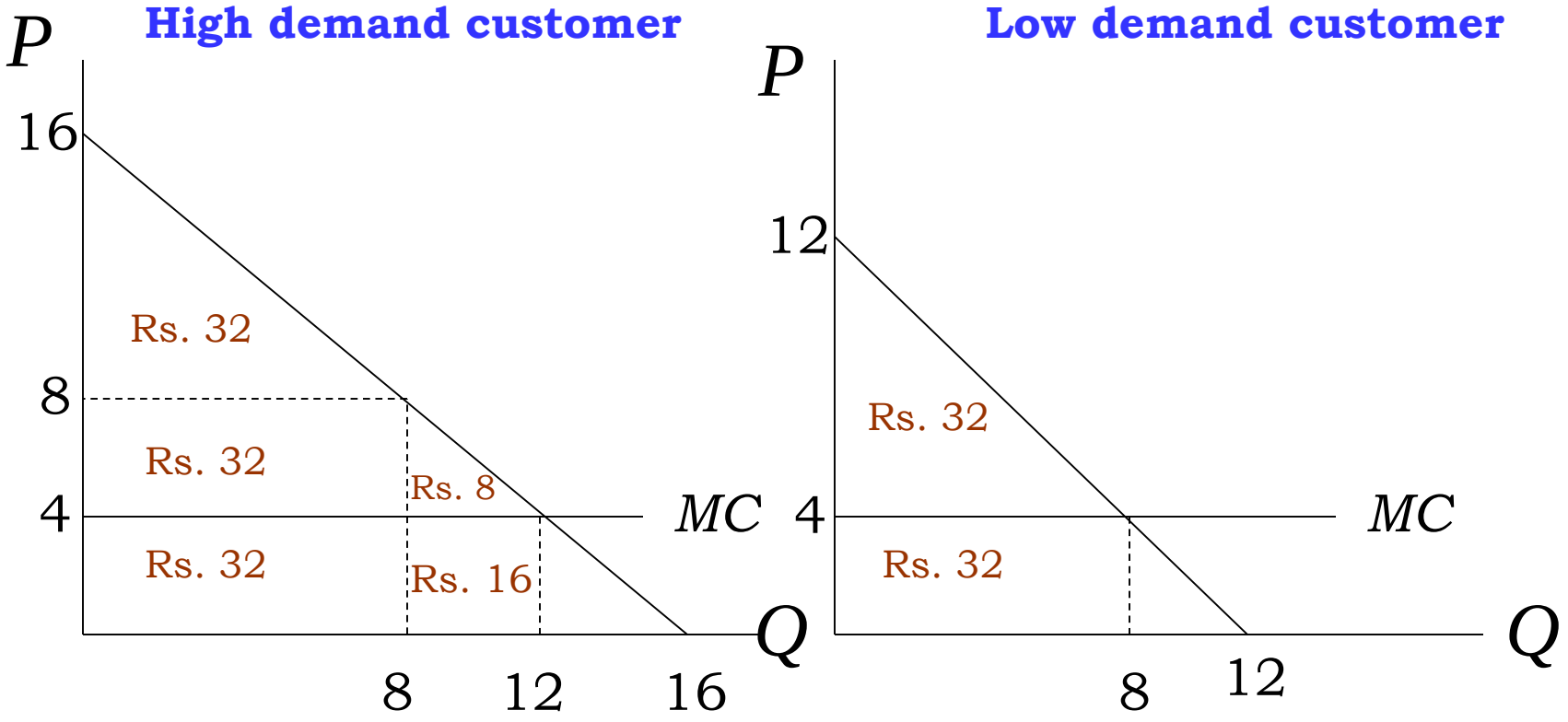
High demand customers will also be willing to pay Rs. 64 for this package as their willingness to pay for 8 drinks is Rs. 96 and they get consumer surplus.

Profit to the club from such a package sold = Rs. 32 per customer

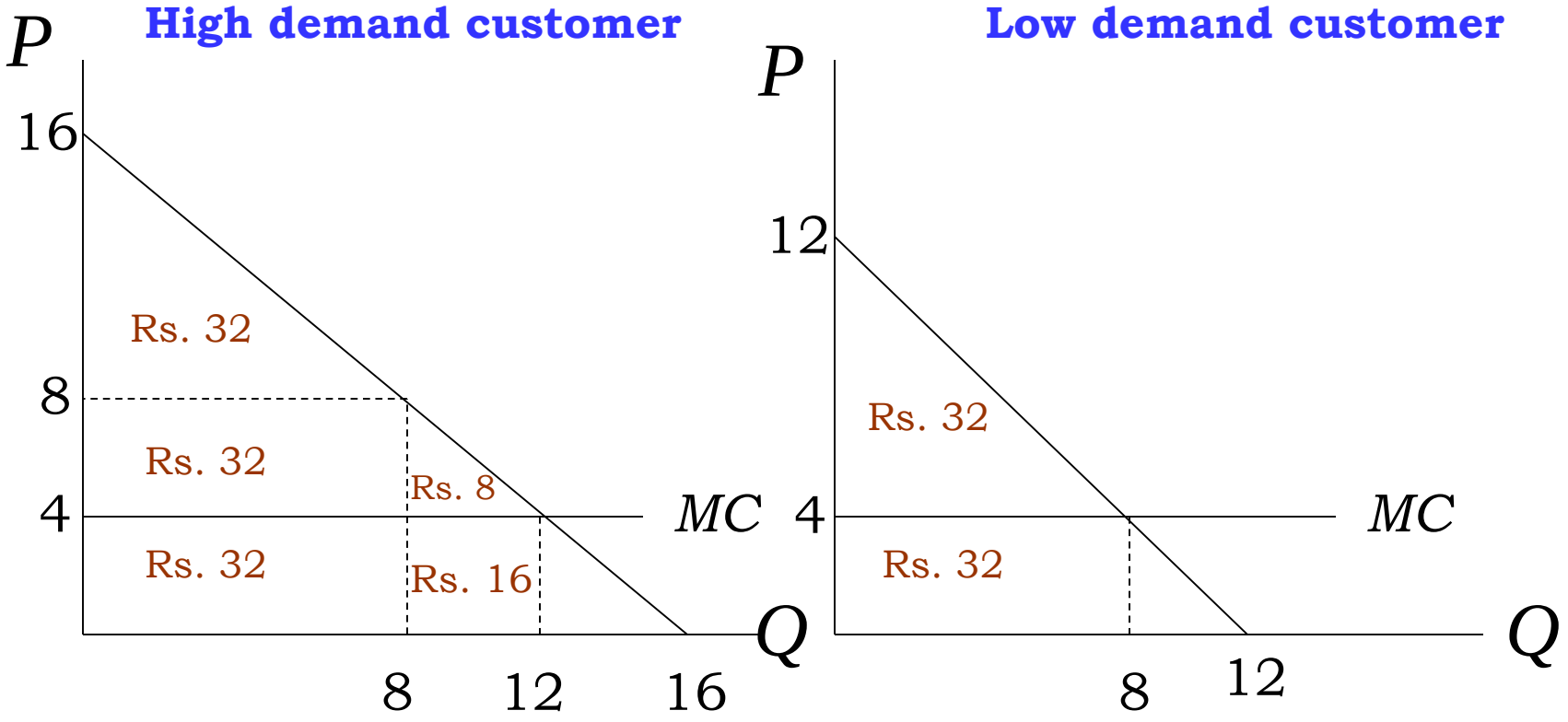


However, club owner knows high demand customers are willing to pay Rs. 120 for 12 drinks.

High demand customer cannot be charged this amount because he can buy the Rs. 64, 8 drinks package and enjoy consumer surplus of Rs. 32



Best owner can do is to create a package that offers high demand customer at least Rs. 32 consumer surplus.



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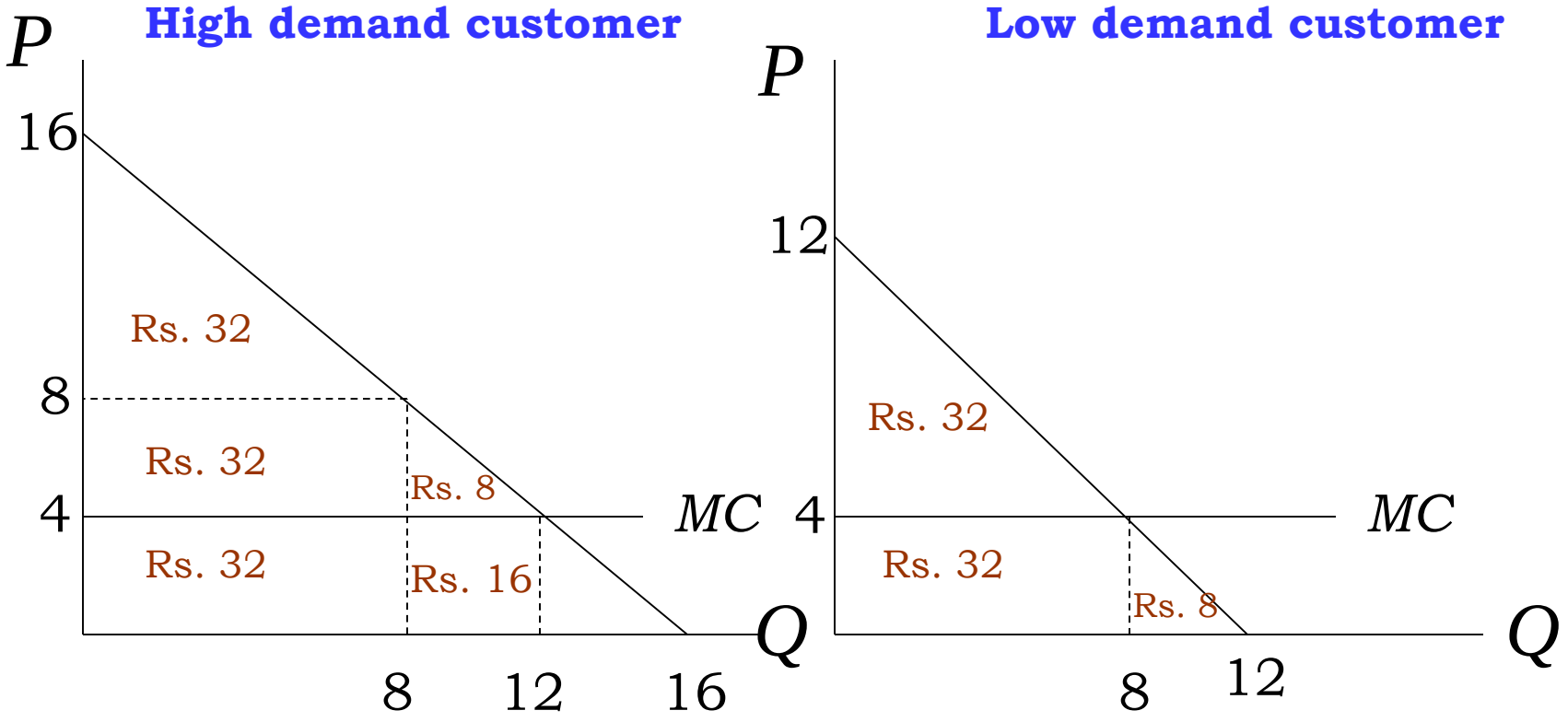
Offer of second package of entry plus 12 drinks for a charge of Rs. 88 = Rs. (120 -32)



Best owner can do is to create a package that offers high demand customer at least Rs. 32 consumer surplus.

Offer of second package of entry plus 12 drinks for a charge of Rs. 88 = Rs. (120 -32)

Low demand customer will not buy this package as his willingness to pay for 12 drinks is Rs. 72, but high demand customer will buy this package.

1. These two packages – Rs. 64 + 8 drinks and Rs. 88 + 12 drinks – have succeeded in making the club's customers reveal their types through their purchases.

2. The second package increases the profit that the club owner gets from high demand customers.
   From Rs. 64, 8 drinks package he earns Rs. 32
   From Rs. 88, 12 drinks package he earns Rs. 40

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3. Feature of second degree price discrimination is that it involves quantity discounts.

Average price per drink of Rs. 64, 8 drink package = Rs. 8
Average price per drink of Rs. 88, 12 drink package = Rs. 7.3

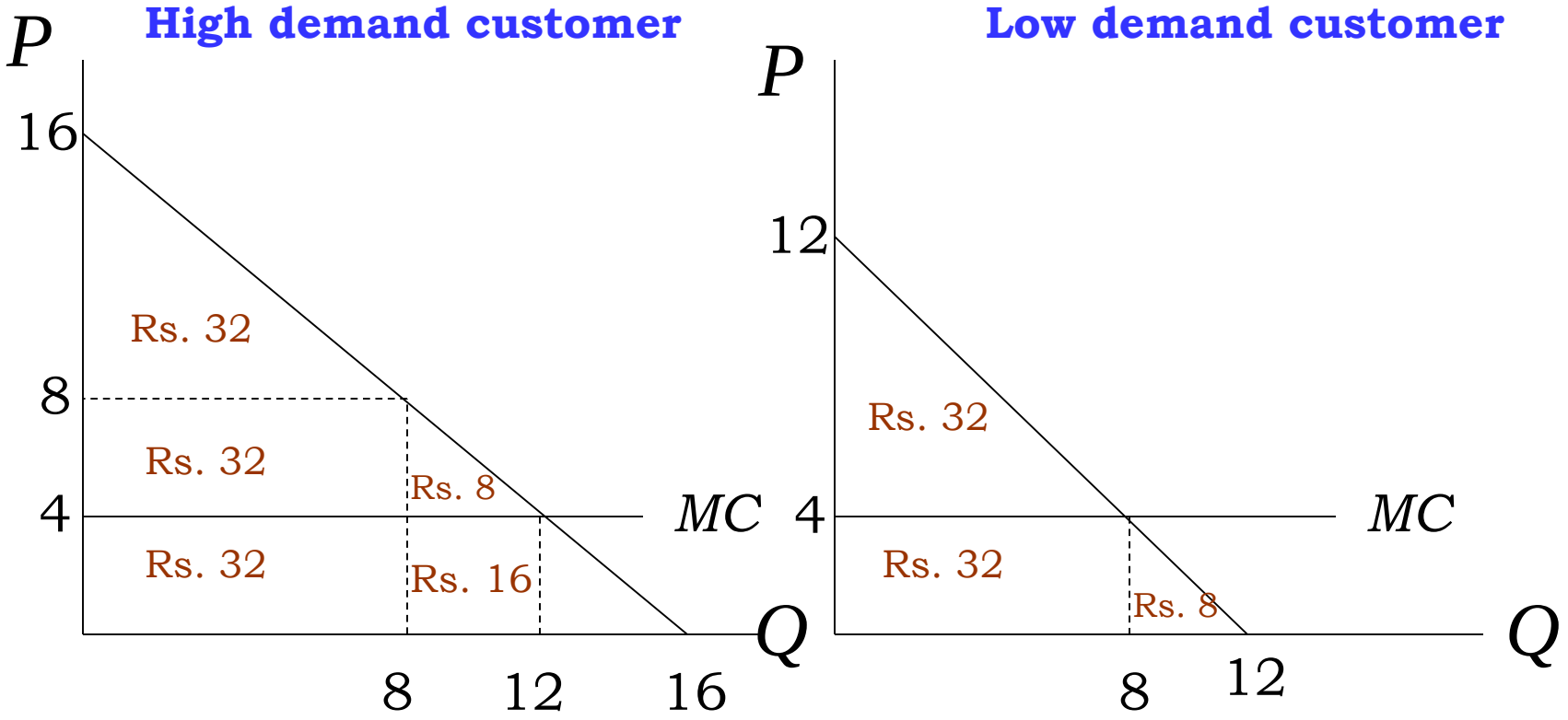
Movie theatres, restaurants, concert halls, stadiums, and supermarkets all use this type of pricing.

E.g.: Cheaper to buy one huge container of popcorn than many small ones.

Wine sold by the glass is per unit more expensive than wine sold by the bottle.

Cheaper to buy a five day ticket for a test match than to buy tickets for each day individually.

Issue for consideration: Any package designed to attract the low demand customer constrains the ability of the monopolist to extract surplus from high demand customer.



E.g.: If club owner decides not to attract low demand customer he can offer a package to high demand customer of entry + 12 drinks for Rs. 120 giving a $\pi = \text{Rs.}\,72$ per package sold.

Block pricing represents a compromise between setting a high charge that loses sales to low demand buyers and a low charge that foregoes significant surplus that can be earned from high demand buyers.

Third degree price discrimination -

This differs from first and second degree price discrimination with respect to pricing policy the monopolist adopts.

Here the monopolist charges a uniform price to all consumers within a particular group.

Thus there is some observable criterion such as age, income, geographic location, or education by which consumers can be grouped in terms of their willingness to pay.

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Discrimination arises because the uniform price charged to one group need not be the same as uniform price charged to another group.

E.g.: Senior citizen discounts and "kids are free" programmes are types of third degree price discrimination.

E.g. Journals discriminate on the basis of income

Annual Membership Fee for American Economic Association

Regular member with annual income < $40,000	$ 59
Regular member with annual income $40,000 – 53,000	$ 71
Regular member with annual income > $53, 000	$ 83
Junior member (available to registered students for five years maximum)	$ 30

E.g.: Restaurants offer "early bird specials"

Assume there are two types of consumers and the monopolist is able to identify these types and to prevent arbitrage between them.

Market demand by type 1 consumer is less elastic at any product price than market demand by type 2 consumers.

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First necessary condition for π maximization -

Sales in each market is such that *MR* is the same. If this did not hold then the monopolist can raise revenue and π by shifting sales from the low *MR* market to the high one.

$$MR_1 = MR_2$$

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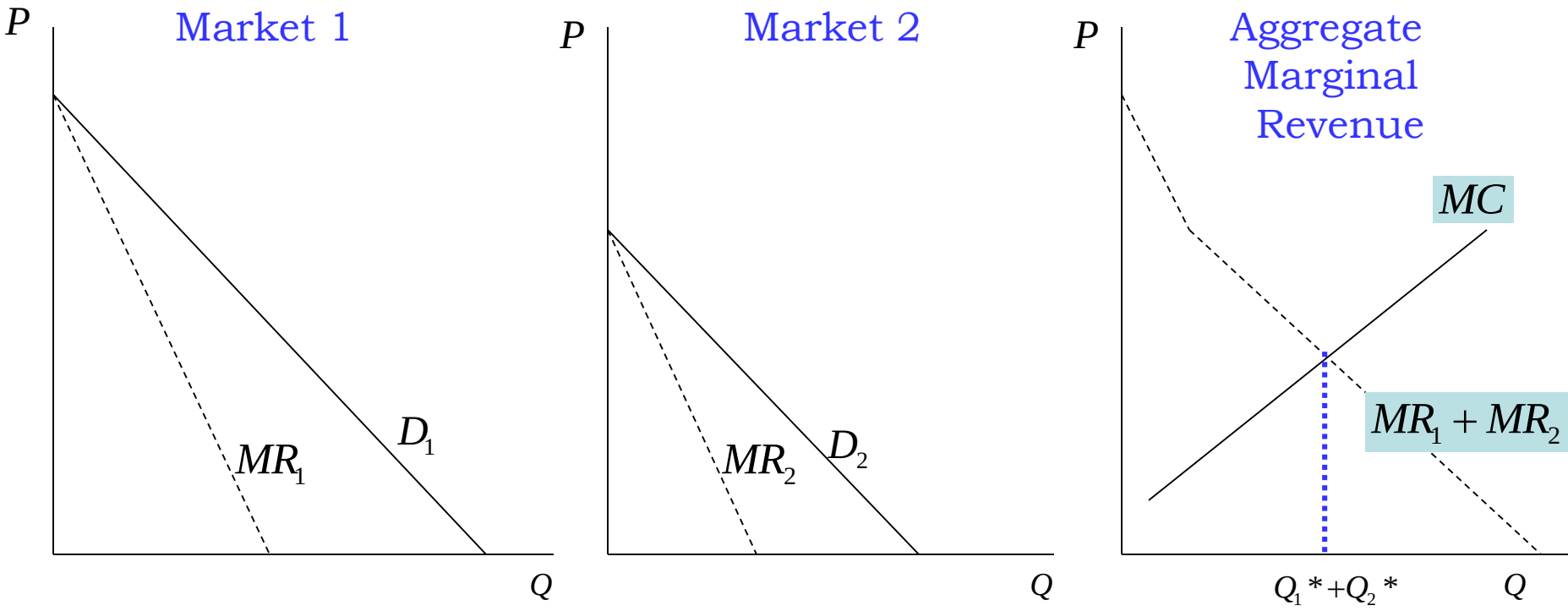
Second condition -

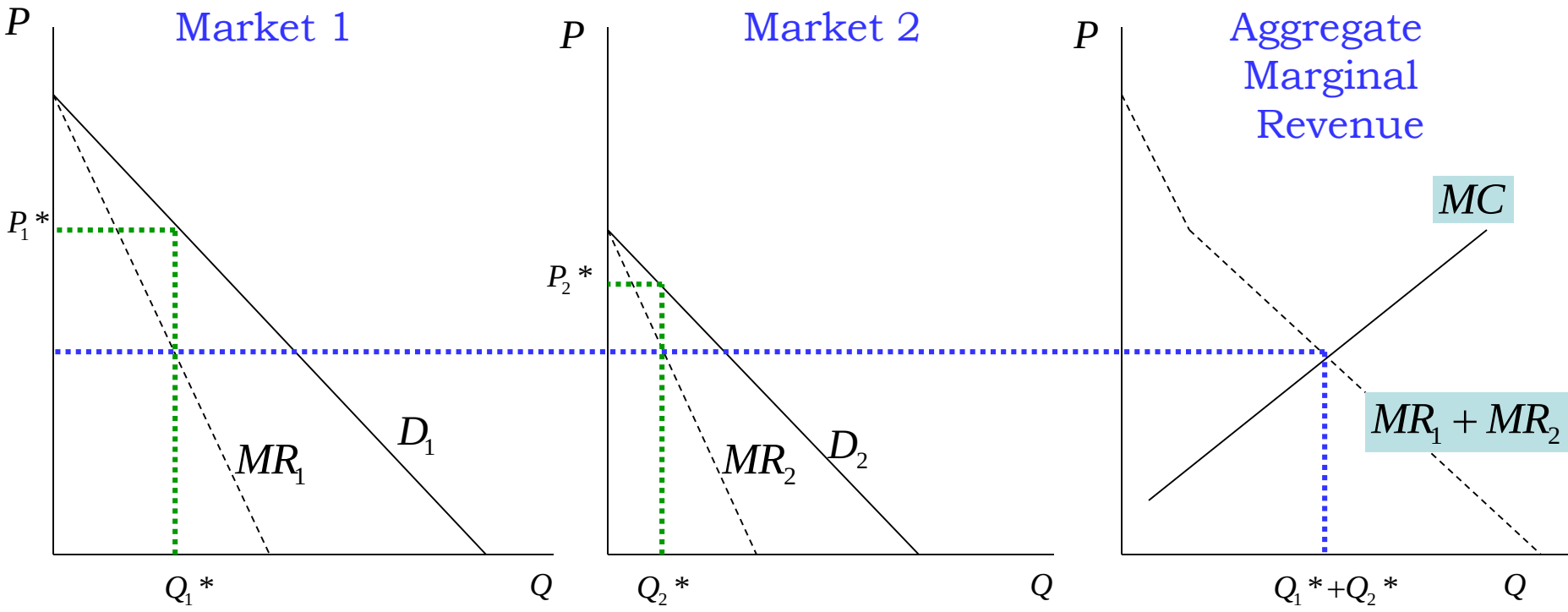
Marginal revenue in each market must equal *MC*. If this were not the case in either market, the last unit sold is generating either more or less in cost than it is earning in revenue. Cutting back or increasing output would then raise π

$$MR_1 = MC$$

$$MR_2 = MC$$



Marginal revenue curves MR_1 and MR_2 are added horizontally to give the aggregate marginal revenue curve $MR_1 + MR_2$ This is equated with marginal cost.



Marginal revenue curves MR_1 and MR_2 are added horizontally to give the aggregate marginal revenue curve $MR_1 + MR_2$ This is equated with marginal cost. Projecting back to the individual markets gives the discriminatory prices in these markets.

Consumers for whom elasticity of demand is low should be charged a higher price than consumers with higher elasticities of demand.

Product and Pricing Strategies for the Multiproduct Firm

Commodity bundling is the practice of selling two or more products in a single package.

E.g.: a complete stereo system in contrast to separate components.

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Bundled goods are always combined in fixed proportions.

E.g.: Fixed price menu at a restaurant will typically specify one appetizer, one entrée, and one dessert – all sold at one price.

A holiday travel package might consist of one return ticket, five nights accommodation, and three trips to the theatre.

Tie-in sales are less restrictive in that the mix of goods is not so rigidly prescribed.

All that is mandated is that the purchase of some amount of one good be conditional on the purchase of some amount of a second, tied product.

E.g.: In the early days of business machines IBM sold machines with the condition that buyer uses only IBM produced tabulating cards.

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In modern times tie-in sales are *technology* based rather than *contractual* as in IBM case.

E.g.: When you buy a printer you are committed to buying ink cartridges that fit it. HP cartridges do not fit Canon printers, and vice versa.
What is tied is the brand, not its quantity.

George Stigler was first to understand commodity bundling.

In 1950s and 1960s airing older Hollywood films was a standard part of television fare.

Film distributors who owned rights to the films would sell presentation rights for a fee to local t.v. stations.

Films were rarely sold individually and were usually sold in packages combining screen gems such as *Casablanca* and *Treasure of Sierra Madre* with grade B losers such as *Gorilla Man* and *Tear Gas Squad*.

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Suppose there are two films – X and Y –
two stations located in different cities – A and B.

	Maximum Willingness to pay for Film X	Max. willingness to pay for Film Y
Station A	$ 8,000	$ 2,500
Station B	$ 7,000	$ 3,000

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If distributor is forced to charge a uniform price then he could charge

For Film X $ 7,000
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Both stations would buy both the films and the distributor's total revenue will be $ 19,000

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Suppose, however, distributor offers the films as a bundle for a combined price of $ 10,000

Both stations value the bundle at least this highly, and both will purchase the bundle giving distributor a revenue of $ 20,000

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When films are unbundled the highest price that can be charged for any specific film is the minimum reservation price either station would pay for that film, i.e., $ 7,000 for Film X and $ 2,500 for Film Y.

When products are bundled, the highest bundle price that can be charged is the minimum of the sums of each station's reservation prices.

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When products are bundled, the highest bundle price that can be charged is the minimum of the sums of each station's reservation prices.

Bundling permits the distributor to circumvent the low value station A places on Film Y and exploit its relatively high valuation of Film X.

It also avoids the need to charge a low price for film X in order to induce station B to buy it by exploiting B's relatively high willingness to pay for film Y.

Stigler's insight incomplete on two counts -

1. No discussion of production costs. The distributor's cost is either sunk or nonexistent.

2. Does not consider strategy of mixed bundling – selling both products individually as well as in a bundle.

In mixed bundling consumers are partitioned into 4 groups than under pure bundling where there are 2 groups.

Mixed bundling always increases the monopolist's sales.

However, it is less clear whether bundling increases the monopolist's profits.

Profit impact of commodity bundling is dependent on the precise distribution of consumer preferences for the goods on offer and the costs of making those goods.

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Suppose monopolist had four customers A,B,C, and D, and the marginal cost of the goods is

$$c_1 = \text{Rs.}100 \qquad c_2 = \text{Rs.}150$$

Consumer reservation prices are as follows -

Consumer	Reservation price for good 1(Rs.)	Reservation price for good 2(Rs.)	Sum of Reservation prices
A	50	450	500
B	250	275	525
C	300	220	520
D	450	50	500

We can use this information to construct the demand schedule for the two goods.

Also, the profit π associated with each level of demand can be calculated as we know the marginal cost of producing the two goods.

Consumer	Reservation price for good 1(Rs.)
A	50
B	250
C	300
D	450

Good 1: $c_1 = \text{Rs.}100$

Price	Demand	T.R.	π
450	1	450	350
300	2	600	400
250	3	750	450
50	4	200	-200

T.R.: Total Revenue π : Profit

Consumer	Reservation price for good 1(Rs.)	Reservation price for good 2(Rs.)
A	50	450
B	250	275
C	300	220
D	450	50

Good 1: $c_1 = \text{Rs.}100$

Price	Demand	T.R.	π
450	1	450	350
300	2	600	400
250	3	750	450
50	4	200	-200

Good 2: $c_2 = \text{Rs.}150$

Price	Demand	T.R.	π
450	1	450	300
275	2	550	250
220	3	660	210
50	4	200	-400

T.R.: Total Revenue π : Profit

Good 1: $c_1 = \text{Rs.}100$

Price	Demand	T.R.	π
450	1	450	350
300	2	600	400
250	3	750	450
50	4	200	-200

Good 2: $c_2 = \text{Rs.}150$

Price	Demand	T.R.	π
450	1	450	300
275	2	550	250
220	3	660	210
50	4	200	-400

Suppose monopolist decides to adopt simple monopoly pricing

π_{max} for good 1 is at Rs. 450 with a price of Rs. 250 and sales to consumers B, C, and D.

π_{max} for good 2 is at Rs. 300 with a price of Rs. 450 and sales only to consumer A.

Total profit from simple monopoly pricing = Rs. 450 + 300
= Rs. 750

Consumer	Reservation price for good 1(Rs.)	Reservation price for good 2(Rs.)	Sum of Reservation prices
A	50	450	500
B	250	275	525
C	300	220	520
D	450	50	500

Pure bundling strategy

Consumer	Reservation price for good 1(Rs.)	Reservation price for good 2(Rs.)	Sum of Reservation prices
A	50	450	500
B	250	275	525
C	300	220	520
D	450	50	500

Pure bundling strategy

1. Bundle price of Rs. 525: Only consumer B purchases.

$$\pi = 525 - (100 + 150) = 275$$

2. Bundle price of Rs. 520: Consumers B and C purchase.

$$\pi = 2(520) - 2(100 + 150) = 540$$

3. Bundle price of Rs. 500: All 4 consumers purchase

$$\pi = 4(500) - 4(100 + 150) = 1000$$

Pure bundling gives higher profits than simple monopoly pricing.

Consumer	Reservation price for good 1(Rs.) R_1	Reservation price for good 2(Rs.) R_2	Sum of Reservation prices $R_1 + R_2$
A	50	450	500
B	250	275	525
C	300	220	520
D	450	50	500

Mixed bundling strategy : Suppose monopolist sets prices

$P_1 = \text{Rs.}\,450 \qquad P_2 = \text{Rs.}\,450 \qquad P_B = \text{Rs.}\,520$

Consumer	Reservation price for good 1(Rs.) R_1	Reservation price for good 2(Rs.) R_2	Sum of Reservation prices $R_1 + R_2$
A	50	450	500
B	250	275	525
C	300	220	520
D	450	50	500

Mixed bundling strategy : Suppose monopolist sets prices

$P_1 = \text{Rs.}\,450 \qquad P_2 = \text{Rs.}\,450 \qquad P_B = \text{Rs.}\,520$

Consumer A: $R_1 < P_1, \quad R_2 = P_2, \quad R_1 + R_2 < P_B$ Buy only good 2

Consumer	Reservation price for good 1(Rs.) R_1	Reservation price for good 2(Rs.) R_2	Sum of Reservation prices $R_1 + R_2$
A	50	450	500
B	250	275	525
C	300	220	520
D	450	50	500

Mixed bundling strategy : Suppose monopolist sets prices

$P_1 = \text{Rs.}\,450 \qquad P_2 = \text{Rs.}\,450 \qquad P_B = \text{Rs.}\,520$

Consumer A: $R_1 < P_1, \quad R_2 = P_2, \quad R_1 + R_2 < P_B$ Buy only good 2

Consumer B: $R_1 < P_1, \quad R_2 < P_2, \quad R_1 + R_2 > P_B$ Buy bundle

Consumer	Reservation price for good 1(Rs.) R_1	Reservation price for good 2(Rs.) R_2	Sum of Reservation prices $R_1 + R_2$
A	50	450	500
B	250	275	525
C	300	220	520
D	450	50	500

Mixed bundling strategy : Suppose monopolist sets prices

$P_1 = \text{Rs.}\,450 \qquad P_2 = \text{Rs.}\,450 \qquad P_B = \text{Rs.}\,520$

Consumer A: $R_1 < P_1, \quad R_2 = P_2, \quad R_1 + R_2 < P_B$ Buy only good 2

Consumer B: $R_1 < P_1, \quad R_2 < P_2, \quad R_1 + R_2 > P_B$ Buy bundle

Consumer C: $R_1 < P_1, \quad R_2 < P_2, \quad R_1 + R_2 = P_B$ Buy bundle

Consumer	Reservation price for good 1(Rs.) R_1	Reservation price for good 2(Rs.) R_2	Sum of Reservation prices $R_1 + R_2$
A	50	450	500
B	250	275	525
C	300	220	520
D	450	50	500

Mixed bundling strategy : Suppose monopolist sets prices

$P_1 = \text{Rs.}\,450 \qquad P_2 = \text{Rs.}\,450 \qquad P_B = \text{Rs.}\,520$

Consumer A: $R_1 < P_1, \quad R_2 = P_2, \quad R_1 + R_2 < P_B$ Buy only good 2

Consumer B: $R_1 < P_1, \quad R_2 < P_2, \quad R_1 + R_2 > P_B$ Buy bundle

Consumer C: $R_1 < P_1, \quad R_2 < P_2, \quad R_1 + R_2 = P_B$ Buy bundle

Consumer D: $R_1 = P_1, \quad R_2 < P_2, \quad R_1 + R_2 < P_B$ Buy only good 1

Consumer	Reservation price for good 1(Rs.) R_1	Reservation price for good 2(Rs.) R_2	Sum of Reservation prices $R_1 + R_2$
A	50	450	500
B	250	275	525
C	300	220	520
D	450	50	500

Mixed bundling strategy : Suppose monopolist sets prices

$P_1 = \text{Rs.}\,450 \qquad P_2 = \text{Rs.}\,450 \qquad P_B = \text{Rs.}\,520$

Consumer A: $R_1 < P_1, \quad R_2 = P_2, \quad R_1 + R_2 < P_B$ Buy only good 2

Consumer B: $R_1 < P_1, \quad R_2 < P_2, \quad R_1 + R_2 > P_B$ Buy bundle

Consumer C: $R_1 < P_1, \quad R_2 < P_2, \quad R_1 + R_2 = P_B$ Buy bundle

Consumer D: $R_1 = P_1, \quad R_2 < P_2, \quad R_1 + R_2 < P_B$ Buy only good 1

$$\pi = (450 - 150) + [520 - (100 + 150)] + [520 - (100 + 150)] + (450 - 100) = 1{,}190$$

Effective mixed bundling is always at least as profitable as pure bundling.

Mixed bundling strategy $\pi = 1{,}190$

Pure bundling strategy $\pi = 1{,}000$

However, it is not always the case that some sort of bundling is more profitable than no bundling at all.

Effective mixed bundling is always at least as profitable as pure bundling.

However, it is not always the case that some sort of bundling is more profitable than no bundling at all.

Drawback of bundling is that some customers may buy the bundle at a reservation price for one of the goods that is less than marginal production costs.
- See slide 85.

Bundling is likely to be profitable only when the variation in consumer valuations of the goods is significant.

Above example: Consumers A and D who buy a single good have very different valuations of the individual goods. Consumers B and C who buy the bundled good have very similar valuations.

"Some people may value an appetizer relatively highly (soup on a cold day), others may value dessert relatively highly (Baked Alaska, unavailable at home), but all may wish to pay roughly the same amount for a complete dinner. The a la carte menu is designed to capture consumer surplus from those gastronomes with extremely high valuations of particular dishes, while the complete dinner is designed to retain those with lower variance" - Adams and Yellen, p. 488

Basic point can be seen in context of Stigler's example -

Stigler's example

Slide 67

	Maximum Willingness to pay for Film X	Max. willingness to pay for Film Y
Station A	$ 8,000	$ 2,500
Station B	$ 7,000	$ 3,000

Revised valuations

	Maximum Willingness to pay for Film X	Max. willingness to pay for Film Y
Station A	$ 8,000	$ 8,000
Station B	$ 3,500	$ 3,500

Differences in relative valuation of the products vanish.

Bundling no longer a profitable strategy.